Deep-Sea Coral Habitats - Research supported by a Memorandum of Agreement between NOAA and Schmidt Ocean Institute

The following is a summary of research activities conducted by Dr. Peter Etnoyer and his laboratory staff under a long-term Memorandum of Agreement (MOA) between Schmidt Ocean Institute (SOI) and NOAA's National Centers for Coastal Ocean Science (NCCOS). The overall goal of the MOA is to promote collaborative deep-sea coral research. The MOA was initiated in 2010 and expires in 2016. The present progress report summarizes research activities performed in 2011-2014 under an existing Statement of Work (SOW). The SOW funded research in cold-water aquaria and husbandry, deep-sea exploration in Honduras, and geo-database development for predictive habitat suitability models.

2011
- DeepCAST II Expedition Report appeared online; representing the first official documentation of *Lophelia pertusa* and precious coral *Corallium* along the Meso-American Reef.

- student Leslie Wickes from College of Charleston traveled to SoCal for fieldwork aboard MV Outer Limits with NOAA Sebastes ROV to study effects of ocean acidification on *Lophelia* reefs

- mating pair of deep-sea dogsharks *Scyliorhinus retifer* placed into NOAA cold-water aquaria

Citation:
Etnoyer PJ, K Lavelle, TC Shirley. 2011 Deep Coral and Associated Species Taxonomy and Ecology (DeepCAST) II Expedition Report. NOAA Technical Memorandum NOS NCCOS 137. National Oceanic and Atmospheric Administration, National Ocean Service, National Centers for Coastal Ocean Science, Center for Coastal Environmental Health and Biomolecular Research. http://purl.fdlp.gov/GPO/gpo16271

Figure 1. This large yellow sea fan (family Plexauridae) was commonly observed in the deep-sea hard bottom habitats around Roatan, Honduras. The species is not yet identified.

2012

- Implemented new image processing techniques to recover discrete coral occurrences from video collected since 1985 for a new deep-sea coral database in Gulf of Mexico.

- Conducted Deep Coral Shakedown Expedition (FK004e) aboard RV Falkor in Gulf of Mexico. Four ROV dives were conducted between 500-2000 m depth over ten days. Several hundred corals were photo-documented. Mapping operations covered a large part of the West Florida Escarpment at 10 m resolution. http://www.schmidtocean.org/story/show/852

- Collected 45 seawater samples for analyses of ocean acidification parameters, including the deepest samples ever evaluated (3000 m) for carbonate chemistry in the Gulf of Mexico.

Gulf of Mexico Aragonite Saturation Profiles

Aragonite Saturation (Ω_{arag})

- ◆ Lunden et al. 2013
- — West Florida Slope
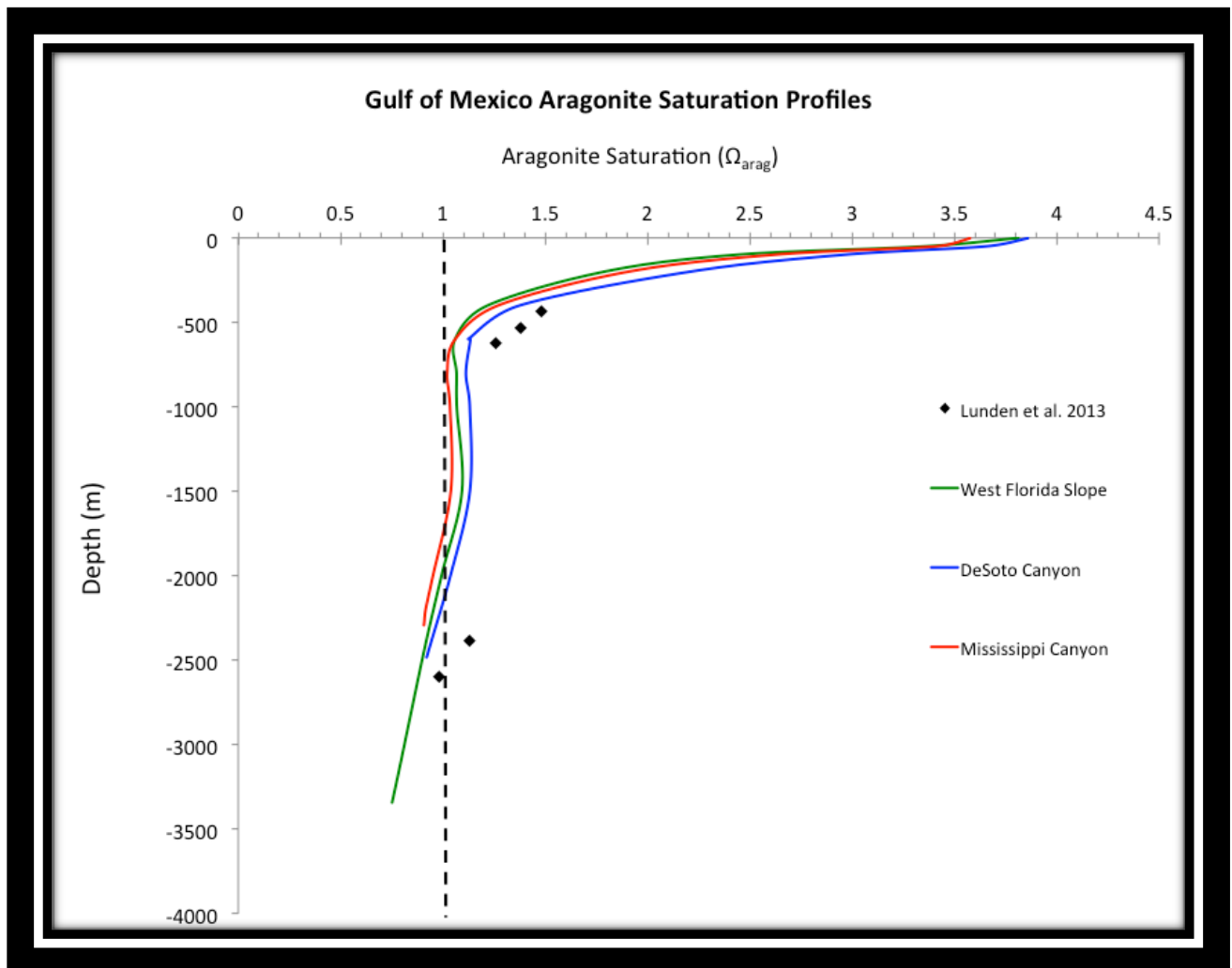- — DeSoto Canyon
- — Mississippi Canyon

Figure 2. Aragonite saturation profiles from water samples in CTD casts from R/V Falkor Cruise 004e in the Gulf of Mexico September 2012. pH and aragonite saturation were lower than previously measured (Lunden et al. 2013); this may have been a function of pH probe drift or a real phenomenon, perhaps an effect of Tropical Storm Isaac that passed through Gulf of Mexico three days prior to measurements. Raw data are undergoing QA/QC.

2013

Leslie Wickes gave a talk on *Lophelia pertusa* under acidic conditions and Matt Rittinghouse presented a poster on multibeam mapping in West Florida at the Benthic Ecology Meeting 2013.

- NOAA published multibeam surveys of West Florida Escarpment (FK004e) published to NOAA NGDC interactive online archive of multibeam data. Download here. See Figure 3.

- RV Falkor conducted multibeam surveys of Isla Roatan in Honduras (FK008t) in April 2013, mapping mesophotic and deep-sea coral reef habitats for the first time. This one-day cruise was called Serendipitous Side Trip by Mark Schrope

- Peter Etnoyer traveled to Hawaii in November 2013 for Schmidt Ocean Institute Inaugural Ocean Research Symposium. The meeting formed the basis of a 'standard products' working group with Nathan Cunningham of SOI.
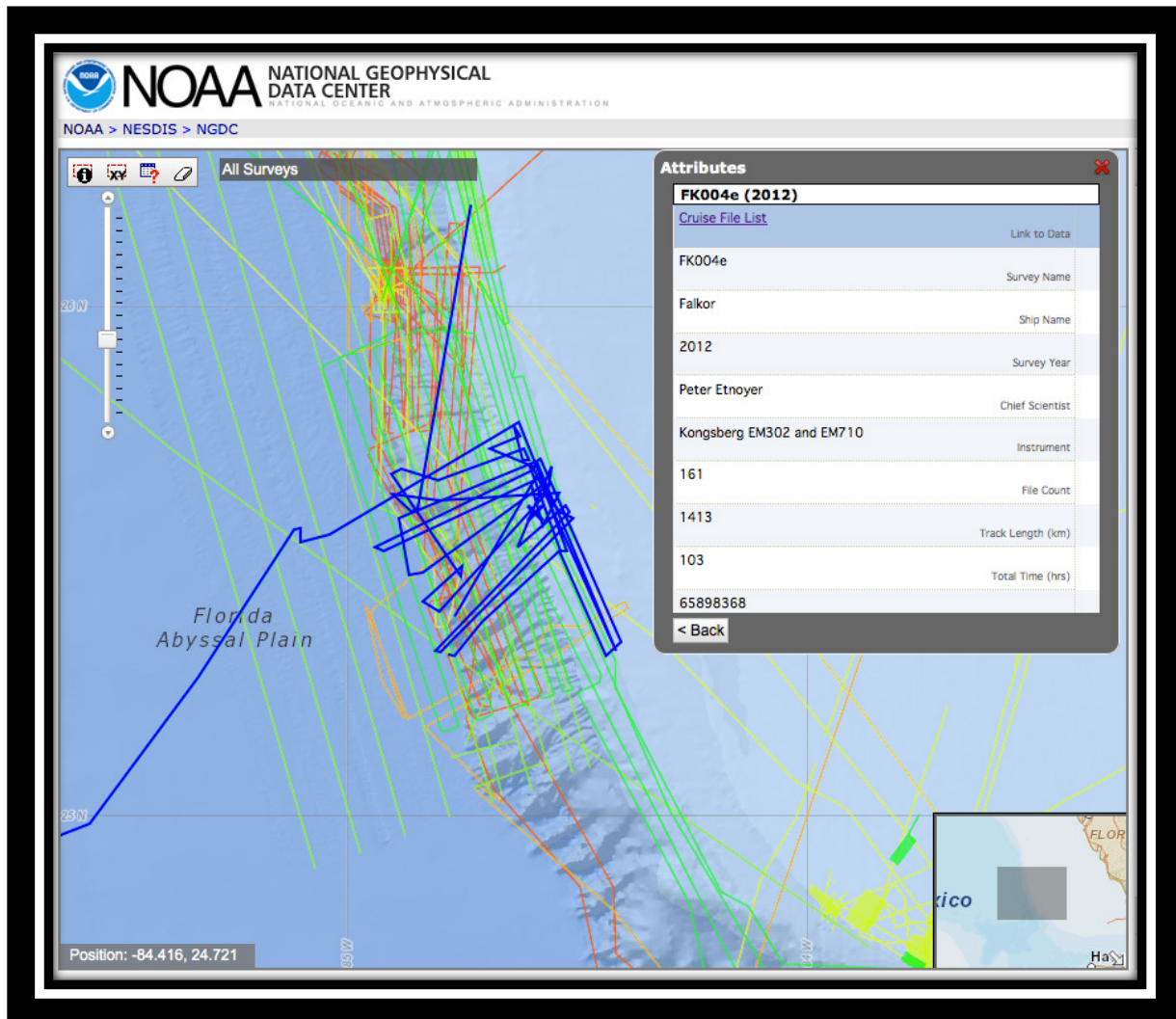

Figure 3. Map showing RV Falkor multibeam tracks (in blue) collected during FK004e Deep Coral Shakedown Expedition. Raw data are available for download through NOAA NGDC.

- Purchased laboratory equipment and supplies to determine the threshold values of carbonate chemistry parameters upon which *Lophelia pertusa* skeleton begins to dissolve in cold-water aquaria and the rate of dissolution for different ocean acidification scenarios.

- Published new habitat suitability maps for *Lophelia pertusa* in the Gulf of Mexico. The maps predict the most likely habitat for deep-sea corals based on depth range, topography, and seafloor geology. The models used deep-coral occurrence records gathered under the NOAA/SOI Memorandum of Agreement.
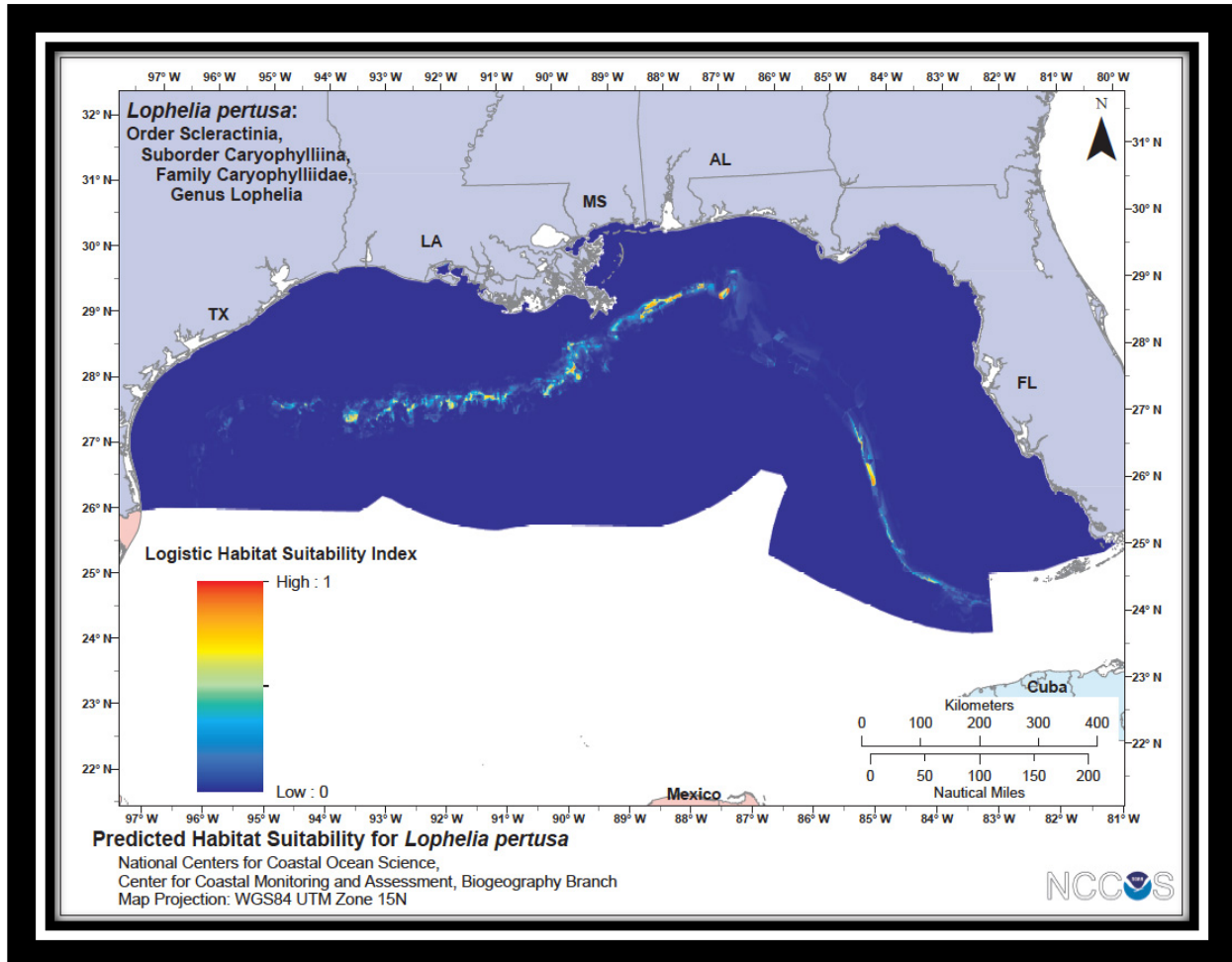

Figure 4. Predicted habitat suitability for *Lophelia pertusa* in the Gulf of Mexico.

Citation:
Kinlan BP, Poti M, **Etnoyer P**, Siceloff L, Jenkins C, Dorfman D, Caldow C. 2013. Digital data: Predictive models of deep-sea coral habitat suitability in the U.S. Gulf of Mexico. Downloadable digital data package. National Oceanic and Atmospheric Administration, National Ocean Service, National Centers for Coastal Ocean Science, Center for Coastal Monitoring and Assessment, Biogeography Branch. Released August 2013. Download from http://coastalscience.noaa.gov/projects/detail?key=35

2014

- Processing multibeam data collected by RV Falkor in Roatan (FK008t) using CARIS and Fledemaus software, as part of a master's thesis by Matt Rittinghouse at College of Charleston (CofC). The maps will guide new ROV exploration by EV Nautilus in 2014.

- Sharing data on more than 10,500 deep-sea coral occurrences in the Gulf of Mexico through NOAA's Deep-Sea Coral Research and Technology Program. These records will be distributed to the Ocean Biogeographic Information Systems and viewable in Google Earth.

- Initiating new cold-water aquaria experiments to determine catshark preference for corals as egg laying substrate. Start-up costs for the cold-water aquaria were partly funded by SOI. CofC graduate student AJ Turner will present a poster summarizing the work at the Benthic Ecology Meeting in 2014.
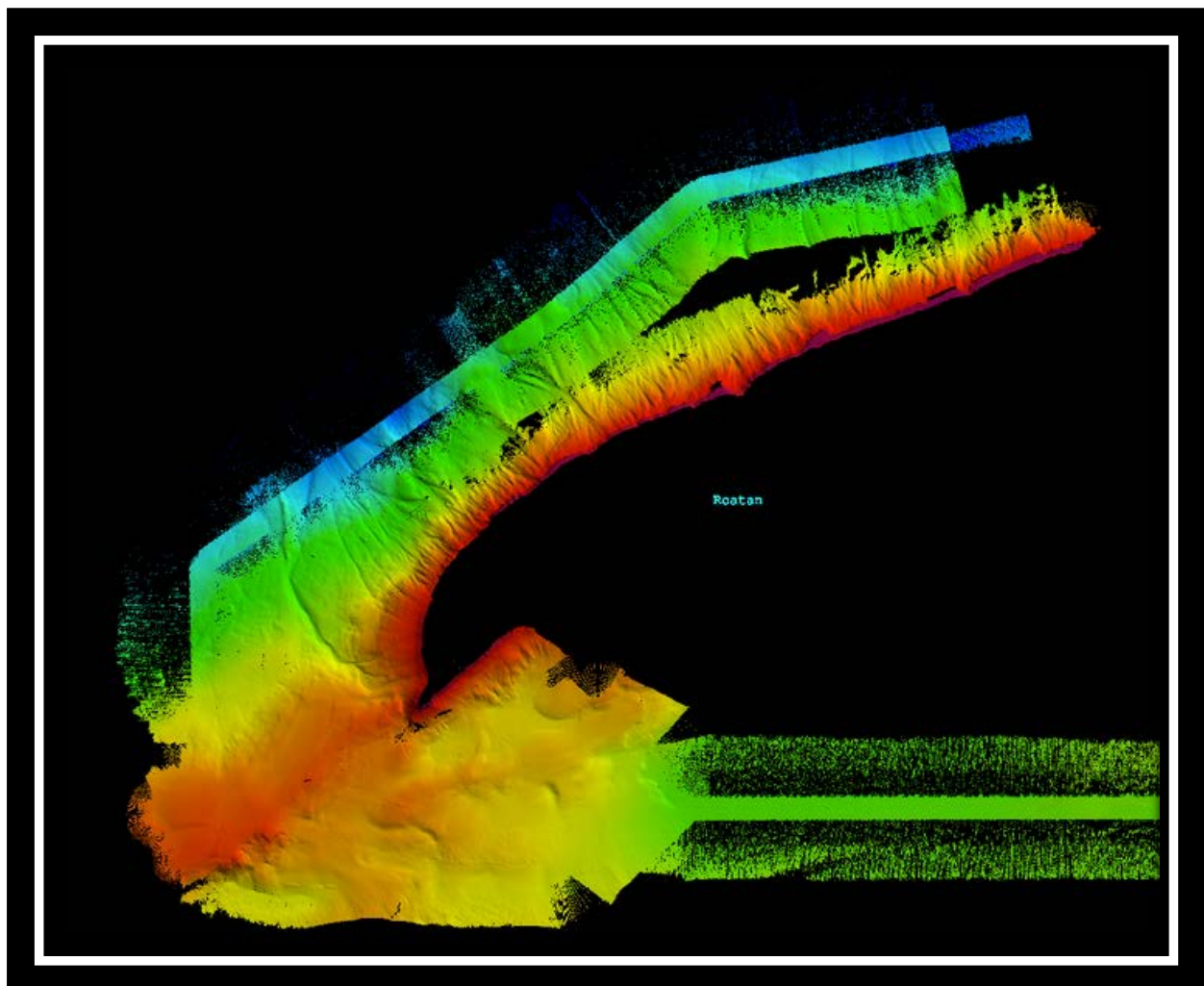

Figure 5. A map of the seafloor off Roatan, Honduras derived from multibeam data collected by RV *Falkor* in April 2013. Red areas are 400 m deep. Blue areas are 2500 m deep. Ridge and canyon features are seen here for the first time.