Sea Grant
NEW YORK

Natural and Nature-based Features
Case Study #5

Ribbed-mussels. Photo credit: Chester Zarnoch.

Enhancing Denitrification: Nature-Based Approaches for Improving Water Quality, New York

Project Overview

This project examines two sites: the first in the Gansevoort Peninsula Salt Marsh (40.739995, -74.012383) and the second in Jamaica Bay (40.617878, -73.834804). The project goal was to assess the effectiveness of bivalves at improving water quality by examining how oyster and ribbed-mussel cultivation in urban wetlands contributes to denitrification processes and improves water quality. This was achieved by measuring nitrogen fluxes via continuous flow incubations and evaluating the impact of recently transplanted ribbed mussels on plant dynamics and nitrogen processes in restored marshes.

Key Takeaways

- Bivalves can facilitate denitrification in both aquaculture applications and natural reef formations. This is due to range of processes that enhance and stimulate nitrification-denitrification.
- Restoring environments via planting of *Spartina* enhances natural recruitment of ribbed mussels, which can enhance denitrification.
- Research prior to implementation can help determine what qualities or features will be successful at the project site. For example, if oysters are intended for water quality improvement, but are sited in an area with high organic carbon in sediment and high water column nitrate, they won't provide the necessary resources to denitrifying microbes and will not be effective.

Project Context

Salt marshes can provide multiple benefits, including the potential to mitigate anthropogenic alterations to biogeochemical cycles. Urban salt marshes that receive high levels of run-off often experience increased nitrogen loading (eutrophication). Understanding the fate of this nitrogen in restored marshes can influence the implementation and success of NNBF projects.

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srijb.org/nature-based-solutions

Gansevoort Peninsula salt marsh restoration, October 2023. Photo credit: Chester Zarnoch.

Results

- Oyster and ribbed-mussel implementations were generally successful in removing nitrogen via denitrification.
- Certain strategies, such as planting *Spartina*, enhance natural recruitment of bivalves.
- Certain environmental qualities, such as high organic carbon in sediment and the presence of nitrate or nitrite, which is often associated with urban environments, prevent substantial denitrification.

Implications for Practice

Baseline conditions for a site, particularly the biogeochemical metrics, must be considered prior to the implementation of oyster/ribbed-mussel structures that are deployed as a form of NNBF. Additionally, native wetland vegetation can assist in stabilization and natural recruitment.

Featured Researcher: Dr. Chester B. Zarnoch

Dr. Chester B. Zarnoch is a Professor of Environmental Studies and Biology at Baruch College, City University of New York (CUNY), is on the graduate faculty in the Biology Program at CUNY's Graduate Center, and is a member of the affiliate faculty at the Science and Resilience Institute at Jamaica Bay. Dr. Zarnoch has been an active researcher in marine ecology and aquaculture since 2001, and has published papers on shellfish biology, sediment nitrogen cycling, salt marsh ecology, and intensive aquaculture. His current research aims to develop and evaluate nature-based solutions for improving water quality in aquatic ecosystems and for making urban shorelines more resilient to climate change.

Relevant Links

Dr. Chester Zarnoch's Lab Website

Dr. Zarnoch's CUNY Profile

Dr. Zarnoch's Google Scholar

Beyond Bioextraction: The role of oyster-mediated denitrification in nutrient management

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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.