Chapter 7

Meeting the Challenge

Restoration efforts over the past decades have dramatically revitalized appreciation of the Kennebec Estuary and resource uses that are compatible with management objectives. Putting in place a new vision for the estuary would represent the next major step toward recovery. Photo: Slade Moore.

The Kennebec Estuary has been subject to a barrage of environmental insults since widespread environmental alteration became a major force of ecological change in the Gulf of Maine. Restorative efforts over the past few decades have made considerable gains, but success is uneven and contemporary recovery plans continue to be challenged by the legacies of past societal choices. The estuary's assets include considerable biological diversity of regional importance, ecological and economic potential, and historical significance. But the Kennebec's current recovery trajectory does not suggest that the estuary is likely to re-emerge as the exemplary system it once was. Achieving ecologically meaningful recovery goals will require novel research and management approaches, adaptation to climate-driven environmental change, and policy shifts that recognize the many benefits offered by estuaries capable of providing a spectrum of goods and services that support and enrich human existence. Although challenges remain, restoration efforts over the past decades have dramatically increased appreciation of the Kennebec Estuary and have promoted uses that are compatible with management objectives. A new vision for the estuary, with recovery goals that are closer to pre-degradation conditions, would represent a major step toward recovery.

Recalibrating a Restorative Vision

It is still possible to come upon hundreds of rafting ducks in Merrymeeting Bay if care is used while threading through the expanses of flooded wild rice and rush meadow. Initiated by a few wary individuals, the inevitable, collective skyward lurch of flushed waterfowl in huge numbers is marked by a gathering roar that reverberates throughout the upper estuary. For the briefest moment, sky and water tremble, resist, and finally unite under thousands of wings. It is hard to imagine the even greater spectacle Frank Noble described in 1905 of mile-long rafts of ducks shaking Merrymeeting Bay with the force of an earthquake and the roar of a waterfall. In his words, natural phenomena of such scale, grace, and power were "never to be forgotten."

Few among us can recount similar experiences. Likewise, few people today can remember diadromous fish migrations in such vast seasonal pulses that, for weeks on end, the Kennebec's waters boiled and flashed with millions of silver-sided river herring. And that is perhaps illustrative of the greatest challenge to assessing and restoring ecosystems that have been so extensively altered from their historical condition. Once people no longer remembered what the estuary was like before dam building, pollution, log drives, and fishery collapses, we were left without meaningful ecological reference points to evaluate present conditions. In the centuries since Europeans first settled in the region, the Kennebec Estuary absorbed some of the worst environmental insults that could be mustered. Although in some respects the estuary fared better than other ecosystems in the Northeast, the extent of the change was so great that present restoration efforts are dogged by the legacies of past choices.

Developing a defensible characterization of past conditions may be the key to setting ecologically meaningful recovery goals for the future. In most cases, scientifically collected data that would otherwise provide an objective, accurate characterization of past conditions date only as far back as the early-mid 20th century. The need to improve our understanding of the Estuary's past ecological potential compels deeper understanding of the longer-term ecological continuum, rather than relying on the scant data that offer only isolated snapshots of relatively recent ecosystem condition at its low point or thereabouts. Another challenge is the collective perception of recent generations, whose understanding of what is environmentally "normal" and "acceptable" is informed by the period marking the Estuary's modest emergence from near ecological collapse. If an understanding of recovery feasibility is the goal, a range of knowledge systems must be accessed, including existing scientific data, but also historical documents, environmental proxies (e.g. seed banks and diatoms locked in sediments), first-person testimonies, and other indirect and non-traditional sources. As these diverse sources allow a profile of ecosystem potential to emerge, experimental ecological investigations can be used to test hypotheses and improve the resolution and reliability of our assumptions.

The lack of data allowing assessments of current ecological conditions will hinder restoration efforts until consistent funding sources are marshaled to support and in some cases expand programs that have demonstrated benefit. There is also a dire need to initiate new research and monitoring programs that more realistically reflect the complexity of managing natural systems. Currently, accurate assessments of system health and risk to human well-being are hampered by a lack of data that would otherwise characterize lynchpins of ecosystem integrity and resilience such as water quality, dominant plant communities, and toxic contaminant levels.

Diadromous fish restoration efforts in the Kennebec Estuary are hobbled by a complex history of human-induced environmental alteration, ongoing policy choices, and the responses of fish populations to both. Managing an ecologically meaningful restoration of diadromous species requires development of benchmarks and goals that take into consideration the co-evolved nature of aquatic and terrestrial

communities and the probability that former super-abundances of fish represented something other than a surplus that is not essential to a healthy system.

Can an exemplary level of ecosystem functioning be reattained? Many questions remain to be answered before we will know. Some of the most persistent challenges may include those resulting from the magnitude of change. Where present, "alternate stable" ecological conditions—those that result from profound ecosystem change and are highly resilient to restorative actions—may lessen the feasibility of obtaining restoration targets that closely mirror historical conditions. Examples from other ecosystems, such as the Gulf of Maine, include the functional extinction of keystone predators, with cascading impacts throughout lower trophic levels. Elsewhere, historical land uses that caused widespread erosion resulted in thick deposits of fine soils in rivers and estuaries that now hinder water quality efforts. However, there are some very obvious opportunities for reinvigorating the restoration process. The removal of barriers to in-stream connectivity, such as dams, and to a lesser extent re-establishing fish passage where dams remain, represent actions that would unequivocally offer considerable benefit to diadromous fish restoration and conservation efforts.

The complexity of multiple monitoring and management targets focusing on such a variety of inter-disciplinary factors requires a comprehensive and equitable approach that can only be offered by adjusting the present resource management paradigm. Though rarely put into practice, ecosystem-based approaches may prove effective by systematically addressing functional linkages between key biological and abiotic ecosystem elements; the contributions of particularly influential species and communities to estuary-wide integrity and resilience; terrestrial-estuarine-riverine relationships; and the needs and guidance of multi-sector resource users, all within the context of the most ecologically relevant geographic scale. There are few practical examples of ecosystem-based management approaches being implemented in the United States, though Maine is the site of one (Moore and Sowles 2010). A shift toward these more integrative, equitable, and place-based approaches to management may represent the next step needed to bring the Kennebec, and other systems affected by centuries of abuse, closer to ecological recovery.