

**NOAA
COOPERATIVE INSTITUTE FOR
OCEAN EXPLORATION, RESEARCH AND TECHNOLOGY**

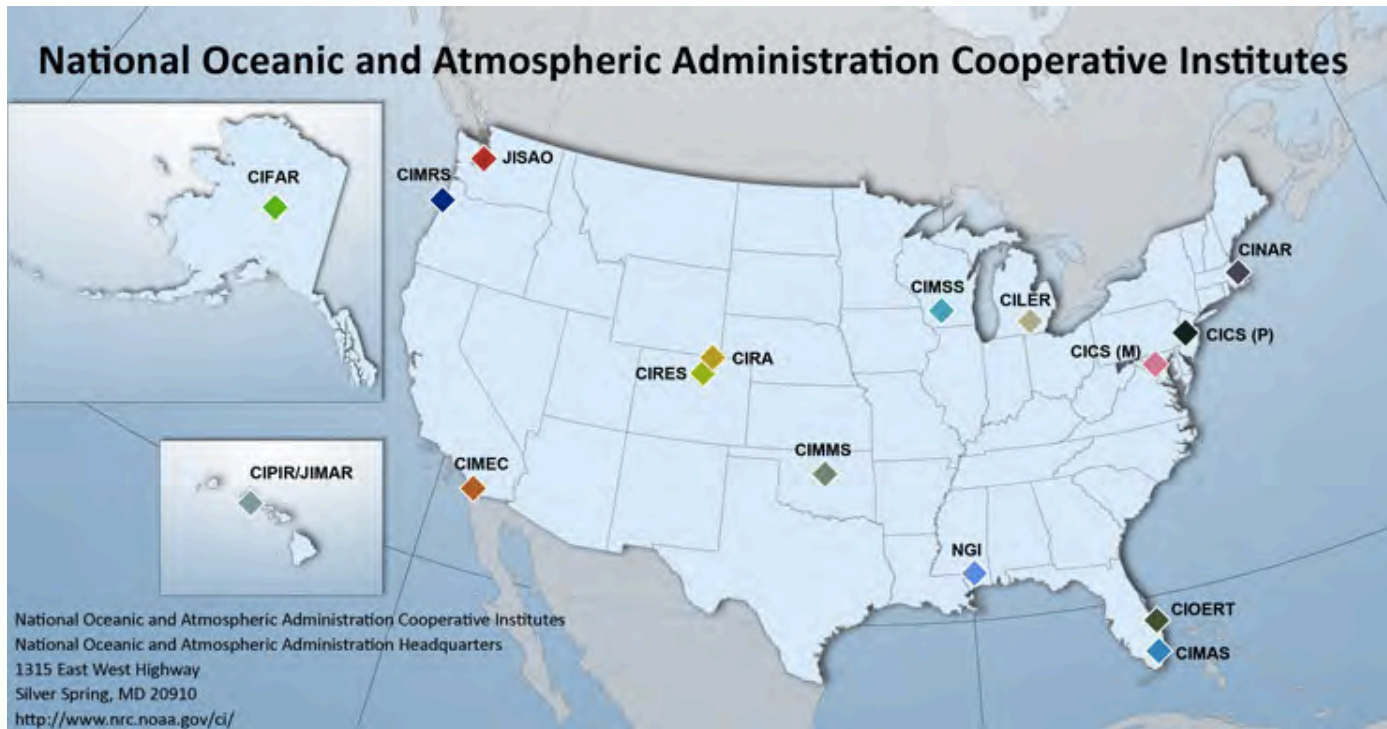


HARBOR BRANCH

FLORIDA ATLANTIC UNIVERSITY



NOAA supports 16 NOAA Cooperative Institutes



- **Academic and non-profit research institutions that demonstrate the highest level of performance and conduct research to support NOAA's Mission Goals and Strategic Plan**
- **Link resources** of a research-oriented university or institution with OAR and other branches of NOAA **to develop and maintain a center of excellence in research** relevant to NOAA's mission.
- **Formal, collaborative long-term research partnerships**
- Established under a **Memorandum of Agreement (MOA)**

Cooperative Institute Activities = “Tasks”

- Task I: Administration and Education
 - Task IA: Administration & management of the CI
 - Task IB: General education, outreach, & R2X activities
- Task II: Research activities that involve on-going direct collaboration with NOAA scientists. This collaboration is typically fostered by joint participation of NOAA and CI scientists on committees and teams (and by co-location of NOAA and CI scientists).
- Task III: Research activities that require minimal collaboration with NOAA scientists and may include research funded by NOAA non-competitive and competitive intramural and extramural grant programs, as well as funding from other Federal agencies for projects that are directly linked to CIOERT themes.

Cooperative Institute Research Topics = “Themes”

“NOAA maintains flexibility in defining the research topics (themes) of the CI because of the diverse nature of NOAA research.

For some CIs, a regional research focus may be appropriate, while at others a larger global perspective may be necessary to address problems related to phenomena with large temporal and spatial scales.”

NOAA COOPERATIVE INSTITUTE FOR OCEAN EXPLORATION, RESEARCH AND TECHNOLOGY



Managing Partners: HBOI/FAU and UNCW/CMS
Shirley Pomponi, HBOI-FAU, PI, Executive Director
Dan Baden, UNCW, Co-PI, Managing Director
Deborah Glickson, HBOI-FAU, Associate Director
Dennis Hanisak, HBOI-FAU, Education Director

Limited Partners: UM/RSMAS/CIMAS and SRI



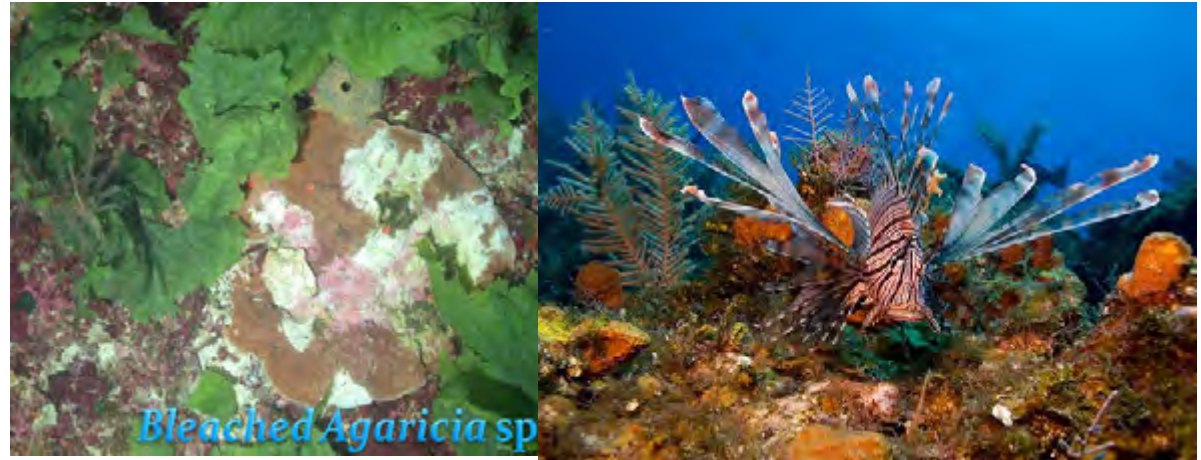
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CIOERT Themes

Explore continental shelf frontiers
(with a focus on
the southeast US
and Gulf of Mexico)



Improve understanding of vulnerable
coral & sponge ecosystems



Develop advanced
underwater
technologies



Educate & engage:
our NextGen workforce!



Project Selection & Performance Criteria

- Annual Science Plan
- Projects developed within theme areas
 - Relevance to NOAA priorities
 - Merit and quality of milestones and deliverables
 - Realistic transition plan and demonstrated readiness level progress in R2X
- Performance metrics
 - Timely completion of milestones & deliverables

CIOERT Project Highlights: FY09-15

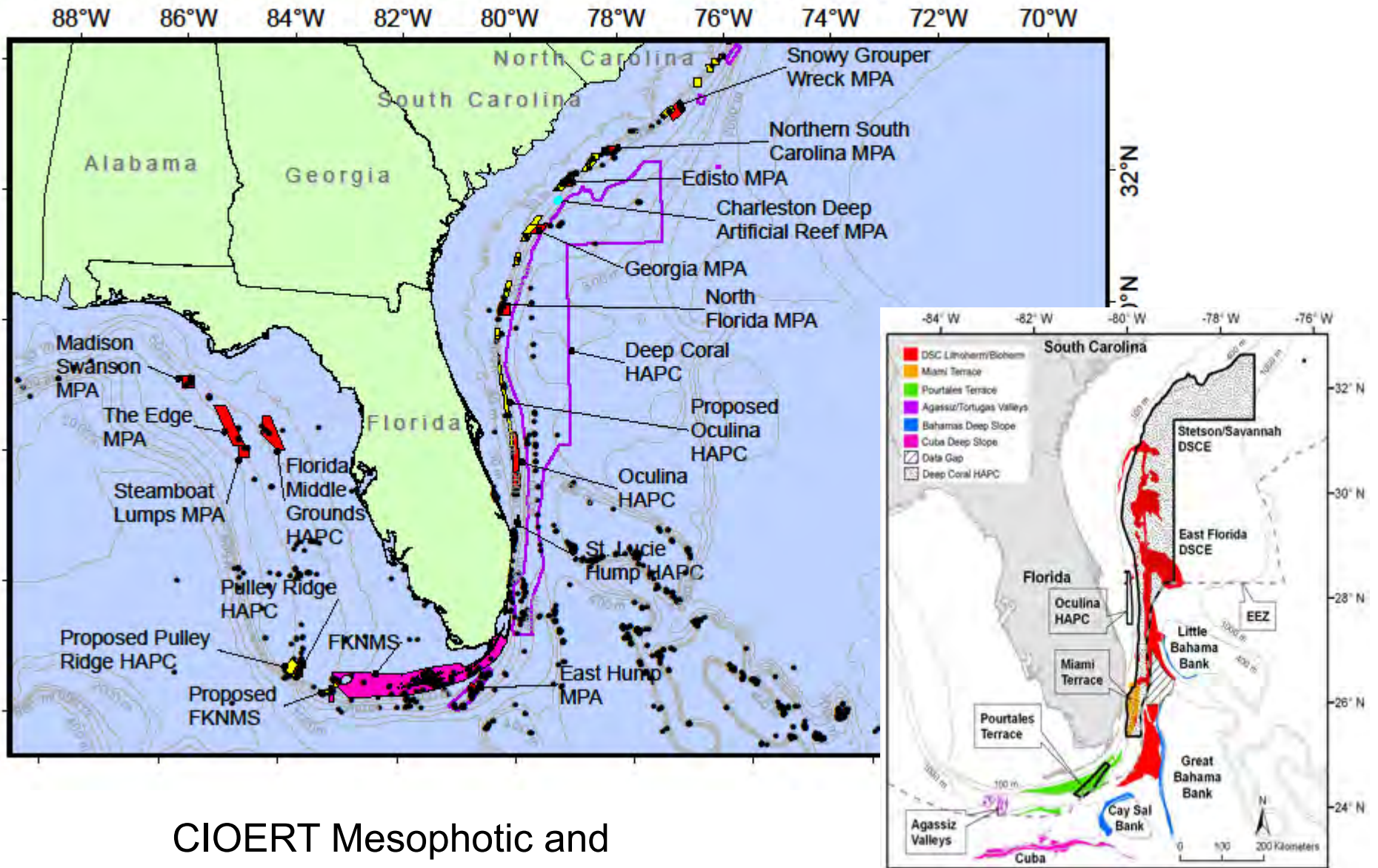
- Discovery and protection of deep coral reefs
- Discovery of novel therapeutics
- New technology development
- Exploration, education & telepresence

Proposed and Established MPAs & HAPCs

NAD 1983; UTM 17N

S. Farrington & J. Reed - Harbor Branch Oceanographic Institution at FAU

- Dive Sites
- MPA
- Proposed MPA
- Deep Coral HAPC
- FKNMS



CIOERT Mesophotic and Deepwater MPA Study Sites

Why are these reefs important? Why do they need to be protected?



Deepwater corals grow very slowly, ~1/2" year, and are very fragile and subject to breakage from bottom tending fishing gear, including weights, longlines, fish/crab traps and trawls. A single coral mound may be 100-thousands of years old.

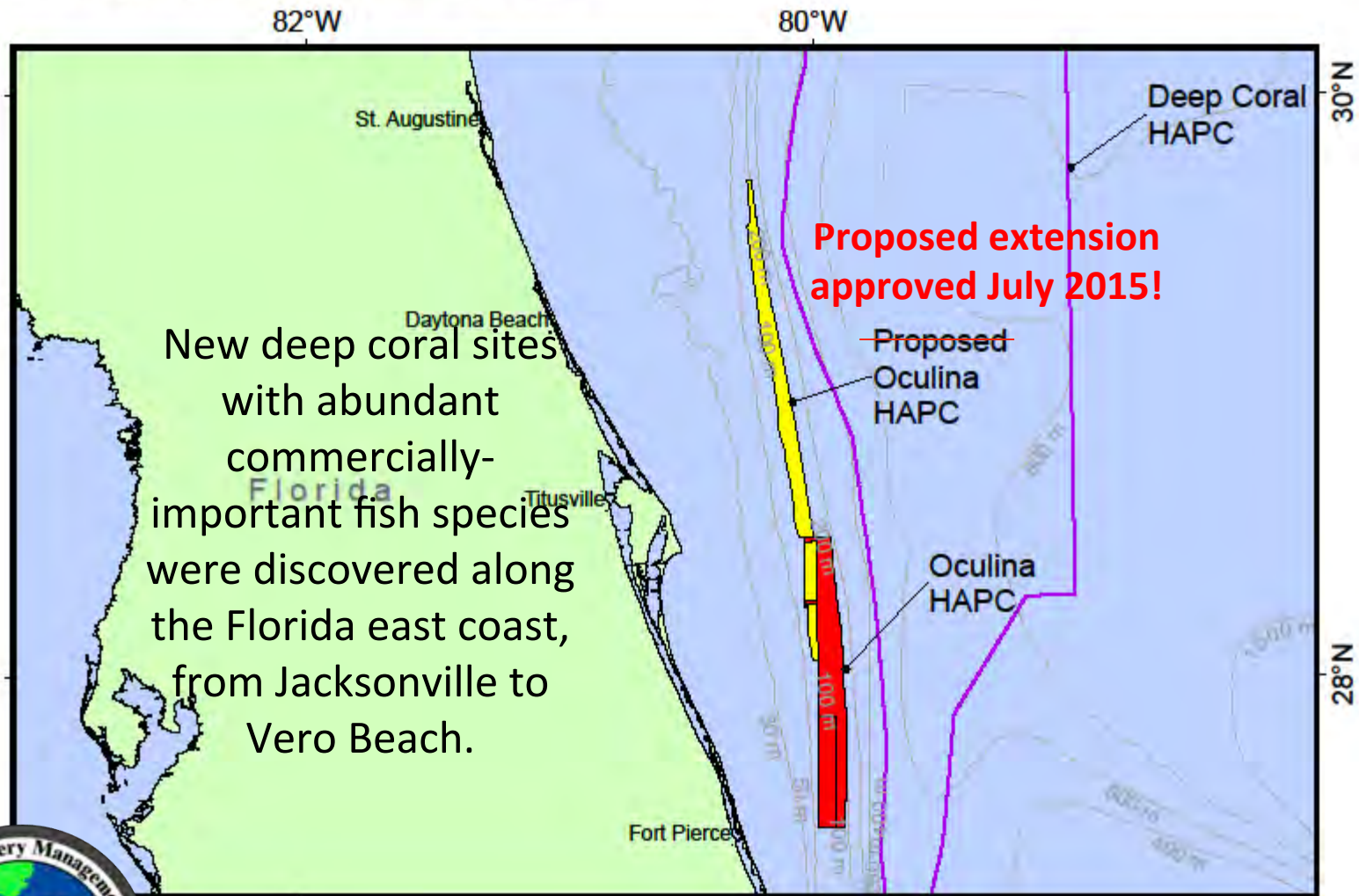
Golden crab, *Chaceon fenneri*, are common on the *Lophelia* reefs and are fished with longline crab pots, which would destroy coral habitat (Reed and Farrington, 2010).



Bottom trawling for rock shrimp has devastated a vast amount of the *Oculina* reef habitat.



Oculina HAPC



New deep coral sites with abundant commercially-important fish species were discovered along the Florida east coast, from Jacksonville to Vero Beach.



The SAFMC recommended expansion of the *Oculina* Habitat Area of Particular Concern based on these discoveries.

Understanding Coral Ecosystem Connectivity in the
Gulf of Mexico:
Pulley Ridge to the Florida Keys
Processes to Decision-Support Tools

NOS-NCCOS

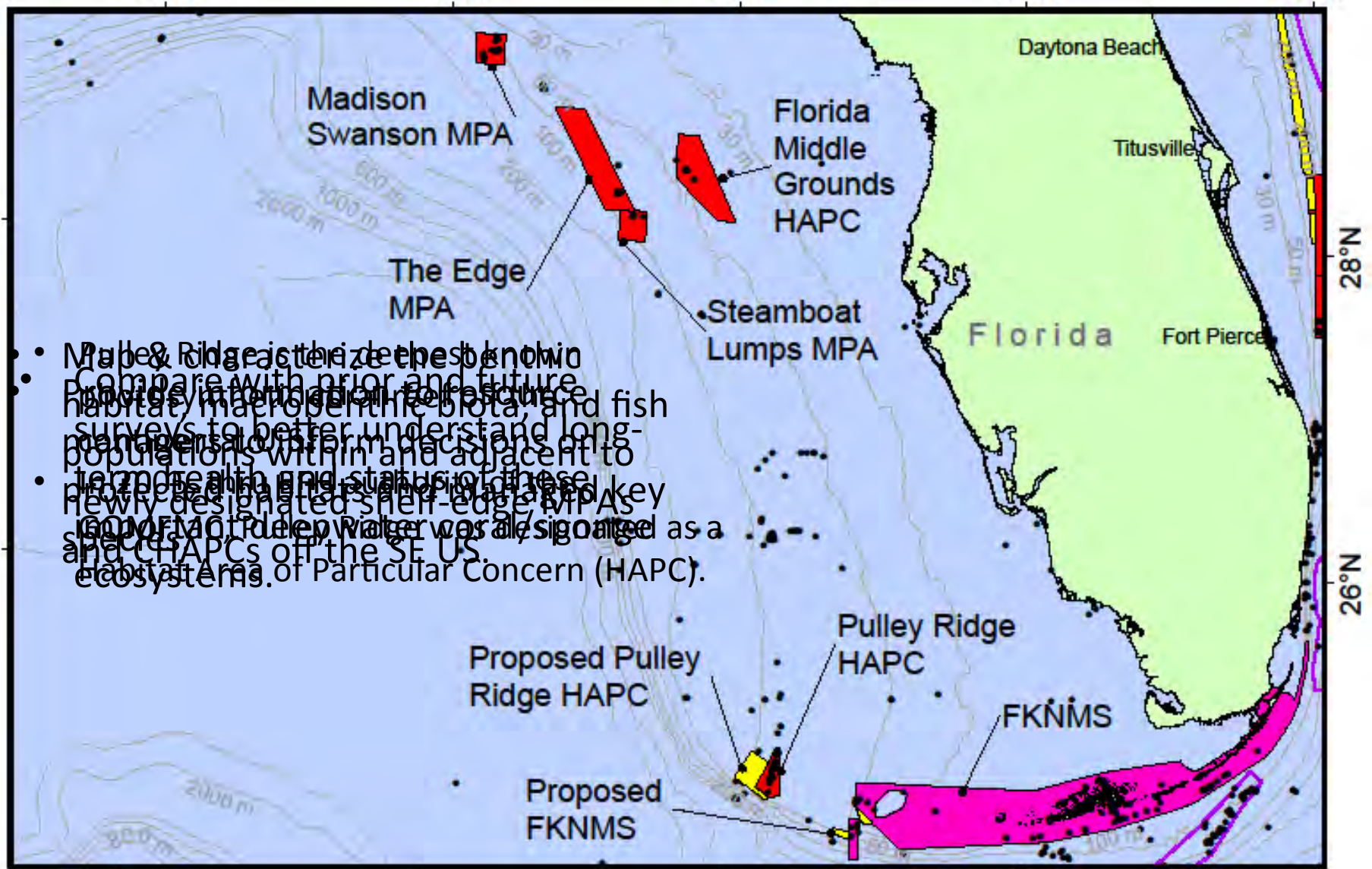
Fisheries (SEFSC)
OAR (OER)



Cooperative Institute for Marine and Atmospheric Studies



88°W 86°W 84°W 82°W 80°W

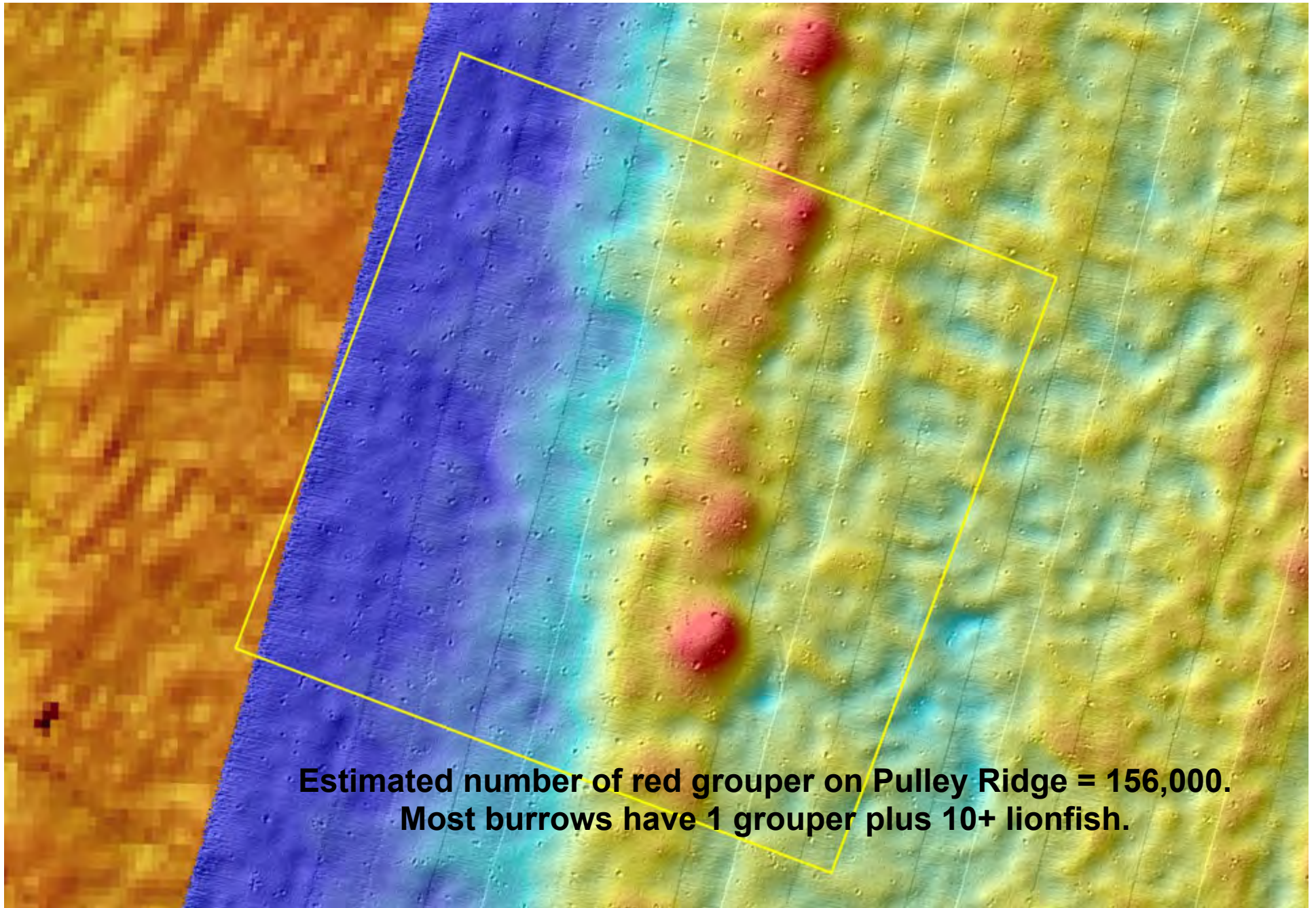


Proposed Pulley Ridge HAPC and Tortugas Mesophotic Reef HAPC extensions.



More than 60 species of reef fishes occur on Pulley Ridge.
The red grouper *Epinephelus morio* forms large pits 6-10 m wide, providing an oasis for smaller reef fish (like this *Chromis scotti*), 262 ft.

Photo Credit: University of North Carolina at Wilmington, National Undersea Research Center.



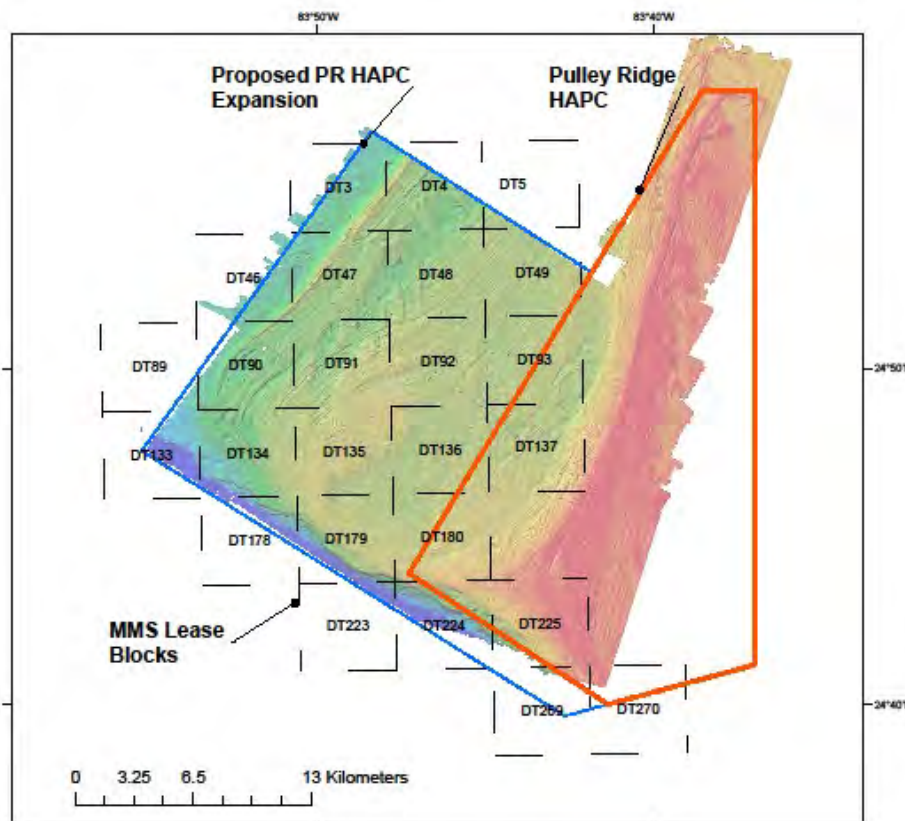
**Estimated number of red grouper on Pulley Ridge = 156,000.
Most burrows have 1 grouper plus 10+ lionfish.**

Multibeam sonar map showing red grouper burrows (10 m dia) at Pulley Ridge HAPC



Lionfish are now prevalent throughout the Pulley Ridge HAPC and in particular associated with red grouper burrows or “pits”—
depopulating the small and juvenile reef fish?

In 2014 & 2015 we discovered vast fields of plate coral – outside of the Pulley Ridge protected area!

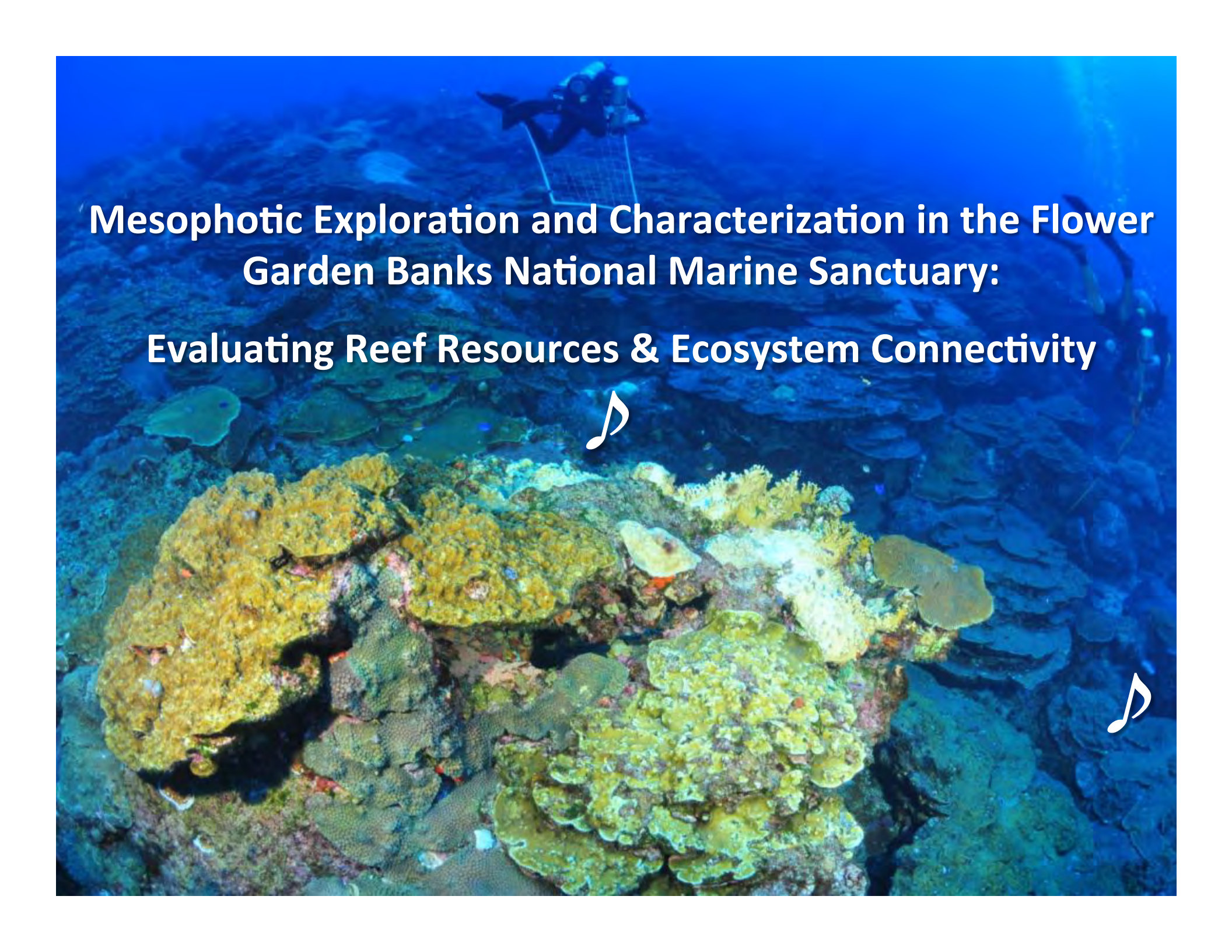


Proposed
Extension to
Pulley Ridge
HAPC = Blue

Pulley Ridge
HAPC = Red

MMS Blocks
numbered (5
km-squares)



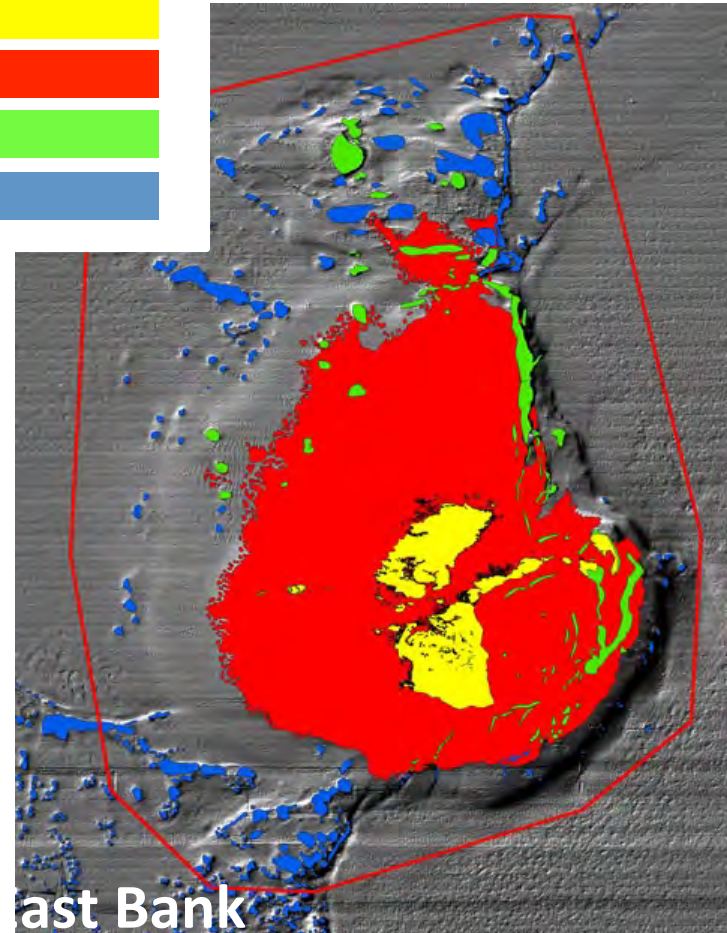
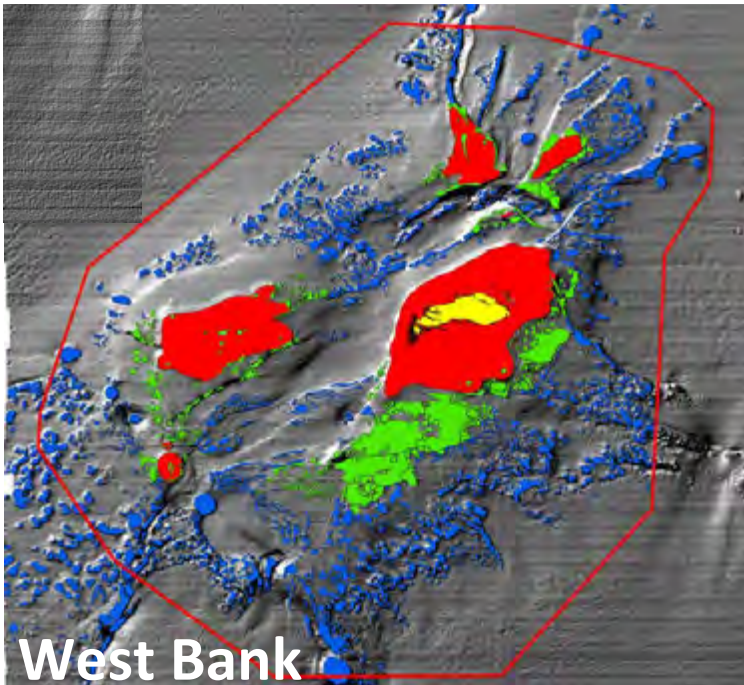
An underwater photograph showing a diver in the upper center, holding a large rectangular net. The diver is positioned above a diverse coral reef. The foreground is dominated by large, yellowish-green coral structures. The background shows a deep blue water column with some faint light patterns. The overall scene is a scientific or exploratory activity in a marine sanctuary.

**Mesophotic Exploration and Characterization in the Flower
Garden Banks National Marine Sanctuary:
Evaluating Reef Resources & Ecosystem Connectivity**



Benthic Habitat Maps by Community Type

Coral Reef Cap Zone
Algal Nodules Zone
Coralline Algae Reef Zone
Deep Coral Zone



- Overall coral cover 51% (on Cap)
- Potential for partial, experimental fisheries closure after 3 years of baseline assessment



Project Outcomes

- Based on the three years of baseline data collection in the Flower Garden Banks, the Sanctuary Council is considering a proposed 8-year fishing exclusion in a portion of the Sanctuary.

Chapter 5

Benthic and Fish Communities in the Mid and Lower Mesophotic Zone of the Sanctuary

Joshua Voss, Harbor Branch Oceanographic Institute at FAU and NOAA CIOERT

Maureen Williams, Harbor Branch Oceanographic Institute at FAU and NOAA CIOERT

John Reed, Harbor Branch Oceanographic Institute at FAU and NOAA CIOERT

Randy Clark, NOAA NOS/NCCOS/CCMA

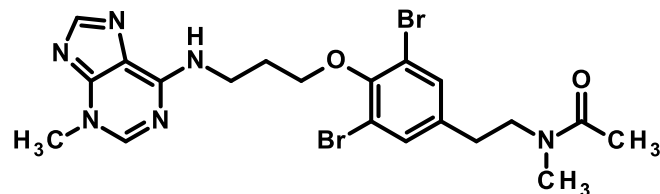


CIOERT Project Highlights

- Discovery and protection of deep coral reefs
- **Discovery of novel therapeutics**
- New technology development
- Exploration, education & telepresence

Aphrocallistin Kills Cancer Cells

- Aphrocallistin was isolated from a sponge *Aphrocallistes beatrix* collected in 1600 fsw off Fort Pierce



- It shows strong selectivity for cancer cells with mutations in DNA repair
- It is most active against triple negative breast cancer cells and malignant melanoma cancer cells
- Compound can be synthesized: potent analog will be clinically evaluated.
- Research to applications!



“Shrek” Sponge May Cure Alzheimers



- compounds active in Alzheimer's
- in vivo (animal) studies planned

CIOERT Project Highlights

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CISME: New Technology Development to Measure Coral In Situ Metabolism

- **Goal:** develop a diver-operated underwater instrument for non-destructively measuring coral metabolic rates in situ
- **Measurements:** respiration rates, photosynthesis rates, and a port to collect water samples for other analyses (e.g. calcification, nutrient and toxicant effects)
- **Proposed use:** rapid assessment and monitoring of metabolic health of corals and other key coral reef species.
- **Capability:** compare metabolic rates among sites or over time (e.g. compare diseased/bleaching and normal appearing corals).
- **Value:** to NOAA coral reef monitoring and research programs.
- **Tech development:** can be adapted for use on deep coral and other benthic organisms or substrate types.



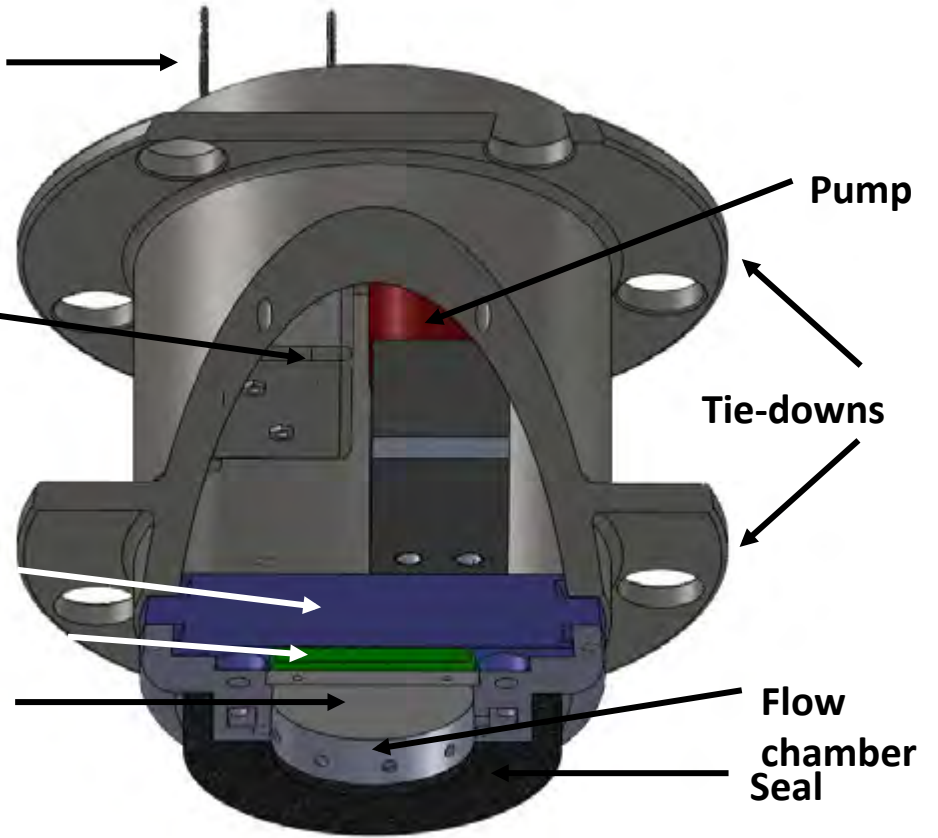
Pull tabs

Removable volume

LED heat sink

LED circuit board

Window

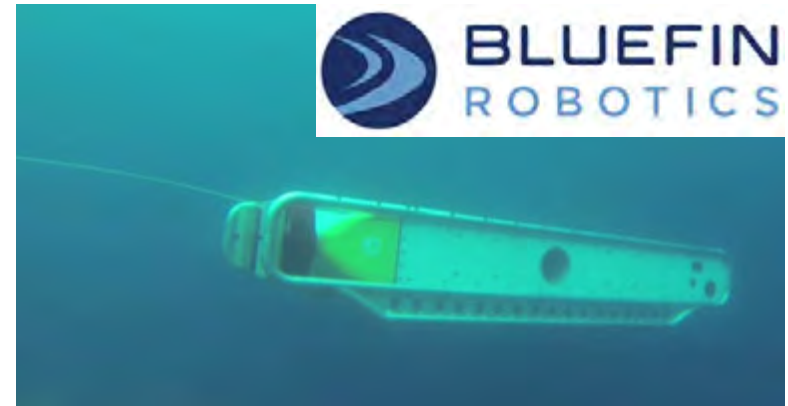


Autonomous Underwater Hybrid Platform (Bluefin U-4000) Integrated with High Resolution Carbonate Chemistry Sensors



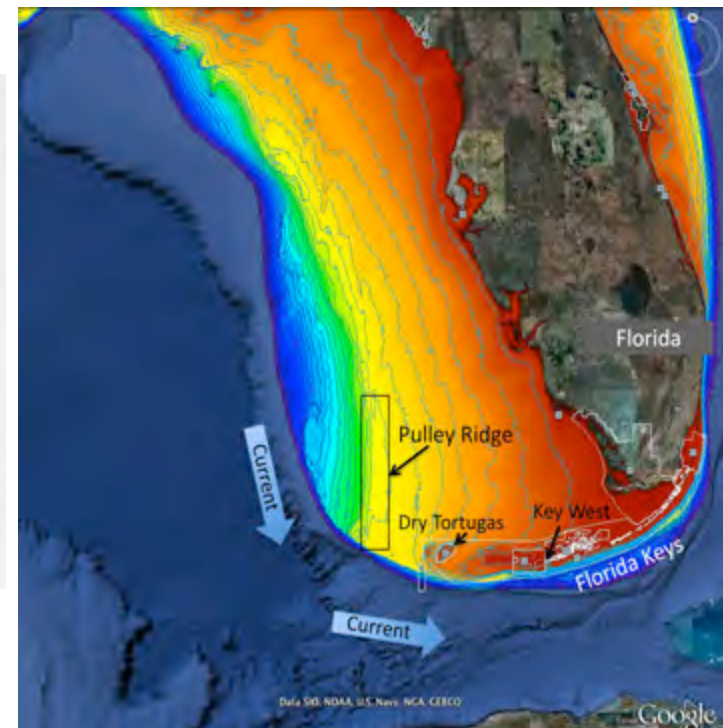
HydroC pCO₂ sensor

- High-precision optical analyzing NDIR system
- Standard calibration is 200 – 1000 μatm
- Op. depth 2,000 m
- Response time: 60
- Accuracy: $\pm 1\%$ of reading



SAMI-pH sensor

- High accuracy fast response
- Accuracy: ± 0.003 pH units
- Response time: 3 min.
- Salinity range: 25-40
- pH range: 7-9 units
- Long deployment (234 d)



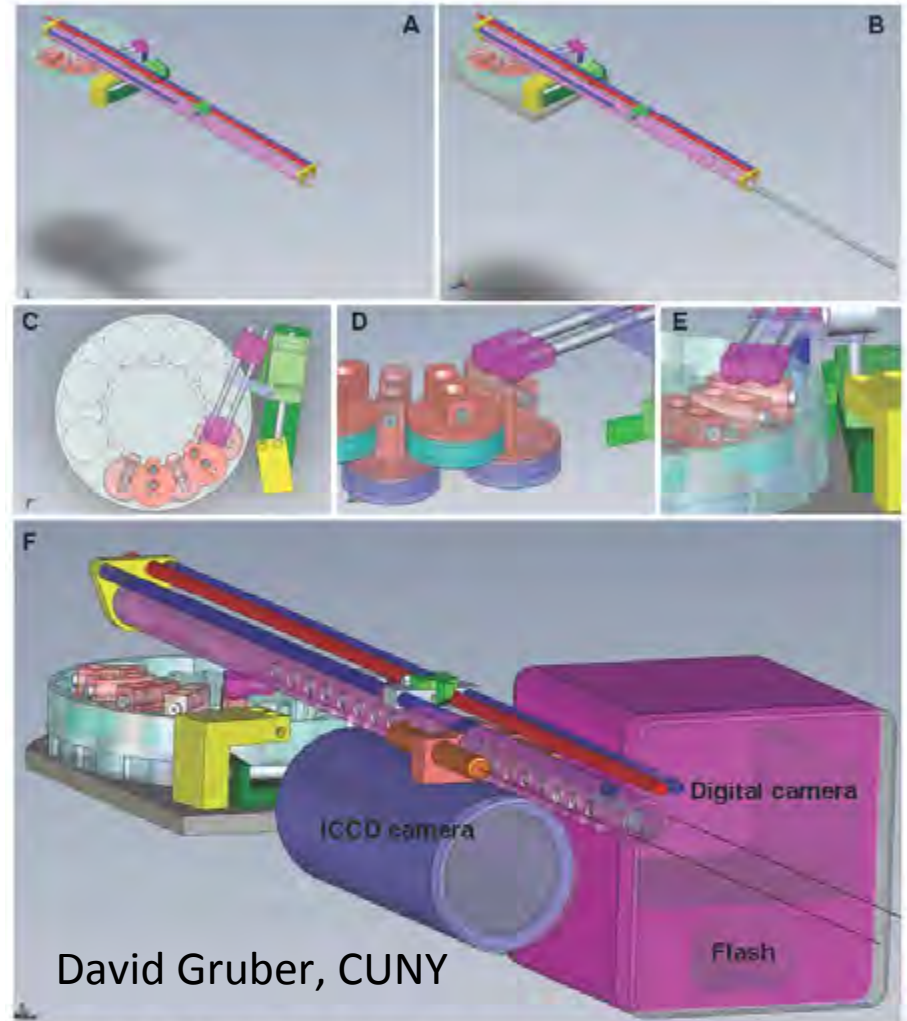
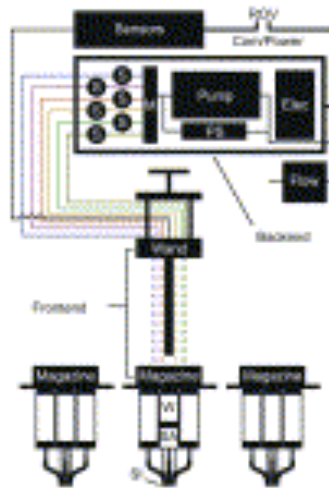
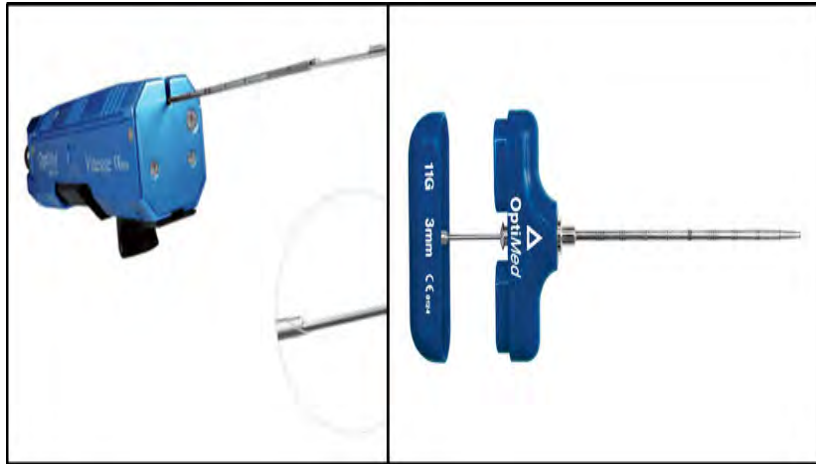
CTD, DO and Chl sensors will be integrated as well. Other measurements will include CTD Rosettes for water properties

Subsea Environmental LiDAR Technology

- WaveGlider SV3 & Fast Coastal Glider (PMEL) LiDAR Integration – OAR Technology Development Funds
- Long-term goal: better understand fine temporal and spatial scale beam attenuation and backscatter properties of undisturbed three-dimensional scattering volumes.
- Important for observing intermittent turbulent mixing events and resolving short-lived processes (e.g., thermal, chemical, and biological fluxes) throughout the water column, which are otherwise nearly impossible to capture from conventional ship-based measurements.



Small-volume “needle-biopsy” sampler: The Stinger



David Gruber, CUNY

Breier et al., Deep Sea Research,
2012, doi:10.1016/j.dsr.2012.10.006

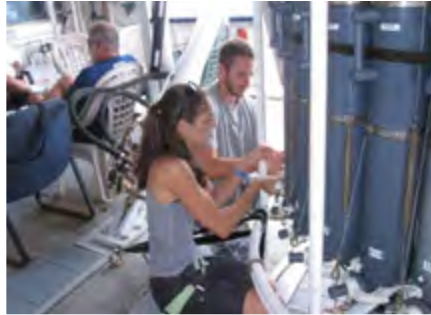
Figure 5: Ballistic sampling device and camera sled. One design idea for a device that ballistically samples substrata. A) The device in a “cocked” position

CIOERT Project Highlights

- Discovery and protection of deep coral reefs
- Discovery of novel therapeutics
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CIOERT Ocean Discovery Cruises

- Pre-cruise meetings with participants
- 7-10 day oceanographic research cruise
- Semester course
- Research poster presentations (end of course)



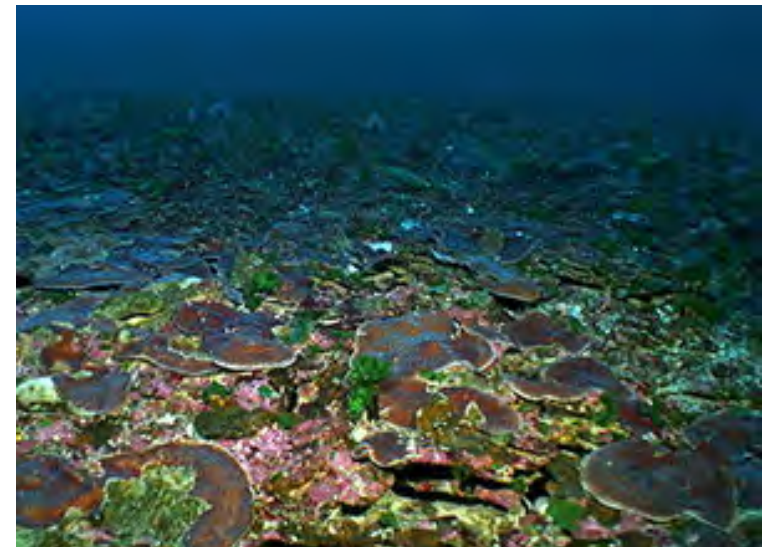
Telepresence



EXPLORE

CIOERT Ocean Discovery Cruises

- *Okeanos Explorer* pilot cruise –HBOI ECC (Caribbean Trenches & Seamounts, April 2015)
- Development of graduate course – *Okeanos Explorer* cruise (Pacific Marine Monuments & Sanctuaries, September 2015)
- Telepresence – CIOERT cruises



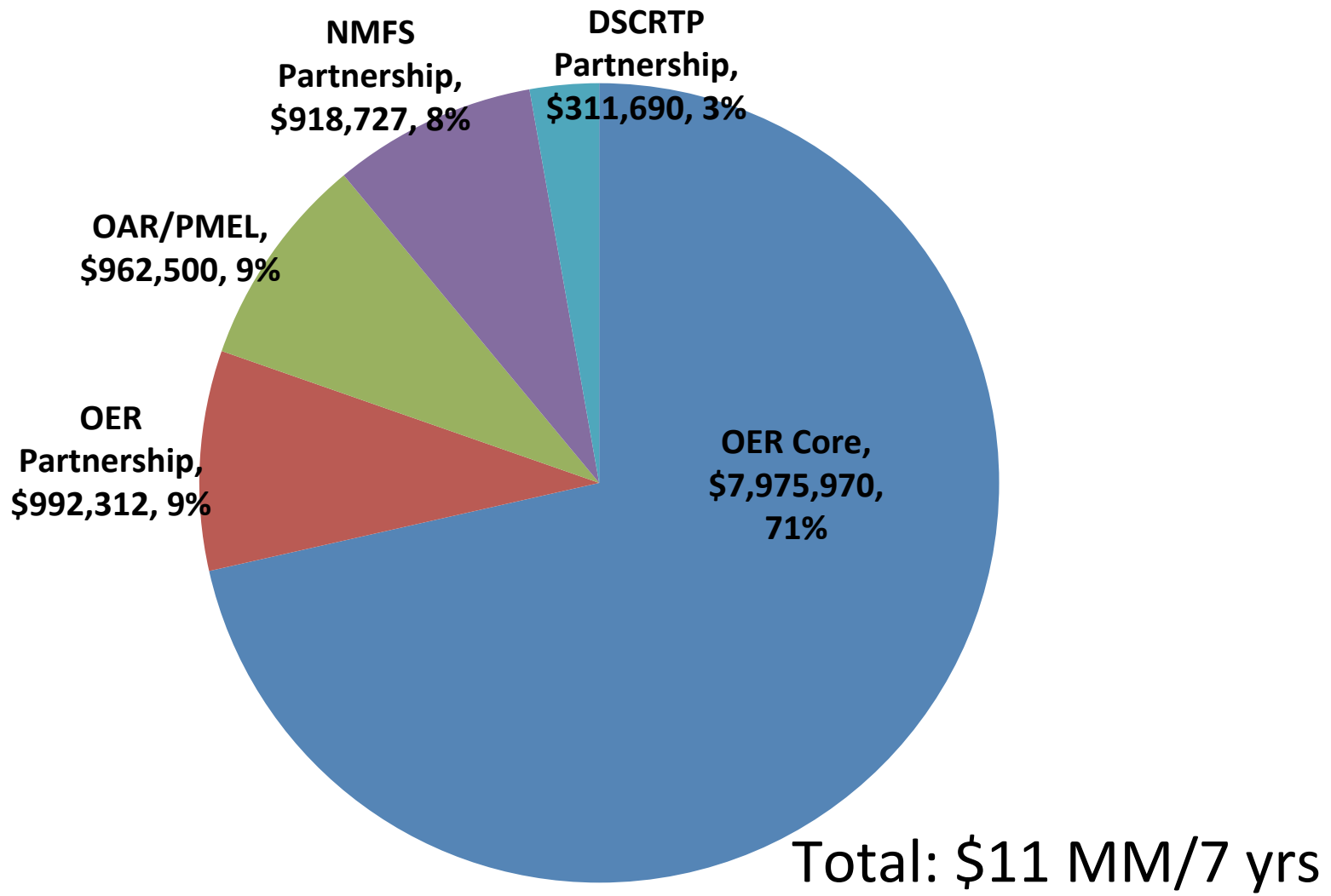
Cooperative Institute Funding Mechanisms

- Base funding is provided annually by NOAA to the CI, pending availability of funds.
- Throughout award period, funding for *additional* activities is added to the CI award as proposals are submitted by the CI and approved by NOAA.
- The CI award functions as **an administrative vehicle** established jointly with a research institution **to more closely link NOAA & CI research.**
- Because the CI is established through a rigorous competitive process, ***funding for any proposal associated with one of the approved scientific themes is not required to undergo a competitive merit review process.***
- NOAA still reviews each proposal to determine if the project is scientifically sound & the budget is appropriate.

CIOERT History

- FFO: OAR-CIPO-2008-2001403
- Cooperative Agreement awarded May 2009
- \$22.5M *authorized* – 5 years: FY 09-14
- Progress reviewed by SAB in 2012:
“Outstanding”
- Non-competitive renewal (FY 14 –19)
- \$22.5M *authorized* – 5 years: FY 14-19
- To date actuals (FY 09-15): \$11M

Funding by Source & Type



Leveraging

- Across NOAA LO's, Labs, and CI's
 - OAR (AOML, PMEL)
 - NOS (CSCOR, Sanctuaries)
 - Fisheries (SEFSC, DSCRTP)
- Across Federal & State Agencies
 - NIH (NCI)
 - DOE
 - State of Florida (DEP, FWC)
 - State of North Carolina

NOAA Collaborators

- **OAR**
 - OER, PMEL, AOML/CIMAS
- **Fisheries**
 - SEFSC
 - DSCRTP
- **NOS**
 - Sanctuaries
 - FGBNMS
 - FKNMS
 - CCMA
 - CSCOR

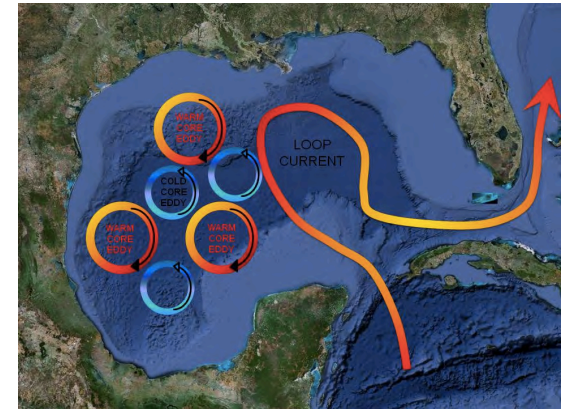
FY16 and beyond

- Synthesize & integrate theme areas
- Build on successes:
 - Continue to provide value to NOAA across LO's & agencies
- Shift more resources to HR/HR projects
- Roadmap to transition E/R/T to applications

US-Cuba “Sister Sanctuary” Designation

- Incorporates a relationship with the FKNMS and the FGBNMS

- Banco de San Antonio – FGBNMS
- Guanahacabibes – FKNMS



- Gives researchers the key to evaluate ecosystem functions and changes at the two sites.

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www.cioert.org

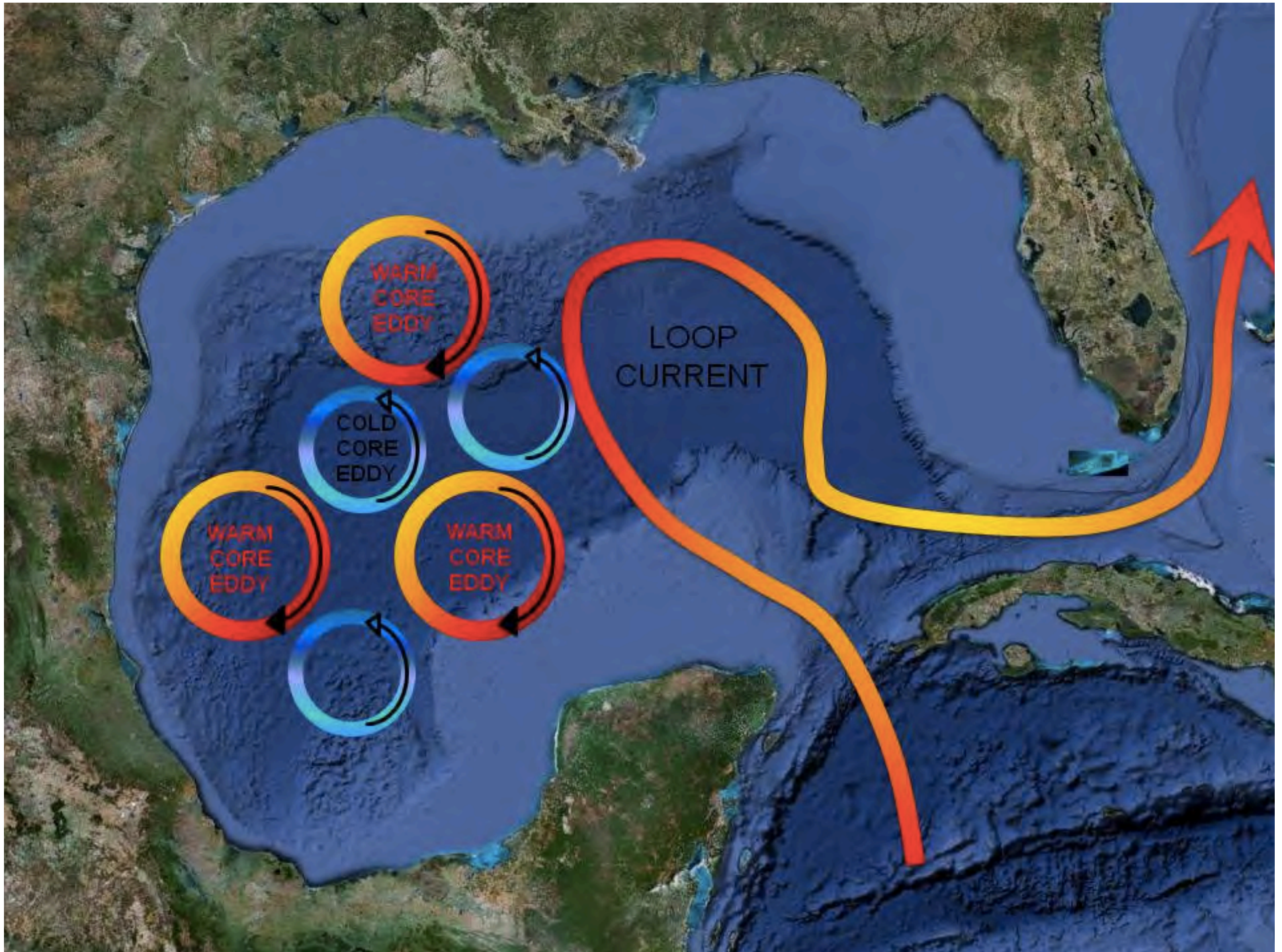
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NOAA Fisheries Technology Projects

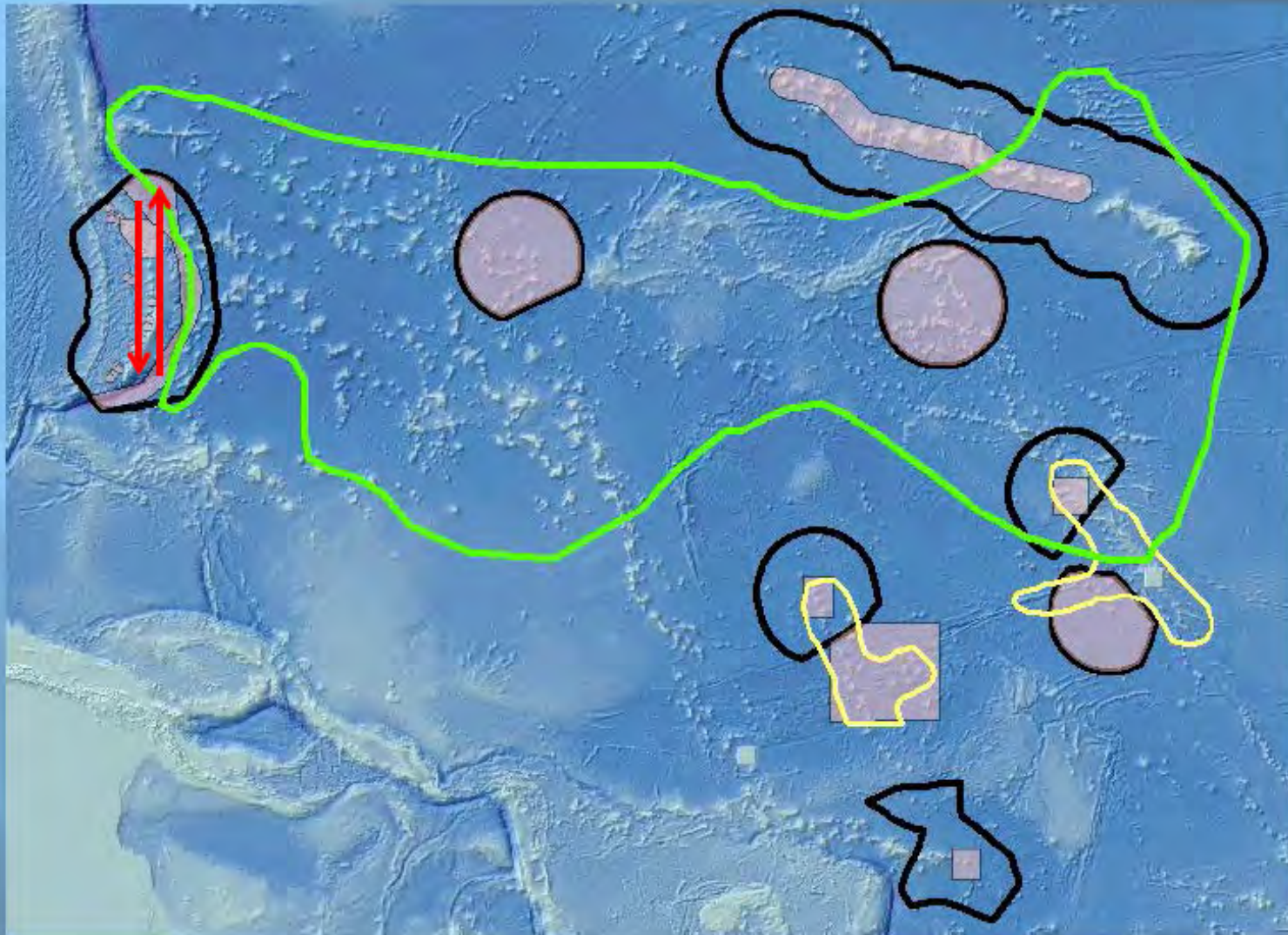
- SRI: Real-Time Image Detection and Tracking for Improved Fish Classification and Counting
- USF: Instrumenting and Testing a Fishery Echosounder in an Ocean Glider
- USF: Untrawlable Habitat Strategic Initiative: Snapper and Grouper Behavior toward CBASS and Other Moving Camera Vehicles

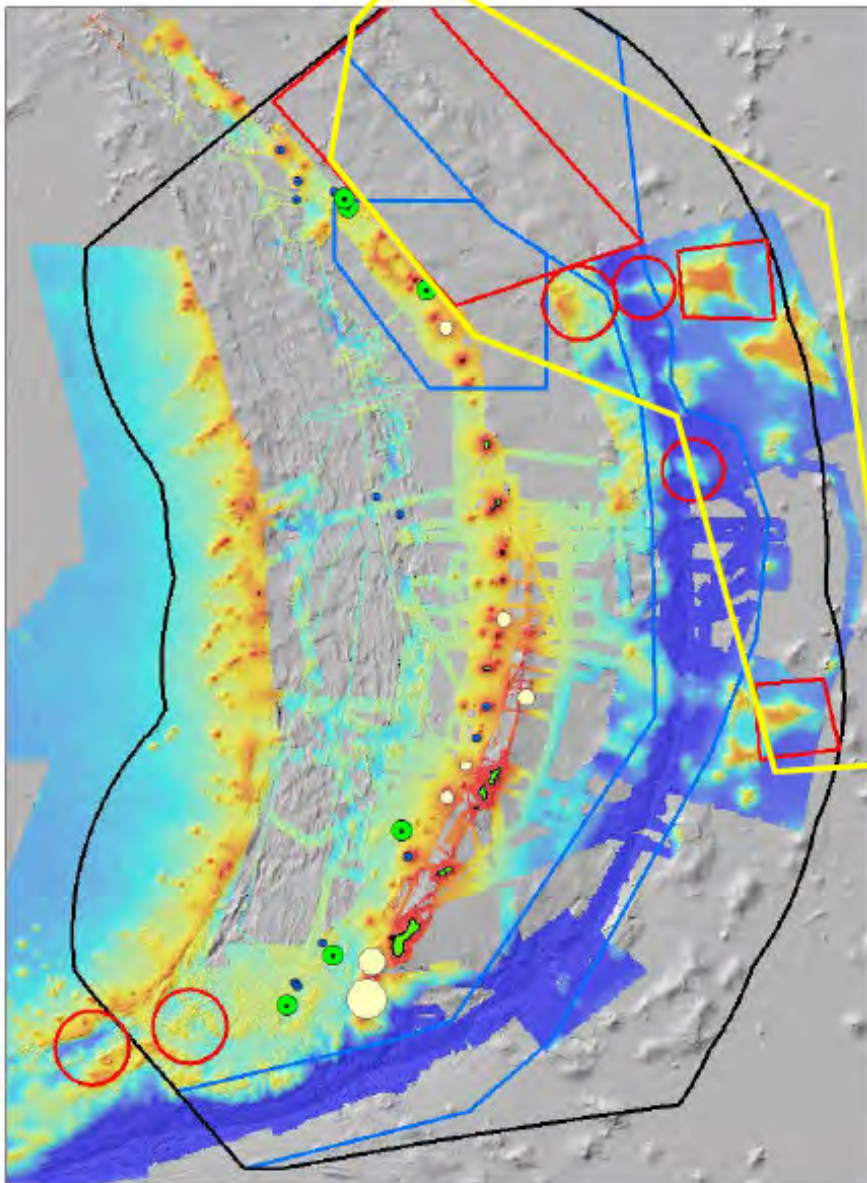


Deep Coral “Superlatives”

- The shallowest known *Lophelia* ecosystem in the U.S. was discovered at ~200m off Jacksonville, Florida.
- The southern-most living deepwater *Lophelia* reef in the continental U.S. waters was discovered at 500 m off the Florida Keys.
- A new *Lophelia* reef was discovered in the southeastern Gulf of Mexico.

CNMI ROV & Mapping





Leg 3 ROV

Trench/subduction zone
Mud volcanoes
Mn-crust seamounts