

# Unifying Approaches to Oyster and Coral Reef Research to Accelerate Climate Resilience and Conservation

## OVERVIEW

Biogenic reefs, built by oysters and corals, are the ocean's most biodiverse habitats and support a wealth of threatened ecosystem services and human livelihoods. Oyster and coral reefs provide similar functions and services in temperate vs tropical ecosystems, but are rarely considered together. Comparative study of these systems has exciting potential to accelerate our understanding of reef resilience in the current era of rapid ocean warming and multiple stressors. We seek a postdoctoral fellow who will leverage ongoing research by the Smithsonian Environmental Research Center and the MarineGEO program to take innovative approaches to understand climate change adaptation capacity of coastal marine communities. We are especially interested in research that explores how understanding responses of diverse types of reefs to stressors can inform effective reef conservation and restoration via ecosystem-based adaptation and nature-based solutions.

## IMPORTANCE

Biogenic reefs, created by living marine organisms, are the foundations of marine ecosystems throughout the world, supporting biodiversity and ecosystem services critical to human health and livelihoods. Oyster reefs, primarily in temperate zones, have declined by 85% from historical abundances and are functionally extinct in many regions. Coral reefs, primarily in the tropics, have suffered a 50% decline. The causes of these declines are many, including overfishing, habitat destruction, pollution, and disease, but reefs now face additional, increasing pressure from rapid human population growth and development and rapid ocean warming. Adaptation strategies and science-informed policy responses to these stressors are urgently needed and are a central focus of the UN Decade of Ocean Science for Sustainable Development.

Many of the ecosystem services provided by reefs are shared by oyster and coral reefs: most fundamentally the creation of physical structure, which facilitates provisioning of food and employment opportunities for people, supporting biodiversity, production of fish and shellfish protein, filtration of contaminants and nutrient pollution from the water, providing habitat for reef-associated species and their predators, and others. Despite their functional similarities and complementary geographic distributions, oyster and coral reef ecosystems are rarely considered together in research and conservation. Doing so offers exciting opportunities to cross-fertilize and strengthen understanding of how biogenic marine habitats respond to global change across a broader range of conditions than is possible in either system alone. New comparative and synthetic studies across systems hold the potential to accelerate our understanding of resilience in these parallel, structurally complex ecosystems. Oysters and corals have broad overlap in latitudinal range but shift in relative importance as reef-building species with latitude, providing a natural laboratory for exploring how reef communities and ecosystem services vary across the environmental gradients and how rapid ocean warming will alter the structure and functioning of coastal marine hard-substrate ecosystems. This knowledge will be key to developing ecosystem-based adaptation and nature-based solutions that increase resilience of coastal ecosystems in a warming ocean, and the human communities that depend on them.

## POTENTIAL RESEARCH THEMES

SERC and MarineGEO seek a postdoctoral fellow to explore insights from comparative reef science and how they can inform management, conservation, and restoration to aid recovery, build resilience, and provide benefits to human communities. Research themes could include, but are not limited to:

- Evaluating how oyster and coral reef responses to warming and other stressors are mediated by organismal traits, areal extent, and environment;
- Developing and validating metrics of stress and resilience based on reef location and community composition to identify areas and community types that are resilient versus highly vulnerable;

- Developing better technologies for monitoring reef change and management effectiveness to support ecosystem-based adaptation and nature-based solutions,
- Deriving insights on climate and other impacts on reefs by integrating across systems, time, and space;
- Networking with partners to advance solutions that restore the full benefits coastal communities accrue from healthy reef ecosystems.

## **PROGRAMS AND ASSETS**

MarineGEO is a network of partners around the world collaborating to track the vital signs of coastal marine life, diagnose the causes of change, and inform science-based solutions to build coastal resilience using standardized, coordinated methods. The network has engaged around 100 partners worldwide in comparative research projects, and is expanding along both coasts of the Americas, providing a unique platform for new field research, synthesizing and expanding on MarineGEO's extensive biodiversity and ecological data, building new collaborations, and connecting with coastal communities across latitudinal gradients in two oceans.

The fellow will have access to biodiversity data and time series collected as part of the MarineGEO program and partner initiatives, including multiple years of survey data from SERC and MarineGEO observatory sites around the world, taxonomic and genetic data from intensive biodiversity surveys (BioBlitzes), and from current and past network [projects](#), such as the [Panamex](#), PANELS, and BEACON projects, which continue to generate biodiversity data from coordinated eDNA sampling.

The fellow will have opportunities to collaborate with colleagues and leverage assets from several Smithsonian units, notably MarineGEO's administrative home at the Smithsonian Environmental Research Center, as well as the National Museum of Natural History's Laboratory for Analytical Biology and Ocean DNA initiative. Engagement with MarineGEO network partners can include the National Estuarine Research Reserve System, Marine Biodiversity Observation Network (MBON), Reef Life Survey (RLS) network, and the UN Ocean Decade program Marine Life 2030, among others. Collectively these include data from 100,000s of georeferenced biodiversity observations collected in standardized fashion, often with associated environmental data. Open data sharing is a core tenet of MarineGEO.

## **ADVISORS**

The following SERC and MarineGEO staff commit to serve as advisors for the climate fellows, facilitating access to datasets and project assets: [Matthew Ogburn](#) and [Emmett Duffy](#) (both headquartered at SERC), along with other scientists across the Smithsonian as appropriate.