Engineering With Nature
Project Fact Sheet

Computational Modeling of Manmade Oyster Reefs: Life-cycle, Wave Attenuation, Performance, and Reliability

Background

Manmade oyster reefs have been successfully deployed as part of living shoreline approaches but implementing manmade reefs at scale requires computational modeling tools to quantify their long-term performance. Climate-driven changes in sea level, ocean temperature, and pH will combine with anthropogenic environmental changes and natural disturbances to alter the population dynamics of oysters directly and indirectly, which may in turn affect manmade reef performance and reliability. Moreover, numerical modeling studies that simulate the wave attenuation performance of manmade reefs are scarce and applicable coefficients of friction or drag formulations are presently unknown. This project is intended to provide planners and engineers with the engineering and ecological modeling tools needed to predict oyster reef project performance and evolution over the full range of expected future meteorological and climatic conditions.

Objectives

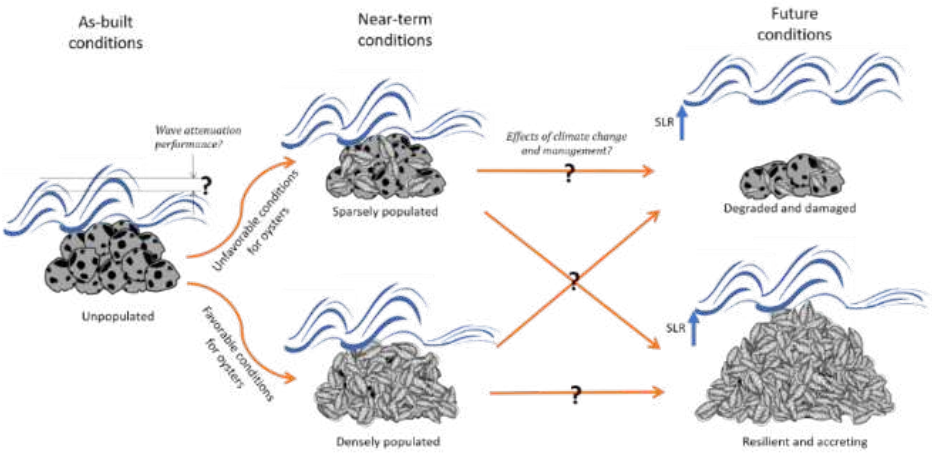
The goal of this project is to advance the state of the practice for manmade oyster reefs through the improvement of performance, life-cycle, and computational modeling tools that can simulate the complex physical and ecological dynamics of these features. The project objectives are to (a) define the appropriate implementation of oyster reefs within existing wave models, (b) determine the effect of the biological layer (i.e., oysters) on manmade reef performance and reliability, (c) ascertain the degree to which future changes exacerbated by climate change will affect reef performance and reliability, (d) provide user guidance on how to computationally model manmade oyster reefs as part of planning and design, and (e) recommend and quantify the effects of management actions to ensure continued performance.

Approach

The project approach is to (1) conduct a literature review of reef model and reef topologies, and develop a conceptual model of manmade reef performance and reliability, (2) define methods for incorporating reef structures and reef population dynamics into common USACE wave models, (3) gather and curate existing oyster reef site data to validate the models, (4) develop wave and population model scenarios for oyster reefs, (5) compare and contract outcomes of wave and population model applications, (6) combine wave and population dynamic models into a combined model application, and (7) assess reef population and wave attenuation performance feedbacks for planning, design, and operations of manmade oyster reef projects.

Outcomes

The new computational modeling tools developed by this project will help USACE design and evaluate proposed reef projects, quantify their benefits and co-benefits (wave attenuation, water quality improvements, increased biodiversity, etc.), and anticipate the performance and evolution of reefs under future environmental conditions. These modeling tools will help promote manmade reefs as an alternative to conventional wave attenuation measures, and demonstrate their resilience, adaptive capacity, and multiple benefits often demanded by project stakeholders.



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