HARBOR BRANCH

FLORIDA ATLANTIC UNIVERSITY®

RESEARCH TOOLBOX

For the past four decades, Harbor Branch Oceanographic Institute at Florida Atlantic University has been conducting research in the Florida marine ecosystems that are at risk for damage from the Deepwater Horizon oil spill in the Gulf of Mexico. The following outlines the Harbor Branch research areas and expertise, baseline data, and tools, technologies, and techniques that may be employed to help understand and mitigate the environmental consequences of this ecological tragedy.

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RESEARCH AREAS & EXPERTISE

Coral Reefs

- We use newly developed molecular technologies and traditional field ecology to diagnose coral health, identify major stressors, and understand the etiology of coral diseases.
- Our habitat mapping and characterization of Florida's deepwater *Oculina* and *Lophelia* coral reefs and *Lophelia* banks in the Gulf of Mexico can serve as a pre-spill baseline.

Edge, Sara (sedge4@hboi.fau.edu) - use of advanced molecular diagnostics (microarray analysis) to detect and characterize environmental stress responses in corals and to identify the mechanisms behind coral bleaching and disease infection

Hanisak, Dennis (dhanisak@hboi.fau.edu) - nitrogen and phosphorus status of coral reef algae, monitoring reef recovery following major impacts, and mesophotic algal communities of the Gulf of Mexico, Florida Keys, southeast U.S. continental shelf, and Caribbean

Lapointe, Brian (blapoin1@hboi.fau.edu) - coral reef eutrophication (excessive, harmful algae growth) and stable isotope analysis for assessing nutrient sources to coastal waters

Pomponi, Shirley (spomponi@hboi.fau.edu) - biology and systematics of deep, mesophotic, and shallow coral reef sponges throughout the Gulf of Mexico, Florida Keys, southeast U.S. continental shelf, and Caribbean

Reed, John (jreed12@hboi.fau.edu) - biology of deep-water coral reefs and taxonomy of reef organisms, including mapping and habitat characterization of shallow, mesophotic, and deep reef environments throughout the Gulf of Mexico, Florida Keys, southeast U.S. continental shelf, and Caribbean

Voss, Joshua (jvoss2@hboi.fau.edu) - coral reef ecology and community dynamics, molecular profiling of bacterial communities, and development of advanced molecular technologies to identify environmental drivers and impacts of coral diseases

Seagrass Communities, Mangroves, & Salt Marshes

- Our understanding of the effects of water quality on seagrass and algal communities represents important baseline data on ecosystem health.
- We study the basic ecology and ecological genetics of estuarine populations, including assessment of the importance of biodiversity and parasite-host relationships.
- We use mangrove mutation rates as indicators of pollution and restoration ecology of marsh and mangrove systems.

Devlin, Donna (ddevlin@fau.edu) - molecular (microsatellites, AFLPs), organismal (defense compounds, plant physiology), population (population biology), community (plant-animal interactions, plant-plant competition) and landscape (mangrove forests and salt marshes, restoration ecology)

Hanisak, Dennis (dhanisak@hboi.fau.edu) - physiology and ecology of marine plants (primarily macroalgae and seagrasses), including primary production, nutrient uptake, and photobiology, as well as cultivation and utilization as resources

Lapointe, Brian (blapoin1@hboi.fau.edu) - harmful algal blooms in subtropical and tropical coastal ecosystems, seagrass ecology, and physiological ecology of invasive macroalgae

Proffitt, Ed (cproffit@fau.edu) - ecology of marine and estuarine macrophytes (mangroves, salt marsh, and seagrass systems) and invertebrates, restoration ecology, and conservation genetics

Oyster Reefs

- Our work has included restoration ecology of oysters in the St. Lucie Estuary and Lake Worth Lagoon.
- We use genetic research to assess source/sink dynamics in natural and restored reefs, including the importance of oysters associated with mangroves as contributors of larvae for reefs.

Scarpa, John (jscarpa1@hboi.fau.edu) - bivalve culture and genome manipulation, oyster restoration/ecology, and delineation of culture requirements of pharmacologically important species

Laramore, Susan (slaramo1@hboi.fau.edu) - histological analysis of aquatic animal health, crustacean, and bivalve diseases; the effect of the environment on the progression of these diseases and immune system function

Proffitt, Ed (cproffit@fau.edu) - ecology of marine and estuarine macrophytes (mangroves, salt marsh, and seagrass systems) and invertebrates, restoration ecology, and conservation genetics

Deep Sea & Open Ocean Communities

- We have conducted extensive exploration, habitat characterization, biochemical analyses, and systematics research of deep water invertebrates (including vulnerable coral and sponge communities) from the Gulf of Mexico, Florida Keys, and southeastern U.S. shelf.
- Our phytoplankton research includes taxonomy, isolation, and culture.
- We use a variety of sampling techniques (plankton and neuston nets, opening/closing Tucker Trawl, MOCNESS) to quantify the daytime distribution patterns and vertical migrations of zooplankton and micronekton.
- We have characterized the physiology and ecology of harmful algal blooms in South Florida coastal waters, the Gulf of Mexico, and the Caribbean.

Frank, Tamara (tfrank3@hboi.fau.edu) - ecology, behavior, and visual physiology of zooplankton and micronekton; predator-prey interactions; effects of light on behavior; vertical migrations in the mesopelagic realm; water column sampling techniques; and electrophysiology

Hanisak, Dennis (dhanisak@hboi.fau.edu) - effects of water quality on phytoplankton and effects of oil on algal reproduction

Lapointe, Brian (blapoin1@hboi.fau.edu) - harmful algal blooms in subtropical and tropical coastal ecosystems and stable isotope analysis for assessing nutrient sources to coastal waters

Pomponi, Shirley (spomponi@hboi.fau.edu) - cell and molecular biology, physiology, and systematics of marine sponges from shallow and deep-water benthic environments throughout the Gulf of Mexico, Florida Keys, southeast U.S. continental shelf, and Caribbean

Marine Mammals

- We conduct stranding response, recovery, and transport of live or deceased marine mammals.
- We conduct large marine mammal necropsies and pathology, and we archive tissues and serum for post-pathobiological analysis.
- We perform population health assessment and epidemiology analysis.
- Our research includes offshore and near-shore surveys and satellite-linked telemetry to monitor marine mammal movement and behavior.
- We use advanced molecular genetic techniques in our ancient DNA laboratory.
- Beginning in August 2010, we will be providing veterinary medical treatment and clinical assessment of marine mammals at the HBOI Critical Care Center.

Goldstein, Juli (jgolds31@hboi.fau.edu) - etiopathogenesis of *Kogia* spp. cardiomyopathy, diagnostic ultrasound, marine mammal rescue and rehabilitation, marine mammal conservation medicine, and policy

Mazzoil, Marilyn (mmazzoil@hboi.fau.edu) - population ecology of dolphins in the Indian River Lagoon and the occurrence of infectious diseases related to site fidelity and environmental data

McCulloch, Steve (smccull5@hboi.fau.edu) - dolphin photo-identification, whale research, and marine mammal rescue and rehabilitation

O'Corry-Crowe, Greg (gocorryc@hboi.fau.edu) - use of molecular genetic techniques and satellite-linked telemetry to study the molecular and behavioral ecology of northern temperate, polar, tropical, and subtropical marine mammals

Schaefer, Adam (aschaefer@hboi.fau.edu) - use of modern epidemiological methods for the study of diseases across marine mammal populations to identify environmental and anthropogenic impacts on wildlife health

Marine Natural Products & Microbial Populations

- Our work includes identification and quantification of the presence of secondary metabolites, including marine toxins produced by marine organisms under both normal and stressed conditions.

- We conduct research on the microbial populations associated with marine invertebrates and sediments using both cultivation and molecular techniques.

Guzmán, Esther (eguzman9@hboi.fau.edu) - the design of high-throughput assays to measure changes in gene and protein expression in cell lines treated with various effector molecules

McCarthy, Peter (pmccart5@hboi.fau.edu) - heterotrophic microbes associated with sponges and their use in biotechnology, such as novel sources of pharmaceutical agents and a new resource for the conversion of terrestrial and marine biomass into biofuels

Pomponi, Shirley (spomponi@hboi.fau.edu) - development of *in vitro* methods for sustainable use of marine-derived chemicals with biotechnological/biomedical applications

Wright, Amy (awrigh33@hboi.fau.edu) - investigation of marine natural products from marine invertebrates and associated bacterial symbionts

Stock Enhancement & Restoration

- We research and develop aquaculture technology to grow fish, invertebrates, and plants for restoring delicate habitats and restocking for fisheries and sport fishing.

Davis, Megan (mdavi105@hboi.fau.edu) - aquaculture of tropical species, including queen conch and spiny lobster; areas of specialty include early life history, nursery and grow out techniques, stock enhancement, and conservation ecology

Garr, Amber (agarr1@hboi.fau.edu) - apple snail stock enhancement and queen conch biology and life history, including effects of the environment on larval development and metamorphosis, captive breeding, nutrition, and juvenile growout programs for stock enhancement

Scarpa, John (jscarpa1@hboi.fau.edu) - bivalve culture and genome manipulation, oyster restoration/ecology, and delineation of culture requirements of pharmacologically important species

Wills, Paul (pwills2@hboi.fau.edu) - development of techniques for intensive controlled aquaculture of high-quality, healthy marine fish suitable for stock enhancement, restoration, and mitigation

Ocean Engineering & Technology

- We develop sensors and sensing systems to collect data on water quality and marine species.
- We study and develop optics and imaging systems to characterize the undersea environment and advance communications.

Dalgleish, Fraser (**fdalglei@hboi.fau.edu**) - underwater laser imaging and communications, optical properties in marine environments, sensor networks, and fluorescence imaging

Frey, Lee (**cfrey@hboi.fau.edu**) - underwater vehicles, robotics, oceanographic instrumentation, optical sensors, control and data acquisition systems, and at-sea operations

Ouyang, Bing (**bouyang@hboi.fau.edu**) - computer vision and image understanding, signal and image processing, and underwater acoustic signal processing

Vuorenkoski Dalgleish, Anni (**adalglei@hboi.fau.edu**) - fluid dynamics, marine particle dynamics, optical diagnostics of fluids and flows, fluorescence and dropsize imaging of hydrocarbon aerosols, and thermodynamics

BASELINE DATA

Baseline Data from Four Decades of Research in Marine Environments

- Characterization of baseline populations of sponges and corals in deep benthic and reef habitats (to 900 m) throughout the northern and eastern Gulf of Mexico, Florida Keys, Atlantic coastal region, Georgia, and South Carolina
- Coral health monitoring (surveys and genetics) of deep and shallow water reefs in the Gulf of Mexico, Florida Keys, South Florida, the Bahamas, and Caribbean
- 25-year record of low-level nutrient data at Looe Key in the Florida Keys, the longest record of coral reef water quality anywhere in the world
- More than 13 years of Indian River Lagoon (IRL) marine mammal study (surveys, genetics, environment)
- Five years of IRL water quality and seagrass monitoring
- Red mangrove mutation rates from virtually every mangrove-dominated estuary in Florida; additional data on tree size and reproductive output for these same sites
- Collection of more than 5,000 frozen and ethanol preserved marine specimens collected in the Gulf of Mexico and Florida in benthic habitats up to 900 m to define pre-spill genetic, microbial, and natural products data

TOOLS, TECHNOLGIES, & TECHNIQUES

Advanced Molecular Genetic Techniques

- Microarray Lab, including a coral health-focused microarray to identify sub-lethal responses to stress or disease
- Quantitative real-time PCR
- Length-heterogeneity PCR
- Genetic sequencing
- Ancient DNA Lab
- Microsatellite analysis
- Fluorescent microscopy

Microbial Community Profiling

- Using both traditional and newer molecular techniques

Histological and Diagnostic Services

- Wax embedding and staining for light microscopy
- Plastic embedding, slicing (thick and thin tissues), and staining for light and transmission electron microscopy

Electrophysiology

- Extracellular (whole animals) and intracellular (isolated tissue) recording techniques

Marine Mammal Veterinary Medicine

- Marine Mammal Critical Care Center (100,000 gal. pool and life support systems)
- Critical Care and Diagnostics Lab
- Aquatic animal diagnostic ultrasound
- State-of-the-art animal pathology facility
- Full-service triage lab for diagnosis and treatment of sick and injured marine mammals
- Population health assessment and epidemiology analysis

Population Biology and Ecology of Marine Apex Predators

- Life history - reproduction, survival rates, mortality
- Telemetry - movements, habitat use, dive patterns
- Surveys - photo-ID, boat-based, and aerial surveys
- Monitoring - capture and remote sampling, monitoring methodologies

Water Quality Analyses

- Monitoring of standard water quality parameters (temperature, salinity, pH, dissolved oxygen, turbidity, chlorophyll *a*)
- Nutrient chemistry (TDN, TDP, ammonium, nitrate, nitrite, SRP)
- Algal tissue nutrients (C:N:P and $\delta^{15}N$)
- EnviroTech "MicroLAB" *in situ* ammonium, nitrate, and phosphate analyzers deployable to 300 m for extended periods
- Seabird "SeaCat" model SBE-19 conductivity, temperature, and density recorder; fitted with fluorometer and transmissometer

- LiCor underwater irradiance measurement systems with terrestrial and submersible PAR sensors interfaced with LiCor dataloggers

Water Column Sampling

- 9 m^2 opening/closing Tucker Trawl (1/4" knotless nylon primary net) with thermally insulated cod-end
- MOC-1 and MOC-10 systems with 153 and 335 μm mesh sizes available; equipped with DOM fluorometer and sensors for temperature, salinity, dissolved oxygen, and light transmission
- CTD - Seabird 911+ with water sampling rosette and sensors available for salinity, temperature, dissolved oxygen, chlorophyll, DOM, and PAR
- EnviroTech Undulating Towed Vehicle (U-Tow) - similar to CTD but can be towed and is therefore optimal for large-scale spatial surveys; payload includes sensors for dissolved oxygen, fluorescence, DOM, and light transmission
- ADCP for current speeds/direction and scattering layer profiling; available models are 38 kHz and 150 kHz Ocean Surveyors, and a 300 kHz lowered ADCP or Work Horse Sentinel

Advanced Chemistry Lab

- Identification and quantification of secondary metabolites and toxins produced by marine plants, invertebrates, and microbes, and measurement of changes in secondary metabolism of these organisms in response to environmental stressors
- Chemical instrumentation lab including HPLC, LC-MS, UV, and high-field NMR analytical capabilities
- High-throughput measurement of differential protein expression and activation related to stress response by FACS Calibur flow cytometric analysis

Ocean Engineering

- Laser line scan undersea imaging - applied research in imaging system performance, prediction model validation, and development of novel hardware for undersea imaging
- Fluorescence imaging - assessment of benthic community structure and coral health
- Lab-based spectro-fluorometer (Horiba Fluoromax-3) for lifetime and spectral measurement of fluorescing compounds
- Inherent optical properties characterization of undersea optical environment (spectral absorption and scattering coefficients, fluorescence, scattering phase function), with *in situ* devices for polarization-sensitive measurements
- Deep coral reef observatory - monitoring and assessing the status of deep-water *Oculina* reef with acoustic recorder, time lapse photographs, CTD, and fouling plates

- Medusa landers – portable, autonomous observatories designed to make unobtrusive video recordings of deep-sea life and water quality measurements down to 2,000 m
- HIDEX Gen 3 - the high-intake defined excitation bathyphotometer, a shipboard profiling instrument designed to measure bioluminescence and related water parameters; contains water samplers and video recording Panther-II Remotely Operated Vehicle (ROV); for use down to 1000 m
- BP drifter - an autonomous, drifting, profiling instrument that can be used to find and measure bioluminescent thin-layers down to 1000 m
- LoLAR II - low-light auto-calibrating radiometer is a computer-controlled, PMT-based, self-calibrating radiometer that measures propagation of light in the ocean down to 1000 m
- AUVs - two autonomous underwater vehicles outfitted with CTD, ADCP, sidescan sonar, and fluorimeter; for use down to 100 m
- DRONE swarming autonomous surface vehicles - investigating the potential of cooperative ASV swarms to seek out and follow thermal, chemical, or bioluminescent plumes