Macroalgae Research Inspiring Novel Energy Resources (MARINER)

An ARPA-E Project

TECHNIQUES FOR TROPICAL SEAWEED CULTIVATION AND HARVESTING

Marine Biological Laboratory

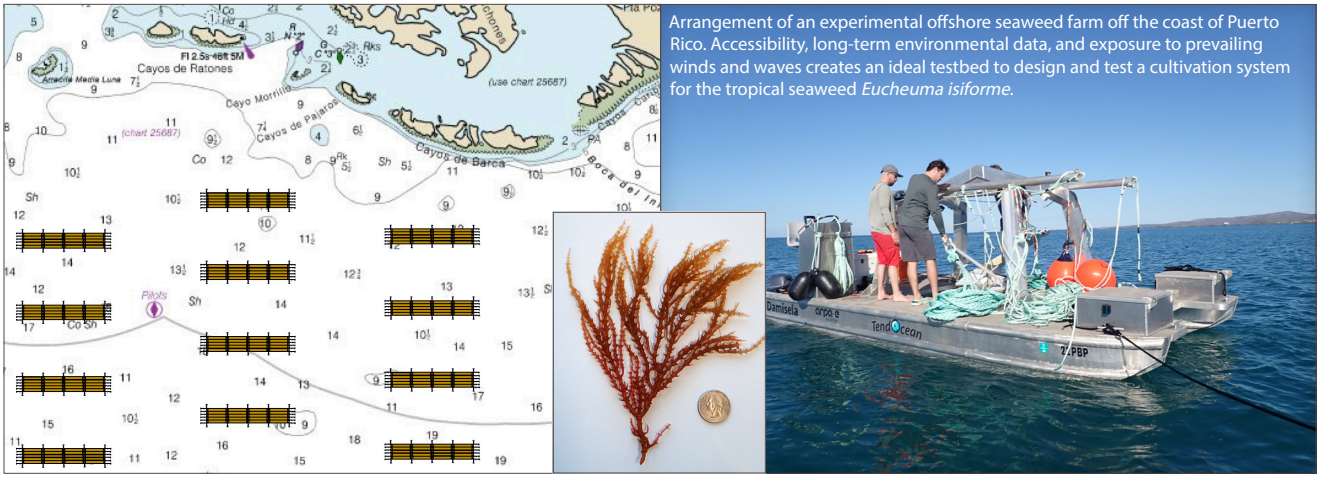
PROJECT SUMMARY

The projects that comprise ARPA-E's MARINER (Macroalgae Research Inspiring Novel Energy Resources) program seek to develop the tools to enable the United States to become a global leader in the production of marine biomass for multiple important applications.

The Marine Biological Laboratory (MBL), located in Woods Hole, MA, is leading a MARINER Category 1 project to design and develop a cultivation system for the tropical seaweed Eucheuma isiforme to produce biomass for biofuels. Eucheuma is a commercially valuable species of "red" macroalgae (also referred to as seaweeds or kelp), primarily cultivated in Asia, which has been difficult to propagate in a cost-effective manner. Cultivation of Eucheuma is labor intensive—making up almost 70% of the production costs—and is limited to easily accessible areas near shore.

The project team is developing a farm system that will mechanize the seeding and harvesting process. The effort will drastically reduce labor costs and allow farms to be deployed in offshore areas to greatly expand large-scale production that increases biomass yield per dollar of capital. The ultimate goal of the project is to cost-effectively produce biomass in underutilized areas of the Gulf of Mexico and tropical U.S. Exclusive Economic Zones where year-round production is possible.

The project has experimental seaweed farms in Puerto Rico, Belize, and Florida. The wide range of wind, wave, and temperature regimes across the sites enables the team to explore the influence of environmental conditions on biological, physiological, and chemical properties of cultivated macroalgae. If successful, this project could disrupt the current practices in the red macroalgae market, reduce reliance on imports from foreign sources, and ultimately scale to production levels relevant for bioenergy production.



Arrangement of an experimental offshore seaweed farm off the coast of Puerto Rico. Accessibility, long-term environmental data, and exposure to prevailing winds and waves creates an ideal testbed to design and test a cultivation system for the tropical seaweed *Eucheuma isiforme.*

PROJECT IMPACTS

Security: Production of biofuels from domestically produced marine biomass could lessen U.S. dependence on foreign oil, bolstering energy security.

Environment: Growing large amounts of macroalgae would not compete with land-based food crops, requires no fresh water, and can be grown without the addition of energy-intensive, synthetic nitrogen fertilizer. Large-scale macroalgae cultivation may help reduce the negative effects of nutrient overload and ocean acidification in many coastal ocean regions.

Economy: A domestic macroalgae industry would not only create a valuable new source of domestic energy, but also create significant new economic and employment opportunities in many waterfront communities along the U.S. coasts from Maine to the Gulf of Mexico, Alaska, and the Pacific Islands.

LEAD INVESTIGATOR

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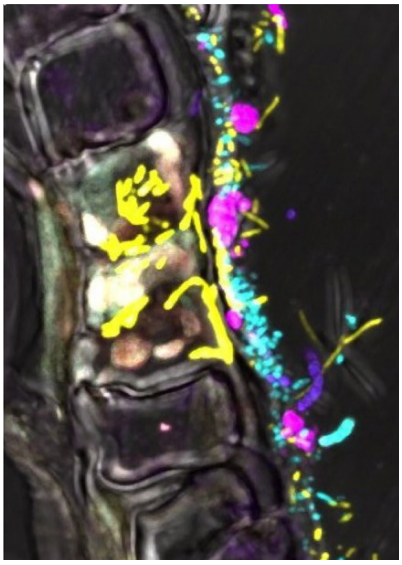
Education

California State University, Northridge – Biology, B.S. 1994
Stanford University, Stanford, CA – Biological Sciences, Ph.D. 2001

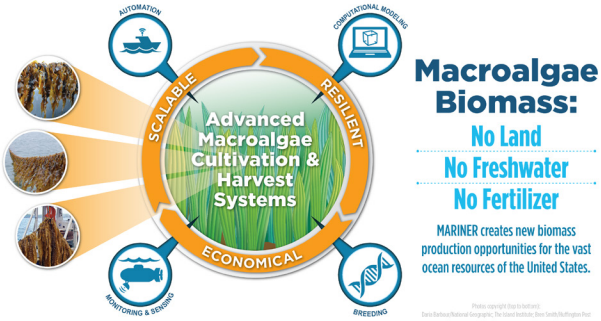
Research Focus

Loretta Roberson is interested in how organisms respond to anthropogenic impacts on coastal marine systems as well as ways to help mitigate or reduce those impacts. As more and more people move to coastal areas and global processes influence local conditions, more pressure is placed on these systems, often with devastating results like the global coral bleaching event in 2016.

The Roberson lab has two main focus areas: (1) use of macroalgae as biomass for sustainable biofuel production and bioremediation and (2) understanding the mechanisms of calcification in corals.



The microbiome of a kelp blade is shown using the MBL-developed imaging technique CLASI-FISH, which provides the unique ability to simultaneously image and identify 15+ microbial taxa. Understanding the microbiome of macroalgae can help improve productivity or prevent disease. MBL scientists participate in microbiome studies at scales ranging from the world's oceans to the human gut.



PRINCIPAL INVESTIGATORS

THE UNIVERSITY OF CHICAGO MARINE BIOLOGICAL LABORATORY · C.A. Goudey & Associates · UCONN · Woods Hole Oceanographic Institution

COLLABORATORS:

CariCOOS (Caribbean Coastal Ocean Observing System), CINVESTAV, The Nature Conservancy, Pacific Northwest National Laboratory, University of California Irvine, Makai Ocean Engineering, Rutgers University, Two Docks Shellfish, University of California Santa Barbara, University of Puerto Rico Rio Piedras, University of Puerto Rico Mayaguez, Cascadia Research Collective.

The Marine Biological Laboratory (MBL) is dedicated to scientific discovery – exploring fundamental biology, understanding biodiversity and the environment, and informing the human condition through research and education. Founded in Woods Hole, Massachusetts in 1888, the MBL is a private, nonprofit institution and an affiliate of the University of Chicago.

Learn more at mbl.edu

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