

How Can Biosphere Reserve Managers Address the Impacts of Climate Change and Global Warming on Biodiversity? An Overview of Some Global Efforts¹

Threats to Protected Areas

While it is true that on paper, approximately 12% of the planet's terrestrial surface is covered with designated Protected Areas (PAs), (www.unep-wcmc.org/wdpa/index.htm) the long-term integrity of these conservers of biological diversity is far from assured. This is a problem being discussed by the Parties to the Convention on Biological Diversity. Many PAs were established on lands with the poorest development potential, *i.e.* high-elevation mountain areas of rock or ice, flooded lands, arid lands, or lands abandoned by 20th Century agriculture as un-profitable. They therefore do not include much of the world's rich biodiversity heritage, though they are usually the last bastions of native biodiversity amid transformed landscapes.

Many are too small in size to maintain their full suite of species, genes and communities. Invasive species are becoming a growing problem due to increasing trade- and transportation- related vectors associated with globalization. The small size of many PAs adds to the threat. The growth in visitor numbers requires greater effort to combat accompanying physical and quality-of-experience degradation. Moreover society is asking that these PAs provide more in ecosystem services such as more and higher quality water, increased carbon sequestration, more of and new kinds of outdoor recreation (*e.g.* canyoning, hang-gliding), and greater protection of traditional cultural values. In addition, civil society is demanding more of a voice in decision-making that complicates governance in which biodiversity conservation may not be such a high priority goal. Increasingly PAs are being asked to generate their own revenue. PA managers/policy-makers are facing very tough challenges. But, in my opinion, the greatest challenge to PA managers may well be that of climate change, if biological diversity conservation is to be achieved. (See Araujo *et al.* 2004). This seems true especially because the impacts on flora and fauna are so unpredictable. For it is not merely a northerly and upward altitudinal shift of communities due to warming, nor an east-west shift due to precipitation change. Species will respond, and migrate (or be eliminated) in different ways, and new assemblages of plants and animals will form (Peters and Lovejoy 1992). Anticipation by "assisted migration" is fraught with uncertainty. A good overview of the situation concerning all aspects of global change is provided in an IUCN/WCPA publication *Securing Protected Areas in the Face of Global Change* (Barber *et al.* 2004)

I personally believe that within the various categories of Protected Areas, that Biosphere Reserves (BRs) have a better potential for response, and that Transborder BRs (TBRs) have even greater potential. Price (2001) has also pointed out that BRs are extremely valuable for global exchange of experience and best practice, and this can include or focus on climate change experience.

¹ Note: This presentation does not consider three important aspects of Protected Areas and climate change:

- What individual PAs can do to reduce their own carbon greenhouse gas emissions and carbon footprint; leading by example;
- PAs provide major sequestration sites for carbon, especially in totally conserved areas, where disturbance, including logging, is minimal. The carbon market may in future offer additional funding to pay for new management strategies that enhance sequestration.
- reducing impacts on other ecosystem services or on visitation/tourism

Adverse climate change impacts on species and ecosystems are best countered by (1) maintaining or increasing resilience; (2) by assuring migration opportunity through connections to other different conserved sites (Hannah et al. 2002; Hansen et al. 2003; Welch 2005).

Resilience

"Resilience" is herein defined by me as the ability to counteract or adjust to new stressors that tend to alter the composition, structure or function of the ecosystems being conserved. Let us look at resilience in a TBR context. I want to briefly consider: size, buffering, health, adaptive management, and monitoring.

Size

Conservation biology and island biogeography have shown us that the smaller the size of an area, the more rapidly it loses its biodiversity, even under relatively stable climate. A changing climate increases this process. For greatest resiliency, PAs need to be as large as possible, to accommodate natural or human disturbance effects. By definition, a BR has a peripheral zone, beyond its core of protection, and this can increase its *effective* size for native biodiversity, if the buffer zone is under nature-friendly management regimes. Moreover, TBRs are effectively larger than a single PA touching a border in isolation, or even border-abutting PAs where there are different management regimes in effect. Opportunity for plant or animal species to migrate across a political border or physical barrier such as a river or mountain range is greater, where there is PA cooperation. This is especially needed where fauna have summer and winter ranges on opposite sides of a border (*e.g.* ibex in Gran Paradiso, Italy and La Vanoise, France). Similarly, where the effective protected width or length of a waterway is increased due to collaboration, aquatic organisms benefit from larger size of conserved habitat (*e.g.* Elbe Sandstones, Czech Republic and Saxonian Switzerland, Germany).

It goes without saying, that if opportunity exists to expand the BR beyond its current boundary, this is very desirable. In particular, try to secure the full range of geo-physical variation in the area. Since species and communities will be not only moving but changing, the geophysical-base diversity will help to conserve biodiversity. The objective should be to include all altitudinal gradients, different cardinal directions, and major soil types, as well as micro- and meso- climatic zones. This helps to provide the "new" sites into which species may move. Be on the alert for those special sites that could become refugia where one or more species might exist over time (*e.g.* cliff faces, bogs).

Buffering

Biosphere Reserves in their classic form consist of a core area where human disturbance is absent or minimal, that has around it a peripheral zone of "nature-friendly" land management. For many wild species that can exist in human-modified landscapes, this represents an effective increase in size of habitat. The buffer area may increase suitable habitat by the mere presence of hunting prohibition on critical species, or by reduced poaching. Aggressive alien species may be controlled by the landowners in the buffer zone, augmenting BR efforts in the core zone.. No-or low-pesticide use may be one of the improved management prescriptions in the buffer zone thus reducing a common stressor on natural systems. The transboundary area, especially where good cooperation and somewhat similar land use practices prevail, serves to increase the buffering effect.

Health

Many very serious adverse impacts on species and ecosystem health are beyond the control of the PA manager. Coming in from outside sources are such maladies as acid precipitation, damaging levels of ozone, and accumulation through deposition of harmful metals such as lead and mercury. These stressors considerably affect the health of whole ecosystem, and often one or more species more than others. They must be addressed at national and international levels or climate change impacts are even more severe.

Maintaining healthy populations of species and ecosystems is easier when there is a cooperative transboundary approach to control of pests, alien species or fire, or even visitor numbers at certain times of the year. This is often the case where there are mutual fire suppression agreements, common measures on insect or disease control or on overpopulation of wildlife species. It is often the case that the return of large predators means healthier populations of species lower on the food chain. Transborder cooperation situations may facilitate this. The Appenine wolf moved across the French border into Mercantour National Park from the Italian Alpi Marittime Nature Park (in spite of anti-wolf sentiment in France, which permitted hunting outside the Park). Having large carnivores helps keep meso-predators and herbivores under control and benefits many species lower on the food chain, including songbirds and herbaceous plants. Unhealthy ecosystems are more easily invaded by alien invasive plants. Indeed in some regions, warmer climate and increased carbon dioxide have favored some invasive species over natives. The forest canopy should be preserved as much as possible, *i.e.* no large clearcuts, and using only small canopy gaps if wood harvesting is permitted. Large openings alter the whole understory, soil temperatures and invasive opportunities (Noss 2001). Excessive visitor numbers in certain sites at critical times of year (e.g. nesting period), or overharvesting of some wild crops, reduces health and is best addressed through common policies.

Adaptive Management

PA managers need to have the governance flexibility to respond to the changing situations, brought about by climate change (Welch 2005). Planning must be iterative and dynamic. An upward moving tree line in the mountains of Europe for instance calls for changes in management, interpretation and educational practices, with respect to any alpine zones and upper meadows. Increased length and severity of dry seasons may require new policies on fire, which may have seldom been a prior problem. Less snow depth and duration will change both plant and animal occurrence. If skiing areas are part of the PA, these may either become obsolete or press to open up new areas at higher elevation. Should this be accommodated or not? Climate change may induce a change in visitation pattern, either in season or in location. Extreme heat and heavy precipitation events may require increased visitor safety services. Adverse impacts on agricultural crops in the buffer zone may increase utilization pressure on the core zone. There may be a more problematic balancing act between the global responsibilities that go with an UNESCO Biosphere Reserve designation and local interests and needs. These and other changes are requiring greater acceptance of uncertainty by managers, and considering responses as "experiments", to be assessed and altered as seems warranted.

Transboundary cooperation and interchange should permit adaptive joint approaches to such problems, and thus avoid unilateral, precipitate response action on one side of the border, and old-time deterministic/static planning on both sides.

It is imperative that there be continuous dialog with scientists, other managers, and above all, with local residents and interested citizens who are stakeholders. Shifts in management policy and practice need to be preceded by a consultative practice within the BR community.

Monitoring

One of the original concepts of BRs, was that the core zone could serve as a benchmark, against which to assess change when compared with the buffer zone. In a time of changing climate, it is very important that monitoring is present to detect the impacts (Noss 2001; Welch 2005). If not already established, study areas need to be put in place to provide baselines and identify changes. We cannot implement adaptive management without detecting change, and then assessing results of new management measures. While there are indeed some Long Term Ecological Monitoring Sites, the marvelous network of 531 BRs in 105 countries around the world are a golden opportunity for the global picture. This process has started in the Biosphere Reserve Integrated Monitoring Programme (BRIM). TBRs are especially powerful,

since standardized, common procedures can occur both sides of the border and data easily exchanged. Krkonose, Czech Republic/Karkonosze, Poland TBR provides an excellent example. Here in Pfalzerwald/Vosges du Nord there exists a very high degree of transborder cooperation, and the unique designation of a single "Coordinator," and in spite of language differences, common monitoring measures are easily achieved.

Connectivity

As global warming occurs and precipitation patterns change, plant and animal species are now being forced to shift their ranges, and will increasingly have to do so to counteract unfavorable habitat conditions. For temperature increases, this will mean plants and animals moving poleward or upward in elevation. For precipitation change it may mean the same, or in an east-west direction. Conservation pathways or stepping stones need to be provided to accommodate migration. Hannah (2007) in summarizing an excellent review paper by an expert 8-person team emphasizes two needed actions: new protected areas and *connectivity*. Managers must enlarge their arena of concern, and elevate their vision to a bioregional or even a continental scale (Hamilton 2002). There need to be "corridors" or connectivity pathways from lowlands to highlands, along mountain ranges, along streams and rivers and along coastlines. The label "Summits to the Sea" as a conserved lands strategy is being increasingly heard. But, we must not neglect the smaller-scale impediments to connectivity, as in: rivers and streams that have obstacles, such as dams or inadequate culverts for passage of aquatic organisms; or transportation arteries that need underpasses or overpasses to permit safe crossings of animals.

Our national systems of publicly-designated PAs needs to be supplemented by "nature-friendly" intervening private land use management to achieve connectivity. From PA "islands" to "networks". Biosphere Reserves by nature, are concerned with achieving nature-friendly land use in the human dominated buffer zones. The challenge is to make them even more friendly, and to increase their bio-permeability, so that species can migrate,- even the large predators. This is no easy task, but it is one where BR managers have more experience than managers of "island" PAs. Moreover, we need to span political boundaries with connectivity,- not always the easiest job in the world, in order to provide the long migration pathways needed. TBRs have already shown the way in this direction, and offer concrete examples to the world. They reduce the importance of political boundaries in recognizing that nature is not defined or constrained by these boundaries.

The IUCN/WCPA Mountain Biome has a major book in press (IUCN and Earthscan) entitled *Connectivity Conservation Management: A Global Guide* (Worboys *et al.* in press). It reviews connectivity science, presents considerations for authorities, planners and managers, has 25 case examples, a set of lessons learned, and then principles and practice for management.

Such corridors or complexes of connectivity are especially needed to permit movement of wide-ranging species such as predators. These are often the keystone species that keep the whole ecosystem healthier and thus more resilient. Several corridor initiatives around the world in fact do use large charismatic carnivores such as the wolf, bear, lynx or mountain lion as symbols to gain support.

I now show you a group of connectivity corridors from around the world to excite your vision. They illustrate different methods of initiation, scale and stage of completeness.

Some Examples from Around the World of Connectivity Initiatives

1. Green Corridor of the Appenines. Conceived by a PA Director. Crosses provincial boundaries, and now adopted in an Appenine Convention.
2. Yellowstone to Yukon. A transboundary corridor on a continental (USA/Canada) scale (3,200 km in length), being fostered and implemented by a coalition of over 300 NGOs.

3. Great Eastern Ranges (Australia). Three State governments agreeing to conservation connectivity of some 2800km, involving State Parks, State Forests and other State Reserves.
4. Andean Spectacled Bear Ecological Corridor (Venezuela and into Colombia). Conceived by a graduate student at Universidad Simón Bolívar and accepted as policy by Parks agencies. Using a flagship species as a symbol.
5. Choco-Andean Corridor (Ecuador). Andes to Coast involving several different kinds of PA: national indigenous reserves, mangrove reserves, cloud forest parks plus NGO areas. Initiated by Maquipucuna Foundation.
6. High Himal to Sub-Tropical Forests. Manas Tiger Reserve (India) to Djingme Dorje National Park (Bhutan's Himalaya summit), connecting formal PAs with conservation area connectors. Governments with WWF.
7. Albertine Rift Corridor (Uganda, Rwanda, Democratic Republic of the Congo, Zaire). Vision and coordination by the NGO, Albertine Rift Conservation Society, getting government agencies of four countries to work together.
8. Southern Appalachian Bioregion (USA). Five States with respective State PAs, plus National Park Service and US Forest Service. Vision, education and watchdog function by a coalition of NGOs called Southern Appalachian Forest Coalition. Nucleus is Great Smoky Mountain National Park, a Biosphere Reserve (crossing two States).
9. Greater Northern Appalachian Bioregion. Four US States and three Canadian Provinces). Effort focused by Two Countries - One Forest, a coalition of NGOs in which I am working wearing both a IUCN/WCPA hat and one from Vermont Nature Conservancy.
10. Naya-Cauca River Watershed. Mountains to coast in Colombia. Conceived by a University group. Aided by Conservation International.
11. Condor BioReserve (Ecuador). Led by The Nature Conservancy, an attempt to form a linked constellation in the Andes. Unusual in that much funding comes from a charge made on each household in Quito for water from the area, which goes back into the PAs through an Antisana Foundation Trust.
12. Meso-American Biological Corridor. Established by international-state treaty, signed by Presidents of all seven Central American countries. Originally conceived by an NGO and called "Path of the Panther," it now involves all State agencies, many NGOs and World Bank.
13. Now look at the sets of transboundary reserves in the Andean Chain. And given North American effort (Y2Y, Sky Islands in the Southern Rockies), cannot one dream of...
14. Corridor of the Americas? A dream? Martin Luther King Jr. "I had a dream" Not "I had a practical strategic plan".
15. And what about Europe? The existence of a fine set of reserves, including many transboundary Reserves such as this one where our meeting is held, or the
16. Krkonose (Czech)/Karkonosze (Poland) International BR in the Giant Mountains,
17. Elbe Sandstone Landscape Conservation Area/Saxsonian Switzerland NP and LCA, and
18. Hohe Tauern (three states in Austria).
19. Leads one to visualize a fantastic pan-western European corridor based on the Alpine Arc and indeed ALPARC is working toward this. Other large bioregional corridors are also possibilities, such as one emanating from the very area where we meet.
20. One other aspect I would like to address as being opportunities for TBRs, --peace and cooperation. Future scenarios for the world seem to indicate increased conflict between nation states. Many think that water will soon supplant oil as a cause of tension and conflict.
21. The water sharing-transfer tension between South Africa and Lesotho was ameliorated by the establishment of a Maloti/Drakensberg Transboundary Conservation Area, for from these mountains comes most of the water needed and used by both "dry" countries.
22. In some cases the conflict is a complex one of national pride, past animosity and stubbornness. How else to describe the 24-year long open warfare between India and Pakistan over an area of ice and snow, at

around 6000 m--the Siachen Glacier? Ninety-five percent of casualties have been due to high altitude conditions rather than to weapons. Why not a Siachen Glacier Peace Park with a "fuzzy" border?

23. National boundaries are often arbitrary, artificial constructs on the landscape.

24. Why not extend hands across the border as here at the world's first International Peace Park, Glacier/Waterton (both BRs)?

25. Or here, --a small friendship ceremony of civic officials at the border between Elbe Sandstones/Saxonian Switzerland (Czech Republic/German)?

26. These are much better actions than the one we in the USA have adopted on our southern border. A barrier to both people and wildlife.

Transboundary Cooperation at the PA level can transmute into more harmonious relations between the wider publics on both sides. IUCN has a publication available with information on benefits, problems and wider impacts. (show publication)

You who are gathered here at this meeting are at the forefront of promoting harmony and good relationships across cultures and bureaucracies. I salute you.

Take home message: You who are already committed to international cooperation... Think big! Forces of globalization demand it. Climate change makes it imperative. Connectivity is a major operative word. Have a dream!

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