Climate Adaptation Toolkit for Marine and Coastal Protected Areas

Restore Vegetative and Hydrological Connectivity

An Adaptation Brief

Overview

Many salt marshes, mangroves, and other coastal wetlands have been degraded by losses of vegetative and hydrological connectivity associated with human development. This strategy focuses on restoring fundamental ecological functions and processes that maintain appropriate flooding regimes and water quality for wetland plant communities and associated fish and wildlife, as well as the dynamic conditions that allow these systems to respond to and recover from stressors and extreme events.

Identifying Climate and Non-Climate Vulnerabilities

Potential future changes and associated impacts of climate change on coastal and marine habitats and species include:

Warmer temperatures

- → **Diminish dissolved oxygen**
- → **Increase harmful algal blooms, particularly during dry periods**

Longer dry periods

- → **Reduce freshwater inputs**
- → **Shift the composition of vegetation toward upland species** (including invasive species)

More frequent and/or severe storms

- → **Change sediment flow**
- → **Increase turbidity and changes in salinity due to sudden influxes of freshwater into the system**

Sea-level rise and storm surges

- → **Increase inundation and coastal erosion**
- → **Reduce the extent of habitat where development and other land uses restrict inland migration**

Climate changes such as those listed above are likely to impact degraded systems to a greater degree, exacerbating the existing effects of habitat loss, changes in plant community composition and distribution, and decreased water quality that are already associated with loss of vegetative and hydrological connectivity.

Matt Poole/USFWS via Flickr.

Reducing Vulnerabilities through Adaptation Actions

The following are examples of adaptation actions that may be used to restore vegetative and hydrological connectivity, with the goal of reducing climate change vulnerability:

ACTION: Remove, replace, or retrofit hydrological barriers (e.g., dikes, culverts) **to restore tidal exchange**

- ✔ Restores sediment supply, helping habitats keep pace with sea-level rise and/or migrate inland
- ✔ Supports movement of fish and wildlife, facilitating response to climate change and extreme events
- ✔ Restores natural hydrological and salinity regimes important for plant health and natural recolonization

ACTION: Restore coastal wetland vegetation to increase habitat extent and connectivity

- ✔ Increases storm protection through wave attenuation, reducing coastal erosion
- ✔ Enhances carbon sequestration and storage (“blue carbon”)

ACTION: Plant salt- and flood-tolerant vegetation in adjacent upland areas

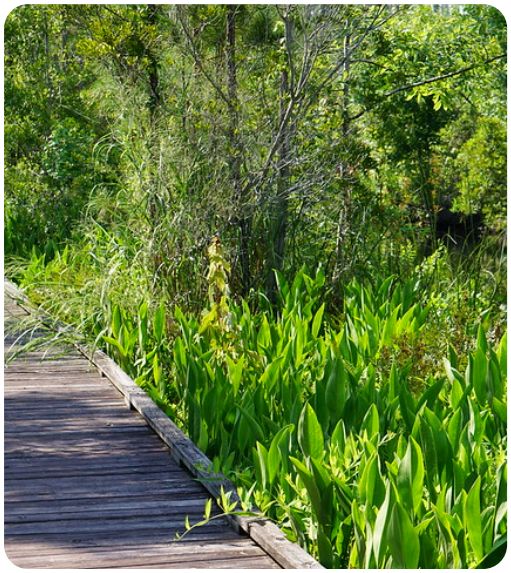
- ✔ Supports landward habitat migration
- ✔ Increases storm/flood protection
- ✔ Provides refuge for wildlife during storms and high tide events

Case Studies

The following case studies demonstrate how this adaptation strategy is being used to reduce climate change vulnerability in various regions of North America and in habitats ranging from mangroves to salt marshes.

RESTORING VEGETATION AND HYDROLOGY IN THE ALLIGATOR RIVER NATIONAL WILDLIFE REFUGE

Albemarle-Pamlico Estuary in Dare and Hyde Counties, North Carolina, United States



NC Wetlands via Flickr.

The North Carolina chapter of The Nature Conservancy and the US Fish and Wildlife Service are partnering to evaluate the effectiveness of adaptation strategies on North Carolina coastal habitats (e.g., swamps, marshes, pocosin) likely to be impacted by sea-level rise, shoreline erosion, and saltwater intrusion.

The adaptation strategies being tested include:

- Using oyster reefs to dissipate wave energy, slow currents, and reduce shoreline erosion
- Using water control structures equipped with flashboard risers and tide gates to restore the hydrologic regime and prevent saltwater intrusion
- Planting salt- and flood-tolerant vegetation to stabilize shorelines, combat expected habitat loss, and allow inland movement of species from low-lying areas

For more information: ***Alligator River National Wildlife Refuge/Albemarle-Pamlico Peninsula Climate Adaptation Project case study***

RESTORING TIDAL FLOW AND ENHANCING SHORELINE RESILIENCE IN THE NISQUALLY RIVER DELTA

Nisqually National Wildlife Refuge in the South Puget Sound region, Washington, United States

The US Fish and Wildlife Service, the Nisqually Indian Tribe, and Ducks Unlimited have partnered in a series of ongoing restoration efforts in the Nisqually River Delta, which include the removal of over four miles of dikes that have restricted tidal flow and caused critical habitat loss for fish, birds, and marine mammals. The dike removal in 2009 restored tidal flow to 762 acres of tidal marsh within the Nisqually National Wildlife Refuge, increasing salt marsh habitat in the South Puget Sound region by 50%.

Dike removal to restore hydrology in these tidal wetlands has allowed reestablishment of old channels and sloughs, and enhanced habitat for birds, juvenile salmonids, and other native species. Scientists are monitoring sediment delivery, geomorphic change, and species response to the restored wetlands, which are expected to be more resilient to increased storms, sea-level rise, and flooding associated with climate change.

For more information: ***Nisqually Delta Restoration Project case study***

Joaquimoly via Wikimedia Commons (CC BY-SA 3.0).

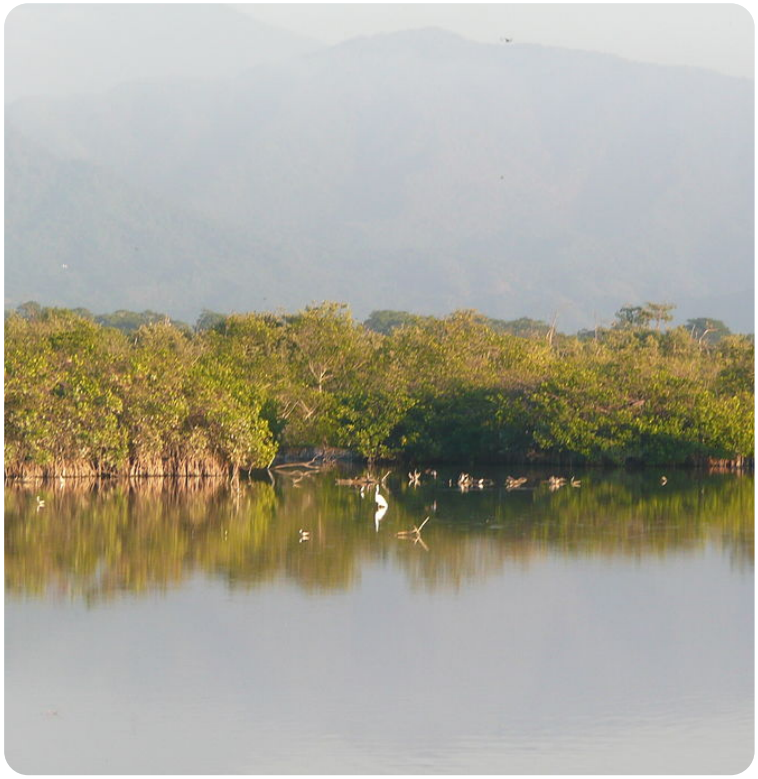
RESTORATION OF MANGROVES AND HYDROLOGICAL FLOWS IN MEXICO

Marismas Nacionales Biosphere Reserve, Nayarit, Mexico

Mexico's National Commission of Natural Protected Areas (Conanp) partnered with local communities to restore mangrove ecosystems that are vulnerable to hurricanes as well as changes in precipitation patterns that influence local salinity. Community restoration efforts have included the **reestablishment of natural hydrology via strategic channel management**, allowing an appropriate mix of fresh and salt water that reduces local salinity and increases nutrient exchange.

In addition to payments for mangrove rehabilitation, Conanp also provided communities with more opportunities for sustainable use of mangrove ecosystems, increasing community appreciation of the ecosystems and the role they play in buffering the impacts of climate change on fisheries.

For more information: ***Restoration of Mangroves and Hydrological Flows case study***



Oescalona via Wikimedia Commons (CC BY-SA 3.0).

Key Resources

- **EPA Climate-Ready Estuaries**: The site provides a variety of resources and case studies related to estuary, wetland, and coastal management in the face of climate change.
- **Adaptation Strategies and Actions - Restore tidally-driven rivers, estuarine, and marine habitats**: A summary of stressors, types of restoration, and key tools/resources for use in assessment and planning purposes (Massachusetts-focused but it also includes information and resources applicable to other areas).
- **Estrategia para la restauración del ecosistema regional del Golfo de México**: Strategies for ecosystem restoration for fisheries, habitat, and economic resilience.
- **Manual on Community-based Mangrove Rehabilitation**: Expertise and support for community-based mangrove rehabilitation; focused on the Philippines but applicable to other locations.
- **Managing Mangroves for Resilience to Climate Change**: Outlines management choices for mangroves, given climate change challenges.
- **Threats to Mangroves from Climate Change and Adaptation Options**: A review of the state of knowledge of vulnerability and responses to climate change and adaptation options.

Cvmontuy via Wikimedia.

U.S. EPA, Jeanethe Falvey via Flickr.

This brief is based on adaptation strategies and case studies from the **Climate Adaptation Toolkit for Marine and Coastal Protected Areas (MPA Toolkit)**, an online resource created to make climate adaptation planning a simple, direct, and feasible process for marine protected area managers. The MPA Toolkit contains:

- A step-by-step guide to undertaking a Rapid Vulnerability Assessment for marine and coastal areas
- Structured and searchable adaptation strategy ideas with supporting case studies, reports and tools
- Foundational adaptation resources
- Selected experts who can be contacted for technical guidance

Find the Toolkit at https://www.cakex.org/MPAToolkit

EcoAdapt™
Meeting the challenges of climate change