

## Tidal Restoration for Wellfleet's and Truro's Herring River Estuary:

### Common Benefits

Some of the most productive and biologically diverse habitats on this planet occur along edges – interfaces between forests and shrub lands, woods and grasslands, and between the land and the sea. Salt-marsh estuaries are an outstanding example of this, with higher productivity (in terms of organic matter produced per unit space and time) than nearly all Earth's ecosystems. Although the extreme stresses of salt, soil waterlogging, winter ice damage, etc. limit vascular plants to only a few hardy grasses, their ability to convert solar energy to organic matter is prodigious, and supports a huge diversity of other living things. These are the organisms, from bacteria, phytoplankton and zooplankton to clams, finfish and birds, which have evolved lifestyles to exploit the abundant store of energy captured by the tidal marshes.

The restoration of the tidal connection between Herring River and the marine environment will benefit the community by: 1) eliminating the damage caused by 100 years of diking and drainage and 2) restoring a functional estuarine system with all of its accompanying social values. The environmental and social benefits are detailed below.

*Primary productivity* - Salt-tolerant grasses, along with seaweeds and phytoplankton, are the solar engines that drive the intense productivity of our salt marshes, capturing solar energy in organic compounds as they grow. Although resistant to salt, flooding and winter ice scour, these hardy grasses cannot tolerate competition; they need the salt water, not physiologically, but to keep out other plants which, in the absence of salinity, would quickly shade out the salt marsh. In this way diking decreased salt marsh cover in Herring River from 1100 to less than 10 acres in just a few decades. The salt-tolerant grasses have been replaced with invasive and many non-native plants, with a serious loss in the organic production that fed fish, clams, crustaceans, birds and people in both the river and Wellfleet Bay.

A program of gradual tidal restoration will increase salinity and water levels and thereby kill invasive shrubs and trees. Their removal will allow salt marsh grasses to re-colonize the broad flood plain, converting current shrub thickets to a carpet of green, while re-opening the marshlands for fish, birds and people.

*Water chemistry* – Despite the exclusion of saltwater, even freshwater animals are scarce in the river because of drainage (and oxidation) of salt-marsh peat, releasing acidity and metals.

Tidal restoration will reverse the chemistry that has led to these problems. Further, recurrent dissolved oxygen depletions will end with restored flushing with oxygen-saturated Cape Cod Bay water – twice each day. These improvements will lead to the recovery of aquatic animals, including migratory fish like eels and river herring.

*Shellfish water quality* – Dikes reduce tidal flushing and cause fecal coliform bacteria to accumulate, a process that has kept the rich oyster beds just seaward of the Herring River dike closed to harvest for over two decades.

Restored tidal flushing will dilute coliform bacteria, and restored salinity will reduce their survival, very likely resulting in the re-opening of shellfishing below the dike.

*Groundwater quality* – Although counterintuitive, research suggests that keeping salty tidal water from our estuaries causes the adjacent fresh groundwater lens to become thinner. This is because the thickness of this lens is in part due to the average water level in the coastal wetland into which it flows. Diking artificially lowers the wetland water level. This lower level allows more freshwater to leak from the adjacent groundwater aquifer causing it to decrease in thickness.

Tidal restoration will increase both the average wetland water level and the thickness of the adjacent freshwater aquifer. In any case, because groundwater always flows from the aquifer to the coast (except in the case of intense municipal groundwater withdrawal too near the coast), salt water cannot penetrate inland to affect groundwater quality.

#### *Nuisance mosquitoes*

The nineteenth century response to salt-marsh mosquito production was to try to eliminate their wetland habitat, through diking. When that failed to reduce floodwater mosquito breeding, people tried to drain the diked wetlands by digging deep ditches. But the drainage so damaged water quality and (thus) mosquito predators, particularly estuarine fish, that mosquito production remained high in remaining floodwaters.

Now mosquito control experts support tidal restoration to improve water quality and physical access for mosquito predators. Restored tidal flooding of the marsh surface will provide access for salt-marsh fish (e.g. killifish), voracious predators of mosquito larvae, and improved low-tide drainage will eliminate present floodwater breeding sites. Meanwhile, water quality will radically improve for both fish and other mosquito predators.

#### Wetland subsidence

For the past 2000 years, i.e. until the ecosystem was diked 100 years ago, the Herring River's thousand-plus-acre marshland stayed above the rising sea by accumulating sediment. This sediment came in with the tides and was augmented with the roots and rhizomes of salt-marsh plants. Diking has blocked the marine source of sediment and also drained the accumulated peat; both processes have caused the wetland to subside. Although the effect is invisible without careful measurement, much of the marshlands have lost 2-3 feet in elevation, while sea level has continued to rise since 1909 diking.

Restored tides will again bring sediment from the Cape Cod Bay system onto Herring River's marshes. Increased water levels will resaturate presently drained peat, allowing organic matter to again accumulate. Both processes contribute to marsh building in the face of sea-level rise.