

Coastal Marsh Restoration

A DOI Nature-Based Solutions Roadmap Fact Sheet



Coastal marshes are partially flooded coastal wetlands that are inundated by salt water brought in by the tides.¹ They occur where fine sediments accumulate along shorelines protected from the open ocean. Around half of coastal marshes globally have been lost or significantly degraded.² Prominent drivers of this decline include polluted stormwater runoff, erosion, invasive species, drought, and sea level rise.³ Coastal marsh restoration varies regionally, but typically includes isolating an area via dikes and pumping in sediment, planting native vegetation, or diverting nearby rivers to flow through the marsh.⁴

TECHNICAL APPROACH

While coastal marsh restoration techniques vary, three steps are generally used to restore the marsh's structure and function to a more natural state:

- Restoring tidal exchange by removing preexisting dikes⁵ and excavating canals and culverts.
- Adding sediment to restore natural sediment characteristics and the marsh's elevation profile. Organic soils, often from mangroves, are sometimes mixed into the existing topsoil to restore sediment characteristics,⁵ and dredged sediment from nearby channels can be used to build up marsh elevation.⁶
- Vegetative restoration to remove invasive species, if necessary⁷ and revegetate with native species, most commonly *Spartina* spp. and *Juncus roemerianus* along the Eastern seaboard of the United States.⁸

BENEFITS

Climate Threat Reduction

- Reduced flooding
- Storm protection
- Sea level rise adaptation and resilience
- Carbon storage and sequestration

Social and Economic

- Property and infrastructure protection
- Mental health and well-being
- Resilient fisheries
- Food security
- Recreational opportunities
- Jobs
- Increased property values
- Cultural values

Ecological

- Improved water quality
- Increased primary productivity
- Supports wildlife

SITE SUITABILITY FACTORS

- ✓ Low elevation gradient (shallow slope)
- ✓ Tidal exchange should reach most of the salt marsh
- ✓ Elevation within the tidal frame -- between the mean high water of neap tides (MHWN) and the level of the highest astronomical tides (HAT)
- ✓ Salinity levels between 18 and 35 ppt
- ✓ Sediment available
- ✗ Wave energy greater than 1.2 m/s

EXAMPLE PROJECT

The Ni-les'tun Marsh in Bandon National Wildlife Refuge supported salmon harvest by the Confederated Tribes of the Siletz before it was drained for agriculture in the 1800s. The U.S. Fish & Wildlife Service led the restoration of 400 acres by filling drainage ditches, excavating historic tidal channels, constructing fish habitat, and removing tide gates. Now, tides bring in nutrients and sediment to the restored marsh, supporting a variety of wildlife including Coho salmon.



Aerial view of the newly restored marsh flooding during high tide. Photo credit: Roy W. Lowe / USFWS. CC BY-NC 2.0.

REFERENCES

- 1 NOAA. 2023, January 20. "What is a Salt Marsh?" *National Oceanic and Atmospheric Administration*. <https://oceanservice.noaa.gov/facts/saltmarsh.html>.
- 2 DiGiacomo, A. 2020, January 21. "Summer in the Salt Marshes: Using Drones to Monitor the Health of Coastal Habitats". *Duke University Bass Connections*. <https://bassconnections.duke.edu/about/news/summer-salt-marshes-using-drones-monitor-health-coastal-habitats>.
- 3 Clemson HGIC. 2021, January 20. "Life Along the Salt Marsh: Troubleshooting Salt Marsh Decline". *Clemson College of Forestry, Agriculture and Life Science Home and Garden Information Center*. <https://hgic.clemson.edu/factsheet/life-along-the-salt-marsh-troubleshooting-salt-marsh-decline/>
- 4 Olander, Lydia, Christine Shepard, Heather Tallis, David Yoskowitz, Kara Coffey, Christine Hale, Rachel Karasik, Sara Mason, Katie Warnell, Katya Wowk. 2021. "Gulf of Mexico Ecosystem Service Logic Models and Socioeconomic Indicators (GEMS): Salt Marsh Restoration." *Nicholas Institute for Energy, Environment and Sustainability, The Hart Research Institute and The Nature Conservancy*. <https://nicholasinstitute.duke.edu/eslm/salt-marsh-restoration>
- 5 Billah, M. M., Bhuiyan, M. K. A., Islam, M. A., Das, J., & Hoque, A. R. 2022. "Salt marsh restoration: An overview of techniques and success indicators". *Environmental Science and Pollution Research*, 29(11), 15347–15363. <https://doi.org/10.1007/s11356-021-18305-5>
- 6 Kutcher TE, Chaffee C, Raposa KB. 2018. "Rhode Island Coastal Wetland Restoration Strategy." *Rhode Island Coastal Resources Management Council*. pp 1–55. <http://www.crmc.ri.gov/habitatrestoration/RICWRestorationStrategy.pdf>
- 7 Xie B, Han G, Qiao P, Mei B, Wang Q, Zhou Y, Zhang A, Song W, Guan B. 2019. "Effects of mechanical and chemical control on invasive *Spartina alterniflora* in the Yellow River Delta". *China Peer J* 7:7655. <https://peerj.com/articles/7655/>
- 8 Craft C, Megonigal P, Broome S, Stevenson J, Freese R, Cornell J. 2003. "The pace of ecosystem development of constructed *Spartina alterniflora* marshes". *Ecological Applications*. 13(5):1417–1432 <https://esajournals-onlinelibrary-wiley-com.proxy.lib.duke.edu/doi/full/10.1890/02-5086>

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KEY RESOURCES

Title and Link	Site Suitability	Design and Construction	Monitoring Guidance	Example Projects
Handbook for Restoring Tidal Wetlands (Joy Zedler, Ed.)	✓	✓	✓	✓
Maintaining Salt Marshes in the Face of Sea Level Rise (US ACE)	–	✓	✓	–

LEARN MORE

Visit the DOI Nature-Based Solutions Roadmap for more information on coastal marsh restoration, other nature-based solutions, and principles and considerations broadly relevant for nature-based solutions projects. The coastal marsh restoration summary includes additional details on each section included in this fact sheet, plus information on operations and maintenance, common barriers, and more resources and example projects.

Explore the Roadmap



Full Roadmap Document



Coastal Marsh Restoration Section

www.nicholasinstitute.duke.edu/roadmap