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MANUAL FOR CLIMATE CHANGE VULNERABILITY ASSESSMENT OF COASTAL AND MARINE PROTECTED AREAS (CMPAs)

Grant No. EuropeAid/DCI-ENV/2010/248-197

Acknowledgements

Preparation of this Manual was led by Alison Clausen (Climate Change Adaptation Consultant) with substantial contributions from (in alphabetical order): Alexander Belokurov (WWF International), Oscar Guevara (WWF Colombia), James Lumanog (WWF Philippines), Harisoa Rakotondrazafy (WWF MWIOPO) and Vola Ramahery (WWF MWIOPO). We would like to thank all those who commented on earlier drafts and provided suggestions on how to improve the Manual including (in alphabetical order):

- Angela Andrade (Conservation International)
- Cassandra Brooke (WWF International)
- Maria Claudia Diazgranados (Conservation International)
- Nigel Dudley (Equilibrium Research)
- Kathy MacKinnon
- Huong Thanh Tri Mai (WWF Vietnam)
- Luis German Naranjo (WWF Colombia)
- Emily Pidgeon (Conservation International)
- Trevor Sandwith (IUCN)
- Sue Stolton (Equilibrium Research)
- Martin Taylor (WWF Australia)

The Manual was prepared as part of the EU-funded project '*Implementing Climate Change Adaptation Strategies in the World's Most Outstanding Places*' (Grant No. EuropeAid/DCI-ENV/2010/248-197).

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Abbreviations & Acronyms

BAVAPA	Basic Vulnerability Assessment for Protected Areas
CC	Climate change
CMPA	Coastal and marine protected area
CMPA	Marine protected area
CMS	Convention on Migratory Species
CO2	Carbon dioxide
CVCA	Community Vulnerability and Capacity Analysis
ENSO	El Nino Southern Oscillate
ES	Ecosystem service
EU	European Union
ICSEA-C-CHANGE	Integrated Coastal Sensitivity, Exposure, Adaptive Capacity to Climate Change
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Conservation Union
MPA	Marine protected area
MWIOPO	Madagascar and Western Indian Ocean Program Office
NAPA	National Action Program for Adaptation
NGO	Non-Governmental Organization
PA	Protected area
pH	Degree of acidity
SLR	Sea level rise
SST	Sea surface temperature
SVI	Social Vulnerability Index
TURF	Tool for Understanding Resilience of Fisheries
US EPA	United States Environmental Protection Agency
UV	Ultraviolet
VA	Vulnerability assessment
WWF	World Wide Fund for Nature

Part 1: Introduction

Background and Context

This "*Manual for Climate Change Vulnerability Assessment of Coastal and marine protected areas*" has been prepared as part of the '*Implementing Climate Change Adaptation Strategies in the World's Most Outstanding* Places' Project, funded by the European Union (Grant No. EuropeAid/DCI-ENV/2010/248-197) and implemented jointly by WWF International, WWF Colombia, WWF Madagascar and Western Indian Ocean Program Office (MWIOPO) and WWF Philippines, in partnership with Conservation International (Madagascar), Corponariño (Colombia) and the Colombia National Parks Authority. The objective of the project is to ensure that:

"*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 project has the goal of developing a tested and proven methodology to support stakeholders in identifying adaptation strategies and actions that can help build the resilience of ecosystems in these protected areas based on an understanding of their vulnerability.

This Manual has been developed as part of the first area of activity of the project namely the carrying out of climate change vulnerability assessments for coastal and marine protected areas (CMPAs). It has been released as a working draft at this time to allow further testing and refinement and will eventually be integrated, in a finalized version, into the overall project methodology that will be published on project completion in 2014.

Need for the Manual

The impacts of climate change on CMPAs and the species and ecosystems that they protect are better understood than ever before. There is a rapidly growing body of scientific knowledge on the direct and indirect effects of increasing intensity and/or frequency of extreme events such as cyclones[1], rising sea levels, changes in ocean acidity, increased sea surface temperatures, and changes in precipitation patterns on marine and coastal ecosystems. While much of this research in the past has focused on coral reefs, increasingly attention is being turned to other ecosystems including mangroves, sandy beaches and seagrasses. 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[2], and that certain changes may already be "locked-in" in the world's marine environments.

Key characteristics of coastal and marine protected areas that influence their vulnerability to climate change include the high degree of mobility of key ecosystem components, elevated dispersal rates and distances of many species, relative absence of physical barriers to horizontal and vertical dispersion, high degree of interconnection between habitats and ecosystems and the greater heat capacity of water than air which means that sudden changes in temperature experienced in terrestrial ecosystems do not occur in marine environments[3]. Impacts on protected areas, including coastal and marine protected areas; under climate change are likely to include loss of habitat, loss of climatic conditions for particular species, new pressures such as invasive species, loss of key species, extreme events such as cyclones or floods, and increased human or non-climate pressures[4]. Effects of climate change that may be specific to coastal and marine protected areas include loss of habitat due to sea level rise or coastal erosion and the indirect effects of "mal-adaptation" such as hardening of coastlines that affect natural areas.

There is growing awareness on the part of protected area managers that climate change is a reality as the effects of climate induced stresses on marine and coastal ecosystems are becoming more frequently observed. This is particularly of concern due to the degraded condition of many of the

[1] IPCC, 2012
[2] IPCC, 2007
[3] Soto, 2002
[4] Dudley et al, 2010

world's marine and coastal zones and their relatively low representation in protected area networks. The importance of links between the species and ecosystems found in coastal and marine protected areas and the effects of climate change on the human communities that depend on or impact natural resources found in protected areas are also beginning to be better understood. Such understanding is vital given that more than 1 billion people, including many of the world's poor who are amongst the most vulnerable groups to climate change, live in low-lying coastal zones and depend on the natural resources or ecosystem services found there.

If properly planned and managed, coastal and marine protected areas can play a fundamental role in protecting biodiversity from the effects of climate change, and ensuring that ecosystems continue to provide essential goods and services to communities. To achieve this, coastal and marine protected area managers need to be able to identify where and how the effects of climate change will be felt, and to develop measures – referred to as "climate change adaptation measures" – that aim to achieve two inter-related outcomes:

1. "Adaptation for Protected Areas" involving measures that aim to increase the resilience of coastal and marine protected areas to future climate change thus reducing the likely negative impacts of climate change and optimizing potential positive impacts.

2. "Protected Areas for Adaptation" involving measures that seek to integrate coastal and marine protected areas as integral components in broader landscape or regional level climate change adaptation strategies for communities and ecosystem services.

Climate change vulnerability assessments are an essential first step in the development, implementation and monitoring of climate change adaptation measures. Climate change vulnerability assessments are a means of systematically analyzing the potential future effects of climate change on a system of interest, whether it be a coastal and marine protected area, a village, a species or an ecosystem. Until the scale, magnitude and distribution of potential climate change impacts is understood as a result of a vulnerability assessment, it is not possible to rigorously design and implement adaptation measures.

To date protected area managers and other stakeholders interested in protected area conservation have lacked practical tools and guidance that draw on the latest scientific research to allow analyses of the vulnerability of coastal and marine protected areas in the face of future climate change. This is particularly true in developing country contexts where data and technical and financial resources to carry out complex vulnerability assessments is often lacking.

This Manual has been developed to help address this gap. It provides a modular approach to vulnerability assessments of coastal and marine protected areas that draws on the most recent advances and methodologies in vulnerability assessments. It has been designed to be implemented for a range of situations, with a focus on developing country contexts, and can be tailored to the needs of an individual coastal and marine protected area in terms of data and resource availability.

Objective of the Manual

The objective of this Manual is to provide practical and scientifically sound guidance to facilitate climate change vulnerability assessments of coastal and marine protected areas. The vulnerability assessments produced through application of this Manual will be the first step in defining site specific, practical and effective climate change adaptation measures.

Principles of Manual Development

The manual is focused on the assessment of the climate change vulnerabilities of coastal and marine protected areas and surrounding human communities to ensure consideration of critical links between ecological and social systems particularly in a developing country context where natural resource dependence is typically high, but where data and technical resources are typically low.

It is based primarily on existing and proven methodologies for vulnerability assessments but adds value to these methodologies by combining them in a logical and ordered sequence and providing guidance on an "A to Z" approach to vulnerability assessment in a single manual. Importantly the Manual has been developed in a modular format that can be used in a variety of situations depending on the resources and data available, and the objectives of the VA study. Where a detailed study is

required and where adequate resources and knowledge are available, the Manual guides the user through a comprehensive assessment that applies a range of technical analytical methodologies to different social and ecological targets. At the other end of the spectrum, where limited data and resources exist, the Manual proposes a simple, yet robust methodology for vulnerability analyses that relies primarily on expert opinion and local knowledge.

Specifically, the manual has been developed to encompass the following principles that typify a robust vulnerability assessment[5]:

1. A **multi-disciplinary approach** that looks at both ecological and social systems and the links between them as well as considering important ecosystem services.

2. A **participatory approach** that emphasizes involvement by key stakeholders from the outset of the VA process and then draws on technical, community and Government stakeholders to ensure a wide range of quantitative and qualitative data is sourced, and local perspectives and knowledge are integrated into the process.

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

4. A **short-term and long-term approach** that considers both the effects of short-term climate variability and longer-term climate change (refer Box 1.1). 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.

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

6. A **tested approach** that presents a methodology that has been tested and refined by country teams in Colombia, Madagascar and the Philippines to optimize its functionality and practicality. The modular format of the Manual ensures that it can be updated and refined as new tools and methodologies are developed and tested thus ensuring it will remain up to date and current.

Box 1.1: Climate Variability & Climate Change

In broad terms, climate variability refers to the variation of a climate parameter from its long-term mean, whereas climate change refers to changes in the long-term mean itself.

Long-term climate means are generally measured over periods of 30 years but in practice climate varies on both shorter and longer time scales due to either natural internal processes or external forces. Climate deviations from mean conditions on timescales that are shorter than the climatic averaging period are referred to as climate variability. Important differences between climate variability and climate change are:

1. Climate variability is not necessarily caused by human-induced climate change
2. Climate variability can manifest itself in the form of extreme events
3. Climate variability occurs on shorter timescales than climate change

For PA managers and others interested in the vulnerability of protected areas, shorter-term climate variability can be just as important, if not more important, than longer-term climate change. Scenario development and application of technical VA methodologies in the Manual should be carried out in consideration of whether climate variability and/or climate change need to be analyzed in the VA process.

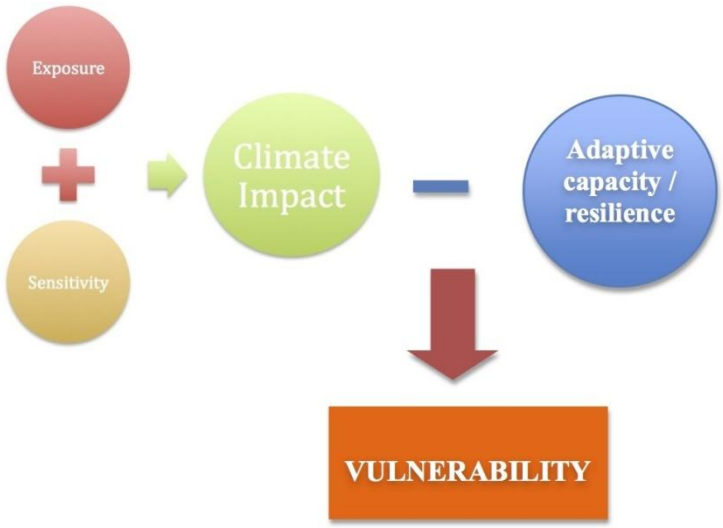
Key Concepts in Manual Development

There are numerous definitions and conceptual models related to climate change vulnerability. In the interests of maintaining simplicity and clarity, the definition of **climate change vulnerability** that has

[5] Adapted from Ellison, 2012 and Schroeter, 2004

been adopted for the Manual is that of the IPCC (2007), namely, the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Importantly, the IPCC breaks vulnerability down into its component parts of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity. A simple illustration of the relationship between the different components of vulnerability that has been adopted for the development of this Manual is shown below.

Figure 1.1: Simple Illustration of Elements of Climate Vulnerability



The Manual defines a **climate change vulnerability assessment** is a methodological process for identifying the "who", "what", "how" and "why" of vulnerability to climate change. That is, "who" and "what" is vulnerable to climate change? "How" does this vulnerability manifest? "Why" are these targets vulnerable to climate change; i.e. what are the factors causing and influencing vulnerability? In this presentation of vulnerability assessments, there is a need to focus on the "process" aspect of a vulnerability assessment; the original VA is a representation of the vulnerability of a place at one point in time. The information collected during this original vulnerability assessment needs to be updated and refined in response to new information and in response to the evolution of the vulnerability.

The overall objective of climate change vulnerability assessments is to inform decision-making of specific stakeholders about options for adapting to the effects of change[6]. Vulnerability assessments should not only to identify the risk factors (i.e. who and what is vulnerable to climate change), but also to identify the driving forces behind this vulnerability[7]. In this way, vulnerability assessments can provide clues as to how vulnerability can be reduced through adaptation measures.

Who is the Manual for?

The manual has been designed to be used by a wide range of stakeholders including PA managers, NGOs, or local or national Government agencies who are interested in having a better understanding of climate change vulnerabilities of one or more coastal and marine protected areas. The manual has been designed for users with knowledge of a particular area, but without necessarily a detailed technical knowledge of 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.

Structure of Manual

The Manual is structured as follows:

[6] Schroeter, 2004
[7] Cutter et al, 2009

- Part 1: provides an introduction to the Manual purpose and objectives and some of the key concepts that have underpinned its development
- Part 2: provides an overview of the Manual's methodological approach
- Part3: provides detailed worksheets and guidance notes which can be used to guide implementation of the Manual
- Part 4: provides concluding comments and observations on lessons learnt during application of the Manual and outlines the way forward for the continued improvement and use of the Manual

A glossary and list of useful resources included at the end of the Manual.

Box 1.2: CMPAs and Climate Change

In terms of measures that can increase the resilience of CMPAs to climate change, McLeod et al (2009) identified the following principles that can be applied to CMPA design and management:

- **Size:** CMPAs should be as large as possible, while not compromising the ability to manage, monitor and enforce, to protect the full range of marine habitat types and the processes on which they depend, and to accommodate self-seeding by short distance dispersers.
- **Shape:** simple shapes should be used to minimize edge effects while maximizing interior protected areas.
- **Risk Spreading:** Protect at least 20 to 30% of each habitat type (representation), at least three examples of each habitat type (replication) and ensure replicates are geographically separated to reduce the risk that they are affected simultaneously by a single climate event (spread).
- **Critical areas:** Protect critical areas that are: (i) biologically or ecologically important; and (ii) most likely to survive the threat of climate change.
- **Connectivity:** Place the CMPA within the context of a network with the aim that CMPAs are mutually replenishing, can accommodate adult movement of mobile species and where possible can accommodate future modeled connectivity patterns of species.
- **Maintain ecosystem function:** Maintain healthy populations of key functional groups, particularly herbivorous fishes.
- **Ecosystem based management:** Embed CMPAs in broader management frameworks that address non-climate threats and threats external to their boundaries, for example through use of an

Feedback and Comments

This manual is designed to be a dynamic document that will be updated periodically in response to comments and feedback from users and advances in scientific understanding of the impacts of climate change on coastal and marine protected areas.

This first version of the Manual has been pre-released as a working draft to allow its testing and refinement by a wide range of practitioners. Following feedback from these tests a final version will be prepared and published in 2014.

We would greatly appreciate your feedback and comments on the Manual. Please send your comments or questions to:

WWF International
Attention: "Coastal and Marine Protected Areas Climate Change Vulnerability Assessment Manual"
Email: abelokurov@wwfint.org

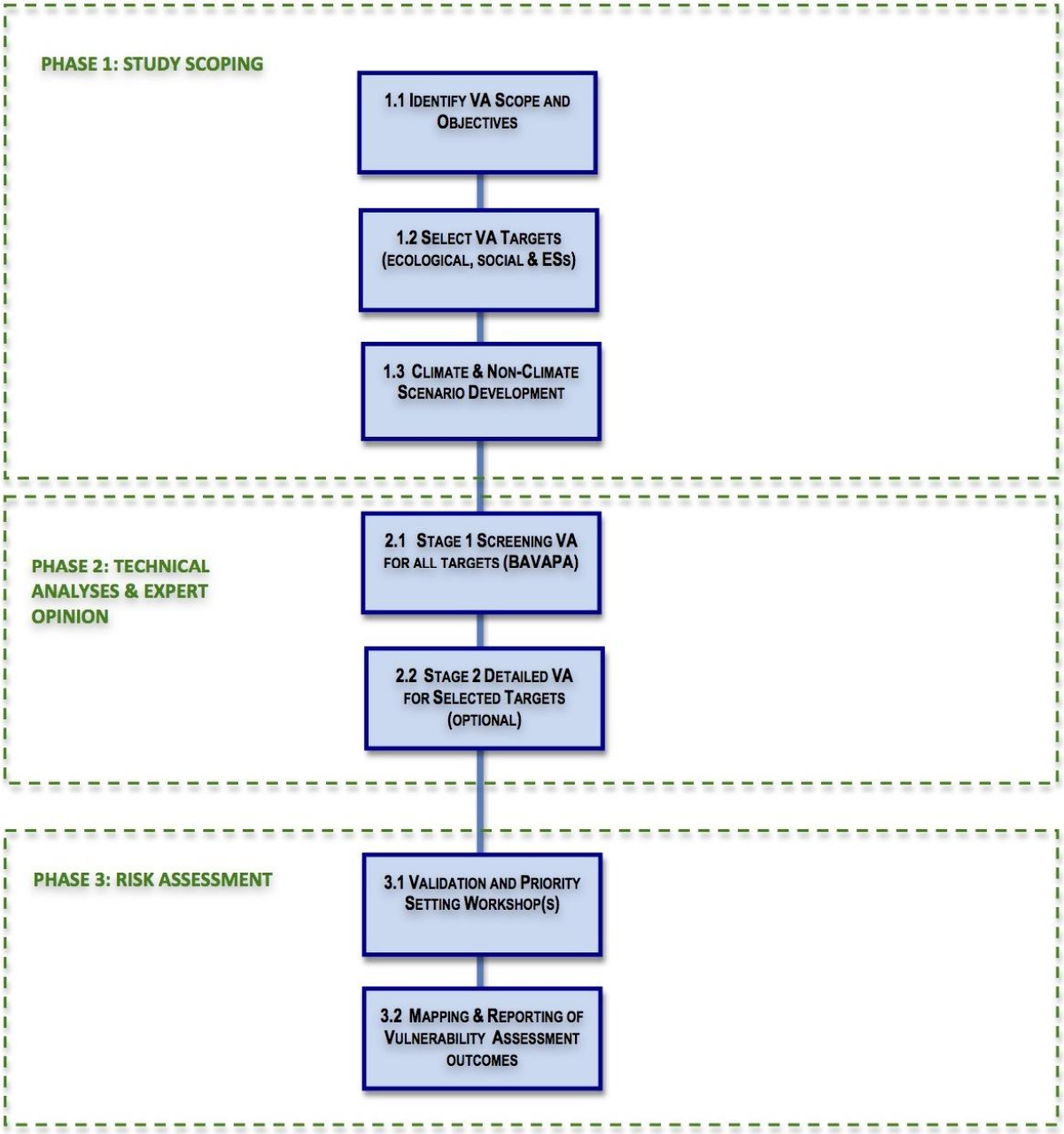
Part 2: Methodological Approach of Vulnerability Assessment Manual

This section provides an overview of the methodological approach adopted for the Manual and describes each of the key activities in Manual implementation. It then describes a recommended structure for stakeholder consultation that can be applied throughout each stage of Manual implementation.

Methodological Approach adopted for VA Manual

The methodology described in the Manual is based around three phases (Figure 3.1).

Figure 2.1: Flowchart of Phases and Activities in VA Process



Each of the three phases contains a number of activities that are carried out in a progressive manner with the outputs of each activity feeding into subsequent activities. Stakeholder participation is a cross-cutting activity that feeds into each phase and each activity of the methodology. A description of the phases and the corresponding activities is as follows. The following chapter of the Manual provides a series of worksheets that can be used to guide implementation of each activity of the Manual if desired by the project team.

Phase 1: VA Scoping

The first phase of the methodology sets the framework of the VA study and is the basis for the subsequent phases and activities. It includes identification of the objectives and the geographical and temporal scope of the VA, development of climate and non-climate scenarios for the area within which the VA will be carried out, and identification of ecological and social targets that will be carried forward for detailed analysis in the latter stages of the VA. The activities that are included in Phase 1 are as follows:

Activity 1.1: Identify Objectives and Scope of VA

The objectives of the VA need to be defined at the outset of the process so that they can be used as a guide throughout the VA process. VAs can have a range of different types of objectives. Examples of different types of VA objectives are as follows and the team's VA may seek to fill one or several of these objectives, or may have another set of objectives. Examples include:

- To incorporate climate change issues into the PA management plan;
- To build capacity of PA staff in climate change vulnerability assessments;
- To identify the vulnerabilities of species or ecosystems within or linked to the PA to facilitate future adaptation planning;
- To identify the vulnerabilities of villages or communities that are linked to the PA to facilitate future adaptation planning; and/or
- For research, communication and/or education purposes.

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

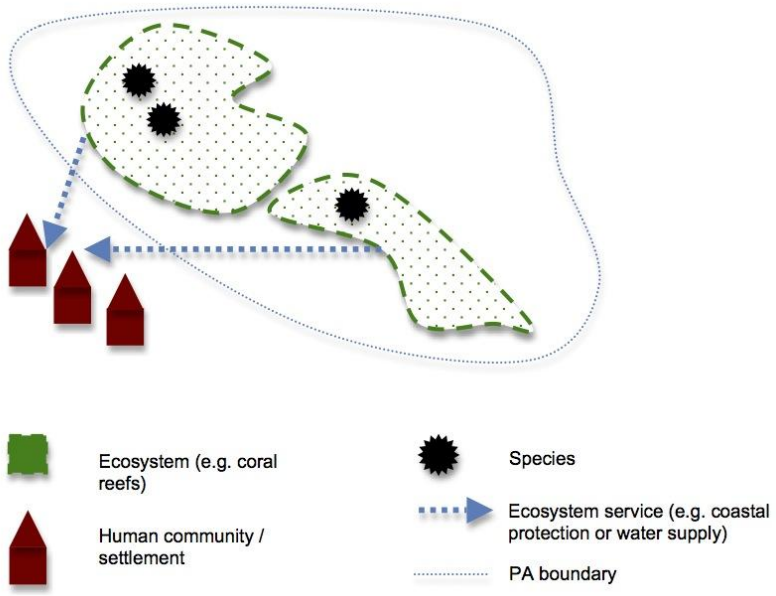
In terms of the temporal scope, is there - based on the objectives of the VA - a need to look just at the short term (0 – 5 years) e.g. if development and implementation of short term adaptation measures is a key part of the VA objective or if the VA is going to focus most closely on the effects of short term climate variability; the medium term (0 - 10 years) e.g. if the study is going to set longer term strategic priorities; or the long term (0 - 20+ years) e.g. if the VA is for research or long term monitoring purposes?

While it may seem evident and even implicit to those most closely involved in the study, the clear and unambiguous discussion, documentation and communication of the VA objectives and scope with the study team and key stakeholders is an important first step in the VA process. Not only will it ensure that all stakeholders have common expectations of the VA process, but it will have the complementary benefit of triggering discussions between stakeholders on the VA process.

Activity 1.2: Identify VA Targets

Once the objectives, physical boundaries and timeframe of the VA are agreed upon, the VA targets need to be identified. The VA targets are those items, places or issues that will be subject to detailed investigation in the VA. Targets are drawn from the range of elements that make up a CMPA. In the Manual VA targets are divided into ecological (species, ecosystems and habitats) targets, ecosystem services targets and social targets (refer Figure 3.2).

Figure 2.2: Schematic Illustration of range of CMPA VA Targets



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

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

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

Activity 1.3: Climate and Non-Climate Scenario Development

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

A climate change scenario is defined by the IPCC as *'… a plausible future climate that has been constructed for explicit use in investigating the potential consequences of anthropogenic climate change.'* A climate change scenario does not represent a climate prediction but a "possible climate future" based on best available knowledge and data. A single climate scenario addresses a range of climate manifestations that occur in the project area. Climate scenarios can be developed in different

ways depending on the type of information that is available; ideally they are informed by quantitative data on climate variability and/or climate change model projections, but if such projections are not available alternative methods can be used as described in the Guidance Note attached to this worksheet.

Climate scenarios are used in the VA to provide an overall vision of how the project area may evolve in terms of climate conditions and to allow the extraction of climate exposure data for use in the technical VA analyses. Climate scenarios can be developed for short-term climate variability and/or longer-term climate change (refer Box 3.1) depending on the objectives and temporal scope of the VA. The climate scenarios that are developed in this worksheet can be improved and modified as you proceed through the VA process and identify additional information.

Box 3.1: Global projections for Marine and Coastal Climate Variables

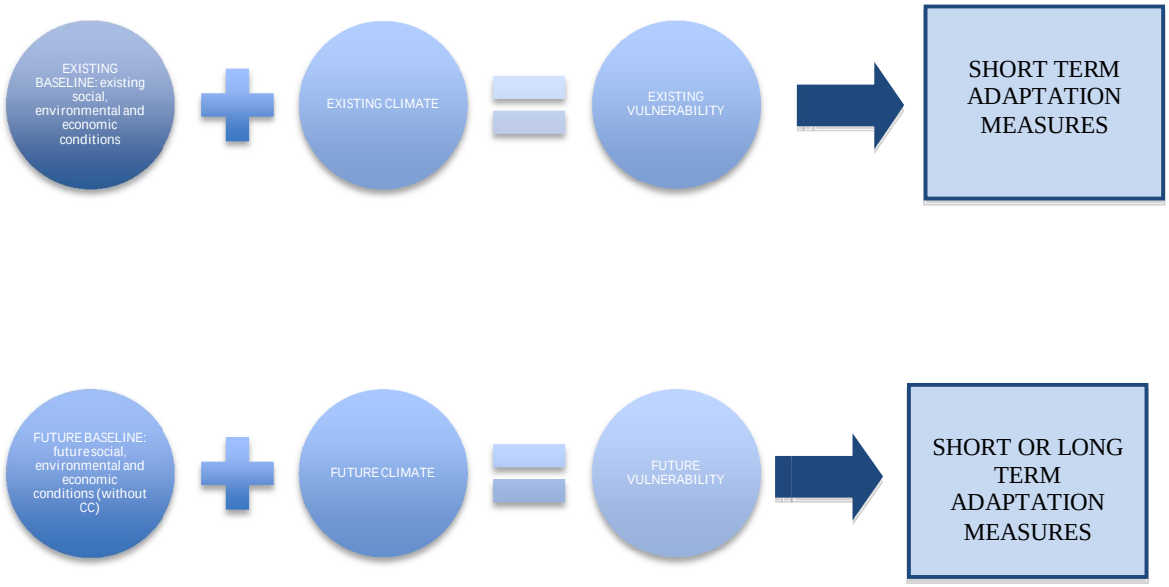
The following data sources may be useful for global projections for future climate conditions:

- ClimaScope – most terrestrial parameters and sea surface temperature
- Climate Wizard – temperature and rainfall www.climatewizard.org
- World Bank Climate Change Knowledge Portal – historic and future temperature and rainfall - http://sdwebx.worldbank.org/climateportal/
- IPCC Fourth Assessment Report – sea level rise scenarios; global circulation model projections for temperature, rainfall; projections on acidity, SST and other parameters http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm
- Global Warming Art – Sea Level Rise Explorer http://www.globalwarmingart.com/wiki/Special:SeaLevel
- Country level national communications to UNFCC – http://unfccc.int/national_reports/items/1408.php
- Country level National Action Programs for Adaptation (NAPA) - http://unfccc.int/national_reports/napa/items/2719.php
- Database of the International Research Institute for Climate and Society (IRI) of the Columbia University - http://iridl.ldeo.columbia.edu/
- Database of the CSAG group of the University of Cape Town - http://cip.csag.uct.ac.za/webclient/introduction

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

In order to be able to analyze the future vulnerability to climate change in the project area, it is necessary to have an understanding of the evolution of the environmental, social and economic characteristics of the project area in the absence of climate change; this is referred to later in the VA process as the future baseline. By understanding the future baseline conditions in the absence of climate change, the VA can then look at the effects of future climate change to determine the overall future vulnerability (Figure 3.2).

Figure 2.2: Existing and Future Climate Vulnerability and Relation to Adaptation Planning



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

Phase 2: Technical Analyses

Once the objectives, scope and targets of the VA have been identified in Phase 1, the second phase of the methodology includes a technical evaluation of the relative climate change vulnerability of the identified targets. This phase of the methodology uses established and proven technical methods for vulnerability analyses, and commences with guidance on the choice of the methodologies that are the most appropriate for the subject VA. The key output of this phase is the production of spatial data on the relative vulnerability of targets for the defined study timeframe. The activities that are included in Phase 2 are as follows:

Activity 2.1: Stage 1 Screening VA for all Targets

The Manual advocates a two stage approach to vulnerability assessment (refer Figure 3.3). For all targets, a first screening VA is carried out using a methodology that was developed specifically for the Manual – the BAsic Vulnerability Assessment for Protected Areas (BAVAPA) methodology. This methodology has been designed and field tested during development of the VA Manual. The BAVAPA methodology aims to provide a simple, practical, "first-cut" VA methodology that applies to a wide range of VA targets and that can be

Box 3.2: Criteria for Selection of VA Methodologies included in the Manual

All methodologies included in the Manual meet three essential criteria:

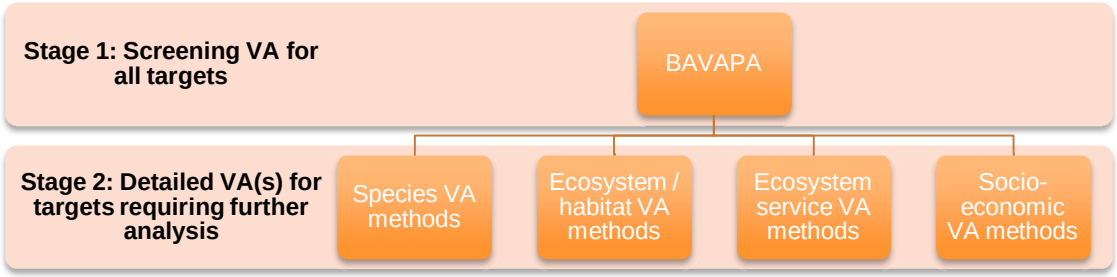
(i) They include consideration of the interaction between climate and non-climate stresses and particularly how climate impacts and adaptive capacity may be worsened or improved through synergistic effects of non-climate influences.

(ii) 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.

(iii) They have been tested in one or more of the project pilot sites to ensure that they are suitable for use in a developing country context and to allow development of recommendations to modify or improve certain elements of methodology application.

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

Figure 2.3: Stage 1 and Level 2 Vulnerability Assessment Methods



Following the application of the BAVAPA methodology for all targets, the user can decide if there are targets that require detailed further analysis based on the initial BAVAPA results. To determine this the Manual provides a range of exploratory questions / criteria to determine if a detailed VA would be warranted. Should one or more targets warrant a more detailed second stage analysis if data, resources and time allow the Manual guides the user though this process.

Activity 2.2: Application of Stage 2 Detailed VA Methodology(ies) for Selected Targets

This activity involves the application of the stage 2 detailed technical VA methodology(ies) that have been selected. For the second stage analyses, there exists a wide range of established VA methodologies for ecological systems (species, habitats etc) and social systems (communities, households, municipalities), and a lesser but growing number of methodologies for ecosystem services. The approach that the current manual has taken is to provide guidance on the selection and combination of the use of existing methodologies that are appropriate for a VA that is focusing on a CMPA and surrounding environment.

The Manual presents a selection of potentially suitable methodologies and assists the user to select one or more of these methodologies based on criteria of available resources, data availability, ease of application, required outputs and timeline of the VA study (refer Table 3.1). Many of the methodologies presented address only one or a small number of aspects of a full VA study for a CMPA (e.g. some only refer to species vulnerability or only to human community vulnerability). Thus for any single CMPA VA study, it is likely that more than one methodology will be required depending on the range of VA targets that have been identified.

Table 2.1: Stage 2 Technical VA Methodologies referred to in Step 2.2 of Manual

Methodology Name	***Methodology Target***
CARE Climate Vulnerability and Capacity Analysis Handbook[8] Climate Witness[9] Social Vulnerability Index (SVI)[10]	Social targets
Climate Change Vulnerability Assessment Adaptation Planning for Mangrove Systems[11] IUCN Coral Reef Resilience Protocol[12]	Ecosystems / habitats
US-EPA Threatened Species Vulnerability Assessment Tool[13]	Species

[8] CARE International, 2009
[9] WWF South Pacific Programme, undated
[10] Refer Appendix 3
[11] Ellison, 2012
[12] Obura & Grimditch, 2009
[13] US-EPA, 2010

Methodology Name	*Methodology Target*
CMS Migratory Species Vulnerability Assessment Tool[14]	
Tool for Understanding Resilience of Fisheries - TURF[15]	Ecosystem services -fisheries
Integrated Coastal Sensitivity, Exposure, Adaptive Capacity to Climate Change – ICSEA-C-CHANGE[16]	Integrated social and ecological targets

In addition to the methodologies identified in Table 2.1, the WWF network was at the time of preparation of the Manual preparing an integrated ecosystem and social vulnerability assessment methodology known as 'Flowing Forward'. It is envisaged that future iterations of the Manual will include reference to the Flowing Forward methodology as a detailed VA methodology.

Manual users are provided guidance in the application of the selected methodology in a coastal and marine protected area context through a series of Guidance Notes that are included in Appendix 2. Each Guidance Note provides a brief description of the methodology, the equipment and resources that would be needed for its application, a discussion on how it can be combined with other methodologies and tips for applying it in the context of a CMPA. The Guidance Note also provides links to sources of further information and worked examples of the methodology. The Guidance Notes do not replace the guidance manuals or instructions that exist for the methodologies but provide complementary information to allow the methodologies to be selected and applied in the context of a CMPA.

Phase 3: Risk Assessment and Validation

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

Activity 3.1 Validation and Priority Setting Workshop(s)

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

The form that the validation and priority setting process should take is through one or more workshops and/or focus groups that aim to validate the consolidated results of the VA analyses (including data gaps and the assumptions used in the VA process) and undertake an initial identification of priorities for future action. Different stakeholder groups will have differences in terms of the level and type of information that may be of interest, and they operate within different institutional frameworks. Thus the messages and the methods must be tailored to their specific characteristics. It is important to note that the aim is not to split up groups in terms of their areas of technical specialty, as one of the key aims of the risk management process is to bring knowledge from a range of technical domains into the process in an integrated manner. VA teams will at this point in the process have a good understanding of the different stakeholder groups and their interests and should tailor the risk management process to fit their individual circumstances. As a guide, VA teams can consider the following groups that could be consulted either individually or in a combined exercise:

[14] ZSL, 2010
[15] Geronimo et al, 2013
[16] Ibid

i. "National/regional leaders and experts" with national/regional Government, technical experts and national/regional civil society
ii. "Local deciders and managers" with PA managers, local/regional Government, local/regional civil society, private sector
iii. "Community and local resource users" with PA agents, local communities, local/municipal Government, local civil society, local private sector

The detailed agenda and forms in which information is presented will vary according to the participants (refer below), but in general, the following issues/questions should be addressed in each exercise:

1. **What is the context? =>** Provide participants with information on the overall VA context and information on process followed.
2. **What assumptions were used and what uncertainties remain? =>** Provide participants on the key assumptions used in the VA process and the uncertainties that remain. Ask participants to consider if the assumptions are valid and if the uncertainties could be reduced.
3. **What are the important VA results?** Provide information on the key outcomes of the VA for different targets and ask participants their views – i.e. Do they 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?
4. **What are the priorities for further action?** Based on the spatial picture of vulnerability can different zones be prioritized for future action because of an elevated vulnerability of one or more targets? Do certain targets need specific priority? What actions are needed for different priorities – i.e. "Address/Adapt", "Research to Learn More", "Monitor & Revisit", or "No Action"?

Activity 3.2: Mapping and Reporting of VA Outcomes
This activity represents the last but essential activity in the VA process; it involves "putting it all together" and producing a comprehensive, yet concise documentation of the VA process, results and next steps. The narrative and maps produced during this step will have numerous functions – they can be used for forward planning, presentation of baseline data for monitoring and evaluation, education and information, or as pilot studies for other areas. It is important that VA teams dedicate the time and resources needed to produce a thorough and useful report. The Manual provides guidance on the key elements to include in reporting.

Organizational Structure for Application of VA Manual

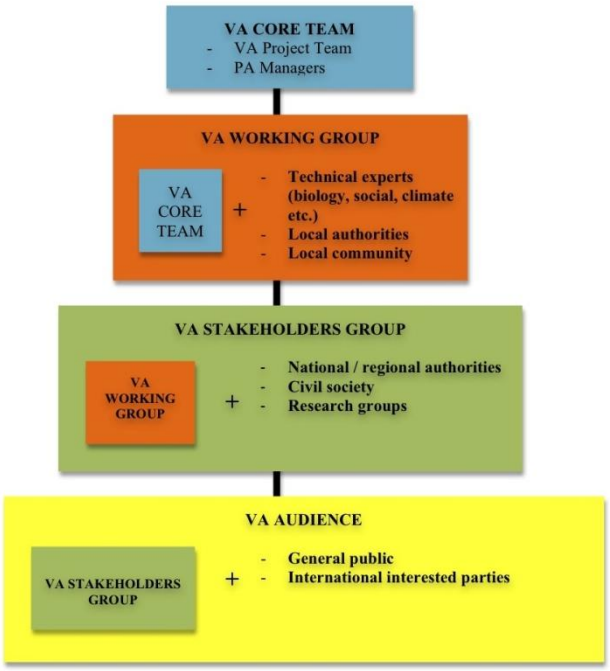
A wide range of stakeholders can have an interest in VA studies and importantly can contribute technical or non-technical information that is important for analyses undertaken in the VA process. A key characteristic of the VA methodology presented in this manual is that it is undertaken in a participatory manner with different stakeholders – including technical, community, and Government stakeholders - involved at different stages of the process. While each VA will need to develop a program of stakeholder involvement that is specific to the individual circumstances, Figure 3.4 overleaf provides a suggested structure for stakeholder organization and involvement. The suggested organizational structure has been developed in a nested manner and is structured around the following key groups:

Group	Suggested Participants	Major Functions and Responsibilities
VA Core Team	Project team within the organization carrying out the VA; protected area technical staff; key technical consultants	Day to day technical and financial management of the VA and coordination of VA methodology implementation; involved in all steps of VA
VA Working Group	VA Core Team + PA managers, technical experts (climate, social, biodiversity etc.), local authority representatives, local community representatives, research or academic institutions involved in PA-related research, private sector	Strategic oversight of VA process and technical or strategic advice at key steps of VA process; involved in selected steps of the VA process when decisions need to be made or when technical information needs to be validated

Group	Suggested Participants	Major Functions and Responsibilities
	representatives	
VA Stakeholders Group	VA Working Group + national or regional authorities, civil society, wider group of research institutions, private sector	Provision of technical or strategic planning information and validation of VA outcomes at key steps in the process. The composition and form of such groups will depend on the technical methodologies selected for use in the VA process.
VA Audience	VA Stakeholders Group + general public and any other interested parties	Presented with final VA results as a means of information

In each of the subsequent worksheets, suggestions are made as to the stakeholder groups that should be included or consulted in VA activities. VA teams are however encouraged to tailor not only the composition of the groups but their role in the VA process to meet their specific needs.

Figure 2.4: Suggested Organizational Structure for VA Study Implementation



Part 3: Vulnerability Assessment Manual Worksheets

This section provides the Worksheets that have been prepared to guide Manual users through implementation of each activity contained in the Manual.

Overview of Worksheets

Tools have been developed for each activity of the methodology contained in the Manual in the form of worksheets, and Guidance Notes where more detailed guidance on a particular issue is required. While the Manual can be implemented wither with or without referring to these worksheets and guidance notes, these tools were found to be useful during the testing phase particularly when used to guide discussions or in participatory exercises in meetings or workshops.

Table 1 describes the tools that have been developed and provides a cross-reference to the relevant methodology phase and activity. Worked examples from each of the six pilot PAs are included in this section to provide examples of how the worksheets have been applied in a real VA situation.

Table 3.1: Tools & Guidance Notes to support VA Methodology Implementation

Phase	Activity	Worksheets in Manual	Detailed Guidance Notes (Further Information on Key Activities)
1	***1.1 Identify VA scope and objectives***	i. Worksheet 1.1 for VA objectives and scope	
	1.2 Identify social and ecological targets	ii. Worksheet 1.2 to identify social and ecological VA targets	
	1.3 Climate scenarios and exposure data / non-climate scenarios	iii. Worksheet 1.3a on baseline situation documentation and bibliography preparation iv. Worksheet 1.3b on climate scenario development and climate exposure data v. Worksheet 1.3c on non-climate scenario development	"Methods for Climate Scenario Development"
2	***2.1 Stage 1 Screening VA for all targets***	vi. Worksheet 2.1 Apply Stage 1 Screening VA to all Targets	"Guidance Note for Implementation of Stage 1 BAVAPA Methodology"
	2.2 Stage 2 Detailed VA for selected targets (optional)	vii. Worksheet 2.2 (optional) Apply Stage 2 Detailed VA(s) to selected Target(s)	"Guidance Notes for Stage 2 Detailed VA Methodologies"
3	***3.1 Validation and priority setting workshop(s)***	viii. Worksheet 3.1 for stakeholder workshop(s)	
	3.2 Reporting and mapping of VA outcomes	ix. Worksheet 3.2 for reporting and mapping of VA outcomes	

What you need to get started – a checklist…

Before you commence the VA process, use the following checklist to make sure you have access to all of the required human and technical resources that you will need throughout the VA process:

Human Resources (one person may fill more than one role)	YES / NO
Designated VA team leader	
Climate change specialist(s)	
Biodiversity specialist(s)	

Socio-economic specialist(s)	
Workshop / community facilitator(s)	
GIS analyst(s)	
Documents / Data	
PA Management Plan and related documents	
Grey and published literature and reports on PA conservation targets	
Grey and published literature on communities and villages in proximity to PA	
Grey and published literature on climate patterns, natural disasters and future climate change projections at the most relevant scale for the PA	
Contact details of Government stakeholders	
Contact details of community leaders / key community stakeholders	
Contact details of private sector stakeholders	
Materials	
Baseline map of the PA and surrounds in hard copy	
Baseline map of the PA and surrounds in GIS form	
Presentation materials, flipcharts, pens	

Worksheet No. 1.1: VA objectives and scope	
Methodology Cross-Reference:	Phase 1, Activity 1.1: Identify VA Objectives and Scope
Purpose:	To facilitate the development and documentation of the VA objective(s) and the VA geographic and temporal scope
Inputs & Resources Required:	Baseline map of broad study area; knowledge of land use and development patterns around study area; knowledge of key stakeholder groups; PA management plan
Expected Results:	Documented VA study objectives; documented and mapped scope of VA study
Suggested Stakeholder Involvement:	VA Working Group

Step I: VA Objectives

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

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

Do you want to achieve the following with your VA?	Yes – it is one of the main purposes of the VA	Partially – it is a secondary or related benefit of the VA process	No – the VA does not need to achieve this
(i) *(ii)* *(iii)*			

Step II: VA Scope

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

In terms of the geographical limits of the VA study area, in addition to the PA itself, do you want to include:	Yes	No	Specify which ones…
- any nearby or connected PAs?			
- any nearby or connected ecosystems or habitats that are not included in the PA boundaries?			
- human communities living in the PA that depend on the ecosystem services furnished by the PA?			
- human communities living near the PA that depend on the ecosystem services furnished by the PA?			
- economic activities / industries / private sector activities that affect or are affected by the PA?			
- other…			
- other…			
- other…			
- other…			
In terms of the objectives of the VA study which timeframe should apply to the VA study:	**0 to 5 years**	**0 to 10 years**	**0 to 20+ years**
Final Statement of VA Scope:			

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

Worksheet No. 1.2: Ecological, ecosystem service, and social VA targets	
Methodology Cross-Reference:	Phase 1, Activity 1.2
Purpose:	To document and map the ecological, ecosystem service and social targets that will be investigated in detail during the VA
Inputs & Resources Required:	Baseline map; PA management plan; broad data on surrounding socio-economic conditions; initial studies on species or ecosystem vulnerability; understanding of ecosystem services provided by the PA and importance of PA resources to local communities
Expected Results:	Documentation and mapping of ecological, ecosystem service and social VA targets
Suggested Stakeholder Involvement:	VA Core Team (Steps I - III) / VA Working Group (Step IV)

Step I: Ecological Targets – Species and Habitat

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

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

Step II: Ecosystem Service Targets

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

Provisioning Services	Regulating Services	Cultural Services	Supporting Services

Step III: Social Targets

1. In the first column of the following table list all the villages or household groups that occur in the PA, in the vicinity of the VA or that rely on services furnished by the PA
2. For each village or group of households, consider each of the following questions, and reply "Yes", "Unknown" or "No"[17]:
    a. Are there demographically vulnerable groups in the village – e.g. poor households, female-headed households, or indigenous households?
    b. Do households in the village depend on natural resources and ecosystem services that are potentially vulnerable to climate change impacts?
    c. Do households in the village have access to natural resources and ecosystem services that are potentially useful and that are potentially vulnerable to climate change impacts (whether or not they are currently exploiting them)?
    d. Do households in the village have, or could have, a diverse range of livelihoods and incomes?
    e. Is there access to climate related information in the village?
    f. Are villagers aware of climate hazards or have they experienced natural disasters in the past?
    g. Is there equitable access to resources in the village?
    h. Are there formal and informal support networks within the village – e.g. professional associations, womens' groups, local Government presence?

    It is quite possible that there will be a large number of questions to which you will reply "Unknown"; this is to be expected as many of these issues will only be investigated in detail in the latter stages of the VA. In this case you should employ the precautionary approach and retain the village in question in the long-list of possible social targets.

3. Document the name of the villages or household groups for which you have replied "Yes" or "Unknown" for one or more of these questions in the first column of the table below and note any relevant comments about possible drivers of vulnerability in the second column that may have arisen from discussions in Step 2 above; such issues will be interesting to re-visit in technical VA analyses for these targets. These villages will form the basis of the long-list of social targets to be validated with the VA Working Group in Step IV.

Village Name	Possible Drivers of Vulnerability

Step IV: Validate and Map Targets

4. Once the "long-lists" of ecological, ecosystem service and social targets are developed, it is recommended that a validation exercise is undertaken with the VA 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:

    i. Do we have the resources and the time to address all the targets?

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

ii. How does each target align with the team's priorities as expressed in the VA objectives?
iii. Are there some targets that are of a lower priority that could be left for a second stage VA?
iv. Do we have the information for all of the targets to at least allow a preliminary VA or are there some targets that we should put directly into the research plan and carry out the VA when we have the required information?
v. Within the groups of targets is there one target that could act as a proxy for others in the VA process? For example, is there one village that is representative of other villages or one species that is representative of other species?
vi. Is there any duplication between ecosystem services targets and ecological targets? Could any of these targets be combined?

5. Once validated, the ecological and social targets should be included on the baseline mapping either through a GIS platform or manual mapping. For species you can map occurrence records, distribution area, resource use zones, or key habitat areas.

Worksheet No. 1.3a: Document baseline scenario	
Methodology Cross-Reference:	Phase 1, Activity 1.3
Purpose:	To collect data and document baseline conditions on the study area
Inputs & Resources Required:	Available data on existing and future climate, socio-economic, biophysical, ecological, environmental, and governance / institutional conditions in the study area.
Expected Results:	Documented baseline of study area and bibliography
Suggested Stakeholder Involvement:	VA Core Team + Experts in various disciplines

Step I: Collate Background Documents

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

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

Step II: Document Study Area Baseline Conditions

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

Issue	Baseline Conditions
Climate (average conditions and extreme events)	
Biophysical (hydrology, topography, soils, geology etc)	
Socio-economic (population, age distribution, incomes, livelihoods, poverty, use of natural resources, indigenous groups etc)	
Ecological (habitats, species, ecosystem services etc.)	
Environment (pollution levels and sources)	

Issue	Baseline Conditions
Governance (Local and regional Government structure and roles, administrative boundaries, land use / development and other relevant policies, plans and planning cycles, legislation, stakeholder groups etc.)	
Other…	
Other…	

Worksheet No. 1.3b: Future climate scenarios	
Methodology Cross-Reference:	Phase 1, Activity 1.3
Purpose:	To discuss and develop plausible future climate scenarios for the project area
Inputs & Resources Required:	Available climate change projections (e.g. GCM and regional model results) for study area; Guidance Note No. 01 'Methods for Developing Climate Change Scenarios'
Expected Results:	Future climate scenarios for project area
Suggested Stakeholder Involvement:	VA Core Team + Climate Experts

Step I: Identify possible climate manifestations in the project area

1. Use the team's knowledge on climate variability and future climate change projections to identify a long list of potential climate manifestations[18] in the project area by marking an "X" in the "Yes" column of the table below if a climate manifestation is likely to be experienced; an "X" in the "Unknown" column if there is inadequate information to determine if a manifestation is likely to occur; or an "X" in the "No" column if it is known that the climate manifestation will not occur in the study area.
2. Adopt a precautionary approach in this task – if there is any doubt about the future occurrence of a particular climate manifestation then mark "Unknown" rather than "No".

Climate Manifestation	**Likely to be experienced in project 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 – calendar			
Ambient T°C – day time			
Ambient T°C – night time			
Heatwave			
Drought			
Flooding			
Fire			
Surface water hydrology			
Groundwater hydrology			
Coastal erosion through changes to beach profiles or coastal morphology			
Others….			
Others….			
Others….			
Oceanic Parameters – will climate variability / climate change lead to changes in ….			
Sea surface temperature			
Sea acidity			
Upwellings			
Salinity			
Extreme waves			
Solar radiation			
Sedimentation			
Chlorphyll			

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

Climate Manifestation	Likely to be experienced in project area?		
	Yes	Unknown	No
Humidity / evaporation			
Others….			
Others….			
Others…			

Step II: Documentation of available data

Complete the following table for each climate manifestation identified as "Yes" or "Unknown" in the table in Step 1 of the worksheet using the guidance below:

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

Climate Manifestation (those manifestations marked "Yes" or "Unknown" in the table in Step 1)	**Description of historic climate conditions, climate variability and recent changes**	**Projected future changes in climate conditions (based on model outputs and/or temporal analogue approach)** *Note: can refer to climate variability and/or climate change depending on VA scope*	**Comments on data source / quality**

Step III: Climate scenario development

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

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

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

Worksheet No. 1.3c: Non-climate scenarios	
Methodology Cross-Reference:	Phase 1, Activity 1.3
Purpose:	To develop plausible future scenarios of non-climate conditions in the project area
Inputs & Resources Required:	Knowledge of environmental, social and economic conditions in project area; knowledge or projections of likely future trends in environmental, social and economic conditions in project area; knowledge of non-climate threats to PA resources and likely evolution of these threats.
Expected Results:	Future non-climate scenarios for project area
Suggested Stakeholder Involvement:	VA Working Group + VA community stakeholders

Step I: Identify key issues and data sources to create future scenarios

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

Theme	Issues	Data Sources (historic, existing, future conditions / qualitative or quantitative)
Environmental	Anthropogenic pressures in PA	
	Anthropogenic pressures near PA	
	Environmental pollution - water	
	Environmental pollution - soil	
	Environmental pollution - air	
	Land degradation, erosion and loss of fertility	
	Deforestation / clearing	
	Other….	
	Other….	
	Other….	
Social	Population growth	
	Age distribution	
	Incomes	
	Livelihood types	
	Migration	
	Education	
	Employment	
	Other….	
	Other….	
	Other….	
Economic	GDP per capita	
	Industry trends	
	Economic activity	
	Other…	
	Other….	
	Other….	
Policy / Institutional / Governance	Legislation development	
	Policies / plans development	
	Institutional structure changes	
	Other…	
	Other….	
	Other….	

Step II: Documentation of available data

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

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

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

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

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

For each scenario, fill in the following table:

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

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

Worksheet No. 2.1: Screening VA for all Targets	
Methodology Cross-Reference:	Phase 2, Activity 2.1: Apply Stage 1 screening VA (BAVAPA methodology) to all identified targets
Purpose:	To apply a simple consistent VA methodology to all targets to (i) generate a baseline level of information on the vulnerability of each targets; and (ii) screen targets to prioritize those that need further detailed VA analyses
Inputs & Resources Required:	Results of preceding activities in Phase 1; baseline mapping
Expected Results:	Initial understanding of relative vulnerability of VA targets; list of priority targets needing detailed Stage 2 VA
Suggested Stakeholder Involvement:	VA Working Group

Step I: Apply BAVAPA methodology to all targets

The BAVAPA methodology should be applied to all targets identified in Activity 1.2. Guidance Note A3.1 in Appendix 3 outlines the steps involved in the application of the BAVAPA methodology. It also contains templates for reporting the results of application of the BAVAPA methodology for each target.

Step II: Identify targets warranting detailed Stage 2 VA

Use the following table to analyze whether further detailed analyses of vulnerability are required for certain targets. Fill out the table for each of the targets that were identified in Activity 1.2 and subsequently subject to the application of the BAVAPA methodology. As a general rule if the team responds 'YES' to one or more of the questions, then the need for further analyses should be considered in detail.

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

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

Worksheet No. 2.2: Detailed VA for Selected Targets (Optional)	
Methodology Cross-Reference:	Phase 2, Activity 2.2: Undertake detailed vulnerability analyses for selected targets (optional)
Purpose:	To apply comprehensive VA methodologies to targets that require further analyses based on the results of the Stage 1 Screening VA
Inputs & Resources Required:	Results of preceding activity 2.1; baseline mapping; relevant datasets for selected targets and methods
Expected Results:	Detailed understanding of vulnerability and drivers of vulnerability for priority targets
Suggested Stakeholder Involvement:	VA Working Group

Step I: Select the methodology to be implemented for each target

1. Consider the list of VA social and ecological targets and work through the descriptions of various methodological options to choose the appropriate methodology(ies). 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 and additional information on the required data and resources can be found in the Guidance Notes contained in Appendix 1:

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

Methodology Name (and link)	Description & Worked Examples	Advantages	Disadvantages	Data	Resource	Complexit	Robustne	Adaptabili
Social Targets								
Social Vulnerability Index (SVI) Refer Appendix 3	Involves development of a tailored index that combines multiple social vulnerability indicators to produce a vulnerability index that indicates that relative vulnerability of social targets. Refer Guidance Note 03 for detailed description.	First level screening VA method that allows a project area wide view of social vulnerability. Adopts participatory approaches that catalyze discussion on key vulnerability influences. Results in mapped outputs. Allows sensitivity testing through weighting and rating	Requires careful selection of input indicators and development of weighting and rating matrices. Requires additional in depth analysis of targets to allow adaptation planning.	M	M	L	M	H

Methodology Name (and link)	Description & Worked Examples	Advantages	Disadvantages	Data	Resource	Complexit	Robustne	Adaptabili
		scores.						
CARE Climate Vulnerability & Capacity Analysis Handbook http://www.careclimatechange.org/cvca/CARE_CVCAHandbook.pdf	A participatory approach methodology that combines various social research tools to understand vulnerability at all levels of society – national to local levels.	Relatively well known and tested methodology that can explore vulnerability drivers in targeted communities. Combines scientific and traditional knowledge. Results provide strong basis for adaptation planning. It involves community stakeholder participation and thus has secondary benefits for awareness raising. It orders and presents results clearly. Results are qualitative but can be noted in GIS database linked to location for adaptation planning. Good second phase tool to guide adaptation planning.	Coverage of livelihoods / natural resource links not strong. Facilitators need good experience in participatory tools included in methodology. It focuses on existing climate hazards and would need to be adapted to also address future climate hazards.	*M*	*H*	*M*	*M*	*H*
WWF Climate Witness Community Toolkit http://wwf.panda.org/about_our_earth/all_publications/?uNewsID=162722	A participatory approach methodology that combines various social research tools to understand vulnerability of local communities.	Relatively well known and tested methodology that can explore vulnerability drivers in targeted communities. It addresses natural resource – livelihood links and focuses on the adaptive capacity of local communities. 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	Facilitators need good experience in participatory tools included in methodology. Full process requires several days engagement with local communities which may not be feasible for community members.	M	H	M	M	H

Methodology Name (and link)	Description & Worked Examples	Advantages	Disadvantages	Data	Resource	Complexit	Robustne	Adaptabili
		adaptation planning. Good second phase tool to guide adaptation planning.						
Ecological Targets – Species								
Framework for Categorizing the Relative Vulnerability of Threatened and Endangered Species - Galbraith and Price http://www.google.com/search?client=safari&rls=en&q=A+framework+	A excel based approach that provides ranking of relative vulnerability for groups of species. Can use qualitative or quantitative data and includes a narrative section that identifies assumptions and future research needs.	Can use expert opinion where quantitative data not available. Addresses multiple climate and non-climate influences on vulnerability. Narrative provides information on issues to consider in adaptation planning. Detailed manuals and guidance available. Narrative based analysis can be prepared for single species or small group of species.	Difficult to apply to data poor species due to high data input needs. Intended to apply to threatened and endangered species in USA.	H	H	H	H	M
Climate Change Vulnerability of Migratory Species: Species Assessments www.cms.int/publications/pdf/cms_climate_change_vulnerability.pdf	Quantitative assessment tool for migratory species that uses comprehensive data on interactions between migratory species and climate to score overall vulnerability.	Designed specifically for migratory species and thus highly relevant in the context of CMPAs.	Requires comprehensive understanding of species – climate interactions	H	H	M	H	M
Ecological Targets – Coral Reefs								
IUCN Coral Reef Resilience Methodology http://www.reefresilience.org/Toolkit_Coral/C6cc1_RapidAssess.html	Recognized methodology for undertaking resilience assessments of coral reef ecosystems. http://cmsdata.iucn.org/downloads/report_nosy_hara_resilience_feb_3_submitted.pdf	Comprehensive and tested methodology. Detailed guidance and examples.	Data collection needs are intensive and require specialist inputs.	H	H	H	H	L
Ecological Targets – Mangroves								
Vulnerability Assessment and Adaptation of Mangrove Systems (WWF-US) www.worldwildlife.org/climate/publications/index.html	Manual for mangrove VAs developed through three year GEF funded project in Fiji, Tanzania and Cameroon.	Comprehensive manual with clear steps and range of options for achieving results. Detailed guidance includes case studies from application in pilot countries.	Data needs are relatively high.	H	H	H	H	L
Ecological Targets – Fisheries								

Methodology Name (and link)	Description & Worked Examples	Advantages	Disadvantages	Data	Resource	Complexit	Robustne	Adaptabili
Tool for Understanding Resilience of Fisheries (TURF)	Tool to understand vulnerability of reef based fisheries, inside or outside of CMPAs, to climate change hazards.	Focuses on a key ecosystem service provided by CMPAs. Simple and adaptable methodology.	Requires relatively extensive data on fisheries.	M	M	L	H	H
Social and Ecological Targets (can be used for combined or separate analyses)								
Integrated Coastal Sensitivity, Exposure, Adaptive Capacity to Climate Change – ISEACCHANGE	Provides a rapid synoptic assessment of the acute, immediate impacts of climate change in coastal areas.	Based on simple scoring tables and can be applied to a range of targets with limited specialist knowledge.	Addresses short term impacts and responses only.	M	M	L	M	H

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

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

Step II: Apply the selected methodology(ies)

Detailed Guidance Notes contained in Appendix 2 have been prepared for each of the short-listed methodologies to aid in identifying the data and resources needed for methodology application and to provide further information on the use of the methodology. These Guidance Notes should be used in the application of the selected methodology(ies).

Worksheet No. 3.1: Validation and priority setting workshop(s)	
Methodology Cross-Reference:	Phase 3, Activity 3.1: Validation and priority setting workshop(s)
Purpose:	To present VA results to a wide audience of stakeholders and technical experts, test assumptions, address uncertainties, seek validation of results and undertake initial identification of priorities for future work
Inputs & Resources Required:	Results of preceding activities in Phases 1 – 3; baseline mapping
Expected Results:	Validated VA outcomes; initial list of priority areas / issues for further action
Suggested Stakeholder Involvement:	VA Stakeholders Group

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

1. Develop a long-list of all stakeholders within the VA Stakeholders Group. Determine the number of workshops that will be held and the location and participants for each workshop by taking into consideration: (i) the available budget and time; (ii) the need to keep workshop(s) to a manageable size (ideally fewer than 30 people); (iii) the locations of different stakeholders; and (iii) the different technical capacities of stakeholders.

2. Develop an agenda for each workshop. The four key issues identified above should be included in the agenda. An example agenda for a one-day workshop is provided below and can be used as a guide. Identify who will facilitate the workshop to guide participants through the different stages of the workshop and ensure that the facilitator understands the workshop aims and agenda.

Workshop Title:	*XYZ Coastal and marine protected area Vulnerability Assessment Validation and Priority Setting Workshop*	
Workshop Duration:	*1 day*	
Time	**Topic**	**Participants**
9.00 - 9.15	*Welcome and Objectives of Workshop*	*Facilitator*
9.15 - 9.30	*Presentation of Participants*	*All*
9.30 - 10.00	*Overview of XYZ Coastal and marine protected area*	*PA Managers*
10.00 - 11.00	*Background to VA: objectives, scope and methods*	*VA Core Team*
11.00 - 12.00	*Presentation of technical VA results*	*VA Core Team*
12.00 - 12.30	*Presentation of Assumptions & Uncertainties*	*Facilitator / All*
12.30 - 14.00	*LUNCH*	*All*
14.00 - 15.00	*Exercise 1: Discussion of assumptions and uncertainties*	*Facilitator / All*
15.00 - 16.00	*Exercise 2: Ground-truthing of VA results*	*Facilitator / All*
16.00 - 17.00	*Exercise 3: Priorities for future action*	*Facilitator / All*
17.00 - 17.30	*Wrap-up and Workshop Close*	*Facilitator*

Step II: Prepare background material

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

Target Name:	
Target Vulnerability Rank:	
VA Methodology(ies) Applied:	

Non-Climate Impacts	**Climate Impacts**	**Adaptive Capacity**	**Data Gaps / Assumptions**
A summary of the identified non-climate impacts acting on the target now and in the future.	*A summary of the identified likely climate impacts (resulting from variability and vulnerability as necessary), including comments on*	*A summary of the key internal and external adaptive capacity factors acting on the target.*	*A summary of the key data gaps and assumptions that have influenced VA results.*

	interactions with non-climate impacts.		

2. Prepare mapping (manually or using GIS). Use the following schedule as a guide for the minimum types of maps that should be produced:

    a. 1 map for all HIGH vulnerability species, ecosystems/habitats, ecosystem services, and social targets
    b. 1 map for all MEDIUM vulnerability species, ecosystems/habitats, ecosystem services, and social targets
    c. 1 map for all LOW vulnerability species, ecosystems/habitats, ecosystem services, and social targets
    d. 1 map showing HIGH, MEDIUM and LOW vulnerability species targets
    e. 1 map showing HIGH, MEDIUM and LOW vulnerability ecosystems/habitats targets
    f. 1 map showing HIGH, MEDIUM and LOW vulnerability ecosystem services targets
    g. 1 map showing HIGH, MEDIUM and LOW vulnerability social targets

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

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

3. Distribute background materials to participants in advance of the workshop.
4. Prepare large format maps, pens, markers, paper, cards and other required workshop resources.

Step III: Hold workshop(s)

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

Exercise 1: Testing Assumptions and Uncertainties

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

Step 1: Testing VA Assumptions					
Assumption	***Stage in VA Process***	***Possible Influence on VA Results?***	***Valid Assumption (Yes / No / Unknown)?***	***If 'No' or 'Unknown' is there an Alternative Assumption with data sources?***	***Comments / Observations***
Step 2. Testing Uncertainties					
Uncertainty	***Stage in VA Process***	***Possible Influence on VA Results?***	***Data to Reduce Uncertainty Available?***	***Source of Additional Data?***	***Comments / Observations***

Exercise 2: Ground Truthing of VA Results

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

Exercise 3: Initial Identification of Priorities

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

Step IV: Document workshop outcomes

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

Worksheet No. 3.2: Mapping and reporting of VA outcomes	
Methodology Cross-Reference:	Phase 3, Activity 3.2: Mapping and Reporting of VA Outcomes
Purpose:	To prepare comprehensive reporting of the VA process and outcomes and spatial presentation of key results
Inputs & Resources Required:	Results of preceding activities in Phases 1 – 3; baseline mapping
Expected Results:	Final VA Report and Maps
Suggested Stakeholder Involvement:	VA Core Team

Step I: Preparation of VA Report and Maps

1. While each VA team will determine the reporting structure that best suits their needs, a guide to assist in this process has been provided below in Table 4.1. This guide follows the logic and sequence of steps and activities in the VA Manual and maximizes use of text and documentation already prepared in the completion of the Manual worksheets to prepare the report. In particular, the documentation prepared in advance of the validation and priority setting workshops can be used as a starting point for the final VA reporting.

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

Table 4.1: Suggested VA Reporting Outline

SUGGESTED SECTION HEADING	SUGGESTED CONTENTS
Section 1: Introduction and Context	
1.1 Introduction	General introduction to PA and to VA process (who, why, how…)
1.2 VA Objectives and Scope	
- VA Objectives	Taken from Worksheet 1.1
- VA Scope (narrative and maps)	Taken from Worksheet 1.1
- VA Targets (narrative and maps)	Taken from Worksheet 1.2
1.3 Description of Existing Study Area	Taken from Worksheet 1.3a
1.4 Projected Future Conditions in Study Area	
- Future Non-Climate Scenarios for Study Area	Taken from Worksheet 1.3b
- Future Climate Scenarios for Study Area	Taken from Worksheet 1.3c
Section 2: Technical VA Assessment Results	
2.1 Overview of Technical Assessment Methodology(ies) Applied	Taken from relevant Guidance Note(s) on technical VA methodologies
2.2 Technical Assessment Summary (narrative and maps)	Taken from Worksheet(s) 2.1 and 2.2
Section 3: Conclusions & Recommendations	
3.1 Risk Assessment and Stakeholder Validation Outcomes – Priorities and Next Steps	Taken from Worksheet 3.1
Annexes	
Study team	
List of people consulted	
Completed worksheets	
Additional maps	

Part 4: Lessons Learnt and the Way Forward

This VA Manual was developed in an iterative process with comprehensive testing and discussion of different approached between country teams. While all the pilot PAs were located in coastal and marine zones in developing countries, there were a number of significant differences between the PAs in terms of size, management, geographical isolation and integration with local communities, and the range of ecosystems and species that they harbored. This diversity in pilot PAs led to lively debate about the best way to approach VAs and generated a large number of lessons that not only informed Manual development, but which are documented here (in no particular order) in the hope that the experiences of the country teams involved in the Manual development will also be of interest to practitioners carrying out VAs in the future.

There is no one correct way to do VA and there are no 'right' or 'wrong' answers from a VA

As indicated in the Manual there are numerous VA methodologies, all of which have their own strengths and weaknesses. For a complicated and unique system such as a PA which incorporates a diversity of different types of targets (e.g. communities, ecosystems, species, ecosystem services) there is not a 'one size fits all' solution to VA methods. Each of the country teams involved in Manual testing adopted a different mix of VA methods that was the best adapted to their individual situation both in terms of the characteristics of their PAs, but also in terms of available data and resources and the expectations of stakeholders. All of the methods adopted generated important information on the vulnerability of targets that was used to guide adaptation planning – the ultimate goal of the VA process.

VAs are a tool and you need to make the tool work for you

It should be remembered that VAs are simply a tool. As with all tools, teams should focus on understanding how they operate and then use them to achieve the desired objectives. If a VA method does not work for the situation at hand then it should be modified or discarded until a more appropriate tool can be found.

Remember that VAs are not the 'end-game' and plan to move past VA into adaptation planning

In related manner, VAs are not an exercise unto themselves. Teams should bear in mind that the goal of the VA process is to produce practical information on the drivers of vulnerability that could be addressed through the implementation of adaptation activities. It is important that teams do not get caught up in the details of the VA process and methods, to the disadvantage of adaptation planning and implementation. It is preferable to adopt a modest and efficient approach to VA that develops important and robust information on priority issues.

Uncertainty or lack of data should not create obstacles to proceeding with VAs – "do not let perfect be the enemy of the good"

VAs incorporate uncertainty. Data gaps, lack of information, inadequate time or resources are all factors the influence the fact that no single VA will ever be 100% complete or perfect. But if we accept that adaptation planning cannot take place without an understanding of vulnerability, then the importance of going forward with what is available, however imperfect, is clear.

This means that VA results incorporate uncertainty and data gaps and results needs to be interpreted as such

However, an important caveat to the above lesson is that because no VA is 100% perfect, then the results need to be interpreted with caution and with an understanding of the limitations of the results and the data gaps and assumptions that were inherent in the VA process. Most VAs present results in terms of "relative" rather than "absolute" vulnerability and in the examples presented in the Manual are not generally directly comparable between different PAs. This in itself should not be seen as an obstacle to carrying out VAs when the results are destined to be used for adaptation planning at the level of the individual PA.

VA should not be a one-off process

Finally, because of the uncertainty and data gaps inherent in VAs coupled with the fact that our understanding of climate change and its effects on PAs is constantly evolving no VA should be seen as a one-off process. Efforts should be made to update critical parts of the VA when possible and

undertake monitoring both of the vulnerability of targets and the effectiveness of the adaptation measures.

The Way Forward…

This Manual does not aim to be the last or definitive word in VA processes for CMPAs. Rather, it aims to contribute to the ongoing dialogue and debate on vulnerability and climate change adaption for natural systems and the communities that rely on these systems. The team involved in the preparation of the Manual has worked to develop and test this manual in a number of pilot PAs, but we believe that the Manual would benefit from further testing and review by other teams carrying out VAs in similar contexts. To this end, we hope that the Manual will be a 'living' document that is updated periodically in response to new information, methods and comments from users.

This first version of the Manual has been pre-released as a working draft to allow its testing and refinement by a wide range of practitioners. Following feedback from these tests a final version will be prepared and published in 2014.

We would greatly appreciate your feedback and comments on the Manual. Please send your comments or questions to:

WWF International
Attention: "Coastal and Marine Protected Areas Climate Change Vulnerability Assessment Manual"
Email: abelokurov@wwfint.org

Appendix 1: BAVAPA Method Guidance Note

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

1. Introduction

BAVAPA - ***'BAsic methodology for Vulnerability Assessment of Protected Areas'*** - has been developed as a rapid vulnerability assessment tool to be included in the *Manual for Climate Change Vulnerability Assessments for Marine Protected Areas*, which is being prepared as part of the EU-funded project 'Natural Solutions: Global Initiative for Protected Areas and Climate Adaptation'.

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

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

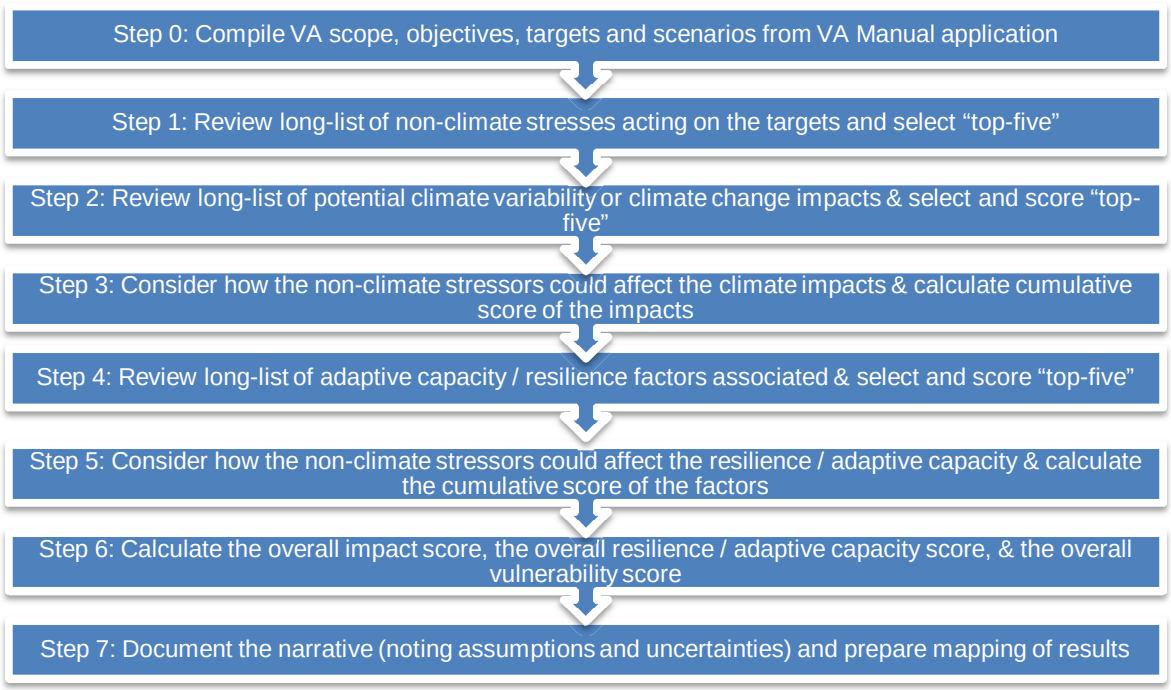
It aims to provide broad guidance on the relative and qualitative vulnerability of targets. The scores developed by BAVAPA have no quantitative meaning in themselves but provide: (i) an understanding of the relative vulnerability of a series of targets; and (ii) an understanding of the relative contribution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

BAVAPA is based around a series of checklists and an accompanying series of Excel worksheets that guide the user through an identification of likely climate change impacts and the existing adaptive capacity of social and ecological systems to climate change to allow calculation of overall vulnerability. It has been designed as an integral component of the Natural Solutions VA Manual and thus relies on teams to implement the initial steps in that Manual to define VA scope, objectives and targets before commencing application of BAVAPA. Information on definitions, concepts and other relevant information are also found in the Manual and are not repeated here.

Due to the nature of the methodology and the subject that it addresses, BAVAPA should be considered to be a work-in-progress. As with the other outputs of the Natural Solutions project, the methodology will be subject to ongoing testing and refinement both in the three pilot countries and more broadly by partners. Your experience in using BAVAPA will be extremely helpful in helping us to improve the tool and we would greatly appreciate your feedback and suggestions for improvement. Comments can be sent to:

WWF International
Attention: Alexander Belokurov
abelokurov@wwfint.org

2. Overview of Steps in the BAVAPA Methodology



3. Detailed Guidance and Checklists

Methodology Participants & Setting

The BAVAPA methodology is designed to be applied in a participative manner in a workshop or group setting. The participants in methodology application could include as representatives from the following groups: PA managers; experts with knowledge of social, ecological and ecosystem service targets; local community; local authorities; climate specialists; civil society; and private sector interests.

Typically the methodology can be applied in a one-day workshop, however if resources are available a longer workshop could be organized that included a more detailed briefing session for participants on key concepts. It is recommended that participants are provided with background information in advance of the workshop so that they can come prepared with useful data and information on-hand.

Step 0: Compile VA scope, objectives, targets and scenarios from VA Manual application

Application of activities 1.1, 1.2 and 1.3 of the VA Manual will guide teams through the process of defining the VA scope (geographical and temporal), objectives, and targets and aid them in the development of the baseline, climate and non-climate scenarios. All this information will be required in the application of the BAVAPA methodology so teams should compile this before commencing application of the methodology and ensure that all stakeholders that will participate in the methodology application are familiar with this information.

Step 1: Review long-list of non-climate stresses acting on the targets and select "top-Five"

For each of the VA targets, the teams should work through the Checklist A: Non-Climate Stressors and, in Worksheet A, list the top five to ten stresses that currently act on each target or that are likely to act on targets in the future. Information for this step can be drawn from the baseline and future non-climate scenarios developed in Activity 1.3 as well as the knowledge of workshop participants. While it is recognized that more than ten stresses may act on any one target, it is necessary to prioritize the influences to carry forward into future stages of the methodology. It may be useful to form small groups for this step to allow different groups to work on different targets. Note that the checklist is simply a guide for this step and teams should feel free to add, delete or change the items in the checklist as relevant to their circumstances. The narrative section of Worksheet A should be used to provide a short description of each non-climate stressor that can be understood by those not involved in the methodology application.

Step 2: Review long-list of potential climate variability or climate change impacts & score "top-Five" potential impacts

Climate variability impacts or climate change impacts are defined as the physical effects on targets resulting from short-term climate variability or longer-term climate change. Such impacts are the result of the interaction of a target's exposure to climate and its sensitivity to climate. The choice of whether the team looks at the impacts of climate variability and/or climate change will depend on the agreed scope of the VA. For each of the VA targets, the teams should work through the Checklist B: Climate Impacts and, in Worksheet B, list the top five to ten impacts that could act on each target. Information for this step can be drawn from the climate scenarios developed in Activity 1.3 as well as knowledge of workshop participants on how targets have reacted to climate stresses in the past or are currently reacting to climate conditions and events. Note that the checklist is simply a guide for this step and teams should feel free to add, delete or change the items in the checklist as relevant to their circumstances. The narrative section of Worksheet B should be used to provide a short description of each impact that can be understood by those not involved in the methodology application.

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

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

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

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

The scale and magnitude of climate impacts can be influenced positively or negatively by interactions with the range of non-climate stressors acting on the target. For example, an identified climate impact of coastal erosion may be negatively influenced, that is increased, by a non-climate stressor of deforestation of mangroves for charcoal production. The aim of this step of the methodology is to discuss and reach consensus on the way that the identified non-climate stressors may affect climate impacts. This step will not provide definitive right or wrong answers, but by carrying it out in a workshop setting with a view of participants it will represent the a solid and informed opinion in relation to this issue.

To implement this step, consider each of the climate impacts listed in Worksheet B in the context of the non-climate stressors listed in Worksheet A and discuss whether one or more of the non-climate stressors could act to have: (i) a negative effect – i.e. increase the adverse elements of the impact; (ii) have a positive impact – i.e. decrease the adverse elements of the impact; or (iii) a neutral impact – i.e. no effect on the adverse elements of the impact. The aim is to arrive at an overall picture of how each climate impact could be influenced by the full range of climate stressors that are acting on it. A relative score from -2 to +2 for each impact should be entered into Worksheet B using the guide below. The Worksheet will then automatically calculate an overall cumulative impact score that takes into account the climate impact score, and the cumulative effect of the non-climate impacts. The assumptions and uncertainties associated with the application of this step need to be recorded in the narrative section of Worksheet B along with other relevant comments or observations.

SCORING OF EFFECT ON NON-CLIMATE IMPACTS	INTERPRETATION
-2	The cumulative effects of all the non-climate stressors will have a highly beneficial influence on the climate impact (i.e. significantly enhance the

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

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

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

Adaptive capacity, defined as the ability to change in anticipation of, or in reaction to disturbance or stress, or resilience factors, defined as those factors that increase or reduce the ability of a target to resist or recover from climate impacts. While there is some ongoing academic debate about the differences between resilience and adaptive capacity, for the purposes of this methodology a broad definition has been used that encompasses the two terms. For each of the VA targets, the teams should work through the Checklist C: Adaptive Capacity / Resilience Factors and, in Worksheet C, list the top five to ten factors associated with each target. Information for this step can be drawn from the knowledge of workshop participants on the inherent characteristics of the targets as well as the surrounding environment as described in the baseline and future non-climate scenarios developed in Activity 1.3 of the VA Manual. Note that the checklist is simply a guide for this step and teams should feel free to add, delete or change the items in the checklist as relevant to their circumstances. Once the top five to ten factors have been identified, the teams should assign them a score between -2 and +2 using the grid below as a guide. The scores should be entered into Worksheet C. The narrative section of Worksheet C should be used to provide a short description of each factor that can be understood by those not involved in the methodology application.

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

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

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

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

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

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

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

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

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

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

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

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

For each of the scores calculated, the following grill can be used to convert them to a descriptive, qualitative view of vulnerability as the resulting numbers have no real quantitative meaning once they have been used as tools to allow calculation of the scores. The first table provides an interpretation of overall impact scores and overall AC / R scores, and the second provides an interpretation of overall vulnerability scores.

Interpretation of Overall Impact and AC / R Scores

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

Interpretation of Overall Vulnerability Scores

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

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

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

The BAVAPA methodology is applied as part of Activity 2.2 of the VA Manual. The VA Manual's templates to document the narrative, including the assumptions and uncertainties identified in the VA process, and mapping of the VA results are reproduced below and should be used to summarize the outcomes of the BAVAPA methodology. This step can be carried out by the VA project team following the workshop but ideally would be sent to workshop participants for comments and revisions prior to finalization.

Template 1. Narrative of BAVAPA Methodology	
Relevant Target(s):	
Key Data Inputs:	

Template 1. Narrative of BAVAPA Methodology	
Key Activities / Steps Carried Out:	1. 2. 3. 4. …..
Strengths / Advantages of Methodology:	
Weaknesses / Disadvantages of Methodology:	
Other Comments:	

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

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

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

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

Checklist A: Suggested Non-Climate Stressors

Species Targets[19]	Habitat / Ecosystem Targets	Ecosystem Service Targets	Social Targets[20]
1 Residential & commercial development *(1.1 Housing & urban areas; 1.2 Commercial & industrial areas; 1.3 Tourism & recreation areas)*			Rapid population growth
2 Agriculture & aquaculture development *(2.1 Annual & perennial non-timber crops; 2.2 Wood & pulp plantations; 2.3 Livestock farming & ranching; 2.4 Marine & freshwater aquaculture)*			Low population growth
3 Energy production & mining activities *(3.1 Oil & gas drilling; 3.2 Mining & quarrying; 3.3 Renewable energy)*			Uneven age distribution
4 Transportation & service corridors *(4.1 Roads & railroads; 4.2 Utility & service lines; 4.3 Shipping lanes; 4.4 Flight paths)*			Income inequality
5 Biological resource use *(5.1 Hunting & collecting terrestrial animals (intentional or unintentional use); 5.2 Gathering terrestrial plants (intentional or unintentional use); 5.3 Logging & wood harvesting; 5.4 Fishing & harvesting aquatic resources (intentional or unintentional use))*			Limited access to natural resources
6 Human intrusions & disturbance *(6.1 Recreational activities; 6.2 War, civil unrest & military exercises; 6.3 Work & other activities)*			High dependency on natural resources
7 Natural system modifications *(7.1 Fire & fire suppression; 7.2 Dams & water management/use; 7.3 Other ecosystem modifications)*			High levels of immigration / outward migration
8 Invasive & other problematic species, genes & diseases *(8.1 Invasive non-native/alien species/diseases; 8.2 Problematic native species/diseases; 8.3 Introduced genetic material; 8.4 Problematic species/diseases of unknown origin; 8.5 Viral/prion-induced diseases; 8.6 Diseases of unknown cause)*			High level of debt
9 Pollution *(9.1 Domestic & urban waste water; 9.2 Industrial & military effluents; 9.3 Agricultural & forestry effluents; 9.4 Garbage & solid waste; 9.5 Air-borne pollutants; 9.6 Excess energy)*			Lack of land use titles / landlessness
10 Geological events *(10.1 Volcanoes; 10.2 Earthquakes/tsunamis; 10.3 Avalanches/landslides)*			Lack of access to housing, health, education or other basic social services
Other…			High degree of poverty / low household income
Other…			Female headed household
Other…			Chronic or seasonal food insecurity
Other…			Poor health
Other…			Other…
Other…			Other…

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

[20] Adopted from Marshall et al, 2010

Checklist B: Suggested Climate Impacts

Species Targets	Habitat / Ecosystem Targets	Ecosystem Service Targets	Social Targets
Climate driven migration	Coastal erosion or accretion		Coastal erosion or accretion
Loss of suitable habitat through inundation	Climate driven expansion of habitat		Change in availability of natural resources (accessibility, abundance, over-exploitation etc.)
Loss of suitable habitat due to habitat retreat	Climate driven retreat of habitat		Pressure or conflicts from presence of climate migrants
Inundation from sea level rise or storm surge	Inundation from sea level rise or storm surge		Inundation from sea level rise or storm surge
Coral bleaching	Coral bleaching		Cyclone or storm damage to infrastructure, crops or livelihood assets
Cyclone or storm damage	Cyclone or storm damage		Inundation from changed precipitation
Inundation from changed precipitation	Inundation from changed precipitation		Drought
Drought	Drought		Bushfires
Bushfires	Bushfires		Heatwave
Heatwave	Heatwave		Inadequate surface water
Inadequate surface water	Inadequate surface water		Inadequate groundwater
Inadequate groundwater	Inadequate groundwater		Pathogen / disease spread
Invasive species / pathogen spread	Invasive species / pathogen spread		Forced climate migration
Other…	Other…		Other…
Other…	Other…		Other…

Checklist C: Suggested Adaptive Capacity / Resilience Factors

Species Targets[21]	Habitat / Ecosystem Targets[22]	Ecosystem Service Targets	Social Targets[23]
No or low specialized habitat and/or microhabitat requirements	Not located near geographical extent of habitat range		Ability to cope with past climate events
Wide environmental tolerances or thresholds	Wide environmental tolerances or thresholds		Formal and informal support networks
No or limited dependence on specific environmental triggers or cues that are likely to be affected by climate change	High physical diversity (topography, slope, soils, geology, elevations, hydrology etc.)		Ability to cope with change
No or limited dependence on interspecific interactions that are likely to be disrupted by climate change	Rapid regeneration times (inc. keystone species)		Local environmental and climate knowledge and information
Ability to disperse or to colonize a new or more suitable range (genetic / physical)	High biodiversity		Employability / diverse skills / flexibility to change occupation
High reproductive rate	Low fragmentation		Land security
Large population size	Resilient keystone species		Livelihood diversity (current and perceived)
No or limited fluctuations in population size	Physical and genetic ability to disperse		Access to markets, education services / training, health services, clean water & sanitation
Short generation times	Large extent of habitat type		Access to credit
High genetic diversity	Low level of habitat fragmentation		Level of education of household head
Other…	Other…		Food / seed reserves
Other…	Other…		Financial reserves
Other…	Other…		Physical isolation
Other…	Other…		Access to new technologies
Other…	Other…		Low degree of physical isolation
Other…	Other…		Sales points for agricultural products / fishing supplies
Other…	Other…		Governance arrangements for equitable access to resources
Other…	Other…		Other…

[21] Adapted from Foden et al, 2008
[22] Adapted from US-EPA, 2010
[23] Adopted from Marshall et al, 2010

Appendix 2: General Guidance Notes for VA Manual Use

GUIDANCE NOTE A1.1
'METHODS FOR DEVELOPING CLIMATE CHANGE SCENARIOS'

I. Purpose

To provide guidance on the purpose, use and development of climate scenarios in a VA context.

II. Methodology Cross-References

Phase 1, Activity 1.3 – Climate scenarios and exposure data

Worksheet No. 1.3b – Climate change scenarios

III. Guidance

What is a climate change scenario?
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.'*

Importantly, a climate change scenario does not represent a climate prediction but a "possible climate future" based on best available knowledge and data.

What are climate change scenarios used for?
Climate change scenarios can have many uses, but in the context of fine scale vulnerability assessments, climate change scenarios are used as a means of translating large-scale climate data (such as is available from global scale models with scales of many hundreds of kilometers) to a regional or local scale that can then be used in the evaluation of likely impacts. In a developing country context, where climate data and modeling resources are often limited, climate change scenario development can provide an important alternative means of generating data on climate change exposure.

How are climate change scenarios developed?
Various methods exist for the development of climate change scenarios. The choice of method depends on various factors including skills of the project team, available financial and technical resources and importantly, available climatic data.

In broad terms, climate change scenario development involves:

(1) Establishment of a ***baseline climate*** over a given time period for a specific geographic region (referred to as the observational baseline climate). This should be developed at spatial and temporal resolutions that provide sufficient information for developing future climate scenarios. That is, if high-resolution climate scenarios are needed, then the baseline climate data should be of comparable resolution.
(2) Analysis of ***change*** between present and future climate
(3) Construction of a ***future climate scenario*** by adding the model-based change to the baseline climate.

The second step in this process can use a variety of methods. The two techniques analyzing change between the baseline and future conditions for the purposes of vulnerability assessments are:

(i) **Temporal analogue analyses:** this method involves the use of historic and current local / regional climate data and information on general global climate change projections to generate scenarios. The major objection to this method analogues is that climate anomalies during the past century have been fairly minor compared to anticipated future changes, and in many cases the anomalies were probably associated with naturally occurring changes in atmospheric circulation rather than changes in greenhouse gas concentrations. However in data poor situations, or for teams with no modeling resources, this method is the most suitable.

(ii) **Downscaling:** this method involves the use of (i) specially developed regional climate models to carry out “dynamical downscaling” or (ii) statistical modeling of the relationships between observed data and GCM variables to carry out “statistical downscaling”. These methods require the involvement of climate scientists and modelers to undertake the technical analyses. Discussions should be held at the outset of the scenario development process to determine if downscaling approaches are suitable or feasible for the subject VA.

For any given situation a combination of these approaches may be used for different climate parameters. For example, the results of downscaling approaches may be more commonly available for climate parameters such as temperature and precipitation, while lesser studied parameters such as wind, upwellings or acidity levels may require use of the temporal analogue approach.

Worksheet 2.2.2 provides a guide to determining the need for climate scenarios and the choice of a suitable methodology and then provides a guide to the temporal analogue approach to climate scenario development. It does not address the technical details of the downscaling approach; if this approach is determined to be the most suitable then VA project teams should be guided by specialized climate scientists and modelers in the application of downscaling techniques.

Climate scenario development should carried out with a multi-disciplinary team to ensure that relevant areas of expertise are included in the process. It is therefore proposed that a climate scenario development working session be held involving the project team, climate scientists and modelers, and biodiversity experts in the early stages of the VA process. The working session will have the dual purpose of determining what scenario development has already been undertaken (especially in terms of available downscaling results) and determine what scenario development needs remain and the best way to achieve them. The working session can also be used as a forum to undertake temporal analogue scenario creation if appropriate baseline data is available.

GUIDANCE NOTE A1.2
'CHECKLIST OF DIRECT THREATS (NON-CLIMATE AND CLIMATE) TO PROTECTED AREAS'

The following list of threats is taken from the 'Management Effectiveness Tracking Tool: Version 2' (World Bank & WWF, 2007) and has been adapted from the 'Conservation Measures Partnership Taxonomy of Direct Threats' (http://www.conservationmeasures.org/initiatives/threats-actions-taxonomies/threats-taxonomy/). It can be used in the application of technical VA methods as a means of identifying potential direct threats to a protected area. The list focuses on non-climate threats and is thus particularly useful as check-list to ensure that relevant non-climate stressors have been considered in the VA process.

Residential and commercial development within a protected area: *Threats from human settlements or other non-agricultural land uses with a substantial footprint*
1.1 Housing and settlement
1.2 Commercial and industrial areas
1.3 Tourism and recreation infrastructure
2. Agriculture and aquaculture within a protected area: *Threats from farming and grazing as a result of agricultural expansion and intensification, including silviculture, mariculture and aquaculture*
2.1 Annual and perennial non-timber crop cultivation
2.1a Drug cultivation
2.2 Wood and pulp plantations
2.3 Livestock farming and grazing
2.4 Marine and freshwater aquaculture
3. Energy production and mining within a protected area: *threats from production of non-biological resources*
3.1 Oil and gas drilling
3.2 Mining and quarrying
3.3 Energy generation, including from hydropower dams
4. Transportation and service corridors within a protected area: *Threats from long narrow transport corridors and the vehicles that use them including associated wildlife mortality*
4.1 Roads and railroads (include road-killed animals)
4.2 Utility and service lines (e.g. electricity cables, telephone lines,)
4.3 Shipping lanes and canals
4.4 Flight paths
5. Biological resource use and harm within a protected area:
Threats from consumptive use of "wild" biological resources including both deliberate and unintentional harvesting effects; also persecution or control of specific species (note this includes hunting and killing of animals)
5.1 Hunting, killing and collecting terrestrial animals (including killing of animals as a result of human/wildlife conflict)
5.2 Gathering terrestrial plants or plant products (non-timber)
5.3 Logging and wood harvesting
5.4 Fishing, killing and harvesting aquatic resources
6. Human intrusions and disturbance within a protected area:
Threats from human activities that alter, destroy or disturb habitats and species associated with non-consumptive uses of biological resources
6.1 Recreational activities and tourism
6.2 War, civil unrest and military exercises
6.3 Research, education and other work-related activities in protected areas
6.4 Activities of protected area managers (e.g. construction or vehicle use, artificial watering points and dams)
6.5 Deliberate vandalism, destructive activities or threats to protected area staff and visitors
7. Natural system modifications: *Threats from other actions that convert or degrade habitat or change the way the ecosystem functions*
7.1 Fire and fire suppression (including arson)
7.2 Dams, hydrological modification and water management/use
7.3a Increased fragmentation within protected area

7.3b Isolation from other natural habitat (e.g. deforestation, dams without effective aquatic wildlife passages)
7.3c Other 'edge effects' on park values
7.3d Loss of keystone species (e.g. top predators, pollinators etc)
8. Invasive and other problematic species and genes: Threats from terrestrial and aquatic non-native and native plants, animals, pathogens/microbes or genetic materials that have or are predicted to have harmful effects on biodiversity following introduction, spread and/or increase
8.1 Invasive non-native/alien plants (weeds)
8.1a Invasive non-native/alien animals
8.1b Pathogens (non-native or native but creating new/increased problems)
8.2 Introduced genetic material (e.g. genetically modified organisms)
9. Pollution entering or generated within protected area: *Threats from introduction of exotic and/or excess materials or energy from point and non-point sources*
9.1 Household sewage and urban waste water
9.1a Sewage and waste water from protected area facilities (e.g. toilets, hotels etc)
9.2 Industrial, mining and military effluents and discharges (e.g. poor water quality discharge from dams, e.g. unnatural temperatures, de-oxygenated, other pollution)
9.3 Agricultural and forestry effluents (e.g. excess fertilizers or pesticides)
9.4 Garbage and solid waste
9.5 Air-borne pollutants
9.6 Excess energy (e.g. heat pollution, lights etc)
10. Geological events: *Geological events may be part of natural disturbance regimes in many ecosystems. But they can be a threat if a species or habitat is damaged and has lost its resilience and is vulnerable to disturbance. Management capacity to respond to some of these changes may be limited.*
10.1 Volcanoes
10.2 Earthquakes/Tsunamis
10.3 Avalanches/ Landslides
10.4 Erosion and siltation/ deposition (e.g. shoreline or riverbed changes)
11. Climate change and severe weather: *Threats from long-term climatic changes which may be linked to global warming and other severe climatic/weather events outside of the natural range of variation*
11.1 Habitat shifting and alteration
11.2 Droughts
11.3 Temperature extremes
11.4 Storms and flooding
12. Specific cultural and social threats
12.1 Loss of cultural links, traditional knowledge and/or management practices
12.2 Natural deterioration of important cultural site values
12.3 Destruction of cultural heritage buildings, gardens, sites etc

Appendix 3: Technical Guidance Notes for VA Methods Implementation

Guidance Note A2.1
Technical VA Methodology: *"Resilience Assessment of Coral Reefs: Rapid assessment protocol for coral reefs, focusing on coral bleaching and thermal stress"*

1. Introduction

This Guidance Note has been prepared to provide rapid guidance on the technical vulnerability assessment methodology *"Resilience Assessment of Coral Reefs: Rapid assessment protocol for coral reefs, focusing on coral bleaching and thermal stress"* (Obura & Grimditch, 2009) in the context of the "*Manual for Climate Change Vulnerability Assessments of Coastal and marine protected areas*".

The purpose of the Guidance Note is twofold: (i) to give potential users of the methodology an overview of the methodology's objectives and activities, as well as information on data and resources needed and the situations in which its application may be appropriate to assist them in deciding whether the methodology is suitable for application in a given situation; and (ii) should potential users decide to adopt the methodology, the Note also provides guidance on its implementation in the context of an CMPA and tips for combining the methodology with other vulnerability assessment methodologies.

The Note is not intended to replace detailed guidance on methodology application; links to detailed guidance are provided at the end of the Note.

2. Objectives of Methodology

The methodology aims to fill a gap in vulnerability assessment methods for coral reefs by providing monitoring and assessment protocols for a set of basic resilience indicators for coral reefs at an individual site level that can be quantified using rapid assessment methods. The methodology focuses on bleaching events. Specifically, the protocol is intended to:

i. Assess the factors affecting coral bleaching during a bleaching event (resistance factors).
ii. Assess the factors affecting coral and reef recovery following a bleaching event (resilience factors).
iii. Enable between-site comparisons at a local area/region/CMPA (network) level.
iv. Enable inter-regional comparisons at larger scales.

In a management context, the protocol should thus facilitate:

i. Understanding of bleaching resistance and resilience factors that can be addressed by CMPA design and management
ii. Assessment of whether CMPA design and management practices to date have addressed bleaching resistance and resilience
iii. Design of networks of CMPAs based on bleaching resistance/resilience characteristics
iv. Provision of information to adaptively manage coral reefs in response to bleaching events and reef resilience

3. Guidance on When to Use the Methodology

This methodology is well suited for application in a CMPA setting where coral reefs are a priority ecosystem or a conservation target. It is suitable for use in situations where adequate time and resources are available to dedicate to monitoring activities, including training of monitors as necessary (refer below). It has been designed for use in a developing country context. While the assessment protocol can be undertaken as an independent study, it is most useful in a CMPA adaptive management structure that already incorporates annual or routine monitoring or in a situation where it is proposed to develop such monitoring.

4. Resources and Data Needed

1.1 Human Resources & Equipment

Implementation of this methodology ideally requires a team of 4 - 5 experienced divers, although a team of 2 to 3 divers could carry out the work with modifications to the dive planning as shown in the methodology. There should be at least one diver who can lead the benthic work, at least one diver very familiar with fish, and at least one diver very familiar with corals. Including divers with considerable experience in the study area will reduce the subjectivity in the quantitative analyses

included in the methodology. Skills for other team members can be built up through on-site training; 1 – 3 days of training may be necessary. Other skills required by team members will include data entry and analysis, literature review and reporting.

Equipment required by the team is listed below:

- Temperature loggers
- Digital camera with underwater housing
- Transect lines / rulers / slates
- Light / radiation meters
- GPS
- Depth sounder
- Computer (Coral Point Count / Adobe Photoshop or equivalent)
- Datasheets from Methodology publication

1.2 Data Needed

A good knowledge of the current status and recent history of the study area's reefs is necessary, including information on past bleaching events. A literature review of local studies and monitoring programs, and consultation with scientists and managers familiar with the local setting, are necessary. Specific data that will be necessary:

- Data on each resilience and constituent factor (benthic cover, physical / environmental parameters, coral condition and population structure, coral associates, fish community structure, anthropogenic factors, connectivity and genetic relatedness)
- Coral reef health and any changes over time
- Historical data on coral diversity and relative abundance and changes in composition
- Coral recruitment and sizes
- Past extreme events (cyclones / floods)
- Historic data on coral bleaching or diseases as well as land or sea based stresses or vectors for bleaching or disease
- Historic data on fish and any herbivory studies
- Fisheries data that shows effort levels, catch trends and composition

Identification guides for corals, fish, coral diseases and lesions will be required.

Local and regional climate data should be compiled using the below table as a guide. While primary data at the local site are most desirable, in many cases datasets may only be available from nearby locations or at larger scales.

Geographic Area	Purpose of Data Collection	Recommended Datasets
Local climate – seawater temperature	Variability and trends in sea surface temperature	*In situ* datasets on seawater temperature, light penetration, etc.
Local climate - meteorological and oceanographic	Proxies for medium term patterns in local climate - seasonal/annual variability	Air temperature, rainfall, wind speed/direction, radiation, sunhours/cloud cover, storms/cyclones, waves, long term seawater temperatures
Regional climate – long term trends	Long term trend indicators and projections	Available regional climate/sea change scenarios

Detailed coastal and bathymetric charts and high-resolution remote sensing images can be used in site selection for survey work if they are available.

5. Key Steps in the Methodology Application

The methodology starts with a literature review and consultations with reef managers and scientists. Subsequent phases of the methodology are built around comprehensive survey work that investigates indicators related to reef resilience (habitat/environment, coral community, interactions/responses, anthropogenic influences and climate/thermal stresses) and links them to more comprehensive quantitative measures of drivers of thermal stress and bleaching.

Following site selection, survey effort is broken down as follows:

- Benthic cover
- Coral community composition

- Coral size classes and population structure
- Coral condition and threats
- Fish community structure and herbivory
- Site resilience factors

Guidance and datasheets are provided for the collection of data during survey work together with guidance on the rating of indicators.

6. Tips for Application in the Context of the VA Manual

The methodology has been designed for use in CMPAs in developing countries and is entirely compatible with the process proposed in the Manual. If a long term monitoring program is underway in the CMPA, or in nearby areas such that data sharing in a network is possible, then the protocol should be customized to match the existing methods and/or the existing methods should be updated to be consistent with the protocol

7. Combination with other Methodologies

The methodology focuses solely on coral reefs and thus could be combined with any of the other ecological or social vulnerability methods presented in the Manual in a parallel process. It could be supplemented by species specific investigations into coral species vulnerability using the IUCN species vulnerability method if deemed necessary based on the results of the methodology implementation.

8. Additional Resources and Case Studies

"Resilience Assessment of Coral Reefs" Handbook =>
http://www.reefresilience.org/pdf/Obura_etal_2009.pdf

Additional guidance from Reef Resilience Network =>
http://www.reefresilience.org/Toolkit_Coral/C6cc1_RapidAssess.html

Example of application in Nosy Hara CMPA, Madagascar =>
http://cmsdata.iucn.org/downloads/report_nosy_hara_resilience_feb_3_submitted.pdf

Guidance Note A2.2
Technical VA Methodology: "*A Framework for Categorizing the Relative Vulnerability of Threatened and Endangered Species to Climate Change*"

1. Introduction
This Guidance Note has been prepared to provide rapid guidance on the technical vulnerability assessment methodology *"A Framework for Categorizing the Relative Vulnerability of Threatened and Endangered Species to Climate Change"* (USEPA, 2009) in the context of the "*Manual for Climate Change Vulnerability Assessments of Coastal and marine protected areas*".

The purpose of the Guidance Note is twofold: (i) to give potential users of the methodology an overview of the methodology's objectives and activities, as well as information on data and resources needed and the situations in which its application may be appropriate to assist them in deciding whether the methodology is suitable for application in a given situation; and (ii) should potential users decide to adopt the methodology, the Note also provides guidance on its implementation in the context of an CMPA and tips for combining the methodology with other vulnerability assessment methodologies.

The Note is not intended to replace detailed guidance on methodology application; links to detailed guidance are provided at the end of the Note.

2. Objectives of Methodology
The aim of this matrix-based methodology is to rank a group of species in relation to their relative vulnerability to climate change thus allowing decisions to be made about conservation investment priorities. Initially designed for use with species listed under the Threatened Species Act in the United States of America, it is suitable for use for other species for which adequate data exists.

The methodology considers both the existing, "non-climate change" vulnerabilities and pressures acting on a species and combines these with likely future climate related vulnerabilities to determine an overall, future level of vulnerability. In this way the methodology overcomes a common criticism of vulnerability assessments that they treat climate-induced threats in isolation from non-climate stressors. The methodology is quantitative and relies on published and grey literature sources, complemented by expert opinion on species' natural history.

The theory underlying the methodology is based on the following questions that need to be posed when considering the vulnerability of a species:

1. What are the current vulnerabilities acting on the species in the absence of climate change?
2. What are the potential effects of the different manifestations of climate change on a species?
3. How do the current and potential future vulnerabilities interact to determine the overall future vulnerability of a species?
4. What are the uncertainties implicit in the analyses carried out for a species and what additional data is required to address these knowledge gaps?

3. Guidance on When to Use the Methodology
This methodology can be used to determine the relative vulnerability of different species within taxon groups and is thus most effectively applied to a group of species.

The availability of adequate data is the key influence in the ability to effectively apply this methodology. The methodology requires data across a range of issues to be analyzed and while it allows for expert opinion to compensate or supplement lacking documented data, experience in application of the methodology has found that a basic level of information is required (i.e. some level of information is required for each of the topics listed in 4.2 below) for the methodology application to be successful.

4. Resources and Data Needed
4.1 Human Resources & Equipment
The application of the methodology requires the inputs of expert opinion on the species in question; the level of input depends on the other data sources that are available. Ideally there would be one or more expert available for each taxon group to be considered. The methodology is best applied in a

workshop setting to allow interaction between experts and discussion of uncertainties and priorities for future research.

No specific equipment is required for the methodology implementation other than a computer with basic word processing and database software.

4.2 Data Needed

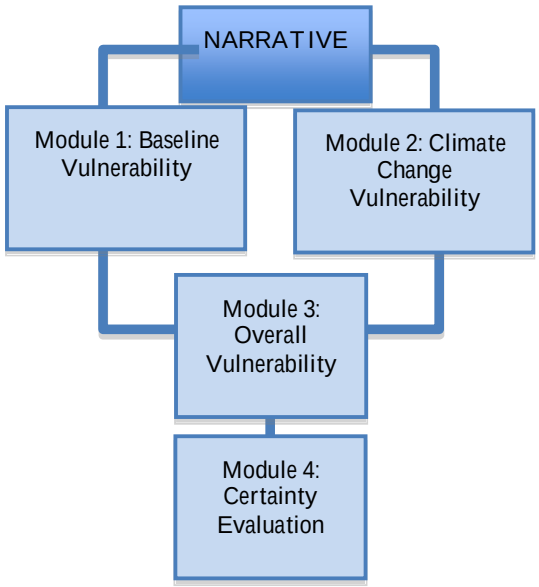
Data in the form of published data, 'grey' literature, project reports, monitoring reports or undocumented expert opinion is required for each species. Specific data needs include:

i. Basic existing and future climate information for study area (data or scenarios)
ii. Physiological information
iii. Demographic / life history information
iv. Habitat information
v. Phenological information
vi. Information on threats and stresses in the absence of climate change, and the possible evolution of these stresses (data or scenarios)
vii. Climate sensitivity of species' physiology (temperature, rainfall, extreme events)
viii. Species distribution
ix. Population status

The methodology has been developed so that data gaps are documented and used to inform future research.

5. Key Steps in the Methodology Application

The evaluation methodology contains four evaluation modules and a narrative.



- **Narrative:** The aim of the narrative to ensure that the data sources, assumptions and thought processes that are used in the completion of the remaining four technical modules are documented.
- **Module 1 – Baseline Vulnerability:** This module evaluates the existing vulnerability of the species to extinction or a major reduction of its population based on an understanding of current and recent trends in population size and species range, and the nature and scale of current, non-climate change stressors acting on the population.
- **Module 2 – Climate Change Vulnerability:** This module evaluates the likely future vulnerability of the species to climate change induced stressors by scoring the elements of its physiology, life history and ecology that will be likely to important determinants of its response to the dominant manifestations of climate change. This module allows for the fact that certain species may benefit from climate change.
- **Module 3 – Overall Vulnerability:** This module allows an overall "best-estimate" of the vulnerability to the combined effects of existing stressors and future climate change. Using a

matrix based approach, the species are categorized as either critically vulnerable, highly vulnerable, less vulnerable, least vulnerable or likely to benefit from climate change. The categories represent likely approximations of each species' relative vulnerability and do not represent absolute vulnerability.

- **Module 4 – (Un) Certainty Evaluation:** The approximate level of uncertainty associated with each score is recorded individually in the modules and are combined in this module to give an overall confidence level for the vulnerability ranking of each species.

6. Tips for Application in the Context of the VA Manual

The methodology does not directly result in mapped outcomes, which are important in the context of a PA vulnerability assessment undertaken in the context of the VA Manual. The results of the methodology could be represented by attaching different coloring or shading to the mapped distribution or ranges of assessed species based on the different levels of relative vulnerability.

7. Combination with other Methodologies

The methodology is a standalone methodology for species. If other species based methodologies are used in combination with this methodology care should be taken not to attempt comparison of results across methodologies.

The methodology can be used in conjunction with a range of ecosystem and/or social vulnerability assessment methodologies.

8. Additional Resources and Case Studies

Detailed description of the methodology and examples of its application =>
www.epa.gov/ncea

Guidance Note A2.3
Technical VA Methodology: "Climate Change Vulnerability of Migratory Species: Species Assessments"

1. Introduction

This Guidance Note has been prepared to provide rapid guidance on the technical vulnerability assessment methodology *"Climate Change Vulnerability of Migratory Species: Species Assessments"* (ZSL, 2010) in the context of the "*Manual for Climate Change Vulnerability Assessments of Coastal and marine protected areas*".

The purpose of the Guidance Note is twofold: (i) to give potential users of the methodology an overview of the methodology's objectives and activities, as well as information on data and resources needed and the situations in which its application may be appropriate to assist them in deciding whether the methodology is suitable for application in a given situation; and (ii) should potential users decide to adopt the methodology, the Note also provides guidance on its implementation in the context of an CMPA and tips for combining the methodology with other vulnerability assessment methodologies.

The Note is not intended to replace detailed guidance on methodology application; links to detailed guidance are provided at the end of the Note.

2. Objectives of Methodology

The methodology was developed in recognition of the specific and unique threats posed to migratory species by climate change. It is a methodology that aims to facilitate grading of migratory species in terms of their vulnerability to climate change, and to allow for identification of the main limiting factors for species resilience and ability to adapt to climate change.

3. Guidance on When to Use the Methodology

The methodology can be used in relation to migratory species and in the context of the VA Manual is suitable when migratory species have all or part of their range in a protected area or use the resources contained in a protected area.

4. Resources and Data Needed

4.1 Human Resources & Equipment

The methodology requires specialist knowledge on migratory species and their interactions with climate. Lack of such specialist knowledge may be a limiting factor in the ability to apply this methodology. Basic computing equipment and software is require to allow preparation of reports and basic calculations of vulnerability grades.

4.2 Data Needed

The methodology requires relatively comprehensive data on migratory species and their interactions with climate. Data is required in the form of published and/or un-published literature and expert opinion. Specific data is required in relation to:

- Vulnerability of habitat/s: to identify whether species will be affected by climate change impacts on key dependent habitats.
- Ecological flexibility: to identify the adaptation potential and resilience of species to climate change by reviewing key life history traits and characteristics. These include species degree of specialization and ability to disperse to new suitable ranges as well as the degree to which climate change will impact on reproductive success and important environmental triggers or phenological cues.
- Species interactions: to identify whether species will be affected by climate change due to impacts on predator, prey, and competitor species as well as impacts on key mutualistic and symbiotic relationships.
- Synergistic threat processes: to identify whether further threats, including those directly anthropogenic driven as well as diseases and invasive species, will reduce species ability to adapt and reduce their resilience to climate change impacts alongside any potential interactions between these threat processes and climate change.

5. Key Steps in the Methodology Application

The methodology adopts a four-phase approach to the analyses of vulnerability:

- Phase 1 - Review of current research findings: in-depth literature review focused around three key themes: (i) overview of research directly relating species with climate change impacts and vulnerabilities (species and taxon groups); (ii) review of research directly relating species with climate change impacts and vulnerabilities; and (iii) review of research indirectly relating species with climate change impacts and vulnerabilities.
- Phase 2 - Climate change vulnerability assessments - expert scoping reviews: To identify initial indicator of climate change vulnerability gradings for each species and provide an index suitable for prioritizing species for policy attention. This step involves a quick methodology for rapid review of large number of species that identifies a grading for each species. It involves species specialists completing a rapid expert assessment. Experts are asked to identify scenarios most relevant to their subject species for each criterion within the assessment. Rationale, evidence and related references are requested for each selection. Feedback is compiled and referred to second round of expert reviewers where necessary. The final step involves reviewing assessments and providing initial gradings.
- Phase 3 - Climate change vulnerability assessments - in depth reviews: to identify in-depth climate change vulnerability gradings for each species. Using climate change vulnerability assessment format contained in the methodology, each species is assessed in terms of categories of climate change vulnerability. The results of the previous phase can be used to increase the speed of assessment process. This phase results in written assessments for each species and provides important information for inclusion in management and policy recommendations. It also provides an index suitable for prioritizing species for policy attention by assigning grades of high / medium / low climate change vulnerability to each species
- Phase 4 - Individual species reports: to provide detailed reports for key species in liaison with species specialists. This phase involves reviewing information and research directly relating to species and the vulnerability of dependent factors such as habitat, prey, phenological events. It involves compilation of information into a report identifying all potential threats, vulnerabilities as well as uncertainties and discussion of points raised and graphical information where available. There is liaison between species specialists and, where available, climate change specialists during production of the report.

6. Combination with other Methodologies

The methodology is a standalone methodology for migratory species. If other species based methodologies are used in combination with this methodology care should be taken not to attempt comparison of results across methodologies. The methodology can be used in conjunction with a range of ecosystem and/or social vulnerability assessment methodologies.

7. Additional Resources and Case Studies

Detailed description of the methodology and examples of its application =>
http://www.cms.int/publications/pdf/cms_climate_change_vulnerability.pdf

Guidance Note A2.4
Technical VA Methodology: "*Climate Change Vulnerability Assessment and Adaptation Planning for Mangrove Systems*"

1. Introduction
This Guidance Note has been prepared to provide rapid guidance on the technical vulnerability assessment methodology *"Climate Change Vulnerability Assessment Adaptation Planning for Mangrove Systems"* (Ellison, 2012) in the context of the "*Manual for Climate Change Vulnerability Assessments of Coastal and marine protected areas*".

The purpose of the Guidance Note is twofold: (i) to give potential users of the methodology an overview of the methodology's objectives and activities, as well as information on data and resources needed and the situations in which its application may be appropriate to assist them in deciding whether the methodology is suitable for application in a given situation; and (ii) should potential users decide to adopt the methodology, the Note also provides guidance on its implementation in the context of an CMPA and tips for combining the methodology with other vulnerability assessment methodologies.

The Note is not intended to replace detailed guidance on methodology application; links to detailed guidance are provided at the end of the Note.

2. Objectives of Methodology
The methodology was developed in recognition of the fact that while climate change impacts on mangroves are well understood, there has been limited development of climate change vulnerability assessment methods and adaptation actions that are specific to mangroves. Borne out of a GEF funded project that included pilot sites in three countries (Tanzania, Fiji and Cameroon), the methodology has the following stated objectives:

(i) To describe methods and give examples of how to carry out vulnerability assessments in mangrove ecosystems
(ii) To demonstrate how the results can be analyzed and applied to prioritize adaptation actions.

The methodology thus goes beyond vulnerability assessments to the stage of adaptation planning; however, this Note will focus on those parts of the methodology that refer to vulnerability assessments of mangrove ecosystems.

3. Guidance on When to Use the Methodology
The methodology applies to all types of mangrove ecosystems. It contains a range of 'low-technology to 'high-technology' methods ranging from simple methods that require relatively few resources, to more complex and more comprehensive methods.

4. Resources and Data Needed
The methodology encompasses a range of methods each with their own resource and data needs. An overview of resource and data needs ranging from the most to the least intense is included in the following section of the Note.

5. Key Steps in the Methodology Application
The methodology commences with an initial desktop review of existing information and then proposes nine steps (refer below). For each of the eight technical steps, a range of methods is proposed that vary in their complexity and need for specialized resources or equipment. The final step refers to the synthesis and analysis of data to allow calculation of an overall vulnerability rank.

Key Steps and Resource Needs

Step in Methodology	Purpose / Actions	Methods Proposed	Human Resources and Equipment	Data
Step 0: Initial desktop review of existing information	To collect data on mangrove baseline condition, coastal spatial change, surface elevation data, tide gauge data, sedimentation rates, climate modeling, rainfall and river flow, resource use, legislation and community knowledge	Literature review with suggested sources	Study team	Range of published and unpublished data sources suggested
Step 1: Forest assessment of mangroves	To provide a baseline of current forest conditions, which is a sensitivity factor, thus providing a quantitative baseline from which change over time can be measured in the future.	Rapid assessment	Low level of expertise, basic field equipment	Community held data on local stressors and threats
		Permanent plot measurement	Medium level of expertise, long lead time, basic field equipment	No specific needs
		Mangrove litter productivity study	Medium level of expertise but labor intensive, long lead time, basic field equipment, drying oven	No specific needs
Step 2: Recent spatial changes of mangroves	To understand retreat of the seaward edge of mangroves and reduction in overall mangrove area over time, which are sensitivity factors, through GIS analysis	GIS analysis	GIS specialist	Satellite data sources
Step 3: Ground elevations in and behind mangroves	Survey of ground elevations in the mangrove area and immediately to landward to determine sensitivity related to restricted elevation zones, tidal range and areas for landward expansion	High technology methods: dGPS, EDM, photogrammetry, LiDAR	Highly specialized human resource, equipment and data needs – to be carried out by specialist service provider	
		Water level method	Basic field survey experience and field equipment	No specific needs
Step 4: Relative sea level trends	Establishment of long-term relative sea level trends as an important exposure factor	Tide gauge data	Ability to interpret data	Historic time-series of tide gauge data relevant to project site
		Stratigraphy / pollen analysis	Highly specialized human resource, equipment and data needs – to be carried out by specialist service provider	
Step 5: Sedimentation rates under mangroves	Measurement of the rate of erosion or accretion of sediment under a particular area of mangroves; sediment supply rate is an exposure factor and actual sedimentation rate is a sensitivity factor	Radiocarbon dates from stratigraphy	Highly specialized human resource, equipment and data needs – to be carried out by specialist service provider	
		Sedimentation stakes	Low level of expertise in field surveys, basic field equipment	No specific data needed
Step 6: Adjacent ecosystem resilience	Coral reef and seagrass ecosystem baseline assessment as resilience in ecosystems adjacent to mangroves is a sensitivity factor	IUCN Coral Reef Resilience protocol	Refer Guidance Note A2.1 of this Manual	
		Seagrass Watch baseline monitoring manual	Specialists in seagrass identification, basic field equipment	Background data on seagrass condition

Step in Methodology	Purpose / Actions	Methods Proposed	Human Resources and Equipment	Data
Step 7: Climate (rainfall) modeling	Understanding of projected changes in rainfall and humidity in project area	Use of available projections – global or downscaled	Expertise in interpretation of modeling data	Climate model data relevant to project site
Step 8: Compilation of local community knowledge	Understanding of local mangrove use and adaptive capacity	Surveys and questionnaires	Expertise in socio-economic data collection	Published and un-published data sources on local socio-economic conditions
Step 9: Synthesis and analysis of data	Synthesis of all data to identify overall vulnerability and drivers of vulnerability through consideration of exposure, sensitivity and adaptive capacity factors derived from application of preceding steps	Results ranking	Study team	Data from pervious steps

6. Tips for Application in the Context of the VA Manual

The methodology is suitable without modification for application in mangrove ecosystems in a protected area in the context of the VA Manual.

7. Combination with other Methodologies

The methodology focuses on biophysical and biological vulnerability of ecosystems. If the mangrove ecosystems in question are influenced by human activities or provide essential goods and services to nearly human populations, then consideration should be given to the need to combine this methodology with one focused on social vulnerability.

8. Additional Resources and Case Studies

***Methodology guidelines with case studies of its application* =>**
http://www.worldwildlife.org/climate/Publications/index.html

Guidance Note A2.5
Technical VA Methodology: "Climate Vulnerability and Capacity Analysis Handbook (CVCA)"

1. Introduction
This Guidance Note has been prepared to provide rapid guidance on the technical vulnerability assessment methodology *"Climate Vulnerability and Capacity Analysis (CVCA) Handbook"* (CARE, 2009) in the context of the "*Manual for Climate Change Vulnerability Assessments of Coastal and marine protected areas*".

The purpose of the Guidance Note is twofold: (i) to give potential users of the methodology an overview of the methodology's objectives and activities, as well as information on data and resources needed and the situations in which its application may be appropriate to assist them in deciding whether the methodology is suitable for application in a given situation; and (ii) should potential users decide to adopt the methodology, the Note also provides guidance on its implementation in the context of an CMPA and tips for combining the methodology with other vulnerability assessment methodologies.

The Note is not intended to replace detailed guidance on methodology application; links to detailed guidance are provided at the end of the Note.

2. Objectives of Methodology
The methodology provides a framework for analyzing vulnerability and capacity to adapt to climate change at the community level. It prioritizes local knowledge on climate change. The stated objectives of the CVCA are to:

(i) Analyze vulnerability to climate change and adaptive capacity at the community level
(ii) Combine community and scientific data to yield greater understanding about local impacts of climate change

The methodology also provides guidance on the use of vulnerability analyses in the development of adaptation options; however, the Guidance Note focuses on those elements of the methodology related to vulnerability analyses themselves.

3. Guidance on When to Use the Methodology
The methodology focuses on a qualitative assessment of community level vulnerability to climate change and is thus suitable for use in relation to social targets. However, because of the participatory nature of the methodology, it is best suited for use in situations where a number of individual villages or household groups are being analyzed rather than large human settlements. Although the methodology does state that a sampling approach can be used, the non-quantitative nature of the methodology ensures that it would be hard to demonstrate a robust degree of sample representativeness in such a case.

4. Resources and Data Needed
4.1 Human Resources & Equipment
The methodology is based on principles of participatory assessment that involves local communities and stakeholders as key informants in the process of analysis. The methodology contains guidance on the implementation of a range of participatory analysis tools including hazard mapping, seasonal calendars, historical timelines, venn diagrams, and vulnerability matrices. Staff or consultants with expertise in the planning and facilitation of such tools should be included in the VA team. The methodology suggests that the team should include coverage of the following skill sets: research skills, climate change, policy and institutional analysis, scientific expertise in relevant sectors, gender and diversity, conflict management, qualitative interviewing and writing skills. The methodology recommends that local authority representatives are included in the project team.

Equipment is limited to basic equipment for workshops and meetings, including large sheets of paper, pens, cards, camera, clipboards etc.

4.2 Data Needed
Prior to the commencement of the methodology data on the prevailing socio-economic and past and projected future climate conditions should be collected and reviewed by the project team. The

methodology suggests that available data is collected in relation to the following issues: climate change projections, biophysical conditions of study area (topography, agro-ecological regions, infrastructure etc.) and census and poverty data.

5. Key Steps in the Methodology Application

The CVCA process is based around a desire to understand if a range of 'enabling factors' are in place at the national, local and household level to allow effective climate change adaptation to take place. It uses a series of guiding questions based around the following four themes to collect and analyze information at the national, local government/community and household individual levels: (i) resilient livelihoods; (ii) disaster risk reduction; (iii) capacity development; and (iv) underlying causes of vulnerability. The methodology proposes a range of participatory tools to collect and analyze this information:

Level of Analysis	Tools Proposed for Information Collection and Analysis
National	Secondary research; institutional mapping; policy analysis; key informant interviews
Local Government / Community	Secondary research; policy analysis; institutional mapping; key informant interviews
Household / Individual	Secondary research; hazard mapping; seasonal calendars; historical timeline; vulnerability matrix and Venn diagram

6. Tips for Application in the Context of the VA Manual

The methodology focuses primarily on questions of resilience and adaptive capacity that allow a description of the status of 'enabling factors' for effective adaptation in a purely qualitative manner. It addresses questions of climate impacts in less detail through discussion of existing climate and non-climate hazards and how these hazards are likely to change over time. However, the methodology does not discuss in detail the relative extent or scale of climate hazards. It is recommended that additional analysis of issues relating to climate impact are included through the addition of 'guiding questions' that facilitate the ranking of existing and likely future climate hazards from the highest impact hazard to the lowest impact hazard.

The methodology does not include guidance on how to transform the VA results into vulnerability rankings, how to draw out information on the drivers of vulnerability in terms of climate impact and resilience / adaptive capacity nor on mapping of the spatial distribution of vulnerability. Nonetheless to ensure compatibility of the outcomes of this methodology with other methodologies in the Manual a simple ranking and mapping process is required that allows an understanding not only of the overall vulnerability, but vulnerability drivers. To achieve this, it is recommended that the following template that is derived from the guiding questions in the methodology be used for each social target that is subject to the methodology. This template will develop a simple ranking system that will also allow mapping of outcomes by target.

Target Name:		HIGH, MEDIUM OR LOW
Climate Impacts => Based on the following questions, determine if this target is likely to experience high, medium or low climate impacts.	• Is the target located in a zone identified as particularly vulnerable? • Does the target face any of the most highly ranked climate hazards? • Will the target face any of the most highly ranked climate hazards in the future? • Will any non-climate hazards act, now or in the future, to expose the target to highly ranked climate hazards?	
Adaptive Capacity / Resilience => Based on the following questions, determine if this target is likely to experience high, medium or low adaptive capacity or resilience.	• Does the target have good access to climate information? • Are there early warning systems in place? • Is there authority / community capacity to respond to climate events? • Are there policies / legislation to address climate impacts? • Are households engaged in diverse, climate resilience livelihoods? • Are key assets protected? • Is there equitable participation in decision	

<table>
<tr><td></td><td colspan="5">making processes?
• Do households have economic and social safety nets?</td><td></td></tr>
<tr><td rowspan="5">Overall Vulnerability => Based on the conclusions in relation to climate impacts and adaptive capacity or resilience, determine an overall vulnerability rank using the following matrix.</td><td colspan="2"></td><td colspan="3">Adaptive Capacity / Resilience</td><td rowspan="5"></td></tr>
<tr><td colspan="2"></td><td>High</td><td>Medium</td><td>Low</td></tr>
<tr><td rowspan="3">Climate Impacts</td><td>High</td><td>Medium vulnerability</td><td>High vulnerability</td><td>High vulnerability</td></tr>
<tr><td>Medium</td><td>Low vulnerability</td><td>Medium vulnerability</td><td>High vulnerability</td></tr>
<tr><td>Low</td><td>Low vulnerability</td><td>Low vulnerability</td><td>Medium vulnerability</td></tr>
</table>

A final point is that the methodology contains limited consideration of links between communities and their use of the goods and services provided by natural resources. To overcome this limitation, additional questions or issues for consideration can be added into participatory activities that address natural resource issues.

7. Combination with other Methodologies

The methodology can be combined with other methodologies that address one or more ecological targets, or can be used as a second stage assessment following the application of a Level 1 assessment that identifies priority social targets for more detailed analysis.

8. Additional Resources and Case Studies

Detailed description of the methodology and examples of its application =>
http://www.careclimatechange.org/index.php?option=com_content&view=article&id=25&Itemid=30

Guidance Note A2.6
Technical VA Methodology: "Developing a Protected Area Scale Social Vulnerability Index (SVI)"

1. Introduction
This Guidance Note has been prepared to provide rapid guidance on the technical vulnerability assessment methodology *"Developing a Protected Area Scale Social Vulnerability Index (SVI)"* in the context of the "*Manual for Climate Change Vulnerability Assessments of Coastal and marine protected areas*".

The purpose of the Guidance Note is twofold: (i) to give potential users of the methodology an overview of the methodology's objectives and activities, as well as information on data and resources needed and the situations in which its application may be appropriate to assist them in deciding whether the methodology is suitable for application in a given situation; and (ii) should potential users decide to adopt the methodology, the Note also provides guidance on its implementation in the context of an CMPA and tips for combining the methodology with other vulnerability assessment methodologies.

The Note is not intended to replace detailed guidance on methodology application; links to detailed guidance are provided at the end of the Note.

2. Objectives of Methodology
The methodology aims to provide a quantitative assessment of the relative social vulnerability of social targets that depend on or influence the condition of a protected area.

3. Guidance on When to Use the Methodology
The methodology has been developed for use at the village or community level. It relies on the availability of adequate climate and socio-economic data, either as secondary data or as primary data generated specifically for the methodology application.

4. Resources and Data Needed
4.1 Human Resources & Equipment
Required human resources include social scientists or team members with expertise in concepts of social vulnerability. Basic data management and analysis skills be needed. If primary data is to be collected through household surveys or other participatory tools then specialists in survey design and analysis will be required. Team members with climate science knowledge will also be required to develop climate exposure indicators. If climate modeling is to be undertaken to supplement or replace missing secondary data, then specialist skills in projection development will be required. Basic computing equipment is needed as well as required equipment to undertake household surveys and/or climate modeling if primary data is to be generated.

4.2 Data Needed
The methodology requires development of a SVI Framework in which project teams define the socio-economic and climate indicators that will be used as the architecture of the Index. Once these indicators are defined, adequate secondary or primary data at the scale of the target(s) in question will be required. Depending on the indicators selected and the availability of secondary data, data generation needs can be significant and teams should assure themselves that adequate resources area available to collect robust and credible data.

5. Key Steps in the Methodology Application
The methodology guides users through five steps:

- Step 1 - Vulnerability Index Framework and Data Collation: identification of relevant climate exposure, sensitivity and adaptive capacity indicators and collection / generation of data.
- Step 2 - Existing and Future Exposure Scores: calculation of prevailing and likely future climate exposure scores using simple statistical techniques
- Step 3 - Existing and Future Sensitivity Scores: calculation of prevailing and likely future social sensitivity scores using simple statistical techniques
- Step 4 - Existing and Future Adaptive Capacity Scores: calculation of prevailing and likely future social adaptive capacity scores using simple statistical techniques

- Step 3 - Existing and Future Relative Vulnerability Scores: calculation of prevailing and likely future relative vulnerability scores using simple statistical techniques

The methodology is focused on a quantitative approach that allows weighting of indicators through a participatory process, but also provides guidance on a semi-quantitative approach (using high, medium, low rankings) that simplifies the statistical calculations required.

6. Tips for Application in the Context of the VA Manual

The methodology has been developed specifically for use in the context of the VA Manual and should thus not require any modification for application.

7. Combination with other Methodologies

The methodology focuses on social targets and will thus need to be used in conjunction with one or more methodologies for ecological targets. The methodology can be used as a more detailed Level 2 assessment for selected targets following the application of a Level 1 assessment that prioritizes social targets for more detailed analysis. The methodology would benefit from the complementary application of a qualitative social vulnerability analysis to allow ground-truthing of results and testing of assumptions.

8. Additional Resources and Case Studies

Detailed description of the methodology and examples of its application =>
VA Manual Guidance Note A3.2

Guidance Note A2.7
Technical VA Methodology: "Climate Witness Community Toolkit"

1. Introduction
This Guidance Note has been prepared to provide rapid guidance on the technical vulnerability assessment methodology *"Climate Witness Community Toolkit"* (WWF South Pacific Programme) in the context of the "*Manual for Climate Change Vulnerability Assessments of Coastal and marine protected areas*".

The purpose of the Guidance Note is twofold: (i) to give potential users of the methodology an overview of the methodology's objectives and activities, as well as information on data and resources needed and the situations in which its application may be appropriate to assist them in deciding whether the methodology is suitable for application in a given situation; and (ii) should potential users decide to adopt the methodology, the Note also provides guidance on its implementation in the context of an CMPA and tips for combining the methodology with other vulnerability assessment methodologies.

The Note is not intended to replace detailed guidance on methodology application; links to detailed guidance are provided at the end of the Note.

2. Objectives of Methodology
The Climate Witness Toolkit provides a simple, participatory methodology for assessment of climate change impacts and adaptive capacity and allows planning of future adaptation priorities. It has been developed for use in marine / coastal environments in developing countries.

3. Guidance on When to Use the Methodology
The methodology focuses on a qualitative assessment of community level vulnerability to climate change and is thus suitable for use in relation to social targets. However, because of the participatory nature of the methodology, it is best suited for use in situations where a number of individual villages or household groups are being analyzed rather than large human settlements. Although the methodology also includes tools to elicit community responses on priority adaptation measures, this Guidance Note will focus on those elements of the methodology related to vulnerability analyses.

4. Resources and Data Needed
4.1 Human Resources and Equipment
The methodology is based on principles of participatory assessment that involves local communities and stakeholders as key informants in the process of analysis. The methodology contains guidance on the implementation of a range of participatory analysis tools. Staff or consultants with expertise in the planning and facilitation of such tools should be included in the VA team. Equipment is limited to basic equipment for workshops and meetings, including large sheets of paper, pens, cards, camera, clipboards etc.

4.2 Data Needed
Prior to the commencement of the methodology data on the prevailing socio-economic and past and projected future climate conditions should be collected and reviewed by the project team.

5. Key Steps in the Methodology Application
The methodology is based around a two-day workshop within local communities. During this two-day workshop, the methodology contains detailed instructions on a range of participatory tools that aim to elicit community views on the local impacts of climate change and the existing adaptive capacities within communities. The recommended tools (relevant to the vulnerability assessment component of the methodology) are as follows:

- Step 1: Mapping of resource availability, infrastructure and area of cultural significance
- Step 2: Seasonal calendar identifying locally significant seasons and cycles throughout the year
- Step 3: Time line to better understand the natural and human events that have influenced the lives of the communities
- Step 4: Animal and plant inventory as a quick method of obtaining information on plant and animal types within a community's boundary

- Step 5: Presentation and review of results generated from earlier activities/identifying climate related changes
- Step 6: Identification of concerns and opportunities to identify and organize community climate change related issues and consider options to address them
- Step 7: Community values identification to encourage discussion and consideration within the community about what is important to community members lives and what they wish to maintain into the future
- Step 8: Priority values discussion to prioritize values that are appreciated more by the collective group rather than by the individual.
- Step 9: Root cause analysis to discuss whether identified community problems are directly related to climate change
- Step 10: Sun ray exercise to brainstorm ideas for solving a problem in an ordered and logical form
- Step 11: Two-way vision to determine how communities perceive climate change will impact their lives and how they would like their future to be instead.

While not specified in the methodology, it is recommended that data collection and review of prevailing conditions in the study area be undertaken prior to methodology application.

6. Tips for Application in the Context of the VA Manual

Experience in the application of this methodology concluded that a two-day workshop may not always be possible to implement due to the unavailability of community members for this long a period. Experience also showed that in some countries the questions and analyses advocated in the methodology were too complex and needed to be simplified. It is recommended that the project team review the methodology in full prior to application to see if simplification is required, and if possible, that the project team pilot the methodology before launching full scale implementation.

While addressed inherently in the methodology, it does not include specific guidance on how to transform the VA results into vulnerability rankings, how to draw out information on the drivers of vulnerability in terms of climate impact and resilience / adaptive capacity nor on mapping of the spatial distribution of vulnerability. Nonetheless to ensure compatibility of the outcomes of this methodology with other methodologies in the Manual a simple ranking and mapping process is required that allows an understanding not only of the overall vulnerability, but vulnerability drivers. To achieve this, it is recommended that the following template that is derived from the questions addressed in the methodology be used for each social target that is subject to the methodology. This template will develop a simple ranking system that will also allow mapping of outcomes by target.

Target Name:		HIGH, MEDIUM OR LOW
Climate Impacts => Based on the following questions, determine if this target is likely to experience high, medium or low climate impacts.	• Has the target been subject to significant climate impacts in the past? • Does the target currently suffer from significant climate impacts? • Is the target likely to suffer from significant climate impacts in the future? • What types of outcomes do existing climate impacts have? How is this likely to change in the future? • What is the effect of climate impacts on livelihoods and the community's way of life?	
Adaptive Capacity / Resilience => Based on the following questions, determine if this target is likely to experience high, medium or low adaptive capacity or resilience.	• Does the target have good access to climate information? • Has the community been able to respond to climate impacts in the past? • Is there community capacity to respond to climate events? • Are there policies / legislation to address climate impacts? • Are households engaged in diverse, climate resilience livelihoods? • Are key assets protected?	

<table>
<tr><td></td><td colspan="5">• Is there equitable participation in decision making processes?
• Do households have economic and social safety nets?</td><td></td></tr>
<tr><td rowspan="5">Overall Vulnerability => Based on the conclusions in relation to climate impacts and adaptive capacity or resilience, determine an overall vulnerability rank using the following matrix.</td><td colspan="2"></td><td colspan="3">Adaptive Capacity / Resilience</td><td rowspan="5"></td></tr>
<tr><td colspan="2"></td><td>High</td><td>Medium</td><td>Low</td></tr>
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</table>

7. Combination with other Methodologies

The methodology can be combined with other methodologies that address one or more ecological targets, or can be used as a second stage assessment following the application of a Level 1 assessment that identifies priority social targets for more detailed analysis.

8. Additional Resources and Case Studies

Detailed description of the methodology and examples of its application =>
http://www.worldwildlife.org/what/wherewework/coraltriangle/WWFBinaryitem7771.pdf

Guidance Note A2.8
Technical VA Methodology: "Integrated Coastal Sensitivity, Exposure, Adaptive Capacity to Climate Change – ICSEA-C-CHANGE"

1. Introduction

This Guidance Note has been prepared to provide rapid guidance on the technical vulnerability assessment methodology *"Integrated Coastal Sensitivity, Exposure, Adaptive Capacity to Climate Change – ICSEA-C-CHANGE"* (Geronimo et al, 2013) in the context of the "*Manual for Climate Change Vulnerability Assessments of Coastal and marine protected areas*".

The purpose of the Guidance Note is twofold: (i) to give potential users of the methodology an overview of the methodology's objectives and activities, as well as information on data and resources needed and the situations in which its application may be appropriate to assist them in deciding whether the methodology is suitable for application in a given situation; and (ii) should potential users decide to adopt the methodology, the Note also provides guidance on its implementation in the context of an CMPA and tips for combining the methodology with other vulnerability assessment methodologies.

The Note is not intended to replace detailed guidance on methodology application; links to detailed guidance are provided at the end of the Note.

2. Objectives of Methodology

The ICSEA-C-CHANGE methodology aims to provide a rapid synoptic assessment of the acute, immediate impacts of climate change in coastal areas. It focuses on criteria relevant to biodiversity of coral reefs and mangroves, coastal integrity and fisheries. Intended to be used part of a suite of tools included in "*Vulnerability Assessment Tools for Coastal Ecosystems: A Guidebook*" (Geronimo et al, 2013) it has been designed as a first level scoping tool that provides an initial profile of vulnerabilities and allows users to prioritize areas and actions. The application of the related and more detailed CIVAT and TURF tools that focus on coastal integrity and fisheries respectively can be subsequently employed to allow focused analyses of priority issues.

3. Guidance on When to Use the Methodology

This methodology is particularly suitable for small, relatively homogenous CMPAs that are considered likely to have vulnerability issues associated with coastal integrity or fisheries ecosystem services. The starting point for analyses in this methodology is the local or village administrative level so it is also useful when data is available primarily at this level, or when information on village-level threats and responses is specifically sought. Note that the methodology evaluates acute, short-term (cited as 1-year) impacts of climate change with a specific focus on fisheries and coastal integrity. Biodiversity issues are considered but primarily insofar as they affect vulnerability of coastal integrity and fisheries rather than in terms of their inherent vulnerability. If VA teams are looking for information on longer-term vulnerabilities or vulnerabilities across a wider range of issues, then alternative methods may be preferred.

4. Resources and Data Needed

4.1 Human Resources & Equipment

This methodology is typically applied in a participatory manner by coastal park managers or local authorities. No special equipment is needed other than basic field reporting and computing equipment.

4.2 Data Needed

The methodology requires, at a minimum, information from coastal resources assessments, topographical maps, nautical charts, satellite images (e.g. from Google Earth), socio-economic profiles, census data, coastal mapping of main habitats, anecdotal information on past and present coastal characteristics.

5. Key Steps in the Methodology Application

The methodology is relatively simple to apply. It requires collection of available data and a rapid field assessment of the villages/local administrative units that are to be considered in the VA. In a participatory process a range of pre-defined criteria related to exposure, sensitivity, and adaptive capacity are then considered and scored. The scoring tables in the methodology then allow calculation

of relative vulnerability – with a focus on fisheries and coastal integrity - of each village/local administrative unit.

6. Tips for Application in the Context of the VA Manual

ICSEA-C-CHANGE is similar to the BAVAPA methodology in that it is a first level VA that allows a rapid VA to be undertaken to prioritize issues for further analyses. The main difference with the BAVAPA methodology is that it is typically undertaken at the level of a single administrative unit such as a village or commune, rather than at the level of a VA ecological or social target.

Experience with the use of this methodology has shown that it is particularly useful in the case of small CMPAs that cover a very small number of administrative units with higher levels of homogeneity throughout the CMPA. This methodology is useful when relative vulnerability of a number of these administrative units is required.

7. Combination with other Methodologies

The ICSEA-C-CHANGE methodology can theoretically be used as an alternative to the BAVAPA methodology but it is recommended that where possible they are used as complementary methodologies because of the stronger focus of BAVAPA on measures of ecological vulnerability, and its focus on VA targets as the starting point of the assessment.

ICSEA-C-CHANGE is most useful when it is used as a pre-cursor to the TURF and CIVAT methodologies developed as part of the same suite of tools.

8. Additional Resources and Case Studies

The final version of "*Vulnerability Assessment Tools for Coastal Ecosystems: A Guidebook*" (Geronimo et al, 2013) which will contain detailed guidance on this methodology is not yet publically available.

Guidance Note A2.9
Technical VA Methodology: *"Tool for Understanding Resilience of Fisheries - TURF"*

1. Introduction
This Guidance Note has been prepared to provide rapid guidance on the technical vulnerability assessment methodology *"Tool for Understanding Resilience of Fisheries - TURF"* (Geronimo et al, 2013) in the context of the "*Manual for Climate Change Vulnerability Assessments of Coastal and marine protected areas*".

The purpose of the Guidance Note is twofold: (i) to give potential users of the methodology an overview of the methodology's objectives and activities, as well as information on data and resources needed and the situations in which its application may be appropriate to assist them in deciding whether the methodology is suitable for application in a given situation; and (ii) should potential users decide to adopt the methodology, the Note also provides guidance on its implementation in the context of an CMPA and tips for combining the methodology with other vulnerability assessment methodologies.

The Note is not intended to replace detailed guidance on methodology application; links to detailed guidance are provided at the end of the Note.

2. Objectives of Methodology
This VA methodology aims to assess the vulnerability of reef-based coastal fisheries, inside or outside of CMPAs, to climate change hazards. The methodology is applied at the village/local administrative unit level and aims to identify the relative vulnerability of fisheries activities in a number of different villages or units. It includes consideration of fisheries productivity, socio-economic and coral reef ecosystem issues and determines their relative influence on the overall relative vulnerability of fisheries. The methodology has not been designed to investigate vulnerabilities of non-reef base fisheries.

3. Guidance on When to Use the Methodology
This methodology is part of a suite of tools included in "*Vulnerability Assessment Tools for Coastal Ecosystems: A Guidebook*" (Geronimo et al, 2013). It is designed as a second level, more detailed vulnerability assessment tool to be applied when an initial first level assessment has indicated that fisheries services may be particularly vulnerable to climate change. The VA tool is applied at the level of the village / local administrative unit so it is particularly useful when a relative view of the vulnerabilities of a number of discrete villages / administrative units is required.

4. Resources and Data Needed
4.1 Human Resources & Equipment
The methodology has been designed to be applied by coastal managers and local authorities with assistance from fisheries experts and coastal resource management experts to help with data analysis and interpretation. Basic field reporting and computing equipment is needed.

4.2 Data Needed
The methodology requires primary data on fisheries productivity to be collected, together with secondary data such as municipal fisheries profiles and data generated through use of the companion VA tool ICSEA-C-CHANGE. Key information that is needed to apply the tool is indicated below:

Fisheries Related Data	Reef Ecosystem Data	Socio-Economic Data
Dominant catch Catch rate Gear dependence Habitat condition Size and amount of catch Presence of fry fisheries Change in catch composition through time	Abundance of exposure tolerant species Density of coral dependent species Habitat quality Extent of habitats Presence of adjacent habitats	Population density Fisheries ecosystem dependency Annual fisheries income Percentage of fishers with alternative livelihoods Annual cumulative incomes from other sources

5. Key Steps in the Methodology Application

The methodology is based around a series of relatively simple matrices that contain criteria on exposure, sensitivity and adaptive capacity. A participatory process is used to score criteria and calculate exposure, sensitivity and adaptive capacity scores that leads to a calculation of overall fisheries vulnerability scores.

6. Tips for Application in the Context of the VA Manual

The methodology has been developed for use at the village / local administrative unit. Depending on the scale of the CMPA an alternative approach would be to divide the CMPA into a number of discrete fishery zones and apply this methodology to these zones. In this case criteria and scoring would need to be reviewed by fisheries and VA experts to ensure their relevance to the local situation.

7. Combination with other Methodologies

This methodology focuses on fisheries ecosystem services and can be used in conjunction with methodologies for other ecological or social targets.

8. Additional Resources and Case Studies

The final version of "*Vulnerability Assessment Tools for Coastal Ecosystems: A Guidebook*" (Geronimo et al, 2013) which will contain detailed guidance on this methodology is not yet publically available.

Appendix 4: Glossary of Terms

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Precautionary principle is defined in the Rio Declaration (1992) as where there are threats of serious

or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation

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

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

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

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

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

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

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

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

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

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

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