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Bioregional Approach to Protected Areas

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- serving as a leading global forum for the exchange of information on issues relating to protected area establishment and management
- ensuring that protected areas are placed at the forefront of contemporary environmental issues such as biodiversity conservation and ecologically sustainable development.

Cover photo: The Serro do Mar (Mountains of the Sea) rise sharply from Brazil's Atlantic coast south of Rio de Janiero. Photo: Fabio Columbini.

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Editorial

KENTON R. MILLER AND LAWRENCE S. HAMILTON

THIS SPECIAL issue of Parks contains four case studies that demonstrate successful use of bioregional planning – an exciting approach with considerable potential to strengthen our efforts to integrate parks and protected areas into the larger landscape. The four cases, drawn from Australia, Bhutan, Brazil, and North America, were chosen to represent the much larger number of efforts underway in all parts of the globe. We encourage you to study the materials in this issue, discuss the ideas and methods with your colleagues, and consider ways and means to incorporate bioregional planning and action into your work plans and budgets.

Challenges facing our Protected Areas in the 21st Century

Roads, human settlements, reservoirs, agricultural expansion, and land degradation are fragmenting landscapes. Remaining wildlands are being reduced to smaller patches surrounded by human-dominated land and water use. The science of Conservation Biology tells us that in these 'islands,' as size decreases, the number of species that can be maintained also decreases. Small areas are more vulnerable to natural- or human-caused catastrophe or serious disturbance. The edges of these remaining areas become ever more vulnerable to invasion by exotic and pest species. Both ecosystem resilience and biodiversity are both seriously compromised in this process. And, as the distances between the remaining wild areas increase, the possibilities for species migration and genetic flow drop dramatically. To a considerable extent these same factors and results apply to the marine environment as well as to the terrestrial scene.

Human populations are growing. Peoples' demands for water, food, and living space are placing ever-greater pressure to domesticate remaining open spaces and wildlands. By 2050 it is anticipated that over seventy percent of the world's 10 billion people will live in urban centres, and be totally dependent upon rural areas for their basic needs.

The disruption of ecosystems through changes in land and water use and the introduction of foreign plants and animals are setting the stage for a surge of 'invasive species'. The impacts are anticipated to include increases in agricultural, forest, freshwater, and marine pests and diseases.

Subtler and potentially more powerful will be the impacts of changing climates and sea level. Even if governments agree to reduce emissions of greenhouse gases sufficiently in coming years, existing accumulations already spell changes in forest, wetland, savanna, montane, coastal, and coral reef ecosystems. Some species are expected to adapt by moving to more suitable environments. Others may not find hospitable habitats or the rate of change may be too fast for viable migration to occur, especially for plants.

Bioregional planning and management

What strategies can we as protected area professionals employ to anticipate and manage these and other changes? How can we continue to meet our responsibilities

to society and our commitments to nature and culture in the face of such challenges? One option that has been receiving considerable attention during recent years is 'bioregional planning and management.' (Miller 1996, TNC 1997, UNEP 1998, WWF 1998). The bioregional approach seeks to maintain biological diversity across entire landscape regions while meeting people's needs. The bioregional approach embodies key characteristics (below), combining scientific, informational, social, and economic considerations to define management opportunities and to implement programmes of action and investment. A related approach has also been promoted for mountain protected areas by Hamilton (1996) involving corridors of connected core areas through managed nature-friendly lands among mountain ranges, or from summits to the lowlands.

Key characteristics of bioregional management

Drawing from the elements and experience of Bioregionalism, Man and the Biosphere Program, International Conservation and Development Projects, Protected Area Management, and Ecosystem Management, we can identify 14 defining characteristics of bioregional management work.

1. Large, biotically viable regions

Bioregional management programmes embrace regions large enough to include the habitats and ecosystem functions and processes needed to make biotic communities and populations ecologically viable over the long-term. These regions must be able to accommodate migratory patterns, anticipate nature's time cycles, and absorb the impacts of global change.

2. Leadership and management

The leadership to establish bioregional programmes may come from public agencies or from the community of residents and resource users. The tasks of convening stakeholders, preparing and negotiating vision statements, planning and implementing agreed upon activities can be shared cooperatively between public and private entities, or fully community-based.

3. A structure of cores, corridors, and matrices

These programmes include core wildland sites that feature representative samples of the region's characteristic biodiversity. Ideally such sites, which may already be designated as protected areas, are linked by corridors of natural or restored wild cover to permit migration and adaptation to global change. Both the core sites and the corridors are nested within a matrix of mixed land uses and ownership patterns.

4. Economic sustainability

The livelihoods of people living and working within the bioregion, including those in industry, and especially in the matrix, are encouraged. Appropriate incentives to make optimal use of local resources, and apply sustainable technologies, are combined with a system for sharing the costs and benefits of conservation and managed use fairly.

5. Full involvement of stakeholders

All parties who can affect or benefit from the resources in the region develop skills,

information, and opportunities to be fully involved in planning and managing the bioregional programme. The key here is building the local capacity to participate, negotiate, and perform the various tasks involved.

6. Social acceptance
Any proposals for changes in the way of life and livelihoods of the residents and local peoples, including indigenous communities, need to be acceptable to them. All stakeholders warrant the opportunity to participate in programme management and implementation.

7. Solid and comprehensive information
All stakeholders have at their disposal the critical information needed to facilitate biodiversity management. Geographic Information System technology is used to help stakeholders envision their region and its distinctive features clearly. GIS also helps them model options and scenarios for the future.

8. Research and monitoring
Research and inquiries focus on people/environment interactions, the development of innovative methods for managing natural resources, and the long-term monitoring of environmental factors and the impact of management practices.

9. Use of knowledge
Scientific, local, and traditional knowledge are employed in planning and management activities. Biology, anthropology, economics, engineering, and other related fields are tapped. Such knowledge helps stakeholders and programme managers to anticipate nature's long and short cycles and to track global change.

10. Adaptive management
Bioregional programs are operated on an experimental basis, from which lessons may be drawn from real-world experience to respond appropriately.

11. Restoration
Where the viability of some habitats or ecological functions have been impaired through excessive or inappropriate use, then these areas are to be restored.

12. Cooperative skills development
Communities and public and private organizations together locate and mobilise the skills, knowledge, and information needed to be able to manage the area.

13. Institutional integration
Alliances with other institutions and with local organizations are forged to close gaps, minimise overlap, and make management and investment in the region more efficient.

14. International cooperation
Because some ecosystems cross international boundaries and, in some cases, extend globally along animal-migration routes or along venues where endangered species are traded, international cooperation agreements and mechanisms for joint research, information management, and investments are part of the biodiversity management

programme. (The Man and the Biosphere Program is particularly suited to this purpose.)

As illustrated graphically in Figure 1 below, the key elements of the bioregional approach are:

- well-protected critical ecosystems, or core wildlands, that are often under appropriate IUCN Protected Areas regimes (IUCN 1997); the objectives of these core areas can include maintaining wild habitats, producing the range of ecosystem services, and ensuring the protection of cultural and spiritual sites;
- buffer or transition zones that surround core areas to manage unfavourable impacts that flow between core areas and their surrounding landscapes, including marauding animals, invasive plants, fire, and other agents;
- corridors that connect critical ecosystems to encourage and facilitate migration and dispersal; and,
- cooperative programmes that foster collaboration among farmers, foresters, fishers, local governments, NGOs, and indigenous peoples who live in, utilise or own the majority of the landscape held in private or communal ownership; the aim of such programs is to promote policies and practices that lead to 'biodiversity-friendly' land and water uses while generating livelihoods for the region's residents.

Broadening the geographic scale of management to whole regional ecosystems, or bioregions, implies that managers step into two significant points of conflict. First, they will find themselves working with the people who live and work, or who actually own the land and water beyond area boundaries. Second, they will be working out beyond the legal jurisdiction of their agency of government. Facing these challenges requires the establishment of new partnerships with neighbours, being responsive to their needs and concerns, and developing incentives and other policies that will promote the necessary cooperation among stakeholders.

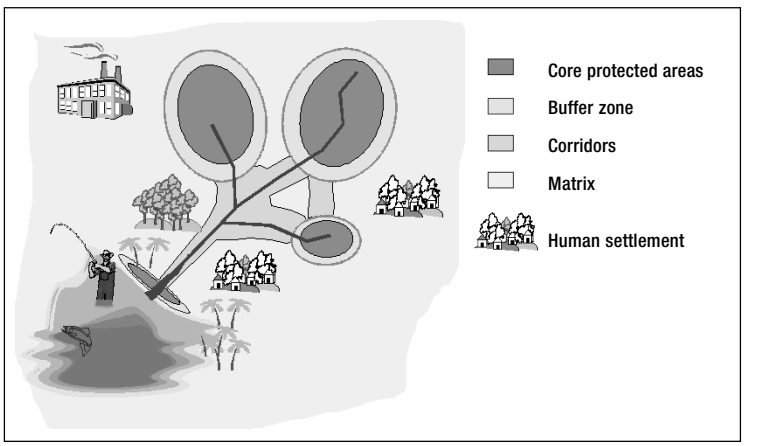

Figure 1. *Manage core areas, buffer zones and corridors as fundamental components of working bioregions.*

The Albany workshop

The World Commission on Protected Areas (WCPA) of IUCN convenes the once-in-a-decade World Parks Congress, a process of professional dialogue and debate that reviews progress and problems in protected area management and sets goals and programs for action by the world's protected area professionals. In 1997, WCPA and the Government of Western Australia convened and hosted an inter-sessional workshop in Perth to review progress since the Caracas 4th Congress of 1992, and set goals leading up to the 5th Congress being planned for 2002 in Durban, South Africa. One session featured a series of case studies that served to focus the debate on options for anticipating and managing the kinds of changes noted above. We have selected four of these cases to illustrate some of the more

fundamental elements and principles of the bioregional approach that are emerging from science and field practice around the world.

Observations and generalisations that can be drawn from the case studies

Information – Compiling adequate information is key to identifying corridors and linkages for bioregional management. Bhutan identified the needs for corridors based, among other things, on the observed migration ranges of elephants and tigers. Complete species inventories are still underway, but the early conclusions based on megafauna provided a justification to get started. The Yukon to Yellowstone effort covers an enormous area and many political jurisdictions, so mapping the area and publishing a descriptive atlas was an important step in generating the large-scale vision of what was possible. Brazil promptly recognised the complexity of the analysis that they faced, and turned to a geographic information system to deal with the complexity and make analysis of different scenarios possible. Australia is already moving to the monitoring phase, systematically tracking changes over time and adapting management interventions to changes in this dynamic situation.

Education – A vital element in all of the cases has been and continues to be education. Park administrators will have to ensure that a number of different audiences become aware of the importance of the ecoregional approach. One strategy is to begin with school children and teachers, then progressively broaden the outreach programs to include the general public, resource professionals, business leaders, politicians, and related government agencies.

Communication – Once a park manager begins to look beyond the park boundaries, the number of 'audiences' with whom one must communicate grows dramatically. The human communities on one side of a protected area may have very different demands and expectations from the communities on the other side. Even if the communities eventually all agree, the park manager will spend many more hours in community meetings than anticipated. The cases in Bhutan and North America involve cooperation not just across communities but also across international borders. All the cases involve several layers of state and local governments, plus different government ministries and departments.

Integration – At bioregional scales of analysis, it usually becomes apparent that the resulting vision or strategy will involve many small steps to integrate a variety of units into a larger mosaic. Community water catchments, farms, traditional grazing lands, protection forests, managed forests, cultural monuments, wildlife refuges, and national parks can be assembled into a integrated functioning whole that is much greater than the sum of the parts. Integration must also ensure that benefits from protected areas enter the local economy. When local and regional neighbours begin to recognise the economic contribution of protected areas, they are more likely to become supporters of the bioregional strategy.

Coordination – In order for the different parts of a diverse and decentralised system to move in concert, there needs to be some coordination. If for no other reason than to keep management decisions by different entities from cancelling each other, it

helps to have a shared vision, a common strategy, and ideally a plan reached by consensus. Inevitably there will be variances and exceptions, so the park managers should anticipate an increased need for coordination. Eventually this might be accomplished by annual meetings where stakeholders review the strategy, assess progress, and plan the next year. At the beginning of a bioregional undertaking, these coordinating meetings might be semi-annually or even quarterly.

Longer time-scales – Each of the case studies is a work in progress. The process will continue to evolve as more stakeholders join the effort, adding their demands and talents. As current problems are solved, other issues will surface that warrant priority attention by the community.

Restoration and regeneration – As the bioregional approach begins to identify the habitat requirements of individual species, and to adapt the landscape to the pressures of climate change and fragmentation, the need for habitat restoration and regeneration will become paramount. A bioregional landscape becomes a patchwork quilt of wildlands, farms, forests, wetlands, fishing and wildlife harvesting zones and infrastructure. Modern and traditional knowledge will point to the need to rebuild those areas critical to retain and enhance the production of ecosystem services and the overall productivity of the region.

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The Western Australian South Coast Macro Corridor Project – a bioregional strategy for nature conservation

JOHN WATSON AND PETER WILKINS

An innovative strategy of 'bioregional initiatives' to improve the viability of protected areas has been widely accepted by environmental land managers around the world. The South Coast Region of Western Australia has outstanding biodiversity values with an extremely high degree of endemism, much of which is represented within the Fitzgerald River National Park Biosphere Reserve, an internationally significant protected area. The wider community of the South Coast Region and relevant government agencies are working together on a bioregional initiative called the 'Macro Corridor Project' – a bold programme to increase viability of the existing protected area network by either maintaining existing linkages or re-establishing previous linkages between the biosphere reserve, major national parks, nature reserves, and other remnant vegetation across the region.

THERE HAS been a sad decline in the distribution and survival of many plants and animals on the Australian continent over the 200 years or so since European settlement (Commonwealth Department of the Environment, Sport and Territories, 1996). For example, more mammal species have become extinct over the past 100 years in Australia than in any other country (Bailey, 1996).

This has been caused by a combination of three major factors:

- Changes in land *use*, particularly extensive clearing of natural vegetation for agricultural purposes, and urbanisation mainly around the coastal fringes of the continent.
- Changes in land *management*, for example the unavoidable introduction of 'unnatural fire regimes' (with regard to both frequency and intensity) and the edge effects resulting from roads and other access.
- *Introduced organisms*, notably the European fox and the rabbit, and fungal pathogens such as *Phytophthora cinnamomi,* which has had a particularly dramatic impact on highly diverse heathland habitat.

Collectively these factors have led to a total loss of natural vegetation in some areas, gross fragmentation and subsequent decline in quality in other

A 'Macro Corridor Project' is to be set up at the Fitzgerald River National Park.

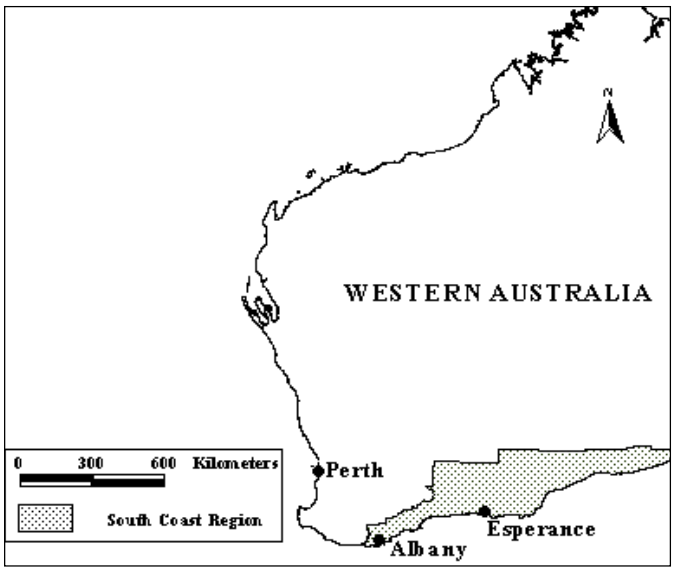

Figure 1.
South coast region of Western Australia.

areas, and predation of wildlife generally.

At the landscape level, four major approaches have evolved in order to better 'protect' nature conservation values and biodiversity:

- establishment and management of 'protected area systems' usually at a state or national level;
- retaining or developing buffer zones around protected areas in order to reduce the rate of decline in natural values caused by edge effects, a typical approach used in biosphere reserves (Robertson Vernhes, 1993);
- improved connectivity between protected areas or fragments through the establishment of continuous corridors or 'stepping stone' linkages (Bennett, 1997, 1998);
- encouragement of additional protection for biodiversity and wildlife habitat at a local level in the remainder of the landscape, for example through landowner incentives, town planning schemes, catchment-based programmes and, in Australia, 'Bushcare' programmes.

These four approaches all have nature conservation value in their own right, but in combination will be particularly powerful because they create a total landscape approach and, equally important, because they involve all sectors of the local and regional community.

The Western Australia South Coast Macro Corridor Project

The South Coast Macro Corridor Project is partially funded by the Australian Commonwealth Natural Heritage Trust Bushcare programme, and is implemented through the Western Australia Department of Conservation and Land Management (CALM). The project evolved from an earlier review of the protected area system in the South Coast Region of Western Australia (Figure 1; CALM, 1991). One of the objectives of that review was to assess remnant vegetation and develop recommendations for the establishment of major 'corridor' reserves as links or conduits to improve habitat connectivity and the movement of fauna between parks and reserves (Watson, 1997). An assessment of river foreshore corridors between the towns of Albany and Esperance found high potential for their establishment as conservation reserves (Watson, 1991; Leighton and Watson, 1992; Watson, 1997). The South Coast Bioregional Initiative or Macro Corridor Project is further developing the potential for an integrated reserve system, and inclusion of strategic remnant vegetation across the entire South Coast Region of Western Australia (Figure 2).

The project objectives are to:

- establish, consolidate, and maintain a major bioregional 'macro-corridor' of native vegetation stretching some 700 km from Israelite Bay to the town of Denmark along

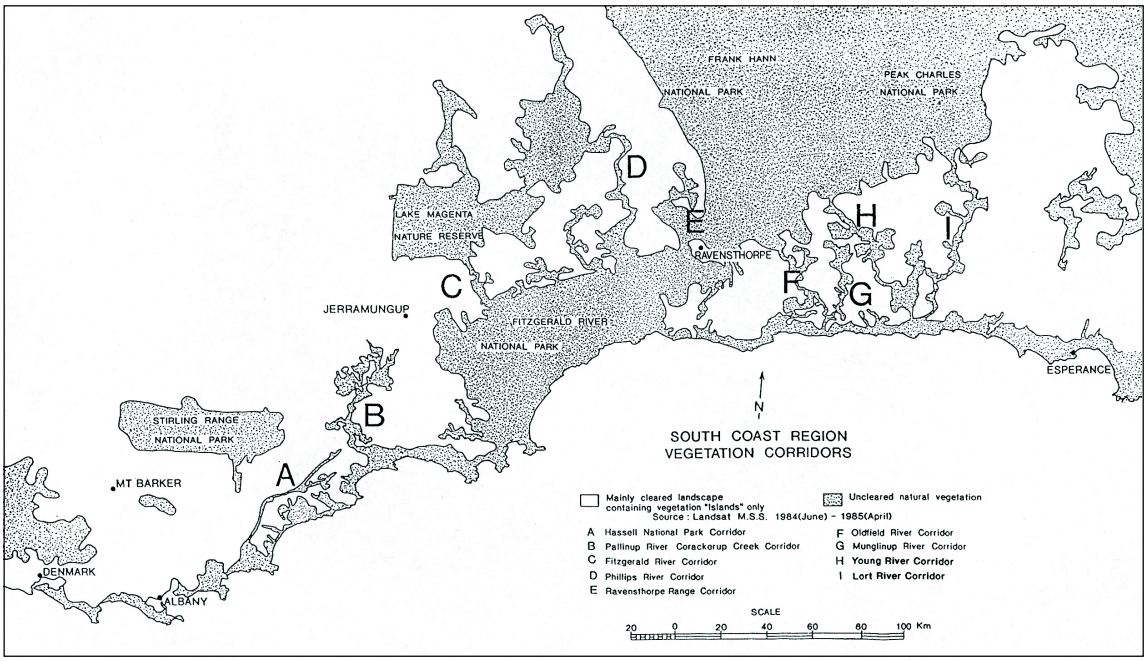

Figure 2. *Existing vegetation corridors are the basis for a Macro Corridor Network across the South Coast Region of Western Australia.*

Western Australia's southern coastline, with inland linkages along major river systems to protected areas and other uncleared bushland (Figure 2);

- actively involve all relevant landowners and agencies. Promote community education (including schools), awareness, and support. Encourage adoption of protective covenants and other hands-on involvement;
- prepare a broad management strategy for the network to involve all sectors of the community and including 'best management practices' in protected areas (national parks, nature reserves, Shire reserves, and proposed protected areas such as unvested reserves, vacant Crown land, and marine reserves) and stewardship models in non-public components;
- promote integrated catchment management of entire watersheds with due regard to downstream wetland, riverine, and marine conservation values;
- secure migratory pathways and other ecosystem functions with particular regard to the long-term conservation of threatened species, threatened communities, and the representativeness of ecosystems. Encourage revegetation to provide linkages between remnant vegetation where possible. Promote regional approaches to abatement of threatening processes such as disease (*Phytophthora*), weeds, feral animals, and fire;
- establish a strategic network of monitoring sites across the bioregion i.e. with latitudinal, longitudinal, and altitudinal spread, as a baseline network to monitor long-term (e.g. global climate) change. This network will expand upon existing sites established in the Fitzgerald Biosphere Reserve (Sanders, 1996) and on mountain peaks (Barrett, 1996); and
- encourage recognition and adoption of the macro-corridor network as one of the IUCN World Commission on Protected Areas – Bioregional Initiatives (Miller and Hamilton, 1997) and hence provide a 'flagship model' for Australia in one of its most biologically diverse regions.

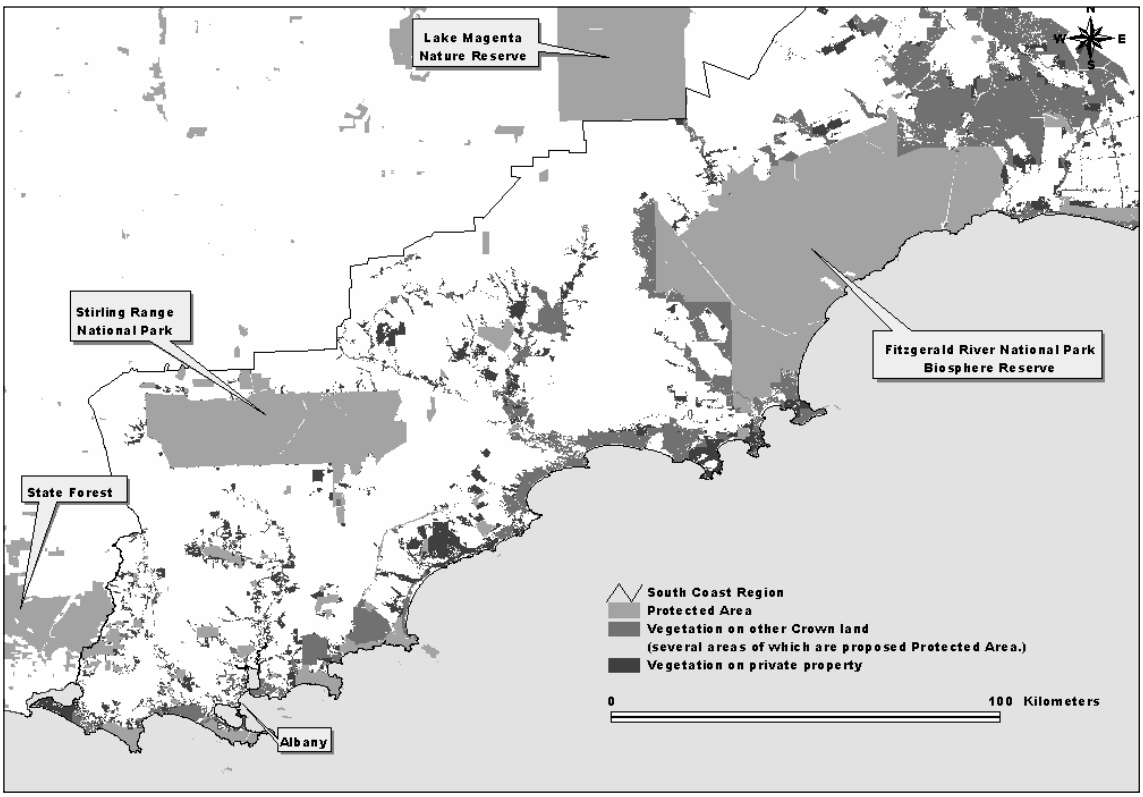

Figure 3.
The Macro Corridor Project endeavours to link major protected areas with remnant vegetation that exists within other crown lands and on private property.

What is a 'macro corridor'?

We define a *macro corridor* as a linear assemblage of mainly continuous vegetation, functioning as a conduit for wildlife movement between protected areas and as habitat (non-continuous 'stepping stone' vegetation may also be included). Macro corridors will, where possible, be composed of pristine, indigenous, and strategic vegetation, but will also utilise the potential of non-pristine native vegetation and exotic woodlands for wildlife. The dimensions of a macro corridor may be hundreds of metres to several kilometres in width and tens of kilometres in length.

A *macro corridor network* is a system of macro corridors interconnected across a region of many thousands of square kilometres and managed to provide high-quality connectivity to many major landforms, vegetation communities, and regional microclimates to assist in maintaining overall landscape processes (Maciejewski *et al*, 1999).

The need for a strategic macro corridor network

The Macro Corridor Project aims to increase the long-term viability of protected areas by connecting major national parks and nature reserves with other remnant vegetation. Figure 3 illustrates the potential for linking the Fitzgerald River National Park with Lake Magenta Nature Reserve, as well as with a series of coastal reserves with remnant vegetation existing within other Crown lands, and with native vegetation on private land.

To realise this potential and reach long-term objectives, an assessment of habitats is being made to determine those which are of most value for a bioregional wildlife corridor network. Characteristics that are being assessed include:

- remnants with significant nature conservation value. Factors to determine conservation value include representation of vegetation types within the current protected area system, habitat values, and the presence or absence of rare and threatened flora and fauna;
- the location of remnant vegetation within the landscape which is necessary to assess the degree of risk from threatening processes, such as rising groundwater (see George *et al.* 1995). Vegetation along drainage-lines and other low-lying areas is particularly vulnerable to salinity and/or waterlogging, whilst wind erosion is adversely affecting small patches of remnant vegetation located high in the landscape. It is also important to determine the degree to which threats can be managed;
- the strategic location of vegetation within the landscape determines whether native vegetation can be incorporated within a continuous corridor or used as part of a 'stepping stone' corridor;
- the function of corridors for native fauna. Some groups of birds, large mammals, larger reptiles, and possibly some flying insects may not have special requirements for corridors, whereas small mammals, reptiles, many invertebrates, and plants are most likely to require continuous habitat to survive along corridors (Wallace, 1998). In addition, it may be that some fauna require corridors that comprise a 'stepping stone' habitat arrangement, whereas other smaller species may require continuous native vegetation to maintain ecological stability. The 'focal species approach' may be used to maximise habitat adequacy for wildlife. This approach identifies threats to wildlife and ranks species according to their sensitivity to a threat or threats. Those species that are most sensitive become the focus for habitat reconstruction as it is considered that creating or managing habitat for these species will also benefit a range of other non-target species (Lambeck, 1997); and
- a knowledge of other land-uses, available resources, and the attitudes and the requirements of land managers (both private and government agencies) to nature conservation need to be considered.

'Stepping stone' corridors are an alternative to continuous corridors.

This strategic approach is identifying areas of high biodiversity and conservation value, which in turn is assisting in prioritising the need for connectivity and is providing information on the likelihood of maintaining, improving, or creating connectivity between these areas. For example, a strategic approach has identified linkages to the Stirling Range National Park, and the Porongurup National Park from the State Forest to the southwest (Figure 4).

Furthermore, information regarding the longevity of remnants and their value for wildlife dispersal can be used to plan the best alignment and location for macro corridors.

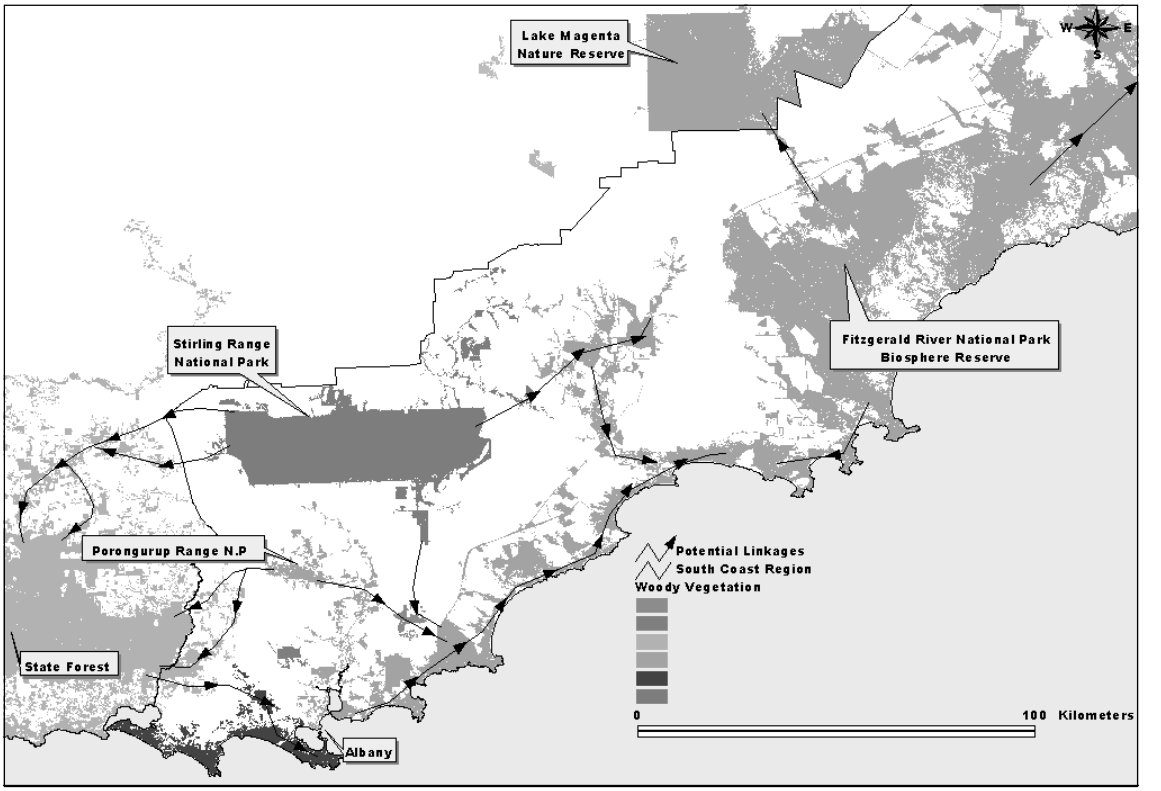

Figure 4. Continuity of remnant vegetation corridors in the western portion of the South Coast Region of Western Australia.

Advantages of a macro corridor network to nature conservation

The importance of our macro corridor network is its potential to provide some counter measures to compensate for the effects of habitat loss and fragmentation of ecosystems within the South Coast Region. Bennett, (1997) has discussed such benefits which in our case include:

- expanding the area of protected habitats for flora and fauna by encouraging long-term conservation agreements for native vegetation on private property and where necessary altering the purpose of vested Crown lands for the conservation of flora and fauna;
- maximising the condition of existing habitats through management of feral animals, weeds, fungal disease (e.g. *Phytophthora*), fire, and stock exclusion;
- minimising the detrimental impacts arising from surrounding land-uses (e.g. mitigating the effects of wind and water erosion);
- enhancing connectivity between existing areas of protected native vegetation providing conduits through which:
  - wildlife can disperse from areas which have reached maximum carrying capacity and/or competition, and recolonise other favourable habitats, perhaps improving the conservation status of the population;
  - wildlife can follow or escape local or longer-term seasonal changes in environmental conditions;
  - wildlife can reach previously separated populations with which breeding may take place, better maintaining and possibly improving genetic variability;

- allowing other ecological processes (e.g. nutrient recycling and seed dispersal) to benefit from an increase in wildlife dispersal (Bennett, 1998); and
- allowing ecological processes to operate at a landscape level.

Potential benefits of integrating a macro corridor network with an agricultural system

The implementation of farm plans, best practise farm management, and strategic revegetation linked to existing corridors can all work together to protect both long-term productivity of agricultural systems and nature conservation values. For example:

- an increase in the movement of biota through corridors may 'add value' to connecting remnants and revegetated areas. Fauna will transport and deposit seeds of other plant species into vegetated areas potentially improving the vegetation structure. This will make vegetated areas more efficient as 'water pumps' to help combat rising groundwater and more sustainable over the long-term, perhaps saving ongoing costs that might otherwise have been incurred as trees die; and
- the potential cost savings of biological control agents for agriculture are huge. For example, an estimated $600 M a year is lost to the damage caused by rabbits, through the cost of rabbit control and agricultural production losses in Australia (Gale, 1999). Remnant vegetation could be viewed as a 'biological control agent' for the control of agricultural threats such as soil salinity, as well as for control of wind and water erosion. It is not difficult to imagine the long-term cost savings that healthy remnant vegetation could create knowing the damage that secondary salinisation will cause to agricultural production.

Furthermore, there are other landscape-scale advantages to both natural and agricultural systems, in particular the aesthetic integration of corridors and revegetation programmes. This has the potential to enhance a 'sense of place' amenity for local residents and to provide a more attractive landscape, enhancing the integration of tourism with other rural enterprises.

Roles of the community and other land managers

An education programme to enhance community awareness of and support for a macro corridor network is essential. This involves various forms of media, as well as activities such as school visits and public gatherings. This programme highlights the value of the South Coast's natural heritage to the local community, and also illustrates the importance of an integrated conservation system for long-term nature conservation.

The project is gathering information required for the strategic planning of the macro corridor network. This information is being used to assess the continuity of remnant vegetation, locate areas where enhancement of existing major corridors is required, and assess the possibility of reconstructing other corridors with the Region. An example of continuous and 'stepping stone' macro corridors identified using this process is illustrated in Figure 4. This figure illustrates where remnants greater than 50 hectares in size are within 500 metres of large (>1500 ha) and/or continuous remnants and within 500 metres of each other. The changes in grey illustrate where continuity exceeds 500 metres between 50-hectare remnants.

A two-phase approach involving a geographical information system (GIS) software package is being used to make this possible. The aim of the first phase was to gain a general appreciation of the vegetative resource within the project area and to determine the potential for creating linkages with this resource.

The second phase of this process is placing conservation values on each of these remnants, then producing a map of remnants within macro corridors, each remnant being coloured according to conservation value or priority. This map is assisting the decision-making process of how and where to allocate resources when implementing on-the-ground works.

Representatives of the community, as well as local and state government land managers participate in planning the project. They provide information on progress to the general community at a local level, as well as identifying and developing projects to strengthen and protect macro corridors using best practice management information and methods. They work closely with local advisory networks (e.g. Bushcare, Coastcare, Landcare, Rivercare) and community groups to integrate the macro corridor network with other projects within the Region.

A biological monitoring programme is being established across the macro corridor network. It incorporates some existing monitoring sites such as the 'Mountain Peak' monitoring sites (Barrett, 1996; Barrett and Gillen, 1997), the Fitzgerald River Biosphere monitoring sites (Sanders, 1996; Watson and Sanders, 1997) and CALM's fox baiting monitoring sites used to monitor fauna recovery. The flora and fauna data collected may provide feedback on the effectiveness of the macro corridor network and could play an important part in any international network of long-term marine and terrestrial monitoring sites which gather information on topics such as global change, biodiversity, and forest health.

Where to from here...? the grand vision...

Ultimately we seek the establishment and community ownership of a strategic macro corridor network across the entire South Coast Region of Western Australia. This will comprise major macro corridors, especially along the coast and running inland along river valleys, but also narrower corridors, good quality remnant vegetation, and a gradation down to 'micro' corridor establishment or protection at the individual farm or property level. This is somewhat analogous to a road transport system consisting of an interconnected network of wide free ways, highways, major arterial roads, secondary roads, minor roads, and four-wheel-drive bush tracks. Furthermore, the macro corridor network will be multidimensional (i.e. latitudinal, longitudinal, and altitudinal) thereby linking all components of the landscape and including all major vegetation types and habitats.

In essence this will be an expansion out across the whole region of the biosphere reserve principles of the Fitzgerald River National Park which lies at the central hub of the macro-corridor network (Figure 2).

Finally, there is potential for the macro corridor network to be regarded as one protected area comprising a range of IUCN categories, in particular categories I, II, III, IV, and VI. Thus there will be wilderness areas, national parks, nature reserves, and bushland protected through other agencies and landowners – but all interconnected through the one network.

Watch this space!

Acknowledgments

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We thank Sandra Maciejewski, Keith Claymore, Alan Danks, Ian Herford, and Alan Walker for useful comments in early drafts of this paper.

We also acknowledge the Natural Heritage Trust (NHT) Bushcare programme and CALM for funding the Western Australian South Coast Macro Corridor Network Project.

Additional background

The February 1997 issue of *Parks* 7(1) focused on protected areas in Western Australia, particularly along the South Coast. The issue was compiled to help provide background on protected area and threatened species work that would be included in a full-day field trip during the IUCN World Commission on Protected Areas (WCPA) mid-term symposium 'From Islands to Networks' held at Albany, Australia, in November 1997.

One of the key sessions at that symposium was by Kenton Miller and Larry Hamilton where they presented a case for a global network of large 'bioregional initiatives' as part of a 'scaling up' to reach out from 'island' protected areas through major networks (Miller and Hamilton, 1997).

This paper presents an update on progress with our 'South Coast Macro Corridor Project' – now recognised as a component of the WCPA global bioregional initiative network.

Four papers from the February 1997 *Parks* issue are particularly useful in understanding the background to our Macro Corridor Project *viz* an overview on regional planning and protected areas (Watson, 1997), a historical and descriptive review of the Fitzgerald River National Park Biosphere Reserve (Watson and Sanders, 1997), a series of case studies on threatened species management in the region (Gillen *et al*. 1997) and a more specific paper on mountain protected area management issues (Barrett and Gillen, 1997). In the same issue a paper by Andrew Bennett provides an excellent Australian overview of the role of habitat linkages, connectivity and corridors (Bennett, 1997).

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Yellowstone to Yukon: romantic dream or realistic vision of the future?

LOUISA WILLCOX AND PETER AENGST

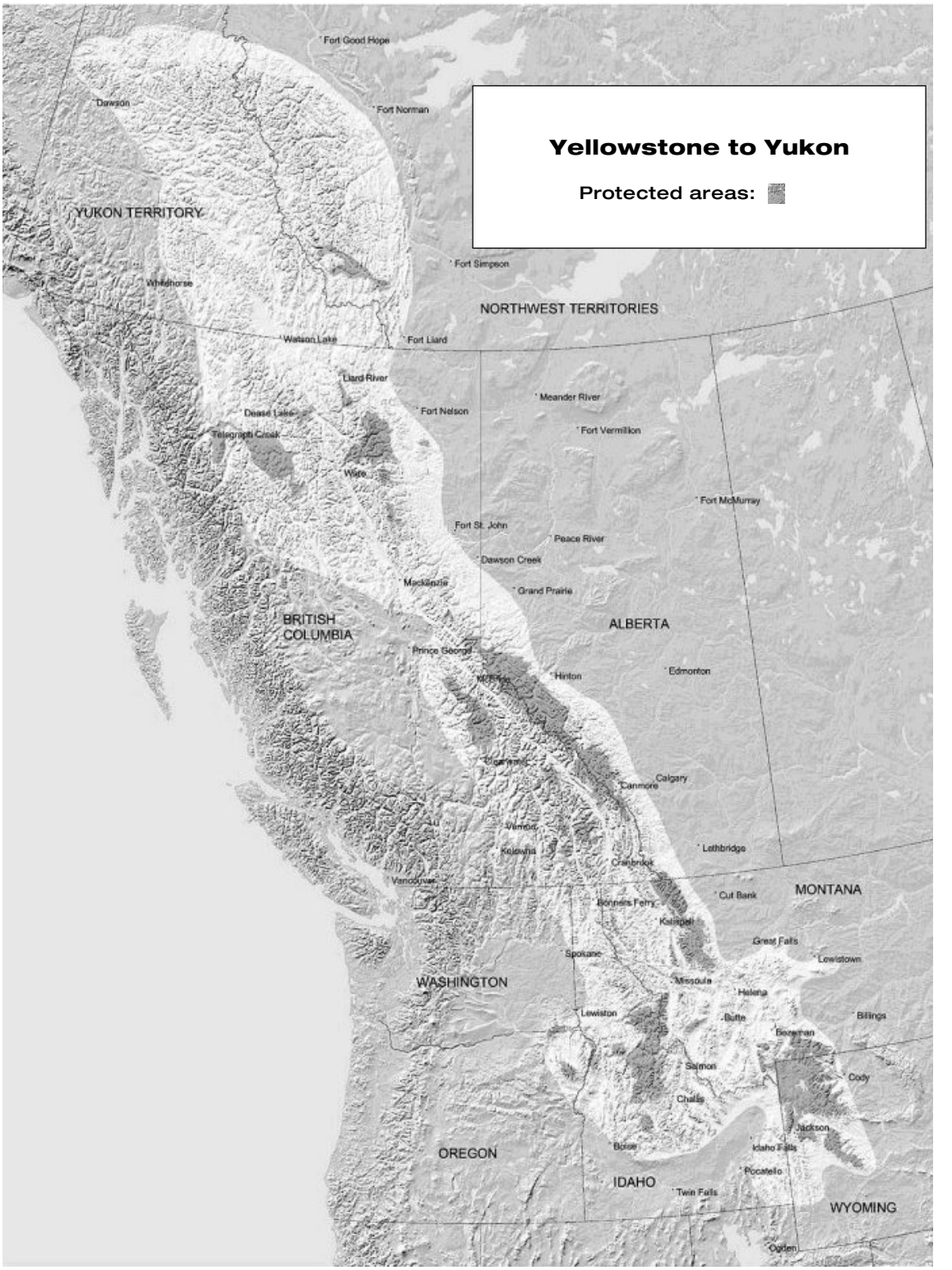
Yellowstone to Yukon (Y2Y) is a bi-national effort to restore and maintain biological diversity and landscape connectivity along the spine of the North American Rockies, from the Greater Yellowstone Ecosystem in the south to the Mackenzie Mountains in the north. Encompassing over 1.2 million square kilometres, the Y2Y range is a huge territory, an ecoregion that hosts not only a rich diversity of wild habitats and creatures, but also native cultures and rural communities that have been shaped by the power of the wild. In short, it is geography to challenge our ability to understand it, and to dare us to create for it a different future than that slated for the tamed and tilled landscapes of North America.

A central focus of the Y2Y initiative is to establish a system of protected wildlands designed to maintain connectivity along the 2,000 miles from the Yukon south to the Red Desert in Wyoming. Ignited about six years ago, the initiative has caught fire in the imagination of scientists and conservation activists, as well as land managers and citizens of the region. Today the network includes a diverse array of over 200 conservation groups and individuals in the US and Canada, who support the vision and are working to ensure the ecological integrity of the wild Rockies.

THE Y2Y AIMS to restore, maintain, and protect one of the world's last great mountain ecosystems. The Rocky Mountains of western Canada and the northern United States offer some of the most spectacular wilderness in the world, including some of the best remaining habitat for species eliminated or drastically reduced in numbers elsewhere. This is particularly true for large carnivores, including such wide-ranging species as grizzly bears, wolves, wolverines, and lynx, as well as native fish populations. Such animals, however, face an uncertain future: the forces that led to their extermination elsewhere – clear cutting, oil and gas development, mining, hunting, trapping, pest eradication, diversion and damming of rivers, pollution, subdivision, and suburban sprawl – are mounting here, too.

One of the most significant challenges is the region's vast, even mind-boggling, scale. Those involved in the initiative face a daunting array of administrative jurisdictions, each with unique mandates, fiscal constraints, and cultures. The Y2Y region includes parts of two countries, four states, two provinces, two territories, the reservation or traditional lands of over 30 Native governments, and a veritable alphabet soup of government land agencies. The communities, too, reflect dramatic differences in socio-economic conditions, history, and culture – from the sparsely populated settlements

A hiker stopping to wash his face in Dean Lake, Bob Marshall Wilderness, northern Montana. Photo: Karsten Heuer.


Yellowstone to Yukon
Protected areas:
Fort Good Hope
Dawson
Fort Norman
YUKON TERRITORY
Whitehorse
Fort Simpson
NORTHWEST TERRITORIES
Watson Lake
Fort Liard
Liard River
Meander River
Fort Nelson
Dease Lake
Telegraph Creek
Fort Vermilion
Watson
Fort McMurray
Fort St. John
Peace River
Dawson Creek
Mackenzie
Grand Prairie
BRITISH COLUMBIA
ALBERTA
Prince George
Hinton
Edmonton
Calgary
Canmore
Lethbridge
Kelowna
Cranbrook
Vancouver
Cut Bank
MONTANA
Bonners Ferry
Kalispell
Great Falls
Lewistown
Spokane
WASHINGTON
Missoula
Helena
Lewiston
Butte
Billings
Bozeman
Salmon
Cody
Challis
Jackson
Boise
Idaho Falls
OREGON
Pocatello
IDAHO
Twin Falls
WYOMING
Ogden

in the Yukon to the rapidly growing towns surrounding the national parks around Banff, Glacier, and Yellowstone. In addition, the international border can act as a kind of psychological, legal, and management block to coordination between the northern and southern parts of the Rockies.

Yellowstone to Yukon: big peaks, big wilderness, and big rivers

As portrayed in the accompanying map, the Yellowstone to Yukon ecoregion can be defined generally as lands in the Rockies above about 1,050 m (3,500 feet) in elevation, characterised by extensive coniferous forests, and encircled at lower elevations by prairie grasslands. This is the headwaters for ten major river systems draining into the Pacific, Arctic, and Atlantic Oceans, supplying water for wildlife and human communities in the prairies, cities, and farms thousands of miles from the rivers' mountain sources. When people think of Yellowstone to Yukon, though, they think first of mountains, and the drama of the region's geology. In fact, Y2Y boasts the oldest rocks found in North America, as well as the largest geological displays of former volcanic activity in the world.

Today, as they have for millennia, fire and ice shape the land. Given such rugged topography and punishing natural processes, it is surprising that so many plants and animal have claimed the Rockies as their home. Some bird species achieve their highest breeding densities in the Rockies, and some of the rarest species found in North America – the grizzly bear, wolf, black-footed ferret, and whooping crane – reside here.

And, for at least the last 10,000 years, human beings have also called the region home. Y2Y comprises the traditional territory of 31 First Nations/Native American groups, each with a distinct culture, language, and history reflecting a way of life adapted to the plains, mountain recesses, forests, and grasslands. To native peoples, this was a sacred geography, shared by successive generations that renewed their relationships with the land through story and religious practices. To increasing numbers of people today, Y2Y provides a place for spiritual renewal and reflection in the beauty and solitude of wilderness.

An ecoregional context

Ecoregions have been defined as 'large areas of the landscape determined by shared climate and geology, which, in turn, affect the kinds of ecosystems and animals and plants found there.' Ecoregions can frame our thinking about the land, and about strategies to protect our natural heritage.

Y2Y fits the broad definition of an ecoregion. The landscape shares common geologic, hydrologic, and climatic features, which in turn explain the similarities of plants and animals adapted to live here, ranging from caribou and bull trout to boreal and ponderosa pine

Pack trip above the Gataga River in the Muskwa-Kechika area of northern British Columbia. Photo: Wayne Sawchuk.

Fishing in Peter Lougheed Provincial Park, southern Alberta. Photo: Bart Robinson.

forests. Certainly Y2Y includes many identifiable ecosystems, defined as a relatively self-sustaining, dynamic interaction among plants, animals, and their physical environment.

An ecosystem, of course, can be as small as a pond or as large as the geographic range of a grizzly bear population. Many distinct smaller ecosystems, each bounded by related ecological processes and parameters, overlap and form progressively larger ecosystems. A small stream is part of a river system, for example, and a grove of trees stands in a coniferous forest. Thus, ecosystems are bounded somewhat arbitrarily, and can be viewed at multiple scales.

So too, our idea of Y2Y as an ecoregion is something of an artificial construct, for there is no hard separation between what is included within the boundary and the lands outside. The boundary on the maps should not be interpreted as a sharp delineation based on a crisp ecological difference, but rather as a permeable membrane, through which animals, rivers, and ecological processes cross continually. Y2Y, then, can be viewed as a region comprising smaller connected ecosystems and linked to other large ecoregions such as the prairie grasslands and the arctic barrens.

One biological fact that pertains to ecoregions and ecosystems at all scales is that change is inevitable. Big forest fires, like the 1988 Yellowstone fires, can produce big impacts that last for years, while local landslides can alter hydrology and vegetation on local scales. The drought of one summer can lead to a major big game die-off the next winter. Deep winter snows give wolves an advantage in their pursuit of elk and moose, and replenish rivers and lakes. Some elements of ecosystems, such as geologic landforms, change relatively slowly, while others, such as communities of spring beauty and globemallow wildflowers at the edge of a melting snowfield, change almost overnight.

Y2Y: connected by problems and people

While change from natural forces is the norm, change associated with certain types and levels of human activity can harm the capacity of the broader ecosystem or ecoregion to function well. In Y2Y, road building, clear cutting, oil and gas development, damming and diverting rivers, suburban sprawl, and even unfettered recreation are adversely affecting and altering the natural integrity of some parts of the ecoregion. Grizzlies and wolves, for example, have been extirpated in 99% of the

lower 48 states and all but a few areas of Montana, Idaho, and Wyoming in the US – and their numbers have been greatly reduced in Alberta and parts of southern British Columbia. Native salmon and westslope cutthroat trout are at precariously low levels throughout the region. More and more species are being added to the US Endangered Species Protection List each month – and would be in Canada if they had comparable legislation.

Species abundance, however, is just one measure of ecological health. At risk in certain areas is the ability of the whole ecosystem to function, evidenced by the collapse in species composition and radical simplification of the ecosystem resulting from toxic waste pollution from mine sites such as the infamous Anaconda mine smelter near Butte, Montana. The human effects of fire suppression, potential elimination in Yellowstone of native white bark pine from an introduced disease, and spread of noxious weeds are among the litany of other long lasting major ecological impacts we do not yet know how to measure.

Thus, within Y2Y, we are connected as much by our common concerns and problems as we are by the region's common flora, fauna, and natural forces. Because threats such as excessive oil and gas development and suburban sprawl are similar throughout the region, placing them in continental and international contexts provides a useful frame of reference for addressing them. Indeed, many of these threats would be best addressed through a coordinated approach that reflects a comprehensive understanding of ecological relationships across provincial, state, and international boundaries.

Through a close examination of ecosystems, which straddle the US/Canada border, for example, concerned citizens are learning some important and surprising lessons. First, that the health of wilderness-dependent species such as grizzlies, wolverine, and bull trout in Canada is critical to maintenance and recovery of these imperilled species in the US Second, Canada should not be seen as an endless repository for such species, in light of escalating development and human settlement which are reducing available habitat on the Canadian side of the border. Grizzly expert Stephen Herrero reinforced this point, saying, 'The US should not bank on Canadian grizzlies to achieve US recovery; in fact, the reverse might be more true.'

Transportation corridor and industrial development creates problems for wildlife movement in Bow Corridor near Banff National Park. Photo: Pat Morrow.

In addition to the ecological connections, the human inhabitants of Y2Y are also linked culturally and economically. Yellowstone to Yukon is our home ecosystem: we move up and down the spine of the continent because we are mountain people. We love this place, and we choose to make our living here. The trick, as more and more of us are realizing every year, is to learn to make our living without irretrievably damaging what it is that we love. The ecosystems comprising Y2Y and the organisms that reside here are an integral part of our home; they form our geographic context and the basis of a shared language about who and where

we are. In this sense, Y2Y as a place, is a force that shapes us as people and communities, binding us together in profound ways.

So what have we learned in the last seven years?

With meetings at least every six months for the last seven years, those involved in Y2Y have had the opportunity to learn about ecological connections and issues that previously were foreign (literally). The strategising and frequent interaction – on foot/skis/snowshoes – have changed the atmosphere for conservation in this part of the world in important ways. And the process of sharing information and exploring issues at larger scales is changing how conservation is pursued in the region.

First, local activists, who often feel isolated and overwhelmed by powerful opponents, are beginning to feel they are part of a larger family of concerned individuals, who can lend a hand or provide some necessary expertise. Regular postings on the computer listserv (125+ participants) include requests for economic, scientific, or other kinds of advice, pleas for letters of support, or calls for help.

Second, through this kind of interchange, in several cases conservationists have created opportunities to pursue issues differently – with some success. For example, Y2Y network members were able to help shine a spotlight on the ecologically critical Bow Valley near Banff and remind local elected officials of the international biological consequences of their development decisions in this area. US activists also played a small but helpful part at the final stage of a campaign to protect the vast Muskwa-Kechika area in northern British Columbia, and are now involved with helping Canadian activists press for an Endangered Species Act in Canada.

Third, we developed a first-ever assessment of the Yellowstone to Yukon region, its natural and cultural resources, as well as the threats to its integrity. Blessed with contributions from world-class experts in biological sciences, anthropology, and economics, the 'Y2Y atlas' (*A Sense of Place: Issues, Attitudes, and Resources in the Y2Y Eco-region*) proved to be an important first step. It helped us to define this as a unique region, compile information concerning ecological, cultural, and economic differences and similarities within this region and – perhaps most important – develop one coherent map.

This map also told several important stories, including the following:

- given road building, logging, oil and gas development, and settlement patterns directly north and south of the 49th Parallel – the international boundary between Canada and the US – the two countries could be ecologically severed in a number of places if current development trends continue;
- the southern Y2Y region is a land of fragmented island ecosystems, whereas the northern portion is a landscape still significantly wild. The implication is that in the south, protecting and maintaining all remaining wildlands and linkages, as well as restoration of degraded areas are the primary conservation tasks. In the north, the key issue is protection of vast wildlands before similar fragmentation takes place;
- socio-economically, southern British Columbia and Alberta are undergoing rapid change similar to what has been happening in much of the Northern Rockies in the US. Much can be gained through sharing knowledge about approaches effective in addressing growth issues. In addition, throughout the Y2Y region there has been a dramatic economic shift toward new amenity-based sources of income: tourism, recreation, retirement, and 'foot-loose entrepreneurs' moving to this area seeking a clean environment and a high quality of life;

- much relevant information, particularly in the areas of avian and aquatic resources and fisheries, still has not been synthesised across the border in a way that would be most useful to conservation;
- the *Sense of Place* publication was both humbling and surprising. It confirmed in some ways much of what we do know already – and reaffirmed that we still don't know important things about Y2Y as a whole.

Fourth, our outreach efforts are teaching us how to communicate effectively with diverse constituents, from reporters to park managers.

Some other important lessons we've learned include the following:

- Be specific about the implications to people of setting up core reserves, transition zones, and corridors.
  - Questions about Y2Y in the region typically focus on what Y2Y will mean on the ground. Would a recognised wildlife corridor prohibit hunting within its boundaries? Would any logging be allowed in buffers, and if so, what kinds? Would quotas on non-motorised recreation in corridors eventually be imposed? Our answers can often sound ambiguous, since there is no 'one size fits all' answer for a region so diverse, and since science does not always give conclusive answers. Yet, vague-sounding responses often do not satisfy groups and individuals that are leery of conservation initiatives in the first place. In fact, in parts of the Y2Y region, groups opposed to conservation have latched on to this perceived lack of specificity and been able to spread misperceptions about the Y2Y.
  - Thus, the challenge for Y2Y has been to develop some broad, but accurate statements on generally acceptable activities in core reserves, corridors, or transition zones – as well as a general philosophy on practices like hunting or ranching – without creating false expectations or constraining future conservation plans.
- Integrate existing planning processes into Y2Y's conservation efforts.
  - Numerous government-initiated local and regional management-planning processes have been undertaken in the Y2Y region. While some have been less than successful, many have effectively compiled important scientific baseline information and have addressed some key issues of landscape connectivity. Within Y2Y there is recognition that for conservation planning to be successful, a full inventory and review of existing agency plans in each region must precede any ecoregional plans. This review will identify deficiencies and strengths in existing plans, avoid duplication, and ensure that mapping and research efforts are focused on crucial gaps in the knowledge base.
- Be inclusive.
  - Affirming that Y2Y will rely on scientific information and traditional ecological knowledge and local input has been critical to building public support. Indeed, Y2Y participants view its role in the process as a catalyst and support centre – serving to instigate and coordinate work that will be largely carried out by local groups, scientists, and individuals in the various regions.

Where to from here?

In recent months, we have taken important next steps to further this initiative:

First, we assembled a science oversight committee to help guide us through a process to orient conservation planning for the future. And, we hired a science coordinator to assist this scientific dialogue and future analysis.

Second, we formed a conservation planning committee, designed to facilitate learning from efforts in the diverse regions, and to support broader-scale assessments of ecological processes like climate change. The committee is also beginning to develop a comprehensive conservation plan for the region.

Third, we have developed an outreach programme, hired necessary staff, and are actively pursuing a programme to discuss our efforts and philosophy with citizens and others in the region. We are also developing a committee on human dimensions, which will evaluate the nature of the changing economy, help foster sustainable development, and incorporate social considerations into further planning efforts.

Through this initiative, we are deepening the understanding of the ecological complexities of this vast region, fertilizing the social soil of the region, and planting seeds for a new vision for the Y2Y region. We are starting to think along the North/South axis of the Rockies, and across the international border, rather than east-to-west along man-made routes such as Interstate-90 or the Trans-Canada Highway. Research efforts on large-scale trans-boundary questions are expanding and experts from various disciplines are beginning to synthesise the data. In short, we may not yet have an eagle's view, but wings are flapping – and our brood is growing.

Obviously, there is much to be done, and a well-grounded sense of urgency about doing it. The Rockies offer perhaps the best chance left on earth to keep intact a fully functional mountain ecosystem. The actual charting of the Y2Y campaign will require a new, diverse kind of community – a community of conservation biologists, economists, activists, First Nations, visitors, residents and others bound together by a common concern for the future of this region. Tapping new talents and new ideas, and working along a new axis (north-south), such a community may yet succeed in developing and implementing a comprehensive plan of complementary actions to ensure that future generations will enjoy the biological riches and superb wilderness that defines Yellowstone to Yukon.

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The corridor of the Serra do Mar

GEORGE GEORGIADIS AND SILVANA CAMPELLO

For 100,000 years during the last glaciation, all of the biological diversity of the south-east Brazilian rain forest survived on the slopes of the Serra do Mar, in an area no larger than that which is still forested today. Thus the Pleistocene refuge theory provides strong evidence that the remaining forest of the Serra do Mar can effectively protect all of its rich and unique biota, but only if its integrity is maintained. By implementing effective measures to consolidate existing conservation units and maintain gene flow between them, one of the most important ecosystems on earth can be preserved ess entially intact for future generations.

The Serra do Mar corridor was first proposed by a coalition of conservation groups from the northern portion of the range as a strategy to extend effective conservation actions and integrated management to the entire ecosystem. The strategy of the proposal combines idealism with pragmatism.

THE GREAT mountain range that stretches for 1300 kilometres along the south-eastern coast of Brazil is called the Serra do Mar – the Mountains of the Sea. It is, as the name suggests, a long escarpment of ridges and valleys rising over the coast, touching the sea in some places, towering over a narrow coastal plain in other places, and everywhere folding upon itself to form bays and push out headlands and islands into the South Atlantic.

The name also evokes the vital link between the ocean and the ancient forest that covers those ridges and valleys. The Serra do Mar rises in one of the few places in the tropics where the coastline faces Antarctica. Thus, every winter, great oceanic cold fronts sweep into the Serra do Mar, blowing life-giving moisture into its rain forests just when vegetation elsewhere in Brazil wilts from the dry season. As a result, the forests of the Serra do Mar harbour a richness of life rarely seen elsewhere. Moreover, recent studies indicate that during past glacial periods, when the climate of Brazil was drier and the country was mostly covered by savannas, the Serra do Mar remained cloaked in rain forest, moistened by oceanic winds that shed rain as they rose over its ridges. Evolution has thus run uninterrupted on its slopes for perhaps five million years, producing an outstanding variety of plants, animals, and unique ecological communities. As the glaciers retreated and the climate became wetter, eight to ten thousand years ago, the forest spread and joined with other forests to the north. Thus was formed the Atlantic forest, which covered one million square kilometres of coastal Brazil when Europeans arrived in 1500.

Butress roots of Mata Atlantica rainforest tree in Serra do Mar. Photo: Fabio Colombini.

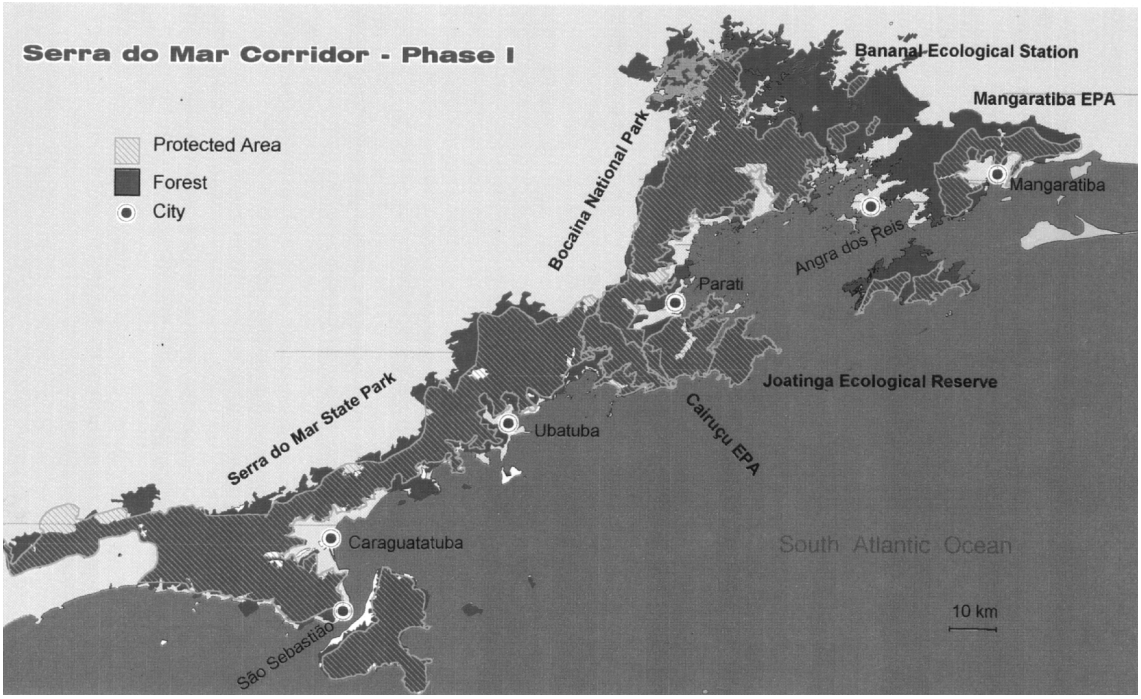
Today the Atlantic forest has again retreated, this time driven not by changing climate but by the axe, the plough, and the bulldozer. It has given way to the cities and farms of modern Brazil – nearly three quarters of all Brazilians live in its former domain. Only 8% of the original forest remains, much of it degraded and fragmented, making the Atlantic forest one of the world's top three priorities for conservation, based on biological diversity and level of threat.

The Serra do Mar has been saved thus far by its inaccessibility: it is the only place on Brazil's coast where settlers did not find a broad plain rising gently to a plateau. Instead, they found a steep escarpment covered by dense jungle. Development and deforestation proceeded behind the Serra do Mar: roads, railroads, agriculture, and industry penetrated the plateau through valleys parallel to the coast, but spared the escarpment itself. The result of this process is that today over 30 million Brazilians live in cities that are within an hour's drive of a primeval forest. This forest grows next to the most developed part of Brazil, an urban, industrial region of metropolises such as São Paulo (population 15 million), Rio de Janeiro (pop. 8 million), and Curitiba (pop. 4 million) – yet it still shelters jaguars, tapirs, and three-hundred-year-old trees. It is home to more species of birds, bromeliads, and butterflies than most of the Amazon. The Serra do Mar is undeniably the most important corridor of mountain wilderness in Brazil, perhaps one of the most important in the world. And it is still ecologically intact: it has suffered no known extinctions, and its forests show no major gaps for hundreds of kilometres. For us in Brazil, the challenge is to keep it that way.

Current state of implementation

In recognition of the Serra do Mar's beauty and biological diversity, the federal government and the governments of the states it spans enacted a number of conservation laws and created a chain of conservation units which seeks to maintain its ecological integrity. This special recognition begins in Brazil's federal constitution, which states that the Serra do Mar is part of the nation's heritage, and that its use must be subject to laws aiming to preserve its natural environment. Among the many federal and state laws that seek to implement this mandate, perhaps the most important are those creating the chain of parks and reserves that spans the Serra do Mar from north to south (see map). In its core region, this chain of protected areas is nearly unbroken, and spans a broad stretch of continuous rain forest. At present, a bird can fly under a closed canopy from Mangaratiba Environmental Protection Area (EPA) in Rio de Janeiro to Guaraqueçaba EPA in Paraná, a distance of over 550 km spanned by 14 federal and state protected areas. Over this distance, the only interruptions in the canopy are formed by the half-dozen roads that connect ports and seaside resorts to the great cities of the interior. The width of this forest corridor varies from 30 km at the widest parts to 3 or 4 km at a couple of bottlenecks.

The core of this chain of protected areas potentially protects approximately 900,000 hectares of the Serra do Mar. It leaves a few gaps in its coverage of the 550-km corridor that it forms, but for the moment at least, these gaps are bridged by wide strips of healthy forest. The forest outside the protected areas is protected by a number of federal and state laws. The Serra do Mar is also slated for strict environmental protection by several municipal master plans. Legally, the entire core of the corridor, from Mangaratiba to Guaraqueçaba, is protected, reflecting a political consensus at the national and local levels that it is an exceptional region to be preserved as part of the heritage of all Brazilians.



Serra do Mar Corridor – Phase 1.

Unfortunately, legal protection does not always mean effective protection. Enforcement of conservation laws is slack in some areas and nonexistent in others, reflecting different jurisdictions, different priorities, different budgetary and technical constraints, and different levels of coordination between the two dozen or so federal, state, and municipal agencies with environmental protection duties in the Serra do Mar. These agencies are both pressured and assisted by several national and local environmental non-governmental organizations (NGOs) that feature the Serra do Mar in their agendas. The effectiveness and level of funding of these NGOs also varies, and their coverage leaves gaps.

As a result, the Serra do Mar corridor, legally monolithic, is actually a mosaic. Some of its pieces are covered with undisturbed primary forest; many more hold secondary forest in various stages of regeneration. Many pieces of the mosaic are unoccupied, but others hold banana plantations, pasturelands, or abandoned fields. Some of the lower-elevation pieces hold urban sprawl: the narrow coastal strip at the foot of the mountains is Brazil's greatest resort area, sought by as many as five million vacation-seekers during each summer holiday season.

Conservation law implementation is also a mosaic: some protected areas carry out on-site enforcement, research, public education, and planned recreation and tourism. Others are mere paper parks, with little or no effective implementation. Outside protected areas, there are sites and jurisdictions where Atlantic forest protection laws are enforced, others where they are not, some where they are still unknown, and still others where they have been weakened by court decisions. Generally speaking, implementation of conservation units and enforcement of conservation laws is poor in the state of Rio de Janeiro, good but starting to suffer from budget cuts in São Paulo, average in Paraná, and insufficient at the federal level.

The Serra do Mar (Mountains of the Sea) rise sharply from Brazil's Atlantic coast south of Rio de Janeiro. Photo: Fabio Colombini.

Thus, although many individual protected areas are in good shape, the Serra do Mar corridor as a whole is currently threatened by fragmentation and habitat loss. The threat of fragmentation is particularly disturbing: few of the protected areas are ecologically viable by themselves. Of the 14 conservation units at the core of the corridor, 11 are smaller than 100,000 hectares, and 7 are smaller than 10,000 hectares. The larger protected areas cannot shelter viable populations of top predators: jaguars, for instance, need at least 5,000 hectares of habitat per individual in this region. The smaller parks and reserves would lose even larger portions of their biological diversity if they were to be isolated: studies on the minimum critical size of tropical forest fragments indicate that over time, fragments smaller than 10,000 hectares can lose as much as 25% of their bird and mammal species.

The strategy proposed by a coalition of conservation groups calls for the corridor to be implemented in three phases, whose scope and order of priority have been determined by an analysis of the state of conservation and level of threat of each sector of the Serra do Mar:

- **Phase 1: Mangaratiba to São Sebastião.** This sector of the Serra do Mar, in addition to incorporating one of the most threatened sections, is widely believed to be the core of the south-east Brazil Pleistocene refuge, and may be the most species-rich region of the entire Atlantic rain forest. This sector has been thus chosen for the first phase due to a combination of biodiversity, imminent threat of fragmentation (particularly of foothill ecosystems), and existence of a coalition of public and private interests willing to drive the process, including municipal and state governments, citizen's groups, academic circles, and local business.
- **Phase 2: São Sebastião to Guaraqueçaba.** Forest coverage is nearly continuous along this sector, and protected area coverage leaves few gaps. This sector also includes the only large areas where there are no coastal roads or resort towns at the foot of the Serra do Mar, and consequently protected forests extend to the seashore. Coordination of the many current conservation initiatives at the state and NGO levels can result in effective consolidation of this sector of the corridor. This may in part be achieved by the World Heritage designation for the Southeast Atlantic Forest Reserves, which encompasses some of this section of the corridor (although it does not encompass the centres of endemism located between São Sebastião and Santos.
- **Phase 3: Desengano State Park to the Serra Geral.** Once the sectors of the corridor that currently display nearly continuous forest coverage are consolidated, the much more ambitious goal of linking the entire Serra do Mar can be tackled. This would involve considerable reforestation: the largest gap in forest coverage, between Tinguá Biological Reserve and Mangaratiba Environmental Protection Area, both in Rio de Janeiro, would require reforestation of abandoned pasture and coffee

plantations along a straight-line distance of 30 kilometres. At the moment, this may seem far-fetched. Once phases 1 and 2 are implemented, however, the practical experience and publicity gained may make a realistic strategy to restore the entire Serra do Mar a goal within reach. This would result in long term ecological viability for important forest remnants that are now isolated, such as those in Serra dos Orgãos National Park and Desengano State Park to the north and in Aparados da Serra National Park to the south. In the Brazil of 1999, phase 3 is the distant dream of a few conservationists; in the Brazil of 2020, it may be a national goal within reach.

Method used to identify linkages between protected areas

The integration of the protected areas strung along the Serra do Mar begins with the mapping of their locations and the identification of gaps in their coverage. Once gaps are identified, the most likely linkage pathways can be located, and steps can be taken to protect and improve appropriate habitat along them. Using federal government and World Bank funding, in 1998 such a procedure was carried out for the northern portion of the corridor using a GIS database. The study was implemented by the Tangará Environmental Consulting firm on behalf of the Rio de Janeiro State Secretariat for the Environment, the federal Ministry of the Environment, and the municipalities of Angra dos Reis and Paraty.

The linkage pathways do not necessarily follow a straight line: the forests of the Serra do Mar differ in the composition of their fauna and flora according to altitude. Many endemic species of animals and plants are restricted to cold and wet higher altitudes, while others rarely leave the warmer, drier forest of the foothills. Thus it is important to identify linkage pathways that can provide gene-flow corridors for both upper and lower montane ecosystems. Identification of such pathways and development of an implementation strategy requires detailed ecological data.

A rapid ecological assessment (REA) of the northern portion of the Serra do Mar corridor was carried out as part of the 1998 study. The REA combined remote sensing and field data in a GIS database in order to determine the different classes of ground cover along the Serra do Mar. Ground truthing then determined the characteristics and ecological role of each vegetation class. The result of this procedure was an up-to-date vegetation map, which allowed the identification of existing linkage corridors between different forest ecosystem types of the Serra do Mar.

Each of the major natural communities that occur in the Serra do Mar was analysed through a series of transects, in which microhabitat diversity, forest structure, and bird community structure were determined. Statistical analysis of the results permitted a measure of the uniqueness of each type of forest habitat, as well as an understanding of the ecological interactions between different habitats. This was then used to determine the role of each forest type as habitat for resident species and as a gene-flow pathway between other forest types. In this way, effective linkage corridors can be designed with a greater level of certainty than would be possible if all forest types were assumed to be homogeneous habitat.

Finally, in order to ensure that the proposed linkage corridors made economic as well as ecological sense, a study of comparative advantages for different land uses within the corridor region was carried out. The region was classified into discrete

terrain units, based on topography, soil types, vegetation cover, existing and planned infrastructure, local microclimate, and other parameters. The economic potential, environmental impact, and mitigation potential of competing land uses in each class were studied and discussed with local community leaders in a series of workshops. The result was the definition of a zoning and land use plan for the region which incorporates broad corridors of native forest surrounded by buffer strips devoted to ecotourism, agroforestry, and other compatible economic activities. In this manner it was possible to propose a corridor system which optimises the use of each parcel of land in economic and ecological terms.

Principal problems facing strategy implementation

Identification of existing protected areas, priority habitat for conservation, and most effective linkage corridors is only the first step in the implementation of the Serra do Mar corridor. The next step is clearly the implementation of existing conservation units. It makes little sense to speak of linkages between parks and reserves when many of the parks and reserves themselves are no more than paper parks, with little to set them apart from unprotected areas. An analysis of the current state of implementation of these formally protected areas reveals three main reasons for their present ineffectiveness as conservation units:

- **Lack of funds.** Brazil's successful revitalization of its economy dictated austerity for government agencies, and nature protection agencies are no exception. Some protected areas receive budget allocations that cover only a fraction of their needs, while others actually receive no budget allocations at all.
- **Weak management agencies.** Most government agencies with jurisdiction over Serra do Mar protected areas suffer from political interference and chronic shortages of manpower and equipment. In addition, low salaries make it difficult to recruit qualified professionals for protected area management, while rigid bureaucratic procedures and institutional cultures that do not value field work often make for inefficient use of the personnel and resources that are available. Management agencies thus often have staff in excess at their city headquarters, while personnel stationed in the field are generally scarce, overworked, underpaid, and under qualified.
- **Lack of public support.** This is perhaps the most fundamental reason for the current state of neglect of many protected areas in the Serra do Mar. Widespread public support, especially at the local level, could result in more resources and political muscle for park management agencies, as well as for the environmental NGOs that operate in the region. This in fact happens in other protected areas in the same states, such as Iguaçu National Park in Paraná or Tijuca National Park in Rio de Janeiro. Both of these parks differ from most protected areas in the Serra do Mar corridor in that they are open to visitation, receive large numbers of visitors, and consequently represent a significant resource for the local economy. As a result, although they also have problems, they are relatively well funded and well protected by the public sector, and receive significant private donations as well. Meanwhile, parks in the Serra do Mar are mostly closed to visitation and offer little or no infrastructure for tourism and recreation. They thus remain unknown to the general public and contribute little directly to the economies of the resort towns that surround them.

The implementation of the Serra do Mar corridor thus must begin with the integration of existing protected areas into the local economy. As mentioned above,

the Serra do Mar is Brazil's most popular resort region. The economy of all concerned municipalities already revolves around tourism, and ecotourism in particular is the fastest-growing segment of the industry. Already a number of resort hotels have established private conservation units for their guests on the slopes of the Serra do Mar. Seeing the trend, some management agencies and NGOs are beginning to build trails, visitor centres, and other visitor infrastructure into some conservation units, such as Serra do Mar State Park, and the results are promising. More and more Brazilians are beginning to enjoy nature trails, mountain climbing, bird watching, and other forms of nature-based tourism. Foreign visitors are beginning to discover the Serra do Mar, where it is possible to see 150 species of birds (out of a possible 600) and 200 varieties of bromeliads in a single morning's hike. Each new visitor to the Serra do Mar adds to the growing pool of public support at the national and international level, while tourist revenues generate support at the local level. Meanwhile, owners of property along prospective corridors become more receptive to conservation, and even set up privately-maintained reserves, as they become aware that the greatest economic return from their lands can be obtained by keeping them as pristine as possible in order to attract ecotourists. This, we believe, is the path to successful implementation of the Serra do Mar corridor.

Implementation strategy

As mentioned above, implementation of phase 1 of the Serra do Mar corridor has already begun. This effort has received support from government agencies and private donors. Gradually a coalition of diverse interests is being formed, with the protection of the Serra do Mar as its common goal. The strategy developed to build this coalition and achieve its aims consists of the following components:

- Integration of protected areas into the local economy – as shown above, the single most important obstacle to implementation of the Serra do Mar corridor is lack of public support at the local level. By developing activities such as ecotourism in each of the protected areas where legislation and management regulations allow it, parks and reserves can be turned into economic assets for surrounding towns. Once this is accomplished, resources and support for effective implementation become much easier to secure.
- Expansion of protected area coverage – this is the most effective way to link existing protected areas along the corridor. Protected area coverage can be expanded by a variety of approaches, such as enlarging the boundaries of existing parks and reserves or working with municipal governments to prevent development on the slopes of the Serra do Mar through municipal master plans and zoning ordinances. The best approach varies on a case-by-case basis, and it is important to not expand protected area coverage beyond the management

The Serra do Mar has so far largely been saved from clearing by its relative inaccessability of steep escarpment topography. Photo: Fabio Colombini.

capacity of implementing agencies. It is also important to base proposals for extension of protected areas on up-to-date economic and land use data, in order to demonstrate to decision makers that ecosystem conservation is actually the optimum land use for the areas in question.

- Establishment of private reserves – this is another way to expand protected area coverage, and holds considerable promise. Many tourism interests have already established private reserves dedicated to ecotourism, while some wealthy private landowners protect their lands for their own aesthetic enjoyment. NGOs also establish private reserves for conservation and research purposes, often with support from companies and private donors. Most private lands on the slopes of the Serra do Mar lend themselves to little else: the soils are poor and susceptible to erosion, the steep slopes make road building extremely expensive, and environmental legislation restricts almost all forms of legal development of forested lands. Land values are therefore low: in some areas forested land can be purchased for as little as US$ 10 per hectare. Thus a strategy to stimulate the establishment of private reserves, and of outright acquisition of land by conservation NGOs, is both feasible and promising.
- Development of ecotourism – currently most visitors to the Serra do Mar are drawn by the superb beaches and coastal waters that it frames. The Serra do Mar is a region of rain forests, however, and consequently the weather is often overcast and rainy. When it rains, the tourism revenues associated with sun-seeking beach-goers then drop considerably. At the same time, the few local tour operators that offer ecotourism activities centred on the forests and waterfalls of the Serra do Mar report no drop in demand; ecotourists that come to enjoy the rain forest generally expect to find rain, and do not mind it. Further expansion of ecotourism in the region, through establishment of infrastructure such as nature trails and parkways, training of operators and trail guides, and effective protection of parks in order to facilitate the viewing of birds and animals, would provide a much-needed resource to the local economy and would generate a strong demand for well-maintained protected areas. Ecotourism is not a cure-all, and if not properly carried out can result in undesirable environmental impacts; currently, however, ecotourism is practically the only economic activity that does not take place in most of the parks and reserves of the region. As a replacement for poaching, illegal heart-of-palm extraction, logging, and banana-growing (all of which currently take place inside and outside protected areas in the Serra do Mar), ecotourism is an activity to be stimulated as much as possible.
- Establishment of public-private partnerships for conservation – Downsizing, decentralisation, and privatisation are the current trend in public administration in Brazil, and the good macroeconomic results this trend has produced mean that it is likely to continue. In this context it makes little sense to think that there will be increases in park budgets or staffing. Instead, management agencies are experimenting with various combinations of subcontracting, cooperation with NGOs and municipal governments, and seeking of private and corporate support for parks and reserves. Many of these initiatives have yielded positive results, and will most likely become the basis for a new model of protected area management, with official management agencies providing oversight and enforcement powers while NGOs and municipal governments handle day-to-day management, often using a combination of private donations and public funds.

Political acceptability

Formally, there can be little doubt that the Serra do Mar corridor is politically acceptable. The large amount of federal, state, and municipal legislation that calls for the protection of the Serra do Mar ecosystem is evidence of that fact. Most of the Serra do Mar is already formally protected by a chain conservation units set up with little or no political opposition. The constituency for these legislative acts is largely composed of the citizens of the large cities near the Serra do Mar. These urban areas are home to over 35 million Brazilians, a large proportion of whom are educated members of the middle class with a high level of environmental awareness. To this politically influential group, the Serra do Mar – and the splendid coastline over which it rises – is a national asset to be preserved for recreational and aesthetic purposes.

At the local level, political acceptability is also strong, although support for the actual means of implementation may vary. Municipal governments and local business in general see the Serra do Mar as a potential asset, and this is often reflected in municipal conservation laws and private conservation initiatives. At the same time, the heavy-handed imposition of federal and state conservation laws is often resented, as many of these laws are seen as unfair to local interests, and the implementing agencies are often seen as unresponsive to local needs. In recent years Brazil has undergone a profound restructuring of its federal system, involving decentralization and empowerment of local government and citizen groups. It has therefore become essential to win local support in order for a conservation initiative to be successful. Some problems with political acceptability remain at the regional level. The Serra do Mar corridor encompasses portions of several states, and it also overlaps with previous initiatives such as the Atlantic Forest Biosphere Reserve. There is some difficulty in persuading agencies and politicians to think in terms of ecological viability across entire landscapes, as rivalry between states and between political groups competing for funding and influence is considerable. As a result, there is for example not a single conservation initiative crossing the border between Rio de Janeiro and São Paulo, even though the largest national park in the region straddles the border (the park is currently only managed on the São Paulo side).

Lush, diverse vegetation and rich associated fauna are fostered by the rainfall and cloud moisture regime of a coastal mountain range.
Photo:
Fabio Colombini.

State of local support

The Serra do Mar corridor is essentially a local initiative. At the community level, however, some resistance to the many Serra do Mar conservation laws and initiatives can be detected, due to the fact that until recently, protected areas in the region were managed without taking into account the needs of local stakeholders. This often resulted in antagonistic relationships between local interests and conservation unit managers. Recent efforts by conservationists to be more responsive to local stakeholders

have begun to overcome this resistance, and even to convert it into support for conservation measures.

One local group whose opposition may require some effort to overcome is composed of individuals who use public lands on the Serra do Mar to grow cash crops, mainly bananas. This group comprises less then 2% of the inhabitants of the Serra do Mar region, but it includes most of the people who actually live within the protected areas and proposed linkage corridors. Banana growing is relatively unimportant for the local economy as a whole, but it is a form of social security for many local families: an older family member keeps the banana plantation while the other family members do seasonal jobs in tourism, fisheries, and construction. During the low season for tourism, or during the closed season for fishing, unemployed family members pitch in at the banana fields and the family makes do until next year. One way to break these cycles and reduce these families' dependence on slash-and-burn banana planting is to attract tourists to the region year-round. The current low tourist season is during the southern winter, when cool weather keeps most people away from the beach resorts at the foot of the Serra do Mar. This season, however, coincides with the high season for ecotourism, which peaks during the northern summer. It also coincides with the dry season in the Serra do Mar, when forest trails are more accessible and wildlife is more easily seen. By developing ecotourism in the region's protected areas, it may be possible to even out of tourist flow over the year and thus convert many seasonal jobs into permanent ones, whose holders can then give up the family banana field and join the national social security system.

Summary

In summary, the key to winning local support for the Serra do Mar corridor is to integrate it into the local economy. Command-and-control approaches to nature conservation have proven ineffective in Brazil, where people traditionally have learned how to get around unpopular laws imposed from above. Success can only be achieved if local stakeholders see benefits in protected areas and conservation laws. Opposition then turns to support, and locally-driven initiatives combined with social pressure prove far more effective than centrally-planned law enforcement. Fortunately, the Serra do Mar is not some remote range surrounded by land-hungry peasants; it rises in one of the most beautiful coastal resort regions in the world, next to some of the largest and wealthiest cities of the southern hemisphere. The local economy already revolves around the tourists and second-home owners who come seeking the region's natural beauty. The great challenge of the Serra do Mar corridor is to harness this economic system to help preserve the splendid ecological system of the Serra do Mar, created by five million years of undisturbed evolution, without damaging it in the process.

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Linking protected areas for ecosystem conservation: a case study from Bhutan

MINGMA NORBU SHERPA AND UGEN P NORBU

The Royal Government of Bhutan follows a far-sighted policy to pursue economic development at a pace that is in harmony with the rich cultural and natural heritage of the country. Nature conservation has always received the highest priority in national development programs. As a result, Bhutan today possesses a unique and relatively unspoiled environment with an astounding 64.4% of its land area still covered by natural forests. Approximately 26% of the total land area of the country is designated as a national protected area system consisting of four national parks, four wildlife sanctuaries and one strict nature reserve.

In order to conserve the range of natural ecosystems found in the country, the Royal Government of Bhutan enlarged Royal Manas National Park to connect with the Black Mountains National Park to the north and with India's Manas Tiger Reserve to the south. Furthermore, Royal Manas, Black Mountains, and Jigme Dorji National Parks were selected as priority protected areas for immediate conservation management. The three protected areas create a spectacular biological corridor protecting major ecosystems of the country from the moist tropical forests of the south, through the species-rich temperate mountain forests of central Bhutan, to the alpine habitats and permanent ice fields in the north. As a result, Bhutan is probably the only country in Asia with such a comprehensive and versatile protected area system with a contiguous north-south biological corridor.

This paper attempts to highlight the important initiatives taken by the Royal Government and people of Bhutan in establishing linkages between several protected areas to provide biological connectivity for wildlife migration and natural succession. The lessons learned in developing a network of protected areas for ecosystem conservation in Bhutan are particularly noteworthy as national parks and other protected areas in most regions of the world today form no more than islands of biodiversity surrounded by highly degraded environments.

LOCATED IN the Eastern Himalayas, Bhutan is one of the ecological wonders of the world. The Kingdom straddles two biogeographical realms: the Palearctic realm of temperate Euro-Asia, and the Indo-Malayan realm of the Indian subcontinent and mainland Southeast Asia. The result is a nation incredibly rich in biodiversity. Cursory biological surveys have recorded some 5,400 species of vascular plants, 770 species of birds, and 160 species of mammals representative of the Southeast Asian, Indian, East Asian, Tibetan, Euro-Siberian, and Alpine-Tundra elements. More detailed and comprehensive surveys are expected to reveal higher species diversity. Within an area of 46,500 km^2, the biomes in Bhutan stretch from tropical savanna in the south, through temperate mountain forests in the central interior, to alpine highlands in the north. These various biomes support an array of fauna of both Euro-Asian and Indo-Malayan origins. Tropical wildlife of Indo-Malayan origin such as the Bengal tiger, Asian elephant, one-horned rhinoceros, wild buffalo, and hog deer are found in southern Bhutan. Wildlife species of the Euro-Asian type such as the snow leopard, red panda, and wolf are found in the temperate and alpine habitats of central and northern Bhutan. This rich diversity

of fauna in Bhutan can be largely attributed to extreme variations in topographical and climatic factors.

In 1993, Bhutan revised the national system of protected areas to encompass representative samples of the full range of habitat types and ecosystems found in the country. The revised system includes a strict nature reserve (IUCN category I), four national parks (IUCN category II) and four wildlife sanctuaries (IUCN category IV). In addition, several small scenic landscapes and conservation areas have been set aside for aesthetic and nature conservation purposes. Jigme Dorji National Park, Black Mountains National Park, and Royal Manas National Park were identified as priority areas for scientifically-based management to conserve the major ecosystems of the country ranging from the lowland tropical grasslands and forests in the south to permanent snow fields in the north.

Three protected areas – Black Mountains National Park to the north, Royal Manas National Park in the centre, and India's Manas Tiger Reserve to the south, form an integral protected natural complex. It features a wide range of habitats, from lowland tropical forests all the way up to permanent ice fields; all located in one of the world's most important ecological regions. Together, these three protected areas constitute possibly the most important protected region in all of Asia. Royal Manas National Park is the richest and most biologically diverse of the three protected areas.

Similarly, Black Mountains National Park has the potential to be connected with the Jigme Dorji National Park. The richly forested link area already includes forest management units in Kotokha and Chendebji areas and a black-necked crane conservation area in Phobjikha valley. The conservation importance of this link area has become further evident from ongoing nationwide tiger surveys. These have recorded tiger occurrence in several parts of the link area as well as in Jigme Dorji National Park at elevations ranging up to 4,000 m. Tiger surveys are yet to be carried out in the Black Mountains National Park. There are strong indications that the a healthy tiger population exists in the park since tiger signs have been recorded in the peripheral areas adjoining the northern, eastern, and southern boundaries of the park. Contiguous tracts of intact natural habitat could be the primary reason for the wide occurrence of tigers in Bhutan. Likewise, Asian elephants have been found at 2,000 m in the hills of Bhutan during the summer months when they migrate from the plains of India. In addition, the biological corridor serves as an important migratory route for several bird species such as the oriental turtledove and black-headed sibia.

Description of the linked areas

Royal Manas National Park

Royal Manas National Park, covering an area of 1,023 km^2 in south central Bhutan, is linked with the Black Mountains National Park to the north and Manas Tiger Reserve in India to the south. Much of the park is characterised by rugged, mountainous terrain with moderately steep slopes, which peak at 2,707 m in the northern part of the park. Running through the park is the Manas River, Bhutan's largest, draining about two-thirds of the country.

Tropical monsoon forests interspersed with swathes of natural grasslands, evergreen tropical and subtropical forests, and warm and cool temperate broadleaf forests characterise the park. The largely deciduous forests along the foothills give way

to subtropical broadleaf forests in the mid-elevations and temperate broadleaf in the higher elevations. Patches of pine forests occur in the mid and higher elevations. Wildlife habitats identified in the park are: tropical grassland, tropical monsoon forest, tropical broadleaf forest, subtropical broadleaf forest, scrubland, temperate broadleaf forest, subtropical pine forest, riparian forest, floodplain/ dry riverbed.

Royal Manas National Park in Bhutan: sub-tropical lush rain forests supporting healthy populations of tigers, golden monkey, elephant and guar. Photo: Mingma Sherpa.

The park's location, and its largely pristine forest, which covers approximately 92% of the area, contributes to its extremely rich biodiversity. Its varied habitats support a wide range of fauna, including many rare and endangered species such as the Bengal tiger, Asian elephant, greater one-horned rhinoceros, gaur, wild buffalo, leopard, and wild dog. Species endemic to the Eastern Himalayan foothills, such as golden langur, capped langur, pygmy hog and hispid hare also occur in the park. The park is also extremely rich in avifauna and other lower vertebrate and invertebrate fauna. A total of 366 species of birds have so far been recorded, more than any other protected area of its size in the region. Globally endangered species include the rufous-necked hornbill and Pallas' fish eagle, and 14 other species recorded from the park are considered to have globally significant breeding populations in Bhutan. The chestnut-breasted partridge for which there are no recent records outside Bhutan has also been recorded in this richly forested park. In addition, more than 900 species of vascular plants have been recorded in the park. Several of these species have value as cultivars for crop agriculture and other horticultural uses, and a number of others are of immense economic, medicinal, traditional, and religious significance.

Besides the wild flora and fauna, about 9,000 local people live in and around the national park. The economy of these people is almost entirely nature-based. They interact with their natural surroundings to sustainably derive construction timber, fuelwood, food, agricultural manure, medicine, raw materials for local handicrafts, and a host of other goods and services. Human settlements and agricultural areas within and in the peripheries of, the park have been zoned for multiple land use and buffer zone management based on the principles of integrated conservation and development.

Royal Manas is linked to the Black Mountains National Park to the north and India's Manas Tiger Reserve in the south. The principal reason for this linkage is to provide a continuous gradation of protected natural habitats from tropical duars all the way to alpine Himalayan highlands. This initiative is without doubt a unique conservation achievement in the Himalayas.

Black Mountains National Park

With an area of 1,400 km^2, Black Mountains National Park, in Central Bhutan, covers a wide range of habitat types, from permanent ice, alpine lakes and pastures, to subalpine, temperate, and subtropical forests. Plant species found in the area include chir pine, several species of oak, birch, maple, alder, several species of rhododendron,

hemlock, spruce, blue pine, larch, fir, juniper and cypress. The park is also rich in wildlife – Himalayan black bear, leopard, Bengal tiger, goral, red panda, serow, sambar, wild boar, golden langur, Asiatic wild dog, and occasionally gaur and Asian elephant are found in the area. Preliminary avifauna surveys have already recorded 449 species of birds in the combined areas of the Black Mountains and Royal Manas National Parks. The park constitutes the largest and best protected sample of the species-rich temperate mountain forest ecosystem in the Himalayas.

More important, the park is linked to Royal Manas National Park to the south by a forested corridor. This results in a unique conglomerate of natural landscapes spanning the entire gradient from tropical duars to permanent ice fields. The combined park would certainly merit recognition as a World Heritage Site under the UNESCO World Heritage Programme.

Black Mountains National Park with temperate habitats supporting populations of Himalayan black bear, red panda and hornbills. Photo: Mingma Sherpa.

The park contains almost no permanent residents. There are a few small farms on the borders of the park along the Mangde River, in the lower Hara River, and along the park's southern border. These areas have been set aside for buffer zone management. A larger human settlement in the Nubi area will be enclaved and left out of the park boundaries. The only major biotic use currently made of this area is the grazing of large numbers of yaks in summer on the northern alpine meadows of the park. This area will be zoned as a seasonal grazing area to preserve the traditional grazing rights of the local people. However, further cutting of the adjacent forests to extend the natural grazing area will be prohibited by park regulations. A conservation management plan, based on the results of rapid biodiversity and socio-economic surveys, is under preparation.

Jigme Dorji National Park

Jigme Dorji National Park is the largest protected area in Bhutan, encompassing an area of 4,349 km^2 in the north-western corner of Bhutan. Jigme Dorji falls within the biologically-rich Eastern Himalayan ecosystem and represents one of the last remaining tracts of the upper Himalayan mountain ecosystem. With altitudes ranging from 1,400 to over 7,000 metres, the park contains 8 of the 11 classified vegetation types found in Bhutan. These range from pristine riverine temperate broadleaf forests along the steep gorges

to temperate evergreen forests, subalpine grasslands, alpine meadows, and glaciated ice, rock, and scree found in the higher elevations. In addition to populations of wildlife such as blue sheep, takin, snow leopard, musk deer, Himalayan black bear, Bengal tiger, and red panda, approximately 6,500 local people live within the park. They practice subsistence agriculture at the lower elevations and subsistence livestock grazing, particularly yak management, at the higher elevations.

The wide variety of natural habitats – from the alpine highland of the north to broadleaf forests in south – is important for several migratory wildlife species such as takin, snow leopard, Bengal tiger, blue sheep, deer, and blood pheasant. A richly-forested corridor connects the park to the Black Mountains National Park.

Jigme Dorji has immense cultural and economic significance. Alternatively known as 'the abode of gods,' the park has many sacred natural features and cultural monuments. Mount Chomolhari and Mount Jitchu Drake, two of the most popular mountain peaks in Bhutan, are worshipped by the Bhutanese as homes of the local deity. Outstanding fortresses such as Lingshi Dzong and Gasa Dzong reflect Bhutan's magnificent culture and history. Four major rivers – Mo Chhu, Pho Chhu, Wang Chhu, and Pa Chhu – have their sources in the glacial lakes located in the alpine valleys of the park. Hydropower plants downstream in southern Bhutan harness the turbulent waters of these rivers to produce electricity, currently the country's largest export product in terms of generation of foreign revenue. The protection of these rivers is also critical for downstream communities in Bhutan, India, and Bangladesh.

Biological corridor linking Black Mountains and Jigme Dorji National Parks

A forest corridor connects the Black Mountains and Jigme Dorji National Parks. This area is not officially recognised for major conservation intervention. Subtropical and temperate forests cover more than 75% of the area. The forest corridor serves as wintering grounds for the charismatic but rare black-necked cranes. Several forestry and conservation units within the corridor already provide substantial protection to the link area.

Conservation Areas: Phobjikha and Khotokha areas have been set aside as conservation areas for protecting the wintering habitats of the black-necked cranes. The conservation areas attract more than 200 cranes every winter. These areas are multiple-use areas and do not require detailed conservation plans. Nevertheless, they require some special regulations to provide adequate protection for the cranes and their natural habitats.

Scenic Landscapes: Pele La, a main divide of Wangdi and Tongsa Dzongkhags, serves as a scenic area and also provides prime habitat for langur, red panda, and many bird species such as satyr tragopan and blood pheasant. This largely forested landscape is managed by the Forestry Service Division, which applies restrictions on forest uses as necessary.

Forest Management Units: Two forest management units, one in Khotoka area and the other in Chendebji area, allow harvesting of timber and fuelwood based on sustainable forest management plans. Ecological and socio-economic considerations receive due attention in operating the forest management units. These units and other forested areas serve as an excellent wildlife corridor for both migrant and resident species. Most of the valleys and the ridges along Pele La are still densely forested and serve as a good biological corridor.

Alpine meadows and sub-alpine areas in Jigme Dorje supporting a number of species such as oak trees, rhododendrons, takin, snow leopard and blue sheep. Photo: Mingma Sherpa.

Key challenges

Settlements and development

Some of the villages along the boundaries of Royal Manas National Park, such as Panbang, Surey, and Tingtibi, are relatively large commercial centres and require adequate attention as potential conservation threat areas. Similarly, over 6,500 people live within Jigme Dorji National Park, subsisting on park resources. The increasing populations put greater pressure on the park, including demands for already scarce fuelwood and pastures. Subtropical habitats are already threatened by unsuitable agricultural and other land uses. Short rotation shifting cultivation on steep hill slopes has already caused much soil erosion, and natural forests around major settlements are becoming gradually degraded by unsustainable patterns of use of forest resources to meet the demands of an increasing population and associated development. Large-scale burning of grasslands to increase new forage disrupts wildlife movement and causes habitat degradation.

Jigme Dorji National Park has a heavily populated human enclave in Gasa area up the Mochhu valley and some high altitude seasonal grazing areas in the Lingshi, Laya, and Lunana areas. These areas have been zoned for intensive use. Creation of the park will thus cause minimum disruption to the lifestyle and land use rights of the local people. The area has high potential for trekking tourism but that will require intensive monitoring of cultural and environmental impacts. Moreover, the limited number of park staff are already required to address a number of pressing environmental concerns such as overgrazing, overharvesting of medicinal plants, and wildlife poaching.

Community development initiatives that focus on conservation education and alternative livelihoods are critical to mitigate conservation threats from local communities. The conservation management plans for both Jigme Dorji and Royal Manas duly recognise the importance of involving local communities and gaining their support in natural resources management. Projects focusing on integrated conservation and development are already underway in Royal Manas and Jigme Dorji National Parks.

Integrating nature conservation objectives and community development needs has become a major challenge for our conservation personnel. Specifically, they will need to design and implement people-based approaches to conservation management in these areas, rather than the more conventional restricted model.

Wildlife poaching

As a result of the political turmoil in the adjacent Indian State of Assam and a consistently lucrative international market for wildlife parts and products, poaching of wildlife poses a serious problem in India's Manas Tiger Reserve. Since wildlife migrate freely across the international boundary, poaching in the Manas Tiger

Reserve affects the fauna in the Bhutanese part of the Manas ecosystem. The greater one-horned rhinoceros is almost extinct in the Indian reserve due to increased poaching. Bengal tiger, Asian elephant and the agarwood tree currently face the same fate as a result of organised poaching to meet the demands of international markets for wildlife parts and products. Poaching of other animal and fish species for consumption and sale continues, despite anti-poaching patrols and heavy penalties. Several instances of illegal tree felling have also been reported along the southern boundary of Royal Manas. The southern border is thus threatened from relatively large-scale poaching and deforestation practices. Possibility of implementing a joint park patrol programme between the park authorities of India and Bhutan needs to be explored.

Inadequate implementation capacity

Bhutan's Forestry Services Division is handicapped by a dearth of trained conservationists, poor park management infrastructure, and an insufficient information base. Only three of the nine protected areas have been brought under proper management. Despite its huge area and rugged terrain, Jigme Dorji National Park has only 13 staff. Black Mountains National Park is also constrained by a similar manpower situation. A majority of the park staff in Royal Manas has received little or no formal training in conservation science. The open international border in Royal Manas offers easy access to poachers whereas insufficient park staff with a poor communication network makes it difficult to counter this threat.

Jigme Dorji and Black Mountains National Parks have inadequate infrastructure and facilities required for park management. An on-site park management headquarters is long overdue in Royal Manas. Facilities for conservation research and public education are virtually non-existent. The information base is poor and generally inadequate. Rugged terrain and harsh working conditions call for increased manpower and improved infrastructure in the three priority protected areas to begin with, and eventually in the other protected areas.

Cross-sectoral coordination

Traditionally, nature conservation was seen as a business of the Forestry Services Division solely. There was little, if any, consultation with other sectors such as agriculture, livestock development, and education. This led to planning and implementation of conservation interventions with a very constricted and totally ecological perspective, isolating them from other interconnected aspects.

New approaches for conservation require stronger coordination among different sectors. This makes protected area management a complex and often difficult process. Efforts are ongoing to develop and nurture working partnerships between the Forestry Services Division and local government authorities, such as the Dzongkhag (District) Administrations. National NGOs, such as the National Women's Association of Bhutan and the Royal Society for the Protection of Nature, are also becoming more involved in protected area management, particularly in aspects dealing with community development and public education. In the absence of institutionalised mechanisms for inter-sectoral coordination of nature conservation programmes and activities, planning and implementation of protected area management activities in a holistic, concerted, and consensual manner is difficult.

Opportunities for ecosystem conservation

Multiple land use concept a means for biodiversity conservation

With the rapid rate of development and population growth, local communities are finding it increasingly difficult to sustain their needs of natural resources. Growing demand for fuelwood, construction timber, and other forest products, slowly growing urbanization, and a lucrative international market for rare wildlife species and medicinal plants, all threaten biological diversity and sustainable development. Several experiences from within the Asia and Pacific region demonstrate that successful biodiversity conservation needs to be built on community participation and support. Conservation initiatives need to be inter-sectoral in nature and should incorporate biodiversity conservation into the main productive sectors of the national and local economy. Integrated rural development addressing livelihood issues of local and indigenous communities living in buffer zones of protected areas might include community forestry, agroforestry, soil and water conservation, livestock production, sustainable mountain agriculture, vocational training, and community education. Just as important, it is essential to identify and implement innovative economic instruments to finance biodiversity conservation at local, national, and regional levels. Conservation with a human face will be an important issue to be incorporated in all biodiversity conservation and sustainable development initiatives.

While the concept of multiple land use as a means for biodiversity conservation is relatively new in Bhutan, neighbouring countries have gained substantial experience, both good and bad, in practicing the concept. Bhutan can benefit from the lessons learnt in Nepal, the Himalayan parts of India and Pakistan, and other countries with considerable experience in implementing the multiple land use concept in mountain forest ecosystems.

Transborder cooperation

Royal Manas National Park in Bhutan and Manas Tiger Reserve in India, which together constitute the Manas ecosystem, share many rare and threatened wildlife and critical natural habitats. Some of these wildlife such as the greater one-horned rhinoceros, Bengal tiger, and Asian elephant face serious threats from poaching. A joint conservation research and anti-poaching scheme between the Indian and Bhutanese park authorities would greatly help curtail the threats from wildlife poaching.

Field level cooperation

The relations between park management staff at the local level are fairly good with informal meetings being convened between the staff of the two protected areas at ad hoc intervals. The main entry route to Royal Manas National Park is through India's Manas Tiger Reserve. Since ethnic Bodo tribal agitation in Assam broke in the late 1980s, considerable disturbances have occurred in the Reserve. The impact is stronger in the buffer areas where illegal felling of trees and poaching are more common. Despite the insurgency and manpower problem, staff in both protected areas patrol the vulnerable and threatened areas of the park regularly to ensure reasonably good protection to an otherwise fast-dwindling wild flora and fauna.

Bhutanese people living in the southern buffer areas of Royal Manas National Park are allowed unrestricted passage through the Indian Manas Tiger Reserve to reach markets in the neighbouring towns of India.

Collaboration at bilateral level

The Royal Government of Bhutan and the Government of India have maintained friendly political ties for several decades. This provides a policy environment conducive for strengthening bilateral partnerships in the conservation of the Manas ecosystem, which is a unique natural heritage for both countries.

Senior government officials have held a series of discussions to manage the greater Manas ecosystem for tiger conservation. Already there are plans for a joint meeting between the park authorities of India and Bhutan as well as funding possibilities by international aid agencies on both sides of the Manas ecosystem. Both protected areas are bordered in east, west, and north by forested areas and are fairly safe from encroachment. The southern part of Indian Manas Tiger Reserve is heavily populated and requires immediate attention to design and implement eco-development interventions.

Recognition as a World Heritage Site

The Manas Tiger Reserve in India was designated as a World Heritage Site in 1985. The importance of Manas ecosystem – linking tropical forests, duars, and grasslands to temperate and alpine habitats of the Black Mountains, or even further to Jigme Dorji National Park – requires attention from the world community for enlisting it as a World Heritage Site. The combined protected area system provides a rare opportunity to conserve a high-value biodiversity complex in the South Asian region.

Status of implementation

Management of protected areas

The Forestry Services Division, a technical division within the Ministry of Agriculture, is responsible for the overall protection and management of forests and wildlife resources in Bhutan. It is one of the largest government organizations in Bhutan with staff strength of over 800 and a network of field offices spread throughout the country.

Within the Forestry Services Division, the Nature Conservation Section is specifically responsible for coordinating and technically backstopping nature conservation and protected area management activities. Today, the Nature Conservation Section has over 20 staff members with separate units for conservation management planning, wildlife inventory, protected area extension, and the geographic information system. The Section is responsible for providing policy and technical advisory support for the management of Royal Manas, Black Mountains, and Jigme

Royal Manas National Park. Photo: Bruce Bunting.

Dorji National Parks. A well-trained park manager administers each of these parks. The 1995 Forest and Nature Conservation Act of Bhutan provides the main legal framework for establishment and management of these protected areas.

Based on the findings of biological and socio-economic surveys carried out over 2–3 years, conservation management plans have been developed for Royal Manas and Jigme Dorji National Parks. The preparation of a conservation management plan for Black Mountains National Park is currently underway.

Community development

Whilst Black Mountains National Park is uninhabited in most parts, the Jigme Dorji-Black Mountains link area, and the Jigme Dorji and Royal Manas National Parks have significant human populations living in and around them. Conservation approaches in the settled areas will need to be participatory so that the needs and problems of local communities are incorporated into protected area management. In other words, local community development needs and nature conservation objectives will have to be meaningfully reconciled. To address this, integrated conservation and development projects are being implemented in the enclave and buffer zones of both Jigme Dorji and Royal Manas National Parks.

Dzongkhag Administrations are responsible for planning and on-the-ground implementation of community development programmes such as health and sanitation, education, agriculture, animal husbandry, social forestry, and water supply. These Administrations work through two community-based committees: the Dzongkhag Yargey Tshogchung or District Development Committee, at which district-level decisions are made, and the Geog Yargey Tshogchung or Block Development Committee, a forum for local participation at the grassroots level. Major community development components of the parks are being implemented through the Dzongkhag Administrations and these well-established forums for community participation. In Royal Manas National Park, a national NGO called the National Women's Association of Bhutan is working hand in hand with local government institutions to implement integrated rural development programmes based on local community needs.

Bhutan's National Assembly endorsed the corridor concept in August of 1999. Biological corridors will link nine different protected areas, including Royal Manas National Park, Black Mountain National Park, and Jigme Dorje National Park, and enhance survival prospects for such species as the tiger, red panda, Asian elephant, and greater one-horned rhino. Thus, these corridors will form a contiguous network of 15,000 square miles, that will allow wildlife to migrate between protected areas, an effort that will restore fragmented habitats and prevent further isolation of important wildlife populations.

Conclusion

There remains no doubt about the commendable initiatives undertaken by the Royal Government and people of Bhutan to conserve the natural heritage of the country even at the expense of economic development opportunities. The largely intact forest cover and the national protected area system bear tangible evidence of the country's commitment to nature conservation.

The corridors that link Bhutan's protected areas illustrate the significant advantages of applying ecosystem approaches to biodiversity management. In all

earnestness, the authors would like to appeal to policy makers and fellow conservationists, both in the Royal Government of Bhutan and in the international community, to help promote designation of the Royal Manas, Black Mountains, and Jigme Dorji National Parks as World Heritage Sites. As illustrated by this paper, these three protected areas have significant ecological, social, economic, aesthetic, and spiritual values not only for the Bhutanese people but also for the world population at large.

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Future steps

KENTON R. MILLER AND LAWRENCE S. HAMILTON

If there is a single conclusion from the opening editorial and four case studies, it is that parks and protected areas will face a world of change as we prepare for the 21st Century. Protected area systems will be challenged as never before to provide the goods and services that growing human populations will demand and expect of these special ecosystems. We as protected area professionals have a responsibility to anticipate these challenges. But we also have a growing responsibility to reach beyond our borders – those fragile boundaries that demarcate protected areas – to engage that same outside world in the wider debate over resource conservation, sustainable use, and holistic thinking.

From the Albany workshop and as illustrated in the cases, we propose four key actions that managers can take to launch a bioregional programme in their area. A list of references can provide further information to the interested reader.

First, re-conceptualise the role of protected areas

Most protected areas already safeguard outstanding scenery, rare species, and recreation opportunities. To these totally legitimate goals, we now need to add the management of ecosystems that provide fundamental services to people at local, regional, and global scales. These include potable and industrial water, nutrients and genetic resources for food security, and sites of value for spiritual renewal and cultural identity. We need to elevate the visibility and acceptance of IUCN Category V (Protected Landscapes/Seascapes) as areas where private, communal, and corporate owners can promote types of forestry, farming, grazing, and fishing that foster sustainable livelihood while promoting biodiversity protection, restoration, and movement. This category can orient policy and management practice for the lands and waters that connect core wild areas, or places of high value to biodiversity.

The valid but limited and partial perception of the conventional role of protected areas needs to be enriched to include the notion that these special places are vital to human security and well being. To achieve such a shift in popular and political attitudes, the education and outreach programmes of park agencies should be modified to carry a new message to political leaders, other economic sectors, and the general public.

> *The ecosystems we manage as protected areas provide people with their most fundamental needs. They ensure the flow of high quality water to cities and rural farmers and settlements, irrigation works, power plants, fisheries, and navigation. Soil nutrients flow from them to adjacent food production areas. Their wild genetic resources are being explored as the basis for future foods and medicines. The sacred sites they contain harbour values critical to the spirituality of many individuals and societies. Their wild environments and historic landscapes are providing solace to millions of visitors, and helping to build personal character in our young people, and personal and cultural identity. These areas also serve to integrate peoples, their economies, and their cultures.*

Second, re-scale protected area programmes

Action is needed at local, regional, and global levels to conserve biodiversity and ecosystem services. Core areas (national parks and other IUCN Categories) are elements of greater, ecosystem-wide conservation areas. It is these 'bioregions' that now must become the 'management unit' – including core areas, their buffer zones, and the remaining surrounding lands and waters in farms, forests, wildlife and fishery production and infrastructure. Obviously, this requires a challenging level of cooperation with neighbours, other jurisdictions, and even adjacent countries where boundaries cut across common ecosystems.

In some cases, parks and reserves themselves cannot be expanded to cover geographic spaces sufficiently large for maintaining biodiversity and generating the full array of ecosystem services. The bioregional approach raises the scale of planning to that of whole landscapes so that corridors, buffer zones, and cooperative programmes with neighbours can increase the effective biological size of the area. These mechanisms can also facilitate migration and dispersal in the face of climate change and sea-level rise, reduce land degradation, and increase the chances of meeting protected area goals. Globally, most countries have accepted the responsibilities of the 1992 Conventions on Biological Diversity, Climate Change, and Desertification. Goals and actions to save and wisely use diversity, develop response mechanisms for climate change, and halt land degradation call for international cooperation among national governments.

Third, reform the institutions

Finally, we need to establish mechanisms that permit and encourage protected area managers to work with neighbours and other institutions that can help design and implement management programmes. Such action can anticipate fragmentation and other forms of change and promote the full range of ecosystem services. This generally requires revision of policies, and occasionally of legislation. But, most important, it requires development of economic incentives and institutional agreements that encourage people to participate and cooperate. Furthermore, at scales greater than wild core areas, we will need to cooperate with those in charge of other jurisdictions, private and communal ownership, and ecosystems that range into other countries. This calls for new ways of negotiating and shaping agreements among those that benefit and are affected by these bioregional programmes. Transborder protected areas also can be effective in reducing international tensions (Westing 1993) and even forming Peace Parks, as has been proposed for the Korean Demilitarized Zone by Westing (1999) and by the Peace Parks Foundation for Southern Africa (Hanks 1999). The benefits and drawbacks, and guidelines for effective transborder cooperation, have been discussed by Hamilton *et al.* (1996).

Fourth, reconsider the role of protected area managers

Managers will argue that they have enough problems addressing the issues they already face within their jurisdictional boundaries without adding further demands upon their limited time and resources. But, as our argument and the cases have shown, a new set of challenges is looming over the horizon that may simply overwhelm manager's current agenda. The opportunity is for managers to adapt their policies and practices to meet these new challenges head-on while time permits.

Protected area managers need **not** plan and implement all the cited aspects of bioregional planning and management. Indeed, the talents and capacities of many agencies, professions and stakeholders will be required to do the job. Rather, managers have the opportunity to **catalyse the process** of establishing bioregional programmes in their region. Essentially this consists of convening key stakeholders to prepare strategies and action plans that are consistent with the nature of the region and the perceptions of local residents. This is a job of leadership.

Prologue

The potential of the bioregional approach has begun to capture the imagination of communities and governments beyond biologists and conservationists alone. The corridor concept has gained particular attention. For example, the Ministers of Environment of Latin America and the Caribbean will consider at their inter-ministerial meeting in March 2000 how bioregional planning and the establishment of corridors in the region can promote economic and cultural integration and the restoration of natural resources. The Presidents of Central America signed a treaty to establish the Mesoamerican Biological Corridor in 1997. The Central American Commission on Environment and Development (CCAD) has achieved significant integration of and cooperation among regional institutions, aid agencies, and public and private groups to design and implement this ambitious seven-country programme. The five States of southern Mexico are now preparing to join the programme. The Global Environment Facility is supporting these initiatives as well as corridor projects in the Eastern Carpathians, the Western Tian Shan, and in Kazakhstan, among others.

Successful bioregional management appears to depend upon a level of decentralisation of authority and responsibility that promotes local stewardship over natural resources (Miller *et al.* 1996, World Bank 1997; WWF 1998). Evidence suggests that where local governments, NGOs, communities, and indigenous groups benefit from incentives and encouraging public policies, they will develop and incorporate resource use practices that maintain biodiversity and restore their resource base.

Proposals for corridors and applications of the bioregional approach are becoming more ambitious. The Wildlife Conservation Society and other IUCN members are now proposing a 'Corridor of the Americas', a suggestion first proposed by Jim Thorsell of the IUCN Secretariat and James Barborak of the Wildlife Conservation Society. This initiative envisions creating landscape linkages between and among protected areas stretching from Alaska and Yukon south to Tierra del Fuego, (Mario Boza and John Robinson, Pers. Comm. 1999). This ambitious goal is paralleled by indigenous communities and leaders calling for a 'cultural corridor of the Andes,' extending from the Sierra Nevada de Santa Marta in Colombia, to southern Argentina and Chile. (Alejandro Argumendo, Pers. Comm. 1999).

Already Government Parties to the Convention on Biological Diversity are debating how they can employ 'ecosystem approaches' for conserving biodiversity and promoting its wise use. (Schei *et al.* 1999; SBSTTA/5 2000) By mid-2000, they are expected to adopt agreements to encourage countries and communities to employ such mechanisms in their efforts to conserve biodiversity. This global level of agreement and cooperation opens a new opportunity for protected area managers to elevate the role of critical ecosystems and plans of action onto the national agenda.

The world's protected area professionals will meet in Durban to hold their 5th World Congress in 2002. The agenda is expected to include these topics for discussion and debate. Will we accept the challenge to adapt to the messages coming from science and the lessons from the field? It is hoped that we will be prepared to set goals for the coming decade to expand conservation efforts geographically, socially, and institutionally, to whole ecosystem scales. Then we can send a message to the world, our governments, and our peoples that protected areas will contribute centrally to a sustainable future.

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Résumés

Le projet du 'Macro-couloir de la côte méridionale de l'Australie-Occidentale' – une stratégie biorégionale pour la conservation de la nature

JOHN WATSON ET PETER WILKINS

Une stratégie novatrice basée sur des 'initiatives biorégionales' visant à améliorer la viabilité des zones protégées a été largement adoptée par les responsables environnementaux chargés de l'aménagement des terres à l'échelle mondiale. La région méridionale de l'Australie-Occidentale possède des valeurs de diversité biologique remarquables ainsi qu'un degré élevé d'endémisme, dont une bonne partie peut être observée dans la 'Fitzgerald River National Park Biosphere Reserve', une importante zone protégée à l'échelle planétaire. La vaste communauté de la région méridionale et les agences gouvernementales concernées mettent actuellement sur pied une initiative biorégionale baptisée 'Macro Corridor Project'(Projet du Macro-couloir). Il s'agit d'un programme audacieux qui a pour but d'améliorer la viabilité du réseau de zones protégées existant, soit en maintenant les liens présents, soit en réétablissant les liens anciens entre la réserve de la biosphère, les parcs nationaux les plus importants, les réserves naturelles et autres végétations restantes à travers cette région.

De Yellowstone à Yukon : rêve romantique ou vision réaliste pour l'avenir ?

LOUISA WILLCOX ET PETER AENGST

De Yellowstone à Yukon (Y2Y) relève d'une initiative 'bi-nationale' ayant pour objectif de rétablir et de maintenir la biodiversité et le ' lien ' des paysages tout le long de la crête des montagnes rocheuses d'Amérique du Nord, et ce du 'Grand système écologique' de Yellowstone au Sud jusqu'aux montagnes du Mackenzie au Nord. Englobant plus de 120.000.000 millions d'hectares, la chaîne Y2Y constitue un territoire immense, une région écologique qui abrite non seulement une trés large diversité d'habitats et de créatures sauvages, mais aussi des cultures indigènes et des communautés rurales formées par la force de la nature. En bref, c'est la géographie qui se doit de remettre en question notre capacité à la comprendre et de nous mettre au défi de créer pour elle un avenir différent de celui imposé par les paysages fades et labourés de l'Amérique du Nord.

L'initiative Y2Y concentre principalement ses efforts sur l'établissement d'un système d'espaces végétaux et animaux protégés destiné à maintenir un ' lien ' tout le long des 3.218 km de la région sud du Yukon au Désert Rouge du Wyoming. Amorcée il y a environ 6 ans, cette initiative a suscité un intérêt énorme auprès des scientifiques et des militants de la défense de l'environnement ainsi que des responsables chargés de l'aménagement des terres et des habitants de la région. Aujourd'hui, ce réseau comprend plus de 200 groupes de défense de l'environnement divers et de particuliers répartis entre les Etats-Unis et le Canada, soutenant cette vision et oeuvrant ensemble pour assurer l'intégrité écologique des montagnes rocheuses.

Le couloir de la Serra Do Mar

GEORGE GEORGIADIS ET SILVANA CAMPELLO

Pendant 100.000 ans durant la dernière période de glaciation, toute la biodiversité de la forêt tropicale du sud-est du Brésil a survécu sur les pentes de la Serra Do Mar, dans une région dont la superficie n'est pas plus importante que celle de l'aire encore boisée aujourd'hui. Ainsi la théorie du refuge du pléitoscène démontre bien que la forêt encore présente à ce jour de la Serra Do Mar peut effectivement protéger toute sa biote aussi riche qu'exceptionnelle, à la seule condition d'être préservée entièrement. C'est en introduisant des mesures efficaces permettant de renforcer les unités de préservation existantes et de maintenir le flux génétique entre ces derniers qu'il sera possible de sauvegarder tel quel l'un des systèmes écologiques les plus importants de la planète pendant les générations à venir.

Le projet du 'Couloir de la Serra Do Mar' a été proposé pour la première fois par une coalition de groupes de défense de l'environnement provenant de la partie nord du pays en tant que stratégie visant à étendre les mesures de préservation performantes ainsi que l'aménagement intégré à l'ensemble du système écologique. Cette stratégie conjugue pragmatisme et idéalisme.

Etablissement de liens entre les zones protégées en vue de la conservation du système écologique : Etude de cas – Région indienne de Bhutan

MINGMA NORBU SHERBA ET UGEN P. NORBU

Le Gouvernement royal du Bhoutan a adopté une politique à long-terme, afin de poursuivre le développement économique de ce pays à un rythme qui respecte son riche patrimoine culturel et naturel. La conservation de la nature a toujours été en première place dans les programmes de développement nationaux et c'est grâce à cela que la région du Bhutan possède à ce jour un environnement unique, relativement peu pollué. En effet et de manière étonnante, 64,4% de ses terres sont encore recouvertes de forêts naturelles. Environ 26% de la totalité de la superficie du pays constituent un système de zones protégées national composé de 4 parcs nationaux, 4 réserves ainsi qu'une réserve strictement naturelle.

Afin de préserver l'éventail de systèmes écologiques naturels que l'on peut trouver dans ce pays, le Gouvernement royal du Bhoutan a élargi le ' Royal Manas National Park ' pour le relier au ' Black Mountains National Park ' au nord et à la 'Manas Tiger Reserve' indienne. En outre, les parcs nationaux 'Royal Manas, Black Mountains et Jigme Dorji' ont été choisies en tant que zones protégées prioritaires en vue d'une sauvegarde immédiate. Les trois zones protégées créent un couloir biologique impressionnant protégeant les plus importants systèmes écologiques du pays des forêts tropicales humides du sud, en passant par les forêts tempérées des montagnes du Bhoutan central riches en espèces, jusqu'au habitats alpins et aux champs de glace permanents du nord. Le Bhoutan est donc probablement le seul pays d'Asie à posséder un système de zones protégées aussi vaste et versatile avec un couloir biologique nord-sud contigu.

Le présent exposé tente de mettre en exergue les importantes initiatives prises par le Gouvernement royal et le peuple du Bhoutan en vue d'établir des liens entre plusieurs zones protégées et ce afin de créer une ' conjonction ' biologique pour la migration des espèces végétales et animales et la succession naturelle. Les leçons que l'on peut tirer de la mise en place d'un réseau de zones protégées visant à conserver le système écologique du Bhutan sont notamment remarquables, à un moment où les parcs nationaux et autres zones protégées de la plupart des régions du monde ne constituent pas plus que des ilôts de biodiversités dont les environnements font l'objet d'une forte dégradation.

Actions à venir

KENTON R. MILLER ET LAWRENCE S. HAMILTON

Au delà de nos frontières

Si l'on peut tirer une simple conclusion de l'éditorial d'ouverture et des quatre études de cas, c'est que les parcs et les zones protégées seront confrontés à de nombreux changements alors que nous nous préparons au 21ème siècle. Les systèmes de zones protégées devront faire face à un défi sans pareil pour procurer les biens et les services que les populations humaines en croissance exigent et attendent de ces systèmes écologiques particuliers. En tant que professionnels responsables des zones protégées, nous nous devons non seulement d'aller au devant de ces défis, mais aussi et de plus en plus d'aller au-delà de nos frontières.... ces frontières fragiles qui délimitent les zones protégées, et ce afin d'entraîner ce même monde extérieur dans un débat plus large sur la sauvegarde des ressources naturelles, l'exploitation durable et la pensée holistique.

C'est à partir de 'l'atelier Albany' et des quatre études de cas illustrés ici que nous proposons de mettre en place quatre plans d'actions-clés que les responsables chargés de l'aménagement des terres peuvent adopter pour lancer un programme biorégional dans leur zone concernée. Une liste de références visant à fournir de plus amples informations aux personnes intéressées est disponible.

Resumenes

El Proyecto del macro corredor en la Costa Sur de Australia. Una estrategia bioregional para la conservación de la naturaleza

JOHN WATSON AND PETER WILKINS

Alrededor del mundo, los administradores de tierras ambientales han aceptado ampliamente una estrategia novedosa de 'iniciativas bioregionales' para mejorar la viabilidad de áreas protegidas. La región de la costa sur de Australia Occidental tiene extraordinarios valores de biodiversidad con un grado de endemismo extremadamente alto,la mayoría de los cuales están representados dentro de la Reserva de la bioesfera del Parque Nacional del Río Fitzgerald. Una gran parte de la comunidad de la región de la costa del sur y las agencias gubernamentales pertinentes están trabajando juntas en una iniciativa bioregional denominada el 'Proyecto del macro corredor'. Es un programa atrevido para aumentar la viabilidad de la red de áreas protegidas existente, ya sea manteniendo uniones existentes o restableciendo enlaces anteriores entre la reserva de la bioesfera, parques nacionales importantes, reservas naturales y otra vegetación remanente a lo largo de la región.

De Yellowstone a Yukón: ? Un sueño romántico o una visión realística para el futuro?

LOUISA WILLCOX Y PETER AENGST

De Yellowstone a Yukón (Y2Y) es un esfuerzo binacional para restaurar y mantener la diversidad biológica y la conexión del paisaje a lo largo de la espina de los Rockies de Norte América, desde el ecosistema del Yellowstone Mayor en el sur hasta las Montañas Mackenzie en el norte. Abarcando más de 1.2 millones de kilómetros cuadrados, el sistema Y2Y es un territorio enorme, una ecoregión que alberga no solamente una variedad muy rica de habitats y criaturas salvajes sino también culturas nativas y comunidades rurales que han sido moldeadas por el poderío de lo salvaje. En breve, es una geografía que desafía nuestra habilidad para entenderla y nos reta a crear para ella un futuro diferente al delineado para los paisajes domesticados y cultivados de Norte América.

El foco central de la iniciativa Y2Y es el de establecer un sistema de tierras salvajes diseñado para mantener la conexión a lo largo de 2.000 millas desde el Yukón del sur hasta el Desierto Rojo de Wyoming. Luego de haber sido encendida hace unos seis años, la iniciativa prendió fuego en la imaginación de científicos y activistas de la conservación, así como en la de los administradores de tierras y ciudadanos de la región.

Hoy en día la red incluye una formación variada de más de 200 grupos de conservación e individuos de los Estados Unidos y Canadá, que apoyan la visión y están trabajanso para asegurar la integridad ecológica de los Rocky Salvajes.

El corredor de la Serra do Mar

GEORGE GEORGIADIS Y SILVANA CAMPELLO

Por 100.000 años durante el último glaciar, el total de la diversidad biológica de la selva tropical lluviosa del sureste de Brasil, sobrevivió en la falda de la Serra do Mar en un área no más grande que la que permanece arbolada en la actualidad. Por esa razón, la teoría de refugio del Pleistoceno suministra una evidencia poderosa de que la selva remanente de la Serra do Mar puede proteger efectivamente la totalidad de su biota rica y única, pero sólo si se mantiene su integridad. Uno de los ecosistemas más importantes de la tierra puede ser preservado intacto para futuras generaciones a través de la implementación de medidas efectivas para consolidar unidades de conservación existentes y mantener entre ellas el flujo de genes.

El corredor de la Serra do Mar fue propuesto inicialmente por una coalición de grupos de conservación de la porción nórdica de la cordillera como una estrategia para extender las acciones de una conservación efectiva del manejo integrado de la totalidad del ecosistema. La estrategia de la propuesta combina idealismo y pragmatismo.

Uniendo áreas protegidas para la conservación del ecosistema: un caso estudiado en Bhutan

MINGMA NORBU SHERPA Y UGEN P. NORBU

El Real Gobierno de Bhutan sigue una política visionaria para perseguir un desarrollo económico a un paso que está en armonía con el rico patrimonio natural y cultural del país. La conservación de la naturaleza ha recibido siempre la más alta prioridad en programas nacionales de desarrollo. Como resultado Bhutan posee, hoy en día, un entorno único y un medio ambiente relativamente sin estropear, con un extraordinario 64,4% de su territorio todavía cubierto con bosques naturales. Aproximadamente un 26% del área total de tierra del país ha sido designado un sistema de área protegida nacional y consiste en 4 parques nacionales, 4 santuarios para la vida salvaje y 1 reserva nacional estricta.

Para permitir la conservación de la gama de ecosistemas naturales que se encuentran en el país, el Real Gobierno de Bhutan agrandó el Parque Nacional Royal Manas para conectarlo con el Parque Nacional Black Mountains (Montañas Negras) hacia el norte y la Reserva Mans Tiger de la India hacia el sur. Más aún, los Parques de Royal Manas, Black Mountains y Jigme Dorji han sido seleccionados como áreas protegidas prioritarias y por lo tanto serán implementadas con una administración inmediata de conservación. Las tres áreas protegidas crean un corredor biológico espectacular protegiendo los mayores ecosistemas del país desde los bosques tropicales húmedos del sur, a través de los bosques montañosos templados de Bhutan central, rico en especies, hasta los habitats alpinos y las tierras permanentemente heladas del norte. Como resultado, Bhutan es probablemente el único país en Asia que cuenta con un sistema de áreas protegidas tan comprensivo y versátil con un corredor contiguo de norte a sur.

Este artículo trata de subrayar las importantes iniciativas tomadas por el Gobierno Real y el pueblo de Bhutan al establecer vínculos entre varias áreas protegidas para proveer una conexión biológica para la migración de la vida salvaje y la sucesión natural. Las lecciones aprendidas con el desarrollo de una red de áreas protegidas para la conservación del ecosistema en Bhutan, son particularmente notables ya que los parques nacionales y otras áreas protegidas en la mayoría de las regiones del mundo de hoy, no son más que islas de biodiversidad rodeadas de entornos en un alto nivel de degradación.

Pasos futuros

KENTON R. MILLER Y LAWRENCE S. HAMILTON

Más allá de nuestros bordes

Si existe una conclusión única a consecuencia de nuestro artículo de fondo y los cuatro casos de estudio, es la de que los parques y las áreas protegidas enfrentarán un mundo de cambio a medida que nos preparamos para el siglo XXI. Los sistemas de áreas protegidas se verán desafiados más que nunca a proveer bienes y servicios que las poblaciones humanas en crecimiento demandarán y esperarán de estos ecosistemas especiales. Nosotros, los profesionales de las áreas protegidas, tenemos la responsabilidad de anticiparnos a esos retos. Pero tenemos también una creciente responsabilidad de extendernos más allá de nuestros bordes—esos frágiles límites que demarcan las áreas protegidas—de envolver ese mundo de afuera en el más amplio debate sobre conservación de recursos, uso sostenible,y un pensamiento que abarque la totalidad.

Desde el taller de Albany y como se ha ilustrado en los casos, proponemos cuatro acciones claves que los administradores pueden tomar para iniciar un programa bioregional en sus respectivas áreas. Una lista de referencias puede proporcionar más información para los lectores interesados.

IUCN – The World Conservation Union

Founded in 1948, The World Conservation Union brings together States, government agencies and a diverse range of non-governmental organisations in a unique world partnership: over 800 members in all, spread across some 125 countries.

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World Commission on Protected Areas (WCPA)

WCPA is the largest worldwide network of protected area managers and specialists. It comprises over 1,100 members in 150 countries. WCPA is one of the six voluntary Commissions of IUCN – The World Conservation Union, and is serviced by the Protected Areas Programme at the IUCN Headquarters in Gland, Switzerland. WCPA can be contacted at the IUCN address above.

The WCPA mission is to promote the establishment and effective management of a worldwide network of terrestrial and marine protected areas.

Protected Areas Programme

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- serving as a leading global forum for the exchange of information on issues relating to protected area establishment and management
- ensuring that protected areas are placed at the forefront of contemporary environmental issues such as biodiversity conservation and ecologically sustainable development.

Cover photo: The Serro do Mar (Mountains of the Sea) rise sharply from Brazil's Atlantic coast south of Rio de Janiero. Photo: Fabio Columbini.

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