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CHANGING TIDES

Climate Adaptation Methodology for Protected Areas (CAMPA) Coastal and Marine

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Climate Adaptation Methodology for Protected Areas (CAMPA):

Coastal and Marine

Version 0

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This is Version 0 of the Climate Adaptation Methodology for Protected Areas (CAMPA) – Coastal and Marine, for comment. Please send your inputs and suggestions to Alexander Belokurov, WWF-International before December 31, 2014 (abelokurov@wwfint.org).

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CONTENTS

Part I: INTRODUCTION

The Climate Adaptation Methodology for Protected Areas (CAMPA) has been developed to help managers in this case of Coastal and Marine Protected Areas and other stakeholders respond and adapt to climate change. It is designed to build the resilience of Protected Areas (PAs) and associated ecosystems based on a thorough understanding of their vulnerability and a participatory agreement on the best ways to respond.

It has been prepared as part of an EU funded project entitled 'Implementing Climate Adaptation Strategies in the World's Most Outstanding Natural Places', carried out jointly by WWF International, WWF-Colombia, WWF-Madagascar and Western Indian Ocean Program Office (MWIOPO) and WWF-Philippines, in partnership with: Madagascar National Parks authority and Conservation International (Madagascar); Corponariño and Parques Nacionales, the Colombian National Parks Authority (Colombia); and Local Government Unit of the Island Garden City of Samal (Philippines). The overall objective of the project was to "Effective climate change adaptation strategies are developed and being implemented in six protected areas and related adaptation issues are integrated into local planning frameworks for associated coastal and island ecosystems by empowered and resourced stakeholders in Colombia, Madagascar and the Philippines."

The development of this methodology has been one of the major outputs of this global project and we hope that it can be of use to many Coastal and Marine Protected Areas around the world.

CAMPA does two main things:
1. It provides practical and scientifically sound guidance to facilitate climate change vulnerability assessments of coastal and marine protected areas;
2. Based on an understanding of that vulnerability, it then facilitates decision-making on the most appropriate adaptation measures.

The Climate Context

Climate change is creating multiple pressures on coastal and marine habitats[1]. Critical issues include sea level rise and its impacts on coastal habitats[2]; higher water temperatures with numerous side-effects, including coral bleaching[3] and spread of invasive alien species[4]; and the pervasive and still poorly understood impact of ocean acidification[5]. Effects of climate change that may be specific to coastal and marine protected areas include loss of habitat due to sea level rise or coastal erosion and the indirect effects of "maladaptation" such as hardening of coastlines that affect natural areas. These climate change issues are serious enough on their own: however in practice they are further exacerbated by existing pressures on the marine environment, such as chronic over-fishing and damaging use of fishing technology[6]; pollution from fossil fuels, persistent pesticides, nitrate, garbage and heavy

1 Cheung, W.W.L., V.W.Y. Lam, J.L. Sarmiento, K. Kearney, R. Watson and D. Pauly. 2009. Projecting global marine biodiversity impacts under climate change scenarios. Fish and Fisheries 10: 235-251

2 Church, J.A. and N.J. White. 2006. A 20th century acceleration in global sea-level rise. Geophysical Research Letters 33: L01602, doi:10.1029/2005GL024826

3 Hoegh-Guldberg, O., P.J. Mumby, A.J. Hooten, R.S. Steneck, P. Greenfield, E. Gomez, C.D. Harvell, P.F. Sale, A.J. Edwards, K. Caldeira, N. Knowlton, C.M. Eakin, R. Iglesias-Prieto, N. Muthiga, R.H. Bradbury, A. Dubi and M.E. Hatziolos. 2007. Coral Reefs Under Rapid Climate Change and Ocean Acidification. Science 318: 1737-1742

4 Stachowicz, J.J., J.R. Terwin, R.B. Whitlatch and R.W. Osman. Linking climate change and biological invasions: Ocean warming facilitates nonindigenous species invasions. Proceedings of the National Academy of Sciences 99 (24): 15497–15500

5 Doney,S.C., V.J. Fabry, R.A. Feely and J.A. Kleypas. 2008. Ocean Acidification: The Other CO_2 Problem. Annual Review of Marine Science 1: 169-192

6 Pauly, D., R. Watson and J. Alder. 2005. Global trends in world fisheries: impacts on marine ecosystems and food security. Philosophical

metals[7]; disturbance to marine life from ocean-going vessels[8]; and catastrophic levels of damage to coastal and inshore habitats such as coastal marshes[9], mangroves[10], coral reefs[11] and seagrass beds[12].

An additional complicating factor is that due to geophysical time lags, many of the impacts of climate change, including warming, are likely to persist in the oceans for thousands of years[13], and that certain changes may already be "locked-in" in the world's marine environments[14].

Key characteristics of coastal and marine protected areas that influence their vulnerability to climate change include the high degree of mobility of key ecosystem components, elevated dispersal rates and distances of many species, relative absence of physical barriers to horizontal and vertical dispersion, high degree of interconnection between habitats and ecosystems and the greater heat capacity of water than air which means that sudden changes in temperature experienced in terrestrial ecosystems do not occur in marine environments.

There is growing awareness on the part of protected area managers that climate change is a reality as the effects of climate induced stresses on marine and coastal ecosystems are becoming more frequently observed. This is of particular concern due to the degraded condition of many of the world's marine and coastal zones and their relatively low representation in protected area networks.

The importance of links between the species and ecosystems found in coastal and marine protected areas and the effects of climate change on the human communities that depend on or impact natural resources found in protected areas are also beginning to be better understood. Such understanding is vital given that more than a billion people, including many of the world's materially poorest who are amongst the most vulnerable groups to climate change, live in low-lying coastal zones and depend on the natural resources or ecosystem services found there.

The role of Protected Areas in Climate adaptation

If properly planned and managed, PAs can play a fundamental role in protecting biodiversity from the effects of climate change, and ensuring that ecosystems continue to provide essential goods and services to communities. To achieve this, PA managers need to be able to identify where and how

the effects of climate change will be felt, and to develop measures – referred to as "climate change adaptation measures" – that aim to achieve two inter-related outcomes:

Transactions of the Roya; Society B. 360, 5-12

7 Islam, S.M. and M. Tanaka. 2004. Impacts of pollution on coastal and marine ecosystems including coastal and marine fisheries and approach for management: a review and synthesis. Marine Pollution Bulletin 48: 624–649

8 Carlton, J.T. and J.B. Geller. 19993. Ecological roulette: The global transport of nonindigenous marine organisms. Science 261: 78-82

9 Greenberg, R., J. Maldonado, S. Droege and M.V. McDonald. 2006. Tidal marshes: a global perspective on the evolution and conservation of their terrestrial vertebrates, BioScience 56: 675-685

10 Farnsworth E.J. and A.M. Ellison. 1997. The global conservation status of mangroves, Ambio 26: 328-334

11 Mumby, P.J. and R.S. Steneck. 2008. Coral reef management and conservation in light of rapidly evolving ecological paradigms, Trends in Ecology and Evolution 23: 10

12 Orth R.J., T.J.B. Carruthers, W.C. Dennison, C.M. Duarte, J.W. Fourqurean, K.L. Heck Jr., A.R. Hughes, G.A. Kendrick, W.J. Kenworthy, S. Olyarnik, F.T. Short, M. Waycott and S.L. Williams. 2006. A Global Crisis for Seagrass Ecosystems, Bioscience 56: 987-996

13 IPCC, 2007: Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.), IPCC, Geneva, Switzerland

14 Soto C.G. 2002. The potential impacts of global climate change on marine protected areas. Reviews in Fish Biology and Fisheries 11: 181–195

1. "Adaptation for Protected Areas" involving measures that aim to increase the resilience of PAs to future climate change thus reducing the likely negative impacts of climate change and optimizing potential positive impacts on PA objectives.
2. "Protected Areas for Adaptation" involving measures that seek to integrate PAs as components in broader landscape or regional level climate change adaptation strategies for communities and ecosystem services.

Box 1: Coastal and marine protected areas:
IUCN defines a protected area (on land or sea) as follows: "A protected area is a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values"[15]

The definition includes all governance types of Pas including Indigenous and Community Conserved Areas and other traditional governance, private reserves, co-managed Pas and governmental Pas.

Areas which may incidentally appear to deliver nature conservation but DO NOT HAVE STATED nature conservation objectives should not automatically be classified as protected areas, as defined by IUCN[16]. Coastal and marine protected areas (CMPAs) are expanding rapidly around the world. In 2010, countries that are signatories to the Convention on Biological Diversity agreed that CMPAs should cover at least 10 per cent of marine and coastal areas. CMPAs have a critical biodiversity conservation role and also supply a range of ecosystem services including supporting fisheries, tourism and recreation and protecting against natural disasters.

Box 2: Marine PAs and their response to Climate Change (from Natural Solutions Report):
Marine protected areas provide multiple responses to climate change. They mitigate climate change by conserving marine carbon stores in seagrass, kelp beds, etc. MPAs also help to adapt to climate change, for instance by rebuilding depleted fish stocks and protecting coastal habitats that buffer human communities against sea-level rise and ocean surge. Protecting whole ecosystems is important to maintain resilience. Reefs are better able to withstand the impacts of climate change if herbivorous fish species that graze on algae and help keep the ecosystem in balance are present. Studies on herbivore and coral interactions suggest that in the absence of herbivores, corals are more susceptible to bleaching events induced by warming temperatures[17].

Need for the methodology

We are still at the early stages of learning how to manage for climate change from a conservation perspective; indeed we still don't know if it is going to be possible to manage our way through the scale

and speed of projected changes. This is particularly the case for the marine and coastal environment, where changes are likely to be profound and where the number of stakeholders and resulting social issues are often numerous and complex. Nonetheless, innovative CMPA managers and researchers have been learning from experience over the last few years, both about predicting likely new pressures

15 Dudley, N. (ed.) 2008. Guidelines to Protected Area Management Categories, IUCN, Gland, Switzerland
16 Day J., N. Dudley, M. Hockings, G. Holmes, D. Laffoley, S. Stolton and S. Wells, 2012. Guidelines for applying the IUCN Protected Area Management Categories to Marine Protected Areas. IUCN, Gland, Switzerland
17 Mumby, P. J., A. R. Harborne, J. Williams, C. V. Kappel, D. R. Brumbaugh, F. Micheli, K. E. Holmes, C. P Dahlgren, C. B. Paris and P. G. Blackwell (2007); Trophic cascade facilitates coral recruitment in a marine reserve, Proc Natl Acad Sci, 104, 8362-8367

on the CMPA and experimenting with ways in which these could be countered. There are already steps that we know are worth taking. But this is seldom if ever just a simple checklist of actions; strategies need to be modified for particular situations, stakeholder needs and in line with the resources and expertise available.

The current manual provides a framework to help managers – whether these are state officials within the national park service or collective groups managing an indigenous peoples or community conserved area – to make meaningful decisions with respect to climate change in MCPAs. It focuses in particular on assessing vulnerability and then using this information to develop response strategies. The manual includes up-to date information about tools and methodologies, but also lays out a process for working with stakeholders to identify the best approaches in a particular site.

This methodology has been designed for a range of situations. It has a focus on developing country contexts although could be applied anywhere, and can be tailored to the needs of an individual coastal and marine protected area in terms of data and resource availability.

Principles of the Methodology

The methodology is focused on the assessment of the climate change vulnerabilities and adaptation options of CMPAs and surrounding human communities to ensure consideration of critical links between ecological and social systems particularly in a developing country context where natural resource dependence is typically high, but where data and technical resources are typically low. It is based primarily on existing and proven methodologies but adds value to these by combining them in a logical framework. It also introduces new tools and provides guidance on how to use them. The framework approach allows the required flexibility to adress individual PAs/country needs and capacities.

Specifically, the methodology encompasses the following approaches[18]:

A **multi-disciplinary approach** that looks at both ecological and social systems, and at science-based approaches along with Traditional Ecological Knowledge and the links between them as well as considering important ecosystem services.

A **participatory approach** that emphasizes involvement of key stakeholders from the outset of the process and then draws on scientific, local community and government stakeholders to ensure that a wide range of quantitative and qualitative data is sourced, and local perspectives and knowledge are integrated into the process. Even when decision-making power is in theory entirely with the PA manager, effectiveness depends to a large extent on how these wider stakeholders view management and react to the management plan.

A **holistic approach** that looks at both climate and non-climate influences on systems that are being investigated in the study by only including reference to scientific analytical methods that include consideration of non-climate stressors in combination with climate stressors.

An **integrated approach** where conservation and development are considered. Adaptation efforts

18 Adapted from Ellison J.C. 2012. Climate change vulnerability assessment and adaptation planning for mangrove systems. Washington DC, World Wildlife Fund and Schroeter D., Polsky C. and Patt A.G. 2004. Assessing vulnerabilities to the effects of global change: an eight step approach, Mitigation and Adaptation Strategies for Global Change, vol 10, pp 573 - 596

that do not integrate ecosystems and communities will have a higher risk of failure.

A **short-term and long-term approach** that considers both the effects of short-term climate variability and longer-term climate change. The manual achieves this by requiring an up-front definition of the timeframe and the climate parameters for which the analyses will be carried out, and then linking all subsequent analyses to this framework.

A **risk management approach** whereby the technical analyses are fed into a participative validation and priority setting exercise that aims to address uncertainties and ground-truth technical analyses to local realities.

A **tested approach** that presents a methodology that has been tested and refined by country teams in Colombia, Madagascar and the Philippines to optimize its functionality and practicality. The framework format of the manual ensures that it can be updated and refined as new tools and methodologies are developed and tested thus ensuring it will remain up to date and current.
Additionally to the core principles outlined above, the following summarises a number of other important principles that can help to ensure that PA approaches to climate change adaptation are as successful as possible.

- Good governance: is an essential part of ensuring that adaptation policies are implemented effectively and equitably. It draws on a series of ethical imperatives, including fairness, lack of corruption, transparency, and other values that are sometimes hard to measure[19]. Ensuring good governance is particular important when a site is undergoing rapid changes that require wide-ranging and challenging responses.
- Benefit sharing: participatory approaches and community buy-in to projects depend on benefits being shared as equitably as possible. Revenue-raising projects often benefit a few politically powerful or entrepreneurial people; those left out may be worse off than before. It is important to ensure that as many people as possible benefit from innovations within and around the PA. Thus tourism activities should include jobs for local people; increased fish stocks from PAs should benefit local artisanal fishers; and coastal protection should reduce disaster risk reduction for local communities. Equitable benefit sharing involves consultation with stakeholders and also negotiation at a higher level to prevent the richest and most powerful players grabbing most of the benefits.
- Gender issues and climate change: there are gender inequalities with respect to climate vulnerability: women's less privileged position often puts them at greater risk but sometimes this can be reversed: more men died than women in Hurricane Mitch in 1998 because of expectations that they led rescue efforts[20]. These issues need to be addressed, including gender sensitive questions relating to research[21], and opportunities for adaptation to help address issues of gender inequality[22].
- Poverty reduction: many CMPAs are expected to deliver measurable poverty reduction benefits

19 Borrini-Feyerabend, G. N. Dudley, T. Jaeger, B. Lassen, N. Pathak-Broome, A. Philips and T. Sandwith. 2013. Governance of Protected Areas: From understanding to action, Best Practice Protected Area Guidelines Series number 20, IUCN, Gland, Switzerland
20 Blomstrom, E., S. Cunningham, N. Johnson and C. Owren. 2009. Women at the Forefront. UN Population Fund and Women's Environment and Development Organisation
21 Bäthge, S. 2010. The Governance Cluster: Climate change and gender: Economic empowerment of women through climate mitigation and adaptation. Working Paper, GTZ, Eschborn, Germany
22 Chaudhury M., P. Kristjanson, F. Kyagazze, J.B. Naab and S. Neelormi. 2012. Participatory gender-sensitive approaches for addressing key climate change-related research issues: evidence from Bangladesh, Ghana, and Uganda. Working Paper 19. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), Copenhagen

related to the Millennium Development Goals and other poverty initiatives. Protected areas are not generally set up to address entrenched poverty issues, and are often located in places where poverty remains a challenge. Including potential economic benefits for local communities within adaptation planning and, importantly, reporting back on these to donors and others are both important steps in many projects.

- Incentives for management: incentives need not be financial or even utilitarian: local communities often respond positively to conservation needs if these do not directly undercut livelihoods or entail excessive cost, but this implies time spent on explanation and building support, for instance from children and the young. Other incentives might include grants, micro-finance loans, direct payments, compensation payments, supply of community needs (a health centre or a school for instance) or other benefits such as jobs, increased access to natural resources and disaster risk reduction
- Communication, capacity building and awareness-raising: to inform people of proposed management changes so that they can comment; describe likely or observed changes in the environment and their implications; outline opportunities for adaptation; provide training on adaptation; and give information about meetings, contact details etc. The most effective communication is still by direct personal contact; but other methods include posters, letters, email, web site and text messages, tailored to types of communication used in communities. Lessons learned need to be told to other protected areas: staff exchanges and visits between PAs can be a good option. What did not work is as important, sometimes more important, than what worked.
- Advocacy and policy: participatory approaches do not imply a free for all; the CMPA managers will have opinions and it is legitimate to promote these. Advocacy may also be needed at a political level; this can be undertaken by PA staff but may be more effective through partners, such as NGOs, who can speak more freely. Advocacy that includes both PA managers and local communities demanding the same changes is far more powerful than a PA or NGO working alone. Supportive policy initiatives, both at national level and international level, such as the Convention on Biological Diversity's Programme of Work on Protected Areas, national and local adaptation strategies and land-use plans can support advocacy. Furthermore, PA adaptation plans must be referenced in policy frameworks.
- Monitoring and evaluation: a good monitoring system is one of the most important elements of success in conservation projects. Success often only comes when managers have been able to adapt: particularly by noting what isn't working and taking steps to make the necessary changes. The monitoring system is the major source of information to facilitate adaptive management. Some aspects of monitoring need to be driven by experts but many can and should involve local communities. Monitoring needs to be transparent and accessible to everyone so that people understand trends and recognise the need for action.

All the above are not optional extras, but fundamental elements of adaptation in CMPAs.

Key Concepts

There are numerous definitions and conceptual models to address the challenge of understanding and managing future climate changes, risks, impacts, resilience, adaptive capacity, and to identify Pathways for Adaptation. This Manual focuses on understanding and managing key concepts in the context of assessing, planning and mainstreaming climate adaptation into Protected Area management. These are defined below:

Adaptation:

The IPCC-AR5 (2014) definition of adaptation is: "The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate harm or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to expected climate and its effects." This definition follows the lead of the IPCC –SREX (2012) in introducing a degree of purposefulness by adding the phrase "which seeks to moderate" rather than simply "which moderates" as in AR4.

The SREX and AR5 definitions of adaptation also clarify the distinction between adaptation in human and natural systems. AR5 indicates that "natural systems have the potential to adapt through multiple autonomous processes (e.g., phenology changes, migration, compositional changes, phenotypic acclimation, and/or genetic changes), and humans may intervene to promote particular adjustments such as reducing non-climate stresses or through managed migration. But successful adaptation will depend on our ability to allow and facilitate natural systems to adjust to a changing climate, thus maintaining the ecosystem services on which all life depends" (IPCC -AR5 2014).

In the process of building future adaptive capacity in the context of PA management, this Manual builds upon IPCC's AR5 foundation for defining adaptation. The overarching framework of climate adaptation adopted by this manual is managing and reducing current and future climate risks through the design of effective risk management, and also through building and strengthening protected areas resilience informed by an understanding of both risks and existing adaptive capacity.
A simple illustration of the relationship between the different components of Climate Adaptation planning.

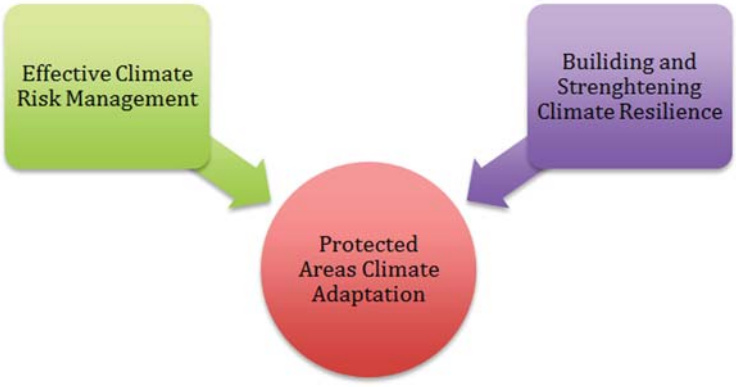


Figure 01: Simple Illustration of Elements of Climate Adaptation

Climate Risks

In this manual, a climate risk is the potential effect on natural and human systems of extreme weather and climate events and of climate change. An effect is generally refer to impacts on "lives, livelihoods, health, ecosystems, economies, societies, cultures, services, and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific time period and the vulnerability of an exposed society or system" (IPCC AR5 2014).
Methodologically, climate Risks arise from the interaction between a hazard (triggered by an event or trend related to climate), vulnerability (susceptibility to harm), and exposure (people, livelihoods, assets or biodiversity at risk). In this Manual, hazards include processes that range from different physical manifestations, such as severe storms, to slow trends, such as multi-century sea-level rise.
Climate Risk can be represented as the probability of occurrence of those hazardous events or trends multiplied by the magnitude of the consequences (impacts) if these events occur. Therefore, "high risk can result not only from high probability outcomes, but also from low probability outcomes with very severe consequences" (IPCC AR5 2014). Climate risks can be understood either qualitatively or quantitatively. Moreover, most approaches for managing risk do not necessarily require that risk levels can be accurately quantified.

A simple illustration of the relationship between the different components of Climate Adaptation planning that has been adopted for the development of this manual is shown in Figure 02.

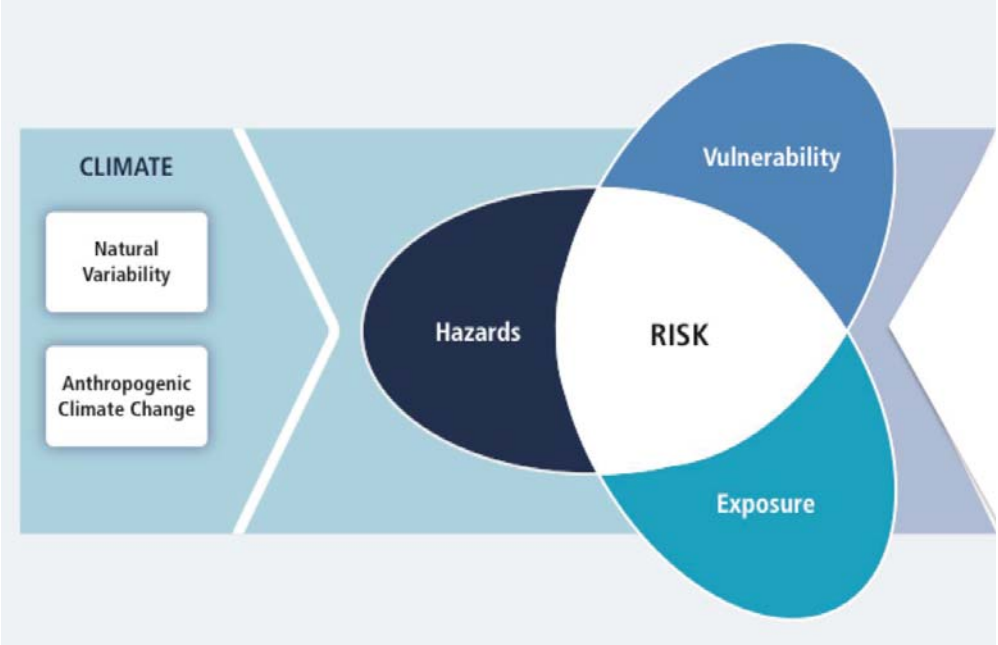


Figure 02: Simple Illustration of Elements of Climate Risk (Adapted from IPCC –SREX & AR5)

Vulnerability:

The use of this term in the literature, including the IPCC reports, has been inconsistent. Until IPCC - AR4, vulnerability was viewed as comprising three elements: exposure, sensitivity, and adaptive capacity (IPCC, 2007). However, in IPCC-SREX (2012) and IPCC-AR5 (2014) vulnerability focuses only on sensitivity and capacity, with exposure more appropriately incorporated into the concept of risk. In that sense, the most recent definition adopted by IPCC recalls that Vulnerability is "the propensity or

predisposition of a system to be adversely affected".

Adaptation Framework:

Even if the terminology used to describe exposure, impacts, sensitivity, vulnerability, risks and adaptive capacity changes, the basic underlying assumptions follow a similar logic (figure 03):
There is system of concern which is affected by climate-related stress
This stress produces potential harm to the system (in AR4, vulnerability; in AR5, impact/risk).
Harm is moderated by attributes of the system itself (in AR4, sensitivity; in AR5, vulnerability).
The system has an ability to adjust to potential damage, to take advantage of opportunities, or to respond to consequences (in AR4, adaptive capacity)

While AR4 uses the concepts of sensitivity and adaptive capacity to describe the moderating attributes of the system (Biophysical and Socio Economic Environment), AR5 uses the concept of exposure (the presence of a system in places that could be adversely affected) and vulnerability (the moderating attributes of the system).

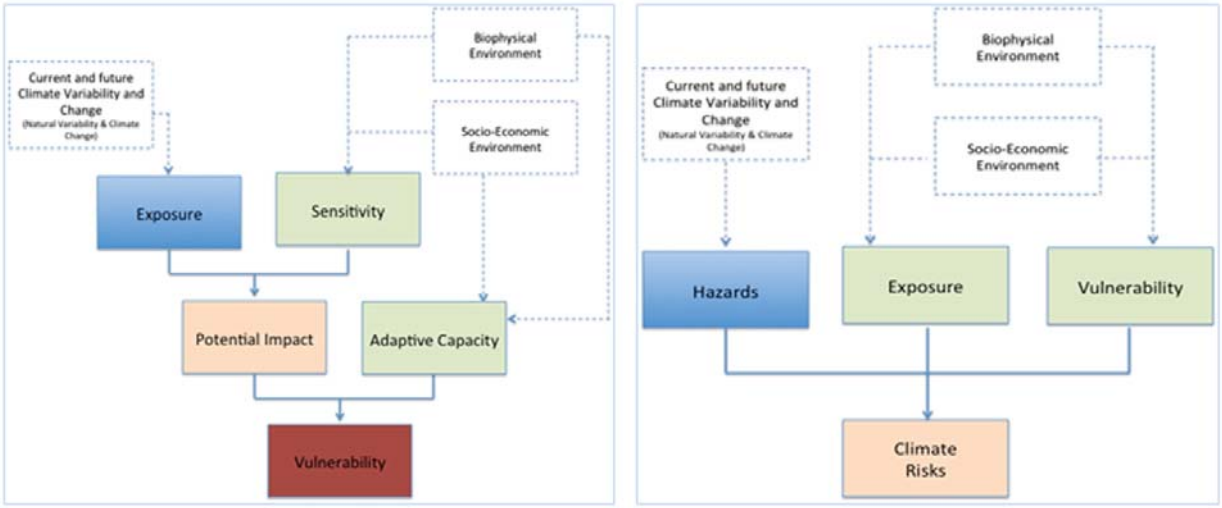


Figure 03: Illustration of the Climate Vulnerability IPCC AR4 and Climate Risk IPCC AR5 Framework (Guevara 2014)

Ecosystem-based adaptation (EBA)

EBA describes a loose collection of techniques that aim to help human communities to cope with rapidly changing environmental conditions. Although some of the techniques that today get included with EBA are already well known, others are newer and untested. The application of EBA in marine environments is quite new and scientists, coastal and marine managers and coastal communities are learning together. What techniques are best? What are most cost effective? What are the side effects – good and bad? Managers of coastal and marine protected areas are often on the frontline of climate change and can be so overwhelmed by day-to-day problems that they have little time to think about long-term adaptation strategies. Almost all of such actions could and sometimes are applied for

reasons quite apart from climate change: EBA is sometimes dismissed as simply another name for good management. But the differences come from the motivations for applying a particular management strategy and also the combination of strategies employed.

Although the main responses described in this manual relate to EBA, we also consider other adaptation approaches where they are appropriate, particularly various methods of community-based adaptation; the two are described in the box below.

Box 3: Ecosystem-based and community-based adaptation

Ecosystem-based adaptation: The United Nations Environment Programme defines ecosystem-based adaptation as follows: '"Ecosystem-based Adaptation" (EbA), uses biodiversity and ecosystem services as part of an overall adaptation strategy to help people and communities adapt to the negative effects of climate change at local, national, regional and global levels.

'In addition to protection from climate change impacts, EbA also provides many other benefits to communities, for example through the maintenance and enhancement of ecosystem services crucial for livelihoods and human well-being, such as clean water and food. Appropriately designed ecosystem management initiatives can also contribute to climate change mitigation by reducing emissions from ecosystem loss and degradation, and enhancing carbon sequestration.'

Community-based adaptation: refers to adaptation options that are rooted in local community actions; some of these may also involve EBA approaches. "Community-Based Adaptation (CBA) projects are interventions whose primary objective is to improve the capacity of local communities to adapt to climate change. From CARE's perspective, effective CBA requires an integrated approach that combines traditional knowledge with innovative strategies that not only address current vulnerabilities, but also build the resilience of people to face new and dynamic challenges. It also aims to protect and sustain the ecosystems people that depend on for their livelihoods"

Predictive planning

Traditional conservation plans assume static conditions, or regular cycles such as El Niño events in the Pacific. Planning now needs to factor in climate change. In marine systems this includes gradual changes, to sea level, water temperature and acidity; and sudden, hard to predict changes, including extreme weather events, invasive species and fish population collapses. Predictive planning uses computer models to project changes. If sea level is predicted to rise, the CMPA needs to include space inland to allow the re-establishment of mangroves; plans should include early warning systems and response strategies for invasive species, etc. Predictive planning can never be certain, but can substantially increase the possibility of CMPAs maintaining their values over time.

Disaster Risk Reduction (DRR) systems: "The concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events."(UNISDR, 2009)

A complement to predictive planning is an effective system for providing warning against, and planning

for, extreme events. Following the 2004 tsunami in Asia, many communities have been trained to identify an imminent tsunami. CMPA managers can develop similar early warning systems for other occasional events, such as typhoons, hurricanes and sea surges. But DRR can also address gradual disasters: for example declining fish stocks or a degrading coral reef. A monitoring system can include "triggers" to stimulate a response: if fish catches are falling below an agreed minimum this can trigger stricter zoning, temporary no-catch areas etc. This implies that responses will have been agreed with all stakeholders ahead of time.

Who is the Methodology for?

The Climate Adaptation Methodology for Protected Areas (CAMPA) has been designed to be used by a wide range of stakeholders including CMPA managers, NGOs, Community based organizations, or local or national Government agencies who are interested in having a better understanding of climate change vulnerabilities and potential responses of one or more CMPAs. The manual is designed for users with knowledge of a particular area, but without necessarily a detailed technical background in climate change science or vulnerability analyses. The manual aims to provide users with relevant background information on key concepts, and guide them in a step-by-step process, pointing out stages at which expert advice or additional technical data may be required and advising them on how to locate additional resources.

Box 4: What do we mean by "manager"?
Throughout this manual we will be referring to managers of coastal and marine protected areas. But what this means precisely differs with the type of CMPA. A government run national park, wilderness area or similar will generally have a manager, who will be like the CEO of the site and he or she will usually have staff working for them. But in the case of private and, particularly, indigenous peoples or local community run CMPAs the term "manager" may be used more loosely and could include for instance a council of management, a collection of elders, a headman or a cooperative. We use "manager" here as shorthand but do not imply that every CMPA has a single person invested with management decision-making.

Using the Methodology

The following manual aims to help CMPA managers and stakeholders working with the CMPA to design and implement adaptation options. It doesn't set out to be a complete "how to" guide to marine and coastal adaptation, which would take several books and in any case is unnecessary because many good sources of information exist. Instead, the manual aims to promote a proactive approach to climate adaptation, by providing an overview of options and a way of deciding which one or combination will be best in any particular situation.

Importantly the methodology has been developed in a modular format that can be used in a variety of situations depending on the resources and data available, and the objectives of the study. Where a detailed study is required, and where adequate resources and knowledge are available, this manual guides the user through a comprehensive assessment that applies a range of technical analytical methodologies to different social and ecological targets. At the other end of the spectrum, where

limited data and resources exist, the manual proposes a simple, yet robust method that relies primarily on expert opinion and local knowledge.

What is of critical importance is that the process you decide on makes sense in your own country context and in light of on-going work on dealing with the realities of climate change in conservation. Where there are existing initiatives, you must decide how best to incorporate the ideas in this methodology. The case studies at the end of this document show how this was done in three pilot countries: Colombia, Madagascar and the Philippines.

What you need to get started

A checklist…

Before you start, use the checklist to make sure you have access to the required human and technical resources that you will need throughout the process. CMPAs will vary in the amount of research and monitoring data available and teams coordinating such exercises will vary in size and resources. The following is an ideal, not all sites will have all this available.

Table 1: Checklist of resources for carrying out the methodology

Human Resources –team members with an understanding of the following:	Yes / No
Climate change	
Biodiversity	
Socio-economic issues	
GIS analysis (if GIS is being used)	
Documents / Data – reference should be made to the following if they exist:	
Any CMPA management plans, work plans and related documents	
Land-use and other relevant plans	
Grey and published literature and reports on CMPA conservation targets, monitoring data, management effectiveness assessments etc	
Grey and published literature on communities and villages in proximity to CMPA	
Grey and published literature on climate patterns, natural disasters and future climate change projections at the most relevant scale for the CMPA	
Contact details of stakeholders:	
Government stakeholders	
Community leaders / key community stakeholders	

Human Resources –team members with an understanding of the following:	Yes / No
Private sector stakeholders	
Materials for the workshop – ideally all of the following	
Baseline map of the PA and surrounds in hard copy	
Baseline map of the PA and surrounds in GIS form	
Presentation materials, flipcharts, pens, possibly a projector	

How much time will it take?

It is difficult to estimate this since it will change in every situation depending on time and resources available, the availability of information, the level of trust already existing with wider stakeholders, and so forth. We hope that CAMPA gives the user ways to undertake this work ranging from basic to extremely detailed – which can therefore take between a couple of weeks to a number of years.

Who does it?

A wide range of stakeholders can have an interest in this type of study and importantly can contribute technical or non-technical information that is important for analyses undertaken in the process. A key characteristic of the methodologies presented in this manual is that they are undertaken in a participatory manner with different stakeholders – including technical, community, and Government stakeholders - involved at different stages of the process. While each adaptation study will need to

Group	Suggested Participants	
Adaptation Working Group	Project team within the organization carrying out the study; protected area technical staff; key technical consultants	Day to day technical and financial management of CAMPA implementation; involved in all steps
Adaptation Extended Working Group	Adaptation Working Group + PA managers, technical experts (climate, social, biodiversity etc.), local authority representatives, local community representatives, research or academic institutions involved in PA-related research, private sector representatives	Strategic oversight of the process and technical or strategic advice at key steps of the process
Adaptation Stakeholders Group	Adaptation Working Group + national or regional authorities, civil society, wider group of research institutions, private sector	Provision of technical or strategic planning information and validation of adaptation outcomes at key steps in the process. The composition and form of such groups will depend on the technical methodologies selected for use in the process.

Adaptation Audience	Adaptation Stakeholders Group + general public and any other interested parties	Presented with final results as a means of information

develop a program of stakeholder involvement that is specific to the individual circumstances, the following provides a suggested structure for stakeholder organization and involvement. The suggested organizational structure has been developed in a nested manner and is structured around the following key groups:

What is needed to run a workshop?

As a widely participatory process, workshops will be held throughout. Before starting it is useful to think about those. At its most basic a workshop requires a place where to meet and someone to facilitate. But if the project has more resources, several specialised or adapted bits of equipment can help. Worksheet 23 below lists some options – most of these are optional – all are useful. The structure of the meeting is also important – workshops where someone stands in the front are common but not ideal, sitting in a circle or similar is better for bringing people into the conversation.

Table 2: Things needed to run a workshop

Element	Yes	No
A meeting place, ideally with some shelter		
A meeting facilitator – either an MPA staff member or other local stakeholder or someone with specific expertise brought from outside		
Somewhere to sit – chairs or a carpet		
Somewhere to write		
Facilities for serving a drink and perhaps food to those attending		
Possibly additional rooms if break-out groups are envisaged		
Paper and pens for people to take notes		
Then for more formal workshops		
Source of electricity		
Laptop computer		
Projector and screen for PowerPoint and similar presentations		

Recording device for capturing the proceedings verbatim, to provide a permanent record		
Video recording equipment to record participants making statements		
Camera to take some pictures of the workshop and participants Flip chart and felt pens		
Coloured cards and pin board for running participatory sessions		
Maps of the area, possibly including illustrations of how climate change may affect the CMPA		

PART II: THE METHODOLOGY - CAMPA

The main part of the manual summarises the methodology used to assess vulnerability and plan a range of adaptation options. It is laid out in a series of Steps, summarised in the box below.

Box 5: Structure of CAMPA

STEP 1: Identify Objectives and Scope
- Activity I: Objectives
- Activity II: Scope

STEP 2: Identify Targets and Baseline
- Activity I: Identify ecological targets – species and habitat
- Activity II: Identify ecosystem service Targets
- Activity III: Identify social targets
- Activity IV: Validate and map targets
- Activity V: Collate background documents and baseline conditions

STEP 3: Carry out a Vulnerability Assessment

Step 3, stage 1: Climate and non-climate scenario development
- Activity I: Identify possible climate manifestations in the area
- Activity II: Documentation of available data (climate manifestation)
- Activity III: Climate scenario development
- Activity IV: Non-climate scenario development
- Activity V: Documentation of available data

Step 3, stage 2: Technical vulnerability analysis (impact assessment)

Screening VA for all Targets
- Activity I: Apply BAVAPA

Detailed VA for selected Targets
- Activity I: Select the detailed methodology to be implemented for each Target and implement methodologies

Step 3, stage 3: Risk assessment and validation

Validation and priority setting workshops
- Activity I: Determine participants and agenda for workshop
- Activity II: Prepare background materials
- Activity III: Hold workshop
- Activity IV: Document workshop outcomes

Step 3, stage 4: Reporting on VA outcomes
- Activity I: Preparation of VA report and maps

STEP 4: Adaptation Options Assessment

An approach for identifying adaptation options

Step 4, Stage 1: Expert process to identify possible adaptation actions

A framework to help choose the best tools for adaptation

Step 4, Stage 2: Running a workshop

Step 4, Stage 3: Drawing up an Adaptation Plan

Step 4, Stage 4: Adaptation Plan checked by stakeholders

STEP 5: Implementation

STEP 6: Monitoring, evaluation and adaptive management

STEP 7: Mainstreaming into policy and planning

STEP 1: Identify objectives and scope

Purpose:	To facilitate the development and documentation of the adaptation objective(s) and the geographic and temporal scope
Inputs and resources required:	Baseline map of broad study area; knowledge of land use and development patterns around study area; knowledge of key stakeholder groups; PA management plan
Expected results:	Documented adaptation study objectives; documented and mapped scope of study

The objectives of the exercise need to be defined at the outset so that they can be used as a guide throughout the adaptation process. There is a wide range of different types of objectives that can be identified. For example a site that was about to redo its management plan might view the objectives through that particular lens, while other sites might want to focus on particular project opportunities or use adaptation as a way of engaging a broader range of stakeholders. A number of examples are given below:

- To incorporate climate change issues into the PA management plan or annual work plans;
- To build capacity of PA staff in understanding how to predict likely climate change impacts and how to manage for these;
- To identify the vulnerabilities of biodiversity and/or human communities within or linked to the PA to facilitate future adaptation planning;
- To draw up funding proposals for adaptation projects For research, communication and/or education purposes.

Objectives will be influenced by the social context in which adaptation is taking place, and the presence of any existing adaptation projects. PAs containing human communities, with their own needs and wants, will often have different priorities than those existing in isolated or unpopulated places. Adaptation efforts should link to and support existing work, which means understanding and taking account of the history of the site.

Once the objectives are fixed, the geographical scope (physical boundaries) and the temporal scope (timeframe) need to be defined and mapped. For instance, is the study going to focus on just the PA and the immediate surrounds or are there linked ecological or social systems (e.g. upstream catchments, urban centres) that need to be included in the work? The current methodology is focused on CMPA-level adaptation and teams thus need to be able to define a scope that is relevant to the objectives of the exercise without excluding important linked ecological or social systems.

In terms of the temporal scope, is there, based on overall objectives, a need to look at the:

- Short term (0 – 5 years), e.g. if development and implementation of short term adaptation measures is a key part of the objective or if the study is going to focus most closely on the effects of short term climate variability;
- Medium term (0 - 10 years), e.g. if the study is going to set longer term strategic priorities; or

- Long term (0 - 20+ years) e.g. if the purpose is for research or long term monitoring?

A clear and unambiguous discussion, documentation and communication of the overall objectives and scope between the study team and key stakeholders is an important first step in the adaptation process. Not only will it ensure that all stakeholders have common expectations, but it will have the complementary benefit of triggering discussions between stakeholders.

Activity I: Objectives

1. Work through each of the following questions and mark an "X" in the columns as relevant. Note that the final objective for the exercise can include as many elements as necessary for the individual situation.
2. Use these answers to craft an 'Overall Objective' for the adaptation process – a global, high-level but concise objective of 1 sentence and up to three more detailed 'Specific Objectives' and note these in the worksheet.

Worksheet 1: Main objectives

Do you want to achieve the following with your adaptation project?	*Yes – it is one of the main purposes of the VA*	*Partially – it is a secondary or related benefit of the VA process*	*No – the VA does not need to achieve this*
Incorporation of climate change adaptation into the PA managent plan?			
Increased capacity of PA staff or other organizations working in the PA in relation to climate change?			
Increased awareness and capacity of local communities in relation to climate change?			
Definition of areas and priority issues for future adaptation planning for the PA or the species or ecosystems found in the PA?			
Definition of areas and priority issues for future adaptation planning for the local communities in and/or around the PA?			
Generation of scientific research on vulnerability of the PA including a research plan?			

Development of a monitoring framework for the PA or local communities?			
Other…			
Other…			
Other…			
Other…			
Final Statement of Objectives Overall Objective: Specific Objectives: (i) (ii) (iii)			

Activity II: Scope

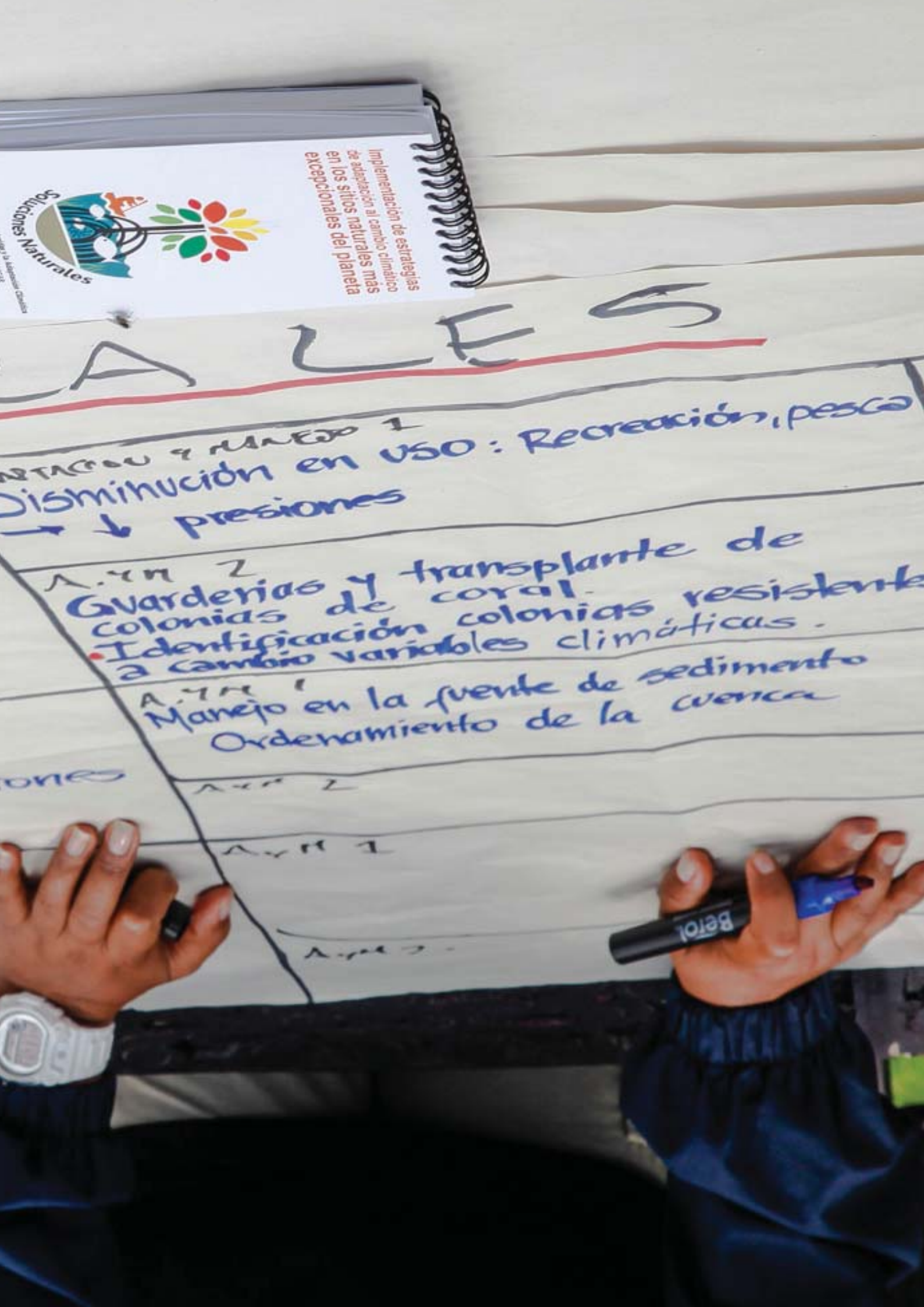
1. Work through the following questions and note an "X" in the relevant column.
2. Use these answers to define the geographical and temporal scope of the study and map the geographical scope on the baseline mapping

Worksheet 2: Intended scope of adaptation

In terms of the geographical limits of the study area, in addition to the PA itself, do you want to include:	*Yes*	*No*	*If Yes, specify which ones…*
- any nearby or connected PAs?			
- any nearby or connected ecosystems or habitats that are not included in the PA boundaries?			
- human communities living in the PA that depend on the ecosystem services furnished by the PA?			
- human communities living near the PA that depend on the ecosystem services furnished by the PA?			
- economic activities / industries / private sector activities that affect or are affected by the PA?			

- other…			
- other…			
- other…			
- other…			
In terms of the objectives of the study which time-frame should apply to the study:	0 to 5 years	0 to 10 years	0 to 20+ years
Final Statement of Scope:			

3. Using a GIS platform or manual mapping, document the geographic scope of the study on a baseline map of the study area.


Soluciones Naturales
Implementación de estrategias de adaptación al cambio climático en los sitios naturales más excepcionales del planeta
Disminución en uso: Recreación, pesca
↓ presiones
Guarderías y transplante de colonias de coral.
Identificación colonias resistente a cambio variables climáticas.
Manejo en la fuente de sedimento
Ordenamiento de la cuenca


Implementación de estrategias de adaptación al cambio climático en los sitios naturales más excepcionales del planeta
Soluciones Naturales
Aumento de la temperatura del mar
→ Blanqueamiento coralino
Variación en los pat
de precipitación
Berol

Step 2: Identify Targets and Baseline

Step 2 identifies a series of management targets to be investigated by the vulnerability assessment, and collects data on baseline conditions in the study area.

Identify ecological, ecosystem service and social targets for the VA

Purpose:	To document and map the ecological, ecosystem service and social targets that will be investigated in detail during the process
Inputs and resources required:	Baseline map; PA management plan; broad data on surrounding socio-economic conditions; initial studies on species or ecosystem vulnerability; understanding of ecosystem services provided by the PA and importance of PA resources to local communities
Expected results:	Documentation and mapping of ecological, ecosystem service and social targets for the VA

Once the objectives, physical boundaries and timeframe of the study are agreed, targets need to be identified. Targets are those items, places or issues that will be subject to detailed investigation in the vulnerability analysis. Targets are drawn from the range of elements that make up a CMPA. Identified targets are divided into ecological (species, ecosystems and habitats) targets, ecosystem services targets and social targets.

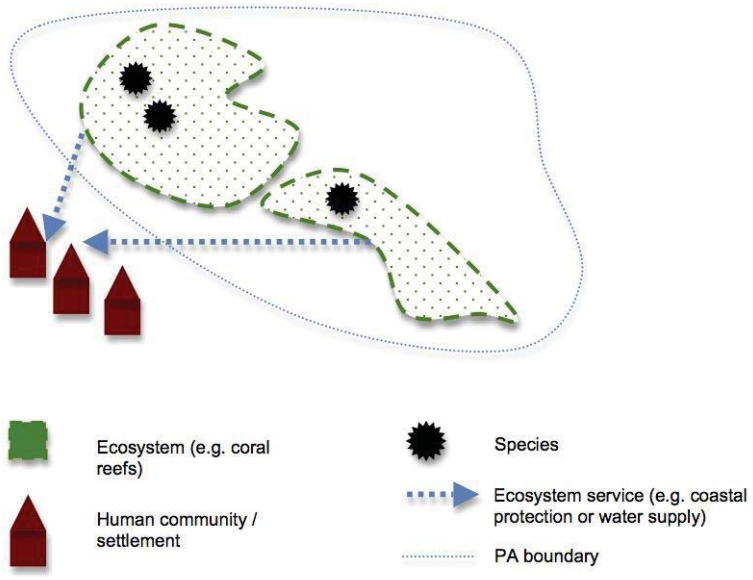


Figure 04: Schematic Illustration of range of CMPA Adaptation Targets

The identification of ecological targets for inclusion in the VA should start with the PA management plan. Habitats and ecosystems that are identified as important in the plan (e.g. conservation targets)

are obvious choices for consideration in the VA. Other ecological targets include habitats / species which may become important from a conservation view point in the future because of increasing non-climate pressures; species that may not be identified conservation targets, but are key for the fitness of the conservation target species (e.g. keystone species); threatening invasive species; or ecosystems / habitats that are outside the PA but that provide important ecological services for local human populations or the PA itself.

Activity I: Identify Ecological Targets – Species and Habitat

1. List all the species level conservation targets in the first column
2. List all the habitat level conservation targets in the second column
3. List all additional species or habitats found in the PA that meet one or more of the following criteria in the third column:
    a. Other species / habitats with conservation value (e.g. IUCN Red List, national biodiversity plans;
    b. Habitats / species which may become important from a conservation view point in the future because of increasing non-climate pressures;
    c. Species that may not be identified conservation targets, but are key for the fitness of the conservation target species (e.g. keystone species);
    d. Threatening invasive species that have the potential to be exacerbated by climate change; and/or
    e. Habitats that are outside the PA but that provide important ecological services for local human populations or the PA itself.
4. The species and habitats that you have listed will form the basis of a long-list of ecological targets for validation with the Adaptation Working Group in Step IV.

Worksheet 3: Long list of conservation targets

PA Conservation Targets – Species	*PA Conservation Targets – Habitats*	*Other Species or Habitats (refer Point 3 above)*

The identification of ecosystem services targets for inclusion in the VA will be based on an understanding of the ecosystem services provided by the PA that are important for human communities in or around the PA, or for the natural environment within which the PA is located. Common examples of the types of ecosystem services that could be important in the context of a coastal and marine protected area include coastal protection functions provided by mangroves or coral reefs, timber and fuelwood provided by mangroves, water or sediment regulation services provided by terrestrial forests, or cultural and recreational values.

Activity II: Identify Ecosystem Service Targets

1. In the first column of the following table list all the important provisioning services provided by the PA to human communities
2. In the second column of the table list all the important regulating services provided by the PA to human communities
3. In the second column of the table list all the important cultural services provided by the PA to human communities
4. In the second column of the table list all the important supporting services provided by the PA to human communities
5. The species and habitats that you have listed will form the basis of a long-list of ecosystem services targets for validation with the Adaptation Working Group in Step IV.

Worksheet 4: Long list of ecosystem service targets

Provisioning Services	*Regulating Services*	*Cultural Services*	*Supporting Services*

Activity III: Identify Social Targets

The identification of social targets for inclusion in the exercise will depend on the socio-economic context of the PA and the density and type of surrounding development. For the purposes of this work social targets are considered in terms of villages, local communities or small groups of households. Villages that have a strong reliance on the protected area either directly or indirectly in terms of the ecosystem services that it provides (e.g. for resource use, coastal protection, and/or economic activity) and that could thus either be affected by the impacts of climate change on the PA, or which could change their resource use / dependence on the PA if they are themselves influenced by climate change are suitable choices for VA targets.

1. In the first column of the following table list all the social groups, villages or household groups that occur in the PA, in the vicinity of the PA or that rely on services furnished by the PA
2. For each village or group of households, consider each of the following questions, and reply "Yes", "Unknown" or "No"[23] :
    a. Are there demographically vulnerable groups in the village – e.g. poor households, female-headed households, or indigenous households?
    b. Do households in the village depend on natural resources and ecosystem services that are potentially vulnerable to climate change impacts?
    c. Do households in the village have access to natural resources and ecosystem services that are

23 These questions have been adapted to function as social vulnerability screening questions from Wangbusarakum and Loper, 2011 and Marshall et al, 2009, both of which present options for social vulnerability indicators relevant coastal communities in the face of climate change.

potentially useful and that are potentially vulnerable to climate change impacts (whether or not they are currently exploiting them)?
d. Do households in the village have, or could they have, a diverse range of livelihoods and incomes?
e. Is there access to climate related information in the village?
f. Are villagers aware of climate hazards or have they experienced natural disasters in the past?
g. Is there equitable access to resources in the village?
h. Are there formal and informal support networks within the village – e.g. professional associations, women's groups, local Government presence?

It is quite possible that there will be a large number of questions to which you will reply "Unknown"; this is to be expected as many of these issues will only be investigated in detail in the latter stages of the VA. In this case you should employ the precautionary approach and retain the village in question in the long-list of possible social targets.
2. Document the name of the villages or household groups for which you have replied "Yes" or "Unknown" for one or more of these questions in the first column of the table below and note any relevant comments about possible drivers of vulnerability in the second column that may have arisen from discussions in Step 2 above; such issues will be interesting to re-visit in technical VA analyses for these targets. These villages will form the basis of the long-list of social targets to be validated with the Adaptation Working Group.

Worksheet 5: List of social targets

Social group	*Possible Drivers of Vulnerability*

Activity IV: Validate and Map Targets

Once the "long-lists" of ecological, ecosystem service and social targets are developed, it is recommended that a validation exercise is undertaken with the Adaptation Working Group to seek additional feedback to refine the final selection of targets. This exercise is most effectively carried out in a meeting format where the following types of questions are posed:

1. Do we have the resources and the time to address all the targets?
2. How does each target align with the team's priorities as expressed in the adaptation objectives?
3. Are there some targets that are of a lower priority that could be left for a second stage VA?
4. Do we have the information for all of the targets to at least allow a preliminary VA or are there some targets that we should put directly into the research plan and carry out the VA when we have the

required information?
5. Within the groups of targets is there one target that could act as a proxy for others in the adaptation process? For example, is there one village that is representative of other villages or one species that is representative of other species?
6. Is there any duplication between ecosystem services targets and ecological targets? Could any of these targets be combined?

Once validated and prioritised, the targets should be included on the baseline mapping either through a GIS platform or manual mapping. For species you can map occurrence records, distribution area, resource use zones, or key habitat areas. The Adaptation working group can make the decision as to which elements of the targets can and should be mapped to give a picture of priority areas/issues in the overall area of study.

Worksheet 6: Consolidated list of targets

Target groups		*List of targets*
Conservation targets	Species	
	Habitats	
Ecosystem service targets	Provisioning	
	Regulating	
	Cultural	
	Supporting	
Social targets		

Document baseline scenario

Purpose:	To collect data and document baseline conditions on the study area
Inputs and resources required:	Available data on existing and future climate, socio-economic, bio-physical, ecological, environmental, and governance / institutional conditions in the study area.
Expected results:	Documented baseline of study area and bibliography

Activity V: Collate Background Documents and Baseline Conditions

1. Collect published and un-published research, study reports, Government and NGO datasets and documents (plans, policies, laws), media articles, and interviews with local and regional authorities and experts in different climate, social, environmental, and governance issues in the study area.
2. Use the following table as a guide to note the details of these documents:

Worksheet 7: Background data

Author	*Date*	*Title*	*Publisher*	*Format / Weblink if relevant*	*Summary of Contents*	*Comments / Observations*

3. Use the following table as a guide to provide a summary narrative of key baseline conditions in the study area

Worksheet 8: study area baseline conditions

Issue	*Baseline Conditions*
Climate (average conditions and extreme events)	
Biophysical (hydrology, to-pography, soils, geology etc)	
Socio-economic (population, age distribution, incomes, livelihoods, poverty, use of natural resources, indigenous groups etc)	

Ecological (habitats, species, ecosystem services etc.)	
Environment (pollution levels and sources)	
Governance (Local and regional Government structure and roles, administrative boundaries, land use / development and other relevant policies, plans and planning cycles, legislation, stakeholder groups etc.)	
Other…	
Other…	


NACIONALES
PARQUES
NATURALES
DE COLOMBIA

Step 3: Carry out a Vulnerability Assessment

Once the scope and objectives of the process have been identified, and a long list of targets agreed, the main vulnerability assessment begins. This includes:

- Developing climate and non-climate scenarios for the PA
- Carrying out an expert-driven technical vulnerability analysis in simplified form for all targets and using an optional, more detailed assessment system for particular targets if desired
- Validating this and carrying out priority setting in a workshop
- Mapping and reporting the outcomes of the vulnerability assessment

Step 3, stage 1: Climate and non-climate scenario development

A scenario for the purpose of the Vulnerability Assessment (VA) process is a 'possible future' for the project area. This activity commences with the documentation of the study area baseline (see previous step) – that is, a compilation of data on the key characteristics of the study area that is starting point for scenario development - and then moves onto the development firstly of climate scenarios and then of non-climate scenarios.

A climate change scenario is defined by the IPCC as '... a plausible future climate that has been constructed for explicit use in investigating the potential consequences of anthropogenic climate change.' A climate change scenario does not represent a climate prediction but a "possible climate future" based on best available knowledge and data. A single climate scenario addresses a range of climate manifestations that occur in the project area. Climate scenarios can be developed in different ways depending on the type of information that is available; ideally they are informed by quantitative data on climate variability and/or climate change model projections, but if such projections are not available alternative methods can be used as described in the guidance.

Climate scenarios are used in the VA to provide an overall vision of how the project area may evolve in terms of climate conditions and to allow the extraction of climate exposure data for use in the technical VA. Climate scenarios can be developed for short-term climate variability and/or longer-term climate change depending on the objectives and temporal scope of the VA. The climate scenarios that are developed in this worksheet can be improved and modified as you proceed through the VA process and identify additional information.

In order to be able to analyze the future vulnerability to climate change in the project area, it is necessary to have an understanding of the evolution of the environmental, social and economic characteristics of the project area in the absence of climate change; this is referred to later in the VA process as the future baseline. By understanding the future baseline conditions in the absence of climate change, the VA can then look at the effects of future climate change to determine the overall future vulnerability.

Box 6: Sources of global projections for Marine and Coastal Climate Variables

The following data sources may be useful for global projections for future climate conditions:

- ClimaScope – most terrestrial parameters and sea surface temperature http:// climascope.tyndall.ac.uk/
- Climate Wizard – temperature and rainfall www.climatewizard.org
- World Bank Climate Change Knowledge Portal – historic and future temperature and rainfall - http://sdwebx.worldbank.org/climateportal/

- IPCC Fifth Assessment Report - http://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_LONGERREPORT.pdf
- Global Warming Art – Sea Level Rise Explorer http://www.globalwarmingart.com/wiki/Special:SeaLevel
- Country level national communications to UNFCC – http://unfccc.int/national_reports/items/1408.php
- Country level National Action Programs for Adaptation (NAPA) - http://unfccc.int/national_reports/napa/items/2719.php
- Database of the International Research Institute for Climate and Society (IRI) of the Columbia University - http://iridl.ldeo.columbia.edu/
- Database of the CSAG group of the University of Cape Town - http://cip.csag.uct.ac.za/webclient/introduction

The climate scientists in your team should also be able to assist in determining what information exists in terms of global projections for the selected climate manifestations.

Climate scenario development

Purpose:	To discuss and develop plausible future climate scenarios for the project area
Inputs and resources required:	Available climate change projections (e.g. GCM and regional model results) for study area
Expected results:	Future climate scenarios for project area

Activity I: Identify possible climate manifestations in the area

1. Use the team's knowledge on climate variability and future climate change projections to identify a long list of potential climate manifestations in the project area by marking an "X" in the "Yes" column of the table below if a climate manifestation is likely to be experienced; an "X" in the "Unknown" column if there is inadequate information to determine if a manifestation is likely to occur; or an "X" in the "No" column if it is known that the climate manifestation will not occur in the study area.
2. Adopt a precautionary approach in this task – if there is any doubt about the future occurrence of a particular climate manifestation then mark "Unknown" rather than "No".

Worksheet 9: Possible climate manifestations

Climate Manifestation	*Likely to be experienced in project area?*		
	Yes	Uknown	No
Terrestrial Parameters – will climate variability / climate change lead to changes in….			

Climate Manifestation	*Likely to be experienced in project area?*		
	Yes	Uknown	No
Wind patterns			
Cyclone / storm frequency			
Cyclone / storm intensity			
Sea level rise			
Storm surge			
Rainfall – volume			
Rainfall – calendar			
Ambient T°C – day time			
Ambient T°C – night time			
Heatwave			
Drought			
Flooding			
Fire			
Surface water hydrology			
Groundwater hydrology			
Coastal erosion through changes to beach profiles or coastal morphology			
Others….			
Others….			
Others….			
Oceanic Parameters – will climate variability / climate change lead to changes in ….			
Sea surface temperature			

Climate Manifestation	*Likely to be experienced in project area?*		
	Yes	Uknown	No
Sea acidity			
Upwellings			
Salinity			
Extreme waves			
Solar radiation			
Sedimentation			
Chlorphyll			
Humidity / evaporation			
Others....			
Others...			

Activity II: Documentation of available data

Complete the following table for each climate manifestation identified as "Yes" or "Unknown" in the previous table using the guidance below:

1. In the first column you should note the climate manifestation to which you are referring.
2. In the second column, use published and grey literature on past and current climate conditions and climate variability, together with the knowledge of PA managers, and anecdotal information collected from communities to describe how this climate manifestation appeared in the past and any recent changes that have occurred.
3. In the third column, use advice from climate experts, global climate change projections (refer Box 1), published or grey literature on climate variability, climate change projections, and/or application of the temporal analogue or downscaling approaches (refer Guidance Note A1.1) to document likely future changes in conditions for the climate manifestation of interest.
4. In the fourth column carefully note all data sources and reference persons and make comments on the quality of data used.

Worksheet 10: Data on possible climate manifestations

Climate Manifestation (those manifestations marked "Yes" or "Unknown" in the table in previous worksheet)	*Description of historic climate conditions, climate variability and recent changes*	*Projected future changes in climate conditions (based on model outputs and/or temporal analogue approach) Note: can refer to climate variability and/or climate change depending on VA scope*	*Comments on data source / quality*

Activity III: Climate scenario development

Once you have identified the climate manifestations that could occur in the study area and documented the information that you have on the past and future climate conditions, you can put it all together to document relevant climate scenarios. Development of future climate scenarios for the project area involves combining projections for a range of climate manifestations. Scenarios can be developed for future climate variability and/or future climate change depending on the temporal scope of the VA. Normally a range of climate scenarios will also be developed. You may want to separate climate variability and climate change scenarios if you are considering both short-term and long-term changes in climate conditions. For each climate scenario, the following table should be completed in narrative form.

- Row 1: Give the scenario a unique identifier e.g. one that indicates whether it is a low-end or high-end scenario
- Row 2: Note the physical and temporal limits of the scenario
- Row 3: Note the group of climate manifestations that have been included in the scenario
- Row 4: In narrative form describe the possible climate future that would result based on the projections for the considered climate manifestations

Worksheet 11: Climate scenarios

Scenario Name:	
Spatial and Temporal Limits of Scenario:	
Climate Manifestations included in Scenario:	
Climate Scenario Description:	

Activity IV: Non-Climate scenario development

Purpose:	To develop plausible future scenarios of non-climate conditions in the project area
Inputs and resources required:	Knowledge of environmental, social and economic conditions in project area; knowledge or projections of likely future trends in environmental, social and economic conditions in project area; knowledge of non-climate threats to PA resources and likely evolution of these threats.
Climate Manifestations included in Scenario:	Future non-climate scenarios for project area

Identify key issues and data sources to create future scenarios

1. Based on the team's knowledge of the project area, look at each theme and the suggested issues below and carry out a brainstorming exercise to identify which issues may be important influences in the future evolution of the study area
2. For those issues that are likely to be important, document identified data sources or reference persons that can be used to gather information on historic, existing or future conditions

Worksheet 12: Non-climate pressures on the PA

Theme	*Issues*	*Data Sources (historic, existing, future conditions / qualitative or quantitative)*
Environmental	Anthropogenic pressures in PA	

Theme	*Issues*	*Data Sources (historic, existing, future conditions / qualitative or quantitative)*
Climate Manifestations included in Scenario:	FAnthropogenic pressures near PA	
	Environmental pollution - water	
	Environmental pollution - soil	
	Environmental pollution - air	
	Land degradation, erosion and loss of fertility	
	Deforestation / clearing	
	Other....	
	Other....	
	Other....	
Social	Population growth	
	Age distribution	
	Incomes	
	Livelihood types	
	Migration	
	Education	
	Employment	
	Other....	
	Other....	
	Other....	
Economic	GDP per capita	
	Industry trends	
	Economic activity	
	Other...	
	Other....	
	Other....	

Theme	*Issues*	*Data Sources (historic, existing, future conditions / qualitative or quantitative)*
Policy / Institutional / Governance	Legislation development	
	Policies / plans development	
	Institutional structure changes	
	Other…	
	Other…	
	Other…	

Activity V: Documentation of available data

For each of the issues identified in Step I, fill in the table below.

1. In the first column you should note the issue to which you are referring.
2. In the second column, use published and grey literature on past conditions, together with the knowledge of PA managers, and anecdotal information collected from communities to describe how this issue has evolved in the past.
3. In the third column, use advice from social experts, Government authorities or civil society, published or grey literature on socio-economic projections, or "best-guess" expert opinion to document likely future changes in conditions for the issue of interest.
4. In the fourth column carefully note all data sources and reference persons and make comments on the quality of data used.

Worksheet 13: Data on non-climate pressures on the CMPA

Issue	*Description of historic conditions and recent changes*	*Expected future changes (based on model outputs, projections and/or temporal analogue approach)*	*Comments on data source / quality*

Activity III: Document "future baseline", non-climate scenarios

Identify the number of scenarios that will be developed – if projected future trends in the project area are very clear based on sound analyses then a single scenario may suffice. However, if there is some uncertainty about the way that environmental, social and/or economic conditions in the study area will evolve then two (low-end and high-end) or three ((low-end, middle of the road and high-end) scenarios should be developed to reflect the range of possible futures.

For each scenario, fill in the following table:

- Row 1: Give the scenario a unique identifier that indicates whether it is a low-end, middle of the road or high-end scenario
- Row 2: Note the physical and temporal limits of the scenario
- Row 3: Note the key issues that have been included in the scenario
- Row 4: In narrative form describe the possible future baseline for the scenario using a combination of qualitative data, quantitative data and expert opinion / informed judgment

Worksheet 14: Future baseline non-climate scenarios

Scenario Name:	
Spatial and Temporal Limits of Scenario:	
Key Issues included in Scenario:	
Future Baseline Scenario Description:	

Future baseline conditions in the project area can be identified through means of a scenario development exercise that focuses on non-climate issues. As for the climate scenarios, quantitative models or projections where they are available (e.g. population projections) and/or qualitative methods such as the temporal analogue approach or expert option can be used.

Step 3, stage 2: Technical vulnerability analyses (impact assessment)

Once the objectives, scope and targets have been identified, the next phase of the methodology includes a technical evaluation of the relative climate change vulnerability of the identified targets. This phase of the methodology uses established and proven technical methods for vulnerability analyses, and commences with guidance on the choice of the methodologies that are the most appropriate for the subject VA. The key output of this phase is the production of spatial data on the relative vulnerability of targets for the defined study timeframe.

The Manual advocates a two-level approach to vulnerability assessment. For all targets, a first screening VA is carried out using a methodology that was developed and field tested specifically for the manual – the BAsic Vulnerability Assessment for Protected Areas (BAVAPA) methodology. BAVAPA aims to provide a simple, practical, "first-cut" VA methodology that applies to a wide range of VA

targets and that can be implemented in data-poor situations and/or situations with limited resources. It is by no means an exhaustive methodology that should be relied on to provide detailed answers to questions about vulnerability, but it aims to be robust enough so that if no other VA analysis is carried out for a particular target, then the results of its application still provide broad guidance and pointers on overall target vulnerability and as required, the development of adaptation strategies. The Manual provides guidance on the application of BAVAPA to a range of targets (see Appendix 1). If necessary, a more detailed assessment is carried out for selected targets. We start by describing assessment using BAVAPA.

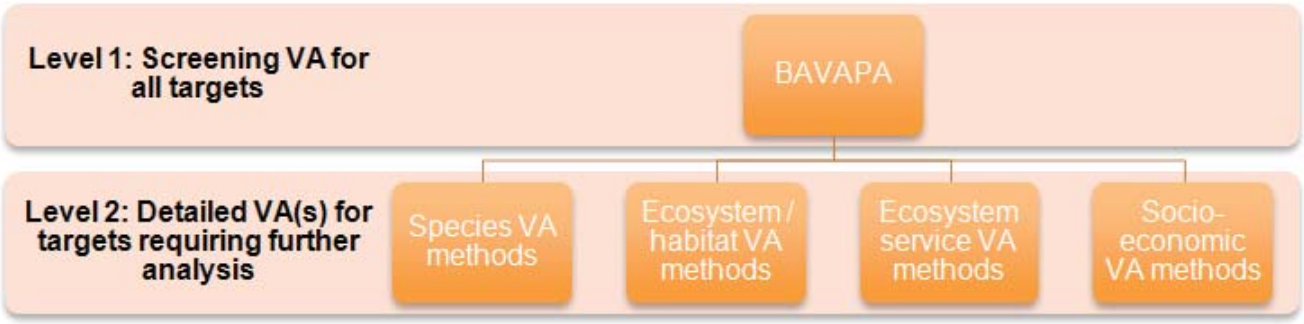


Figure 05: Level 1 and Level 2 Vulnerability Assessment Method

Screening VA for all Targets

Purpose:	To apply a simple consistent VA methodology to all targets to (i) generate a baseline level of information on the vulnerability of each targets; and (ii) screen targets to prioritize those that need further detailed VA analyses
Inputs and resources required:	Results of preceding activities in Phase 1; baseline mapping
Expected results:	Initial understanding of relative vulnerability of VA targets; list of priority targets needing detailed Stage 2 VA

Activity I: Apply BAVAPA methodology to all targets and identify targets requiring detailed Level 2 VA

The BAVAPA methodology should be applied to all targets identified in Step 2. Appendix 1 outlines the BAVAPA methodology, and gives templates for reporting the results of application of the BAVAPA methodology for each target.

Following the application of the BAVAPA methodology for all targets, the user can decide if there are targets that require detailed further analysis based on the initial BAVAPA results. To determine this,

the manual provides a range of exploratory questions / criteria to determine if a detailed VA would be warranted. Should one or more targets warrant a more detailed second level analysis if data, resources and time allow the Manual guides the user though this process.

For the second level analyses, there exists a wide range of established VA methodologies for ecological systems (species, habitats etc) and social systems (communities, households, municipalities), and a lesser but growing number of methodologies for ecosystem services. The approach taken here is to provide guidance on the selection and combination of the use of existing methodologies that are appropriate for a VA focusing on a CMPA and surrounding environment.

The Manual presents a selection of potentially suitable methodologies and assists the user to select one or more of these based on criteria of available resources, data availability, ease of application, required outputs and timeline of the VA study. Many of the methodologies presented address only one or a small number of aspects of a full VA study for a PA (e.g. some only refer to species vulnerability or only to human community vulnerability). Thus for any single PA VA study, it is likely that more than one methodology will be required depending on the range of VA targets that have been identified.

Use the following table to analyze whether further detailed analyses of vulnerability are required for certain targets. Fill out the table for each of the targets that were identified in Step 2 and subsequently subject to the application of the BAVAPA methodology. As a general rule if the team responds 'YES' to one or more of the questions, then the need for further analyses should be considered in detail.

This table should be considered only as a guide to identifying if certain targets would benefit from further detailed analyses. A range of other factors may also influence the desire of the team to carry out further detailed analyses such as the importance of a target for conservation planning purposes or the priorities of Government or community partners. Resource and data availability will also influence the ability to carry out more detailed vulnerability assessments.

Worksheet 15: Identifying targets for more detailed analysis

Target Name	*Summary of BAVAPA results*	*Did the BAVAPA results indicate a potentially 'high' or 'very high' degree of relative vulnerability?*	*Did the BAVAPA results indicate that the target could experience a 'negative' or 'highly negative' climate impact?*	*Did the BAVAPA results indicate that the target has 'low' or 'very low' adaptive capacity?*	*Are there one or more 'unknowns' or data gaps that affected the ability to draw conclusions using BAVAPA?*

Detailed VA for selected Targets

Purpose:	To apply comprehensive VA methodologies to targets that require further analyses based on the results of the Level 1 Screening VA
Inputs & Resources Required:	Results of preceding activity; baseline mapping; relevant datasets for selected targets and methods
Expected Results:	Detailed understanding of vulnerability and drivers of vulnerability for priority targets

Box 7: Criteria for selection of VA methodologies included in the manual
All methodologies included in the Manual meet three essential criteria:
1. They include consideration of the interaction between climate and non-climate stresses and particularly how climate impacts and adaptive capacity may be worsened or improved through synergistic effects of non-climate influences.
2. They allow "deconstruction" of the results of the analyses to facilitate understanding of the drivers of vulnerability specifically through understanding of climate impacts (a function of exposure and sensitivity) and adaptive capacity and resilience factors – elements that are essential for future stages of adaptation planning.
3. They have been tested in one or more of the project pilot sites to ensure that they are suitable for use in a developing country context and to allow development of recommendations to modify or improve certain elements of methodology application.

Activity I: Select the detailed methodology to be implemented for each target and implement methodologies

1. Consider the list of VA social and ecological targets and work through the descriptions of various methodological options outlined in Table 2 below to choose the appropriate methodology or methodologies. The choice of method to be used should be looked at in the context of the overall VA timeline and resources as well as a clear understanding of the relative importance of targets. The columns in the table are as follows:

- Name and Link: The name of the methodology and a web-link to the methodology.
- Description and Worked Examples: A brief description of the methodology and links to completed VAs that have used the methodology in question where they exist.
- Advantages: A summary of the key advantages of the methodology.
- Disadvantages: A summary of the main disadvantages of the methodology.
- Overall Evaluation: Evaluation of each methodology against the following criteria using scores of High, Medium or Low:
    - Data Needed: The amount of data that is needed to apply the methodology (either existing data or data to be generated)
    - Resources Needed: The human, technical and financial resources needed to apply the methodology.
    - Complexity: The ease or simplicity of application of the methodology.
    - Robustness: The degree to which the method has been tested or peer reviewed.

- Adaptability / Replicability: The degree to which the method can be applied to different types of social or ecological targets, including biomes other than marine and coastal biomes

Table 3: Analysis of detailed vulnerability methodologies

Methodology Name (and link)	Description & Worked Examples	Advantages	Dis -advantages	Data Needs	Resource Needs	Complexity	Robust -ness	Adapt- ability Replic- ability
Social Targets								
Social Vulnerability Index (SVI)	Involves development of a tailored index that combines multiple social vulnerability indicators to produce a vulnerability index that indicates that relative vulnerability of social targets.	First level screening VA method that allows a project area wide view of social vulnerability. Adopts participatory approaches that catalyze discussion on key vulnerability influences. Results in mapped outputs. Allows sensitivity testing through weighting and rating scores.	Requires careful selection of input indicators and development of weighting and rating matrices. Requires additional in depth analysis of targets to allow adaptation planning.	M	M	L	M	H
CARE Climate Vulnerability & Capacity Analysis Handbook http://www.careclimatechange.org/cvca/CARE_CVCAHandbook.pdf	A participatory approach methodology that combines various social research tools to understand vulnerability at all levels of society – national to local levels.	Relatively well known and tested methodology that can explore vulnerability drivers in targeted communities. Combines scientific and traditional knowledge. Results provide strong basis for adaptation planning. It involves community stakeholder participation and thus has secondary benefits for awareness raising. It orders and presents results clearly. Results are qualitative but can be noted in GIS database linked to location for adaptation planning. Good second level tool to guide adaptation planning.	Coverage of livelihoods / natural resource links not strong. Facilitators need good experience in participatory tools included in methodology. It focuses on existing climate hazards and would need to be adapted to also address future climate hazards.	M	H	M	M	H
WWF Climate Witness Community Toolkit http://wwf.panda.org/about_our_earth/all_publications/?uNewsID=162722	A participatory approach methodology that combines various social research tools to understand vulnerability of local communities.	A tool centred around community knowledge and full participation.	Facilitators need good experience in participatory tools included in methodology. Full process requires several days engagement with local communities which may not be feasible for community members.	M	H	M	M	H

Ecological Targets – Species								
Framework for Categorizing the Relative Vulnerability of Threatened and Endangered Species - EPA, 2009 http://www.google.com/	An excel based approach that provides ranking of relative vulnerability for groups of species. Can use qualitative or quantitative data and includes a narrative section that identifies assumptions and future research needs.	Can use expert opinion where quantitative data not available. Addresses multiple climate and non-climate influences on vulnerability. Narrative provides information on issues to consider in adaptation planning. Detailed manuals and guidance available. Narrative based analysis can be prepared for single species or small group of species.	Difficult to apply to data poor species due to high data input needs. Intended to apply to threatened and endangered species in USA.	H	H	H	H	M
Climate Change Vulnerability of Migratory Species: Species Assessments www.cms.int/publications/pdf/cms_climate_change_vulnerability.pdf	Quantitative assessment tool for migratory species that uses comprehensive data on interactions between migratory species and climate to score overall vulnerability.	Designed specifically for migratory species and thus highly relevant in the context of CMPAs.	Requires comprehensive understanding of species – climate interactions	H	H	M	H	M
Ecological Targets – Coral Reefs								
IUCN Coral Reef Resilience Methodology http://www.reefresilience.org/Toolkit_Coral/C6cc1_RapidAssess.html	Recognized methodology for undertaking resilience assessments of coral reef ecosystems. http://cmsdata.iucn.org/downloads/report_nosy_hara_resilience_feb_3_submitted.pdf	Comprehensive and tested methodology. Detailed guidance and examples.	Data collection needs are intensive and require specialist inputs.	H	H	H	H	L

Ecological Targets – Mangroves								
Vulnerability Assessment and Adaptation of Mangrove Systems (WWF-US) www.worldwildlife.org/climate/publications/index.html	Manual for mangrove VAs developed through three year GEF funded project in Fiji, Tanzania and Cameroon.	Comprehensive manual with clear steps and range of options for achieving results. Detailed guidance includes case studies from application in pilot countries.	Data needs are relatively high.	H	H	H	H	L
Ecological Targets – Fisheries								
Tool for Understanding Resilience of Fisheries (TURF) http://www.coraltriangleinitiative.org/sites/default/files/resources/42_Vulnerability%20Assessment%20Tools%20for%20Coastal%20Ecosystems_A%20Guidebook.pdf	Tool to understand vulnerability of reef based fisheries, inside or outside of CMPAs, to climate change hazards.	Focuses on a key ecosystem service provided by CMPAs. Simple and adaptable methodology.	Requires relatively extensive data on fisheries.	M	M	L	H	H
Social and Ecological Targets (can be used for combined or separate analyses)								
Integrated Coastal Sensitivity, Exposure, Adaptive Capacity to Climate Change – ISEACCHANGE (url as above)	Provides a rapid synoptic assessment of the acute, immediate impacts of climate change in coastal areas.	Based on simple scoring tables and can be applied to a range of targets with limited specialist knowledge.	Addresses short term impacts and responses only.	M	M	L	M	H

2. Document the selected methodology(ies) in the table below as well as any relevant notes or observations about resources, data or support that will be required to effectively implement the methodology(ies).

Worksheet 16: Selected methodologies

Target Name	Selected Methodology(ies)	Comments / Observations
Ecosystem services		
Social Targets		

Mapping

1. Prepare mapping (manually or using GIS). There is a potential for many maps to be produced. A useful minimum would be the following:

- 1 map showing High, Medium and low vulnerability index for each target (species, ecosystems/

habitat, ecosystem services and social targets)
- 1 map for showing High, Medium and low overall vulnerability index for the MPA

Use the table below as a guide the type of information you should consider mapping for each type of target depending on the nature of the PA and the targets and the issues that you wish to highlight in the workshop:

Table 4: Considerations for mapping targets

Target Type	Examples of Information to Map
Species	Distribution area within PA Important resource use areas (habitat, feeding, nesting, roosting sites)
Ecosystems / habitats	Full extent of ecosystem / habitat areas High conservation quality zones
Ecosystem services	Provisioning ecosystems Key flow paths for ecosystem services
Social targets	Community / village boundaries Important resource use or collection areas

Step 3, stage 3: Risk assessment and validation

The next stage subjects the results of the technical vulnerability evaluation to a participatory risk assessment thus facilitating a process of 'ground-truthing', validation and refinement of technical results by a wide range of stakeholders. Importantly, this process allows for PA-level consolidation of the different components of vulnerability that have been assessed at the level of targets. This stage allows the development (and testing) of a vision of the overall PA vulnerability, and is critical to addressing questions of uncertainty in the overall VA process and allowing a first-cut prioritization of issues to ultimately be addressed in adaptation planning.

Validation and Priority Setting Workshop(s)

Purpose:	To present VA results to a wide audience of stakeholders and technical experts, test assumptions, address uncertainties, seek validation of results and undertake initial identification of priorities for future work

Inputs & Resources Required:	Results of preceding activities; baseline mapping
Expected Results:	Validated VA outcomes; initial list of priority areas / issues for further action

At this point in the VA process, the technical analyses for a range of VA targets have been completed and VA teams have produced narratives and maps presenting the results. This stage guides users through a process of consolidation, validation and priority setting. It is based on risk management principles and: (i) allows uncertainties and assumptions made in different steps of the VA process to be tested by a range of stakeholders; (ii) allows the vulnerabilities associated with different targets across the MPA to be viewed, critiqued and validated in a PA-wide manner; and (iii) facilitates a participatory approach to start discussing how, why and when to move forward to address identified vulnerabilities.

Activity I: Determine participants and agenda for workshop(s)

1. One or more workshops and/or focus groups validate the consolidated VA analyses (including data gaps and assumptions used) and undertake an initial identification of priorities for future action. Develop a long-list of all stakeholders within the VA Stakeholders Group. Determine the number of workshops that will be held and the location and participants for each workshop by taking into consideration: (i) the available budget and time; (ii) the need to keep workshop(s) to a manageable size (ideally fewer than 30 people); (iii) the locations of different stakeholders; and (iii) the different technical capacities of stakeholders. One of the key aims of the risk management process is to integrate knowledge from a range of technical domains. Adaptation teams will by this point have a good understanding of the different stakeholder groups and their interests and should tailor them to fit their individual circumstances. As a guide, VA teams can consider the following groups that could be consulted either individually or in a combined exercise:

- National/regional leaders and experts with national/regional government, technical experts and national/regional civil society
- Local deciders and managers with PA managers, local/regional government, local/regional civil society, private sector
- Community and local resource users with PA agents, local communities, local/municipal government, local civil society, local private sector

2. Develop an agenda for each workshop, including the four key issues identified below. Identify who will facilitate the workshop and ensure that the facilitator understands the workshop aims and agenda.

Key issues for the workshop:

- What is the context? Information on the overall VA context and information on process followed.
- What assumptions were used and what uncertainties remain? Ask participants to consider if the assumptions are valid and if the uncertainties could be reduced.
- What are the important VA results? Prepare information on the key outcomes of the VA for different targets and ask participants if they think results make sense in terms of the on-the-ground conditions? How do the assumptions and uncertainties discussed previously influence or

affect the results; does a precautionary approach need to be adopted in certain cases? How can the vulnerabilities of different targets be "bundled" to give an overall spatial picture of vulnerability for a linked system?

- What are the priorities for further action? Can different zones be prioritized for future action because of an elevated vulnerability of one or more targets? Do certain targets need priority? What actions are needed for different priorities – i.e. "Address/Adapt", "Research to Learn More", "Monitor & Revisit", or "No Action"?

Activity II: Prepare background materials

2. Prepare simple summaries of the key results for each VA target using the following template as a guide. These summaries should be a maximum length of 1 page for each target to allow them to be used as simple reference documents during the workshop. As necessary and appropriate you can also distribute additional information to participants such as detailed technical VA reports or other relevant background information.

Worksheet 17: Background material for validation workshop

Target Name:			
Target Vulnerability Rank:			
VA Methodology(ies) Applied:			
Non-Climate Impacts	Climate Impacts		Data Gaps / Assumptions
A summary of the identified non-climate impacts acting on the target now and in the future.	A summary of the identified likely climate impacts (resulting from variability and vulnerability as necessary), including comments on interactions with non-climate impacts		A summary of the key data gaps and assumptions that have influenced VA results.

Activity III: Hold workshop(s)

Regardless of the detailed agenda developed, all workshops should involve three basic exercises: (i) testing assumptions and uncertainties; (ii) ground-truthing of VA results; and (iii) initial identification of priorities for future action. Ideally these exercises would be undertaken in small groups of 5 – 10 people within the workshop setting that are facilitated by a member of the Adaptation Working group team. Time should be allowed for feedback from the small groups to the workshop as a whole. Suggestions

are given below as to how these exercises could be facilitated.

Exercise 1: Testing assumptions and uncertainti es

1. Present the following table that provides space for a list of the key assumptions including a description of the stage in the VA process at which they were used and how they have influenced VA results to the group.
2. Ask the group (or break the workshop down into small groups if the workshop participants are numerous) to complete the table by noting whether they feel that each assumption is valid or not, and if not why not. Make sure that the key points of the discussion around each point are recorded.
3. For those assumptions that the group considers are not valid, ask the group to develop alternative assumptions including data sources to support any alternative assumptions.
4. Present to the group the following table that provides space for a list of the key uncertainties including a description of the stage in the VA process at which they occurred and how they have influenced VA results.
5. Ask the group to complete the table by noting whether they know of additional information that exists that could be used to complete the data gaps.

Worksheet 18: Testing VA assumptions

Testing VA Assumptions					
Assumption	Stage in VA process	Possible influence on VA results?	Valid assumption (Yes / No / Unknown)?	If 'no' or 'unknown' is there an alternative assumption with data sources?	Comments / observations

Worksheet 19: Testing VA uncertainties

Testing Uncertainties					
Uncertainty	Stage in VA process	Possible influence on VA results?	Data to reduce uncertainty available?	Source of additional data?	Comments / observations

Exercise 2: Ground-Truthing of VA Results

1. Provide the group with a full set of large size maps of the VA results and a copy of the relevant narrative (make sure a representative of the VA core team is on hand to answer questions and explain the maps and the narrative).
2. Ask the group (or small groups of participants) to critically examine the maps and mark areas where they feel there is a mismatch between the VA results and the on-the-ground realities of the local situation.
3. Where such mismatches occur, ask the group to note questions, comments/observations, additional data sources or priorities for further investigation on the map and attach it to the map.
4. For this activity it can be very useful to have GIS facilities present at the workshop to allow real-time manipulation of maps and data.

Exercise 3: Initial Identification of Priorities

1. Using the maps and the narratives considered in the previous exercise, ask the groups to do a first-cut prioritization exercise. Groups can consider individual targets (e.g. species, village, ecosystem) and/or geographic zones (north-west zone of protected area, all villages outside of protected area) for this exercise. The aim is to generate some initial ideas for future actions that can be re-visited during the adaptation planning process.
2. For this activity it can be very useful to have GIS facilities present at the workshop to allow real-time manipulation of maps and data.
3. Ask the group to list the targets / zones that they will consider and to complete the following matrix that contains the following broad categories of actions:
a. Address and adapt: The target or zone is likely to require active management to help it adapt to climate change; specific climate change adaptation strategies are likely to be needed.
b. Research to learn: More information is needed in relation to the zone or target to better understand vulnerability or to better plan for adaptation.
c. Monitor and revisit: The vulnerability of the zone or target should be monitored to see how it evolves and to see if action is required in the future.

Activity IV: Document workshop outcomes

Ensure that the workshop proceedings and outcomes are documented. This should include the internal discussions and results of the group exercises, as well as discussions and questions / responses in the plenary sessions. The workshop proceedings will be an important input to adaptation planning in the future.

Step 3, stage 4: Reporting on VA outcomes

This activity represents the last but essential activity in the VA process; it involves "putting it all together" and producing a comprehensive, yet concise documentation of the VA process, results and next steps. The narrative and maps produced during this step will have numerous functions – they can be used for forward planning, presentation of baseline data for monitoring and evaluation, education and information, or as pilot studies for other areas. It is important that VA teams dedicate the time and

resources needed to produce a thorough and useful report. The manual provides guidance on the key elements to include in reporting.

Purpose:	To prepare comprehensive reporting of the VA process and outcomes and spatial presentation of key results
Inputs & Resources Required:	Results of preceding activities in Phases 1 – 3; baseline mapping
Expected Results:	Final VA Report and Maps

Activity I: Preparation of VA report and maps

1. While each VA team will determine the reporting structure that best suits their needs, a guide to assist in this process has been provided below in Table 3. This guide follows the logic and sequence of steps and activities in the Manual and maximizes use of text and documentation already prepared in the completion of the Manual worksheets to prepare the report. In particular, the documentation prepared in advance of the validation and priority setting workshops can be used as a starting point for the final VA reporting.

2. In all cases, spatial presentation of VA results is essential and mapping should thus form an important part of the report; whether prepared on a GIS system or manually, maps should be clear, legible and suitable for reproduction in black and white.

Table 5: Suggested VA Reporting Outline

SUGGESTED SECTION HEADING	SUGGESTED CONTENTS
Section 1: Introduction and Context	*General introduction to PA and to VA process (who, why, how…)*
1.1 Introduction	
1.2 VA Objectives and Scope	
- VA Objectives	Taken from Worksheet 1
- VA Scope (narrative and maps)	Taken from Worksheet 2
- VA Targets (narrative and maps)	Taken from Worksheet 6
1.3 Description of Existing Study Area	Taken from Worksheets 7 and 8
1.4 Projected Future Conditions in Study Area	
- Future Climate Scenarios for Study Area	Taken from Worksheet 11

- Future Non-Climate Scenarios for Study Area	Taken from Worksheet 14
Section 2: Technical VA Assessment Results	
2.1 Overview of Technical Assessment	Taken from Table 3
Methodology(ies) Applied	
2.2 Technical Assessment Summary (narrative and maps)	Taken from Worksheet 16
Section 3: Conclusions & Recommendations	
3.1 Risk Assessment and Stakeholder Validation Outcomes – Priorities and Next Steps	Taken from Worksheets 19 and 20
Annexes	
Study team	
List of people consulted	
Completed worksheets	
Additional maps	

Step 4

Purpose:	To identify a range of adaptation measures to address issues identified in the vulnerability analysis
Inputs & Resources Required:	Baseline map of broad study area; vulnerability analysis; knowledge of key stakeholder groups; PA management plan
Expected Results:	Broad plan of action

The process described in this Step draws on three main elements:
1. A list of expected climate risks and ecological and social targets derived from the vulnerability assessment (known forthwith as "targets")
2. An assessment framework to compare various possible adaptation options based on the outcomes of the VA
3. A draft list of possible adaptation options (which can be expanded during the assessment)

We are not aiming for a "how to" manual on adapting coastal and marine protected areas to climate change, but instead a structured approach to helping relevant stakeholders to decide which approaches to adaptation are most suitable in a particular situation. There is certainly no standardized adaptation option for each 'target' as it depends on VA target results and the general context of the area. It should also be noted that while a wide range of adaptation options may be available, we focus here for the most part on Ecosystem Based Adaptation.

An approach for identifying adaptation options

The methodology is based around a stakeholder workshop, with additional work to prepare for and draw from this workshop. Although the approach is participatory, walking unprepared into a stakeholder workshop can result in a confusing and inconclusive process. We suggest that the Adaptation Working group comprised of PA staff, local experts or small committees draw up initial ideas and test these with a wider group. "Testing" might mean starting from the beginning if stakeholders reject initial ideas. However, the decision about whether or not it is strategic to start a workshop with a prepared plan, however preliminary, needs to be made on a local basis depending on stakeholder expectations and likely level of resistance to plans imposed from outside. The core of the methodology is very simple, as illustrated.

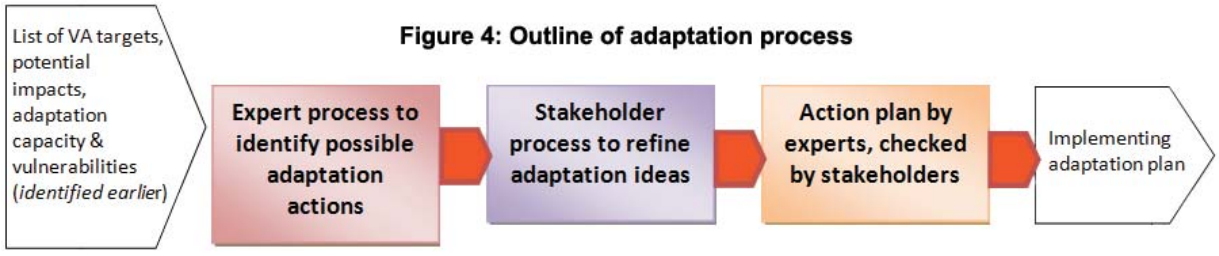


Figure 4: Outline of adaptation process

Figure 06: Outline of adaptation process

The process draws on information from the **vulnerability assessment** outlined in step 3 above. This will have identified social and ecological targets and assessed their vulnerability to climate change and the existing adaptive conditions that determine vulnerability in face of climate change. For example, a coastal PA set up to protect a coral reef and seabird colony, which also contains a small fishing community, might have a vulnerability assessment that focuses on: ecological targets such as seabirds (e.g., threats from sea-level rise, extra storms) and coral (e.g., threats from bleaching, acidification) and social targets on risks to the community, (e.g., inundation of coastal villages, risks to fish stocks). With the vulnerability assessment in hand, the process continues as follows:

1. A small team (Adaptation working group) makes a **preliminary adaptation assessment**: (i) matching vulnerabilities and existing adaptation strategies with potential responses, using a pre-existing list (see page ##), along with any other ideas; (ii) evaluating each response using an assessment framework, outlined in this manual; and (iii) considering the role existing policies can play in assisting adaptation strategies
2. A stakeholder **workshop is organised**, ensuring that all relevant interests are represented, which: (i) evaluates and compares strategies from the initial assessment, using the assessment framework; (ii) adds any new adaptation strategies that emerge in discussion; and (iii) considers spatial and temporal implications of these strategies
3. The project team takes the strategies identified at the workshop and translates these into an **adaptation plan**, with timeline, taking into account available resources, staff, policies etc
4. The adaptation plan is **checked back with stakeholders**, formally or informally as circumstances suggest, and finally approved
5. The agreed strategies are **implemented** by the PA staff and other partners
6. The actions are monitored for effectiveness and **adjusted** as required

Step 4, Stage 1: Expert process to identify possible adaptation actions

As a first step, the Adaptation Working Group draws up a draft list of potential adaptation actions, responding to the identified priority targets and associated strategy proposals. This stage could be done by the PA manager and staff collectively, if they felt confident, or delegated to one staff member, or contracted to a local or international consultant. Whatever method is used, the manager and staff need to have talked through the results before they start the workshop. The potential adaptation actions given in Worksheet 21 below provide some initial ideas: each PA will have its own challenges and responses. Local communities are often capable of coming up with their own responses.

Worksheet 20: A first checklist of adaptation strategies to use at a workshop

Adaptation option	*Possible*	*Not possible*	*Why not?*
Ecosystem options			
- Coastal mangroves			
Reducing pressures on mangroves and adaptive management			
Identifying and protecting refuges			
Establishing buffer zones			
Actively planting mangrove seedlings			
- Coral reefs			
Identifying and protecting naturally resilient areas of coral			
Shading and cooling of limited areas			
Active seeding and restoration of coral polyps			
- Sand dune systems			
Sand fencing, boardwalks etc to rebuild dunes			
Pest and disease control to maintain native species			
Planting of native sand dune species on and adjacent to dunes			
Artificial rebuilding of dunes			
- Seagrass meadows			
Identify and protect resilient seagrass beds within CMPAs			
Identify and foster patterns of connectivity			
Reduce stress from anchorage, trawling, tourist activity			
Plant native seagrass species to rebuild beds			
- Coastal salt marshes			

Adaptation option	*Possible*	*Not possible*	*Why not?*
Ecosystem options			
Reduce stress from trampling, vehicles, pollution			
Restore coastal marshes by restoring natural estuarine flow			
Plant keystone species to rebuild natural marsh vegetation			
Protected area design options			
- Expanding the size of the CMPA and optimising boundary design			
Enlarging the total size of the CMPA			
Changing boundary shape of CMPA to include critical habitat			
Changing the boundary shape of the CMPA to allow for inshore expansion			
Connecting two nearby CMPAs			
- Improving ecological connectivity			
Expanding the total size of the CMPA			
Agreeing temporary fishery closures etc to help movement of species			
Remove artificial barriers to movement of species in and outside CMPAs			
- Relocation of mangroves in the event of sea-level rise			
Replanting or planting new mangroves on higher elevations to ensure habitat survival			
Management options			
- Management effectiveness and improving enforcement within the CMPA			
Undertaking regular assessments of management effectiveness to improve success			
Strengthening enforcement and anti-poaching activities			
Liaising with local communities to improve management			
- Resource-use management: no-take zones, closures, landing restrictions and fishing quotas			

Adaptation option	*Possible*	*Not possible*	*Why not?*
Ecosystem options			
Seasonal fishery closures within and around CMPAs			
Horizontal zoning			
Landing and anchoring restrictions for boats			
Control of recreational activities such as jet skiing and diving			
Codes of practice for ecotourism (e.g., wildlife watching)			
Reduction of pollution, litter etc			
- Improved freshwater management			
Reducing pollution from agrochemicals, sewage, sedimentation			
Restoring natural flow regimes			
- Biosecurity: control and mitigation of Invasive Alien Species			
Develop CMPA processes for detecting and addressing IAS when they occur			
Build public awareness and engagement in IAS, particularly with fishing and tourist groups			
Promote sharing of information between CMPAs and other interested parties			
- Translocation and relocation of people			
Livelihood options			
Ecotourism			
Promote codes of practice for responsible tourism			
Work with tourism operators to agree strategies and principles			
Obtain support from visitors and tour operators			
Manage impacts of tourism (e.g., sewage and litter, disturbance, water use)			
- Alternative livelihoods and poverty reduction			

Adaptation option	*Possible*	*Not possible*	*Why not?*
Ecosystem options			
Employ local people within CMPAs, including as rangers, to build grassroots support			
Investigate alternative livelihood options to take pressure of key CMPA natural resources			
- Engineering options			
Artificial reefs, levees and breakwaters			
Each option is discussed briefly in Annexe 1. More options may be suggested in individual CMPAs			

A framework to help choose the best tools for adaptation

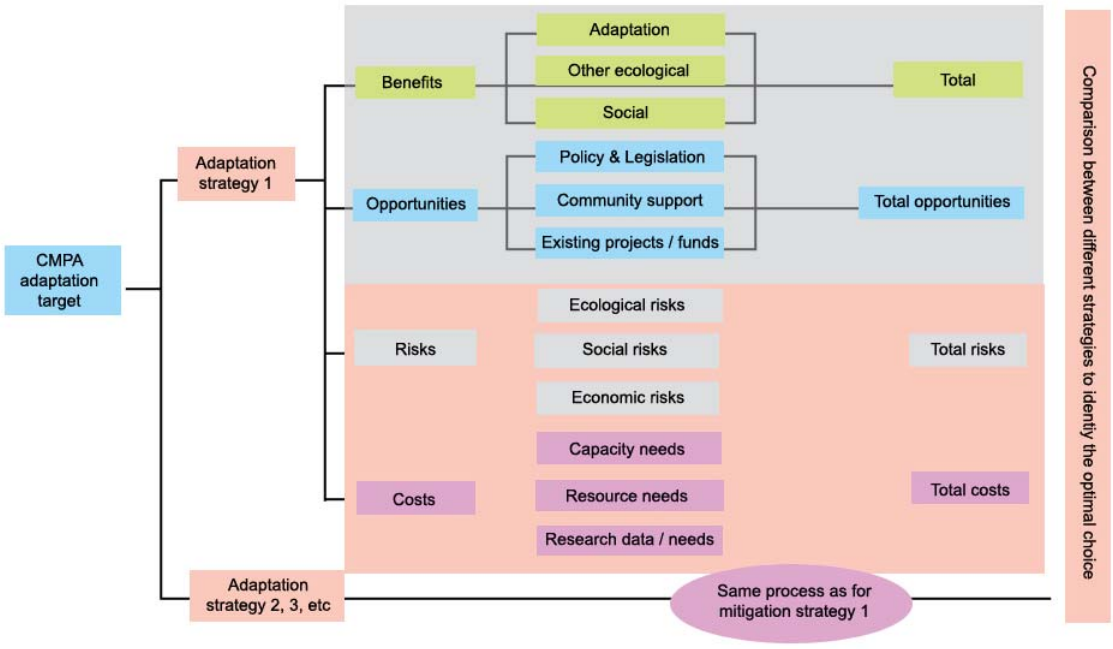
Assessment here means looking at the costs and benefits of each option. The framework overleaf provides a quick way of making sure that nothing is forgotten. For any technique stakeholders should be encouraged to think about the potential benefits and risks, likely costs and opportunities that might swing the balance for or against any option. But each of these has several sub-components: benefits include direct benefits in terms of addressing the problem being discussed, but there may also help address other climate change challenges or provide other benefits for stakeholders. The stimulus for restoring mangroves might be to help protect coastlines from rising seas, but they also protect from storms (another climate change effect) and provide nursery grounds for fish to support local fishing communities (not necessarily a climate change issue but likely to be beneficial).

It is important to formulate the adaptation intervention clearly enough, so that everyone understands what is to be done without getting too bogged down in detail. A vague statement such as "restore mangroves" probably does not give enough information for people to make an informed decision. But going into huge detail about where individual saplings might be planted is probably too much. In this case, saying approximately where the mangroves are to be planted, the approximate number, species mix and methods would all help tell people what to expect. .

Each potential adaptation strategy needs to be assessed from four different perspectives:
1. **Benefits** it will bring in terms of both adaptation and other ecological and social benefits
2. **Opportunities** that already exist and can support the particular strategy: in terms of existing legislation, level of community support and presence of existing projects or funds
3. **Risks** of ecological side effects, detrimental social impacts and economic risks
4. **Costs** including capacity needs to implement the adaptation, the resources needed and whether or not further research or information is needed

Some options for making the assessment are discussed in the section on running a workshop below.

Conceptual framework for assessing adaptation options in PAs: any adaptation strategy needs to consider the following: (diagram)



Step 4, Stage 2: Running a workshop

The draft list of options drawn up in the previous stage is just a start. These need to be tested with other stakeholders in a workshop, including particularly local communities living inside or nearby and individuals or companies with a commercial interest, such as tourism operators. Other people may want to come as well, like conservation NGOs, other industry representatives, government officials and large fishing interests. Running a participatory workshop, in which all voices are heard and respected, is challenging: many guides exist but the reality is usually messier and less perfect than the descriptions in reference manuals. The following addresses some of the common questions that need to be answered.

Who comes?

The workshop will only reach a genuine consensus if all interest groups are represented and have an opportunity to make their opinions heard. This is difficult: some less powerful groups tend to be excluded; some people find it difficult to speak in public; some will be inhibited because of their position in society, gender, age or religion. Practical considerations usually mean that not everyone can attend, so it is important to invite people who can represent particular groups (e.g. fishing communities, tourism operators and women's groups) and who have the confidence and trust of other members of these groups. Some guides that explain how to identify a representative group are listed in the resources section.

Worksheet 21: Who to invite to the workshop

Potential workshop groups	*Invited*	*Not invited*	*Not present*
Protected area manager and staff			
Local communities – men			
Local communities – women			
Representatives from local fishing organisations or operators			
Representatives from farming communities in or around the PA			
Hoteliers, dive operators and other tourism operators who live in or use the PA			
Local government officers			
IRepresentatives from local or international social/environmental NGOs active in the PA			
Leaders of faith groups important in the area			

What should people expect?

Stakeholders need to know the aims and limitations of the process. Don't raise expectations that because PA managers are listening to opinions this means everyone's ideas can be implemented. But neither should the meeting simply be an airing of views and everything carries on exactly as before: there needs to be commitment by the PA to listen and adapt. Ideas and proposals should be captured as transparently as possible: in a more formal setting (and where most people are literate) a running record can be kept by writing a document or PowerPoint slide that is being projected: people can see what is being recorded and comment if they disagree. Circulating a draft of the discussion and recommendation to people after the meeting – and before finalisation – is also a key way of ensuring accuracy.

Meetings should be fairly informal, giving plenty of space for participants to take part and make their points. At the same time, it is important that the main issues all get covered. The facilitator needs to balance the need for full participation with the need to cover all the relevant points. The form of the meeting depends on individual situations. It should start with everybody introducing themselves and explaining their interest in the PA, then some brief explanations about the PA, likely climate changes, and identified vulnerabilities. The facilitator can then either move on to a presentation of the preliminary suggestions for discussion, or open the meeting up to suggestions from the floor and use the draft list of ideas as back-up to ensure that no options are missed; which option is best can depend on factors like the willingness of participants to speak, prior understanding etc

How does the workshop reach a decision?

A workshop is the critical event for making decisions about which, if any, type of adaptation to implement within the PA. Reaching a decision can be challenging in a large group; although consensus is ideal there may well be cases where it is impossible to satisfy everyone's needs or desires and a majority decision will be the best possibility. In these cases it is important that a disaffected minority does not walk away from the meeting determined to undermine the whole process; the skill of the facilitator and the overall attitudes of stakeholders towards the PA management will be important determinants of how results are perceived. The way you reach decisions will depend on the particular dynamic and skills of the group and the cultural context in which the meeting is taking place. There are three broad options:

1. An unstructured discussion between all the participants which gradually weighs up the evidence and reaches a decision – whilst not quantitative, a discussion can be the most effective way of reaching a decision, particular with people who are unfamiliar with analytical techniques; it also avoids risks of statistical distortions.
2. A simple but structured assessment framework that helps to clarify complex issues and provide a more rigorous basis for making the decision – see Worksheet 24 below
3. Some more complex form of multivariate analysis that can provide some form of comparative "score" – Worksheet 25 below

Whatever method is used, you will need a discussion; we would caution against relying entirely on a scoring system as the issues are so complex; recording of analysis should be transparent and open to comment from participants.

Worksheet 22: A simple comparative framework for analysis

Assessment	*Adaptation option 1*	*Adaptation option 2*	*Adaptation option 3*	*Adaptation option x*
Benefits				
Adaptation				
Other ecological				
Social				
Opportunities				
Policy and legislation				
Community support				
Existing projects				
Risks				

Assessment	*Adaptation option 1*	*Adaptation option 2*	*Adaptation option 3*	*Adaptation option x*
Benefits				
Ecological risks				
Social risks				
Economic risks				
Costs				
Capacity needs				
Resource needs				
Research / data needs				

Each option can be scored very high, high, medium and low (or not applicable); these can also be converted into a numerical score if desired:

For **benefits** and **opportunities**
Very high = 4
High = 3
Medium = 2
Low = 1
Not applicable= 0

For **risks** and **costs**:
Very high = -4
High = -3
Medium = -2
Low = -1
Not applicable= 0

It will not always be possible to reach a decision in one workshop. Sometimes participants raise questions that it takes time to answer or need further research. In other cases the PA is too large, or people too dispersed, to make a single meeting feasible. Different social and cultural groups may have problems interacting. Quite often an additional meeting would need to take place with local communities. Recognising that meetings cost time, money and effort, the process should remain flexible and stakeholders discuss often enough until a consensus or clear majority decision is reached.

Step 4, Stage 3: Drawing up an Adaptation Plan

The initial analysis and workshop should result in a draft list of actions – potential adaptation projects – that the PA can take and which have the support of all or at least a significant proportion of stakeholders. The next stage is to convert this into an achievable strategy, through completion of an Adaptation Plan. Worksheet 26 lays out what the plan should include:

Table 6: Structure of the adaptation plan

Section	*Details*	*Length (pages)*
Background	Details of all the adaptation sub-projects agreed, with the objectives of each clearly identified	2 - 3
Management activities	A detailed set of steps towards each potential adaptation project, laying out precisely what needs to happen, who will be responsible and ideally dates by which each of the various steps should be completed. This should include details of who will be responsible for particular actions and also about how the success of the various actions might be measured	5- 7
Implementation	Chart summarising the main action points in the Adaptation Plan along with a timetable for putting the management actions into place	2
Monitoring and evaluation	Details of how the various conservation targets will be measured, presented as a chart including indicators.	2
Budget	A budget, that costs out each of the various aspects involved, including as necessary staff time, consultants' time, purchase of equipment, seeds, etc, land purchase, community compensation, etc (including funding needs if applicable)	1
	Key contacts, both those responsible for the projects and other stakeholders who will oversee or be consulted	2

Suggested length is approximate, the point being that the plans should not be very long. But they need to be detailed enough so that everyone is completely clear about what is entailed and so the PA can monitor progress. Within management actions, each action needs to be outlined, with those responsible and a timetable, as in the examples in the following table:

Table 7: Information on each adaptation option

Adaptation option	*Activities*	*Responsible*	*Period*
Mangrove restoration	Collection of propagules	Community members	June 2014
Improving coral reef	Controls on damaging fishing practices	Fishing communities	Applied as soon as agreed
Re-zoning protected area to increase protection of sensitive areas	Stakeholder workshop to agree zoning plan	All stakeholders	September 2014

It is likely that some of the ideas that emerged from the brainstorming session may become less attractive once they have been fully costed out and all the implications thought through. So during the process of drawing up the plans it may be necessary to come back to some of the stakeholders and think through abandon or modify certain of the steps.
The adaptation plan will have most chance of being implemented if it is seen as part of the day-to-day running of the PA, for example by being integrated into an existing management plan or work plan.

Step 4, Stage 4: Adaptation plan checked by stakeholders

Once the plan has been prepared it needs to be checked back with all relevant stakeholders to ensure that the plan addresses the decisions of the workshop and that nothing important has been left out; or that decisions have been changed, distorted or reversed. The extent to which this is needed depends to some extent on the existing levels of trust between the PA and the local community, but some level of checking back is always necessary.

In most cases this can be a smaller and more informal process than the initial workshop, because the main issues will already have been discussed. However it will be particularly important to get sign-off from key interest groups on those parts of the action plan that directly concern themselves: fishing communities need to understand and where possible support any controls on fishing; tourism enterprises need to be consulted about limits on visitation, fees, etc. (Ideally representatives of these interest groups will already have been involved in drawing up the action plan.)

It is also important that people know the plan is ready to be read and open to comments. Word of mouth, text messages (many fishing communities have at least one mobile phone), posters and announcements at village meetings can all help disseminate information. Local and community radio stations are also often very good sources of publicity.

Normally we would suggest that checking be carried out with individual interest groups, although the plan should be available for anyone who wants to check. For instance copies could be at the PA office, in local government offices, at a school, community meeting place or religious building. Increasingly a proportion of community members will be accessing via the web and an online copy should also be available. In cases where particularly contentious issues remain, another workshop may be necessary.

Unless there are major disagreements, at this stage the action plan can be finalised. Major modifications (for example if something important was inadvertently left out; or if some actions need to be changed) will require further checking. Getting agreement at this stage is critical if the plan is to be successful and therefore the time taken will not be wasted.

STEP 5: Implementation

After all the research, talking and planning, the most important step of all is to ensure the agreed tasks are fulfilled satisfactorily. "Implementation" might be everything from printing a leaflet to undertaking major engineering works. Depending on the nature of the project, there are several things worth bearing in mind:

1. Explain what is happening, whenever site work, building, planting or other active management is taking place. Even very simple explanatory signs can help, or ensuring that local communities are informed before and during work that is likely to cause disruption. Explanations to visitors can present projects as a positive management response rather than simply something that is making a mess.
2. Ensure people know who to talk to: the project will need a liaison person in case of questions, complaints or requests. All stakeholders should know who they are and how to get in touch with them: a local person is obviously ideal if possible. The people implementing the adaptation plan should be identified so that stakeholders know the team involved.
3. Identify responsibilities: clarify who is responsible for what, how different tasks are shared between stakeholders and who is in charge.
4. Keep on schedule: with regular meetings between PA staff and any outside contractors or consultants involved in implementation. The meetings should be short and informal (and can be by phone or similar if it is difficult to meet physically). They should address the timetable, understand any delays or blockages; identify problems (particularly if these might mean modifying plans); and try to look ahead to future needs such as extra staff or additional equipment.
5. Minimise site disturbance: including waste, garbage, unsightly work etc. Projects invariably make a mess, but this needs to be controlled as much as possible, particularly in PAs that attract tourists or have resident communities
6. Minimise social disturbance: in the case of remote communities, projects that mean bringing workers or consultants from outside can also bring a range of social pressures, such as alcohol and other drugs, prostitution and the disturbance from sudden injections of cash into the economy. The PA managers have the difficult task of ensuring that the net benefits for local stakeholders are positive.
7. Provide training: for communities and other stakeholders as necessary on how to implement different adaptation options
8. Remain flexible: projects seldom work to plan. The managers will need to adjust as they go along, depending on relative success or failure of particular elements, reactions of stakeholders and other events. The ability to adapt is linked to understanding of what is happening, itself related to monitoring and evaluation as explained below.

Worksheet 23: Steps involved in implementation

Steps	
- Explain what is happening	
Explanatory notices in the PA	
Letter to local authorities	
Notices in the village, renewed as the project develops	
Use local press and radio to publicise	

- Make a contact point for stakeholders	
Appoint a local liaison officer (ideally someone from the community)	
Let people know his/her name and contact details	
Provide a full list of those involved in implementing the action plan	
- Identify responsibilities	
Draw up a list of different responsibilities within the plan	
- Keep to the agreed schedule	
Appoint a "timekeeper" to check progress on the project	
Have regular face-to-face or phone meetings between staff (and contractors if used	
- Minimise site disturbance	
Ensure litter and detritus is regularly cleared from the site	
Put up explanatory notices when work is taking place in the CMPA	
- Provide training	
Run training courses for local stakeholders	
Provide written training material where appropriate	
- Adapt	
Check that stakeholders are happy with progress	
Hold public meetings if problems come to light	
Agree a process for making changes to plans if necessary	
Explain any agreed changes to other stakeholders	

STEP 6: Monitoring, evaluation and adaptive management

Monitoring is a critical factor in any project that needs to be considered at planning stage and implemented throughout. Monitoring needs to consider five aspects of the project:

Outputs: whether the adaptation action keeps to time and budget

1. Whether the work plan is going to schedule: the plan should have a timetable and this can be checked regularly, e.g. at weekly staff meetings
2. Whether expenditure is keeping to budget: again this should be relatively easy to check against the proposed budget in the adaptation plan.

Outcomes: whether the adaptation action delivers the long-term benefits hoped for

3. Success of the adaptation actions: this is a much longer monitoring process and indicators of success need to be identified while the action plan is being drawn up. Most will have more than one type of indicator: for example restoration of mangroves could include both whether the mangroves grow successfully and then whether they provide the expected benefits (more fish, better coastal protection). Some of these indicators necessarily need to be measured over the long term.
4. Impacts on biodiversity: monitoring of target species and general biodiversity can help determine whether the adaptation is also helping the overall health of the protected area
5. Socio-economic impacts: again, these are hard to measure and range from qualitative issues such as peoples' attitudes to the PA and the adaptation work to quantitative data such as impacts on local incomes and flood mitigation costs.

There are numerous guides to developing monitoring systems. Monitoring only works if it is relatively simple, cost effective and maintained over the long term. We therefore suggest identifying a relatively small range of indicators that together can represent the key aspects of adaptation. Indicators that can be observed directly by local community members are ideal because this makes for a very transparent system and involves people directly in understanding the success or failure of the adaptation project. A good monitoring system is recognised as a critical element of project success, because it provides information that allows managers to adapt continually in response to the information gathered in. Worksheet 29 outlines a possible system.

Worksheet 24: A monitoring system for adaptation in Coastal and Marine Protected Areas

Outputs of adaptation		
Keeping to timetable		
Stages of adaptation action	Target date for completion	Actual date for completion
Action 1		
Action 2		
Action 3 etc…		
Keeping to budget		

Budget by item	Target cost	Actual cost
Budget item 1		
Budget item 2		
Budget item 3 etc …		
Outcomes of adaptation		
Adaptation action	Dates, Records	
Indicator 1		
Indicator 2 etc …		
Biodiversity outcomes	*Dates, Records*	
Indicator 1		
Indicator 2 etc …		
Socio-economic outcomes	*Dates, Records*	
Indicator 1		
Indicator 2 etc …		

So as an example of outcome indicators for mangrove restoration as a form of EBA

Adaptation action	*Dates, Records*
Number of mangrove trees planted	
Area of mangrove restored	
Biodiversity outcomes	*Dates, Records*
Increase in fish population	
Socio-economic outcomes	*Dates, Records*
Comparative protection of coastal areas	
Livelihood indicator for fishing community	

STEP 7: Mainstreaming into Policy and Planning

High levels of interest in coastal and marine climate change adaptation, coupled with confusion about how this should be addressed, mean that individual adaptation projects can sometimes provide lessons and experience that have policy implications well beyond the borders of a PA. Mainstreaming these experiences into local or national policy is often one of the stated aims of projects funded by external donors, while government-backed projects also generally include lessons-learning among their aims. Getting these messages across to policy makers is therefore important. Conversely, in other countries the projects will be taking place within the context of existing policy initiatives, which has a different set of implications for the approach taken. There are a number of ways of addressing policy issues, and we summarise some issues to take into note of in the section below.

Where climate change adaptation policies already exist

Many countries will have outlined policies towards addressing climate change; in some states these policies may already be well-developed and even covered by legislation. In these cases the first priority of a project is to make sure that it does not ignore, duplicate or countermand existing laws or policies, which may mean adjusting methods and approaches to meet national standards. For example, if a country has already stipulated a certain approach to vulnerability assessment, this should be used rather than the one we outline here, unless there are very good reasons not to do so. In other cases countries will have some aspects of approaches to adaptation already laid down in policy but these will remain incomplete: here the methods outlined in this manual can be selected as necessary to fill in any gaps. There are several ways of assessing climate change vulnerability and planning adaptation; we are providing technical guidance but it is not our intention to insist on a single approach. Indeed it will be clear from the case studies that several of the countries where the manual was planned and developed have adjusted their own methods to meet national approaches. The manual should be used in a complementary way with existing policies rather than being applied in opposition to such policies. In this regard the Case Studies at the end of this Manual are extremely helpful references.

Where climate change adaptation policies are partial or absent

In other cases, an adaptation project in an MPA may be the first time that adaptation has seriously been addressed in coastal and marine ecosystems and can thus help to set future policies in the country. Here we suggest you apply the methods described above in their entirety and note for future purposes any changes that may be needed to meet local conditions. Once project managers and rangers are confident that they have developed an optimal approach for a particular place, it is worth publicising this with a range of different stakeholders so that it can be used more widely.

These stakeholders include:

Local communities: who can learn about what the project has achieved through informal meetings, more formal workshops, articles in the press and interviews on local radio stations. The MPA itself can publicise results of a project for local people and visitors through signs and exhibitions in headquarter buildings. Developing support for the project should not stop with initial approval of the work, but needs to continue well beyond the finish date so that people remember what has happened and recognise any beneficial results.

National communities: to achieve effective mainstreaming, the message needs to reach well beyond local people. Publicity about results can be achieved through use of similar outlets nationwide, including radio and television, national newspapers, magazines and presentations at high-level meetings. Media outlets are always looking for human interest stories; the personal stories of people involved in the project or living in the PA can sometimes be used as a hook for wider discussions about adaptation policies.

Within the protected area community: through briefings, staff exchanges, conversations with agency heads and via newsletters, magazines and journals with the wider global protected areas community. Informing colleagues may be the most effective form of publicity, because these are the people with a direct opportunity to repeat and build on the work. For example once a project is completed it would be worth inviting staff from any other PA in the country to visit, to see what has been achieved.

Business community: particularly businesses that have direct links with the protected area, such as tourism companies and fishing interests. Understanding what has happened and how it might affect their own way of life is important; if business leaders approve of what the MPA has done they can provide important support in wider political debates. Politicians nearly always listen more to the business community than to the conservation community.

Politicians and policy-makers: finally, mainstreaming results involves taking them directly to the people who set national policies: civil servants, members of parliament, local councillors, religious leaders and community leaders. While senior figures are important for the backing they can give to particular policies, the hard work in drawing these up will usually be done by their aides, who should also be included in efforts to disseminate experience. Inviting local or national leaders to visit a PA where a successful project has taken place can be a great photo opportunity for them and for the PA. Linking the achievement to things that policy makers worry about on a day-to-day basis, like meeting international obligations under conventions and treaties, or what to say at a forthcoming regional conference, will make the messages immediately palatable.

Policy work takes time and effort, can be frustratingly slow and may not work. Individual protected areas will have to decide about the extent to which they want to engage. But at a time when many governments are increasingly anxious about how to address problems from climate change, lessons from a powerful project can help to influence the way that a whole country is thinking.

PART III: CASE STUDIES

The following three case studies from the Philippines, Colombia and Madagascar outline how the whole process was undertaken in specific Coastal and Marine Protected Areas in each country. Each endeavour was naturally quite different, the process itself adapting to the local context and on-going conservation / climate change initiatives. They highlight clearly that there is no blueprint for undertaking this work, but provide many insights into the ways in which such a methodology can be used for the purpose of strengthening PA management in a changing climate. Note that the case studies informed the CAMPA methodology – which is why steps taken in each place sometimes vary from the methodology presented here.

Case study 1
Island Garden City of Samal (IGACOS), Philippines
By Chrisma Salao and Maricar Samson

Site description

The Philippines is at the apex of the Coral Triangle, where the earth's richest marine biological diversity can be found. At the south of the country is the Davao Gulf, a veritable playground for whales, dolphins, dugongs and marine turtles. It is an important spawning and nursery ground for tuna, and has extensive coral reefs. At the same time, beyond the richness of marine life the four provinces surrounding the gulf are home to multinational companies engaged in a wide range of industries, from agriculture to oil depots. Generally considered typhoon free until recently, the Davao region is also the fruit basket of the country, responsible for making the Philippines the fourth largest exporter of bananas worldwide.

At the innermost tip of the Davao Gulf is the Island Garden City of Samal (IGACOS), with a total land area of 30,000 hectares. It is composed of mainland Samal, a small island to the southwest called Talicud, and much smaller islands such as Malipano, Big Ligid and Little Ligid. The city's population was 95,000 in 2010.

Because of the environmental and economic importance of the Davao region, it is one of the focus sites of WWF Philippines, the implementing agency of the project in the country. With assistance from local partners, IGACOS was chosen as the project site because of its several Marine Protected Areas (MPAs), then numbering 10 but now 18. These MPAs have been declared by the city government but are generally in need of improved management.

The project was initially focused on MPAs 1 and 2, with a total aggregate area of 3,400 hectares, on the northern coast of IGACOS. The Vulnerability Assessment (VA) tools used were thus applied only to these two MPAs. However, adaptation to climate change—even for MPAs and especially for those near densely populated areas—cannot be undertaken in isolation of nearby communities, the governance system under which it belongs, and economic activities in the surrounding areas. Therefore, subsequent studies on geologic and hydrologic hazards and risk based assessments covered the entire city.

In addition, in October 2013, the city government of IGACOS requested WWF Philippines for assistance in updating their Comprehensive Land Use Plan (CLUP). The CLUP is required by the national government from local governments and serves as framework for land use and management. Increasingly, CLUPs include freshwater and coastal and marine areas that fall within the city or municipal government's jurisdiction. The CLUP, being an official and legal document, therefore presented itself as the perfect

platform upon which climate change adaptation measures could be incorporated and mainstreamed in the city government's policies and management plans.

In response to the city government's request, the project conducted an additional study on climate related risks, i.e., storm surge, sea level rise and flooding, and the natural and manmade assets they could affect. Thus, the project site was expanded to the entire city of IGACOS.

Methodological approach and results

A total of four VA tools were administered in MPAs 1 and 2, and two other risk assessment studies were conducted for the entire IGACOS. All the results of the VAs were presented to stakeholders in a workshop conducted on 05 June 2014, where the participants identified adaptation strategies they would like to implement to prepare for the effects of climate change. Below is a description and results of the VAs undertaken in IGACOS, and a brief discussion of the workshop results.

Vulnerability assessments for MPAs 1 and 2
The four VA tools used to assess the vulnerabilities of MPAs 1 and 2 are the following:

- Integrated Coastal Sensitivity, Exposure, and Adaptive Capacity to Climate Change (ICSEACChange);
- Tools for Understanding Resilience of Fisheries (TURF);
- Coastal Integrity Vulnerability Assessment Tool (CIVAT); and
- Basic Methodology for Climate Change Vulnerability Assessment of Protected Areas (BAVAPA).

The first three—ICSEACChange, TURF and CIVAT—were developed by a project funded by the Philippines' Department of Science and Technology (DOST) and implemented by six universities across the country from 2009 to 2011, called the "Integrated Control Enhancement: Coastal Research Evaluation and Adaptive Management" or ICE CREAM project. A guidebook on these tools was published by the Marine Environment and Resources Foundation (MERF) in the Philippines in 2013. BAVAPA, on the other hand, was developed in the framework of the current WWF-led project, and is included in this manual. The table below summarizes the objectives, information that can be generated, and data needs of the 4 tools that were implemented.

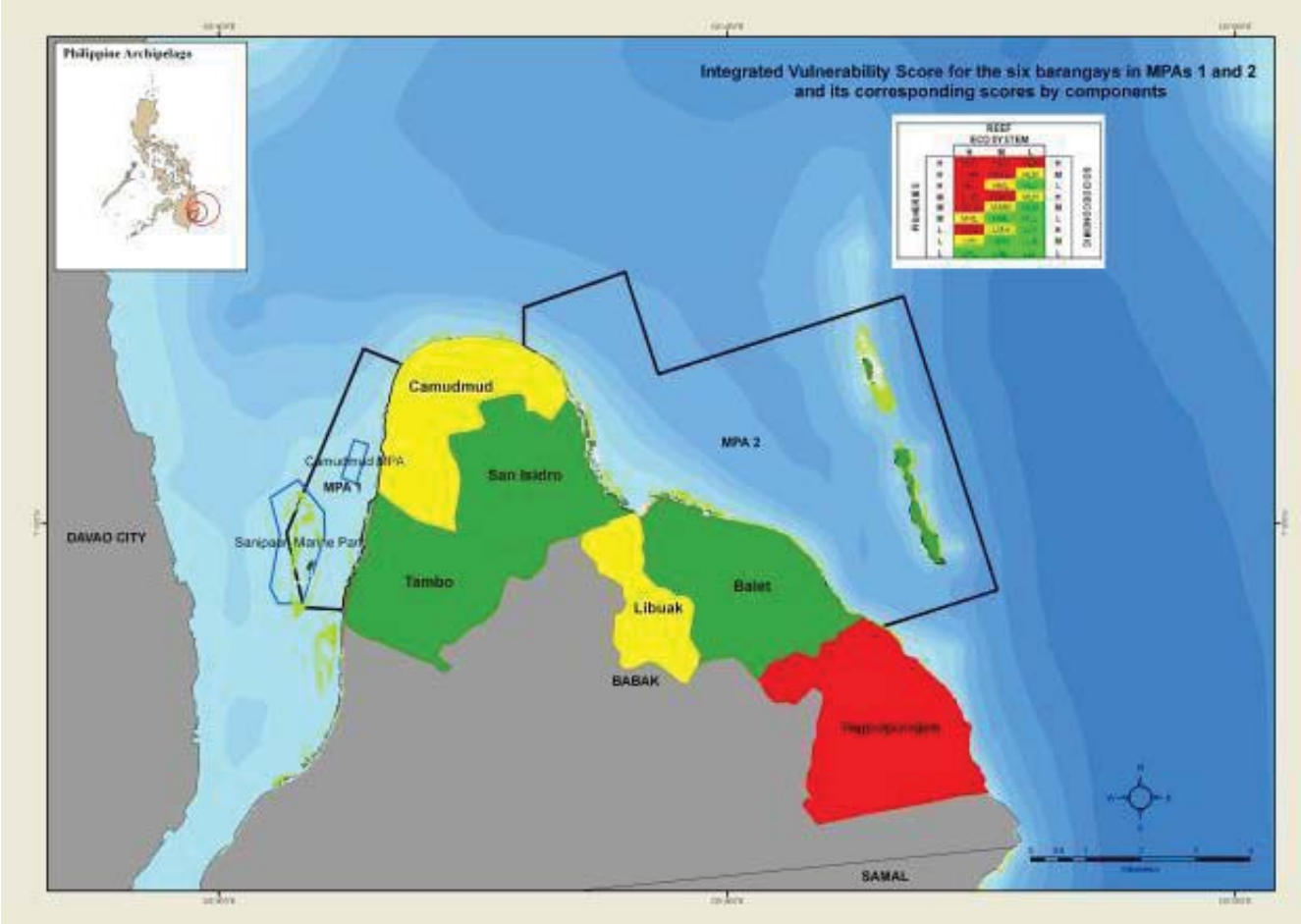
Objectives, information that can be generated and data needs of the four VA tools used

The results of each VA tool are summarized below:

ICSEACChange: Three barangays were assessed using this VA tool—the two barangays (Tambo and Camudmud) of MPA 1 but only one (San Isidro) out of the four barangays of MPA 2, due to limitation of available information. The integrated results of ICSEACChange yielded a medium vulnerability for all three barangays, but the sources of vulnerability varied. Barangay Tambo of MPA 1 was the most vulnerable due to its moderately high scores for sensitivity and low adaptive capacity of the fisheries and coastal integrity components as well as its relatively high exposure to sea level rise, sedimentation and rainfall. Barangay Camudmud was the least vulnerable due to its relatively lower score for sensitivity and exposure to sea level rise and rainfall. Likewise, San Isidro had relatively lower adaptive capacity score.

TURF: For the fisheries sector, all six barangays of MPAs 1 and 2 were assessed. The most vulnerable is Tagpopongan due to the combined results of high vulnerability in fisheries, moderate vulnerability in reef ecosystem and socioeconomic attributes. Moderately vulnerable are barangays Camudmud and Libuak. Least vulnerable are San Isidro and Balet.

For all the VA tools, the sensitivity, exposure and adaptive capacity were mapped for a more visual presentation of the results. For illustration and brevity, only the map rendition of the integrated results of TURF is given in the following figure.



Integrated results of Tools for Understanding Resilience of Fisheries (TURF)

CIVAT: For coastal integrity, IGACOS, being situated in an island system, has relatively narrow coastal plains and limited sediment supply mainly derived from fringing reefs on its western and northern coasts and small rivers on its eastern coast. This necessitates the need for climate change adaptation planning to carefully consider the limitations posed by the aforementioned characteristics of this island. In MPA 1, Camudmud was given a a high vulnerability score, while in MPA 2, almost all of the barangays scored high except for Libuak due to its wider extent of coastal habitats and lesser coastal developments.

Beyond MPAs 1 and 2, however, the overriding concern on the coastal integrity of IGACOS is the presence of groins that virtually every resort constructs to use as docking area for the boats that ferry their guests, and also to demarcate the beachfront of their properties. By Philippine law, shorelines cannot be owned and should be open to public access. Through the construction of groins, however, resorts effectively fence in their beachfronts. As of 2013, 112 groins were recorded in the northern and western parts of Samal, as shown in the figure above.

These groins compromise the coastal integrity of IGACOS by altering the shape of the coastline—they are affecting the natural distribution patterns of sediments and potentially trap pollutants. Poor visibility due to sedimentation was noted during the field surveys in the conduct of the VA tools, and the coral reefs and seagrass beds are already slowly showing adverse effects. Since IGACOS is situated in the Davao Gulf which is surrounded by large agricultural plantations, it is exposed to further hazards from agricultural wastes and industrial effluents, including other forms of marine pollution.

The non-climatic factors were almost the same in the two MPAs, and these included: the passive response of stakeholders; poverty incidence and population growth; pollution and solid waste; and uncontrolled coastal development. The interaction of the climatic and non-climatic factors may have brought about the medium (seagrass) to high vulnerability (coral reefs and mangroves) of target systems in the MPAs. The factor that may have contributed to the high vulnerability of barangays in MPA 2, particularly barangay Balet, for the socio-economic and land use attributes were poor enforcement vis-a-vis the prevalence of illegal fishing.

Risk assessments for IGACOS

The project undertook two risk assessments that covered the entire IGACOS:

Geologic and hydrologic risk assessment: This was conducted through the collection of available secondary information and site validation. The geologic hazards identified for IGACOS are: coastal areas that are more prone to ground collapse due to dissolution of limestone and cave formation near or at water table elevation; areas with existing collapse structures (i.e., Bito depression due to fallen meteor toward the south) are high risk for large development; and soil creep, although this is limited to steep slopes with thick soil and relatively limited considering the terrace-like terrain of the island.

The present estimated total water demand in Samal is only 10% of the estimated annual recharge. These demands include domestic, commercial and agricultural needs. The Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) estimated a 3% decline in rainfall for the neighboring Davao City by 2020. Based on these figures, the volume of freshwater supply of Samal is safe. What is of concern, however, is the quality of the freshwater, which is threatened by current practices and water resources development. During the survey, shallow dug wells toward the north of the island showed an acidic characteristic, which is quite unusual since the bedrock is limestone that normally produces a more basic type of water. One of the possible explanations for this phenomenon is the influence of rainwater on the shallow groundwater. The depths of the water table encountered by the wells suggest a typical profile of a water lens floating on sea water, but these

could be discontinuous water bodies called perched groundwater. Groundwater is widely tapped on the island through wells, and prone to seawater intrusion.

Hazard mapping and asset based projection: Based on interviews, two climate related hazards have occurred in IGACOS, storm surge and flooding due to rains. The affected areas were identified through key informant interviews and delineated using Digital Terrain Model (DTM). Upon consultation with the city government, sea level rise of 2 metres and 4 metre projections were added to the exercise. After mapping, natural and manmade assets in the affected areas were inventoried, and projections of 3% and 5% increases in affected assets were made.

In terms of land area, only a small portion of IGACOS would be affected—less than 1% is affected by flooding and has been affected by storm surge, and 2% of the land area would be affected by sea level rise projected at 4 metres. However, the centres of population in IGACOS are near the coast, and therefore the potential number of people and structures are much more signficant—an estimated 30% of the population and households would be directly affected. There is only one known case of storm surge in IGACOS which occurred in October 1970. Witnesses related stories of waves as high as six metres, with no known casualties. However, the coasts hit by the storm surge were uninhabited at the time, which is no longer the case today.

Climate Change Adaptation (CCA) planning workshop

As a culminating activity of the research and planning phase, the project convened a CCA planning workshop on 05 June 2014 in Davao City. All the results of the vulnerability and risk assessments were presented, including a presentation on short and long-term adaptation strategies, and the outputs of the workshop discussions were identified adaptation measures. The workshop was attended by about 125 stakeholders, of whom more than 70% were barangay officials. The rest of the participants were from the city government, national agencies, WWF staff and consultants.

For the planning session, the participants were divided into three groups and each was assigned a hazard—storm surge, sea level rise and flooding—to identify climate change adaptation strategies. The results of the discussions could be summarized into the following actions per area:

Inland areas: tree planting and waste management to protect their groundwater.
Coastal areas: proper mangrove planting, implementation of the easement law, relocation of communities in high risk areas and preparation of evacuation centres.
Marine areas: designate anchorage areas for boats to avoid anchor damage on coral reefs. During the ensuing discussion, the Fisheries Officer of the city government added the improvement of MPA management.
Crosscutting activities: information dissemination, approval and implementation of environmental code and proper zoning, and solid waste management.

Based on these outputs, WWF Philippines and the IGACOS city government will continue discussions to prioritize and select three or four adaptation measures that the project will support for implementation.

Lessons

Planning the sequence of events, outputs, and expectations for a regional project could have been better for this project. For example, this project aims to develop a VA methodology and CCA strategy identification tool. However, the Philippines has developed several VA tools which the government, academia, NGOs and aid agencies are already implementing nationwide. The results of these VA tools and the concomitant development of the CCA plan, therefore, has a wider scope than the strategy identification tool developed by the project.

Secondly, the appropriate policy platform might also have been identified earlier on, so that the scale of project activities could be better matched. In this case, the project focused on MPAs 1 and 2 during the first three years of the project. Considering that most of the MPAs in IGACOS are virtually "paper parks", and the four barangays where MPA 2 is situated do not want to work together, the viability of each MPA as a management unit that would implement adaptation measures is quite weak.

More importantly, under Philippine law, it is the city or municipal government that has jurisdiction over its municipal waters, not the barangay. It is also rare for MPAs in the Philippines to have financial resources at their disposal, and it is usually the city or municipal government, if not external organizations, that provides support in setting up and establishing MPAs.

It was therefore an unforeseen but fortunate development that the city government requested the project for assistance in updating its Comprehensive Land Use Plan, giving the project a chance to match its geographical scope with an appropriate policy platform.

Thirdly, VAs may yield compelling scientific and physically irrefutable evidence, but implementation of the appropriate adaptation strategies would still depend on political will and good governance, which could be challenging, to say the least. This is the case of the 112 groins that have been constructed by the resorts in IGACOS, and have become the bone of contention between the city government and resort owners. The results of CIVAT and ICSEACChange make it obvious that the groins and violations of the easement law are compromising the beaches of Samal, which is the selling point of their tourism industry. However, as explained by the Officer-In-Charge City Administrator, Mr. Guillermo Olden, during the workshop cases have been filed and counter-filed, and their hands are tied until these are resolved. However, as these cases go, this process could take years or decades, if they are resolved at all. In the meantime, the coastal integrity of Samal continues to be compromised.

Adaptation planning is supposed to prepare communities for possible impacts of climate change and prevent disasters, but some adaptation strategies may be too big, or politically infeasible, or against the interest of those in power. What is worrisome is that tragedies do not work on a schedule, such as the case of Tacloban and typhoon Haiyan in November 2013. In September of that year, the city government was told they should prepare for a mega storm in the next 20 years. It took two months for that storm to arrive.

At the end of the day, the vulnerability assessments conducted in IGACOS pointed out not only climate change related hazards, but how human impacts are exacerbating the potential impacts that climate change may bring. The question is whether the information brought forth by the VAs will propel the people and government into action.

Case Study 2
Assessing and Mainstreaming Climate Risks, Adaptive Capacity and Adaptation Actions in Coastal and Marine Protected Areas in Colombia

By Oscar Guevara, WWF-Colombia, Julio Herrera, Consultant

1. Introduction

This case study gives a brief overview of what WWF Colombia, together with the National Parks Authority, has been doing since 2011 with two National Protected Areas (PA), Sanquianga and Gorgona, offering a perspective of how Colombia's conservation portfolio can be an example of continual learning and mainstreaming of the climate change agenda. The approach of the case study is one of narrating the methodologies and activities, from the first experience of a learning process, to the current commitment to identify and implement adaptation actions.

In particular, the project's goal for PA Gorgona and PA Sanquianga was to help develop and test the methodology presented here to support stakeholders in identifying climate risks, existing adaptive capacity, and adaptation strategies and actions that can help build the resilience of ecosystems in these protected areas based on an understanding of their climate vulnerability.

2. Context

PA Gorgona and PA Sanquianga are located in two adjacent ecoregions: (i) The Choco Darien terrestrial ecoregion; (ii) The Panama Bight marine ecoregion. They are both included in WWF's Global Ecoregions, as part of the "Earth's most biologically outstanding terrestrial, freshwater and marine habitats[24]" .

The **Choco Darien Ecoregion**[25] receives one of the highest levels of rainfall on the planet (13,000 mm annually in some places), and has "one of the world's most diverse assemblages of lowland plants and animals, with exceptional richness, uniqueness and endemism in plants, birds, reptiles and amphibians, and butterflies[26]" .

The **Tropical Eastern Pacific (TEP) – Panama Bight Ecoregion**[27]. The TEP extends along the Pacific Coast of the Americas, from the southern tip of the Baja California Peninsula in the north to Peru in the south. It also includes a number of islands and island groups, including Gorgona, Galapagos, Revillagigedo, Cocos and Clipperton. As part of the TEP, The Panama Bight is a marine ecoregion, which extends eastwards from the Azuero Peninsula in Panama along the coast of the Gulf of Panama and Archipelago de las Perlas. It continues south along the entire Pacific coast of Colombia to northern Ecuador.

The Panama Bight marine ecosystems "contain dense mangroves, extensive beds of coral, and cetacean communities. Coral diversity here is lower than on the Caribbean side, but coral cover tends to be much higher – 67 % in 1998, 74 % in 2001, 62 % in 2007), something rarely found in the Caribbean.

Sanquianga National Natural Park

Sanquianga National Park is located on the southwest Pacific coast of Colombia. This 80,000-hectare protected area, established in 1977, protects a complex estuary delta system formed by the Sanquianga,

24 http://wwf.panda.org/about_our_earth/ecoregions/about/
25 Adapted from http://wwf.panda.org/about_our_earth/ecoregions/chocodarien_moist_forests.cfm
26 Ibid.
27 Adapted from http://wwf.panda.org/about_our_earth/ecoregions/panama_bight.cfm

Patía, La Tola, Aguacatal and Tapaje Rivers. It contains approximately 20 per cent of Colombia's Pacific mangrove forests, being the largest coastal protected area and mangrove ecosystem under a conservation scheme in Latin America's Coastal Pacific region.

A great diversity of marine species is found within the mangrove ecosystems including mollusks, crabs and the piangua shellfish (Anadara tuberculosa). This PA has the highest concentration of shore and seabirds on the Colombian Pacific coast and is a primary nesting ground for Brown Woodrail (Aramides wolfi), Gull-billed Tern (Gelochelidon nilotica), Tumaco Seedeater (Sporophila insulata) and the Neotropical Cormorant (Phalacrocorax brasilianus). The PA also provides nesting habitat for Olive Ridley (Lepidochelys olivacea). Other fauna include sloths (e.g. Bradypus variegatus), common green iguana (Iguana iguana), common caiman (Caiman cocrodylus), and neotropical Otter (Lontra longicaudis).

Sanquianga National Park also harbors indigenous and Afro-Colombian communities, with a total population of about 11,000. They have been occupying the mangrove and cativo forest (Prioria copaifera), in the Pacific Coast and tropical humid forest region in the country's southwestern Nariño region for the last 200 years since the abolishment of slavery in Colombia. Most of these people live in small settlements in and around the PA, and practice a combination of activities including fishing, farming, extraction of resources from the mangroves (firewood, logging, crabs etc.), and gold mining.

The PA is managed by National Parks (Special Administrative Unit of the National Natural Parks System). Due to the fact that it doesn't have facilities for tourists, there is no record of the number of people who visit the PA each year. However, it is estimated than only a couple of hundred people, moust of them researchers and NGOs, visit the PA annually.

Gorgona National Natural Park

Gorgona is a Colombian island in the Pacific Ocean located about 35km off the Colombian Pacific coast and separated from the continent by an 80m deep underwater depression. The island was a prison (similar to Alcatraz) until 1985 when it was turned into a National Natural Park.

The island has an average annual temperature of 26°C and average humidity of 90%. Rainfall is experienced throughout the year and is most significant in September and October. Intense rainfalls and misty days are frequent and the island has at least twenty-five permanent freshwater streams. The shores of Gorgona Island are comprised of predominantly steep plunging cliffs, with small sandy and shingle beaches supplied on its eastern side, by coral reef detritus. A dense, humid tropical forest ecosystem covers the majority of the island.

The Island harbors an important number of endemic terrestrial species resulting from its isolation from the American continent. The island's dense rainforest has been isolated for thousands of years from the mainland, and harbors the endemic Blue Anole (Anolis gorgonae), which is the only all-blue anole lizard in the world. Other endemic subspecies include the Brown-throated Sloth (Bradypus variegatus gorgon) and the White-throated Capuchin (Cebus capucinus curtus). Gorgona is also famous for its snakes. There are various venomous snakes including the much-feared venomous pit viper species, Bothrops asper. Many non-venomous snakes such as the Boa constrictor and the Brown Vine Snake (Oxybelis aeneus) also inhabit the island. Approximately 3200 people visit the Park each year,

predominantly for scientific purposes, snorkeling and diving.

3. Opportunities for Climate Smart Conservation

At the time of the EU project, there were two main opportunities to integrate Climate Adaptation into PA conservation planning, and therefore moving forward and consolidating an approach called "climate smart conservation". The first opportunity was to build on Colombia's existing PA management framework, adopted as the standard to plan conservation management in all the national-level PAs (Including PA Gorgona and PA Sanquianga). The second opportunity was the development of the EU project's conceptual framework, that relies on the development of Climate Adaptation based conceptual framework that was favored by IPCC 4th and 5th assessment reports – 2007 and 2014 respectively. Here our theory of climate smart conservation was based on identifying opportunities to assess climate risks and adaptive capacity, and to identify and prioritize adaptation actions, in a participatory manner, compatible to both conceptual frameworks, and using the best available information and resources.

With regards to the first opportunity, the national system of PAs in Colombia has a history of evolution and strengthening since 1960, the year when the first protected area of national character was established. Since then Colombia with now 56 National Parks has a number of tools integrated into a macro-process, known as " PA Planning and Management Framework". This framework, is divided in turn into sub processes, that offer an exceptional opportunity to mainstream climate adaptation actions, among which are the following: (1) Establishment of conservation objectives; (2) Identification of target values conservation; (3) Assessment of ecological integrity; (4) Assessment of hazards and threats; (5) Assessment of risk scenarios; (6) PA Zoning; (7) Identification of PA management strategies.

The second opportunity is the CAMPA framework methodology outlined in this manual. Considering those opportunities, PAs Gorgona and Sanquianga, together with WWF, finally adopted an approach that favours the mainstreaming of four critical steps into both conceptual frameworks. This decision offered an outstanding opportunity not only to position the relevance and validity of the Climate Vulnerability and Risk Assessments, but also to promote a Climate Smart Conservation approach to the Management Framework on Coastal and Marine Protected areas in Colombia. The four steps are:

Units of Analysis: The main starting point for integration between the PA Management Framework and the exercises undertaken in the EU-funded project were the units of analysis. As such, In Colombia we took the decision to use the Conservation Targets of each PA as the units of analysis: Conservation Targets corresponding to ecosystems (course filter) and species (fine filter).

Hazards and Drivers of Change: A second point of integration relates to the factors that may affect conservation objectives. In this case, it was agreed to expand the context in which they identify and prioritize threats and pressures on protected areas, including those that may be associated with changes in climate and oceanographic average conditions, variability, or in extreme weather and oceanographic events. This included an "extended assessment of hazards and drivers of change" not just in the context of climate change, but also a series of pressures and threats of an anthropogenic nature.

Risk Assessments & Risk Scenarios: The third point of integration between the PA Management Framework and the EU-funded project is related to the Assessment of Risks and the corresponding Identification of Risk Scenarios. This step builds on the previous "assessment of hazards and drivers of change", and thus establishes the conceptual relationship between the PA's conservation targets and the PA'ss prioritized hazards. Moreover, in Colombia, National Parks and WWF established "risk metrics" for each conservation targets, using the indicators of ecological integrity of each target, and defining if those indicators are likely to be affected for de different hazards (including climate related hazards).

Adaptation Actions & Adaptation Planning: Finally, the PA Management Framework and the EU Project integration derived in the identification and prioritization of adaptation actions. Those actions were mainstreamed as part of the PAs management strategies, classified as "climate adaptation" or "adaptive management".

4. Integrating Climate Adaptation into Conservation Planning and Management

a. Conservation Targets and Adaptive Management

The point of convergence between the PA management planning process and the present adaptation work was found in the Conservation Targets. Methodologically, the identification and selection of Conservation Targets was the result of working with two multidisciplinary working groups (one for each PA). These scientific committees are comprised of professionals from National Parks, universities, Research Institutes and NGOs. It is worth noting that each protected area opted to independently develop an extended version of this exercise, using two types of "filters" to select targets: (i) coarse filter-ecosystems; (ii) fine filter- species.

HABITATS AND ECOSYSTEMS SELECTED AS CONSERVATION TARGETS	
PA GORGONA	PA SANQUIANGA
Freshwater ecosystem Coral formations (coral reefs) Rocky-coastal ecosystem (Rocky shores intertidal) Hard-bottom ecosystem (Rocky shores sub tidal) Soft-bottom ecosystem (sub tidal) Sandy-coastal ecosystem Pelagic ecosystem Rainforest	Mangrove ecosystem Coastal basin – Deltaic System Sandy beach ecosystem Muddy flat ecosystem Coastal and marine hydro-biological resources

SPECIES AND COMMUNITIES OF SPECIES SELECTED AS CONSERVATION TARGETS	
PA GORGONA	PA SANQUIANGA
Land snakes community (19 species) Bats community (15 species) Anuran community (7 species) Seabird community: Pelecanus occidentalis murphy (Brown Pelican) Sula leucogaster etesiaca (Brown Booby) Sula nebouxii (Blue-footed Booby) Fregata magnificens (Magnificent Frigatebird) Sea Turtle community: Lepidochelys olivacea (Olive Ridley) Chelonia mydas agassiizii (green turtle) Chelonia mydas (black turtle) Eretmochelys imbricata (Hawksbill Turtle) Demersal fish assemblage: Brotula clarkae (Pacific bearded brotula) Hyportodus acanthistius (Rooster Hind) Lutjanus argentiventris (Amarillo snapper) L. guttatus (Spotted rose snapper) L. peru (Pacific red snapper) Recreational Fish: Triaenodon obesus (Whitetip Reef Shark) Other species: Stenella attenuata (Pantropical Spotted Dolphin) Bradypus variegatus gorgon (Brown-throated Sloth) Proechimys semispinosus gorgonae (Tome's Spiny Rat) Dactyloa gorgonae (blue anole) – Synonym Anolis gorgonae Caiman cocrodylus (Common Caiman)	Macroinvertebrate communities associated with mangrove Eggs, larvae and juvenile fish and shrimp Lepidochelys olivacea (Olive Ridley) Charadrius wilsonia (Wilson's Plover) Numenius phaeopus (Whimbrel) Anadara tuberculosa (pustulose ark) Scomberomorus sierra (Pacific sierra) Bagre panamensis (Chilhuil sea catfish) Cynoscion albus (Whitefin weakfish) Brotula clarkae (Pacific bearded brotula) Hyporthodus acanthistius (Rooster Hind) Cetengraulis mysticetus (Pacific anchoveta) Litopenaeus occidentalis (white shrimp)

It is noteworthy that the exercise of identification and selection and the level of detail (ecosystems, habitats, species) is the first of its kind for CMPAs in Colombia. The common practice of most of PA management exercises is based on the results of coarse filter (ecosystems) studies.

b. Hazards and Drivers of Change

The second area of work related to updating the two PA management plans is the identification and prioritization of threats and pressures that can affect conservation objectives. Methodologically, the manifestations of climate and oceanographic processes identified in the current manual were integrated with other pressures and threats of anthropogenic and natural origin in one comprehensive assessment. This process was also undertaken with two multidisciplinary working groups, the scientific committees (one for each protected area). Again, it is important to highlight that that this type of "comprehensive" assessment of natural, climatic and anthropic hazards is the first of its kind in Colombia. The traditional practice is to limit the hazards assessment to those of anthropic origin.
The results of the assessment of threats and pressures follows:

PA Gorgona

The outcomes of the experts' workshop was organized and tabulated to identify the critical and severe threats that can possibly have negative effects on the conservation status of the park's conservation objectives. The following table lists the most important threats, noting that 60% of the most striking are climate-related.

Table 1. Critical and Severe Threats to Conservation Targets in PA Gorgona

Climatic	*Anthropic*
Ocean acidification	Oil / Seismic operations
Increase in sea level / tidal seasonal floods	Sedimentation
Changes in frequency and intensity of ENSO events	Overfishing / illegal fishing
Changes of surface water hydrology (flow)	Breach of rules defined in the Tourist Park Planning
Changes precipitation (seasonality)	Dumping of waste (solids and liquids)
Cyclone (depression, storm, hurricane)	*Natural*
Thermal fronts and / or upwelling	Invasive / exotic species
Storm surge and swell	Alterations primary productivity (eg chlorophyll)
Pattern Winds changes / Wind Field changes (magnitude and direction)	Earthquake-Tsunami (seismic activity)
Salinity changes	
Air Temperature increases	
Sea Surface Temperature (SST) increases	

PA Sanquianga

The following table lists the most important threats to Conservation Targets in Sanquianga. Here anthropogenic threats are the most important with about 43% of the Conservation Targets involved, followed by climate hazards with 36% and finally natural threats at 21%.

Table 2. Critical and Severe Threats to Conservation Targets in PA Sanquianga

Climatic	*Anthropic*
Ocean acidification	Agriculture
Increase in sea level / seasonal floods by tidal ("Pujas" in Spanish)	Illicit crops
Sea Surface Temperature increase	Oil spill
Changes in the pattern of winds and currents	Diversion Channels
Changes in frequency and intensity of ENSO events	Extraction of building materials and drag material
Changes in salinity	Infrastructure (houses, kiosks, docks, cabins, bridges, erosion control works)
Changes of surface water hydrology (flow)	Flurry Mining large-scale or tech
Changes in precipitation (seasonality)	Sedimentation
Storm surge and swell	Overfishing / illegal fishing
Variability in precipitation / Volume - Calendar, seasonality / drought or excessive rains. Changing water regime	Deforestation
Natural	Unregulated tourism
Erosion (coastal, and terrestrial channels)	Solid and liquid waste
Invasive / exotic species	
Flood	
Extreme waves	
Landslide	
Earthquake-Tsunami (seismic activity)	

c. Assessing Risks to Conservation Targets (Potential Impacts)

In the PAs the risk assessment was conducted in a two step process: (i) First, it identifies the Conservation Targets that are, on average, subject to a greater number of pressures and threats; (ii) Second, the risk assessment determined the ecological integrity attributes of those targets that are likely to be affected by the various pressures and threats. By doing so, the risk assessment can determine the "risk metrics" for all conservation targets. In other words, a risk metric allows PA Managers to anticipate which attributes of the ecological integrity of the conservation targets, are more likely to be affected by the different hazards. Following the previous approach, this assessment was undertaken with the scientific committees (one for each PA). This type of risk assessment is also new in the context of PAs in Colombia.

CONSERVATION TARGETS ON CRITICAL AND SEVERE LEVEL OF RISK	
PA GORGONA	PA SANQUIANGA
Rocky Shores Seabird communities Octocorals Spotted Dolphin Demersal fish assemblage	Charadrius wilsonia, Numenius phaeopus Coastal Basin Mangrove Forest Macroinvertebrate communities associated with mangrove

RISK METRICS FOR CONSERVATION TARGETS ON CRITICAL AND SEVERE LEVEL OF RISK	
PA GORGONA	PA SANQUIANGA
Rocky Shores : Number of Focal species Macroinvertebrate richness	Charadrius wilsonia Highest abundance in non-breeding season Area available for nesting Number of breeding pairs Number of nesting and resting sites
Seabirds Community Number of nests Abundance Number of nesting and resting sites	Numenius phaeopus Abundance in roosts in islerías Number roost (MANGROVE)
Octocorals % Diseased octocoral Density of octocorals Percentage of coverage - Carijoariisei Octocoral richness by locality	Coastal Basin Volumetric zooplankton biomass Eggs engraulidae Total Eggs Larvae engraulidae Total larvae
Spotted Dolphin Abundance Group size	Mangrove Forest Red Mangrove Rhizophora sp (# Natural spatial units) Guandal (# Natural spatial units) Fern Ranconcha Acrostichum aureum (# Natural spatial units)

Demersal fish assemblage Zooplankton biomass Chlorophyll Nitrates Physicochemical parameters	Macroinvertebrate communities associated with mangrove Relative abundance Sizes Structure Proportion of mature individuals, based on the TMMS

d. Climate Adaptation Planning

The methodology and results for the identification and selection of climate adaptation strategies are presented here. Such management actions are grouped under a "climate adaptation plan" for each of the PAs.

The adaptation strategies were developed collectively following the current manual. Initially, the experts considered the results from Climate Vulnerability and Risk Assessments, to identify tendencies of climate impacts and pressures associated with each Conservation Target, and thus guide the exercise. Then the group decided to identify adaptation strategies only for coarse filter targets of each PA. After identifying potential adaptation strategies (at least five per target) a multi-criteria prioritization was done.

PA GORGONA - CVRA OVERALL SCORES							
Target Identification		*Overall Climate Impact Score*		*Overall AC & Resilience Score*		*Overall Vulnerability Score*	
No.	Name. Identification						
1	Tropical rainforest	3	The target is expected to experience a highly negative climate impact.	1	The target has high adaptive capacity / resilience.	2	The target has medium level relative vulnerability.

2	Freshwater ecosystem	2	The target is expected to experience negative climate impact.	1	The target has high adaptive capacity / resilience.	1	The target has medium level relative vulnerability
3	Coral formations (coral reefs)	3.5	The target is expected to experience a highly negative climate impact.	1	The target has high adaptive capacity / resilience.	2.5	The target has high relative vulnerability
4	Rocky-coastal ecosystem	2	The target is expected to experience negative climate impact.	1	The target has high adaptive capacity / resilience.	1	The target has medium level relative vulnerability
5	Hard-bottom ecosystem	1	The target is expected to experience negative climate impact.	1	The target has high adaptive capacity / resilience.	0	The target has medium level relative vulnerability.
6	Sandy-coastal ecosystem	2	The target is expected to experience negative climate impact.	1.5	The target has high adaptive capacity / resilience.	0.5	The target has medium level relative vulnerability.
7	Pelagic ecosystem	3	The target is expected to experience a highly negative climate impact	1	The target has high adaptive capacity / resilience	2	The target has medium level relative vulnerability

PA SAN-QUIAN-GA- CVRA OVERALL SCORES							
Target Identification		*Overall Climate Impact Score*		*Overall AC & Resilience Score*		*Overall Vulnerability Score*	
No.	Name. Identification						
1	Mangrove Ecosystem	2	The target is expected to experience negative climate impact.	1	The target has high adaptive capacity / resilience.	2	The target has medium level relative vulnerability.
2	Coastal Basin	3	The target is expected to experience a highly negative climate impact	0	The target has medium level adaptive capacity / resilience.	3	The target has high relative vulnerability
3	Sandy beach ecosystem	2	The target is expected to experience negative climate impact.	1	The target has high adaptive capacity / resilience.	1	The target has medium level relative vulnerability
4	Muddy flat ecosystem	2	The target is expected to experience negative climate impact.	1	The target has high adaptive capacity / resilience.	1	The target has medium level relative vulnerability

5	Coastal marine resources Proxy 1: Anadara tuberculosa	3	The target is expected to experience a highly negative climate impact	1	The target has medium level adaptive capacity / resilience.	2	The target has medium level relative vulnerability
6	Coastal marine resources Proxy 2: Litopenaeus occidentalis	2	The target is expected to experience negative climate impact	0	The target has medium level adaptive capacity / resilience.	2	The target has medium level relative vulnerability

i. Criteria for Identification and Prioritization of Adaptation Options

In the specific context of the two PAs, a working group was settled to identify the criteria for prioritizing alternatives for Climate Adaptation. The following explains this briefly:

• Benefits: This criteria refers to the possibility that the climate adaptation strategy can generate benefits of two types:
- Direct benefits
- Indirect benefits

• Costs: This criteria refers to the various requirements associated with proper implementation of climate adaptation strategies. For the case of Gorgona and Sanquianga, those costs were classified into three categories:

Installed capacity

- Resources
- Research
- Risks: This criteria seeks to anticipate possible adverse or negative consequences due to a possible implementation of climate adaptation strategies. The possible risks considered are:
- Ecological
- Social
- Economical
- Political
- Opportunities: In this criteria the intention is to address the possible synergies and positive externalities of climate adaptation strategies. Among the possible categories of opportunities, the following were used:
- Policies and regulations
- Existing projects

Therefore, the exercise considers Benefits (B) (direct and indirect), Costs (C) (installed capacity, resources and research), Risks (R) (ecological, social, economic and political) and Opportunities (O) (associated with policies or rules, existing projects). Each of these variables (11 in total) were categorized into one of four levels: very high, high, medium and low. The prioritized strategies will be those that present great benefits and opportunities, and lower costs and risks.

ii. Expert Identification and Evaluation of Climate Adaptation Options

With the same group of experts the identification and evaluation of alternatives for climate adaptation in the PAs was undertaken. It is important to highlight that all the climate adaptation strategies are targeting at least one Conservation Target in each protected area.

Adaptation strategies for PA Sanquianga- using four prioritization criteria: B (benefits), C (costs), R (risks) and O (opportunities). Note that the following are a small selection of a much more detailed set of results, to give a concrete example to the reader.

PA Sanquianga

Mangrove Forest

Adaptation strategy	*Actions*
1.1. Promoting the sustainable use and conservation of the mangrove ecosystem in PA Sanquianga	1.1.1. Transfer technical capacity of successful projects for reforestation activities.
	1.1.2. Perform reforestation in degraded areas with high potential for success, with community participation.
	1.1.3. Conduct environmental education events in communities on sustainable use and conservation of mangrove ecosystem.

Coastal Basin

Adaptation Strategy	*Actions*
2.1. Identify, develop and implement tools to support management decisions, through forums with scientists, resource managers and other related sectors (Scientific Committee).	2.1.1. Formalize the space of PNN Sanquianga Scientific Committee.
	2.1.2. Plan meetings under the Scientific Committee to develop tools and management actions.
2.2. Increase awareness of the Park team on climate change and skills to design, implement and evaluate programs of adaptation.	2.2.1. Conduct training workshops on issues related to climate change led to the park equipment.
	2.2.2. Promote the exchange of experiences with other areas or institutions that advance related to climate change adaptation work.
2.3. Raise awareness and educate communities protected in conservation and sustainable use of resources area.	2.3.1. Designing educational materials related to the conservation and sustainable use.
	2.3.2. Conduct information seminars in: schools, and fishermen, piangüeras, and local leaders (municipalities), where issues related to sustainable use of resources are addressed.

Sandy Beaches

Adaptation Strategy	*Actions*
3.1. Increase knowledge of the dynamics of the sandy beaches of the Park and associated fauna	3.1.1. Conduct monthly monitoring of the beaches of the park through the profiling method.
	3.1.2. Continued monitoring of loggerhead and Thick-billed plover.
3.2. Perform actions to control and mitigate the impact generated by the cattle pens through maintenance	3.2.1. Community Building enclosures for cattle.
	3.2.2. Seek alternative livestock feeding local forages.

PNN Gorgona

Tropical Humid Forest

Adaptation Strategy	*Actions*
1.1. Generating knowledge for ecosystem management to conserve species diversity	1.1.1. Establish permanent plots to monitor ecosystems and their associated species (amphibians, reptiles, mammals, and insect fauna), considering the zoning of the protected area (La Laguna, Cerro La Trinidad, Path to Yundigua and Palm).

Coral Reefs

Adaptation Strategy	*Actions*
2.1. Continue SIMAC System (Coral Reef Monitoring) monitoring and sampling complemented by climatic variables (SST, salinity, extreme low seas, etc.)	2.1.1. Perform an output per year to implement the methodology SIMAC
	2.1.2. Analyze historical data for monitoring results SIMAC

	2.1.3. To evaluate the effect of climatic variables on the conservation status of coral reefs in the area
2.2. Reduce the pressure on the reefs by human activities	2.2.1. Undertake environmental education and prevention, and continue the conference control and monitoring
	2.2.2. Verifying the probable marketing coral colonies in Buenaventura and other nearby villages
2.3. Implement pilot ecological restoration (REM) as a preventive measure and to generate knowledge of biological reef	2.3.1. Shaping dive sites from coral communities built in the REM process, in order to release natural areas.
	2.3.2. Install a "nursery" of coral reproduction and controlled growth.

Rocky – Coastal Ecosystem

Adaptation Strategy	*Actions*
3.1. Increase knowledge of the rocky coastline of the protected area and ensure their preservation	3.1.1. Set up monitoring to assess erosion and sedimentation rates, and the effects generated in biological communities.
	3.1.2. Start a monitoring program to assess the ecological function of Playa Hole.

Sandy – Coastal Ecosystem

Adaptation Strategy	*Actions*
4.1. Reduce pressure on the assembly of marine turtles Palmeras Playa	4.1.1. Redirect path on the Playa Palmeras (200 m).
	4.1.2. Most vulnerable time and space restriction of access to visitors to the areas of the beach
	4.1.3. Continue to monitor tortoise breeding.
	4.2.2 Continue monitoring dynamics of beaches

Pelagic Ecosystem

Adaptation Strategy	*Actions*
6.1. Strengthen the processes of local and regional management	6.1.1. Generate a proposed ordering of Sanquianga allowing sub-Gorgona affect regional planning and management of fishery resources, and exploration activity / exploitation of hydrocarbons, among other activities.
6.2. Ensure continuous monitoring of the pelagic ecosystem	6.2.1. Describe and assess the impacts of climate change on pelagic biological communities.
	6.2.2. Continue monitoring of physical and biological oceanography, and perform processing and analysis of the collected historical data.
6.3. Reduce the pressure on the pelagic ecosystem by anthropogenic activities	6.3.1. Maintain regulations related to the occasional humpback whales (resolution 1531)
	6.3.2. Strengthen the process of dissemination of good practice diving to observe pelagic and demersal species (groupers, whale sharks, mantas, sea turtles).

5. Conclusions and Recommendations

During this case study, the main issues and outcomes related to the support and strengthening of PA planning and management processes have been highlighted. The following summarizes the main conclusions and recommendations from the process.

Among the lessons learned at this point is that a framework methodology to work on Climate Adaptation in protected areas requires that:

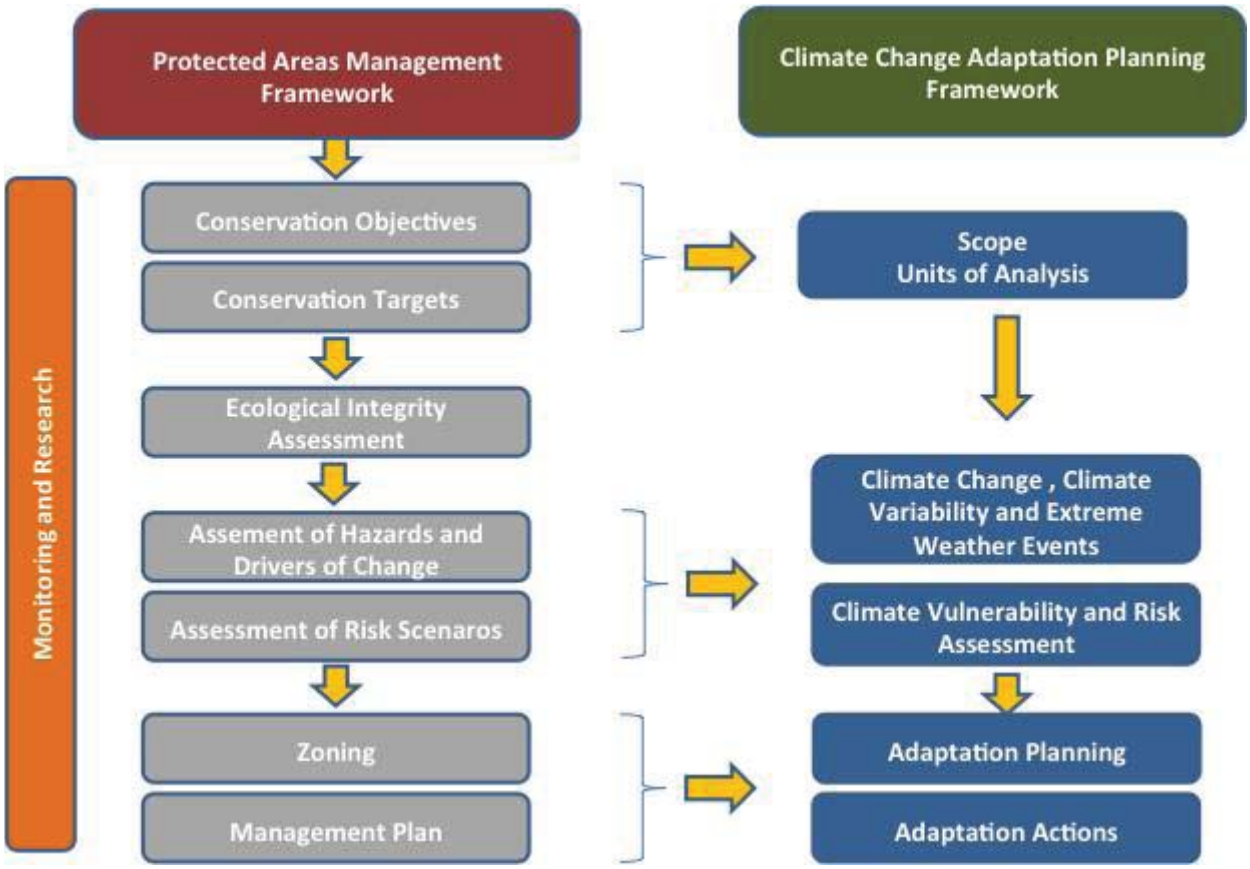
• The units of analysis associated with climatic needs and adaptation priorities should, if possible, be consistent with existing management units.
• The analysis of different pressures and threats are an essential component of the management of PAs. New analysis, such as those associated with Climate Change, should as far as possible, consider findings and recommendations that can be used within existing decision-making schemes.
• The recommendations of climate adaptation actions should not be viewed in isolation from other conservation actions. The best alternative is the integration of the management agenda of climate change within the actions of planning and management of PAs.
• In the case of Colombia, a process to support the management plan of a PA is more successful to

the extent that it bases its analysis and management recommendations as units of analyses using conservation target values.

Framework Methodologies

The first and main conclusion is related to the importance of framework methodologies. The implementation of conservation actions or projects must necessarily anticipate and seek alternatives not only to reach their own objectives, but also how to strengthen existing planning and management schemes of protected areas. One example is the experience of conducting the vulnerability and climate risk analysis and the identification and prioritization of climate adaptation actions, which, in addition to specific methodologies, required a framework methodology to anticipate its utility and use within the overall management scheme of National Parks.

Graphically, a simplified form of a methodology framework, which anticipates the relationship between the current EU funded project and the management plans of PAs Gorgona and Sanquianga:



Assessing and managing the risks of a changing climate

Climate change poses risks for human and natural systems. Moreover, in Colombian PAs climate change involves complex interactions with other hazards and drivers of change, making conservation decision-making a process that needs to balance options, opportunities, constraints, limits, and other aspects associated with socio-ecological conditions.

In this context, the second group of lessons learned is related to how the climate-induced (and oceanographic) threats and corresponding risk scenarios can be integrated, within the scheme of planning and management of PAs. According to the experience of the analysis of climate risk and vulnerability, the following points should be noted:

• From a technical standpoint, the starting point should focus on building a conceptual framework that recognizes that the climate may pose a threat. This also includes ways in which threats of climatic origin, hydro-meteorological or oceanographic can positively or negatively affect the conservation objectives of a PA.
• It is possible to develop an extended exercise of pressure and threat analysis, so that the main drivers of change and possible adverse consequences of PAs are understood.
• Assuming a Climate Risk framework in the management of PAs allows us to work not only with climate change, but also with those threats related to climate variability (i.e. periods of rain and drought intensified by "El Niño" and "La Niña") and lengthy processes due to other climate change phenomena (eg desertification, sea level rise, etc.).

Final Thoughts

The PA management process conducted by National Parks of Colombia is based on the Pressure - State - Response (PSR) developed by the OECD (1993) from the original model proposed by Rapport & Friend (1979). This framework is probably the most accepted worldwide due to its simplicity and applicability to different levels, scales and human activities. Thus, the PSR model has been applied in environmental management of protected areas in Colombia (Pardo, 2002, 2005; Jug, 2011) and construction of management plans in recent years (Ospina, 2010). The PSR model is a framework for organizing simple information at macro level and used as a format for structuring environmental indicators. It involves developing an outline of human actions that cause pressure on natural resources leading to a change in the state the environment to which society responds to with measures or actions to reduce or prevent the impact.

Under this management context, it is noteworthy that there is no simple solution to address the issue of climate change. Whether from a perspective where you intervene at the causes associated with the increase in the concentration of greenhouse gases in the atmosphere (mitigation) or under the initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected effects of a climate change (adaptation), this is a complex problem.

The various manifestations of climate (i.e. temperature, precipitation) have historically had a material effect on protected areas but they have not been incorporated extensively into the options for planning and use.

Finally, recommendations for climate adaptation actions should not be viewed in isolation to other conservation actions. The best alternative is to take a proactive climate adaptation approach to strengthening existing planning and management strategies of protected areas, as has been done in this case.

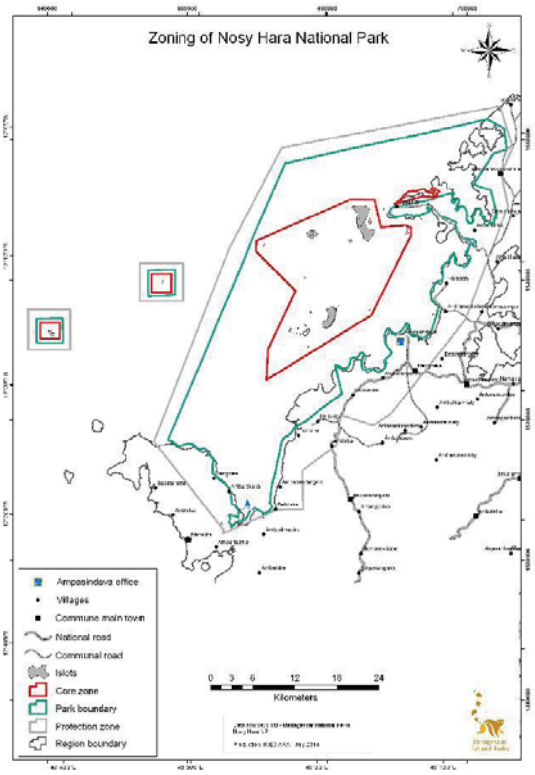
Case study 3
Nosy Hara and Ambodivahive Marine Protected Areas, Madagascar
By Vola Ramahery and Harisoa Rakotondrazafy

I. Introduction

The impacts of climate change in Madagascar are already evident. These have serious implications for the unique biodiversity, natural resources, and human communities, changing both the basic characteristics of the environment and the delivery of ecosystem services on which local communities depend. However, it is widely recognized that protected areas can play an important role, and building their resilience is a crucial strategy to support ecosystems and people in the face of the potential impacts of climate change. Business as usual management practices for PAs will also need to change if they are to support climate change adaptation. However, understanding the links between protected areas and climate change is still limited in Madagascar as is the development of an appropriate strategy to address it. This means that PA managers are in danger of being caught unaware by the negative effects of climate change, and will have no plans to minimize actual and future vulnerability. In this context, with European funding (Implementing Climate Adaptation Strategies in the World's Most Outstanding Natural Places project), WWF International, Colombia, Madagascar and Philippines are implementing adaptation projects in six pilot marine protected areas in order to increase the resilience of coastal ecosystems to maintain the provision of environmental goods and services, and disaster risk reduction to benefit local communities in the face of future climate conditions. WWF Madagascar has focused their work in two MPAs in the northern part of the country: Nosy Hara National Park and Ambodivahibe.

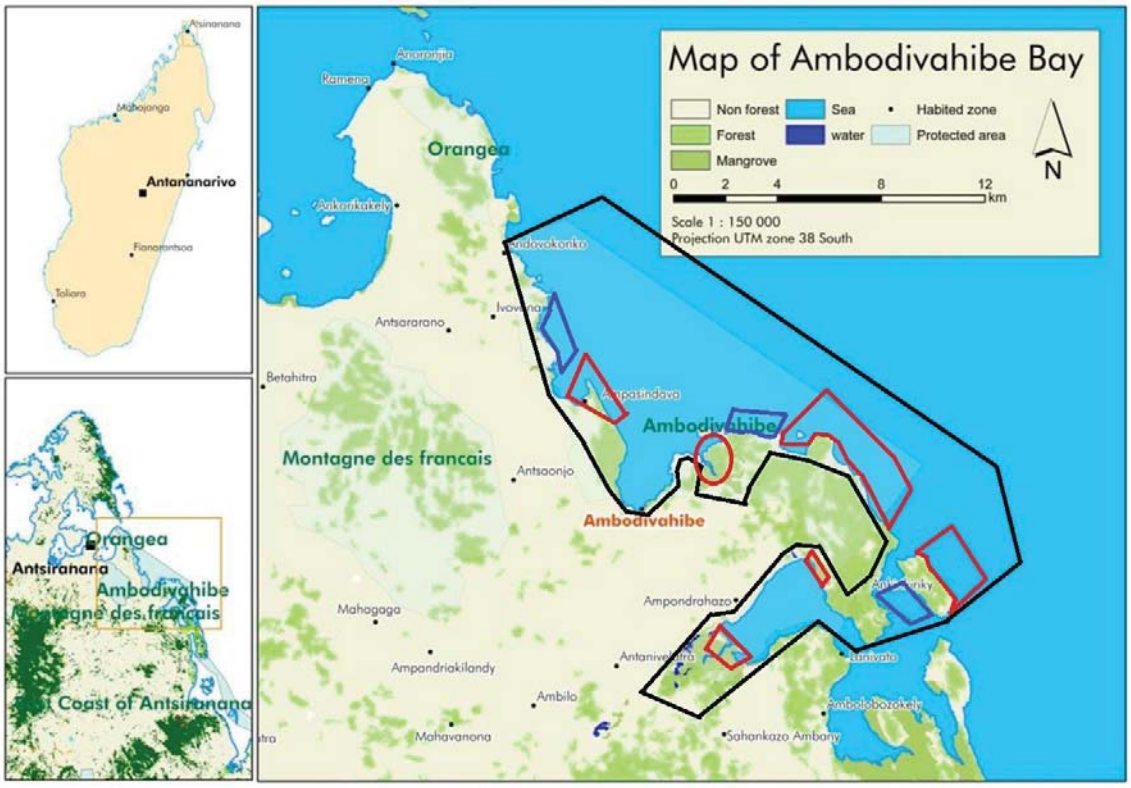
II. Madagascar MPA pilot sites

Nosy Hara National Park lies in the extreme northwest of Madagascar, just below the northern tip and to the west of Antsiranana. The park covers 125,471 ha including a core conservation zone of 32,310 ha and extends from the coast over the continental shelf and small islands further offshore. Established in 2007, Nosy Hara National Park obtained a definitive protection status in 2011. The part is managed by Madagascar National Parks (MNP), a national agency, in close collaboration with local structures (multi-stakeholder orientation and monitoring committees, formed by local communities). The Nosy Hara management plan covers seven primary conservation targets: coral reefs, seagrass zones, mangroves, islets, marine turtles, marine mammals (cetaceans and dugong), and sea and shore birds. The park's total population is about 16,000 inhabitants located in four Communes and thirteen Fokontany (smalles administrative unit). The main anthropogenic threats are: overfishing by using illegal fishing gear, reef degradation by sedimentation, anchoring and trampling, uncontrolled migration, poaching, and illegal logging of mangrove trees. The whole region is increasingly affected by climate change impacts, including sea level rise, changes in precipitation patterns and a higher frequency of extreme events such as cyclones.



Zoning map of Nosy Hara National Park

Ambodivahibe MPA is on the northeast coast of Madagascar, approximately 25 km from Antsiranana. This MPA covers a total of 13,400 ha and is a well-preserved marine environment recognized for its diversity of coral reefs (approximately 281 species), fish species (271 species, 3 endemic of the Indian Ocean), marine birds, bats, molluscs, crustaceans and as feeding area for marine turtles. It is also characterized by the presence of two deep bays, Ambodivahibe and Ampondrahazo, and several small islands spans two rural communes, Mahavanona and Ramena. The bay appears to exhibit a high natural resilience to climate change due to localized upwelling of cooler water, and is thought to have an important ecological role as a source population for surrounding marine ecosystems. The area, proposed for protection by local communities in partnership with Conservation International (CI) in 2007, was awarded temporary protection in 2010. The MPA management plan is being elaborated to obtain definitive protection status. On the social side, there are 1,845 inhabitants living within the MPA. The main threats are: overfishing with illegal fishing gear, reef degradation by sedimentation, anchoring and trampling, uncontrolled migration, poaching, and illegal logging of mangrove trees. Ambodivahibe is vulnerable to climate change related events such as: increase of sea surface temperature, increase of cyclone frequency and intensity, water shortage and increase of wind intensity and duration.



Zoning map of Ambodivahibe

III. Methodology and approach

- Strengthening MPA managers and key stakeholder knowledge on climate change

In 2012, Madagascar MPA managers including MNP and the CI team were trained on climate change adaptation. A regional expert was hired to support the WWF climate change team to provide practical training that would help them integrate CC issues in their respective MPA management tools. All initiatives on climate change adaptation should start with capacity building to ensure a common understanding of climate change concepts by MPA managers. Without sound knowledge on CC, they will not be able to understand its link with their business as usual work, particularly how CC could directly affect MPA targets and/or exacerbate existing threats, and how to address it by relying on the whole MPA management strategy. Practical training tools and material are therefore required to show these interactions.

- Climate change vulnerability assessment (VA)

A VA was undertaken in Nosy Hara and Ambodivahibe from 2011 to 2013 to identify the level of vulnerability of each target and adaptation options that will help strengthen social and ecological resilience. The assessments were focused on Nosy Hara and Ambodivahibe conservation targets including mangroves, coral reefs, traditional fisheries, seabirds, marine turtles and socio-economic aspects and climate related impacts. They were guided by multi-expert processes and carried out in

collaboration with Association Reniala[28] , Blue Ventures[29] , Asity Madagascar / The Peregrine Fund[30], marine turtle and socio-economic experts and the Meteorology Department[31]. Based on the IPCC's definition, methodologies used were mainly focused on the combination of these three elements (exposure, sensitivity and adaptive capacity). Particularly for coral reefs, mangroves, birds and local community analysis, renowned methodologies were used and adapted to the local context. They are respectively: a methodology on resilience assessment developed by Obura & Grimsditch (2009), manual on CC vulnerability and adaptation planning for mangrove systems, developed by Ellison (2012), a framework for Categorizing the Relative Vulnerability of Threatened and Endangered Species to Climate Change" (US EPA, 2009) and climate witness toolkit developed by WWF (2009). Lack of long-term data (climate, ecological and social data) was the key challenge during this work as VA required historical information to better track changes. Key lessons learned from this VA work are as follows:

- Lack of data (climate, bio-ecological and socio-economic) should be not a barrier in doing a VA. It can be updated progressively. As we wait for complete data and information, CC impacts are already difficult to manage.
- Relying on community knowledge is crucial to address this lack of long-term data particularly in a country like Madagascar where this kind of data is missing at local level.
- Using standardized analysis tools (albeit adapted to different target groups) facilitates cross-referencing of individual assessments and the identification of complementary results. The standardization should facilitate comparisons between study sites with Madagascar and elsewhere.
- Links and synergies between all target vulnerability assessments should be established to better understand their interaction.
- A common scale is therefore needed in order to produce an overall MPA vulnerability map and particularly to identify the most vulnerable area within the MPA that merits particular attention.
- VA is a learning-by-doing process, which should involve a multi-expert knowledge.

• Identifying and prioritizing adaptation options

Identification of adaptation options must be built on the outcomes of VAs. For the two MPAs in question, it was undertaken in three steps:

- Step 1: For each VA target (ecological and social), experts in charge of the VA have provided long list of possible adaptation options.
- Step 2: this list was discussed with the MPA managers and stakeholders involved in coastal marine conservation and resource use, as well as other people working on PA issues (national and local authorities, NGOs, etc.) to prioritize those with highest potential to enhance resilience of MPA conservation targets and local people who depend on them.
- Step 3: community consultations to check and validate if those prioritized adaptation options really address local needs, particularly those related to sustainable livelihoods.

Four criteria were used[32] to prioritize relevant adaptation options such as the range of benefits that the adaptation option provides, opportunities that enable its implementation, required costs for its implementation (capacity and resource needs, etc.) and risks at different levels (social, ecological, economic, etc.). Adaptation measures providing multi-benefits, supported by several opportunities,

28 Mangrove expert
29 Fisheries and coral reef expert
30 Bird expert
31 Climate expert
32 CAMPA

lowest implementation cost and lowest associated risks were prioritized. Key lessons learned in this process are mainly:

- Participants should have at least a basic knowledge on climate change adaptation to be able to better participate in the selection of right adaptation options.
- In terms of methodology, a sound understanding of the four criteria, their meaning, ranges and significance, by the participants before the prioritizing process is needed in order to avoid bias during the scoring exercise and to ensure they have the same level of understanding.
- It is advisable to identify in advance the existing development and conservation initiatives in the area so as to choose the adaptation options with highest relevance. It will help to reduce the long list of potential adaptation options and to focus only on the highest priority ones, to avoid redundancy of activities and to ensure complementarity with existing work that will also lower costs.

The main challenges encountered during the climate change adaptation work in Nosy Hara are summarized as follows:

- Low technical capacity and knowledge on climate change adaptation, considering that CC is a relatively new and complex phenomenon.
- Distinguishing anthropogenic pressures from climate change impacts. Both need to be addressed simultaneously given that CC could be a direct threat and/or exacerbate existing threats to social and ecological targets.
- Lack of historical data (including climate, socio-economic and ecological data), which makes the VA challenging. It is useful to have information that reflects changes over time.
- Development of a locally relevant methodology given that there was no standardized methodology for vulnerability assessments.
- Communicating climate change issues to local people has proven challenging. Even though they do not need to understand the scientific aspects of CC, they should be aware that changes are happening and need to be addressed.
- Defining the right approach to integrate CC into existing PA management tools.
- Showing the link between adaptation and the work MPA managers are doing, and stressing how adaptation differs from their regular activities.

Appendix 1: BAVAPA Methodology

Guidance Note on "Basic Vulnerability Assessment Methodology for Coastal and Marine Protected Areas – BAVAPA"

1. INTRODUCTION

BAVAPA - 'BAsic methodology for Vulnerability Assessment of Protected Areas' - has been developed as a rapid vulnerability assessment tool to be included in the Climate Adaptation Methodology for Protected Areas (CAMPA).

BAVAPA was developed in response to the identified need to make available a simple, rapid, 'first-cut' methodology for vulnerability assessments that could be implemented in data or resource poor environments. It is by no means exhaustive as a methodology to assess vulnerability but it has been used successfully in testing to screen targets for further detailed investigation and to provide broad guidance on relative vulnerability and drivers of vulnerability. It is based on the widely accepted understanding about the influencing factors on vulnerability:

VULNERABILITY is influenced by EXPOSURE, SENSITIVITY (which together contribute to POTENTIAL IMPACTS) and ADAPTIVE CAPACITY
It aims to provide broad guidance on the relative and qualitative vulnerability of targets. The scores developed by BAVAPA have no quantitative meaning in themselves but provide: (i) an understanding of the relative vulnerability of a series of targets; and (ii) an understanding of the relative contribution of climate impact and resilience to that vulnerability. The methodology aims to also include consideration of non-climate stressors acting on the targets by carrying out a qualitative analysis of how such stressors could affect climate impacts and resilience. It is important to bear in mind that the methodology is intended to provide a rapid-first pass assessment and therefore involves higher degrees of uncertainty than other more comprehensive methodologies. It is however considered to be a useful tool to prioritize targets for further detailed analysis, or to allow rapid assessments when resources do not allow for more detailed assessments.

BAVAPA is based around a series of checklists and an accompanying series of Excel worksheets that guide the user through an identification of likely climate change impacts and the existing resilience of social and ecological systems to climate change to allow calculation of overall vulnerability. It relies on the initial steps of CAMPA to define scope, objectives and targets before commencing application of BAVAPA.

2. OVERVIEW OF STEPS IN THE BAVAPA METHODOLOGY

3. DETAILED GUIDANCE AND CHECKLISTS METHODOLOGY PARTICIPANTS & SETTING

The BAVAPA methodology is designed to be applied in a participative manner in a workshop or group setting. The participants in methodology application could include representatives from the following groups: PA managers; experts with knowledge of social, ecological and ecosystem service targets; local community; local authorities; climate specialists; civil society; and private sector interests.
Typically the methodology can be applied in a one-day workshop, however if resources are available a longer workshop could be organized that included a more detailed briefing session for participants on key concepts. It is recommended that participants are provided with background information in

advance of the workshop so that they can come prepared with useful data and information on-hand.

STEP 0: COMPILE SCOPE, OBJECTIVES, TARGETS AND SCENARIOS FROM CAMPA

Application of Steps 1-2 of CAMPA will guide teams through the process of defining the VA scope (geographical and temporal), objectives, and targets and aid them in the development of the baseline, climate and non-climate scenarios. All this information will be required in the application of the BAVAPA methodology so teams should compile this before commencing application of the methodology and ensure that all stakeholders that will participate in the methodology application are familiar with this information.

STEP 1: REVIEW LONG-LIST OF NON-CLIMATE STRESSES ACTING ON THE TARGETS AND SELECT "TOP-FIVE"

For each of the VA targets, the teams should work through the Checklist A: Non-Climate Stressors and, in Worksheet A, list the top five to ten stresses that currently act on each target or that are likely to act on targets in the future. Information for this step can be drawn from the baseline and future non-climate scenarios developed as well as the knowledge of workshop participants. While it is recognized that more than ten stresses may act on any one target, it is necessary to prioritize the influences to carry forward into future stages of the methodology. It may be useful to form small groups for this step to allow different groups to work on different targets. Note that the checklist is simply a guide for this step and teams should feel free to add, delete or change the items in the checklist as relevant to their circumstances. The narrative section of Worksheet A should be used to provide a short description of each non-climate stressor that can be understood by those not involved in the methodology application.

STEP 2: REVIEW LONG-LIST OF POTENTIAL CLIMATE VARIABILITY OR CLIMATE CHANGE IMPACTS & SCORE "TOP-FIVE" POTENTIAL IMPACTS

Climate variability or climate change impacts are defined as the physical effects on targets resulting from short-term climate variability or longer-term climate change. Such impacts are the result of the interaction of a target's exposure to climate and its sensitivity to climate. The choice of whether the team looks at the impacts of climate variability and/or climate change will depend on the agreed scope of the VA. For each of the VA targets, the teams should work through the Checklist B: Climate Impacts and, in Worksheet B, list the top five to ten impacts that could act on each target. Information for this step can be drawn from the climate scenarios developed as well as knowledge of workshop participants on how targets have reacted to climate stresses in the past or are currently reacting to climate conditions and events. Note that the checklist is simply a guide for this step and teams should feel free to add, delete or change the items in the checklist as relevant to their circumstances. The narrative section of Worksheet B should be used to provide a short description of each impact that can be understood by those not involved in the methodology application.

Once the top five to ten impacts have been identified, the teams should assign them a score between -2 and +2 using the grid below as a guide. The scores should be entered into Worksheet B. The assumptions and uncertainties associated with the application of this step need to be recorded in the narrative section of Worksheet B along with other relevant comments or observations.

CLIMATE IMPACT SCORE	INTERPRETATION
-2	The climate impact in question will be highly beneficial to the target
-1	The climate impact in question will be beneficial to the target
0	The climate impact in question will be insignificant or neutral for the target
+1	The climate impact in question, after consideration of the cumulative effects of all the non-climate stressors will be negative for the target
+2	The climate impact in question, after consideration of the cumulative effects of all the non-climate stressors will be highly negative for the target

This part of the methodology calls for the group to make subjective judgments based on experienced, local knowledge and expert opinion. The broader the group of stakeholders involved in this process, the stronger the resulting informed opinion.

STEP 3: CONSIDER HOW THE NON-CLIMATE STRESSORS COULD AFFECT THE CLIMATE IMPACTS & CALCULATE CUMULATIVE SCORES FOR EACH OF THE IMPACTS

The scale and magnitude of climate impacts can be influenced positively or negatively by interactions with the range of non-climate stressors acting on the target. For example, an identified climate impact of coastal erosion may be negatively influenced, that is increased, by a non-climate stressor of deforestation of mangroves for charcoal production. The aim of this step of the methodology is to discuss and reach consensus on the way that the identified non-climate stressors may affect climate impacts. This step will not provide definitive right or wrong answers, but by carrying it out in a workshop setting with a view of participants it will represent a solid and informed opinion in relation to this issue. To implement this step, consider each of the climate impacts listed in Worksheet B in the context of the non-climate stressors listed in Worksheet A and discuss whether one or more of the non-climate stressors could act to have: (i) a negative effect – i.e. increase the adverse elements of the impact; (ii) have a positive impact – i.e. decrease the adverse elements of the impact; or (iii) a neutral impact – i.e. no effect on the adverse elements of the impact. The aim is to arrive at an overall picture of how each climate impact could be influenced by the full range of stressors that are acting on it. A relative score from -2 to +2 for each impact should be entered into Worksheet B using the guide below. The Worksheet will then automatically calculate an overall cumulative impact score that takes into account the climate impact score, and the cumulative effect of the non-climate impacts. The assumptions and uncertainties associated with the application of this step need to be recorded in the narrative section of Worksheet B along with other relevant comments or observations.

SCORING OF EFFECT ON NON-CLIMATE IMPACTS	INTERPRETATION
-2	The cumulative effects of all the non-climate stressors will have a highly beneficial influence on the climate impact (i.e. significantly enhance the positive elements of the impact)
-1	The cumulative effects of all the non-climate stressors will have a beneficial influence on the climate impact (i.e. enhance the positive elements of the impact)
0	The cumulative effects of all the non-climate stressors will be insignificant or neutral for the climate impact
+1	The cumulative effects of all the non-climate stressors will have a negative influence on the climate impact (i.e. enhance the negative elements of the impact)
+2	The cumulative effects of all the non-climate stressors will have a highly negative influence on the climate impact (i.e. significantly enhance the negative elements of the impact)

Again this part of the methodology calls for the group to make subjective judgments based on experienced, local knowledge and expert opinion. The broader the group of stakeholders involved in this process, the stronger the resulting informed opinion.

STEP 4: REVIEW LONG-LIST OF ADAPTIVE CAPACITY / RESILIENCE FACTORS ASSOCIATED & SCORE "TOP-FIVE" FACTORS

For each of the VA targets, the teams should work through the Checklist C: Adaptive Capacity / Resilience Factors and, in Worksheet C, list the top five to ten factors associated with each target. Information for this step can be drawn from the knowledge of workshop participants on the inherent characteristics of the targets as well as the surrounding environment as described in the baseline and future non-climate scenarios developed in CAMPA. Note that the checklist is simply a guide for this step and teams should feel free to add, delete or change the items in the checklist as relevant to their circumstances. Once the top five to ten factors have been identified, the teams should assign them a score between -2 and +2 using the grid below as a guide. The scores should be entered into Worksheet C. The narrative section of Worksheet C should be used to provide a short description of each factor that can be understood by those not involved in the methodology application.

ADAPTIVE CAPACITY / RESILIENCE SCORE	INTERPRETATION
-2	The resilience factor in question will be highly negative for the target (i.e. it will act to strongly decrease overall adaptive capacity/resilience)

-1	The resilience factor in question will be negative for the target (i.e. it will act to decrease overall adaptive capacity/ resilience)
0	The resilience factor in question will be neutral for the target (i.e. it will act to will not change overall adaptive capacity/ resilience)
+1	The resilience factor in question will be beneficial for the target (i.e. it will act to increase overall adaptive capacity/ resilience)
+2	The resilience factor in question will be highly beneficial for the target (i.e. it will act to strongly increase overall adaptive capacity/resilience)

Once more, the broader the group of stakeholders involved in this process, the stronger the resulting informed opinion.

STEP 5: CONSIDER HOW THE NON-CLIMATE STRESSORS COULD AFFECT THE RESILIENCE / ADAPTIVE CAPACITY FACTORS & CALCULATE CUMULATIVE SCORES FOR EACH FACTOR

Just as the scale and magnitude of climate impacts can be influenced positively or negatively by interactions with the range of non-climate stressors acting on the target, the characteristics of the targets that give it its resilience can also be affected by non-climate stressors. For example, an identified resilience factor of strong genetic diversity between populations could be negatively affected by a non-climate stressor related to habitat loss that isolates populations and hinders breeding between populations. The aim of this step of the methodology is to discuss and reach consensus on the way that the identified non-climate stressors may affect resilience / adaptive capacity factors of targets. This step will not provide definitive right or wrong answers, but by carrying it out in a workshop setting with a view of participants it will represent the a solid and informed opinion in relation to this issue.

To implement this step, consider each of the resilience factors listed in Worksheet C in the context of the non-climate stressors listed in Worksheet A and discuss whether one or more of the non-climate stressors could act to have: (i) a negative effect – i.e. decrease the degree of resilience; (ii) have a positive impact – i.e. increase the degree of resilience; or (iii) a neutral impact – i.e. no effect the degree of resilience. The aim is to arrive at an overall picture of how each resilience factor could be influenced by the full range of climate stressors that are acting on it. Once this is completed, a score from -2 to 2 should be identified for each factor using the below scale and entered in Worksheet C. The assumptions and uncertainties associated with the application of this step need to be recorded in the narrative section of Worksheet C along with other relevant comments or observations.

RESILIENCE SCORE	INTERPRETATION
-2	The cumulative effects of all the non-climate stressors will have a highly negative influence on the factor (i.e. significantly enhance the negative elements of the factor)
-1	The cumulative effects of all the non-climate stressors will have a negative influence on the factor (i.e. enhance the negative elements of the factor)
0	The cumulative effects of all the non-climate stressors will be insignificant or neutral for the factor
+1	The cumulative effects of all the non-climate stressors will have a positive influence on the factor (i.e. enhance the positive elements of the factor)
+2	The cumulative effects of all the non-climate stressors will have a highly positive influence on the factor (i.e. significantly enhance the positive elements of the factor)

STEP 6: CALCULATE THE OVERALL IMPACT SCORE, THE OVERALL RESILIENCE SCORE, & THE OVERALL VULNERABILITY SCORE

A calculation of the degree of vulnerability of a target is often thought of as the desired end-point of a vulnerability assessment. However, most often vulnerability assessments are the first phase of climate change adaptation planning and in this case, understanding the drivers and components of vulnerability is arguably more important than only identifying an absolute or relative degree of vulnerability. The aim of this step is therefore to determine the overall climate impact score, the overall resilience score and the overall vulnerability score for each target. The first two scores will be particularly important in the latter stages of adaptation planning. All scores are calculated automatically in Worksheet D and the analyses used explained below.

The overall impact score and the overall resilience score are calculated by identifying the median of the range of impact and resilience scores respectively for each target. The median is the preferred statistical tool to use in this case as it represents the middle score for a set of data that has been arranged in order of magnitude.

The overall vulnerability score is calculated by the application of the following formula:

VULNERABILITY = CLIMATE IMPACT (a function of exposure and sensitivity) minus ADAPTIVE CAPACITY / RESILIENCE

This formula is founded in the widely accepted logic that the adaptive capacity / resilience offsets the climate impact.

For each of the scores calculated, the following grill can be used to convert them to a descriptive, qualitative view of vulnerability as the resulting numbers have no real quantitative meaning once they

have been used as tools to allow calculation of the scores. The first table provides an interpretation of overall impact scores and overall AC / R scores, and the second provides an interpretation of overall vulnerability scores.

Interpretation of Overall Impact and Resilience Scores

RESULTING OVERALL IMPACT OR RESILIENCE SCORE	INTERPRETATION FOR OVERALL IMPACT SCORE	INTERPRETATION FOR OVERALL RESILIENCE SCORE
-4 or -3	The target is expected to experience a highly positive climate impact.	The target has very low resilience.
-2 or -1	The target is expected to experience a positive climate impact.	The target has low resilience.
0	The target is expected to experience a neutral or negligible climate impact.	The target has medium level resilience.
+1 or +2	The target is expected to experience negative climate impact.	The target has high resilience.
+3 or +4	The target is expected to experience a highly negative climate impact.	The target has very high resilience.

Interpretation of Overall Vulnerability Scores

SCORE	INTERPRETATION FOR OVERALL VULNERABILITY SCORE
-8 to -6	The target has very low relative vulnerability.
-5 to -3	The target has low relative vulnerability.
-2 to +2	The target has medium level relative vulnerability.
+3 to +5	The target has high relative vulnerability.
+6 to +8	The target has very high relative vulnerability.

It is also important to note that the scores and the descriptive results are relative. That is, they can be used to compare relative vulnerability across targets that have been analyzed using the BAVAPA method in the same workshop / evaluation process. They are not absolute values and thus can not be directly compared to the results of VAs carried out obtained from the application of different methodologies, or even the BAVAPA methodology used in different locations or with different groups.

STEP 7: DOCUMENT THE NARRATIVE (NOTING ASSUMPTIONS AND UNCERTAINTIES) AND PREPARE MAPPING OF RESULTS

The BAVAPA methodology is applied as part of CAMPA. CAMPA's templates to document the narrative, including the assumptions and uncertainties identified in the VA process, and mapping of the VA results are reproduced below and should be used to summarize the outcomes of the BAVAPA methodology. This step can be carried out by the Adaptation Working Group following the workshop but ideally would be sent to workshop participants for comments and revisions prior to finalization.

Template 1. Narrative of BAVAPA Methodology	
Relevant Target(s):	
Key Data Inputs:	
Key Activities / Steps Carried Out:	1. 2. 3. 4. .....
Strengths / Advantages of Methodology:	
Weaknesses / Disadvantages of Methodology:	
Other Comments:	

Template 2. Narrative of Results using BAVAPA Methodology	
Relevant Target(s):	
Zones / targets exhibiting high vulnerability:	
Drivers of high vulnerability for relevant zones/targets (i.e. exposure, sensitivity, resilience drivers):	
Zones / targets exhibiting medium vulnerability:	
Drivers of medium vulnerability for relevant zones/targets (i.e. exposure, sensitivity, resilience drivers):	
Zones / targets exhibiting low vulnerability:	
Drivers of low vulnerability for relevant zones/targets (i.e. exposure, sensitivity, resilience drivers):	
Overall vision of vulnerability and drivers for relevant targets (< 100 words):	

Template 3. Mapping of Results using BAVAPA Methodology	
Relevant Target(s):	
Map Name	Suggested Elements
Baseline map	PA boundaries Geographical scope of VA Villages and human settlements Major drainage, topographical and physical features Administrative boundaries Nearby PAs All ecological targets and limits - note that for species this could include distribution / range / resource use zones as appropriate All social targets and limits Legend, north-point etc.
Areas of high vulnerability	Baseline map Geographical limits of targets with high vulnerability – note that for species this could include distribution / range / resource use zones as appropriate
Areas of medium vulnerability	Baseline map Geographical limits of targets with medium vulnerability – note that for species this could include distribution / range / resource use zones as appropriate
Areas of low vulnerability	Baseline map Geographical limits of targets with low vulnerability – note that for species this could include distribution / range / resource use zones as appropriate
Overall vulnerability	Baseline map Areas of high vulnerability Areas of medium vulnerability Areas of low vulnerability

Template 4. List of Assumptions using BAVAPA Methodology			
Relevant Target(s):			
Assumption	Stage of methodology at which assumption was made	Justification for assumption	Possible influence on VA outcomes or process

Template 5. List of Uncertainties / Data Gaps using BAVAPA Methodology			
Relevant Target(s):			
Uncertainty / Data Gap	Stage of methodology at which uncertainty / data gap arose	Explanation of how uncertainty / data gap was treated	Possible influence on VA outcomes or process

Checklist A: Suggested Non-Climate Stressors[33] [34]

Species Targets	Habitat / Ecosystem Targets	Ecosystem Service Targets	Social Targets
1 Residential & commercial development (1.1 Housing & urban areas; 1.2 Commercial & industrial areas; 1.3 Tourism & recreation areas)			Rapid population growth
2 Agriculture & aquaculture development (2.1 Annual & perennial non-timber crops; 2.2 Wood & pulp plantations; 2.3 Livestock farming & ranching; 2.4 Marine & freshwater aquaculture)			Low population growth
3 Energy production & mining activities (3.1 Oil & gas drilling; 3.2 Mining & quarrying; 3.3 Renewable energy)			Uneven age distribution
4 Transportation & service corridors (4.1 Roads & railroads; 4.2 Utility & service lines; 4.3 Shipping lanes; 4.4 Flight paths)			Income inequality
5 Biological resource use (5.1 Hunting & collecting terrestrial animals (intentional or unintentional use); 5.2 Gathering terrestrial plants (intentional or unintentional use); 5.3 Logging & wood harvesting; 5.4 Fishing & harvesting aquatic resources (intentional or unintentional use))			Limited access to natural resources

33 Adapted from IUCN Threat Classification Scheme http://www.iucnredlist.org/technical-documents/classification-schemes/threats-classification-scheme

34 Adopted from Marshall et al, 2010

6 Human intrusions & disturbance (6.1 Recreational activities; 6.2 War, civil unrest & military exercises; 6.3 Work & other activities)			High dependency on natural resources
7 Natural system modifications (7.1 Fire & fire suppression; 7.2 Dams & water management/use; 7.3 Other ecosystem modifications)			High levels of immigration / outward migration
8 Invasive & other problematic species, genes & diseases (8.1 Invasive non-native/alien species/diseases; 8.2 Problematic native species/diseases; 8.3 Introduced genetic material; 8.4 Problematic species/diseases of unknown origin; 8.5 Viral/prion-induced diseases; 8.6 Diseases of unknown cause)			High level of debt
9 Pollution (9.1 Domestic & urban waste water; 9.2 Industrial & military effluents; 9.3 Agricultural & forestry effluents; 9.4 Garbage & solid waste; 9.5 Air-borne pollutants; 9.6 Excess energy)			Lack of land use titles / landlessness
10 Geological events (10.1 Volcanoes; 10.2 Earthquakes/ tsunamis; 10.3 Avalanches/ landslides)			Lack of access to housing, health, education or other basic social services
Other...			High degree of poverty / low household income
Other...			Female headed household

Other…			Chronic or seasonal food insecurity
Other…			Poor health
Other…			Other…
Other…			Other…

Checklist B: Suggested Climate Impacts

Species Targets	Habitat / Ecosystem Targets	Ecosystem Service Targets	Social Targets
No or low specialized habitat and/or microhabitat requirements	Not located near geographical extent of habitat range		Ability to cope with past climate events
Wide environmental tolerances or thresholds	Wide environmental tolerances or thresholds		Formal and informal support networks
No or limited dependence on specific environmental triggers or cues that are likely to be affected by climate change	High physical diversity (topography, slope, soils, geology, elevations, hydrology etc.)		Ability to cope with change
No or limited dependence on interspecific interactions that are likely to be disrupted by climate change	Rapid regeneration times (inc. keystone species)		Local environmental and climate knowledge and information
Ability to disperse or to colonize a new or more suitable range (genetic / physical)	High biodiversity		Employability / diverse skills / flexibility to change occupation
High reproductive rate	Low fragmentation		Land security
Large population size	Resilient keystone species		Livelihood diversity (current and perceived)
No or limited fluctuations in population size	Physical and genetic ability to disperse		Access to markets, education services / training, health services, clean water & sanitation

Short generation times	Large extent of habitat type		Access to credit
High genetic diversity	Low level of habitat fragmentation		Level of education of household head
Other…	Other…		Food / seed reserves
Other…	Other…		Financial reserves
Other…	Other…		Physical isolation
Other…	Other…		Access to new technologies
Other…	Other…		Low degree of physical isolation
Other…	Other…		Sales points for agricultural products / fishing supplies
Other…	Other…		Governance arrangements for equitable access to resources
Other…	Other…		Other…

Appendix 2: Glossary of terms

Adaptation is defined by the IPCC (2007) as the process of developing and implementing measures to reinforce the resilience and adaptive capacity of systems, to assist them to adjust to the effects of climate change, to moderate potential damages, take advantages of opportunities or cope with consequences.

Adaptive capacity is defined by the IPCC (2007) as the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

Climate change is defined in the UNFCCC (1992) as a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.

Climate hazards are threats that have the potential to harm people and places. Cutter et al (2009) categorize climate hazards into two classes: (i) sudden onset hazards that appear rapidly but last for a short time these are also referred to as extreme climate events or natural disasters and examples include flooding or cyclones; and (ii) chronic hazards that are slow onset events that are barely perceptible on a day to day level and that affect populations incrementally. With such hazards it is not until some tipping point is reached that they transcend into disasters. Examples include droughts or sea level rise.

Climate is defined by the IPCC (2007) as the "average weather", or more rigorously, as the statistical description of the weather in terms of the mean and variability of relevant quantities over periods of several decades (typically three decades as defined by WMO). These quantities are most often surface variables such as temperature, precipitation, and wind, but in a wider sense the "climate" is the description of the state of the climate system.

Climate manifestation is the physical outcome of climate variability or climate change. For any future climate, there will be a range of different climate manifestations – e.g. changes in temperature, changes in rainfall, changes in intensity of storms, changes in sea levels.

Climate threshold is defined by UNEP (2009) as the point at which external forcing of the climate system triggers a significant climatic or environmental event which is considered un-alterable, or recoverable only on very long timescales.

Coral bleaching is defined by UNEP (2009) as the paling in colour of coral which occurs if a coral loses its symbiotic, energy providing organisms.

Corals are defined by UNEP (2009) as the common name for the Order Scleractinia, all members of which have hard limestone skeletons, and which are divided into reef building and non-reef building, or cold and warm water corals.

Ecosystem service is defined by the Millenium Ecosystem Assessment (2005) as a benefit people obtain from ecosystems.

El-Nino Southern Oscillation (ENSO) is defined by UNEP (2009) as systematic and re-occuring patterns of the ocean-atmosphere system in the tropical Pacific having important consequences for

weather around the globe.

Indicators are defined by Cutter (2009) as quantitative measures intended to represent a characteristic or a parameter of a system of interest.

Inter-tidal Zone is defined by UNEP (2009) as an area of the foreshore and seabed that is exposed to air at low tide and submerged at high-tide, or the area between tide marks.

Mangroves are defined by UNEP (2009) as shrubs and trees of the families Rhizophoraceae, Acanthaceae, Lythraceae and Arecaceae or the subfamily Pellicieraceae (family Tetrameristaceae) that grow in dense thickets or forests along tidal estuaries, in salt marshes, and on muddy coasts.

No-regrets measures are defined by the IPCC (2007) as measures whose benefits—such as improved performance or reduced emissions of local/regional pollutants, but excluding the benefits of climate change mitigation—equal or exceed their costs. They are sometimes known as "measures worth doing anyway."

Ocean acidification is defined by UNEP (2009) as a decrease in pH of the seawater due to an uptake of atmospheric carbon dioxide.

Precautionary principle is defined in the Rio Declaration (1992) as where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation

Resilience is defined by Cutter et al (2009) as the capacity of the population, system, or place to buffer or adapt to changing climate conditions.

Risk is defined by Cutter et al (2009) as the likelihood of incurring harm, or the probability that some type of injury or loss would result from the hazard event.

Scenario is defined by the IPCC (2007) as A plausible description of how the future may develop, based on a coherent and internally consistent set of assumptions about key relationships and driving forces (e.g., rate of technology changes, prices). Note that scenarios are neither predictions nor forecasts.

Sea level rise is defined by UNEP (2009) as an increase in the mean level of the ocean. Eustatic sea level rise is a change in global average sea level brought about by an increase in the volume of the world ocean. Relative sea level rise occurs when there is a local increase in sea level relative to the land, which may be due to ocean rise and/or land level subsidence.

Sensitivity is defined by the IPCC (2007) as the degree to which a system is affected by a climate stimulus

Social vulnerability is defined by Cutter et al (2009) as the demographic or socio-economic factors that increase or attenuate the impacts of climate hazards on local populations. That is the characteristics of the population that influence the capacity to prepare for, respond to and recover from hazards and disasters.

Stakeholder is defined as those parties or individuals that have a direct or indirect interest in the PA and the ecosystem services that it provides from a scientific, conservation, socio-economic and/or political point of view.

Thermal expansion is defined by UNEP (2009) as an increase in the volume and a decrease in the density that results from warming water.

Tropical cyclones are defined as storm systems characterized by a low-pressure center and numerous thunderstorms that produce strong winds and heavy rain. The characteristic that separates tropical cyclones from other cyclonic systems is that at any height in the atmosphere, the center of a tropical cyclone will be warmer than its surroundings. The term "tropical" refers both to the geographical origin of these systems, which usually form in tropical regions of the globe, and to their formation in maritime tropical air masses.

Vulnerability is defined by Cutter et al (2009) as the susceptibility of a given population, system or place to harm from exposure to a climate hazard and which directly affects the ability to prepare for, respond to, and recover from hazards and disasters. The IPCC (2007) defines vulnerability as the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.

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