

# Pulley Ridge and West Tortugas Characterization

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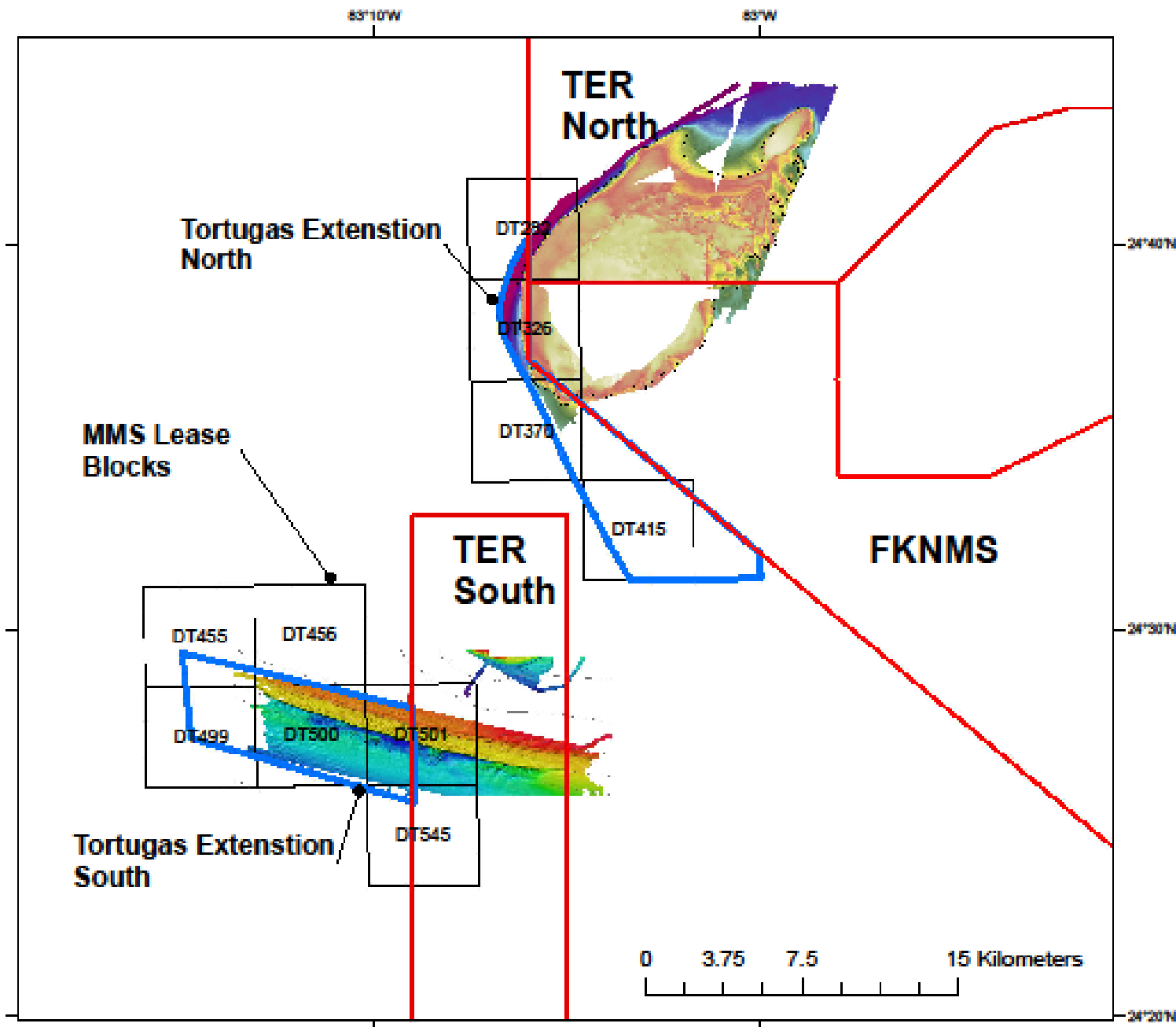
# NOAA-NOS-NCCOS: REPP Connectivity of the Pulley Ridge-South Florida Coral Reef Ecosystem: Processes to Decision-Support Tools

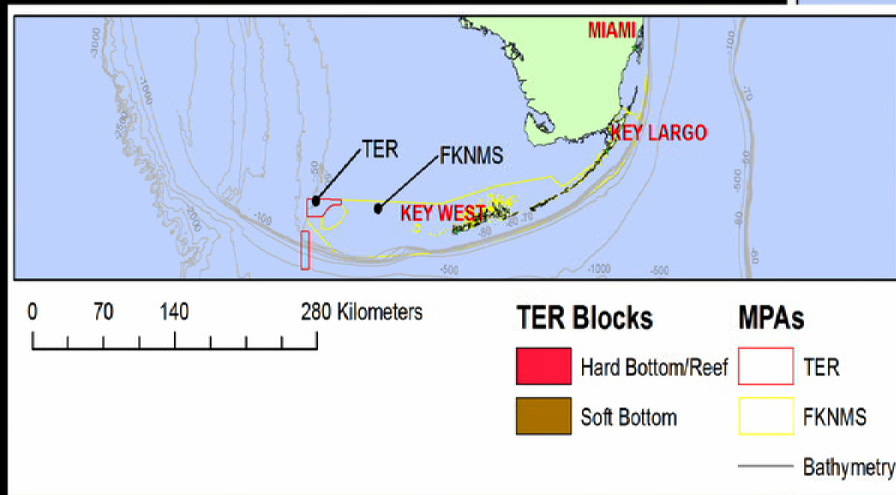
- NOAA Cooperative Institute for Marine and Atmospheric Studies at the University of Miami (CIMAS) (Peter Ortner & Robert Cowen)
- NOAA Cooperative Institute for Ocean Exploration, Research, and Technology at Florida Atlantic University (CIOERT) (Shirley Pomponi)
- Kimberly Puglise, NOAA-NOS-NCCOS Project Federal Program Officer
- More than 35 scientists at 11 different universities
- State and federal agency scientists
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  - Stephanie Farrington, HBOI-FAU
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NOAA/NOS/NCCOS  
NOAA/OAR/OER

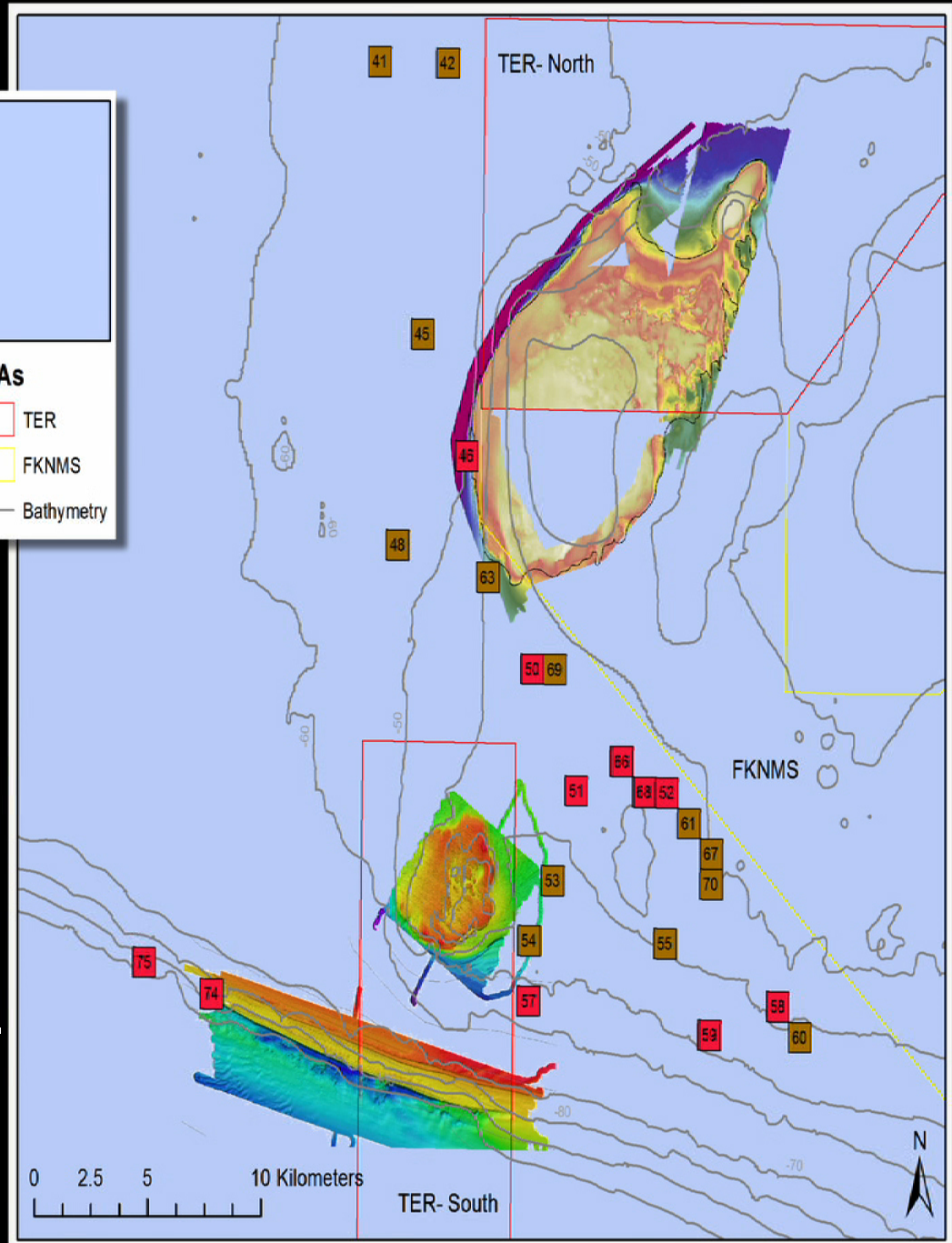






2013-2014 CIOERT ROV surveys of random 1 km<sup>2</sup> blocks outside of the Tortugas Ecological Reserve and Florida Keys National Marine Sanctuary.

Red blocks had reef and hard bottom habitat.





## 2010 and 2013 HBOI Dive Sites

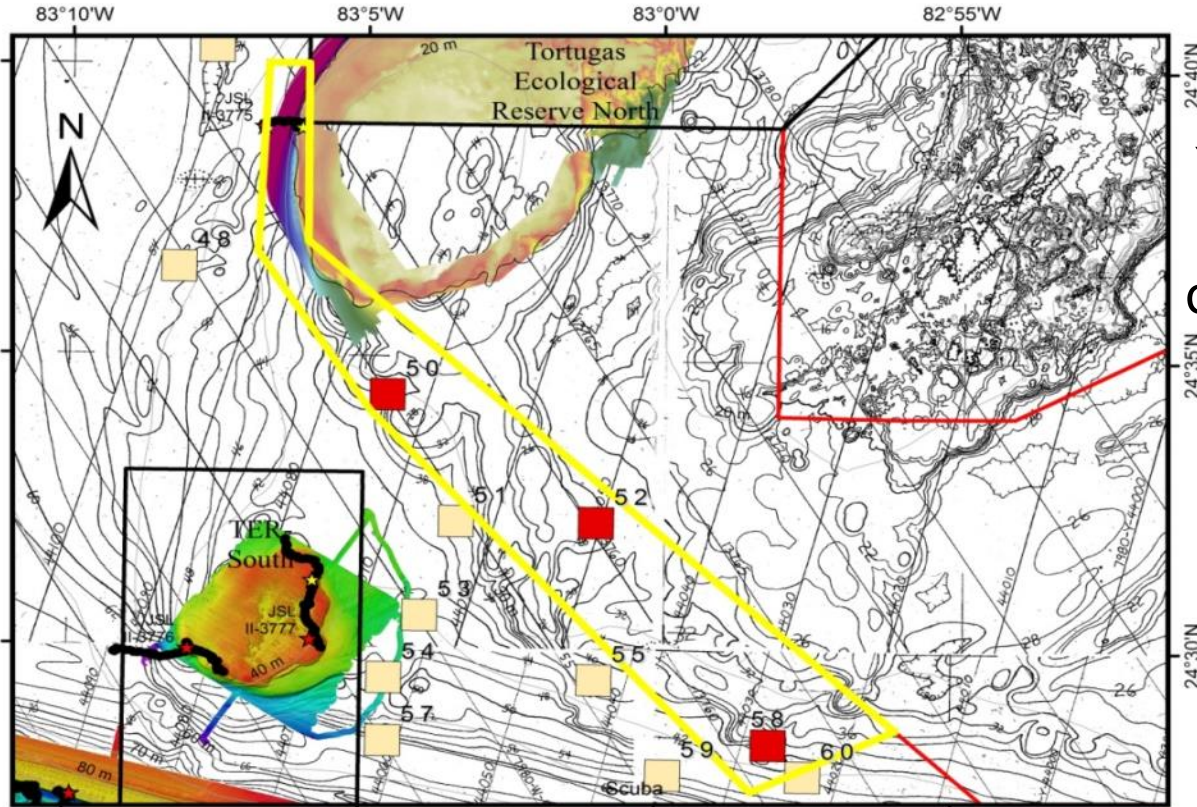
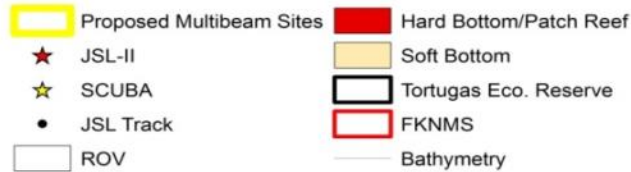
Tortugas Sites

Stephanie Farrington & John Reed

NAD\_1983\_UTM\_Zone\_17N

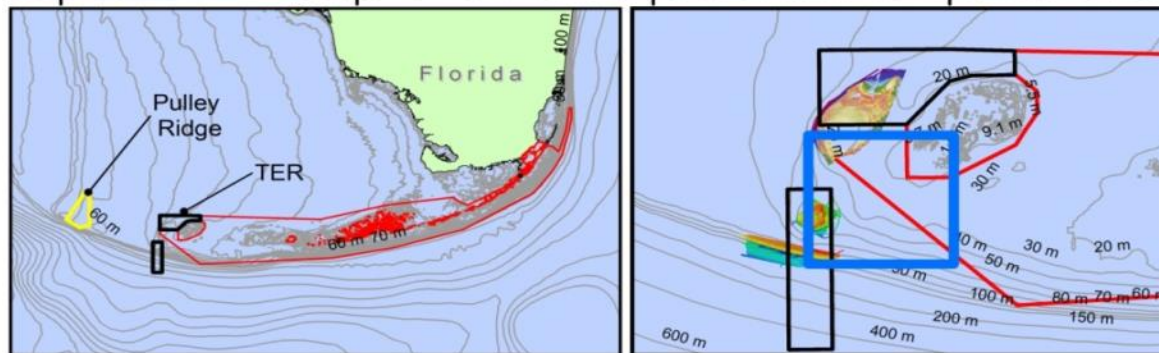
Projection: Transverse\_Mercator

Datum: D\_North\_American\_1983



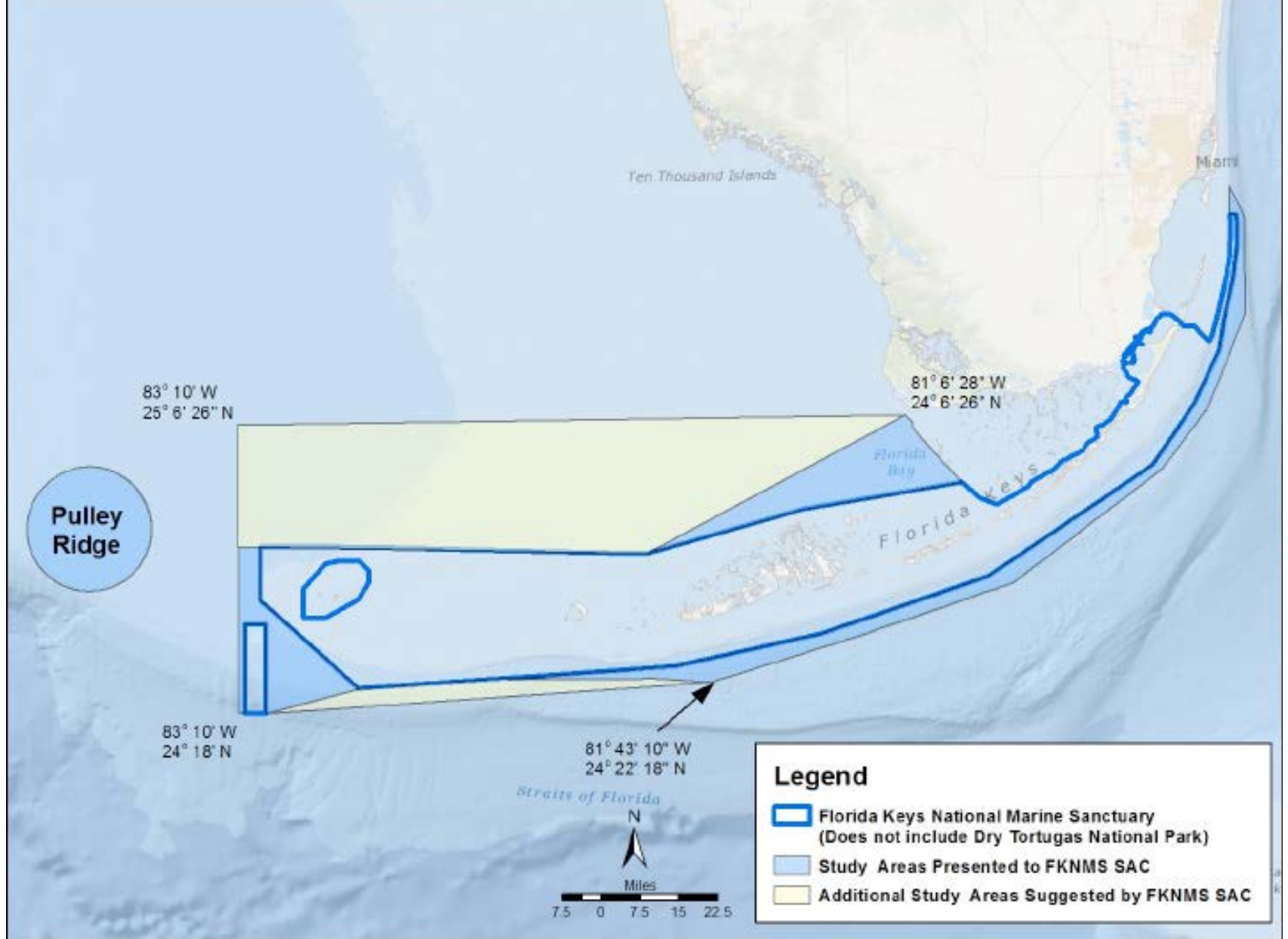
Yellow polygon = areas of mesophotic patch reefs occur along and outside of the western boundary of the Florida Keys National Marine Sanctuary.

An extensive mesophotic fringing reef occurs outside of the North TER along the west edge.



**HARBOR BRANCH**

FLORIDA ATLANTIC UNIVERSITY

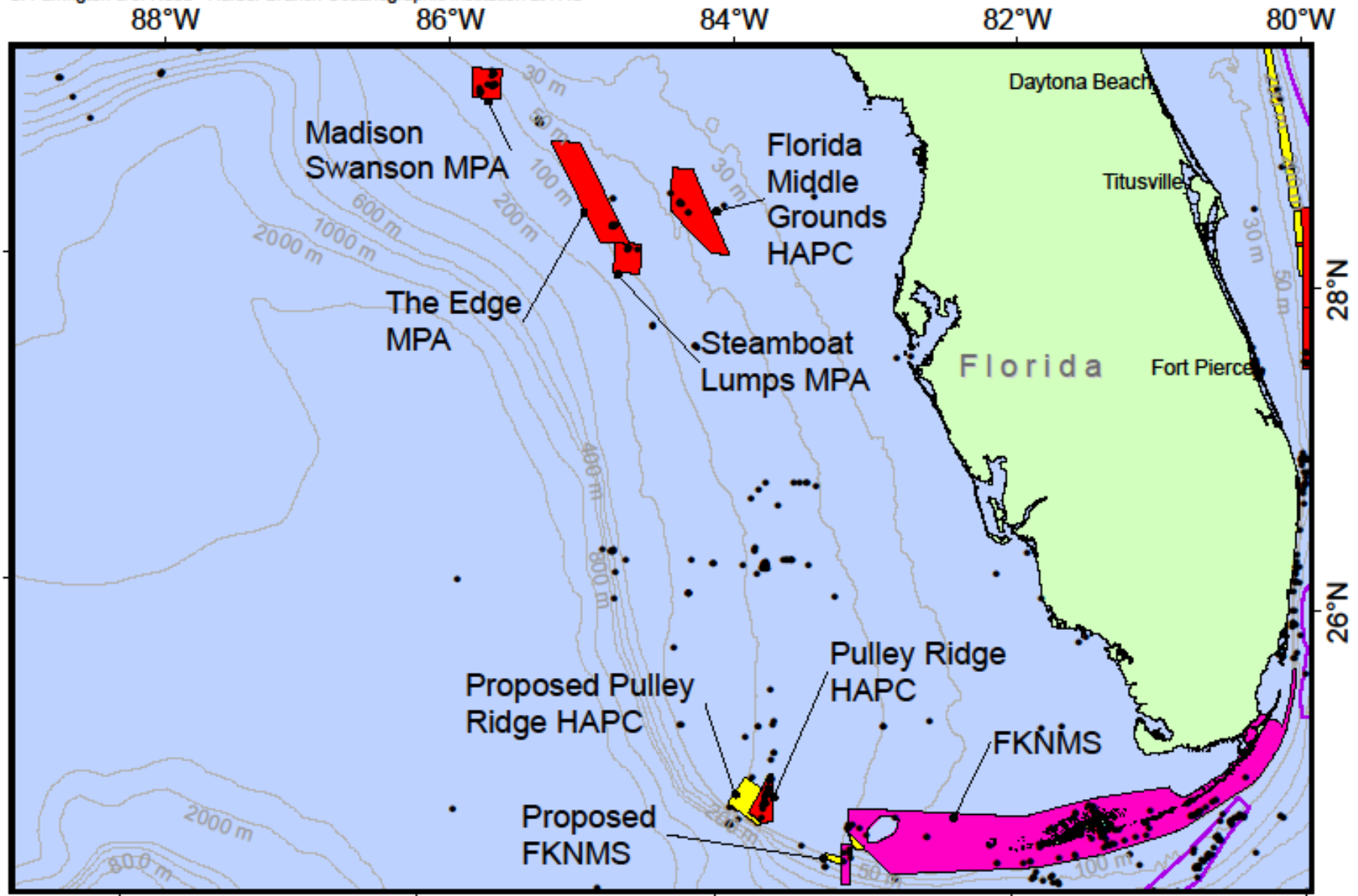


Areas under study by the Sanctuary Advisory Council for potential inclusion into the Florida Keys National Marine Sanctuary. *Photo Credit: NOAA Florida Keys National Marine Sanctuary.*



## Pulley Ridge: General Background

- Pulley Ridge is the deepest known photosynthetic coral reef off the continental U.S.
- In 2005, thru EFH authority of the GOMFMC, Pulley Ridge was designated as a Habitat Area of Particular Concern (HAPC).
- HAPC designation: areas that are rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area.
- Pulley Ridge: rare and especially ecologically important and under some circumstances (e.g., oil spills) may be environmentally stressed.
- Regulations prohibit bottom anchoring by fishing vessels, bottom trawling, longlines, buoy gear, and all traps/pots.
- HAPC designation does not protect Pulley Ridge from anchoring by non-fishing vessels, impacts from divers, or from any other non-extractive uses.
- The HAPC does not cover all of Pulley Ridge

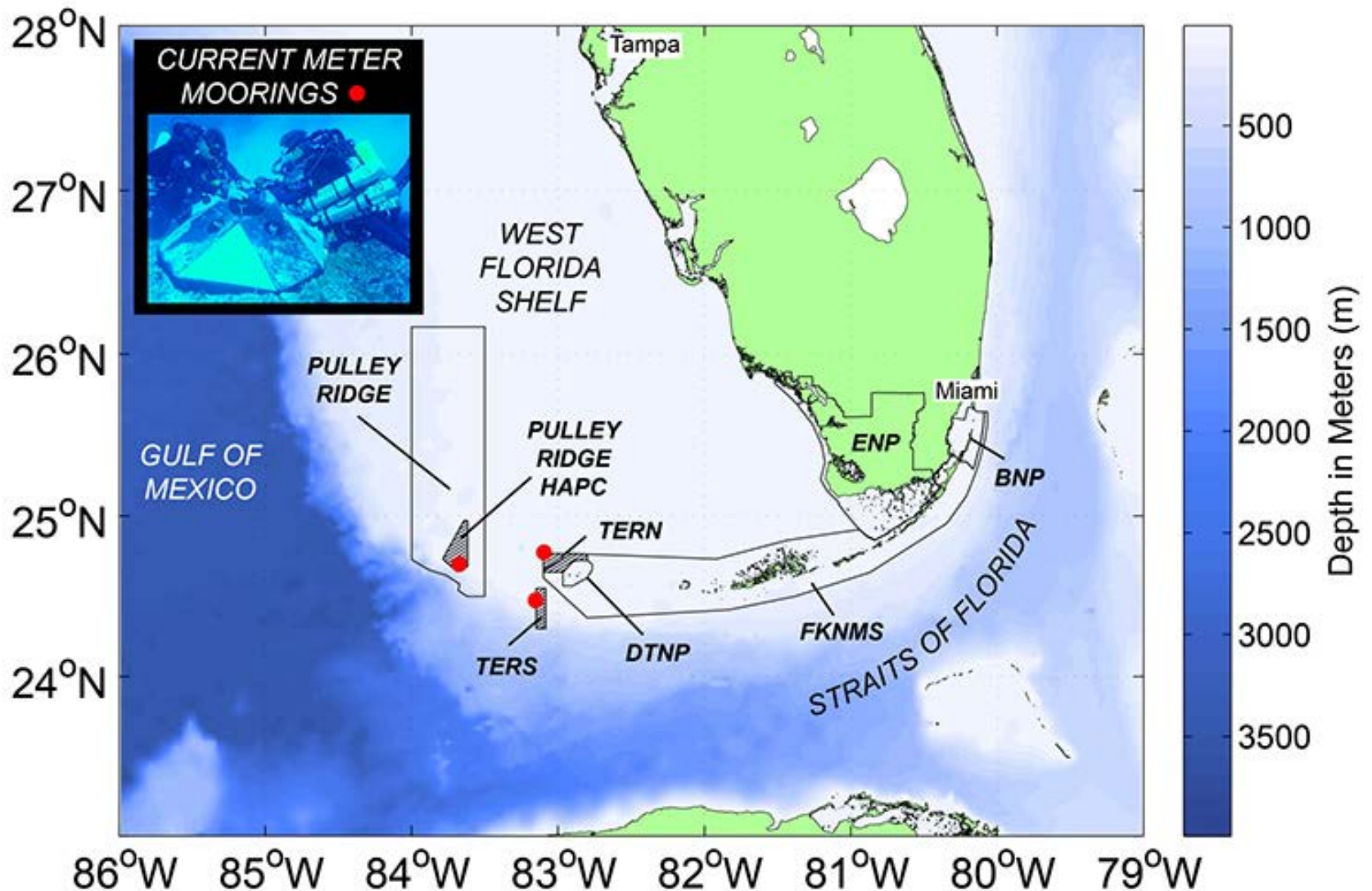


Proposed Pulley Ridge HAPC and Tortugas Mesophotic Reef HAPC extensions.



## **Pulley Ridge Connectivity Research Project Goals:**

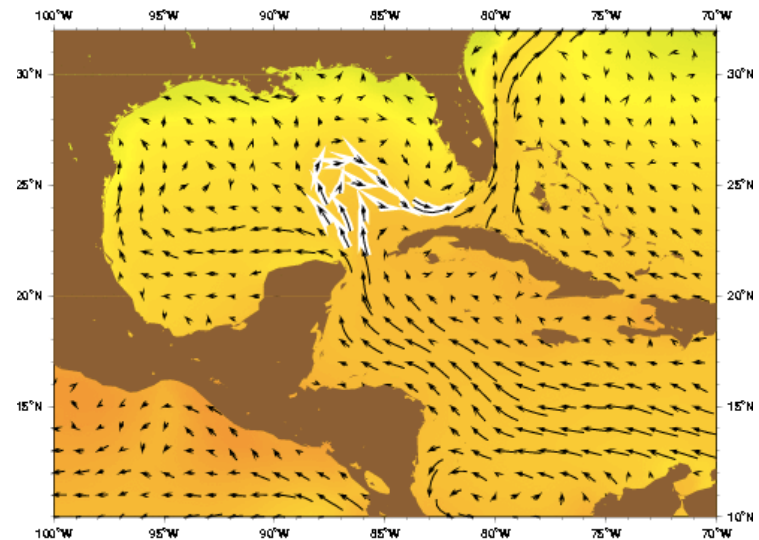
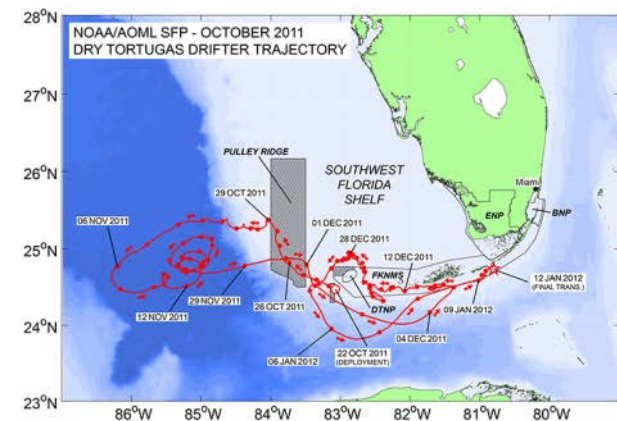
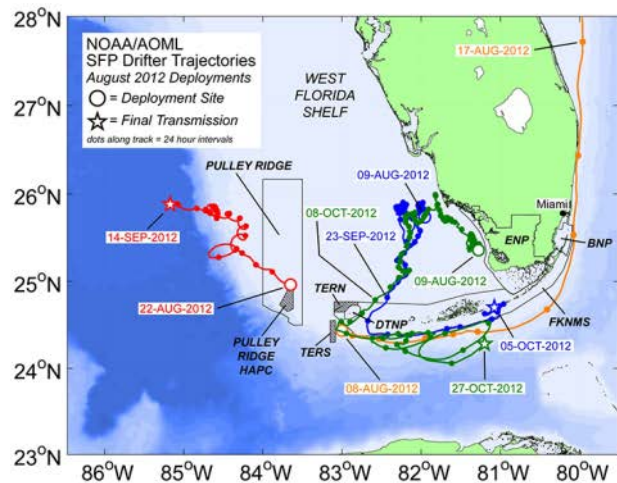
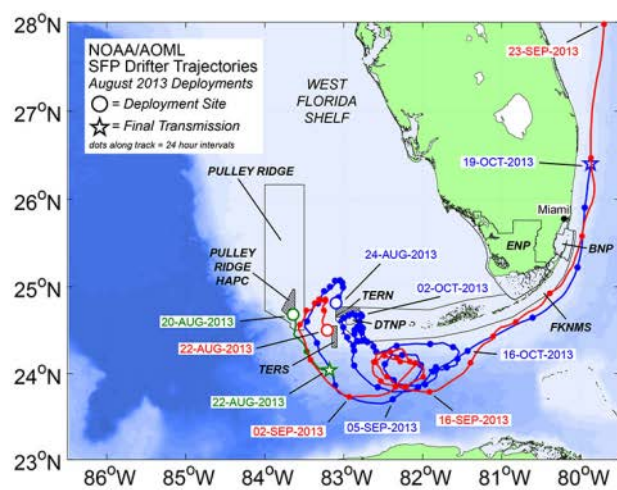
- Map & characterize the benthic habitat, macrobenthic biota, and fish populations within and adjacent to newly designated shelf-edge MPAs and CHAPCs off the SE US.
- Compare with prior and future surveys to better understand long-term health and status of these important deepwater coral/sponge ecosystems.
- Provide information to resource managers to inform decisions on protected habitats and managed key species.



Red dots are locations of moorings with ADCP and temperature/salinity recorders. Project divers service these moorings annually to recover data, clean the sensors, and replace instrument batteries (inset).

Map credit: Ryan Smith, NOAA's Atlantic Oceanographic and Meteorological Laboratory. Inset image credit: Mike Echevarria, Florida Aquarium.





Above: the Loop Current can trap reef fish larvae at spawning grounds in the Dry Tortugas and deliver them to other reefs along the Florida Keys.

This is an important mechanism for replenishing fish stocks in the Florida Keys.

Left: trajectories from surface drifters deployed around the region in 2011, 2012, and 2013. These tracks demonstrate the highly variable circulation pathways that affect south Florida's coastal marine ecosystems.

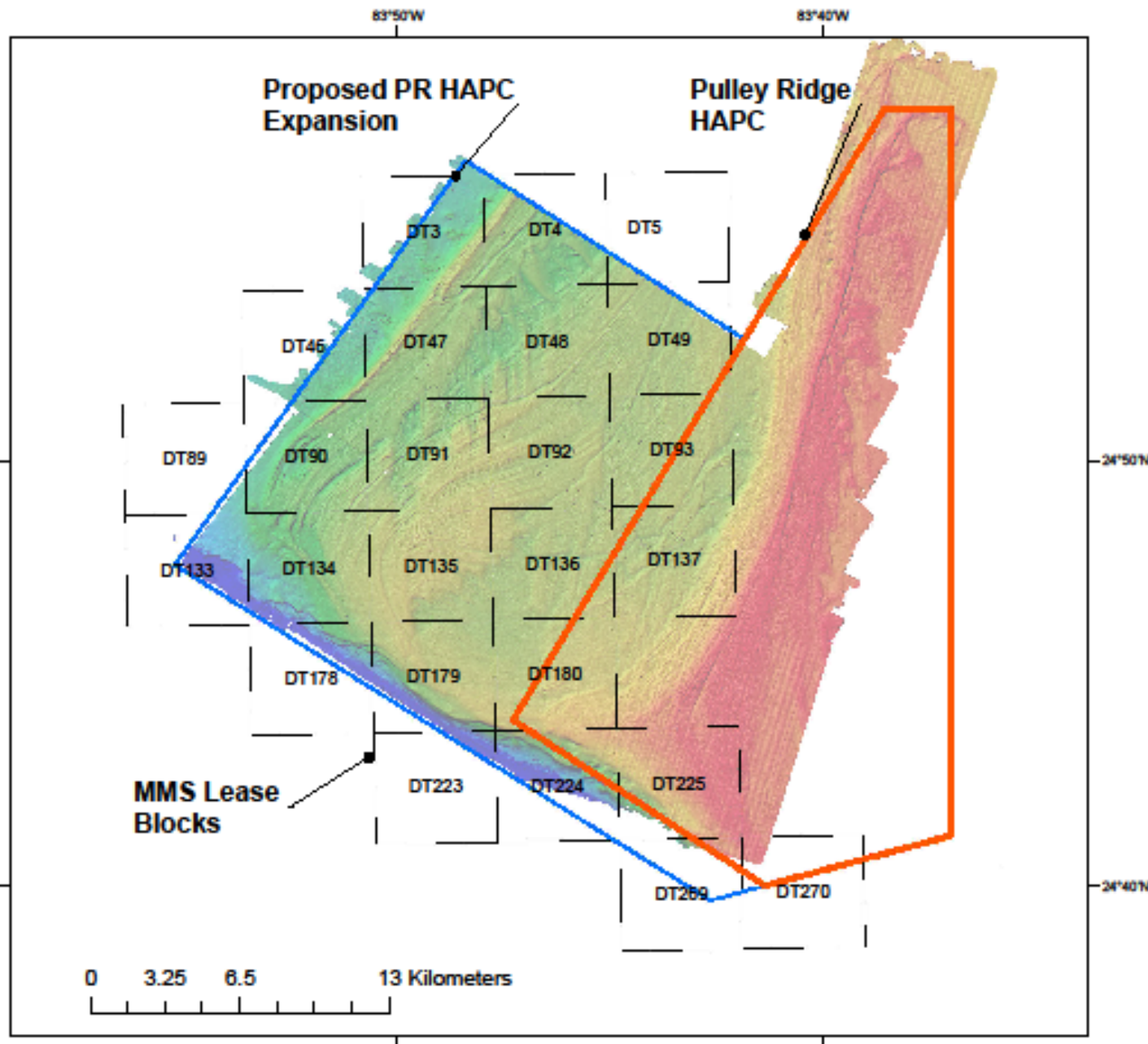
*Image credit: Ryan Smith, NOAA AOML*

# Mesophotic Corals



- Are mesophotic corals healthier than their shallow counterparts? (bleaching/disease)
- Are mesophotic reefs refugia from adverse effects of temperature on shallow reefs?
- Is there genetic connectivity between shallow and deep reefs (vertical and horizontal)?





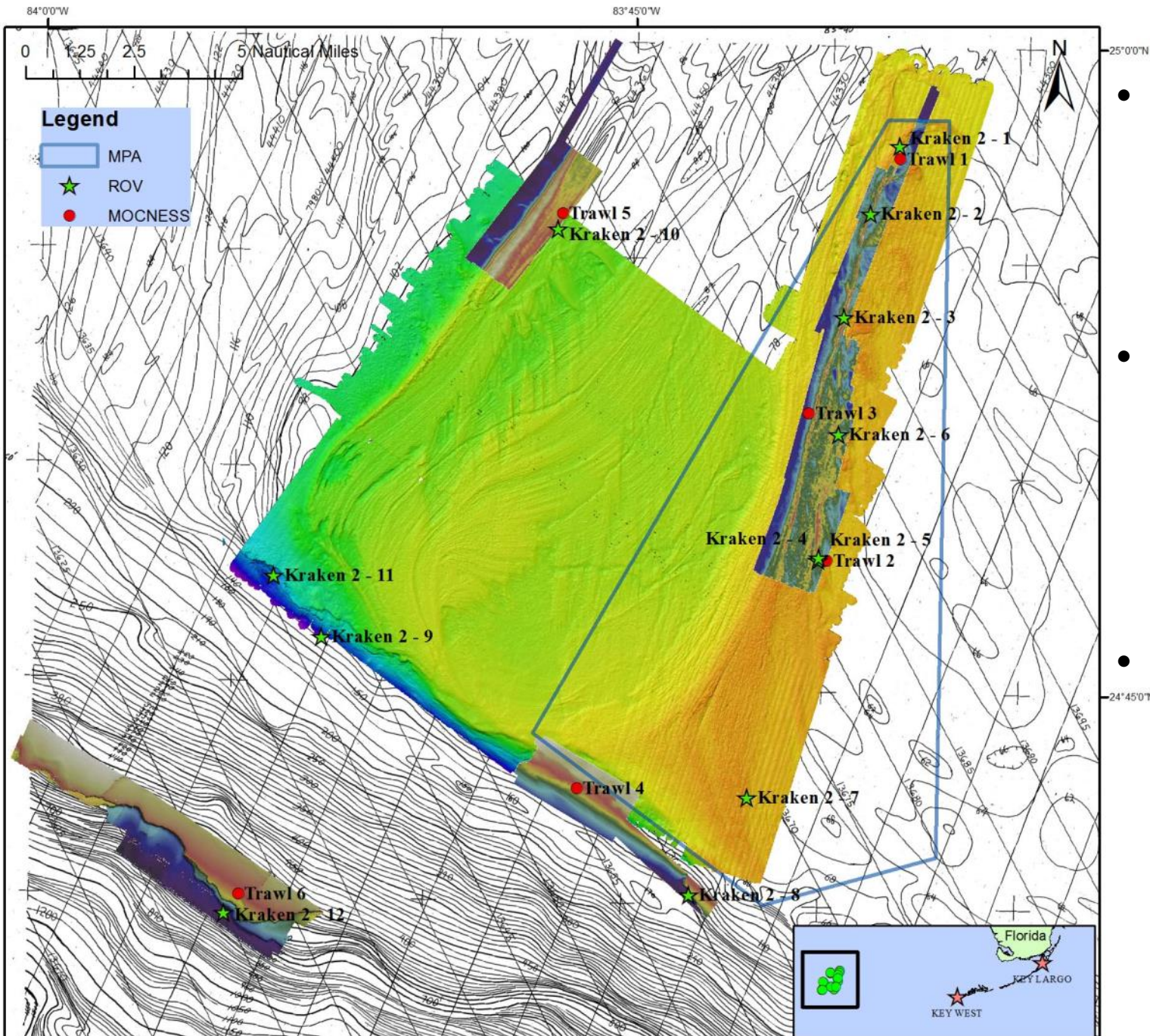
Pulley Ridge  
HAPC = Red

Proposed  
Extension to  
Pulley Ridge  
HAPC = Blue

MMS Blocks  
numbered  
(5 km squares)

## AVAILABLE DATA

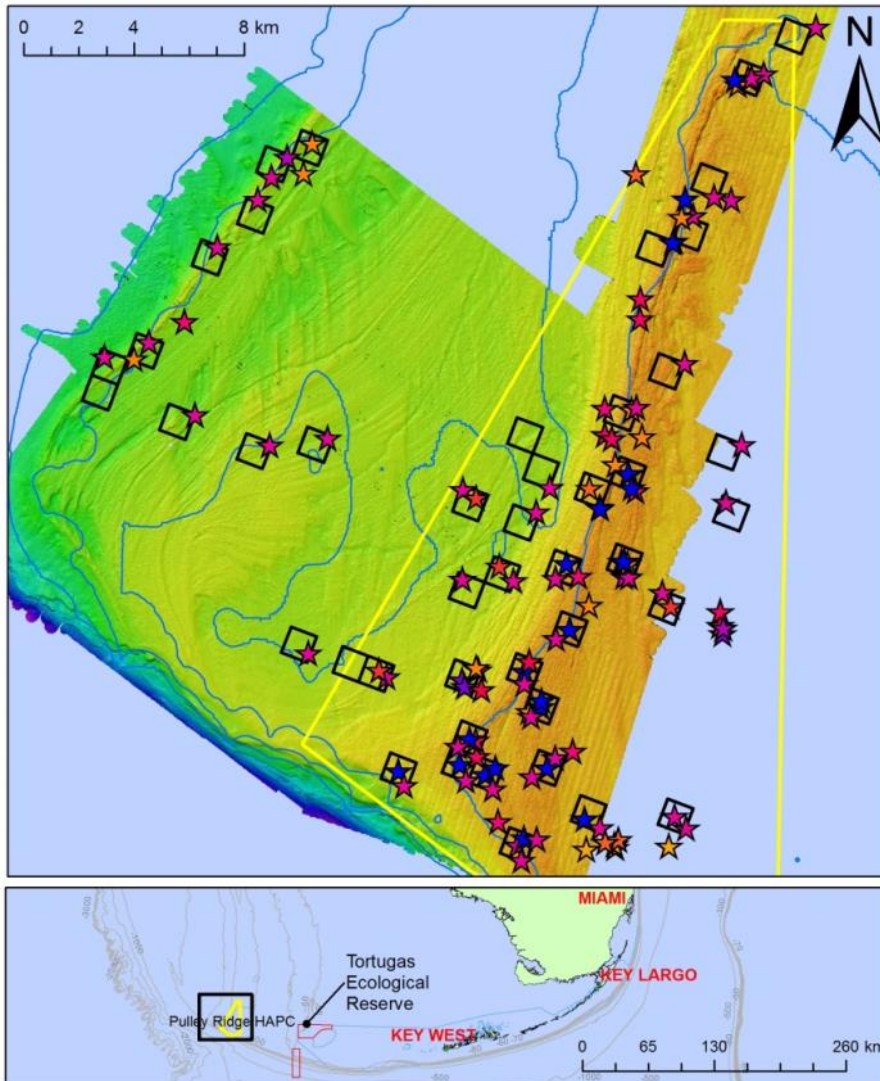
- Multibeam of entire proposed HAPC (D. Naar, USF, 10 m resolution)
- New high resolution MB (2011 Nancy Foster, J Reed, HBOI-FAU; 1-2 m resolution)
- 2011 Kraken ROV dives (Reed, HBOI-FAU-CIOERT)





## 2012 - 2014 Pulley Ridge Sites

J. Reed & S. Farrington  
HBOI-FAU  
WGS\_1984\_UTM\_Zone\_17N  
Datum: D\_WGS\_1984



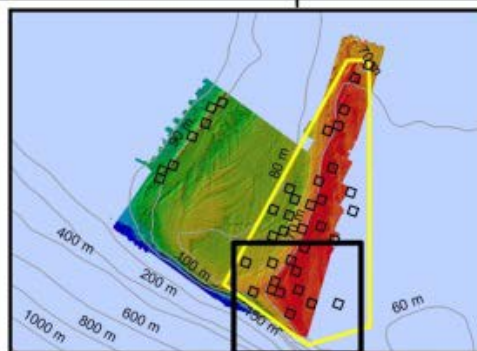
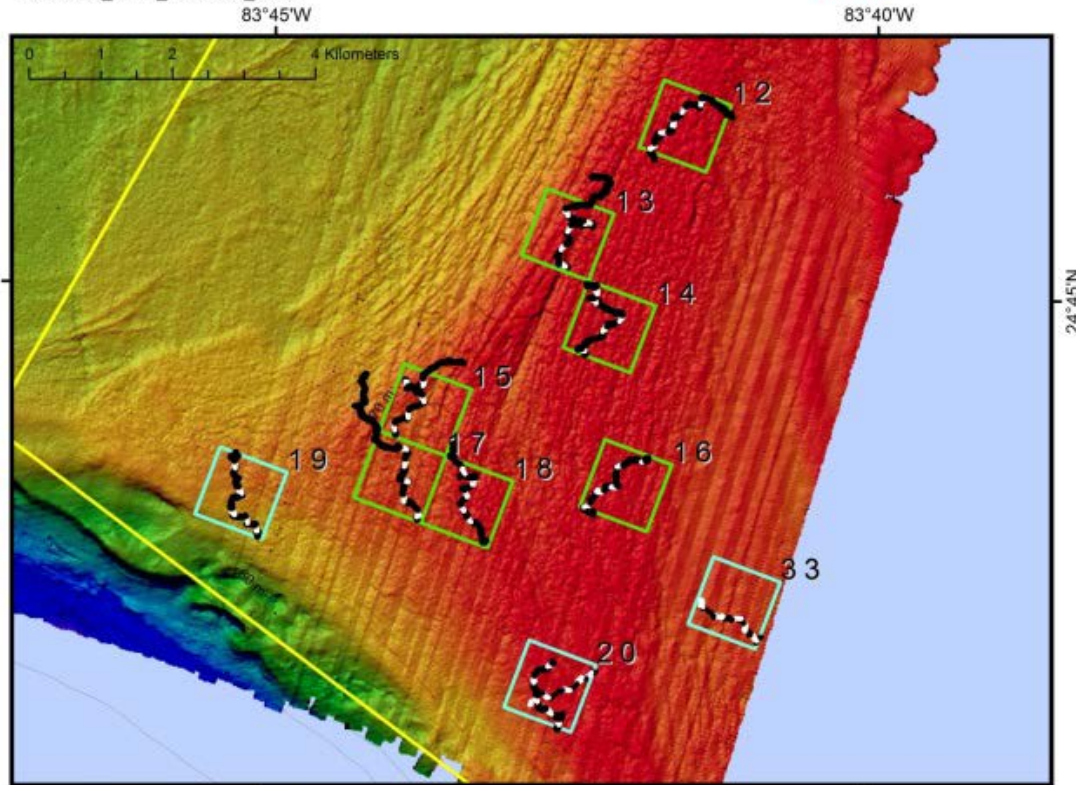
## Summary of 2012-2014 R/V Walton Smith Cruises

3-yr of ROV  
surveys  
examined 45  
1-km<sup>2</sup> random  
blocks on Pulley  
Ridge

- |                      |                         |                 |
|----------------------|-------------------------|-----------------|
| ★ Oceanographic Buoy | ★ Drop Camera           | ★ ROV           |
| ★ CTD                | ★ ISIIS                 | ★ Rock Dredge   |
| ★ Chevron Trap       | ★ Light Trap (plankton) | ★ Seepage Meter |
| ★ Drifter - SVP      | ★ MOCNESS (plankton)    | ★ Tech Dive     |
|                      | □ Blocks                |                 |



2012/2013 Pulley Ridge  
 R/V Walton Smith – Cruise Nos.  
 WS1213 & WS1312  
 Southern Sites  
 NAD\_1983\_UTM\_Zone\_17N  
 Projection: Transverse\_Mercator  
 Datum: D\_North\_American\_1983



- 45 ROV dives
- 7848 photos used for quantitative analysis of percent cover of habitat and benthic macrobiota
- 107 hrs video for analysis of fish densities

Each 1 km<sup>2</sup> random block was surveyed with five 100-m ROV transects





Over 50% of the bottom at Pulley Ridge HAPC and proposed extension is covered with dense and diverse fauna and algae (40.8% to 78.85% cover by block). Dominant biota include coralline algae, *Anadyomene* green lettuce algae, diverse sponges, black coral, octocoral, and scleractinian coral (216 taxa).



Example of corals and algae found on Pulley Ridge:  
the plate corals *Leptoseris cucullata* (foreground) and *Agaricia fragilis*;  
the finger coral *Madracis* sp.;  
the leafy green alga *Anadyomene menziesii*; and the branching alga *Dictyota*  
sp.

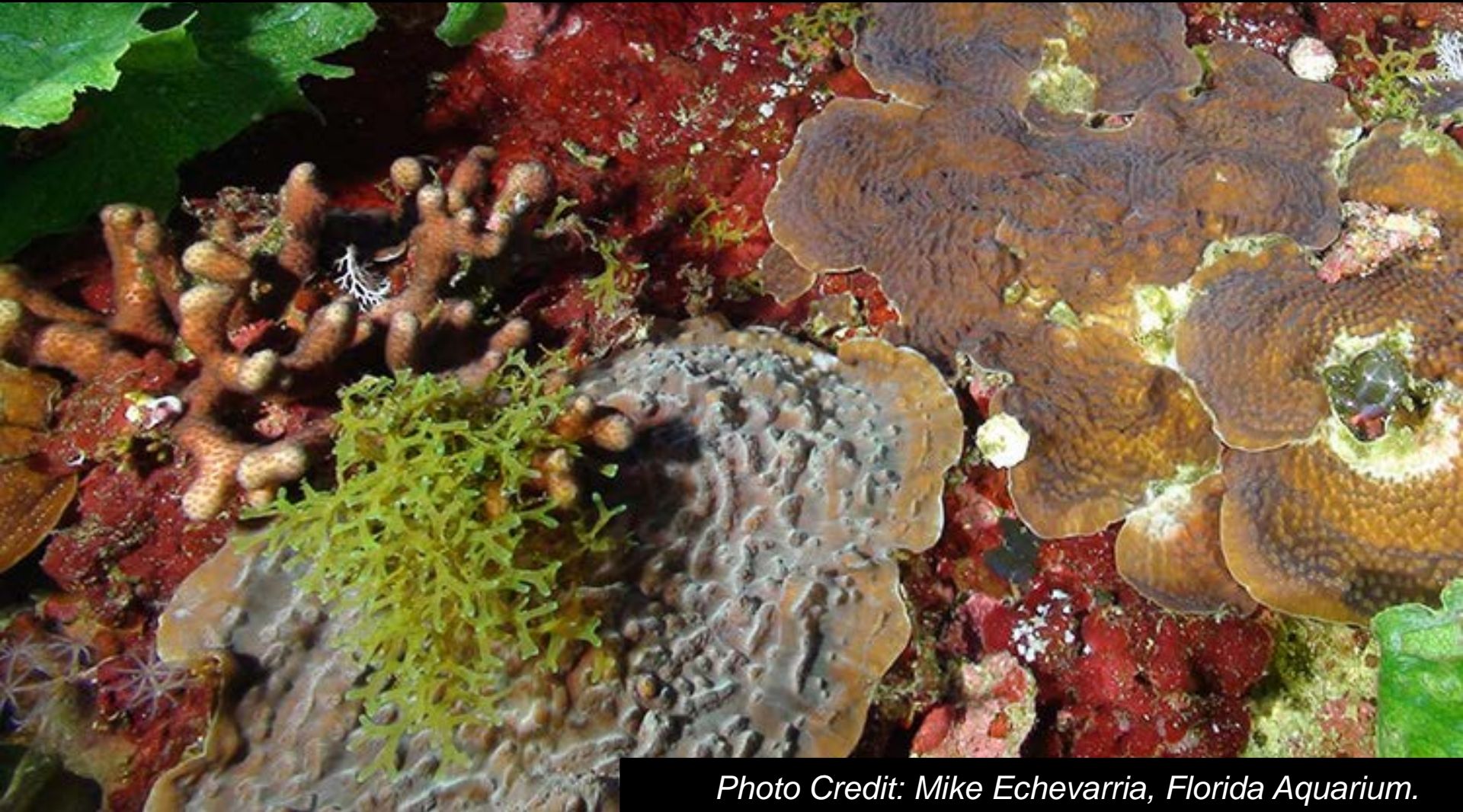


Photo Credit: Mike Echevarria, Florida Aquarium.





Plate and branching corals  
(*Agaricia*, *Leptoseris*, *Montastraea*, and *Madracis*) are common.



*Montastraea cavernosa* coral which is common on shallow reefs survives here at depths of 225 feet. Some corals were found to over 300 ft deep which is deepest known in U.S. continental waters.





Sponge densities and diversity were especially high in the proposed extension area of the PR HAPC on the western ridge. 102 sponge taxa were documented in quantitative photo transects on Pulley Ridge.

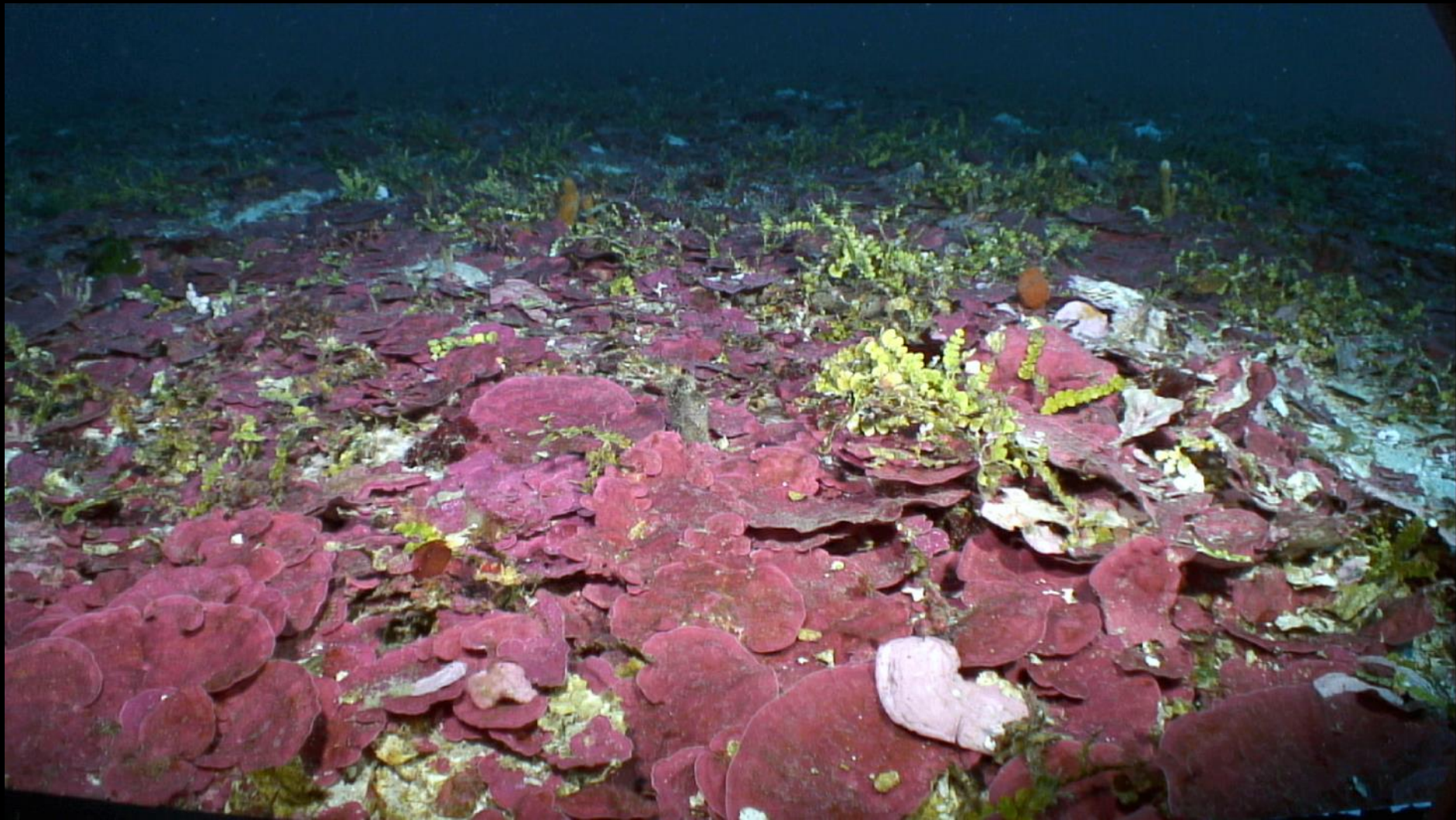




The giant barrel sponge, *Xestospongia muta*, with crinoids at 68 m on Pulley Ridge. This image is taken using a remotely operated vehicle with a camera that points straight down, so you are viewing the top of the sponge.

Photo Credit: John Reed using the University of North Carolina at Wilmington Super Phantom S2 ROV.



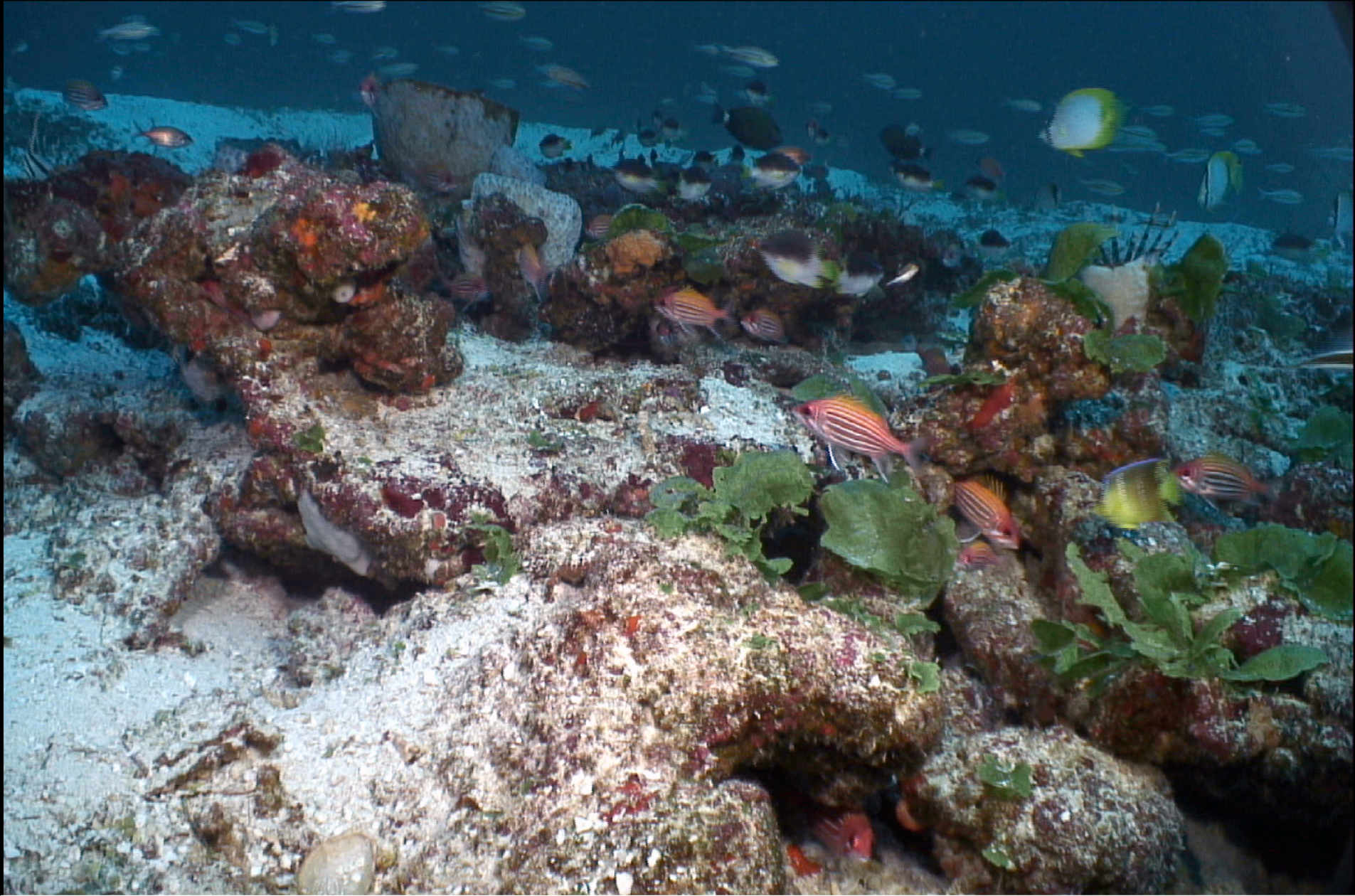


Macro-algae truly dominate the Pulley Ridge mesophotic reef:  
crustose coralline algae, *Halimeda* & *Anadyomene* green algae.



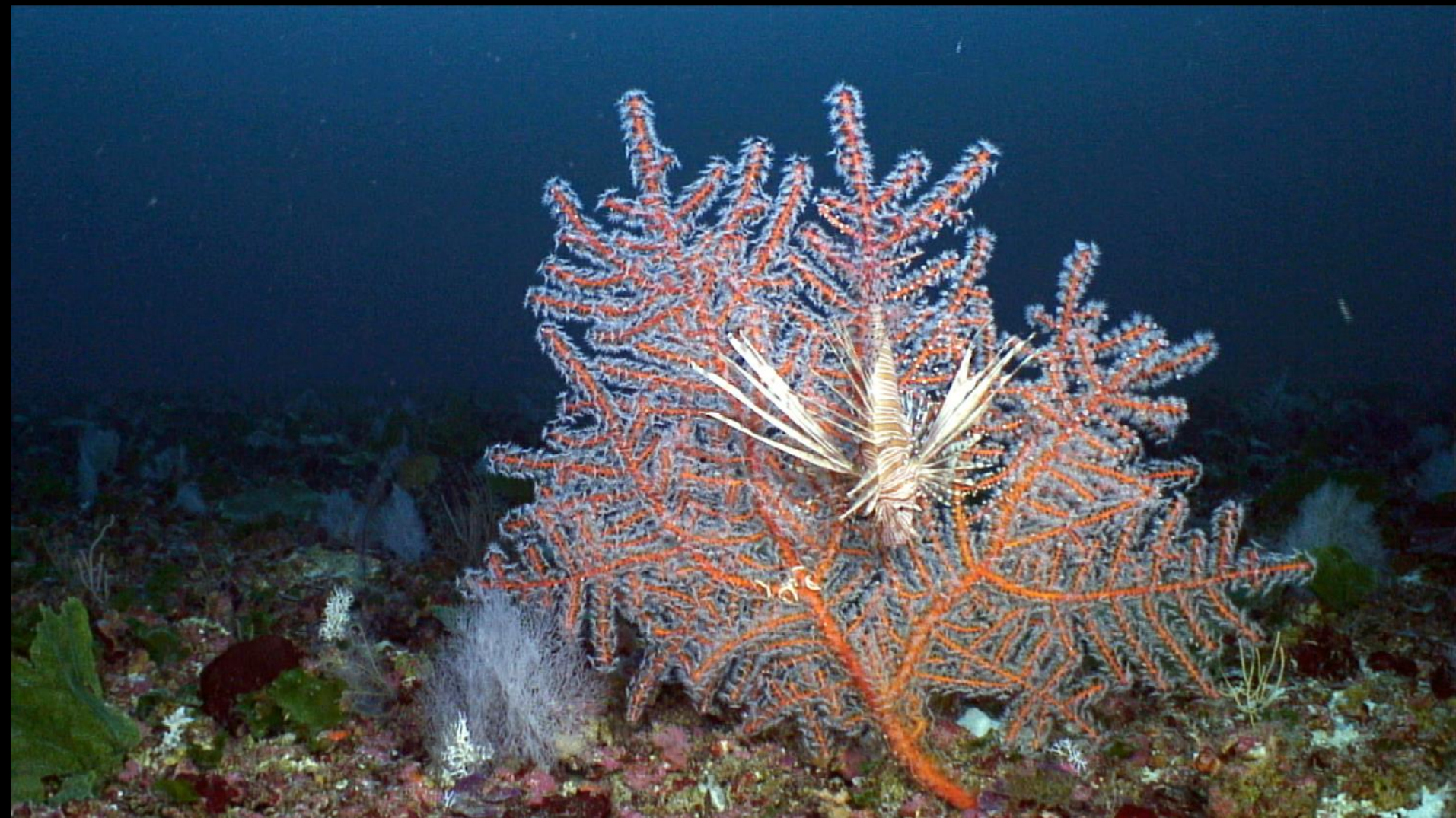
Evidence of possible diseased coral and reduced coral population levels exceed 95% in some areas





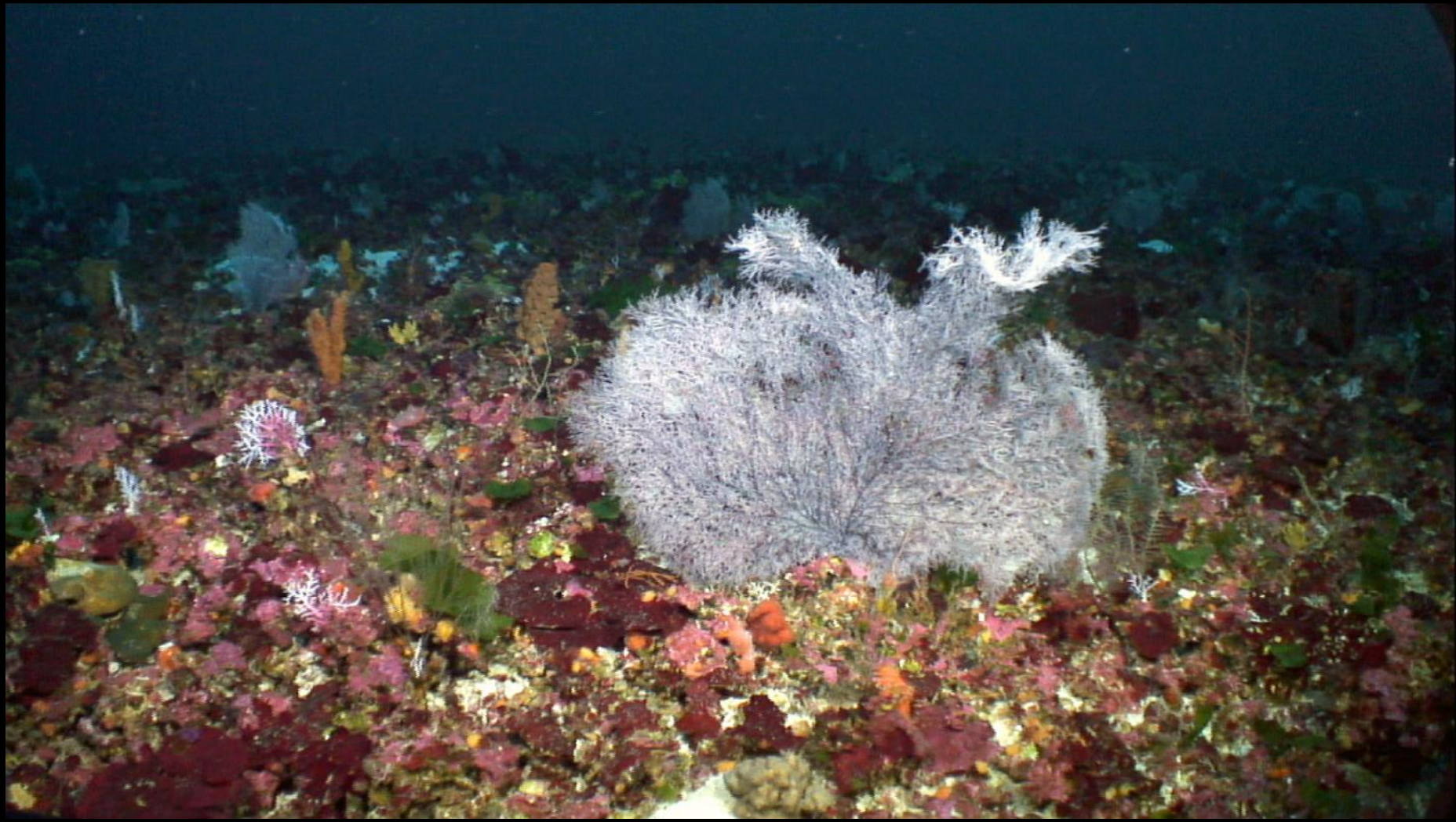
Schools of reef fish:  
bicolor damsels, reef butterfly, bank butterfly, squirrelfish, anthiids





*Swiftia exerta* gorgonian with lionfish.

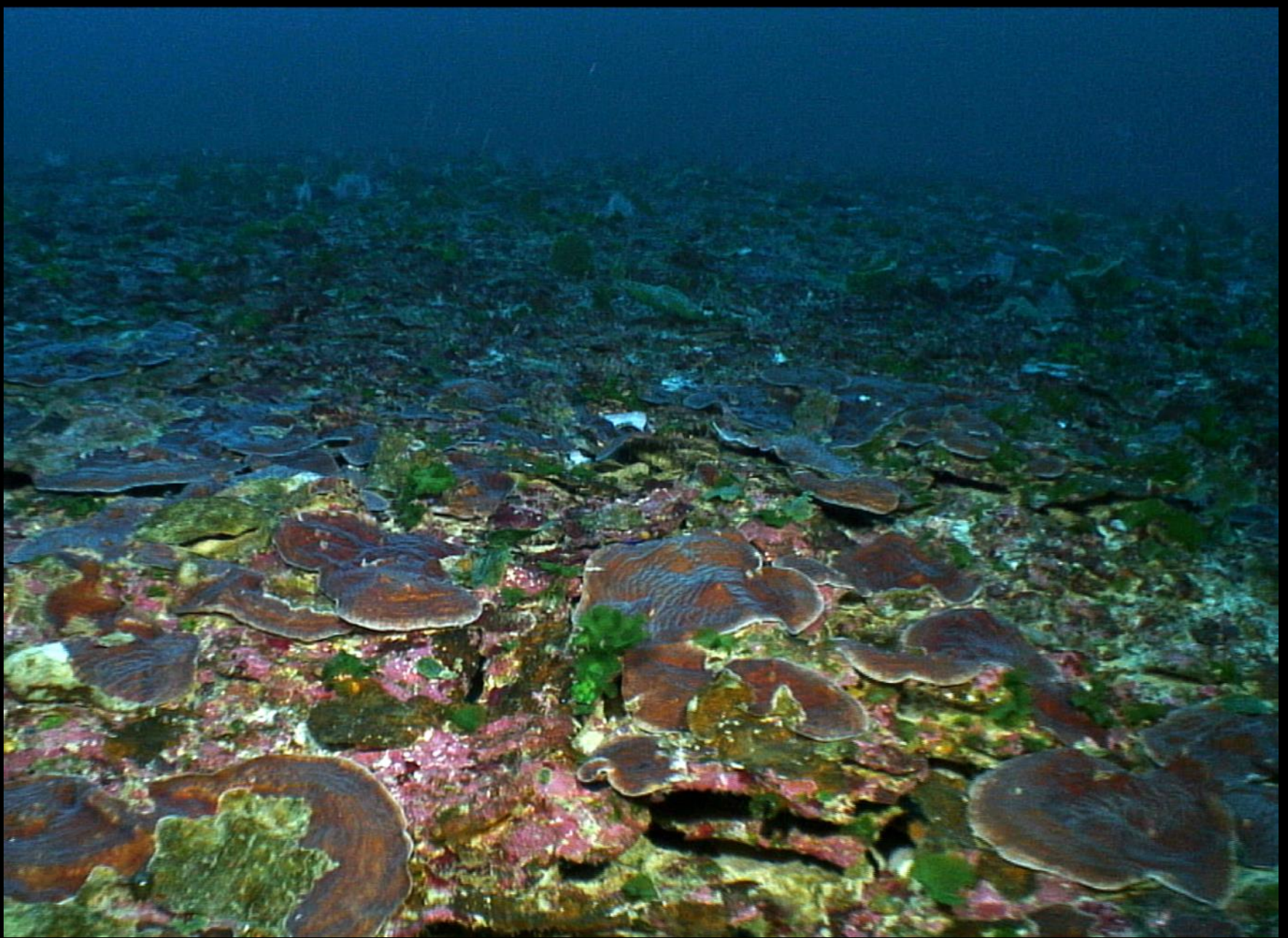




Most black corals at mesophotic depths can not be identified accurately to species level without a specimen in hand.

Black corals are common on Pulley Ridge and there may be 6-10 species.





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





*Agaricia* plate corals extended tens of meters in diameter outside of the HAPC, but within the proposed PR HAPC extension.  
Coral densities averaged 17 colonies /m<sup>2</sup> (from 3 to 77 colonies /m<sup>2</sup>).



Tech divers with rebreathers deployed ADCPs and collected coral, sponges, algae and fish for the genetic connectivity studies for the project.





Tech diver collecting *Agaricia* coral for genetics; 265 ft.

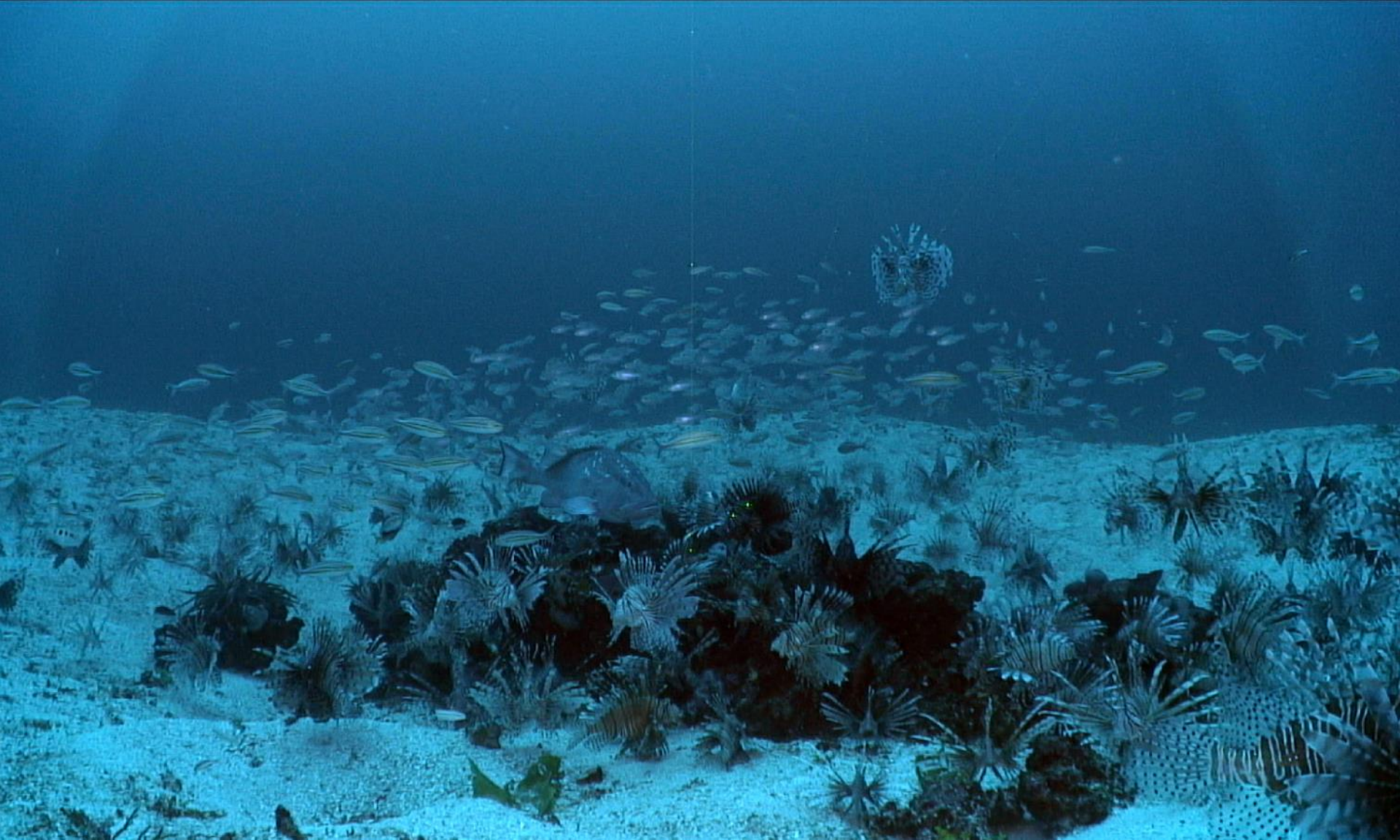


More than 60 spp of reef fish occur on Pulley Ridge.

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.

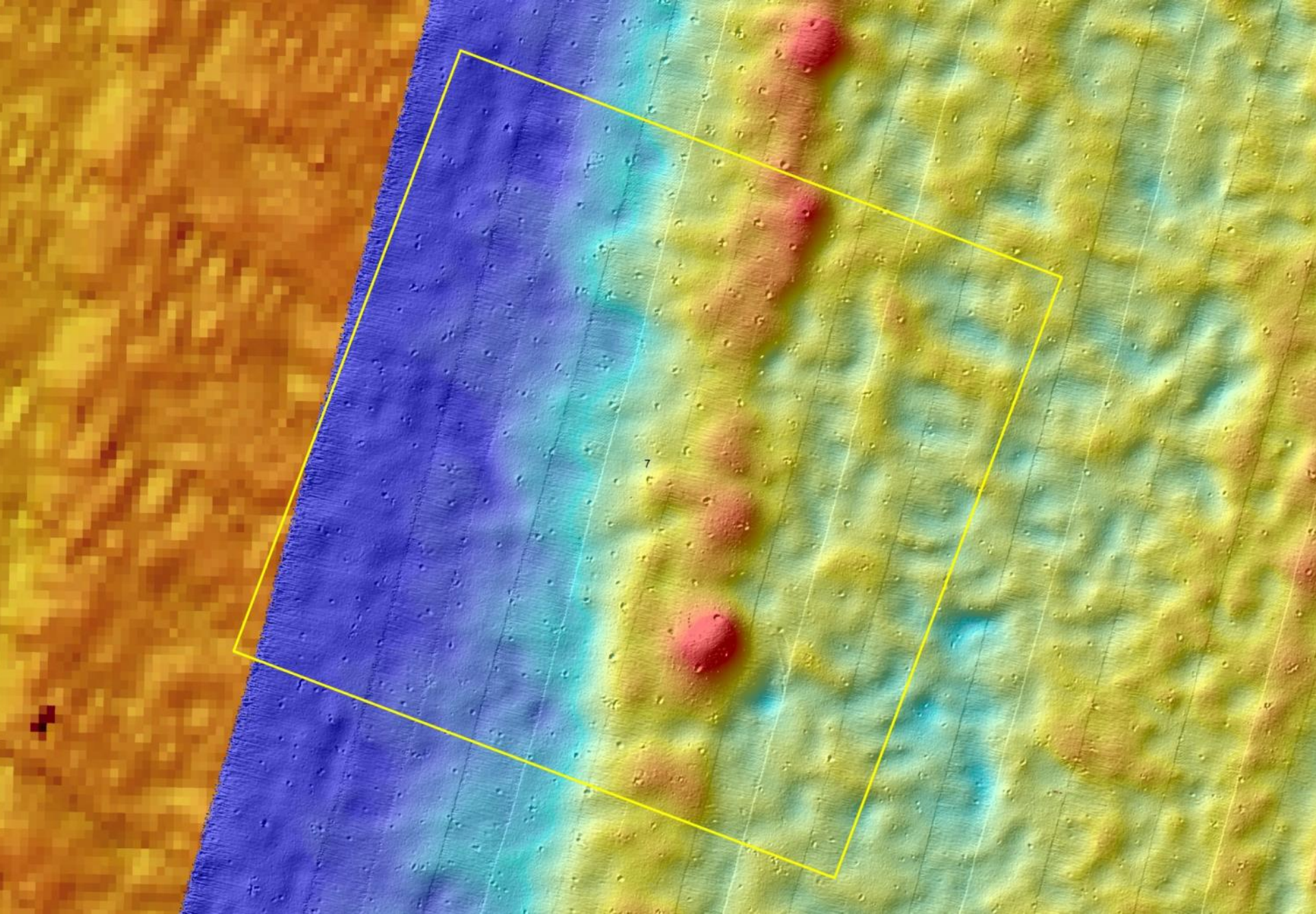
*Photo Credit: University of North Carolina at Wilmington, National Undersea Research*





Red grouper burrows are 30 ft in diameter and form an oasis for small fish including hundreds of reef fish such as bicolor damsels, anthiids, yellowtail reeffish, cardinalfish, angelfish, and unfortunately, recently numerous lionfish.





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



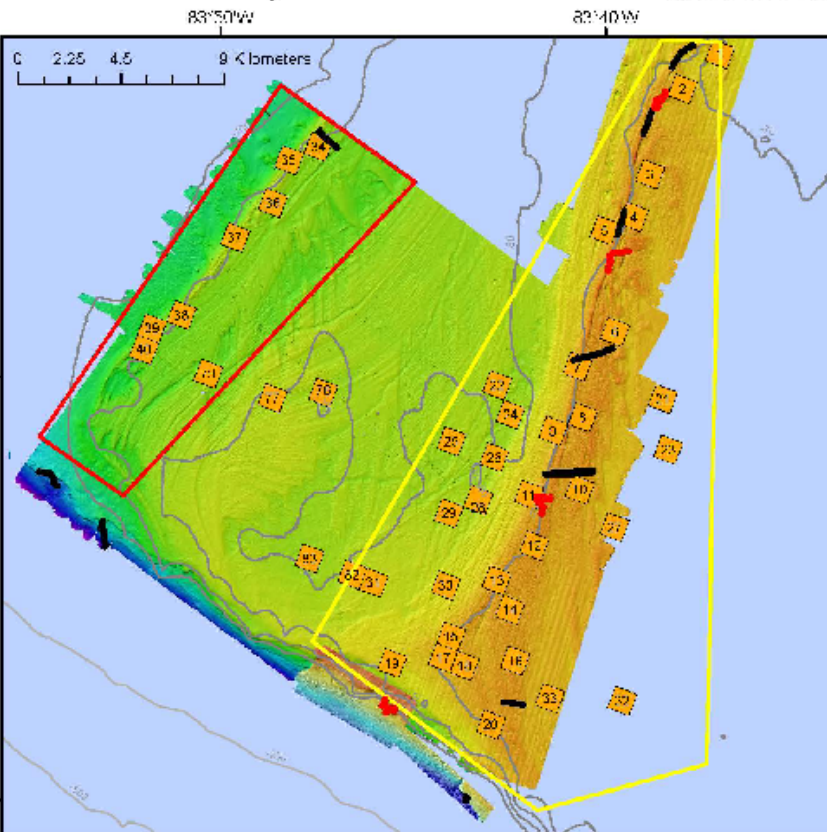


Lionfish are now prevalent throughout the Pulley Ridge HAPC and in particular associated with red grouper burrows— depopulating the small and juvenile reef fish?



# 2010-14 CIOERT Cruises ROV/JSL Surveys

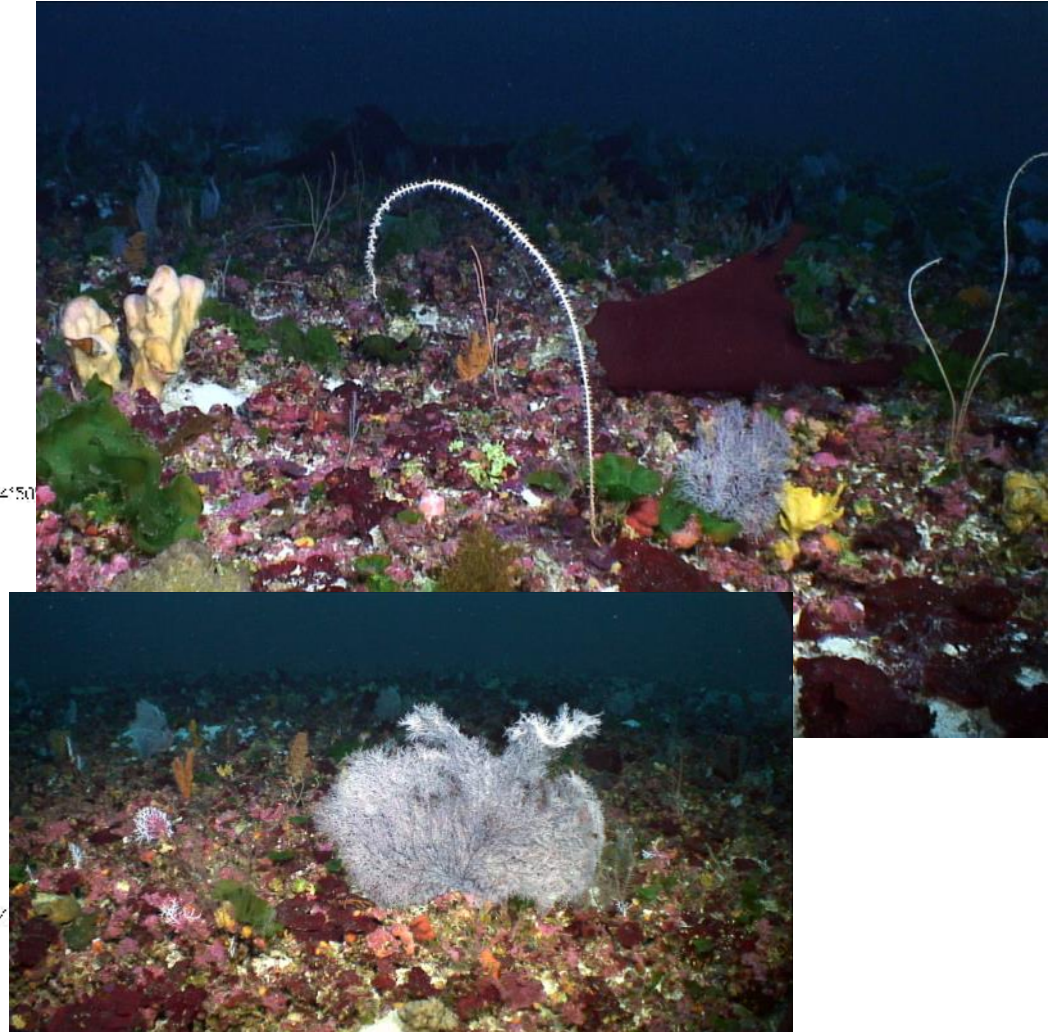
J. Rice & S. Harrington  
HROI FAU  
WGS\_1984\_UTM\_Zone\_17N  
Datum: D WGS\_1984



- PR West Ridge
- 2010 JSL Dive Tracks
- 2011 Kraken ROV Dive Transsects
- 2012-14 ROV Dives: 1 km² Blocks
- PR HAPC

## Pulley Ridge- West Ridge

Dense and diverse demosponges, dense populations of gorgonians and antipatharians and red grouper.



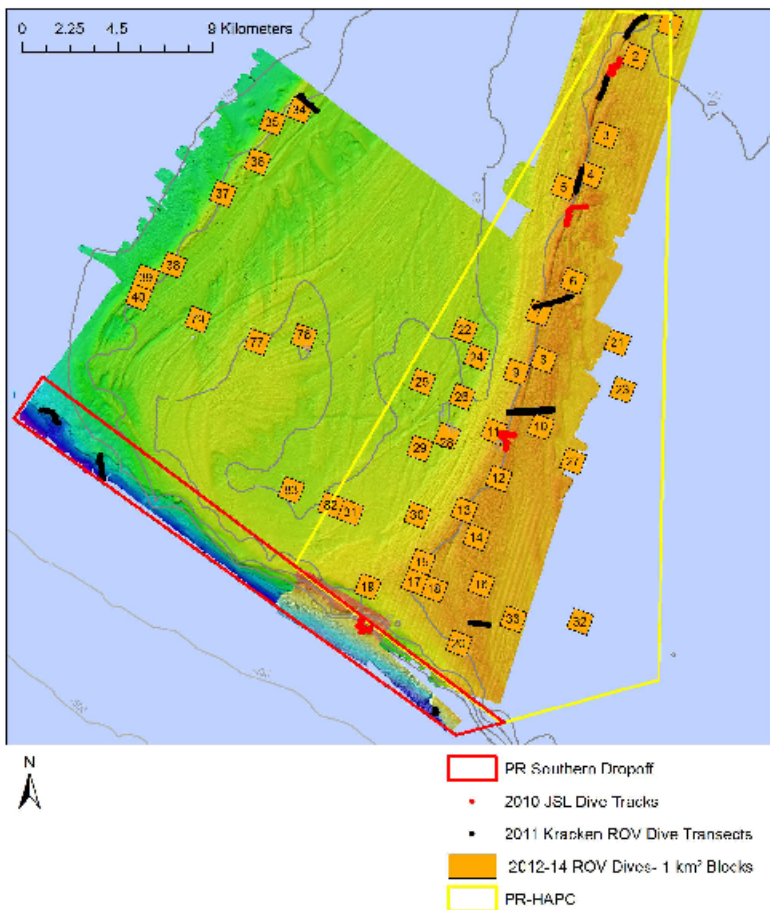
Proposed Extension to West Ridge  
of Pulley Ridge HAPC = Red

Pulley Ridge HAPC = Yellow



# 2010-14 CIOERT Cruises ROV/JSL Surveys

J. Read & S. Farrington  
HBOI FAU  
WGS\_1984\_UTM\_Zone\_17N  
Datum: D\_WGS\_1984



## Pulley Ridge Southern Dropoff

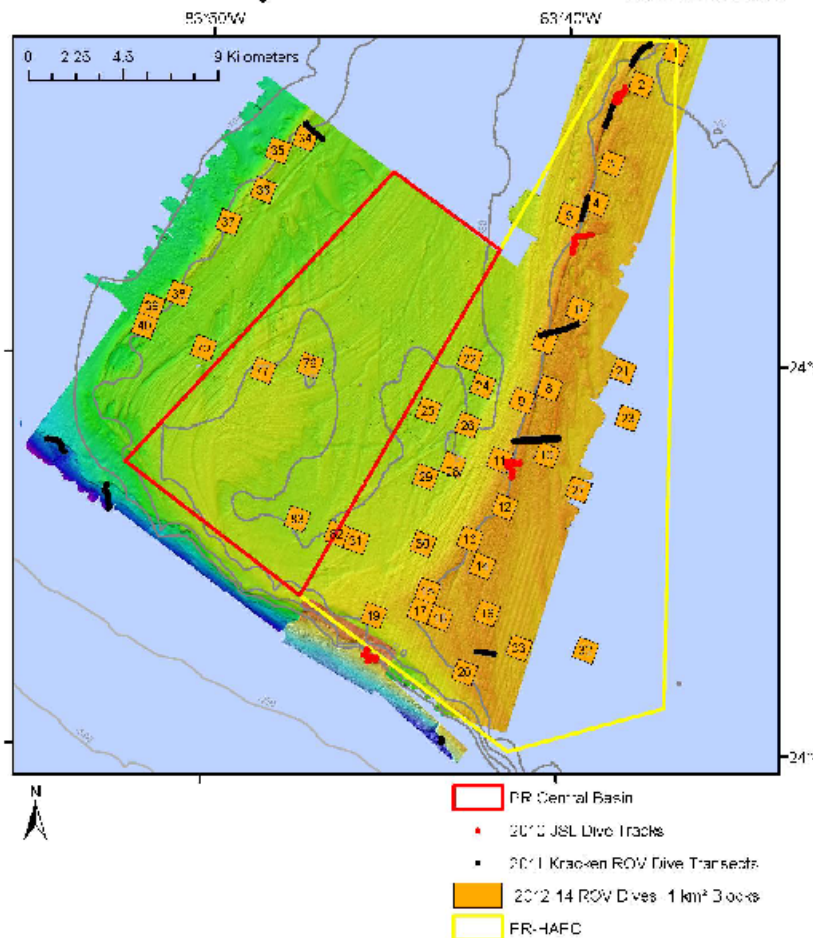
Essential Fish Habitat for large grouper including: Warsaw, speckled hind, scamp, gag, and red grouper and also snapper.

## Proposed Extension (red) to Southern Dropoff of Pulley Ridge HAPC



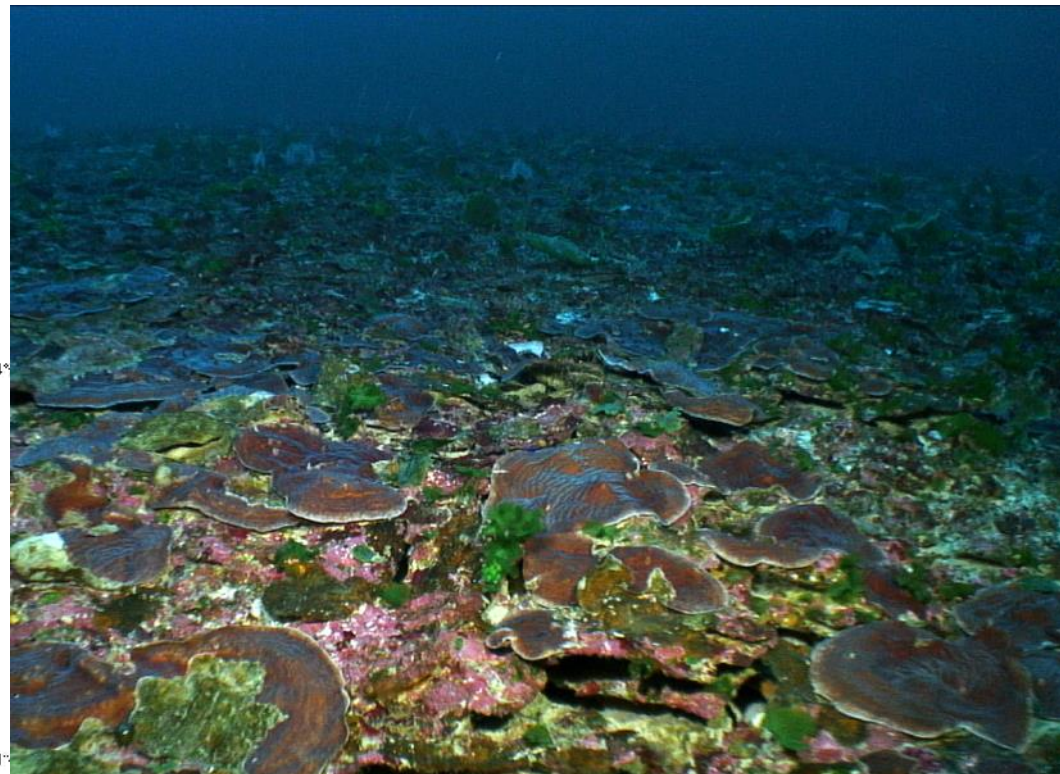
The populations of large fish on the dropoff are much denser, especially scamp grouper. We documented large Warsaw grouper, speckled hind (endangered species), scamp grouper, gag grouper, dozens of greater amberjack, purple reef fish, lionfish, snapper, and sharks.





### Pulley Ridge- Central Basin

Large populations of agariciid plate corals discovered in 2014.



**Fields of *Agaricia* coral outside of the HAPC in the Central Basin of Pulley Ridge.**

**CENTRAL BASIN**  
**Proposed Extension (red)**  
**to the Central Basin of**  
**Pulley Ridge HAPC**



Outside the HAPC....

Questions?

