

# **UNIVERSITY OF FLORIDA: INTEGRATIVE BIODIVERSITY ASSESSMENT OF CORAL-SPONGE COMMUNITIES OF W FLORIDA SHELF: ESTABLISHING A BASELINE FOR A SENSITIVE ECOSYSTEM**

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## **SCIENCE ACTIVITIES**

### 1) General Summary

The objectives of this project were to assess the diversity and community structure of the hard-bottom coral-sponge ecosystem along the W Florida shelf through biodiversity sampling and quantitative monitoring. Ninety-nine stations were surveyed along the shelf from the keys to the panhandle during three cruises, and many additional sites were surveyed from small boats, especially in the Big Bend region. Taxonomic teams covered algae (Craft), sponges (Biggs, Strimaitis, Wulff), cnidarians (Williams), polychaetes (Moore), bryozoans (Winston), crustaceans (Baeza, Evans, Hecht, Thomas), mollusks (Paulay, Slapcinsky), echinoderms (Lessios, Michonneau, Starmer), ascidians (Lotufo), and fish (Robins). Over 6000 lots of invertebrates of >1500 species were collected and vouchered at FLMNH, with the majority of these photo-documented, and subsampled for tissues, and samples of species sequenced for the DNA barcoding gene COI. A large proportion of these collections as well as collections from previous efforts were identified to species by project participants and our large network of collaborating taxonomic specialists. At present we have vouchers of >4500 species of marine invertebrates, with ~34,000 georeferenced occurrences, and ~20,000 images of live/fresh animals from Florida. Records are available through the FLMNH online database, GIS mapping of records currently through GBIF, and an online photo database in preparation, anticipated to be available by the end of 2013.

Monitoring sites were set up in the Big Bend region on hard grounds at 9-12 m depths. Fish and macroinvertebrate communities were characterized by belt transects, bottom cover (algae and sessile animals) photogrammetrically, and smaller fauna were monitored in ARMS (Autonomous Reef Monitoring Structures – set of stacked PVC settling plates). Sponge communities were further evaluated using permanent 10 m<sup>2</sup> census plots, within which every sponge was marked, measured, and identified. Biodiversity (presence and relative abundance) of macroalgae, macroinvertebrates, and fish were recorded in timed-diversity surveys. In addition to the three sites per location set up for full-scale monitoring, additional sites were visited and evaluated by less-comprehensive methods, ranging from spot dives to documenting cover photogrammetrically and biota through collections, photography, or timed-diversity searches.

### 2) Results and scientific highlights

None of the sites visited showed obvious evidence of damage from the spill, although given that they were all distant from the spill, surveyed substantially later, and there was no before-data, this is not surprising or meaningful. The objective of the project was to get baseline data.

Hardground communities appeared healthy, thriving, and diverse at most locations. A few sites showed damage from scouring, presumably by storm-carried sediments, on octocorals and stony corals. Partial bleaching was observed on a large proportion of *Oculina robusta* and *Solenastrea hyades* colonies in the Big Bend area. We are not aware of previous bleaching reports of in these corals, nor of the patchy bleaching pattern observed (Fig. 1). We are pursuing funding to follow the dynamics of bleaching on a per-colony basis to evaluate its significance. Alternative hypotheses are that it represents a natural phenomenon in this cold-adapted reef coral clade, or that it is in response to and correlates with environmental stressors. The former is based on the observation that these species, together with several others from four “traditional coral families” form a small, but unusual phylogenetic lineage, that is most successful in warm temperate/subtropical biomes, and appears to have unusually labile symbioses with zooxanthellae.

A surprising result of the surveys in the Big Bend region was the abundance of hard ground communities. Previous hard ground mapping from NOAA’s habitat survey (Dale & Santos, 2006) suggested that hard grounds were a predominant feature of only the southern Gulf shelf. In contrast our diver surveys indicated hard grounds to be more prevalent in the northern Gulf shelf in the Big Bend area (hence we focused our surveys in this region), then in the southern Gulf shelf sites visited. Large tracks in this area have exposed limestone with luxuriant communities of sessile benthos, variably dominated by sponges, octocorals, stony corals, sessile



bivalves, ascidians, and algae. There are marked gradients in community composition cross shelf and latitudinally even within the Big Bend. Thus while the inner shelf stony coral community is dominated by 6 species (*Cladocera*, *Oculina*, *Solenastrea*, *Siderastrea*, *Manicina*, *Phyllangia*), these species are much less common on the Florida Middle Grounds, which in turn has a more diverse scleractinian fauna of about 20 species; while stony corals are rare in hard grounds in the northern end of the Big Bend. The dominance and relative abundance of sessile species varies markedly on a finer spatial scale as well, such that nearby hard grounds can be dominated by communities dominated by different sponge species, arcid or chamid bivalves, *Cladocora*, ascidians, or other taxa. This variation appears to be at least partly driven by physiography of exposed limestone terrain. Given the size of available habitat and abundance of corals, the Big Bend area of the Gulf shelf likely supports the largest population of reef corals in Florida.

Sponges and octocorals often dominate hard ground communities, and sponges are very diverse. A single 10 m<sup>2</sup> census survey can have >40 species represented. Sponge community composition varies especially substantially among sites.

**Figure 1.** Bleaching in *Solenastrea hyades* on side (upper left) and base (upper right) of colony, and in *Oculina robusta* (bottom).

Taxonomic efforts led to numerous new records in the area, including several of species with major ecological influence (keystone species). The following four examples illustrate the range of discoveries, and highlights how little we know about the biota of the Gulf shelf:

(1) The forcipulate sea star *Coscinasterias tenuispina* was not previously recorded from Florida (or anywhere in the US Gulf coast) is abundant on the outer shelf hard grounds in the N shelf. Forcipulates are voracious predators of temperate rocky habitats (the concept of keystone species originated from Paine's study of the forcipulate *Pisaster*), unlike the predominantly microphagous sea stars of tropical reefs. Only one other forcipulate reaches Florida. *Coscinasterias* attacked and fed upon a variety of mollusks and ophiuroids in captivity.

(2) The nudibranch *Okenia* cf. *quadricolor*, a predator of molgulid ascidians, was found now in two winter seasons to be so abundant as to decimate populations of *Bostricobranchus digonas* in the Big Bend. This ascidian itself is phenomenally abundant under the right conditions (many hundreds per m<sup>2</sup> locally in the Big Bend), is reported to control winter phytoplankton blooms in Tampa Bay (Bay Study Group 1998), and is itself a new record for N Florida (previously known only from the type locality near Charlotte and Tampa Bay). The nudibranch is a new record for the SE US; it is conspecific with or belongs in the same species complex as *O. quadricolor* (Europe/Mediterranean) and *O. ascidicola* (considered a synonym of *O. quadricolor*; known only from New England). We are studying this species in collaboration with Angel Valdes to determine whether it is conspecific with either the New England or European population, and indigenous or introduced/invasive.

(3) The sea cucumber *Holothuria surinamensis* collected in the Gulf is genetically deeply divergent from *H. surinamensis* in the tropical Atlantic, indicating it to be a likely new species and Gulf endemic.

(4) The parasitic juveniles of the anemone *Peachia*? species were abundant on a bloom of the scyphozoan jellyfish *Pelagia noctiluca*; this group of anemones has not been reported from the Gulf of Mexico. *Pelagia noctiluca* is one of the most abundant scyphozoans in the ocean and forms enormous blooms. Up to 10 parasitic anemone larvae were observed on individual jellies, devouring their host. *Peachia* has the unusual life cycle of a parasitic juvenile stage that feeds on medusozoans and an adult free-living stage in soft bottoms. The adult source of the juvenile population, clearly very substantial, remains undiscovered.

Overall the surveys indicated a diverse, heterogeneous, and little know ecosystem in the Gulf hard grounds, which are presently healthy and represent very large reservoirs of reef corals and other species of concern. We have initiated several lines of investigation on this system, and have also started a Florida-wide database of marine biodiversity (see grants below; also unfunded projects).

Dale D, Santos K. 2006. Gulf of Mexico: Habitat areas of particular concern. National Marine Fisheries Service, Gulf of Mexico Fishery Management Council.

[http://sero.nmfs.noaa.gov/hcd/pdfs/efhdocs/gom\\_efhhapc\\_poster.pdf](http://sero.nmfs.noaa.gov/hcd/pdfs/efhdocs/gom_efhhapc_poster.pdf)

Bay Study Group 1998. Does the tunicate *Bostrichobranchus digonas* (Abbott) control the seasonal distribution of phytoplankton biomass in Tampa Bay? A report submitted in accordance with Consent order 96-3452 to The Florida Department of Environmental Protection, Southwest District Office. The Bay Study Group; Department of Sanitary Sewers; City of Tampa. [http://scholarcommons.usf.edu/basgp\\_report/61/](http://scholarcommons.usf.edu/basgp_report/61/)

3) Cruises & field expeditions

Ship or Platform Name	Class (if applicable)	Chief Scientist	Objectives	Dates
RV Weatherbird		Gustav Paulay	Biodiversity survey of SW Florida shelf	March 4-8, 2011
RV Weatherbird		Gustav Paulay	Biodiversity survey of NW Florida shelf	March 10-14, 2011
RV Bellows		Gustav Paulay	Biodiversity survey of Big Bend shelf	May 22-26, 2012

4) Peer-reviewed publications, if planned (Note: a special section will focus on student and post-doctoral publications)

- a. Published, peer-reviewed bibliography (Copies of the papers are requested)
- b. Manuscripts submitted or in preparation (Please note target journal, and anticipated date of publication or submission)

Most of the results are still being analyzed. The following synthetic publications include material from this project.

Appeltans, W., et al. 2012. The Magnitude of Global Marine Species Diversity. *Current Biology* 22: 1-14.

Evans, N., Paulay, G. 2012. Barcoding methods for invertebrates. pp. 47-77 In: W.J. Kress & D.L. Erickson (eds). DNA barcodes: methods and protocols. Humana Press, New York.

Duffy, J.E., Amaral-Zettler, L.A., Fautin, D. G., Paulay, G., Ryneerson, T., Sosik, H.M., Stachowicz, J.J. 2013. Envisioning a National Marine Biodiversity Observation Network. *BioScience*, in press. due our spring 2013

5) Presentations and posters, if planned (Please provide copies of each) (Note: a special section will focus on student presentations)

Title	Presenter	Authors	Meeting or Audience	Abstract published (Y/N)	Date


6) Other products or deliverables

7) Data

Over 6000 lots of mostly invertebrate vouchers were generated by this project, and an additional 4000 lots of Florida marine invertebrates were also processed (identified and databased). Taxonomic and occurrence data for these are available through the FLMNH Invertebrate Zoology collection database: [http://www.flmnh.ufl.edu/scripts/dbs/malacol\\_pub.asp](http://www.flmnh.ufl.edu/scripts/dbs/malacol_pub.asp). GIS data of this and all other georeferenced records at FLMNH from Florida available through <http://www.gbif.org/>.

**PARTICIPANTS AND COLLABORATORS**

8) Project participants

First Name	Last Name	Role in Project	Institution	Email
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Judy	Winston	Scientific participant	Virginia Museum	Judith.Winston@vmnh.virginia.gov

Janie	Wulff	coPI	SFU	wulff@bio.fsu.edu
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Plus students listed separately below.

**MENTORING AND TRAINING**

9) Student and post-doctoral participants

First Name	Last Name	Post-doc / PhD / MS / BS	Thesis or research topic	Institution	Supervisor	Expected Completion year
Jenna	Moore	BS, PhD	Polychaete systematics	UF, Scripps IO	G Paulay, G Rouse	2016
Nat	Evans	PhD	Crab systematics	UF	G Paulay	2015
Francois	Michonneau	PhD	Holothuroid systematics	UF	G Paulay	2013
John	Starmer	PhD	Echinoderm systematics	UF	G Paulay	2013
Brendan	Biggs	PhD	Sponge ecology	FSU	J Wulff	2013
Anna	Strimaitis	BS	Sponge ecology	FSU	J Wulff	2012

10) Student and post-doctoral publications, if planned

- a. Published, peer-reviewed bibliography (Copies of the papers are requested)
- b. Manuscripts submitted or in preparation (Please note target journal, and anticipated date of submission or publication)

Results from these surveyed will be included in the dissertation and synthetic papers on focal taxa being prepared by Moore, Michonneau, and Biggs.

11) Student and post-doctoral presentations and posters, if planned (Please provide copies of each)

Title	Presenter	Authors	Meeting or Audience	Abstract published (Y/N)	Date
Molecular systematics of the Holothuriidae (Echinodermata: Holothuroidea).	F. Michonneau	F. Michonneau & G. Paulay	14 <sup>th</sup> International Echinoderm Conference. Brussels	yes	August 2012

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12) Images

Ca. 12,000 images of >1000 species of live/fresh marine organisms and of benthic cover along transects were generated by this project. The majority of photographed specimens were collected and vouchered in the FLMNH collections. All images were databased, with locality, voucher, taxonomic, etc data captured, and linked to the FLMNH collection database through catalog numbers when of vouchered specimens. An additional ~6,000 images of previously photographed specimens from Florida were also processed, matched with vouchers, and databased. FLMNH is currently developing a new image database program that will provide online access to this (and other) image collections; completion is anticipated this calendar year.

13) Continuing Research

We have submitted two grants to continue this work in January 2013; they are both pending:

**An integrated marine biodiversity database as a tool for research and resource management. University of Florida Research Opportunity Funds.**

The goal of this project is to develop an integrated database for the marine biodiversity of Florida, to demonstrate the feasibility and power of such a resource, and use it as a spring-board for comprehensive regional and US-wide efforts. The database will be assembled from numerous taxonomic sources by mashing and checking taxonomic data using informatics tools and a network of taxonomic experts. We will develop and implement a system of identification matching to evaluate, match, and track alternative names used in different resources. We will expand the checklist with information on occurrences, and images and DNA barcodes created from biodiversity surveys of habitats around UF’s two marine laboratories (Whitney and Sea Horse Key), as well as from previously assembled collections at the Florida Museum of Natural History (FLMNH).

**Widespread partial bleaching of reef corals along the Gulf coast: natural variability or stress response? Florida “Protect Our Reefs” Grants Program**

The objective of this project is to document the pattern and evaluate the likely causes of prevalent partial coral bleaching in the reef corals *Solenastrea hyades* and *Oculina robusta*, dominant corals in coral communities in the Big Bend area of Florida. The FIO-BP survey indicated that two of the five dominant corals in the area are commonly bleached across large portions of colonies.