Sea Grant NEW YORK

Natural and Nature-based Features
Case Study #4

Integrating an oyster reef into the design of a living shoreline. Photo credit: Joel Fodrie

Integrating Oyster Natural History and Fish-Habitat Relationships in Living Shoreline Designs, North Carolina

Project Overview:

In Morehead City, North Carolina (34.722738, -76.755337) and Sugarloaf Island, North Carolina (34.718100, -76.710303), living shorelines were developed with the following project goals: (1) Structural Integrity/Hazard Mitigation: Leverage the natural history of oyster reef formation and growth to optimize the design of intertidal oyster-reef restoration projects aimed at providing shoreline protection and (2) Ecosystem Function: Assess how living shoreline designs impact landward-seaward movement of larger mobile fishes and maximize the provision of ecosystem services and resilience to climate change, ensuring a self-sustaining reef in perpetuity.

Key Takeaways

- Living shorelines should be designed with oyster natural history in mind. Oysters naturally grow in groins, not sills. When reefs were installed as sills during this project, high oyster mortality occurred on both landward and seaward sides.
- When implemented as sills, living shorelines may alter the movement of large marine fauna, potentially serving as a barrier to mobility. However, sill gaps and low-relief sills may mitigate these concerns.

Project Context

In a densely developed area with a low to moderate wave-energy environment in coastal North Carolina, Dr. Joel Fodrie's team strove to create and assess sill structures (oyster reefs) as components of living shorelines.

Kathleen M. Fallon, Ph.D.
Sr. Coastal Processes and Hazards Specialist | email: kmf228@cornell.edu | 631-824-4746

This fact sheet is a product resulting from the U.S. Coastal Research Program's Translating Coastal Research to Application, funded under award NOAA-OAR-SG-2022-2007298 from the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce to Cornell University on behalf of New York Sea Grant.

December 2025

srijb.org/nature-based-solutions

Results

Dr. Fodrie and his team discovered that when oyster reefs are established as groins, oyster mortality is lower than when established as sills. This finding emphasizes the importance of mimicking natural structures. Additionally, groins may be better for larger fishes. While pre-NNBF project baseline data were not available, control sites established at nearby locations to compare landward-seaward movement of larger mobile fishes acted as a baseline, with results suggesting the possibility of large, high relief, contiguous sills becoming a barrier to mobility for large marine fauna.

Implications for Practice

Structure type (groins versus sills) plays a key role in the development of oyster reefs in living shorelines. At this location it was determined that groins would perform better; however, each site must be individually assessed to determine what living shoreline type will be successful. Ongoing research into whether these living shorelines may alter the movement of large marine fauna is required to assess the long-term impacts of creating sill structures.

Featured Researcher: Dr. Joel Fodrie

Dr. Joel Fodrie is a professor at the Institute of Marine Sciences at University of North Carolina - Chapel Hill, where he studies the population and community ecology of coastal fishes, shellfish, seagrasses, and saltmarshes. In 2021, USCRP funded Dr. Fodrie's project "Investigating oyster-reef morphodynamics to optimize nature-based infrastructure."

Offshore sill structures are investigated to determine patterns of oyster settlement and survival.
Photo credit: Google Earth

Relevant Links

Dr. Joel Fodrie's Lab Website

Dr. Fodrie's UNC Profile

Dr. Fodrie's Google Scholar

2021 USCRP Funded Research

Gittman RK, CH Peterson, CA Currin, FJ Fodrie, MF Piehler, and JF Bruno (2016) Living shorelines can enhance the nursery role of threatened coastal habitats. Ecological Applications 26: 249-263

Keller DA, RK Gittman, MC Brodeur, MD Kenworthy, JT Ridge, LA Yeager, AB Rodriguez, and FJ Fodrie (2019) Salt marsh shoreline geomorphology influences the development of restored oyster reefs and use by associated fauna. Restoration Ecology 27: 1429-1441

Inspecting an oyster reef living shoreline.
Photo credit: Science.org

About SRIJB (https://srijb.org/): The SRIJB is a CUNY-wide institute created through a partnership amongst the National Park Service, the City of New York, and the City University of New York (CUNY). Our mission is to produce integrated knowledge that increases biodiversity, well-being, and adaptive capacity in coastal communities and waters surrounding Jamaica Bay and New York City. The Institute is hosted and supported by Brooklyn College and works closely with member organizations including NY Sea Grant, the Jamaica Bay Rockaway Parks Conservancy, and the Jamaica Bay Ecowatchers.

New York Sea Grant (NYSG) (www.nyseagrant.org) is a partnership program of the State University of New York, Cornell University, and the National Oceanic and Atmospheric Administration that delivers science-based solutions for environmental stewardship, economic vitality, and resilience across New York's Marine and Great Lakes regions.