BRIEFING

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Climate change adaptation briefing 2

CLIMATE-SMART CONSERVATION

How climate change interacts with other stressors

Introduction

Climate change brings new threats and compounds existing threats to our priority places and species and the people that rely upon the ecosystem services they provide.

This briefing describes the complex interaction of multiple climate and non-climate stressors.

It draws on our work in Belize and the recent US publication *Impacts of Climate Change on Biodiversity, Ecosystems, and Ecosystem Services: Technical Input to the 2013 National Climate Assessment*[1].

Pathways of Interaction:[1]

Direct and indirect impacts of climate change

For example, a coral reef can be *directly* affected by an increase in surface water temperature and *indirectly* affected by changes in rainfall patterns that result in increased run-off and higher sedimentation of reefs. Both stresses can occur together.

Maladaptation

People are responding to the increasing challenges of climate change, and their adaptation strategies may negatively affect biodiversity, ecosystems, or ecosystem services. For example, sea walls designed as protection from storm surges may destroy and fragment mangroves that provide natural protection for people, infrastructure and coasts.

Climate change may alter the interaction of different stressors with one another

For example, changes in rainfall patterns may result in increased run-off, resulting in higher sedimentation on reefs. This makes reefs more susceptible to stressors such as disease or warmer water temperatures.

Linear and synergistic interactions[1]

The effect of multiple stressors on ecosystems is most likely to be *synergistic* i.e. multiple stressors have a greater impact in combination. Alternatively the effect may be *additive or linear* i.e. the effect of multiple stressors is equal to the sum of each stressor acting alone.

Synergistic threats: an example from Belize[2]

In the coastal zone of Belize, changing precipitation patterns, warmer sea temperatures, and sea-level rise interact with non-climatic drivers to exacerbate impacts such as coastal erosion, flooding, saltwater intrusion, coral bleaching, and mangrove loss and die-back:

- **Warmer sea temperatures = increase the risk of stronger hurricanes** at lower latitudes, with more rapid transition to hurricane categories 4 and 5.
- **More frequent severe storms = increase the risk of major flash flooding and run-off**, leading to sedimentation of the marine environment, resulting in localized die-off of reefs and seagrasses.
- **More frequent severe storms = increase the vulnerability of people** to injury and disease, as storm surges bring rubbish ashore affecting impoverished communities.
- **Warmer sea surface temperatures = increase the risk of mass coral bleaching** which can leave corals more susceptible to disease and physical damage from hurricanes.
- **Loss of corals and other climate change impacts adversely affects livelihoods.** The loss of corals has direct impacts on marine biodiversity affecting fisheries production and tourism. Nature-based tourism is the largest source of income for Belize
- **Sea level rise and unsustainable coastal development = increase the risk of coastal erosion**. Areas of the coast already degraded by unsustainable development, such as

Community members and volunteers replant seedlings in front of a seawall to restore a mangrove in Belize.

Sarah Hutchison WWF-UK

A storm surge brought rubbish ashore in a district of Belize City making people already living in poverty more vulnerable to disease and injury.

increased dredging and sand mining, are more vulnerable to sea-level rise.

- **Sea-level rise adversely affects mangroves, reducing shoreline protection.** Sea level rise may harm mangrove ecosystems, particularly those located in low islands or restricted from migrating landward by infrastructure. Loss of mangroves will also reduce flood control benefits and affect fisheries production, resulting in a loss of biodiversity and local income.

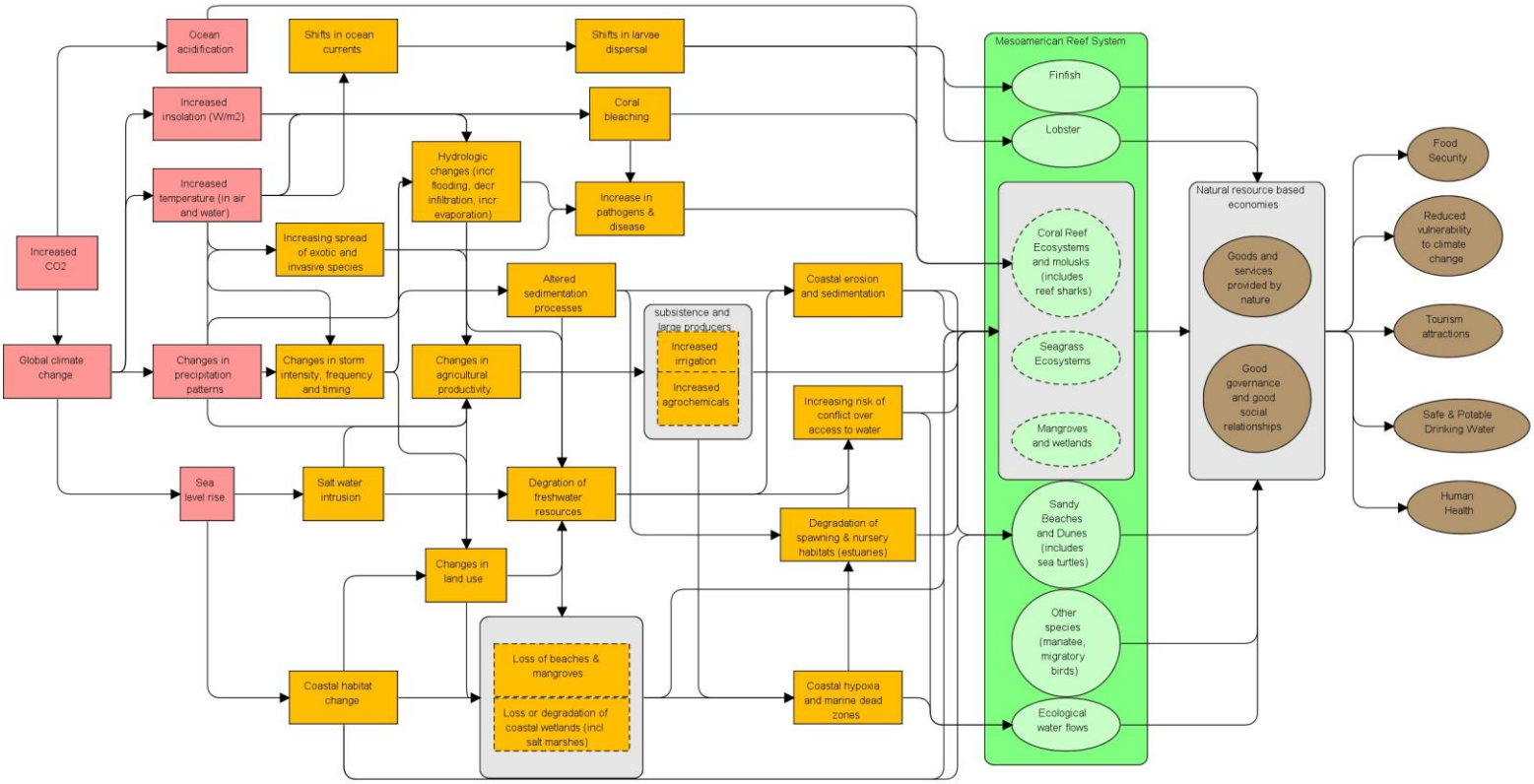
Adapting our conceptual models, threat rankings and ways of working

The relationship between climate and non-climate threats has implications for our conceptual models and threat ranking.

Shortly after WWF Belize began integrating climate change into its programme, it recognised the need to update its conceptual model. The programme developed the conceptual model shown below which shows the likely impacts of direct climate threats e.g. an increase in sea surface temperature is likely to increase coral bleaching.

The most concerning threat to a coral reef may be considered to be an existing stressor such as agrochemical pollution. However, climate change impacts may exacerbate such pollution e.g. farmers may adapt to new pests by increasing the use of insecticides and heavy rainfall may increase run-off of those insecticides, further degrading coastal and marine ecosystems.

In WWF Belize, comprehensive monitoring of mangroves and coral reefs has become integral to the programme. We achieve this by working with new partners including local businesses



such as dive shops, the national university and tourism developers. We continue to work with agricultural industries to promote better management practices. Partnership working has enhanced community and institutional adaptive capacity and stimulated awareness of and care for the coastal zone of Belize, which is part of the largest reef in the Western hemisphere and one of WWF's priority regions, the Mesoamerican reef.

References

1. This briefing draws on Chapter 5 Multiple Stressors. *Impacts of Climate Change on Biodiversity, Ecosystems, and Ecosystem Services: Technical Input to the 2013 National Climate Assessment. Cooperative Report to the 2013 National Climate Assessment. 296 p. 2012*. Michelle D. Staudinger, Nancy B. Grimm, Amanda Staudt, Shawn L. Carter, F. Stuart Chapin III, Peter Kareiva, Mary Ruckelshaus, Bruce A. Stein. Available at: http://downloads.usgcrp.gov/NCA/Activities/Biodiversity-Ecosystems-and-Ecosystem-Services-Technical-Input.pdf
2. For details and references *see 'Coastal Zone Management Authority and Institute (2001). State of the Coast Report 2000 (Belize).* Available at: http://www.coastalzonebelize.org/wp-content/uploads/2010/04/state_ofthe_coast_report_2000.pdf

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FOR MORE INFORMATION

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