

**HARBOR BRANCH OCEANOGRAPHIC INSTITUTE
AT FLORIDA ATLANTIC UNIVERSITY
INFRASTRUCTURE**

Aquaculture and Stock Enhancement

Fish Aquaculture – Contact [Paul Wills](#)

The HBOI-FAU and USDA-ARS fish culture facilities have pretreated fresh and saltwater, aeration, emergency oxygen systems, and backup power generators. Each of the 5 culture buildings is a 4,500 ft² metal clad agricultural building with an automated forced air ventilation system for heat control during summer and propane fired heaters for temperature control during winter months.

The engineering building includes:

- A 60 m² shop area, a 37 m² air conditioned analytical field laboratory, a 37 m² AC laboratory culture area
- A ventilated 165 m² building with two recirculating systems (one ten tank and one nine tank; 1 m³ tanks), a 3 hp rotary vane blower, a 2 hp rotary vane blower, 0.6 m³ polygeyser filter, two 350 Lpm rotary drum filter, nine 0.1 m³ moving bed filters, one 0.8 m³ moving bed filter, two 200 Lpm foam fractionators with ozone control. Both systems are utilized for pilot scale studies and equipment evaluation.
- Handheld and laboratory equipment includes various scales, two HACH 2700 spectrophotometers, HACH HQ30 and HQ40 dissolved oxygen meters, YSI salinity and conductivity meters, Pointfour™ CO₂ meter, a CO₂ gas meter, a gas tensionometer, YSI multiprobe meter, nine YSI 5200 water quality monitor and control units, BOD and COD analyzers, and a tabletop pH meter

The nutrition laboratory includes:

- Supply of ozone sterilized fresh and saltwater
- Includes over 300 tanks of various capacities from 10 to 1,400 L which have temperature control and are recirculating or flow-through systems

The nutrition analytical laboratory (1,900 ft²):

- Is equipped for nutritional, biochemical and physiological measurements with a temperature-controlled centrifuge, micro-hematocrit centrifuge, tissue homogenizers, freeze dryer, ultra-cold freezer, water baths, analytical balances, pH meters, and distilled R/O water
- Analytical equipment includes bomb calorimeter; muffle furnace; N-analyzer; Soxhlet apparatus; automated lipid extractor; automated ADF, NDF, ADL fiber analyzer; heating block; UV-VIS spectrophotometer with Peltier temperature

controller and nucleic acid, protein, fraction read/plot, enzyme kinetics, and enzyme mechanism analysis capability; ICP spectrometer, vapor pressure osmometer; I-Stat clinical blood analyzer; blood glucose meter; an HPLC with UV and fluorescence detectors; an amino acid derivatization workstation; and a GC/MS with an auto-sampler and SPME capability.

The experimental feed manufacturing laboratory (1,500 ft²) and air conditioned feed storage area (750 ft²):

- Is equipped with equipment for manufacturing and storing diets
- Equipment includes an ingredient particle size reduction Kelly-Duplex hammermill, Wiley mill, Patterson-Kelly 16-qt twin-shell V-mixer, two industrial food mixer/grinders, Marion paddle mixer, CPM diet crumbler, 604 ft³ walk-in cooler for ingredient storage, 27 ft³ automated drying oven

The reproduction and larviculture laboratory includes:

- 12 replicated 5,700-L broodstock recirculating tank units equipped with temperature and light control rotifer and *Artemia* culture rooms, egg incubation system with 12 125-L tanks, a larviculture system containing 48 recirculating tank units (110-L), a spawning/mass hatching system of eight 800-L, and water quality analysis equipment and microscopes

The production scale sustainable tank aquaculture recirculating research (STARR) facility contains:

- Four 45 m³ high-head recirculating aquaculture systems and four 43 m³ low-head recirculating aquaculture systems
- Each high-head system has two 0.7 m³ propeller-wash bead filters, three 2 hp centrifugal pumps, degassing towers, an oxygen contactor, and in-tank oxygenation with micropore oxygen diffusers
- Each low-head systems has a moving bed bioreactor capable of holding 4.75 m³ of structured biofilter media at 70% fill, a single 1.5 hp stainless steel propeller pump, and two 3.5 hp regenerative blowers for biofilter media movement and degassing, and in-tank oxygenation with micropore oxygen diffusers
- Each of the eight systems includes a microscreen rotating drum filter for primary solids control, 0.6 m³ side tank static filters for additional biofiltration and fine solids removal, and an 800 watt 250 nm UV sterilizer for pathogen control
- Other system equipment includes automatic feeders for each tank, oxygen probes in each tank with PLC control of tank oxygen input, water meters for monitoring saltwater, freshwater, and drum filter rinse water of each system as well as facility salt and freshwater use, kilowatt meters, oxygen mass flow meters for each system, and two 2.5 hp regenerative air blowers

- The facility has two 15 m³ storage tanks for freshwater on a constant recirculating polishing loop that includes bag filtration (5 microns) and UV sterilization

Bivalve Research Facility – Contact [John Scarpa](#)

A 6,780 ft² culture facility is used primarily for bivalve hatchery and nursery research, but can be used for other invertebrate (e.g., sponge, tunicate) research. It is equipped with:

- Filtered and UV-treated seawater from a salt water well, thereby limiting pathogen introduction; effluent is directed to retention ponds
- An assortment of tanks (eight 125-gallon cylindrical for larvae culture and 38 125-gallon rectangular for nursery culture) for experimental culture and two temperature controlled conditioning systems (each with six 250 gallon circular tanks)
- Microalgae culture is performed in a 1,200 sq ft. environmentally-controlled room with an associated prep area and autoclave. The culture area maintains monocultures and produces up to 1000L of high-density microalgae/day

Gastropod Research Facility (queen conch and apple snails) – Contact [Amber Garr](#)

A 1,500 ft² facility has fresh and salt water and houses:

- Five recirculating aquaculture systems that include sixteen 2' x 8' stacked troughs, six 5' to 6' circular tanks, six 2' x 10' stacked troughs, a 24 tank experimental research system, 24 individual aquariums used in bioaccumulations studies
- Each of the systems has an individual heater or heater/chiller with thermostat control
- The building has a thermostat controlled cooling system to maintain a semi-constant temperature and a light timer to maintain photoperiod

An additional insulated 1,156 ft² facility equipped with salt water houses:

- A 160 ft² dry lab that has two temperature and light controlled incubators and
- Air conditioning to maintain the room temperature
- Two work benches suitable for microscopes, aquariums, or other laboratory equipment

Aquatic Animal Health Laboratory Facilities – Contact [Susan Laramore](#)

The 685 ft² Aquatic Animal Health Laboratory has equipment and space for diagnostic work and research with bacteria, viruses, fungi and parasites through molecular, microbiological and histological techniques. The facility is divided into 4 rooms – PCR, Microbiology room ~ 265 ft², wet lab ~295 ft², Changing room ~ 60 ft², Entry and viewing room 65 ft². Equipment includes:

- PCR: 16 KM Marathon centrifuge, 96 well Biorad I-cycler thermocycler, 48 well thermolyne amplifitron II thermocycler, standard heat block, UV illuminator and AccuPower electrophoresis power supply; 2 Kodak BioMax QS 710 horizontal electrophoresis units and a IBI 2025 horizontal gel electrophoresis unit; a polaroid gel camera and 0.85x and 0.3x electrophoresis hoods
- Microbiological: Olympus CX40 compound scope and Olympus SZX stereomicroscope, an Optronics camera system and a Labconco purifier clean bench,
- Histology: Two Thelco Precision Scientific ovens (paraffin, plastic), fume hood, AO 820 manual microtome, 3 donated Leitz 1512 manual microtomes, a new motorized Microme HM 355 microtome, a Tissue Tek II paraffin dispenser, a Shandon embedding center, Tissue Tek manual slide staining system, water bath, slide warmers, 2 donated tissue processors – Tissue Tek VIP, Fisher Histomatic Model 166 MP
- General: Dell Vostro 200 computer and Epson printer, AB104-S/Fact Mettler Toledo balance and RS-P42 Printer; a Precision 2EG incubator and a Precision low-temperature incubator; a Forma Scientific 5472 ultra-low chest freezer, a mini vortexer, a hot plate, and water bath; a sterilmatic sterilizer, an Ohaus balance, a Corning pH meter, a refrigerator, a microwave, a blender, Labconco chemical fume hood

Marine Biomedical and Biotechnology

Natural Products Chemistry – Contact [Amy Wright](#)

Hitachi HPLCs (multiple)
Waters Autopure System
ISCO Combiflash x 4
ISCO Combiflash Companion
Dionex ASE extractor
Rotatory Evaporators (multiple)
Genevac EZ-2
Virtis Table Top Freeze Drier
High Vacuum System
JEOL ECA 600 four channel NMR
Protasis CapNMR probe
Thermo Finnigan LTQ with Surveyor HPLC

Cell Biology – Contact [Esther Guzmán](#)

BMG NOVO STAR Plate reader
Beckman L7-65 ultracentrifuge
Beckman J2-HS centrifuge
Olympus FVX-BX50 confocal laser scanning microscope with FLUOVIEW software
TOMTEC cell harvester unit
DMS Aquamax 2000 cell plate washer
BD FACS Canto flow cytometer with HTS device
Berthold Detection Systems ORION 384 well plate luminometer with injector
Hybaid hybridization chamber
MJ Research minicycler
BioRad ICycler RT PCR
Packard CYCLONE Phosphor Imager with OPTIQUANT software and Research Genetics PATHWAYS software
Stratagene Eagle eye.

Microbiology and Fermentation – Contact [Peter McCarthy](#)

Olympus microscope for phase contrast and epifluorescence microscopy
New Brunswick Innova orbital incubators (3)
New Brunswick Innova 4900 Multi-Tier Environmental shaker
New Brunswick BioFlo 3000 fermentor with 1, 5 and 13 liter vessels
Beckman DU530 spectrophotometer
Pharmacia FPLC system
Consolidated Autoclaves (2)

Marine Ecosystem Health

Coral Reef Health and Conservation – Contact [Joshua Voss](#)

The Robertson Coral Reef Program laboratory has capabilities for advanced molecular investigations including bacterial community profiling with length heterogeneity PCR and denaturing gradient gel electrophoresis, DNA microarrays development and implementation, and cloning and sequencing. Appropriate microscopy and video archiving capabilities for documenting of coral reef biodiversity is available. Common-use facilities include environmental chambers for coral and microbial culture work, the ELGA Purelab (as a source of up to 18-megaohm deionized water), ice machine, and autoclaves. Lab equipment includes:

- -80° deep freeze refrigerator (Ultima II, Thermo Electron Corp/Revco)
- -20° refrigerator (Isotemp, Fisher Scientific)
- Microarray laser scanner (GenePix Professional 4200A, Axon Instruments)
- Spectrophotometer (NanoDrop, ND-1000)
- Incubation oven (Bambino, Boekel Scientific Hybridization Oven)
- Refrigerated centrifuge (Marathon 2100R, Fisher Scientific)
- Thermocycler (DNA Engine, Bio-Rad)
- Thermocycler (MJ Research MiniCycler)
- Centrifuge (Marathon 16KM, Fisher Scientific)
- Centrifuge (Eppendorf Model 5430)
- Vortexer (Vortex Genie 2, Scientific Industries)
- 2 Molecular Hoods (C.B.S. Scientific Co.)
- Gel electrophoresis power source (E-C Apparatus Corp)
- Gel electrophoresis set tray and run equipment (Owl Co.)
- Galaxy centrifuge (VWR)
- 22 various pipettors (Eppendorf, Gilson)
- Compound and dissecting microscopes
- Video editing equipment for various formats
- Hard drives for long-term archiving of images (video and still)
- Extensive voucher archive of deep-water benthic organisms
- iCycler iQ™ Real-Time PCR Detection System (Bio-Rad)
- Corning Hot Plate Stirrer
- 1 Large and 1 Small Autoclave (Consolidated Stills and Sterilizers)
- Analytical Balance (Mettler)

Field gear includes:

- SCUBA gear, including buoyancy compensators, regulators, wet suits
- Nikonos underwater cameras and strobes
- Various lines, tags, hammers; 3 transect lines; various calipers, water sample bottles, plastic ware

Indian River Lagoon Observatory and Marine Botany – Contact [Dennis Hanisak](#)

This program is based on field and laboratory studies and analysis. The mesocosm and environmental chambers in the building are used for algal culture. Other common-use facilities utilized include the ELGA Purelab for de-ionized water, ice machine, and the autoclaves in the Media Prep Lab. Laboratory equipment includes:

- Compound and dissecting microscopes
- Video scope
- Drying ovens
- Muffle furnace
- Turner AU-10 fluorometer
- Centrifuge
- Incubator

The Marine Botany work relies on boats from the Marine Science Education program; other field equipment includes:

- YSI Model 6600V2 datasonde water quality multiprobes, equipped with temperature, salinity, dissolved oxygen, ph, turbidity, and chlorophyll *a* sensors
- LiCor LI-193SA spherical underwater quantum sensors and LI-1400 DataLoggers
- Phytoplankton nets
- Refractometers
- Secchi disks

The Marine Botany Cultivation Facility

- Approx. 8,100 ft² of outdoor tank area for cultivation of marine macroalgae and seagrasses under ecologically relevant (ambient light, temperature, and water quality) conditions
- Experimental tanks from 100 to 1,000-L
- Indian River Lagoon seawater (flow-through or batch)
- Aeration available via Sweetwater regenerative blowers

Marine Mammal Research and Conservation (MMRC): Stranding Response / Rescue and Recovery of Sick, Injured, Entangled and Out of Habitat Marine Mammals – Contact [Steve McCulloch](#)

The infrastructure for this group supports 24/7 regional response and recovery of live and dead marine mammals (dolphins and whales) within the Indian River Lagoon (IRL) and near coastal waters. Staff and resources also provide statewide support to the National Marine Fisheries Service (NMFS) South East United States Marine Mammal Health and Stranding Response (MMHSR) Network, to coordinate and supervise open water rescues involving injured or entangled marine mammals. MMRC also performs

pathobiological examinations and provides volunteer training, lectures, public outreach and access to train veterinary interns, post-docs and residents.

Additionally, MMRC conducts annual dolphin health and environmental risk assessments (HERA) within the IRL. These NOAA/NMFS-permitted research activities involve broad-based collaborations between numerous agencies, organizations, and specialists from around the world. HERA is a comprehensive, integrated, multi-disciplinary research project designed to assess the health of Atlantic bottlenose dolphins (*Tursiops truncatus*) via screening-level assessments and standardized methods to identify health threats and develop links to possible environmental stressors, as well as to develop tools and techniques to better assess dolphin health.

The program maintains and operates:

- NMFS/USDA-approved Marine Mammal Critical Care and Quarantine Center
- Advanced Life Support Systems (Filtration) / Propane Generator Back-up
- Critical Care Center Offices, Diagnostics Laboratory, and Pharmacy
- Nutritional Laboratory and Fish and Formula Preparations Kitchen (560 ft²)
- Water Quality Laboratory with Remote Monitoring Capacity (420 ft²)
- Marine Mammal Stranding Response Office and Volunteer Trailer (720 ft²)
- Marine Mammal Ambulance 1999 / Ford F-450 for education outreach
- Marine Mammal Ambulance 2009 / International 4300 for rescue and transport
- Marine Mammal Truck 2010/ F-250 (4x4) for stranding response & boat towing
- Four Primary Research and Rescue boats and trailers (19' – 36')
- Two Sea Doo GTX search and rescue jet skis
- Rescue, Research and Safety Equipment (nets, transport systems, field equip.)
- Webcam, Security Systems and Monitors

The Marine Mammal Research and Conservation Program's Dr. C. Dana Bossart Necropsy Laboratory is a state-of-the-art animal pathology facility. Modeled after human medical examiner facilities, the laboratory performs post-mortem forensic and life history examinations on large marine mammals. The facility is one of only three in the state of Florida that is authorized by NMFS to provide in-depth post-mortem forensics and renderings of previously sick or injured marine mammal carcasses. This laboratory is equipped to train aquatic animal pathology to visiting veterinary residents, interns, and students. The laboratory is self-contained to meet and/or exceed all applicable OSHA and USDA regulations regarding the handling, processing and disposal of all related bio-hazard wastes, biological and biomedical samples. Associated data, serums, tissue samples are archived in power redundant cryogenic storage media. The centralized pathology and life history database is maintained on-site and provides cross reference to the NMFS MMHSR national database.

Specific infrastructure includes:

- Marine mammal field recovery and necropsy trailer (custom design)
- Specialized stainless steel necropsy tables (2)
- Custom designed stainless steel counter top and cutting stations
- Histopathology hood for analyzing and processing tissue
- Walk-in cooler and freezer for carcass and sample storage
- Two -80°C freezers (small and large) / Two -20°C freezers (small and large)
- Tissue processing equipment, chemical storage containers (formalin, DMSO)
- Specialized necropsy tools (knives, saws, surgical instruments, lights)
- Electric hoist, I-Beam, digital scale, slings and harnesses
- Antimicrobial floor coating, drains and self-contained medical waste storage
- Webcam, security cameras and photo-documentation table
- Garage, maintenance and storage area for vehicles, boats and trailers
- Bathrooms, showers and laundry facility for quarantine containment
- Osteology lab with equipment and supplies

Marine Mammal Research and Conservation: Clinical Veterinary Laboratory –

Contact [Juli Goldstein](#)

The Veterinary Clinical Lab is equipped as a full-service triage lab for the diagnosis and treatment of sick and/or injured marine mammals, and also facilitates teaching of veterinary students, interns, and/or post doctoral fellows. These same facilities also encompass equipment and laboratory provisions needed to support annual dolphin health and environmental risk assessments involving the capture and sampling of wild dolphin stock.

The program maintains and operates the following:

- HERA lab (280 ft²), pharmaceutical, medical equipment, and sampling supplies (e.g., biopsy, cytology, urine, fecal, optic, thermal)
- Diagnostic tools (endoscope, ultrasound, multi-head microscope, blood and gas analyzers)
- Two field medical kits equipped w/ emergency medications, clinical supplies
- Cryogenic containers, equipment and supplies (e.g., freeze branding irons)
- Refrigerated centrifuge
- Autoclave
- Water purifier
- Gel Doc Imaging System
- IDEXX VetLyte and VetTest Blood CBC Analyzers
- Reference documentation
- Tissue archival station and storage

Marine Mammal Research and Conservation: Epidemiology – Contact [Adam Schaefer](#)

The infrastructure devoted specifically to the epidemiology work is minimal, however, this work is directly linked to the marine mammal clinical and population health work. Epidemiology is an important part of the dolphin health and risk assessment (HERA) project and the software programs used to maintain and analyze the data are the following: Statistical Software - SPSS (PASW), Mplus, and STATA; and Database Software - Microsoft Access.

Population Biology and Behavioral Ecology

This is a field- and laboratory-based program that focuses on arctic and subtropical marine mammals. A major component involves extensive data analysis that requires substantial computing power and flexibility. The program's computing facility hosts three desktop computers to run simulations, analyze satellite telemetry data, and assess images for photo-ID studies.

The Molecular Ecology Laboratory (Contact [Greg O'Corry-Crowe](#)) is a climate-controlled facility with 140 ft of bench space, fume hoods, and chemical storage. It has the features of a standard molecular biology lab, and hosts a tissue and DNA archive and workstations for separate DNA extraction, PCR, post-PCR, and cloning. Equipment includes:

- ABI 3130 *Avant* Automated DNA sequencer
- Five PCR machines
- FastPrep DNA extraction machine
- RO water system and MQ water system
- Two ultra-low (-80°C) freezers; two refrigerators, two -20°C freezers
- Mini-centrifuge and plate centrifuge
- Nanodrop spectrophotometer

The Ancient DNA Laboratory is used for the extraction and analysis of DNA from ancient material (typically 100 to 40,000 yr bp) and requires dedicated equipment and supplies. There are two ultraclean labs (separated from the molecular ecology lab) with air filtered chambers, two UV sterile lab stations with suits, a fume hood and 90 ft of bench space. Established in late 2008, the facility has already produced data on prehistoric (1500 – 2,000 yr. old) mammal (bear and beluga whale) teeth. The primary equipment includes an incubator, refrigerator, -20°C freezer, and a refrigerated mini-centrifuge.

The field studies include biotelemetry, biosampling, and acoustics on marine mammals in remote high-latitude regions, including the Alaskan, Canadian, and Russian Arctic.

Field research focuses on telemetry, photo-ID and biopsy sampling. Dedicated space is required for tag development and equipment storage. To date, the equipment has been stored off site. A new research initiative, acoustic monitoring of cetaceans, has begun and the lab has a number of acoustic recorders and has borrowed others. Primary equipment includes satellite tags, field laptop computers, tagging equipment; nets, boats, drysuits, survival suits; polar tents, polar gear; biopsy equipment (crossbows, air rifles); cameras, binoculars; two CPOD – cetacean passive acoustic recorders; and a hand-held hydrophone.

The Florida Marine Mammal Photo Identification Laboratory (Contact [Marilyn Mazzoil](#)) includes both field and laboratory infrastructure. The research is conducted primarily in the Indian River Lagoon and other areas along the east coast of Florida. This lab is focused on population health and ecology of dolphins and collaborates closely with the Marine Mammal Research and Conservation initiatives, especially HERA. Equipment includes:

- Boats:
 - 19' Twin Vee
 - 22' Twin Vee tower
 - 22' Twin Vee cuddy
- Cameras:
 - Four Canon 1D Mark II camera bodies
 - Four 100-400mm lenses
- Specialized software:
 - Photoshop CS and CS4
 - ESRI ArcGIS 9.3

Ocean Engineering and Technology

Marine Operations – Contact [Bill Baxley](#)

Marine Operations provides support of at-sea operations. The facilities include:

Johnson Sea Link II submersible

- Overall dimensions - 26' 4" L x 9' 9" W x 10' 11" H
- 2 crew and 2 scientists/observers
- Weight – 2,800 lbs.; payload - 1,000 lbs.
- Operational depth – 3,000 ft
- Manipulator, cable cutter, collection devices, video and still photography

Panther Remotely Operated Vehicle System

- Overall dimensions – 66" L x 41" W x 42.5" H
- Vehicle weight - 2,000 lbs
- Weight with launching and recovery system- 25,000 lbs
- Operational depth – 3,300 fsw (1000 m)
- Manipulator, cable cutter

Marine Maintenance Facility

- Hydraulic repair and testing equipment
- Welding and fabrication equipment
- Spray paint booth with ventilation/filter system

Marine Railway

- 156 ft long, 45 ft wide
- Certified to 575 long tons
- Blocking and other required equipment available

Engineering Facilities – Contact [Bill Baxley](#)

Engineering services involve the design, fabrication, and testing of unique solutions for the research and educational communities. These efforts are supported by a variety of equipment and facilities, and include a well-equipped machine shop, a large fabrication facility, and various smaller laboratories. The facilities include:

Machine Shop

- Computer numerically controlled (CNC) milling machine
- Various metal working lathes and milling machines
- Grinders, sanders, shapers, and other metal fabrication tools

Fabrication Facility

- Welding equipment (MIG, TIG, arc)
- Cutting and burning equipment
- Saws, milling machines, lathes, presses
- Forklifts, overhead fixed boom cranes
- High ceiling (50 ft) and large rollup door for unimpeded access

Pressure Test Facility

- 4500 psi (10,100 fsw) pressure testing tank
- 24 inch inside diameter
- 60 inch inside length
- Contains both electrical and hydraulic penetrators
- Pressure cycling capability

Robotics Laboratory

- Electronic fabrication and testing equipment
- Well stocked electronics parts inventory
- Small scale machining capability (combined lathe and milling machine)
- Reconfigurable work tables and load handling equipment (1000 lb capacity)

Hydraulics Facility

- Hydraulic testing equipment including gauges, pumps, test benches
- Hydraulic hose fabrication capability
- Cylinder rebuild and testing capabilities
- Winch, crane, and forklift repair and testing equipment

Ocean Visibility and Optics Laboratory – Contact [Fraser Dalglish](#)

Underwater optical engineering research and development facilities at HBOI have been ongoing for more than 20 years. Recent additions include:

- Bio-photonics salt water test tank (2004), recently updated (2009-2010) for heavy particle suspension measurements and fluorescence imaging sensor development
- Large laser test tank facility with three optics laboratories around the tank (2005-2008)
 - Two-ton crane allows the placement of instruments inside tank
 - Five-degrees-of-freedom manipulator allows for precise placement of instruments

The laboratory is a fully equipped, state-of-the-art optical R&D facility with optical tools and components that include:

- Vibration-isolated optical bench, HEPA-filtered laminar flow boxes, a multitude of precision opto-electronic actuators and opto-mechanical components, galvanometric and polygon scanning systems; MEMS scanning development kits
- Single- and multi-mode lasers throughout the visible spectrum including:
 - Low repetition rate pulsed green lasers (1 - 1000Hz; 500ps pulse duration, 40uJ pulse energy)
 - High repetition rate (357kHz; 7 ns pulse duration FWHM, 5uJ pulse energy) pulsed frequency doubled Nd:YAG
 - Amplitude modulated (up to 500MHz) 405nm lasers

- Picosecond light source for photo-detector impulse response measurements
 - Single-mode CW lasers: 300mW at 473nm and 3W at 532nm
 - Low-power modulated red (658nm) lasers assembled as a lidar emulator
- Integrating sphere, spectral calibration sources, NBS referenced radiometric calibration sources, planar irradiance PAR sensors
- High-speed gated PMTs (up to 6GHz)
- Laboratory spectrofluorometer for EEM mapping (Fluoromax-3 with 2010 version of Fluorescence software)
- *In situ* spectrophotometers (2 x Wetlabs ac-9, 1 x Wetlabs c-star)
- Custom *in situ* scattering meter and particle sizer with additional polarization sensitive channel (Lisst-Stokes)
- Fast Digital Oscilloscope (Tektronics DPO 7254; 2.5 GHz bandwidth at 40 GSPS)
- Vector Signal Generator (80MHz to 6.6GHz) and Vector Signal Analyzer (10MHz to 6.6GHz)
- The laboratory also includes advanced analog, RF, and digital electronics design capabilities in-house to rapidly respond to and address research needs, prototype development, and testing of new concepts
- The in-house engineers utilize advanced analog and digital electronics and other simulation tools including PADS, Agilent ADS, LabVIEW and Matlab/Simulink to address an array of research needs, prototype development, simulation, and testing of new ideas

Ocean Exploration and Undersea Research

Visual Ecology – Contact [Tammy Frank](#)

The majority of the Visual Ecology research is conducted at sea, using externally supported ships, submersibles, and other research platforms. Important common-use facilities the Histology Lab (see Infrastructure Aquaculture and Stock Enhancement) and the environmental chambers for maintaining deep water animals collected at sea for laboratory experiments. The program also relies on custom-designed equipment built and software programming capability by engineers at HBOI-FAU and utilizes the Transmission Electron Microscope at the Smithsonian Marine station in Fort Pierce, Florida. Laboratory equipment includes:

- Sorvall Porter-Blum MT2-B ultramicrotome
- Diamond knife
- Ocean Optics spectrometer and calibrated light source
- Micro-electrode Amplifier
- Instruments SA monochromator with bifurcated fused silica light guide
- Radiometers, including LiCOR with submersible sensor
- Kriesel tanks
- Chiller units
- Compound and dissecting microscopes
- Fluorescence scope

Field Gear (Special Midwater Capabilities) includes

- Opening and Closing 9-m² Tucker Trawl: This net is designed to bring animals up alive and in pristine condition, for both physiological studies and voucher specimens for taxonomic analysis. The 15-m long primary net consists of 5-mm knotless nylon, and funnels down gradually from a mouth opening of 9-m² to a 1 m dia ring. Attached to this ring is a 5 m long secondary net, composed of 292- μ m Nynex, which funnels down to a 15 cm dia canvas sleeve. Attached to the canvas sleeve is a 10-L thermally insulated cod-end that can be closed at depth, removing the fatal thermal shock that occurs in uninsulated cod-ends during net recovery. The bag inside the cod-end is a 1-mm mesh, ensuring sufficient flow such that all of the animals enter the cod-end. A two-cycle net timer, designed by HBOI-FAU engineers, allows the net to be sent down closed (imperative in regions where net-clogging gelatinous zooplankton are abundant), opened at depth, and then closed at depth before the net is brought to the surface, with programmable cycles ranging from 10 min to 12 hrs. When the net closes, the insulated cod-end closes, maintaining the water temperature at the capture depth, even when brought through 25°C warmer surface waters. A current meter can be attached via a 3-point connection to hang in the mouth opening when

quantifiable samples are required. The depth capabilities with the timer attached are 10-1000 m. A Seabird 911+ sensor can be mounted on the tow bar, and, when used with conducting cable, provides real-time depth, temperature, and salinity as the net is being fished.

- Biobox - Insulated collection container for transport of organisms collected at depth to minimize light and temperature shock for specimens brought to the surface for use in physiological/behavior measurements.

Marine Science Education

Marine Science – Contact [Dennis Hanisak](#)

The Johnson Education Center is equipped with classrooms, teaching labs, a 350-seat auditorium with sophisticated audio-visual capabilities, and a computer lab. One classroom is equipped with Distance Learning capabilities for transmission and reception of classes to and from other FAU sites. Many of the labs involve field work in the Indian River Lagoon and other nearby coastal waters. The specific lab equipment includes:

- Video Scope and TV/VCR
- Compound and dissecting microscopes with fiber optic lights
- Megapixel compound digital microscope (Corescope T-1754)
- Drying ovens
- Muffle furnace
- Electronic balances
- Spectronic Genesys 8 UV/visible spectrophotometer
- Centrifuge
- Two chemical fume hoods
- Incubator
- Refrigerator
- Hot/Stir plates
- Compressed air and propane lines
- Assorted glassware and specimen bowls
- Seawater (for batch applications)
- Assorted aquaria and supplies
- Field guides and reference texts
- Overhead projector, laptop, and LCD projector
- 14 networked Dell PCs with Internet access and laser and inkjet printers
- Laptop, LCD projector, and screen

Field and collecting equipment includes:

- Two Pontoon boats (accommodates up to 12 students each) for classes
- Small boat (Sundance) for collections
- Three 15-passenger vans
- Otter trawls
- 0.25- and 0.5-m plankton nets
- 3-, 6-, and 15-m seines
- Dip and cast nets
- Cast nets
- Sieves and shovels
- Water quality meters and test kits

- Refractometers
- Secchi disks
- Battery operated aerators
- Snorkeling equipment, vests, and dive flags
- Sediment corer
- Seagrass quadrats

Aquaculture – Contact [Susan Laramore](#)

The classroom (855 ft²) and covered area (500 ft²) located in the Aquaculture Development Park are used for a variety of educational settings, including middle and high school tours, VIP tours, teacher training, Indian River State College aquaculture classes, and specialized training courses. The research aquaculture facilities are used for hands-on teaching and demonstrations (see Infrastructure: Aquaculture and Stock Enhancement).

- Classroom for 30 has a dell computer, a Sharp Notevision projector and large screen, a VHS player, a VHS/DVD combo player, microscope with camera adapter
- Classroom and covered area equipment includes
 - Water quality equipment (e.g., DO meters, pH meters, calipers), balances, Precision incubator, water bath, and general lab equipment (pipettors, counters, dissecting kits, beakers, graduated cylinders)
 - Eleven compound microscopes and 6 dissecting microscopes (owned by Indian River State College, but available for general use)
 - Four recirculating aquaculture system teaching tanks (89 cm high x 157 cm diameter) with 2 sandfilters, 2 bead filter and 2 biofilters
 - One large demonstration tank (122 cm high x 305 cm diameter)
 - One large self draining lab wet table
 - One large storage cabinet for nets, brushes