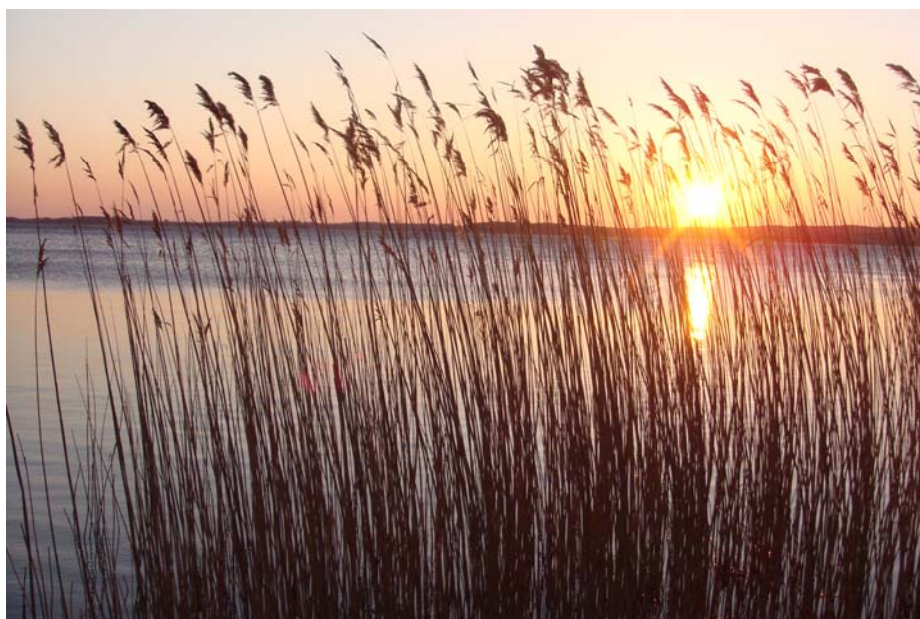




Managing for climate change – developing strategies for protected area managers

Edited by Sue Stolton and Nigel Dudley



**Results of a Seminar organised by BfN and the United
Nations Development Programme at the International
Academy for Nature Conservation on the Island of Vilm,
Germany**

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Vilm, Germany, January 2011

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i: Acronyms

BfN	German Federal Agency for Nature Conservation
CAP	Conservation Action Planning
C	Carbon
CBA	Community based adaptation
CH ₄	methane
CIFOR	Center for International Forestry Research
CO ₂	Carbon dioxide
CONANP	National Commission on Protected Areas (Mexico)
EBA	Ecosystem Based Adaptation
FAO	Food and Agriculture Organization of the United Nations
GBIF	Global Biodiversity Information Facility
GEF	Global Environment Facility
GHG	Greenhouse gas
GIS	Geographic information systems
GLORIA	global observation network in alpine environments
IAS	Invasive alien species
ICDP	Integrated Community Development Projects
ICIMOD	International Centre for Integrated Mountain Development
IPCC	Intergovernmental Panel on Climate Change
IISD	International Institute for Sustainable Development
IUCN	International Union for Conservation of Nature
IUCN-SSC	IUCN – Species Survival Commission
IUCN-WCPA	IUCN's World Commission on Protected Areas
NGO	Non-governmental Organisations
KEA	Key Ecological Attributes
LULUCF	Land use, land-use change and forestry
METT	Management Effectiveness Tracking Tool
NCEAS	National Center for Ecological Analysis and Synthesis
NDVI	Normalized Difference Vegetation Index
N ₂ O	nitrous oxide
PAME	protected area management effectiveness
PoWPA	Programme of Work on Protected Areas of the Convention on Biological Diversity
PRA	participatory rural appraisal
RAMSAR	The Convention on Wetlands (Ramsar, Iran, 1971)

REDD	Reducing Emissions from Deforestation and Forest Degradation
SEI	Stockholm Environment Institute
SPAGS	fish spawning aggregations
TEAM	Tropical Ecology Assessment and Monitoring
TEEB	The Economics of Ecosystems and Biodiversity
TEK	Traditional Ecological Knowledge
TNC	The Nature Conservancy
UNDP	United Nations Development Programme
UNEP-WCMC	United Nations Environment Programme - World Conservation Monitoring Centre
UNESCO	United Nations Educational, Scientific and Cultural Organization
VRA	Vulnerability Reduction Assessment
WCS	Wildlife Conservation Society
WMO	World Meteorological Organization

ii. Figures and tables

Figure 1: Methodology overview for modelling of climate scenarios

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1 Managing for climate change – developing strategies for protected area managers: Seminar aims and summary

The aim of this workshop was to bring together a range of experts¹ to help develop strategies for protected area managers to understand likely climate change impacts and plan management responses at a site level. The specific purposes of the workshop were to use the results of the discussions:

- To contribute to the development of a planned International Union for Conservation of Nature's World Commission on Protected Areas (IUCN-WCPA) publication on protected area management and climate change in its "Best Practice" series – the publication will target protected area managers and others involved in site level planning and management and provide guidance on approaches to assessing and addressing climate change impacts at site level.
- To use existing and planned United Nations Development Programme (UNDP) / Global Environment Facility (GEF) projects to develop and demonstrate the role of expanded protected areas systems as vehicles for climate change adaptation and to integrate the results in the guidelines for protected area managers.

This publication thus reports the "brainstorming" on the topics addressed, rather than providing a comprehensive analysis of the subject.

The workshop discussions were centred on five key themes:

- Understanding climate change impacts at the site level;
- Managing for climate change at the site level;
- Biome management in the face of climate change;
- Monitoring and adaptive management; and
- Restoring and connecting landscapes (protected areas in the wider landscape).

¹ See appendix 9.1 for the biographies of those involved

Each of the sessions looked at four issues related to climate change:

- What is already available for managers?: e.g. approaches and tools;
- What experiences can managers draw on?: e.g. best practices and case studies (including short presentations from participants);
- What else do managers need?: e.g. guidance, best practice example, research;
- What resources do managers need?: e.g. finances, knowledge and capacity.

The workshop was organised by the German Federal Agency for Nature Conservation (BfN), in cooperation with the United Nations Development Programme (UNDP) and the IUCN-WCPA. It was attended by 28 delegates including professionals, scientists and protected area managers with experience in climate change adaptation and protected areas from various institutions including NGOs, UNDP, IUCN-WCPA and government agencies. Sixteen countries were represented: Armenia, Australia, Belarus, Canada, Germany, Kazakhstan, Mexico, Moldova, Montenegro, Peru, Romania, Russia, Slovakia, Turkey, UK and USA.



Workshop participants

2 Understanding climate change impacts

2.1 Overview: Introduction into the topic

Marc Hockings, Associate Professor, University of Queensland

Over the last few years there have been a number of much needed reviews, policy and advocacy publications on climate change and protected areas (e.g. IUCN-WCPA, The Nature Conservancy (TNC), UNDP, Wildlife Conservation Society (WCS), The World Bank and WWF jointly published the report *Natural Solutions: Protected areas helping people cope with climate change*² and the World Bank's *Convenient Solutions to an Inconvenient Truth: Ecosystem-based Approaches to Climate Change*³); as well as various studies and tools for identifying the likely impacts of climate change on protected area systems and in particular biomes.

But there remains a major gap in guidance for site managers as much of the information is aimed at policy makers, protected area system planners and scientists. Furthermore many of the studies, tools and models work at regional or larger scales and address issues across protected area systems, meaning that there is little consolidated information available that directly addresses needs at a site level. Site managers often lack access to assessment tools or capacity to use more 'complex' tools. Site managers may also lack necessary biophysical and socio-economic data to be able to predict likely impacts or know how to scale down broader studies to a local level.

The workshop aimed to fill some of these gaps by collecting together information, case studies and advice from people who have been working in the field. It also marked the start of a process to assemble this into a more user-friendly format within the IUCN-WCPA best practice series. The resulting guidelines will be published in English, French and Spanish, with other languages made available if funding permits. We recognise that this is a rapidly developing field and that therefore information may be lacking: the first edition will necessarily be incomplete and IUCN plans a second edition as we learn more.

² <http://www.iucn.org/about/union/commissions/wcpa/?4345/Natural-Solutions---Protected-Areas-Helping-people-cope-with-climate-change>

³ <http://beta.worldbank.org/climatechange/content/convenient-solutions-inconvenient-truth>

2.2 Introduction: Raising awareness of climate change in protected area management

**Adriana Dinu, Environment and Energy UNDP, Europe and the CIS,
Bratislava Regional Centre**

Raising awareness about what?

- Climate change is a key driver of biodiversity loss
- Climate change impacts on protected areas: current and projected
- Protected areas as essential components of climate change strategies
- Climate change has implications for protected areas planning and management

We have high confidence that climate change is affecting:

- *Terrestrial ecosystems*: earlier timing of spring events, e.g. bird migration, egg-laying, leaf unfolding.
- *Marine and freshwater ecosystems*: e.g. salt water intrusion leading to changes in mangroves affecting proposed marine protected areas in Vietnam.
- *Snow, ice and frozen ground*: loss of sea ice; increased number of glacial lake outbursts; increased ground instability in permafrost, e.g. Adélie Penguin populations have shrunk 33% in 25 years due to declines in winter sea ice.

Major changes in ecosystem structure and function will have many impacts, for example:

- Aquatic freshwater habitats, wetlands, arctic and alpine ecosystems, and cloud forests are all amongst the most sensitive ecosystems to climate change.
- Coral reefs, which in turn will affect the livelihoods of 500 million people.
- Approximately 10% of species become at high risk of extinction for every 1°C rise in global mean temperature.
- South African protected area systems are calculated to undergo serious losses of plant diversity in semiarid regions with low landscape heterogeneity.
- Parks Canada research indicates that in all climate scenarios substantial vegetation change will occur in over half the protected areas, with loss of tundra and increase in temperate forests.

Protected areas are the most sensible response to these challenges; and are an essential part of the global response to climate change.

- *Mitigation*

A: Storage existing and potential forest protected areas are the world's richest carbon pools; they store 312 Gt of terrestrial Carbon (C) and if lost would equate to the equivalent to 23 times the total global C emissions for 2004;

B. *Capture*: further sequestration of carbon dioxide (CO₂) increasing the size of carbon pools (e.g. through afforestation, reforestation and restoration);

- *Adaptation*: protected areas maintain ecosystem integrity; reduce vulnerability to climate change and provide ecosystem services.

We need to demonstrate that protected areas can:

- Reduce the vulnerability of humans to climate change: to do this we need to nest the protected areas agenda into the development agenda;
- Be an effective means of safeguarding ecosystem services, vital to adaptation, carbon storage and sequestration;
- Be a cost effective means of providing these services, relative to the costs of other land governance systems.

Improved protected area management can:

- Enhance resilience to climate change;
- Protect carbon stores;
- Contribute to adaptation strategies;
- Reduce vulnerability to natural hazards and extreme climatic events.

Communicating the right messages

Globally, we need people to:

- Recognize the contribution of protected areas to as part of national strategies for supporting adaptation and mitigation;
- Facilitate climate change funding (e.g. Reducing Emissions from Deforestation and Forest Degradation (REDD) and adaptation funds) for the establishment of comprehensive, effectively managed protected area systems;
- Renew the Programme of Work on Protected Areas (PoWPA) to address the role of protected areas as part of the global response to climate change.

National and sub-national governments should:

- Increase the role of protected areas in national climate change strategies;
- Incorporate climate change into ecological gap assessments;
- Increase coverage, protection and management effectiveness of protected areas;

- Develop landscape approaches and connectivity to promote resilience across large landscapes;
- Strengthen protected area networks in areas of high deforestation pressure and high carbon as a strategy to reduce emissions.

Protected area agencies/managers need to:

- Incorporate impacts of climate change on ecosystems and people in protected areas management: most protected area management plans still focus mainly on wildlife management, tourism and threat reduction;
- Use vulnerability assessment, as part of threat assessment to identify the degree of exposure and sensitivity that species and ecosystems will face under climate change scenarios;
- Manage for change: many climate change impacts are exacerbated by other pressures;
- Plan for climate change in restoration activities by anticipating changes in ecological structure and function;
- Plan for change: advice and political support are both needed for planning protected area networks to withstand or adapt to change.

Rethinking the approach to protection and management – climate change creates some new needs and challenges:

- Permanence, protection works best if the area remains protected for the foreseeable future;
- Shifting protected areas may sometimes be necessary to keep up with moving ranges of species, but we should note that replacement land and water might not be available;
- Fire management should be judged against regional conservation goals—either maintenance of forest or promotion of grassland in newly suitable climate space;
- Management of sensitive areas: climate change-driven alterations in range or abundance may render once resilient species sensitive;
- Management of ‘representative’ ecosystems, which may no longer exist in future climates.

We have tools, guidance and reports, so what is missing? Communication is not only about information; communication should also deliver and raise awareness; knowledge; concern and motivation and capacity to act. Communicating climate change to scientists... is not the same as communicating to policy makers! We need

an effective communication approach that engages our minds, surprises us, reaches out hearts, sticks in the minds of decision makers and the public and ultimately changes our behaviour for the better. We need to learn from corporate marketing (the average American 12-year old can recognize 1,000+ corporate logos....but can recognize fewer than a dozen local species) and social marketing (using the same tactics that sell iPods and Coca Cola to sell good ideas and change behaviour for the better).

An Effective Communications Campaign

An effective communication campaign should:

- Have clearly defined audience;
- Be based on a clear hypothesis on how change will occur;
- Be able to change knowledge, attitudes, skills, hearts and minds, along with social norms;
- Provide incentives and remove barriers to change.

Questions for Discussion

Key questions for the working group to discuss include:

- What might be the elements of an effective communications campaign on climate change for protected area management?
- How can we convince policy makers and politicians to value protected areas?
- What tools do we have to change knowledge, attitudes and social norms?

2.3 Working group results: Raising awareness of climate change in protected area management

Nigel Dudley, Equilibrium Research

The discussion focused mainly on the specific needs of managers and on how these could best be addressed in a manual.

Main aims

- Raise awareness of the protected area manager; climate change is still not an important issue on a day-to-day basis for many managers;
- Encourage integration of protected areas into national adaptation strategies;

- Help protected area manager raise awareness in others including particularly local community members.

Needs

- Flexible manual – because opportunities to address climate change in management will have different entry points in different parts of the world;
- Many languages – a strong argument for including a Russian language version;
- Key entry points for guidance – management plans, legislation etc – are different for different regions and this needs to be reflected in the text and through case studies;
- Principles, guidance and capacity building levels are all important;
- Locally-specific guidelines may be needed to complement some “global” guidelines.

Key issues in raising awareness

- Explain main ecosystem services that can be important with respect to climate change, e.g. with respect to water, invasive species, fire;
- Explain main mitigation opportunities with respect to climate change;
- Distinguish between new and existing protected areas in opportunities and management responses – building the link between site level and system level responses to climate change;
- Combat a tendency to blame protected areas for climate change issues, e.g. blaming protected areas for spread of fire when higher temperatures or drought are the real issues.

Various case studies were suggested in need of following up including: Mongolia; Kazakhstan – community-based adaptation; Australian Alps – adaptation to water; Peru – initiative to create interpretive trail in a region where glaciers are retreating; Komi – forest options; International Centre for Integrated Mountain Development (ICIMOD) in Nepal; and South Africa – water.

2.4 Introduction: Developing pilot climate change adaptation programmes for protected areas within landscapes / seascapes in southern Mexico

Ignacio March Mifsut, The Nature Conservancy Mexico and Northern Central America Program

This presentation describes a joint project of the Mexico's National Commission on Protected Areas (CONANP), the Mexican Fund for the Conservation of Nature and TNC.

Major goals of the project:

1. To develop an efficient methodology for planning climate change adaptation pilot programs for protected areas and their surrounding landscapes/seascapes in southern Mexico;
2. To analyse and test a variety of tools and techniques involved in assessing climate change impacts on biodiversity and for designing climate change adaptation strategies and management practices;
3. To design four specific projects for the implementation of adaptation management responses focused on high vulnerable conservation targets with "low" uncertainty of climate change impacts.

Approaches and scope:

Develop a methodology focused on four major targets:

1. Understanding climate change impacts on biodiversity;
2. Planning adaptation strategies based on science;
3. Adjusting existing PA monitoring and evaluation procedures;
4. Designing adaptation management practices based on Landscape Approach and Ecosystem Based Adaptation (EBA).

In addition, the project aimed to promote cooperative mainstreaming of stakeholders and to prevent human adaptation responses that have high adverse impacts on biodiversity and sustainability (maladaptation). The main focus is on practical adaptive management practices based on precautionary principles and science. It also aimed to link climate change adaptation with climate change mitigation.

Some potential tools are already available, for example:

- Cristal, Community-based risk screening tool – Adaptation and Livelihoods, International Institute for Sustainable Development (IISD), Stockholm Environment Institute (SEI), IUCN, Inter Cooperation⁴
- MIRADI, Adaptive Management Software⁵
- Hypothesis of Change method from TNC⁶
- Climate Change Vulnerability Index, NatureServe⁷

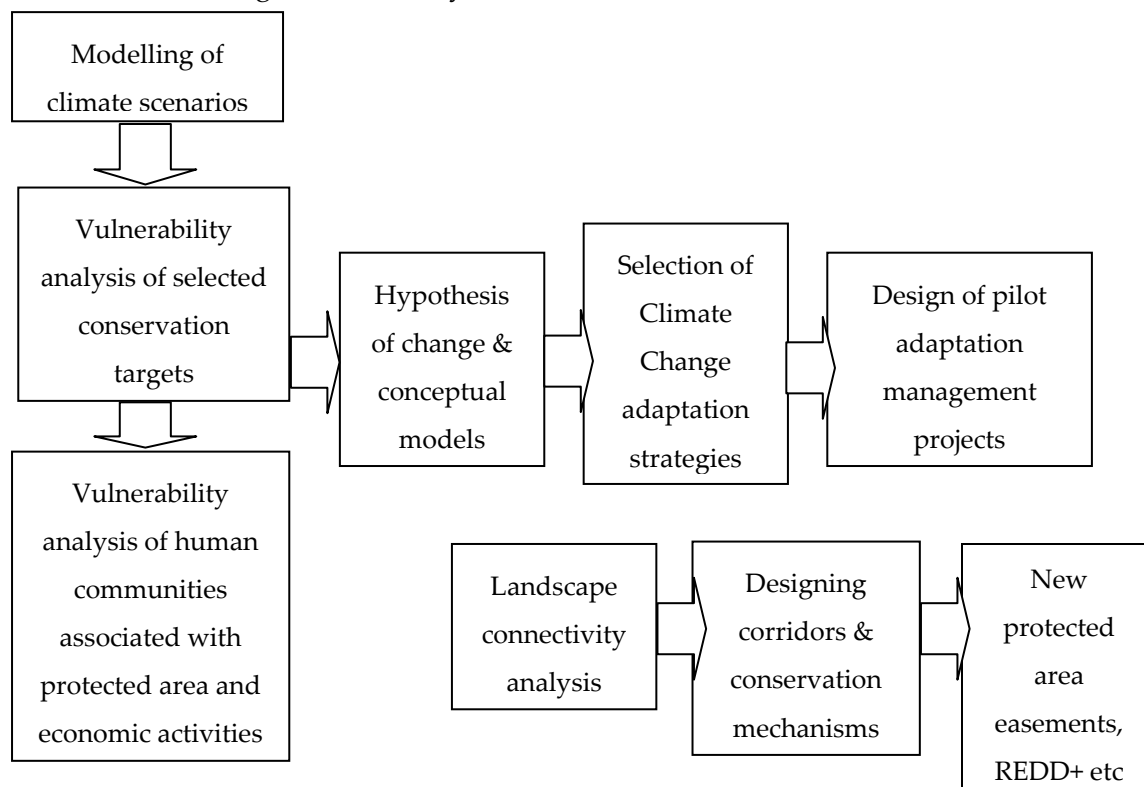


Figure 1: Methodology overview for modelling of climate scenarios

Southern Mexico: a series of protected area aggregations or complexes were chosen:

- Caribbean coast and reefs (Eastern Yucatan Peninsula)
- Mayan rainforest (Central portion of Yucatan Peninsula)
- Zoque rainforest (Western Chiapas, Oaxaca)
- Chiapas southern mountains and coast

To date, climate modelling has helped develop understanding within the study regions. Climate scenarios for southern Mexico include progressive increase in temperature, increasing frequency and intensity of extreme meteorological events

⁴ <http://www.cristaltool.org/>

⁵ <https://miradi.org/>

⁶ <http://conserveonline.org/workspaces/climateadaptation/documents/climate-clinic>

⁷ <http://www.natureserve.org/prodServices/climatechange/ClimateChange.jsp>

(e.g. hurricanes) and a progressive decrease in total annual rainfall; specific impacts vary as outlined below:

- **Caribbean coasts and reefs** are likely to experience ocean acidification, sea-level rise (affecting mangroves and marine turtle nesting sites), extreme meteorological events, mainly hurricanes and impacts on fish spawning aggregations (SPAGS) and fisheries, particularly for pink conch and lobster;
- **Mayan rainforest** in the Yucatan Peninsula will experience increasing hurricane impacts, fuel accumulation and catastrophic forest fires in non-adapted rain forests, phenological asynchronies, and increase in exotic invasive species and in addition there is likely to be increased biofuel production in forested areas;
- **Zoque rainforest** will also experience increased hurricane incidence, fuel accumulation and catastrophic forest fires, invasive species and changes in phenology and there are additional risks of losing connectivity between forest areas;
- **Chiapas Southern mountains and coast** will see an increase in landslides, catastrophic fires in non-adapted rain forests, sea-level rise with impacts on mangroves, phenological asynchronies and decreased coffee yields.

The project is now planning suitable response strategies

Tools

In addition to the four tools mentioned above, a number of other tools and resources are potentially useful in planning climate change responses; some are listed below:

- Future International Climate Change Action Network⁸
- Climate Change Resource Center of the US Forest Service⁹
- United Nations Environment Programme – World Conservation Monitoring Centre (UNEP-WCMC)¹⁰
- Climate Analysis Indicator Tool (World Resources Institute)¹¹
- Climate Change Explorer Tool from Wiki-Adapt and the University of Cape Town¹²
- US Environmental Protection Agency¹³
- US Environmental Protection Agency coastal¹⁴

⁸ <http://www.fiacc.net/>

⁹ <http://www.fs.fed.us/ccrc/tools/>

¹⁰ <http://www.unep-wcmc.org/climate/>

¹¹ <http://cait.wri.org/>

¹² http://wikiadapt.org/index.php?title=The_Climate_Change_Explorer_Tool

¹³ <http://www.epa.gov/climatereadyestuaries/monitoring.html>

¹⁴ <http://www.epa.gov/climatereadyestuaries/vulnerability.html>

- SERVIR¹⁵
- Connectivity Analysis Toolkit¹⁶
- Geographic information systems (GIS) tools for connectivity, corridor, or habitat modelling, Corridor Design¹⁷
- Connectivity GIS tool¹⁸
- Flood Maps¹⁹
- Climate Wizard TNC and partners²⁰
- UK Met Office²¹
- Climate Predictability Tool, International Research Inst. for Climate and Society²²
- Climate Change and Sea Level Rise Tool, University of Arizona²³
- Sea Level Rise and Coastal Flood Frequency Viewer, National Oceanic and Atmospheric Administration Coastal Services Center²⁴
- GTK Sea Level Rise Modelling Tools²⁵
- Sea Level Affects Marshes Model (SLAMM) VIEW²⁶

Learning Networks

- Adaptation Network²⁷
- WikiAdapt - Advancing Capacity for Climate Change Adaptation²⁸
- Climate Action Network²⁹
- Climate Change Knowledge Network³⁰
- Future International Climate Change Action Network³¹
- University of Edinburgh³²
- Climate, Community and Biodiversity Alliance³³

¹⁵ http://www.servir.net/en/biodiversity_and_climate_change

¹⁶ <http://www.connectivitytools.org>

¹⁷ http://www.corridordesign.org/designing_corridors/resources/gis_tools

¹⁸ <http://el.erd.usace.army.mil/emrrp/gis.html>

¹⁹ <http://flood.firetree.net/>

²⁰ <http://www.climatewizard.org/>

²¹ <http://www.metoffice.gov.uk/climatechange/science/projections/>

²² <http://portal.iri.columbia.edu/portal/server.pt?open=512&objID=697&PageID=7264&mode=2>

²³ http://www.geo.arizona.edu/dgesl/research/other/climate_change_and_sea_level/sea_level_rise/sea_level_rise.htm

²⁴ <http://www.csc.noaa.gov/digitalcoast/tools/slviewer/index.html>

²⁵ <http://www.gtk.fi/slr/toolmethod.php?id=1>

²⁶ <http://www.slammview.org/>

²⁷ <http://www.adaptationnetwork.org/>

²⁸ http://wikiadapt.org/index.php?title=Main_Page

²⁹ <http://www.climatenetwork.org/>

³⁰ <http://www.cckn.net/>

³¹ <http://www.fiacc.net/>

³² <http://www.hss.ed.ac.uk/climatechange/about.htm>

2.5 Working group results: Scaling down predictions and developing base-line data for understanding climate impacts at protected area level and using appropriate technologies and methods for managers

Marc Hockings, Associate Professor, University of Queensland

The session was divided into two sub-themes, looking at (i) understanding climate change scenarios and dealing with uncertainty at this scale and (ii) baselines and socio-economic modelling for climate change.

Understanding climate change scenarios

Best practice:

- It is important to match the resolution of scenarios to the scale of climate change impact (but it is better to be vaguely right than precisely wrong);
- Climate change predictions need to be linked to a socio-ecological model of the protected areas and surrounding landscapes as a basis for assessing vulnerability and planning responses (especially during planning exercises);
- Change scenarios need to be built on the best available climate change models;
- Use of expert knowledge should be maximised in understanding impacts.

Tools and resources include MIRADI, Data Basin³⁴ and CAKE³⁵ online resources. Examples and potential case studies suggested included Banff national park in Canada, linking climate change to a socio-economic model; and work by Professor Peter Duiinker of Dalhousie University on forest communities.

Baselines and socio-economic modelling for climate change

Best practice

The working group highlighted a number of best practices when considering scaling down predictions and developing base-line data for understanding climate impacts at protected area site level, including:

- Re-evaluate monitoring plans in relation to climate change;

³³ <http://www.climate-standards.org/>

³⁴ <http://databasin.org/>

³⁵ <http://www.cakex.org/>

- Link baseline and monitoring information collection to socio-economic and climate change models;
- Nest climate change monitoring into broader protected area monitoring;
- Maintain at each protected area a weather station network as a basis for finer scale climate change predictions (linked to weather station grid for the region at appropriate standards, where this is possible);
- Establish partnerships with research institutes, universities and others working on climate change issues;
- Search out historical weather data and palaeontology studies and analyze this as baseline;
- Apply both generic indicators and additional site specific indicators for monitoring climate change;
- Maximise use of expert knowledge in understanding impacts.

Tools and resources of use in this respect include: the Center for International Earth Science Information Network³⁶ which has compilations of climate data; the GLOCHAMORE (Global Change in Mountain Regions³⁷) project which aims to develop a global change research strategy for mountain regions, in particular, for protected areas such as United Nations Educational, Scientific and Cultural Organization (UNESCO) Biosphere Reserves³⁸; the global observation network in alpine environments (GLORIA)³⁹; the Tropical Ecology Assessment and Monitoring (TEAM) network⁴⁰; the Food and Agriculture Organization of the United Nations (FAO) Global Terrestrial Observing System⁴¹ and the UNEP-WCMC.

Examples and cases studies to be investigated which can provide best practices and lessons learned include: Reef Watch⁴², a community environmental monitoring project, in South Australia; frog monitoring in Costa Rica⁴³; polar bear and ice cover monitoring by WWF Canada and partners; weather and permafrost monitoring for climate change by Parks Canada at Ivvavik National Park and studies on climate change impacts carried out in the Australian Alps.

³⁶ <http://www.ciesin.org/>

³⁷ http://www.nbu.ac.uk/biota/glochamore_page.htm

³⁸ http://www.edinburgh.ceh.ac.uk/biota/glochamore_page.htm

³⁹ <http://www.gloria.ac.at/>

⁴⁰ <http://www.teamnetwork.org/en/>

⁴¹ <http://www.fao.org/qtos/>

⁴² <http://www.reefwatch.asn.au/>

⁴³ RANA - Red de Análisis para los Anfibios Neotropicales Amenazados <http://rana.biologia.ucr.ac.cr/>

Major gaps in knowledge and information were identified and needs identified:

- A list of key/ generic indicators;
- Consideration of synergistic impacts on climate change;
- Hydrological monitoring and impacts outside protected areas;
- Matching existing global monitoring systems to various biomes.

2.6 Introduction: Role of threat assessments in understanding climate change impacts

Jamison Ervin, UNDP and Loring Schwarz, Loring Schwarz Associates

Threat assessments

Protected area threat assessments are often a “black box”; we need to unpack climate related threat assessments in order to understand their full implications and bring them into planning.

There are many different scales of threat assessments: regional or landscape scale to locate and prioritize new protected areas; at protected area system level to identify most prevalent threats and most threatened areas; and at protected area site level to develop strategies and to improve protected area site-level management. And there are also different levels of assessment, from simple lists to detailed mapping, and assessments can be carried out from a coarse to fine resolution.

Assessments can also be made to different scenarios, timelines and levels of certainty looking at varying intensities of threat impacts; i.e. very high; high; moderate; low and beneficial. Threats can also be combined in a number of different ways, for example by simply adding them up, or through some approach that includes the potential for synergism between threats or with an algorithm.

The following diagram summarises some of the steps needed to incorporate climate change into protected area threat assessments, including information needs, understanding and responses strategies.

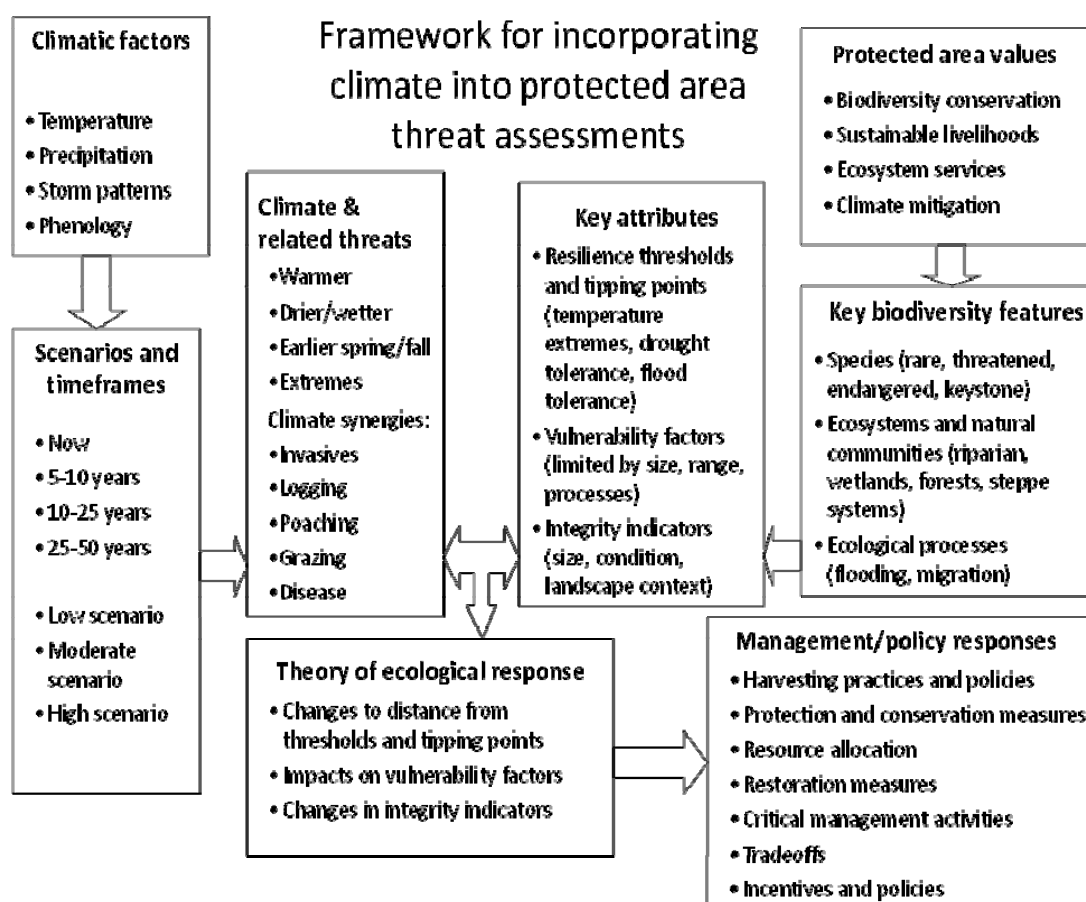


Figure 2: Framework for incorporating climate into protected area threat assessments

In this diagram, if a pressure-state-response model is applied:

- Climatic factors, the related scenarios and other related threats are *pressure*;
- Protected area values, key biodiversity features and inherent attributes are *state*;
- Theory of ecological responses and management responses are *responses*.

The model was applied to populations of Saiga in Mongolia.

Conservation Action Planning to address climate change impacts on key biological features

TNC's Conservation Action Planning (CAP) methodology has been applied with respect to climate change to 20 projects in 5 "classes": mountains; grasslands and drylands; estuaries, lakes and wetlands; coastal and marine; and regional scale projects (terrestrial or marine). The standard CAP model is shown in figure 3: in this application identification of Key Biodiversity Features and Hypotheses for Change are both particularly important.

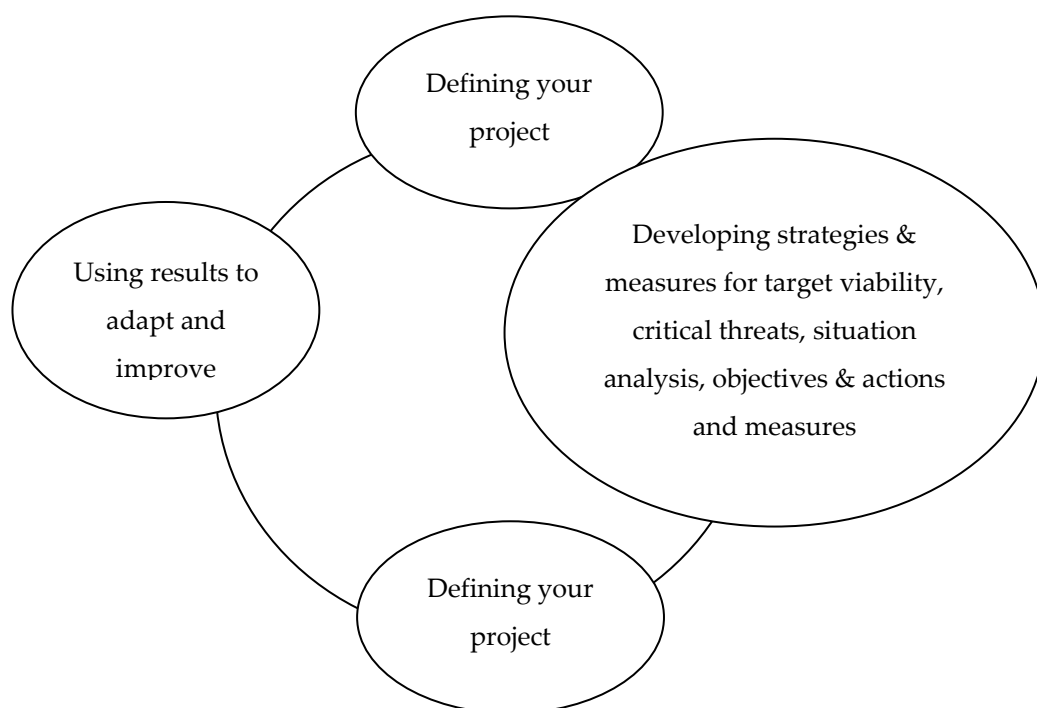


Figure 3: **Standard CAP model**

Integrating climate concerns into the CAP encourages managers to consider the likely impact that climate will have on key biological features in the protected area, either directly or through the impact of human response to climate change. These predictions are captured in predicted ‘hypotheses of change’, which can help to identify better climate savvy management strategies. See Conserveonline⁴⁴ for details on Climate CAP processes and results in different ecosystems across the globe.

Table 1: **Some examples of “hypotheses of change” in key ecological attributes due to climate change**

Conservation target	Climate factor	Key ecological attribute	Hypothesis of change	Likelihood of impact
Mangrove ecosystem	Sea-level rise	Erosion deposition sediment regime	Predicted increase in sea level will accelerate <i>erosion – deposition regime</i> moving mangrove ecosystem into adjacent upslope areas	Virtually certain

⁴⁴ <http://conserveonline.org/workspaces/cbdgateway/cap/index.html>

Conservation target	Climate factor	Key ecological attribute	Hypothesis of change	Likelihood of impact
Patch coral reef ecosystem	Ocean temperature	Live coral cover	Predicted increase in ocean temperatures (2-4 degrees C) will reduce live coral cover for patch coral reef	Very likely
Riparian ecosystem	Snowmelt	Hydrologic flow regime	Significantly reduced winter snowpack (~20-40%) will alter the spring and summer <i>hydrologic flow regime</i>	Uncertain
Tropical dry forest ecosystem	Temp + precipitation (no. of dry months)	Fire regime	Higher temperatures (x-y degrees C) and lower/ similar precipitation will increase <i>intensity, frequency and extent of fires</i>	Likely

Summary of key advice from those participating in the first Climate CAP workshops:

- Understand impacts of climate on the Key Biodiversity Features you are trying to protect;
- Develop Hypotheses of Change to key attributes of those features;
- Predict human responses that will also be threats;
- Decide which threats are the most important to address;
- Develop strategies and evaluate;
- Measure, adapt and learn.

In addition:

- Do not get bogged down in information overload; choose the best references and experts;
- Work on a 50 year timeframe – beyond which uncertainty interferes with strategy development;
- Use Key Ecological Attributes (KEA) to work out which climate impacts are threats; definition of KEA can be found at the Conserveonline website.
- Be mindful of how KEAs will be impacted in the future. Will your local priority be viable? Will you need to make trade-offs?
- Do you need to re-define your KEA's? Will the KEA change in time due to climate change?
- Uncertainty demands that we think in terms of ranges rather than absolutes;
- Develop conceptual models and diagrams with other stakeholders.

2.7 Working group results: Role of threat assessments in understanding climate change impacts

Loring Schwarz, Loring Schwarz Associates

The first issues discussed were based around how to evaluate **diverse timelines, scenarios, uncertainty factors, future threats and unanticipated changes caused by climate change impacts**. Best practices identified included:

- Consult best resources, tools and specialists about proposed climate impacts to the protected areas;
- Understand how climate has already changed and its impacts;
- Consider natural climate cycles including extremes to differentiate from climate changed world;
- Be explicit about what you want to protect and the timeline you are to use;
- Proactively identify resilient refugia and migration corridors (e.g. low climate change impact areas, north/south slopes); buffer/enlarge area strategically to protect resiliency and ecosystem services if possible;
- Encourage proactive management energized with science underpinnings; much of this management will emphasize things that you are already doing... you may need to apply management techniques (e.g. fire, invasive species control) more intensively and review them more regularly;
- Anticipate additive, synergistic and increased intensity of climate and existing threats;
- Evaluate societal threats from outside protected areas;
- Determine how ecosystem services and sustainable livelihoods are affected by all threats.

Key tools and resources which can help in developing threat assessments include local experts, data resources and climate models; CAP applied to climate change, including Hypotheses of Change, understanding ecosystem services and carbon evaluation methods.

Examples and cases studies to be investigated which can provide best practices and lessons learned include: bark beetles in Romania; reef resilience⁴⁵; Saiga and drought; and water resources in the Mediterranean.

⁴⁵ www.Reefresilience.org

Gaps which need to be addressed in relation to threat assessment for climate change include further development of climate models; better temperature and monitoring data and improved social, economic and resource trend information.

For effective threat assessment there is a need to better understand **key features and particularly their resilience thresholds, limiting factors and vulnerability to combined threats**; best practices include:

- Develop vulnerability analysis of your key features in protected areas;
- Understand the role of different ecological processes; and the vulnerability of each to climate change;
- Try to estimate the synergistic effect that climate change will have on other threats to ecological processes and Key features;
- Understand the significance and role of limiting factors for identified Key Features and how this may impact protected area objectives;
- Recognise scale and variety of threats and threat assessment (e.g. poaching and peat protection) and ranking relative to management objectives and key attributes so that you can prioritize your efforts more efficiently;
- Eliminate perverse incentives;
- Use not only data but also long term model patterns to avoid false hypotheses and prioritize threats;
- Consider how periodicity and intensity become more than possible to overcome;
- Use qualitative understanding and management expertise where necessary to determine trigger points for taking action against a particular threat;
- Establish clear “triage” guidelines based on rough thresholds and limits to make hard choices if trade-offs need to be made;
- Think at regional or larger scales about resilience; you may find common bonds with other managers for regional and national protected area strategies;
- Understand how systems recover from extreme events;
- Encourage research, monitoring information exchange and build on traditional knowledge.

The need to clarify management objectives and visions and use them both in guiding threat assessments was stressed. Best practices in relation to this point include ensuring a thorough process of understanding how objectives need to evolve with dynamic understanding and periodic review and incorporate into threat assessments and using the information from adaptive management and monitoring of key features to update management objectives.

3 Managing for climate change

3.1 Overview: Managing for change

Michael Dunlop, Commonwealth Scientific and Industrial Research Organisation (CSIRO) Climate Adaptation Flagship

There will be a cascade of impacts caused by climate change and involving: the wider environment, individual biology, individual ecology, species populations, ecosystems and societal values.

These many types of change include:

- Changing interactions between species;
- Individual species responses.

Change is expected in a wide range of ecological parameters that are important for conservation and society, including: distributions, abundance, interactions, ecosystem processes and threats. Many of these changes are still very hard to predict. The impacts of climate change will affect all aspects of biodiversity management.

The key message for adaptation is that, while significant change to biodiversity is highly certain, there will be many types of change and there is much uncertainty about the specific details of future changes and losses.

Impacts vary regionally and different methods and models also predict different changes, making it hard for managers to know who to believe and to make informed choices. There are three overarching scenarios or “mental models” of change:

1. Local adaptation;
2. Macro-scale distributional shifts;
3. Influxes of “new” species, both exotic and native.

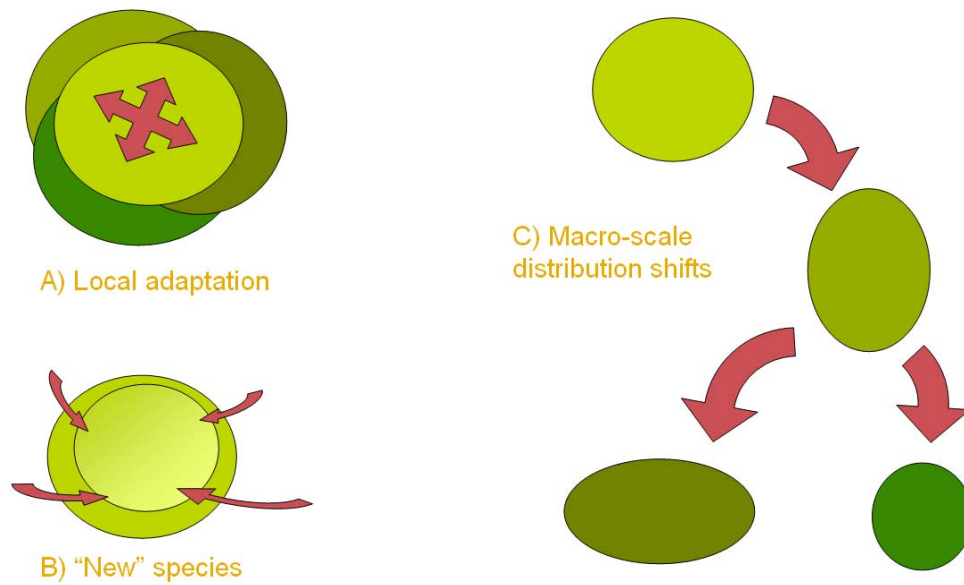


Figure 4: **Three mental models characterising different ecological outcomes as a result of climate change. The different colours represent different environments, and the arrows represent population shifts as different environments become suitable**

There is good evidence for all three types of change— any one could dominate ecological outcomes in different places in coming decades—and each has its own management and research implications. Managers and planners need to keep all three models in mind when developing adaptation responses.

The inevitability of widespread ecological change means that the conservation challenge is changing; this can be summed up as “manage the change ... to minimise the loss”. But this begs the questions which species, ecosystems or regions should we target for conservation efforts? One problem is the high level of uncertainty about the impacts of climate change. *Detailed and accurate predictions* about species and ecosystems will never be available. There are also evolving objectives for conservation, which change our priorities over time. Adaptation strategies need to accommodate these issues.

Types of management strategies

Various types of adaptation strategies have been suggested, but each has its limitations, for example:

- *Proactive*: entailing predicting and often optimising; but uncertainty is high.

- *Reactive*: entailing planning, monitoring and responding; much more certain, but quite possibly “too late” as detecting change is hard in the face of variation;
- *Practice robust management*: entailing developing strategies that work under all contingencies (for many species and impact scenarios); have no regrets (minimal “down side” risk) and work with minimal information requirements (as they are not dependent of the details of specific predictions); but they are less targeted and may not be the most effective strategy in a specific contingency.

The journey to managing climate change for protected area managers should thus take several steps:

1. Acknowledge the need to do something; but also the need for local agreement;
2. Revise management objectives: *manage the change, minimise the loss*;
3. Develop adaptation options: noting the likely effectiveness and knowledge requirements of different types of strategies;
4. Implement: ideally within existing management, but probably with new information.

There is often a desire to rush from step one to three and four; however reassessing management objectives is critical—potentially with major implications for choices of strategy and implementation. Managing for climate change is a learning journey with many iterations; the answers must eventually be developed *by* managers, not *for* managers, although experts can help. The question for this session of the workshop is to work out how can we help best?

3.2 Introduction: Managing species: identifying risk, impacts, management options

Jeff Price, WWF

Climate is always a potential stressor for ecosystems; protected area managers need to be aware of how climate can impact on a particular protected area and reduce vulnerability to variation. Climate change alters everything – the entire management matrix changes – habitats, animals, agriculture, fisheries, water, sea-level rise... managing changes on this scale requires major responses.

The following text summarises information on two initiatives that can help managers make the responses necessary: the **Wallace Initiative**⁴⁶ and **ClimaScope**⁴⁷. The Wallace Initiative is developing a web-based tool that provides mapping of likely ranges for species, in which users:

- Select either family, genus and species for analysis (so for instance analysis is possible at both family level or individual species level);
- Select emission scenario and climate model;
- Select time scale;
- Select dispersal options (i.e. none, realistic, optimal, full).

Output will be in the form of GeoTIFFS (georeferencing information to be embedded within a TIFF file), KML (a file format used to display geographic data in an Earth browser, such as Google Earth and Google Maps) giving top three climate variables. The tool can be used to help calculate adaptation solutions, adaptation requirements and importantly identifies existing thermal refugia.

CLIMASCOPE (Coherent Climate and Impacts Visualisation System) is another web-based tool that includes:

- Temperature (max, min, mean), precipitation, wet day frequency, sea surface temperature, cloud cover;
- BioClim variables from Wallace Initiative;
- Can view output on chain of greenhouse gas (GHG) emissions, GHG concentrations (single gases and equivalent CO₂), global climate, regional climate, impacts;
- Weather generator for extreme events and probabilities;
- Multiple time-slices (post 2020);
- Uncertainty surfaces (scatter plots);
- Impacts models linked in a coherent fashion;
- Scenarios linked to the Intergovernmental Panel on Climate Change (IPCC) process, stabilization scenarios or custom scenarios;
- Allows tiling with thousands of public (or your own private) data sets, especially useful for livelihoods issues;
- Uploading of individual data sets for co-analysis;
- Free, web-based. Low bandwidth specified. No bandwidth stand-alone version can be provided. Web enabled cell phone possible.

⁴⁶ <http://www.elanadapt.net/the-wallace-initiative>

⁴⁷ <http://www.elanadapt.net/climascope>

3.3 Working group results: Managing species: identifying risk, impacts, management options

Marc Hockings, Associate Professor, University of Queensland

Species prioritisation

The discussion started by identifying best practice management in relation to prioritising species most under threat from climate change; these included:

- Clarify conservation values and link to associated species and other dimensions of biodiversity (and hence management objectives);
- Understand species interactions/ecosystem linkages for these species (social - ecological models);
- Use ranking schemes (e.g. values, political etc);
- Link to climate threats (impact models);
- Use available life history/biological knowledge to understand vulnerability;
- Monitor climate vulnerable species;
- Consider extremes versus means;
- Minimising change versus managing change;
- Use of flagship species to attract conservation resources.

Two key information resources for this issue were noted: Foden, W. et al. (2008): *Species susceptibility to climate change impacts*⁴⁸ and Galbraith, H and J Price (2009) (draft): *A Framework for Categorizing the Relative Vulnerability of Threatened and Endangered Species to Climate Change*⁴⁹. Possible case studies identified to illustrate issues of species management under climate change included: Musk Ox reintroduction (and associated problems); marine turtles in Costa Rica and restoration in the wet tropics (missing key attributes).

Major gaps in information in relation to managing the impacts of climate change and species identified by the working group included: connection between scientific knowledge and management (and traditional knowledge and policy); missing information on species interactions and understanding of species importance.

⁴⁸ http://cmsdata.iucn.org/downloads/species_susceptibility_to_climate_change_impacts.pdf

⁴⁹ <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=203743>

Synergistic threats

The discussion then moved on to discuss synergistic threats and related best practice, which included:

- Consider synergism amongst threats;
- Manage/prevent disturbance regimes;
- Consider ecosystem capacity to support species and address threats to this;
- Consider likely social-economic and consequent land use changes arising from climate change;
- Use management effectiveness tools to monitor changes to threats and impacts.

Resource needs and sources were discussed; and the need to access resources from REDD+ and other carbon projects and ecosystem services/poverty alleviation and adaptation funding were noted.

Examples and possible case studies to be included in the best practice series suggested included: Liana vines and fast growing trees; CO₂ fertilization (impacts on protein, growth); agriculture (food security, biofuels); Siberian crane.

Invasive alien species (IAS) and invasive species versus colonists

It was suggested that the best practice guidelines include a section on IAS and invasive species versus colonists; and four best practices were noted:

- Consider native species (colonists?) separately
- Consider vulnerability to IAS from species loss as a result of climate change and climate change related disturbance;
- Monitor invasion and early intervention is critical;
- Apply integrated IAS approach.

Examples and possible case studies should consider: species modelling; integrated approach; Global Invasive Species Programme examples; examples from South Africa and freshwater fisheries in Arctic.

Major gaps identified were lack of awareness of significance of IAS by managers and not enough sharing of case studies.

3.4 Introduction: Managing for overall ecosystem resilience

David Hole, Conservation International, Science and Knowledge Division

Resilience can be defined as: “*The magnitude of disturbance that can be absorbed by the ecosystem before the variables and processes that control its behaviour change, and move into another stability domain*”. However – there is ambiguity in its use in relation to ecosystems, even in the peer-review literature.

Resilience is impacted by humans:

- The less resilient the system – the lower the magnitude of disturbance it takes to cause it to flip to an alternate state (e.g. coral reefs may flip from coral dominated to algal dominated states following over-exploitation and in the presence of other pressures such as pollution);
- We have been massively reducing the capacity of ecosystems to cope with change by modifying them (top-down and bottom-up pressures);
- Evidence indicates human-modified ecosystems usually get transformed into less productive or otherwise less desired states;
- Ecosystem service provision declines = reduces mitigation and adaptation options and impacts human wellbeing.

It is increasingly being recognised that resilience to climate change and health of biodiversity are inter-connected:

- *For example* – the removal of large-bodied seed dispersers leads to **reduced forest carbon density** (Brodie, J and H Gibbs, 2009, Bushmeat Hunting as Climate Threat, *Science*⁵⁰);
- There is a growing body of evidence that ecosystems are **more resilient/recover faster** from disturbance under higher levels of biodiversity;
- High levels of biodiversity provide a classic “insurance” effect – functional-group and functional-response diversity.

Maintaining biodiversity can thus also help to maintain ecosystem resilience to climate change. Examples of management options at a site-scale include:

- Mitigation of other threats – e.g. invasive species, pollution;
- Maintenance of key species’ interactions and functional diversity;

⁵⁰ http://foodsecurity.stanford.edu/publications/bushmeat_hunting_as_climate_threat/

- Maintenance of appropriate disturbance regimes – e.g. fire, flood pulse.

Examples of management options at a landscape-scale or with large reserves include:

- Maintenance of landscape heterogeneity – i.e. different successional stages;
- Capturing environmental gradients within protected areas;
- Maintenance or creation of corridors and stepping stones;
- Maintenance of key ecological/abiotic processes – e.g. hydrology.

Protected area management in the real world however is pretty generic – how do we target and prioritize these actions to the ecosystems that are most at risk of losing resilience? How to make this relevant to the manager on the ground? There is a lack of data to characterize/understand key ecosystem interactions. Despite the potential to utilize “no regrets” management actions to address climate change (i.e. actions that increase resilience to both current non-climatic threats AND to potential future climate stressors), many management actions will be additional to what managers have to do already – on highly limited budgets! Landscape options in particular assume new sites can be set-up or at least existing sites added to – how realistic is this in most areas of the world?

Issues for the working group to consider:

1. What is already available for managers? – e.g. approaches and tools currently available;
 - Numerous indicators of likely severity of climate change – e.g. “velocity” of change in temperature;
 - But all these indicators deal with climate change – what exists for resilience?
2. What experiences can managers draw on? – e.g. best practices and case studies (short presentations from participants):
 - What have you found useful for thinking about resilience and climate change?
3. What else do managers need? – i.e. gaps and needs – e.g. guidance, best practice examples, research:
 - No clear framework for rapidly assessing resilience of an ecosystem.
4. What resources do managers need? – e.g. finances, knowledge and capacity:
 - Is it simply only about the need for extra financial resources to implement resilience promoting strategies? What about capacity?

3.5 Working group results: Managing for overall ecosystem resilience

Jamison Ervin, UNDP

Key themes

- Identifying key thresholds and tipping points in relation to resilience; understanding what key ecosystem processes are present and how they relate to resilience; and identifying key issues for resilience-based research issues (especially related to thresholds and tipping points);
- Landscape-level planning for ecosystem resilience (connectivity);
- How to define ‘pockets of resilience’, identify local refugia; define gradients;
- How do we need to modify current management practices to take into account ecosystem resilience?
- The role of connectivity, multi-scale bioregional planning landscape in encouraging resilience.

Key questions

- How do you manage to have resilience in various climate scenarios?
- Are we looking for resilience in current conditions or future conditions?
- Is resilience a useful concept? Should we focus simply on improving integrity?
- Are there multiple definitions on resilience and do we need a clearer definition?
- Do we need to redefine resilience to be more relevant and appropriate?

Best practices

- Management plans should include clear objectives that identify, maintain and proactively manage refugia and pockets of resilience (e.g., intensify existing management activities such as flow levels, maintain landscape heterogeneity);
- Define and apply thresholds of potential concern for key protected area management objectives (e.g., biodiversity, sustainable livelihoods and ecosystem services);
- Identify key processes that are required in order to sustain the key biodiversity features that maintain primary protected area values (e.g., biodiversity conservation, sustainable livelihoods, ecosystem services);
- Identify the key attributes that we can maintain as biodiversity changes -- whatever we are seeking to maintain, it must be maintainable as the climate changes; we should look for overlaps in present resilience and future resilience models – natural cover, functional diversity, heterogeneity, natural processes;

- Identify key attributes that describe and define a resilient system;
- Communicate with a broad constituency about benefits of resilient protected area systems in terms of maintaining ecosystem services;
- Encourage governance systems of protected area use and protection that are flexible and responsive to the system (e.g., dynamic management practices, adaptive policies, seasonal reserves);
- Build in the use of key concepts in conventions and bi-lateral and multi-lateral funding (e.g., building into GEF a shift from site-level to systems-level planning);
- Incorporate ecological land units into gap assessments (conserve the stage, not the actors) for future climatic scenarios.

Tools and resources

- Economic valuation of ecosystem services such as The Economics of Ecosystems and Biodiversity (TEEB) process;
- Jeff Price's refugia work;
- Resilience Alliance⁵¹;
- South Africa work on thresholds potential concern (Kruger National Park);
- Walker, B.H. and D. Salt (2006): *Resilience Thinking: Sustaining Ecosystems and People in a Changing World*. 174p. Island Press, Washington, D.C., USA;
- Series of tools associated with forecasting; climate change trends where there are likely to be refugia pockets.

Case studies

- South African National Biodiversity Institute⁵² tools for assessing resilience at landscape level; special ecological concern, evolutionary processes, patterns and functions;
- South Africa bioregional planning on resilience;
- WCS – National Center for Ecological Analysis and Synthesis (NCEAS) Adaptation for Conservation Targets Framework (Cross et al, in review, Environmental Management) *Adaptation for Conservation Targets*⁵³;
- Australia – national water commission;
- Australian Alps restoration discussion on bog communities which assist in water delivery;
- Namibia – adaptation strategy for ecosystem resilience;

⁵¹ www.resalliance.org

⁵² <http://www.sanbi.org/>

⁵³ http://nmconservation.org/dl/6_Cross_TNC_bearriver_final.pdf

- Boreal forests, Kazakhstan; Russia managing forests in Altai Sayan for resilience; Armenia programme looking at strategic priority on adaptation, forest ecosystems to enhance resilience looking at pest outbreaks and fire management.

Gaps

- Data gap: no agreement on what we want to protect, how the ecosystem functions (basic ecological model); or the appropriate climate change model;
- Thresholds and tipping points for extinctions, regime shifts, major degradations in ecosystem services functioning;
- Lack of national expertise; gap in training;
- Clarification of how buffers, connectivity is applied for resilience;
- Gap between CBD's mandates and IUCN-WCPA agenda and priorities as well as national agendas;
- Lack of development of ecological networks.

3.6 Introduction: Working with communities on managing and understanding climate change impacts

Stanislav Kim, UNDP Kazakhstan

Changes in temperature, precipitation, sea-level and extreme weather events will impact on:

- Health: mortality, diseases, illness;
- Agriculture: crop yields, pests, irrigation demand;
- Disasters: frequency, intensity, new threats;
- Water resources: supply, quality, competition;
- Coastal systems: erosion, inundation, infrastructure;
- Natural resource management: loss of habitat and species.

Climate change is global, but impacts are regional and local. Impacts will affect different communities differently based on their specific circumstances ... so, solutions must be locally specific. UNDP has several on-going projects and approaches which offer important insights into how we can better work with local communities in managing and understanding climate change impacts.

Community based adaptation (CBA)

CBA is:

- Community-driven;
- The grass-roots component of climate change adaptation;
- Can respond to locally specific needs, and develop lessons for global and national stakeholders to further adaptation practice.

The CBA is a global programme, with pilot countries selected to represent a variety of ecosystems and climate impacts. The CBA will be implemented in 10 countries: Bangladesh, Bolivia, Guatemala, Jamaica, Kazakhstan, Morocco, Niger, Namibia, Samoa and Viet Nam.

CBA Projects and Strategic Programme for Adaptation

- CBA Projects will be community-driven, addressing local development priorities;
- Like normal GEF Small Grants Program⁵⁴ projects, CBA projects will be selected in regions where community development priorities and global environmental objectives overlap...;
- ...and where communities are vulnerable to climate change including variability...;
- The CBA will operate where Global Environmental Benefits and adaptation priorities overlap.

Some of the challenges in relation to CBA project include: low interest of potential applicants because of: 1/1 co-financing requirements; no clear understanding of what type of activities are suitable for adaptation projects and which ones are not; difficulty of achieving tangible results in the project life time; due to the continental climate of Central Asia ordinary people and local communities are not convinced about the reality of climate change risk; there is no state support for climate change and adaptation projects; and there are a limited number of qualified experts who are ready to cooperate.

Vulnerability Reduction Assessment (VRA) Methodology

- The VRA approach is an important element of UNDP's monitoring and evaluation framework for climate change adaptation projects at the community, sub-national, and national levels;

⁵⁴ <http://sgp.undp.org/>

- The VRA can be compared to a guided participatory rural appraisal (PRA), focusing on community perceptions of vulnerability to climate change and capacity to adapt;
- The VRA's perception-based approach is a key complement to quantitative indicators that are also used to measure project results;
- The VRA is based on a composite of four indicator questions, tailored to capture locally relevant issues that are at the heart of understanding vulnerability to climate change:
 1. Vulnerability of livelihood/welfare to existing climate change and/or climate variability;
 2. Vulnerability of livelihood/welfare to developing climate change risks;
 3. Magnitude of barriers (institutional, policy, technological, financial, etc) barriers to adaptation;
 4. Ability and willingness of the community to sustain the project intervention.

Participatory Video (PV)

- PV is a set of techniques to involve a group or community in shaping and creating their own film;
- The idea behind this is that making a video is easy and accessible, and is a great way of bringing people together to explore issues, voice concerns or simply to be creative and tell stories;
- This process can be very empowering, enabling a group or community to take action to solve their own problems and also to communicate their needs and ideas to decision-makers and/or other groups and communities;
- PV can be a highly effective tool to engage and mobilise marginalised people and to help them implement their own forms of sustainable development based on local needs;
- In PV the subjects make their own film in which they can shape issues according to their own sense of what is important, and they can also control how they will be represented.

Almanario Project

Almanario is a participatory community project development tool developed for designing projects. *The Almanario* is a simple tool – it is a booklet of about 15 pages – designed to allow semiliterate communities to define the key elements of a project. By facilitating the involvement of communities in the design phase, the tool promotes

ownership, and is used to build capacity of local communities in project management skills. Almanario uses the logical framework theory and is designed to be easy to use by communities.

3.7 Working group results: Working with communities on managing and understanding climate change impacts

Nigel Dudley, Equilibrium Research

Community involvement is critically important, but work is required to develop recognition of climate change issues at community level. Important steps include:

- Link climate change to immediate issues;
- The need for effective communication and genuine participation – there is currently too much lip-service to participation;
- Clear case studies (written or orally presented) from similar environments.

Climate change can create new opportunities for protected area strategies:

- The potential of protected areas to contribute to ecosystem services such as water and food security can appeal to local communities;
- Modification of gap analysis can help in identifying these services;
- There is still a need for simple economic assessment tools.
- Some of the areas identified for protection under these new scenarios may be beyond IUCN categories I-VI, i.e. may not be protected areas;

Possible case studies for illustrating community involvement in the best practice series were suggested including: the presented experience in Kazakhstan; examples from the GEF/UNDP small grants programme; Turkey; Caucasus partner-building case study; Beverley-Kaminurak Caribou Management Board, Canada and Brazilian indigenous people and carbon credits. Reports on Sri Lanka, Tanzania, Zambia, Nicaragua and Guatemala tests of CRiSTAL (Community-based Risk Screening Tool – Adaptation and Livelihoods)⁵⁵.

⁵⁵ <http://www.cristaltool.org/>

4 Biome management

4.1 Overview: Biome management

Yildiray Lise, UNDP Turkey

All biomes are important reservoirs of carbon. Different biomes have different levels of ecological and social impacts in relation to climate change and thus different priorities, different threats and different management practices. Current changes in land and water use are causing loss of stored carbon, often at an accelerating rate. Some changes also reduce the ability of ecosystems to capture additional carbon dioxide. For example, inland wetlands and peatlands store high amounts of carbon and their protection is thus critically important but, like many other ecosystems, they may be either net sources or sinks of carbon, depending on conditions and management practices. Forests are the world's largest terrestrial carbon stock and continue to sequester large amounts of carbon, but they are under risk of deforestation, degradation and the long-term impacts of climate change. Grasslands are potentially a major carbon sink but loss and degradation are currently releasing large amounts of carbon; they can be sinks or sources of carbon depending on management, precipitation and CO₂ level.

Four strategies for managing climate change:

1. **Fieldwork, research and application:** This strategy includes site-level and national-level **testing**, experimentation, applied **research** and adaptation and mitigation **projects**.
2. **Knowledge sharing and capacity building:** This strategy includes the synthesis and analysis of best practices through **workshops** and literature reviews, the development of guidance **tools** and documents for **practical application of best practices**.
3. **Communication and outreach:** This strategy includes activities aimed at promoting and **communicating** climate change adaptation and mitigation through protected areas, and **coordinating** communication efforts across organizations.
4. **Policy:** This strategy includes influencing intergovernmental processes, such as the CBD Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA), the UN General Assembly and the Climate Summit, shaping donor priorities, and creating favourable governmental policies.

A national workshop on protected areas and climate change held in Ankara, Turkey in February 2010 resulted in a *Draft National Strategy on Protected Areas and Climate Change*⁵⁶ developed by 120 experts in three working groups. This workshop was organized by WWF-Turkey, under the Protected Areas for a Living Planet Programme and in partnership with Ministry of Environment and Forestry, UNDP-Turkey under joint GEF funded project of “PIMS 1988: Enhancing Coverage and Management Effectiveness of the Subsystem of Forest Protected Areas in Turkey’s National System of Protected Areas”.

The results can provide a good starting point for this working group’s discussions:

- **Forests:** local actions needed for threat management – experience sharing is crucial;
- **Wetlands and Steppes:** lack of awareness of their importance, threats are increasing;
- **Marine and Coastal:** less information on climate change impacts.

Management actions for both climate change adaptation and mitigation are equally important and it is also necessary to think beyond the boundaries of protected areas in developing strategies. First steps include identification of conservation values and management objectives, including management for:

- Conservation/carbon;
- Livelihoods;
- Ecosystem health;
- Threats;
- Ecosystem services
- Resilience.

Key actions for biome management include:

- More and larger protected areas;
- Connecting protected areas within landscapes (connectivity);
- Understanding biome dynamics;
- Clarifying conservation values and management objectives;
- Updating management plans with climate change concerns;
- Improving management within protected areas;
- Increasing management effectiveness of protected areas;

⁵⁶ <http://www.kdmp.gov.tr/>

- Increasing the level of protection for carbon stores within protected areas (special attention to refugia);
- Working out the best management strategies (focusing on management specifically on mitigation and adaptation needs);
- Enhancing resilience of ecosystems;
- Integrating approaches to protection and ecosystem services (clean water supply, food security);
- Maintaining key species interactions for biome-restricted species;
- Maintaining key ecological / abiotic processes in the related biome;
- Appreciating lessons learned from traditional knowledge and practices;
- Communicating protected areas critical role in climate change mitigation and adaptation for wider public support;
- Establishing monitoring systems.

4.2 Introduction: Forests and mountains

Yildiray Lise, UNDP Turkey

Forests are important for biodiversity, and they generate critical ecosystem goods and services such as water, food and income from over 5,000 commercial forest products. Mountains are early indicators of climate change. The average rate of thickness loss measured on 30 reference glaciers worldwide has doubled since the year 2000 compared with the period 1980-1999. Forests and mountains sustain the cultural and spiritual identity of billions of people, foremost among them the indigenous peoples and local communities.

Major threats to forest and mountain biomes include:

- Deforestation;
- Land use changes (e.g. conversion to agriculture, settlements);
- Fires;
- Illegal logging / excess fuelwood demand;
- Diseases – beetle outbreaks/epidemics;
- Uncontrolled grazing;
- Poaching.

Major climate change impacts to forest and mountain biomes include:

- Habitat shift (e.g. change in forest type and altitudinal habitat shift);
- Loss of habitats;
- Loss of forest canopy;
- Increased impacts of diseases – beetle outbreaks/epidemic;
- Higher frequency and distribution of forest fires;
- Melting of tropical glaciers and snow caps (affecting water flows to valleys);
- Afforestation versus protection?

Current management practices include:

- Connectivity: Russia forest case studies, etc.;
- Species management;
- Creating alternatives to destructive practices: e.g. projects such as:
 - Uzbekistan Tugai Forest where gasification schemes supported to cater for 60 households = annual cut reduction by 360 cubic meters = saving 144 ha of virgin forests over 10 years;
 - Morocco High Atlas Mountains: changing cooking patterns;
 - Romania Carpathians: Sawdust briquette making;
 - Uzbekistan: straw-bale houses as an alternative to wood;
 - Turkey Kure Mountains National Park Buffer Zone: Solar heating systems for forest villagers: saving 468 ha of oak coppice forest over 15 years;
- Fire prevention, e.g. UNDP/GEF projects supporting fire-prevention infrastructure in carbon rich boreal forests (Russia, Kazakhstan, Tanzania);
- Monitoring (impacts of climate change);
- Technical applications: Prevention of glacial lake outburst in the Himalaya, or safeguards against slope instability due to permafrost decay in the Alps and northern Europe;
- Controlled grazing: rotational grazing;
- Sustainable Forestry Management: regulation of water quality, protection from natural hazards, alleviation of poverty, conservation of biodiversity, carbon sequestration.

Major gaps in information include: limited tools for experience sharing; thinking and acting beyond boundaries; limited information on new diseases and pests; information on the genetic effects of climate change; fire versus fire suppression.

4.3 Working group results: Forests and mountains

Nigel Dudley, Equilibrium research

The working group first considered **loss and change of habitats** (e.g. altitudinal shift, loss of cloud forests, human migration) and related best practices to these issues and identified the following needs for best practice, to:

- Manage and lead debate about how to conserve species that have lost habitats: e.g. *ex situ*, translocation etc;
- Provide advice on incentive schemes to maintain high priority habitats, including traditional management approaches;
- Carry out a gaps review of current incentive schemes;
- Undertake a vulnerability analysis of key species and habitats;
- Secure assurance populations (*ex situ*) for highly threatened populations and social decisions about the future of these;
- Create and maintain seed banks for species likely to lose habitats;
- Introduce sustainable forestry practices in protected landscapes and buffer zones;
- Take opportunities for expansion of protected areas to secure altitudinal gradient.

Tools and resources: for restoration of habitat – some existing approaches and institutions exist, e.g. REDD; Alpine Convention and Caucasus Convention. Various resources are available, for example: IUCN-Species Survival Commission (IUCN-SSC) amphibians' specialist group; Center for International Forestry Research (CIFOR); IUCN-WCPA Mountains; ICIMOD and GLOCHAMORE. A major gap however is in phenology and an understanding of the implications of timing changes on the survival of species and ecosystems. Possible case studies could be sought from: Madagascar; Moldova and Mesoamerica. Loope, L.L. and T.W. Giambelluca (1998); Vulnerability of Island Tropical Montane Cloud Forests To Climate Change, With Special Reference to East Maui, Hawaii. *Climatic Change*, **39**: 503–517⁵⁷

The working group then went on to discuss **prioritization of biomes and habitats**. Best practices identified included:

- Gap analysis and other prioritisation processes (on global, regional and site level);
- Site prioritisation methodologies;
- Identification of old-growth forest;

⁵⁷ <http://www.springerlink.com/content/x717340541q46248/>

- Identification of areas where high biodiversity overlaps with high carbon habitats;
- Identification of refugia sites.

In addition it was noted that there is a need for a global list of most vulnerable habitats to climate change.

There are many gap analysis tools available and key resources include: WWF; UNEP-WCMC; Meso-America cloud forest group. Possible examples and case studies include Australian Alps; Mongolia (World Bank project); Turkey and World Bank and UNDP/GEF case studies.

In terms of **priorities for management best practices**, both social and ecological, include:

- NGO and protected area managers cooperation;
- Prepare local community decision-makers for likely changes (e.g. in animal populations, water availability), protected area risk management, and provide guidance on how to respond;
- Communicate protected area importance for risk management under climate change;
- Help to build local support.

Tools and resources: Denmark Hydrological Institute⁵⁸. Examples: Governance and ICDP (Integrated Community Development Projects) examples. Major gaps: Participation and awareness amongst communities.

The next topic discussed related to **changes in management practices** – e.g. due to loss of glaciers, changes in grazing etc. In this regard best practices identified were:

- Changes in management of fuel load to respond to different fire behaviour;
- Strengthening responses to invasive species;
- Visitor management to address climate induced hazards (avalanche, flooding, fire etc);
- Guidance on management of transformation of tourist objectives due to climate change – e.g. from snow-based tourism to summer-based tourism;
- Disease and beetle epidemic management.

⁵⁸ <http://www.dhigroup.com/>

Examples and cases: Romania; British Columbia; Russia and Green hikers in Himalaya. Resource people: IUCN-WCPA groups – e.g. tourism; FAO (case studies on under-grazing); IUCN ecosystems management groups. Major gaps: sharing experience and case studies and understanding of the changing relation to fire management.

Monitoring, indicators and management best practice included:

- Design monitoring programme to address vulnerable habitats, ecological change, species, meteorological data and social status;
- Use site-based systems that feed into a global monitoring programme;
- Build information on baselines, gaps and historical values;
- Introduce protected area-based meteorological stations.

Tools and resources: Gloria⁵⁹; GLOCHAMORE; Long Term Ecological Research Network⁶⁰; FAO tools. Examples and cases: Romania long-term; Russian Federation – 10 territories; Cape South Africa; Banff, Canada; ICIMOD; Parks Canada Ecological Integrity. Resource person: Stephen Woodley. Major gaps: Baseline values; Historical values; Monitoring of social issues.

Role beyond boundaries – protected area connectivity best practice:

- Cooperate with other protected area managers for connectivity – transboundary protected areas – with respect to e.g. pest animal, education, monitoring;
- Provide advice with respect to altitudinal connectivity;
- Explore innovative mechanisms to conserve connectivity areas in protected area network;
- Use stepping stones to connect habitats for migratory species;
- Map ecosystem services.

Tools and resources: gap analysis; Alpine Convention; Carpathian Convention; Residential Energy Services Network⁶¹. Examples and cases: Caucasus Transboundary Protected Area, West Tianshan, Meso-American Biological Corridor⁶², Pan-European PA network and Great Eastern Ranges. Resource people: IUCN-WCPA Task Force for Transboundary Protected Areas.

⁵⁹ <http://www.wmrs.edu/projects/gloria%20project/default.htm>

⁶⁰ <http://www.lternet.edu/>

⁶¹ <http://www.resnet.us/>

⁶² <http://www.cbmm.gob.mx/>

Fire and incident management (storm, landslide) best practice:

- Build protected area manager capacity for incident management;
- Collaborative working with other agencies;
- Agree and implement fire management strategy with operational guidelines (distinguish between ecological and operational fire management);
- Develop cooperative fire management actions;
- Apply incident management for protected areas – best practices North America.

Examples and cases: Turkey – low impact logging in Kure Mountains National Park buffer zone and fire management in forest ecosystems; Altai-Sayan cooperative fire fighting and Mexico – learning community for fire management (Comunidad de Aprendizaje de Manejo del Fuego – Camafu)⁶³.

Major gaps:

- Lack of training materials in range of languages;
- Capacity building;
- Limited cooperation;
- Ecological fire management;
- Gaps in legislation.

4.4 Introduction: Freshwater and peatlands

Tatiana Minaeva, Wetlands International

Freshwater and peatland ecosystem services provide many essential services including:

- Water regulation;
- Climate regulation and feedback;
- Highest productivity;
- Specific biodiversity;
- Life and livelihoods;
- Transportation and development;
- Historical, aesthetic, informative;
- Mitigation of catastrophic events;
- Refugia of life.

⁶³ <http://www.camafu.org.mx/>

Peatland is a wetland type where:

- Water logging delays decay;
- Dead parts of plants form peat;
- Peat is an ideal thermo-isolating material for permafrost and is responsible for forming river flow;
- Three components (water, plants and peat) are in obligatory connection to form peatland;
- Peat accumulates for thousands of years storing concentrated atmosphere carbon in thick layers
- As soon as peat becomes dry – it decays or burns with emission of CO₂ and nitrous oxide (N₂O)
- As soon as peat is covered with water in warm conditions – methanogenesis starts (methane – CH₄)

Peatlands occur in 175 countries, covering 4 million km² worldwide (3% of global land surface);

Peatlands are included in greenhouse gas (CO₂, CH₄, N₂O) source inventories under IPCC 2006 Guidelines (Volume 4, Chapter 7 Wetlands⁶⁴). Globally peatlands store 550 Giga ton (Gt) C, which is equivalent to 30% of terrestrial carbon, represents 75% of all carbon in the atmosphere and is twice the amount of carbon stored in forests. However 15% of peatlands are threatened and degrading; which is resulting in the release of 2 Gt CO₂ per annum (25% increase since 1990) or some 6% of global emissions. Hotspots of CO₂ emissions from drained peat are: SE Asia - 1 Gt; EU - 174 Mt; Russia - 160 Mt; Central Asia - 115 Mt and the USA - 72 Mt.

Resolution VIII.17 of the 8th Conference of Parties of the Ramsar Convention in 2002 adopts “guidelines for global action on peatlands” and calls for the establishment of a coordinating committee for global peatlands action plan implementation. But countries have been very variable in how they have reported plans as national reports from 2008 show as shown in table 2.

Table 2: Summary of global peatlands action plan implementation 2008

	Yes	No	Partly	Planned	Not applic.
Europe	12	3	0	0	0
Americas	1	9	5	5	5

⁶⁴ http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_07_Ch7_Wetlands.pdf

	Yes	No	Partly	Planned	Not applic.
Africa	1	22	1	5	10
Asia	6	15	4	2	2
Oceania	1	2	1	0	1

Specific management features needed to manage peat for carbon storage and capture include understanding of:

- Water regime – quality and quantity within and outside protected areas;
- Peat accumulation/storage conditions;
- Adequate area of protected landscapes;
- Adequate distance to next wetland;
- Integrity;
- Cumulative impact;
- Adequate regime for linear object;
- It is also important to remember that for all practical purposes peat is IMPOSSIBLE TO RESTORE.

Sub-themes for discussion might include issues relating to object identification; biodiversity; regulation functions; climate vulnerable features and parameters; monitoring; resources; and livelihoods (local communities and indigenous peoples).

4.5 Working group results: Freshwater and peatlands

Marc Hockings, Associate Professor, University of Queensland

The group's initial discussions focussed on highlighting freshwater and peatlands role in providing **ecosystem services** and in particular **carbon storage**. Issues related to best practice focussed on:

- Make the case for wetlands – listing and quantification of ecosystem services (cost benefit analysis);
- Apply RAMSAR (The Convention on Wetlands (Ramsar, Iran, 1971) wise use guidelines (avoid, mitigate, compensate, restore) – priority for protection;
- Document impacts of alternative energy (hydro, bio, wind) – especially in category V or VI protected areas;
- Document lifecycle impacts of developments/use on water;

- Prevent invasive species, e.g. no live bait , avoid boat washdown etc;
- Avoid inter-basin water transfer.

Relevant tools and resources: InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) of the Natural Capital project⁶⁵. Possible sources for examples and case studies included: Bogotá, Quito, Catskills, Canaima; WWF-World Bank *Running Pure* report⁶⁶; World Bank case studies on watersheds, restoration of ecosystem services; rewetting case studies from Belarus, Indonesia; carbon release from hydropower in tropics; and Canada Hudson Bay lowlands 200,000 sq km – primarily for carbon. Resources noted included: RAMSAR, WWF, World Bank review and river restoration active river management.

Major gaps identified included:

- No good estimate of the amount of carbon stored in peatlands;
- Lack of data on water regulation services from wetlands;
- Understanding of climate change impacts on biodiversity in freshwater systems (food chains, lifecycles etc).

The discussion went on to look at **wetland specific indicators for monitoring**. Best practices noted included:

- Use the RAMSAR list of indicators;
- Evaluate wetland for ecosystem services, biodiversity attributes and functional processes and link indicators to these attributes – specific for each wetland but based on general guidelines;
- Focus on those features vulnerable to climate change.

The lack of guidelines for monitoring of wetlands was highlighted as a major gap in connection to climate change.

In relation to the discussion on **guidelines for assessment of wetlands for adaptive management**, best practices included:

- Put protected areas in a spatial (catchment) and temporal context;
- Consider barriers to migration in watersheds;
- Recognise the special need to manage watershed in partnership with other land users in the watershed;

⁶⁵ <http://www.naturalcapitalproject.org/home04.html>

⁶⁶ <http://assets.panda.org/downloads/runningpurereport.pdf>

- Consider the role of protected areas for flyways and other migrating species (marine etc).

Finally, the group looked at issues of **restoration**; with key best practices being:

- Consider ecosystem services and functionality not just hydrology and species present in restoration, in the context of changed climate not past climate
- Consider connectivity opportunities and limitations in planning restoration or wetlands
- Consider wetlands as options for “soft” engineering solutions.

Tools and resources: Restoration manuals; Belarus manuals; Canada and UK manuals and TNC coastal resilience modelling. Examples and cases: TNC case study in restoration anticipating sea level rise and Belarus peatland restoration project (Alexander Kozulin).

4.6 Introduction: Grasslands and steppes

Sergey Sklyarenko, The Association for the Conservation of Biodiversity of Kazakhstan (ACBK)

The world’s temperate grasslands are the most threatened and least protected biome. Temperate grasslands cover only 8% of the world; of which only 5% is protected.

Within the Palaearctic realm, two biogeographic provinces consist of steppe: the Mongolian-Manchurian steppe (0.6 million km²) and the Pontian steppe (1.9 million km²). The Pontian steppe province contains over 24% of the world’s temperate grasslands. A significant portion of the natural Pontian steppe habitat is found in Kazakhstan and Russia. In Kazakhstan, there are five steppe ecological zones: forest steppe, meadow steppe, dry steppe, desertified steppe and steppe semi-desert. These five steppe zones cover 160 million ha, or about 59% of the country’s territory, and include about 123 million ha of remaining natural habitats.

Habitat fragmentation and loss have had a major impact on the grassland and steppe biome. The key threats are:

- *Conversion to agriculture*: grasslands from the Argentine Pampas, American prairies and tall-grass Western Eurasian steppes have been almost entirely converted to agricultural production.

- *Livestock grazing*: The major land use. Steppe ecosystems are strongly influenced by the presence of large ungulates and other herbivorous mammals. Moderate grazing is essential for the stability of many steppe communities. So the management challenge is to find a balance between “Overgrazing” and “Undergrazing”. In Kazakhstan, for example, Saiga antelope numbers were reduced some 97% by hunting during a ten-year period from 1994-2003. The drastic decline of Saiga, together with changes in livestock numbers and distributions after collapse of the USSR, caused substantial ecological changes across Kazakhstan’s steppe zone. The lack of cyclic grazing has led to massive changes in vegetation, including invasion of weeds. Without grazing, old leaves of steppe plants are not removed before snowfall; as a result, accumulations of old plant material can impede the germination of spring plants. In addition, the increased height and projected cover of vegetation limits the distribution and amount of rodents that are the main food source for many predators.
- *Proliferation of roads*
- *Urbanization, incl. industrial development, mining*
- *Altered fire regimes*: Humans have caused dramatic alterations to grassland fire.
- *Hunting*: Not only threatens target species directly, but also leads to broader, ecosystem-level impacts associated with sharply reduced levels of grazing.
- *Spread of invasive species*.
- *Pollution*: Increased atmospheric CO₂, nitrogen deposition, other pollutants.

Climate change impacts in Kazakhstan: current and projected

Climate change impacts in Kazakhstan are leading to longer periods with stable hot weather in summer; which increases the probability of years with bad grazing conditions for livestock. Under different climate scenarios developed for Kazakhstan it is expected that grassland productivity will increase in the early vegetation period, but lower precipitation will negatively affect the second part of the growth period, when vegetation productivity may decrease anywhere between 30-90%. Synergies between climate change and other human impacts, such as grazing, and increased frequency of drought, may also negatively impact grasslands. The most visible changes are expected in the “border” areas between different steppe types.

Current management practices

Protected areas in Kazakhstan cover 8.1% of the land area; the steppe zone makes up only 2.5% of the area protected. There is an emphasis on a traditional approach to protected area expansion, which will not be sufficient to achieve steppe ecosystem

conservation. There are also inadequate tools, practices and processes for landscape-level conservation. Management is carried out in isolation from the surrounding landscapes and there is a lack of cooperation between conservation agencies, development sectors and land-use planning and governmental agencies etc. Furthermore limited systemic, institutional and individual capacities of protected area also hinder steppe conservation and management.

Altyn Dala Conservation Initiative

Large-scale steppe habitat and key species conservation programme include a number of projects; partnership of national and international organisations (e.g. Committee of Forestry and Hunting of Ministry of Agriculture of Kazakhstan, Association for the Conservation of Biodiversity of Kazakhstan, Frankfurt Zoological Society, the Royal Society for the Protection of Birds with participation of many others). Its aims includes the creation of a network of reserves with total size up to 5 to 7 Million ha.

The UNDP/GEF Project “Steppe Conservation and Management”

This project has three planned outcomes:

1. Protected area system of Kazakhstan contains representative samples of steppe ecosystem under various conservation management regimes and provides effective coverage of ecosystems and ecological processes;
2. Tools for landscape-level steppe conservation planning and management are developed and implemented by key stakeholders (incl. ecological corridors identification and operationalisation);
3. The systemic, institutional and individual capacity for steppe conservation in a wide productive landscape is strengthened.

Key questions for discussion in the working group:

- Current gaps in protected areas management and steppe ecosystem monitoring;
- Possible answers to climate change.

4.7 Working group results: Grasslands and steppes

Jamison Ervin, UNDP

The working group began by identifying the key features of grassland and steppes in protected area management and related best practice:

- *Management objectives are critical:* it is more critical to define the objectives in grasslands because the outcomes will vary so much more than other biomes;
- *Grazing regimes and management practices are critical to maintaining systems:* grazing regimes and management practices are critical to maintaining vegetation, soils, composition of natural communities. There are intricate inter-linkages between threats – e.g. decline of Saiga in Kazakhstan = decline of grasslands = decline of grassland-dependent species;
- *Steppes are about migratory species:* there are very large distances; grasslands are primarily about migratory species;
- *Spatial and temporal patterns are critical:* to protect steppes, there need to be adequate conditions for calving, breeding, migration at specific times of the year.

Best practice: Managers should set clear management objectives about what conditions and processes the grassland/steppes should maintain, and what optimal numbers of ungulates are required, and should design specific grazing regimes and management practices to achieve those objectives;

- *Importance of wider landscape:* it is more critical to manage the wider landscape; this is a challenge in that managers are usually managing fragments or too small patches of grassland, but very large populations of ungulates. Steppe ecosystems require landscape approaches, and the mosaic of land uses all have implications for steppe management;
- *Flexible and innovative management regimes are required:* including different types of conservation management regimes, specific to time and space: agricultural practices, grazing practices, seasonal reserves. Traditional types of protection are not necessarily what is needed nor are they sufficient (still need core areas, but during specific times of year, need specific vegetation management during key times).

Best practice, managers should:

- Set objectives at the landscape scale to take into account migratory processes;
- Identify areas of spatial and temporal significance (calving, breeding, migratory

corridors), monitor those sites over time and adapt over time;

- Explore flexible and innovative management regimes to take into account large-scale migratory processes;
- Focus on quickly protecting the last remaining intact areas, but at the same time focus on parallel conservation measures (precautionary principle).
- *Genetic management is important*: Genetic management is more of an issue, especially with fragmented populations;

Best practice: explicitly include genetic management in landscape-scale management;

- *Steppe management requires strong community relations*: because management of steppe requires a broad suite of land uses, and threats are related to human uses, there is a strong need to have good community relations;
- *Threat management is critical*: management practices must include threat reduction measures, poverty alleviation measures, alternative livelihoods;

Best practice: design and implement effective community relations programs aimed at preventing and mitigating key threats (e.g. poaching)

- *There are high levels of management variability*: migration patterns are constantly changing, impacts of disease, surrounding land use are all difficult to manage for the present and forecast for the future;

Best practice: Need to develop

- *Transboundary management is important*: and is critical in some places (e.g., Uzbekistan) – explore military zones as potentially important areas;
- *Trade agreements are important*: because one of the main threats is poaching, with sale of horn to China, must look at international trade;

Best practice: explore transboundary agreements and trade agreements aimed at maintaining populations across boundaries.

Key questions:

- What is the optimal number of ungulates in order to maintain the ecosystem?
- If the Saiga antelope (*Saiga tatarica*) in Central Asia, or other sociable wild ungulates in other regions, disappears, what are the cascading effects? Are there substitutes? What species will be affected?
- Could we test landowner agreements and replicate success stories? What works and what doesn't in flexible governance and conservation management regimes

in steppe systems? What kind of compatible land use agreements could work well?

- Role of wild horses;
- How climate change will have an impact on grassland systems – shifting northwards;
- What are genetic and population size thresholds and tipping points for sociable ungulates (e.g. Saiga) in maintaining steppe systems – when are they functionally extinct?

Key issues:

- Grassland issues are not homogenous – veldt, steppe, pampas, prairie all have very different issues, and we need to explore these issues more fully in the guide (e.g., in South Africa, the issue is primarily about mainstreaming in economic sectors such as game meat certification, land abandonment in temperate grasslands and role of agro-environment subsidies, invasive species in South Africa);
- In climate change, there will be a disappearance of tallgrass steppe; there is no buffer zone for natural steppes...food security for arable lands will be an increasingly important issue, and new agricultural technologies/techniques are being explored;
- Restoration is extremely expensive – seeds are too expensive because they have to be hand-collected; even pilot testing is difficult and limited; how many years to do we need for restoration?
- Land degradation releases carbon – can this be calculated? Land use, land-use change and forestry (LULUCF) – can it be tapped for carbon finance for steppe/grassland management?
- Are there mechanisms for funding alternative livelihoods to reduce poaching? (Possible in Kazakhstan)
- Adaptation of agriculture is a research gap, and the impact of agricultural practices on grasslands – “bad grass”;
- Alternatives to managing black moss;
- Need to build capacity for managers to explore partnerships, work with communities, and work with broader sectors.

Resources and tools:

- IUCN-WCPA Temperate grassland initiative⁶⁷;
- Steppe Bulletin (in Russia) of Ilia Smelyansky⁶⁸;
- Steppe Research Institute (Orenburg);
- Several projects of UNDP/GEF – management practices for Steppe ecosystems (Russia, Uzbekistan, Kazakhstan);
- Biodiversity offset for steppe in Uzbekistan (similar in Wyoming) to avoid vulnerable areas, critical habitats; South Africa is doing with coal sector in temperate grasslands, looking in Russia;
- GEF Small Grant Program
- Altyn-Dala Conservation Initiative in Kazakhstan supported by national and international organisations⁶⁹.

⁶⁷

http://www.iucn.org/about/union/commissions/wcpa/wcpa_what/wcpa_conserving/wcpa_grasslands_tf/

⁶⁸ <http://www.biodiversity.ru/programs/steppe/bulletin/stepbull.html>

⁶⁹ http://acbk.kz/index.php?option=com_content&task=view&id=21&Itemid=331&lang=en

5 Monitoring climate impacts and adaptive management

5.1 Introduction: Monitoring and adaptive management

Stephen Woodley, Parks Canada

Climate change impacts will (almost) always be a result of interaction with other stressors – actions to respond to climate will be on those stressors not climate change. Arctic and high elevation areas are predicted to be the most significant species change “hotspots”, where there will be the highest species turnover (species gains plus species losses). In these places species recruitment is likely to be greater than species loss. Connectivity and systems context become key questions that we need to answer in order to attempt to manage change. Our “response spaces” to climate change range from management to flight and are influenced by both the extent of warming and our knowledge; represented diagrammatically as follows:

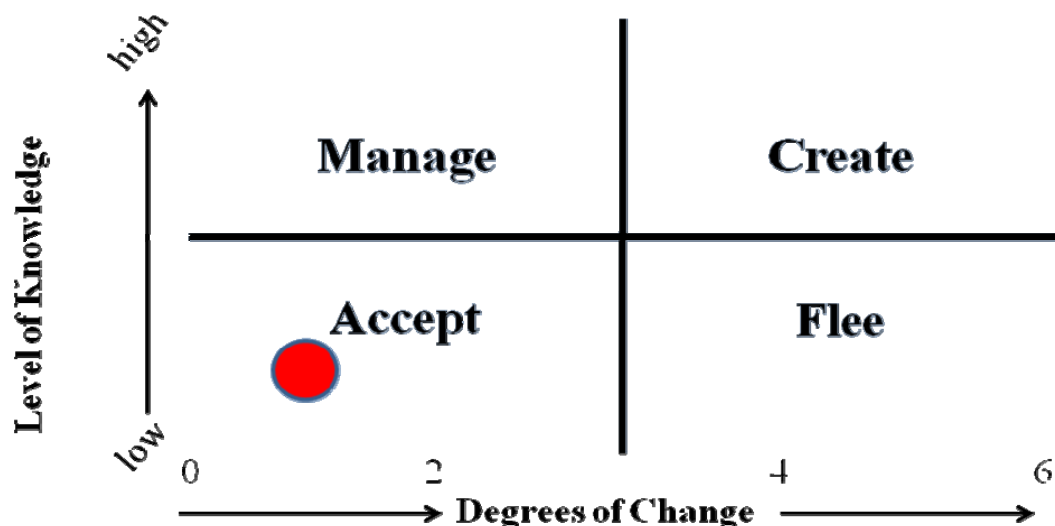


Figure 5: Response spaces to climate change

The vast majority of protected areas do not have high levels of knowledge. Thus monitoring systems and development of these should be a priority. Good ecological monitoring will cover most elements of climate change; including:

Biodiversity

- Species richness: native species; alien species;
- Focal species: mortality/natality; immigration/emigration; viability/persistence; Red Listed Species;
- Trophic structure: size class distribution; predation levels.

Structure and processes

- Local ecosystems: most important structure and process, e.g. decomposition, nutrient cycling;
- Landscapes: most important structure and process, e.g. productivity, connectivity, land cover.

Stressors

- Inside protected areas: most critical in-park stressors, e.g. highway mortality, poaching;
- Outside protected areas (buffer): local stressors, e.g. agriculture;
- Bioregion: most critical long distance stressors, e.g. climate change, nitrogen deposition.

Management targets and thresholds are key parts of any monitoring system, so managers are aware when a system is operating outside of levels which are considered to be acceptable. The example refers to caribou, and illustrates how measures variable have management thresholds

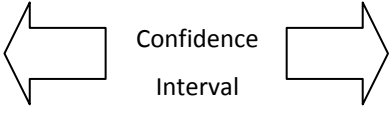
				
Impaired ecological integrity	Fair ecological integrity	Good ecological integrity	Fair ecological integrity	Impaired ecological integrity
<50% chance of survival in 100 years	50-95% chance of survival in 100 years	>95% chance of survival in 100 years	50-95% chance of survival in 100 years	<50% chance of survival in 100 years

Figure 6: **Management targets and thresholds**

If climate change predictions are remotely accurate, the new situation:

1. Alters our fundamental idea of what a 'protected area' is, i.e., representative of a relatively stable natural area with a set of flora and fauns that can be considered part of that ecosystem;
2. Changes the notion that we can base monitoring thresholds on an analysis of historical rates of change that represent natural variability of a 'protected area';
3. Requires new thinking - 'stationarity is dead' (Milly et al. 2008. *Science*, **319** 573-574);
4. Underscores the role of protected areas, and monitoring within protected areas, as benchmarks of ecological change;
5. Requires knowing what you want to protect.

Learning - Need for Process-Based Inventory "Knowledge Based Management"

- Need to understand changes in distribution and composition of ecological communities and species across a protected areas landscape;
 - o Prerequisite - mapping and classifying ecosystems;
- Need to understand the ecological drivers that control the distribution and composition of ecological communities – link communities to drivers and modelling;
 - o 'ecotype' and 'bioclimate' concepts for terrestrial;
 - o assessment of drivers for freshwater and pelagic marine ecosystems.

Ecological processes determine species distributions and ecotype boundaries. Climate change impacts can be predicted for a number of different scenarios, e.g. the following divides ecotypes into different impact classes assuming increased precipitation of 40%:

Table 3: Predicting climate change effects: scenario of increased precipitation by 40%

Impact class	Rational for class assignment assuming increased precipitation of 40%
Very high	Active, alluvial floodplains
High	Wetlands, inactive alluvial terraces, nivation and seepage slopes, drainage channels
Moderate	Dry to moist mountain slopes, wet mountain slopes, pediment slopes
Low	Alpine, rock lichen

Guidance for monitoring with a changing climate:

- Use protected areas as ecological reference areas to track ecological change, including climate change;
- Build on ongoing cooperation to formalize science for climate adaptation (other governments, academics, museums);
- Focus on social ecological resilience; promote community monitoring and citizen science;
- Target monitoring, research and modelling for operational systems, e.g., protected areas;
- Link to other initiatives nationally and internationally - standardize core variables and protocols.

Conservation dependent species form a particular sub-group and are:

- A growing issue;
- Using a high percentage of conservation investment;
- Needing guidance about when to “move on” on a world of rapid climate change;
- One focus of global monitoring effort.

Adaptation at a protected area system level should include:

- *Protect* sufficient core areas to ensure population viability;
- *Connect* cores areas to allow immigration and emigration;
- *Restore* sufficient cores where they are absent;
- *Track* and monitor.

Path forward for protected area managers:

- Review/start monitoring programme that incorporates accounts of climate change;
- Get a weather station;
- Use climate change scenarios to define scope and direction of change;
- Use process-based inventories to define key features and processes to measure;
- Define limits of conservation dependence;
- Connect monitoring to management;
- Define protected area role in a systems context.

5.2 Working group results: Monitoring and adaptive management

Nigel Dudley, Equilibrium Research

The working group started by discussing **what to measure**. Best practices included:

- Advise on the number and location of weather stations (e.g. at least two per protected area, at highest and lowest sites for smaller sites whereas for protected areas of thousands of hectares and with a very complex relief and ecosystems interspersed weather station networks will be required in order to monitor weather changes) and where possible connect these with the national weather station network;
- Use of traditional ecological knowledge;
- Establish citizen science programme (e.g. timing of ice, leaf break, etc);
- Monitor to validate models and scenarios, testing ecological hypotheses;
- Target predicted vulnerable species and communities;
- Outline some future monitoring options;
- Measure water temperature/pH, tidal gauges and visibility.

Tools and resources: World Meteorological Organization (WMO) monitoring standards and national standards⁷⁰; international phenological networks; Parks Canada's Citizen Monitoring guide (internal document); The Global Biodiversity Information Facility (GBIF)⁷¹, Normalized Difference Vegetation Index (NDVI); Datasets of the Climate Research Unit at the University of East Anglia⁷²; Landsat⁷³; Worldclim⁷⁴; US Park Service established the Inventory and Monitoring Program; E-bird – the online checklist programme of the Cornell Lab of Ornithology and National Audubon Society⁷⁵; World Database on Protected Areas⁷⁶. Examples and cases: Parks Canada and citizen monitoring⁷⁷; The UK Butterfly Monitoring Scheme⁷⁸; Alaska Native Knowledge Network⁷⁹; Soil monitoring in West Africa and collecting Traditional Ecological Knowledge (TEK) data.

⁷⁰ http://www.wmo.int/pages/index_en.html

⁷¹ <http://www.gbif.org/>

⁷² <http://badc.nerc.ac.uk/data/cru/>

⁷³ <http://landsat.gsfc.nasa.gov/>

⁷⁴ www.worldclim.org

⁷⁵ <http://ebird.org/content/ebird>

⁷⁶ <http://www.wdpa.org/>

⁷⁷ For example see: <http://www.pc.gc.ca/eng/pn-np/ab/waterton/ne/ne3/ne3b.aspx>

⁷⁸ <http://www.ukbms.org/>

⁷⁹ <http://www.ankn.uaf.edu/>

Resource people: Virginia Burkett, Dan Ashe and Patrick Gonzales.

Secondly the working group discussed best practice in relation to **building a monitoring system** that integrates management, data sharing and reporting:

- Link to management;
- Link to global monitoring programme/national/regional;
- Report and share data – governments, local communities, schools;
- Report back to protected area staff;
- Draft list of generic indicators;
- Produce guidance to managers for collection of day-to-day data – changing culture;
- Use of herbaria.

Tools and resources: The Global Learning and Observations to Benefit the Environment (GLOBE) Program⁸⁰; include monitoring bibliography; Wetlands International: database flyway; European Commission Transnational Environmental Resource System; IUCN database TEMATEA⁸¹; Historical photographs. Examples and cases: elementary school nature monitoring in Kazakhstan; State of Parks reports in e.g. Finland, India, Colombia. Resource people: Jeff Price setting up data sharing system; Birdlife.

5.3 Introduction: Incorporating climate change into management effectiveness assessments

Jamison Ervin, UNDP

There are a suite of management effectiveness tools, methodologies and case studies available. Most protected area management effectiveness (PAME) assessments are based around the IUCN-WCPA framework (see figure 7)⁸², and most yield similar results.

⁸⁰ www.globe.gov

⁸¹ <http://www.tematea.org>

⁸² <http://data.iucn.org/dbtw-wpd/edocs/PAG-014.pdf>

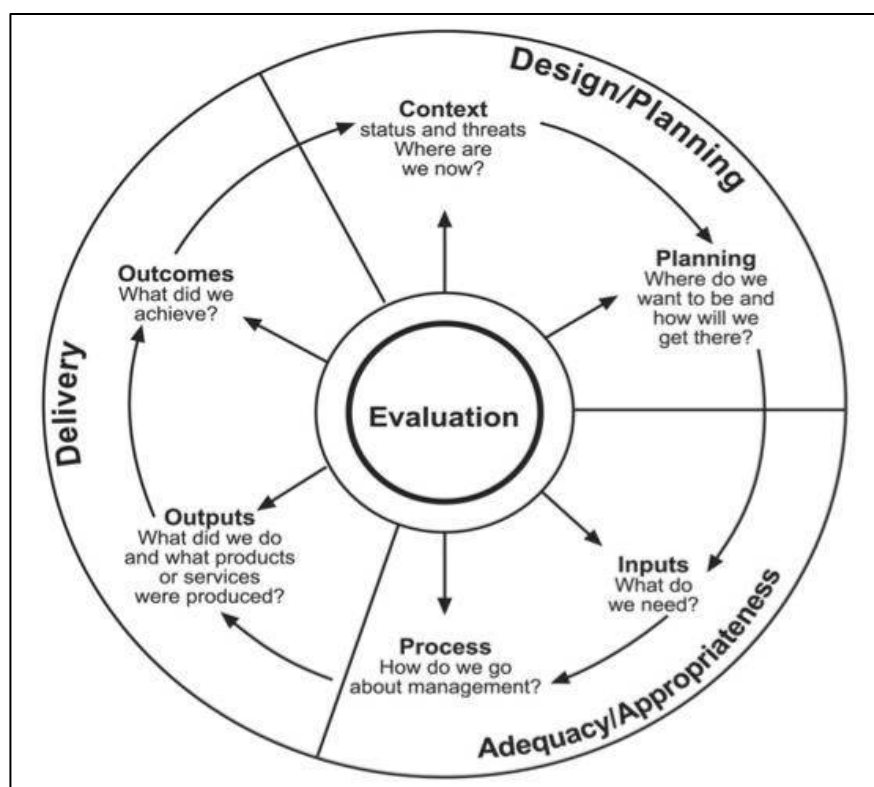


Figure 7: **The Framework for assessing management effectiveness of protected areas**

The four main outputs of PAME assessments are:

1. Critical threats;
2. Key management weaknesses;
3. Major policy constraints;
4. A prioritized list of actions.

There are three main options for incorporating climate issues into PAME assessments discussed below:

1. Minor changes to existing methodologies;
2. Create a separate module for existing methodology;
3. Extensive changes and new approaches.

Option 1: Add a few questions to existing methodologies

For example:

1. The protected area manager and staff understand potential implications of climate change to their protected area;
2. If the ecological, social and economic impacts of climate change are assessed;

3. The management plan incorporates information about possible climate scenarios;
4. Management of natural resources (e.g., forest harvesting, fire maintenance, water flow management) accounts for and minimizes the likely impacts of climate change;
5. Research and monitoring on the impacts of climate change is adequate to inform critical management activities.

Option 2: Incorporate climate issues throughout an existing methodology

For example, in relation to management processes:

1. The management plan explicitly incorporate likely impacts of climate change;
2. There is an analysis of, and strategy for addressing, threats related to climate change;
3. Decisions related to the tradeoffs in managing for biodiversity and climate are transparent;
4. The impacts from climate change are clearly recorded, and compared against baseline information;
5. Research on key climate issues is consistent with the impacts of climate change on the protected area.

Or threats:

1. Degree of climate impacts on key ecosystems (e.g., forest fragmentation, marine acidification and bleaching, peatlands clearing);
2. Degree of climate impacts on key processes (e.g., hydrological regimes, fire regimes, invasive species);
3. Degree of climate impacts on key species (e.g., changes in connectivity, habitat ranges, and spatial and temporal migration patterns).

Or inputs:

1. Staff members have adequate skills and knowledge to manage for climate change adaptation and mitigation;
2. Existing data on the potential impacts of climate change are adequate for management planning;
3. There is adequate communication about the role of protected areas in climate adaptation and mitigation;
4. Equipment and facilities are adequate to monitor climate change impacts
5. The area makes use of appropriate climate-related financial mechanisms (e.g., REDD+, mitigation funds).

Option 3: Develop a new climate specific assessment methodology

Key issues and questions for the working group to discuss:

1. What is the global need and who is the global audience?
2. What is the purpose of a climate PAME assessment tool?
3. Do we need a new tool for each major threat?
4. What are the broader implications for implementation of PAME assessments?

5.4 Working group results: Incorporating climate change into management effectiveness assessments

Marc Hockings, Associate Professor, University of Queensland

The working group began with a general discussion highlighting a number of issues:

- Climate change action is a lens for what you should be doing now for good protected area management.
- Go for something as simple (but perhaps elegant) as possible...tools which build on what we have now, e.g. Management Effectiveness Tracking Tool (METT) could include a climate change tracking question. There was recognition of different purposes for different audiences....therefore there is potential for different tools....not all habitats are equally impacted....more complex monitoring may be needed.
- Include a checklist of indicators for a specific issue of management interest (such as carbon stocks, which would include biome specific indicators). The rapid change in condition linked to climate change may be difficult to assess and may require extensive baseline data.
- For operational issues there needs to be a preparedness for dealing with climate change enhanced phenomena such as severe storms and severe fire weather conditions and will require the evaluation of ambient weather conditions and their dynamic.

Best practices recommended:

- **A range of tools:** consider a range of management effectiveness assessment options (and) tools for a range of conditions and purposes...there is no one best option. Keep all tools simple, easily implemented, build on existing tools....consider creating e-"branched" tools for specific threats where more detailed evaluation is needed.

- **Operational responses to climate change enhanced phenomena:** identify the critical management actions linked to most critical climate related issues (e.g. preparation of checklists related to managing extreme fire events and severe storms).
- **Undertaking climate change related operational responses:** assess management effectiveness of undertaking the response (e.g. processes and outputs).
- **Performance assessment:** use climate change related assessment results on how well you are managing the carbon stocks to raise funds and showcase values...to use the assessment for advocacy.
- **Reporting:** provide critical climate change reporting information for the protected area and for the system for example in the annual report such as funding reporting for carbon management

Existing tools: Protected Area – Benefits Assessment Tool (PA-BAT)⁸³; METT⁸⁴; Rapid Assessment and prioritization of protected area management (RAPPAM)⁸⁵; *Enhancing Our Heritage*⁸⁶. Examples and cases: Armenia GEF project on calculated carbon stocks⁸⁷.

Major gaps:

- Knowledge of ambient conditions;
- What is the minimum set of climate change indicators?
- How to calculate the carbon stocks...tools to do this;
- Simple decision tree branched e-tool which prioritises threats and achieves evaluation.

Exploring minimum set of PAME indicators

Potential PAME indicators for climate change:

Planning

- Does the management plan address impacts from climate change?
- Has an impact assessment of vulnerability to climate change effects been completed?

Monitoring

- Is there a robust monitoring system in place including for climate change issues?

⁸³ http://www.equilibriumresearch.com/upload/document/PA_BAT_-_Final_Feb_2008.pdf

⁸⁴ http://assets.panda.org/downloads/mett2_final_version_july_2007.pdf

⁸⁵ http://www.panda.org/what_we_do/how_we_work/conservation/forests/tools/rappam/

⁸⁶ <http://whc.unesco.org/en/series/23/>

⁸⁷ https://www.thegef.org/gef/gef_country_prj/AM

- Are data collected for climate change issues including baseline data?
- Are populations of climate change indicator species assessed?
- Are climate change effects on phenology assessed?
- Is biodiversity conservation the primary objective and safeguards in place when dealing with carbon management?

Outputs

- Has the annual plan of critical climate change management actions been implemented?
- What funds have been raised using the climate fund?
- Have assessment data been collected for carbon stocks?
- What is the status of staff awareness for climate change issues?
- What is the status of surrounding communities' awareness of climate change issues?

5.5 Introduction: Planning management for protected areas considering climate change

Stephan Amend, GTZ

"Planning is the tool for thinking about and creating the future". Carlos Matus (Ex-Minister for Economy in Chile, creator of the strategic situational planning tool). There are a variety of plans and documents used at various stages of protected area planning and management:

Before designation:

- Technical report to designate a transitory protected area;
- Report of consultation process;
- Technical report to designate protected area.

Designation:

- Legal document for designate.

After designation:

- Operational plan for getting started;
- Strategic Plan;
- Zoning Plan;

- Specific Plans (Tourism, Resource Use, Environmental Communication);
- Annual operational plan;
- Monitoring/ evaluation plan for activities/ impacts;
- Monitoring plan for conservation issues.

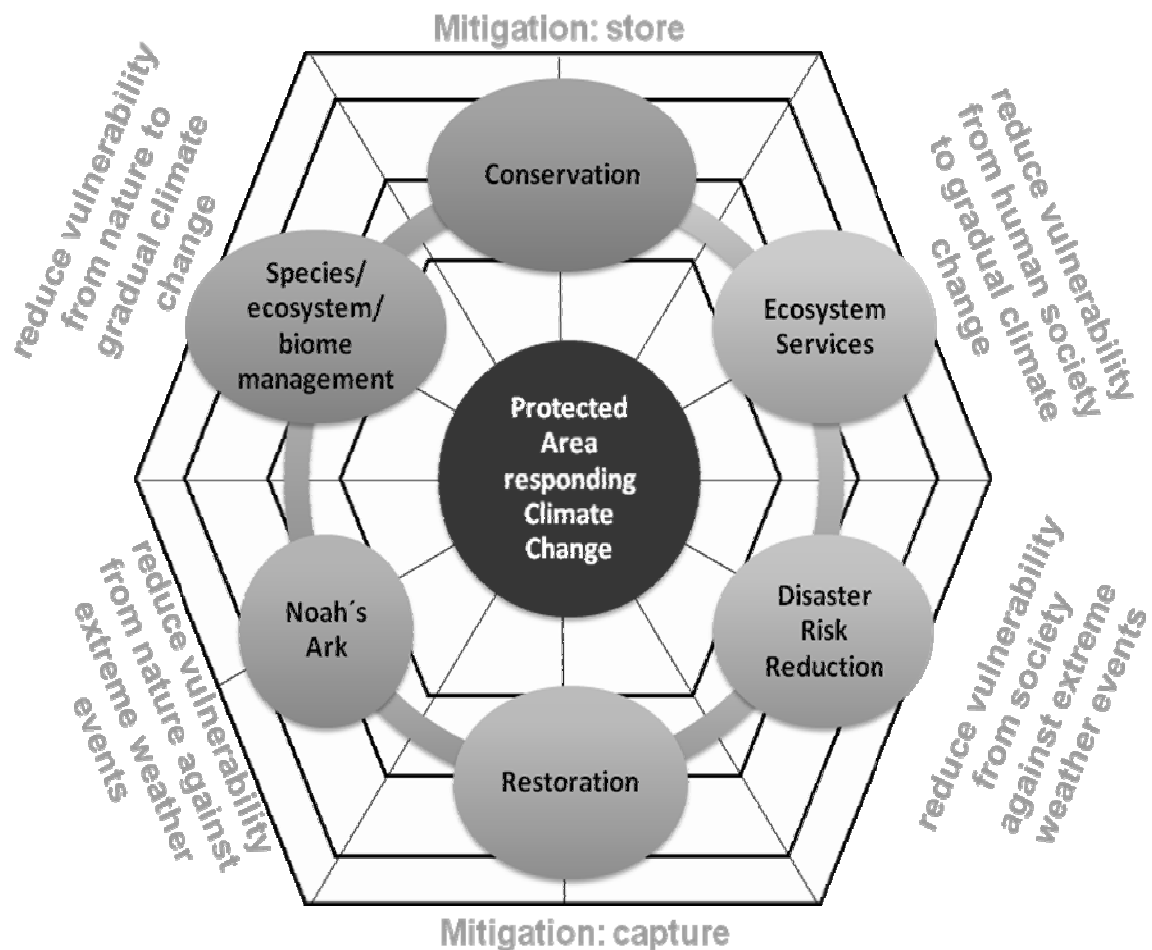


Figure 8: Protected area responses to climate change

And each of these plans and documents carry with them a number of requirements inherent in planning process:

- Creating of a vision;
- Defining problems and potentials;
- Whom to involve in planning process;
- Prioritizing strategies and activities;
- Indicators for monitoring;
- Information needed;
- Planning process;
- Planning methodology.

Protected areas already have a vast array of objectives including:

- Conserving biodiversity;
- Maintaining diversity of landscape or habitat and of associated species and ecosystems;
- Providing ecosystem services;
- Delivering benefits to resident and local communities;
- Delivering recreational benefits;
- Facilitating low-impact scientific research activities;
- Helping to provide educational opportunities.

And now managers have to think of two more:

- *Buffering against the impacts of climate change;*
- *Reduce disaster risk of extreme weather events.*

5.6 Working group results: Planning management for protected areas considering climate change

Marc Hockings, Associate Professor, University of Queensland

The workshop session started by considering the **challenges** associated with planning processes. A number of best practices were identified:

- Vision, values and objectives for the protected area should consider likely changes arising from climate change (e.g. we need to develop a resilient network of protected areas);
- There is a need to plan at a wider landscape scale (therefore need to consider new stakeholders) and with a longer timeframe (temporal as well as spatial expansion);
- Climate change creates expanding information needs;
- Changes in surrounding land use (especially relating to fire, water, land use change, introduction of new species) that will impact on protected areas need to be considered;
- Identify susceptibility to climate change as an input into detailed planning;
- Explicitly link site planning to system planning and regional planning;
- Climate change enhances need for adaptive approach to management;
- Audit existing plans to incorporate climate change considerations.

Examples and cases: Ontario parks and climate change planning; TNC Ecoregional planning with climate change. The major gap identified was related to staff capacity.

The second element of the discussion focused on **planning principles** and associated best practice; which were identified as:

- Consider climate change in all protected areas management planning;
- Climate change enhances the need for adaptive approach to management and planning;
- Use a values-driven rather than an issues-driven planning process;
- Use preventative, precautionary and risk assessment approach (no regrets strategies);
- Plan for different scenarios – not just one (and include worst case);
- Aim for realistic plans (cost effective, feasible, practical);
- Use transparent, participatory, evidence based decision making using best available information supported by information systems;
- Use scientific, expert and traditional knowledge and practice;
- Considering history (past management experience and past climatic variability);
- Put more emphasis on monitoring and evaluation linked to management – implications for indicators;
- Consider shifting baselines;
- Question traditional management approaches for relevance under a changed climatic regime;
- Report failures as well as successes;
- Address both mitigation and adaptation.

Examples and cases: WCS – NCEAS Adaptation for Conservation Targets Framework (Cross et al, in review, Environmental Management) *Adaptation for Conservation Targets*; Great Barrier Reef Marine Park Authority, Australia; BirdLife/Durham University's work on the sub-Saharan Important Bird Area network – "Towards a management framework for protected areas under climate change", *in press*, Conservation Biology

The next subject discussed related to developing management planning **objectives**. Best practices here included:

- Consider objectives in context of climate change – may increase importance of ecosystem service and representativeness values;
- Articulate the value of protected areas for ecosystem services outside the

protected areas, and conservation in a regional context, including as a species and genetic source for radiation (management and communication issue).

Examples US Fish & Wildlife Service case study (Michael Dunlop).

6 Restoring and connecting landscapes

6.1 Introduction: Corridors and connectivity conservation as they relate to climate change

Graeme Worboys, IUCN-WCPA

Connectivity conservation is defined using biodiversity conservation criteria, but also includes social and institutional dimensions. Connectivity conservation describes actions taken to conserve landscape connectivity, habitat connectivity, ecological connectivity or evolutionary process connectivity for natural and semi-natural lands that interconnect and embed established protected areas. (...) The strong connectedness of people to natural and semi-natural connectivity lands is also recognised (Worboys et al, 2010, pxxxi⁸⁸).

From the biological perspective, connectivity conservation is essentially about the degree of movement of organisms (plants and animals) and processes which include ecological interactions, ecosystem processes and natural disturbances (Crooks, and Sanjayan, 2006⁸⁹).

This is described as four types of connectivity which are:

1. **Ecological connectivity:** The connectedness of ecological processes at multiple scales (ecological perspective);
2. **Evolutionary process connectivity:** The connectedness required by spatially dependent evolutionary processes;
3. **Habitat connectivity.** The connectedness of habitat patches for a given species (single species perspective); and
4. **Landscape connectivity.** The connectedness of vegetation cover within a given landscape (human perspective).

⁸⁸ Worboys, G.L., Francis, W.L. and Lockwood, M. (2010) *Connectivity Conservation Management*, Earthscan, London

⁸⁹ Crooks, K.R. and Sanjayan, M. (2006) *Connectivity Conservation*, Cambridge University Press, Cambridge

Connectivity conservation helps retain large scale interconnected natural landscapes across many degrees of latitude and many degrees of longitude and is a critical response to global change and especially climate change.

The concept of connectivity conservation includes:

- Interconnecting protected areas
- Helping to conserve natural lands between protected areas and thus retain large areas of natural lands
- Active management of connectivity conservation lands
- Working to help minimise the effects of climate change on the landscape by retaining natural vegetation, and especially for water supply catchment areas; for steep lands which help protect people from slope hazards during extreme weather events and for habitat suitable for the conservation and retention of wildlife

Characteristics of connectivity conservation areas include:

Size: IUCN is dealing with very large areas of essentially natural lands. Some are thousands of kilometres long; they may be hundreds of kilometres wide and most are linked to mountainous areas.

People: Many people are involved in connectivity corridors

Tenure: Land ownership is typically diverse and may include public, private and community protected areas; non protected area government lands; private property; community lands and indigenous lands.

Purpose: Connectivity corridors help conserve healthy environments and species by conserving habitat; conserving habitat linkages; retaining the connectedness of ecological and evolutionary processes; undertaking active management of threats and, retaining opportunities for change within natural settings.

Management: Managing for connectivity conservation necessarily involves working with many people; working with many different sectors; and recognising the importance of an agreed vision.

Example: The Yellowstone to Yukon (Y2Y) Corridor is an example of connectivity conservation. It is 3207 km long, between 202-805 km wide, it extends from 61 metres in altitude to 4,209 metres but is mostly above an altitude of 1,067 metres. Land cover in the corridor includes: 1.5% bare rock; 18.9% tundra; 59% forested; 13.5%

shrublands; 4.5% grasslands and 2.6% agricultural. The Y2Y Corridor helps to conserve natural interconnections which retain the natural home ranges for key species such as the Grizzly Bear.

There is a Vision and five functions of management recognised in connectivity conservation (see Figure 9):

The Vision: This statement provides the guiding direction for the corridor and is agreed to by the majority of corridor supporters.

Context: Identifies that the Nature, People, and Management contexts are important to know and that they are different at different times and they vary across a corridor. Understanding context and its dynamics are critical for the effective management of large-scale corridors.

Leading: Identifies that leadership at different scales including site, local area, whole of corridor, national and international scales is needed to help manage large-scale corridors. It recognises that there will be many leaders involved.

Planning: Identifies that planning is important at each of the different scales at which the corridor management functions.

Implementing: Recognises that connectivity conservation is about the active conservation management of corridor land.

Evaluating: Is an essential function of management, but the management framework identifies that the evaluation may be different for the different scales in which the corridor is being managed.

The framework is presented with interactive arrows, which identifies that managing corridors is very dynamic. Changed circumstances for context (for example) may influence the leadership needed, what planning is undertaken, and the changed implementation actions undertaken.

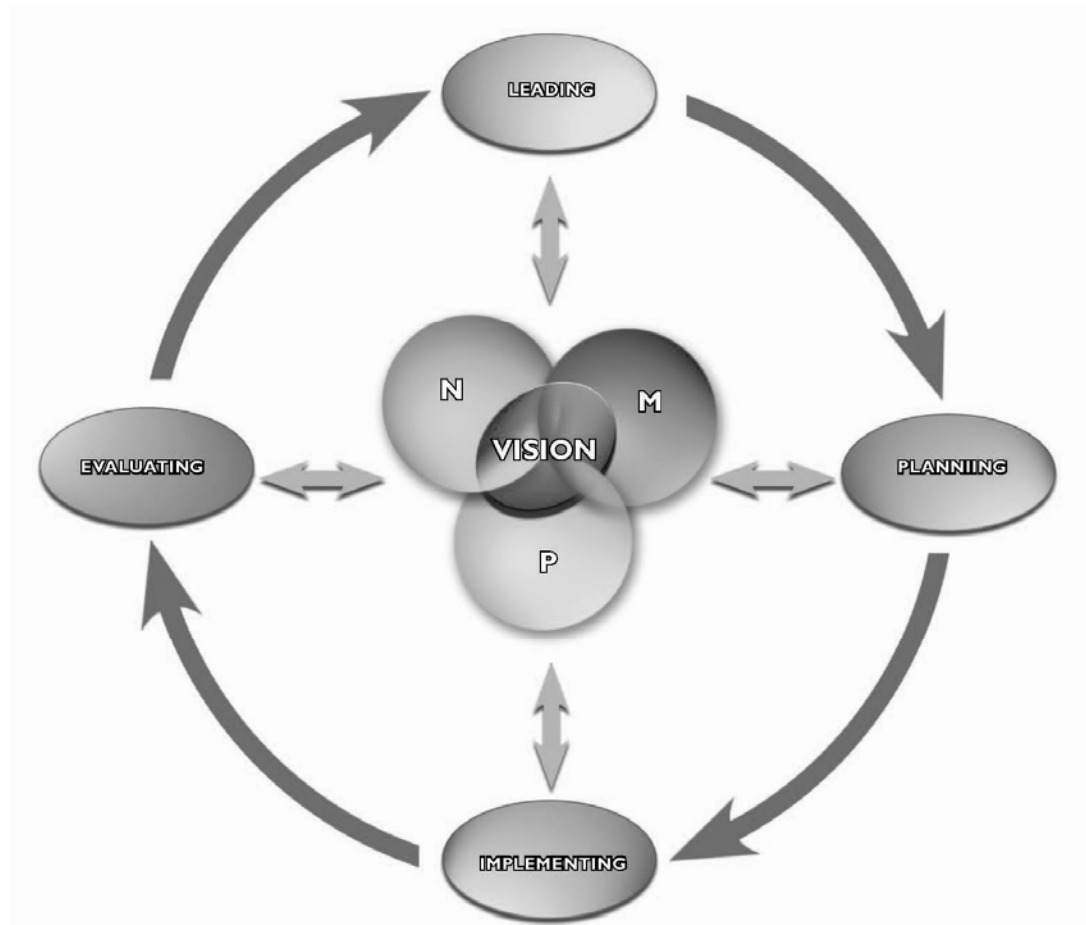


Figure 9: **The five functions of connectivity conservation management** (Worboys et al, 2010)

Delivery tasks

1. Manage finances, human resources and assets;
2. Deploy instruments;
3. Manage for threats;
4. Assist management of incidents;
5. Strive for sustainable resource use;
6. Rehabilitate degraded areas;
7. Provide and manage research opportunities.

Cross-cutting tasks

1. Work with partners;
2. Work with stakeholders;
3. Undertake communication.

Connectivity conservation management actions may be undertaken for:

- Maintaining the health of water catchments and ecosystem service benefits to people;
- Maintaining sustainable resources for people;
- Improving resilience against threats such as weeds and pest animals;
- Responding to changed fire behaviour;
- Retaining forest cover for green carbon, severe storm protection, water supply catchment cover and potential financial benefits for people;
- Working with wild animal conservation;
- Restoring habitat and connectivity;
- New integrated approaches to land management and partnerships and transboundary management;
- Working with people to reduce greenhouse gas emissions.

6.2 Working group results: Local scale corridors and connectivity as they relate to climate change

Jamison Ervin, UNDP

Key issues to consider in relation to **connectivity** include:

- Connectivity for what: connectivity is important for different purposes (species maintenance, climate resilience, evolutionary potential, genetic variation, sustainable livelihoods, etc.);
- Complexity: connectivity involves temporal, spatial and process-related issues; and there are dynamic interrelationships between climate and connectivity;
- Scale: recognize the importance of moving away from site-level management to an integrated landscape approach;
- Broader matrix: recognize the predominant role of corridors, but looking at the broader conservation context and the broader landscape matrix (buffer zones, stewardship agreements, mainstreaming agreements, sectoral integration);
- Key connectivity features: recognize that there are key connectivity areas within a broader landscape that are particularly important for linking protected areas, core areas, species and processes (e.g. rivers and riparian ecosystems contribute to connectivity of processes and populations throughout gradients across landscapes);

- Managerial needs: at the managerial level, understand the connectivity needs within and beyond the protected areas; where the gaps and bottlenecks are in connectivity; and the key species and processes that require connectivity;
- Challenges for managers: understand that most protected area managers have little or no experience in working outside their own areas and working with sectors and other agencies;
- Policy environment: develop the policy environment as a critical enabling factor;
- Leadership: build the role of leadership as being critical at regional levels (to create a vision) and at a site level (to manage for connectivity, communicate connectivity values)

The working groups discussion on connectivity conservation **best practices** highlight:

- Expand the area that is managed by working within the production landscape, as well as the protected area and associated buffers and corridors;
- Capitalize on natural connectivity opportunities, (e.g. protected vegetation corridors that follow the natural connectivity of rivers);
- Focus research efforts in and around protected areas to understand key connectivity issues, including migratory routes, resilience, ecological processes, livelihoods, etc.;
- Consider connectivity issues and opportunities at different scales (site, landscape, regional, mega);
- Participate in REDD+ for forest ecosystems that can assist in connectivity;
- Promote the exchange of learning and professional development among protected areas managers working on common connectivity issues across boundaries;
- Recognize the important role that individual protected areas managers can play in leadership and legislation;
- Embed corridor thinking at national protected area system (e.g., by identifying areas for joint planning and research across protected area system and other agencies) and identify key champion at protected area system and beyond;
- Recognize and be explicit about different values and purposes of connectivity issues, and capitalize on the range of values (e.g. corridors of social/sacred significance, corridors for resilience and livelihoods, etc.);
- Incorporate the most important areas for connectivity within protected area management planning.

Tools and resources

- Graeme L. Worboys, Wendy L. Francis and Michael Lockwood, (2010): *Connectivity Conservation Management, A Global Guide*; Earthscan;
- Sandwith, T., Shine, C., Hamilton, L. and Sheppard, D. (2001). *Transboundary Protected Areas for Peace and Co-operation*. IUCN, Gland, Switzerland and Cambridge, UK;
- Freedom to Roam⁹⁰;
- System conservation planning;
- Living Landscapes in the UK⁹¹;
- Integrated river basin management;
- Ervin, J., K. J. Mulongoy, K. Lawrence, E. Game, D. Sheppard, P. Bridgewater, G. Bennett, S.B. Gidda and P. Bos. 2010. *Making Protected Areas Relevant: A guide to integrating protected areas into wider landscapes, seascapes and sectoral plans and strategies*. CBD Technical Series No. 44. Montreal⁹²;
- Spatial vulnerability (WWF);
- GIS tools.

Examples and cases: Madagascar connectivity corridor using REDD⁹³; Mesoamerican Biological Corridor (Mexico and Central America); Huichol Indigenous Group in Mexico (Huichol Route to Huricuta), Mexico⁹⁴; South Africa mega reserves (CAPE programme, contact Trevor Sandwith or Mandy Barnett for details).

Major gaps: Vulnerability index for isolation; thresholds for isolation; how migratory routes will change with climate; lack of manager knowledge on connectivity; lack of enabling legislation; suite of effective incentives; managing connectivity for resilience and dynamic in landscape; professional connectivity; climate model for smaller areas and impacts on connectivity; and freshwater habitat connectivity.

Connectivity – guidelines for protected areas managers

- Identify key areas for connectivity within the protected areas;
- Understand the importance of overall protected areas within broader connectivity vision/initiative;
- Know which corridors are particularly important for climate resilience;

⁹⁰ <http://freedomtoroam.org/>

⁹¹ <http://www.wildlifetrusts.org/index.php?section=environment:livinglandscapes:schemes>

⁹² <http://www.cbd.int/doc/publications/cbd-ts-44-en.pdf>

⁹³ <http://www.theredddesk.org/book/export/html/360>

⁹⁴ <http://www.chac.org.mx/>

- Identify which are the key species that will depend on corridors under climate scenarios;
- Work out the scope and opportunity for influence;
- Understand the interrelationship between connectivity and climate resilience (e.g. understand dynamic species management, and the role of connectivity corridors under climate scenarios);
- Know how climate exacerbates other stressors on connectivity issues.

What s/he should do:

- Incorporate connectivity issues, and climate-related connectivity issues, into management planning, research, monitoring;
- Communicate the values of connectivity and role of protected areas.

Key question:

- Is climate a new justification for promoting connectivity, or is connectivity for climate resilience fundamentally different from what we've been doing?

Connectivity – barriers and obstacles

Barriers:

- Mountains will become isolated islands;
- Dams prevent riparian connectivity;
- Tropical rivers prevent connectivity;
- Roads, energy infrastructure, cities, border areas;
- Agricultural deserts and increased desertification;
- Fences, veterinarian fences;
- Increased diseases and uncertainty of disease patterns.

Obstacles:

- Lack of enabling legislation;
- Lack of systematic planning;
- Protected areas manager's mandate – confined to boundaries;
- Lack of funding (maintaining status quo requires tripling existing funding);
- Increasing demand for energy (more dams, more windfarms, more biofuels);
- Food security (higher conversion of agricultural lands, more intensive);
- Communication and understanding about role of connectivity in promoting climate resilience.

6.3 Introduction: Restoration in protected areas in the context of climate change

Nigel Dudley, Equilibrium Research

The viability of restoration as a strategy varies between ecosystems and habitats, e.g. very low for peat but comparatively high for many mangrove ecosystems.

In the past, responsible restoration reflected three main sets of values:

- Ecological values;
- Social values;
- Economic values;

To which a fourth has now been added:

- Climate values.

Climate change will influence our choices and opportunities. There are five critical restoration issues that will need to be addressed in the manual:

1. Restoration for resilience;
2. Restoration for ecosystem services;
3. Restoration for carbon;
4. Restoration for individual species;
5. Restoration for functional ecosystems – this may not be the same as “original ecosystems”.

6.4 Working group results: Restoration in protected areas in the context of climate change

Marc Hockings, Associate Professor, University of Queensland

The group suggested the following as elements of best practice with respect to restoration in this context:

- It is better ecologically and much cheaper to maintain existing habitat rather than to restore, so ensure that options for maintaining values in intact habitat have been fully explored first;
- Always consider enhancing (or maintaining) landscape functionality through restoration;

- Consider all potential aims of restoration (resilience, ecosystem services and livelihoods, engagement and education, species, carbon, ecosystem function, landscape function and research) and possible synergies between these;
- Use scenario planning to help determine aims of restoration;
- Measure baselines, get agreement on objectives, integrate monitoring closely
- Share lessons from restoration efforts through established mechanisms (e.g. Climate Adaptation Knowledge Exchange⁹⁵, Centre for Evidence-Based Conservation⁹⁶);
- Consider climate change in recovery planning.

Tools and resources include a peatland restoration manual from Belarus and Jeff Price's refugia modelling.

Potential case studies include a peatland restoration and carbon trade case study from Belarus; "planting for the future" project in North Carolina, United States; work on moving species to match climate scenarios being developed in Canada; "Greening Australia" project using genetic stock; post-tsunami mangrove restoration in Asia; and use of local provenances in restoration in Moldova.

Gaps requiring further work identified by the group were:

- Research into different provenances with respect to restoration;
- Approaches for large-scale restoration as a climate change response are still not fully understood;
- Restoration monitoring data;
- A systematic review is needed on the potential for restoration in conditions of climate change;
- Social aspects of restoration require further development.

⁹⁵ <http://www.cakex.org/>

⁹⁶ <http://www.cebc.bangor.ac.uk/>

7 Conclusions and next steps

Kathy MacKinnon facilitated a group discussion that attempted to reach some general conclusions about the meeting and propose some next steps.

The workshop had two main aims:

- To provide training for participants in issues relating to climate change and protected areas and a first quick compilation of available information, contained in this report;
- To collect ideas, opinions and potential case studies for a “best practice guidelines” publication on managing protected areas in the face of climate change, to be researched and published by the IUCN-WCPA.

Results of the first part are contained in this report. “Training” should more accurately be described as co-learning; everyone in the meeting had ideas, information and experience to contribute. Results of the second objective are reported in Appendix 1 of these proceedings in the form of a proposed structure for the report. The opportunity to discuss the contents with so many practitioners has already substantially altered and we believe improved the proposed text; we already have an impressive list of key people, case study examples, tools and information.

The group noted that the workshop had not considered all biomes (for example there was little discussion on marine biomes) nor all parts of the world. It had also focused predominantly on issues related to natural science and a parallel process to consider social science questions is also needed.

In addition, during the final session, a draft list of follow up actions was assembled; these are presented below and have been divided into issues directly relating to the manual and more general suggestions for building capacity around climate change and protected areas.

Development of the IUCN-WCPA guide to managing protected areas under climate change

- Before the guidelines are formally published, develop brief “modules” on the major best practices to be released in different forms to the staff of protected area systems of different countries so they can start thinking on these issues;
- Use a proposed IUCN-WCPA climate change workshop in 2011 to test the draft;

- Use UNDP/GEF protected area projects globally to test relevant guidance developed for the book;
- Address the guidelines to national protected areas agencies through IUCN channels;
- Translate into local languages;
- Incorporate the guide into protected area capacity-building efforts that the Convention on Biological Diversity is coordinating;
- Specifically, use the guide in proposed training workshops relating to the CBD Programme of Work on Protected Areas at the International Academy for Nature Conservation Isle of Vilm and elsewhere;
- Advertise the guide within the EUROPARC Federation and EUROPARC Germany newsletters.

General suggestions

- Advocate for protected areas in national climate change strategies;
- Create a shared and open database on-line which links specific protected areas to specific climate change threats;
- Insert climate change questions into the WWF/World Bank Management Effectiveness Tracking Tool;
- Consider developing an e-learning programme: *Connecting protected area managers in a changing climate*;
- Develop IUCN-WCPA regional workshops to build capacity for protected area managers on issues related to climate change;
- Investigate ways to manage forests to create and support biological corridors between protected areas under climate change;
- Complete Turkish translation of 'Natural Solutions' publication;
- Include climate change concerns into Kure Mountains National Park (Turkey) management planning;
- Identify old-growth forest suitable as carbon stock in northern forests in Turkey.

8 Appendix: Plans for the IUCN-WCPA best practice publication

Marc Hockings, Associate Professor, University of Queensland

One of the aims of the workshop was to further develop outline plans and collect case studies for the planned IUCN-WCPA best practice series: *Managing for climate change – developing strategies for protected area managers*. The notes below will be used over the next few months to further develop the outline and draft text.

Foreword

Written by a “world champion” of protected areas, sending a motivational message about not giving up on the enormous challenge of conserving biodiversity through protected areas, under the context of climate change. Recognising the incredible value of current protected areas as the “seed sources” for the ecosystems of the future...etc.

Introduction

Artistic figures, graphs and drawings showing an ideal model of a protected area network (hypothetical) and a complex of protected areas within a landscape where several adaptation practices are being implemented by a variety of sectors (conservation, agriculture, tourism etc.) and different stakeholders (suggesting mainstreaming).

Possible Funders

Governments, World Bank-Economic sectors, GEF (Global Environment Facility), PES (Payments for Environmental Services), CIF (Climate Investment Fund), Auctioning AAU (International Climate Initiative), Innovative partnerships, Conservation trust funds, Climate risk insurance, Economic valuation (carbon sequestration), Foundations, Adaptation funds, Agri-Environment schemes and REDD+.

Chapter headings

- Planning management
- Site to system
- Data exchange (databases)
- Natural resource management

- Threats
- Changing objectives and values
- Resources and tools
- Participatory management
- Climate, climate change impacts: using and understanding models, scenarios and uncertainties
- Enabling policy environment
- Legal and policy implications (advocacy needs, national and international legal implications)
- Developing legislation
- Role of national protected area coordinator
- Managing ecosystem services
- How to measure climate and evaluate data for the future impacts in your protected area

Case studies

Monitoring

- Design climate change and ecosystem change monitoring programmes that may contribute to global monitoring networks, e.g. Altai-Sayan (RU) Katunskiy Biosphere Reserve

Connectivity and Restoration

- “Huiricuta” corridor connecting sacred sites of the Huichol people and protecting its biodiversity (Contact: Conservación Humana, A.C.⁹⁷);
- The Mesoamerican Biological Corridor, Mexico (Contact: Pedro Alvarez Icaza⁹⁸);
- Connectivity in steppe ecosystems, Kazakhstan (Contact: GEF Steppe project manager Mr. Asylkhan Assylbekov, Astana and Adriana Dinu, UNDP);
- Legislation Act of rule of peatland restoration in Belarus (Contact: Maxim Vergeichik, UNDP);
- Manual on peatland restoration in eastern Europe, Belarus (Contact: Maxim Vergeichik, UNDP);
- Transboundary cooperation and protected areas in Caucasus ecoregion (Contact: WWF Caucasus Programme Office/ WWF – Turkey: Nugzar Zazanashuili);
- Planting spekboom to restore veld and water supplies: Baviaanskloof, South Africa (Contact: Anthony Mills);

⁹⁷ <http://www.chac.org.mx/>

⁹⁸ <http://www.cbmm.gob.mx/>

- Restoration of fenmire for globally threatened species, aquatic warbler, Belarus (Contact: Maxim Vergeichik and Alexander Kozulin, UNDP);
- 'Great Eastern Ranges' connectivity corridor (Contact: GraemeWorboys);
- Australian Alps climate change adaptation strategies (Contact: GraemeWorboys);
- Altai-Sayan, national and transboundary (Contact: Vladimir Cheranov, UNDP/GEF Kazakhstan project, vladimir.cheranov@undp.org and Adriana Dinu);
- 'Agulhas Biodiversity Initiative', South Africa (Contact: Adriana Dinu);
- 'Econnect', restoring the web of life;
- Caucasus gap analysis (Turkish part) including climate change, to be completed December 2011 (Contact: WWF Turkey, Başak Avcioglu);
- 'Pan European Ecological Network' in South Eastern Europe – ECNC, Center for Cartography of Fauna and Flora, Slovenia, Vesna Grobelnik⁹⁹.

Awareness/Understanding, Biome Management, Managing Ecosystems, Managing Species

New zoning considerations as species move within protected areas. Need for regional plans and objectives to inform management of species and ecosystems in protected areas.

- Guidance from AFWA (Association of Fish and Wildlife Agencies, North America);
- A CAP for Climate Change: Site-based guidance from TNC;
- Turkey: KMNP (Kure Mountains National Park) buffer zone forest management (Contact: Yildiray Lise);
- Turkey: WWF project, water management and adaptation in agricultural production (including changing agricultural methodologies and products) under climate change (Contact: Buket Durmaz bdivrak@wwf.org.tr and/or Başak Avcioglu bavcioglu@wwf.org.tr);
- Turkey: Draft National Strategy on protected areas and climate change (Contact: Başak Avcioglu and Yildiray Lise);
- Kazakhstan: Managing Forest Ecosystem protected areas in the face of climate change (Contact: Adriana Dinu);
- Mexico: Developing "pilot programs:" for adaptation of protected areas in southern Mexico (Contact: Ignacio March, Mexico);
- South Africa: Bioregional Planning (Contact: Caroline Petersen; Kristal Maze);

⁹⁹ <http://www.ecnc.org/publications/technicalreports/indicative-map-of-peen-see>

- Tajikistan: Sustaining agro-biodiversity in the face of climate change (role of protected areas);
- Turkey: Marine invasive species research in Mediterranean MPA and marine turtle nesting and climate change (Contact: Ayşe Oruc aoruc@wwf.rog.tr);
- Active River Management (ARM program).

Resources, Tools and People

- Global Invasive Species Programme (GISP);
- Systematic conservation planning (Alexander Belokurov, WWF Int; UNEP WCMC; South African National Biodiversity Institute – Mandy Driver);
- Vulnerability assessment;
- Adaptation learning mechanisms (UNDP).

New Topics

- Capacity building
- Designing climate-related training programmes for protected area staff
- How to use this guide, by whom
- Resilience to climate change
- Role of protected areas in disaster mitigation, how to use protected areas for mitigation
- How to reduce vulnerability of humans through protected area services
- How to help nature to adapt to climate change
- Biome-specific challenges and opportunities
- Incident management
- Communication strategies (to raise funds, to raise awareness, to increase support)
- Park operations

Other issue to note

- Climate change highlights the need to: a) clarify conservation objectives and b) improve management;
- Need to focus on livelihoods – especially to address ecosystems in between protected areas;
- There is a limited scope for adaptation; we need to be realistic with respect to objectives;
- Need to focus on more than managers;
- There is much more expertise at the site level that is not scaled-up and used;
- Importance of including climate change in protected area planning;

- Climate change must be considered as a threat that has an exacerbating effect on most other threats within the management and planning process;
- Need to define 'invasive species' and 'native' when managing natural areas under climate change;
- All models are wrong but very useful for asking "what if" questions;
- There needs to be a change in concept from protected area management to a larger 'conservation area management';
- There is a degree of variability in expert opinion;
- The needs and capacity of protected area managers vary;
- Regional thinking is needed - Working at a landscape scale is very difficult;
- There is a great deal we don't know about managing for ecosystem resilience/integrity/sustaining ecosystems in the face of climate change;
- Ecosystems that retain their natural level of biodiversity are likely to be more resilient than those that lose significant numbers of species;
- A common vision is important between stakeholders in planning for connectivity;
- There are no best case studies for protected area management under climate change impacts;
- Need to create champions for protected area and climate change;
- 'Ideal' and 'Real' protected area management;
- Rethinking conservation objectives is crucial.

9 Workshop participants

9.1 Participant biographies

1. Stephan Amend (Peru): GTZ

Stephan has been working for German Technical Cooperation in protected area management as part of regional development initiatives since 1990 in Venezuela, Ecuador, Panama, as advisor in GTZ headquarters and at present in Peru. He has edited and published several books on protected areas, biocorridors, Co-management, environmental education, one of which is "*Management Plans - Concepts and Proposals*".

2. Başak Avcioglu (Turkey): WWF Turkey

Başak has been involved in nature conservation since 1996 starting as a volunteer. She has been employed by WWF-Turkey since 2002 and works on ecoregion conservation and protected areas in Mediterranean and Caucasus Ecoregions. She completed BSc. Landscape Architecture and MSc. Diplomas in Landscape Planning and Regional Planning. She is now national coordinator for the PA4LP Programme.

3. Costel Bucur (Romania): UNDP

Originally a forester, Costel started working on conservation issues ten years ago. Together with a local NGO he helped set up a nature park in his local region of Romania which now encompasses over 130,000 ha. For five years he managed the GEF/UNDP project supporting the park's establishment and management. He currently manages the park.

4. Adriana Dinu (Romania): UNDP

Adriana is the Environment and Energy Practice Leader for UNDP - Europe and Central Asia. She has over 24 years of applied experience in biodiversity conservation and protected area management planning in Southern Africa, Central America, Eastern Europe, Caucasus and Central Asia. She is interested in the contribution of biodiversity to development and poverty alleviation and in landscape level conservation planning and management for enhancing ecosystem resilience and reducing societies' vulnerability to climate change.

5. Nigel Dudley (UK): Equilibrium Research

Nigel is an ecologist working as a consultant, mainly on issues related to protected areas and broad-scale conservation. He has worked in over fifty countries around the world, mainly for non-governmental organisations, United Nations agencies and academic institutions.

6. Michael Dunlop (Australia): CSIRO

Michael is a research scientist with CSIRO in Australia. He works on assessing the implications of climate change for conservation and developing conservation strategies that will be effective as species, ecosystems and landscape change.

7. Jamison Ervin (USA): UNDP

Jamison manages the UNDP Early Action Grant. She has worked for TNC, WWF, FSC and CBD among others. She focuses on protected area design, management and assessment. She has a PhD in natural resources from the University of Vermont.

8. Paul Gray (Canada): Climate Change Programme, Ministry of Natural Resources, Ontario , Canada

Paul has a PhD in biology and has worked on a variety of natural asset management projects in Canada and Zimbabwe. He currently works in the Applied Research and Development Branch within Ministry of Natural of Resources in Canada focussing on climate change issues.

9. Marc Hockings (Australia): IUCN-WCPA/University of Queensland

Marc co-ordinates environmental management programs at the University of Queensland. Marc is a vice-chair of the IUCN-WCPA and a member of the Commission's Executive Committee. Marc leads the program within IUCN-WCPA on Science and Management of Protected Areas.

10. Dave Hole (UK): Conservation International

Dave is an ecologist, working in CI's Science and Knowledge Division, with a principal interest in how climate change may impact biodiversity, ecosystems and their services, that we, as a society, depend upon.

11. Judith Jabs (Germany): International Academy for Nature Conservation Isle of Vilm, German Federal Agency for Nature Conservation

Judith has a Brazilian and German background in biology and sustainable resource

management. Working at the International Academy for Nature Conservation Isle of Vilm, she plans and organizes workshops on nature conservation.

12. Karen Jenderedjian (Armenia): UNDP

Karen worked in the Ministry of Nature Protection until a move to UNDP in 2010. He has been the Ramsar National Focal Point for Armenia since 1994 and was honoured in 2003 by the Minister of Nature Protection for '*significant input into establishment and development of Sevan National Park*'. Author over 80 papers on species, hydrology, protected area management etc.

13. Stanislav Kim (Kazakhstan): UNDP

Stanislav graduated in Environmental Management from the Kazakh National State University. He has worked for UNDP on several projects in the region and is currently head of the Energy and Environment Department for UNDP in Kazakhstan.

14. Yildiray Lise (Turkey): UNDP

Yildiray completed his B.Sc. and M.Sc. in Biological Sciences at the Middle East Technical University in Ankara, Turkey. He has worked for WWF-Turkey and Nature Association (BirdLife Turkey) and is currently deputy manager of a UNDP/GEF project on enhancing coverage and management effectiveness of forest protected areas in Turkey. He is a member of IUCN-WCPA and UNESCO Turkish National MAB Committee.

15. Kathy MacKinnon (UK): Conservation Biology Group, University of Cambridge

Formerly Lead Biodiversity Specialist at the World Bank working on conservation and protected area projects globally. Kathy is now a member of Conservation Biology Group, University of Cambridge and Vice-Chair of the IUCN-WCPA for the CBD. Author of World Bank publications *Convenient Solutions to an Inconvenient Truth: Ecosystem-based approaches to Climate Change* and co-editor of *Natural Solutions Protected Areas helping People to cope with Climate Change*.

16. Ignacio J. March Mifsut (Mexico): TNC

Bachelor degree in Biology; Masters in Wildlife Management and Conservation from the Universidad Nacional of Heredia, Costa Rica; postgraduate courses on wildlife physiopathology and GIS. Former Regional Director for the Maya Rainforest

Program at CI and since 2004, Science Coordinator at TNC's Mexico and Northern Central America Program.

17. Tatiana Minaeva (Russia): UNDP

Tatiana was Arctic Senior Technical officer for Wetlands International and coordinator of their peatlands projects in Russia before joining UNDP in 2009. Her PhD, from Komarov Botanical Institute, Russian Academy of Sciences, focuses on botany and specialization in mire vegetation.

18. Jeff Price (USA/UK): WWF US

Jeff is the Senior Scientist for climate change adaptation at WWF-US, the coordinator of "The Wallace Initiative: Identifying Refugia in a Changing Climate" and a visiting fellow at the Tyndall Climate Change Centre (UK). Jeff was a lead author on the IPCC 3rd and 4th Assessment Reports as well as the CBD AHTEG (Ad Hoc Technical Expert Group) on climate change and biodiversity.

19. Alexandru Rotaru (Moldova): UNDP

Alexandru studied economics and forestry at University. He has worked for the Biodiversity Office in the Ministry of Environment of Moldova and has worked with UNDP since 2007; he is currently a project assistant for a UNDP/GEF protected areas project.

20. Loring Schwarz (USA): Loring Schwarz Associates

Loring has worked in the conservation arena for 35 years, most recently in leadership roles with TNC, overseeing management and conservation strategies in the Massachusetts state and Eastern Caribbean Programs, focused on PoWPA (Programme of Work on Protected Areas) implementation and managing the impacts of climate change.

21. Sergey Sklyarenko (Kazakhstan): Association for the Conservation of Biodiversity of Kazakhstan (ACBK)

Ornithologist, PhD in Biology. ACBK Science Director and Head of Centre of Applied Biology of ACBK, national Important Bird Area Coordinator. Formerly senior research scientist of Institute of Zoology of Academy of Science of Kazakhstan, studied tits, raptors, Houbara Bustard, desert and mountain avifauna. 30-years experience in field work, expertise in planning of protected areas, wildlife legislation and environment impact assessment.

22. Borko Vulikic (Montenegro): UNDP

After working several years in NGO sector, Borko worked for EU CAFAO mission in Montenegro and then as a UNDP project manager for remediation of environmental hot spot. Currently programme manager for projects focusing on protected area system and finance.

23. Stephen Woodley (Canada): Parks Canada

Stephen is an ecologist, who has worked in the field of environmental management for 25 years. He is Chief Ecosystem Scientist for Parks Canada, where he works on a number of issues related to protected areas, including ecological monitoring, species at risk, wildlife disease, ecological restoration and science policy.

24. Graeme Worboys (Australia): IUCN-WCPA

Graeme is Vice Chair (Mountains Biome and Connectivity Conservation) for IUCN-WCPA. He has worked in protected area management for 37 years and is co-author/editor of IUCN's *"Protected Area Management: A Global Guide"* (2006) and *"Connectivity Conservation Management: A Global Guide"* (2010).

25. Tatyana Yashina (Russia): UNDP

Tatyana moved to the Altai Mountains 9 years ago to work on the conservation of the Katunskiy Biosphere Reserve. Since 2010 she has worked for UNDP-GEF Project "Conservation of Biodiversity in the Russian Portion of the Altai-Sayan Ecoregion" as a climate change expert. Interests include connectivity conservation as an adaptive response to climate change in Altai-Sayan transboundary region.

26. Svetlana Zagirova (Russia): UNDP

Svetlana is a biologist, a Doctor of Science, working for the Forest Science Department of the Institute of Biology, Komi Science Centre, Russian Academy of Sciences. Her research focuses on CO₂ fluxes in forests and environment response of plants; she has produced over 50 publications.

9.2 Participant details

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10 Workshop Programme

Wednesday, 25 August

19.30	Welcome, workshop objectives and introduction of participants and the place	Organisers
21.00	Informal get-together	

Thursday, 26 August

1 UNDERSTANDING CLIMATE CHANGE IMPACTS

09.00	Introduction to the topic	MARC HOCKINGS
09.10	Introduction to WS 1: Raising awareness of climate change in protected area management: what are the changes and the likely climate change impacts?	ADRIANA DINU (RAPP.: NIGEL DUDLEY)
09.20	Introduction to WS 2: Scaling down predictions and developing base-line data for understanding climate impacts at protected site level and using appropriate technologies and methods for site managers	IGNACIO MARCH MIFSUT (RAPP.: MARC HOCKINGS)
09.30	Introduction to WS 3: Threat assessments role in understanding climate change impacts	JAMIE ERVIN (RAPP.: LORING SCHWARZ)
09.40	Questions, comments and onwards to working groups	
10.50	Working groups (coffee / tea break included)	
13.30	Guided tour around the Isle of Vilm	JUDITH JABS, BfN

2 MANAGING FOR CLIMATE CHANGE

15.00	Introduction to the topic	David Hole or Michael Dunlop
15.10	Introduction to WS 1: Managing species: identifying species most at risk, what are the impacts likely to affect them, how do you manage those threats?	JEFF PRICE (RAPP.: JAMIE ERVIN)

15.20	Introduction to WS 2: Managing for overall ecosystem resilience: e.g. looking at invasive species, fire, disease, drought, protected area site design, etc.	DAVID HOLE (RAPP.: MARC HOCKINGS)
15.30	Introduction to WS 3: Working with communities on managing and understanding climate change impacts	STANISLAV KIM (RAPP.: NIGEL DUDLEY)
15.40	Questions, comments and onwards to working groups	
15.45	Working groups (coffee / tea break included)	
19.30 – 20.30	Presentation and discussion of the outputs from the days working groups	

Friday, 27 August

3 BIOME MANAGEMENT

09.00	Introduction into the topic	YILDIRAY LISE
09.10	Introduction to WS 1: Forests and mountains	YILDIRAY LISE (RAPP.: NIGEL DUDLEY)
09.20	Introduction to WS 2: Freshwater and peatlands	TATIANA MINAEVA (RAPP.: MARC HOCKINGS)
09.30	Introduction to WS 3: Grasslands and steppes	SERGEY SKLYARENKO (RAPP.: JAMIE ERVIN)
09.40	Questions, comments and onwards to working groups	
10.50	Working groups (coffee / tea break included)	
13.45	Group photograph	

4 MONITORING AND ADAPTIVE MANAGEMENT

14.00	Introduction to the topic	Stephen Woodley
14.10	Introduction to WS 1: Monitoring climate impacts and adapting management	STEPHEN WOODLEY (RAPP.: NIGEL DUDLEY)
14.20	Introduction to WS 2: Management effectiveness and climate change	JAMIE ERVIN (RAPP.: GRAEME WORBOYS)
14.30	Introduction to WS 3: Planning Management considering climate change	STEPHAN AMEND (RAPP.: MARC HOCKINGS)
14.40	Questions, comments and onwards to working groups	
15.00	Working groups (coffee / tea break included)	
19.30 – 20.30	Presentation and discussion of the outputs from the days working groups	

Saturday, 28 August

5 RESTORING AND CONNECTING LANDSCAPES

09.00	Introduction to the topic	GRAEME WORBOYS
09.10	Introduction to WS 1: Local scale corridors and connectivity as they relate to climate change	GRAEME WORBOYS (RAPP.: JAMIE ERVIN)
09.20	Introduction to WS 2: Restoration	NIGEL DUDLEY (RAPP.: MARC HOCKINGS)
09.30	Questions, comments and onwards to working groups	
09.45	Working groups (coffee / tea break included)	

13.30	Report back from working groups	
14.00	Conclusions and next steps: Reviewing, discussing and assimilating the outputs from the working groups, planning the IUCN-WCPA best practice guidelines and climate change strategies/action and generally agreeing next steps, future projects, etc.	KATHY MACKINNON (RAPP.: NIGEL DUDLEY)
16.00	Closure of the workshop	ORGANISERS
16.15	<u>Optional</u> : presentation and review of the e-learning module on climate change and PAs	JAMIE ERVIN
17.35	<u>Optional</u> : Departure of the boat from Vilm for a boat trip through the Greifswald Bodden, a special area for conservation (costs: ca. 10 Euros)	
	Either 18.30 dinner on Vilm island Or 20.15 dinner in Lauterbach (return to Vilm by ferry at 22.00)	
Sunday, 29 August		
07.30, 09.30	Departure (boat)	
08.00 10.00	Departure (train) from Lauterbach Mole	