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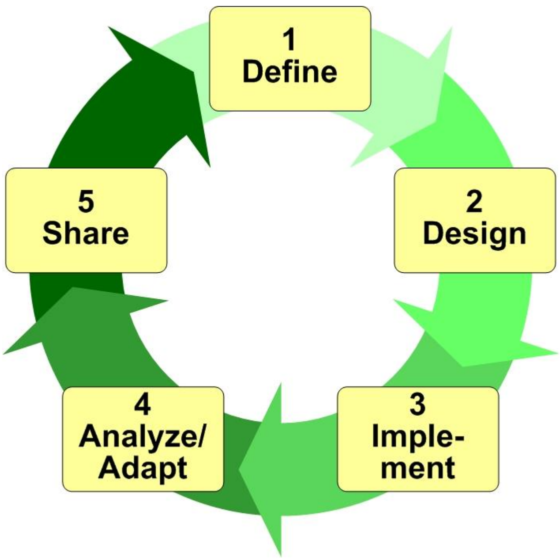
Resources for Implementing the WWF Project & Programme Standards

Climate Adaptation: Mainstreaming in Existing Conservation Plans

July 2011



WWF for a living planet®

Climate Adaptation: Incorporating in Existing Conservation Plans

Contents

This document is intended as a guidance resource to support the implementation of the *WWF Standards of Conservation Project and Programme Management.* Although each step in these *Standards* must be completed, the level of detail depends on the circumstances of individual projects and programmes. Accordingly, each team will have to decide whether and to what level of detail they want to apply the guidance in this document.

This document may change over time. The most recent version can be accessed at: www.panda.org/standards

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In March 2010 the WWF Network Climate Adaptation Team (NCAT) developed *Principles of Good Climate Adaptation* to guide the Network's climate adaptation work:

Good Climate Adaptation:
1. Is grounded in best available knowledge on climate variability and climate change;
2. Recognises that humans are part of nature;
3. Is undertaken in partnership with others;
4. Addresses uncertainty and integrates learning;
5. Works at the appropriate scale to address the problem;
6. Applies appropriate and robust approaches;
7. Influences policies and institutions;
8. Communicates to empower.

Climate Adaptation

1. Terminology – What is Climate Adaptation?

The Intergovernmental Panel on Climate Change (IPCC) defines climate adaptation as an "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (IPCC 2007b).

2. What is Climate Adaptation?

This adjustment may include a range of existing and new strategies that can promote resilience in natural systems and in some cases facilitate a transition to different resilient natural systems. General conservation adaptation approaches include:

- Protecting the conservation targets and key ecological attributes that underpin the system;
- Reducing direct (non-climate) threats to the system;
- Increasing the representation of genotypes, species, and natural communities under protection;
- Increasing the replicates of ecosystems, natural communities, and species under protection;
- Restoration of ecosystems that have been degraded or lost;
- Identifying and protecting climate refugia areas where the climate will likely be more stable;
- Relocation of organisms (Kareiva et al. 2008).

Most of these approaches are familiar to conservation practitioners because they have been in use for decades. What distinguishes adaptation from 'conservation as usual' is that strategies are checked for their ability to reduce vulnerability to climate, based on a vulnerability assessment. While planned actions based on the vulnerability assessment may be predominantly the same or similar to existing actions, they may be prioritized differently to make a program 'climate-smart'. Parallels with disaster risk reduction (DRR) may also be noted: many actions taken in a climate adaptation framework will also buffer and increase the resilience of ecosystems and human communities in the face of current threats or extreme stresses (e.g. surges, flooding, landslides, etc.) not necessarily related to climate change.

Human responses to climate variability and change may also lead to direct and indirect positive or negative effects on biodiversity. Some examples of human responses are migration, changes to agricultural production and water resource use, and alteration of demographic and social behaviour. In many cases, these human responses will have a greater or more rapid impact than the direct climatic changes. Regions of high social vulnerability to climate change are likely to witness bigger or earlier upheaval. Human responses to the changes can reduce the resilience of natural systems, further destabilizing systems upon which humans and rest of the planet depend.

An integrated approach, involving both ecosystems and people, has the best chance of developing adaptation responses that avoid placing additional pressures on natural systems. In this way, we try to avoid maladaptation, which may bring benefits in the short term but causes adverse impacts to ecosystems and people in the longer term. Since people benefit from ecosystem services, they benefit from resilient ecosystems.

3. Why Is Climate Adaptation Important?

There is strong evidence that many natural systems have already been affected by a changing climate. The earth's atmosphere has absorbed so much carbon to date that even if all anthropogenic carbon emissions ended immediately, the earth's climate would continue to shift for decades and — in the case of sea-level rise and ocean acidification — centuries or millennia. Our environment is entering into a more dynamic phase that may last centuries. People must and will respond – the key is to respond appropriately. It is hoped that appropriate planning can direct adaptation responses such that natural systems are as resilient as possible or can facilitate change to new resilient natural systems.

Since 1906, the global average surface temperature has increased by 0.74°C ± 0.18°C, and the rate of warming averaged over the last 50 years (0.13°C ± 0.03°C per decade) is nearly twice that for the last 100 years. Past carbon emissions are expected to result in a further 0.6°C relative to 1989-1999 levels even if greenhouse gas concentrations remain at 2000 levels (IPCC 2007a). While these global, annual-scale numbers seem relatively small from a human perspective, regional and local impacts have been orders of magnitude greater, while some regions have seen little or no observable impact to date. Moreover, studies such as (Root et al. 2002) and (Parmesan 2006) show that many species and ecosystems are able to respond quite rapidly to even small shifts in climate regime.

Thus, while the mitigation of greenhouse emissions, either through prevention or through carbon sequestration, is essential if we are to limit the future impacts of climate change, the earth has already experienced significant change and is committed to much more change. People must and will respond – the key is to respond appropriately. It is hoped that appropriate planning can direct adaptation responses such that natural systems are as resilient as possible or can facilitate change to new resilient natural systems.

Until recently, people have based many of their climate and hydrologic engineering calculations on the idea of "stationarity," the assumption that natural systems vary within a fixed envelope of probability. Whether this concept was ever true is arguable, but it is clearly no longer true, and we must now plan while the world shifts around us (Milly et al. 2008). This guidance benefits from the work of other conservation organizations and readily incorporates the outputs of other tools (e.g. development organizations' human vulnerability assessment tools).

4. When to Integrate Climate Adaptation into your Strategic Plan?

This brief document describes a method for incorporating climate adaptation into existing conservation plans using the WWF Standards for conservation planning. So this guide assumes that you already have a conservation plan that was developed using the WWF Standards. If you already have a plan, there is no reason to wait to consider climate adaptation. Experience shows that all or virtually all of your previous work will not be wasted – but you may make some adjustments or additions, and you will have much more confidence that your current efforts are 'climate smart'.

This guide is not intended to help develop a stand-alone adaptation plan or to simply develop funded adaptation projects, but to fully integrate adaptation concepts into a conservation plan from a practical, applied perspective. Note that there is a much longer and more detailed version of this document, with references, workshop suggestions, and links to further information which can be accessed at: www.panda.org/standards.

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5. How to Integrate Climate Adaptation

Most of these approaches are familiar to conservation practitioners because they have been in use for decades. What distinguishes adaptation from 'conservation as usual' is that strategies are checked for their ability to reduce vulnerability to climate, based on a vulnerability assessment. While planned actions based on the vulnerability assessment may be predominantly the same or similar to existing actions, they may be prioritized differently to make a program 'climate-smart'. The fundamental concepts regarding the impacts of climate change can be summarized as:

Exposure + Sensitivity – Adaptive Capacity = Vulnerability

In other words, the vulnerability of an ecosystem, species, or community is a function of the degree of exposure to climate changes, plus its sensitivity to the changes, minus its capacity to adapt to the changes. Climate change exposure refers to changes in climate parameters such as the timing and magnitude of changes in temperature and precipitation. Sensitivity is the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli (USCCP 2008)(USCCP 2008). Adaptive capacity is the ability of a system, institution, or individual 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. A component of a system's adaptive capacity is its resilience or the capacity of a system [human or ecological] to absorb disturbance and reorganize while undergoing change and still retain essentially the same function, structure, identity, and feedbacks.

Uncertainty plays a large role in climate adaptation. The farther out in time you consider, the greater the uncertainty. There is uncertainty regarding the amount of future CO_2 emissions; this is compounded by uncertainty in global circulation models used to project climate based on the CO_2 emissions; there is additional uncertainty in regional climate downscaling of the global circulation models. How natural systems will respond to changes in climate also involves uncertainty. And how will people be affected and how will they respond? Conservation planners and managers have always acted without important information – uncertainty in and of itself should not prevent us from taking action. Our advice is to take action based on:

1. Current vulnerabilities to climate extremes;
2. The need to collect specific information for decision making and for signaling significant change;
3. Avoiding actions that may be maladaptive;
4. Facilitating the transition of relevant policies and institutions towards a "climate-smart" approach;
5. The need to continue to monitor and reduce pressures from other drivers.

Adaptation is a long-term process. Part of this process is learning to cope with current climate variability and retrofitting adaptation into existing projects and programmes, but it is also about anticipating and planning for future change. Short-term adaptation measures are needed to address immediate risks posed. However, adaptation measures developed to address a longer timeframe can provide the foundation for adaptation to new and evolving climate hazards over decades. In the context of climate change, this will require a shift in the way WWF traditionally frames programmatic goals and vision statements which are based on ecological restoration and the way in which success is measured.

The following process can be pursued in a number of different ways. It can be used by a small planning team over a few days. It can structure a much longer process involving teams and experts that come in and out of the process. It can also frame a multi-stakeholder participatory process in a workshop or series of workshops. The approach is up to the user(s).

5.1 Gather Existing Climate Data and Reports (PPMS 0.1 General Practices and Assumptions)

You should start by gathering existing data that may inform analyses and strategy development. Use your contacts in local universities, government agencies, and other NGOs, plus the internet to find climate-related documents for your project area (and beyond).

5.2 Review Stakeholders (PPMS 1.4 Context and Stakeholders)

A stakeholder analysis could be placed anywhere in the process, and is one component often revisited and revised several times. Who has information or knowledge to inform the vulnerability assessment and planning process? Who will be affected by current or predicted climate changes and how might they react? Who can influence the success of proposed strategies?

5.3 Vulnerability Assessment (PPMS 1.4 Context and Stakeholders)

Next you need to understand the range of existing and potential climate change impacts on systems (ecological and human) and assess vulnerability. Vulnerability assessments are the primary tool or process that informs adaptation planning. There are many varieties of vulnerability assessments, and they can be sophisticated and expensive or simple and inexpensive. The next section describes a simple vulnerability assessment process using the WWF Standards as a framework. More detailed vulnerability assessments for particular sectors or species may eventually be appropriate, but the following steps should spell out the range of likely climate change impacts with sufficient rigour to be credible to partners and donors. Existing vulnerability assessments from the study area may also prove useful as a reference for your own assessment.

5.3.A Examine Vulnerability to Current Climate Extremes

The first sub-step of a vulnerability assessment is to gauge the conservation targets' vulnerability to current climate extremes. This analysis can be retrospective (considering changes that have occurred to today) or current (considering the current situation). The objective is the same: to get your project team thinking about how the conservation targets are currently vulnerable to extremes in climate (since, in general, increases in the mean will not be the most important exposure). The idea of this step is to document the vulnerability (exposure + sensitivity – adaptive capacity) of each conservation target.

Besides noting the exposure, you are looking to identify resulting vulnerabilities, usually associated with sensitivities:

- Universal elements of sensitivity (e.g., hydrology, fire, wind and storm events)
- Species level elements of sensitivity
    - Physiological factors (e.g., temperature, moisture, pH, salinity)
    - Dependence on sensitive habitats (e.g., wetlands, alpine, low-lying floodplains)
    - Dependence on ecological linkages
        - Physical (e.g., access to a range of habitats)
        - Functional (e.g., dependence on and sensitivity of prey items, abundance of irruptive species)
    - Phenological changes (changes in plant and animal life history cycles, especially where they interact)
    - Population growth rate and reproductive strategy (ability to rebound quickly may favor some species over others)
    - Specialization (less specialized species may be more flexible) (Glick et al. 2011).

The team can choose whether to include current human vulnerabilities. The recommended tool for this step is a simple "ecological drawing" which illustrates the conservation targets and how those targets are currently influenced by climate extremes. See Example 6.A.

5.3.B Consider the Range of Future Climate Projections

Next your team should attempt to summarize the long-term potential exposure of the conservation targets and people to climate changes, that is, the potential magnitude and range of climate changes. Refer to existing climate models or vulnerability assessments. The point is to understand what the projections are saying. Some adaptation practitioners believe that reference to future climate modelling is not advisable (since they are full of uncertainty), but we believe that it is important to understand both the uncertainty and what these models are saying. Ignoring the results of climate projections is even more inadvisable. See Example 6.B.

5.3.C Assessing Ecological Impacts of Climate Projections

Using a fresh copy of their ecological drawing, your team is now encouraged to assess the vulnerability of the conservation targets given likely climate exposure. In other words, how are ecosystems and species likely to be affected by the most likely or most serious future climate impacts? The range of human response impacts will be covered in the next sub-step.

You are encouraged to consider alternative development scenarios ranging from rampant, unchecked growth to business-as-usual to climate-smart planning. If the latter scenario is a realistic possibility, consider how to contribute by implementing strategies that are focused on policy and affecting decision-makers. This choice involves considerable extra work, but if it may be warranted if there is an opportunity to demonstrate the dramatically different futures to policy and decision makers.

5.3.D Considering Future Projections, What are the Likely Human Exposures, Responses and Associated Ecological Impacts

Using another fresh copy of the ecological drawing, your project should evaluate human exposure, sensitivity and associated coping and adaptive actions, and the close and often complex linkages with natural systems. Human responses can be designed in a way to minimize adverse impacts on natural systems. However, human responses can also be "maladaptive", bringing benefits in the short term but in the longer term diminishing the ability of ecosystems to support biodiversity and people. Conceptually, this sub-step could be combined with the previous sub-step, and some teams may choose to do that. We have separated it deliberately to ensure it gets sufficient attention.

5.3.E Capture the Most Certain and Most Critical Potential Impacts as "Hypotheses of Change"

The purpose of this sub-step is to organize the most critical potential climate impacts. The most critical risks may be a combination of some certain but moderate impacts plus some uncertain but high severity future impacts. The idea is to formally capture the most critical ideas from the two previous steps (potentially messy drawings) as organized hypotheses in a table. Only include those impacts the team feels it must address now or must track carefully. When the table is complete, you may want to sort the table based on the likelihood of impact, severity of the ecological change, or both. If alternative climate or development scenarios are applicable, develop a separate hypothesis of change table for each. See Example 6.C.

5.3.F Capture All Projected Future Climate Impacts in Box & Arrow Conceptual Model(s)

Your project should already have a conceptual model showing the conservation targets, direct threats, and drivers (also called indirect threats, factors, etc.) and "climate change" may have been included as a direct threat. Now that climate threats have been analyzed with the ecological drawings and hypothesis of change table, they can be put into the conceptual model, including the indirect human responses which may raise new threats or simply exacerbate existing threats. Add the climate impacts, one by one, and any associated human responses from the hypothesis of change table into the conceptual model. You will want to be sure to identify:

- direct climate threats;
- indirect climate threats (interactions between climate and other existing threats);
- human responses that may affect the conservation targets;
- institutional and policy challenges (drivers).

You may need to create several copies of your new conceptual model, for alternative climate and development scenarios or for impacts with varying degrees of certainty. It may be useful to indicate the degree of certainty of occurrence for the given factors. See Example 6.E.

5.3.G Re-Rank Direct Threats

Direct threats should be re-prioritized to include the more detailed impacts of climate change. Referring to the revised conceptual model, re-rank the direct threats by scope, severity, and irreversibility using Miradi. Recall that, for conventional planning, the time horizon for the threat ranking is 10 years. Ten years is still a reasonable time frame for planning, but some severe climate change hazards may not be felt for several decades. Therefore, we suggest the threat ranking be reviewed both using the 10-year scale and some longer (e.g., 30 to 50 year?) time horizon, depending on available projections and the appetite of the planning team. Note that this applies to each alternative climate and development scenario. Your team now has thought considerably about climate impacts, and further vulnerability assessments may not be necessary. See Example 6.F.

5.4 Review Targets and Goals

(PPMS 1.2 Scope and Vision, 1.3 Targets)

You should now review the conservation targets and goals. Some possible climate hazards may jeopardize the project's goals. For example, will the conservation targets still be viable in the project area? Will other conservation targets move in? Are the long-term goals for each conservation target achievable? Are the goals appropriate in the light of potential climate change? This step does not require wholesale restructuring of a project, but it provides impetus for the project team to think about whether its goals and objectives are achievable or even desirable.

5.5 Identify potential climate adaptation strategies based on new conceptual model

(PPMS 2.1 Action Plan: Goals, Objectives and Operations)

This step develops a portfolio of strategies; some certain, some alternative in nature. The number of climate and development scenarios and short- vs. long-term timelines will help determine how many conceptual models you need. We suggest that you brainstorm strategies on the conceptual model in two stages:

- A short-term (1-3 year) time horizon – for strategies that you would realistically pursue (e.g. "no-regrets" strategies that build resilience to current or very likely climate extremes in species, ecosystems and people); and
- A second, longer term time horizon – for alternative strategies to be implemented if severe climate projections start to pan out.

Given all of the uncertainties associated with climate projections, which strategies does it make sense to pursue in the short-term? Our advice in the short-term is to pursue "no-regrets" strategies associated with:

1. Reducing vulnerabilities to current climate extremes;
2. The need to collect specific information for decision making and for signalling significant change;
3. Avoiding actions that may be maladaptive;
4. Facilitating the transition of relevant policies and institutions towards a "climate-smart" approach.

Within each conceptual model (with multiple development or climate scenarios you may have several conceptual models at this point), this step is essentially no different than the normal WWF Standards process, but some of the strategies themselves will be different.
Make sure that the strategies chosen are practical - does the team really have the resources and capacity to implement additional adaptation strategies?

5.6 Rank strategies by feasibility, cost, benefit, and no-regrets to different future climate

(PPMS 2.1 Action Plan: Goals, Objectives and Operations)

Ranking the brainstormed strategies by objective criteria helps to evaluate their predicted effects and practicality. A simple strategy ranking considers benefits, feasibility, and cost. Another criterion is "no-regrets." The process for no-regrets is straightforward: take each strategy one by one and evaluate whether it would be adaptive against all of the potential future climate parameters that you examined during the Vulnerability Assessment (Step 3). A no-regrets strategy should increase the resilience of natural systems (either directly or indirectly) no matter what future climate comes to pass. Strategies that are helpful in a drier climate but maladaptive in a wetter climate do not qualify. Strategies should be ranked separately for each climate and development scenario.

5.7 Develop detailed logic chains for climate adaptation strategies

(PPMS 2.1 Action Plan: Goals, Objectives and Operation, 2.2 Monitoring Plan, 2.3 Operational Plan)

Once strategies have been selected, this step is essentially the same as in the typical WWF Standards process. Teams may build separate results chains for strategies dealing with alternative climate or development scenarios or contingent, bifurcating results chain that accounts for different climate, development, or ecological outcomes together. Evaluating multiple alternative strategies in the same diagram makes it clear the team has acknowledged uncertainty about what scenarios may occur, but has considered a range of alternative strategies. When considering multiple strategies, do your best to identify critical climate, development, or ecological thresholds that would trigger an alternative strategy. These thresholds will need to be monitored, so be realistic. In any case, the documentation of risks and assumptions is all the more critical when considering the uncertainties of climate change.

6. Examples

The following provides examples of key steps of the processes described above:

6.A Examine Vulnerability to Current Climate Extremes

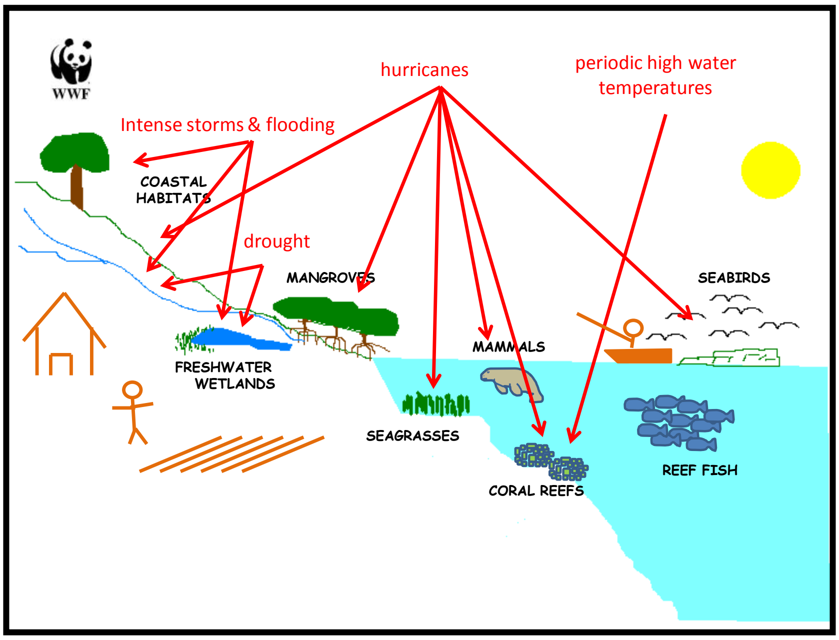

Figure 1. An example of an "ecological drawing" with current climate extremes

6.B Consider the Range of Future Climate Projections

Example Summary of Projected Climate Exposures				
Climate Exposure		**2030**	**2060**	**2090**
Temperature	**Mean**	+ 0.5 to 0.75^0 C	+ 0.75 to1.25^0 C	+ 1.5 to2.0^0 C
	Extreme	More extreme heat days	More extreme heat days	More extreme heat days
Precipitation	**Mean**	Either slightly less or slightly more rain	Slightly less rain	Moderately less rain
	Drought	Unclear	Longer droughts	Longer droughts
	Flooding	More and larger flood events	More and larger flood events	More and larger flood events
Wind/Storm Events	**Frequency**	More frequent	More frequent	More frequent
	Intensity	Unclear	Probably more intense	More intense

Table 1. An example Summary of Future Climate Projections

6.C Capture Most Certain and Most Critical Potential Impacts as "Hypotheses of Change"

Example Hypotheses of Ecological Change Due to Climate Change									
Climate Exposure	**Likelihood of Climate Exposure**	**Potential Human Stress**	**Potential Human Response**	**Likelihood of Human Response (assuming Climate Exposure Occurs)**	**Conservation Target**	**Key Ecological Attribute**	**Hypothesis of Ecological Change**	**Likelihood of Ecological Change (assuming that Climate Impact Occurs)**	**Notes**
Longer and more severe droughts	Highly likely				Freshwater stream systems	Flow regime – volume of flow at height of dry season	The longer and more severe droughts are predicted to entirely dewater several key streams every 2-3 years	Likely	Direct impact of longer and more severe droughts
Longer and more severe droughts	Highly likely	Loss of freshwater for drinking and irrigation	Building small check dams to hold water during dry season	Virtually certain	Freshwater stream systems	In-stream connectivity	In-stream connectivity would be severed for catadromous fishes by a series of check dams	Certain	Indirect impacts of longer and more severe droughts

Table 2. An example "Hypotheses of Change" table

6.E Capture All Projected Future Climate Impacts in Box & Arrow Conceptual Model(s)

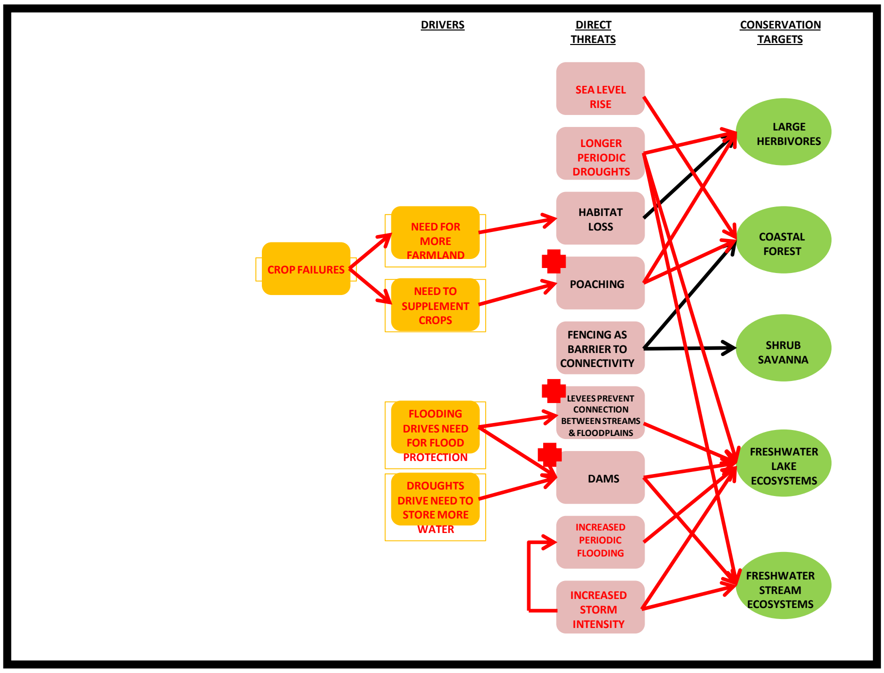

Figure 2. An example climate-modified conceptual model
(most drivers removed for clarity, changes in red)

6.F Re-Rank Direct Threats

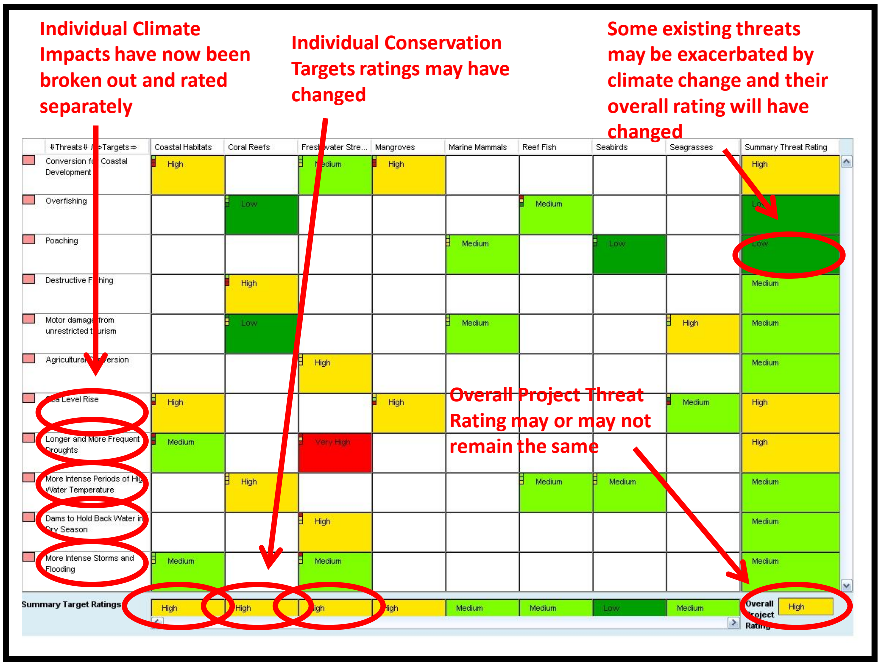

Figure 3. An example threat ranking table which has been modified

7. Outputs

The outputs from this process can vary greatly and may include:

- Revisions to the Scope;
- Review of Stakeholders;
- Revisions to the conservation targets;
- Revised conceptual model;
- Revised threat ranking table;
- Results chains for new strategies;
- Revisions to the Monitoring Plan.

Acknowledgements and References

The Nature Conservancy has been extremely generous by including WWF staff in the development of TNC's own climate guidance (The Nature Conservancy 2009). In particular, WWF staff were included in a 20-team, 150 person climate clinic sponsored by the The Nature Conservancy in Salt Lake City, UT in September 2009. Karen Poiani and Jon Hoekstra were extremely welcoming and supportive. In addition, the largely Nature Conservancy-sponsored Conservation Coaches Rally held in November 2010 in Santa Cruz, CA provided an opportunity to present WWF's proposed climate adaptation guidelines to a wider audience and get feedback. The assistance of Anne Wallach Thomas during that session of the Rally is very much appreciated. Thanks finally to the participating members of the WWF-US Climate Change Adaptation Team: Jonathan Cook, John Matthews, Judy Oglethorpe, Jeff Price, Bart Wickel. Other colleagues who provided valuable input include Judith Balint, Lonneke Bakker, Will Beale, Jorge Bartolome, Cassandra Brooke, Alison Clausen, Annick Cros, Wendy Elliot, Evan Girvetz, Marina Gomei, Helen Jeans, Gunilla Kuperus, Karen Lawrence, Beth Marshall, Shaun Martin, Richard Moss, Elizabeth O'Neill, Antonia Oviedo, Alessandra Pomé, Phyllis Rachler, Anne Schrag, Hui Shim Tan, and Jon Tua.

IPCC. 2007a. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change - The Physical Science Basis in S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor, and H. L. Miller, editors.

IPCC. 2007b. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change - Impacts, Adaptation and Vulnerability in M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. van der Linden, and C. E. Hanson, editors. Cambridge University Press, Cambridge, UK.

Kareiva, P., C. Enquist, A. Johnson, S. H. Julius, J. Lawler, B. Petersen, L. Pitelka, R. Shaw, and J. M. West. 2008. Synthesis and Conclusions. Pages 9-1 to 9-66 in S. H. Julius, and J. M. West, editors. Preliminary review of adaptation options for climate sensitive ecosystems and resources. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. U.S. Environmental Protection Agency, Washington, DC.

Milly, P. C. D., J. Betancourt, M. Falkenmark, R. M. Hirsch, W. K. Zbigniew, D. P. Lettenmaier, and R. J. Stouffer. 2008. Stationarity Is Dead: Whither Water Management? Science **319**:573-574

Parmesan, C. 2006. Ecological and evolutionary responses to recent climate change. Annual Review of Ecology, Evolution and Systematics **37**:637-669.

Root, T. L., J. T. Price, K. R. Hall, S. H. Schneider, C. Rosenzweig, and J. A. Pounds. 2002. Fingerprints of global warming on wild animals and plants. Nature **421**:57-60.

The Nature Conservancy. 2009. Conservation Action Planning Guidelines for Developing Strategies in the Face of Climate Change. Page 26. Conservation Science, The Nature Conservancy, Arlington, VA.

USCCP. 2008. Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources. A report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research in S. H. Julius, and J. M. West, editors. U.S. Environmental Protection Agency, Washington, D.C.