WWF

MANUAL

INT

2016

THIS REPORT HAS BEEN PRODUCED IN COLLABORATION WITH:

Funded by The European Union

# CHANGING TIDES

## Climate Adaptation Methodology for Protected Areas (CAMPA)

## Coastal and Marine

**Climate Adaptation Methodology for Protected Areas (CAMPA):**
**Coastal and Marine. Changing Tides.**

**Authors:** Alexander Belokurov (project coordinator), Luz Teresa Baskinas, Ricky Biyo, Alison Clausen, Nigel Dudley, Oscar Guevara, James Lumanog, Harisoa Rakotondrazafy, Volanirina Ramahery, Chrisma Salao, Sue Stolton and Liza Zogib.

**Additional case study authors:** Julio Herrera, Jean Hervé Bakarizafy, Yacinthe Razafimandimby, Maricar Samson

**Suggested citation:** Belokurov A., Baskinas L., Biyo R., Clausen A., Dudley N., Guevara O., Lumanog J., Rakotondrazafy H., Ramahery V., Salao C., Stolton S., Zogib L. 2016 *Climate Adaptation Methodology for Protected Areas (CAMPA): Coastal and Marine.* WWF, Gland, Switzerland. 160pp.

panda.org/campa
#CAMPA

**WWF**
WWF is one of the world's largest and most experienced independent conservation organizations, with over 5 million supporters and a global Network active in more than 100 countries.

WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by: conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

Design by millerdesign.co.uk

Published in 2016 by WWF-World Wide Fund For Nature (Formerly World Wildlife Fund), Gland, Switzerland. 

ISBN 978-2-940529-28-5

Funded by The European Union
Grant No. EuropeAid/DCI-ENV/2010/248-197

This document has been produced with the financial assistance of the European Union. The contents of this document are the sole responsibility of WWF and can under no circumstances be regarded as reflecting the position of the European Union.

# CONTENTS

## ACKNOWLEDGEMENTS


The methodology was field tested in three countries with special thanks to all those involved:

**Colombia:** Parques Nacionales Naturales de Colombia staff, in particular: Julia Miranda Londoño, General Director; Edna Carolina Jarro Fajardo, Protected Area Management and Stewarship Sub-director; Claudia Marcela Sanchez, Planning and Management Coordinator and Juan Ivan Sanchez, Director, Pacific Regional Directorate; Maria Ximena Zorrilla, Park Manager, Gorgona National Park and Nianza Angulo and Jose Arley Loaiza, Park Managers, Sanquianga National Park.
**Madagascar:** Jean Hervé Bakarizafy (Nosy Hara Park Director) and his staff from Madagascar National Parks; Yacinthe Razafimandimby (Regional Marine Coordinator) and his staff from Conservation International
**Philippines:** Hon. Aniano P. Antalan, City Mayor of IGACOS

**We would also like to thank all those who peer reviewed the methodology and commented on earlier drafts:** Angela Andrade (Conservation International Colombia), Cassandra Brooke (formerly WWF International), Maria Claudia Diazgranados (Conservation International), Marianne Fish (WWF Canada), Julio Herrera (Consultant, WWF Colombia), Charlotte Hicks (UNEP-WCMC), Kathy MacKinnon (IUCN WCPA), Huong Thanh Tri Mai (WWF Vietnam), Shaun Martin (WWF US), Luis German Naranjo (WWF Colombia), Martin Nicoll (WWF Madagascar), Judy Oglethorpe (WWF Nepal), Emily Pidgeon (Conservation International), Trevor Sandwith (IUCN), Klaus Schmitt (GIZ Philippines), Martin Taylor (WWF Australia), Carina Wyborn (Luc Hoffmann Institute)

# FOREWORD

There is no longer any doubt that climate change is a reality that we all have to deal with.


Our global conservation community is, and must be, at the front line of a battle against climate change. We must work hand in hand with the many communities – from the high mountains to lowland plains to the coasts around the world – who are, or will be, most affected by the impacts of change.

Apart from tackling climate change at its very root, we are left with no other option than to be pragmatic and support both human and ecological communities adapt to the changes being keenly felt now.

The world's protected areas are not spared from the risks related to a rapidly changing climate. Protected areas are both affected by climate change – and can play an essential and pivotal role in any strategy to help people and nature cope with change and minimise risks for communities all over the world. They, therefore, have become key elements for us to consider, and urgently so.

But like everyone else, the protected area community is struggling to adapt – to understand how to adapt and to get the appropriate tools and assistance to do so. For this reason the Climate Adaptation Methodology for Protected Areas (CAMPA - Coastal and Marine) is so critically important.

I trust that this framework methodology will be used widely within the protected area community in order to make our world's protected areas more resilient to imminent and potentially radical change.

Yolanda Kakabadse
President
WWF International

*"Apart from tackling climate change at its very root, we are left with no other option than to be pragmatic and support both human and ecological communities adapt to the changes being keenly felt now."*



Young villagers of Ambodivahibe Marine Protected Area, Madagascar

# EXECUTIVE SUMMARY


## Climate change poses serious threats to many coastal and marine systems, including those being managed as protected areas.

Yet people responsible for the management of coastal and marine protected areas (CMPAs) do not have to wait and see their sites deteriorate, but can take active steps to minimise the detrimental impacts of climate change. Because many coastal areas are heavily settled by human communities, such actions need to be taken in close cooperation with people living inside or near to the CMPA, which often include fishing communities and tourism operators.

The following manual describes an approach – Climate Adaptation Methodology for Protected Areas (CAMPA): Coastal and Marine – for developing climate adaptation measures in CMPAs. It combines ecosystem and community-based approaches to adaptation and uses a participatory approach that aims to build consensus amongst stakeholders on the actions necessary to address the current and potential impacts of climate change. The methodology is described in detail and three case studies summarise lessons learned from its field-testing in six CMPAs in Colombia, Madagascar and the Philippines. It utilises a series of worksheets to simplify the process of completion and can be applied either in a detailed, data-driven process that will take some time or a shorter, quicker but less rigorous assessment to help make basic decisions about management.

An introductory section provides some background and key concepts. The CAMPA begins by defining the objectives and scope of any approach, then identifies ecological, ecosystem service and socio-economic targets and explains how to collate information on baseline conditions.

The main vulnerability assessment then starts by identifying possible climate and oceanographic manifestations (i.e. weather and climate events) in the area of the CMPA, along with non-climate influences, and develops scenarios looking at likely changes as a result of these various threats. A vulnerability analysis is then carried out: the manual lists various alternative methods and provides a simple assessment approach developed specifically for the CAMPA. Results from whatever vulnerability assessment system is used then undergo validation and prioritisation in a workshop involving a range of stakeholders. The end result will be the identification of potential impacts, categorised by type, plus a long list of possible adaptation actions to address these impacts. The proposals are compared against a checklist of adaptation actions to test for gaps and are further assessed in a second stakeholder workshop, which considers the benefits, opportunities, risks and costs of each from environmental, social and economic perspectives. The workshop aims to develop a priority list of actions for climate adaptation in the protected area. Advice is given on running a workshop and drawing up and checking the resulting adaptation plan. A final section provides guidance on implementation, monitoring and evaluation and adaptive management.

Case studies describe application of CAMPA in the Gorgona and Sanquianga National Protected Areas in Colombia; Nosy Hara and Ambodivahibe Marine Protected Areas in northern Madagascar and two small protected areas in the Island Garden City of Samal in the Philippines.


The manual is backed with extensive reference material and worksheets are provided in electronic format to facilitate use. These, and more information about CAMPA, can be found at panda.org/campa

© Alexander Belokurov

An underwater world in IGACOS marine protected area, the Philippines

# PART I INTRODUCTION

The Climate Adaptation Methodology for Protected Areas (CAMPA) has been developed to help managers of coastal and marine protected areas and other stakeholders adapt to a changing climate.

CAMPA is designed to build the resilience of protected areas and associated ecosystems based on a thorough understanding of their vulnerability to climate change and a participatory agreement on the best ways to respond to these threats. With minor adjustments the methodology could be adapted to terrestrial and freshwater protected areas.

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 Country Office (MDCO) and Kabang Kalikasan ng Pilipinas Foundation, Inc. (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 the following: '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 methodology has been one of the major outputs of this global project and we hope that it can be of use to many protected areas around the world.

CAMPA does two main things:

- It provides practical and scientifically sound guidance to facilitate climate change vulnerability assessments of coastal and marine protected areas (CMPAs).
- Based on an understanding of that vulnerability, it then facilitates decision-making on the most appropriate adaptation actions.

## The climate context

Climate change is creating multiple threats to coastal and marine habitats (Cheung et al, 2009; IPCC, 2014) and on the human societies that live there. Critical issues include sea-level rise and its impacts on coastal habitats (Church and White, 2006); higher water temperatures with numerous side-effects, including coral bleaching (Hoegh-Guldberg et al, 2007) and spread of invasive alien species (Stachowicz, 2002); increased storm events (Palmer and Räisänen, 2008); and the pervasive and still poorly understood impact of ocean acidification (Doney et al, 2008). Effects of climate change that may be specific to CMPAs 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. Climate change also affects ocean currents resulting in major impacts on marine and coastal biodiversity. These climate change issues are serious enough on their own: however they are further exacerbated by existing threats on the marine environment, such as chronic over-fishing and damaging use of fishing technology (Pauley and Alder, 2005); pollution from fossil fuels, persistent pesticides, nitrate, garbage and heavy metals (Islam and Tanaka, 2004); disturbance to marine life from ocean-going vessels (Carlton and Geller, 1993); and catastrophic levels of damage to coastal and inshore habitats such as coastal marshes (Greenberg et al, 2006), mangroves (Farnsworth and Ellison, 1997), coral reefs (Mumby and Steneck, 2008) and seagrass beds (Orth et al, 2006).

People living in these areas face multiple problems from loss of food resources, increasingly disruptive climate conditions, deteriorating ecosystem services and at an extreme, loss of coastal communities due to sea-level rise and storm damage. The poorest people and most vulnerable communities are likely to experience disproportionately large impacts (Reid and Swiderska, 2008).

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 (IPCC, 2007), and certain changes may already be 'locked-in' in the world's marine environments (Soto, 2002).

Important characteristics of CMPAs 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.

**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' (Dudley, 2008).

The definition includes all governance types of protected areas including Indigenous and Community Conserved Areas and other traditional governance, private reserves, co-managed protected areas and government-run protected areas. Marine 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 (Day et al, 2012).

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.

## The role of protected areas in climate adaptation

If properly planned and managed, protected areas (see Box 1) can play a fundamental role in building resilience to the effects of climate change, and ensuring that ecosystems continue to provide essential goods and services to communities and beyond (Dudley et al, 2010). To achieve this, protected area managers need to be able to identify where and how the effects of climate change will be felt, and to develop actions that aim to achieve two inter-related outcomes:

1. **Adaptation for protected areas:** involving actions that aim to increase the resilience of protected areas to current and future climate change thus reducing the likely negative impacts of climate change and optimising potential positive impacts on protected area objectives.

2. **Protected areas for adaptation:** involving actions that seek to integrate protected areas as components in broader landscape or regional level climate change adaptation strategies for communities and ecosystem services (see Box 2).

Protected area managers are increasingly aware 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 CMPAs, 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 poorest and most vulnerable groups, live in low-lying coastal zones and depend on the natural resources or ecosystem services found there.

**Box 2: CMPAs and their response to climate change: the chance of a triple win**

CMPAs provide multiple responses to climate change: at their best they supply a 'triple win' of mitigation, adaptation and additional benefits in terms of biodiversity conservation, social, cultural, and economic returns. They mitigate climate change by conserving marine carbon stores in seagrass, kelp beds, and other forms of marine biomass (Laffoley and Grimsditch, 2009). CMPAs 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 (Dudley et al, 2010). Finally, well planned and managed CMPAs protect biodiversity while at the same time helping human communities through, for example, maintaining fish stocks (Salm and Clark, 2000).

# SAFEGUARDING NATURAL CAPITAL

Coral Garden of Samal, the jewel of IGACOS, a sanctuary that protects different corals and coral formations along with rich marine life.

## 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 do not 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 protected area managers and researchers have been learning from experience over the last few years, both about predicting likely new threats and experimenting with ways in which these could be countered. But this seldom if ever involves a simple checklist of actions; strategies have to be modified for particular situations, to meet stakeholders' needs, and in line with the resources and expertise available. Further modifications will be needed as climate change advances.

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

The methodology has a focus on developing country contexts but could be applied anywhere, and can be tailored to the needs of individual protected areas in terms of data and resource availability. In many cases, adaptation will be applied to whole networks of CMPAs, adding to the complexity of planning and implementation.

## Principles of the methodology

The methodology is focused on the assessment of the climate change vulnerabilities and identification of adaptation options of CMPAs and surrounding human communities. It aims to ensure consideration of critical links between ecological and socio-economic systems particularly in a developing country context where natural resource dependence is typically high, but where data and technical resources are often low. It is based partly on existing and proven methodologies but adds value to these by combining them in a logical framework. The framework approach allows CAMPA to have the flexibility to be implemented in individual protected areas within the context of a country's needs and capacities. The methodology encompasses the following approaches (adapted and expanded from Schroeter et al, 2004; and Ellison, 2012):

**Multi-disciplinary:** considering both ecological and socio-economic systems, and both Western science-based approaches and the traditional knowledge of local people, considering the links between them.

**Participation:** involvement of key stakeholders is emphasised from the outset, including 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 protected area manager, effectiveness depends to a large extent on how these wider stakeholders view management and react to the management plan.

**Holistic approach:** looking at both climate and non-climate influences on systems being investigated.

**Integration of conservation and development:** adaptation efforts that do not integrate ecosystems and communities will have a higher risk of failure.

**Short-term and long-term:** considering 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.

**Risk management:** 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.

**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 (Borrini-Feyerabend et al, 2013). Ensuring good governance is particularly important when a site is undergoing rapid changes that require wide- ranging and challenging responses.

**Scale:** issues of scale are hugely important in the CAMPA approach. While it has been geared towards assessing the vulnerability of individual protected areas, these cannot be viewed in isolation. All protected areas are influenced in one way or another by surrounding areas and threats, particularly when thinking about climate change. Therefore when undertaking CAMPA, responses need to be designed around the scale of the intervention and linked to activities at different scales.

**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 protected area (including a particular focus on local and vulnerable people). Thus tourism activities should include jobs for local people; increased fish stocks from protected areas should benefit local artisanal fishers; and coastal protection should reduce disaster risk for local communities. Equitable benefit sharing involves both consultation with stakeholders and negotiation at a higher level to prevent the richest and most powerful players grabbing most of the benefits.

**Gender issues and climate change:** women's less privileged position often puts them at greater risk from climate change, although sometimes the reverse can be true. More men died than women in Hurricane Mitch in 1998 because of expectations that they led rescue efforts (Blomstrom et al, 2009). These issues need to be addressed, including gender sensitive questions relating to research (Bäthge, 2010), and opportunities for adaptation to help address gender inequality (Chaudhury et al, 2012).

**Other issues of inequity:** it is important to identify and consider other socially-marginalised groups of people within communities (due to caste, age, taboos, or other hierarchical systems) at the outset of the exercise.

**Poverty reduction:** many protected areas are expected to deliver measurable poverty reduction related to the Millennium Development Goals and other poverty initiatives. 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. Poor people are often the most dependent on natural systems – they may not have access to land and may depend on natural resources, or may use natural systems as a safety net if their normal livelihood fails. They also have the lowest capacity to withstand shocks (e.g. from extreme weather events), since they have little or no capital to withstand crop failure, or loss of livestock, or to rebuild houses. They are likely to become more dependent on natural resources during and after shocks. So helping to reduce their vulnerability and build their resilience or help them to adapt to climate change helps to reduce the risk of extra non-climate stresses on natural systems – which in turn helps build resilience of natural systems. While economic benefits can help build poor people's resilience, often a lot more is needed (e.g. empowering under-privileged groups and enabling them to access resources); reducing their exposure to disasters; ensuring better access to health care; etc. The case studies of the Philippines and Madagascar give good examples of where local people were central to the CAMPA exercise.

**Incentives for management:** include grants, micro-finance loans, direct payments, compensation payments, supply of community needs (e.g. a health centre or school) or benefits such as jobs, increased access to natural resources and disaster risk reduction. There are many ways of incentivising and measuring incentives, such as certification and stewardship schemes. However, incentives need not be financial. Local communities often respond positively to conservation needs if these do not directly undercut their livelihoods, but this implies time spent on explanation and building support.

**Communication, capacity building and awareness-raising:** to inform people of proposed management changes so 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 by personal contact; but other methods include posters, letters, email, website and text messages, tailored to types of communication used in the communities. Lessons learned need to be told to other protected areas: staff exchanges and visits can help. What did not work is as important, sometimes more important, than what worked.

**Advocacy and policy:** advocacy that includes both protected area managers and local communities demanding the same changes is far more powerful than a protected area or NGO working alone. Supportive policy initiatives 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, protected area adaptation plans must be integrated in policy frameworks to ensure implementation and long-term effectiveness.

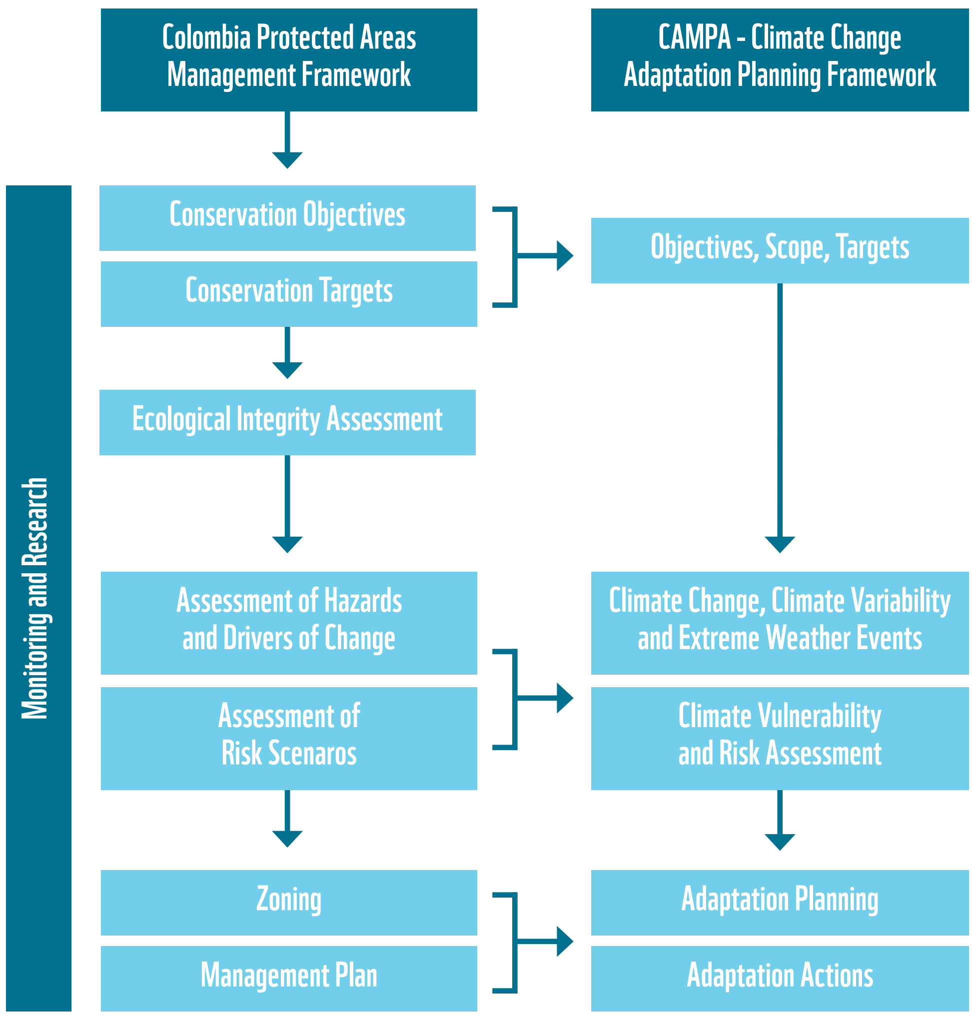
**Monitoring and evaluation:** a good monitoring system is one of the most important elements of success in conservation and adaptation projects and the major source of information to facilitate adaptive management. Some aspects of monitoring need to be driven by experts but many can and should involve 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.

## Mainstreaming CAMPA

It is important to think about mainstreaming right from the outset of the CAMPA process. Protected area managers have a lot of things to think about, to monitor and to implement. Therefore integrating the CAMPA process within existing actions and management planning processes is critical to ensuring that adaptation programmes continue in the long term (Morrison, 2011). Showing how climate-smart conservation can be achieved in any context will be a key output of the CAMPA experience. In particular, CAMPA actions and plans need to be integrated into the protected area management plan/system, the monitoring protocols and into annual work plans, so that they become a central focus of everyday management rather than a stand-alone project. If the management plan is due for renewal, it should be easy to integrate CAMPA results, but in the event that the plan already has some years to run, managers may need a special exercise to integrate the results. An example of the mainstreaming process developed in Colombia is illustrated in Figure 1.

*Figure 1: Mainstreaming climate adaptation in Colombia*



**Policy**
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 protected area. Mainstreaming these experiences into local or national policy is a common aim of projects funded by external donors, while government-backed processes also generally include lessons-learning. Getting these messages across to policy-makers is therefore important. Conversely, in other countries adaptation processes 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, and we summarise some issues to take note of in the section below.

*Where climate change adaptation policies already exist:* Many countries have policies aimed at addressing climate change; in some states these will be well-developed and even covered by legislation. In these cases CAMPA needs 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. It will be clear from the case studies that countries have adjusted methods to meet national approaches. The manual should be used in a complementary way with existing policies rather than be applied in opposition to such policies.

*Where climate change adaptation policies are partial or absent:* In other cases, implementing CAMPA 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 the methods described in the manual can be applied in their entirety, noting any changes needed to meet local conditions.

**Outreach**
Once managers and staff are confident that they have developed an optimal approach for a particular place, it is worth publicising this with a range of stakeholders so that it can be used more widely. Some suggestions are given below.

*Local communities:* who should be involved in and can learn about what implementing the CAMPA has achieved through informal meetings, more formal workshops, articles in the press and interviews on local radio stations. The protected area itself can publicise results of CAMPA through signs and exhibitions in headquarter buildings. Developing support for the results 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; these can sometimes be used as a hook for wider discussions about adaptation policies.

© Alexander Belokurov

Children enjoying the clear waters and beaches of IGACOS island in the Philippines

*Within the global protected area community:* through briefings, staff exchanges, conversations with agency heads and via newsletters, magazines and journals with the wider global protected area 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 an adaptation plan has been completed it would be worth inviting staff from any other protected area 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 operators. Understanding what has happened and how it might affect their own way of life is important; if business leaders approve of what the protected area 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 protected area where a successful CAMPA implementation has taken place can be a great photo opportunity for them and for the protected area. 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 PAs 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 adaptation plan and implementation can help to influence the way that a whole country is thinking.

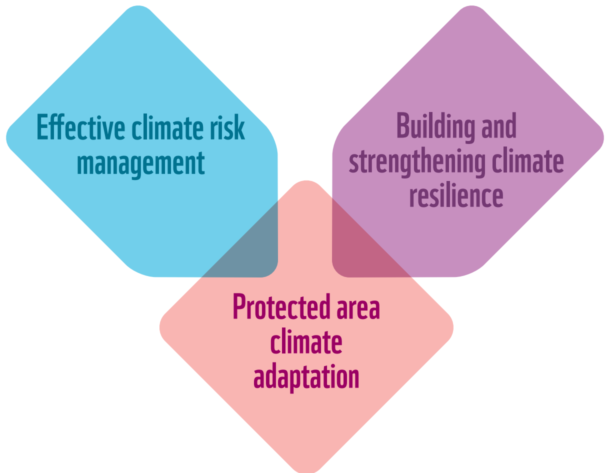
## Key concepts

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, drawing on the latest consensus thinking of climate scientists, particularly as reflected in the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) and in the IPCC report Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (IPCC-SREX, 2012).

**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 the IPCC’s Fourth Assessment Report, AR4 (IPCC-AR4, 2007).

The current definitions of adaptation also distinguish 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 risks 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). The overarching framework of climate adaptation used here is ***managing and reducing current and future climate risks through the design of effective risk management, and by building and strengthening protected areas' resilience through an understanding of both risks and existing adaptive capacity***. Figure 2 illustrates the relationship between the components of climate adaptation planning.

***Figure 2: Simple illustration of elements of climate adaptation***




The term 'climate adaptation' is used here to include both ecosystem-based adaptation and community-based adaptation. This relationship is discussed in Box 3.

**Adaptive capacity:** 'The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences' (IPCC-AR5, 2014).

**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 generally refers 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). Hazards include processes that range from abrupt manifestations, such as severe storms or collapse of fish populations, 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

**Box 3: Ecosystem-based adaptation, community-based adaptation and an integrated approach**

The CAMPA methodology consists of an integration of ecosystem-based adaptation and community-based adaptation, which are both defined below.

**Ecosystem-based adaptation:** the United Nations Environment Programme defines ecosystem-based adaptation (EbA) as follows: 'the use of 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 this context, ecosystem services are defined as the benefits people obtain from ecosystems (UNEP, 2012).

**Community-based adaptation:** refers to adaptation options that are rooted in local community actions; some of these may also involve EbA approaches. CARE International offers the following definition: '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 that people depend on for their livelihoods' (CARE, undated).

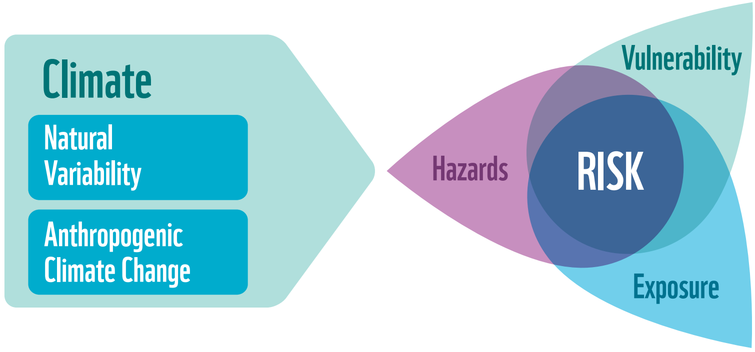
The distinction between these two approaches is increasingly being seen as unhelpful (Girot et al, 2011), and effective adaptation to climate change will require both ecological and community elements if it is to succeed. We therefore refer in general terms to climate adaptation.

Almost all of the actions resulting from climate adaptation could and sometimes are applied for reasons quite apart from climate change: climate adaptation is in consequence 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: if an action is applied as a way to reduce an identified vulnerability to climate, it is climate adaptation.

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). Most approaches to 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 3.

**Disaster Risk Reduction (DRR):** '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). Included in DRR activities are the establishment of effective systems for providing warning against, and planning for, extreme events. For example, following the 2004 tsunami in Asia, many communities have been trained to identify an imminent tsunami and in how best to protect themselves. CMPA managers can develop similar early warning systems for events such as typhoons, hurricanes, extreme tides and sea surges. But DRR can also address

*Figure 3: Simple Illustration of Elements of Climate Risk (Adapted from IPCC – SREX & AR5)*




gradual disasters such as declining fish stocks or a degrading coral reef. A monitoring system can include 'triggers' to stimulate a response: if fish catches fall 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.

**Exposure:** Is defined in this context as 'The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected' (IPCC-AR5, 2014).

**Resilience:** Is defined as 'The capacity of an ecological or socio-economic system to absorb disturbance and reorganise while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks' (IPCC-AR5, 2014, drawing on Holling, 1973).

**Sensitivity:** Is defined in this context as 'The degree to which a system or species is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g. a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g. damages caused by an increase in the frequency of coastal flooding due to sea-level rise)' (IPCC-AR5, 2014).

**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'. See Appendix 1 for a more detailed discussion of this complex issue.

Other important terms are defined in the Glossary in Appendix 1.



Traditional boats on a beach in IGACOS, the Philippines

# PART II USING THE METHODOLOGY

The CAMPA has been designed to be used by a wide range of stakeholders including: CMPA managers; NGOs; community based organisations; and local or national government agencies.

Users should ideally have knowledge of a particular area, but not 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.

The manual aims to help protected area managers and other stakeholders 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 is unnecessary because many good sources of information exist. Instead, it aims to promote a proactive approach to climate adaptation, by providing an overview of options and a way of deciding which combination will be best in any particular situation.

The methodology is presented as a series of steps (see figure 4) that can be used selectively depending on the objectives, and the resources and data available. Where a detailed assessment is required, and where adequate resources and knowledge are available, the manual outlines a comprehensive assessment that applies a range of analytical methodologies to different socio-economic and ecological targets. At the other end of the spectrum, where limited data and resources exist, a simple yet robust method is proposed that relies primarily on expert opinion and local knowledge. It is important that the process you choose makes sense in your own context and in light of ongoing 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 show how this was done in three pilot countries.

## Implementing CAMPA

The methodology involves a mixture of work by specialist groups and at least two well-developed workshops to validate the vulnerability assessment and adaptation plan, involving multiple stakeholders. Before you start, use the checklist to identify the human and technical resources needed. Protected areas will vary in the amount of research and monitoring data available and teams coordinating such exercises will vary in size and resources. Table 1 provides an ideal make-up of this group, not all sites will have all this available – make your own judgement call as to the minimum resources required.

**CAMPA Worksheets**

The methodology uses a series of simple worksheets that need to be filled in throughout the process. Examples from case study areas have been provided to help you along. Additionally, there are checklists, useful tables and links to other resources for further guidance.

CAMPA worksheets are available electronically at panda.org/campa

**Table 1: Checklist of resources for carrying out the methodology**

| **Human Resources – members with an understanding of the following:** |
|---|
| ✓ Climate change, oceanography, hydrology |
| ✓ Biodiversity |
| ✓ Socio-economic issues |
| ✓ GIS analysis (if GIS is being used) |
| **Documents / Data – reference should be made to the following if they exist:** |
| ✓ Any protected area management plans, work plans and related documents |
| ✓ Land-use and other relevant plans |
| ✓ Grey and published literature and reports on protected area conservation targets, monitoring data, management effectiveness assessments, etc. |
| ✓ Grey and published literature on communities and villages in proximity to protected area |
| ✓ Grey and published literature on climate patterns, natural disasters and future climate change projections at the most relevant scale for the protected area |
| ✓ Any other national or site level adaptation plans or vulnerability assessments that could be relevant. |
| **Contact details of stakeholders:** |
| ✓ Government stakeholders |
| ✓ Community leaders / key community stakeholders (e.g. local NGOs, business associations, etc.) |
| ✓ Private sector stakeholders |
| **Materials for the workshop – ideally all of the following:** |
| ✓ Baseline map of the protected area and surrounds in hard copy |
| ✓ Baseline map of the protected area and surrounds in GIS form |
| ✓ Presentation materials, flipcharts, pens, possibly a projector |

**Box 4: What do we mean by 'manager'?**

Throughout the manual we will be referring to managers of protected areas. But what this means differs with the type of protected area. 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 protected areas the term 'manager' may be used more loosely and could include for instance a community council, council of management, a collection of elders, a headman or a cooperative. We use 'manager' here as shorthand but do not imply that every protected area has a single person invested with management decision-making.

- **How much time will it take?**

It is difficult to estimate this since it will differ 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. The framework methodology is flexible in recognition of the fact that users' needs and resources can vary dramatically. We hope that CAMPA gives the user ways to undertake this work ranging from basic to extremely detailed – which can therefore take anywhere from

**Table 2: Adaptation Working Group**

| Members | Details |
|---|---|
| Co-ordinator | Responsible for driving the adaptation planning process, organising meetings, invitations, reports etc. |
| Chair | To be decided strategically, probably best from the local community if this will work, or from the protected area |
| Climate specialist | Ideally someone local, if not it may be necessary to include a climate specialist from further afield (say a university) and have them take part remotely. Needed for technical advice. |
| Protected area representatives | The manager, at least one staff member/ranger (ideally local to the area) and a monitoring officer if one exists |
| Community representatives | Individuals representing different community aspects (e.g. fishing, tourism, women's issues, education) and ideally balancing gender and age |
| Business representatives | Ecotourism companies, guiding, hoteliers, fishing and other relevant businesses |
| Local government | Local council, planning or monitoring division |
| *Note that these are the interests that need to be represented: a single individual may represent more than one. Ideally the group should be no more than 8-12 people.* | |

a month to a number of years. A detailed vulnerability assessment and stakeholder process to choose adaptation options could easily take two years if it involves large-scale data collection, research and analysis. On the other hand, if sites use the simplest approaches outlined here, and rely primarily on existing data or expert judgement, then a useful planning process can take place in a few weeks: both approaches were used in the case studies.

- **Who does it?**

A wide range of stakeholders can have an interest in this type of process and can contribute technical or non-technical information for the analyses. The methods presented here are undertaken in a participatory manner with different stakeholders – including technical, community, and government stakeholders – involved at different stages of the process. Table 2 provides some suggestions for the *Adaptation Working Group* – the term used to describe a team of people who will lead the process from start to finish. It is important to get the composition of this group right to ensure participation.

- **What is needed to run a workshop?**

As a widely participatory process, workshops are an important part of the CAMPA process. Before starting it is useful to think about what is required. At its most basic a workshop requires a place to meet and someone to facilitate. But if the process has more resources, several specialised or adapted bits of equipment can help put across ideas and stimulate conversation. Table 3 lists some options. The structure of the workshop 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.

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. The following addresses some of the common questions that need to be answered.

- **Who comes to the workshops?**

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:

**Table 3: Checklist – Things that can help when running a workshop**

| Basic equipment: |
|---|
| ✓ A meeting place, ideally with some shelter |
| ✓ A meeting facilitator – either protected area 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 |
| **For more formal workshops:** |
| ✓ Source of electricity, adaptors, extensions |
| ✓ 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 protected area |

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 vulnerable groups) and who have the confidence and trust of other members of these groups.

- **What should people expect from workshops?**

Stakeholders need to know the aims and limitations of the process. Don't raise expectations that because protected area managers are listening to opinions this means everyone's ideas can be implemented. But neither should the meeting simply be an airing of views after which everything carries on as before: there needs to be commitment by the protected area to listen and adapt its plans in light of stakeholders' opinions. 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 projected: people can see what is being recorded and comment if they disagree. Circulating a draft of the discussion and recommendations after the meeting – and before finalisation so that people have a chance to comment – 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 get covered. The facilitator must balance the need for full participation with the need to cover all the relevant points. Meetings should start with everybody introducing themselves and explaining their interest in the protected area, then some brief explanations about the protected area, likely climate changes, and identified vulnerabilities.

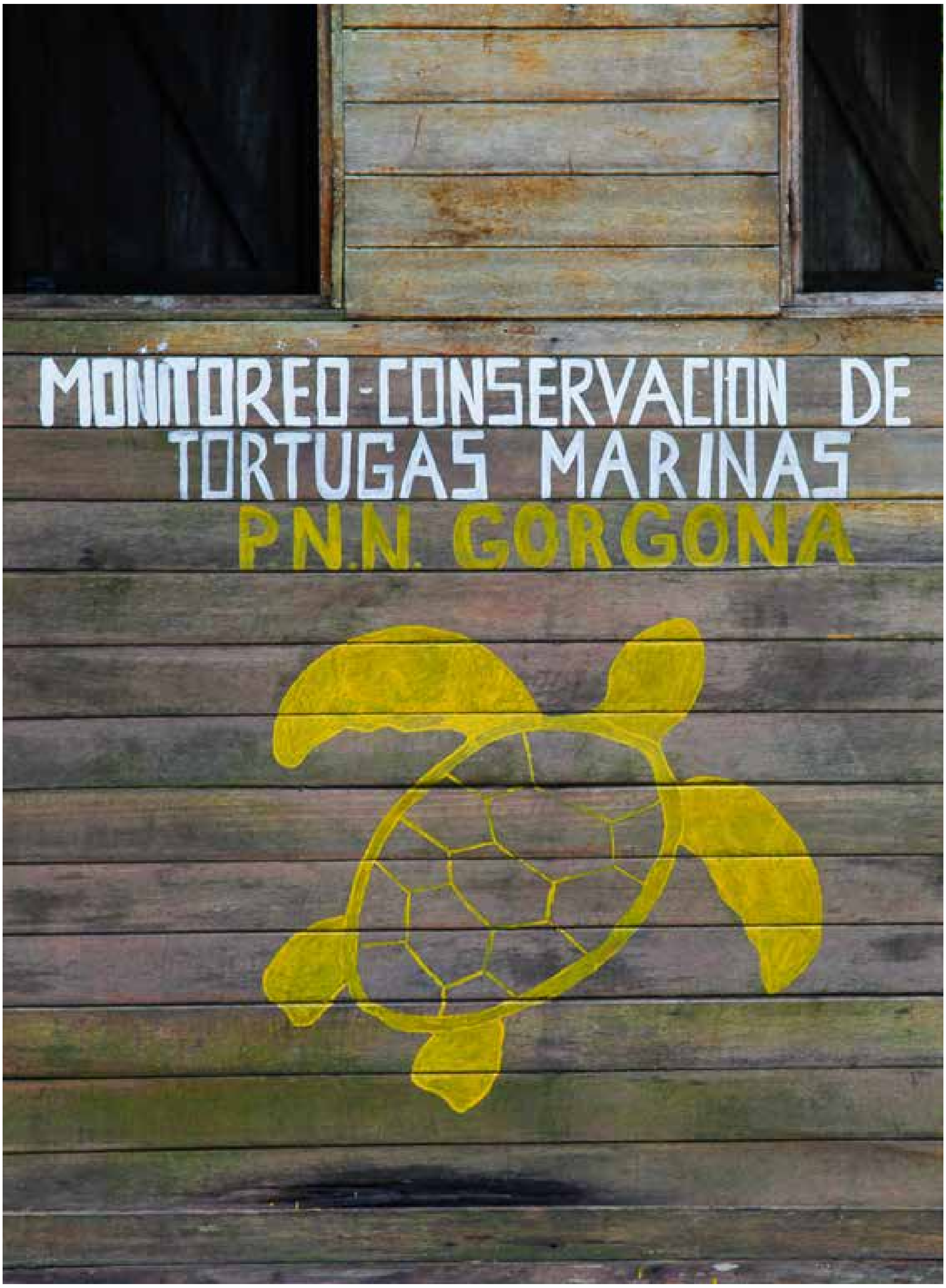
- **How does the workshop reach a decision?**

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. It is important that a disaffected minority does not walk away from the meeting determined to undermine the process; the skill of the facilitator and the attitudes of stakeholders towards the protected area management will help determine how results are perceived.

It will not always be possible to reach a decision in one workshop. Sometimes participants raise questions that it takes time to answer or that need further research. In other cases the protected area is too large, or people too dispersed, to make a single meeting feasible. Different social and cultural groups may have problems interacting. 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.

© Alexander Belokurov

Climate Change Adaptation planning Workshop in Davao city, the Philippines






Scientific monitoring site of marine turtles in Gorgona National Park, Colombia

# PART III
## 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 below.

**Box 5: Structure of CAMPA**

**STEP 1: Identify objectives and scope**
Activity 1.1: Identify objectives and timescale
Activity 1.2: Identify the scope

**STEP 2: Identify targets and baseline**
Activity 2.1: Identify ecological targets
Activity 2.2: Identify ecosystem service targets
Activity 2.3: Identify socio-economic targets
Activity 2.4: Validate, prioritise and map targets
Activity 2.5: Collate background documents and baseline conditions

**STEP 3: Develop non-climate and climate scenarios**
Activity 3.1: Non-climate scenario development
Activity 3.2: Identify possible climate and oceanographic manifestations
Activity 3.3: Climate scenario development

**STEP 4: Vulnerability analysis**
Activity 4.1: Review and prioritise non-climate threats
Activity 4.2: Review potential climate variability / climate change
Activity 4.3: Consider interactions between climate and non-climate factors
Activity 4.4: Review adaptive capacity / resilience factors
Activity 4.5: Consider how non-climate threats affect resilience / adaptive capacity
Activity 4.6: Calculate overall scores
Activity 4.7: Document narrative and map results
Activity 4.8: Detailed vulnerability analysis

**STEP 5: Validate, prioritise and report on vulnerability analysis**
Activity 5.1: Prepare background materials and test confidence in results
Activity 5.2: Validate results with stakeholders
Activity 5.3: Report on vulnerability analysis outcomes

**STEP 6: Assess adaptation options**
Activity 6.1: Identify possible climate adaptation options
Activity 6.2: Assess and refine adaptation options

**STEP 7: Develop and validate adaptation plan**
Activity 7.1: Draw up adaptation plan
Activity 7.2: Validate adaptation plan with stakeholders

**STEP 8: Implement, monitor and adapt management**
Activity 8.1: Implement actions
Activity 8.2: Develop monitoring
Activity 8.3: Practise adaptive management

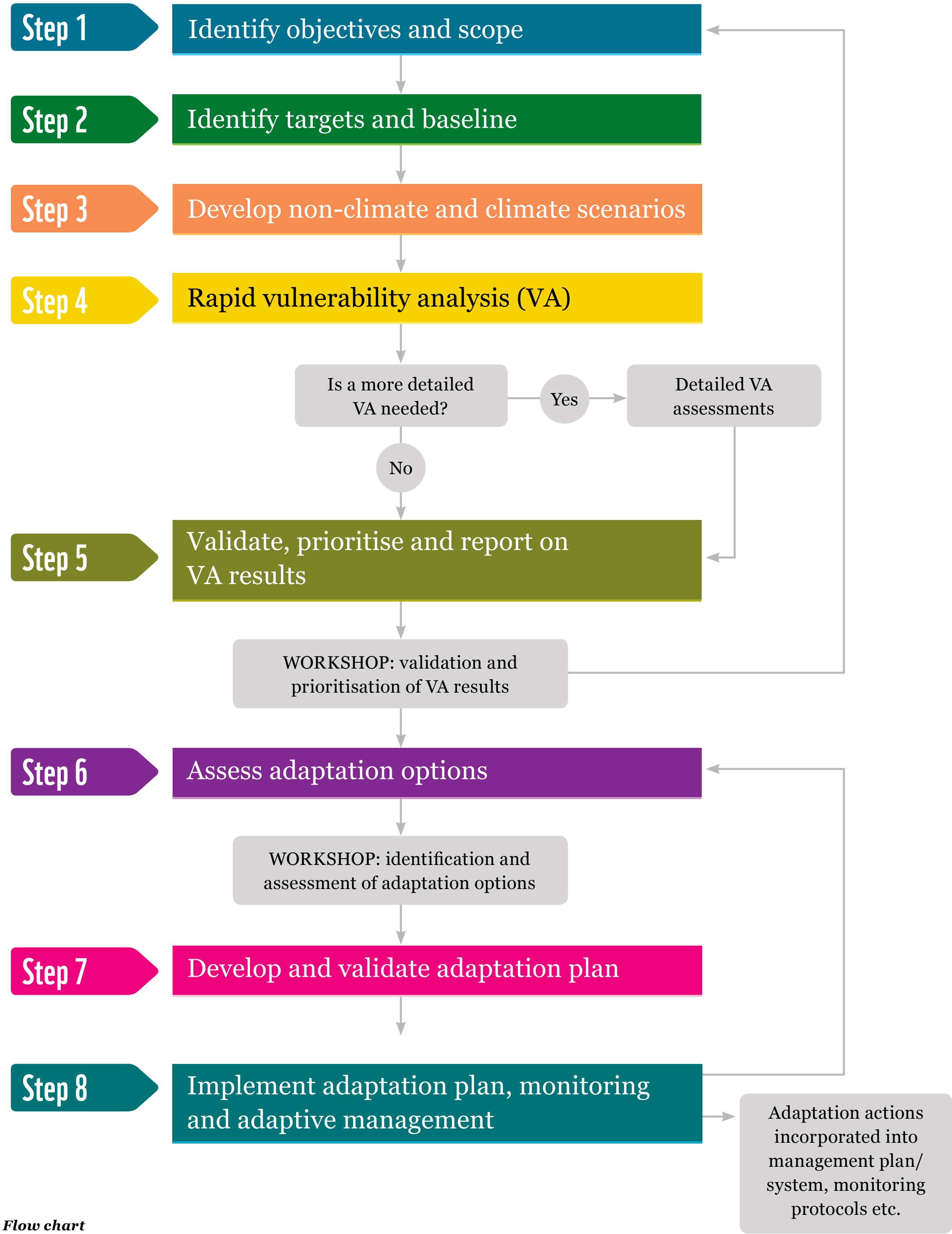



***Figure 4: Flow chart outlining the main steps in the CAMPA methodology***

# STEP 1
## IDENTIFY OBJECTIVES AND SCOPE

Take some time to make sure the whole Adaptation Working Group agree on the reasons why the climate adaptation process is taking place; on what you expect to get out of it; and on roughly how long each objective will take to achieve. Then decide on whether the process is just aimed at the protected area itself or if it extends out to neighbouring areas of land and sea as well.

The ***objectives*** of the climate adaptation process need to be defined at the outset so that they can be used as a guide throughout the process. Many different types of objectives can be identified (see Table 4). 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 use adaptation as a way of engaging a broader range of stakeholders.

Objectives will be influenced by the socio-economic context in which adaptation is taking place, and the presence of any existing adaptation projects. Protected areas containing human communities will often have different priorities than those existing in unpopulated places. Objectives are also likely to be influenced by governance – i.e. by who is in charge of the protected area: a CMPA owned and managed by the government may well have different priorities to an indigenous territory or community conserved area.

**Table 4: Checklist of some potential objectives**

| Some potential objectives of the climate adaptation process |
|---|
| ✓ Incorporation of climate change adaptation into the protected area management plan |
| ✓ Increased capacity of protected area staff in understanding how to predict likely climate change impacts and how to manage for these |
| ✓ Increased awareness and capacity of local communities in relation to climate change |
| ✓ Identifying the vulnerabilities of biodiversity and/or human communities within or linked to the protected area to facilitate future adaptation planning |
| ✓ Identifying priority issues for future adaptation planning for the protected area or the species or ecosystems found in the protected area |
| ✓ Identifying priority issues for future adaptation planning for the local communities in and/or around the protected area |
| ✓ Generation of scientific research on vulnerability of the protected area including a research plan |
| ✓ Development of a monitoring framework for the protected area or local communities |
| ✓ Development of funding proposals for adaptation projects |
| ✓ Communicating issues relating to climate change to local communities and/or visitors |

Adaptation efforts should link to and support existing work, which means understanding and taking account of the history of the site. Adaptation should be integrated with the wider objectives of the protected area. Analysis should show how these objectives are likely to be influenced by climate change and the adaptation responses should help to maintain these values and services.

Once the objectives are fixed, the ***geographical scope*** (physical boundaries) and the ***temporal scope*** (timeframe) need to be defined and mapped. Is the process going to focus on just the protected area and the immediate surrounds or are there linked ecological or social systems (e.g. upstream catchments, urban centres) that need to be included? In terms of the timescale, the Adaptation Working Groups should consider whether to look particularly at the:

- **Short term (0 – 5 years):** for example, if development and implementation of short-term adaptation measures is a key part of the objective, or if the process is going to focus most closely on the effects of short-term climate variability and extreme weather events (note that community adaptation planning tends to be short-term, whereas significant ecosystem impacts may take longer to appear);
- **Medium term (0 – 10 years):** for example, if the process is going to set longer-term strategic priorities in terms of increasing resilience of the site against projected future climate change; or
- **Long term (0 – 20+ years):** for example, if the purpose is for research or long-term monitoring, or planning for very substantial changes (e.g. changing shoreline, translocation of species) in the event of major changes in future decades.

A clear and unambiguous discussion, documentation and communication of the overall objectives and scope between the Adaptation Working Group and key stakeholders is an important first step in the adaptation process, to ensure that all those involved have common expectations.

## 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 area; knowledge of land use and development patterns around the area; knowledge of key stakeholder groups; protected area management plan
- **Expected results:** Documented adaptation objectives; documented and mapped scope of process

## Activity 1.1: Identify objectives and timescale

1. Identify the objectives of the climate adaptation work; Table 4 suggests some examples. Note that a specific objective can include as many elements as necessary for the individual situation.

2. Use the list of objectives to identify an **Overall Objective** for adaptation – a concise objective of one sentence along with up to three more detailed 'specific objectives' and note these in Worksheet 1.

3. Identify a timescale for each objective: how long will it take to achieve the objective?

### Worksheet 1

**Identifying the objectives of climate adaptation and the timescale involved**

| | | Timescale (in years) | | |
|---|---|---|---|---|
| | | 0-5 | 0-10+ | 0-20+ |
| Overall objective | | | | |
| Specific objectives | | | | |
| | | | | |

### Worksheet 1: Example from Sanquianga National Natural Park (NNP), Colombia

**Identifying the objectives of climate adaptation and the timescale involved**

| | | Timescale (in years) | | |
|---|---|---|---|---|
| | | 0-5 | 0-10+ | 0-20+ |
| Overall objective | To identify the vulnerability of conservation targets in Sanquianga and propose adaptation or adaptive management strategies to reduce that vulnerability, which are integrated into the management plan of the protected area | | x | |
| Specific objectives | To incorporate the issue of adaptation to climate change in the management plan of the protected area | x | | |
| | To establish a quantitative baseline of relevant biological parameters for conservation targets most likely to be affected by climate change, against which to monitor future change | x | | |
| | To increase capacity of protected area staff or other organisations working in the protected area in relation to climate change vulnerability assessments | | x | |
| | To increase awareness and capacity of local communities in relation to climate change vulnerability assessments | | x | |
| | To identify focal areas for further detailed analysis. | | x | |
| | To contribute to ongoing national or regional adaptation strategies or related policy processes | | x | |

## Activity 1.2: Identify the scope

1. Identify the geographical scope of the process, filling in Worksheet 2 to work out how far the CMPA has an influence in the immediate vicinity, and therefore how large an area needs to be considered.
2. Use these answers to define the geographical and temporal scope of the process.
3. Using a GIS platform or manual mapping, document the geographic scope of the process on a baseline map of the area

All the factors should be taken into account in defining the geographical scope, if they are present.

### Worksheet 2: Intended scope of adaptation

| Factor influencing the geographical scope of the climate adaptation | If important, give details of location and importance |
|---|---|
| All of the protected area or specific zones (e.g. marine zone in large protected area) | |
| Nearby or connected protected areas | |
| Nearby or connected ecosystems or habitats that are not included in the protected area boundaries | |
| Human communities living in the protected area that depend on the ecosystem services furnished by the protected area | |
| Human communities living near the protected area that depend on the ecosystem services furnished by the protected area | |
| Economic activities / industries / private sector activities that affect or are affected by the protected area | |
| Other factors | |

### Worksheet 2: Example from Nosy Hara National Park, Madagascar

| Factor influencing the geographical scope of the climate adaptation | If important, give details of location and importance |
|---|---|
| All of the protected area or specific zones (e.g. marine zone in large protected area) | Whole protected area |
| Nearby or connected protected areas | No |
| Nearby or connected ecosystems or habitats that are not included in the protected area boundaries | No |
| Human communities living in the protected area that depend on the ecosystem services furnished by the protected area | 13 Fokontany (smallest administrative unit), 4 Rural Communes; about 16,900 inhabitants |
| Human communities living near the protected area that depend on the ecosystem services furnished by the protected area | Seasonal migrant fishermen from different areas of the region, even from other regions |
| Economic activities / industries / private sector activities that affect or are affected by the protected area | Small scale fishery, seafood collectors, ecotourism, cruise ships |
| Other factors | None |

# STEP 2
## IDENTIFY TARGETS AND DOCUMENT BASELINE CONDITIONS

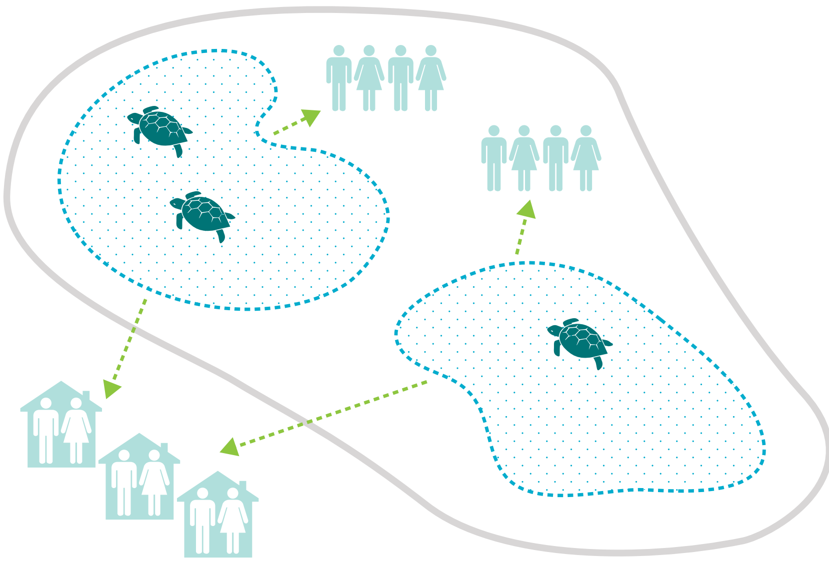
In this step the management 'targets' are identified. They will include species, habitats, ecosystem services and socio-economic targets.

Once the objectives, physical boundaries and timeframe of the CAMPA are agreed, management targets need to be identified. Targets are those items, places or issues that are the main focus of management in the protected area and will be subject to detailed investigation in the vulnerability analysis and, if vulnerabilities are identified, will be subject to climate adaptation. Targets are divided into ecological (species, ecosystems and habitats), ecosystem services and socio-economic targets (Figure 5). Not all processes will necessarily have targets which represent all three. ***Note that most of the targets should already have been identified in the protected area's management plan, assuming that a plan exists***, or may emerge in discussions with stakeholders.

***Figure 5: Schematic illustration of range of protected area adaptation targets***

*Key*

- Ecosystem (e.g.coral reefs)
- Human community / settlement
- Species
- Ecosystem service (e.g. coastal protection or water supply)
- PA boundary



## Identify ecological, ecosystem service and socio-economic targets

- **Purpose:** to document and map the ecological, ecosystem service and socio-economic targets that will be investigated in detail during the process and if necessary will be the focus of adaptation actions
- **Inputs and resources required:** baseline map; protected area management plan; broad data on surrounding socio-economic conditions; initial studies on species or ecosystem vulnerability; understanding of ecosystem services provided by the protected area and importance of protected area resources to local communities
- **Expected results:** documentation and mapping of ecological, ecosystem service and socio-economic targets

## Activity 2.1: Identify ecological targets – species, habitats and ecosystems

The identification of ecological targets recorded in Worksheet 3 should start with the protected area management plan. Species, habitats and ecosystems that are identified as important in the plan (e.g. conservation targets) are obvious choices for consideration. Other ecological targets include habitats and species which may become important from a conservation view point in the future because of increasing non-climate threats; species that may not be identified as conservation targets but are key for the survival of the conservation target species (e.g. prey species); threatening invasive species; or habitats and ecosystems that are outside the protected area but provide important ecological services for local human populations or the protected area itself (e.g. water sources).

The species, habitats and ecosystems that you have listed will form the basis of the initial list of ecological targets for validation and prioritisation in Activity 2.4.

### Worksheet 3: Initial list of ecological targets

| Existing protected area conservation targets: species |
| --- |
| 1. |
| 2. |
| **Existing protected area conservation targets: habitats and ecosystems** |
| 1. |
| 2. |
| **Other species, habitats and ecosystems not listed above** |
| 1. |
| 2. |

| **Worksheet 3: Example from Gorgona NNP, Colombia** |
|---|
| **Existing protected area conservation targets: species** |
| 1. Land snakes community (19 species) |
| 2. Bats community (15 species) |
| 3. Anuran community (7 species) |
| 4. Seabird community: *Pelecanus occidentalis murphy* (brown pelican); *Sula leucogaster etesiaca* (brown booby); *Sula nebouxii* (blue-footed booby); *Fregata magnificens* (magnificent frigatebird) |
| 5. Sea turtle community |
| 6. Demersal fish assemblage |
| 7. Recreational fish (species important to recreational fisheries) |
| **Existing protected area conservation targets: habitats and ecosystems** |
| 1. Freshwater ecosystem |
| 2. Coral formations (reefs) |
| 3. Rocky-coastal ecosystem (rocky shores intertidal) |
| 4. Hard-bottom ecosystem (rocky shores sub tidal) |
| 5. Soft-bottom ecosystem (sub tidal) |
| 6. Sandy-coastal ecosystem |
| 7. Pelagic ecosystem |
| 8. Rainforest |
| **Other species, habitats and ecosystems not listed above** |
| 1. *Stenella attenuata* (pantropical spotted dolphin) |
| 2. *Bradypus variegatus gorgon* (brown-throated sloth) |

## Activity 2.2: Identify ecosystem service targets

The identification of ecosystem service targets for inclusion in the vulnerability analysis and adaptation planning will be based on an understanding of the ecosystem services provided by the protected area that are important for human communities, or for the natural environment within which the protected area is located. Common examples of the types of ecosystem services that could be important 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.

The Millennium Ecosystem Assessment (MEA) provided a typology to identify different types of ecosystem services, and we use this here; see Box 6. Use Worksheet 4 to identify an initial list of ecosystem service targets. As in the case of ecological targets, while it is important to identify and list those already within the management objectives of the protected area, the list should not necessarily be confined to these.

**Box 6: Ecosystem services and related goods from protected areas**

The MEA explains: 'Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services, such as nutrient cycling, that maintain the conditions for life on Earth' (MEA, 2003). Examples of the different types of ecosystem services are shown below.

**Supporting services**

*Services necessary for the production of all other ecosystem services*

• Ecosystem process maintenance
(soil formation, nutrient cycling, primary production etc.)
• Lifecycle maintenance
(nursery habitats, seed dispersal, species interactions etc.)
• Biodiversity maintenance and protection
(genetic, species and habitat diversity)

| **Provisioning services** | **Regulating services** | **Cultural services** |
|---|---|---|
| An ecosystem's ability to provide resources:<br>• Food provisioning<br>• Water provisioning<br>• Provisioning of raw material (timber, wood, fuel, fibre)<br>• Provisioning of medicinal resources / biochemicals (natural medicines, cosmetics, pharmaceuticals etc.)<br>• Provisioning of ornamental resources<br>• Provisioning of genetic resources | An ecosystem's beneficial regulatory processes:<br>• Climate regulation<br>• Natural hazards regulation<br>• Purification and detoxification of water, air and soil<br>• Water / waterflow regulation<br>• Erosion and soil fertility regulation<br>• Pollination<br>• Pest and disease regulation | An ecosystem's non-material benefits:<br>• Opportunities for recreation and tourism<br>• Aesthetic values<br>• Inspiration for the arts<br>• Information for education and research<br>• Spiritual and religious experience<br>• Cultural identity and heritage<br>• Mental well-being and health<br>• Peace and stability |

**Source:** Stolton et al (2015) adapted from MEA (2003)

### Worksheet 4: Initial list of ecosystem service targets

| **Provisioning services** |
|---|
| 1. |
| 2. |
| **Regulating services** |
| 1. |
| 2. |
| **Cultural services** |
| 1. |
| 2. |
| **Supporting services** |
| 1. |
| 2. |

### Worksheet 4: Example from Nosy Hara National Park, Madagascar

| **Provisioning services** |
|---|
| 1. Food from fisheries resources (coral reefs, mangroves) |
| 2. Water (coastal forests) |
| 3. Timber (coastal forests, mangroves) |
| 4. Fuelwood (coastal forests, mangroves) |
| **Regulating services** |
| 1. Water purification (coastal forests, mangroves) |
| 2. Shoreline protection (mangroves)= |
| 3. Storm surge protection (coral reefs) |
| **Cultural services** |
| 1. Funeral, sacred sites |
| 2. Recreational, ecotourism |
| 3. Educational |
| **Supporting services** |
| 1. Primary production |

# SECURING A FUTURE FOR COASTAL COMMUNITIES

Marine Protected Areas of IGACOS are critically important for local communities, securing income from fisheries and providing recreation for the Davao region

## Activity 2.3: Identify socio-economic targets

The identification of socio-economic targets will depend on the context of the protected area and particularly the density and type of surrounding development and human population. Some will likely already have been identified in existing management plans. For the purposes of analysis and subsequent adaptation, socio-economic targets are considered mainly in terms of villages, local communities or small groups of households. Villages that have a strong reliance on the protected area are often suitable choices for particular management targets. These targets could be direct or indirect in terms of the ecosystem services that the protected area provides (e.g. for resource use, coastal protection, and/or economic activity), either where impacts of climate change on the protected area could directly affect livelihoods, or where climate change influences outside the protected area boundaries could change people's resource use and their dependence on the protected area itself.

For each village or group, consider the following questions which may inform the focus of targets (drawn from Wongbusarakum and Loper, 2011; and Marshall et al, 2009):

- Are there demographically vulnerable groups in the village (e.g. poor households, female-headed households, or indigenous households)?
- Do households in the village depend (for subsistence or economic gain) on natural resources and ecosystem services that are potentially vulnerable to climate change impacts?
- Do households in the village have access to natural resources and ecosystem services that are potentially useful and that are potentially vulnerable to climate change impacts (whether or not they are currently exploiting them)?
- Do households in the village have, or could they have, a diverse range of livelihoods and incomes?
- Is there access to climate related information in the village?
- Are villagers aware of climate risks or have they experienced natural disasters in the past?
- Is there equitable access to resources in the village?
- Do the villagers carry out agricultural activities which influence or rely on ecosystem services from the CMPA?
- Is there significant infrastructure in the village that influences, or may be influenced by, ecosystem services from the CMPA?
- Are there formal and informal support networks within the village (e.g. professional associations, women's groups, or local government presence)?

There may be a number of questions where answers are unclear; this is to be expected as many issues will only be investigated in detail during the analysis. Here, employ the precautionary approach and retain the village in the long-list of possible socio-economic targets.

Document the name of the villages or household groups in the first column of Worksheet 5 and in the second column note any relevant comments about possible drivers of vulnerability from discussions of the questions above; such issues will be interesting to re-visit in the technical vulnerability analyses for these targets.

**Worksheet 5: Initial list of socio-economic target groups (i.e. stakeholders who should be involved in the process)**

| Social target group | Why they are identified |
|---|---|
| 1. | |
| 2. | |
| 3. | |

**Worksheet 5: Example from Nosy Hara National Park, Madagascar**

| Social target group | Why they are identified |
|---|---|
| 1. Local communities from coastal villages and Comité Local du Parc (i.e. the local park committee made up of villagers chosen to work with the park managers in patrolling and monitoring activities) | They use the natural resources within the MPA and are affected by extreme climate events. |
| 2. Local authorities (Fokontany, Commune, District, Region) | They represent the State and validate and support activities with appropriate policies. |

## Activity 2.4: Validate, prioritise and map targets

Once the list of possible ecological, ecosystem service and socio-economic targets is 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:

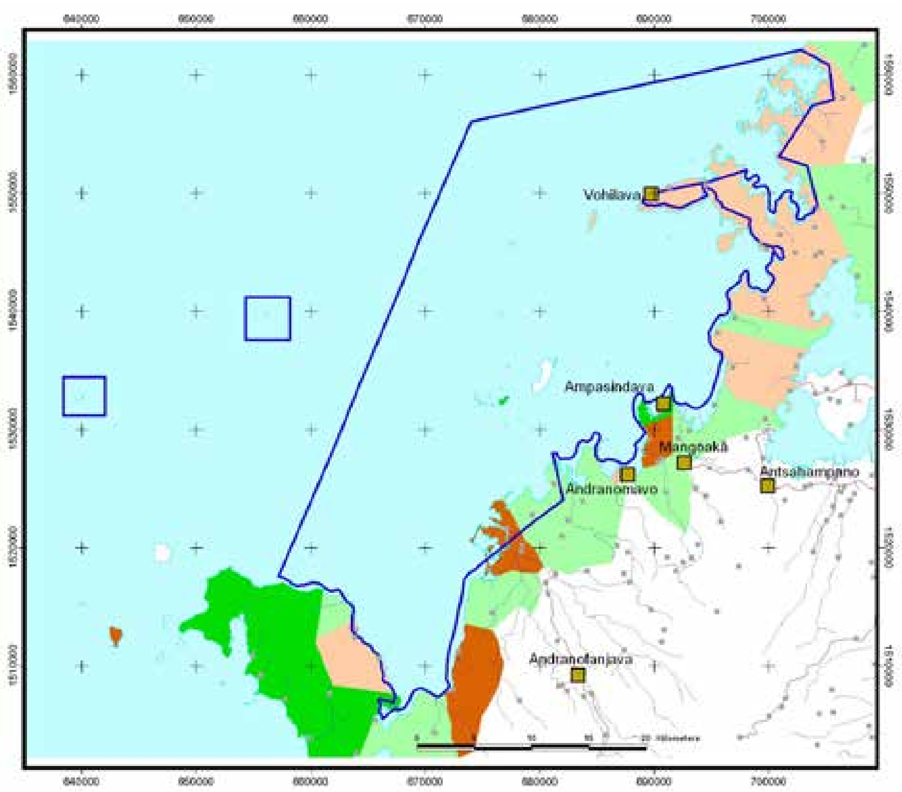
1. How does each target align with the adaptation objectives?
2. Does the process have the resources and the time to address all the targets?
3. Are there some targets that are of a lower priority and could be left for a second stage?
4. Do we have enough information to analyse all the targets or do some targets require further research?
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 service targets and ecological targets? Could any of these targets be combined?
7. Do the protected area managers and staff have the training, resources and capacity needed to undertake adaptation?
8. Are there specific policy or legal aspects that provide constraints or opportunities?
9. Are there particular aspects of the governance of the protected area that will influence the validity and ability to address the selected targets?

It is important to be realistic about the number of targets that can be addressed; probably five to eight is realistic although some projects are much more ambitious. Once validated and prioritised, the targets should be recorded on Worksheet 6 and included in baseline mapping either through a GIS platform or manual mapping (see example in Figure 6). Species and habitats can be mapped by occurrence records, distribution area, or resource use sites (e.g. habitat, feeding, nesting, roosting). Ecosystem services maps could record provisioning ecosystems or the flow paths for ecosystem services. Social mapping can include information such as community or village boundaries the process is working in, ethnic groups or land use. 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.

***Figure 6: Social vulnerability index to drought for Nosy Hara MPA***

*Key*

- Town, village
- River
- MPA Nosy Hara
- Sea
- Very low vulnerability
- Low vulnerability
- Medium vulnerability
- High vulnerability




## Worksheet 6: Prioritised list of targets

| Target groups | List and number targets |
|---|---|
| Ecological targets (species, habitats and/or ecosystems) | 1. |
| | 2. |
| Ecosystem service targets (provisioning, regulating, cultural and/or supporting) | 3. |
| | 4. |
| Socio-economic target groups | 5. |
| | 6. |

## Worksheet 6: Example from Nosy Hara National Park, Madagascar

| Target groups | List and number targets |
|---|---|
| Ecological targets (species, habitats and/or ecosystems) | 1. Birds |
| | 2. Sea turtles |
| | 3. Coral reefs |
| | 4. Mangroves |
| Ecosystem service targets (provisioning, regulating, cultural and/or supporting) | 5. Small scale fishery |
| Socio-economic target groups | 6. Local coastal communities |

## Document baseline conditions

- **Purpose:** to collect data and document baseline conditions on the project area and targets
- **Inputs and resources required:** available data on existing climate, socio-economic, biophysical, ecological, environmental, and governance / institutional conditions in the area.
- **Expected results:** documented baseline conditions of the area and targets and wa bibliography of resources.

## Activity 2.5: Collate background documents and baseline conditions

Collect published and unpublished 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, economic, environmental, and governance issues in the project area bearing in mind in particular the targets (see Worksheet 6). If it helps, Worksheet 7 might be used as a guide to note the details of these documents.

Use Worksheet 8 as a guide to provide a summary narrative of key baseline conditions in the area.

### Optional: Worksheet 7: Background literature

| Author | Date | Title | Publisher | Format/ weblink | Summary | Comments |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |

### Optional Worksheet 7: Example from Sanquianga NNP, Colombia

| Author | Date | Title | Publisher | Format/ weblink | Summary | Comments |
|---|---|---|---|---|---|---|
| Rodríguez-Rubio, E. y S. A. Lopez. | 2006 | Sea-level rise differences on the Colombian Pacific ocean between tide gauges and altimetry data | In: Workshop, Understanding Sea-level Rise and Variability, 6-9 June, 2006, Paris, France. | Poster | Sea-level trends for Tumaco and Buenaventura are near to the global trend reported by over the last decade (1993-2003), which shows that sea level has been dropping in the eastern Pacific | |

### Worksheet 8: Baseline conditions

| Issue | Baseline conditions |
|---|---|
| Climate (average conditions, extreme events, length of time for which data are available) | |
| Biophysical (hydrology, topography, soils, geology, etc.) | |
| Socio-economic (population, age distributions, incomes, livelihoods, poverty, use of natural resources, indigenous peoples, etc.) | |
| Ecological (ecosystems, habitats, species, ecosystem services, etc.) | |
| Environment (pollution levels and sources) | |
| Governance (local and regional structure and roles, land use/ development and other policies, administrative boundaries, plans and planning cycles, legislation, stakeholder groups, etc.) | |
| Environment (key drivers of environmental change in the area) | |
| Other | |



Coco´s beach - a turtle nesting site in Gorgona National Park, Colombia

**Worksheet 8: Example from Gorgona NNP, Colombia**

| Issue | Baseline conditions |
|---|---|
| Climate (average conditions, extreme events, length of time for which data are available) | Between February and April there is a rise in the thermocline (7.5 - 23.7m), with the consequent entry of cold water (<20°C) and high salinity (> 34). In the second period (April-November) there is a deepening of the thermocline (42.8 - 47.0m), warming (> 25°C) and low salinity (<34). In short the months with lower sea surface temperatures (SST) are from January to March, and the months with highest SST are May and June, with minimum / maximum values of 26.4°C and 28.1°C, respectively. The coldest months (environment temperature) are from October to January with values below 23°C and the warmest May and June (> 24°C). Coincident with the colder months (warm) showed lower (higher) precipitation, ranging from 8 to 18mm / day. The rainiest months are observed in this area in May and June, coinciding with the warmer months. The driest month is February (9.5mm / day). During the warm phase of El Niño, the region experienced negative anomalies in rainfall and river discharge decreases, otherwise what happens during the cold phase (La Niña). Similarly, the effects of ENSO vary according to the seasonal cycle, being higher during the period from December to February and weaker during the period from March to May. |
| Biophysical (hydrology, topography, soils, geology, etc.) | Gorgona is a continental island with a strategic location, just 35 miles from the nearest point of the coastline (Point Reyes, Nariño), with maximum depths of 85m. Approximately 90% of the island consists of mafic and ultramafic volcanic rocks; the rest is covered by Tertiary and Quaternary sediments. The maximum height is 338m above sea level on the hill 'La Trinidad'. The high rainfall of Gorgona produces many streams that plunge into the sea, mainly on the eastern side, with about 25 streams during the time of lower rainfall. |
| Socio-economic (population, age distributions, incomes, livelihoods, poverty, use of natural resources, indigenous peoples, etc.) | Gorgona has no full-time resident populations. Its population is seasonal, made up of visitors and staff. |
| Ecological (ecosystems, habitats, species, ecosystem services, etc.) | The island has two of the most diverse tropical ecosystems: coral reefs and tropical rainforest. It also has a high variety of habitats in marine environments such as sandy and rocky areas, depth gradients and terrestrial environments, wooded areas, cliffs, beaches and rocks emerging, enabling the convergence of high biodiversity in a relatively small island. |
| Environment (pollution levels and sources) | One of the major threats to coral reefs is the increased sedimentation generated by the Naranjo channel, on the coast. |
| Governance (local and regional structure and roles, land use/ development and other policies, administrative boundaries, plans and planning cycles, legislation, stakeholder groups, etc.) | Gorgona has presence in Guapi through an office, which allows it to initiate relationship processes to interact with stakeholders at different levels. The main relationship is with the Community Councils of Black Communities of the lower area of the municipality of Guapi (Guapi-Abajo, Guajuí y Chanzará). |


© Alexander Belokurov

Rich biodiversity of coral reefs in IGACOS island, the Philippines

# STEP 3
# DEVELOP NON-CLIMATE AND CLIMATE SCENARIOS

Scenarios describe possible futures, drawing on current conditions and trends to make a best guess at what economic, social and environmental conditions will be like in a few years' time.

Scenarios help to identify what could happen to the management targets identified previously. They can be simple or complicated; the manual describes how to draw up scenarios influenced by climate change and others that focus on non-climate factors

Once the scope and objectives of the process have been identified, targets agreed and baseline conditions understood, the vulnerability analysis (VA) begins. A scenario for the purpose of the VA is a 'possible future' for the project area which has been identified in Step 1.

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' (IPCC, 2001). 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 area. Climate scenarios can be developed in different ways depending on the type of information 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 below.

Climate scenarios provide an overall vision of how the area may evolve in terms of climate conditions and thus inform the technical VA process (Step 4). Climate scenarios can be developed for short-term climate variability and/or longer-term climate change depending on the objectives and timescale of the VA. The climate scenarios that are developed can be improved and modified as you proceed through the VA process and identify additional information.

In order to analyse 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 condition. By understanding the future baseline conditions, the VA can then look at the effects of future climate change to determine the overall future vulnerability.

The climate scientists in your Adaptation Working Group should also be able to help find what information exists in terms of global projections for the selected climate manifestations (see Box 7). Some countries have developed their own climate change projections: national or regionally downscaled projections may be more relevant than global projections and may have greater buy-in from authorities.

**Box 7: 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 *facebook.com/Climascope*
- Climate Wizard – temperature and rainfall *www.climatewizard.org*
- World Bank Climate Change Knowledge Portal – historic and future temperature and rainfall – *sdwebx.worldbank.org/climateportal/*
- IPCC Fifth Assessment Report – *www.ipcc.ch/report/ar5/*
- Global Warming Art – Sea Level Rise Explorer *www.globalwarmingart.com/wiki/Special:SeaLevel*
- Country level national communications to UNFCC – *unfccc.int/national_reports/items/1408.php*
- Country level National Action Programs for Adaptation (NAPA) – *unfccc.int/national_reports/napa/items/2719.php*
- Database of the International Research Institute for Climate and Society (IRI) of the Columbia University – *iridl.ldeo.columbia.edu/*
- Database of the CSAG group of the University of Cape Town – *www.csag.uct.ac.za*

*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' (IPCC, 2001).*

## Non-climate scenario development

- **Purpose:** to develop plausible 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 protected area resources and likely evolution of these threats
- **Expected results:** non-climate scenarios for project area

Most protected areas face a range of non-climate threats that influence the health and integrity of the site, and the chances of it maintaining its ecological and socio-economic values over time. Many of these will interact with and influence climate change impacts; furthermore some non-climate threats may be addressed at the same time (sometimes even with the same actions) as climate adaptation. The next stage therefore builds up non-climate scenarios, to help put the adaptation work into a wider context. Non-climate threats include direct environmental threats such as pollution, land-use change, and land degradation; direct socio-economic influences including population change, livelihood activities and level of income; economic factors including growth of industry; and issues relating to the overall political situation, level of governance and rule of law.

**Box 8: Definition of threat**

Direct threats are the proximate human activities or processes that have caused, are causing, or may cause the destruction, degradation, and/or impairment of biodiversity targets (e.g. unsustainable fishing or logging). Direct threats are synonymous with sources of stress and proximate pressures. Threats can be past (historical), ongoing, and/or likely to occur in the future.

**Source:** cmp-openstandards.org/using-os/tools/threats-taxonomy/

## Activity 3.1 Carry out non-climate scenario development

Based on the Adaptation Working Group's knowledge of the project area, look at each theme and suggested issues in Worksheet 9 and carry out a brainstorming exercise to identify which issues may be important influences in the future evolution of the project area, looking at the same time-scales as have been used in the climate scenarios above.

### Worksheet 9: Non-climate threats to the protected area and surrounding area

| Non-climate threats or potential threats | Likely to be experienced in your area? | | |
|---|---|---|---|
| | Yes | Unknown | No |
| **Environmental threats** | | | |
| Anthropogenic threats in protected area (e.g. resource extraction) | | | |
| Anthropogenic threats near protected area | | | |
| Environmental pollution – water | | | |
| Environmental pollution – soil | | | |
| Environmental pollution – air | | | |
| Deforestation and other conversion of natural ecosystems | | | |
| Land degradation, erosion and loss of fertility | | | |
| Other…. | | | |
| **Social threats** | | | |
| Rapid population change (increase, decrease, or changes in age distribution) | | | |
| Changes in income | | | |
| High level of crime | | | |
| Social, cultural or religious tensions | | | |
| Rapidly changing livelihood strategies | | | |
| Migration in and out of the area | | | |
| Low levels of education including literacy levels | | | |
| High level of unemployment | | | |
| Other…. | | | |
| **Economic threats** | | | |
| Rapid changes to gross domestic product (GDP) | | | |
| Increasing industrial activity | | | |
| Increasing development activity | | | |
| **Policy, legal and governance influences** | | | |
| Unhelpful laws and policies | | | |
| Perverse economic incentives | | | |
| Rapid institutional or structural change | | | |

### Worksheet 9: Example from Nosy Hara NP, Madagascar

| Non-climate threats or potential threats | Likely to be experienced in your area? | | |
|---|---|---|---|
| | Yes | Unknown | No |
| **Environmental threats** | | | |
| Anthropogenic threats in protected area (e.g. resource extraction) | x | | |
| Anthropogenic threats near protected area | x | | |
| Environmental pollution – water | x | | |
| Environmental pollution – soil | x | | x |
| Environmental pollution – air | | | x |
| Deforestation and other conversion of natural ecosystems | x | | |
| Land degradation, erosion and loss of fertility | x | | |
| Etc... | | | |

For issues identified in Worksheet 9 as being important or potentially important, use Worksheet 10 to document historic, current and projected future changes and identify and comment on data sources or reference persons that can be used to gather information on historic, existing or future conditions.

- In the first column note the non-climate issue under consideration.
- In the second column, use published and grey literature on historic conditions, together with the knowledge of protected area managers, and information collected from communities to describe how this issue has evolved in the past.
- In the third column, use advice from natural and social scientists, government authorities or civil society, published or grey literature on environmental and socio-economic projections, or 'best-guess' expert opinion to document likely future changes in conditions for the issue.
- 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 non-climate threats to the protected area and surrounding area

| Threat | Description of historic conditions and recent changes | Expected future changes (based on model outputs, projections and/or temporal analogue approach) | Data sources and comments on quality |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

**Worksheet 10: Example from Sanquianga NNP**

| Issue | Description of historic conditions and recent changes | Expected future changes (based on model outputs, projections and/or temporal analogue approach) | Data sources and comments on quality |
|---|---|---|---|
| Anthropogenic pressures in protected area PA | Currently the main pressures on the PA are: extractive illegal activities, illicit crops, overfishing, forestry and aquatic resource depletion, and mining | No projections on the subject. However, it is likely that all these pressures will intensify | |
| Anthropogenic pressures near PA | Anthropogenic pressures near PA are: increased sedimentation, illegal artisanal and industrial fisheries, oil spill, non-degradable waste on beaches and water column, tourism, resource depletion | No projections on the subject. However, it is likely that all these pressures will intensify | |
| Environmental pollution – water | Sewage from the main towns. Hydrocarbon concentrations constant input to the medium (values above 1.0mg / L), as a result of improper handling of petroleum products used in boats and illicit crops | Due to the mining boom it is likely that water quality will diminish. | The data have limited spatial and temporal coverage. It is necessary to implement a water quality monitoring in Sanquianga NNP |
| Environmental pollution – soil | Illicit crops, mining | Due to the mining boom it is likely that soil quality will diminish.<br>The same situation applies for illicit crops | There is very little information on the subject |
| Land degradation, erosion and loss of fertility | Deforestation, increasing illicit crops, illegal mining | If the felling of mangroves continues, there will be an increase in the rate of sedimentation | It is necessary to know the current sedimentation rates and its future projections |
| Deforestation / clearing | Deforestation caused by poor forest management. Among the causes are: indiscriminate felling of mangroves driven by poverty, lack of economic alternatives and population growth.<br>Illicit crops, Mining | Due to the mining boom an increase in deforestation is likely.<br>The same situation applies for illicit crops | |

Once this information has been collected, it is used to develop one or more non-climate scenarios. 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 uncertainty about the way that environmental, social and economic conditions in the project 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 Worksheet 11.

### Worksheet 11: Non-climate scenarios

| Narrative describing non-climate scenarios | |
|---|---|
| Scenario Name | *Give the scenario a unique identifier that indicates whether it is a low-end, middle of the road or high-end scenario* |
| Spatial and Temporal Limits of Scenario | |
| Key Issues included in Scenario | |
| Scenario Description | *In narrative form describe the possible scenario using qualitative and quantitative data and expert opinion* |

### Worksheet 11: Example from Sanquianga NNP

| Narrative describing non-climate scenarios | |
|---|---|
| Scenario Name | Sanquianga NNP: Scenario 1 – Worst case |
| Spatial and Temporal Limits of Scenario | Sanquianga NNP – 2050 year |
| Key Issues included in Scenario | Anthropogenic pressures in PA, environmental pollution, deforestation, population growth, economic activity |
| Scenario Description | Anthropogenic pressures on Sanquianga will increase. There will be intensified fishing and extractive activities in general (e.g. Piangua, *Anadara tuberculosa*). The population will increase due to high birth rates and the displacement caused by the worsening of social and armed conflict. Similarly, the extent of mangrove cover will decrease due to logging. The increasing expansion of illicit crops (coca) to the header area, the discharge of suspended solids as a result of the activities of the existing population in the region, and waste from fuel and precursors for the production of drugs, will degrade significantly the quality of soil and water, which also will bring great effects to the health of ecosystems. |

## Climate scenario development

- **Purpose:** to discuss and develop plausible climate scenarios for the project area
- **Inputs and resources required:** available climate change projections (e.g. General Circulation Model and regional model results) for the area.
- **Expected results:** climate scenarios for the area

### Activity 3.2: Identify and document possible climate and oceanographic manifestations in the area

Use the Adaptation Working Group’s knowledge on climate variability and climate change projections to identify a list of potential climate and oceanographic manifestations in the project area by marking an ‘X’ in the ‘Yes’ column of Worksheet 9 if a 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 manifestation will not occur in the project area.

Adopt a precautionary approach in this task – if there is any doubt about the future occurrence of a particular climate and oceanographic manifestation then mark ‘Unknown’ rather than ‘No’.

## Worksheet 12: Possible climate and oceanographic manifestations in the CMPA and surroundings

| Climate and Oceanographic Manifestation | Likely to be experienced in your area? | | |
|---|---|---|---|
| | Yes | Unknown | No |
| **Terrestrial Parameters – will climate variability / climate change lead to changes in…** | | | |
| Wind patterns | | | |
| Cyclone / storm frequency | | | |
| Cyclone / storm intensity | | | |
| Sea-level rise | | | |
| Storm surge | | | |
| Rainfall – volume | | | |
| Rainfall – annual patterns | | | |
| Rainfall – intensity | | | |
| Ambient Temperature °C – day time | | | |
| Ambient Temperature °C – night time | | | |
| Heat-wave | | | |
| Drought | | | |
| Flooding | | | |
| Extreme tides | | | |
| Fire | | | |
| Surface water hydrology | | | |
| Groundwater hydrology | | | |
| Coastal erosion through changes to beach profiles or coastal morphology | | | |
| Others… | | | |
| **Oceanographic Parameters – will climate variability / climate change lead to changes in …** | | | |
| Sea surface temperature | | | |
| Sea acidity | | | |
| Upwellings | | | |
| Salinity | | | |
| Extreme waves | | | |
| Solar radiation | | | |
| Sedimentation | | | |
| Chlorophyll | | | |
| Humidity / evaporation | | | |
| Others… | | | |

| Worksheet 12: Example from Nosy Hara National Park, Madagascar | | | |
|---|---|---|---|
| **Climate and Oceanographic Manifestation** | **Likely to be experienced in your area?** | | |
| | Yes | Unknown | No |
| **Terrestrial Parameters – will climate variability / climate change lead to changes in…** | | | |
| Wind patterns | x | | |
| Cyclone / storm frequency | x | | |
| Cyclone / storm intensity | x | | |
| Sea-level rise | x | | |
| Storm surge | | x | |
| Rainfall – volume | x | | |
| Rainfall – annual patterns | x | | |
| Rainfall – intensity | x | | |
| Ambient Temperature °C – day time | x | | |
| Ambient Temperature °C – night time | x | | |
| Heat-wave | | | x |
| Drought | x | | |
| Flooding | | x | |
| Extreme tides | | x | |
| Fire | | | x |
| Surface water hydrology | x | | |
| Groundwater hydrology | | | |
| Coastal erosion through changes to beach profiles or coastal morphology | x | | |
| **Oceanographic Parameters – will climate variability / climate change lead to changes in …** | | | |
| Sea surface temperature | x | | |
| Sea acidity | | x | |
| Upwellings | | x | |
| Salinity | x | | |
| Extreme waves | | | x |
| Solar radiation | x | | |
| Sedimentation | x | | |
| Chlorophyll | | x | |
| Humidity / evaporation | x | | |

Once the list is complete, the identified and potential climate and oceanographic manifestations are described in detail in Worksheet 13 for each climate and oceanographic manifestation identified as 'Yes' or 'Unknown' in Worksheet 12, drawing on the guidance below:

- In the first column note the climate and oceanographic manifestation to which you are referring.
- In the second column, use published and grey literature on historic and current climate conditions and climate variability (referring to Worksheet 8), together with other knowledge that may come from protected area managers, local communities and indigenous people to describe how this climate and oceanographic manifestation appeared in the past and any recent changes that have occurred.
- In the third column, use advice from climate experts, global climate change projections (refer to Box 7), published or grey literature on climate variability, climate change projections, and/or application of the temporal analogue or downscaling approaches to document likely future changes in conditions for the climate and oceanographic manifestation of interest.
- 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 possible climate and oceanographic manifestations in the protected area and surroundings

| Climate and oceanographic manifestation | Description of historic climate conditions, climate variability and recent changes | Projected changes in climate conditions (based on model outputs and/or temporal analogue approach) *Note: can refer to climate **variability** and **change*** | Comments on data source/quality |
|---|---|---|---|
| | | | |
| | | | |

### Worksheet 13: Example from Sanquianga NNP, Colombia

| Climate and oceanographic manifestation | Description of historic climate conditions, climate variability and recent changes | Projected changes in climate conditions (based on model outputs and/or temporal analogue approach) *Note: can refer to climate **variability** and **change*** | Comments on data source/quality |
|---|---|---|---|
| Wind patterns | The seasonal circulation in the Panama Bight has been evaluated by studying the wind field derived from satellite data (Rueda et al, 2007; Devis-Morales et al, 2008), but it is not known whether there has been a change in the zonal and meridional field. No specific data for Sanquianga NNP. | There is no information. | * Rueda, J. G., Rodríguez-Rubio E. and J. R. Ortiz. 2007. Caracterización espacio temporal del campo de vientos superficiales del Pacífico colombiano y el Gofo de Panamá a partir de sensores remotos y datos in situ. Boletín Científico CCCP 14: 49-68.<br>* Devis-Morales, A., Schneider, W., Montoya-Sánchez, R. A. and E. Rodríguez-Rubio. 2008. Monsoon-like winds reverse oceanic circulation in the Panama Bight. Geophysical Research Letters 35 L20607: 1-6. |

## Activity 3.3: Carry out climate scenario development

Once the known and potential climate and oceanographic manifestations have been identified and information on the historical and future climate conditions has been documented, this can be compiled to document relevant climate scenarios. Development of climate scenarios for the project area involves combining projections for a range of climate and oceanographic manifestations. Scenarios can be developed for future climate variability and/or future climate change depending on the timescale of the intended VA. 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, Worksheet 14 should be completed in narrative form.

### Worksheet 14: Climate scenarios (one filled in for each scenario)

| Narrative describing climate scenarios | |
|---|---|
| Scenario name | *Give the scenario a unique identifier e.g. one that indicates whether it is a low-end or high-end scenario* |
| Spatial and temporal limits of scenario | |
| Climate and oceanographic manifestations included in scenario | |
| Climate scenario description | *Describe the possible climate future that would result based on the projections for the considered climate and oceanographic manifestations* |

### Worksheet 14: Example from Colombia

| Narrative describing climate scenarios | |
|---|---|
| Scenario name | Gorgona and Sanquianga NNP: Scenario 1 – Worst case |
| Spatial and temporal limits of scenario | Gorgona and Sanquianga NNP – 2050 year |
| Climate and oceanographic manifestations included in scenario | Air temperature, sea surface temperature, precipitation, and sea-level rise |
| Climate scenario description | By 2050 the air temperature in the area of Gorgona and Sanquianga NNPs will increase by 2°C, which will change the status of wet weather to semi-wet weather. The sea surface temperature will increase by 1°C and rainfall will reduce by 10%, while the sea level will rise 15cm. Additionally, the frequency and intensity of El Niño and La Niña will increase (at least one event every two years), which will generate large imbalances in reproduction and recruitment of marine populations. Taken together, these conditions will generate major changes in coastal ecosystems and communities living in Sanquianga NNP and its area of influence. |



Pelican fishing in Gorgona National Park, Colombia

# STEP 4
# DO A RAPID VULNERABILITY ANALYSIS

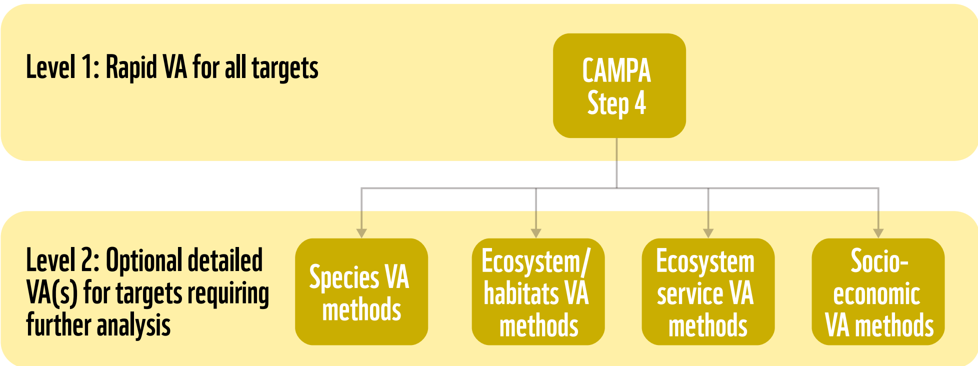
The VA itself can either be a fairly quick and simple process, or a much lengthier series of assessments: the latter will likely be more accurate but will take a lot more time and money. Here we take you through a simple VA method and give you the option to use other more detailed methodologies if you choose.

The IPCC defines vulnerability as comprising a combination of exposure, sensitivity (potential impacts) and adaptive capacity/resilience. In this section, exposure and sensitivity (in terms of non-climatic threats and climate variability) and adaptive capacity and resilience are all assessed. Then the interactions between these are analysed to provide an overall measure of vulnerability.

The next phase of the methodology includes a technical evaluation of the relative climate change vulnerability of the identified targets. The key output is the mapping of vulnerability values and information on the relative vulnerability of the targets for the defined CAMPA timeframe.

The following activities culminate in a basic VA for protected areas. They provide a rapid, practical, 'first-cut' method that applies to a wide range of targets and can be implemented in data-poor situations and/or with limited time and resources. It is not exhaustive, but aims to be robust enough to provide broad guidance and pointers on overall target vulnerability and development of adaptation strategies. If necessary, a more detailed analysis can be carried out for selected targets using one of a series of existing methodologies. Figure 7 illustrates the two levels of analysis.

*Figure 7: Level 1 and level 2 vulnerability analysis method*



## Vulnerability assessment

- **Purpose:** to apply a simple consistent VA methodology to all targets to (i) generate a baseline level of information on the vulnerability of each target; and (ii) optionally screen targets to prioritise those that need further detailed VA analyses.
- **Inputs and resources required:** results of preceding activities; baseline mapping.
- **Expected results:** initial understanding of relative vulnerability of VA targets (i.e. a level 1 VA); list of priority targets needing level 2 VA if a detailed analysis is required.

## Activity 4.1: Review and prioritise non-climate threats to targets

For each target, the Adaptation Working Group should work through the checklist (Table 5) and Worksheet 15. Worksheet 15 generates a list of the top five to ten threats that currently act on each target and/or that are likely to act on targets in the future. For each target identified in column 1 and 2 (which records the number and name of the target) provide a short description of the threat (column 3), record any uncertainties such as lack of data or disagreements regarding the level of the threat depending on stakeholder groups (column 4), add data sources (column 5) and then rank each threat in order of impact on the target, with 1 equalling the highest impact (column 6).

The prioritised list of non-climate threats will be used in calculating climate impacts (Worksheet 16) and adaptive capacity/resilience (Worksheet 17). Information for this step can be drawn from the future baseline conditions and non-climate scenarios as well as expert knowledge. While it is recognised that more than ten threats may act on any one target, it is necessary to prioritise the influences to carry forward into future stages of the methodology. Note that the checklist (Table 5) is simply a guide and Adaptation Working Groups should feel free to add, delete or change the items in the checklist as relevant to their circumstances.

**Worksheet 15: Identification of non-climate threats by target**

| **Target** | | | | | |
|---|---|---|---|---|---|
| **No** | **Target name** | **Threat description** | **Uncertainties** | **Data sources** | **Rank (from 1 which equals the highest impact)** |
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |

**Table 5: Checklist on suggested non-climate threats**

| **Threats to species, habitat / ecosystem targets and ecosystem service targets (adapted from IUCN, undated)** |
|---|
| 1. Residential and commercial development<br>Including: Housi*ng and urban areas; Commercial and industrial areas; Tourism and recreation areas* |
| 2. Agriculture and aquaculture development<br>*Including: Annual and perennial non-timber crops; Wood and pulp plantations; Livestock farming and ranching; Marine and freshwater aquaculture* |
| 3. Energy production and mining activities<br>*Including: Oil and gas drilling; Mining and quarrying; Renewable energy* |
| 4. Transportation and service corridors<br>*Including: Roads and railroads; Utility and service lines; Shipping lanes; Flight paths* |
| 5. Biological resource use<br>*Including: Hunting and collecting terrestrial animals (intentional or unintentional use); Gathering terrestrial plants (intentional or unintentional use); Logging and wood harvesting; Fishing and harvesting aquatic resources (intentional or unintentional use)* |
| 6. Human intrusions and disturbance<br>*Including: Recreational activities; War, civil unrest and military exercises; Work and other activities* |
| 7. Natural system modifications<br>*Including: Fire and fire suppression; Dams and water management/use; Other ecosystem modifications* |
| 8. Invasive and other problematic species, genes and diseases<br>*Including: Invasive non-native/alien species/diseases; Problematic native species/diseases; Introduced genetic material; Problematic species/diseases of unknown origin; Viral/prion-induced diseases; Diseases of unknown cause* |
| 9. Pollution<br>*Including: Domestic and urban waste water; Industrial and military effluents; Agricultural and forestry effluents; Rubbish and solid waste; Air-borne pollutants; Excess energy* |
| 10. Geological events<br>*Including: Volcanoes; Earthquakes/tsunamis; Avalanches/landslides* |
| Other... |
| Other... |
| **Social Targets (adapted from Marshall et al, 2009)** |
| 1. Demographic<br>*Including: Rapid and low population growth; Uneven age distribution; High levels of immigration / outward migration* |
| 2. Natural resources<br>*Including: Limited access to natural resources; High dependency on natural resources* |
| 3. Economic<br>*Including: Income inequality; High level of debt; High degree of poverty / low household income* |
| 4. Well-being<br>*Including: Chronic or seasonal food insecurity; Poor health; Lack of access to housing, health, education or other basic social services; Lack of land use titles / landlessness* |
| Other... |

| Worksheet 15: Example from MPA Gorgona, Colombia | | | | | |
|---|---|---|---|---|---|
| **Target** | | | | | |
| **No** | **Target name** | **Threat description** | **Description & Uncertainties** | **Data sources** | **Rank (1 equals the highest impact)** |
| 1 | Coral Reefs | Extreme low tides | The air exposure of coral colonies during extreme low tide events, generates exposure to solar radiation, desiccation and death of coral polyps. | The coral monitoring, which was undertaken in the protected area 15 years ago, has shown a decrease in live coral cover in shallow areas, which usually remain unobstructed at extreme low tides. Scientific information is generated mainly by the research group for coral reefs of the Universidad del Valle. | 1 |
| | | Sedimentation | Coral reefs are typically located in areas with little sediment discharge. This stressor is considered one of the main obstacles for their growth and development, because it prevents the penetration of light in the water. Given a scenario of increased rainfall and misuse of watersheds, there will probably be an increase in the rate of sedimentation of Sanquianga and Patia rivers, and an adverse affect on the Gorgona corals. | Research projects with coral communities that have directly addressed the issue of sedimentation in coral colonies. | 2 |
| | | Illegal fishing | This stressor refers to unregulated illegal fishing that can be done on coral communities of the NNP Gorgona. As a result, there may be a decrease in the resilience of the community because of the loss of biological and genetic diversity. Fish populations may also be affected due to the extraction of the larger species and individuals as carnivores, which could lead to a collapse in their populations if they are extracted before they reach the average size of sexual maturity. | No data available in Gorgona NNP, since fishing is illegal. | 3 |
| | | Geological events - Earthquakes/tsunamis | This stressor may have implications of great magnitude, although the likelihood of a severe occurrence is low. The main effect would be fragmentation of coral colonies and reef erosion. | No data available. | 4 |
| | | Coral extraction | In 1998 there was a seizure of 800 kg of coral, which was illegally taken from coral reef Azufrada. Although such events have not been recorded since then, is still considered a threat. | | 5 |

## Activity 4.2: Review list of potential climate variability or climate change impacts and score top five potential impacts

Climate 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 Adaptation Working Group looks at the impacts of climate variability and/or climate change will depend on the agreed scope of the VA.
For each of the targets, the Adaptation Working Group should work through the suggested climate impacts checklist (Table 6) and, in Worksheet 16 (note Activity 4.2 and 4.3 are both recorded on Worksheet 16) list the top five to ten impacts (column 3) that could act on each target (listed in columns 1 and 2). Information for this step can be drawn from the climate scenarios developed in Step 3 as well as the knowledge of Adaptation Working Groups 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 Adaptation Working Groups should feel free to add, delete or change the items in the checklist as relevant to their circumstances.

Once the top five to ten impacts have been identified, the Adaptation Working Groups should assign them a score between -2 and +2 in column 4, using the scoring climate impacts guide.

**Table 6: Checklist of suggested climate impacts by target type**

| **Species targets** | |
|---|---|
| ✓ Climate driven migration | ✓ Drought |
| ✓ Loss of suitable habitat through inundation | ✓ Bushfires |
| ✓ Loss of suitable habitat due to habitat retreat | ✓ Heat-wave |
| ✓ Inundation from sea-level rise or storm surge | ✓ Inadequate surface water |
| ✓ Coral bleaching | ✓ Inadequate groundwater |
| ✓ Cyclone or storm damage | ✓ Invasive species / pathogen spread |
| ✓ Inundation from changed precipitation | ✓ Other... |
| **Habitat / ecosystem and ecosystem service targets** | |
| ✓ Coastal erosion or accretion | ✓ Drought |
| ✓ Climate driven expansion of habitat | ✓ Bushfires |
| ✓ Climate driven retreat of habitat | ✓ Heat-wave |
| ✓ Inundation from sea-level rise or storm surge | ✓ Inadequate surface water |
| ✓ Coral bleaching | ✓ Inadequate groundwater |
| ✓ Cyclone or storm damage | ✓ Invasive species / pathogen spread |
| ✓ Inundation from changed precipitation | ✓ Other... |

**continues overleaf**

**Table 6: Checklist of suggested climate impacts by target type (continued)**

| Social targets | |
|---|---|
| ✓ Coastal erosion or accretion | ✓ Bushfires |
| ✓ Change in availability of natural resources (accessibility, abundance, over-exploitation etc.) | ✓ Heat-wave |
| ✓ Pressure or conflicts from presence of climate migrants | ✓ Inadequate surface water |
| ✓ Inundation from sea-level rise or storm surge | ✓ Inadequate groundwater |
| ✓ Cyclone or storm damage to infrastructure, crops or livelihood assets | ✓ Pathogen / disease spread |
| ✓ Inundation from changed precipitation | ✓ Forced climate migration |
| ✓ Drought | ✓ Other... |

**Scoring climate impacts**

| 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 will be negative for the target |
| +2 | The climate impact in question will be highly negative for the target |

## Activity 4.3: Consider the interactions between climate and non-climate factors and calculate cumulative scores for each impact

The scale and magnitude of climate impacts can be influenced positively or negatively by interactions with the range of non-climate threats acting on the target. For example, an identified climate impact of coastal erosion may be negatively influenced, that is made worse, by a non-climate threat of deforestation of mangroves for charcoal production. Alternatively, upstream dams will have negative impacts on freshwater ecosystems but may reduce the impacts of seasonal flooding that has been increased by climate change. The aim of this activity is to discuss and reach consensus on the way that the identified non-climate threats may affect climate impacts. To implement this step, consider each of the climate impacts listed in Worksheet 16 in the context of the non-climate threats listed in Worksheet 15 and list these in column 5 of Worksheet 16. Then discuss whether one or more of the non-climate threats 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 threats that are acting on it. A relative score from -2 to +2 for each impact should be entered into Worksheet 16 (column 6) using the guide below.

The narrative section of Worksheet 16 (column 8) should be used to provide a short description of each impact that can be understood by those not involved in the methodology application. The assumptions and uncertainties associated with the application of this step need to be recorded in columns 9 and 10 along with other relevant comments or observations.

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

**Scoring non-climate impacts**

| Scoring of effect on non-climate impacts | Interpretation |
|---|---|
| -2 | The effects of all the non-climate threats will have a highly beneficial influence on the climate impact (i.e. significantly enhance the positive elements of the impact) |
| -1 | The effects of all the non-climate threats will have a beneficial influence on the climate impact (i.e. enhance the positive elements of the impact) |
| 0 | The effects of all the non-climate threats will be insignificant or neutral for the climate impact |
| +1 | The effects of all the non-climate threats will have a negative influence on the climate impact (i.e. increase the negative elements of the impact) |
| +2 | The effects of all the non-climate threats will have a highly negative influence on the climate impact (i.e. significantly increase the negative elements of the impact) |

Cumulative climate impact score (column 7) can be calculated by simply adding scores from column 4 and column 6 (see example below).

**Worksheet 16: Identification and scoring of climate impacts by target**

| Target | | Top five climate impacts (see Table 6 | | Non-climate threats (see Worksheet 15) | | Cumulative climate impact score | Narrative description of climate impact | | |
|---|---|---|---|---|---|---|---|---|---|
| ***No.*** | ***Name*** | ***Climate impact*** | ***Score*** | ***Non-climate threat acting on climate impact*** | ***Score*** | | ***Description of climate impact*** | ***Uncertainties / assumptions*** | ***Data sources*** |
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |

**Worksheet 16: Example from Sanquianga NNP, Colombia**

| Target | | Top five climate impacts | | Non-climate threats | | Cumulative climate impact score | Narrative description of climate impact | | |
|---|---|---|---|---|---|---|---|---|---|
| *No.* | *Name* | *Climate impact* | *Score* | *Non-climate threat acting on climate impact* | *Score* | | *Description of climate impact* | *Uncertainties / assumptions* | *Data sources* |
| 5 | Anadara tuberculosa (pustulose ark) – 'piangua' | Exacerbation of coastal and marine eutrophication | 2 | - Alluvial mining large-scale or tech<br>- Dumping of waste (solid and liquid)<br>- Change of surface water hydrology | 1 | 3 | | | |
| | | Variability in year class strength of fish | 2 | - Alluvial mining large-scale or tech<br>- Overfishing / illegal fishing | 2 | 4 | | | |
| | | Changes in distribution, migration, recruitment and growth rate of species | 2 | - Alluvial mining large-scale or tech<br>- Change of surface water hydrology | 1 | 3 | | | |
| | | Alteration of the period of breeding and spawning / Variation in the reproductive cycle associated with variation in precipitation levels | 2 | - Change of surface water hydrology | 2 | 4 | | | |
| | | Alteration of the species' behaviour | 2 | - Change of surface water hydrology | 1 | 3 | | | |
| | | Changes in salinity and dissolved oxygen | 2 | - Dumping of waste (solid and liquid)<br>- Change of surface water hydrology | 1 | 3 | | | |
| | | Changes in precipitation (seasonal/volume) | 1 | | 0 | 1 | | | |

## Activity 4.4: Review list of adaptive capacity / resilience factors and score the top five factors

For each of the targets, the Adaptation Working Group should work through the checklist of adaptive capacity / resilience factors (Table 7) and in Worksheet 17 (note activities 4.4 and 4.5 are both recorded on Worksheet 17) list the top five to ten factors (in column 3) associated with each target (columns 1 and 2). 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 future baseline conditions and non-climate scenarios developed in previous steps. Note that the checklist is simply a guide for this step and Adaptation Working Groups should feel free to add, delete or change the items in the checklist as relevant to their circumstances.

**Table 7: Checklist of suggested adaptive capacity / resilience factors**

| Species targets (adapted from Foden et al, 2008) | Habitat / ecosystem and ecosystem service targets (adapted from US-EPA, 2009) | Social targets (adapted from Marshall et al, 2009) |
|---|---|---|
| ✓ No or low specialised 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 colonise 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 and 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 |
| | | ✓ Financial reserves |
| | | ✓ Physical isolation |
| | | ✓ Access to new technologies |
| | | ✓ Low degree of physical isolation |
| | | ✓ Sales points for agricultural products / fishing supplies |
| | | ✓ Governance arrangements for equitable access to resources |
| | | Other… |

Once the top five to ten factors have been identified, the Adaptation Working Groups should assign them a score between -2 and +2 using the guide below. The scores should be entered into column 4 of Worksheet 17.

**Scoring adaptive capacity**

| 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 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) |

## Activity 4.5: Consider how non-climate threats could affect the resilience / adaptive capacity and calculate cumulative scores

Just as the scale and magnitude of climate impacts can be influenced positively or negatively by interactions with the range of non-climate threats acting on the target, the characteristics of the targets that give it its resilience can also be affected by non-climate threats. For example, an identified resilience factor of strong genetic diversity between populations could be negatively affected by a non-climate threat 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 threats 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 the views of participants it will represent a solid and informed opinion in relation to this issue.

To implement this step, consider each of the resilience factors listed in Worksheet 17 in the context of the non-climate threats listed in Worksheet 15 (and list them in column 5 of Worksheet 17) and discuss whether one or more of the non-climate threats could act to have: (i) a negative effect – i.e. decrease the degree of resilience; (ii) a positive impact – i.e. increase the degree of resilience; or (iii) a neutral impact – i.e. no effect on 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 non-climate threats that are acting on it. Once this is completed, a score from -2 to 2 should be identified for each factor using the scoring resilience scale and entered in Worksheet 17 in column 6.

The narrative section (column 9) of Worksheet 17 should be used to provide a short description of each factor that can be understood by those not involved in the methodology application. The assumptions and uncertainties associated with the application of this step need to be recorded in the narrative section of Worksheet 17 (in columns 10 and 11) along with other relevant comments or observations. Once more, the broader the group of stakeholders involved in this process, the stronger the resulting informed opinion.

**Scoring non-climate effects on adaptive capacity/resilience factors**

| Resilience score | Interpretation |
|---|---|
| -2 | The cumulative effects of all the non-climate threats will have a highly negative influence on the factor (i.e. significantly increase the negative elements of the factor) |
| -1 | The cumulative effects of all the non-climate threats will have a negative influence on the factor (i.e. increase the negative elements of the factor) |
| 0 | The cumulative effects of all the non-climate threats will be insignificant or neutral for the factor |
| +1 | The cumulative effects of all the non-climate threats 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 threats will have a highly positive influence on the factor (i.e. significantly enhance the positive elements of the factor) |

Cumulative adaptive capacity and resilience factors score (column 7) can be calculated by simply adding scores from column 4 and column 6 (see example overleaf).



Interactive stakeholder workshop in the Philippines

### Worksheet 17: Identification and scoring of adaptive capacity and resilience factors by target

| Target | | Adaptive capacity and resilience factors | | Non-climate threat | | | Narrative section | | |
|---|---|---|---|---|---|---|---|---|---|
| No. | Name | Factor | Score | Non-climate threat name(s) acting on factor | Score | Cumulative score | Description of adaptive capacity and resilience factors | Uncertainties/ Assumptions | Data Sources |
| 1 | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 2 | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 3 | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |



Children in one of the villages in IGACOS, the Philippines

**Worksheet 17: Example from MPA 1, Philippines**

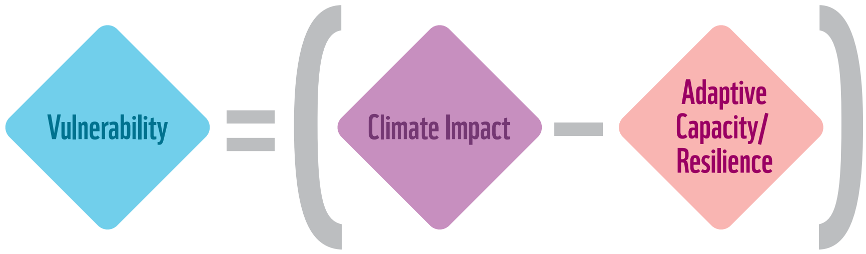
| Target | | Adaptive capacity and resilience factors | | Non-climate threat | | | Narrative section | | |
|---|---|---|---|---|---|---|---|---|---|
| No. | Name | Factor | Score | Non-climate threat name(s) acting on factor | Score | Cumulative score | Description of adaptive capacity and resilience factors | Uncertainties/ Assumptions | Data Sources |
| 1 | Barangay Tambo | Indigenous Climate Change Adaptation Practices/ability to cope with past climate events | 2 | High poverty incidence/low household income; Weak social cohesion; Geological events (ground collapse and tsunami); Weak governance (both local and national) | -1 | 1 | Farmers resorted to fishing when land is too dry; farmers forced to harvest crops untimely; the barangay government of Tambo is working on developing the MPA (Sanipaan MPA) as tourist attraction. People were able to cope with the drought in 2005. | | WWF-Philippines (2011). Socio-Economic Profile of Marine Protected Area 1 and 2. Island Garden City of Samal. |
| | | Institutionalised City and Barangay Disaster Risk Reduction Management Committees | 2 | High poverty incidence/low household income; Weak social cohesion; Geological events (ground collapse and tsunami); | -1 | 1 | The city and barangays each have an approved disaster risk reduction management plan and members are duly capacitated. | | As per information provided by LGU of IGACOS |
| | | Diverse sources of income | 1 | High poverty incidence/low household income; Weak social cohesion; Geological events (ground collapse and tsunami); Weak governance (both local and national) | 0 | 1 | People have diverse sources of income and a number of individuals have secondary sources of income. | | WWF-Philippines (2011). Socio-Economic Profile of Marine Protected Area 1 and 2. Island Garden City of Samal. |
| | | Flexibility to change occupation/ livelihood | 2 | High poverty incidence/low household income; Weak social cohesion; Geological events (ground collapse and tsunami); Weak governance (both local and national) | 0 | 2 | People can readily shift from one type of work to another as per survey. | | WWF-Philippines (2011). Socio-Economic Profile of Marine Protected Area 1 and 2. Island Garden City of Samal. |

## Activity 4.6: Calculate the overall climate impact score, the overall resilience score, and the overall vulnerability score

A good VA does not end by calculating the degree of vulnerability of a target, but also aims to understand how climate change and resilience impact overall vulnerability. This step therefore determines the overall climate impact score, resilience score and vulnerability score for each target. The first two will be particularly important in the latter stages of adaptation planning.

The overall impact and resilience scores are calculated for each target by identifying the median of the range of impact and resilience scores respectively. The median is calculated by ranking the scores in order (from the smallest to the largest) and selecting the middle score. If there is an even number of scores the average of the middle two scores is the median (see example developed from Worksheets 16 and 17).

The overall vulnerability score is calculated by the application of the following formula: **Vulnerability** *equals* **Climate Impact** *minus* **Adaptive Capacity and/ or Resilience**.




**Overall Scores: Example from Colombia**

| **Target Identification** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **No.** | **Name.** | **Overall Climate Impact Score** | | **Overall Adaptive Capacity & Resilience Score** | | **Overall Vulnerability Score** | |
| 1 | Mangrove 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. |
| 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 |

For each of the scores calculated, the overall impact and resilience scoring guidance can be used to convert them to a qualitative description of vulnerability. The scores and descriptive results are relative and can be used to compare relative vulnerability across targets that have been analysed using this method in the same workshop / evaluation process. They are not absolute values and therefore cannot be directly compared to the results of VAs carried out using different methodologies, or even compared directly to other VAs using this method in different places.

**Interpretation of overall impact and resilience scores by target**

| Resulting overall impact or resilience score | Interpretation for overall climate 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 by target**

| 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. |

## Activity 4.7: Document the narrative and map the results

This section provides guidance as to how to document the narrative of your VA exercise and map the results. Work through the template in Worksheet 18. The template should record information for relevant targets, or where appropriate, areas within specific targets.

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

- A map showing high, medium and low vulnerability index for each target (species, habitats, ecosystems, ecosystem services and socio-economic targets).
- A map showing high, medium and low overall vulnerability index for the CMPA.

**Worksheet 18: Documenting the VA narrative**

| Level of vulnerability | Relevant target(s) |
|---|---|
| Very high or high vulnerability | |
| Drivers of high vulnerability (i.e. exposure, sensitivity, resilience drivers) | |
| Medium vulnerability | |
| Drivers of medium vulnerability (i.e. exposure, sensitivity, resilience drivers) | |
| Low or very low vulnerability | |
| Drivers of low vulnerability (i.e. exposure, sensitivity, resilience drivers) | |
| Overall vision of vulnerability and drivers for relevant targets (< 100 words) | |

**Worksheet 18: Documenting the VA narrative, example**

| Level of vulnerability | Relevant target(s) |
|---|---|
| Very high or high vulnerability | Mangroves; coral reefs; sea turtles |
| Drivers of high vulnerability (i.e. exposure, sensitivity, resilience drivers) | Overharvesting mangroves; low community awareness<br>Fishing gear damage; sedimentation<br>Habitat damage; pollution; decreasing population rates |
| Medium vulnerability | Traditional fisheries |
| Drivers of medium vulnerability (i.e. exposure, sensitivity, resilience drivers) | Overfishing; strong fishing cooperatives |
| Low or very low vulnerability | No targets showed low or very low vulnerability |
| Drivers of low vulnerability (i.e. exposure, sensitivity, resilience drivers) | |
| Overall vision of vulnerability and drivers for relevant targets (< 100 words) | The VA has shown that this MPA is highly vulnerable, with all targets showing either medium or high vulnerability. The main drivers are: overfishing with illegal fishing gear, reef degradation by sedimentation, anchoring and trampling, uncontrolled migration, poaching, and illegal logging of mangrove trees. It is vulnerable to climate change related events such as: increase of sea surface temperature, increaseof cyclone frequency and intensity, water shortage and increase of wind intensity and duration. |

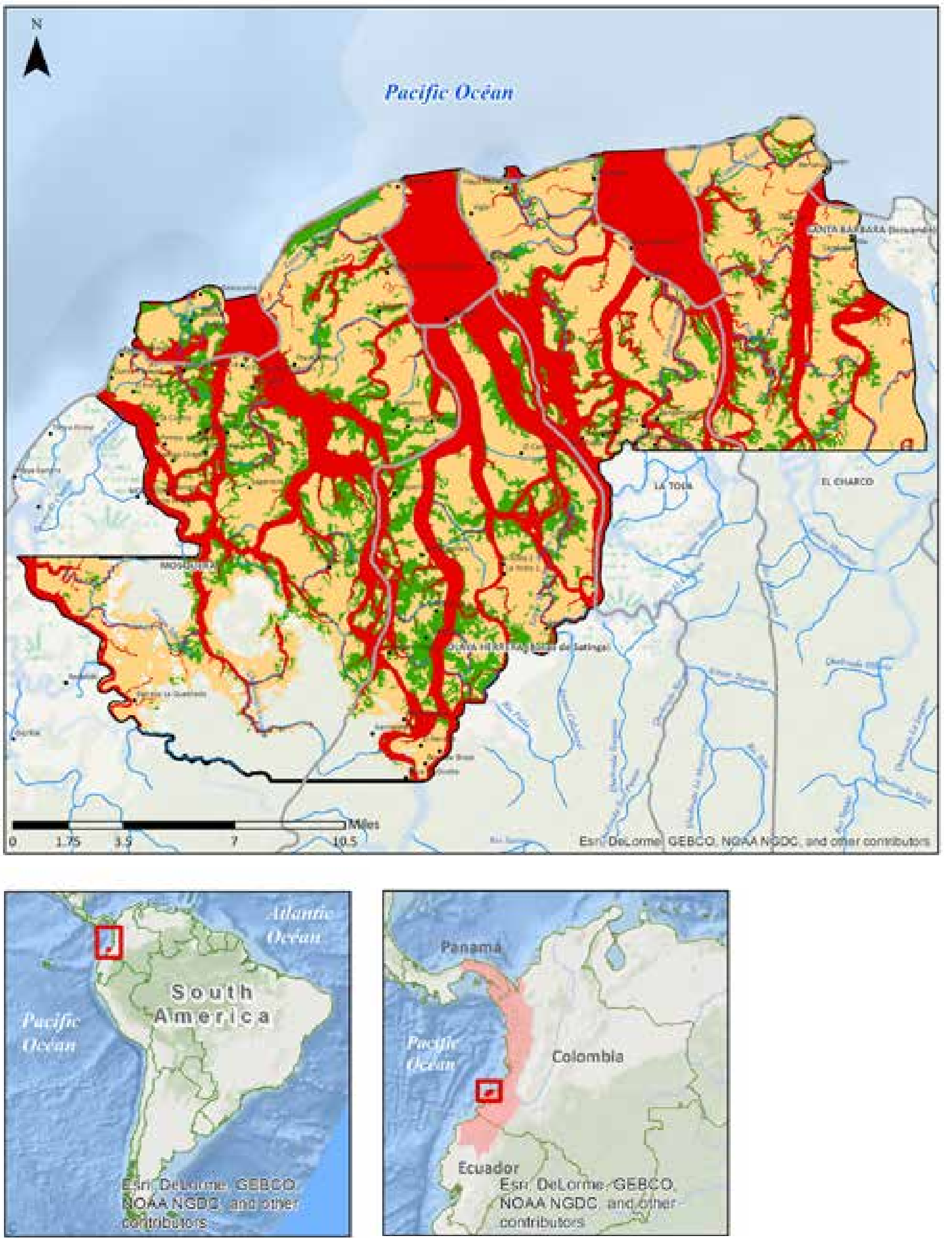
***Figure 8: Map of overall ecosystem vulnerability, Sanquianga National Natural Park, Colombia***

*Key*

- ● Towns
- River
- Country Boundary

***Landcover Sanquianga 2007 vulnerability***

- Target has medium level relative vulnerability
- Target has medium level relative vulnerability
- Target has high relative vulnerability



Use Table 8 as a guide to the type of information that should be mapped for each target depending on the nature of the protected area and the targets and the issues to highlight in the stakeholder workshop that will consider the VA.

**Table 8: Guidance for mapping results**

| **Template: Mapping the Results** | |
|---|---|
| ***Relevant Target(s) name:*** | |
| **Map Name** | **Suggested Elements** |
| Baseline map | Protected area boundaries<br>Geographical scope of VA<br>Villages and human settlements<br>Major drainage, topographical and physical features<br>Administrative boundaries<br>Nearby protected areas<br>All ecological targets and limits – note that for species this could include distribution / range / resource use zones as appropriate<br>All socio-economic targets and limits<br>Legend, north-point etc. |
| Areas of high vulnerability | Baseline map<br>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<br>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<br>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<br>Areas of high vulnerability<br>Areas of medium vulnerability<br>Areas of low vulnerability |

You now have a basic VA. The next activity is optional, where the Adaptation Working Group can choose to go deeper into the analysis of some specific targets if this is considered necessary. If not, move directly to Step 5.

## Optional: Detailed VA for selected targets

- **Purpose:** to apply comprehensive VA methodologies to targets that require further analyses based on the results of the previous activities.
- **Inputs and 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.

Worksheet 19 draws on the results of the VA to determine if a level 2 analysis is required.

Level 2 analyses can draw on a wide range of established VA methodologies for ecological systems (species, habitats etc.) and socio-economic systems (communities, households, municipalities), and a smaller but growing number of methodologies for ecosystem services. The approach taken here is to provide guidance on the selection and combination of existing methodologies appropriate for a VA focusing on a CMPA and surrounding environment. Table 9 therefore presents a selection of potentially suitable methodologies and assists the user in selecting one or more of these based on criteria of available resources, data availability, ease of application, required outputs and timeline. Many of the methodologies address only one or a small number of aspects of a full VA (e.g. some only refer to species vulnerability or human community vulnerability). Thus for any single protected area, it is likely that more than one methodology will be required depending on the range of VA targets identified.

## Optional Activity 4.8: Detailed VA for selected targets

Using the overview provided in Worksheet 19, consider the list of VA targets and work through the descriptions of various methodological options outlined in Table 9 to choose the appropriate methodology or methodologies. (Box 9 outlines some criteria used for selecting VA methodologies in Table 9.) 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.
- 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
  - Adaptability/replicability: the degree to which the method can be applied to different types of social or ecological targets, including biomes other than coastal and marine.

**Worksheet 19: Identifying targets that might require more detailed VA analysis**

| Target Name | Summary of VA results | Did the VA results indicate a potentially 'high' or 'very high' degree of relative vulnerability? | Did the VA results indicate that the target could experience a 'negative' or 'highly negative' climate impact? | Did the VA 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? |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**Box 9: Criteria for selection of VA methodologies**

All methodologies included in Table 9 meet three 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. Most 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.

*Note that there are many other methodologies available; see for example Morgan, 2011 for an overview.*

**Examples of detailed vulnerability methodologies**

***Tool for Understanding Resilience of Fisheries (TURF)***

A local level fisheries ecosystem vulnerability assessment tool, called TURF, or Tool for Understanding Resilience of Fisheries, was used for MPAs 1 and 2 in the Philippine site of IGACOS.

To apply the methodology, information about fisheries, reef ecosystems and socio-economic components is required. For the fishery component, fishery data needed are those related to sensitivity (i.e., dominant catch composition, catch rates, gear dependence on habitats) and adaptive capacity (i.e., changes in catch composition) variables. For reef ecosystems, needed information related to sensitivity includes type of fish in relation to wave exposure, density of coral dependent species, and habitat quality. While the adaptive capacity variables include extent and presence of adjacent habitats. Lastly, for the socio-economic aspect, sensitivity variables require data of population density and fisheries ecosystem dependency. Its adaptive capacity variables necessitate data on annual livelihood income from fisheries, proportion of fishers with other sources of income, and annual cumulative income from other sources relative to the provincial poverty threshold.

Through a workshop, Sensitivity and Adaptive Capacity variables were scored using the categories low, medium, and high. Potential Impact was also obtained. This was done by cross-tabbing the Sensitivity score with the Exposure score. The Potential Impact was then cross tabbed with the adaptive capacity score to get the Vulnerability score. Vulnerability was also categorized into low, medium, and high. The vulnerability scores by component were integrated to obtain the Overall Vulnerability score. The principle adopted for this was the Punnett square formula application using 3 variables.

Among the strengths of the method is that the tool is highly participatory, and solicits information from stakeholders. The entire process or steps needed to obtain the vulnerability status of a particular target area is very easy to generate as long as all the needed information is available. In the presence of a facilitator, the scoring system becomes very easy to comprehend. The generated results are reliable and can easily be duplicated to other areas. It is most applicable to the smallest political unit such as the barangay (village) level. It can be done at a very minimal cost (e.g. workshop meals and transportation).

The limitations of the method is that it does have considerable information needs; it requires a facilitator trained in applying the method; and it is only applicable in areas with fishing activities. The method cannot be applied in large protected marine ecosystems (e.g. large islands) without coastal communities residing within the area.

For more information on TURF: http://www.sciencedirect.com/science/article/pii/S0165783613001719

***Climate Change Vulnerability Assessment and Adaptation Planning for Mangrove Systems: application in the southern Colombian Pacific coast***

The central and southern parts of the Colombian Pacific coast harbour probably the most developed mangroves of the Neotropics. Mangroves in Sanquianga Naational Park and Nariño are located in meso and macrotidal areas behind dynamic barrier islands and deltas with high rainfall and sediment discharge, being the region with the largest mangrove area in Colombia. There, villagers sustain their livelihoods from the ecosystem services provided by mangroves.

Mangrove ecosystem integrity and provision of ecosystem services can be highly dynamic given the characteristics of the Colombian Pacific coast (tectonically active). Additionally, anthropogenic factors, including climate change, can threaten mangrove socio-ecological resilience in this area. The vulnerability to climate change of mangroves in Nariño, including the Sanquianga National Natural Park, was assessed by applying a risk ranking approach developed specifically for mangrove ecosystems (Ellison 2015). This approach considers the three dimensions of vulnerability (exposure, sensitivity and adaptive capacity) and integrates biotic, abiotic and human management components.

Despite Sanquianga being a protected area, its relative vulnerability index was very similar to that of the rest of the region's mangrove ecosystems. Our results indicate low vulnerability to climate change of mangroves in this region compared to micro-tidal non-estuarine areas with projected decreases in rainfall. However, tectonic subsidence, erosion processes and anthropogenic actions could lower resilience and increase vulnerability to climate change in these areas.

If climate change predictions related to increases in rainfall during the cold phases of ENSO (La Niña) occur, freshening of estuarine areas could lead to colonization of terrestrial vegetation in previous mangrove zones (already occurring in the Patía River Delta). Freshening of estuarine areas will not only affect mangrove vegetation but also the fauna associated to these systems (e.g. small pelagic fish) possibly disrupting entire food webs. Despite major uncertainties on the effects of climate change on mangrove socio-ecological systems in this area, maintaining resilient socio-ecological systems will be key to counter these effects. This implies the protection of mangroves against anthropogenic stressors (i.e. pollution, over-exploitation of resources, deforestation) and diversifying people's livelihoods.

**Table 9: Analysis of detailed vulnerability methodologies**

| Methodology name and link | Description | Advantages | Disadvantages | Data needs | Resource needs | Complexity | Adaptability replicability |
|---|---|---|---|---|---|---|---|
| **Social targets** | | | | | | | |
| Social Vulnerability Index (SVI)<br><br>http://www.icrisat.org/what-we-do/mip/training-cc/october-2-3-2009/vulnerability-analysis-manual.pdf | Involves development of a tailored index that combines multiple social vulnerability indicators to produce a vulnerability index that indicates the relative vulnerability of social targets. | First level screening VA method that allows a project area wide view of social vulnerability. Adopts participatory approaches that catalyse 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 | H |
| CARE Climate Vulnerability and Capacity Analysis Handbook (2009)<br><br>http://careclimatechange.org/tool-kits/cvca/ | 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 risks and would need to be adapted to also address future climate risks. | M | H | M | H |
| WWF Climate Witness Community Toolkit<br><br>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 on 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 | H |
| **Ecological targets: species** | | | | | | | |
| Framework for Categorizing the Relative Vulnerability of Threatened and Endangered Species - EPA, 2009<br><br>climate.calcommons.org/bib/framework-categorizing-relative-vulnerability-threatened-and-endangered-species-climate-change | 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 groups 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 | M |

| Methodology name and link | Description | Advantages | Disadvantages | Data needs | Resource needs | Complexity | Adaptability replicability |
|---|---|---|---|---|---|---|---|
| Climate Change Vulnerability of Migratory Species: Species Assessments<br><br>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 | M |
| **Ecological targets: coral reefs** | | | | | | | |
| IUCN Coral Reef Resilience Methodology<br><br>http://www.reefresilience.org/Toolkit_Coral/C6cc1_RapidAssess.html | Recognised methodology for undertaking resilience assessments of coral reef ecosystems. | Comprehensive and tested methodology. Detailed guidance and examples. | Data collection needs are intensive and require specialist inputs. | H | H | H | L |
| **Ecological targets: mangroves** | | | | | | | |
| Vulnerability Assessment and Adaptation of Mangrove Systems (WWF-US)<br><br>http://www.worldwildlife.org/publications/climate-change-vulnerability-assessment-and-adaptation-planning-for-mangrove-systems | 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 | L |
| **Ecological targets: fisheries** | | | | | | | |
| Tool for Understanding Resilience of Fisheries (TURF)<br><br>http://www.sciencedirect.com/science/article/pii/S0165783613001719 | Tool to understand vulnerability of reef based fisheries, inside or outside of CMPAs, to climate change risks. | Focuses on a key ecosystem service provided by CMPAs. Simple and adaptable methodology. | Requires relatively extensive data on fisheries. | M | M | L | H |
| **Social and ecological targets (can be used for combined or separate analyses)** | | | | | | | |
| Integrated Coastal Sensitivity, Exposure, Adaptive Capacity to Climate Change – I-C-SEA Change<br><br>http://www.coraltriangleinitiative.org/sites/default/files/resources/42_Vulnerability%20Assessment%20Tools%20for%20Coastal%20Ecosystems_A%20Guidebook.pdf | 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 | H |

© Ruel Pine / WWF Philippines

The beauty of IGACOS island's unspoiled beaches, the Philippines

# STEP 5
# VALIDATE, PRIORITISE AND REPORT ON VULNERABILITY ANALYSIS

So far results have come from a small team working together. Now anyone interested in the process is invited to comment, support or criticise what the Adaptation Working Group has done, to validate or question the results and suggest which of the identified vulnerabilities are the most important.

The next stage subjects the results of the VA to a process of 'ground-truthing' and validation by a wide range of stakeholders in one or a series of workshops (for advice on running the workshops see Part II above). Importantly, this process allows for protected area-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 overall protected area vulnerability, and is critical to addressing questions of uncertainty in the overall VA process and allowing a first-cut prioritisation of issues to be addressed in adaptation planning. This stage guides users through 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 CMPA to be viewed, critiqued and validated in a protected area-wide manner; and (iii) facilitates a participatory approach to discuss how, why and when to move forward to address identified vulnerabilities.

The workshop that is part of this step is probably also the first time that all stakeholders have had a chance to meet, so it is an important stage in building a community of interest around the process.

## Validation, priority setting and final reporting

- **Purpose:** use a workshop/s 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. Prepare a comprehensive report of the VA process and outcomes and spatial presentation of key results.
- **Inputs and resources required:** results of preceding activities; baseline mapping; stakeholder workshop.
- **Expected results:** validated VA outcomes; initial list of priority areas / issues for further action. Final VA report and maps.

### Activity 5.1: Prepare background materials and test confidence in results

Prepare simple summaries of the key results for each target using Worksheet 20 as a guide. These summaries should be a maximum length of one page for each target to allow them to be used as reference documents during the workshop. As appropriate you can also distribute additional information to participants such as detailed VA reports or other relevant background information.

At this stage, it is also important to provide guidance on the level of confidence in the results and the likelihood of these occurring. The VA results will then be tested in the stakeholders' workshop. The aim is to discuss and assess the level of confidence in the results of the VA and the likelihood that they will occur: in other words how certain everyone is that the judgements made are correct and how likely they are to occur. This is a complex process that requires good facilitation and the presence of one or more people who are fully up to date with the technical aspects of the VA. Note that there is a tendency in workshops for people to group around an expressed view rather than look at this critically; the facilitator and technical specialists must encourage debate. The exercise should aim to:

- Assess issues of uncertainty and risk to the extent possible
- Consider all plausible sources of uncertainty

Confidence in the decisions is gained by reviewing both the strength of the evidence and the level of agreement; this is expressed diagrammatically in Figure 9, with the lightest shading expressing the least confidence and the darkest shading the most confidence. The levels of agreement outlined in Figure 9 can be used to inform the third row of Worksheet 20.

Use the results of this exercise, along with any other VAs that have been carried out, to prepare summary VA results for each of the targets identified earlier and record these on Worksheet 20.

***Figure 9: A depiction of evidence and agreement statements and their relation to confidence (after Mastrandrea et al, 2010)***

| Agreement ↑ | | | |
|---|---|---|---|
| | High agreement<br>Limited evidence | High agreement<br>Medium evidence | High agreement<br>Robust evidence |
| | Medium agreement<br>Limited evidence | Medium agreement<br>Medium evidence | Medium agreement<br>Robust evidence |
| | Low agreement<br>Limited evidence | Low agreement<br>Medium evidence | Low agreement<br>Robust evidence |

Evidence (type, amount, quality, consistency) →

Confidence scale ↓

### Worksheet 20: Summary results of VA analysis

| | | | |
|---|---|---|---|
| **Target Name** | | | |
| **Target Vulnerability** | | | |
| **Level of confidence in the accuracy of the VA** | Use Figure 9 as a guide and referring to column 10 in Worksheets 16 and 17 | | |
| Add a summary of the identified non-climate impacts acting on the target now and in the future (see Worksheet 15) | Add a summary of the identified likely climate impacts (resulting from variability and vulnerability as necessary), including comments on interactions with non-climate impacts (see column 9 in Worksheet 16) | Add a summary of the key internal and external adaptive capacity factors acting on the target(see column 9 in Worksheet 17) | Add a summary of the key data gaps and assumptions that have influenced VA results (refer to column 10 in Worksheets 16 and 17) |

**Worksheet 20: Example from IGACOS, Philippines**

| | | | |
|---|---|---|---|
| **Target Name** | Barangay Camudmud (can be stated for the whole IGACOS too) | | |
| **Target Vulnerability** | High vulnerability | | |
| **Level of confidence in the accuracy of the VA** | High agreement, medium evidence | | |
| *Non-climate impacts* | *Climate impacts* | *Adaptive capacity factors* | *Data gaps and assumptions* |
| Degradation of habitats are likely to continue in the absence of a policy on tourism development and the weak implementation of existing laws on coastal development. | Extreme weather events, coupled with the increasing loss of mangrove cover and decrease in size of corals and seagrass areas will result in heightened community and ecosystem vulnerability. | Habitat restoration activities undertaken by community members, increased awareness on ecosystem value of habitats. | Key ecological data gaps have been identified. |
| Resilience of habitats hampered by increasing illegal fishing activities even within the MPAs | Habitat degradation results in reduced ecosystem services, i.e. fish catch. | Households diversifying income sources; increased awareness on importance of MPAs | |

## Activity 5.2: Validate VA results with stakeholders

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. 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; (iv) the different technical capacities of stakeholders; and (v) social and cultural considerations that may make it difficult for particular stakeholder groups to interact with the process when other stakeholders are present. One of the key aims of the risk management process is to integrate knowledge from a range of technical domains. The Adaptation Working Group will by this point have a good understanding of the different stakeholder groups and their interests. As a guide, Adaptation Working Groups can consider the following groups in the checklist (Table 10) that could be consulted either individually or in a combined exercise.

**Table 10: A checklist of people to consider for the workshop**

| Checklist |
|---|
| ✓ National/regional leaders and experts with national/regional government, technical experts and national/regional civil society |
| ✓ Local deciders and managers with protected area managers, local/regional government, local/regional civil society, private sector |
| ✓ Community and local resource users with protected area agents, local communities, local/municipal government, local civil society, local private sector |
| ✓ Protected area manager and staff |
| ✓ Local communities |
| ✓ Women |
| ✓ Representatives from local fishing organisations or operators |
| ✓ Representatives from farming communities in or around the protected area |
| ✓ Hoteliers, dive operators and other tourism operators who live in or use the protected area |
| ✓ Local government officers |
| ✓ Representatives from local or international social/environmental NGOs active in the protected area |
| ✓ Leaders of faith groups important in the area |
| ✓ Indigenous groups and/or other ethnic minority groups |

Workshops cost time and resources, both for those leading the CAMPA implementation process and for those taking part. Ideally, it is good to get groups with very different perspectives (e.g. local fishing communities, hotel owners and government officials) to talk together. So although multiple workshops are possible and may sometimes be necessary, it is worth trying to minimise the number. Stakeholders invited to the validation workshop will probably be the same as will come to the workshop that plans climate adaptation actions for the protected area, so they need to be committed to taking an active part in the process.

Identify the facilitator and ensure that they understand the workshop aims and agenda. The workshop proceedings and outcomes need to be documented; this is ideally done as the workshop is taking place by a dedicated rapporteur, or failing that as soon afterwards as possible, so that things are recorded while they are fresh in people's minds and fed back to participants quickly. It is a good insurance policy to record the workshop and it is also important to take photographs so there is a clear record. The report 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.

Develop an agenda for each workshop, including the four key issues identified below.

1. **What is the context?** Information on the overall VA and adaptation planning context and information on the process followed.

2. **What assumptions were used and what uncertainties remain?** Ask participants to consider if the assumptions are valid and if the uncertainties could be reduced.

3. **What are the important VA results?** Present information on the key outcomes of the VA for different targets and ask participants if they think the 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? Where is there an overlap, for example where are the overlaps between ecosystem service and socio-economic targets?

4. **What are the priorities for further action?** Can different zones be prioritised for future action? Do certain targets need priority? What actions are needed for different priorities – i.e. 'Address/Adapt', 'Research to Learn More', 'Monitor and Revisit', or 'No Action'?

Regardless of the detailed agenda developed, all workshops should involve three basic exercises:

1. **Test confidence and likelihood**
2. **Validate VA results**
3. **Identify priorities**

Ideally these exercises are undertaken in groups of five to ten people and facilitated by a member of the Adaptation Working Group. Time should be allowed for feedback from these small groups to the rest of the workshop. Suggestions are given below as to how these exercises could be facilitated.

**Exercise 1: Test confidence and likelihood**

- Provide the group with the data in Worksheet 17 (explanation of the VA/s for each of the targets); present the results and discuss issues of confidence, testing the conclusions reached by the Adaptation Working Group and recorded in Worksheet 20.
- This stage provides a first opportunity to present the results and introduce the targets, the VA/s results and the adaptation planning process to the stakeholders, so needs careful preparation and presentation in a way that logically explains the targets and provides an understandable summary of the VA results.
- A rapporteur needs to record reactions; particularly important are disagreements with the conclusions reached about confidence in the analysis and likelihood of the projected impacts.

**Exercise 2: Validate VA results**

- 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 Adaptation Working Group is on hand to answer questions and explain the maps and the narrative).
- Ask the group (or small groups of participants) to examine the maps and mark areas where they feel there is a mismatch between the VA results and the on-the-ground realities.
- Where such mismatches occur, ask the group to note questions, comments/ observations, additional data sources or priorities for further investigation on the map.
- 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. In many situations this will be impractical, and hand-drawing on maps will need to be substituted. Where communities have low literacy skills or are unfamiliar with maps, three-dimensional mapping using simple models is also useful.

**Exercise 3: Identify priorities**

- Using the maps and narratives considered in the previous exercise, ask the groups to do a first-cut prioritisation exercise. Groups can consider individual targets (e.g. species, habitats, ecosystem, ecosystem services or socio-economic) and/ or geographic zones (north-west zone of protected area, all villages outside protected area) for this exercise. The aim is to generate initial ideas for actions that can be re-visited during the adaptation planning process. For this activity it can again be useful to have GIS facilities.
- Ask the group to list the targets or zones within the targets and consider the following broad categories of actions:
  - ◇ 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.
  - ◇ Research to learn: More information is needed in relation to the zone or target to better understand vulnerability or to better plan for adaptation.
  - ◇ 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 5.3: Report on VA outcomes

This activity represents the last but essential activity in the VA process; 'putting it all together' into a comprehensive, concise documentation of the VA process, results and next steps. The narrative and maps 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 Adaptation Working Groups 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.

While each Adaptation Working Group will determine the reporting structure that best suits their needs, a guide has been provided in Table 11. This follows the logic and sequence of steps and activities in the manual and maximises use of text and documentation already prepared in the completion of the Worksheets. In particular, the documentation prepared in advance of the validation and priority setting workshops can be used as a starting point for final VA reporting.

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 11: Suggested VA reporting outline**

| Suggested section heading | Suggested contents |
|---|---|
| **Section 1: Introduction and context** | |
| 1.1 Introduction | General introduction to protected area and to VA process (who, why, how...) |
| 1.2 VA objectives and scope | |
| - VA objectives | Taken from Worksheet 1 |
| - VA scope (narrative and maps) | Taken from Worksheet 2 and maps |
| - VA targets (narrative and maps) | Taken from Worksheet 6 and maps |
| 1.3 Description of existing project area | Taken from Worksheet 8 |
| - Non-climate scenarios for project area | Taken from Worksheet 11 |
| **Section 2: Technical VA assessment results** | |
| 2.1 Overview of technical assessment (Plus any additional methodology(ies) applied) | Referring to Table 9 and the results of Worksheet 19 |
| 2.2 Technical assessment summary (narrative and maps) | Taken from Worksheet 20 |
| **Section 3: Conclusions and Recommendations** | |
| 3.1 Risk assessment and stakeholder validation outcomes – priorities and next steps | Workshop write up |
| **Section 4: References and Appendices** | |
| 4.1 Background literature | Worksheet 7 |
| 4.2 Adaptation Working Group | List of members |
| 4.3 List of people consulted | List of all people contacted or who attended workshops |
| 4.4 Completed worksheets | All worksheets |
| 4.5 Additional maps | Any additional maps |

# STEP 6
# ASSESS ADAPTATION OPTIONS

This step identifies climate adaptation options for stakeholders to respond to vulnerability and threats.

By now there is a list of things that are either already a problem or are likely to be a problem as a result of climate change, possibly linked to other threats such as over-use of natural resources or pollution. These will probably include a wide range of issues: declining fish stocks; species going extinct; habitats disappearing; eroding coastlines; etc. The next stage identifies some responses – climate adaptation options – to address these problems. Stakeholders meet in a workshop or workshops, brainstorm options and then subject each of the identified possibilities to analysis to look at benefits, risks and costs before deciding on a short list of adaptation options.

The process draws on three main outputs:

1. A list of likely climate impacts and adaptive capacity factors for the targets derived from the VA (see specifically Worksheets 16 and 17 and summary in Worksheet 20).
2. An assessment framework to compare various possible adaptation options to address the threats to key targets, based on the outcomes of the VA (developed in Action 6.2).
3. A draft list of possible adaptation options (which can be expanded during the assessment) (see Table 12).

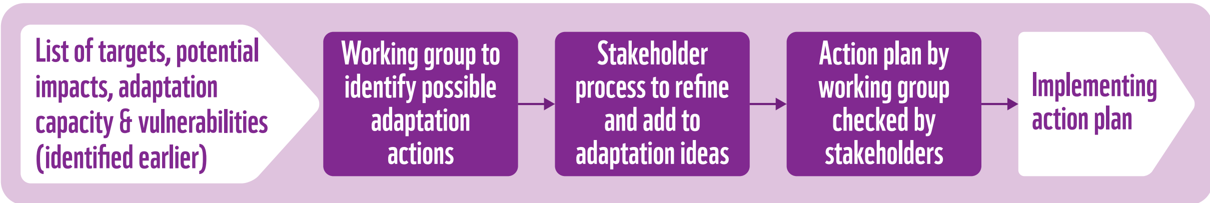
This is not a 'how to' manual on adapting coastal and marine protected areas to climate change, but a structured approach to helping stakeholders decide which adaptation approaches are most suitable. There is certainly no standardised adaptation option for each target as it depends on VA results and the general context of the area.

## An approach for identifying adaptation options

- **Purpose:** to identify a range of adaptation options to address issues identified in the VA.
- **Inputs and resources required:** baseline map of project area; VA results; knowledge of key stakeholder groups; protected area management plan.
- **Expected results:** an agreed list of climate adaptation actions for the protected area.

The process is based around a stakeholder workshop. Although the approach is participatory, walking unprepared into a stakeholder workshop can result in a confusing and inconclusive process. The Adaptation Working Group will usually draw up initial ideas and test these with a wider stakeholder group. 'Testing' might mean starting from the beginning if stakeholders reject the proposals. 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 process is very simple, as illustrated in Figure 10.

*Figure 10: Outline of adaptation process*




The process draws on information from the VA outlined in Steps 4 and 5. This will have identified targets and assessed their potential climate impacts, along with adaptive capacity factors and the existing adaptive conditions that determine vulnerability to climate change. For example, a CMPA set up to protect a coral reef and seabird colony, which also contains a small fishing community, might have a VA that focuses on: ecological targets such as seabirds (e.g. threats from sea-level rise, more frequent storms) and coral (e.g. threats from bleaching, acidification) and socio-economic targets on risks to the community, (e.g. inundation of coastal villages, risks to fish stocks).

The process outlined below moves from the Adaptation Working Group making a preliminary adaptation assessment through to a stakeholder workshop to discuss adaptation strategies. The Adaptation Working Group then takes the strategies identified at the workshop and translates these into an adaptation plan, which is in turn checked back with stakeholders.

## Activity 6.1: Expert process to identify possible climate adaptation actions

As a first step, the Adaptation Working Group draws up a draft list of potential adaptation options, responding to the identified targets and their vulnerabilities. This stage could be carried out by the whole Adaptation Working Group, by the protected area manager and staff collectively if they felt confident to do so, delegated to one staff member, or contracted to a local or international consultant. Whatever method is used, the Adaptation Working Group needs to have talked through the results before they start the workshop.

This stage can already draw on some initial thinking about priority targets and adaptation actions, which have been developed in Activity 5.3 above. The checklist in Table 12 provides additional ideas to help a brainstorming (drawing on Mawdsley et al, 2009): each protected area will have its own challenges and responses. To avoid influencing results, it is best to start by asking people for their own ideas and then use Table 12 if necessary to identify possible gaps and new ideas.

Local people living subsistence lives have been adapting to changing conditions for millennia. Today, they will not be waiting for a special project or a grant before implementing adaptation processes, and in many cases will already be making lifestyle changes in response to changing environmental conditions. These may well have influences on the protected area, or have lessons that can be applied within the protected area, so it is important to understand what they are. As noted above, the Adaptation Working Group should contain members of the local community and their knowledge is particularly important at this stage, later augmented by other members of the community in an open workshop. An initial list can be recorded in Worksheet 21.

### Worksheet 21: Recording initial climate adaptation options

| Adaptation option | Reasons for selection | Which targets this addresses |
|---|---|---|
| **Ecosystem options** | | |
| | | |
| | | |
| **Social options** | | |
| | | |
| | | |
| **Engineering options** | | |
| | | |
| **Cross-cutting options** | | |
| | | |
| | | |

© Alexander Belokurov

Vanishing island – community mangrove restoration site in IGACOS, the Philippines

**Table 12: Potential adaptation options**

| Adaptation option | Notes | Useful information |
|---|---|---|
| **Ecosystem options** | | |
| **Coastal mangroves** | | |
| ✓ Reduce threats on mangroves and adaptive management<br>✓ Identify and protect refuges | Mangroves are relatively able to cope with changing sea levels if there is space for them to expand into, although sedimentation levels are generally not keeping pace with sea-level rise. | McLeod, E. and Salm, R.V. 2006. *Managing Mangroves for Resilience to Climate Change*. IUCN<br><br>Alongi, D.M. 2008. Mangrove forests: resilience, protection from tsunamis and responses to climate change. *Estuarine, Coastal and Shelf Science* 76: 1-13 |
| ✓ Maintain connectivity | Between mangroves and other habitats, and maintaining continual strips of mangrove along suitable coastline | |
| ✓ Establish buffer zones | Buffer zones immediately inland of mangroves can prevent accidental damage | |
| ✓ Actively plant mangrove seedlings<br>✓ Replant or plant new mangroves on higher elevations to ensure habitat survival | Planting is unnecessary except in extreme degradation; if threats are removed and ecological conditions stabilised, natural regeneration is usually successful. Restoration is technically easy although often fails in practice due to poor planning (e.g. planting in places that never supported mangroves; or planting the wrong species; or planting monocultures). | Mangrove Action Project. 2005. *5 Steps to Successful Ecological Restoration of Mangroves*. Some species-specific information only for SE Asia<br><br>Lewis, R.R. 2005. Ecological engineering for successful management and restoration of mangrove forests, *Ecological Engineering* 24(4 SI): 403-418<br><br>IUCN/SSC. 2013. *Guidelines for Reintroductions and Other Conservation Translocations*. Version 1.0. IUCN, Gland, Switzerland |
| **Coral reefs** | | |
| ✓ Identify and protect naturally resilient areas of coral<br>✓ Shading and cooling of limited areas<br>✓ Active seeding and restoration of coral polyps | Most responses reduce threat from physical disturbance (e.g. by anchors), regulating fisheries, controlling pollution (sewage, agricultural chemicals, oil from tankers etc.). Identifying resilient areas can help prioritise management, drawing on past bleaching episodes and predictive models. Resilience is connected with relatively low temperatures, shading and water movement; signs of pre-adaptation (e.g. highly variable temperatures); abundance of coral larvae; strong recruitment and connectivity. In small areas artificial shading can reduce bleaching and maintain living areas for regeneration | Marshall, P. and Schuttenberg, H. 2006. *A Reef Managers Guide to Coral Bleaching*, IUCN. NOAA and Great Barrier Reef Marine Park Authority<br><br>Grimsditch, G. and Salm, R.V. 2006. *Coral Reef Resilience and Resistance to Bleaching*. IUCN, Gland<br><br>Salm, R. and Coles, S. L. (eds) 2001. *Coral Bleaching and Marine Protected Areas*. Proceedings of a Workshop on Mitigating Coral Bleaching through MPA design. The Nature Conservancy, Honolulu |
| **Sand dune systems** | | |
| ✓ Build sand fencing, boardwalks etc. to rebuild dunes | To allow build-up of sand and reduce trampling damage – fencing can vary from professional fencing with posts, wires and slats to simpler breaks constructed of brash, forestry waste and similar. If restoration works, fences should eventually disappear under dunes | Brooks, A. 2001. *Sand Dunes: A Practical Handbook*. The Conservation Volunteers. UK handbook, so details of species not universally applicable<br><br>Dahm, J., Jenks, G. and D. Bergin. 2005. *Community-based dune management for the mitigation of coastal hazards and climate change effects*: A guide for local authorities, New Zealand, same limitations apply |
| ✓ Introduce pest and disease control to maintain native species | Invasive alien species can sometimes take over dune systems, reducing diversity and influencing the whole ecosystem: control is difficult once established so sanitary measures and early identification of alien species before they get established are both important. | |
| ✓ Plant native sand dune species on and adjacent to dunes | Planting should always be of native species and also use local varieties wherever possible; usually well landward of mean high water mark, and is especially important on the seaward slopes | |

| Adaptation option | Notes | Useful information |
|---|---|---|
| ✓ Artificial rebuilding of dunes | Use of imported sand should not usually be necessary: if it is, quarried sand should be sourced from areas where no ecological damage is done, with extreme care not to import invasive alien species, and should be covered with dune sand. | Van Aarde, R.J., Wassenaar, T.D. and R.A.R. Guildemond. 2009. *Dune Forest Restoration*. Pretoria. |
| ✓ Restore vegetation behind the dune | To act as a buffer inshore and to provide space for dune expansion in the event of coast erosion. | |
| **Seagrass meadows** | | |
| ✓ Identify and protect resilient seagrass beds within CMPAs<br>✓ Identify and foster patterns of connectivity<br>✓ Reduce threat from anchorage, trawling, tourist activity | 'Resilient sites' are likely to include those with: (i) high water quality (with at least 10 per cent of surface irradiation reaching the plants); (ii) favourable water movement (neither too still nor very active); (iii) good sediment conditions, with little disturbance and relatively low organic content (< 5 per cent) to avoid hypoxia and the risk of sulphide formation; (iv) high genetic diversity amongst the seagrass; (v) effective management | Björk, M., F. Short, E. Mcleod and S. Beer. 2008. *Managing Seagrasses for Resilience to Climate Change*. IUCN Resilience Science Group Working Paper Series number 3. IUCN, Gland, Switzerland |
| ✓ Plant native seagrass species to rebuild beds | Restoration is also possible although costly and with variable success; worldwide only 30 per cent of transplantation and restoration programmes have been successful. Key factors include choosing suitable sites and the best species: a number of useful guides exist to seed protection and transplantation. | Harwell, M.C. and Orth, R.J. 1999. Eelgrass (*Zostera marina* L.) seed protection for field experiments and implications for large scale restoration. *Aquatic Botany* 64: 51–61<br><br>Orth, R. J., Harwell, M.C. and J.R. Fishman. 1999. A rapid and simple method for transplanting eelgrass using single, unanchored shoots. *Aquatic Botany* 64: 77-85 |
| **Coastal salt marshes and wetlands** | | |
| ✓ Reduce threat from trampling, vehicles, pollution and drainage | Marshes and wetlands are often regarded as waste land, or as a hindrance to development. Explaining the value of coastal wetlands is an important first step towards their conservation. | DECCW. 2008. *Protecting and restoring coastal saltmarsh*. Department of Environment and Climate Change, New South Wales, Sydney<br><br>Crooks, S., Herr, D., Tamelander, J., Laffoley, D. and J. Vandever. 2011. *Mitigating Climate Change through Restoration and Management of Coastal Wetlands and Near-shore Marine Ecosystems: Challenges and Opportunities*, World Bank, Washington, DC. |
| ✓ Restore coastal marshes by restoring natural estuarine flow<br>✓ Restore eroded floodplains/ foreshores<br>✓ Plant keystone species to rebuild natural marsh vegetation | | Broome, S.W., Seneca, E.D. and W.W. Woodhouse. 1988. *Tidal salt marsh restoration*. Aquatic Botany 32 (1): 1-22 |
| ✓ Use t-fences (t-groins) | Fences and stone walls built at right angles to the shore can reduce erosion and drift effects of sand and gravel | |

| Adaptation option | Notes | Useful information |
|---|---|---|
| **Expanding the size of the CMPA and optimising boundary design** | | |
| ✓ Enlarging the total size of the CMPA<br>✓ Change boundary shape of CMPA to include critical habitat<br>✓ Change the boundary shape of the CMPA to allow for inshore expansion<br>✓ Connect two nearby CMPAs | Taking account of:<br>Climate change scenarios:<br>Habitats included: important breeding sites, especially sensitive habitats etc.<br>Refugia: projected to be resistant to climate change<br>Shape: minimising edges and maximising the core area<br>Connectivity:<br>Target driven: based around species of particular conservation concern<br>Land tenure and ownership: considering official and unofficial users<br>Community opinions<br>Cost effectiveness | Secretariat of the Convention on Biological Diversity. 2004. *Technical Advice on the Establishment and Management of a National System of Marine and Coastal Protected Areas.* CBD Technical Series no. 13, SCBD, Montreal |
| **Improving ecological connectivity** | | |
| ✓ Ensure that the CMPA is connected to other natural habitat, by expanding the protected area if needed | Work with protected area management, NGOs and local stakeholders | Worboys, G.L., Francis W.L. and M. Lockwood (eds). 2010. *Connectivity Conservation Management: A global guide*. Earthscan, London<br><br>Cowen, R.K., Gawarkiewicz, G., Pineda, J., Thorrold, S. and S. Werner (eds). 2002. *Population Connectivity in Marine Systems: Report of a Workshop*. National Science Foundation, USA |
| ✓ Increase landscape and seascape permeability by removing artificial barriers to movement of species in and outside CMPAs | Work with other stakeholders to restore suitable linking habitats beyond the boundaries of the CMPA (e.g. mangrove or seagrass restoration) | |
| **Management effectiveness and improving enforcement within the CMPA** | | |
| ✓ Undertake regular assessments of management effectiveness to improve success | Better management effectiveness leads to better conservation and ecosystem services. But the relationship is not simple: some threats may overwhelm good management. In addition, some ways of assessing management effectiveness are better at looking at management systems than management outcomes and over-reliance on these can give a false sense of security. | Hockings, M., Stolton, S., Leverington, F., Dudley, N. and J. Courrau. 2006. 2nd Edition. *Evaluating Effectiveness: A framework for assessing management effectiveness of protected areas*. Best Practice Protected Area Guidelines Series number 14. IUCN, Gland, Switzerland |
| ✓ Strengthen enforcement and anti-poaching activities | Changing climate, growing populations and large-scale commercial fishing operations increase pressure on fish stocks, including those in CMPAs. Managers and local fishing communities have common cause in effective anti-poaching. | |
| ✓ Liaise with local communities to improve management | In some cases, local communities may support and actively become involved in enforcement, for example to stop illegal off-take of marine resources by outsiders, while in others enforcement by CMPA authorities raises tensions and requires lengthy negotiation | Borrini-Feyerabend, G. 1996. *Collaborative Management of Protected Areas: Tailoring the approach to the context*. IUCN, Gland, Switzerland |
| **Resource-use management: no-take zones, closures, landing restrictions and fishing quotas** | | |
| ✓ Introduce fishing quotas | In CMPAs that allow some fishing, with agreed off-take, timing and named fishers | Martin, W., Lodge, M., Caddy, J. and K. Mfodwo. 2001. *A Handbook for Negotiating Fishing Access Agreements*. WWF US, Washington DC |
| ✓ Apply seasonal fishery closures within and around CMPAs | For example to take pressure off fish populations during the breeding season, or during annual aggregations, or migrations. | |

| Adaptation option | Notes | Useful information |
|---|---|---|
| ✓ Introduce restrictions on fishing tackle | Including controls on more damaging types of fishing within a CMPA (e.g. bottom dredging, and certain mesh sizes of nets) | Kelleher, G. (ed). 1999. *Guidelines for Marine Protected Areas. Best Practice Protected Area Guidelines number 3*. IUCN, Gland, Switzerland<br><br>Salm, R.V. and Clarke, J.R. with E. Siirila. 2000. *Marine and Coastal Protected Areas: A guide for planners and managers*. IUCN, Gland, Switzerland<br><br>Tapper, R. (ed) 2005. *User's Manual on the CBD Guidelines on Biodiversity and Tourism Developmen*t, CBD and UNEP, Montreal and Nairobi<br><br>Denman, R. 2001. *Guidelines for Community-based Ecotourism Development,* WWF UK, Godalming, Surrey |
| ✓ Restrict landing and anchoring for boats | Particularly around coral reefs or other sensitive habitats | |
| ✓ Control recreational activities such as jet skiing and diving | For example banning spear fishing by divers to reduce pressure on coral fish species | |
| ✓ Reduce pollution, litter etc. | For example working with local farmers to reduce agricultural pollution into coastal waters | |
| **Improved freshwater management** | | |
| ✓ Restore natural flow regimes | Maintaining hydrological balance to avoid severe water shortages, flood events and erosion in estuaries and near-shore areas, by maintaining natural flow patterns, avoiding excessive channelling of rivers upstream, managing floodplains etc. | Kingsford, R.T. and Biggs, H.C. 2012. *Strategic adaptive management guidelines for effective conservation of freshwater ecosystems in and around protected areas of the world*. IUCN WCPA Freshwater Taskforce, Australian Wetlands and Rivers Centre, Sydney |
| ✓ Reduce pollution from agrochemicals, sewage, sedimentation | Pollution from land and freshwater sources can change species composition in marine systems, stimulating algal blooms and killing fish and other marine species. | |
| **Biosecurity: control and mitigation of invasive alien species** | | |
| ✓ Develop CMPA processes for detecting and addressing invasive alien species when they occur | This could include rapid response mechanisms, educational programmes, invasive alien species specialists on the CMPA staff and basic quarantine regulations for visitors, divers, boats etc. | McNeely, J.A., Mooney, H.A., Neville, L.E., Schei, P.J. and J.K. Waage. 2001. *Global Strategy on Invasive Alien Species*, SCOPE, CAB International and IUCN<br><br>Wittenberg, R. and Cock, M.J.W. 2001. *Invasive alien species. How to address one of the greatest threats to biodiversity: A toolkit of best prevention and management practices*. CAB International, Wallingford, Oxon, UK |
| ✓ Build public awareness and engagement in invasive alien species, particularly with fishing and tourist groups | Signs and information about the most likely invasive alien species, with details about the damage they are likely to cause and where to report any sightings | |
| ✓ Promote sharing of information between CMPAs and other interested parties | Use networks such as GISP Early Warning Systems | |
| **Rare, threatened and endangered species** | | |
| ✓ Focus on the most important species | In adaptation policies, while it is important to address the whole ecosystem, species that are liable to become locally extirpated or globally extinct, because of their limited range or previous population collapse, need to be a particular focus for adaptive management. | Management plans, national and global Red Lists can all help to identify the critical species in a CMPA |

| Adaptation option | Notes | Useful information |
|---|---|---|
| **Socio-economic options** | | |
| **Alternative livelihoods and poverty reduction** | | |
| ✓ Employ local people within CMPAs, including as rangers | This can improve relations with the local community but can also put individuals under pressure, for instance if a relative or friend is poaching. Protected area agencies often have policies about qualifications that prevent people from local communities from advancing a career (e.g. if they have not finished schooling) and this can cause resentment. | Andam, K.S., Ferraro, P.J., Sims, K.R.E., Healy, A. and M.R. Holland. 2010. Protected areas reduced poverty in Costa Rica and Thailand. *Proceedings of the National Academy of Sciences* 107 (22) |
| ✓ Investigate alternative livelihood options to take pressure off key CMPA natural resources | This is a possibility, although if there were obvious alternative livelihood options they would likely have developed anyway. On the other hand, livelihood options linked to the CMPA – so that the success of the CMPA affects the livelihoods – can produce genuine change. | |
| **Capacity building** | | |
| ✓ Introduce capacity building for better understanding of climate change and adaptation options | People generally resent rules and restrictions if they don't understand what they are for. It is important to invest in education about the risks of climate change and the potential for adaptation as part of any programme. | Kropp, J. and Scholze, M. 2009. *Climate Change Information for Effective Adaptation*. GIZ, Eschborn, Germany |
| ✓ Build capacity to understand differential vulnerabilities and react to climate change, particularly amongst economically or culturally disadvantaged groups | Techniques can include material both for people with and without literacy skills: three-dimensional mapping, films, field visits etc. | Munang, R., Liu, J., Thiaw, I. and T. Kasten. 2010. Integrated Solutions for Biodiversity, Climate Change and Poverty, UNEP Policy Series, Policy Brief 1. UNEP, Nairobi |
| ✓ Build climate information and communication systems accessible to the most vulnerable, which can be used to inform adaptation decisions | This can include technical approaches such as flood hazard mapping | McFadzien, D., Areki, F., Biuvakadua, T. and M. Fiu. Undated. *Climate Witness Community Toolkit*. WWF South Pacific, Fiji |
| ✓ Introduce disaster risk reduction training | Specific training on how best to limit the damage caused by disrupted and extreme weather events, making links to use of natural ecosystems within the MPA as buffers against storm surge, high winds etc. | Murti, R. and Buyck, C. (eds) 2014. *Safe Havens: Protected Areas for Disaster Risk Reduction and Climate Change Adaptation*. IUCN, Gland, Switzerland |
| ✓ Facilitate networks | CMPAs can help to build capacity more indirectly, by fostering interchange of information, between communities in or near the protected area itself and between different CMPAs | |
| **Ecotourism** | | |
| ✓ Promote codes of practice for responsible tourism | Codes should focus on both the way in which tourism is developed by the CMPA and local communities, and also on what is expected in terms of tourist behaviour. | Denman, R. 2001. *Guidelines for Community-Based Ecotourism Development*. WWF International, Gland, Switzerland<br><br>CBD and UNEP. 2007. *Managing Tourism and Biodiversity*. SCBD, Montreal: detailed guidelines<br><br>Narain, U. and Orfei, A. 2012. *Biodiversity, Nature-Based Tourism and Joobs*. The World Bank, Washington, DC<br><br>Eagles, P.F.J. and Legault, M.K. 2012. *Guidelines for the Planning and Management of Concessions, Leases, Licenses, and Permits in Parks and Protected Areas*. University of Waterloo, Ontario, Canada |
| ✓ Work with tourism operators to agree strategies and principles | This could include for example agreements to provide a certain amount of profits to local communities, or to CMPA management; to employ local guides, cooks etc., and to minimise damage during tourist visits. | |
| ✓ Obtain support from visitors and tour operators | Through explanatory signage and material, talks with visitors, working with tourism operators to ensure they understand what is happening, etc. | |
| ✓ Manage impacts of tourism (e.g. sewage and litter, disturbance, water use) | Work with tourist operators to reduce impacts | |

| Adaptation option | Notes | Useful information |
|---|---|---|
| **Financing options and other forms of support** | | |
| ✓ Support innovative approaches to climate adaptation | The CMPA can provide or facilitate financial support, training or marketing help for people prepared to experiment with innovative ways of addressing climate change, through diversification, develop partnerships to help share costs of change, and otherwise reward early adapters. | |
| ✓ Help to develop Payment for Ecosystem Service schemes | The CMPA may be able to negotiate Payment for Ecosystem Service schemes that rewards the protected area and resident or local communities for managing natural resources that help mitigate or adapt to climate change | Pagiola, S., Bishop, J. and N. Landell-Mills (eds). (2002) *Selling Forest Environmental Services: Market-based mechanisms for conservation and development,* Earthscan, London, UK |
| **Engineering options** | | |
| ✓ Build artificial reefs, levees and breakwaters<br>✓ Apply hybrid options (e.g. combining engineering and ecosystem approaches) | Natural barriers will not always be sufficient protection, nor do they occur or can they be restored on all coastline vulnerable to climate change. Engineering solutions, and hybrid solutions containing a mixture of engineered and ecosystem responses, are sometimes needed even inside CMPAs. When engineering solutions are employed, particular care must be taken within CMPAs to ensure that they do not undermine existing natural defences. | UNISDR/UNDP 2012. *A Toolkit for Integrating Disaster Risk Reduction and Climate Change Adaptation into Ecosystem Management of Coastal and Marine Areas in South Asia.* UNDP, New Delhi |
| **Crosscutting options** | | |
| ✓ Enact policy interventions at local or national government level | Some changes may be too big for the CMPA to achieve on its own; at that stage work with government officials may be needed to help revise relevant laws and policies; usually part of a long-term process of change | |
| ✓ Awareness raising amongst local communities and visitors to the CMPA | A CMPA has the opportunity to raise awareness about both climate change and adaptation options, because people come to visit and because local communities usually interact with the protected area on a regular basis | UNEP. 2006. *Raising Awareness about Climate Change.* UNEP, Geneva |
| ✓ Monitor impacts of climate change over time, and effects of adaptation | In many cases when trends are still not very clear, regular monitoring can help adaptive management | Bours, D., McGinn, C. and P. Pringle. 2014. *Monitoring and evaluation for climate change adaptation and resilience: A synthesis of tools, frameworks and approaches.* SEA Change CoP and UKCIP, Phnom Penh and Oxford |
| ✓ Translocate or relocate people if they are in danger from rising seas | This is a last resort option. But in the event of major loss of coastline, the CMPA may be in the position of helping nearby communities to relocate. | Hall, C., Lillywhite, S. and M. Simon. 2010. *Guide to Free Prior and Informed Consent.* Oxfam Australia, Carlton, Victoria |

## Activity 6.2: Run a workshop to assess and refine adaptation options

Whether in the Adaptation Working Group, or in an open meeting where some people may know almost nothing about the subject, a logical way is needed to choose between different adaptation options. The framework below attempts to do this. Assessment here means looking at the costs and benefits of each option. The framework outlined in Figure 11 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 together might influence the decision 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 they 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). So at this stage the Adaptation Working Group will be drawing on a wide range of information collected during the VA stage; and including both climate and non-climate threats in their considerations. A climate adaptation option that also addresses other issues, like fish stocks or protection against storms, is likely to attract far more stakeholder support. Promoting ecotourism is likely to be supported if it brings extra jobs and money to the community.

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 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 socio-economic benefits. This is the critical first step in any assessment of options; the action is pointless unless there is good reason to believe it will provide a marked adaptation benefit. And it will be even better if the action also provides other benefits. So there might be good reason to think that restoring mangroves will provide adaptation benefits against storms and sea-level rise. But it will also provide additional ecological benefits in terms of providing spawning and breeding grounds for fish, which in turn will have socio-economic benefits in building fish stocks for local fishing communities. On the other hand, replanting species to restore marsh vegetation might be good for providing protection against future flooding but would have few immediate socio-economic benefits. This first stage looks at what a particular adaptation option brings to different stakeholders.
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. This is the other positive set of reasons for looking at a particular adaptation option. Is it supported by the law? Is the community likely

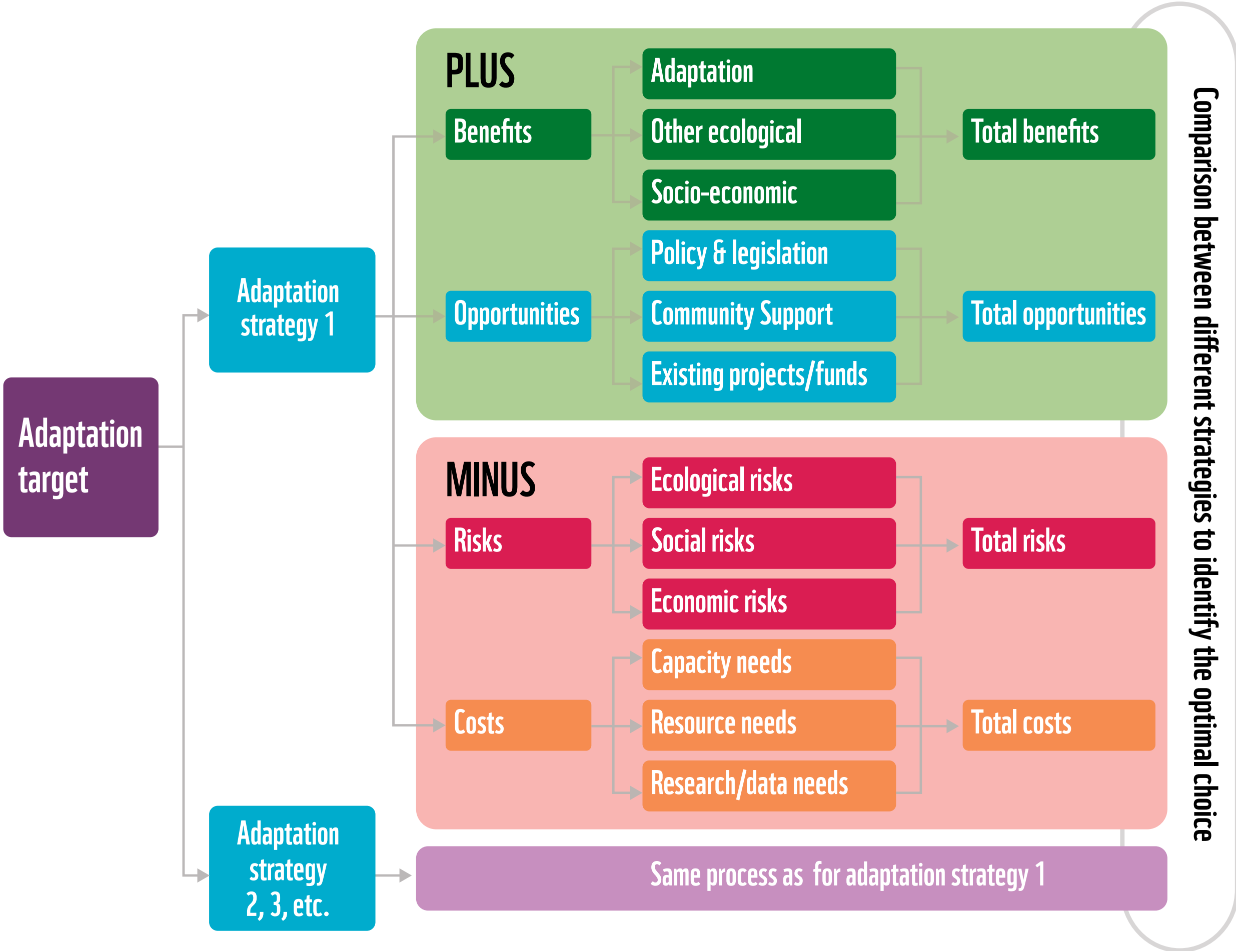



*Figure 11: Conceptual framework for assessing adaptation options in protected areas*

to be enthusiastic? Are there already existing projects or programmes that could include the action without excessive extra costs? Local people are likely to be much more enthusiastic about things that bring benefits in the short term, or that don't interfere with their lives or livelihoods. But enlarging the total size of the CMPA may be viewed with much more caution if people think this will mean further lack of access or restrictions on fishing, dive operations and so on.

3. **Risks** of ecological side effects, detrimental social impacts and economic risks. The last two parts of the assessment look at some of the potential problems of any action. What are the risks? An expensive mangrove restoration might fail, in which case none of the benefits will be realised. Bringing in temporary or permanent fishing restrictions might boost fish stocks but could have an immediate impact on the livelihoods and nutrition of people in fishing communities, many of whom will have few other options to make a living. Here we are looking both at whether or not a particular climate adaptation action will work, and also at whether the socio-economic side effects of a backlash against the CMPA may outweigh the potential benefits. All adaptation actions are necessarily trade-offs between different wants and needs; this part of the analysis tries to identify some of the things that can go wrong.

4. **Costs** including capacity needs to implement the adaptation, the resources needed and whether or not further research or information is needed. Benefits must also be balanced against costs: the money, equipment and peoples needed to carry out the assessment; the skills required, and possibly the need for additional information and research. Can staff and local communities work together to do something, like planting mangroves, or will it be an expensive operation buying in labour and seedlings? Can ecotourism be encouraged with current facilities or does it require expensive investment in places to stay, boats, diving equipment and the like? In this section participants need to be very clear about whether the skills to do the adaptation action exist in the protected area and whether it is realistic to expect to raise the funds.

The draft list of options in Worksheet 21 is just a start. Some groups will prefer to talk through the options; others may like to carry out a more rigorous assessment using an agreed methodology. A workshop is critical for making decisions about which, if any, type of adaptation to implement. The way decisions are reached will depend on the particular dynamic and skills of the group and the cultural context. 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 deciding, particularly 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 22 and Figure 11.
3. Some more complex form of multivariate analysis that can provide some form of comparative ‘score’: also possible using a scoring system with Worksheet 22.

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 takes the elements of Figure 11 and allows you to record a narrative assessment of each adaptation option (listed along the top row of the worksheet). As well as a narrative, Worksheet 22 can be used to assign a value (very high, high, medium, low) or even a score (see scoring benefits and opportunities and example of scoring Worksheet 22). The adaptation strategies with the highest scores would tend to be the most attractive option. But this should not be taken as automatic: there may be one factor that over-rides all the others: for example a low-scoring option may be chosen because there is already a project that can take it on, making it also a low risk option. Alternatively something that looks good may be impossible because of entrenched opposition from some parts of the community. So the score can only ever be an indication.

### Worksheet 22: A simple, comparative framework for analysing different adaptation options

| Issues influencing decision | Adaptation option 1 | Score | Adaptation option 2 | Score | Adaptation option 3 | Score |
|---|---|---|---|---|---|---|
| **Benefits: what the action will provide** | | | | | | |
| Adaptation benefits | | | | | | |
| Other ecological benefits | | | | | | |
| Socio-economic benefits | | | | | | |
| **Opportunities: existing things that might make the option more attractive** | | | | | | |
| Policy and legislation | | | | | | |
| Community support | | | | | | |
| Existing projects | | | | | | |
| **Risks: which could undermine the action, either through it not working, or creating resistance from communities, or financial risks** | | | | | | |
| Ecological / adaptation risks | | | | | | |
| Social risks | | | | | | |
| Economic risks | | | | | | |
| **Costs: in terms of money, time, resources, skills, and further collection of information and data** | | | | | | |
| Capacity needs | | | | | | |
| Resource needs | | | | | | |
| Research and data needs | | | | | | |

| Score | For benefits and opportunities |
|---|---|
| 4 | Very high |
| 3 | High |
| 2 | Medium |
| 1 | Low |
| 0 | Not applicable |
| | **For risks and costs** |
| -4 | Very high |
| -3 | High |
| -2 | Medium |
| -1 | Low |
| 0 | Not applicable |

**Worksheet 22: Illustrative example**

| Issues influencing decision | Mangrove restoration | Building seawall | Restoration of coastal dunes | Protection of coral from boats |
|---|---|---|---|---|
| **Benefits: what the action will provide** | | | | |
| Adaptation benefits | Protects against storms and sea-level rise | Protects against storms and sea-level rise | Protects against storms and sea-level rise | Protects against storms and sea-level rise |
| Other ecological benefits | Supports a wide range of biodiversity | Few other benefits | Supports range of biodiversity | Supports very rich biodiversity |
| Socio-economic benefits | Likely to increase fishing stocks for local communities | In short term possible jobs in the community | | Possibly increased ecotourism |
| **Opportunities: existing things that might make the option more attractive** | | | | |
| Policy and legislation | National laws say mangroves should be preserved | | | National laws to protect coral reefs |
| Community support | Mixed reaction from local community, basically positive | Mixed reaction from local community | Community fairly neutral | Mixed, some fear hindrance to fish and dive tourism |
| Existing projects | No existing projects | No existing projects | No existing projects | No existing projects |
| **Risks: which could undermine the action, either through it not working, or creating resistance from communities, or financial risks** | | | | |
| Ecological / adaptation risks | Small risk of restoration failing | If built in wrong place could undermine CMPA | Small risk of restoration failing | None |
| Social risks | Likely backlash if fish stocks do not obviously expand | | No serious risks | Backlash from parts of fishing and tourism industry |
| Economic risks | Small, mangroves can be planted by volunteers | Very costly exercise | Low costs | Fears of dive tourists going elsewhere |
| **Costs: in terms of money, time, resources, skills, and further collection of information and data** | | | | |
| Capacity needs | Basic understanding of mangrove restoration | Skilled labour, structural engineers | Basic understanding of sand dune restoration | None |
| Resource needs | Organisation of volunteers | Relatively large investment | Small investment, need to pay labourers to build fences | Extra policing of the reef |
| Research and data needs | None | Understanding of tidal process and likely path of tsunami | None | Perhaps more data on current level of damage from boats |

**Worksheet 22: Example from Ambodivahibe protected area, Madagascar**

| Issues influencing decision | Mangrove restoration | Score | Water supply | Score |
|---|---|---|---|---|
| **Benefits: what the action will provide** | | | | |
| Adaptation benefits | Mangroves provide natural barrier against cyclones | 3 | Makes people more resilient (at present they have to walk for more than 9 km for water) | 4 |
| Other ecological benefits | Restoration of mangroves destroyed by former cyclones bring many ecological benefits (nurseries for small fish, etc.) | 2 | Less pressure on fishing as agriculture becomes more feasible | 2 |
| Socio-economic benefits | Increasing fish stocks | 2 | Domestic water problem solved | 4 |
| **Opportunities: existing things that might make the option more attractive** | | | | |
| Policy and legislation | There is scope to influence policy | 3 | | 3 |
| Community support | Community already involved in MPA management | 2 | Water committee composed of local community is under creation | 3 |
| Existing projects | There is another project implemented by CI that can support this initiative | 2 | Similar initiative by CI underway | 2 |
| **Risks: which could undermine the action, either through it not working, or creating resistance from communities, or financial risks** | | | | |
| Ecological / adaptation risks | Stronger cyclones undermine restoration activities | -1 | Will it have the desired effect? | -1 |
| Social risks | It is a new activity for local communities | -2 | Potential community conflicts with regards to access to water | 0 |
| Economic risks | Linked to adaptation and social risks | -1 | Financial implications | -1 |
| **Costs: in terms of money, time, resources, skills, and further collection of information and data** | | | | |
| Capacity needs | Support from experts needed | -2 | Local expertise limited, outside support required | -2 |
| Resource needs | Not so high | -2 | This is quite expensive | -3 |
| Research and data needs | There is little capacity on mangrove restoration | -2 | There is need for research here | -2 |
| **Score** | | **4** | | **9** |



Local fisherman in a village next to Nosy Hara Marine Protected Area in Madagascar

# STEP 7
# DEVELOP AND VALIDATE ADAPTATION PLAN

This step turns shortlisted adaptation actions into a usable adaptation plan.

Once a shortlist of adaptation actions has been selected, the Adaptation Working Group works out the practical steps needed to put them in place. These are best laid out in a clear action plan with activities, responsibilities, timetable and budgets all carefully worked out.

The development and validation of the adaptation plan is necessarily an iterative process; some of the ideas on Worksheet 22 may become less attractive once draft budgets have been developed and all the implications thought through. So while drawing up the plans it may be necessary to come back to other stakeholders and think through abandoning or modifying some options. The adaptation plan will have most chance of being implemented if it is seen as part of the day-to-day running of the protected area, for example by being integrated into an existing management plan, work plan or long-term project. However long it takes, by the end of this step protected area managers should have turned the adaptation options developed in Worksheet 22 into a set of adaptation actions that can be applied to the protected area.

## Developing adaptation plan

- **Purpose:** to work out in detail how to implement the chosen adaptation options.
- **Inputs and resources required:** the final choice of climate adaptation actions, along with details of costs, staff and other workers available, etc.
- **Expected results:** a detailed action plan.

## Activity 7.1: Draw up adaptation plan

The initial analysis and workshop should result in a draft list of options – potential adaptation actions – 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, which will be developed by the Adaptation Working Group or people they delegate. Ideally this should be incorporated into the site management plan. Table 13 lays out what the plan might include.

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 clear about what is entailed and the protected area can monitor progress. As part of the adaptation plan, each of the selected actions needs a summary of the adaptation option, or options, that relate to its achievement. Worksheet 23 provides a quick way of summarising information from the decisions of the workshop; this draws from Worksheets 21 and 22 but focuses on the options that have been selected for implementation.

### Worksheet 23: Information on each adaptation option

| Target | Adaptation option | Adaptation action | Responsible | Period |
|---|---|---|---|---|
| Name | | | | |
| | | | | |
| Name | | | | |
| | | | | |

### Worksheet 23: Example from IGACOS, Philippines

| Target | Adaptation option | Adaptation action | Responsible | Period |
|---|---|---|---|---|
| Protection against storm surge, sea level rise and other climate hazards | Mangrove reforestation | Training on beach and mangrove forest management | City Environment and Natural Resources Office, barangay officials, local community organization | October 2014 |
| | | Improvement of existing mangrove nurseries and set up of new ones in other barangays | | June – October 2015 |
| | Coral reef protection | Installation of mooring buoys in identified frequently dived areas (Coral Garden, within the Dadatan and Linosutan MPAs) | City Local Government Unit, City Fisheries department, barangay officials, MPA managers, community members | Ongoing - applied as soon as agreed (since August 2014) |
| | | Installation of marker buoys in the MPAs (Sanipaan MPA, Camudmud MPA, Tagbaobo Fish Sanctuary, San Remigio MPA, Cogon MPA, Dadatan MPA and Linosutan MPA) | | |
| | | Updating of MPA management plans for Dadatan, Linosutan and Cogon MPAs | | |
| | Proper zonation of areas | Updating of Comprehensive Land and Water Use Plan for IGACOS | City Local Government Unit, barangay officials, NGOs | Ongoing - applied as soon as agreed (since August 2014) |
| | | GIS Training for Local Government Unit staff to help in the mapping/ updating of maps | City Local Government Unit | January 2015 |
| | | Online mapping system application for IGACOS | City Local Government Unit, other stakeholders | October 2015 |
| | Increased knowledge on climate hazards to minimize impacts | Conduct trainings on climate adaptation and climate hazards | City Disaster Risk Reduction and Management Council, barangay Local Government Units, Department of Education | November 2014 |
| | | Provision of information, education and communication materials to barangays, including hazard maps per barangay | Barangay Local Government Units, community members | November 2014/ October 2015 |

**Table 13: Structure of the adaptation plan**

| Section | Details | Pages |
|---|---|---|
| Background | Description of site and targets | 1-2 |
| Overview | Summary of VA results and adaptation options | 1-2 |
| | CAMPA flowchart | 1 |
| Adaptation activities | A detailed set of steps towards each potential adaptation action, laying out precisely what needs to happen | 5-7 |
| Implementation | Chart summarising each adaptation action along with brief details of what is required, who is responsible, along with a timetable for putting the actions into place – see Worksheet 23 for format | 2 |
| Monitoring and evaluation | Details of how the various adaptation actions will be measured, presented as a chart including indicators (refer to Worksheet 24) | 2 |
| Budget | A budget, that costs out each of the various aspects involved in implementing the adaptation action, including as necessary staff time, consultants' time, purchase of equipment, seeds, etc., land purchase, community compensation, etc. (including funding needs if applicable) | 1 |
| Contacts | Key contacts, both those responsible for implementing the actions and other stakeholders who will oversee or be consulted | 2 |

## Activity 7.2: Validate adaptation plan with stakeholders

Once the plan has been prepared it needs to be checked back with all relevant stakeholders to ensure that it matches workshop decisions; that nothing important has been left out; and that no decisions have been changed, distorted or reversed. The extent to which this is needed depends on the existing levels of trust between the protected area and the local community, and the level of community involvement expected in implementation, but some checking is always necessary.

In most cases this can be a smaller and more informal process than the workshop/s outlined above, because the main issues will already have been discussed. However it will be 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 have been involved in drawing up the action plan.)

It is also important that people know the plan is 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 disseminate information. Local and community radio stations are also often very good sources of publicity. Copies could be at the protected area 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 be available. In cases where particularly contentious issues remain, another workshop may be necessary.

Unless there are major disagreements, 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.

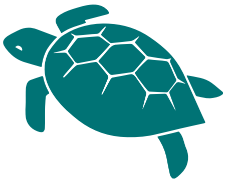
© Danny Ravelojaona / WWF Madagascar

Community mangrove planting in Madagascar

# STEP 8
# IMPLEMENT, MONITOR AND ADAPT MANAGEMENT

This last step provides practical advice on implementing your adaptation plan, monitoring progress and practicing adaptive management.

Implementation is the most important part of all; when the time taken in identifying problems and coming up with solutions pays off in doing something positive to help ecosystems and communities to adapt. But the process doesn't stop there. We still know comparatively little about how to adapt to climate change and in this situation it is even more important than usual to monitor implementation, see what is working and what may not be, and adjust as you go along – so called adaptive management. This last section explains how.



The process draws on three main outputs:

1. A list of likely climate impacts and adaptive capacity factors for the targets derived from the VA (see specifically Worksheets 16 and 17 and summary in Worksheet 20).
2. An assessment framework to compare various possible adaptation options to address the threats to key targets, based on the outcomes of the VA (developed in Action 6.2).
3. A draft list of possible adaptation options (which can be expanded during the assessment) (see Table 12).

This is not a 'how to' manual on adapting coastal and marine protected areas to climate change, but a structured approach to helping stakeholders decide which adaptation approaches are most suitable. There is certainly no standardised adaptation option for each target as it depends on VA results and the general context of the area.

## Implement and adapt

- **Purpose:** to implement the action plan, monitor and adapt to ensure success.
- **Inputs and resources required:** the action plan and an agreed monitoring plan.
- **Expected results:** a successful process that can adapt and learn as it goes along.

## Activity 8.1: Implement the chosen actions

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 adaptation action, there are several things worth bearing in mind which are outlined in Table 14.

**Table 14: Checklist of things to think about during implementation**

| Steps |
|---|
| **Explain what is happening** |
| ✓ Explanatory notices in the protected area, which can be handwritten notices but should be up to date and should present projects as a positive management response rather than simply something that is disruptive |
| ✓ Letters to local authorities |
| ✓ Notices in the village, renewed as implementation develops |
| ✓ Use local press and radio to publicise implementation |
| ✓ Keep the protected area website page up to date |
| ✓ Tell people about activities via social media |
| ✓ Take plenty of photographs before and during activities |
| **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 (including the Adaptation Working Group members) |
| **Identify responsibilities** |
| ✓ Draw up a list of different responsibilities within the plan |
| **Keep to the agreed schedule** |
| ✓ Appoint a 'timekeeper' to check progress on implementation |
| ✓ 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 |
| ✓ Ensure invasive species are not accidentally introduced |
| **Minimise social disturbance** |
| ✓ Ensure that potential social disruption from outside workers or consultants are managed |
| **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 |

## Activity 8.2: Develop monitoring

Monitoring is a critical factor in any process that needs to be considered at planning stage and implemented throughout. The IUCN WCPA has developed a set of best practice guidelines for tracking progress in management effectiveness of protected areas and the monitoring system proposed here follows this framework. An increasing number of protected areas are already carrying out regular management effectiveness assessments and if this is the case in the protected area under consideration then the adaptation plan monitoring system could simply be integrated with this assessment or into other existing monitoring plans.

If not, a stand-alone monitoring system will be needed. As this is monitoring the implementation of the adaptation action plan, rather than the whole protected area, it can be somewhat simpler than a full assessment. IUCN recommends that protected area management effectiveness assessments look at six broad areas (Hockings et al, 2006):

- The **context** of the protected areas (its values, threats facing the area etc.)
- The **planning** in terms of both the size and location of the protected area but also the quality of the management plan and work plans
- The **process** of management and how effectively this takes place
- **Inputs** to the protected area, in terms of the adequacy of staff numbers, training, capacity, equipment, infrastructure etc.
- **Outputs**, meaning whether work plans are being achieved and planning objectives met
- And finally and most importantly **outcomes**, relating to whether the management is delivering the core objectives of the protected area such as biodiversity conservation, ecosystem services and social and cultural values.

The research building up to the adaptation planning and the VA should already have supplied necessary information for an understanding of protected area context and planning; the monitoring process and the adequacy of inputs remain important. However, most important of all in the current context is monitoring the outputs of the actions in terms of whether or not objectives identified in the adaptation plan are being met, and the outcomes in terms of successful climate adaptation. Five aspects are important:

**Outputs:** whether the adaptation action plan 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) – this will also monitor the immediate success or failure of the adaptation actions, such as area of mangroves restored, number of educational programmes run and so on.
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; this section monitors whether or not the adaptation action has the wider effect or effects identified in the plan
4. **Biodiversity impacts:** 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 protected area and the adaptation work, to quantitative data such as impacts on local incomes and flood mitigation costs.

A good monitoring system is recognised as a critical element of success, because it provides information that allows managers to adapt continually in response to the information gathered. There are numerous guides to developing monitoring systems. Monitoring usually only works if it is relatively simple, cost effective and maintained over the long term, including the establishment and implementation of monitoring protocols to standardise data collection. Here it is suggested that the Adaptation Working Group liaise with CMPA staff to identify a relatively small range

### Worksheet 24: A monitoring framework for CAMPA

| Outputs of CAMPA project | | | |
|---|---|---|---|
| **Keeping to the timetable** | | | |
| **Stages of adaptation action** | | **Target deadline** | **Actual time** |
| 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 CAMPA project** | | | |
| **Climate adaptation actions** | | | |
| **Indicator** | **Way of measuring** | **Baseline data** | **Data at end of monitoring** |
| | | | |
| | | | |
| **Biodiversity impacts** | | | |
| **Indicator** | **Way of measuring** | **Baseline data** | **Data at end of monitoring** |
| | | | |
| | | | |
| **Socio-economic impacts** | | | |
| **Indicator** | **Way of measuring** | **Baseline data** | **Data at end of monitoring** |
| | | | |
| | | | |

of indicators that together represent 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 adaptation. Worksheet 24 outlines a possible system. So for example, if a CMPA identified mangrove restoration, voluntary fishing controls and community education about climate change and adaptation as the three key actions they are going to undertake, the monitoring system given as an example of Worksheet 24 might emerge.

Monitoring long-term outcomes is always difficult. Note that in the example given above, changes in fish stocks might be affected by both the mangrove restoration and / or the changes in fishing practice, or by other factors altogether. By sampling young fish in the mangrove the monitoring team can gain a little more insight into the role of mangrove restoration (if there are a lot of fish in the restored area then it suggests overall populations have probably increased) but many uncertainties will remain. Perceptions of local people are very important: if they feel that the adaptation has been a success, due to their intimate relationship with the marine environment and their incentive in terms of food and income, then this is a big pointer to success.

## Worksheet 24: Illustrative example

**Monitoring framework for CAMPA**

**Outputs of CAMPA project**

**Keeping to the timetable**

| Stages of adaptation action | Target deadline | Actual time |
|---|---|---|
| Restore 5 ha mangroves to protect shore and rebuild fish stocks | September 2015 | December 2015 |
| Introduce voluntary fishing control agreements worked out with local community to maintain fish stocks | September 2015 | August 2015 |
| Run community educational programme on climate adaptation | December 2016 | Ongoing |

**Keeping to budget**

| Budget by item | Target cost | Actual cost |
|---|---|---|
| Costs of labourers to fence mangroves | $$$ | $$$$ |
| Fencing materials | $$ | $$ |
| Cost of seed planting of mangroves | $$$ | $$$$ |
| Cost of workshop plus facilitator fee to work out fishing controls | $$$ | $$$ |
| Cost of writing and printing community educational materials | $$ | $$$ |
| Costs of training workshops | $$ | $$$$ |

**Outcomes of CAMPA project**

**Climate adaptation actions**

| Indicator | Way of measuring | Baseline data | Data at end of monitoring |
|---|---|---|---|
| Overall fish stocks | Standardised sampling methods | Numbers | Numbers |
| | Records of fish catch | Fish catch | Fish catch |
| Population of young fish in mangroves | Sampling | Numbers | Numbers |
| Awareness of climate adaptation amongst the local community | Interviews | Responses | Responses |

**Biodiversity impacts**

| Indicator | Way of measuring | Baseline data | Data at end of monitoring |
|---|---|---|---|
| Health of marine biodiversity in the protected area | Sampling to check on presence of expected marine species | Species list | Species list |
| Populations of rare species | There might be justification for specialised sampling if the CMPA protects particular rare species | Presence of rare species | Presence of rare species |

**Socio-economic impacts**

| Indicator | Way of measuring | Baseline data | Data at end of monitoring |
|---|---|---|---|
| Income of families involved in local fishing | Average annual income before and after adaptation actions | Average annual income | Average annual income |
| Attitudes towards the protected area | Surveys | Responses | Responses |

## Activity 8.3: Practise adaptive management

Monitoring is only worth doing if the results are used. Monitoring results therefore shouldn't simply be recorded in a book and stacked on a shelf, or filed away in a computer. The protected area staff need to sit down regularly together and analyse results to see what is working and what isn't, and to take action where things are not going to plan. This might be simple things like trying to speed up an action that is taking longer than it should, or looking for ways to trim the budget if a particular action has been costing more than expected. Or it could be investigating why even though an action has been apparently successful the hoped for results haven't emerged; for example if despite having restored mangroves fish stocks are still declining.

Changing things during the implementation process in response to lessons learned is known as adaptive management; a definition is given in Box 10.

**Box 10: definition of adaptive management**

The National Research Council in the United States defines adaptive management as follows: …flexible decision-making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process (Williams et al., 2009)

Adaptive management is particularly important in climate adaptation processes, when the world still has so much to learn and every action is an experiment. By keeping an eye on what is happening, responding to failures and successes and tailoring management decisions to what works, every process can also help build our understanding of a rapidly changing situation, as well as addressing immediate ecological and socio-economic issues within the protected area.

The CAMPA process is therefore designed as a cycle; assessment of monitoring results allows protected area managers and the Adaptation Working Group to adjust plans in light of experience. As more is learnt about adaptation to climate change, both at a global level and in a particular site, CAMPA encourages development and application of best practice to maximise the chances of success.

# PART IV
## CASE STUDIES

The following three case studies from Colombia, Madagascar and Philippines outline how the whole process was undertaken in specific CMPAs in each country. Each was quite different, the process itself adapting to the local context and ongoing conservation / climate change initiatives. They highlight that there is no blueprint for undertaking this work, but provide many insights into the ways in which the methodology can strengthen protected area 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 COLOMBIA

## Gorgona and Sanquianga National Natural Parks, Colombia

*Oscar Guevara, WWF-Colombia and Julio Herrera, Consultant*

© Gustavo Castellanos / WWF Colombia

Amazing mangrove trees of Sanquianga National Natural Park in Colombia

*The approach of the case study is one of narrating the methodologies and activities, from the first experience of a learning process on how to identify and assess climate risks, to the current commitment to identify and implement adaptation actions as part of protected areas management strategies.*

## Introduction

This case study gives a brief overview of activities since 2011 by WWF Colombia and the National Parks Authority in two National Protected Areas (known in Colombia as National Natural Parks): Sanquianga and Gorgona. It offers 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 on how to identify and assess climate risks, to the current commitment to identify and implement adaptation actions as part of protected areas management strategies.

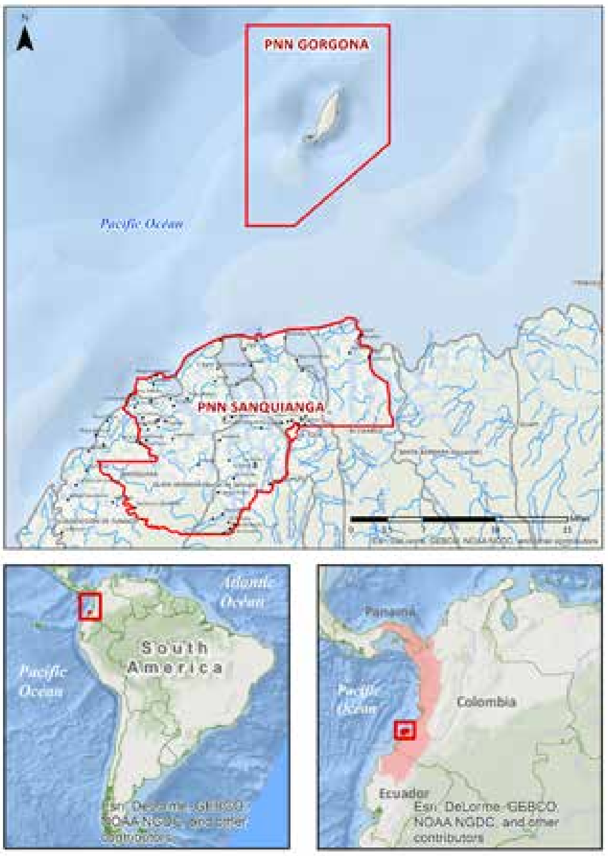
In particular, the EU project's goal for Gorgona and Sanquianga was to help develop and test the CAMPA framework methodology, mainstreamed to support stakeholders in identifying climate risks, existing adaptive capacity, and adaptation strategies and actions that can help build the resilience of ecosystems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

## Site description

***Figure 12: Gorgona and Sanquianga National Natural Parks, Colombia***

*Key*

- ● Towns
- — National Natural Park




Gorgona and Sanquianga National Natural Parks are located in two adjacent ecoregions: (i) The Choco Darien terrestrial ecoregion; and (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' (WWF Global Ecoregions, undated). The Choco Darien Ecoregion 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' (WWF Global Ecoregions, undated). The Tropical Eastern Pacific (TEP) – Panama Bight ecoregion 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 per cent in 1998, 74 per cent in 2001, 62 per cent in 2007), something rarely found in the Caribbean.

**Sanquianga National Natural Park**
Sanquianga is located on the southwest Pacific coast of Colombia. A protected area of 80,000 ha, established in 1977, it protects a complex estuary delta system formed by the Sanquianga, 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 species is found within the mangrove ecosystems including molluscs, crabs and the piangua shellfish (*Anadara tuberculosa*). Sanquianga 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 protected area 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 also harbours 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 south-western 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 protected area, and practise a combination of activities including fishing, farming, extraction of resources from the mangroves (firewood, logging, crabs etc.), and gold mining.

Sanquianga is managed by National Parks (Special Administrative Unit of the National Natural Parks System). Due to the fact that it does not have facilities for tourists, there is no record of the number of people who visit the protected area each year. However, it is estimated that only a couple of hundred people, most of them researchers and NGOs, visit the area every year.

**Gorgona National Natural Park**
Gorgona is an island in the Pacific Ocean located about 35 km off the Pacific coast of Colombia and separated from the continent by an 80 m 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 per cent. 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 harbours 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 harbours 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 3,200 people visit the park each year, predominantly for scientific purposes, snorkelling and diving.

## Climate smart conservation and mainstreaming climate adaptation

At the time of the EU project (2011-2015), there were two main opportunities to integrate climate adaptation into protected area conservation planning and to consolidate an approach to climate smart conservation:

1. Build on the existing management framework, adopted as the standard for planning conservation management in all national-level protected areas.

2. Use our experiences to inform the development of the project's conceptual framework (the CAMPA). Our theory of climate smart conservation was based on identifying opportunities to assess climate risks and adaptive capacity, and to identify and prioritise adaptation actions, in a participatory manner using the best available information and resources available to us.

The national system of protected areas in Colombia has a history of evolution and development. The first protected area was established in 1960, since then, Colombia has designated 56 national natural parks and developed a number of management tools integrated into a macro-process, known as 'Protected Areas Planning and Management Framework' (see Figure 1). This framework is divided into sub processes that offer an exceptional opportunity to mainstream climate adaptation actions, including : (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 management strategies for PAs.

The CAMPA framework methodology was tested and validated in Gorgona and Sanquianga. Working with WWF the protected areas adopted an approach to mainstream this work into park management planning through four critical steps. This offered an opportunity to promote the relevance and validity of climate vulnerability and risk assessments and also promote the Climate Smart Conservation approach to the Management Framework on Coastal and Marine Protected Areas in Colombia. The four steps were:

1. **Units of analysis:** The main starting point for integrating the Protected Area Management Framework and the CAMPA were the units of analysis. As such, in Colombia we took the decision to use the protected areas' conservation targets corresponding to ecosystems (coarse filter) and species (fine filter) as the units of analysis.

2. **Hazards and drivers of change:** It was agreed to expand the context in which to identify and prioritise threats and pressures on protected areas, looking at those that may be associated with changes in climate and oceanographic average conditions, variability or extreme weather and oceanographic events and a series of pressures and threats of an anthropogenic nature.

3. **Risk assessments and risk scenarios:** This step builds on the previous assessments of hazards and drivers of change, and establishes the conceptual relationship between the protected areas' conservation targets and the prioritised hazards. In Colombia, National Parks and WWF established 'risk metrics' for each conservation target, using the indicators of ecological integrity for each target, and defining if those indicators are likely to be affected for different hazards (including climate related hazards).

4. **Adaptation actions and adaptation planning:** Ensuring adaptation actions are mainstreamed into protected area management strategies was the final important step. This step is detailed more in the section below.

## Integrating climate adaptation into conservation planning and management

The starting point for the integration of climate adaptation in protected area management was the agreement to coordinate the updating of management plans of Gorgona and Sanquianga with the implementation of the CAMPA.

**Selecting targets**
Methodologically, the identification and selection of conservation targets was the result of working with two multidisciplinary working groups (one for each protected area). 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 ecosystems (coarse filter) and species (fine filter) as the units of analysis (see Tables 15 and 16).

**Table 15: Habitats and ecosystems selected as conservation targets**

| Gorgona | Sanquianga |
|---|---|
| 1. Freshwater ecosystem | 1. Mangrove ecosystem |
| 2. Coral formations (coral reefs) | 2. Coastal basin – deltaic System |
| 3. Rocky-coastal ecosystem (Rocky shores intertidal) | 3. Sandy beach ecosystem |
| 4. Hard-bottom ecosystem (Rocky shores sub tidal) | 4. Muddy flat ecosystem |
| 5. Soft-bottom ecosystem (sub tidal) | 5. Coastal and marine hydro-biological resources |
| 6. Sandy-coastal ecosystem | |
| 7. Pelagic ecosystem | |
| 8. Rainforest | |

This exercise of identification and selection of targets at this level of detail (ecosystems, habitats and species) is the first of its kind for coastal and marine protected areas in Colombia. The common practice for most protected area management exercises is based on the results of coarse filter (ecosystems).

**Hazards and drivers of change**
The second area of work related to strengthening the updating of the two management plans was the identification and prioritisation of threats and pressures that can affect conservation objectives. Methodologically, the manifestations of climate and oceanographic processes identified in CAMPA were integrated with other pressures and threats of anthropogenic and natural origin in one comprehensive assessment. This process was undertaken with two multidisciplinary working groups (one for each protected area). Again, it is important to highlight that this type of comprehensive assessment of natural, climatic and anthropogenic hazards is the first of its kind in Colombia. The traditional practice is to limit the hazards assessment to those of anthropogenic origin.

In Gorgona the outcomes of the expert workshop were organised and tabulated to identify the critical and severe threats that can have negative effects on the conservation status of the park's conservation objectives. Table 17 lists the most important threats, noting that 60 per cent are climate-related.

### Table 16: Species and communities of species selected as conservation targets

| Gorgona | Sanquianga |
|---|---|
| 1. Land snakes community (19 species) | 1. Macroinvertebrate communities associated with mangrove |
| 2. Bats community (15 species) | 2. Eggs, larvae and juvenile fish and shrimp |
| 3. Anuran community (7 species) | 3. *Lepidochelys olivacea* (Olive Ridley) |
| 4. Seabird community: | 4. *Charadrius wilsonia* (Wilson's Plover) |
| • *Pelecanus occidentalis murphy (Brown Pelican)* | 5. *Numenius phaeopus* (Whimbrel) |
| • *Sula leucogaster etesiaca (Brown Booby)* | 6. *Anadara tuberculosa* (Pustulose ark) |
| • *Sula nebouxii (Blue-footed Booby)* | 7. *Scomberomorus sierra* (Pacific sierra) |
| • *Fregata magnificens (Magnificent* Frigatebird) | 8. *Bagre panamensis* (Chilhuil sea catfish) |
| 5. Sea Turtle community: | 9. *Cynoscion albus* (Whitefin weakfish) |
| • *Lepidochelys olivacea (Olive Ridley)* | 10. *Brotula clarkae* (Pacific bearded brotula) |
| • *Chelonia mydas agassiizii (Green turtle)* | 11. *Hyporthodus acanthistius* (Rooster Hind) |
| • *Chelonia mydas (Black turtle)* | 12. *Cetengraulis mysticetus* (Pacific anchoveta) |
| • *Eretmochelys imbricata (Hawksbill Turtle)* | 13. *Litopenaeus occidentalis* (White shrimp) |
| 6. 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)* | |
| 7. Recreational Fish: | |
| • *Triaenodon obesus (Whitetip Reef Shark)* | |
| 8. 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)* | |

### Table 17: Critical and severe threats to conservation targets in Gorgona

| Climatic | Anthropogenic |
|---|---|
| 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 in 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 (e.g. chlorophyll) |
| Pattern Winds changes / Wind Field changes (magnitude and direction) | Earthquake-Tsunami (seismic activity) |
| Salinity changes | |
| Air Temperature increases | |
| Sea Surface Temperature (SST) increases | |

Table 18 lists the most important threats to the conservation targets in Sanquianga. Here anthropogenic threats are the most important with about 43 per cent of the targets involved, followed by climate hazards with 36 per cent and finally natural threats at 21 per cent.

**Table 18: Critical and severe threats to conservation targets in Sanquianga**

| Climatic | Anthropogenic |
|---|---|
| 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, etc. |
| Changes in salinity | Infrastructure (houses, kiosks, docks, cabins, bridges, erosion control works) |
| Changes of surface water hydrology (flow) | Mining |
| 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) | |

**Assessing risks on conservation targets (potential impacts)**

The risk assessment was conducted in a two step process: (i) Identify the conservation targets that are, on average, subject to the greatest number of pressures and threats; (ii) try to determine the ecological integrity attributes of those conservation 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 the conservation targets. In other words, a risk metric allows protected area managers to anticipate which attributes of the ecological integrity of the conservation targets are more susceptible to be affected by the different drivers of change. In line with the previous step, this assessment was undertaken with the scientific committees for each protected area. This type of risk assessment that tries to position the biophysical attributes as metrics for assessing risks is also new in the context of protected areas in Colombia.

**Assessing risk, resilience and vulnerability scores**

Gorgona and Sanquianga undertook a process for calculating the degree of climate vulnerability of the conservation targets. The aim of this step was to determine the overall climate impact score, the overall resilience score and the overall vulnerability score for each target.

**Table 19: Conservation targets at critical and severe level of risk**

| Gorgona | Sanquianga |
|---|---|
| 1. Rocky Shores<br>2. Seabirds community<br>3. Octocorals<br>4. Spotted dolphin<br>5. Demersal fish assemblage | 1. *Charadrius wilsonia*<br>2. *Numenius phaeopus*<br>3. Coastal basin<br>4. Mangrove forest<br>5. Macroinvertebrate communities associated with mangrove |

**Table 20: Risk metrics for conservation targets at critical and severe level of risk**

| Gorgona | Sanquianga |
|---|---|
| **Rocky Shores:**<br>• Number of focal species<br>• Macroinvertebrate richness | ***Charadrius wilsonia:***<br>• Highest abundance in non-breeding season<br>• Area available for nesting<br>• Number of breeding pairs<br>• Number of nesting and resting sites |
| **Seabirds community:**<br>• Number of nests<br>• Abundance<br>• Number of nesting and resting sites | ***Numenius phaeopus:***<br>• Abundance of roosts in islerías<br>• Number of roosts (mangrove) |
| **Octocorals:**<br>•% Diseased octocoral<br>• Density of octocorals<br>• Percentage of coverage – Carijoariisei<br>• Octocoral richness by locality | **Coastal basin:**<br>• Volumetric zooplankton biomass<br>• Eggs engraulidae<br>• Total eggs<br>• Larvae engraulidae<br>• Total larvae |
| **Spotted dolphin:**<br>• Abundance<br>• Group size | **Mangrove forest:**<br>• Red mangrove *Rhizophora* sp (Natural spatial units)<br>• Guandal (Natural spatial units)<br>• Fern *Ranconcha Acrostichum aureum* (Natural spatial units) |
| **Demersal fish assemblage:**<br>• Zooplankton biomass<br>• Chlorophyll<br>• Nitrates<br>• Physicochemical parameters | **Macroinvertebrate communities associated with mangrove:**<br>• Relative abundance<br>• Sizes structure<br>• Proportion of mature individuals |

For each of the scores calculated, the following grid was 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. Initially, the experts considered the results from climate vulnerability and risk assessments (CVRA), to identify tendencies of climate impacts and pressures associated with each conservation target, and thus guide the exercise.

**Identifying and Prioritising Adaptation Actions**

Gorgona and Sanquianga adopted a two step process to identify and prioritise the adaptation strategies to be included in the management plan: (i) identify the potential adaptation strategies; (ii) try to prioritise and therefore determine which of those strategies will be included in the management plan. Working groups in each protected area were set up to discuss the criteria for prioritising alternatives for climate adaptation suggested in Action 6.2 of the CAMPA, i.e. benefits (direct and indirect), costs (installed capacity, resources and research), risks (ecological, social, economic and political) and opportunities (associated with policies or rules, existing

**Table 21: Overall Scores from Sanquianga**

| Target Identification | | Overall climate impact score | | Overall adaptive capacity and resilience score | | Overall vulnerability score | |
|---|---|---|---|---|---|---|---|
| **No.** | **Name** | | | | | | |
| 1 | Mangrove 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 |
| 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 |

**Table 22: Overall Scores from Gorgona**

| Target Identification | | Overall climate impact score | | Overall adaptive capacity and resilience score | | Overall vulnerability score | |
|---|---|---|---|---|---|---|---|
| **No.** | **Name** | | | | | | |
| 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 medium level 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 |

projects). Each of these variables was categorised into one of four levels: very high, high, medium and low. The prioritised strategies will be those that present great benefits and opportunities, and lower costs and risks.

**Expert development of climate adaptation options**
This step was based around a stakeholder workshop that draws up a draft list of potential adaptation actions for each conservation target in the protected areas, considering the outcomes of the vulnerability scoring and the prioritisation criteria agreed by the group. A synthesis of the outcomes is presented in the Annex at the end of this case study.

## Conclusions and recommendations

The main conclusions and recommendations derived from the case study include:

**Framework methodologies**
The first and main conclusion is related to the importance of a framework methodology. The implementation of conservation actions or projects must anticipate and seek alternatives to reach their own objectives, and also 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 prioritisation of climate adaptation actions, using a framework methodology to anticipate their utility and use within the overall management scheme of national parks.

Among the lessons learned in implementing the framework are:

- The units of analysis associated with adaptation priorities should, if possible, be consistent with existing management units.
- The analysis of threats is an essential component of the management of protected areas. 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. Ideally, climate change actions should be integrated within the existing actions of planning and management of protected areas.
- In the case of Colombia, the process to support the development of management plans saw a successful innovation in basing analysis and management recommendations on the agreement of conservation target values.
- Assessing and managing the risks of a changing climate

Climate change poses risks for human and natural systems. Moreover, in Colombian protected areas 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 protected areas. 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 recognises that the climate may pose a threat. This also includes threats of climatic origin and the fact that hydro-meteorological or oceanographic impacts can positively or negatively affect the conservation objectives of a protected area.
- It is possible to develop an extended exercise of pressure and threat analysis, so that the main drivers of change and possible adverse consequences on protected areas are understood.
- Assuming a climate risk framework in the management of protected areas 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 (e.g. desertification, sea-level rise, etc.).

## Final thoughts

The management process of protected areas conducted by National Parks of Colombia is based on the Pressure - State - Response (PSR) model developed by the OECD (1993) from the original model proposed by Rapport and Friend (1979). This framework is probably the most accepted worldwide due to its simplicity and ease of use 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) and construction of management plans in recent years (Ospina, 2010). The PSR model is a framework for organising simple information at macro level and is 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 of the environment, which society can respond 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 of where you intervene at the level of 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 from 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 Colombia.

# Annex: Summary of the climate adaptation plans for Sanquianga and Gorgona National Natural Parks

**Table 23: Sanquianga National Natural Park climate adaptation plans**

**Mangrove Forest**

| Adaptation strategy | Actions |
|---|---|
| 1.1. Promoting the sustainable use and conservation of the mangrove ecosystem in the Sanquianga | 1.1.1. Transfer technical capacity from 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 |
| | 1.1.4. Monitor and evaluate the process of reforestation |
| | 1.1.5. Establish a mangrove nursery as a research, training, practice and extension activity for mangrove reforestation, with community participation |
| | 1.1.6. Community to construct craft biodigesters with technical support |
| | 1.1.7. Evaluate and monitor the management of biodigesters on the sidewalks |

**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. Formalise the 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 increase skills to design, implement and evaluate adaptation programmes | 2.2.1. Conduct training workshops on issues related to climate change for park's staff |
| | 2.2.2. Promote the exchange of experiences with other areas or institutions related to climate change adaptation work |
| 2.3. Raise awareness and educate communities in conservation and sustainable use of resources area. | 2.3.1. Design educational materials related to conservation and sustainable use |
| | 2.3.2. Conduct information seminars related to sustainable use of resources in: schools and with fishermen, piangüeras (mangrove cockle Anadara tuberculosa collectors), and local leaders (municipalities) |
| 2.4. Promote the proper management of the basin of the Patia Satinga, Tapaje Sanquianga Rivers and through the regulation of forest clearing in the municipalities, allowing ecological connectivity of riparian forest | 2.4.1. Hold meetings with mayors of municipalities to discourage the use of mangrove civil works |
| | 2.4.2. Actively participate in mangrove conservation and use |
| | 2.4.3. Carry out monitoring and surveillance in areas with municipal boundary |
| 2.5. Promote proper management of solid and liquid waste (dumping of latrines), on the sidewalks of the park | 2.5.1. Conduct a feasibility study to evaluate the final disposal of solid waste |
| | 2.5.2. Develop a pilot project to reduce plastic materials for community Mulattoes (classification, reduction and trading of plastic) |
| | 2.5.3. Strengthen the 'Mesa de Manglar' (Mangroves' co-management initiative between Parks and Communities) |
| | 2.5.4. Include the issue of management of solid and liquid waste in environmental education strategy of Sanquianga |
| 2.6. Develop and strengthen inventory, monitoring and information systems to detect and describe conservation targets, climate impacts and adaptive capacity of species, communities and associated ecosystem services | 2.6.1. Monitor environmental variables in the park (e.g. precipitation, humidity, ambient temperature, mean sea level, water temperature, salinity) using controls and surveillance |
| | 2.6.2. Assess trends in the dynamics of the coastline of the protected area |
| | 2.6.3. Generate baseline information for all the conservation targets (species and ecosystems) and the biophysical conditions, hazards, pressures and drivers of change |

### 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 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 of enclosures for cattle |
| | 3.2.2. Seek alternatives for livestock feeding on local forage |

### Muddy Flats

| Adaptation Strategy | Actions |
|---|---|
| 4.1 Promote strategic assessment of these habitats for migratory and commercially important species as well as the generation of knowledge of climate change impacts to natural resources and ecosystem services of the conservation target. | 4.1.1. Strengthen monitoring of birds that use the mud flats, and extend it to the fauna associated with the conservation target and its physical and geomorphological features |
| | 4.1.2. Inform the community on the importance of this ecosystem and its vulnerability to climate change |

### Hydro-Biological Resources

| Adaptation Strategy | Actions |
|---|---|
| 5.1. Strictly control the minimum size of capture | 5.1.1. Inform fishermen not to use illegal operations which cause the capture of immature fish, (e.g. meshes below 2 3/4 of the eye) |
| 5.2. Reduce unsustainable fishing practices (e.g. catch, illegal, and use of harmful fishing gear), and strengthen agreements, use and management of fishery resources | 5.2.1. Reformulate and / or update the use of management agreements. Attempt to generate a single agreement |
| | 5.2.2. Communicate updated management agreement |
| | 5.2.3. Follow up and evaluate management agreement |


Local woman replanting mangroves in Sanquianga National Natural Park, Colombia

**Table 24: Gorgona National Natural Parks climate adaptation plan**

**Tropical Humid Forest**

| Adaptation Strategy | Actions |
|---|---|
| 1.1. Generate knowledge on 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) |
| 1.2. Maintain resilient ecosystem function to climate change | 1.2.1. Adjust zoning of ecosystem units |

**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 SIMAC results |
| | 2.1.3. 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 for visitors and local communities |
| | 2.2.2. Verify the probable marketing of coral colonies in Buenaventura and other nearby villages |
| | 2.2.3. Perform clean-ups of solid waste around reefs and coral communities |
| | 2.2.4. Demarcate and mark the coral reefs and mark dive sites with buoys for anchoring boats |
| | 2.2.5. Zoning of coral reefs including natural recovery area |
| 2.3. Implement pilot ecological restoration (REM) as a preventive measure and to generate knowledge of biological reef | 2.3.1. Design dive programs that can contribute to the monitoring program of coral reefs |
| | 2.3.2. Install a 'nursery' of coral reproduction and controlled growth |

**Rocky –Coastal Ecosystem**

| Adaptation Strategy | Actions |
|---|---|
| 3.1. Increase the 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 programme to assess the ecological function of Playa Hole |
| | 3.1.3 Ensure constant cleaning of rocky beaches |
| | 3.1.4 Follow up on invasive and introduced species |

**Sandy – Coastal Ecosystem**

| Adaptation Strategy | Actions |
| --- | --- |
| 4.1. Reduce pressure on the assembly of marine turtles on Playa Palmeras | 4.1.1. Redirect path on the Playa Palmeras (200 m) |
| | 4.1.2. Restrict access to visitors to the areas of the beach during the most vulnerable times |
| | 4.1.3. Continue to monitor turtle breeding |
| 4.2. Reduce the impact of erosion on Playa Palmeras | 4.2.1. Contents vegetation management in the beach area (e.g. cut dead palms and restoration with local shrubs) |
| | 4.2.2 Continue monitoring dynamics of beaches |
| 4.3. Reduce human pressure on the sandy beaches of Gorgona | 4.3.1. Reduce monthly solid waste arriving on currents (e.g. collection, sorting and removal of the area) |

**Hard-Bottom Ecosystem**

| Adaptation Strategy | Actions |
| --- | --- |
| 5.1. Assessment of the conservation status of rocky bottoms ecosystem | 5.1.1. Perform monitoring *Carijoa riisei* as invasive species (e.g. distribution, persistence, etc.) |
| | 5.1.2. Perform monitoring of underwater tourism activities in the main dive sites (Montañitas and El Horno) |
| | 5.1.3. Monitor the structure and composition of the rocky bottoms (e.g. invertebrates, fish, etc.) |
| | 5.1.4. Make a record of mortality and presence of fungal diseases in Pacifigorgia spp. and make continuous records of water temperature in the presence of the genus sites |
| | 5.1.5. Track the reproductive cycle of Pacifigorgia spp. |
| 5.2. Biological control of *Carijoa riisei* by *Tubastrea coccinea* | 5.2.1. Conduct a pilot biological control in a high incidence of site Carijoa in Gorgona |
| 5.3. Perform clean-up days for solid waste | 5.3.1. Perform cleanups of solid waste in the rocky bottoms (Montañitas and El Horno) |

**Pelagic Ecosystem**

| Adaptation Strategy | Actions |
| --- | --- |
| 6.1. Strengthen the processes of local and regional management | 6.1.1. Strengthen the land use plans at a regional scale, to allow Sanquianga and Gorgona to contribute to the regional planning and management of fishery resources, and other economic activities (i.e. oil exploration) |
| 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 |
| | 6.2.3. Continue monitoring seabirds (e.g. pelicans) |
| | 6.2.4. Resume the monitoring of marine mammals (humpback whale and spotted dolphin) |
| 6.3. Reduce the pressure on the pelagic ecosystem by anthropogenic activities | 6.3.1. Maintain regulations to protect humpback whales (resolution 1531) |
| | 6.3.2. Strengthen the process of dissemination of good practice diving to observe pelagic and demersal species (e.g. groupers, whale sharks, mantas, sea turtles) |
| | 6.3.3. Engage park users through education and outreach efforts related to climate change |
| | 6.3.4. Increase public awareness and understanding of climate impacts on natural resources and ecosystem services |
| | 6.3.5. To continue the programme of control and surveillance |

# CASE STUDY 2 MADAGASCAR

## Nosy Hara and Ambodivahibe Marine Protected Areas Case Study

*Harisoa Rakotondrazafy and Volanirina Ramahery, WWF Madagascar Country Office, Jean Hervé Bakarizafy, Madagascar National Parks and Yacinthe Razafimandimby, Conservation International*



Octopus catch in Ambodivahibe Marine Protected Area, Madagascar

*The Madagascar case study focuses on two Marine Protected Areas in the north of the country and demonstrates the vital links between ecosystems and local communities in adapting to climate change.*

## Context

The impacts of climate change in Madagascar are already evident. These have serious implications on 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 recognised that protected areas can play an important role, and building their resilience is a crucial strategy to support ecosystems and people to address the potential impacts of climate change. Business as usual management practices for protected areas will also need to change if they are to support climate change adaptation. However, a good understanding of the link between protected areas and climate change in Madagascar remains limited as does the development of an appropriate strategy to address it. This means that protected area managers are in danger of being caught unaware of the negative effects of climate change on their work, and will have no plans to minimise actual and future vulnerability. In this context, through European funding (Implementing Climate Adaptation Strategies in the World's Most Outstanding Natural Places project), WWF International, Colombia, Madagascar and Philippines are implementing an adaptation project in six pilot marine protected areas around the world 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 on two Marine Protected Areas (MPA) in the northern part of the country: Nosy Hara National Park and Ambodivahibe MPA.

## Site description

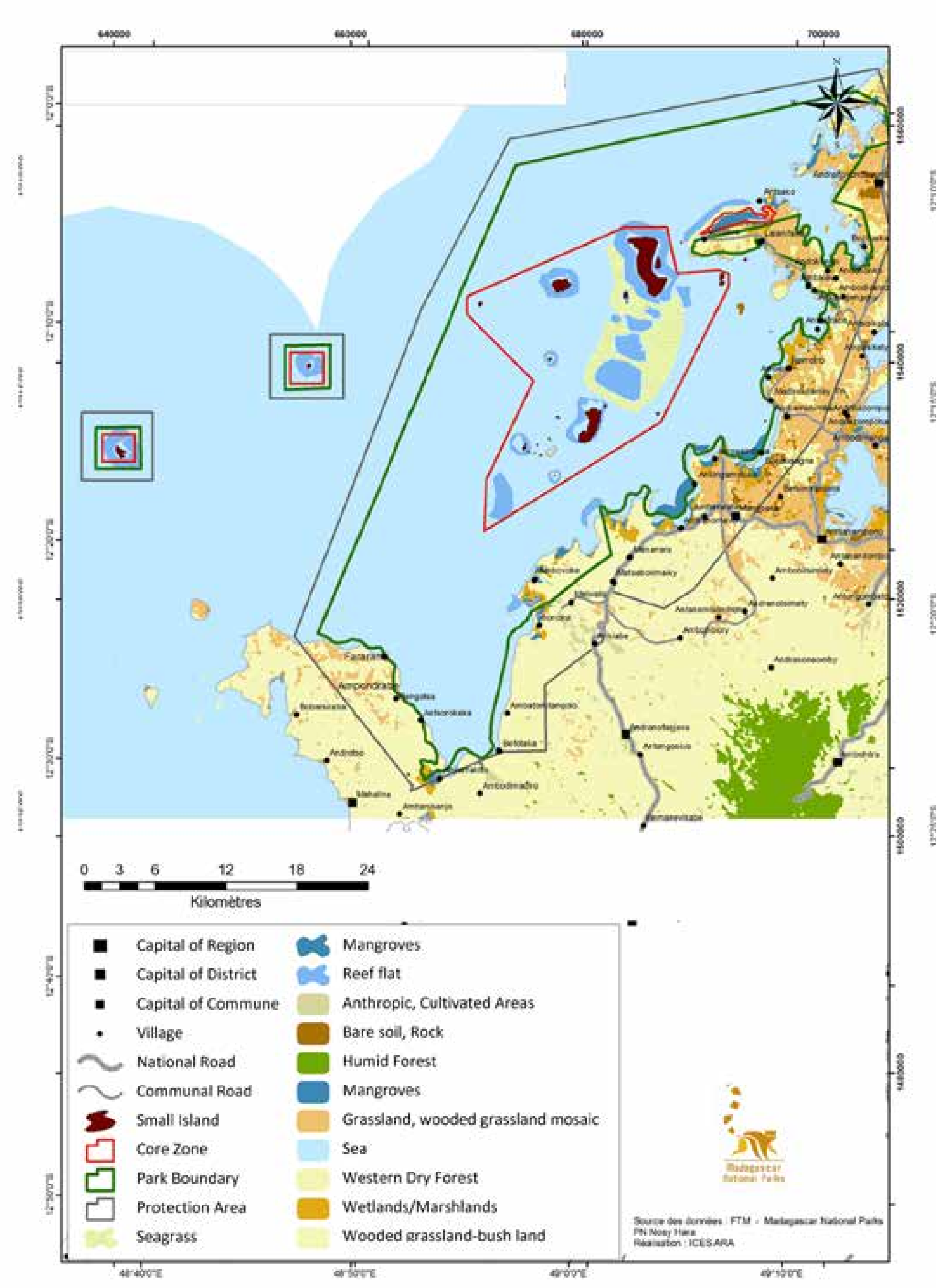
**Nosy Hara National Park**

Nosy Hara National Park lies in the extreme northwest of Madagascar, just below the northern tip and 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 definitive protection status in September 2011. It is classified as a Category II protected area according to the IUCN Protected Area Management Categories. The park is managed by Madagascar National Parks (MNP), a national agency, in close collaboration with local structures (local committees and multi-stakeholder orientation and monitoring committee formed by local communities). The Nosy Hara management plan covers five conservation targets: coral reefs, seagrass zones, mangroves, marine turtles, and sea- and shore birds. The total population in the park is about 16,000 inhabitants (in 2011) located in four Communes and thirteen Fokontany (smallest administrative unit) (Figure 12). The main anthropogenic threats are: overfishing by using illegal fishing gears, 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.

**Ambodivahibe Marine Protected Area (MPA)**

Ambodivahibe Marine Protected Area (MPA) is on the northeast coast of Madagascar, approximately 25 km from Antsiranana (Figure 13). This MPA covers a total area of 13,400 ha and is a well preserved marine environment recognised for its diversity of coral reefs (approximately 281 species), fish species (271 species, 3 endemic to the Indian Ocean), marine birds, bats, molluscs, crustaceans and as feeding area for marine turtles. It is also characterised by the presence of two deep

*Figure 13: Zoning map of Nosy Hara National Park*



bays, Ambodivahibe and Ampondrahazo, and several small islands. The MPA spans two rural Communes, Mahavanona and Ramena. The bay appears to exhibit a high natural resilience to climate change due to localised 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 a definitive protection in May 2015. It is a Category V protected area according to the IUCN classification. The MPA management plan was finalised in 2014 and identified six conservation targets: coral reefs, mangroves, sea turtles, bats, terns and egrets. Regarding the social side, there are 1,140 inhabitants (20 living within the MPA). The main threats are: overfishing by using illegal fishing gears, 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.

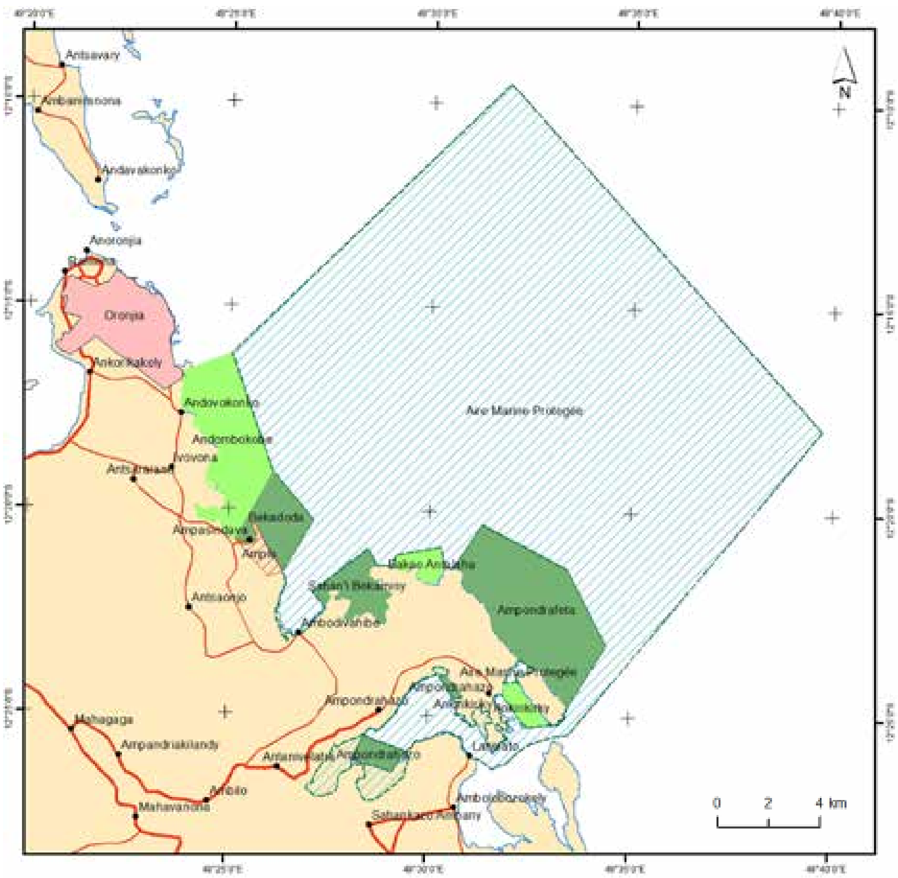



***Figure 14: Zoning map of Ambodivahibe***

*Key*

- Trail
- Road
- NPA Oronjia
- Core Zone
- Usage rights
- Reserve
- CBRN

## Methodology adopted and lessons learned

**• Strengthening MPA managers and key stakeholders knowledge on climate change**

In 2012, Madagascar MPA managers including the MNP and CI team were trained in climate change adaptation. A regional expert was hired to support the WWF climate change team to provide practical training to help them integrate climate change 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 climate change, they will not be able to understand its link with their business as usual work, particularly how climate change could directly affect MPA targets and/or exacerbate existing threats, and how to address this by relying on the whole MPA management strategy. Practical training tools and material are therefore required to show these interactions.

**Climate change vulnerability assessment**

Vulnerability assessment (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 to strengthen social and ecological resilience. The assessments were focused on Nosy Hara and Ambodivahibe conservation targets including mangroves, coral reefs, seabirds, marine turtles, and socio-economic targets (village level and small scale fisheries). They were guided by multi-expert processes and carried out in collaboration with Association Reniala (mangroves), Blue Ventures (fisheries and coral reef), Asity Madagascar / The Peregrine Fund (birds), marine turtle and socio-economic experts and the Meteorology Department (climate). Based on the IPCC's definition, methodologies used were mainly focused on the combination of three elements: exposure, sensitivity and adaptive capacity. Established methodologies were used and adapted to the local context: for coral reefs, the methodology on resilience assessment developed by Obura and Grimditch (2009); for mangrove systems, the manual on climate change vulnerability and adaptation planning developed by Ellison (2012); for birds, a framework for Categorizing the Relative Vulnerability of Threatened and Endangered Species to Climate Change (US-EPA, 2009); and the climate witness toolkit developed by WWF (WWF South Pacific Programme, undated) was employed for local communities. Lack of long-term data (climate, ecological and social data) was the key challenge during this work as the 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 not be a barrier in doing VA. It can be updated progressively. If we wait for complete data and information, climate change impacts could already be 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 standardised analysis tools (albeit adapted to different target groups) facilitates cross-referencing of individual assessments and the identification of complementary results. The standardisation should facilitate comparisons between study sites within 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 prioritising adaptation options**
Identification of adaptation options must be built on the outcomes of vulnerability assessments. For the two MPAs, it was done in three steps:

- **Step 1:** for each VA target (ecological and social), experts in charge of the vulnerability assessment provided a 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 protected area issues (national and local authorities, NGOs, etc.) to prioritise those with the highest potential to enhance resilience of MPA conservation targets and the local people who depend on its resources.
- **Step 3:** community consultations to check and validate if those prioritised adaptation options really address local needs, particularly those related to sustainable livelihoods.

Four criteria were used to prioritise the 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, lowest implementation cost and lowest associated risks were prioritised. 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 the right adaptation options.
- In terms of methodology, a sound understanding of the four criteria, their meaning, ranges and significance, by the participants before the prioritising 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 ahead the existing development and conservation initiatives in the area so as to screen in advance 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 lower the cost.

## Vulnerability and adaptation results for the MPAs

**Climate manifestation in the two MPAs**
Data developed by the Meteorology Department in 2012 have shown that climate parameters in the two MPAs have changed during the last 59 years (1951-2010). The main significant changes are summarised as follows:

- **Nosy Hara**: annual rainfall has decreased at an accelerating rate over the past 30 years particularly in the southern area of the MPA, seasons have changed with an earlier starting date and a later ending date (North and South-East), wind strength has increased during the summer, sea temperatures have risen and salinity is increasing during the dry season.
- **Ambodivahibe:** A reduction of rainfall is observed over the previous 30 years, the wet season begins earlier in the northern area and wind strength increased during the period 1950-2010.

Regarding future modelling, it is expected that temperature will continue to increase in the future, an increase of 0.5 to 4.5°C by 2020 to 2080 respectively for Nosy Hara and 0.5 to 4°C for Ambodivahibe. This will probably have continuous impacts on conservation targets and local communities. Strong monitoring needs to be put in place to better anticipate and reduce these impacts and to better manage the two MPAs.

## Nosy Hara results

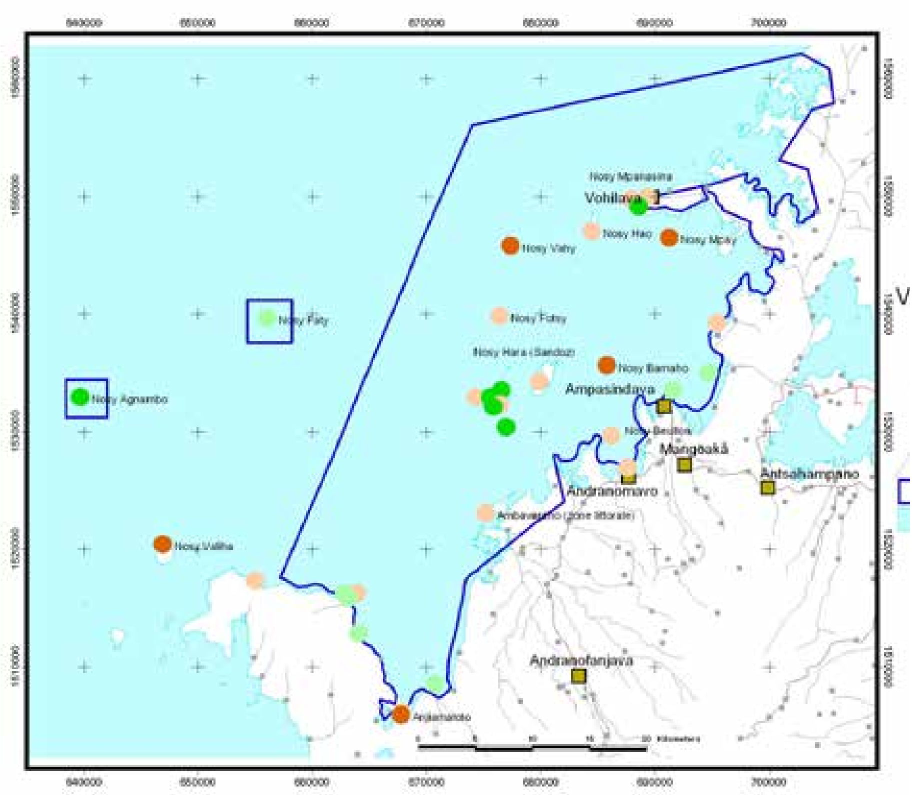
The VA conducted from 2011 to 2013 showed that coral reefs in the marine park appear to be recovering. There has not been any significant disturbance to the reefs of Nosy Hara during the last five years and they are unlikely to have been significantly impacted by a bleaching event. High resilience means high levels of hard coral cover and low levels of fishing pressure. Coral reefs in the Nosy Hara Marine Park showed a high coral cover for the Western Indian Ocean, with levels of 34 per cent (Obura, 2009) and ranked between 2 and 3 (Gough, 2012). However, fish populations are exhibiting signs of overexploitation (low abundance of high trophic guild species and low biomass) and were dominated by fish <10 cm in length (Gough, 2012). As per the definition of 'resilience', this situation could compromise the ability of these reefs to recover in the future. Regarding the mangrove ecosystem, high vulnerability has been observed where stands have been significantly degraded (see Figure 8) which maps the coral vulnerability assessment). Where mangroves are in good condition – showing little or no degradation – their resilience and adaptive capacity are high and vulnerability is low. This applies to all mangrove types that were examined in Nosy Hara. The main cause of concern may also be the vulnerability of seabirds and marine turtles, as their nesting sites face compounded threats from both climatic and non-climatic factors (see Figure 14). At the very least, these threats need to be monitored closely and appropriate measures taken.

In terms of social VA conducted in 2012, local communities in Nosy Hara depend heavily on marine resources from the MPA and on agriculture. Drought and wind have been the main climate stressors affecting community activities (see Figure 6) which maps the impacts of drought on the community), impacting agriculture and fishing respectively. Wind vulnerability is moderate except where reef and open

*Figure 15: Birds vulnerability index for Nosy Hara MPA*

*Key*

- Town, village
- River
- MPA Nosy Hara
- Sea
- Very low vulnerability
- Low vulnerability
- Medium vulnerability
- High vulnerability



sea fishing are dominating sectors. The relatively high vulnerability to drought is a significant concern, but is likely not insurmountable if communities could implement potentially viable alternatives. Due to the prolonged wind and drought, the two main livelihood activities are not sufficient to support their daily income. Resilient alternative livelihoods should be promoted.

The priority adaptation options identified to support ecological resilience in Nosy Hara include establishment of a nursery for marine turtles, mangrove restoration taking into account resilient areas which will support their role as coastal protection and as bird habitat, and finally supporting the resilience of coral reefs. The main adaptation options for local communities using ecosystem goods and services are improved fishing activities (particularly due to the wind pattern changes) and the establishment of a crab fishery reserve as a new activity in the park. In addition, other alternative livelihoods were also identified such as building water supplies (mainly for domestic use and improved farming techniques), sheep and goat rearing and promoting climate-resilient crops. To date, an area of 2 ha of mangroves was restored. In addition, seven local park committees have obtained fishing equipment in order to promote artisanal fishing offshore. It contributes to reducing fishing pressure on coral reefs and thus helps to maintain their resilience and fish biomass recovery and at the same time help local fishermen cope with the strong seasonal wind.

**Ambodivahibe results**
The VA showed that coral reefs are in good health in general with low algal growth. Fish stocks appear to be healthy. Fishers depend primarily on reef fish and these appear to be in good health but there are indications of some diversity in fishing technology and location. There is some overfishing occurring as seen by the number of juveniles landed. The marine ecosystem has some intrinsic resilience to projected climate change but there are some risks associated with inappropriate use of some habitats such as mangroves. However, ecosystems in this area are likely to be exposed to the impacts of climate change in future, particularly with respect to increasing sea surface temperatures, and the increasing frequency and intensity of tropical storms and extreme weather events. The eastern coastline is likely to have a slightly higher level of impact from rising sea surface temperatures, as well as being slightly more exposed to the risk of cyclones and tropical storms than the western side of the island.

In terms of local communities' vulnerability, the study found that villages that do not fish or can fish within mangroves were the least vulnerable. In contrast, villages that depended heavily on fishing on reefs or open waters were particularly vulnerable. Communities with mixed economies that included agriculture and livestock tend to have low vulnerability even if offshore fishing is a primary activity. Even though the latter can be prevented by strong winds, these communities can compensate by engaging in the alternatives. The communities that are most vulnerable to the impacts of strong winds are those that rely almost entirely on offshore fishing. Concerning drought, all subsistence/economic sectors are impacted to some degree. Fishers claim that there is less organic matter washing into the sea from the land and this has an impact on fish distribution. However, the impacts of drought are most heavy in communities that are reliant on agriculture and to a lesser extent livestock.

In accordance with other initiatives already implemented by Conservation International in this MPA, the prioritised adaptation options to support the ecological resilience of Ambodivahibe are mainly mangrove restoration with the aim of planting resilient areas and diversifying income from mangrove fishing, protecting coastal areas against cyclones and extreme weather events and


Smoked fish from Nosy Hara National Park in Madagascar

maintaining the integrity of existing marine ecosystems. For local communities, these include building water supplies (mainly for domestic use and improved farming techniques), promoting short cycle livestock farming, building resilient road infrastructures against heavy rain to help local communities selling their production in the town where they can gain a better price (and therefore better income) and piloting sheep and goat rearing.

In summary, for both MPAs, the following results can be seen as immediate consequences and/or long-term impacts of integrating climate change issues into the management of the two MPAs:

- Improvement of MPA manager skills and understanding of climate change issues and their links with 'business as usual' work;
- Better knowledge of the status of conservation targets (species and ecosystems) and their level of vulnerability and resilience;
- Shifting status of key conservation targets from low resilience to medium or high resilience through the implementation of adaptation options;

- Better knowledge of changes in weather patterns and adaptation actions taken by the community;
- Improvement of local communities' adaptive capacity leading to an increase in their resilience through the implementation of climate-smart alternative livelihoods;
- Climate threats and their drivers well addressed in the MPA management tools;
- Gathering local climate information and its impacts on human and natural systems through a rigorous monitoring system;
- Updated version of Nosy Hara management plan that fully integrates climate change issues as well as consideration of such issues in the Ambodivahibe management plan which has recently been developed;
- Increased awareness of climate change and the relevance of marine protected areas in adaptation among practitioners and local communities; both in the two MPAs and beyond, through the experiences and results of this initiative.

## Mainstreaming climate change into Nosy Hara and Ambodivahibe management tools

Nosy Hara and Ambodivahibe MPAs were created without significant consideration of climate change issues. It means their management tools (management plan and monitoring protocol) were mainly developed to address anthropogenic pressures. The final result of all the processes carried out in the two MPAs is to develop climate-smart management tools that will address both non-climate and climate stresses, strengthen the capacity of the MPAs to tackle climate change issues and support their vital role in adaptation. For Nosy Hara, the management plan is updated every five years. The next update will be in 2016. To date, all data and information needed for integrating climate change into the revised version are available. For Ambodivahibe, its management plan has recently been developed (in 2014). Results from the work on climate change in this MPA were considered during the development of this framework document. In both MPAs, monitoring protocols are under revision in order to track both human pressures and climate impact. Weather station and marine devices have been set up in order to better monitor climate and oceanographic information. The climate-smart management plan of these two MPAs was the first of its kind in Madagascar and will serve as an example for MPAs in other countries.

## Conclusions

Climate change is already affecting marine and coastal areas and could compromise the long-term use of goods and services provided by MPAs. Developing resilient MPAs is therefore crucial in order to protect biodiversity and help people to adapt to current and future climate change. Nosy Hara and Ambodivahibe are among the first MPAs in Madagascar demonstrating how to strengthen MPA resilience against climate change and what is the vital role played by protected areas in terms of adaptation. In fact, WWF recognises the vital links that exist between ecosystems and human populations and aims to optimise the role of natural systems in climate change adaptation which is known as ecosystem based adaptation (EbA). This approach is often more cost effective and more readily accepted and understood by local communities than other types of adaptation measures. In addition, to better incorporate climate change adaptation principles into MPA management, larger areas need to be surveyed, including those outside the MPA, to ensure adequate protection of highly resilient reef areas by the MPA's zoning system. Climate refugia also need to be identified. Modelling future impacts of climate change is therefore crucial in order to identify such refugia and to anticipate negative future impacts with appropriate strategies. In short, the pilot approaches from Nosy Hara and Ambodivahibe are the foundation to later ensure the application of climate change adapted MPA management throughout the country and consideration of climate change aspects in the establishment of new protected areas, by integrating these aspects into the Madagascar Protected Area Network Framework (known as 'Système des Aires Protégées de Madagascar – SAPM'). The best practices and experiences from adaptation work in Nosy Hara and Ambodivahibe should be considered in replication of the process in other MPAs in Madagascar and beyond such as:

- Regular capacity building on climate change adaptation for MPA managers and key stakeholders which helps to understand the practical application of adaptation and how it can be integrated into business as usual work.
- Support from experts (national, regional and international) to ensure homogenisation of the approach particularly across the region and credibility of the results.
- Using traditional knowledge to capture climate evolution and its impacts which can compensate lack of historical data.
- Involvement of local communities during the whole adaptation process, which reinforces their ownership and is also a contributing factor to the success of adaptation work.
- Consideration of climate and non-climate factors in all vulnerability analysis especially in a country like Madagascar where communities' livelihood dependency on natural resources is very high.
- Use of standardised analysis tools (albeit adapted to different target groups) which will facilitate cross-referencing of individual assessments, the identification of complementary results and comparisons between study sites in Madagascar and elsewhere.
- The prior existence of an operational management body (Madagascar National Parks and Conservation International) with good relations with the local community.
- Implementation of this pilot process in a well-established protected area, well rooted in the national protected area system and in a sufficiently large MPA (which allows processes to be observed on a large enough scale in order to clearly recognise climate change induced effects).

# CASE STUDY 3 PHILIPPINES

## Island Garden City of Samal (IGACOS), Philippines

*Chrisma Salao* WWF Philippines and *Maricar Samson* De La Salle University, Shields Ocean Research Center and Integrated School, Philippines

© Ruel Pine / WWF Philippines

Contemplating the clear blue waters of IGACOS island in the Philippines

*The IGACOS case study demonstrates how adaptation projects can be integrated into local planning.*

## 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 ha. 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 EU 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 ha, 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 from nearby communities, the governance system under which it belongs, and economic activities in the surrounding areas. Therefore, subsequent studies on geological and hydrological hazards and risk based assessments covered the entire city.

In addition, in October 2013, the city government of IGACOS requested the assistance of WWF Philippines 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 man-made 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 5 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.

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)
- Draft Basic Methodology for Climate Change Vulnerability Assessment of Protected Areas (BAVAPA) – this methodology is now included in the first sections of the CAMPA

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 has been incorporated into this manual (CAMPA Step 4).

## Results

The results of each VA tool are summarised below:

- **ICSEACChange:** Three barangays (villagers) 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 a 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 socio-economic 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 figure 15.

- **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 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 fewer coastal developments.

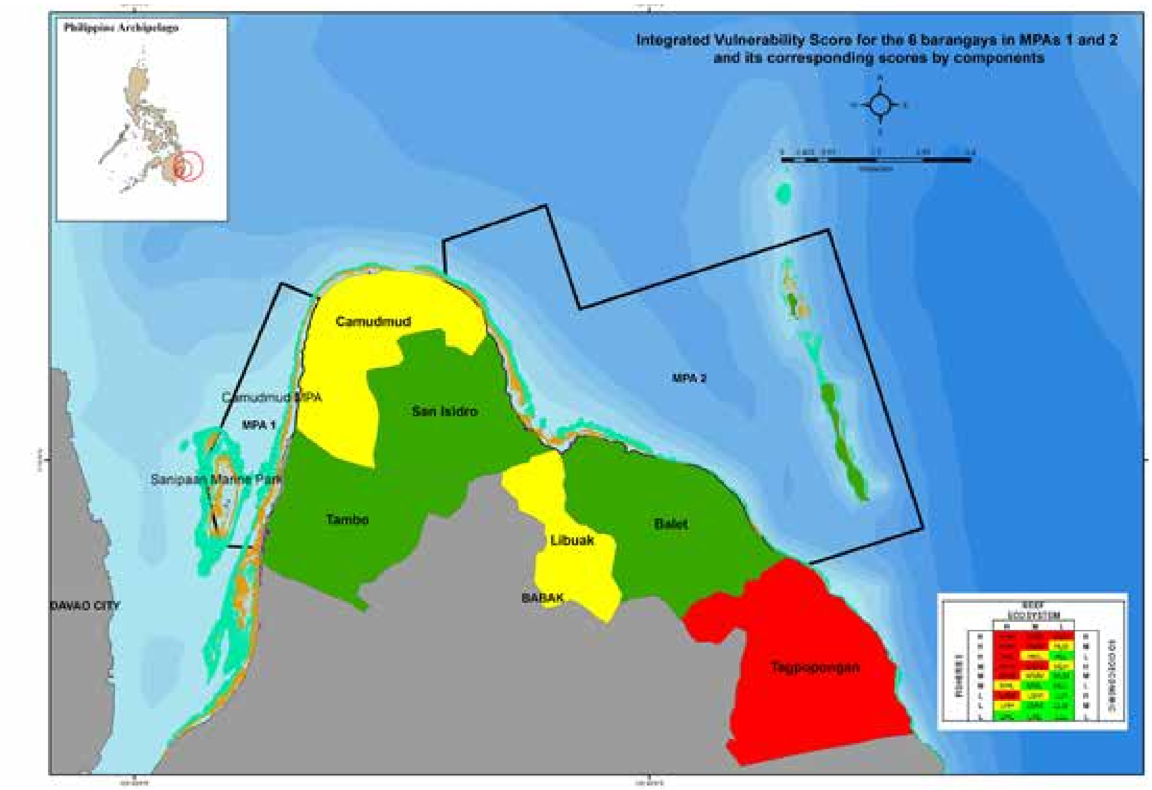



*Figure 16: Integrated results of Tools for Understanding Resilience of Fisheries (TURF)*

Beyond MPAs 1 and 2, however, the overriding concern for the coastal integrity of IGACOS is the presence of groins that virtually every resort constructs to use as a 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. 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 conducting 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.

- **BAVAPA:** As well as looking at climate factors, the BAVAPA included an assessment of the non-climatic factors. These were almost the same in the two MPAs and 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:

- **Geological and hydrological risk assessment:** This was conducted through the collection of available secondary information and site validation. The geological 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 per cent 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 per cent decline in rainfall for the neighbouring Davao City by 2020. Based on these figures, the volume of freshwater supply for 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 alkaline 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 sea-water 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 m and 4 m projections were added to the exercise. After mapping, natural and manmade assets in the affected areas were inventoried, and projections of 3 per cent and 5 per cent increases in affected assets were made.

  In terms of land area, only a small portion of IGACOS would be affected—less than 1 per cent is affected by flooding and has been affected by storm surge, and 2 per cent of the land area would be affected by sea-level rise projected at 4 m. However, the centres of population in IGACOS are near the coast, and therefore the potential number of people and structures are much more significant—an estimated 30 per cent 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 6 m, 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 5 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. The workshop discussions were directed at identifying adaptation measures. The workshop was attended by about 125 stakeholders, of whom more than 70 per cent 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 summarised into the following actions per area:

- **Inland areas:** tree planting and waste management to protect 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, priority adaptation measures were identified to receive immediate support for implementation.

## Lessons learned

Planning the sequence of events, outputs and expectations for a regional project could have been better integrated. 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 not very effectively managed, 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 organisations, that provide support in setting up and establishing MPAs.

It was therefore an unforeseen but fortunate development that the city government requested the project to assist in updating its CLUP, 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 a 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 during the workshop by the Officer-In-Charge City Administrator, Mr Guillermo Olden, 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 to not only climate change related hazards, but to how human impacts are exacerbating the potential impacts that climate change may bring. The main conclusion is that the information brought forth by the VAs should propel the people and government into action.

# PART V APPENDICES

## Appendix 1: Glossary of terms

Some of the terminology referring to climate change altered between the fourth and fifth IPCC reports, for example from climate vulnerability to climate risk. The CAMPA methodology was developed before the fifth IPCC report was published and thus still refers to vulnerability. The relationship between the 'old' and 'new' terminology is discussed in Box 11 and the relationship illustrated in Figure 16.

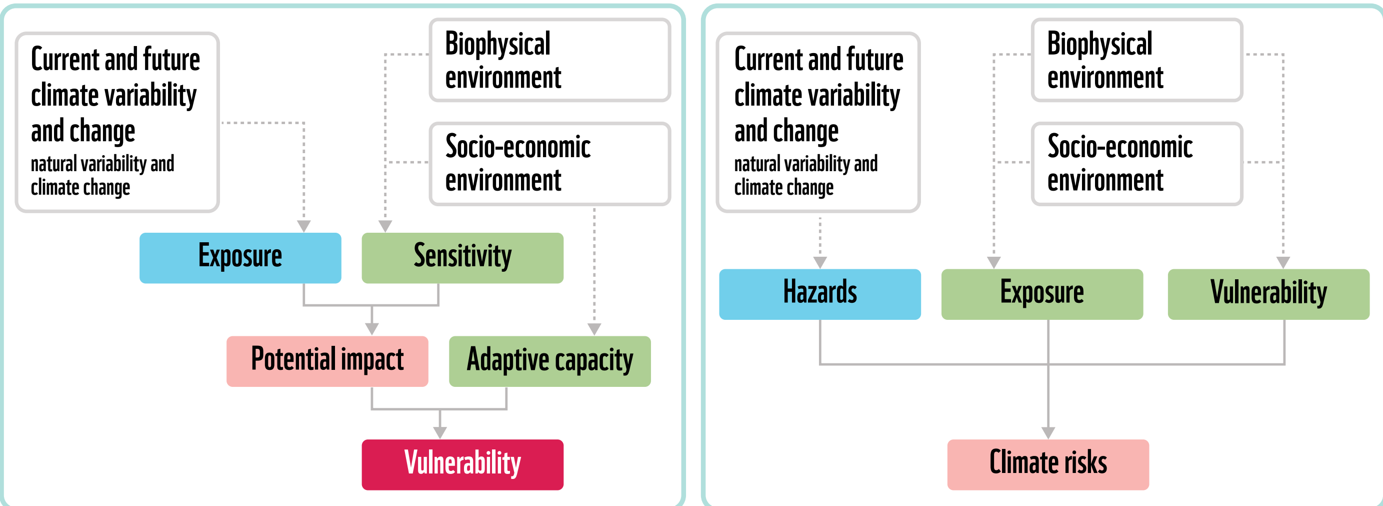
**BOX 11: Adaptation Framework**

Even if the terminology used to describe exposure, impacts, sensitivity, vulnerability, risks and adaptive capacity changes over time, the basic underlying assumptions follow a similar logic (Figure 16) when an ecosystem of concern is affected by climate-related threat.

This threat produces potential harm to the system (in AR4 this is known as vulnerability; in AR5, as 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 17: Illustration of the Climate Vulnerability IPCC AR4 (left) and Climate Risk IPCC AR5 (right) Framework***



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

**Climate-smart conservation** considers how climate and non-climate related pressures affect species, ecosystems and people.

**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 unalterable, 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 Millennium Ecosystem Assessment (2005) as a benefit people obtain from ecosystems.

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

**Indicators** are defined by Cutter et al (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 (UNEP, 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.

**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.

**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 protected area 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 characterised by a low-pressure centre 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 centre 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.


Western basilisk (*Basiliscus galeritus*) in Gorgona National Park, Colombia

# Appendix 2: Acronyms

| | |
|---|---|
| AR | Assessment Report |
| BAVAPA | Basic Methodology for Climate Change Vulnerability Assessment of Protected Areas |
| CAMPA | Climate Adaptation Methodology for Protected Areas |
| CBA | Community Based Adaptation |
| CCA | Climate Change Adaptation |
| CEO | Chief Executive Officer |
| CI | Conservation International |
| CIVAT | Coastal Integrity Vulnerability Assessment Tool |
| CLUP | Comprehensive Land Use Plan |
| CMPA | Coastal and Marine Protected Area |
| DRR | Disaster Risk Reduction |
| DTM | Digital Terrain Model |
| EBA | Ecosystem Based Adaptation |
| ENSO | El Niño Southern Oscillation |
| EC | European Commission |
| EU | European Union |
| GIS | Geographic Information System |
| GIZ | Deutsche Gesellschaft für Internationale Zusammenarbeit |
| ICE CREAM | Integrated Control Enhancement: Coastal Research Evaluation and Adaptive Management |
| ICSEAC Change | Integrated Coastal Sensitivity, Exposure, and Adaptive Capacity to Climate Change |
| IGACOS | Island Garden City of Samal |
| IPCC | Intergovernmental Panel on Climate Change |
| IUCN | International Union for Conservation of Nature |
| NGO | Non Governmental Organisation |
| NNP | National Natural Park |
| MEA | Millennium Ecosystem Assessment |
| MERF | Marine Environment and Resources Foundation |
| MNP | Madagascar National Parks |
| MPA | Marine Protected Area |
| NAPA | National Action Programs for Adaptation |
| NP | National Park |
| OECD | Organisation for Economic Co-operation and Development |
| PA | Protected Area |
| PAGASA | Philippine Atmospheric Geophysical and Astronomical Services Administration |
| PSR | Pressure – State – Response |
| SAPM | Système des Aires Protégées de Madagascar |
| SIMAC | Svendborg International Maritime Academy |
| SLR | Sea Level Rise |
| SREX | IPCC report 'Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation' |
| SST | Sea Surface Temperature |
| TEP | Tropical Eastern Pacific |
| TURF | Tools for Understanding Resilience of Fisheries |
| UNDP | United Nations Development Programme |
| UNEP-WCMC | The United Nations Environment Programme's World Conservation Monitoring Centre |
| UNFCCC | United Nations Framework Convention on Climate Change |
| UNISDR | United Nations Office for Disaster Risk Reduction |
| US-EPA | United States – Environmental Protection Agency |
| VA | Vulnerability Analysis (Assessment) |
| WMO | World Meteorological Organization |
| WWF | World Wide Fund for Nature (formally World Wildlife Fund) |

# Appendix 3: Selected bibliography and references

Alongi, D. 2002. Present state and future of the world's mangrove forests. *Environmental Conservation* 29: 331-349.

Alongi, D. 2008. Mangrove forests: Resilience, protection from tsunamis, and responses to global climate change. *Estuarine, Coastal and Shelf Science* 76: 1-13.

Bäthge, S. 2010. *The Governance Cluster: Climate change and gender: Economic empowerment of women through climate mitigation and adaptation*. Working Paper, GTZ, Eschborn, Germany.

Björk, M., Short, F., Mcleod, E. and S. Beer. 2008. *Managing Seagrasses for Resilience to Climate Change*. IUCN, Gland, Switzerland. 56pp.

Blomstrom, E., Cunningham, S., Johnson, N. and C. Owren. 2009. *Women at the Forefront*. UN Population Fund and Women's Environment and Development Organisation.

Borrini-Feyerabend, G., Dudley, N., Jaeger, T., Lassen, B., Pathak-Broome, N., Philips, A. and T. Sandwith. 2013. *Governance of Protected Areas: From understanding to action*, Best Practice Protected Area Guidelines Series number 20, IUCN, Gland, Switzerland.

Brown, K., Tompkins, E. and W.N. Adger. 2001. *Trade-off analysis for Participatory Coastal Zone Decision-Making*, Overseas Development Group, University of East Anglia

CARE International. 2009. *Climate Vulnerability and Capacity Assessment (CVCA) Handbook*. http://careclimatechange.org/tool-kits/cvca/

CARE. Undated. http://www.careclimatechange.org/tk/cba/en/about_the_toolkit/defining_cba.html

Carlton, J.T. and Geller, J.B. 1993. Ecological roulette: The global transport of non-indigenous marine organisms. *Science* 261: 78-82.

Chaudhury, M., Kristjanson, P., Kyagazze, F., Naab, J.B. 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.

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

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

Congdon, B., Erwin, C.A., Peck, D.R., Baker, C.B., Double, M.C. and P. O'Neill. 2007. Chapter 14 – Vulnerability of Seabirds on the Great Barrier Reef to Climate Change. In: J.E. Johnson and P.A. Marshall (eds), *Climate Change and the Great Barrier Reef*, Great Barrier Reef Marine Park Authority and Australian Greenhouse Office, Australia.

Crooks, S., Herr, D., Tamelander, J., Laffoley, D. and J. Vandever. 2011. *Mitigating Climate Change through Restoration and Management of Coastal Wetlands and Near-shore Marine Ecosystems: Challenges and Opportunities*. Environment Department Papers number 121, World Bank, Washington DC.

Cutter, S.L., Emrich, C.T., Webb, J.J. and D. Morath. 2009. *Social Vulnerabilities to Climate Variability Hazards: A Review of the Literature*. Oxfam America.

Day, J., Dudley, N., Hockings, M., Holmes, G., Laffoley, D., Stolton, S. and S. Wells. 2012. *Guidelines for applying the IUCN Protected Area Management Categories to Marine Protected Areas*. IUCN, Gland, Switzerland.

Doney, S.C., Fabry, V.J., Feely, R.A. and J.A. Kleypas. 2008. Ocean Acidification: The Other CO2 Problem. *Annual Review of Marine Science* 1: 169-192.

Dudley, N. (ed.) 2008. *Guidelines to Protected Area Management Categories*, IUCN, Gland, Switzerland.

Dudley, N., Stolton, S., Belokurov, A., Krueger, L. , Lopoukhine, N., MacKinnon, K. , Sandwith, T. and N. Sekhran. 2010. *Natural Solutions: Protected Areas Helping People Cope with Climate Change*. IUCN-WCPA, TNC, UNDP, WCS, the World Bank, and WWF, Gland, Switzerland, Washington, DC, and New York.

Ellison J.C. 2012. *Climate change vulnerability assessment and adaptation planning for mangrove systems*. WWF, Washington DC.

Fabricius, K.E., Hoegh-Goldberg, O., Johnson, J., McCook, L. and J. Logh. 2007. Chapter 17 – Vulnerability of coral reefs of the Great Barrier Reef to Climate Change. In: J.E. Johnson and P.A. Marshall (eds), *Climate Change and the Great Barrier Reef*, Great Barrier Reef Marine Park Authority and Australian Greenhouse Office, Australia.

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

Fish, M.R. and Drews, C. 2009. Adaptation to climate change: options for marine turtles. WWF report, San José, 20pp.
Foden, W., Mace, G., Vié, J.-C., Angulo, A., Butchart, S., DeVantier, L., Dublin, H., Gutsche, A., Stuart, S. and Turak, E. 2008. *Species Susceptibility to Climate Change Impacts*. IUCN, Gland, Switzerland.
Fuller, R. and Cofer-Shabica, N.. 2010. Marshes on the Move: *A Manager's Guide to Understanding and Using Model Results Depicting Potential Impacts of Sea Level Rise on Coastal Wetland*s. The Nature Conservancy and NOAA.
Gilman, E.L., Ellison, J., Duke, N.C. and C. Field. 2008. Threats to mangroves from climate change and adaptation options: A review. *Aquatic Botany* 89: 237-250.
Girot, P., Ehrhart, C., Oglethorpe, J., Reid, H., Rossing, T., Gamberelli, G., Jeans, H., Barrow, E., Martin, S. and N. Ikkila. 2011. *Integrating community and ecosystem-based approaches in climate change adaptation responses*. Ecosystems, Livelihoods and Adaptation Network.
Gough, C. 2012. *Coral reef resilience assessment of the Nosy Hara marine protected area, northwest Madagascar 2012*. WWF and Blue Ventures Conservation report. Madagascar.
Greenberg, R., Maldonado, J., Droege, S. and M.V. McDonald. 2006. Tidal marshes: a global perspective on the evolution and conservation of their terrestrial vertebrates, *BioScience* 56: 675-685.
Hamer, KE. 2010. The search for winners and losers in a sea of climate change. *International Journal of Avian Science* 152: 3-5.
Hawkes, L.A., Broderick, A.C., Godfrey, M.H. and B.T. Godley. 2009. Climate change and marine turtles. *Endangered Species Research* 7: 137-154.
Hoegh-Goldbery, O. 2005. Climate Change and Marine Ecosystems. In: T.E. Lovejoy and L. Hannah (eds) *Climate Change and Biodiversity*. Yale University Press, New Haven and London.
Hockings, M, S. Stolton, F. Leverington, N. Dudley and J. Corrau. 2006. *Evaluating Effectiveness: A framework for assessing management effectiveness of protected areas. 2nd Edition*. IUCN WCPA and University of Queensland. Gland, Switzerland and Brisbane, Australia.
Hoegh-Guldberg, O., Mumby, P.J. , Hooten, A.J., Steneck, R.S., Greenfield, P., Gomez, E., Harvell, C.D., Sale, P.F., Edwards, A.J., Caldeira, K., Knowlton, N., Eakin, C.M., Iglesias-Prieto, R., Muthiga, N., Bradbury, R.H., Dubi, A. and M.E. Hatziolos. 2007. Coral Reefs under Rapid Climate Change and Ocean Acidification. *Science* 318: 1737-1742.
Holling, C.S. 1973. Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics* 4: 1-23.
International Institute for Sustainable Development (IISD), International Union for Conservation of Nature (IUCN) and Natural Resources and Stockholm Environment Institute. 2003. *Livelihoods and Climate Change: Combining disaster risk reduction, natural resource management and climate change adaptation in a new approach to the reduction of vulnerability and poverty*. International Institute for Sustainable Development, Winnipeg, Canada.
IPCC. 2001. *Climate Change 2001: The Scientific Basis*. Cambridge University Press, Cambridge, UK.
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.
IPCC. 2012. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen,M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA, 582pp.
IPCC. 2014. *Climate Change 2014: Synthesis Report*. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core writing team R.K. Pachauri and L.A. Meyer (eds). IPCC, Geneva, Switzerland.
Islam, S.M. and Tanaka, M. 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.
IUCN. Undated. Adapted from IUCN Threat Classification Scheme http://www.iucnredlist.org/technical-documents/classification-schemes/threats-classification-scheme
Laffoley, D. and Grimsditch, G. 2009. *The Management of Natural Coastal Carbon Sinks*. IUCN, Gland, Switzerland.

Lovelock, C.E. and Ellison, J. 2007. Chapter 9 – Vulnerability of Mangroves and Tidal Wetlands of the Great Barrier Reef to Climate Change. In: J.E. Johnson and P.A. Marshall (eds) *Climate Change and the Great Barrier Reef,* Great Barrier Reef Marine Park Authority and Australian Greenhouse Office, Australia.

Lutchman, I. 2005. *Marine Protected Areas: Benefits and costs for islands.* WWF Netherlands, Zeist.

MacLeod, C.D. 2009. Global climate change, range changes and potential implications for the conservation of marine cetaceans: A review and synthesis. *Endangered Species Researc*h, 7: 125-136.

Marshall, N.A., Marshall, P.A., Tamelander, J., Obura, D., Malleret-King, D. and J.E. Cinner. 2009. *A Framework for Social Adaptation to Climate Change; Sustaining Tropical Coastal Communities and Industries.* IUCN, Gland, Switzerland.

Mastrandrea, M.D., Field, C.B., Stocker, T.F., Edenhofer, O., Ebi, K.L., Frame, D.J., Held, H., Kriegler, E., Mach, K.J., Matschoss, P.R., Plattner, G.-K., Yohe, G.W. and F.W. Zwiers. 2010. *Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties.* Intergovernmental Panel on Climate Change (IPCC).

Mawdsley, J.R., O'Malley, R. and D.S. Ojima. 2009. A review of climate-change adaptation strategies for wildlife management and biodiversity conservation. *Conservation Biology* 23 (5): 1080-1089.

McLeod, E. and Salm, R.V. 2006. *Managing Mangroves for Resilience to Climate Change.* IUCN, Gland, Switzerland.

McLeod, E., Salm, R., Green, A. and J. Almany. 2009. Designing marine protected area networks to address the impacts of climate change. *Frontiers in Ecology and the Environment*, 7:362-370.

Millennium Ecosystem Assessment (MEA). 2003. *Ecosystems and Human Wellbeing: A framework for assessment.* Island Press, New York.

Millennium Ecosystem Assessment (MEA). 2005. *Ecosystems and Human Well-being: Synthesis.* Island Press, Washington, DC.

Morgan, C.L. 2011. *Vulnerability Assessments: A review of approaches.* IUCN, Gland, Switzerland.

Morrison, J. 2011. *Climate Action: Mainstreaming in Existing Conservation Plans.* WWF US, Washington, DC.

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

Newson, S.E., Mendes, S., Crick, H.Q.P., Dulvy, N.K., Houghton, J.D.R., Hays, G.C., Hutson, A.M., Macleod, C.D., Pierce, G.J. and R.A. Robinson. 2009. Indicators of the impact of climate change on migratory species. *Endangered Species Research, 7.*

Obura, D. O. 2009. Coral Reef Resilience *Assessment of the Nosy Hara Marine Protected Area, Northwest Madagascar.* WWF report. Madagascar.

Obura, D. and Grimditch, G.D. 2009. *Resilience Assessment of Coral Reefs: Rapid assessment protocol for coral reefs focusing on coral bleaching and thermal stress.* IUCN, Gland, Switzerland.

OECD. 1993. *Core Set of Indicators for Environmental Performance Reviews, Environmental Monograph* no. 83. Paris: OECD.

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

Ospina, M. 2010. *Ruta para la actualización o reformulación de los planes de manejo de las áreas del Sistema de Parques Nacionales Naturales de Colombia.* Parques Nacionales Naturales de Colombia

Palmer, T.N. and Räisänen, J. 2008. Quantifying the risk of extreme seasonal precipitation events in a changing climate. *Nature* 415: 512-514

Pardo, M. 2002. *Aproximaciones a un sistema de indicadores ambientales para los parques nacionales naturales de Colombia. Instituto de Estudios Ambientales -IDEA*, Universidad Nacional de Colombia.

Pardo, M. 2005. Aspectos conceptuales de la planeación del manejo en Parques Nacionales Naturales. Parques Nacionales Naturales de Colombia. http://www.parquesnacionales.gov.co/PNN/portel/libreria/pdf/publi12.pdf

Pauly, D., Watson, R. and J. Alder. 2005. Global trends in world fisheries: Impacts on marine ecosystems and food security. Philosophical Transactions of the *Royal Society B* 360: 5-12.

Rapport, D., and Friend, A. 1979. *Towards a Comprehensive framework for Environment Statistics: A Stress - Response Approach. Statistics Canada Catalogue.* Ministry of Supply and Services, Otawa, Canada.

Reid, H. and Swiderska, K. 2008. *Biodiversity, climate change and poverty: Exploring the links*. IIED Briefing, IIED, London.
Salm, R. and Clark, J.R. with E. Siirila. 2000. *Marine and Coastal Protected Areas: A guide to planners and managers*. IUCN, Washington, DC.
Schroeter, D., Polsky, C. and A.G. Patt. 2004. Assessing vulnerabilities to the effects of global change: An eight step approach. *Mitigation and Adaptation Strategies for Global Change*. 10: 573-596.
Soto, C.G. 2002. The potential impacts of global climate change on marine protected areas. *Reviews in Fish Biology and Fisheries*. 11: 181-195.
Stachowicz, J.J., Terwin, J.R., Whitlatch, R.B. and R.W. Osman. 2002. Linking climate change and biological invasions: Ocean warming facilitates non-indigenous species invasions. *Proceedings of the National Academy of Sciences* 99 (24): 15497-15500.
Stolton, S., Dudley, N., Avcıoğlu Çokçalışkan, B., Hunter, D., Ivanić, K.-Z., Kanga, E., Kettunen, M., Kumagai, Y., Maxted, N., Senior, J., Wong, M., Keenleyside, K., Mulrooney, D., and J. Waithaka. 2015. Values and benefits of protected areas. In: G. L. Worboys, M. Lockwood, A. Kothari, S. Feary and I. Pulsford (eds) *Protected Area Governance and Management,* pp. 145–168, ANU Press, Canberra, Australia.
Tompkins, E.L. and Adger, W.N. 2004. Does adaptive management of natural resources enhance resilience to climate change? *Ecology and Society*, 9: 10-19.
UNEP. 1992. Rio Declaration on Environment and Development, Nairobi.
UNEP. 2009. *Climate Change Science Compendium 2009*. UNEP, Nairobi.
UNEP. 2012. *Ecosystem-Based Adaptation Guidance: Moving from Principles to Practice*. UNEP, Nairobi.
UNFCCC. 1992. *United Nations Framework Convention on Climate Change*. New York.
UNISDR [United Nations International Strategy for Disaster Reduction]. 2009. *2009 Global Assessment Report on Disaster Risk Reduction: Risk and poverty in a changing climate*. United Nations Office for Disaster Risk Reduction.
United States Environment Protection Agency (US-EPA). 2009. *A framework for categorizing the relative vulnerability of threatened and endangered species to climate change*. Prepared by J. Price and H. Galbraith. Global Change Research Program, National Center for Environmental Assessment, Office of Research and Development, US-EPA, Washington, DC
Vincent, K. 2004. *Creating an index of social vulnerability to climate change for Africa*. Tyndall Centre for Climate Change Research Working Paper 56.
Ward, T., Harte, D., Hegert, E. and K. Short. 2002. *Ecosystem-Based Management of Marine Fisheries: Policy proposals and operational guidance for ecosystem-based management of marine capture fisheries*. WWF International, Gland, Switzerland.
Ward, T. and Hegerl, E. 2003. *Marine Protected Areas in Ecosystem-based Management of Fisheries*. Department of the Environment and Heritage and National Heritage Trust, Canberra.
Waycott, M., Collier, C., McMahon, K., Ralph, P., McKenzie, L., Udy, J. and A. Grech. 2007. Vulnerability of Seagrasses in the Great Barrier Reef to Climate Change. In : J.E. Johnson and P.A. Marshall (eds) *Climate Change and the Great Barrier Reef,* Great Barrier Reef Marine Park Authority and Australian Greenhouse Office, Australia.
Wilkinson, C., Green, A., Almany, J. and S. Donne. 2003. *Monitoring Coral Reef Marine Protected Areas: A practical guide on how monitoring can support effective management of MPAs*. Australian Institute of Marine Science, IUCN and others, Townsville Australia and Gland, Switzerland.
Williams, B.K., Szaro, R.C. and Shapiro, C.D. 2009. *Adaptive Management: The U.S. Department of the Interior Technical Guide*. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC
Wongbusarakum, S. and Loper, C. 2011. *Indicators to assess community-level social vulnerability to climate change: An addendum to SocMon and SEM-Pasifika regional socioeconomic monitoring guidelines* - First draft for public circulation and field testing. Global Socioeconomic Monitoring Initiative for Coastal Management (SocMon), US National Oceanic and Atmospheric Administration, Washington DC, USA
WWF Global Ecoregions. Undated. About Global Ecoregions. http://wwf.panda.org/about_our_earth/ecoregions/about/
WWF South Pacific Programme. Undated. Climate Witness Community Toolkit. http://assets.panda. org/downloads/cw_toolkit.pdf
Zoological Society of London (ZSL). 2010. Climate Change Vulnerability of Migratory Species: Species Assessment. Climate Change Thematic Programme, Zoological Society of London



Bird colony in Gorgona National Park, Colombia

*This manual aims to help coastal and marine protected areas to adapt to climate change, led by those responsible for managing the area and involving other relevant stakeholders as an integral part of the process.*

*"This new methodology is an important development that will guide the WWF network and partners in designing climate change responses and ensuring the viability and resilience of our global protected areas heritage. WWF is committed to the wide application of CAMPA and building important lessons learned and next steps."*

Dr Deon Nel, Global Conservation Director,
WWF International

*"This manual is a welcome addition to the conservation literature and climate adaptation toolbox, illustrating how coastal and marine protected areas can strengthen their management to meet the challenges of climate change and better serve the needs of nature and local communities in a changing world."*

Dr Kathy MacKinnon, Chair,
IUCN World Commission on Protected Areas

*"CAMPA will help managers, decision makers and civil society to turn the value of protected areas as natural solutions to climate change into practical action."*

Trevor Sandwith, Global Protected Areas Programme Director,
IUCN

Funded by The European Union

# Protected Areas:
## Natural Solutions to Climate Change

100%
RECYCLED

**1.1 BILLION**

Protected areas contribute to providing food to 1.1 billion people

**313 GT**

Protected areas store 313 Gt or 15% of terrestrial carbon

**3.4%**

Marine protected areas cover 3.4% of the world's ocean

**209,000**

There are over 209,000 protected areas globally

WWF® · CAMPA 2016

WWF

**Why we are here**

To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

panda.org/campa

#CAMPA



PANDA.ORG/CAMPA