# Benefits of salt marshes to shellfish

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*Coastal wetlands specifically benefit shellfish by intercepting and removing pollutants (e.g. metals) that may be in groundwater before discharge to shellfish waters and converting nitrate in groundwater from developed shorelines into organic matter to feed shellfish and other marine animals.*

1. Valiela, I. et alia. 2020. Role of Salt Marshes as Part of Coastal Landscapes. In *Concepts and Controversies in Tidal Marsh Ecology.*

   Abstract: Salt marshes are located between land and coastal water environments, and nutrient and production dynamics within salt marshes interact with those of adjoining ecosystems. Salt marshes tend to export materials to deeper waters, as shown by mass balance and stable isotopic studies. Salt marshes also intercept land-derived nutrients, and thus modify the potential response of phytoplankton, macroalgae, and seagrasses in the receiving estuarine waters. In particular, the maintenance of eelgrass meadows seems to depend on the ability of fringing salt marshes to intercept land-derived nitrogen. The bulk of the interception of land-derived nitrogen is likely to be the result of relatively high rates of denitrification characteristic of salt marshes. Thus, through exports of energy-rich materials, and interception of limiting nutrients, salt marsh parcels interact in quantitatively important ways with adjoining units of landscape. These interactions are of importance in understanding the basic functions of these mosaics of different coastal systems, as well as providing information needed to manage estuaries, as for example, in conservation of valuable eelgrass meadows.

2. Teal, JM & B. Howes. 2020 Salt Marsh Values: Retrospection from the end of the Century in *Concepts and Controversies in Tidal Marsh Ecology.*

   Abstract: Two of the greatest problems in coastal waters are eutrophicaton and rapid decline in populations of important fish species. Salt marshes are important in combating both these problems. A paradigm for salt marsh function: marshes import inorganic nutrients and export organic nutrients and, as a result, grow fish. As ground and tidal water flow through salt-water wetlands, plants, bacteria and algae produce or transform the organic matter of the food chain that supports fish and shellfish populations. While salt marshes modify the principal plant nutrients, N and P, some of the pathways result in removal of nutrients from biologically active systems. Nitrogen is removed primarily either by being trapped in refractory organic matter that contributes to marsh maintenance through accretion or through loss to the atmosphere (as N2) by denitrification. Salt marshes along the Atlantic coast of the United States have changed during the past century; the number of hectares has declined and the nutrient loading

per hectare has increased. We examine data on the correlation between fish catch and various marsh features from Long Island, New York in 1880. We review research on the ways salt marshes reduce both the level and rate of eutrophication of coastal waters by intercepting nitrate in discharging groundwater. Finally, we consider how these functions have changed with the decrease in area of salt marshes along the Atlantic coast from Georgia to Maine.

3. Kastagno, KA. 2018. Salt marsh restoration and the shellfishing industry: Coevaluation of success components. Coastal Management 297-315. https://doi.org/10.1080/08920753.2018.1474069

   Abstract:

   This study uses an ecosystem services framework to document the current relationship between salt marsh restoration and the shellfishing industry in five towns on Cape Cod, Massachusetts, USA. Salt marshes in their natural form provide many ecologic, economic, and aesthetic benefits to coastal communities. Human alterations to salt marshes (including ditching, diking, and filling), however, restrict water flow, substantially reducing the ecosystem services available to these communities. Salt marsh restoration projects have been implemented along coastal landscapes in an attempt to reclaim their original ecosystem services. The ecologic and social components of restoration, like its connection to the shellfish industry, are well understood, but the inherent linkages between the components are not. Through the co-evaluation of these components, social and ecologic linkages are identified and assessed. This study determined the robust social link between salt marsh restoration and the shellfishing industry. Despite the lack of a clear link between restoration and enhanced ecosystem services that augment shellfish harvest, restoration projects are valued for far more than their direct provisioning ecosystem services, with many shellfishermen emphasizing the cultural value of the salt marsh above all else. The sense of community and culture that rallies around both salt marsh restoration and shellfishing demonstrates that valuation of ecosystem services is robust and imperative to the future of both salt marshes and the shellfishing industry on the outer Cape.

4. Nel et alia. 2022. Contributions of Wetland Plants on Metal Accumulation in Sediment. Sustainability 14: 3679; **https://doi.org/10.3390/su14063679**. Special Issue **Aquatic Plants as Bioindicators of Trace Metal Pollution**

   Abstract: Wetlands, and especially salt marshes, are well-known sinks of metals, which limit toxic amounts of metals from entering the food chain. This study investigated metal concentrations (Cr, Cu, Fe, Mn, Ni, Pb, Zn) in a highly urbanised estuary, and compared vegetated rhizosediment (*Salicornia tegetaria*, *Spartina maritima*, and *Zostera capensis*) with bare sediment, in a depositional and non-depositional site, in the intertidal zone of the Swartkops Estuary. The samples were collected at two sites along the middle and lower reaches of the estuary and analysed using a Total X-ray Fluorescence (TXRF) spectrometer.

It was found that the rhizosediment contained more metals and that metal concentrations in the sediment decreased as follows: *S. tegetaria* > *S. maritima* > *Z. capensis* > bare sediment. Although metal accumulation was similar in bare sediment for the depositional (Site B) and the non-depositional site (Site A), the rhizosediment displayed higher metal accumulation in the depositional site (Site B). However, regardless of site-specific depositional tendencies, rhizosediment displayed higher metal accumulation than bare sediment. These results indicate that vegetated sites and vegetated depositional sites should be the focus of monitoring metals in estuaries around the world.

*Coastal wetlands specifically benefit shellfish by capturing and storing massive amounts of carbon dioxide to mitigate climate change and the consequent warming of coastal waters. But with on-going, and likely accelerating, sea-level rise, salt marshes need space to migrate inland to persist and stay above the rising sea.*

5. Valiela, et. Alia. 2023. Effects of climate change on salt marshes in Climate Change and Estuaries.

Although estimates of the area of salt marsh vary, it appears that major losses have taken place though this century, making these wetlands one of the most threatened natural ecosystems. Human activities have been responsible for the losses in the past, but it now appears that climate-related drivers are likely to become increasingly problematic in the next century. These losses are of special concern because salt marshes provide valuable ecological and human services, including protection of coastlines, sequestration of greenhouse gases, support of coastal food webs, interception of land-derived nutrients and contaminants, nursery habitats for shell- and fin-fish, habitat for marsh-dependent and migrant species, and a variety of human uses.

Decadal trajectories of key climate-related drivers are accelerating, and these drivers interact with increased trends of anthropogenic local variables to strongly alter the status of salt marsh ecosystems throughout the world. Long-term experimental studies have revealed the magnitude and direction of the interactions of global-driven climate-related drivers of change (sea-level rise, warming, acidification) in concert with effects of more local, anthropogenic drivers (increased eutrophication, lower sediment supply) that have, and will continue to affect salt marsh systems into the next century.

Sea-level rise – and its interactions with other climate and human agents of ecological change – seem to be key threats to coastal wetlands. Forecasts based on climatic warming suggest impending increases in sea-level rise through this and the next century. Many reviews have confirmed the likely submergence of salt marshes, and many suggestions have been forwarded as strategies to support salt marsh resilience. Managing to allow landward migration of salt marsh vegetation, plus planned retreat for human populations away from flooded areas, seem scientifically plausible ways to maintain wetland presence on coasts of the world. The increasingly dense human population nearshores, however, will be intently and massively in the way. Landward marsh incursion and planned retreat of human uses nearshore are objectives that will meet unremitting popular opposition, and implementation will require major and unusual efforts in education, concerns with equity, and political leadership.

6. Drake, K. et alia. 2015. Carbon sequestration in tidal salt marshes of the northeast United States. Environmental Management 56:998-1008.

Abstract: Tidal salt marshes provide important ecological services, habitat, disturbance regulation, water quality improvement, and biodiversity, as well as accumulation and sequestration of carbon dioxide ($CO_2$) in vegetation and soil organic matter. Different management practices may alter their capacity to provide these ecosystem services. We examined soil properties (bulk density, percent organic C, percent N), C and N pools, C sequestration and N accumulation at four marshes managed with open marsh water management (OMWM) and four marshes that were not at U.S. Fish and Wildlife National Wildlife Refuges (NWRs) on the East Coast of the United States. Soil properties (bulk density, percent organic C, percent N) exhibited no consistent differences among managed and non-OMWM marshes. Soil organic carbon pools (0–60-cm depth) also did not differ. Managed marshes contained 15.9 kg C/m$^2$ compared to 16.2 kg C/m$^2$ in non-OMWM marshes. Proportionately, more C (per unit volume) was stored in surface than in subsurface soils. The rate of C sequestration, based on $^{137}$Cs and $^{210}$Pb dating of soil cores, ranged from 41 to 152 g/m$^2$/year. Because of the low emissions of $CH_4$ from salt marshes relative to freshwater wetlands and the ability to sequester C in soil, protection and restoration of salt marshes can be a vital tool for delivering key ecosystem services, while at the same time, reducing the C footprint associated with managing these wetlands.