Coral Reef Integrated Model Toolkit

Background

Coral reefs are degrading globally, with populations at an all-time low. Future decision-making for coral reef restoration and sustainability depends on developing an understanding of the complex interactions among the coral reef life cycle, the physical environment, and any human-mediated factors such as management or restoration. In order to accurately forecast the complex dynamics of coral reef systems, an integrated simulation framework is needed that includes coral larvae dispersal as well as population dynamics modeling. NOAA's National Centers for Coastal Ocean Science (NCCOS) and the Engineer Research and Development Center (ERDC) have each developed tools to address these issues individually, but these models have not been integrated into a single toolkit. This multi-agency collaborative effort will integrate existing coral models to refine spatial design of future reef placements and simulate population growth over time to optimize reef-based natural and nature-based feature (NNBF) implementation.

Objectives

Coral reef restoration requires ecologically informed design methods and knowledge of reef dynamics to predict future engineering performance and ecological dynamics, yet integrated technologies are lacking. This project will engage, through workshops, stakeholders from ERDC, NCCOS, Puerto Rico, and the US Virgin Islands to focus on technical aspects of coral risk reduction modeling and to develop strategies for future decision making. Quantitative modeling will yield a state-of-the-art integrated modeling toolkit for coral reef risk reduction. This project aligns with the Engineering With Nature® (EWN®) strategic goal of *Growing the capability to apply EWN® principles and practices at a project and system scale* and will advance the state of knowledge for integrated systems modeling for coral reefs dynamics, while also providing a practical framework for designing reef placement strategies along coastlines.

Approach

A workshop with ERDC modelers and NCCOS technical staff will be held to (1) showcase models developed by each agency, (2) assess current inundation and risk models outside of the ERDC-NCCOS portfolio, (3) gauge model assumptions to determine usefulness for EWN® based coral restoration, and (4) identify model gaps. A second workshop with US Virgin Islands and Puerto Rico stakeholder will determine local needs for risk reduction planning using EWN® reef-based approaches. The model development and integration task focuses on developing and integrating the NCCOS and ERDC models into a useable toolkit for forecasting coral reef dynamics. Subtasks include parameterization of hydrodynamic models for case study sites, studying reef-to-reef connectivity and coral population dynamics, and integration of findings into the model. To develop effective workflow and user guidance for the model toolkit, technical and guidance documents will be developed for different audiences. Content will also be broadly disseminated using the EWN® website, webinars, journal articles, and others.

Outcomes

Coral reefs are declining rapidly, yet they are a critical natural resource that provide numerous ecosystem services, including flood risk reduction. This project will develop a modeling tool and guidance documents for forecasting long term reef dynamics. This fills a critical need to consider the entire life cycle of implementing coral reefs as NNBFs and will help promote the implementation of coral reefs as NNBFs and facilitate their successful incorporation into USACE Coastal Storm Risk Management and restoration studies.

Point of Contact:
Todd M. Swannack, PhD (ERDC-EL), Todd.m.swannack@usace.army.mil, 601 - 415 - 3509