The Guam Ecosystem Collaboratorium's Biorepository

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The Guam Ecosystem Collaboratorium

A global network of research collaborators (individuals and institutions) working on problems of common interest

Collaboration in data collection, storage, digitization, access and analysis

Utilization of existing collections and data sets at a global scale

Utilization of innovative methods to facilitate data analysis and sharing

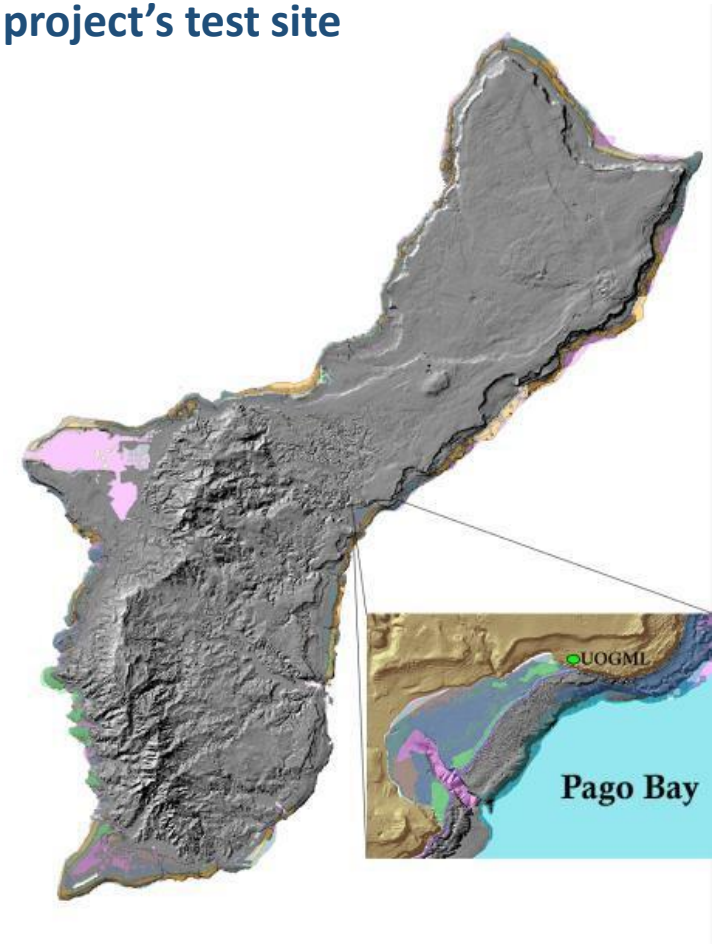
Provision for training and research opportunities between institutions

Support from the **U.S. National Science Foundation's Experimental Program to Stimulate Competitive Research (EPSCOR)**, the University of Guam, and other sources

Where: GEC's current focus is upon the Micronesian Region

Marshall Islands (southwest of Hawai'i) west to the Palau Islands (southwest of Guam)

Guam and Pago Bay, the project's test site



Why: Coral reefs suffer from a number of environmental stressors

- Ocean temperature rise pushes coral reef organisms up against their thermal tolerance levels
- Poor land-use practices create turbidity and sedimentation in coastal systems
- Ocean acidification impacts coral reef and marine systems in a number of ways

Coral reef and marine systems suffer considerable degradation from these and other stressors alone or more frequently in combination

Loss of:

Habitat and shelter

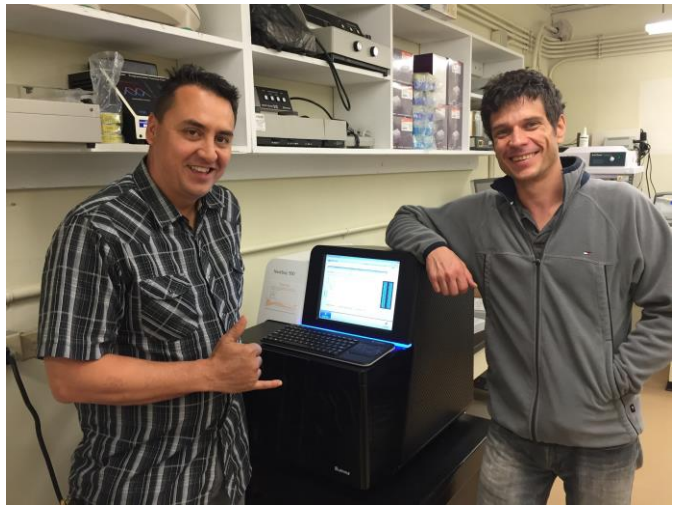
Food

Mating sites

- Localized extinctions of species
- Negative ecological cascades
- Loss of biodiversity locally, regionally and globally

Guam Ecosystem Collaboratorium Biorepository Objectives

- Create a state-of-the-art “warehouse” of the Micronesian Region’s marine biodiversity
- Utilize iDigBio and related protocols to curate new specimens
- Digitize existing collection holdings and data sets
- Create and provide global access to the Biorepository’s data base through existing networks
- Increase local and regional capacity for scientific research and promote unique biodiversity of region for international collaborations



Role of the Biodepository in advancing research on the biodiversity of marine organisms in the Micronesian Region

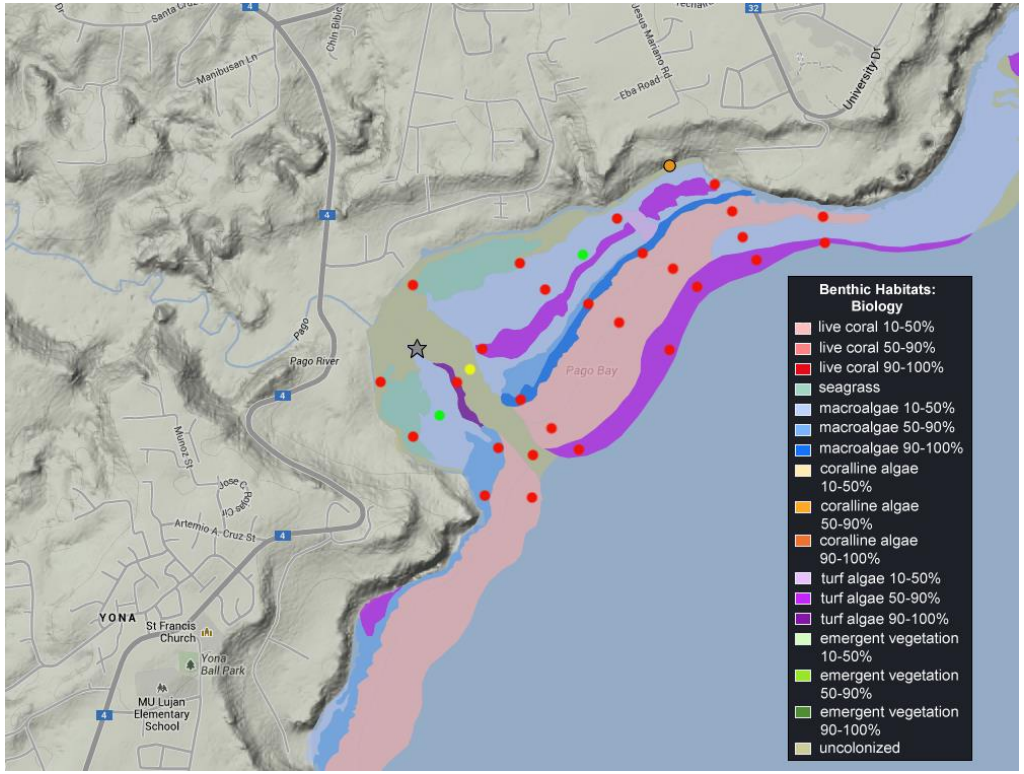
- Identify “key” biotic and abiotic drivers of population structure – Discover, identify, and characterize genotype-specific coral colonies that survive in extreme environments, as well as describe environments where they can or cannot thrive
- Initially, the Biorepository will make it possible to investigate current levels of genetic diversity within two target species of corals, *Montipora venosa* and *Porites rus*, and allow for the identification of source and sink populations
- Inform resource managers of sites that if saved, can serve as “sources” for natural repopulation on local scales

Process: Collect and store various forms of data that may be accessed by researchers globally for scientific research-

- Voucher specimens
- Collection metadata
- Whole organism data
- Genetic data (i.e., genomes)
- Organismal data (i.e., otoliths, gonads, etc.)
- Oceanographic data
- Ecological, geological and environmental data
- Behavioral data

Biodiversity and the Physical Environment

- Identify new forms of biodiversity (interspecific and intraspecific)
- Characterize genotypic-specific responses that promote survival in extreme environments (i.e. ocean warming, turbidity and ocean acidification)
- Identify and describe climate-driven oceanographic conditions that put species at risk.
- Relate genotypic responses of populations to these oceanographic conditions
- Identify populations that can switch-on genes to cope with one or more environmental stressors (temperature, turbidity, ocean acidification)



Process: molecular approaches to detect and measure environmental responses-

- Sample collection, RNA isolation, and Next Generation Sequencing of samples collected from populations of various species

- *De novo* assembly of transcriptomes for use in measuring gene expression under different environmental regimes and to determine phylogenetic (connectivity) patterns to define genetic linkages within and between sites

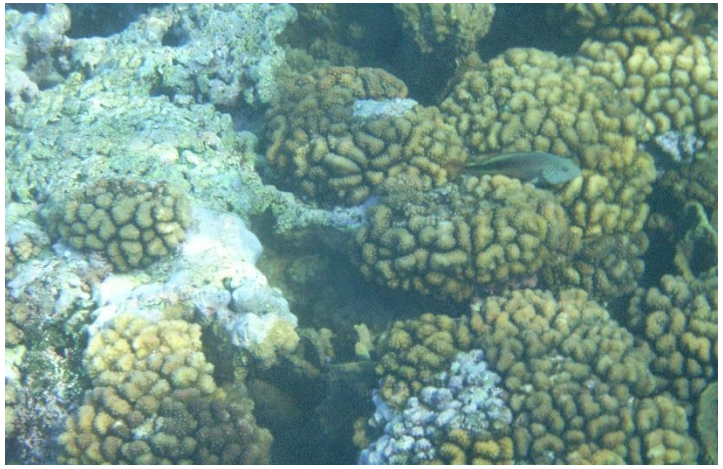
- *De novo* assembly and transcriptome analyses will use bioinformatic pipelines for working with genetic sequences from populations of each species.

- Identification of microsatellites and Single Nucleotide Polymorphisms (SNPs) that control responses

Process: Additional outputs

- Collections and genetic analyses will emphasize discovering, characterizing, and DNA barcoding of currently known and new species

- Within 5-10 years it will be possible to inexpensively and routinely sequence the genome of every research sample



Data Storage

Data will be cross-referenced in a virtual library containing:

- Biometric specimen data
- High-resolution digital photographs
- Videos made at collection sites
- Habitat characteristics of collection sites
- Behavioral characteristics of organisms at collection sites

Cyberinfrastructure and Data Access

- Create a centralized, shared research computing and storage cluster
- This cluster will support a variety of GEC research activities, collaboration tools, and databases
- Dedicated servers for storage and access to cross-referenced data base
- Fiber-optic network for high speed connectivity
- Internet2 to facilitate big data transfer and global access by researchers
- The University of Guam will collaborate with the University of Hawai'i, the Network Startup Resource Center, Pacific Wave, the Western Regional Network, and the Energy Science Network for mentoring and consultation during the development of and implementation of its cyberinfrastructure improvement plan

Incorporation of existing University of Guam collections into the Biorepository Data Base

Marine plant herbarium (see Tom Schils' talk today)

Terrestrial plan herbarium

Diatom and Microscopic Algae Collection

Richard H. Randall Coral Collection (>30,00 specimens)

Richard Dickenson Memorial Mollusc Collection

Invertebrate Collection

Collection of Fishes and Bar Code of Mariana Islands Fish Life Collection

Outcomes

- Digitized collection data for a wide range of marine and aquatic species, collection localities and sites, and kinds of specimens
- Global access to biodiversity data found within the Micronesian region
- Increased local capacity for biological and oceanographic research
- Collaborations established that increase opportunities for graduate and under graduate student research experiences at the University of Guam and collaborating institutions
- Increased ability to accurately identify coral reef species
- GIS-based map of coral and other species at research sites
- Integration of remote sensing data with Biorepository data base
- Increased rates of scientific discovery
- Increased authorship of peer-reviewed publications
- Increased collaboration in large-scale funding schemes

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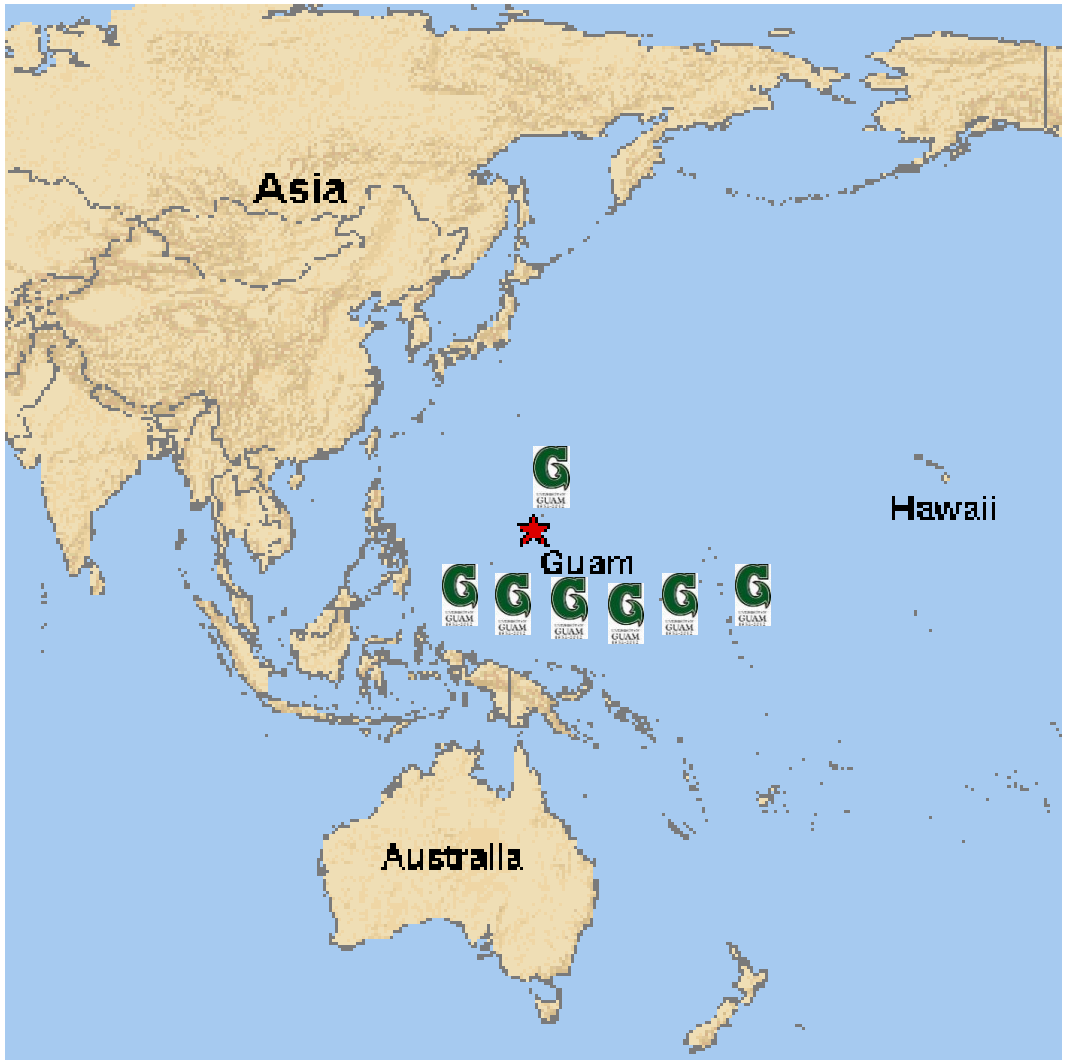

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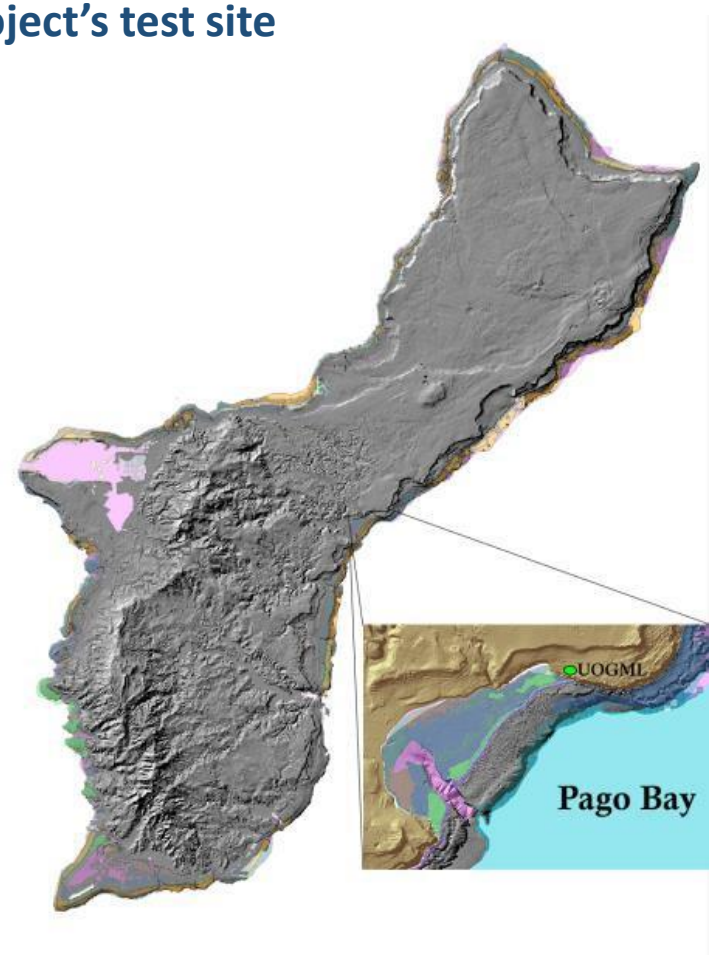

Acknowledgments

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