Climate Considerations in Wetland and Shoreline Restoration

Consider water quantity management needs when designing coastal wetland and shoreline restorations

There are many factors that can contribute to the challenges of coastal wetland management in light of climate change, and water level fluctuations may be one of the most difficult to predict. Due to the alteration of coastal habitats for agricultural or other development, restoration of these habitats can involve the development of water level management infrastructure, such as dikes, water control structures and pumps to restore and then facilitate management to emulate natural wetland conditions.

Regulatory agencies, grant funding agencies and landowners often have concerns over the use of such infrastructure because they can impede fish passage, inhibit development of certain wetland zones, or be used to manage the wetland in a way not perceived as "natural." While these are valid concerns, climate change-related shifts in precipitation and evapotranspiration are already affecting fish habitat connectivity and overall wetland structure and function. Combined with the heavily altered state of many wetlands and coastal areas in the Great Lakes region, this makes a return to previous "natural" conditions difficult. Instead, restoration practitioners in these situations should consider future climate, species distribution and water supply scenarios in developing approaches to restoring wetlands and shoreline habitats. In some cases, water control structures, pumps and fish passage structures, among others that allow managers to emulate natural conditions may be the best approach for ensuring long-term connectivity and ecosystem function, including invasive species control and fish passage. Practitioners can also advocate for naturalized shorelines to increase the ability of wetlands to shift with lake levels and to maintain wetland function. Naturalized shorelines can have additional benefits of reducing polluted runoff from land or reducing flood intensity by absorbing and slowly releasing floodwaters.

This practice can be approached in one of two ways. One is for restoration plans (including goals, objectives and approaches) to be developed based on an understanding of site conditions, landscape position and features, and what water levels are achievable given the reality of climatic variability and change, as well as competing water uses. This is a "climate-smart from the start" approach (involving an assessment of climate vulnerability on all aspects of the project) and, ideally, will become the standard practice. A second option, to be used if goals, objectives and approaches have already been established, is to have planners determine water levels needed to achieve them and then assess the vulnerability of the goals, objectives, approaches and any relevant species, habitats and ecosystem processes to climatic and other changes. Such vulnerability assessments may trigger changes in the approaches used, or even a re-examination of goals and objectives (see Best Practice #14).

In developing action alternatives, planners should consider natural, engineered (i.e., management infrastructure-intensive), social (e.g., water conservation measures allowing for greater water use in environmental projects) and integrated approaches to meeting water supply needs. Alternatives should be evaluated for their ability to maintain expected performance as climate change progresses while minimizing the potential negative ecological effects, as well as for ongoing costs such as repair or upgrading. Planners opting for a less management-intensive approach (i.e., shoreline softening) may also design projects to leave the option open of using a more managed approach in the future, or vice versa. This may mean building water control or fish structures that will remain unused unless certain conditions come to pass, or it may mean using a restoration design that would allow for the relatively easy removal or decommissioning of infrastructure in the future, should it become necessary.

Case Example | Erie Marsh Wetland Restoration

Erie Marsh, just north of the Michigan-Ohio border along Lake Erie, is one of the largest coastal wetlands on Lake Erie. The Erie Marsh Preserve, owned and managed by The Nature Conservancy, covers more than 2,200 acres and contains 11 percent of southeast Michigan's remaining coastal marshes. Wetland hydrology was altered by construction of dikes in the 1940s and 1950s, and ongoing degradation of hydrology and habitat has harmed fish and aquatic birds. A four-phase restoration initiative was begun in 2013 to restore hydrologic connectivity to Lake Erie. With Phase I now complete, fish passage is now occurring for the first time in 60 years.

The other three phases will address other functions and needs in the wetlands complex. Challenges in the case of Erie Marsh include the presence of a state highway, which prevents wetland movement that would otherwise occur with changing lake water levels, and an infestation of invasive *Phragmites*, for which control often entails some type of hydrologic change (e.g., flooding following herbicide treatment and prescribed burn). In light of these conditions, capabilities for some type of finer water level management in much of the complex were recognized, and the addition of dikes in some locations was pursued. These additional water-level management capabilities can assist in both addressing immediate stresses (e.g. *Phragmites*) as well as near- and medium-term threats associated with climate impacts (e.g. lake level changes) in an already-altered ecosystem.

In addition, a number of soft shoreline engineering (or naturalization) projects have been undertaken along the Huron-Erie corridor over the past two decades. Though many projects were undertaken before the recent era of considering climate adaptation, an assessment of ecological effectiveness has been carried out, and subsequent assessments could potentially identify project modifications necessary in light of vulnerabilities associated with climate change.

Challenges and Benefits

Explicitly addressing how water availability and emulating "natural" wetland conditions may change in the future can support more creative thinking around wetland restoration, as well as identify and avoid potential negative ecological effects. It shifts the focus to achieving the ecological goal rather than focusing on specific actions that are available, and allows the consideration of potential outside constraints on objectives (e.g., water supply constraints). Discussing the full range of options—natural, engineered and social—can alienate constituencies that support "all natural" approaches to restoration, or that support extensive engineering. Discussing climate change can also disaffect some stakeholders, although there are a variety of approaches to minimizing this issue (see Best Practice #10).

The up-front cost of wetland management infrastructure can be significant, but managers must also consider the costs of long-term management and maintenance of that infrastructure, and weigh those expenses with the ecological benefits. However, while a less engineering–intensive approach may come with a lower initial price tag, and may appear more "natural," the lifespan and adaptability of such approaches must also be evaluated. Although infrastructure that facilitates adaptation may be more expensive to develop, it could be considered more preemptive methods of including climate change adaptation into a wetland restoration, as it recognizes and prepares for water level uncertainty.

Most types of water level management infrastructure (e.g., dikes, weirs, control structures) require permits for installation, and given longstanding concerns over wetland loss and degradation in the country (as well as statutory and regulatory requirements),

Water control structure - Crow Island State Game Area, Saginaw, Michigan, United States

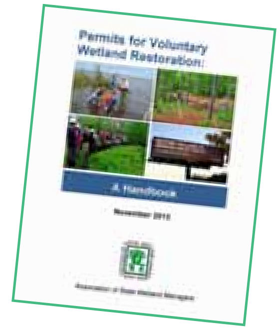
such proposals will be scrutinized carefully. For example, the construction of dikes for water level management may require filling portions of a coastal wetland, which would require a permit. Regulatory agencies may require modifications to the plan or compensatory mitigation for the impacts of the fill. In these cases, planners must justify the need for these actions to regulatory agencies or alternative methods of wetland management may be necessary. Although this can be a challenge, these issues are highly site-specific and require close consultation with regulatory agencies.

Who should implement the practice?

This practice should be implemented by coastal and wetland managers including federal, state, and local agencies and private or non-governmental organizations that actively manage coastal wetland areas.

When should this practice happen?

Tools and Resources



Permits for Voluntary Wetland Restoration: A Handbook, Association of State Wetland Managers (2013) | Includes various aspects involved in permitting for voluntary wetland restoration projects, such as general approaches to permitting, facilitating the process and special considerations that can arise. | **aswm.org/pdf_lib/permits_for_voluntary_wetland_restoration_handbook.pdf**

The Nature Conservancy, Erie Marsh Preserve: Major Restoration Project Brings Back Fish and Birds to Healthier Habitats | Brief overview of site history and recent restoration efforts at Erie Marsh. | **www.nature.org/ourinitiatives/regions/northamerica/unitedstates/michigan/explore/erie-marsh-comeback.xml**

Great Lakes/Atlantic Regional Office Engineering | Brief summaries of recent engineering projects (including Great Lakes region), some of which have the capacity (e.g., water management structures) to address climate change threats to project wetlands or other habitats. | **www.ducks.org/conservation/glaro/engineering**

University of Windsor, Soft Shoreline Engineering | Website summarizing brief case studies on 38 soft shoreline engineering projects in or near the Huron-Erie corridor, including high-level lessons learned and links to ecological effectiveness manuscripts. | **web4.uwindsor.ca/units/stateofthestraight/softs.nsf/inToc/D27D2ED7AB6CBCE48525775F00726983?OpenDocument**

Great Lakes Commission des Grands Lacs

National Wildlife Federation