Chapter 10

Restoration of Tidal Flow to Salt Marshes:
The Massachusetts Experience

Hunt Durey, Timothy Smith, and Marc Carullo

Massachusetts has lost an estimated 41 percent of its precolonial salt marshes (Bromberg and Bertness 2005), and much of the remaining salt marsh is affected by a variety of stressors, including restricted tidal hydrology, anthropogenic eutrophication, and rising sea levels. Today, Massachusetts contains 21,200 hectares of salt marsh (MassGIS 2007; USFWS 2007).[1] Although statewide comprehensive numbers of confirmed tidal restrictions are not available, the state's Wetlands Restoration Program (WRP) has developed atlases for the majority of the state's coastal regions that identify over six hundred potential tidal restrictions. Anecdotal assessment of confirmed and suspected restrictions from these atlases and other sources suggests that over 4000 hectares of existing coastal wetlands are impacted by restricted or blocked tidal flow.

Massachusetts has a long history of stressors on coastal wetlands. For example, in nineteenth-century Boston, which, like most port cities of its time experienced great wealth and expansion, vast areas of salt marsh were destroyed to improve harbor access, expand upland development, and build transportation infrastructure. The most severe alterations occurred in the Boston Harbor region where hundreds of acres were filled to support commercial, residential, and industrial development. Marsh losses continued into the twentieth century at a rapid pace when the Boston Harbor region experienced a 62 percent loss of salt marsh—approximately 1346 hectares from 1893 to 1995—with the greatest losses occurring during the first half of the 1900s (Carlisle et al. 2005). In comparison, Cape Cod and the North Shore lost 23 percent (1860 hectares) and 14 percent (1218 hectares), respectively, during the 1900s (Carlisle et al. 2005). The total salt marsh loss in the Boston region is estimated at a very significant 81 percent (Bromberg and Bertness 2005).

Coastal development pressure remained high in the second half of the twentieth century following the passage of state and federal wetlands protection laws, and overall salt marsh area continued to decline during this period, albeit at a much slower rate. It is important to note, however, that Cape Cod salt marshes declined by nearly 800 hectares during this period, mostly resulting from conversions of salt marsh to upland and brackish/freshwater wetlands (Carlisle et al. 2005). Those conversions are likely the direct result of tidal restrictions, as new roads, cranberry bog dikes, and other infrastructure were built to accommodate Cape Cod's exponential population and land use expansion.

The Massachusetts Wetlands Restoration Program: Program Overview

In 1994, the Massachusetts Executive Office of Environmental Affairs established the Wetlands Restoration Program, one of the first state programs in the country dedicated to proactive wetland restoration. The founding mission of the program was to help people and communities voluntarily restore the state's degraded and former coastal wetlands and the important services they provide. In 2003, WRP was integrated into the state's Office of Coastal Zone Management and focused on the holistic restoration of degraded and former freshwater and tidal wetlands within the state's coastal watersheds. In July 2009, WRP merged with the state's Riverways Program to form a new Division of Ecological Restoration within the Department of Fish and Game. The Division's mission is to restore and protect the Commonwealth's rivers, wetlands, and watersheds for the benefit of people and the environment.

Presently, the state wetland restoration database contains records of over 110 potential, active, and completed salt marsh restoration projects. Projects range in size from less than 1 acre to more than a thousand acres; with costs ranging from less than $20,000 to more than $40,000,000. Ninety-one projects primarily involve restoration of tidal influence. The remaining projects involve other types of restoration actions such as removal or regrading of dredge spoil or other fill from former salt marshes, but these project types are less common, primarily due to higher construction costs relative to tidal restoration.

Salt marsh restoration projects that alleviate tidal restrictions are by far the most common practice in Massachusetts. The majority of these projects involve replacement of undersized or failing road and railroad culverts that historically were designed with little consideration of tidal hydraulics or fish and wildlife passage. Culvert replacement projects involve salt marshes ranging in size from less than 1 to more than a thousand acres. Costs vary widely and are influenced by factors such as the size and type of transportation crossing, traffic intensity, presence of underground or aboveground utilities, low-lying properties or infrastructure, flow volume and velocity, and geotechnical considerations. Nonetheless, culvert

replacements are generally considered very cost-effective restoration treatments that provide benefits to many acres of upstream aquatic habitats with relatively straightforward hydraulic modifications in a small construction footprint.

Several Massachusetts towns and other restoration proponents have recently implemented extremely cost-effective measures to improve salt marsh and estuarine habitat conditions by simply changing the management regime of existing tide gates and other water-control devices. In some cases, the gate was no longer necessary or the reason for installing it was long forgotten, and the gate was able to be removed or permanently fixed in a fully open position. Several other tide gates have been structurally modified or replaced to achieve greater tidal influence while maintaining flood protection. More recently, new tide gate designs in the form of self-regulating tide gates have been implemented in several locations to provide automated control of tidal exchange and water levels.

Partnerships are the backbone of successful tidal restoration efforts in Massachusetts. Without the strong and diverse network of federal, state, local, corporate, and nonprofit partners, restoration projects simply would not get done. At its core, the Division of Ecological Restoration is a network-based program that collaborates with many others to help achieve restoration results.

To enhance the state's habitat restoration network, the Division chairs the Partnership to Restore Massachusetts Aquatic Habitats, a group of over thirty-five organizations involved in aquatic habitat restoration across Massachusetts. The Partnership meets biannually and communicates via an e-mail Listserv to discuss all aspects of habitat restoration, including science, policy, planning, permitting, funding, monitoring, and project implementation.

Federal partners bring extensive expertise, technical assistance, and the majority of funding to the table for Massachusetts projects. Close partnerships with federal restoration programs and staff are crucial to leveraging restoration dollars and advancing projects through construction. State and local government partners also play many key roles by assisting with all aspects of project development, permitting, and implementation.

Nonprofit partners contribute significantly to individual projects as well as to policy, political, and strategic planning needs at the state level. Finally, the corporate role in Massachusetts habitat restoration—through the first-in-the-nation Corporate Wetlands Restoration Partnership—has been exceptional and ranges from voluntary contributions of cash and technical services to advocacy for increasing restoration capacity at the state level.

Achievements and Challenges

Since its founding in 1994, the WRP (now part of the Division of Ecological Restoration) has helped partners complete seventy-five projects with 465 hectares of

wetlands under restoration. Over 450 hectares involved restoration of tidally restricted coastal marshes. WRP is currently working with partners to advance over forty active tidal wetland projects that represent over 1200 hectares of future restoration potential. Working with many partners, the state has made great progress restoring coastal wetlands, but there is much work that remains to be done. While WRP has helped partners achieve significant restoration results, the program has faced many challenges along the way. The most significant challenges—past and present—include maintaining and enhancing support for wetland restoration and increasing program capacity.

Coastal wetland restoration is still an emerging field. When WRP was formed in the early 1990s, wetland restoration was a relatively novel activity. Creation of a formal state restoration program at that time was a major accomplishment and a significant advancement for the field as a whole. Since then, the program has done much to increase public and political support and awareness for restoration, primarily by helping partners produce tangible, on-the-ground results and benefits.

Massachusetts is in the vanguard of aquatic habitat restoration in New England. Major factors in the state's successful implementation of over seventy projects are the support and facilitation provided to local proponents by the WRP. Salt marsh restoration projects in Massachusetts, regardless of size, are frequently complicated and typically involve multiple landowners, stakeholders, and jurisdictions. They also often require contributions from multiple funders to cover high construction costs and must navigate multilayered permitting requirements at the local, state, and federal levels. Coordination of these numerous elements is often beyond the capacity of any single entity. One of WRP's primary strengths is its ability to bring together the partners, expertise, and resources needed to advance restoration projects from concept to completion.

A few tidal restoration projects in Massachusetts have been problematic, and the common thread between them has been the incorporation of water control devices without adequate planning for postconstruction management. These devices include flash boards, stop logs, weirs, and adjustable tide gates designed to restrict flood tide elevation, limit ebb tide drainage, and/or control sediment transport. In these problematic cases, water control devices were included in restoration project designs, but their management goals, operational protocols, and oversight requirements were never documented or made enforceable.

To avoid similar water control structure problems in the future, WRP is working with local project proponents, regulatory agencies, and other restoration partners to require detailed operational and maintenance plans for any water control device proposed as part of a tidal restoration project. These plans specifically identify the purpose and objectives of the structure and the roles and responsibilities of

a multistakeholder oversight committee. Operational and maintenance plans for water control structures are now routinely incorporated into local, state, and federal permit conditions and grant contracts.

Site Selection Criteria, Monitoring, and Adaptive Management: Fundamental to Success

Two primary categories of criteria—ecological and practical—drive the evaluation and selection of restoration sites in Massachusetts. Both categories are equally important and must be carefully considered for each potential restoration project. Ecological considerations for tidal restoration projects are usually fairly straightforward and can be summed up as a qualitative cost-benefit analysis of the environmental effects of restoration treatments. Example criteria include the size and severity of wetland degradation, the potential to improve degraded ecological conditions, the trade-offs of converting one habitat type to another, and the effects of restoration treatments on endangered species.

Practical considerations cover an extremely broad and complex array of issues, including social, political, financial, engineering, and aesthetic. These are the issues that most often turn into project "show-stoppers." Examples of some potential show-stoppers include when restoration of tidal range would flood low-lying properties or infrastructure, when historical fill on salt marsh is contaminated, and when removal of a tidal restriction would alter impoundment water levels, causing a major change in the aesthetics and recreational uses of an open water area.

WRP relies on several different means to identify new projects and advance them through the typical phases of restoration. Many projects are brought to the program's attention via an annual call for Priority Project nominations. WRP uses a competitive process through the state's procurement system to solicit nominations of new restoration projects for state funding and technical support. WRP also conducts ongoing internal restoration planning activities using a combination of geographic information system (GIS), historical data sources, and information from local sources and site visits to identify, assess, and prioritize new restoration opportunities. All of these efforts incorporate the ecological and practical site selection criteria discussed earlier. Based on assessment of these criteria and current program capacity, each project is evaluated for acceptance. Once accepted, projects are eligible for technical assistance and grant funding.

Massachusetts restoration partners recognize that projects are not finished when the heavy equipment departs and the final bills are paid. Some practitioners (including WRP) hesitate to refer to projects as "complete," and instead use terms such as "under restoration" to describe postconstruction status. This term recognizes that completion of restoration treatments simply sets in motion a series of

complex ecological processes with intended outcomes that have been carefully planned, yet remain uncertain. Long-term commitment to postconstruction monitoring and assessment is crucial to fully understand project trajectories and outcomes, and to inform corrective actions if needed.

Massachusetts salt marsh monitoring is dependent on rigorous and credible chemical, physical, and biological data collection tailored to measure and document systemic responses to restoration actions. WRP has found project monitoring and data management to be one of its biggest challenges. With more than seventy projects completed and many others in development, the effort required to adequately monitor all projects is far beyond the existing resources of both the program and local project sponsors.

To address this, WRP has developed a regional, volunteer-based salt marsh restoration monitoring network. The goal of this network is to enhance and utilize local and regional partner capabilities to help meet project monitoring needs. Since 2003, the program has provided grant funding and technical support to regional nongovernmental organizations that recruit, train, and manage volunteers for field data collection. Uniform data collection protocols have been developed, along with standardized data sheets and data management tools to promote statewide consistency and data transferability. These tools include a proprietary software program for data entry, management, and transfer, and a set of Microsoft Office Excel–based templates for analysis and reporting of salt marsh data.

Funding Alternatives

Massachusetts salt marsh restoration partners have spent well over $30 million since 1994 on over seventy constructed projects. The majority of this funding has come from federal agencies, followed, in descending order of relative contribution, by state, municipal, corporate, and other private investments.

As in other states with significant coastal wetland restoration activity, Massachusetts enjoys strong funding support from its federal partners, most notably the National Oceanographic and Atmospheric Administration Restoration Center, US Fish and Wildlife Service, Natural Resources Conservation Service, and US Army Corps of Engineers. However, the strength of these partnerships is bolstered significantly by sustained funding and project management capacity at the state level. The continued support of WRP staff and investment of state project funding are crucial factors in attracting large infusions of federal restoration dollars into Massachusetts. Since 2003, WRP has received a budget allocation for grants and technical services, and the program uses these resources to hire environmental consultants that perform project development tasks such as field survey, engineering design, and permitting. WRP funds are also dispersed to project sponsors and

regional nongovernmental organizations through a competitive grants program for construction-related tasks and project monitoring.

WRP's direct funding for projects is particularly useful for early development tasks, such as initial project feasibility screening and conceptual design, that prepare projects for federal construction grants but that are more difficult to fund through competitive federal sources. In almost every case, WRP staff and funding contributions are also used to help fulfill the nonfederal matching requirements of federal grant programs, greatly leveraging the state's investment.

Several other state programs, such as the Massachusetts Department of Conservation and Recreation and the Department of Fish and Game, also contribute to proactive coastal wetland restoration projects. In addition, cities and towns make significant contributions of cash and in-kind services to projects, especially where elements of the restoration project are closely tied to town infrastructure. These additional state and local contributions provide another important piece of the match needed to secure federal grants.

The Massachusetts Corporate Wetland Restoration Partnership (MA-CWRP) plays a major role in the state's wetland restoration efforts, bringing in significant amounts of private funds and in-kind technical services and conducting important stewardship and public outreach activities. Established in 1999, the MA-CWRP was the first state CWRP in the nation and has been an important partner in advancing the mission of WRP. With over $1.7 million raised so far in cash and in-kind services for Massachusetts projects, the MA-CWRP also provides significant match for federal grants.

Other private funds have been raised from foundations, nongovernmental organizations, and private landowners. A major portion of this funding has come from Massachusetts' two largest private conservation landowners, the Massachusetts Audubon Society and The Trustees of Reservations, both implementing restoration projects on their own properties.

Building a Successful State Wetland Restoration Program: Some Guidance for Others

Developing and growing a stable, long-term state program in a nascent field such as habitat restoration can be challenging, especially with tight budgets and competing priorities. WRP has achieved some success in these important areas by staying focused on its core mission and pursuing the following key priorities:

- Establish and nurture strong partnerships and collaboration with public, private, and nonprofit entities, especially those who have (or could have) financial, political, and/or regulatory influence on restoration efforts.

- Build and maintain program and staff reputations for integrity, professionalism, reliability, and competence.
- Establish solid relationships and reputation with regulators.
- Maximize the leveraging of state investments to bring in local, federal, private, and other funding to support projects.
- Produce successful results and publicize those results with partners, senior agency officials, politicians, and the general public.

The Massachusetts experience has proven without question that successful restoration efforts require active partnerships at the individual project level and, more broadly, sustained collaboration at state and regional levels. Individual projects need to have buy-in and input from many key players, including landowners, neighbors, regulators, government officials, nonprofit organizations, and funders. At the state level, it is very helpful for scientists, regulators, practitioners, and others involved in restoration to get to know each other, communicate on important issues, discuss active and potential projects, and collaborate to advance the field of restoration.

References

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Note

1. MassGIS DEP Wetlands and USFWS National Wetland Inventory data were processed by the authors using the methods described in Carlisle et al. 2005. Source dates for these data vary by locale; the most current data available were used.