Kathy MacKinnon, Nigel Dudley and Trevor Sandwith (Eds.)

Putting Natural Solutions to Work: Mainstreaming Protected Areas in Climate Change Responses

BfN-Skripten 321

2012

Putting Natural Solutions to Work: Mainstreaming Protected Areas in Climate Change Responses

Results of a workshop organised by BfN and the IUCN World Commission on Protected Areas at the International Academy for Nature Conservation on the Island of Vilm, Germany March 27th - 31st, 2012

Editors:
Kathy MacKinnon
Nigel Dudley
Trevor Sandwith

BfN
Federal Agency for Nature Conservation

Cover Picture: Great Green Macaw (*Ara ambiguus*) in San Juan-La Selva Biological Corridor (R. Seitre)

Editors:

Kathy MacKinnon
Trevor Sandwith
IUCN, WCPA (World Commission on Protected Areas) and
GPAP (Global Protected Areas Programme)
IUCN (International Union for Conservation of Nature)
28 rue Mauverney, CH-1196 Gland, Switzerland

Nigel Dudley
Equilibrium Research
47 The Quays
Cumberland Road
Spike Island
Bristol BS1 6UQ / UK
Tel/Fax: +44 (0)117 925 5393
Mobile: +44 (0)773 454 1913
Email: nigel@equilibriumresearch.com
www.EquilibriumResearch.com

This publication is included in the literature database ***"DNL-online"*** (www.dnl-online.de)

BfN-Skripten are not available in book trade but can be downloaded in a pdf version from the internet at:
http://www.bfn.de/0502_skripten.html

Publisher:
Bundesamt für Naturschutz (BfN)
Federal Agency for Nature Conservation
Konstantinstrasse 110
53179 Bonn, Germany
URL: http://www.bfn.de

Printed by the printing office of the Federal Ministry of Environment, Nature Conservation and Nuclear Safety.

Printed on 100% recycled paper

ISBN 978-3-89624-056-9

Bonn, Germany, 2012

Contents

Figures and tables

Figures

Tables

Preface

The following publication draws on presentations and discussions from a specialist workshop held on the Island of Vilm, Germany, 27-31 March 2012, which worked on issues relating to **Putting Natural Solutions to Work: Mainstreaming Protected Areas in Climate Change Responses**. The workshop was an opportunity to carry out a brainstorming on how protected areas might be incorporated into national climate change response strategies.

A sustained effort by the IUCN World Commission on Protected Areas (IUCN WCPA), sympathetic NGOs, government departments and international agencies, has made the case that protected areas can play a role in addressing climate change, both by storing and sequestering carbon in natural vegetation (mitigation) and by supporting ecosystem services needed to manage the climate changes that are occurring and projected to occur in the future (adaptation)[1,2]. While climate change response strategies must focus primarily on reducing emissions through cleaner energy strategies and avoided deforestation, the role of ecosystem management is receiving increased attention. Protected areas are proven to be the most successful way of maintaining natural ecosystems and their associated services.

As countries grapple with implementing response strategies, protected areas often continue to be overlooked simply because politicians and policy makers do not appreciate the relevance of ecosystem-based approaches, or are uncertain how they can be used. The workshop launched an effort by IUCN/WCPA to address this gap, building up to the production of a manual and training materials, tools, good practice examples, films and online databases, for the 2014 IUCN World Parks Congress. Initial material will be available earlier on the WCPA website. This process will involve action learning, where concepts are tested out on the ground, refined and improved to develop good practice. The case studies in the following report show that a significant number of countries have already made substantial progress on integrating protected areas into climate change strategies. The workshop achieved five main outputs:

- An initial collection of **case studies** of how protected area agencies are currently seeking to integrate protected area sites and systems into national and local efforts to address climate change.
- A discussion about the **tools** needed for mainstreaming protected areas into climate responses, including detailed modifications to a draft rapid-assessment tool.
- Development of a conceptual framework for how protected areas can be integrated into national climate change response strategies.
- Initial discussions identifying how much protection is really required to stabilise the world's biodiversity and to supply adequate climate and ecosystem services.
- An agreed list of needs and follow up actions.

We are deeply grateful to the staff of the International Academy for Nature Conservation on the Isle of Vilm for excellent organisation and arrangements for the workshop in very pleasant surroundings, to the German government for financial support and to all the participants for sharing their ideas and knowledge.

---

[1] Dudley, N. et al (2010); *Natural Solutions*, IUCN, The Nature Conservancy, UNDP, WCS, World Bank and WWF, Gland, Switzerland and Washington DC

[2] The World Bank (2008); *Convenient Solutions to an Inconvenient Truth*, Washington DC

Executive summary

Discussions at the UN conventions on climate change (UNFCCC) and biological diversity (CBD) are beginning to consider ecosystem-based approaches to climate change. Protected areas offer some unique advantages in helping countries to address climate change, through carbon storage and capture (mitigation) and maintaining the provision of ecosystem services that help people adapt to the impacts of climate change (adaptation) while continuing to maintain biological diversity. These benefits will only be fully realised, however, if they are incorporated into national climate change strategies and implemented alongside other response measures.

The workshop enabled the development of a draft framework for situating these various responses, starting with the recognition of existing benefits and extending to enhancing these benefits through better management, extending benefits by growing the protected area system and expanding benefits beyond protected areas by means of landscape and seascape approaches, as illustrated below. Issues relating to valuation and vulnerability assessments were discussed at length. The core of the framework is shown below.

Climate change response strategy	**Protected area response**			
	Managing existing protected areas in the face of climate change	Enhancing the role of protected areas through better management and governance	Expanding protected area coverage through enlargement, establishment of new areas and improved connectivity	Integrating protected areas into wider sectoral development strategies
Mitigation	Strengthening protection of Pas to reduce habitat loss and maintain carbon stores		Expanding PA coverage to include areas of high biodiversity and C value	
Adaptation	Managing existing protected areas in the face of climate change		Expanding Pas to increase connectivity	

Practical case studies were cited from Mexico, Costa Rica, the United States, Canada, India, Indonesia, South Africa, Madagascar, Georgia and countries in South-eastern Europe and through the global programmes of BirdLife International and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).

It was agreed that there is need for a series of tools for:

1. Assessing the role of protected areas (both individual sites and protected area systems) in contributing to climate change responses.
2. Managing protected areas to enhance their contribution to mitigation and adaptation.

3. Adapting management of protected areas and protected area systems to conserve biodiversity in the face of climate change[3].
4. Expanding and managing the protected area system to maximise both biodiversity conservation and protection of carbon stores and ecosystem services.
5. Integrating protected area systems into national climate change and sectoral development strategies.

A number of tools are already available which could help meet some of these needs (see Appendix 2) but there is a clear need for development of a good practice toolbox with more simple tools, as well as collation of practical examples of mainstreaming and good practice guidance. As part of the workshop more detailed discussion took place about modification of a draft rapid assessment tool for the site level, which is included as Appendix 3 in this report.

Next steps include identification of research priorities and core tasks outlined below:

1. Making the case: collect relevant case studies to contribute to online resources about how protected areas are contributing to climate change mitigation and adaptation.
2. Develop, test and refine a simple tool to assess potential protected area contributions to climate change mitigation and adaptation.
3. Integrate climate change response strategies into regional protected area processes, such as the EU Natura 2000 network and the Meso-American Biological Corridor.
4. Collate tools and papers for climate change analysis and make these available to WCPA members and other partners.
5. Establish a WCPA toolbox on connectivity online with simple introductory guide, including social and economic tools.
6. Identify key opportunities for mainstreaming protected areas into national climate change and development strategies in pilot countries e.g. inclusion of protected areas in national vulnerability assessments, National Biodiversity Strategies and Action Plans (NBSAPs), new infrastructure and energy developments.
7. Collaborate with other partners to identify and follow up on research needs e.g. overlay analysis of biodiversity, carbon and ecosystem services and review potential costs to protected areas from other mitigation activities e.g. hydropower.
8. Develop good practice guidelines and manual for integrating protected areas into climate change strategies.

This workshop complements other workshops supported by the German Federal Agency for Nature Conservation (BfN) on managing protected areas under conditions of climate change, and ecosystem-based adaptation in Europe. Outputs will supplement ongoing WCPA work including development of best practice guidelines on adapting protected area management in the face of climate change and on restoration in protected areas[4].

---

[3] This is being dealt with through separate good practice guidelines by the WCPA Science and Research Task Force

[4] Keenleyside, K. et al (2012); *Ecological Restoration for Protected Areas*, IUCN, Parks Canada and SER, Gland, Switzerland and Ottawa

Introduction: Mainstreaming Protected Areas into Climate Change Responses

An introduction to the topic and description of the context for the workshop deliberations was provided by Kathy MacKinnon, WCPA, and is reproduced below.

Climate change is adding dramatic new pressures on natural ecosystems, exacerbating existing pressures from habitat loss and fragmentation, overexploitation, pollution and the impacts of invasive alien species. The Millennium Ecosystem Assessment estimates that 60 per cent of ecosystems are already degraded. As average global temperature increases, a number of impacts are becoming apparent, which will have significant impacts for human societies, especially the world's poorest and most vulnerable communities.

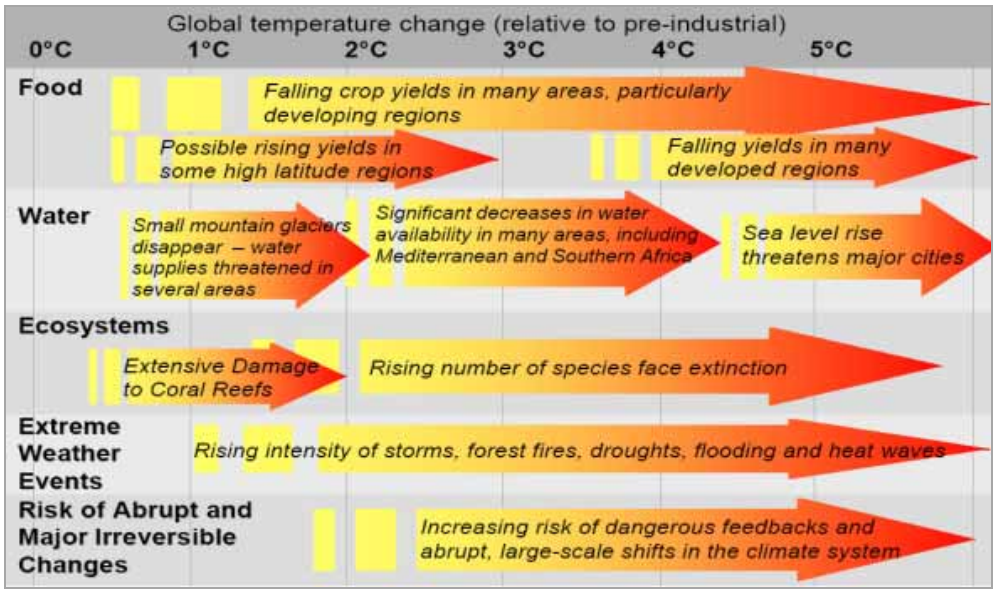


Figure 1: **Threats from climate change** (source: The World Bank)

Likely Regional Impacts of Climate Change on Human Communities and Livelihoods

Africa

- By 2020, 75-250 m people suffering water shortages
- Some countries - 50% reduction yield from rain-fed agriculture
- Strong links to poverty, migration and food security

Asia

- By 2050s, freshwater availability projected to decrease
- Coastal areas, especially heavily populated delta regions, flooding risk
- Increased pressures on natural resources from agriculture expansion
- Endemic morbidity and mortality due to diarrhea/disease rise

Islands

- Sea level rise - inundation, storm surge, erosion, other coastal hazards.
- By 2050, reduced water resources and shortages
- With higher temperatures, increased invasion by non-native species

Ecosystems can enhance resilience to climate change, through:

Mitigation

- ***Store***: Prevent loss of C in vegetation and soils
- ***Capture***: Sequester CO_2 from the atmosphere

Adaptation

- ***Protect***: maintain ecosystem integrity, buffer local climate, reduce risks and impacts of extreme events (droughts, floods, storms, sea level rise)
- ***Provide***: maintain essential services: water supplies, fisheries, agricultural productivity

Forests cover just 35 per cent of land area yet store 50 per cent of terrestrial carbon. They remove 2.4 billion tons of C per year from the atmosphere (equivalent to one-third of fossil fuel emissions), and oceans remove another 1.7 billion tons C/yr. Wetlands, seagrass beds, mangroves and kelp forests are some of the most efficient C sinks. Conversely, with poor management and degradation these habitats can easily switch to become net sources of carbon; land conversion is already responsible for up to 20 per cent of global emissions. Deforestation is responsible for an estimated 1.6 billion tons C per year while losses from degradation of peatlands, although they cover only 3 per cent of global land area, are equivalent to 6 per cent of all fossil fuel CO_2 emissions.

Ecosystem-based mitigation

Many areas of high biodiversity overlap with carbon stores and sinks (e.g., Borneo peat swamp forests), and, at a conservative estimate, 15 per cent of terrestrial carbon is stored in protected areas globally. Protected areas are legally established, with known boundaries (e.g. for monitoring) and thus provide sound ecosystems management units. The Aichi targets of the Convention on Biological Diversity suggested an increase in protected area coverage and connectivity (particularly for wetlands and marine systems), thus increasing potential for better protection of carbon stores and sinks.

The Amazon Region Protected Areas programme (ARPA) in Brazil provides a good example of the mitigation role of protected areas. ARPA has created 22.28 million ha of new protected areas, strengthened management of 8.65 m ha of existing protected areas and created a mosaic of state, provincial, private and indigenous reserves with a total area of 30.93 m ha. ARPA thus contributes to avoided deforestation with a carbon stock estimated at 4.5 billion tons, and reduced emissions estimated at 1.8 billion tons of carbon.

Ecosystem-based adaptation

Ecosystem-based adaptation means recognising biodiversity and ecosystem services as part of adaptation strategies to help vulnerable nations and communities to cope with the effects of climate change. For example, natural ecosystems: maintain water flows and quality; provide coastal protection and natural flood control and pollution-reduction mechanisms; protect reservoirs of wild crop relatives, pollinators and pest control agents; maintain nursery, feeding and breeding grounds for fisheries and wildlife; and restrict spread of invasive alien species (IAS) and disease vectors. Maintenance and/or restoration of mangroves reduce the vulnerability of coastal areas while increasing fisheries and food security. Mangroves

sequester approximately four times more carbon per hectare than tropical forests[5] but are vanishing 3-4 times faster than terrestrial forests. In Vietnam, communities have been planting and protecting mangroves for coastal protection. An investment of US$1.1 m in replanting is estimated to save US$7.3 m/year in sea dyke maintenance; during Typhoon Wukong in 2000 the presence of healthy mangroves also reduced loss of life and property. In Surat Thani, Thailand, the sum of all measured goods and services of intact mangroves is 70 per cent greater than revenues from shrimp farming and aquaculture on lands cleared of mangroves.

Similarly natural vegetation can protect against flooding. Dense vegetation cover in upper watershed areas increases infiltration of rainfall and reduces surface run-off, thus reducing peak flow rates except when soils are already fully saturated. Vegetation also protects against soil and riverbank erosion, reducing soil loss and transport of mud and rock which greatly increase the destructive power of floodwaters. Wetlands and floodplain soils absorb water, reducing peak flow rates downstream

Opportunities

Climate change provides another powerful argument for creating, managing and expanding protected areas, particularly now in marine areas, and places that contain both high biodiversity and high carbon stores. These new protected areas will need to embrace a full range of protected area governance models and efficient management systems for biodiversity, carbon and ecosystem services. Ensuring good connectivity between protected areas may also require restoration of degraded habitats and development of more sustainable land and water management. As discussed in this workshop, it will also be essential to incorporate protected areas into climate change strategies and spatial planning. Carbon markets could encourage more sustainable forestry, ecosystem restoration and community forestry although there are still many issues to resolve, including governance, monitoring, and managing the expectations and distribution of payments for ecosystem services under REDD or other (voluntary and private sector) schemes (like Verified Carbon Standard, Global Conservation Standard, etc.).

A range of opportunities exist that could help these developments over the next decade:

- Convention on Biological Diversity – Target 11, National Biodiversity Strategies and Action Plans
- UN Framework Convention on Climate Change – REDD+ mechanisms, Ecosystem-based adaptation (EBA)
- UN Convention on Combating Desertification – Ecosystem-based approaches in drylands
- Need to incorporate protected areas in Climate, Adaptation (NAPAS) and disaster risk reduction (DRR) strategies
- GEF and other donor funds can provide financial support
- Climate funds and REDD+ mechanisms
- Mainstreaming conservation in development policies and programmes

This workshop focuses on one aspect of this challenge: how countries can integrate protected areas into national climate change response strategies, in policy and practice.

[5] Donato, D.C., J.B. Kauffman, D. Murdiyarso, S. Kurnianto, M. Stidham, and M. Kanninen (2011); Mangroves among the most carbon-rich forests in the tropics, *Nature Geosience* **4**: 293–297

A framework for integrating protected areas into climate response strategies

Building on this background, the workshop sought to organize and understand how to respond to the technical and capacity demands of the challenge of integration, at four levels:

- Dealing with climate impacts on existing protected area systems (Level 1 response);
- Enhancing protected areas through better management and governance (Level 2 response),
- Expanding and connecting protected areas through establishment and enlargement (Level 3 response);
- Fully mainstreaming protected areas into local and national climate strategies and programmes (Level 4 response).

Protected areas support climate change mitigation and adaptation at local, national and global levels. Benefits can be enhanced by implementing responses at all four levels and for both mitigation and adaptation, yielding eight possibilities, as outlined in the matrix. All were considered although the last column, integrating protected areas into wider strategies, was the main focus of the meeting.

Table 1: **Framework for integrating climate change responses into protected area management**

Climate change response strategy	**Protected area response**			
	Existing protected areas	Enhancing protected areas through better management and governance	Expanding protected areas by establishment, enlargement and increased connectivity	Integrating protected areas into wider policy and development strategies
	Existing	*Better*	*More*	*Mainstreaming*
Mitigation				
Adaptation				

There are great opportunities for mainstreaming protected areas into climate change responses, although implementation will depend on a number of **conditions of success**:

- Recognition of a wide range of governance and management regimes for protected areas to ensure social inclusivity regarding protected area establishment and management.
- Determination of the real economic values of protected areas for poverty alleviation, provision of ecological services such as fresh water, public health and disaster risk reduction.
- Adaptive management based on action, participatory learning, science and traditional ecological knowledge as appropriate.
- Policy innovations, compliance and, where necessary, legal reform to allow protected areas to contribute to climate responses

- Strengthened and more effective management and good governance of protected areas
- Education, awareness and appreciation of the wider values of protected area systems to ensure political support and available resources for their management

Beyond the everyday challenges of running a protected area or protected area system, climate change response strategies imply a series of additional **strategic decisions**:

- Identify priorities for protection of natural habitats/expansion of protected areas through an overlay analysis of biodiversity, ecosystem services and carbon storage and sequestration
- Take into account the suitability of different protected area approaches (as exemplified by IUCN protected area categories and governance types) for particular response strategies to increase social and environmental benefits
- Analyse potential costs to protected areas from different climate change adaptation and mitigation options e.g. new energy infrastructure etc
- Monitor and evaluate public opinion toward particular strategies to decide when battles are worth fighting
- Identify the best entry points to promote natural solutions response (e.g., eligibility for carbon finance, adaptation programmes). Maximise the synergy potential from international agreements and conventions

Climate change and the associated response strategies provide both opportunities and challenges for protected areas as discussed in the following pages.

Mitigation

Research suggests that well-managed protected areas can help to mitigate climate change through their role in protecting natural habitats that store and sequester carbon. This role is still under-appreciated. At the same time protected areas, and natural ecosystems beyond their boundaries, may come under threat from other potential mitigation strategies such as creation of new dams and reservoirs or expansion of biofuels – see Table 2. Hydropower and other sources of renewable energy such as wind and wave energy, for example, have significant potential to mitigate climate change by reducing the greenhouse gas intensity of energy production. However, large-scale hydropower development can also have high environmental and social costs, such as changes in land use, disruption of migratory pathways, and displacement of local communities. They can also disrupt environmental flows, reducing a freshwater ecosystem's potential to adapt to climate change[6].

We also need an idea of what the impacts of climate change will be on protected areas. Such assessments need to consider both direct ecosystem responses and also related human activities prompted by climate change (e.g. dam building to address water shortages and palm oil plantations to provide biofuels). The range of these will influence use of conservation resources and communication. Scenario planning is important to understand the threat from climate and indirect threat from reacting humans. Factors for success are not simply

[6] The World Bank (2008); *Convenient Solutions to an Inconvenient Truth*, Washington DC

technical but include communication (telling the big story), access to information and supporting or supportive policy.

Table 2: **Opportunities and costs for protected areas from mitigation activities**

Targets	**Potential protected area opportunities**	**Potential protected area risks/costs**
Overall target: *reduce greenhouse gas emissions*		
Natural ecosystem components of overall target		

Maintain area of carbon-rich ecosystems	• Expanding protected areas
	• Maintaining ecosystems in existing protected areas
	  • Guiding planning to protect C and avoid biodiversity loss
	  • REDD+ and other incentives
	  • Embracing other governance types within protected area systems
		• Favouring carbon storage over biodiversity conservation in expanding protected area system

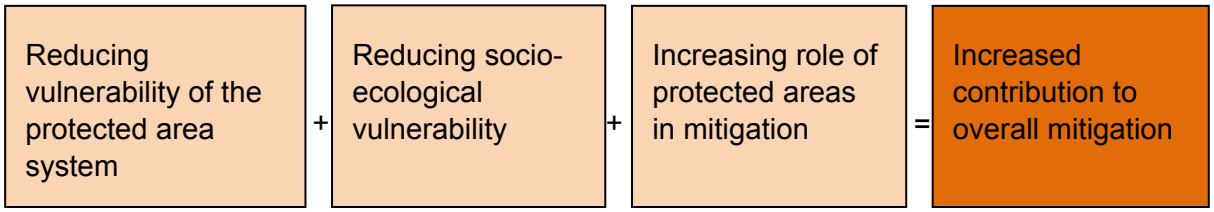
Avoid degradation of carbon-rich ecosystems	• Mitigating pressures in protected areas
	  • Improving fire management and other management approaches
	  • REDD+ and other carbon funds and other Payment for Environmental Service incentives
		• Dictating fire management regimes for carbon storage rather than biodiversity conservation

Restore ecosystems to increase carbon storage	• Ecosystem restoration in and around protected areas, including connecting corridors	• Restoration activities in protected areas that focus on carbon storage at the cost of biodiversity.
Other ecosystem components of overall target		
Create artificial carbon sinks		• Forest plantations in protected areas or conversion of natural ecosystems • Ocean fertilisation in and near marine protected areas • Burying carbon in soils in protected areas

Expand use of renewable energy sources		• Expanding renewable energy with high environmental impact in or influencing protected areas
		  ✓ Hydropower and large dams
		  ✓ Solar electric power stations
		  ✓ Wind farms
		  ✓ Biofuels
		  ✓ Geothermal energy

Obviously decision makers will need to assess the costs and trade-offs between different options when deciding on mitigation strategies but it is clear that protected areas and other ecosystem-based approaches can make a valuable contribution to national strategies, complementing, and sometimes replacing, investments in hard infrastructure.

The relationship of protected areas to mitigation of climate change is as follows:



Adaptation

Similarly adaptation also brings costs and benefits to protected areas.

Table 3: **Opportunities and costs for protected areas from adaptation activities**

Targets	**Potential protected area opportunities**	**Potential protected area risks/ costs**
Overall target: *help humanity to adapt to current and projected climate change*		
Natural ecosystem components of overall target		
General	• Additional arguments for ecosystem protection and ecosystem-based management • Protected areas as case studies to pilot and test approaches and to convince other stakeholders • Making the case for incentives and subsidies that support ecosystem management	Negative public perception that immediate adaptation needs of communities is of lower importance than that of plant and animals
Maintain water supplies	• Watershed protection (especially forests and freshwaters) ✓ Erosion control ✓ Invasive alien species (IAS) control ✓ Fire	• Impoundments e.g. dams, reservoirs • Canalisation
Support agricultural productivity and food security	• Protection of crop wild relatives (genetic diversity) • Maintenance of nutrients/ micronutrients across the landscape • Promote agro-ecological approaches • Promote alternative, ecosystem-based livelihood strategies	• Expanded agricultural footprint ✓ Pressure on protected areas ✓ Climate tolerant cultivars and GMOs released into the environment ✓ Spray drift and leaching of agrochemicals increasing pollution

Support fisheries and aquaculture productivity and food security	• Protection through marine protected areas • Restoration, especially of: ✓ Coral reefs ✓ Mangroves • Promote alternative, ecosystem-based livelihood strategies	• Increased pressure to access resources in MPAs and sanctuaries
Manage water flows and floods	• Protection and restoration of riverine and floodplain habitat, and of montane cloud forests	• Inter-basin transfers • Hard infrastructure for flood control
Manage for disaster reduction	• Design approaches to DRR that combine hard infrastructure with soft green approaches	• Replacement of green with hard infrastructure within protected areas
Address sea-level rise and storm surges	Coastal ecosystem protection and restoration	• Replacement of green with hard infrastructure in protected areas
Address alien invasive species	• Incentive to address one of the key challenges causing biodiversity loss	• Likely spread of IAS with crop improvements, biofuels

Integration of protected areas into the wider landscape

Participants then worked out how these various components could be combined into an integrated climate change strategy within, and beyond, protected areas as outlined in Table 4.

Table 4: **Integrating protected areas into wider landscape/seascape scale adaptation and mitigation strategies**

Targets	**Potential protected area opportunities**	**Potential costs**	**Policy needs and tools**	**Research needs**
Maintain resilience and reduce vulnerability of natural and socio-cultural ecosystems	• Management options: ✓ Adaptation of protected areas ✓ Adaptation of protected area systems ✓ Reducing detrimental impacts on protected areas ✓ Reduce vulnerability of protected areas ✓ Increase and/or maintain connectivity to allow species to move in response to climate change ✓ Increase resilience of protected areas ✓ Expanding protected area systems • Develop livelihood options to reduce pressure on protected areas • Increase co-management approaches and good governance to build support for protected areas • Allow biodiversity to persist in ecosystems with high ecological integrity		• Legal reforms • New policies • Indigenous peoples forums • Compliance and reporting • Incorporating protected areas into sectoral plans • "Soft" natural solutions to disaster risk reduction • Multi-sectoral climate strategies • Conservation-driven and "no-regret" approaches • Biodiversity-friendly development plans • Corporate sustainability • "Champions" • "Presidential decrees" • Initiatives outside governments • Strategic environmental assessments and environmental impact assessments • Civil society or private sector initiatives	• Existing development plans • Climate change strategies • Current legal requirements • Processes for integrated development planning • Vulnerability of different sectors and ecosystems to climate change • Mitigation effects • Energy policies
Manage for altered rainfall intensity, frequency and seasonality	• Increased arguments for connectivity conservation • Conservation plans that take account of predicted changes	• Changing climate opening new agricultural options in natural ecosystems • New oil exploration in polar & other regions		
Develop an integrated approach to climate change adaptation	• Evidence-based approaches addressing costs and benefits • Integrate protected areas into: ✓ Land and marine use planning ✓ Spatial planning to maintain ecosystem services • Encourage multi-agency partnerships and coordination at landscape/seascape scale			

Steps towards integration

Having disaggregated the issues, the workshop sought to identify a means to pull all of the threads together to enable an integrated response – see table 4. The potential for protected areas to contribute to climate change mitigation and adaptation is increasingly well understood; the challenge now is to *find realistic ways in which this can be recognised and implemented*. It is important that protected areas are integrated into wider roadmaps for addressing climate change such as National Adaptation Programmes of Action (NAPAs), which have a clear link to the national budget. Many countries have already prepared NAPAs, often focusing at sub-national level and based around projections of climate change impacts. Local budgets are often explicitly linked to climate change responses. In India, for example, the response strategy has eight elements: research and development, energy, sustainable agriculture, solar power, disaster relief, sustainable habitat, national water programme and "Green India". This creates the additional challenge of trying to retrofit protected areas into existing programmes.

Therefore from a strategic perspective, our focus should be on *what protected areas can provide in terms of carbon storage and sequestration and maintaining ecosystem services to mitigate climate change, reduce vulnerability and enable communities to cope with, and adapt to, climate change*. We need to assess and review country guidance on climate change response strategies to determine when, and where, protected areas can make a "no-regrets" contribution relevant to, and understood by, different national agencies, in order to ensure that protected areas are integrated into the country response strategy. Issues of national concern include biodiversity conservation, food security, coastal protection, disaster reduction, forest conservation, human health (heat, pathogens), energy and water management – see box below. In the next section, we deal specifically with three key topics critical to mainstreaming enhanced ecosystem protection and protected areas into national climate change response strategies: (i) valuing the role of protected areas; (ii) vulnerability assessments and the role of protected areas; and (iii) designing tools to address opportunities and reduce risks

Box: National priorities under climate change (examples):

- **Indonesia**: reducing deforestation; provision of water for irrigation, creating alternative livelihood opportunities, food security
- **Eastern Europe**: Water and maintenance of supply (trade-offs between hydropower versus drinking water and irrigation), pest control
- **Germany**: Energy, food and water
- **Canada**: mitigating industrial emissions, adaptability of forests to pests and pathogens, agricultural viability, managing pests by maintaining ecological integrity, loss of culture or livelihoods
- **US**: sea level rise, water shortages, an increase in extreme weather events
- **India**: water, storm surges, salt water intrusion to deltas, need for agricultural water, potential alteration of river beds, threats to mangroves, loss of medicinal plants
- **Mexico**: emissions reduction, water security, disaster risk reduction, food security

Valuing the role of protected areas

A crucial need is to understand better, in both qualitative and quantitative terms, what role protected area systems currently contribute, or could contribute in the future, in support of strategies to deal with climate change. For mitigation, it is essential that their role in carbon storage and sequestration is calculated and valued. For adaption, their role in sustaining

essential ecosystem functions and services must be quantified and valued. Furthermore these functions and values must be understood in terms of the institutional, governance and management conditions that are also necessary for these values to persist.

Work on REDD has vastly improved the science and measurement of carbon storage in natural ecosystems. The quantification of baselines and reference levels for the amount of carbon stored in above-ground and below-ground biomass is well advanced, and absolute and market-based pricing of the carbon equivalents stored over time is now possible.

Methodologies for economic valuation in a changed climate will in most cases rely on modifying existing methodologies for economic valuation, including cost-benefit analysis. A crucial step is to develop the level of detail that is relevant for decision-making. Generic studies of the economic value of ecosystems of different types could be used for extrapolation of the values of specific sites. Local studies can also show how protected areas provide specific benefits where the economic costs and benefits are accessible to analysis (e.g. where a protected area contributes directly to a water utility, or where household studies on the use of protected area resources has been conducted. On the whole, economic valuation is a valuable tool but it may not always be possible to analyse the specific values for a specific area or specific community, and to understand the differential value with, and without, predicted climate change.

An important consideration in building the case for protected areas is to include the multiple benefits that they provide, and for both mitigation and adaptation which occur simultaneously in the same landscape or seascape. A more complete picture of the value of a country's response to a climate change impact can be gained by considering the *total mitigation and adaptation impacts* (consequences and tradeoffs and co-benefits of various responses). Natural ecosystems often provide multiple benefits with proportionately fewer costs yet are often valued on a single benefit. For example, conserving coral reefs and mangroves (instead of simply building additional sea walls provides coastal protection and societal resilience but can also provide additional benefits ranging from enhanced fish stocks to economically beneficial ecotourism. Conserving a forest will contribute to carbon storage and therefore mitigation, but at the same time will maintain the integrity of watersheds and reduce the risk of floods, landslides or siltation. There are as yet few total valuation studies of protected area sites and/or systems that deal with this level of complexity, and few methods available to contemplate such an analysis. These are real needs to illustrate the real benefits for climate change response strategies that utilize natural ecosystems, whether or not one factors the additional costs and benefits of protected areas into the equation.

Finally, it will be essential to document, communicate and, most importantly, integrate the findings into planning procedures and accounting systems, along with other considerations for natural resource management.

Methodologies for assessing the role of protected areas in adaptation and mitigation

- **Carbon**: storage can be measured, with methodologies available from Woods Hole, University of East Anglia, etc, sequestration potential is more complicated.[7]
- **Food**: Wild crop relative methodology in Peru involving participatory research.[8]
- **Fisheries**: household studies and industrial research into fish banks and spawning aggregations.[9]
- **Mangroves**: many methodologies available[10]
- **Pollination**: hundreds of crops require pollination and there is currently a crisis but little coordinated research[11]
- **Non timber forest products**: including hunting
- **Alternative livelihoods**:
- **Recreation**: this could be a major value with many economic assessment techniques available
- **Water**: can be done at macro and at local level; there are at least 14 economic studies for water in Latin America
- **Disaster risk**: Sri Lanka and Bangladesh have disaster studies and there has been an important study of the role of mangroves in DRR in Vietnam
- **Biodiversity conservation**: providing places for species to persist and adapt

Understanding vulnerability

A country needs a thorough understanding about the likely impacts of climate change on society and environment to make rational choices about land use planning. *Vulnerability assessments and targeted communication campaigns* can increase awareness of the expected impacts from climate change on human society. Vulnerability assessments should be a critical early step in any process of developing adaptation strategies, addressing both ecological and social issues and identifying national priorities. Within an assessment, some issues require local, participatory input (e.g., assessments of food security) while others are more suitable for an expert-driven analysis (e.g., carbon sequestration). Protected areas can play a role in helping to identify the types of impacts expected under climate change. Assessments will also help to identify how, and where, protected areas can help to address specific concerns, e.g., carbon storage, water supplies, and how the protected area system might need to be modified (in terms of expansion, design and management) to meet these new social needs. Water security for agriculture and domestic use is likely to become more critical with climate change. There is already a compelling body of evidence of the value of protected areas in providing both quantity and quality of water supplies[12] yet wetlands are

[7] For instance: Hoover, C.M. (ed.) (2008); *Field Measurements for Forest Carbon Monitoring A Landscape-Scale Approach*. XVIII. Springer, 242 pp; GOFC-GOLD (2009); A sourcebook of methods and procedures for monitoring and reporting anthropogenic greenhouse gas emissions and removals caused by deforestation, gains and losses of carbon stocks in remaining forests and deforestation, GOFC-GOLD report version COP15-1. Alberta, Canada

[8] Altieri, M.A. and P. Koohafkan (2008); Enduring Farms: Climate Change, Smallholders and Traditional Farming Communities, Third World Network, Penang, Malaysia

[9] Cochrane, K.; C. De Young, D. Soto and T. Bahri (eds.) (2009); Climate change implications for fisheries and aquaculture: overview of current scientific knowledge. *FAO Fisheries and Aquaculture Technical Paper*. No. 530. FAO, Rome

[10] Ellison, J.C. (2012); *Climate Change Vulnerability Assessment and Adaptation Planning for Mangrove Systems*, WWF, Washington, DC

[11] Allen-Wardell, G., P. Bernhardt, R. Bitneret et al. (1998); The potential consequences of pollinator declines on the conservation of biodiversity and stability of food crop yields. Conservation Biology **12** (1): 8-17

[12] Dudley, N. and S. Stolton (2003); *Running Pure*, WWF and The World Bank, Gland and Washington DC

currently amongst the least protected biomes and many new mitigation and adaptation measures may actually reduce ecological flows.

Examples of using protected areas to address climate change

A number of important studies already exist:

- **Belize**: Carbon assessment at Rio Bravo
- **Bolivia**: Carbon Assessment at Noel Kempf NP
- **Brazil**: Carbon stocks and potential emissions[13]
- **Canada**: protected area planning in Canada and climate change[14]
- Butterflies, climate change and protected areas in Canada[15]
- Protected areas and climate change and adaptation in Saskatchewan[16]
- **Mexico**: Climate change strategy for protected area system[17]
- Fire management academy and fire management centre for protected areas in Yucatan
- **Turkey:** National Strategy[18]

Tools and other responses to identified needs

If we want to integrate protected areas fully as a vital contribution to government responses to climate change, this implies application, modification and where necessary development of a set of tools. The range of necessary tools identified is as follows:

1 **A set of toolkits for assessing the role of protected areas**: we need to appraise protected areas and understand (qualitatively and quantitatively) exactly what values a particular protected area or protected area system can offer to climate change mitigation and adaptation: i.e. what role does the protected area play in the landscape/seascape in addressing climate change. This can be multifaceted: jobs, research, test sites for new management approaches, etc. Tools are described in more detail on the next page.

2 A set of tools for managing protected areas to provide climate change mitigation and adaptation: what do we have to do differently in managing the protected area system in order to address the demands of climate change: these changes also need to be made *in the face of* climate change? The response will necessarily be complex. Do we need to re-examine the objectives of the protected area, e.g. with respect to fire management, speed of restoration, strictness of management (management category)?

---

[13] Ricketts, T., B. Soares-Filho, G.A.B. da Fonseca et al. (2010); Indigenous lands, protected areas and carbon sequestration. *PLoS Biology* **8**: E1000331

[14] Lemieux, C.J. and D.J. Scott (2005); Climate change, biodiversity conservation and protected area planning, *The Canadian Geographer* **49**: 384-399

[15] Kharouba, H.M. and J.T. Kerr, (2010); Just passing through: Global change and the conservation of biodiversity in protected areas. *Biological Conservation***143**:1094-1011

[16] Vandall, J.P. et al (2006); *Suitability and Adaptability of Current Protected Area Policies under Different Climate Change Scenarios: The Case of the Prairie Ecozone, Saskatchewan*; Saskatchewan Research Council, Publication 11755-1E06, 117 p

[17] Comisión Nacional de Áreas Naturales Protegidas (CONANP), 2010. Estrategia de Cambio Climático para Áreas Protegidas. SEMARNAT– Fondo Mexicano para la Conservación de la Naturaleza. UASID-USFS-Agencia Española de Cooperación Internacional para el Desarrollo. 40 pp. http://cambioclimatico.conanp.gob.mx/

[18] Lise,Y. And B. Avcioğlu Çokçalişkan (2010); *Protected Areas and Climate Change: Draft national strategy for Turkey*. Ministry of Environment, UNDP and WWF, Ankara

3 **Tools for expanding the protected area system**: can the protected area system be expanded (employing mechanisms such as REDD+, carbon markets, voluntary set asides etc) with the explicit goal of capturing the carbon storage potential of the landscape and the associated ecosystem benefits? This requires analytical effort to understand both the carbon and biodiversity values of the landscape and includes consideration of connectivity.

4 **Tools for integrating protected areas into (cross sectoral) national strategies**: the protected area system needs to be embedded within overall development planning

Points 1-3 come together in 4, the central aim of this workshop. In the following section, part 1 is discussed in more detail and a proposal for a simple assessment tool is outlined.

As one of the inputs to the workshop, a set of tools for assessment were presented and discussed in more detail as outlined below. Other necessary tools must still be developed, and the nature of these is outlined in the last section on Needs and Next Steps.

Tools for assessment

A range of tools is required, both qualitative and quantitative, covering a range of different issues

Site level

- **Primarily awareness raising assessments**, amongst protected area managers, local communities and downstream stakeholders (urban dwellers, companies, farmers) and as a resource for training protected area managers, with the following elements:
    1. Online questionnaire (based on the WWF PA-Benefits Assessment Tool) – a qualitative tool (discussed below)
    2. Downscale climate change models being developed by the Joint Research Centre as part of the IUCN BIOPAMA project in Africa, the Caribbean and Pacific countries.
    3. Documentation and dissemination of regional examples.
- **More detailed protected area based assessments** of biodiversity and ecosystem services, vulnerability, ecosystem services, level of impact, at site level for example:
    1. BirdLife rapid ecosystem service assessment – a more quantitative tool, helping to describe the current state of the protected area
    2. Case studies: e.g., Mexico, US – giving examples of successful assessments with lessons learned
    3. Madagascar – giving information about vulnerability (biodiversity and livelihoods)
    4. Working with CARE to adapt its tool for vulnerability assessments for communities (one of the best available) to a protected area context.

System level

- **Protected area system assessment** – to illustrate contribution from the whole protected area system; two options were discussed.
    1. By amalgamating site assessments from individual protected areas
    2. By holding a workshop of managers/experts opinion (in the style of the RAPPAM protected area assessment methodology)
- **Wider landscape/seascape assessment**

Table 5: **Tools for assessment**

Elements needed to develop/implement	**Level of assessment**			
	Basic protected area site assessment	Detailed protected area site assessment	Protected area system assessment	Wider landscape /seascape assessment
Tools/content	Rapid assessment tool	Vulnerability assessment covering: • Level of impact • Ecosystem services • Vulnerability	Expert-based RAPPAM-type assessment?	
Development	Modify Develop online version		Optimisation algorithm?	
Partners	UNEP-WCMC?	BirdLife CARE International Mexico CONANP		

Draft assessment tool

A simple assessment tool had been circulated to participants before the meeting. Comments on this were received from participants, and included the following:

- Include options (possibly on an introductory data sheet) identifying **change** – from climate change and other factors
- Need an associated **manual** on process, data collection methods, units etc to ensure standardisation, including guidance on means of participation
- Could be converted into an **online tool**
- Link to a **central database**
- *Indicative* rather than *quantitative* data are required
- Spell out a range of standardised answers to help respondents in some questions
- Gaps in information will help show where research is needed
- Respondents to the questionnaire should include people other than managers such as communities, urban dwellers, companies etc, to understand wider perspectives
- May need modification for different protected area categories and for different governance types (e.g., private protected areas)
- Important to describe ways of institutionalising assessments

The tool was revised and is presented in appendix 1; it is now ready for field testing, including testing at the World Conservation Congress.

Needs and next steps

Participants agreed a number of next steps from the meeting. These activities will contribute towards drawing up a manual on approaches to integrating protected areas into national climate change response strategies for publication and dissemination at the 2014 World Parks Congress. However since many national response strategies will be completed before 2014 it will be important to develop some tools and components as early as possible for preliminary testing and implementation.

Actions were divided into three categories: core actions for the participants in the workshop; actions by other institutions where participants could make a useful contribution, and issues needing further research. These are summarised below and in a matrix on the page following.

Core tasks

1. Assess potential protected area contributions to climate change mitigation and adaptation

- Complete the draft of the assessment tool, as included in the workshop proceedings and also convert into an online, electronic format. Versions will include: paper copy (eventually in English, Spanish and French), electronic tool and a simple (and easily translatable) PowerPoint version for presentation at workshops and to stakeholders.
- Investigate options for adding some key questions to the RAPPAM site-level methodology to facilitate workshops at national level to work out overall system-wide benefits from protected areas to climate change.

2. Case studies

- Carefully written and edited case studies, to describe practical experience and pass on lessons learned, were identified as being at the heart of any future guidance. It was agreed that these should be produced as soon as possible and loaded onto the IUCN-WCPA website. Initial case study summaries are collected in these proceedings; participants will draw up longer versions to a set format by the end of May 2012 and also collect relevant examples from other sources. Additional case studies will be solicited through the WCPA website. Case studies are particularly needed to address the following issues:
  - ✓ Developing connectivity corridors
  - ✓ Integrating protected areas into land-use spatial plans
  - ✓ Protected areas and food security
  - ✓ Protected areas as green infrastructure in climate change responses
  - ✓ Places where “hard” and “soft” responses have been combined to address disaster risk reduction

Box: Template for case studies

1 Title

2 Contribution to climate response (keywords)

3 Summary

4 Objectives

5 Description of the project

6 Map of the area

7 Lessons learned

8 Key references

9 Contact

10 Date of preparation of case study

11 WDPA Code for the protected area

3. Integrate climate change into regional protected area processes

- Work with regional protected area processes – in particular the Meso-American Biological Corridor and the European Union's Natura 2000 network, to determine ways in which they could be adapted to contribute more to climate change mitigation and adaptation

4. Climate change analysis tools

- Drawing on the work of Ignacio March and others to make available a wide range of climate change tools (online methodologies, papers, research reports) on the web (see appendix 2). Liaise with existing clearing houses, such as CAKE (Climate Adaptation Knowledge Exchange) and the CBD.

5. WCPA toolbox on connectivity

- Develop a WCPA toolbox for connectivity, including tools and case studies illustrating the use of the tools. This includes defining connectivity in practical terms for different ecosystems.

6. Conceptual paper

- Draw together a draft of a concept paper for integrating protected areas into climate change response strategies.

Contributions to other processes

- **Connectivity analysis**: a global tool to identify the best locations for the 17 per cent CBD protected area target, to be piloted under the BIOPAMA project in Caribbean, Pacific and Africa; An analysis of global and national connectivity of existing protected areas has been completed and could be used to identify new corridors that combine carbon and hydrological values between existing protected areas. The first step in this

process is to produce an overlay of biodiversity, carbon and ecosystem services and feed this information into a gap analysis. The connectivity tool is a derivative of existing tools

- **Assessment tools**: contribute where appropriate to other assessment tools under development, including those from BirdLife International, CARE International, the GIZ tool (described in the case study) and the UN Environment Programme. Work with the vulnerability assessment tool developed by CARE International to help identify vulnerabilities associated with communities that are heavily reliant on natural resources.
- **Restoration priority setting**: liaise with the IUCN-WCPA restoration task force in terms of refining guidance on restoring habitats in and around protected areas with regard to mitigation and adaptation.
- **"Other Conserved areas"**: agreeing on the implications of the CBD's definition of the 17 per cent target, and specifically other areas important for biodiversity conservation. Some initial thinking on this issue is presented in Table 6.

Table 6: **Different levels of conservation**

Biodiversity first	Protected areas in all categories and governance types and other areas explicitly putting biodiversity conservation first in management priorities
Biodiversity friendly	A wide variety of management processes that give a high but not dominant priority to biodiversity conservation: this will include a trend from areas hard to distinguish from "biodiversity first" to others where biodiversity conservation is fairly incidental but still important
Biodiversity unfriendly	Areas contributing nothing significant to biodiversity conservation (and often contributing to its continued loss: e.g. intensive agriculture, most cities

Research needed

Some key areas requiring further and urgent research were identified:

- **Potential costs to protected areas from climate change adaptation and mitigation responses, including infrastructure and agricultural expansion.** Most analyses so far have identified the co-benefits of protected areas and climate change response strategies. Nevertheless there may be real costs to protected areas from national and local actions promoted to address mitigation (e.g., expansion of biofuels) and adaptation (e.g., flood barriers, sea walls).
- **Overlay of biodiversity priorities, carbon benefits and ecosystem services:** important in determining (and raising the profile of) potential new protected areas that can provide multiple benefits. Potentially to be developed as part of the IUCN BIOPAMA project, for liaison and collaboration with the EU Joint Research Centre.
- **Suitability of different protected area management categories** in addressing climate change issue: a potential task for the IUCN-WCPA task force on categories.
- **Framing the big ask**: identifying how much protection is really required to stabilise the world's biodiversity and to supply adequate climate and ecosystem services. Such a project would require detailed modelling and analysis to identify costs and trade-offs of different options. This is a potential output for the 2014 World Parks Congress.

Agreed outputs from the Vilm workshop

Table 7: **Actions agreed by participants**

Action	**Details**	**Completion**
Core outputs from participants at the Vilm workshop		
Protected area assessment		
Complete rapid assessment tool	Revise draft and send for comment (N. Dudley)	30.04.12
	Comments received	31.05.12
	Develop online version	
	Explore integrating with WDPA and Protected Planet. Woodley)	
Discuss modifying RAPPAM for use in response strategies	Discussion with WWF and Jamie Ervin	
Contribute to quantitative tool	Liaison with BirdLife	
Case studies		
Development of case studies	Covering: ✓ Integrating protected areas into land-use plans and national vulnerability assessments ✓ Protected areas and food security ✓ Integrating protected areas into development plans to address climate change, Including infrastructure ✓ Integration of hard and soft responses to DRR ✓ Connectivity	
	Template for case studies agreed	30.04.12
	Initial case studies completed	31.05.12
Integrate climate change into regional processes		
Liaison with regional IUCN offices		
Liaison with BIOPAMA		
Liaison with WCPA Europe		
Guide to climate change analysis tools		
Develop online guide to describe suite of tools available	First draft (I. March in Spanish) Translate: O. Chassot (French), S. Woodley (English)	31.05.12
Methods of establishing corridors		
Guidelines and case studies	Draft prepared (O. Chassot)	

Concept paper on an overall framework for using protected areas to combat climate change		
Concept paper to be incorporated into workshop proceedings	Write up notes from meeting (N. Dudley)	30.04.12
	Comments from participants	31.05.12
Input into existing projects		
CARE vulnerability assessment tool	Input from GIZ and BirdLife (informally scoping and starting at the end of June 2012)	
ELC work on protection and legal status of corridors	Integrate Indonesian example Comment on text	
Agree definition of "conserved areas"	WCPA	31.05.12
Compile data on "other conserved areas"	UNEP-WCMC	
Restoration priority setting	Liaison with WCPA Restoration task force	
Issues requiring further research		
Analysis of potential costs to PAs from climate change mitigation		
Overlay analysis of biodiversity, ecosystem services and vulnerability	Liaison with BIOPAMA project and the EU Joint Research Centre	
Suitability of different protected area categories for climate change response strategies	Liaison with WCPA task force on categories	
Framing the "big ask"	A research effort leading up to the World Parks Congress	2014

The workshop also heard details of a number of important case studies that summarise information illustrating the potential of integrating protected areas into climate change responses in five continents. These are summarised below. Some countries, such as Mexico, already seem to be well advanced and fully committed to mainstreaming protected areas and connectivity networks into national climate strategies.

Case studies

Mexican Biodiversity Conservation Model: Protected areas and climate change

Andrew J. Rhodes Espinoza, CONANP

Mexico's protected area system is managed to promote the conservation of Mexico's natural heritage through the protection of biodiversity, its environmental services and promotion of sustainable development. This protected area system contributes to adaptation to climate change. Mexico's National Commission for Natural Protected Areas (CONANP in Spanish) is the Federal Government´s institution responsible for the conservation of the country's natural heritage through establishment, protection and safeguard of protected areas. CONANP manages 174 federal protected areas, covering nearly 13 % of the Mexican territory (over 25 million hectares – 61 million acres) (Figure 2). These protected areas are classified into six different management categories: biosphere reserves, national parks, flora and fauna protection areas, natural resources protection areas, sanctuaries and natural monuments.

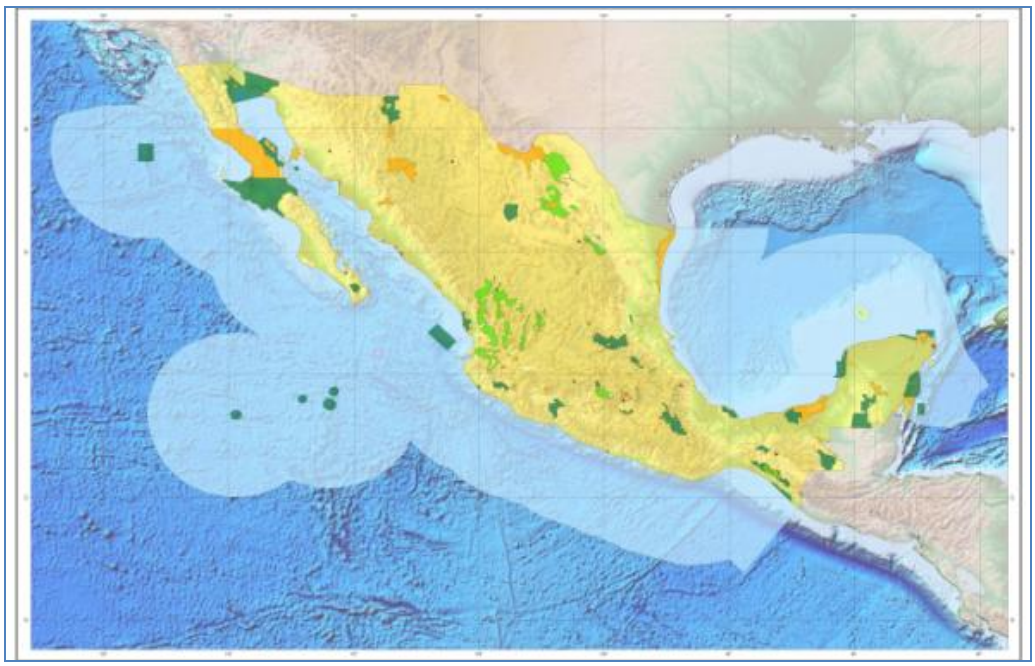


Figure 2: **Protected areas in Mexico** (source CONANP)

In 2009 CONANP launched the Climate Change Strategy for Protected Areas (ECCAP in Spanish) with a range of components:

- Substantial components: mitigation and adaptation
- Support components: knowledge, communication, capacity
- Cross-cutting: public policy

One major component of the strategy is to encourage greater consistency over policy. There are large differences between policies within Mexico (e.g. on dam building) but at least several ministries are now sitting down together to address climate change issues.

Climate Change Adaptation Programs

CONANP has worked on a set of climate change adaption programs, which were developed under a landscape approach since protected areas were grouped into clusters. These programs identified adaptation strategies based on vulnerability of ecosystems, human communities and productive systems. Strategies were then prioritized based on diverse criteria such as feasibility and impact. Afterwards the strategies are implemented on the ground by a diverse array of mechanisms (subsidies, projects with NGOs). To date, CONANP has developed four climate change adaptation programs, including twelve protected areas, as well as a guide to develop climate change adaptation programs for protected areas

Figure 3: a) **Climate Change Strategy for Protected Areas,** b) **Planning Guide for Climate Change Adaption Programs** and c) **Climate Change Adaption Program for Mayan Rainforest**.

The lessons learned in the southeast include the identification of protected area clusters as ways of addressing climate change, including a mixture of core areas and buffer zones. When a protected area is declared, the land use does not change although sustainable policies are promoted and the core zone is strictly protected. New approaches are looking at a more plastic response, including greater restoration in buffer zones and clusters, enhancing connectivity among clusters and increasing management effectiveness within protected and transition areas. Currently there are important efforts to align instruments and subsidies from other sectors to protected areas.

Currently, adaptation actions are being implemented in multiple protected areas, where the adaptation measures identified are being implemented on the ground, including climate monitoring actions, capacity building for integrated fire management and reduction of vulnerability in priority watersheds (soil conservation actions, water management measures, risk mapping). Monitoring of these adaptation actions and measures is being conducted by protected area personnel in order to facilitate adaptive management. Maintaining ecosystem integrity is a way to guarantee the permanence of ecosystem services for local communities.

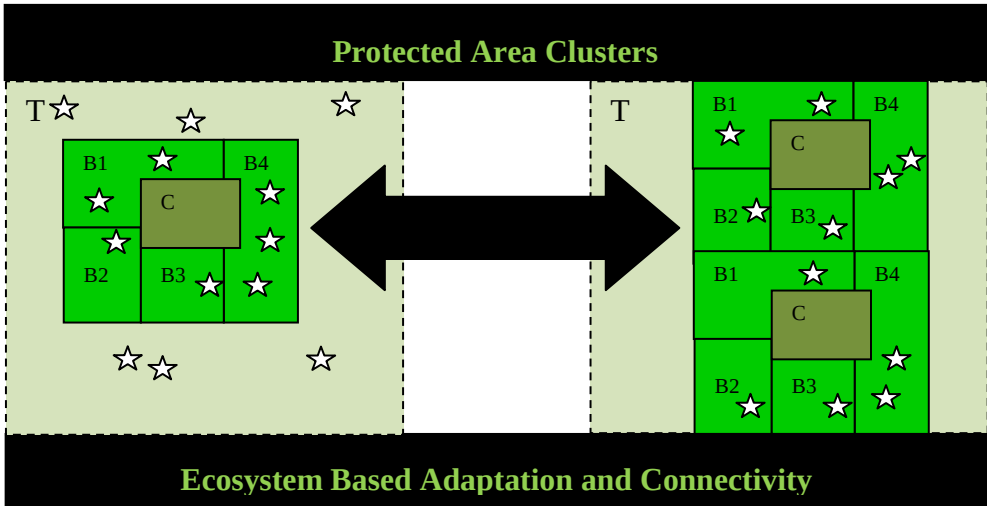


Figure 4: **Common schematic of a Mexico protected area and its transition zone. C: Core area, B1, B2, B3 and B4: buffer zones and T: Transition zone; stars represent communities.**

A document based on *Natural Solutions* is also being used to promote protected areas in combating climate change and promoting capacity development with CONANP personnel and local stakeholders.

Figure 5: **Climate change communication materials based on *Natural Solutions***

In addition, a partnership called *Mexico Resiliente*: *Alliance* has been launched: which encourages the coordination of those stakeholders that participate actively in the conservation of the protected areas by taking actions related to climate change mitigation and adaptation. Currently, the Alliance has attracted eighteen partners[19]. This initiative is now recognised as a technical committee that advises the governmental adaptation working group that in turn responds directly to the president.

Figure 6: **Mexico Resiliente Alliance logo**

[19] For more information on the Alliance: http://cambioclimatico.conanp.gob.mx/aliados.php

Climate change in Marismas Nacionales Coastal Wetland Area, Mexico: First steps towards adaptation

Ignacio March, The Nature Conservancy

The project described below is a joint effort between The Nature Conservancy (an international NGO), CONSELVA (a local NGO) and CONANP (the state protected area agency of Mexico), supported financially by the Packard Foundation. This project is part of a larger effort to develop climate change adaptation programmes for four protected area complexes in southern Mexico: four reports on these are already available for southeast Mexico.[20] Further, a guide to develop climate change adaptation programmes in protected area programmes has also been developed by the project. Amongst other documents this gathers together a wide range of on-line tools for assessing climate change. The goals of the project are to estimate the impact of climate change on coastal ecosystems and economic activities of Marismas Nacionales, and to use this information to design strategies and measures to increase resilience. The final aim is to convince fishing communities, local government and others that restoration is the best option to address climate change: for instance under current climate scenarios it is estimated that 20 per cent of fisheries could be lost by 2050 due to climate change, with disastrous impacts on livelihoods and economies. Work draws on some core concepts: ecosystem based adaptation, vulnerability assessment and the introduction of management practices for adaptation to climate change (see figure below).

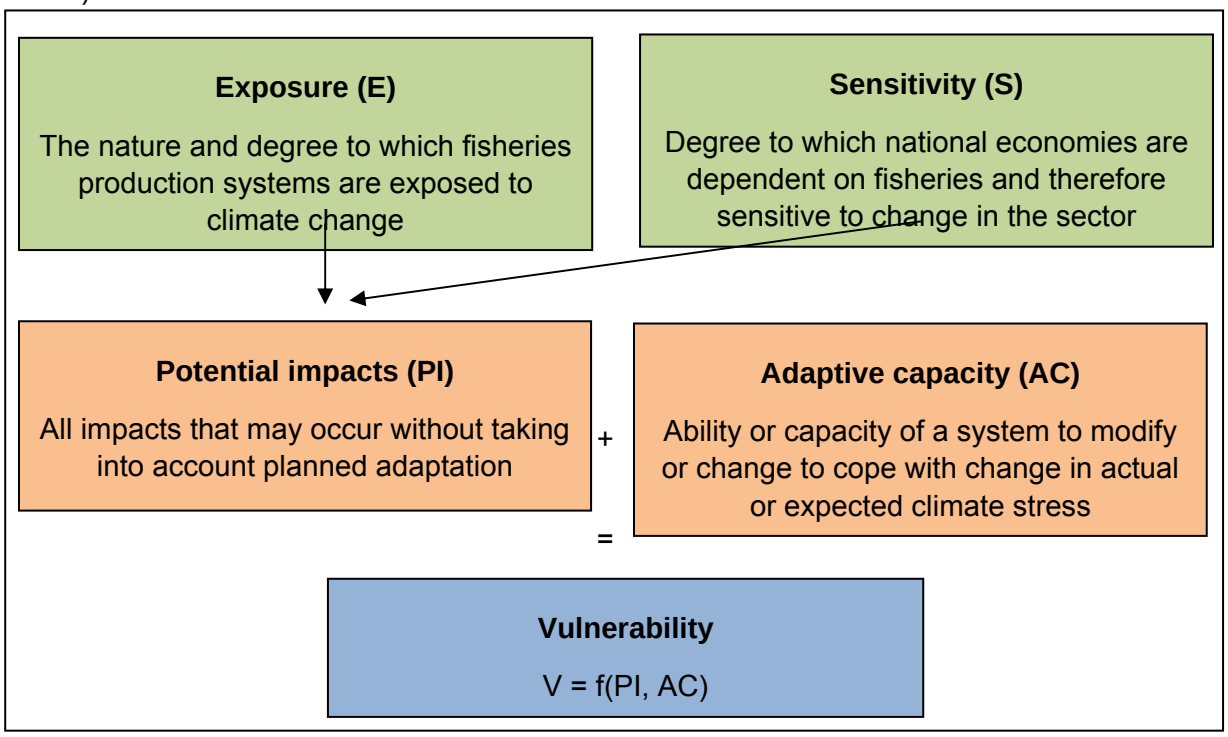


Figure 7: **Conceptual model of vulnerability**, adapted from Allison et al, 2005[21]

[20] http://cambioclimatico.conanp.gob.mx/

[21] Allison, E.H., W.N. Adger, M.C. Badjeck, et al (2005); *Effects of climate change on the sustainability of capture and enhancement fisheries important to the poor: analysis of the vulnerability and adaptability of fisher folk living in poverty*. London, Fisheries Management Science Programme MRAG/DFID, Project no. R4778J

The project is based in important coastal wetlands in two states of western Mexico (Sinaloa and Nayarit), including two biosphere reserves (one that is still being established) and an important Ramsar site. The area is of high priority with respect to its biodiversity value but is also highly vulnerable; it is one of the most important coastal wetlands in North America and is a core site for migratory bird species, including habitat for several endangered species. It is also one of the most productive areas in the country for fisheries and aquaculture; for instance being the site of 40 per cent of shrimp production. A large proportion of American water birds (up to 100,000 birds at one time) use the wetlands during migration. The coastal area is likely to be increasingly vulnerable to cyclones under climate change. Many of the rivers are already dammed, although there is one important river without a dam.One aim of the project is to show the importance of maintaining freshwater flow into this priority coastal wetland.

Major components of the project

- Estimating climate change impacts and model vulnerability
- Making an economic impact (valuation) of these changes using benefit transfer models for ecosystem services valuation and designing potential market mechanisms for financing adaptation actions. The InVEST tool is compatible with GIS. The project is also looking at Blue Carbon markets, working with support from Resources for the Future in Washington DC.
- Designing strategies and monitoring systems
- Developing a communication strategy

Mangroves are being used as a key ecosystem that has links to conservation, development and human welfare. Impacts will be modelled using GIS, incorporating ecological flows and hydrodynamic regimes. One important challenge is to model mangrove vulnerability by considering changes in hydrology, mainly due to changes in salinity (for example by changing access by salt water either deliberately or through sea-level rise). Some dramatic examples of such changes are already occurring in the region as shown by the photograph below. Some of the project will focus on restoration needs for mangrove, and particularly on restoration of black mangrove (*Avicennia germinans*), which is the species most resistant to salinity, along with restoration of natural hydrodynamic regimes

Figure 8: **A 6,000 ha mangrove forest killed in a few months after a canal was dug to increase access by salt water for the purposes of boosting shrimp production**

Adaptation work in protected areas in India

Pramod Krishnan, United Nations Development Programme

Considerable progress has already been made in implementing climate adaptation work into Indian protected areas. India is a highly diverse country with 16 major forest types, 10 biogeographic zones and 27 provinces and is home to 4 biodiversity hotspots: the diversity, size of the country and high population combine to provide an unusual range of challenges for conservation. Key challenges for climate change mitigation and adaptation relate to institutional, knowledge and community issues, including for example the implications of the current high economic growth trajectory with a resulting increased impact on protected areas – for example many coal reserves are in protected areas:

Institutional

- Competing, non-compatible land use practices
- Habitat degradation and fragmentation
- Persistent cross-sectoral coordination issues –individual sector growth models and strategies
- Prevailing 'pockets of poverty' including in, and around, protected areas
- Limited financial resources
- Redundancy of protected area boundaries causing confusion

Knowledge

- Limited understanding and experience with landscape scale conservation-friendly development
- Inadequate information and poor knowledge base on ecosystem dynamics for decision-making
- Need for integrated planning and decision making systems
- Emerging issues (climate change, invasive species, etc)

Community

- Shrinking livelihood opportunities
- Excessive dependency on natural resources
- Unrest and conflicts
- Low coping capacities (to climate change, disasters, socio-economic changes)

Climate change is creating a range of additional impacts on protected areas:

Geophysical impacts

- Loss of ecological infrastructure – e.g. resulting in more landslides, avalanches (e.g. Himalayas)
- Recurring floods and drought (e.g., Kaziranga National Park, Bharatpur National Park)
- Coastal erosion and habitat loss (e.g., Andman, Nicobar megapode)
- Redundancy of protected area boundaries

Biological impacts

- Shift of ecosystems (over 85 per cent predicted)
- Threat to specialist species (e.g., Nilgir Tahr)
- Proliferation of alien invasive species (e.g. *Lantana*, *Michenia*)
- Loss of corridors and habitat fragmentation (e.g., human-animal conflict)

- Impacts on ecosystem types - stand density, recruitment, growth patterns, etc.

Socio-economic impacts

- Escalated vulnerabilities (e.g., reduced access to NTFPs)
- Affected livelihoods (e.g., diminishing fisheries in west coast)

Integrating climate change into protected area response strategies

Integration involves identifying the correct scale of intervention, finding the right entry point and promoting ecosystem-based adaptation as a positive tool. All states are preparing state climate change adaptation plans including ecosystem-based approaches. The following points are important:

1. Level and Scale of intervention:

- Global and regional: UN Conventions and protocols
- National: Policy and legal frameworks.
- Provincial/ sub-national: District level planning and coordination is going to be crucial.
- Local: At community level – on a day to day life basis

2. Identification of entry points for negotiation

- Ecosystem services
- Disaster Risk Reduction
- Mainstreaming agenda with production sector
- Talking economic language

3. Promoting Ecosystem Based Adaptation (EBA)

For addressing climate change as a common slogan among the conservation community

Lessons learned

From experience to date, a number of lessons can be identified:

- There is still only limited recognition of the impacts of climate change and the role of protected areas as a response strategy, even among conservationists.
- The protected area planning framework does not take into consideration climate change issues.

Several responses are possible:

- Promoting low carbon climate resilient development in the protected area landscape (e.g. eco-sensitive zones).
- Improving the sustainability of protected areas (e.g. through Conservation Foundations)

- Mainstreaming biodiversity conservation and sustainable use into production sectors (e.g., in the Gulf of Mannar, Indian Oil Cooperation, Godavari delta).
- Maintaining or improving agro-ecosystems services for sustaining livelihoods (e.g., climate proofing/greening of the Mahatma Gandhi National Rural Employment Guarantee Scheme).
- Generating sustainable flows of forest ecosystem services including those relating to livelihoods of forest dependent people (e.g. protected areas are the source of all major rivers in India and these values can be captured by calculating water source value),
- Reducing pressures on the protected area system from competing land use (e.g. eco-tourism, promotion of sustainable livelihoods).
- Promoting conservation and enhancement of carbon stocks through sustainable management of land use, land-use change, and forestry. (e.g. Green India Mission)
- Promoting integrated planning and management. (e.g. Godavari delta project).

Planning for the future

In addition, planning for the future needs to address a series of capacity development and policy issues, including in particular:

- Strengthening national and sub-national capacities and policy and programme framework for planning adaptive management strategies for protected areas (e.g., National Action Plan on Climate Change, National Biodiversity Strategies and Action Plans, Lal Bahadur Shastri National Academy of Administration, protected area management planning).
- Redesigning protected areas from a territorial approach to functional approach (e.g., to include adequate snow leopard and Nilgiri Tahr habitats)
- Broadening the understanding of climate change impacts. (e.g., Godavari and Sundarbans).
- Quantifying the 'Carbon capture' potential of protected areas. (e.g., Indian Council of Forestry Research and Education).
- Identifying key ecological corridors and dispersal areas. (e.g., Elephant Reserves).
- Quantifying provisioning of ecosystem goods and services by protected area landscapes. (e.g., Godavari).
- Strengthening management effectiveness of protected areas, forest fragments, forest plantations, pasture lands and other key high value biodiversity areas in the protected area landscapes (e.g., High Ranges).
- Promoting natural solutions over/along with engineering solutions – (e.g., Bio-shield in Sundarbans, and Orissa).
- Developing and promoting sustainable livelihoods linked to market opportunities for protected areas (e.g., ecotourism).
- Promoting Payments for Ecosystem Services – 1. Valuation of services as a first step. 2. designing a non-controversial fund

BirdLife: current work in developing support tools for ecosystem based adaptation

Robert Munroe, BirdLife International

The following account describes some of the work of BirdLife International's adaptation work. BirdLife has developed models with Durham University that project changes in species distributions (based on movement of species 'climate space') under a varying climate change scenarios in sub-Saharan Africa, Himalaya and Lower Mekong. Important Bird Areas boundaries have been added to enable a turnover percentage (i.e. change in bird species mix) at these sites to be calculated. Sites are divided into categories depending on the projected change in bird species "mix" (see figure below) and generic management actions are provided for each of the categories. BirdLife is working with ecologists, species' experts, protected area managers and government ministries to develop this use of this information: for example in Vietnam it is hoped that such information will be integrated into vulnerability assessments to inform the Vietnam Biodiversity Master Plan. In conjunction to this work, is a review of National Adaptation Programmes of Action, National Biodiversity Strategies and Action Plans and agricultural policies in Burundi, Rwanda and Uganda, to note opportunities to integrate biodiversity conservation adaptation into these policies.

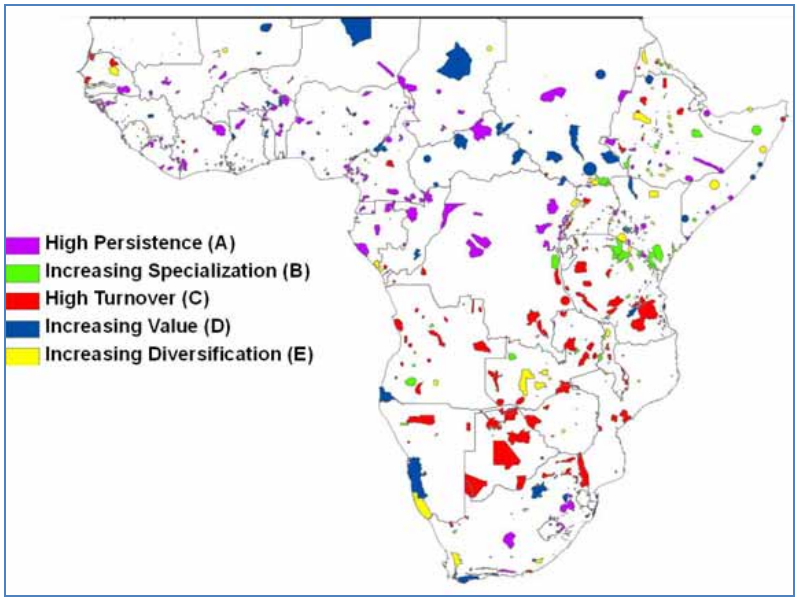


Figure 9: **Spatial distribution of IBAs in the five climate change adaptation strategy categories**[22]

This is being developed into a broader effort to ensure that such "vulnerability assessments" are more fully integrated into national human adaptation policies as an indication of potential climate change impacts on ecosystem integrity and therefore ecosystem services that many people in these areas rely on to adapt.

[22] From Figure 1(b), Hole et al. 2011, 'Toward a Management Framework for Networks of Protected Areas in the Face of Climate Change', *Conservation Biology* **25** (2): 305-315

Ecosystem-based adaptation

BirdLife is also working with partners (CARE International, CATIE, Conservation International, IUCN-CEM, CIFOR, WCS, WWF-US, Inter-American Development Bank) in developing principles and guidance on effective ecosystem based adaptation (EbA), looking at what already exists and identifying some steps for both policy makers and managers. Draft principles and guidelines were drawn up in 2011[23] to initiate a more formal and iterative process to develop more detailed (potentially step-by-step) EbA that can direct readers to appropriate sources of information and recommended tools. These aim to address gaps in useful generic adaptation guidelines that are already available. They are to act as a foundation for planning EbA. The principles are intended to be used by decision makers in national policy in national, territorial and sector planning initiatives, in financial planning, and in project and research design; the guidelines are meant to support best-practices for the design and implementation of EbA.

The principles were considered in the development of UNEP's EbA Decision Support Framework: *Ecosystem-based adaptation guidance: moving from principles to practice*. It has been produced to support decision makers who are planning an adaptation initiative and would like to consider the applicability or appropriateness of EbA in conjunction with more traditional methods of adaptation. This includes some guiding principles and a discussion on "effective EbA", followed by a series of steps: (1) setting the adaptive context; (2) selecting appropriate adaptation options; (3) design for change; and (4) adaptive implementation. BirdLife understands (although clarification would need to be sought from UNEP) that the intention is to trial this framework in a number of decision-making contexts over the latter part of 2012, hone the guidance further before presenting at the UNFCCC Nairobi Work Programme EbA workshop in early 2013, and develop training modules.

A key question in this context is whether we can *integrate* protected areas as one aspect of EbA into existing initiatives like this one to maximise efficiencies and minimise costs in time and resources?

BirdLife, in conjunction with a project team of representatives from UNEP-WCMC, IIED and University of Cambridge, has carried out a systematic review of the scientific literature on the evidence base from EbA; narrowed from 7,000 papers to 132 that make explicit links between the use of biodiversity and ecosystems and human "adaptation" benefits[24]. This includes some specifically on protected areas, e.g. in Amazonia and Honduras. Many protected area case studies were probably excluded in the process of coming up with this list of 132 as they will not have made the explicit link to human adaptation benefits and/or did not have a measure of adaptation effectiveness.

Both guidance work and evidence-base work have been used to inform input into a project where BirdLife is providing support to UNEP-WCMC, which is also working on a project to develop biodiversity criteria for adaptation and natural carbon sinks-project selection and for evaluating funded-project performance for the German Government's International Climate Initiative (ICI). The ICI has supported the role of protected areas in human adaptation and carbon storage and sequestration to a great extent in the past, including projects that intend

---

[23] http://www.iucn.org/about/union/commissions/cem/cem_resources/other_cem_publications_and_papers/?uPubsID=4523

[24] http://pubs.iied.org/G03187.html

to upscale such action to influence policies. Part of this project has been to review existing REDD+ standards, EbA principles, as well as donor funding criteria and the likes of ecosystem-based management and Integrated Coastal Zone Management guidance.

A toolkit called *Measuring and monitoring ecosystem services at the site scale* is being developed by Birdlife, University of Cambridge, UNEP-WCMC, RSPB, and Anglia Ruskin University[25]. It is designed to be used by protected area management and employs simple field measurements, web-based models, questionnaires and proxies. If it is decided that measuring the potential of protected areas is necessary then this rapid assessment toolkit could be used to support the process – complementing the perceptions/accounts of stakeholders with data. It helps to measure carbon (stock, sequestration, loss, fluxes); hillslope/wetland hydrological services (flooding, provisioning, quality); and harvested wild goods, using methodology designed to be simple enough for protected area managers to use (field measurements, look-up tables, simple web-based models, questionnaires, and development of climate change proxies) to highlight the role of IBAs and protected areas in ecosystem service provision. The toolkit is being tested in Nepal and advocacy messages created from the findings, including surrounding the need to consider role of protected area networks in provision of ecosystem services useful for adaptation in Local Adaptation Programmes of Action and National Adaptation Programme of Action review.

[25] http://www.unep-wcmc.org/a-toolkit-for-measuring-ecosystem-services-at-the-site-scale-is-released_751.html

Integrating EBA and Ecosystem Services into development cooperation and development planning: experience from GIZ

Gunnar Finke, Programme Implementing the CBD, GIZ

As the implementing agency for the German Government in the field of international cooperation for sustainable development, GIZ supports partner countries in implementing the CBD Strategic Plan and reaching the Aichi Biodiversity Targets. Work focuses *inter alia* on policy advice on biodiversity management and conservation, strengthening protected area management, fostering sustainable land and coastal zone management or supporting REDD+ initiatives and enabling policy frameworks. Interesting and potentially useful examples in the context of the biodiversity conservation and climate change nexus are listed below and include work on climate proofing protected area management on site and system-level, piloting and field testing vulnerability assessment methodologies and integrating biodiversity and ecosystem services into (development) planning processes.

- A tool called **Climate Proofing for Development (CP4Dev)** aims to address current or future climate change related challenges and opportunities. CP4Dev was originally developed as a four step analysis to integrate climate change aspects into development planning in order to climate-proof GIZ projects. However, it can be adapted to analysing the risks climate change poses to the goals of protected area (buffer zone) management and development plans by analysing adaptation needs, selecting feasible (ecosystem-based) adaptation options, and integrating these into commune market-orientated planning and market-orientated socio-economic development plans.
- The **MARISCO methodology (Adaptive Risk and Vulnerability Management at Conservation Sites)** is used to facilitate the integration of the risk and vulnerability perspective into the management of conservation projects and sites. It is designed to ensure that the impact of climate change is taken into account in the strategic management of protected areas, but is not limited to climate change.
- **Integrating Ecosystem Services into Development Planning (IES)** is a stepwise approach for systematically assessing, valuating and integrating ecosystem services into development planning, based on, but adapted from, the TEEB approach. IES aims to assist in recognising the links between nature and development. It considers the environmental and economic trade-offs associated with development measures and thus to provide help to systematically incorporate ecosystem service-related opportunities and risks into the planning and implementation of strategies. IES is designed to support advisors, project staff and development planners in partner countries to integrate ecosystem services into the design and review of development plans, sector-specific and spatial planning, environmental and climate assessments, as well as into project development and proposal formulation.

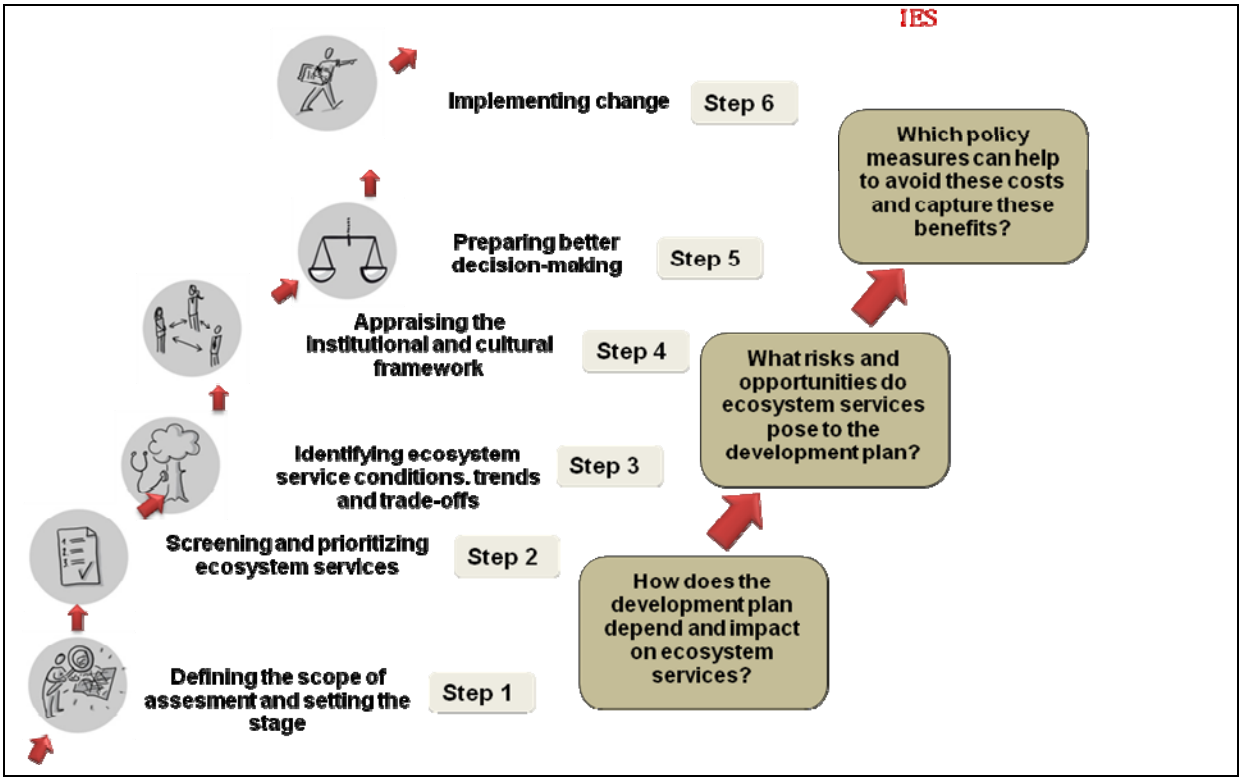


Figure10: **Integrating Ecosystem Services into Development Planning – 6 step approach**

Protected areas as a response to climate change: forest carbon and adaptation projects in practice in Madagascar

Michelle Andrianarisata, Conservation International

The Durban Vision was announced by the President of Madagascar at the 2003 World Parks Congress: "… our decision to increase the protected areas from 1.7 million hectares to 6 million hectares over the next five years …": corresponding to a commitment to 10 per cent of the territory as in the CD's then target for protected areas.

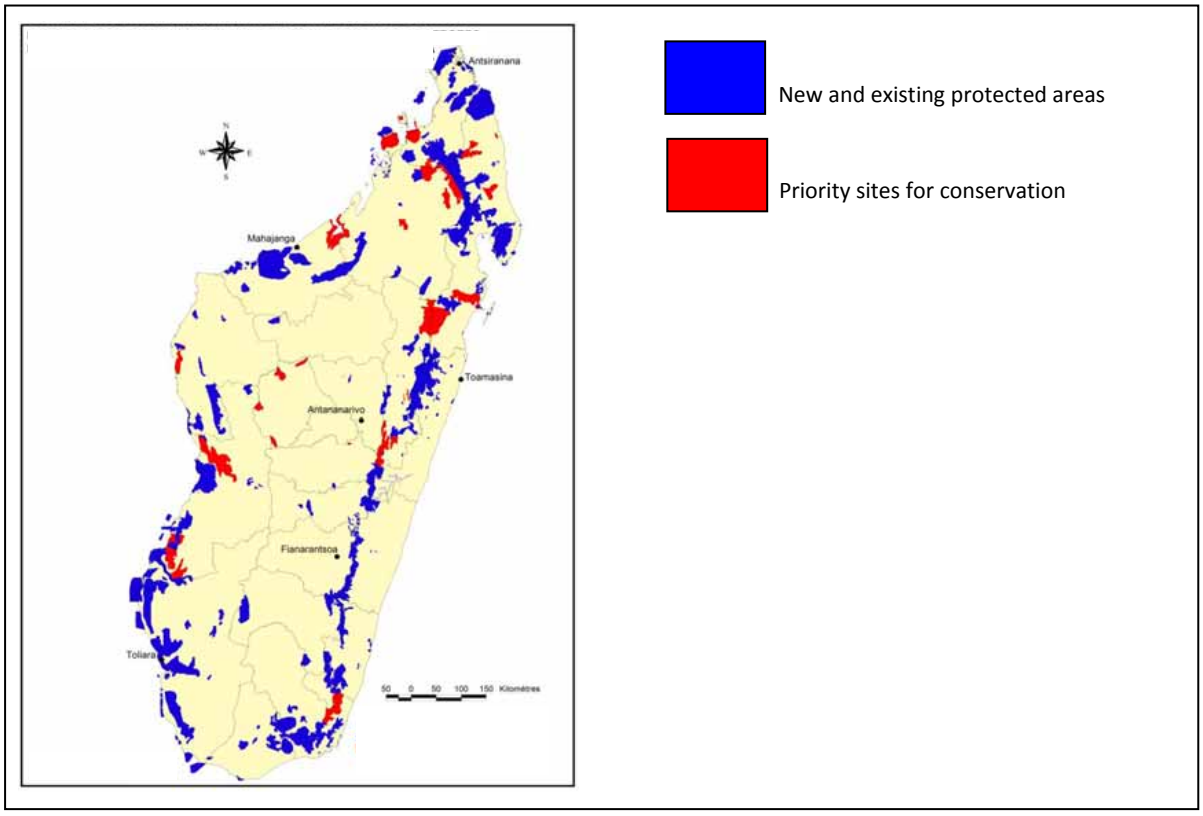


Figure 11: **New and existing protected areas in Madagascar, along with priority sites for conservation** (Source: DCB.SAP *Groupe Priorisation* 2010)

Approximately 6 million hectares of land and freshwater protected areas are being created. Modelling work has also helped identify likely impacts of climate change on species. Three types of data are available: distribution data of 1071 species, climate data and forest cover data. Conservation planning draws on these data and prority sites for protection and restoration have been identified throughout the country. Work includes identification of restoration feasibility, including costs of restoration and development of an action plan for maintaining and restoring forest connectivity in priority areas. Priority zones for restoration have been identified and mapped. Community based adaptation, promoted by Conservation International (CI), includes tests of sustainable livelihood activities aimed at reducing pressure on forests, by improving food production on degraded land and thus also improving our understanding of the impact of future climate change on crop production in Madagascar (see diagram overleaf for an example). Forest carbon projects are being developed as part of this wider vision, including three large corridor projects designed as "avoided deforestation" projects. Capacity building is needed to involve local communities.

Figure 12: **A strategy for reducing deforestation in the Fandriana-Vondrozo Corridor, Madagascar**

For the example of the Forest Carbon Project Design in the Fandriana- Vondrozo Corridor, CI has been working on the creation of new protected areas in the corridor since 2005. In addition to the process of creation and the development of management tools, CI put in place the management structure to coordinate the forest protection activities and insures that the structure is operational by providing technical assistance. In addition to conservation activities, the management activities with local communities in the northern part of the corridor are implemented by CI, in the context of REDD project.

Some lessons learned so far:

- Madagascar protected areas are addressing both UNFCCC and CBD priorities
- Madagascar loses 40,000 hectares of natural forests per year, mainly through slash and burn cultivation – there is still potential to reduce this
- Engaging partners and local communities involves using both strong communication and appropriate incentives
- Revenues from carbon markets can provide an economic incentive for carbon protection
- Public awareness and capacity building on climate change is important for communities, government and civil society
- Need a participatory approach concerning the identification of activities to undertaken and benefits offered, the adequate technique to be adopted
- Collaboration and synergy between other sectors is critically important

National Protected Area Expansion Strategy for South Africa

Trevor Sandwith, IUCN

South Africa has a strong culture of systematic conservation planning, identifying issues relating to both pattern and process – why species persist in a particular landscape. Legal and planning powers are held at a sub-national level. Policy is influenced by the sphere of government (national, province, district and local municipalities), which affects both strategic and spatial planning instruments.

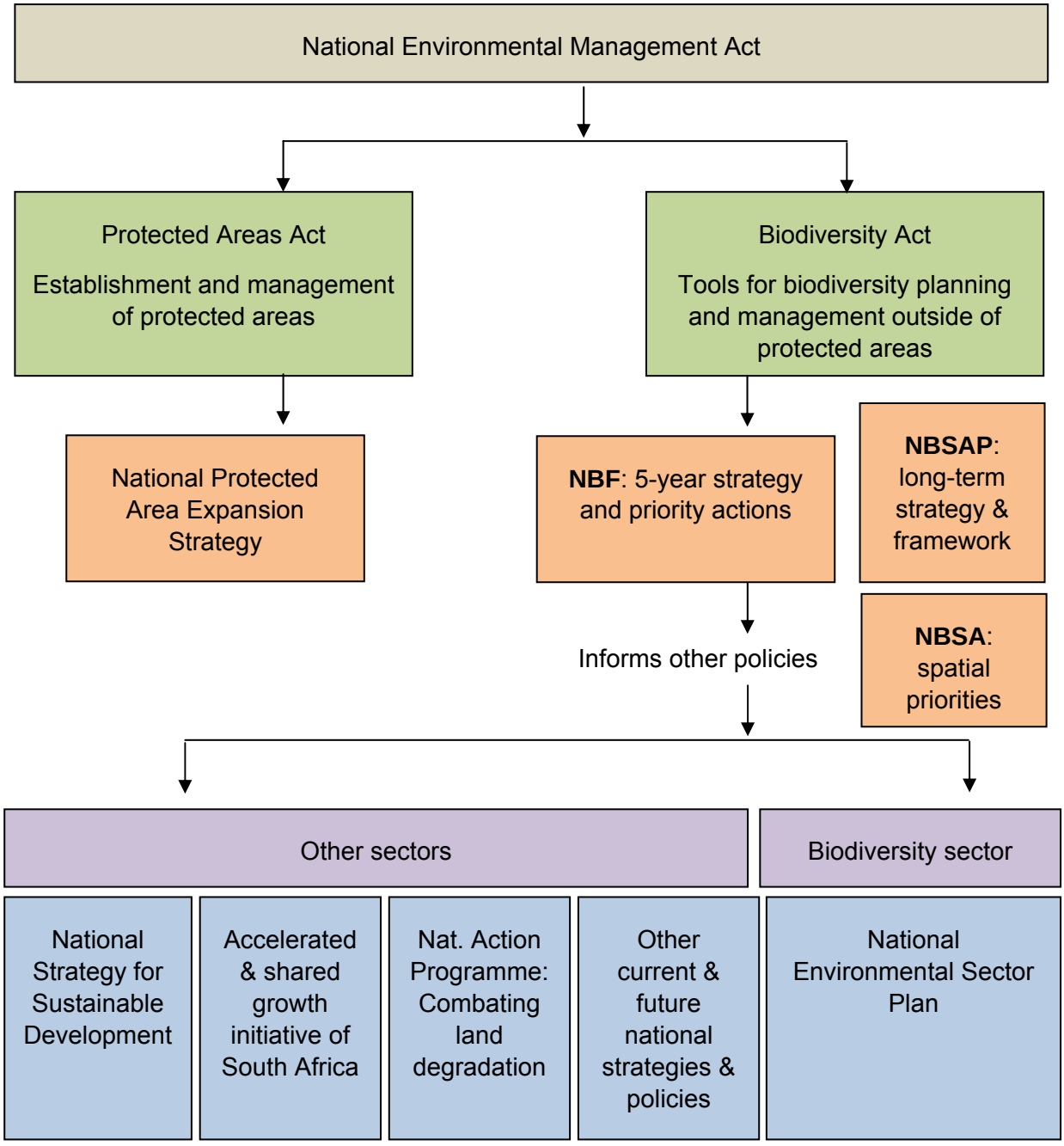


Figure 13: **Tools for biodiversity supporting sustainable development in South Africa**

A set of priorities were agreed to be included in a **biodiversity sector plan**; maps, land use guidance and other information to guide land-use planning and decision-making by all

sectors whose policies and decisions impact on biodiversity. In the Cape region Biodiversity sector plans have been developed for all 60+ areas identified as being a priority from the perspective of biodiversity conservation. A biodiversity sector plan needs to be taken into account, under law, before a sector plan was approved (although where there were existing sector plan some negotiation is needed). Across the landscape, a map is required to illustrate what is required (e.g., in terms of connectivity) and conservation priority areas are divided into protected areas, critical biodiversity areas and ecological support areas, all with different management prescriptions. By definition this includes a climate response and results in a design that is climate friendly and informative. The state cannot orchestrate a response across a whole landscape with multiple owners and in these cases negotiation is needed on a case by case basis. A sophisticated parallel process of **contractual stewardship** has been developed to help implement these plans – including a range of fiscal incentives such as income tax deductions and property tax exclusions.

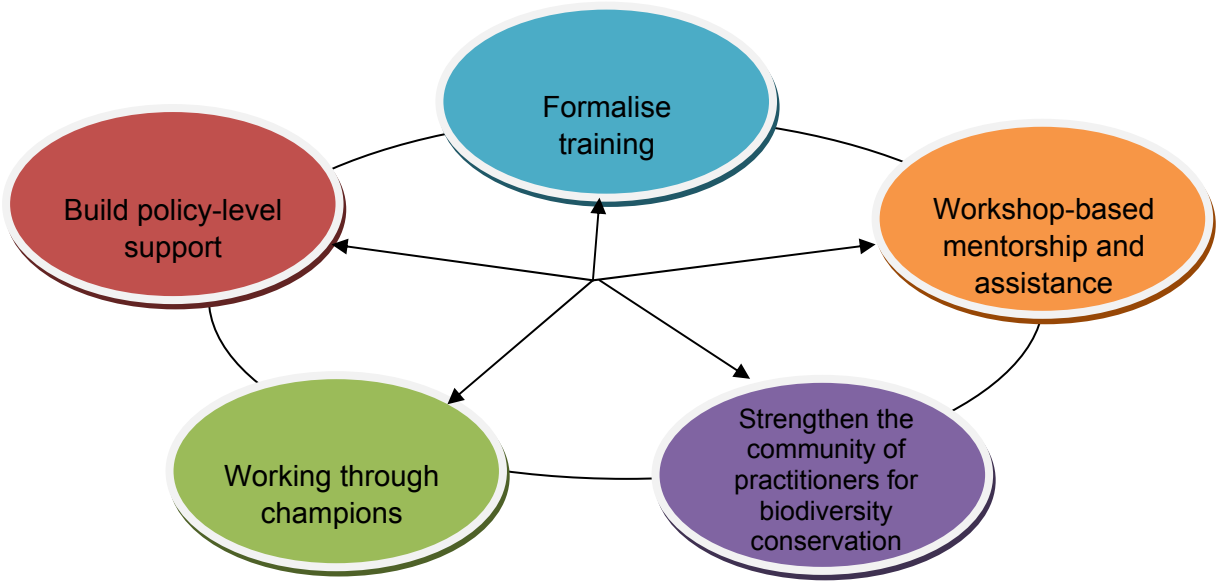


Figure 14: **Strategy for building capacity and support for use of biodiversity planning products**

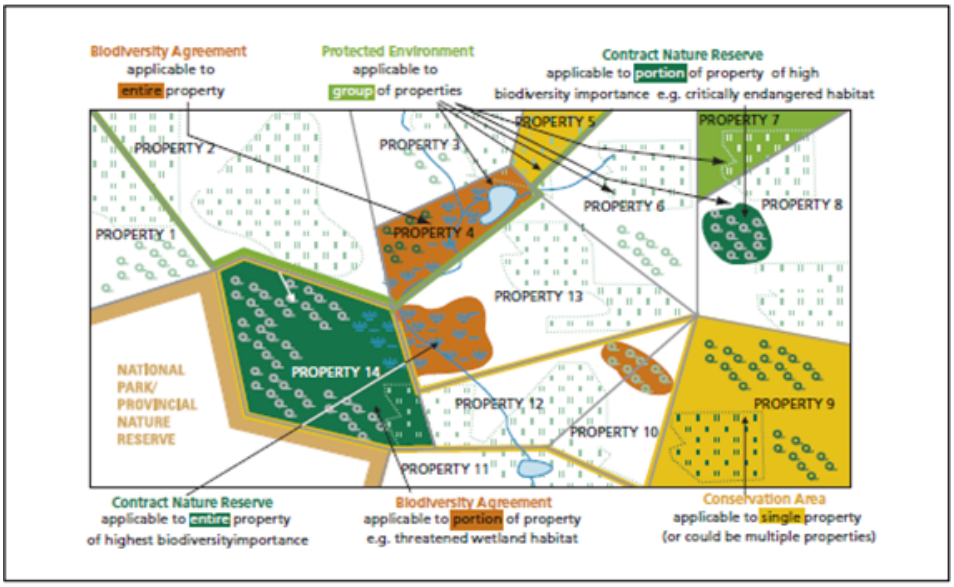


Figure 15: **Hypothetical maps showing how biodiversity stewardship agreements could be applied across a landscape**

The Role of Nature in Adaptation and Mitigation Planning in the Commonwealth of Massachusetts

Loring Schwarz, New Primavera

Massachusetts is a 5 million hectare state, with many ecosystems, and approximately one million acres of permanently protected land in state and private land trust reserves. Severe climate changes are predicted including increased temperature and extreme weather events, a marked increase in precipitation, stream flow disruptions, increase in sea level of up to 2 metres by the end of the century, coupled with storm surge events in populated zones along the coast. The Commonwealth of Massachusetts has a long history of protected area conservation and environmental legislation and now specific laws and programmes are guiding state efforts to mitigate against, and adapt to, climate change.

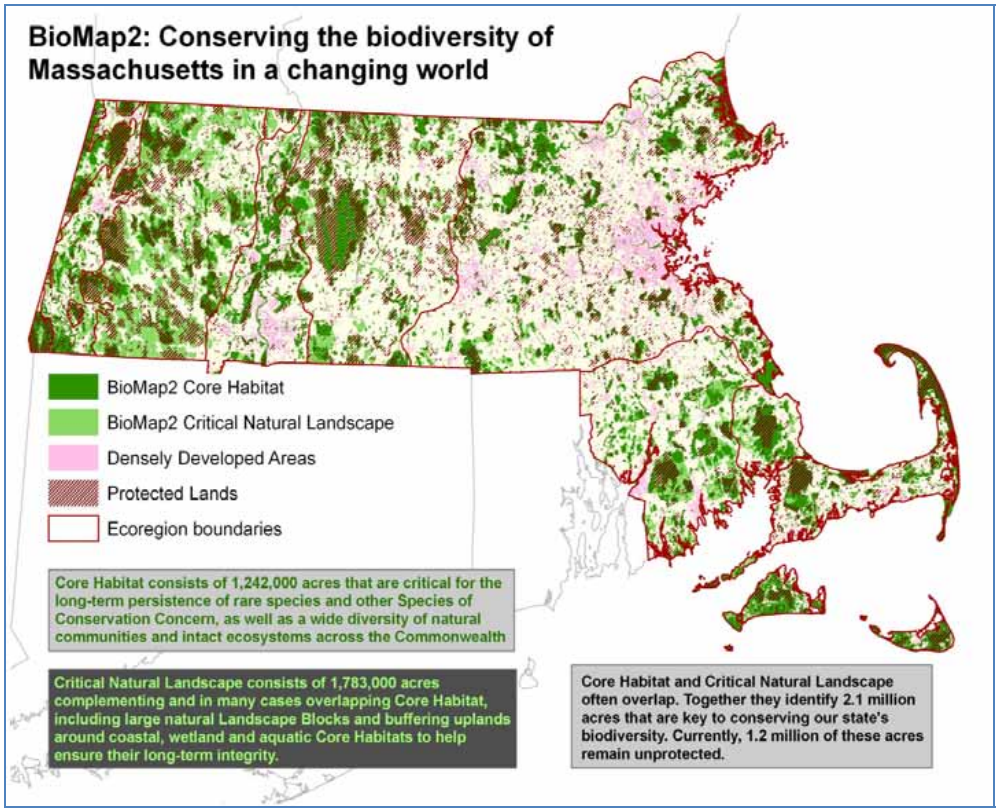


Figure16: **Protected habitats in Massachusetts**[26]

The Global Warming Solutions Act of 2008 acts at a state level as part of the regional Reduce Greenhouse Gas Initiative (RGGI) involving several states. It aims to reduce greenhouses gases by 10-25 per cent by 2020 and 80 per cent by 2050, compared to 1990 levels. At the same time the state aims to maximise opportunities to adapt to climate change: including preparation of a report to Legislature to: "analyze strategies for adapting to the predicted impacts of climate change in the Commonwealth". A range of enabling conditions already exists: the Endangered Species Act (the strongest in the US); Wilderness Protection Act, Rivers Act; the Community Preservation Act (which provides funds to towns derived

[26] Woolsey, H., A. Finton, J. DeNormandie. 2010. *BioMap2*: Conserving the Biodiversity of Massachusetts in a Changing World. MA Department of Fish and Game/Natural Heritage & Endangered Species Program and The Nature Conservancy/Massachusetts Programwww.nhesp.org

from a tax on deed recording fees); the Dam Act (removing non-functional dams); Environmental Bond; the Global Warming Solutions Act; Regional Greenhouse Gas Initiative; Green Communities Act; and policies of the Department of Environment and Energy. In the past 6 years, despite economic troubles and funded largely by a statewide Environmental Bond, between $50-100 million annually has gone to buy land for natural, recreational and agricultural purposes. In 2008, Massachusetts enacted the *Green Communities Act* to augment the state's emission reduction with community efforts. The Act provides incentives to communities to boost energy efficiency and encourages investment in renewable energy and green building design. It also requires utilities to increase investment in energy efficiency and green power, and links emissions reductions RGGI.

Conservation planning tools already exist: *Wildlife and Woodlands* prepared by Harvard Forest, suggesting protection of 2.5 million acres (of a total 3 million acres) as protected areas and woodland; *Biomap2*, a state wildlife action plan identifying areas most critical for ensuring the long-term persistence of species and therefore a land protection strategy for the state (see Figure 16); and vulnerability analyses produced by the independent Manomet Institute, predicting which species and habitats will survive under climate change (Figure 17). BIOMAP delineates resilient habitat for rare and vulnerable species, priority natural communities, intact forest ecosystems, aquatic and riparian habitat, intact wetlands and vernal pool clusters. Functional connectivity incorporated into the model links habitats for fish and wildlife passage as well as ecological processes. Specific climate change benefits of the analysis include ecological buffering of wetlands, connectivity and demarcation of undeveloped uplands adjacent to coastal wetland for migration of coastal natural resources.

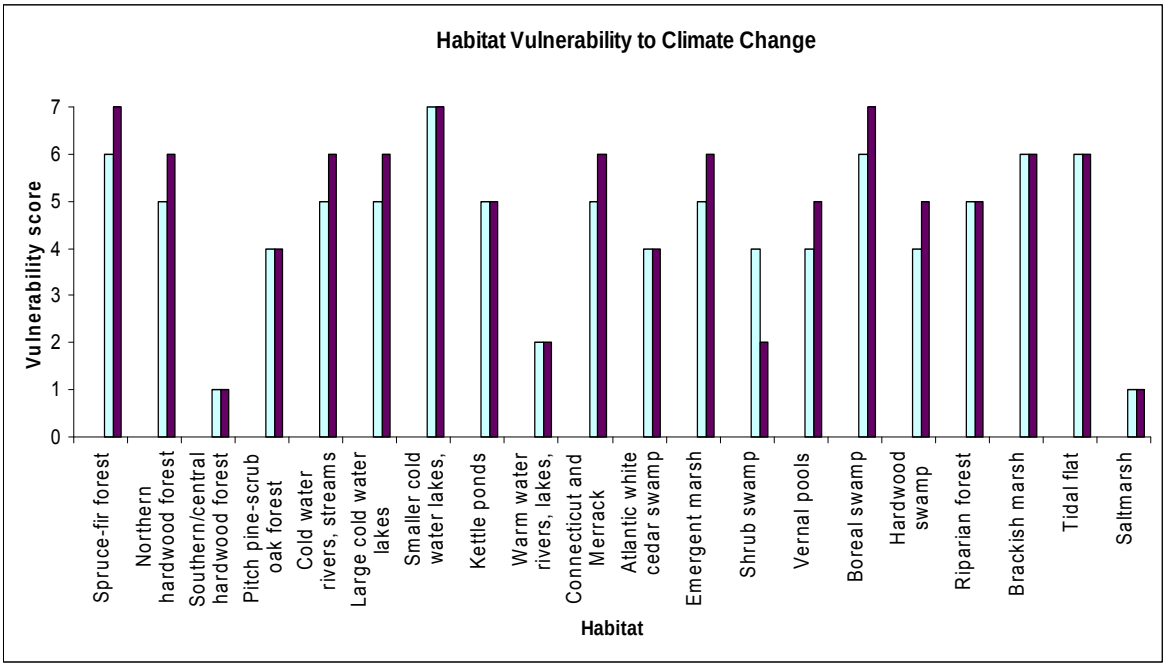


Figure 17: **Habitat vulnerability to climate change**[27]

A Massachusetts Climate Change Adaptation report was published in 2011, giving proposals for maintenance of intact forest and functional connectivity, to reduce the vulnerability of both

[27] Manomet Center for Conservation Sciences and Massachusetts Division of Fisheries and Wildlife, An Agency of the Massachusetts Department of Fish and Game, April 2010, Volume 2 *Habitat and vulnerability*

natural and built systems. The report recommends protecting nature in sufficient size, number and environmental settings, maintaining large scale processes, and using tools such as land protection, restoration and management, policy, flexible regulation, and monitoring. Restoration aims to recover ecological connectivity; including several projects to remove dams and improve culverts to facilitate passage. These are increasingly being translated into other state plans (e.g., highway design, Army Corps Programmatic General Permit, state legislation to encourage dam removal and encouragement of fish passage).

A mitigation plan aims to reduce the carbon footprint of the state by 80 per cent by 2050 and relies heavily on forests to store carbon, which can offset 12 per cent of the state's carbon emissions. At 19 million acres, forests of the North-East are among the largest intact temperate forest in the world, supporting forest and tourism industries totaling $25 billion per year, protecting one of the most secure drinking water supplies in the world. Based on the Blue Ribbon Report, state foresters from New England and New York together with federal staff have drafted an action plan based on three goals:

- Conserve forests – to reduce fragmentation
- Improve stewardship of forests
- Strengthen markets for local forest products

Prompted by the New England Governors Association, the New England/New York Forest Initiative strives to *Keep Forests as Forests in the Northeast* by securing federal funding to protect 6 focus areas. Guiding principles include strengthening forest based economies and creating new models for stewardship to: (1) conserve forest connectivity at landscape scale; (2) encourage job creation/maintenance via "buy local" initiatives and improved markets for forest products; (3) foster partnerships across borders and sectors; (4) encourage significant contributions from private, philanthropic and federal sectors; and (5) support expanding renewable energy resources in responsible ways.

An important aspect of the Massachusetts initiative is to look within state boundaries to mitigate the impact of our own emissions. Funds invested in forest land conservation can protect biodiversity and ecosystem services while sequestering carbon and offsetting emissions elsewhere in the state. The yearly carbon accumulation in Massachusetts forests alone can offset approximately 12 percent of the state's carbon emissions yearly.

Furthermore, since the Massachusetts forest resource is part of a regional temperate forest, there have been some important initiatives to work with neighbours across the Northeast. Between 1997 and 2003 alone, 400,000 acres of forest was developed in the region and a 2006 survey indicated that 86,000 owners of 2.77 million acres plan to sell their land in 5 years or less; the forest industry is leaving due to low prices, high energy costs, foreign competition and lack of local markets; and as a result few forests are properly taken care of as working forests or reserves. Current plans aims to change these trends.

Role of protected areas in combating climate change in Georgia

Ekaterine Kakabadze, IUCN

Georgia has 7.35 per cent of the territory in protected areas, including protected areas in all IUCN categories. There are plans for a further expansion, although economic development sometimes clashes with the priorities of protection. The protected areas include: 14 Strict Nature Reserves; 9 National Parks; 21 Natural Monuments; 18 Managed Reserves; 2 Protected Landscapes and 1 Multiple-Use Territory. Almost 75 per cent of protected areas are covered with forests.

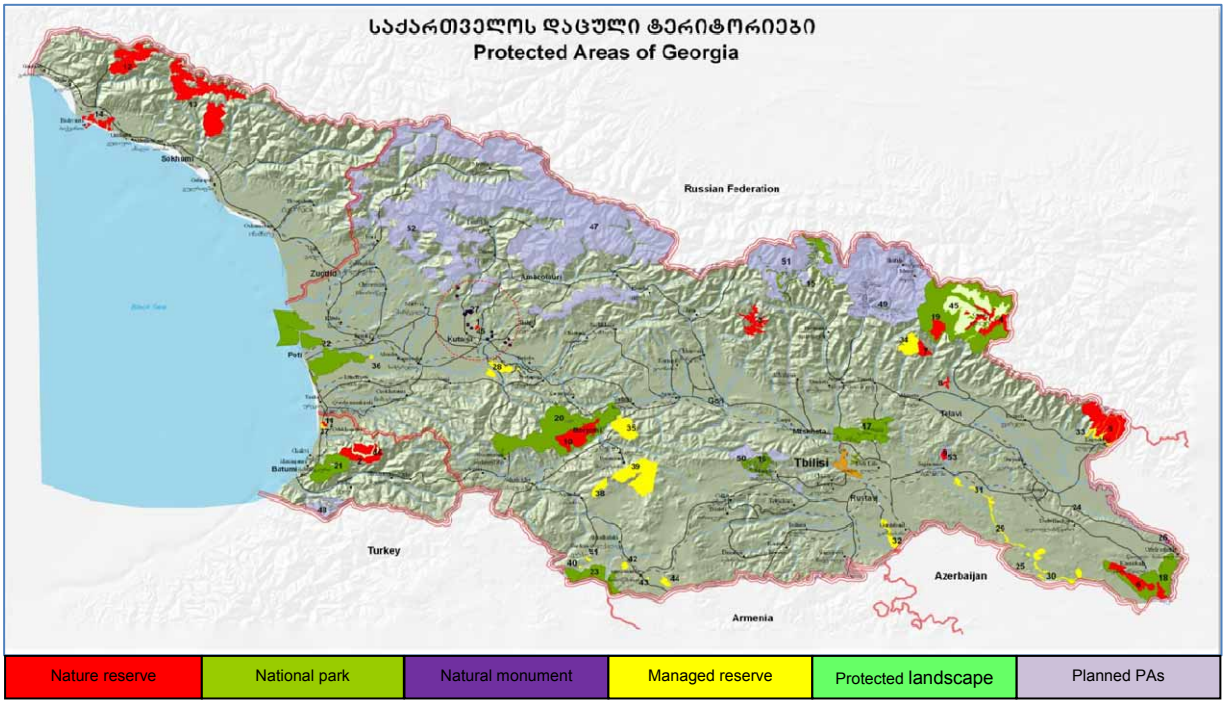


Figure 18: **Protected areas in Georgia**

Some studies have been carried out to date on carbon storage in individual protected areas: for instance preliminary estimations are given in the WWF Caucasus Programmes report, *Valuation of the contribution of Borjomi-Kharagauli and Mtirala National Parks' ecosystem services to economic growth and human wellbeing*, published in 2011, indicates that the combined forests of Borjomi-Kharagauli National Park and Mtirala National Park (100.800 ha), could store about 914.000 tons of CO_2.

These studies on economic valuations of ecosystems in protected areas are attracting increased attention. The WWF Caucasus Programme report mentioned above, and the report *Economic valuation of the contribution of ecosystems to economic growth and human well-being: the cluster of protected areas of Tusheti and the Georgian network of protected areas* conducted under UNDP/GEF project (draft report 2011), were presented at a regional workshop in Georgia, providing policy makers and businesses with information on economic risks and opportunities of undertaking activities that impact on, and are influenced by, biodiversity and ecosystem services.

Georgia acceded to the UNFCCC in 1994 as a non-Annex I Party. A number of strategic documents developed in Georgia include climate change issues. The Second National Environmental Action Plan of Georgia (2012) identifies the possible importance of establishment of new protected areas and improvement of forest management for reduction of GHG. In 2011 preparation of the third national communication to the UNFCCC was started and the role of protected areas in climate change mitigation and adaptation will be indicated.

These issues are now being explored in a new project: *Natural solutions to climate change: the role of protected areas*, being run by IUCN Caucasus Cooperation Centre, financed by BMU/GIZ. The aims of the project are to incorporate the role of protected areas in regard to climate change into national sector strategies, communications to international conventions, e.g. UNFCCC, and to contribute to the effective management of protected areas under conditions of climate change. The main concept is to build knowledge and capacity in the country relating to the incorporation of protected areas as tools to mitigate, and adapt to, climate change. It is planned to build capacity through trainings for protected area staff at policy and local level, to design two to three adaptation and mitigation measures in selected protected areas, and to set up regular expert-policy roundtables to feed the results into relevant strategies and decision-making processes.

Mainstreaming protected areas and biological corridors into climate change responses in Costa Rica

Olivier Chassot and Guisselle Monge Arias: Tropical Science Centre

Costa Rica is currently recovering forest cover area after past deforestation and has a national biological corridor programme, based on a gap analysis completed by the Ministry of the Environment, The Nature Conservancy and other organisations. The programme has been adapted from the Meso-American Biological Corridor according to the decentralised Costa Rican governance model and is open to civil society. Legislation relating to connectivity conservation includes: empowerment of local councils as legal entities; allocation and prioritisation of payments for ecosystem services; and guidelines on the establishment and implementation of biological corridors. A Technical Support Committee was established in 2008 and a National Network of Biological Corridors in 2010.

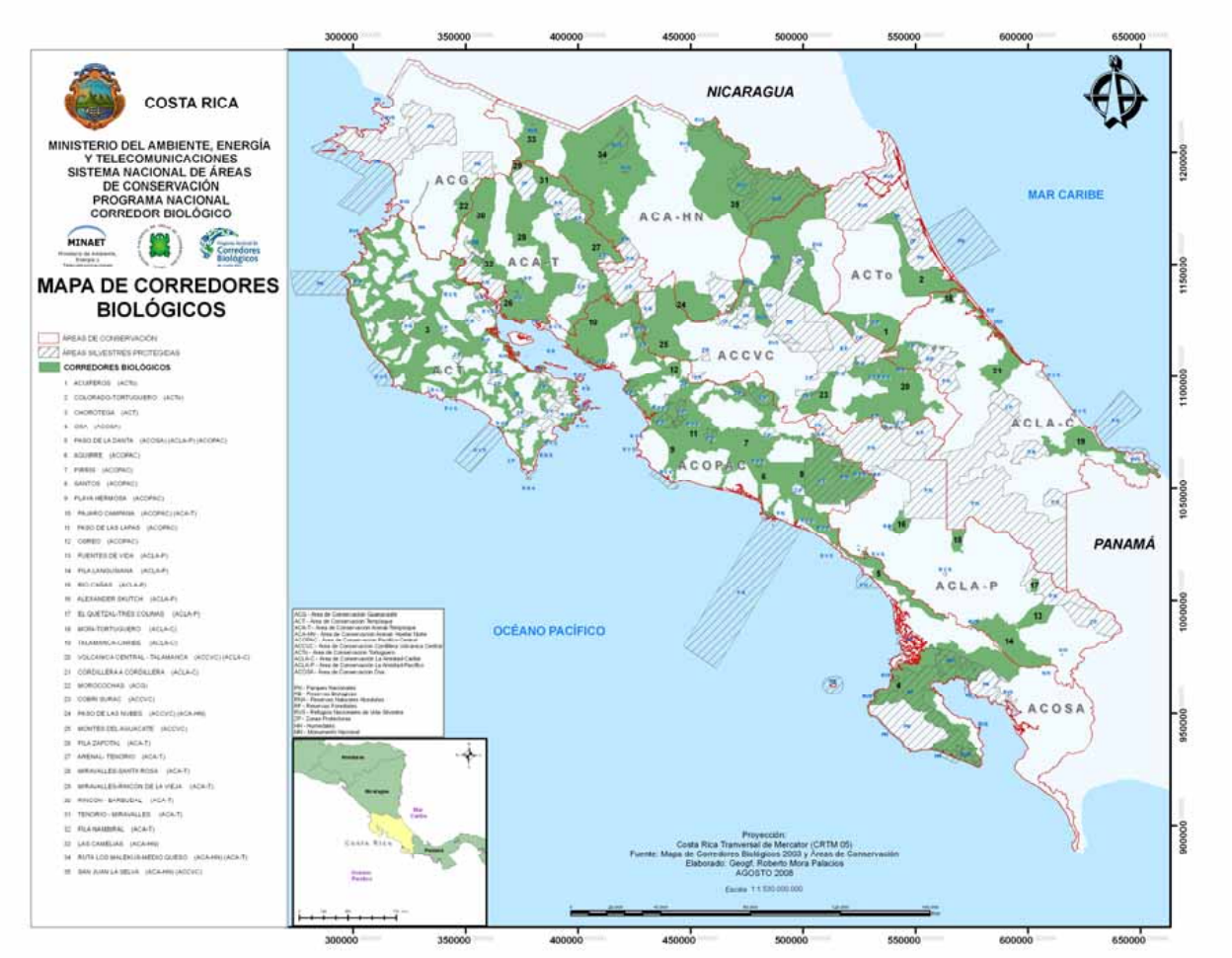


Figure 19: **Biological corridors in Costa Rica** (Source: Costa Rican government)

Payments for ecosystem services

One important element in the Costa Rica biological corridor network is the national system of environmental services payments, which is only available to landowners within the corridor's network who protect their forests for the following services:

- Mitigation of CO_2 effects
- Protection of water and watershed for urban, rural or hydroelectric power
- Biodiversity protection for conservation
- Maintenance of landscape beauty for tourism and scientific use

Table 8: **Payment for Ecosystem Services (PES) options**

Type of PES	**Amount to pay/yr**	**Length of contract**
Reforestation	$816 / ha	10 years
Protection	$320 / ha	5 years
Restoration	$410 / ha	10 years
Agro-forestry system	$1.30 / tree	3 years

The payments are not equal to the amount that could be earned by converting the land but need to be seen in the context that land-use change is not allowed in forests, so payments are an additional positive incentive to an existing law.

San Juan-La Selva Biological Corridor

The San Juan-La Selva corridor is part of the biological corridor system of Costa Rica, and is based around the needs of the Great Green Macaw (*Ara ambiguus*) as a flagship species; the macaw had lost 90 per cent of its habitat by 1994. In addition to the macaw, the corridor has a rich biological diversity with over 515 species of birds.

Management of the San Juan-La Selva Biological Corridor currently involves 22 organisations – local governments, municipalities, farmers' organisations, the academy – under the coordination of two full time coordinators. Partners have monthly meetings to agree policy and take full-consensus decisions. The goal of the alliance is to maintain the biological connectivity between Indio-Maíz Biological Reserve, in Nicaragua, with the protected area system of the Central Volcanic Range, in Costa Rica, through the implementation of the San Juan-La Selva Biological Corridor and the establishment of Maquenque National Park, in order to conserve the biodiversity of tropical lowland wet forest. The main focus of the alliance is on environmental education, research and monitoring, conservation, bi-national activities with Nicaragua, strategic planning, participatory environmental management and protected areas. There are also constant awareness campaigns. As part of this effort, the Maquenque National Wildlife Refuge, the core breeding area for the Great Green Macaw, was established in 2005 and due to the corridor programme numbers have increased to 302 individual macaws (up 98 from 1994).

Lessons learned

Several factors were found to be important:

- Adaptive management and multi-disciplinary approach / ecosystem-based approach
- Horizontal management, with open and equitable participatory mechanisms
- Transparency (information, funds)
- Full consensus decision making
- Leadership, follow up, commitment, ethics and mystic from the coordination
- Integration of all stakeholders
- Efficiency in financial investment
- Applied research as the basis for management

Ecosystem restoration concessions: a new way to conserve rainforest in Indonesia

Agus Utomo: Burung Indonesia (Birdlife Indonesia)

BirdLife focuses on Important Bird Areas (IBAs) as its main vehicle for conservation. All IBAs for Indonesia have now been completed except for Papua; most of these (56 per cent) are *outside* the national protected area system.

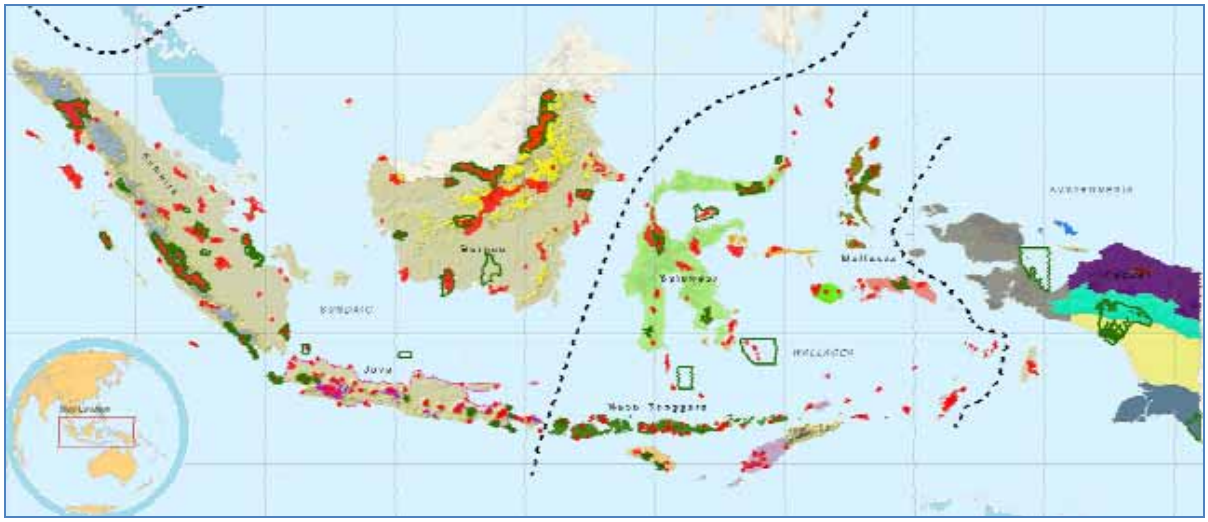


Figure 20: **Important Bird Areas of Indonesia** (in red, all other colours represent Endemic Bird Areas): Source Burung Indonesia

In addition, Indonesia has divided state forests into three types based on the main functions: (1) production (66 million ha); (2) conservation (21 million ha); and (3) protected for watershed functions (34 million ha): the majority of forests are in the production forest category. These are mostly lowland rainforests and very often have high biodiversity values. However, production forests are rapidly degrading in many areas due to un-sustainable logging and conversion. Sumatra has lost most of its forest and deforestation continues. From 2000 to 2005 deforestation in Sumatra caused 154 million tonnes of CO_2 or 60 per cent of emissions from the whole country (IFCA, 2007). In 2002, it was estimated that the remaining lowland rainforest in Sumatra was about 650,000 ha.

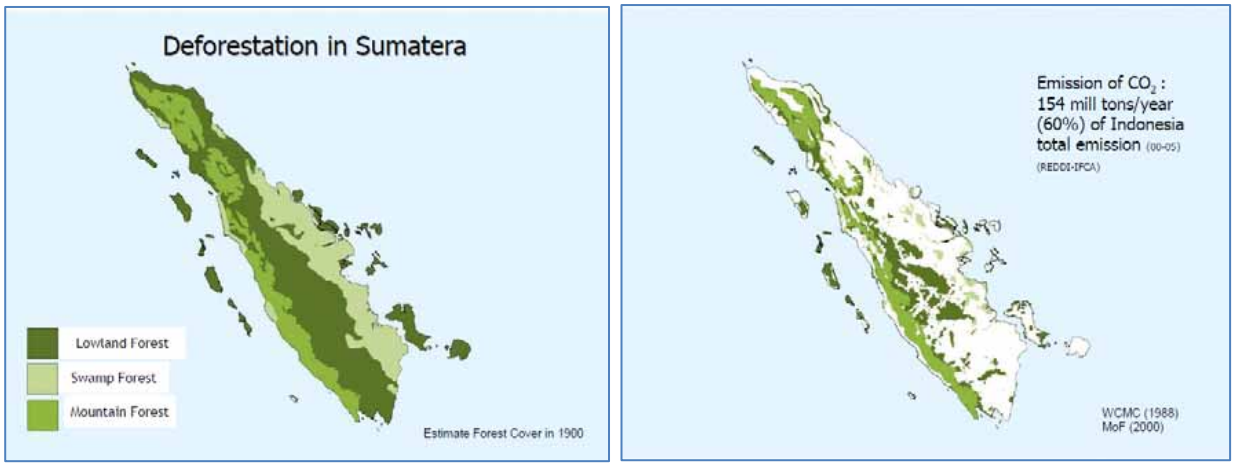


Figure 21: **Loss of forest cover in Sumatra** (Source UNEP-WCMC)

Key ideas of BirdLife's project

- Halt further deforestation
- Combat forest fires and haze hazards
- Develop a new model of "forest governance"

Given the limited resources to commit more protected areas, the only way to secure the remaining Sumatra lowland forest in ex-logging concessions is to establish a forestry concession but not for logging. At the beginning of the project, a conservation concession was not considered to be an option under the national legal framework. Eventually, in 2004 the government agreed to allow production forest to be managed for restoration instead of logging. The policy was amended in 2007 by a government regulation recognizing *ecosystem restoration concession* as a new type of forestry concession and simplifying the licensing procedure, with a license in place for 60 years (extendable for another 35 years) with inclusive rights on environmental services, non-timber forest products but not timber.

Figure 22: **Map showing the location of the BirdLife restoration concession**

Harapan Rainforest is the first ecosystem restoration concession established in 2008. It is managed by a BirdLife Consortium (Burung Indonesia, BirdLife International, and RSPB). Much of the forest in the concession has been logged at least twice and around 30 per cent was initially in relatively good condition. The biodiversity is rich; for example 301 of the 450 bird species in lowland Sumatra have been recorded (many since the concession was agreed), along with 56 mammal species, 29 amphibians and 45 reptile species and 444 species of trees. The project aims to conserve a fifth of the remaining lowland rainforest in Sumatra. The aim is to reverse the trend of deforestation and stop logged forest from degrading. The long term objectives for the Harapan rainforest include creating a viable and healthy ecosystem and a productive landscape, with multi-stakeholder participation. In practice this management includes not just planting trees, but also addressing the needs of local people, particularly allowing them to continue their traditional ways of life based on forest products – for example collection of resins and other non-timber forest products. Additionally, the management plan has to address issues relating to basic needs of local peoples such as access to education and health facilities. One of the major challenges is to

stop the drivers of deforestation and degradation. These are mainly illegal logging and illegal oil palm development.

Given the vast area of production forest available in Indonesia after logging concessions expired, ecosystem restoration concessions is an option to conserve and manage lowland rainforest sustainably. Thirty seven applications for similar types of concession have been submitted by different organizations/companies with four licenses now granted. This opens up new possibilities to maintain habitat connectivity, to promote sustainable forest management and livelihood development. Further, the *ecosystem restoration concessions* have also been recognized in the National Action Plan to Reduce Green House Gases and the current draft of REDD National Strategy.

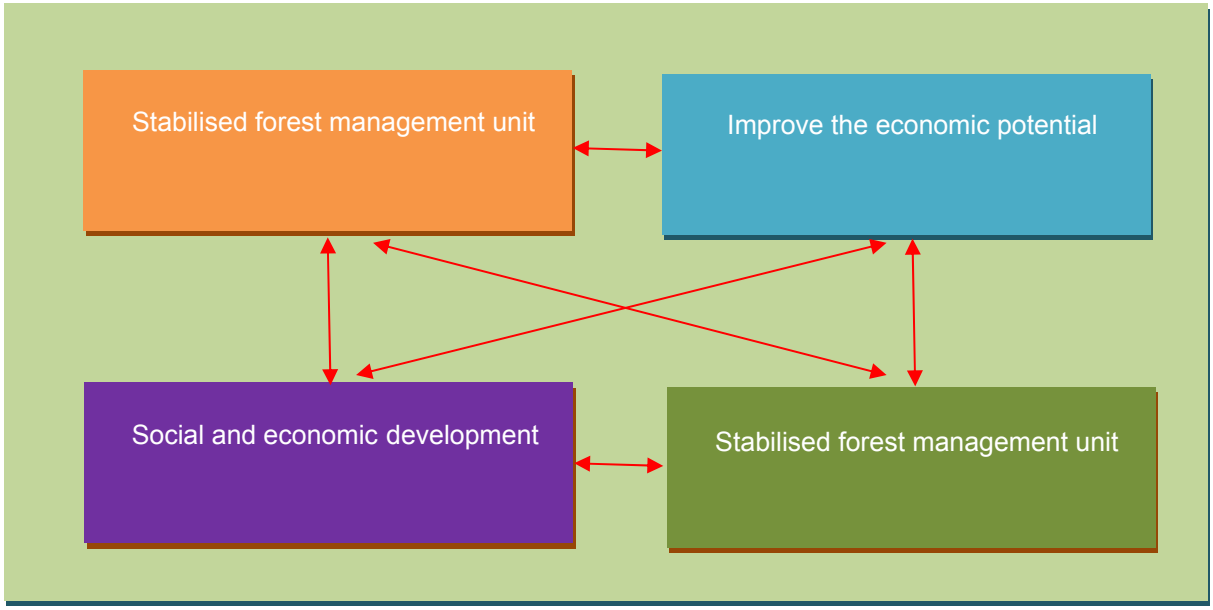


Figure 23: **Framework of activities in the project**

Climate change considerations in SE Europe

Boris Erg, IUCN

The Dinaric Arc is important both as an aquifer and the location of some of the most important biodiversity in Europe; it is an area where conservation is critical to maintain both unique wildlife values and also essential ecosystem services. The IUCN conservation strategy for SE Europe is:

- Improve the **network of protected areas** in the region and **expand protected areas coverage** in relation to global coverage
- Encourage **transboundary cooperation** in protected areas throughout the Balkans
- Ensure the **effective management** of protected areas

The strategy seeks to operate as "conservation without frontiers" and includes the countries of Albania, Bosnia and Herzegovina, Bulgaria, Croatia, FYR of Macedonia, Montenegro, Romania, and Serbia. IUCN SEE is also active in Moldova, Slovenia and Ukraine.

In 2004, IUCN and its partners launched the **European Green Belt** initiative, focusing on creation of an ecological network, from the Fenno-Scandia through Central Europe to the South-Eastern Europe. The Green Belt aims to foster transboundary conservation and regional sustainable development along the former Iron Curtain route, thus creating a network of protected areas and surrounding landscapes and communities. Because it follows a political boundary it is not very ecologically coherent, but has the advantage of allowing important comparison between different habitats.

The most important initiative in the region is the **Dinaric Arc Initiative** bringing together many NGOs, governments and other stakeholders and focuses on sustainable development of the Dinaric Arc region by strengthening regional cooperation, transboundary conservation and capacity building of PA managers and conservation experts. The protected area gap analysis for the Dinaric Arc recognised the significance of climate change. A regional climate change vulnerability assessment was completed recently in the frame of the SEE Forum on Climate Change Adaptation. There is a recent initiative to have a Dinaric Karst World Heritage serial site, a Dinaric Arc network of protected area managers and a resolution on sustainable management of the whole region.

Protected areas have been mentioned in several national reports to the UN Framework Convention on Climate Change as important in mitigating negative effects but as yet there is no real substance to this. Research and assessment on the role of PAs is much needed. There are some reactive actions but less on looking at how protected areas can help.

CROATIA Fifth communication on climate change

- Preservation of migratory corridors for species able to survive by changing the area and scope of appearance
- Adjustment of spatial plans and protected areas management plans
- Planning/predicting changes in boundaries of protected areas
- Adjustment of protection programmes at the species level
- Development of infrastructure for scientific evaluation of the status, forecast and monitoring of changes in terrestrial ecosystems and biodiversity

SERBIA First report on climate change

- Regulate management plans for protected areas
- Organize monitoring of relevant parameters within protected areas
- Adopt a plan for increasing protected areas
- Increase protected areas
- Ensure corridors for the migration of species

MACEDONIA First report on climate change

- Information and scientific infrastructure for evaluation of climate change impact on biodiversity,
- Elaboration of bio-corridors and migration paths
- Increasing the area of PAs and the establishment of new PAs

Looking ahead several ideas are under discussion:

- Ideas should be solution-based including the role of protected areas
- Climate change “responsible” protected areas within national plans
- Nature-based solutions verses national capital – science-based evidence for decision-makers
- Integrated cross-sectoral planning, mainstreaming climate change considerations into sectors
- A social/economic case for protected areas, integrating into the broader climate change sector

Canadian Examples: Governments, First Nations, Citizens and Industry

Stephen Woodley, IUCN

Canada has 3500 protected areas but also several large landscape initiatives, which are mainly citizen-led. Canada is also one of the most urbanised countries in the world and conservation approaches need to account for this reality. Three very different initiatives are described below.

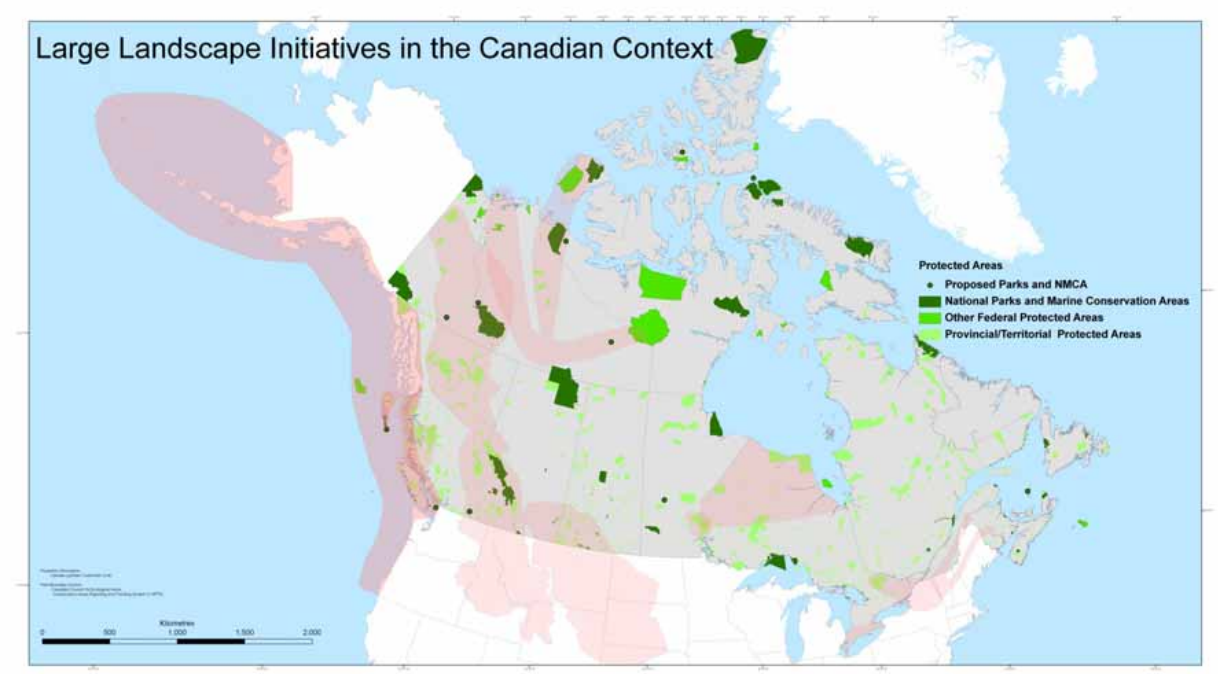


Figure 24: **Map of large landscape planning initiatives in Canada as at 2010**. The figure illustrates the wide geographic scope of planning initiatives, with activities in all areas of the country and in marine and terrestrial systems

Greater Toronto, Rouge National Urban Park: this large and very diverse city will have a new protected area, Rouge Urban National Park – being set up by Parks Canada in the middle of the city; the area is currently a patchwork of remnant natural ecosystems, consisting of steep stream valley, residual undeveloped areas, some farmland and a zoo. The primary value of the park will be educational and an opportunity for urban dwellers to connect to nature. With significant restoration, the area can be important for both biodiversity and climate change. The park concept was driven by the public, who have concerns about climate change. The government has announced Can$141 million to pay for this park, to buy the land, carry out restoration and hire staff.

Ontario and Quebec: There are very large-scale, government-led planning initiatives underway in the northern regions of Ontario and Quebec, Canada's two largest provinces. The government of Ontario is moving to conduct comprehensive land use planning on a large area of land (larger than most European countries) under a single planning act The Ontario Far North Act[28] and committing to protecting 50 per cent. As with most of Northern

[28] http://www.mnr.gov.on.ca/en/Business/FarNorth/2ColumnSubPage/266509.html

Canada, northern Ontario is already experiencing, and will experience, significant climate change effects. The area contains some of the largest carbon stores in the world, such as peatland ecosystems up to 30 metres thick, which are still accumulating carbon. The area is currently ecologically intact and contains a full range of native species, including woodland caribou and wolverine. In return for conserving 50 per cent of the province, there will be a significant development of other areas for resource extraction, primarily mining. All planning will be led by the areas' First Nations communities. Similarly Quebec has initiated the Plan Nord,[29] which also is committed to 50 per cent protection of a large area of the north – an area larger than Germany. This area is also relatively undeveloped but has seen previous large-scale hydro-electric projects. The areas have significant mineral and additional hydro-electric potential. Ontario and Quebec are some of the few areas in the world where such large scale planning can occur and consider conservation in the face of significant climate change.

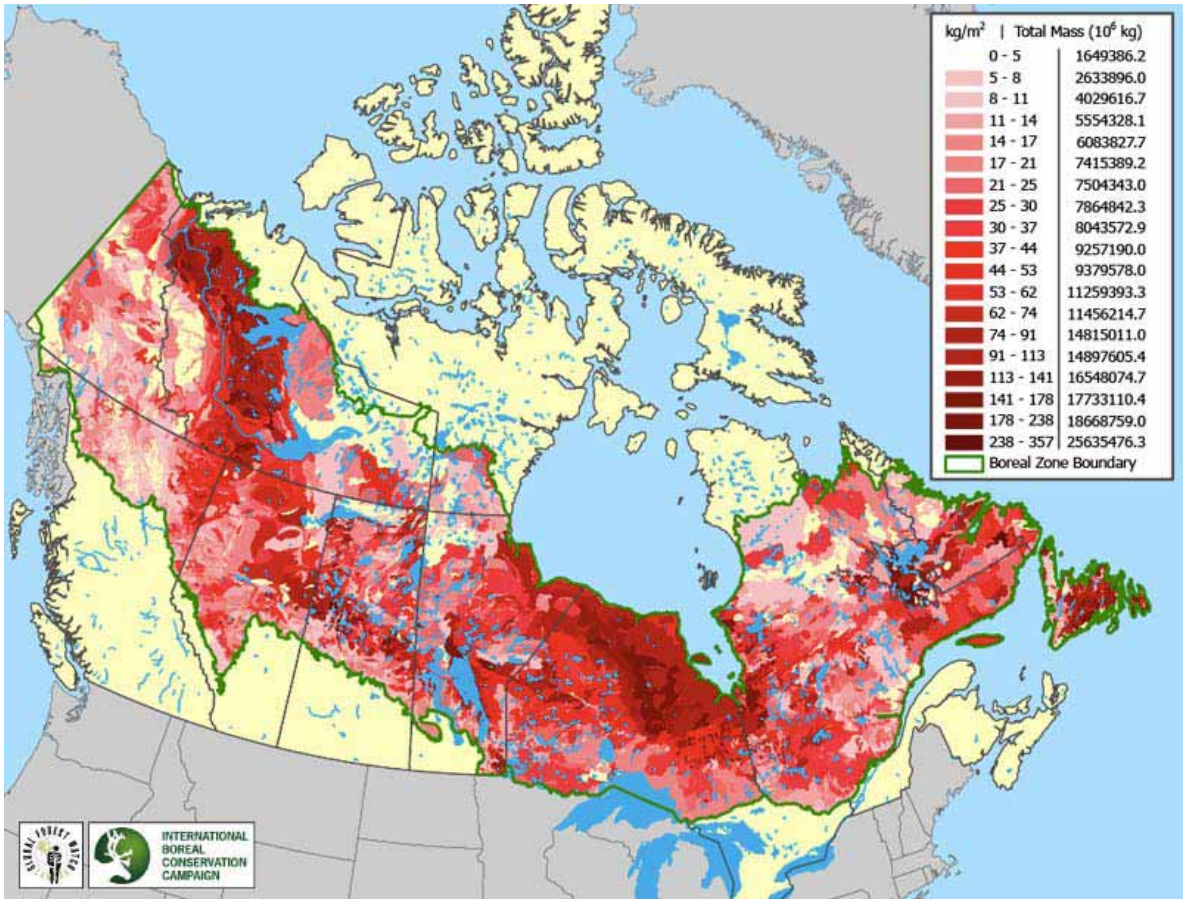


Figure 25: **Soil organic carbon extent in northern Canada**

NGOs in the Canadian boreal: Canadian NGOs have argued that forest companies are impacting the boreal area through unsustainable practices. In order to avoid the continued political and commercial fallout, logging companies have now negotiated an agreement with the NGO's to protect 50 per cent of this boreal forest. The Canadian Boreal Forest Agreement covers more than 76 million hectares of public forests licensed to The Forest

[29] http://plannord.gouv.qc.ca/english/index.asp

Products Association of Canada member companies. This is an agreement[30] between NGOs and forest companies, which was negotiated outside government. The parties to the agreement are now working with Governments and First Nations to try and implement the agreement across the boreal forest.

The government's response to these and other initiatives has been to develop a National Conservation Strategy,[31] which aims to:

- **Protect**: complete the network of Canadian terrestrial and marine protected areas
- **Connect**: integrate the protected areas with sustainably managed land and seascapes
- **Restore**: degraded ecosystems and recover species at risk
- **Engage**: a broad range of Canadians working together in nature stewardship and education

The benefits are that conservation policy will match conservation science; provide the best solution to climate change, and also incidentally lead to increased subsistence and commercial harvest (e.g., in marine systems), a meaningful response to species at risk and the least risk, no regrets option.

[30] http://canadianborealforestagreement.com/

[31] http://www.parl.gc.ca/Content/HOC/Committee/411/ENVI/Reports/RP5641863/411_ENVI_Rpt03_PDF/411_ENVI_Rpt03-e.pdf

Mainstreaming protected areas into Canadian climate change strategies

Karen Keenleyside, Parks Canada

Parks Canada has been involved in climate change issues for almost twenty years, as outlined in the box below.

1990s: *State of Parks* Reports: recognized climate change as a significant stressor
2000: Screening level impact assessment for national parks
2003: Climate scenarios compiled for all national parks
2005 – 2009:

- Publications, presentations, web pages
- Greenhouse gas emission reductions met 2012 target
- Site-specific integrated studies
- Impact of climate change on nature-based tourism
- Monitoring, research and assessments of impacts and adaptation options
- Active management and restoration to improve ecological integrity and resilience

During the latter part of this period, work was underway on developing a climate change strategy for Parks Canada that considered impacts and vulnerabilities in all aspects of our mandate (natural and cultural resource conservation, visitor experience, public education asset management, etc) and set objectives and actions in these areas. However, in reviewing this draft strategy, the CEO of Parks Canada asked for considerations of climate change and protected areas within the wider context of national/ international efforts at adaptation and mitigation: i.e., "how should the agency contribute to the Government of Canada's Climate Change strategy?"

Park Canada's actions 2009-2012

Since 2009, work on climate change has been increased significantly, in three main areas:

Informing policy

- Protected areas and ecosystem-based approaches
- Federal, provincial and territorial collaboration
- North American collaboration
- International collaboration

Investing in science and management

- Conducting ecological inventory, monitoring research
- Implementing active management and restoration
- Understanding carbon content and fluxes

Engaging partners and stakeholders

- Domestic international
- Governmental, non-governmental

Despite initial resistance, even within the agency, Parks Canada has progressively increased the work on the link between protected areas and solutions to climate change. At a domestic level this has included improving decision making regarding climate change and protected areas in the Arctic and working with partners on a broad assessment of climate change impacts and adaptation options for Canada. Parks Canada received funding to help deliver the Government of Canada's commitments on "fast start climate change financing" by supporting protected areas work (mostly restoration to enhance resilience, with a focus on water supplies) in Kenya, Colombia, Mexico and Chile. We are also working with our counterparts in provincial and territorial protected area agencies to identify the contribution we all make to delivering on the "natural solutions" concept. Canada is also working with Mexico and the United States on a "brochure" about the role of protected areas as natural solutions to climate change; in a more general way increasing outreach to other partners and stakeholders. Recognising protected areas as part of the solution also has implications: in terms of monitoring, improved management, reaching out to other landowners to increase connectivity etc.

Key lessons: the bottom line

- Consistent messaging to policy-makers; be policy relevant, don’t give up (it has taken three years to get the words “natural solutions” into one press release)
- Science to support all policy directions: more carbon stored and uptake in managed forests where harvesting is taking place – preliminary results
- You may have more collaborators than you think – listen to collaborators; give them time to engage fully: Parks Canada and the Canadian Forestry Service were not natural or expected collaborators but by doing science together has built an positive alliance

Appendix 1: List of participants

Michele Andrianarisata, Conservation International Madagascar: mandrianarisata@conservation.org

Agus Budi Utomo, Burung Indonesia (BirdLife Indonesia). agus@burung.org

Olivier Chassot: ochassot@cct.or.cr

Nigel Dudley: Equilibrium Research: nigel@equilibriumresearch.com

Boris Erg, IUCN SE Europe: Boris.Erg@iucn.org

Gunnar Finke, Programme Implementing the CBD, GIZ: gunnar.finke@giz.de

Ralf Grunewald, International Academy for Nature Conservation Isle of Vilm, BfN: ralf.grunewald@bfn-vilm.de

Ekaterine Kakabatze, IUCN Georgia: ekaterine.kakabadze@iucn.org

Karen Keenleyside, Parks Canada. Karen.Keenleyside@pc.gc.ca

Pramod Krishnan, Energy and Environment Unit, UNDP, India. Pramod.Krishnan@undp.org

Kathy MacKinnon, WCPA Vice Chair Climate Change. Kathy.s.mackinnon@gmail.com

Ignacio March Mifsut, The Nature Conservancy, Mexico. imarch@tnc.org

Robert Munroe: BirdLife International: robert.munroe@birdlife.org

Andrew Rhodes, CONANP, Mexico: arhodes@conanp.gob.mx

Loring Schwarz: New Primavera: loring@newprimavera.com

Trevor Sandwith, Global Protected Area Programme, IUCN: trevor.sandwith@iucn.org

Stephen Woodley, Global Protected Area Programme, IUCN: Stephen.WOODLEY@iucn.org

Appendix 2: Technical tools for managing protected areas under climate change

Compiled by Ignacio March, The Nature Conservancy

Following are a series of technical tools, available on line, presented in order to help research and management of protected areas to assess potential impacts of climate change, to design activities focused on ecological connectivity, to define participatory programmes for adaptation of human communities, for monitoring of climate change impacts and to assess carbon storage in ecosystems. Although this list of tools is not exhaustive, it offers valuable resources to design and implement mitigation and adaptation activities within protected areas systems and networks.

I) General tools, networks and resources:

This section offers literature and libraries on climate change (reports, scientific papers, proceedings, etc.), tools, case studies and news on different aspects of climate change issues. These sites comprises several tools and methodologies for meteorological and climate data analysis and modelling.

- Future International Climate Change Action Network http://www.fiacc.net/
- Climate Change Resource Center USFS http://www.fs.fed.us/ccrc/tools/
- CAIT, Climate Analysis Indicator Tool (World Resources Institute) http://cait.wri.org/
- The Climate Change Explorer Tool, http://wikiadapt.org/index.php?title=The_Climate_Change_Explorer_Tool
- GIS & Remote Sensing SERVIR, http://www.servir.net/en/biodiversity_and_climate_change
- Climate Action Network International: http://www.climatenetwork.org/
- Climate Change Knowledge Network (iisd), http://www.cckn.net/
- Future International Climate Change Action Network, http://www.fiacc.net/
- The University of Edingburgh Climate Change Network, http://www.hss.ed.ac.uk/climatechange/about.htm
- Climate, Community and Biodiversity Alliance, http://www.climate-standards.org/
- Climate Adaptation Knowledge Environment (CAKE): http://www.cakex.org/
- Climate Change Resource Center USDA, http://www.fs.fed.us/ccrc/
- Adaptation Learning Mechanism ALM, http://www.adaptationlearning.net/about
- Climate Change Knowledge Portal World Bank, http://sdwebx.worldbank.org/climateportal/
- Climate Impacts: Global and Regional Adaptation Support Platform, http://cigrasp.pik-potsdam.de/
- Climate Change Resource Center: A short course for land managers, http://www.fs.fed.us/ccrc/hjar/index_st.html

- Environmental Software and Services Meteorological Modeling, http://www.ess.co.at/METEO/
- Climate Wizard TNC – Univ. of Washington-University of Southern Mississippi, http://www.climatewizard.org/
- Climate Projections (Met Office) http://www.metoffice.gov.uk/climate-change/guide/future/projections
- Climate Predictability Tool, The International Research Institute for Climate and Society, http://portal.iri.columbia.edu/portal/server.pt?open=512&objID=697&PageID=7264&mode=2
- WorldClim, World Climate Data, http://www.worldclim.org/
- EPA Coastal Toolkit, http://water.epa.gov/type/oceb/cre/toolkit.cfm

II) Sea Level Rise

A variety of tools for estimating the impacts of sea level rise associated with climate change

- Climate Change and Sea Level Rise Tool, University of Arizona http://www.geo.arizona.edu/dgesl/research/other/climate_change_and_sea_level/sea_level_rise/sea_level_rise.htm
- Sea Level Rise and Coastal Flood Frequency Viewer, NOAA Coastal Services Center, http://www.csc.noaa.gov/digitalcoast/tools/slrviewer/index.html
- Tool on Sea Level Rise Impact in the Baltic Sea Region, http://weppi.gtk.fi/slr/
- Flood Maps http://flood.firetree.net/
- SLAMM VIEW, Sea Level Affects Marshes Model Visualization, http://www.slammview.org/

III) Tools on Climate Change and Communities:

Resources to support participatory and systematic methodologies to assess climate change impacts on human communities

- CRISTAL, Community-based risk screening tool – Adaptation and Livelihoods, IISD, SEI, IUCN, Inter Cooperation http://www.cristaltool.org/.
- Roadmap for Adapting to Coastal Risk (NOAA), http://csc.noaa.gov/digitalcoast/training/roadmap/index.html

IV) Tools on climate change and agriculture:

Tools developed by United Nations Food and Agriculture Organization (FAO) in order to support decision making in agricultural issues.

- CM Box (Crop Monitoring Box): http://www.foodsec.org/web/tools/climate-change/crop-monitoring/en/
- LocClim (Local Climate Estimate Tool): http://www.fao.org/nr/climpag/pub/en0201_en.asp

- CLIMPAG (Climate Impact on Agriculture): http://www.fao.org/nr/climpag/

V) Species distribution, connectivity and corridors:

Free software and GIS based tools for developing conservation areas networks, analysis of habitat fragmentation and connectivity, and predict species distributions.

- ConsNet - Advanced Software for Systematic Conservation Planning http://uts.cc.utexas.edu/~consbio/Cons/Labframeset.html
- DesktopGarp, package for predict and analyze wild species distributions, http://www.nhm.ku.edu/desktopgarp/
- Connectivity Analysis Toolkit http://www.connectivitytools.org,
- GIS tools for connectivity, corridor, or habitat modeling, Corridor Design http://www.corridordesign.org/designing_corridors/resources/gis_tools
- FRAGSTATS Spatial Pattern Analysis Program for Categorical Maps, http://www.umass.edu/landeco/research/fragstats/fragstats.html
- Landscape Fragmentation Tool, http://clear.uconn.edu/tools/lft/lft2/
- Corridor design: GIS tools and information for designing wildlife corridors, http://corridordesign.org/
- Linkage Mapper: http://code.google.com/p/linkage-mapper/
- Manual sobre conectividad en arrecifes, United Nations University http://www.inweh.unu.edu/Coastal/CoralReef/Handbook/Handbook_EN.pdf

VI) NatureServe Tools:

Tools for modelling habitat condition and assess vulnerability of selected species.

- NatureServe Vista, Decision Support for Better Planning
- http://www.natureserve.org/prodServices/vista/kf_model.jsp
- Climate Change Vulnerability Index
- http://www.natureserve.org/prodServices/climatechange/ccvi.jsp

VII) Monitoring Systems:

Monitoring systems and tools for assessing impacts of climate change on ecosystems; tools for coral reef monitoring and adaptation.

- GLORIA: Monitoring system of climate change impacts in Mountain Ecosystems http://www.gloria.ac.at/?a=2
- Global Coral Reef Monitoring Network http://www.gcrmn.org/
- NOAA Coral Health and Monitoring Program (CHAMP) http://www.coral.noaa.gov/
- Reef Resilience http://www.reefresilience.org/

VIII) Water and hydrological regimes:

Tools for assessing water related resilience, ecological flows and hydrological regimes alteration

- Ecological Limits of Hydrologic Alteration (ELOHA) http://conserveonline.org/workspaces/eloha
- Indicators of Hydrologic Alteration (IHA): http://conserveonline.org/workspaces/iha
- Climate Ready Water Utilities Toolbox: http://www.epa.gov/safewater/watersecurity/climate/toolbox.html

IX) Biomass and Carbon Assessment:

Key references and tools for biomass and carbon assessment, report and monitoring

The Source Book:

- http://unfccc.int/files/methods_science/redd/methodologies/other/application/pdf/sourcebook_version_nov_2009_cop15-1.pdf

- Woods Hole Research Center Field Guide: http://www.whrc.org/resources/fieldguides/carbon/
- Tools for carbon inventory, management, and reporting http://www.nrs.fs.fed.us/carbon/tools/

Appendix 3: Tool for measuring the potential of protected areas to help climate change adaptation and mitigation

This simple tool uses a questionnaire format to identify and to the extent possible quantify benefits from protected areas. It can be used with many stakeholder groups (e.g. managers, scientists, local communities). The tool starts with a data sheet about the protected areas and its status, then datasheets to collect information about: the types of benefits; who they are important to; and information about their level of importance, their relationship to the protected area and the times of year they are important. For each value, the assessment then considers seven issues relating to who benefits and what benefits are supplied[32]:

1. The stakeholder group which benefits from the values

For everything except question 1 below, the main stakeholders groups are listed along the top row of the assessment form and are divided into seven groups.

- Indigenous/ traditional people living, either permanently or temporarily, in the protected area
- Other local people living, either permanently or temporarily, in the protected area
- Indigenous/ traditional/local people living near the protected area, this can include people living in other countries when the protected area is located near national boundaries; local groupings of people including NGOs and those living downstream of protected areas
- Urban populations near a protected area which receive an important ecosystem service.
- National population
- Government
- Industry, including national and international industries both within the protected area, such as the tourism industry, and those industries which rely on resources from a protected area such as water which then supplies hydro-electric power to the wider population
- Global community, who, for example, benefit from environmental services such as climate regulation, recreational values, etc. This category includes international organisations who work in protected areas.

This is inevitably a fairly coarse grouping and we recognise that in some cases one of these groups might contain several different sub-groups. We recommend identifying the main groups in each case and if necessary explaining further in the notes section.

2. The types of benefits supplied

Multiple choice answers are supplied and assessors are asked to mark relevant answers against particular stakeholder groups. **Note that more than one answer may be applicable for a particular stakeholder (for instance resources may have both**

[32] Adapted from N. Dudley and S. Stolton (2009); *The Protected Area Benefits Assessment Tool*, WWF

subsistence and economic value), so all relevant boxes should be marked. **Those boxes which would never be appropriate have been shaded and should not be completed.**

Generally three options for the level of importance are given:

- Minor: this could either reflect low importance for the stakeholder group or that importance is significant to only a small proportion of the stakeholder group, and thus overall the level of importance is minor
- Major: this assessment should be made where the benefit is of significance for a large proportion of the stakeholder group.
- Potential: which identifies potential to increase either the subsistence or economic value; and who could benefit from that increase in potential

This assessment will usually be a matter a judgement, particularly in the wider stakeholder groupings such as national population, industry or global community. At the local level the assessment can be strengthened by completing this section with, wherever possible, the relevant stakeholder groups and by adding (in the box marked notes) supporting research and studies. ***Care should be taken not to provide conflicting answers in this section; i.e. that a benefit is both of minor and major importance to the same stakeholder group.***

3. Amount of protected area involved and period it is exploited

Next, assessors identify how much of the protected area is involved in supplying a particular benefit, choosing from three options. In most of the datasheets the assessors are also asked to identify how much of the time the protected area supplies the benefits, once more choosing from three options for each relevant stakeholder group. If the assessors have the relevant information it would be possible to break this information down for each of the relevant stakeholder groups given above.

4. Economic value

The next section looks at two economic elements: 1) if the economic value of these benefits has been assessed (and if so asks for the US$ value and the date the assessment was made) and 2) asks for information on whether the assessment of cost of managing this value has been made (e.g., through the InVEST tool: http://www.naturalcapitalproject.org/InVEST.html) .

5. Conservation Impact

This section provides the opportunity to give details as to whether the activities relating to the values/benefits are consistent with the area's management objectives. Connectivity that allows distribution adjustments and movement of migratory species should also be considered.

6. Management issues

Although the PA-BAT's primary aim is to identify the range of values, their associated benefits and their importance to different stakeholder groups, space is also given to suggest both current and future management responses to particular issues that have been identified in the assessment.

Background Information Data Sheet

The following data sheet collects critical information about both the protected area and the likely impacts of climate change on the protected area

1. Name, affiliation and contact details of person responsible for completing the assessment (email etc.)							
2. Date assessment carried out							
3. No. of people involved in completing assessment (*put number involved in the boxes below)*							
PA management		PA staff		Other PA agency staff		NGO	
Local community		Donors		External experts		Other	
4. Name of protected area							
5. Size of protected area (in hectares)				6. Date of establishment			
7. WDPA site code *(these codes can be found on www.unep-wcmc.org/wdpa/)*							
8. Country and location							
9. Ownership details (please mark)	Government	Private	Community	Other			
10. Governance (please mark)	State	Co-managed	Private	Community Conserved Area			
11. List the two primary protected area management objectives							
Management objective 1							
Management objective 2							
12. Is the protected area currently a homeland for indigenous or traditional people?	Yes		No				
13. Approximate number of people living in the protected area (state year)							
14. Approximate number of people around the protected area (please define area included, e.g. buffer zone)							
15. Overall migration trend for the area influenced by the protected area	Increasing		Decreasing				
16. Human development index rank (see: hdr.undp.org/en/statistics/)							

17. How has the protected area affected wellbeing in and around its borders? (Choose one option per column.)					
	Subsistence	**Economic**	**Cultural / spiritual**	**Environ-mental services**	**Political**
Has had a negative impact on well-being					
Does not contribute to well-being					
Does not but has potential to contribute to well-being					
Makes a minor contribution to well-being					
Makes a major contribution to well-being					

18. Which of the following descriptions of biodiversity value most accurately describes the protected area?	
• There has been little survey work carried out so the biodiversity value is currently not fully known	
• Biodiversity is of minor importance	
• Biodiversity is of minor importance but restoration is being carried out	
• Biodiversity includes typical native habitats and species	
• Biodiversity includes one of the few examples of a particular habitat or population of an endangered or endemic species	
• Biodiversity includes the only example of a particular habitat or the last viable population of an endangered or endemic species	
• Other (please specify)	

19. Which of the following are likely to happen to the protected area under future projections of climate change?	
• Loss of key ecosystems through changing climatic conditions	
• Loss of key ecosystems due to sea-level rise	
• Loss of keystone species	
• Loss of other species	
• Emergence of invasive species	
• Emergence or increased severity of pests and diseases	
• Increased fire incidence and/or severity	
• Increased frequency and severity of flooding	
• Increased frequency and severity of drought	
• Increased frequency and severity of other extreme climate related events	
• Other (please specify)	

1. Carbon storage and sequestration (in vegetation and soils)						
Carbon storage *(please mark all relevant boxes in the matrix below)*	In forests	In grassland	In soils	In wetland and peat	In coastal marine systems	Other storage
Carbon storage is of no importance						
Carbon storage is of minor importance						
Carbon storage is of major importance						
Carbon sequestration is of no importance						
Carbon sequestration is of minor importance						
Carbon sequestration is of major importance						
There is potential to increase the carbon sequestration and storage through restoration						

Amount of PA currently involved: i.e. the *proportion* of the PA involved in collection: please mark one option below and provide additional comments if necessary			
A: Small section of the site (<10%)			
B: Several areas of the site (10-50%)			
C: Most of the site (51-100%)			
If the **economic value** of these benefits has been assessed please add here the US$ value and the date the assessment of value was made	US$ Date:	If an assessment of the **cost of managing** this value has been made please add here the US$ value and the date the assessment of costs was made	US$ Date:
Conservation Impact: Please give details as to whether carbon storage and sequestration is consistent with management objectives			
What **management is currently** taking place in relation to these values/benefits?		What **additional management** responses are needed?	
Notes: further details, sources, caveats etc			

2. Wild food plants and other primary resources (only answer if sustainable collection of wild plants is permitted in the protected area)							
Please give details of the wild food plants collected							
Use of the resource *(please mark all relevant boxes in the matrix below)*	Indigenous / local people living in the PA	Other local people living in the PA	Indigenous / local people near the PA	National population	Government	Industry	Global community
Collection is of no importance							
Collection is of minor importance to subsistence							
Collection is of major importance to subsistence							
There is potential to increase the importance of wild food plant collection							
Collection is of minor importance as a source of revenue							
Collection is of major importance as a source of revenue							
There is potential to increase the economic importance of wild food plant collection							

Amount of PA currently involved: i.e. the *proportion* of the PA involved in collection: please mark one option below and provide additional comments if necessary			
A: Small section of the site (<10%)			
B: Several areas of the site (10-50%)			
C: Most of the site (51-100%)			
Amount of the year that activity currently takes place: i.e. the *time* that the activity takes place: please mark one option below and provide additional comments if necessary			
A: Only occasional uses for short periods of time			
B: Regular but not continuous			
C: Continuous use			
If the **economic value** of these benefits has been assessed please add here the total US$ value and the date the assessment of value was made	US$ Date:	If an assessment of the **cost of managing** this value has been made please add here the US$ value and the date the assessment of costs was made	US$ Date:
Conservation Impact: Please give details as to whether collection is consistent with management objectives			
What **management is currently** taking place in relation to these values/benefits?		What **additional management** responses are needed?	
Notes: further details, sources, caveats etc			

3. Fishing and aquaculture (only answer if sustainable fishing or aquaculture is permitted in the protected area)							
Please give details of fisheries and note if the value relates to fishing and/or protection of spawning:							
Use of the resource *(please mark all relevant boxes in the matrix below)*	Indigenous / local people living in the PA	Other local people living in the PA	Indigenous / local people near the PA	National population	Government	Industry	Global community
Fisheries are of no importance							
Fisheries are of minor importance to subsistence							
Fisheries are of major importance to subsistence							
There is potential to increase the importance of fisheries							
Fisheries are of minor importance as a source of revenue							
Fisheries are of major importance as a source of revenue							
There is potential to increase the economic importance of fisheries							

Amount of PA currently involved: i.e. the *proportion* of the PA involved in fishing or protecting the spawning area: please mark one option below and provide additional comments if necessary			
A: Small section of the site (<10%)			
B: Several areas of the site (10-50%)			
C: Most of the site (51-100%)			
Amount of the year that activity currently takes place: i.e. the *time* that the activity takes place: please mark one option below and provide additional comments if necessary			
A: Only occasional uses for short periods of time			
B: Regular but not continuous			
C: Continuous use			
If the **economic value** of these benefits has been assessed please add here the US$ value and the date of assessment	US$ Date:	If an assessment of the **cost of managing** this value has been made please add here the US$ value and the date of assessment	US$ Date:
Conservation Impact: Please say whether the activities are consistent with the area's management objectives			
What **management is currently** taking place in relation to these values/benefits?		What **additional management** responses are needed?	
Notes: further details, sources, caveats etc			

4. Agrobiodiversity and genetic resources for food and medicine production (i.e. landraces, crop wild relatives and medicinal products)							
Please give details of traditional agriculture practices:							
Use of the resource *(please mark all relevant boxes in the matrix below)*	Indigenous / local people living in the PA	Other local people living in the PA	Indigenous / local people near the PA	National population	Government	Industry	Global community
Agrobiodiversity resources are of no importance							
Agrobiodiversity resources are of minor importance							
Agrobiodiversity resources are of major importance							
There is potential to increase the importance of agrobiodiversity resources							
Agrobiodiversity resources are of minor importance as a source of revenue							
Agrobiodiversity resources are of major importance as a source of revenue							
There is potential to increase the economic importance of agrobiodiversity resources							

Amount of PA involved i.e. the *proportion* of the PA used for agriculture: please mark one option below and provide additional comments if necessary			
A: Small section of the site (<10%)			
B: Several areas of the site (10-50%)			
C: Most of the site (51-100%)			
Amount of the year that activity currently takes place: i.e. the *time* that the activity takes place: please mark one option below and provide additional comments if necessary			
A: Only occasional uses for short periods of time			
B: Regular but not continuous			
C: Continuous use			
If the **economic value** of these benefits has been assessed please add here the US$ value and the date the assessment of value was made	US$ Date:	If an assessment of the **cost of managing** this value has been made please add here the US$ value and the date the assessment of costs was made	US$ Date:
Conservation Impact: Please say whether agrobiodiversity collection is consistent with management objectives			
What **management is currently** taking place in relation to these values/benefits?		What **additional management** responses are needed?	
Notes: further details, sources, caveats etc			

5. Water quality							
Please give details of water values:							
Use of the resource *(please mark all relevant boxes in the matrix below)*	Indigenous / local people living in the PA	Other local people living in the PA	Indigenous / local people near the PA	National population	Government	Industry	Global community
The protected area is not important for water quality							
Water quality is of minor importance to subsistence							
Water quality is of major importance to subsistence							
There is potential to increase non-commercial benefits from water quality							
High quality water is of minor importance as a source of revenue							
High quality water is of major importance as a source of revenue							
There is potential to increase the economic importance of water quality							

Amount of PA currently involved: i.e. the *proportion* of the PA involved in water use: please mark one option below and provide additional comments if necessary			
A: Small section of the site (<10%)			
B: Several areas of the site (10-50%)			
C: Most of the site (51-100%)			
Amount of the year that activity currently takes place: i.e. the *time* that the activity takes place: please mark one option below and provide additional comments if necessary			
A: Only occasional uses for short periods of time			
B: Regular but not continuous			
C: Continuous use			
If the **economic value** of these benefits has been assessed please add here the US$ value and the date the assessment of value was made	US$ Date:	If an assessment of the **cost of managing** this value has been made please add here the US$ value and the date the assessment of costs was made	US$ Date:
Conservation Impact: Please give details as to whether the activities relating to the above values/benefits are consistent with the area's management objectives			
What **management is currently** taking place in relation to these values/benefits?		What **additional management** responses are needed?	
Notes: further details, sources, caveats etc			

6. Increased supply of water	Yes	No

Please give details of the cultural and historical values:

Use of the resource *(please mark all relevant boxes in the matrix below)*	Indigenous / local people living in the PA	Other local people living in the PA	Indigenous / local people near the PA	National population	Government	Industry	Global community
The protected area is not important for water supply							
Water supply is of minor importance to subsistence							
Water supply is of major importance to subsistence							
There is potential to increase non-commercial benefits from water supply							
Water supply is of minor importance as a source of revenue							
Water supply is of major importance as a source of revenue							
There is potential to increase the economic importance of water supply							

Amount of PA currently involved: i.e. the *proportion* of the PA containing these values: please mark one option below and provide additional comments if necessary			
A: Small section of the site (<10%)			
B: Several areas of the site (10-50%)			
C: Most of the site (51-100%)			
Amount of the year that activity currently takes place: i.e. the *time* that the activity takes place (e.g. a pilgrimage): please mark one option below and provide additional comments if necessary			
A: Only occasional uses for short periods of time			
B: Regular but not continuous			
C: Continuous use			
If the **economic value** of these benefits has been assessed please add here the US$ value and the date the assessment of value was made	US$ Date:	If an assessment of the **cost of managing** this value has been made please add here the US$ value and the date the assessment of costs was made	US$ Date:
Conservation Impact: Please give details as to whether the activities relating to the above values/benefits are consistent with the area's management objectives			
What **management is currently** taking place in relation to these values/benefits?		What **additional management** responses are needed?	
Notes: further details, sources, caveats etc			

7. Soil stabilisation (e.g. avalanche prevention, landslide and erosion)							
Please provide details of the value:							
Use of the resource *(please mark all relevant boxes in the matrix below)*	Indigenous / local people living in the PA	Other local people living in the PA	Indigenous / local people near the PA	National population	Government	Industry	Global community
The PA has no role in soil stabilisation							
The role of the PA in soil stabilisation has a minor non-economic benefit							
The role of the PA in soil stabilisation has a major non-economic benefit							
There is potential to increase the non-economic importance of soil stabilisation							
The role of the PA in soil stabilisation has minor economic benefits							
The role of the PA in soil stabilisation has major economic benefits							
There is potential to increase the economic importance of soil stabilisation							

Amount of PA currently involved: i.e. the *proportion* of the PA which is important for soil stabilisation: please mark one option below and provide additional comments if necessary			
A: Small section of the site (<10%)			
B: Several areas of the site (10-50%)			
C: Most of the site (51-100%)			
If the **economic value** of these benefits has been assessed please add here the US$ value and the date the assessment of value was made	US$ Date:	If an assessment of the **cost of managing** this value has been made please add here the US$ value and the date the assessment of costs was made	US$ Date:
Conservation Impact: Please give details as to whether the activities relating to the above values/benefits are consistent with the area's management objectives			
What **management is currently** taking place in relation to these values/benefits?		What **additional management** responses are needed?	
Notes: further details, sources, caveats etc			

8. Coastal protection (e.g. mangroves, sand dunes, coral reefs)							
Please provide details of the value:							
Use of the resource *(please mark all relevant boxes in the matrix below)*	Indigenous / local people living in the PA	Other local people living in the PA	Indigenous / traditional / local people near the PA	National population	Government	Industry	Global community
The PA has no role in coastal protection							
The role of the PA in coastal protection has a minor non-economic benefit							
The role of the PA in coastal protection has a major non-economic benefit							
There is potential to increase the non-economic importance of coastal protection							
The role of the PA in coastal protection has minor economic benefits							
The role of the PA in coastal protection has major economic benefits							
There is potential to increase the economic importance of coastal protection							

Amount of PA currently involved: i.e. the *proportion* of the PA which is important for coastal protection: please mark one option below and provide additional comments if necessary			
A: Small section of the site (5-10%)			
B: Several areas of the site (10-50%)			
C: Most of the site (51-100%)			
If the **economic value** of these benefits has been assessed please add here the US$ value and the date the assessment of value was made	US$ Date:	If an assessment of the **cost of managing** this value has been made please add here the US$ value and the date the assessment of costs was made	US$ Date:
Conservation Impact: Please give details as to whether the activities relating to the above values/benefits are consistent with the area's management objectives			
What **management is currently** taking place in relation to these values/benefits?		What **additional management** responses are needed?	
Notes: further details, sources, caveats etc			

9. Flood prevention (e.g. mitigation in small watersheds, flood plains and wetland protection)							
Please provide details of the value:							
Use of the resource *(please mark all relevant boxes in the matrix below)*	Indigenous / local people living in the PA	Other local people living in the PA	Indigenous / local people near the PA	National population	Government	Industry	Global community
The PA has no role in flood prevention							
The role of the PA in flood prevention has a minor non-economic benefit							
The role of the PA in flood prevention has a major non-economic benefit							
There is potential to increase the non-economic importance of flood prevention							
The role of the PA in flood prevention has minor economic benefits							
The role of the PA in flood prevention has major economic benefits							
There is potential to increase the economic importance of flood prevention							

Amount of PA currently involved: i.e. the *proportion* of the PA involved in flood prevention: please mark one option below and provide additional comments if necessary			
A: Small section of the site (<10%)			
B: Several areas of the site (10-50%)			
C: Most of the site (51-100%)			
If the **economic value** of these benefits has been assessed please add here the US$ value and the date the assessment of value was made	US$ Date:	If an assessment of the **cost of managing** this value has been made please add here the US$ value and the date the assessment of costs was made	US$ Date:
Conservation Impact: Please give details as to whether the activities relating to the above values/benefits are consistent with the area's management objectives			
What **management is currently** taking place in relation to these values/benefits?		What **additional management** responses are needed?	
Notes: further details, sources, caveats etc			

10. Pollination of nearby crops or pollination products such as honey							
Please provide details of this value and in particular if bee-keeping is an important activity in the area:							
Use of the resource *(please mark all relevant boxes in the matrix below)*	Indigenous / local people living in the PA	Other local people living in the PA	Indigenous / local people near the PA	National population	Government	Industry	Global community
Pollination services are of minor importance to subsistence							
Pollination services are of minor importance to subsistence							
Pollination services are of major importance to subsistence							
There is potential to increase the importance of pollination services							
Pollination services are of minor importance as a source of revenue							
Pollination services are of major importance as a source of revenue							
There is potential to increase economic importance of pollination services							

Amount of PA currently involved: i.e. the *proportion* of the PA which contributes to water quality: please mark one option below and provide additional comments if necessary			
A: Small section of the site (<10%)			
B: Several areas of the site (10-50%)			
C: Most of the site (51-100%)			
Amount of the year that activity currently takes place: i.e. the *time* that the activity takes place: please mark one option below and provide additional comments if necessary			
A: Only occasional role for short periods of time			
B: Regular but not continuous			
C: Continuous role			
If the **economic value** of these benefits has been assessed please add here the US$ value and the date the assessment of value was made	US$ Date:	If an assessment of the **cost of managing** this value has been made please add here the US$ value and the date the assessment of costs was made	US$ Date:
Conservation Impact: Please give details as to whether the activities relating to the above values/benefits are consistent with the area's management objectives			
What **management is currently** taking place in relation to these values/benefits?		What **additional management** responses are needed?	
Notes: further details, sources, caveats etc			

11. Non-wood products (e.g. coral, shells, grass, resin, rubber, rattan. minerals etc) (*only answer if sustainable collection is permitted in PA*)							
Please specify which materials are important:							
Use of the resource *(please mark all relevant boxes in the matrix below)*	Indigenous / local people living in the PA	Other local people living in the PA	Indigenous / local people near the PA	National population	Government	Industry	Global community
Non-wood products are of no importance							
Non-wood products are of minor importance to subsistence							
Non-wood products are of major importance to subsistence							
There is potential to increase the importance of non-wood products							
Non-wood products are of minor importance as a source of revenue							
Non-wood products are of major importance as a source of revenue							
There is potential to increase economic importance of non-wood products							

Amount of PA currently involved: i.e. the *proportion* of the PA involved in collection: please mark one option below and provide additional comments if necessary			
A: Small section of the site (<10%)			
B: Several areas of the site (10-50%)			
C: Most of the site (51-100%)			
Amount of the year that activity currently takes place: i.e. the *time* that the activity takes place: please mark one option below and provide additional comments if necessary			
A: Only occasional uses for short periods of time			
B: Regular but not continuous			
C: Continuous use			
If the **economic value** of these benefits has been assessed please add here the US$ value and the date the assessment of value was made	US$ Date:	If an assessment of the **cost of managing** this value has been made please add here the US$ value and the date the assessment of costs was made	US$ Date:
Conservation Impact: Please give details as to whether the activities relating to the above values/benefits are consistent with the area's management objectives			
What **management is currently** taking place in relation to these values/benefits?		What **additional management** responses are needed?	
Notes: further details, sources, caveats etc			

12. Timber, including fuelwood (only answer if sustainable collection is permitted in PA)							
Please provide details of the value:							
Use of the resource *(please mark all relevant boxes in the matrix below)*	Indigenous / local people living in the PA	Other local people living in the PA	Indigenous / local people near the PA	National population	Government	Industry	Global community
Timber removal from the protected area is of no importance							
Timber removal is of minor importance to subsistence							
Timber removal is of major importance to subsistence							
There is potential to increase the importance of timber removal							
Timber removal is of minor importance as a source of revenue							
Timber removal is of major importance as a source of revenue							
There is potential to increase the economic importance of timber removal							

Amount of PA currently involved: i.e. the *proportion* of the PA involved in timber removal: please mark one option below and provide additional comments if necessary			
A: Small section of the site (<10%)			
B: Several areas of the site (10-50%)			
C: Most of the site (51-100%)			
Amount of the year that activity currently takes place: i.e. the *time* that the activity takes place: please mark one option below and provide additional comments if necessary			
A: Only occasional uses for short periods of time			
B: Regular but not continuous			
C: Continuous use			
If the **economic value** of these benefits has been assessed please add here the US$ value and the date the assessment of value was made	US$ Date:	If an assessment of the **cost of managing** this value has been made please add here the US$ value and the date the assessment of costs was made	US$ Date:
Conservation Impact: Please give details as to whether the activities relating to the above values/benefits are consistent with the area's management objectives			
What **management is currently** taking place in relation to these values/benefits?		What **additional management** responses are needed?	
Notes: further details, sources, caveats etc			