

PROPOSAL TO THE GULF OF MEXICO FISHERY MANAGEMENT COUNCIL

PROPOSED PULLEY RIDGE HAPC EXTENSION

Principal Investigators

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Research, and Technology
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GOMFMC – Coral Group Meeting
December 4, 2014



NOAA COOPERATIVE INSTITUTE FOR OCEAN EXPLORATION, RESEARCH AND TECHNOLOGY (CIOERT)

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FLORIDA ATLANTIC UNIVERSITY



- Explore outer continental shelf edge frontiers
- Study vulnerable coral/sponge ecosystems
- Develop advanced undersea technologies

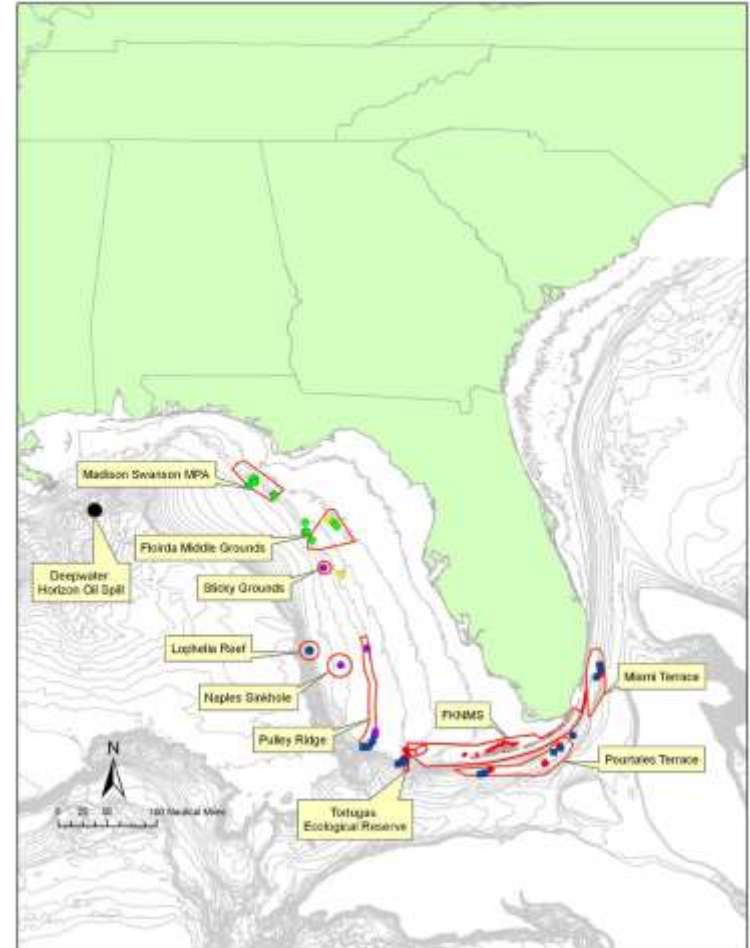


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Project Goals

- 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.

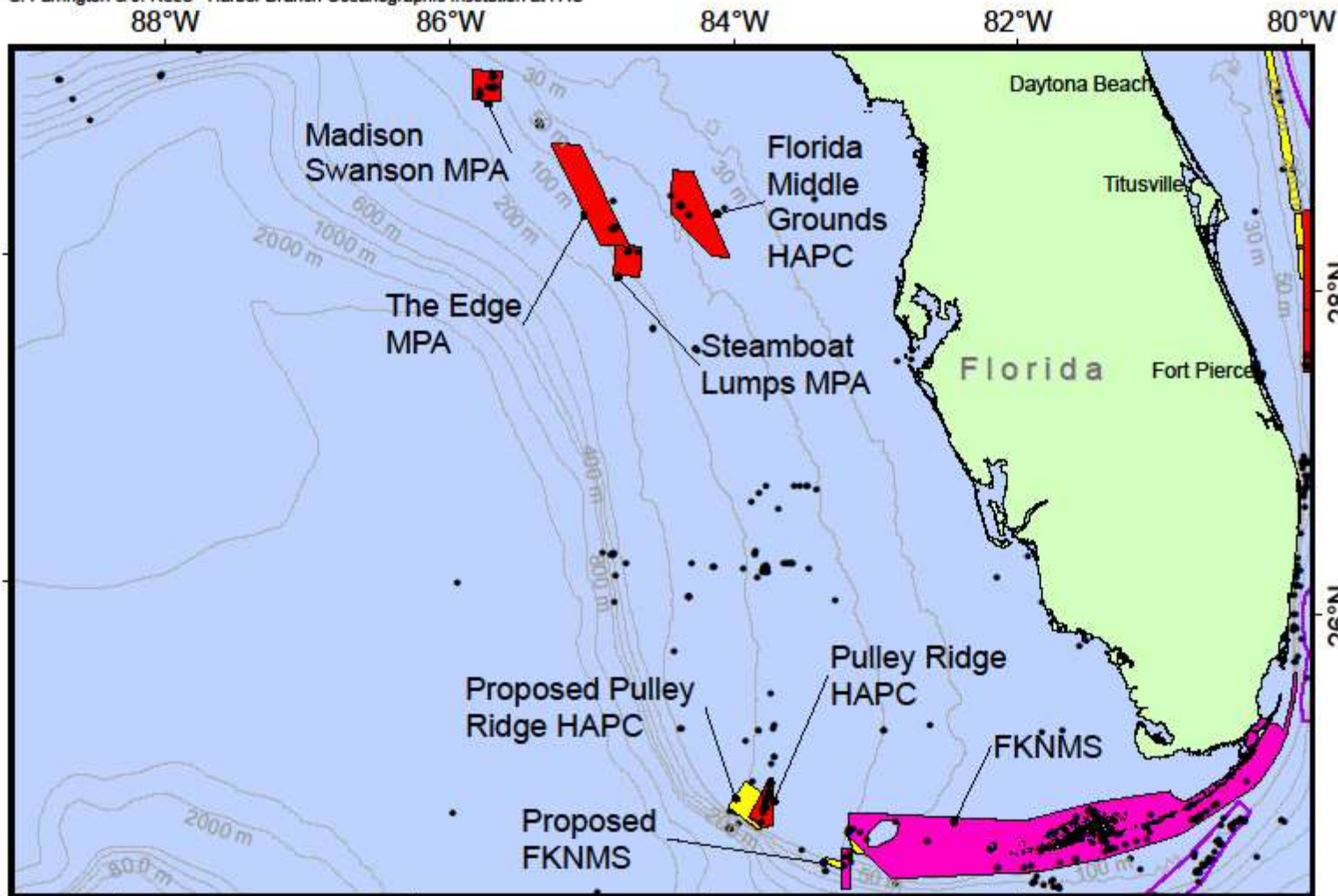


Proposed and Established MPA & HAPC

Eastern Gulf of Mexico

NAD 1983; UTM 17N

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



Proposed Pulley Ridge HAPC and Tortugas Mesophotic Reef HAPC extensions.



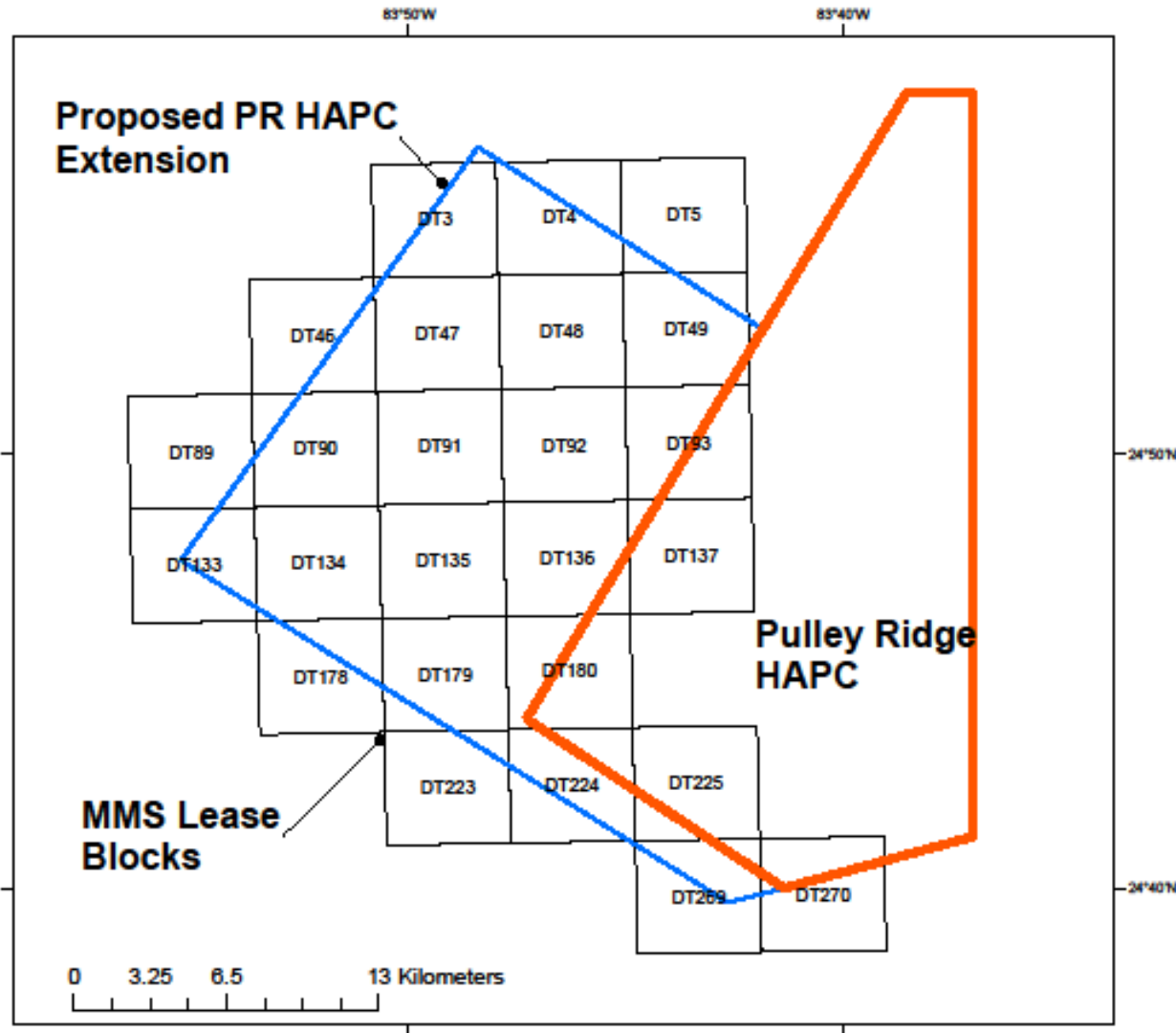
Protection

- Pulley Ridge Habitat Area of Particular Concern- 2005
- Coral WAS common, up to 23% coverage on Pulley Ridge in 2003.



Mesophotic Corals

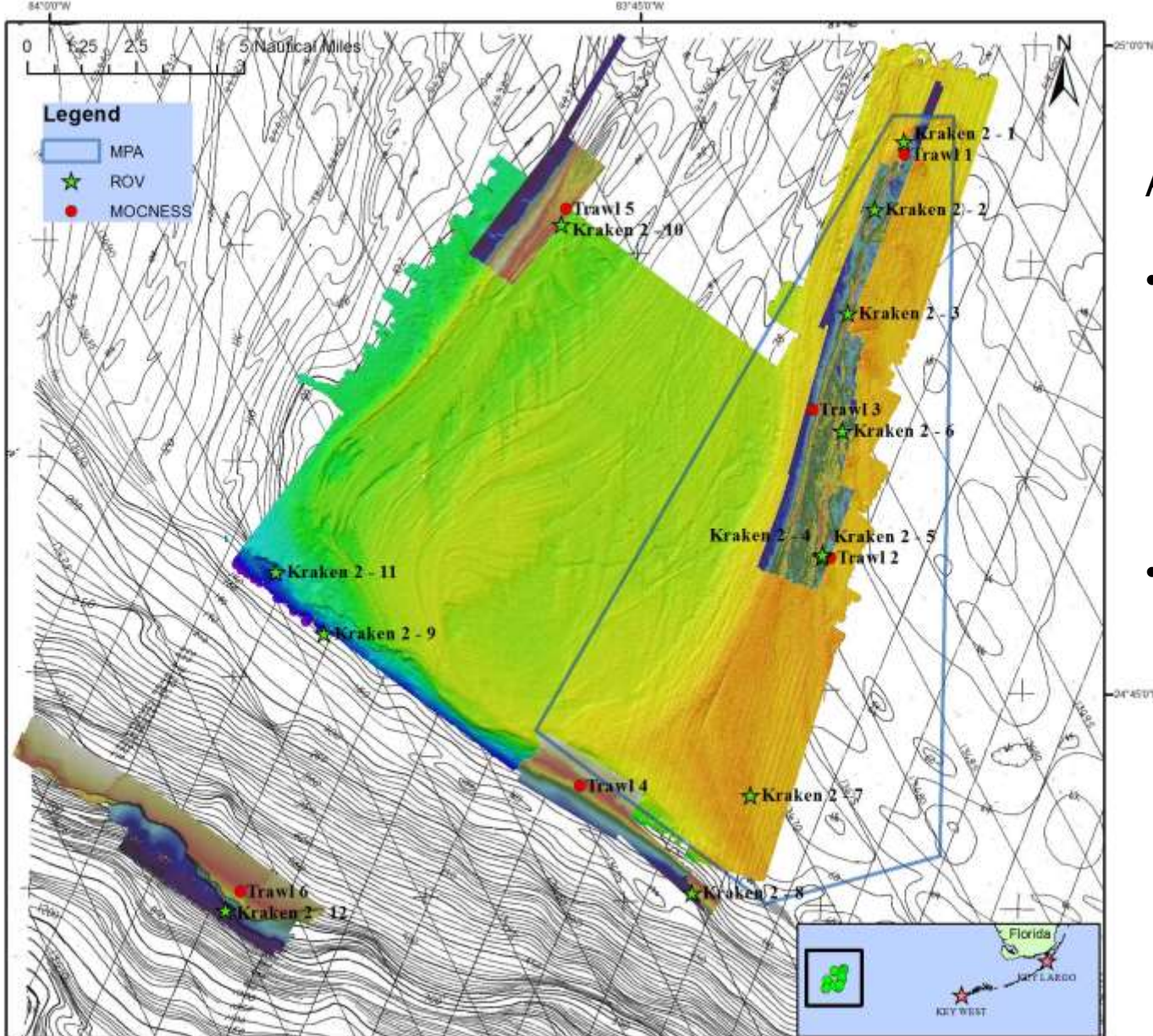
- Are mesophotic corals healthier than their shallow counterparts? (bleaching/disease)
- Are mesophotic reefs refugia from global climate change?
- Genetic connectivity between shallow and deep reefs?



Proposed Extension to Pulley Ridge HAPC = Blue

Pulley Ridge HAPC = Red

MMS Blocks numbered (5 km squares)

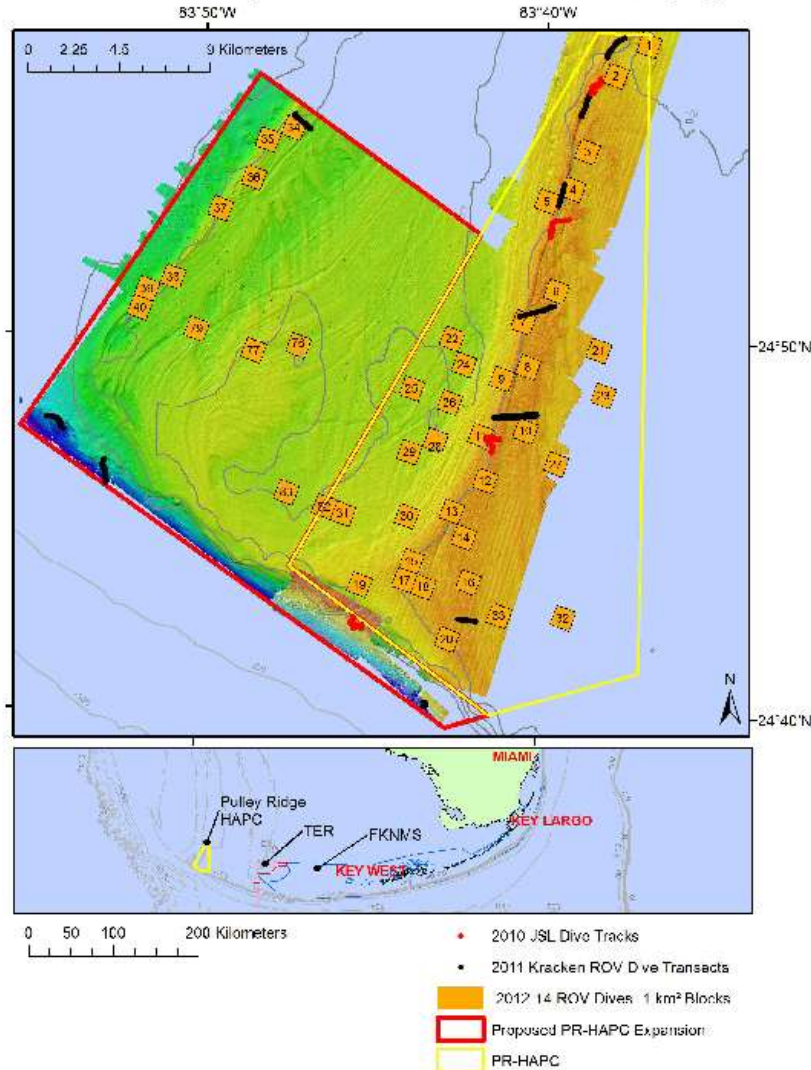


AVAILABLE DATA

- Multibeam of entire proposed HAPC (D. Naar, 10 m resolution)
- New high resolution MB (2011 Nancy Foster- Reed; 1-2 m resolution)

2010-14 CIOERT Cruises
ROV/JSL Surveys

J. Reed & S. Farrington
HBOI FAU
WGS_1984_UTM_Zone_17N
Datum: D_WGS_1984

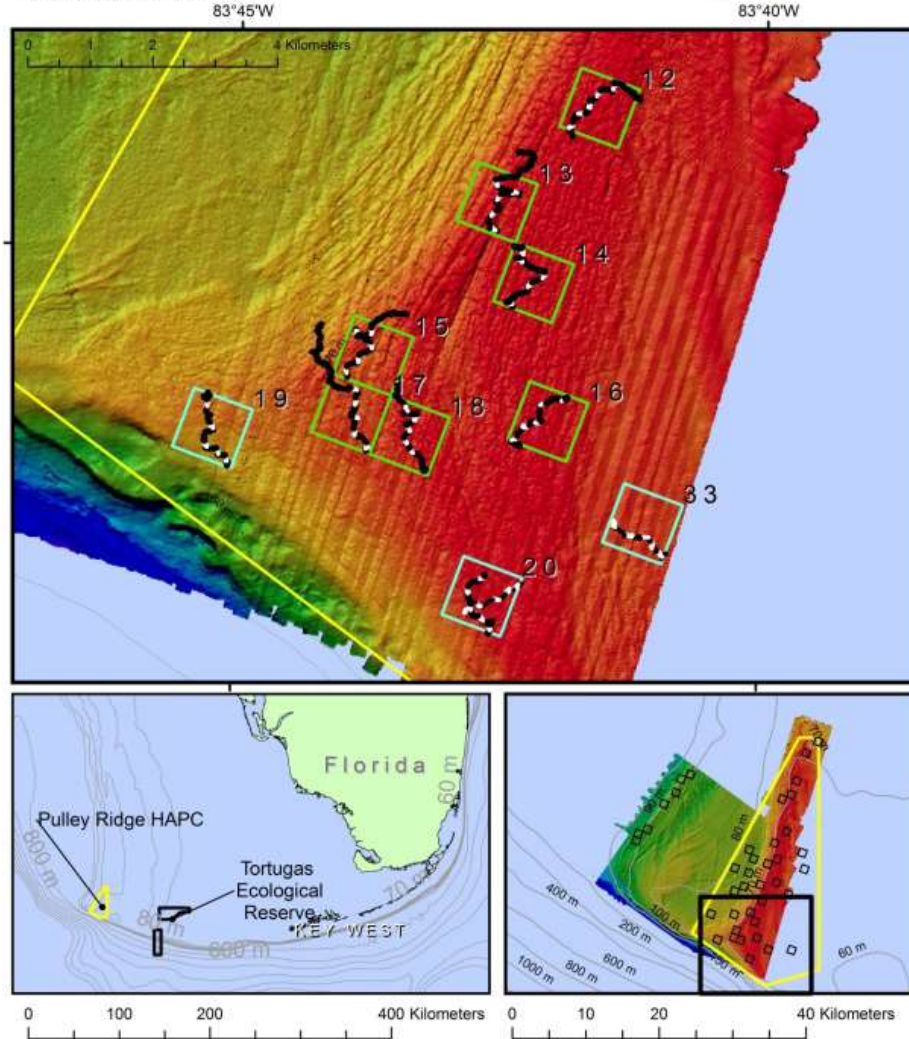


AVAILABLE DATA

2011- 2014 ROV
and JSL data

- Johnson-Sea-Link dives (red lines)
- Kracken ROV dives (black lines)
- UNCW ROV dives (1 km² 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



AVAILABLE DATA

2012-2014 NOAA Mesophotic Connectivity Grant

- 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 km² random block was surveyed with five 100-m ROV transects

Results

- Farrington, S., J. Reed, H. Moe, S. Harter, D. Hanisak, A. David. 2014. Characterization of the Mesophotic Benthic Habitat and Fish Assemblages from ROV Dives on Pulley Ridge and Tortugas during 2012 and 2013 R/V *Walton Smith* Cruises. NOAA CIOERT Cruise Report. Report to NOAA-NOS-NCCOS. 44 pp. HBOI Technical Report Number 147.
- Reed, John K., Stephanie Farrington, Dennis Hanisak, Kevin Rademacher. 2012. NOAA SEADESC Level I Report for the 2012 Pulley Ridge Cruise, August 14-25, 2012, R/V Walton Smith and UNCW Superphantom ROV. Report to NOAA-NOS-NCCOS, 57 pp. Harbor Branch Oceanographic Miscellaneous Contribution Number 847.
- Reed, John K., Dennis Hanisak, Stephanie Farrington, Kevin Rademacher. 2012. Preliminary cruise report, “Connectivity of the Pulley Ridge - South Florida Coral Reef Ecosystem: Processes to Decision-Support Tools”. 2012 Pulley Ridge Cruise, August 14-25, 2012, R/V Walton Smith and UNCW Superphantom ROV. Report to NOAA-NOS-NCCOS, 66 pp. Harbor Branch Oceanographic Miscellaneous Contribution Number 824.
- Reed, John K., Stephanie Farrington, Shirley Pomponi, Dennis Hanisak, Johsua Voss. 2012. NOAA CIOERT cruise report: survey of the Pulley Ridge mesophotic reef ecosystem, NOAA Ship *Nancy Foster*, Florida Shelf-Edge Exploration II (FLoSEE) Cruise, Leg 1-September 12-19, 2011, Report to NOAA. 133 pp. HBOI Miscellaneous Contribution Number 822.
- Reed, J.K. and S. Farrington. 2012. 2011 CIOERT FloSEE II site summary report, Leg 1, Pulley Ridge; NOAA Ship Nancy Foster, September 12-19, 2011. Report to NOAA Cooperative Institute for Ocean Exploration, Research, and Technology, 36 pp. HBOI Technical Report Number 134.
- Reed, J.K. and S. Farrington. 2012. 2011 CIOERT FloSEE II Cruise, SEADESC II Report, Leg 1, Pulley Ridge; NOAA Ship Nancy Foster, September 12-19, 2011. Report to NOAA Cooperative Institute for Ocean Exploration, Research, and Technology, 11 pp.



<u>Hard Coral</u>	<u>Pulley Ridge</u>	<u>Tortugas</u>
<i>Agaricia</i> sp.	X	X
<i>Agaricia fragilis</i>	X	
<i>Agaricia lamarcki/grahamae</i>	X	
<i>Colpophyllia natans</i>		X
<i>Eusmilia fastigiata</i>		X
<i>Favia fragum</i>		X
<i>Leptoseris cucullata</i>	X	
<i>Madracis auretenra</i>	X	
<i>Madracis decactis</i>		X
<i>Madracis formosa</i>	X	
<i>Madracis pharensis</i>	X	
<i>Madracis</i> sp.	X	
<i>Manicina areolata</i>	X	X
<i>Meandrina meandrites</i>		X
<i>Millepora alcicornis</i>		X
<i>Montastraea cavernosa</i>	X	X
<i>Mycetophyllia</i> sp.		X
<i>Oculina diffusa</i>	X	X
<i>Orbicella annularis</i>		X
<i>Orbicella faveolata</i>		X
<i>Orbicella franksi</i>		X
<i>Pseudodiploria clivosa</i>		X
<i>Pseudodiploria strigosa</i>		X
Scleractinia- unid colonial	X	X
Scleractinia- unid solitary	X	X
<i>Scolymia</i> sp.	X	X
<i>Siderastrea siderea</i>		X
<i>Siderastrea radians</i>		X
<i>Solenastrea</i> sp.		X
<i>Stephanocoenia intersepta</i>	X	
Stylasteridae (hydrocoral)	X	
<i>Undaria agaricites</i>		X

Gorgonacea		
Alcyonacea- unidentified gorgonian	X	X
<i>Bebryce</i> sp.	X	
<i>Briareum asbestinum</i>		X
<i>Diodogorgia nodulifera</i>	X	
<i>Ellisella barbadensis</i>		X
<i>Ellisella</i> sp.	X	X
Ellisellidae	X	X
<i>Erythropodium caribaeorum</i>		X
<i>Eunicea</i> sp.		X
<i>Iciligorgia schrammi</i>		X
Isididae	X	
<i>Leptogorgia</i> sp.	X	
<i>Muricea</i> sp.	X	X
<i>Muriceopsis</i> sp.		X
<i>Nicella goreau</i>	X	
<i>Nicella</i> sp.	X	
<i>Plexaura kukenthali</i>		X
<i>Plexaurella nutans</i>		X
<i>Plexaurella</i> sp.		X
Primnoidae	X	X
<i>Pseudoplexaura</i> sp.		X
<i>Pseudopterogorgia</i> sp.	X	X
<i>Pterogorgia anceps</i>		X
<i>Swiftia exerta</i>	X	
<i>Telesto</i> sp.	X	
<i>Thesea</i> sp.	X	

Alcyoniina		
Alcyoniina- unid. sp.	X	
<i>Chirnephthya caribbea</i>	X	
Nephtheidae	X	
<i>Nidalia</i> sp.	X	
Antipathidae		
Antipathidae- unid. sp.	X	
Antipatharia- white fan	X	
<i>Stichopathes lutkeni</i>	X	
<i>Tanacetipathes hirta</i>	X	

Coral	Max Depth
Madracis pharensis	-92.4
Agaricia spp.	-89.5
Madracis auretenra	-89.3
Leptoseris cucullata	-87.2
Madracis formosa	-81
Agaricia lamarcki/grahamae	-74.9
Manicina areolata	-72
Scolymia sp.	-71.2
Agaricia fragilis	-70.5
Montastraea cavernosa	-68



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 of benthic macro-biota)



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



Crustose coralline algae, Halimeda green algae



Agaricia coral, Madracis coral, coralline algae, and Anadyomene green algae. A total of 15 species of hard coral, 15 gorgonacea, 102 sponges, 111 taxa of fish were documented in the ROV surveys.



Montastraea cavernosa coral



Evidence of possible diseased coral and reduced coral population levels in some areas.



This year 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 /m² (ranging from 3 to 77 colonies /m²).



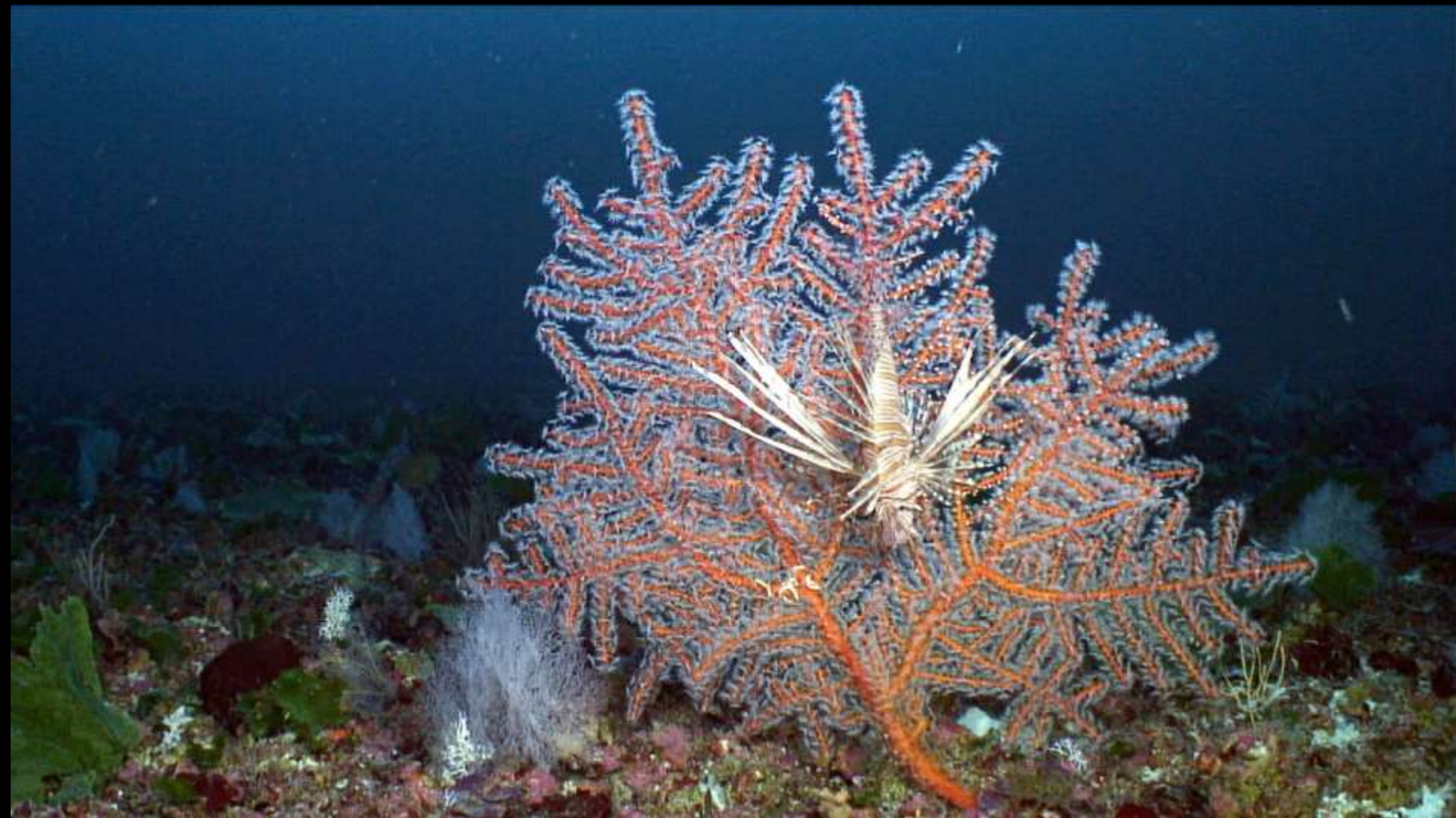
Tech divers with rebreathers deployed ADCP and collected coral, sponges, algae and fish for the genetic connectivity studies for the grant.



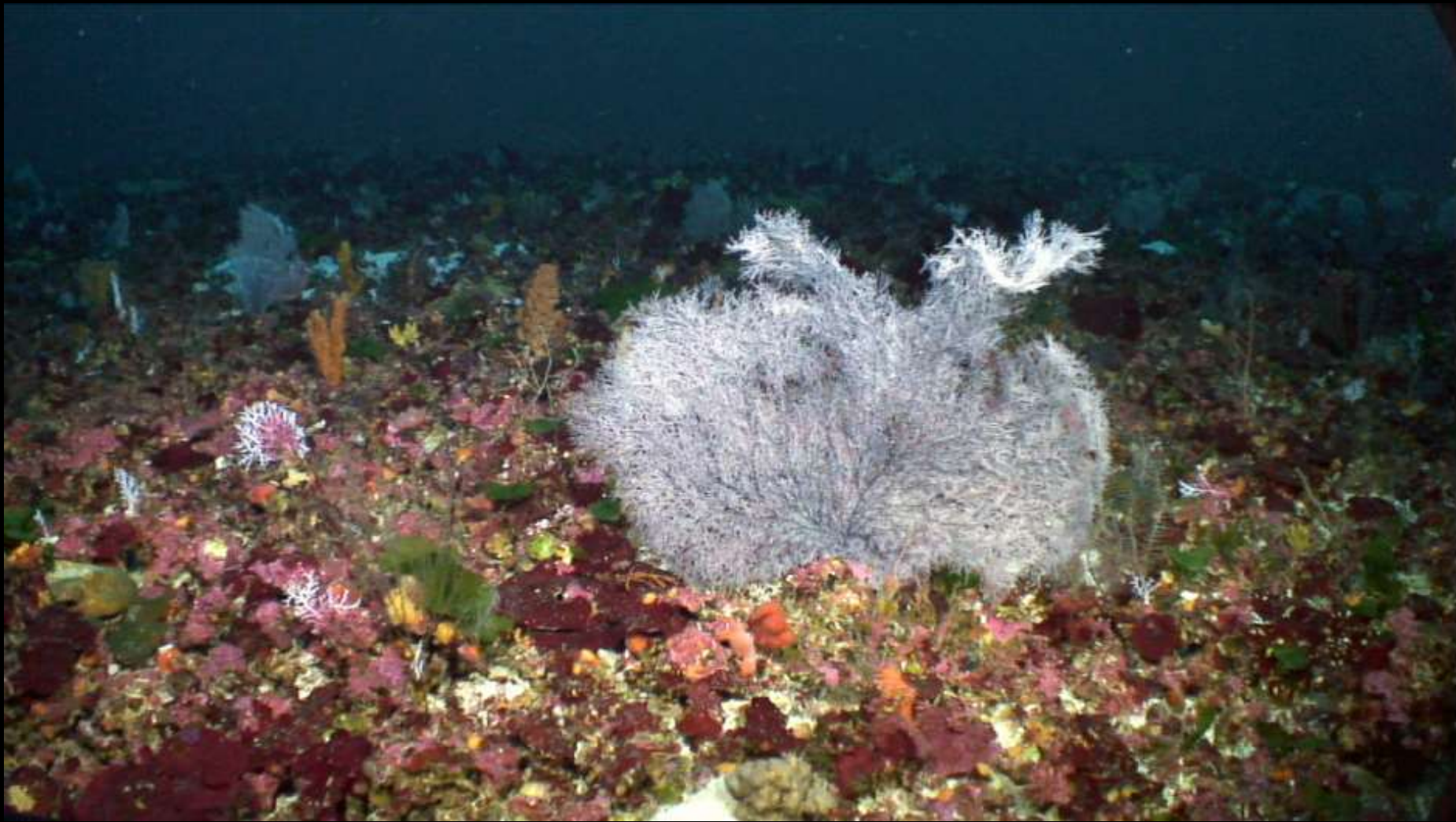
Tech diver collecting *Agaricia* coral for genetics; 265 ft.



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



Swiftia exerta gorgonian with lionfish.



We have found that 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 may be 6-10 species.



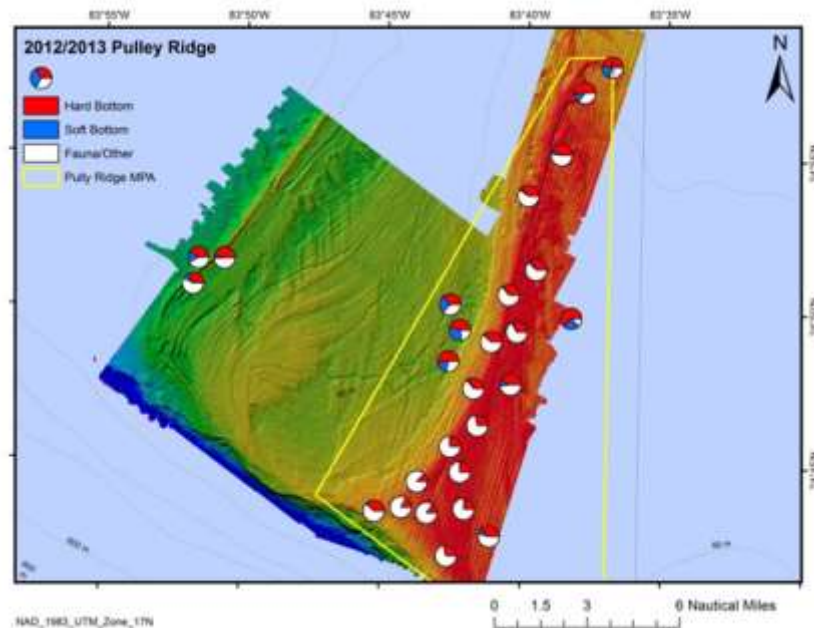


Lionfish are now prevalent throughout the Pulley Ridge HAPC and in particular associated with red grouper burrows— depopulating the small and juvenile reef fish?

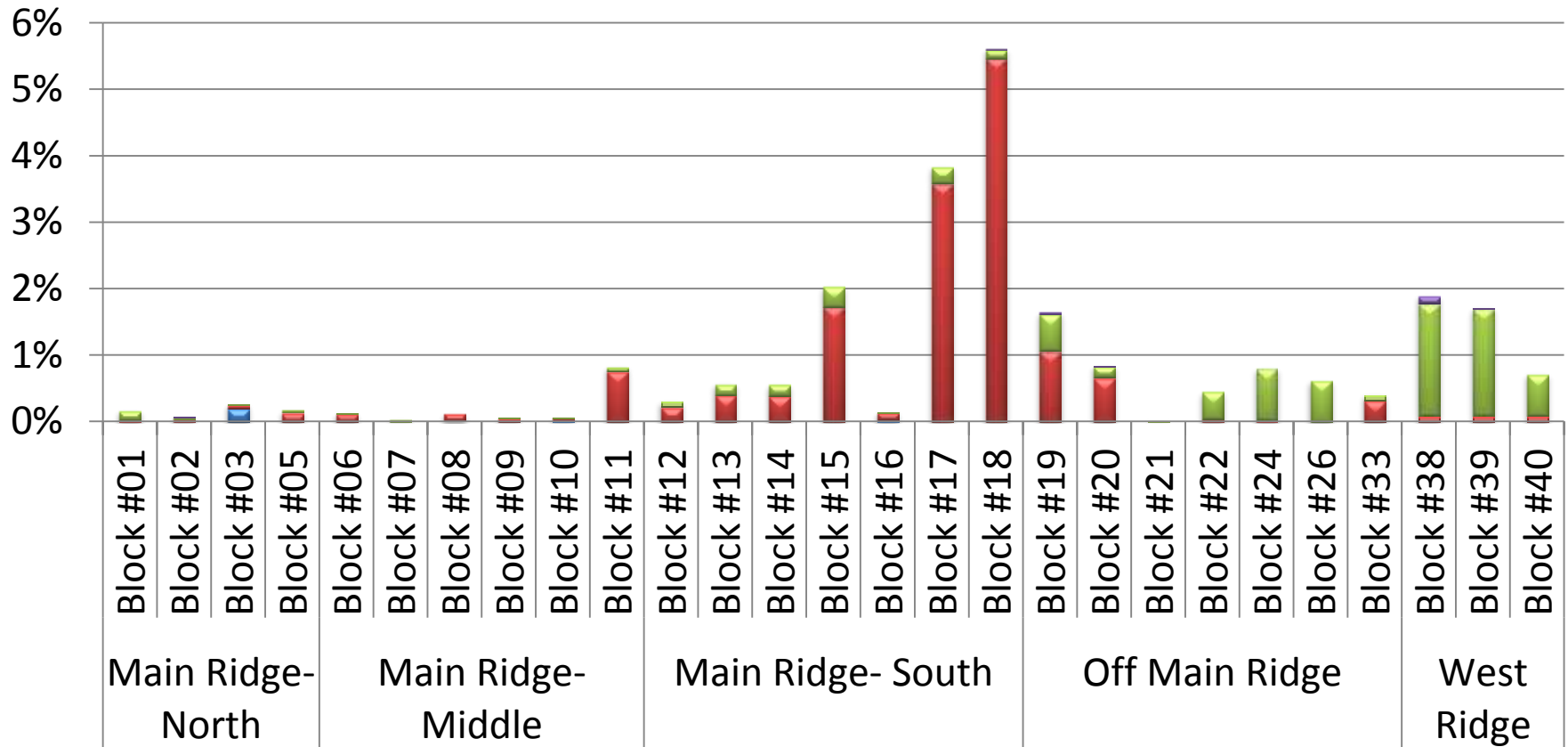
Site Summary- CPCE Point Count

Region	% Cover-Biota	% Cover-Bare Sediment	% Cover-Bare Rock	Depth Range (m)	# 1 km2 Blocks	# ROV Photo XS	Total # Quant. Photos	Total CPCE Points
Pulley Ridge	56.99%	7.74%	35.27%	94.5 m - 60.3 m	28	4,637	3,362	168,100
Tortugas	29.37%	63.81%	6.82%	58 m – 23.1 m	14	2,258	1,634	81,700
Total							4,996	249,800

Region	No. Blocks	% Cover-Biota	% Cover-Bare Sediment	% Cover-Bare Rock	Grand Total	Depth Range (m)
Pulley Ridge	28	57.09%	7.52%	35.39%	100%	94.5 m - 60.3 m
Main Ridge- North	5	47.63%	8.64%	43.72%	100%	73.5 m - 60.3 m
Main Ridge- Middle	6	61.85%	3.49%	34.65%	100%	73.2 m - 61 m
Main Ridge- South	7	78.78%	0.99%	20.23%	100%	71.8 m - 63.5 m
Off Main Ridge	7	40.86%	16.11%	43.03%	100%	83.2 m - 64.5 m
West Ridge	3	49.75%	9.53%	40.72%	100%	94.5 m - 80.1 m
Tortugas	14	29.37%	63.81%	6.82%	100%	58 m - 23.1 m
Grand Total	42	48.17%	25.64%	26.20%	100%	94.5 m - 23.1 m



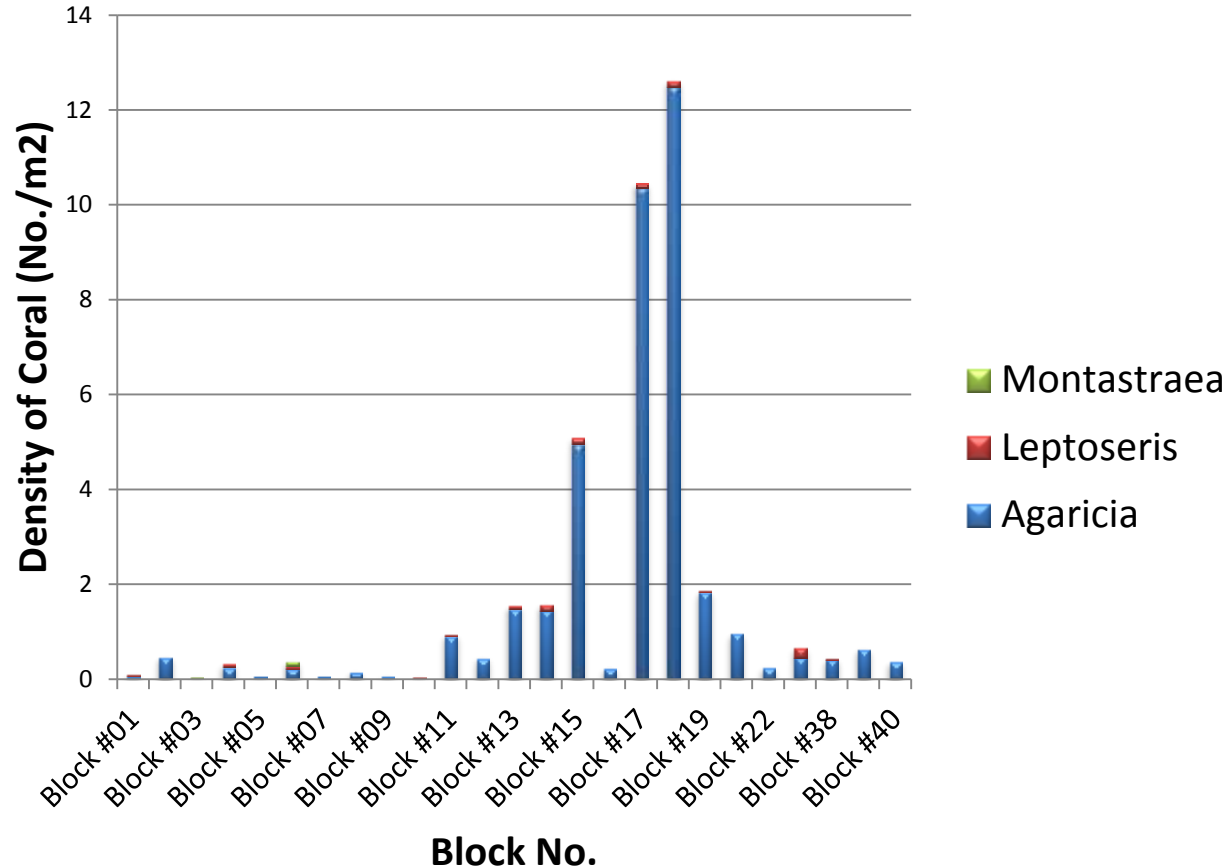
2012/2013- Coral Cover by Type



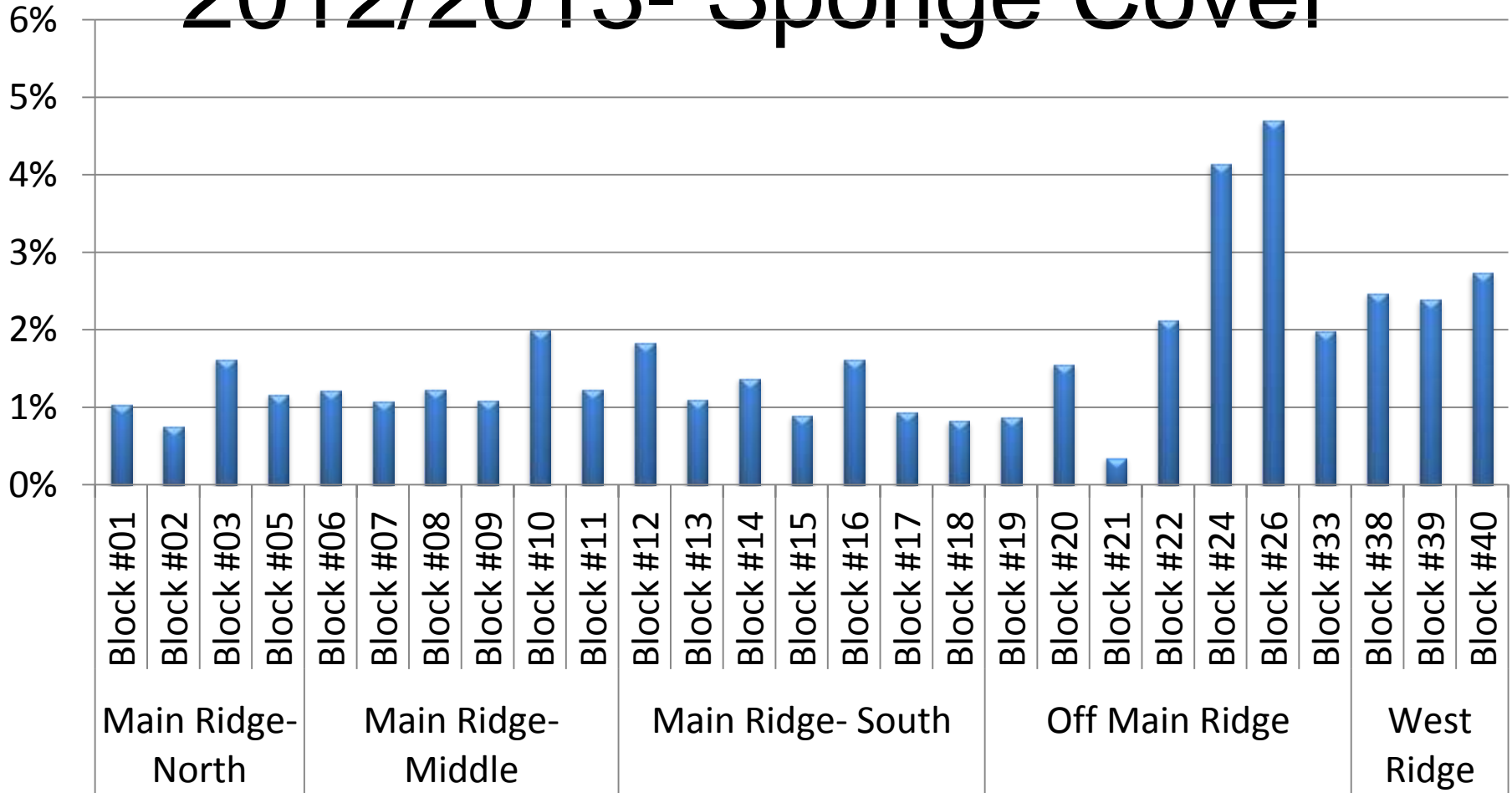
■ Coral - *Montastraea cavernosa* ■ Coral - Plate Corals ■ Coral - *Madracis* sp. ■ Coral - Other Corals

Pulley Ridge- Coral Density

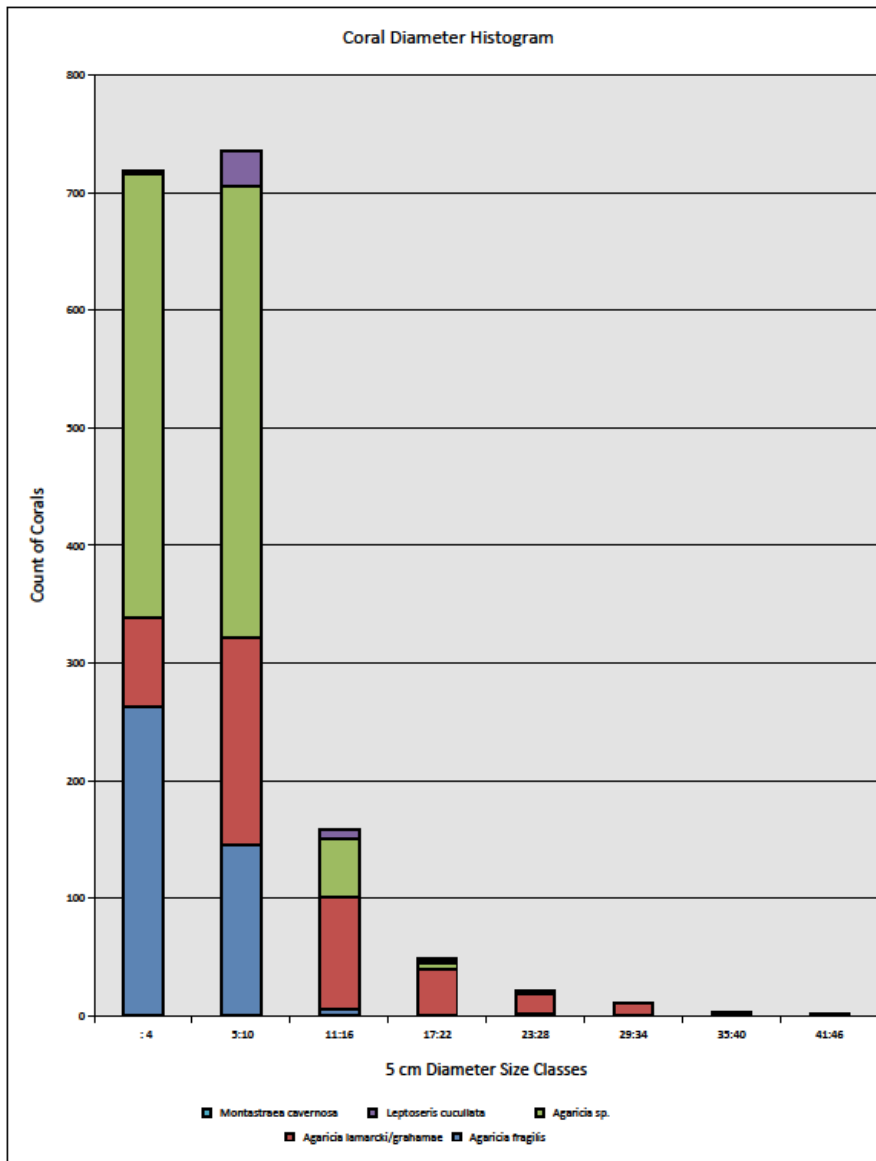
- Density of Corals by Block
- Most are *Agaricia* sp.
- Highest Density
 - Block 17 & 18
 - 11-13 corals/m²



2012/2013- Sponge Cover



■ Porifera



Comparing our 2012-2013 data to USGS data collected in 2003:

Within 10 years the coral cover has drastically declined on Pulley Ridge.

The overall mean coral cover went from 11.90% to 0.85% which is a 92.8% loss of coral cover!

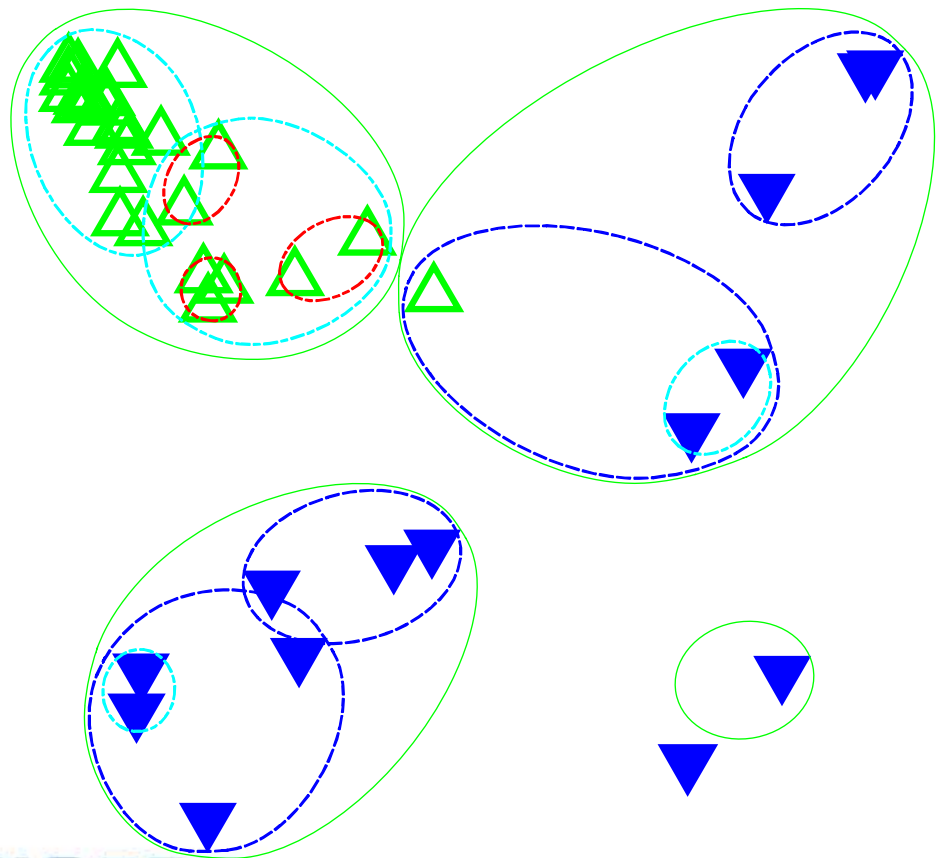
PRIMER- MDS

Multi-Dimensional Scaling

Geographic Region

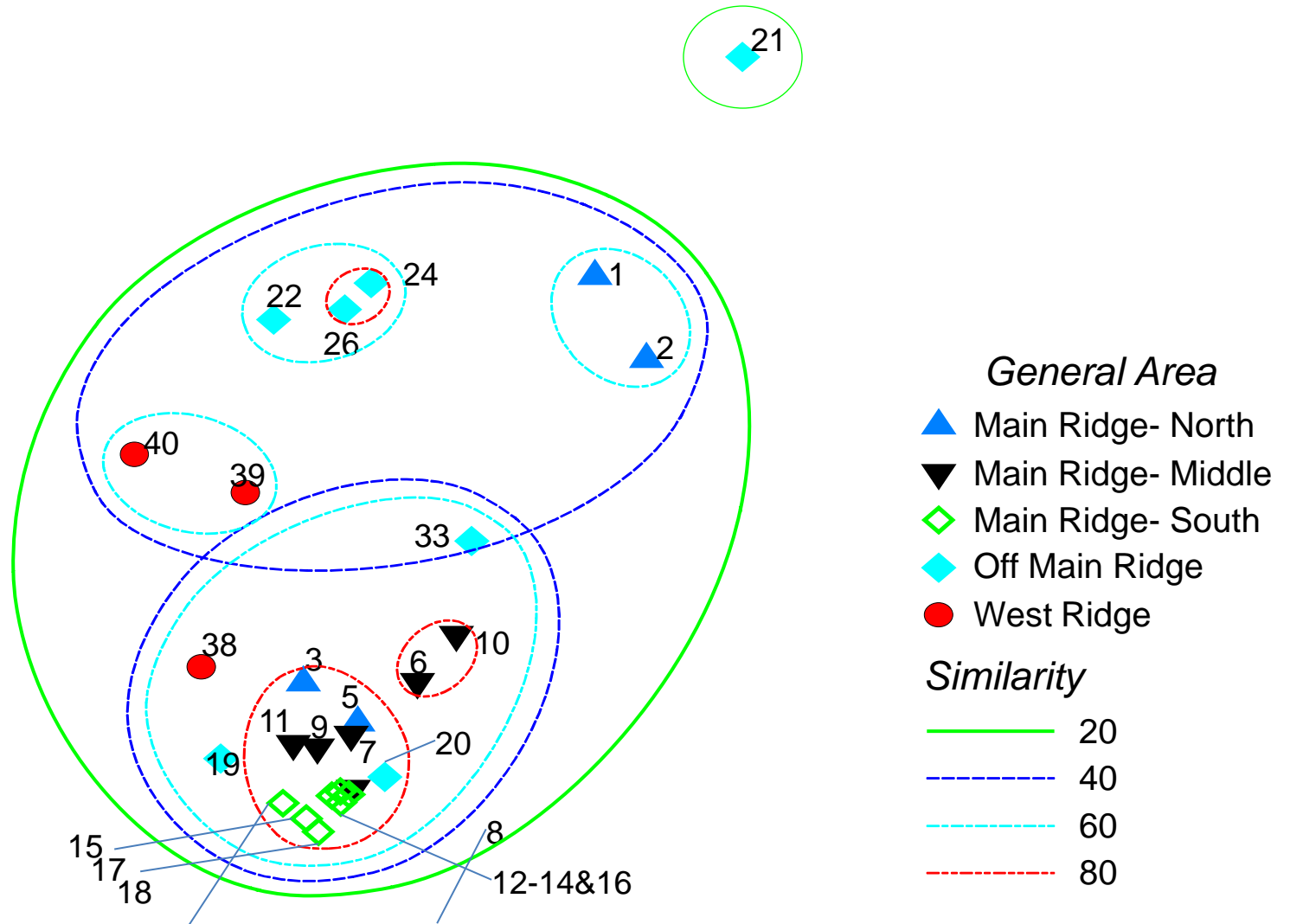
- △ Pulley Ridge
- ▼ Tortugas

- Similarity
- 10
 - - - 20
 - · - · 40
 - · - · - · 60



Resemblance: S17 Bray Curtis similarity

2D Stress: 0.05

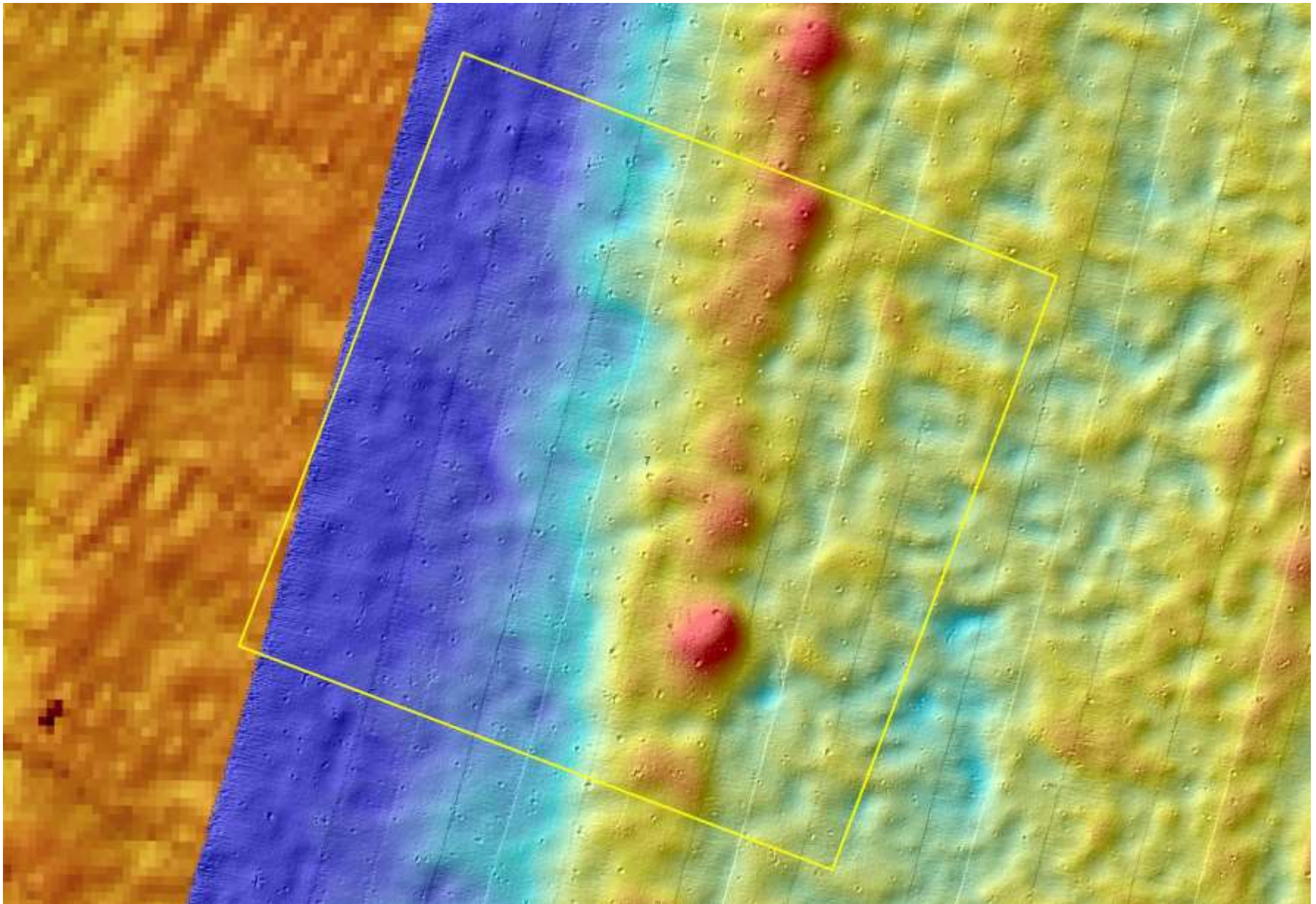




Red grouper and damselfish- 262 ft



Red grouper in burrow. Red grouper pits form an oasis which provides habitat to hundreds of reef fish such as bicolor damselfish, anthiids, yellowtail reeffish, cardinalfish, angelfish, and unfortunately, recently numerous lionfish.



Actually Counted	Block 5		
HAPC Name	IN HAPC	PR HAPC Proposed Extension	Total HAPC + Proposed
Average Diameter (m)	8.05	13.84	
Count of pits	340	119	
Area Measured (km ²)	0.87	1.98	
Density #/km ²	392.61	60.12	
Ridge Size (km ²)	346.84	321.31	668.16
Estimated number of pits	136,174	19,316	155,490

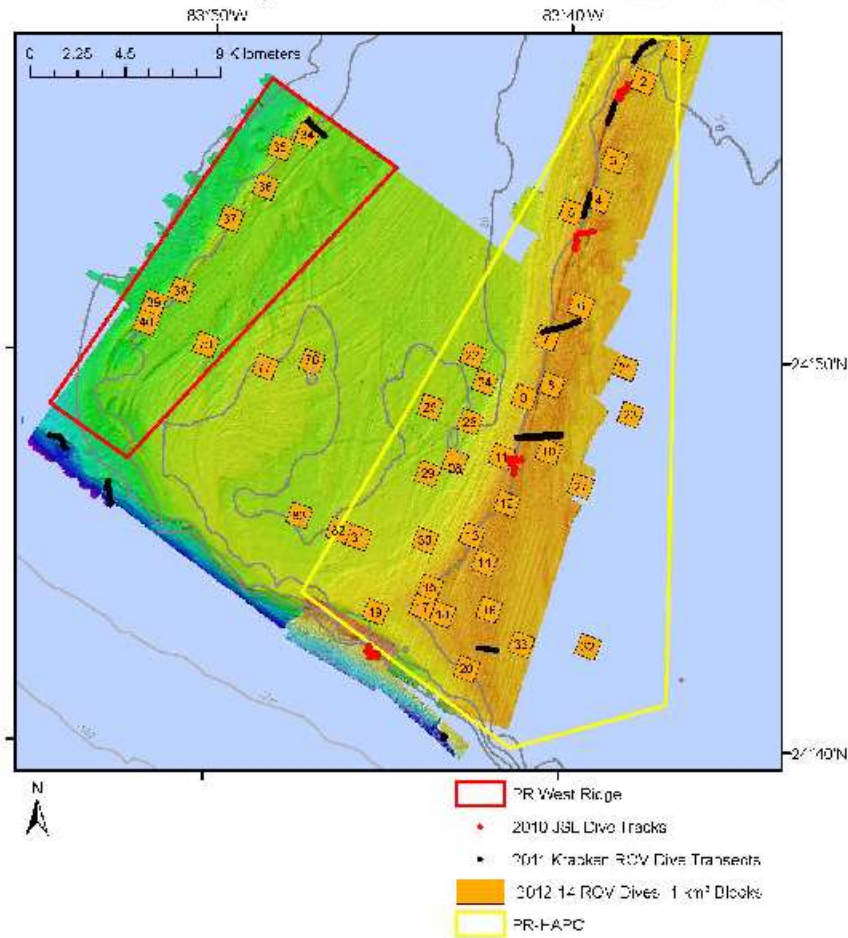
Estimated number of red grouper burrows on Pulley Ridge based on multibeam maps.

Most burrows have 1 grouper plus 10+ lionfish.



2010-14 CIOERT Cruises
ROV/JSL Surveys

J. Rose & S. Harrington
HROI FAU
WGS_1984_LTM_Zone_17N
Datum: D: WGS_1984



Proposed
Extension to
Pulley Ridge
HAPC = Red

Pulley Ridge
HAPC = Yellow

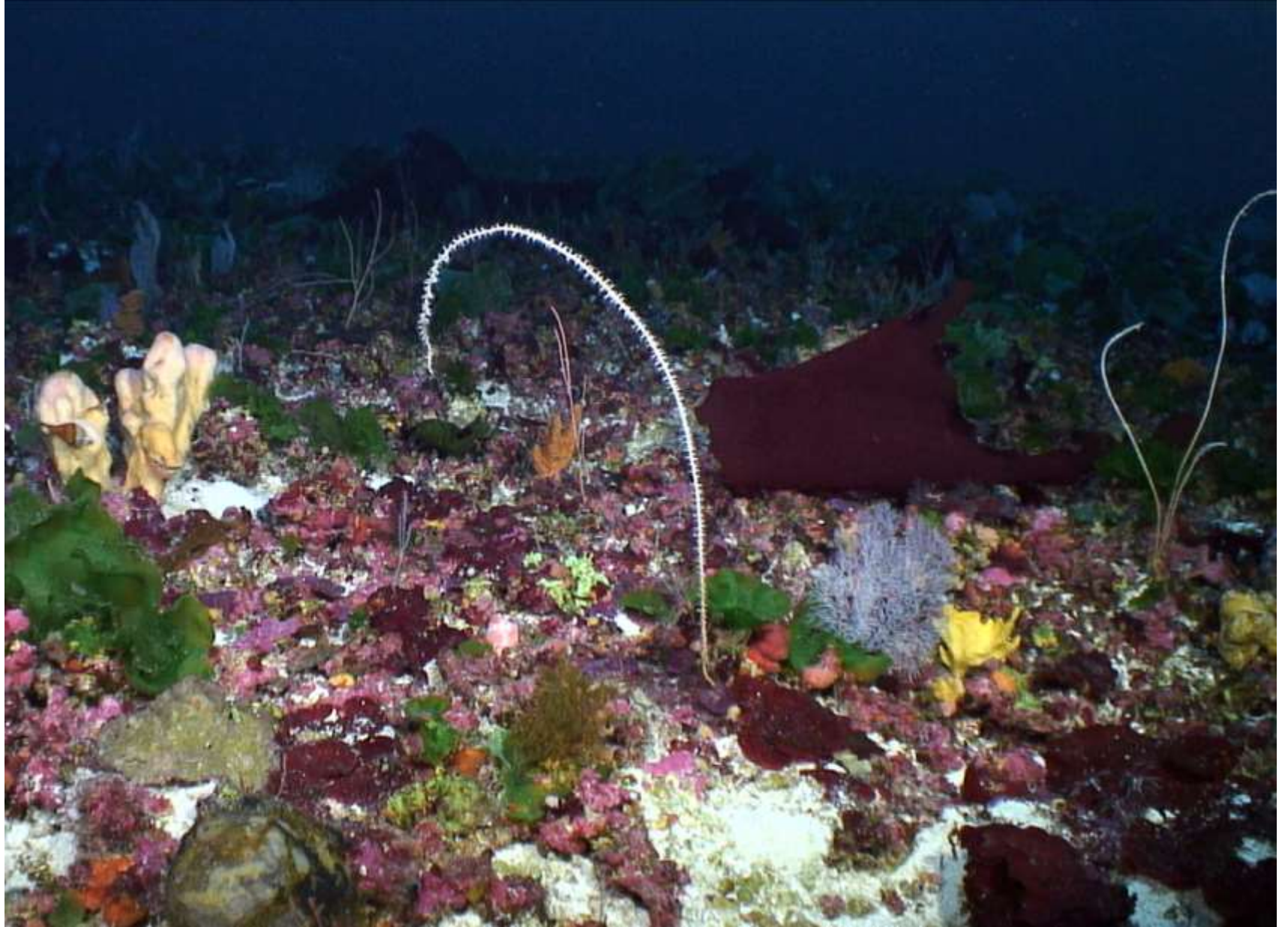
Pulley Ridge- West Ridge

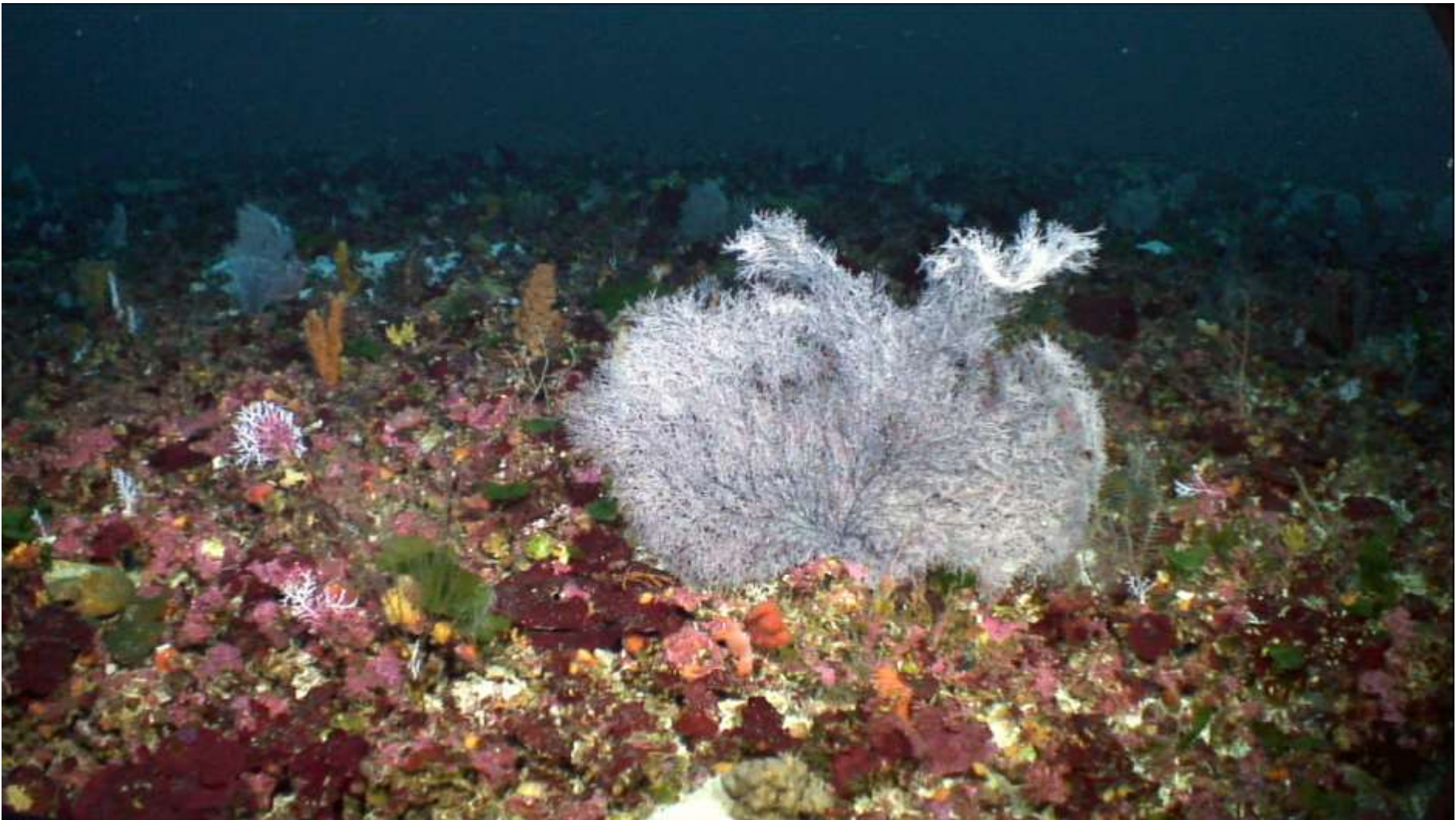
Dense and diverse demosponges, dense populations of gorgonians and antipatharians and red grouper.

West Ridge- West of Pulley Ridge HAPC

- Nine CIOERT ROV dives were made in 2011-2014 in which quantitative surveys of benthic habitat and fish populations were conducted in 1 km² random blocks.
- From the sonar, the west ridge appears to parallel the main HAPC ridge all the way south to the southern drop off.
- We found this site to be somewhat similar to the main ridge but slightly deeper (86 m at the base, 84 m on top). It was 100% hard bottom; dominant benthic species included: dense and diverse sponges, dense gorgonacea and Antipathidae (black coral); green algae- *Anadyomene* and red algae; scleractinian corals were mostly *Oculina diffusa* and *Madracis* spp. Sponges were more diverse and dense than the main ridge.
- Numerous red grouper pits were documented.









Proposed
Extension to PR
HAPC = Red

PR HAPC =
Yellow

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

SOUTHERN DROPOFF Proposed Extension to Pulley Ridge HAPC

Southern Dropoff, Including Howell's Hook

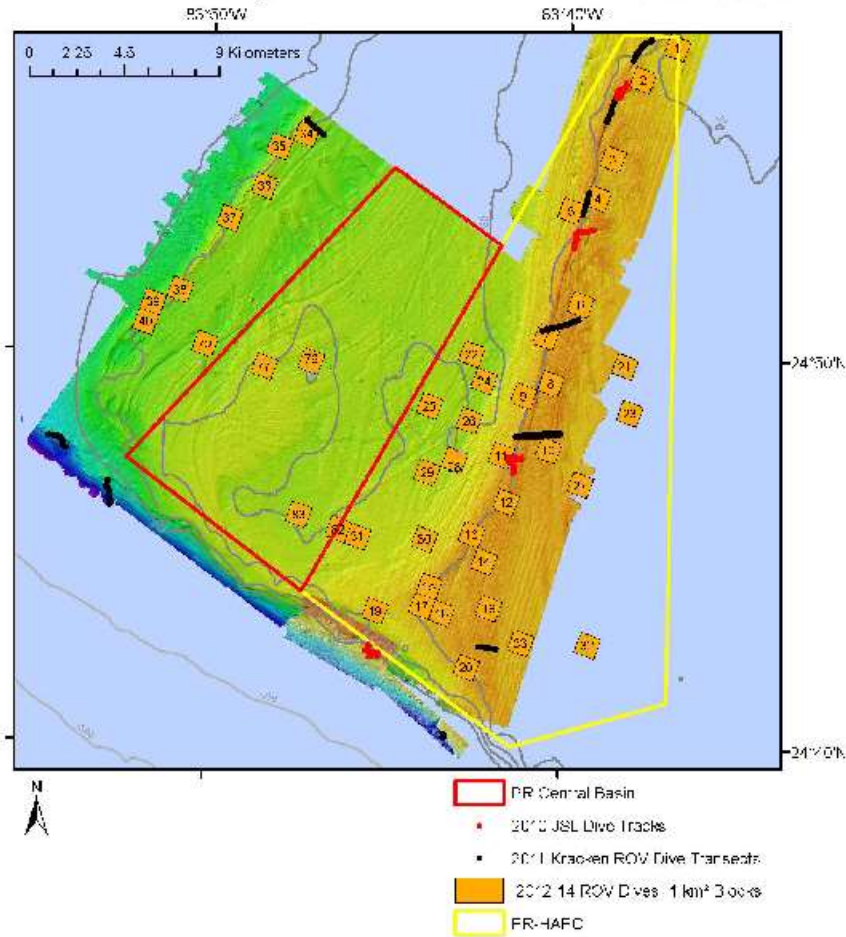
- This was surveyed by JSL sub dives in 2010 and *Kraken* ROV dives in 2012, and multibeam sonar during the 2011 *Nancy Foster* cruise. The western part of this drop off is referred to Howell's Hook in NOAA regional bathymetric charts. This is apparently essential fish habitat to a number of large grouper species.
- The multibeam shows a 50-m relief escarpment, oriented NW-SE; 84-172 m depth. The base of the wall has high-relief rock mounds and the escarpment is a rocky slope of 45-90°. We encountered five abandoned fish traps with pile of long line on top.
- Although the sessile benthic biota is relatively sparse compared to the upper Pulley Ridge terrace, the populations of large fish appeared 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.



Scamp grouper, ghost trap and red grouper on drop-off escarpment of Pulley Ridge (*Kraken* ROV, 2011 *Nancy Foster* cruise).

2010-14 CIOERT Cruises ROV/JSL Surveys

J. Hood & S. Harrington
HBCI FAU
WGS_1984_U_N_Zone_17N
Datum: D WGS 1984



Proposed
Extension to PR
HAPC = Red

PR HAPC =
Yellow

Pulley Ridge- Central Basin
Large populations of agaraciid plate corals discovered in 2014.

CENTRAL BASIN Proposed Extension to Pulley Ridge HAPC

The Central Basin of Pulley Ridge

- The 2014 CIOERT cruise were the first dives in this relatively flat region of Pulley Ridge. ROV dives were made to ground-truth this portion of the multibeam map which hasn't been described previously.
- To our amazement we discovered the densest cover of agariciid plate corals known in the Gulf of Mexico including Flower Gardens NMS, Florida Middle Grounds HAPC, or Florida Keys NMS. And greater density than in Pulley Ridge HAPC!
- These included *Agaricia lamarcki* and/or *grahamae*, *A. fragilis*, *Leptoseris cucullata*.
- Quantitative photographs were taken every 30 seconds during surveys of 1 km² random blocks. These downward images have 10 cm lasers for scale and each image is ~1.5 m².
- We found many of the images to have 3-10 individual coral colonies per image which would be 2-6 corals/m².
- Some colonies of the *Agaricia* exceeded tens of m in diameter.

