Climate Vulnerability Assessments

Conduct climate change vulnerability assessments that include fish, wildlife, vegetation, invasive species and coastal communities to inform selection of appropriate response plan(s)

Climate change adaptation is generally conceived of as actions taken to reduce vulnerability to climatic changes or effects or to take advantage of opportunities presented by a changing climate. Reducing vulnerabilities means understanding them. The Intergovernmental Panel on Climate Change (IPCC) presented a generic approach to vulnerability assessment, and defines vulnerability as a combination of the target's exposure and sensitivity to climatic changes and its capacity to conduct vulnerability assessments. However, how vulnerability assessments are carried out in practice varies widely, and can include differences in spatial scale, temporal scale, complexity, components of vulnerability addressed, and the role of quantitative vs. qualitative input. The focus of different vulnerability assessments also varies widely, and can address anything of concern to practitioners, including biological or ecological targets (e.g., species, habitats, hydrology), infrastructure, wetland policies or practices, or socioeconomic targets. No approach is universally superior in all cases. There are also increasing examples of climatic changes and impacts being combined with other sources of vulnerability or risk into a single integrated assessment. Such integrated approaches may be most appropriate for wetlands given the number of non-climate-related threats to wetland structure and function, as well as possible interactions between climate-related changes and these other threats.

Practitioners can select or adapt assessment methodologies based on the goals and intended use of the assessment as well as available expertise, funding, information and time. The importance of clearly articulated goals and intended uses cannot be overstated, and should inform all elements of vulnerability assessment design and implementation. This is particularly true when assessments are intended to feed into established wetland conservation and restoration procedures and practices with standard sets of calculations and parameters used in design and decisionmaking. Strong involvement by individuals with deep familiarity with local wetland systems and local conservation and restoration practices is essential for such assessments.

Like all aspects of a vulnerability assessment, assessment outputs should be tailored to the objectives and intended use of the assessment. Common output types include vulnerability scores, maps of vulnerability or various components of vulnerability, a detailed narrative description, conceptual models, or some combination thereof. Vulnerability scores are useful for quick comparisons and ranking, but may not capture critical differences in sources of vulnerability. Vulnerability maps facilitate an understanding of spatial patterns in vulnerability, and can highlight vulnerability differences for a particular species or habitat type across its range, but like vulnerability scores, it may obscure important information on contributing factors. Detailed narrative descriptions can capture the most information but can be time-consuming to use. They can be particularly useful if the practitioners who will be using them are engaged in creating them. In these cases, the text serves as a reminder of what they learned as part of the process. Conceptual models can help to capture scientists and practitioners' understanding of how the system works and to identify key intervention points where vulnerability is greatest or adaptation action could be most useful.

Case Example | Vulnerability Assessment to Inform Climate-Smart Restoration in the Great Lakes

NWF, NOAA and EcoAdapt partnered to create a guidebook for doing climate-smart restoration in the Great Lakes (see Tools and Resources below). The steps of the climate-smart restoration process are as follows:

1) Identify restoration goals, targets and approaches
2) Sketch climate-smart process
3) Assess climate change vulnerability
4) Review and revise goals, targets and approaches
5) Identify and select climate-smart restoration options
6) Develop monitoring approach
7) Implement restoration options
8) Review, revise, reassess, recreate

This approach highlights that vulnerability assessment is not an end in itself, but a step in developing and implementing climate-smart restoration projects.

The guidebook appendices include a worksheet that supports a screening level vulnerability assessment by providing a table with various climate change parameters and asking project planners to describe the importance and relevance (if any) of each to the project. It also includes illustrative vulnerability assessments for common types of restoration projects within the Great Lakes, including:

- Fish passage restoration
- Drowned river-mouth wetland habitat restoration
- Coaster brook trout habitat restoration
- Whitefish habitat restoration
- Invasive species management
- Water quality restoration
- Oil spill damage assessment, remediation, restoration
- Amphibian habitat restoration
- Wild rice habitat restoration

The initial guidebook was released in 2011, and a revised version was released in 2014.

One unique element of this guidance is that the preliminary version was pilot tested with seven Great Lakes Restoration Initiative projects, allowing for refining the guidance (including recommendations) based on the case studies. Vulnerability assessments in these test cases relied on readily available information such as historical and projected temperature, lake level and rainfall information or past and projected future ranges for tree species. There were several vulnerabilities common to all projects, such as the possible shift in the suitability of tree and shrub species used in restoration projects. Other vulnerabilities were more project-specific. For example, one restoration project plan included the proposed reconnection of a diked 43-acre wetland to Bear Creek, a major tributary of Bear Lake, adjacent to Muskegon Lake in west Michigan. The wetland had been used for celery farming, leaving wetland sediments high in nutrients, particularly phosphorus. Reconnecting the wetland could thus lead to the remobilization of these sediments; climate change could increase this risk through projected increases in heavy rainfall and storm events. The increased nutrient input to Bear Lake, particularly in combination with projected increases in water temperature due to climate change, would lead to more severe harmful algal blooms. Responses to this information on vulnerability could include more limited reconnection of the wetlands to Bear Creek, treatment to reduce phosphorus release and transport, or full wetland restoration with water control structures.

An example of a more targeted and intensive vulnerability assessment comes from Environment Canada. The goal of this project was not to inform specific restoration decisions, but to deepen our understanding of sources and level of vulnerability in Great Lakes coastal wetland communities as a means of generating adaptation options. Researchers developed climate vulnerability indices for wetland vegetation communities and associated fish and bird species, and examined vulnerability under four different climate scenarios.

Saginaw Bay, Michigan, United States

Challenges and Benefits

Vulnerability assessments can help to increase the effectiveness and efficiency of wetland projects by avoiding or reducing vulnerabilities or by taking advantage of opportunities related to changes in the climate. They can also help focus wetland adaptation actions around key vulnerabilities or leverage points, and even build support for wetland conservation as a means of decreasing societal vulnerability to climate change-related drought and flooding.

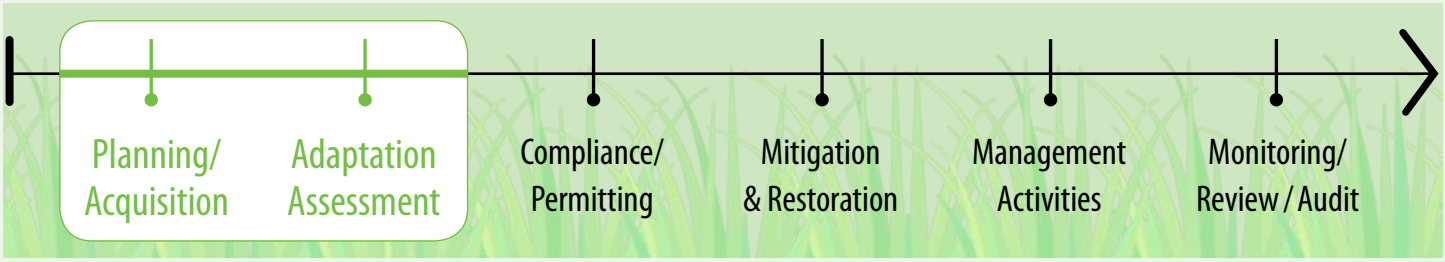
On the other hand, vulnerability assessments can put the focus on vulnerabilities and impacts rather than on taking action to increase wetland resilience and conservation, leading to "analysis paralysis" or a demotivating sense of doom. If people see climate change assessments as separate from or in addition to their existing work, they may see them as just one more item being added to an already long to-do list.

Vulnerability assessments with active, ongoing engagement and collaboration by scientists, managers and practitioners can be effective in building ongoing partnerships and collaboration, but they can also be complicated, expensive and time-consuming to carry out, and project timelines and budgets may not allow for detailed assessment. Without such engagement, however, it can be difficult to set assessment parameters that are meaningful and usable.

Who should implement the practice?

Anyone investing time or resources into coastal wetland restoration, conservation, or management should do some level of vulnerability assessment. At a minimum this should include a quick check to determine whether the likely vulnerability of target species, habitats, communities or proposed actions is high enough to warrant a more detailed vulnerability assessment.

When should this practice happen?



Tools and Resources

Scanning the Conservation Horizon: A Guide to Climate Change Vulnerability Assessment (2011) | Guidance document produced to provide resource managers some background information and approaches to conduct vulnerability assessments. | www.habitat.noaa.gov/pdf/scanning_the_conservation_horizon.pdf

National Wildlife Federation and EcoAdapt – Restoring the Great Lakes' Coastal Future: Technical Guidance for the Design and Implementation of Climate-Smart Restoration Projects (2014) | Guidance document that provides an overview of adaptation principles, guidance for climate-smart restoration projects in the Great Lakes, and reviews experience from seven case studies. | www.nwf.org/~/media/PDFs/Global-Warming/Climate-Smart-Conservation/2014/Restoring-the-Great-Lakes-Coastal-Future-032114.pdf

Great Lakes Coastal Wetland Communities: Vulnerabilities to Climate Change and Response to Adaptation Strategies (2006) | www.env.uwaterloo.ca/research/aird/aird_pub/Great_Lakes_Coastal_Wetlands_Report_2006.pdf

ClimateWizard | Enables technical and non-technical audiences alike to access leading climate change information and visualize the impacts anywhere on Earth. | www.climatewizard.org/

The National Conservation Training Center | Offers in-person vulnerability assessment training and an online, self-paced version of the same training. | nctc.fws.gov/courses/programs/climate-change/training-resources.html

NatureServe's Climate Change Vulnerability Index | Helps identify plant and animals that are particularly vulnerable to the effects of climate change. | www.natureserve.org/conservation-tools/standards-methods/climate-change-vulnerability-index

Climate Change Vulnerability Index for Ecosystems and Habitats | Focuses on species and uses a scoring system that integrates a species' predicted exposure to climate change within an assessment area and three sets of factors associated with climate change sensitivity, each supported by published studies. | www.natureserve.org/conservation-tools/data-maps-tools/climate-change-vulnerability-index-ecosystems-and-habitats

Changing Climate, Changing Wildlife A Vulnerability Assessment of 400 Species of Greatest Conservation Need and Game Species in Michigan (2013) | Presents the results of a NatureServe CCVI analysis on 400 species of fish and wildlife in Michigan. | www.michigan.gov/documents/dnr/3564_Climate_Vulnerability_Division_Report_4.24.13_418644_7.pdf

Great Lakes Commission des Grands Lacs

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