REPP – Connectivity of the Pulley Ridge – South Florida Coral reef Ecosystem: Processes to Decision Support Resources

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Pulley Ridge Project

- Funding:
  - NOAA National Centers for Coastal Ocean Science
  - NOAA Office of Ocean Exploration and Research
- Managed through two Cooperative Institutes
  - CIMAS – UM
  - CIOERT – FAU/HBOI
- 35 PIs, 10 Institutions plus NOAA labs
- NOAA Program Manager – Kimberly Puglise

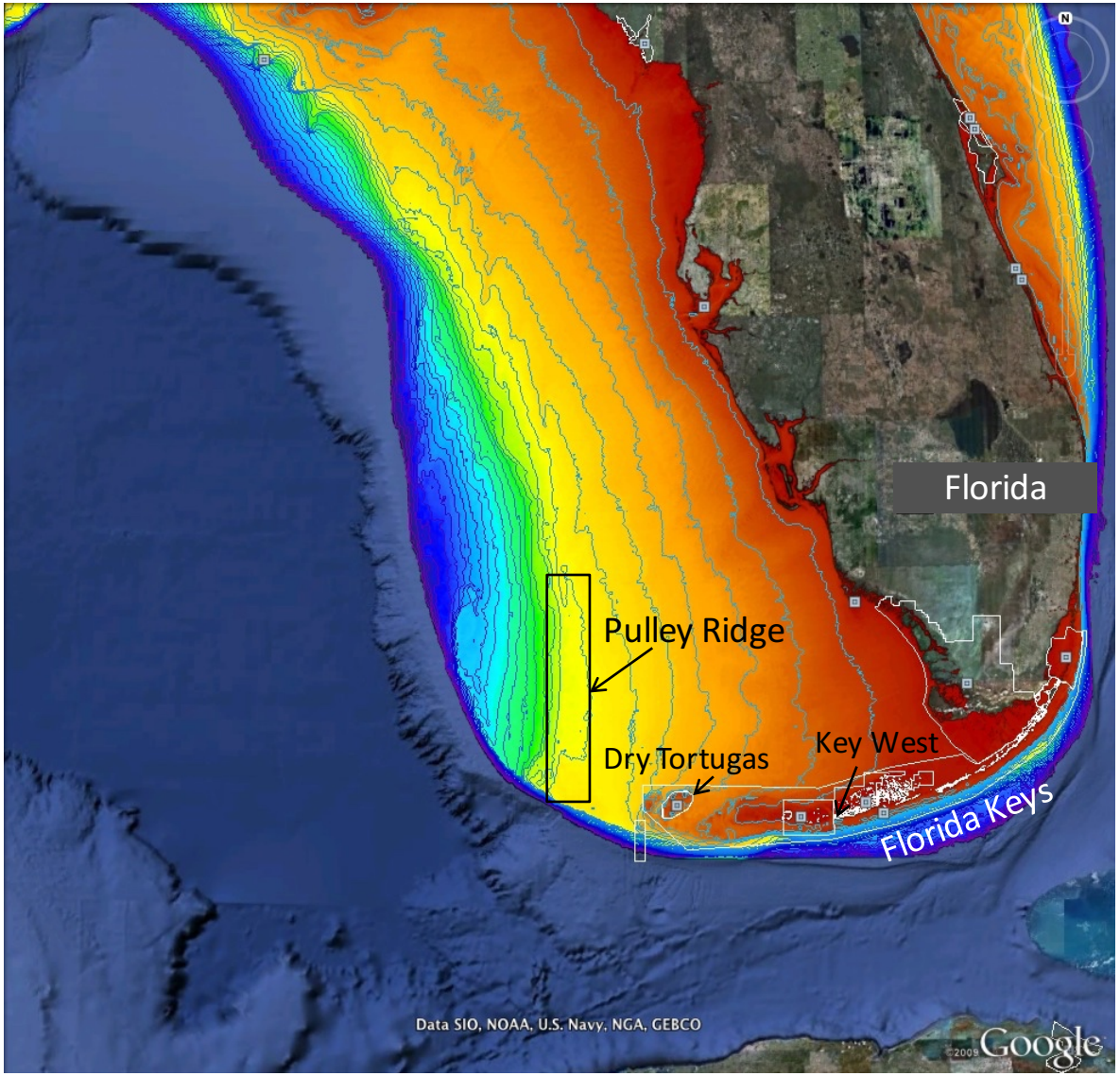
Outline of Today's talk

- Rationale of project –
  - Overview of program – interest, knowledge gaps
  - Key project goals –
    - Population Connectivity (horizontal and vertical (refuge hypothesis)
    - Community Structure (description of PR)
    - Economic analysis – ecosystem linkages
- Project outline
  - Requirements of resolving Population connectivity
  - Sub group structure
  - Models, empirical data, existing data, products
- Today's talks –

Program Overview:

History

Preliminary research efforts



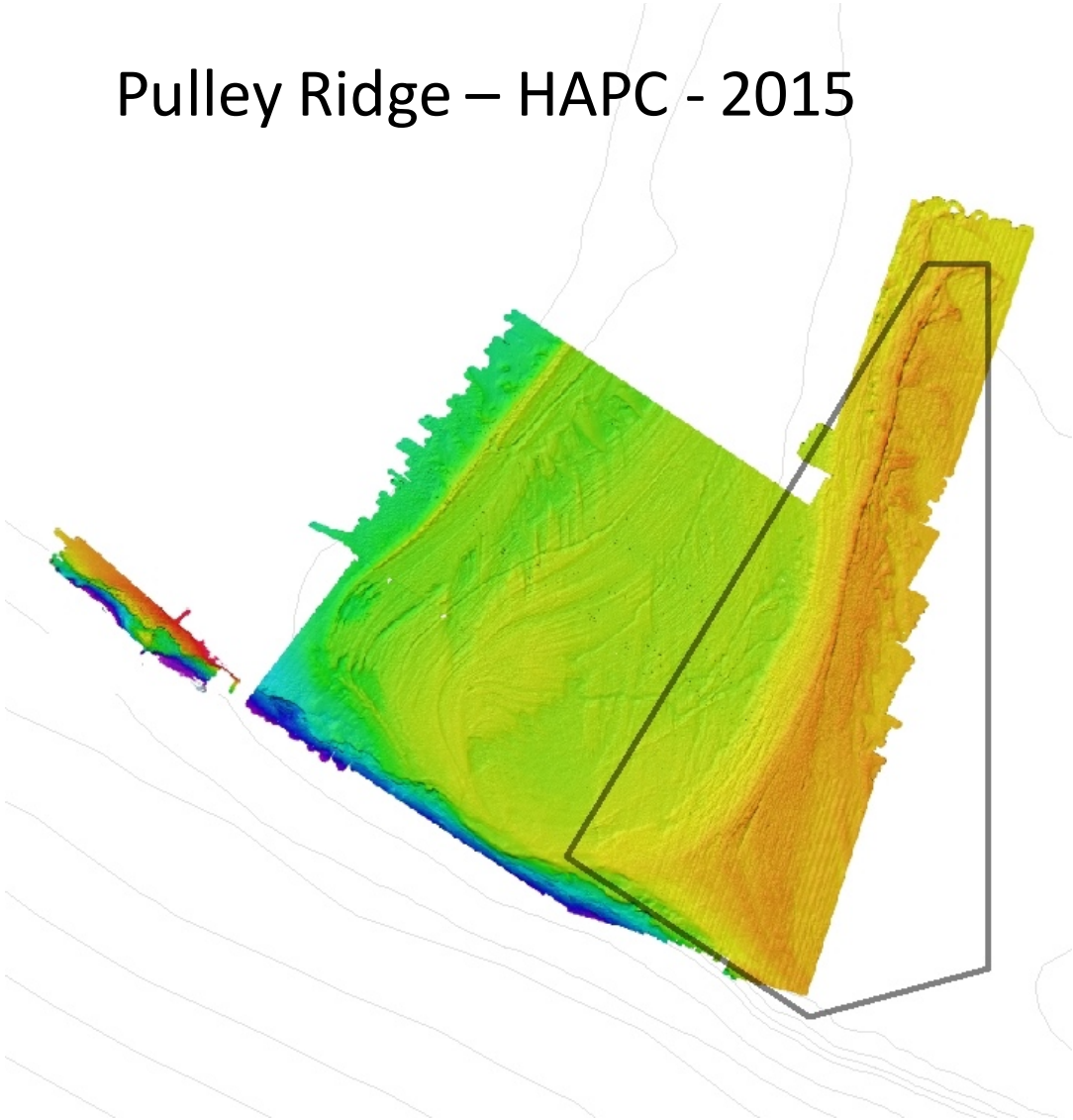
Program Overview:

History

Preliminary research efforts

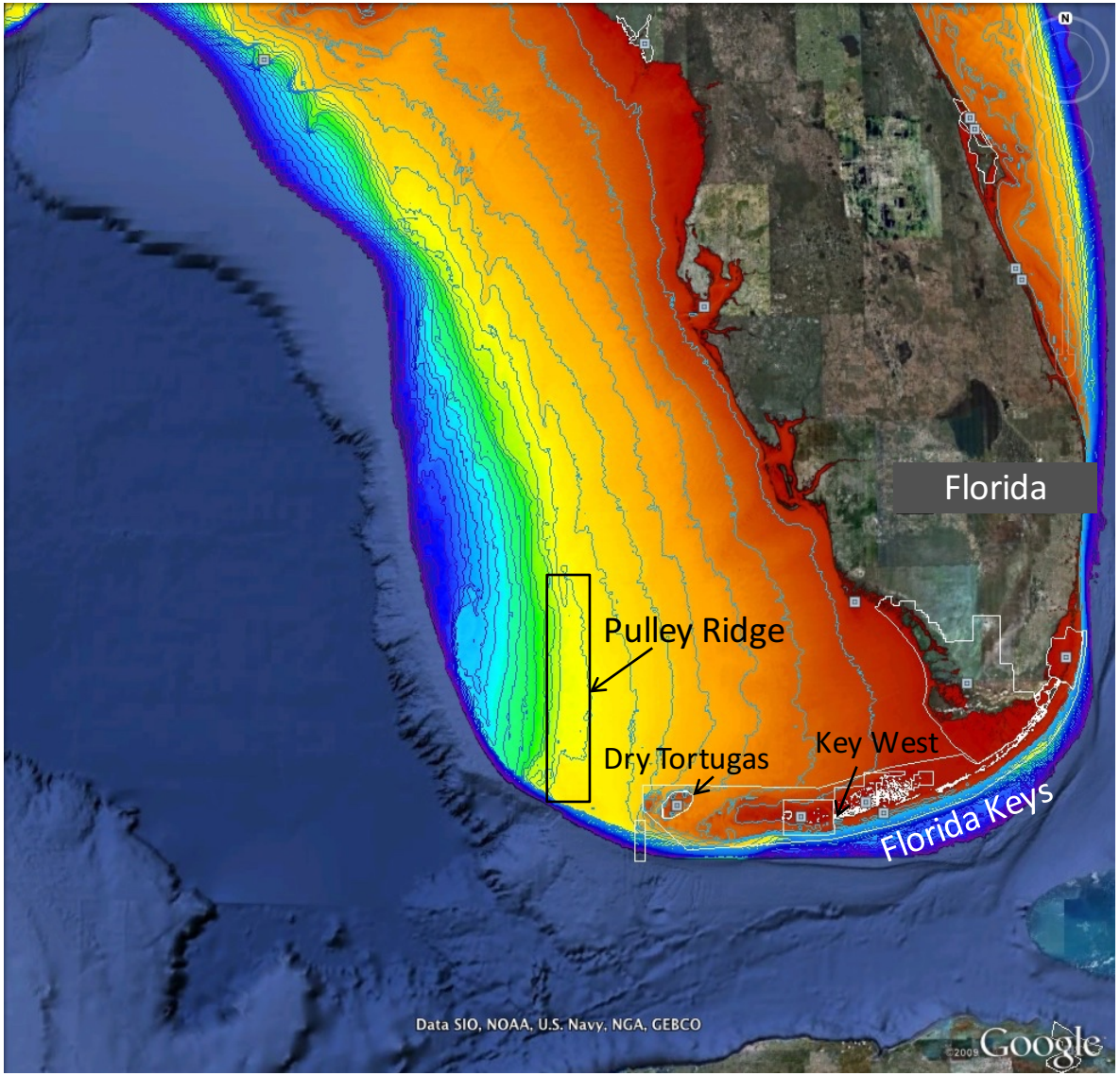
Management actions

Pulley Ridge – HAPC - 2015



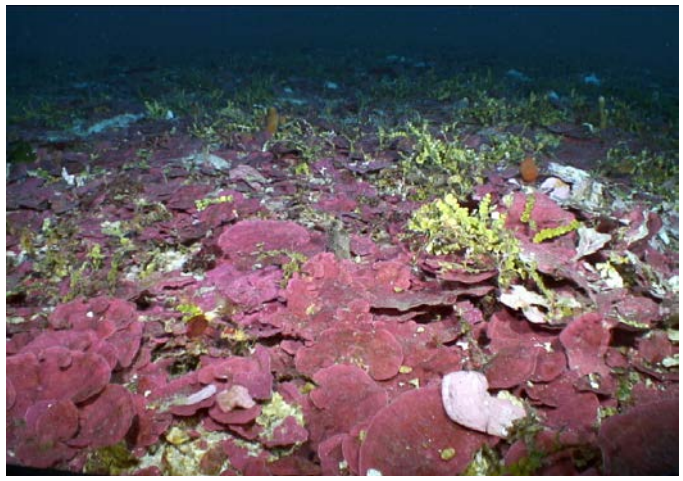
Program Overview:

- History
- Preliminary research efforts
- Management actions
- NOAA NCCOS – program funding
- This Project



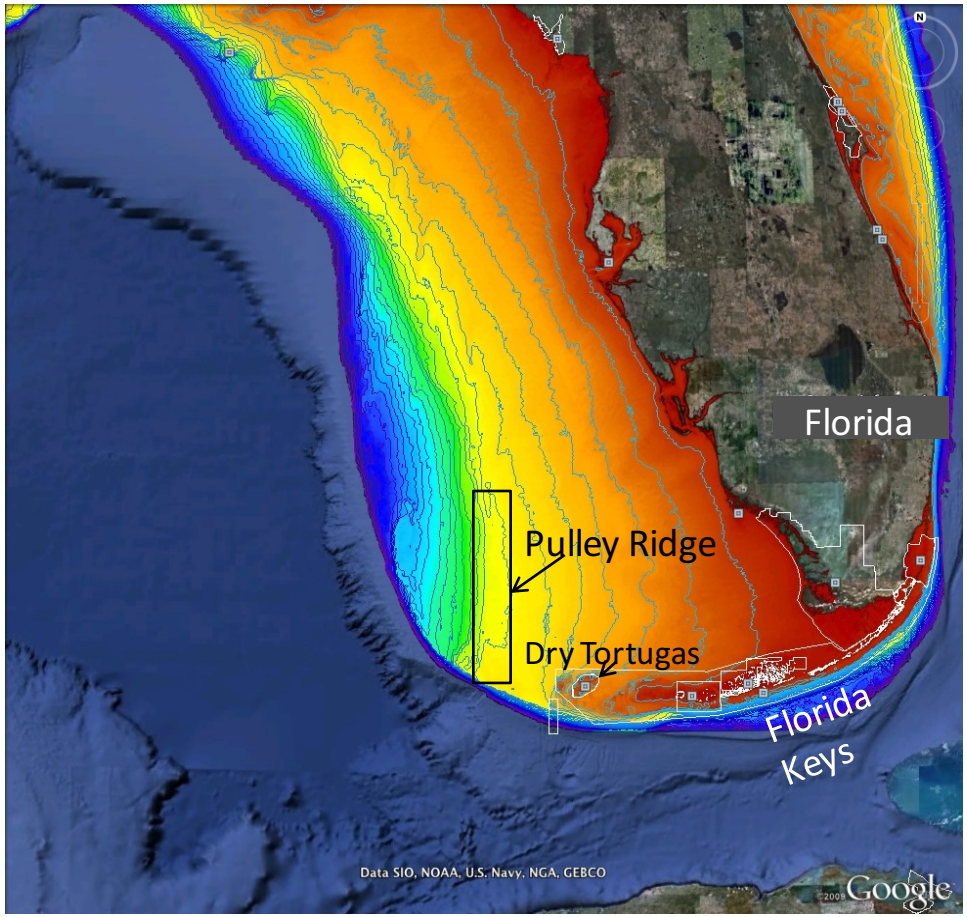
Mesophotic Reefs

- Connectivity
- Community Structure
- Valuation



Project Goals

- Assess scale of connectivity
  - Spatial
  - Vertical (Deep ←→ Shallow)
- Describe extent and community structure
  - Benthos (algae, coral, sponges)
  - Fish populations
- Bio-economic valuation
- Decision Support Resources

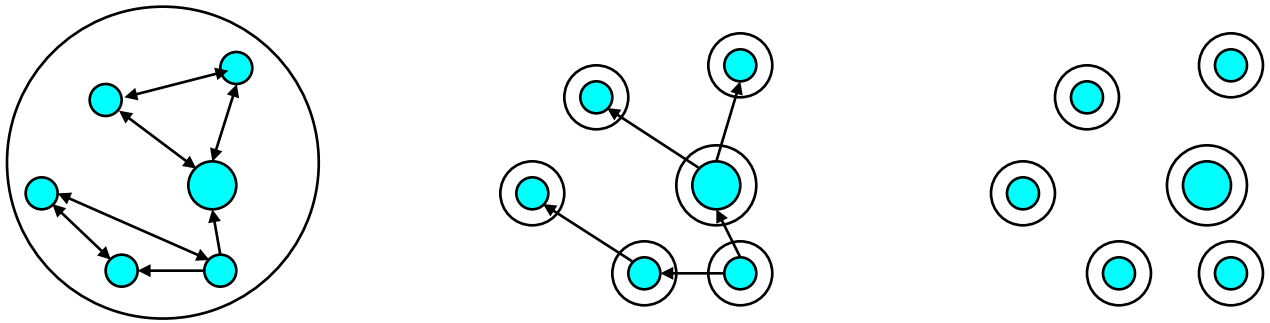


Population Connectivity

Single, patchy population

Metapopulation

Separate populations



High ⟷ **Low**

Population Connectivity

Modified from Harrison and Taylor (1997)

Key Requirements for successful connectivity

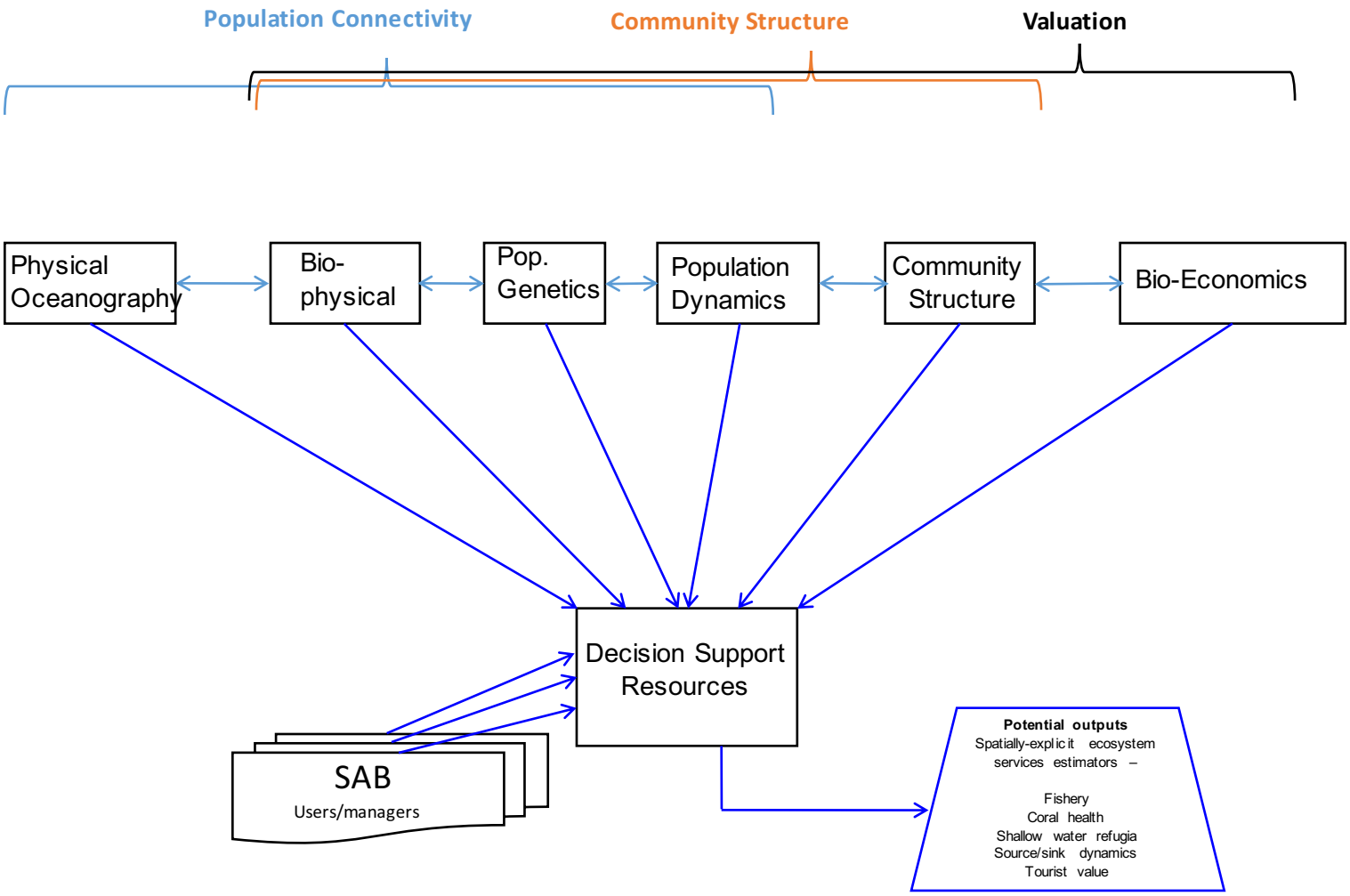
- Currents
- Larval behavior
- Trophic pathway
- Suitable habitat for survival
- Reproduction

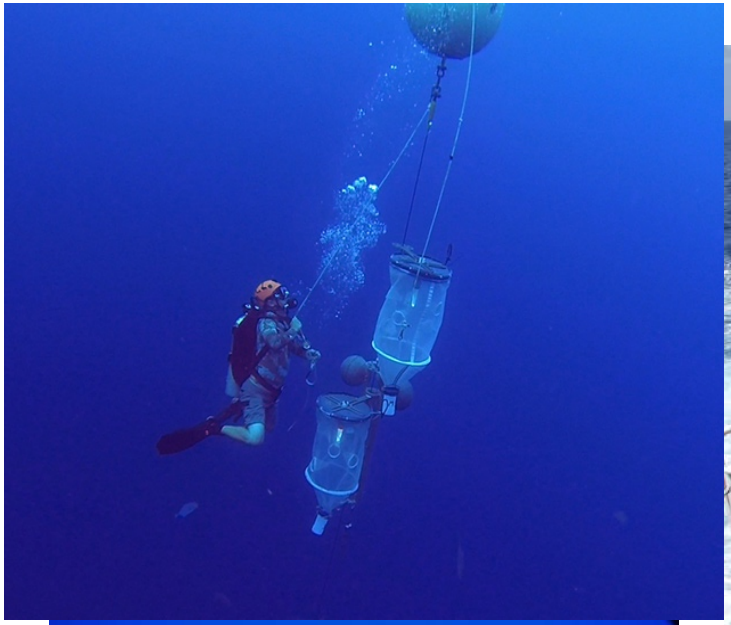
Deep Reef Refuge Hypothesis

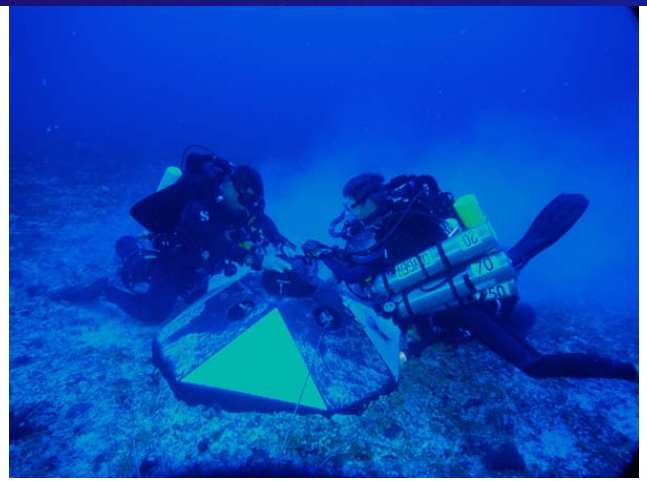
Requirements for Viable connection between Deep water and shallow water Populations

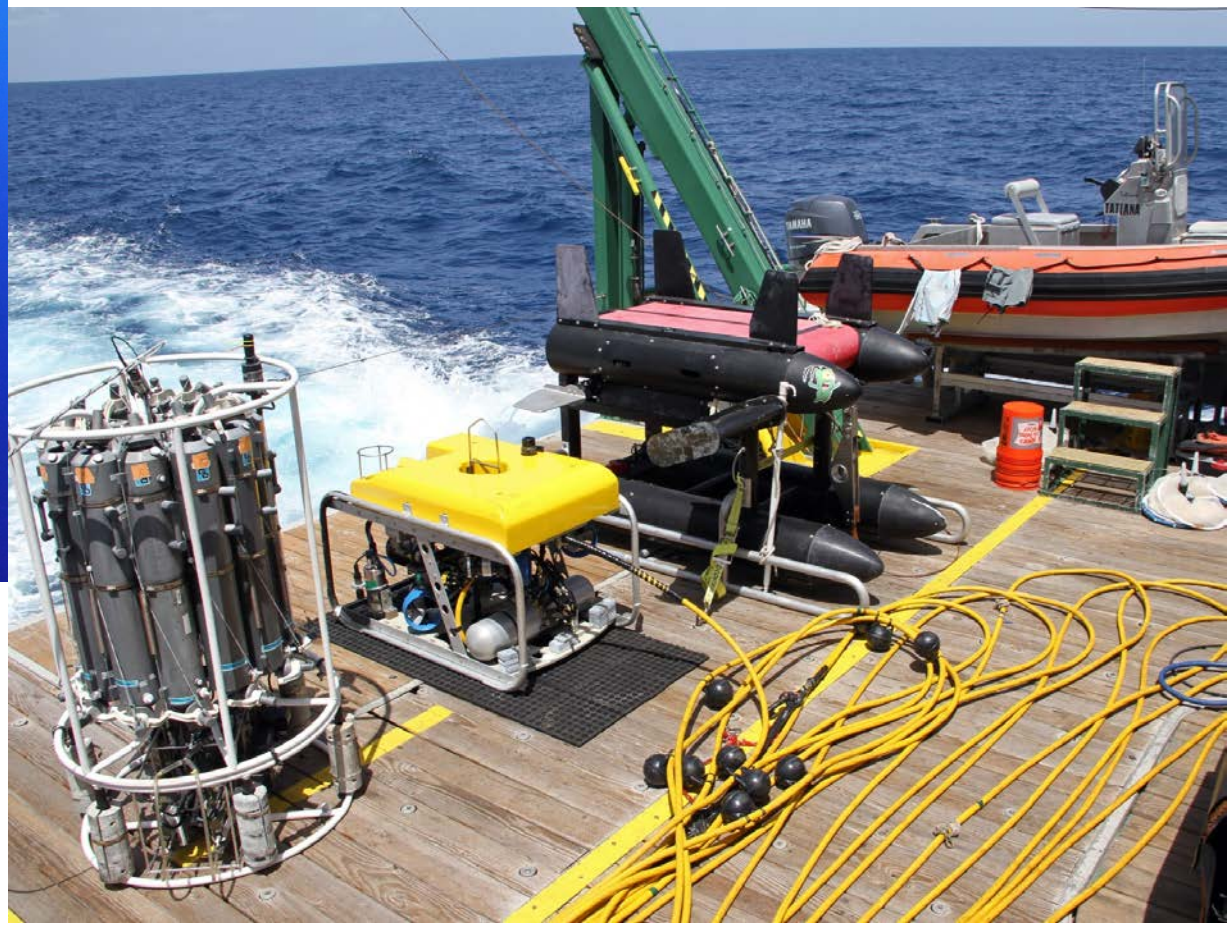
- (1) robust populations of shallow-reef species *must* co-occur at mesophotic depths,
- (2) shallow and mesophotic habitats *must* be physically connected by currents, and
- (3) life history traits of organisms *must* enable successful delivery of viable larvae from mesophotic to shallow reefs.

- No single factor is proof, all three must be operating.


Population Connectivity
Community Structure
Valuation
Physical Oceanography
Bio-physical
Pop. Genetics
Population Dynamics
Community Structure
Bio-Economics
Decision Support Resources
SAB
Users/managers
Potential outputs
Spatially-explicit ecosystem services estimators –
Fishery
Coral health
Shallow water refugia
Source/sink dynamics
Tourist value






YAMAHA
TATIANA

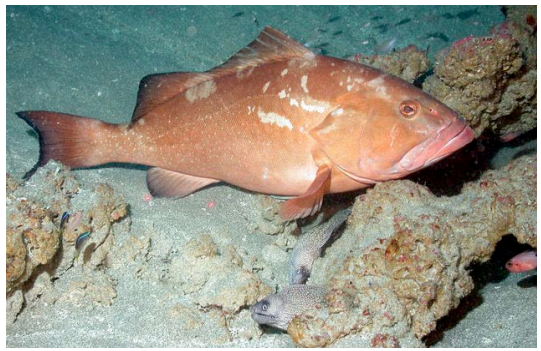
Target species for Genetic studies

- **Corals**
  - ***Montastraea cavernosa***
  - ***Agaricia* spp.**
  - ***Porites astreoides***
- **Algae**
  - ***Halimeda* spp.**
- **Sponges**
  - ***Xestospongia muta***
- **Fish**
  - ***Lionfish (Pterosis sp.)***
  - ***Epinephelus morio (red grouper)***
  - ***Stegastes partitus* (bicolor damselfish)**

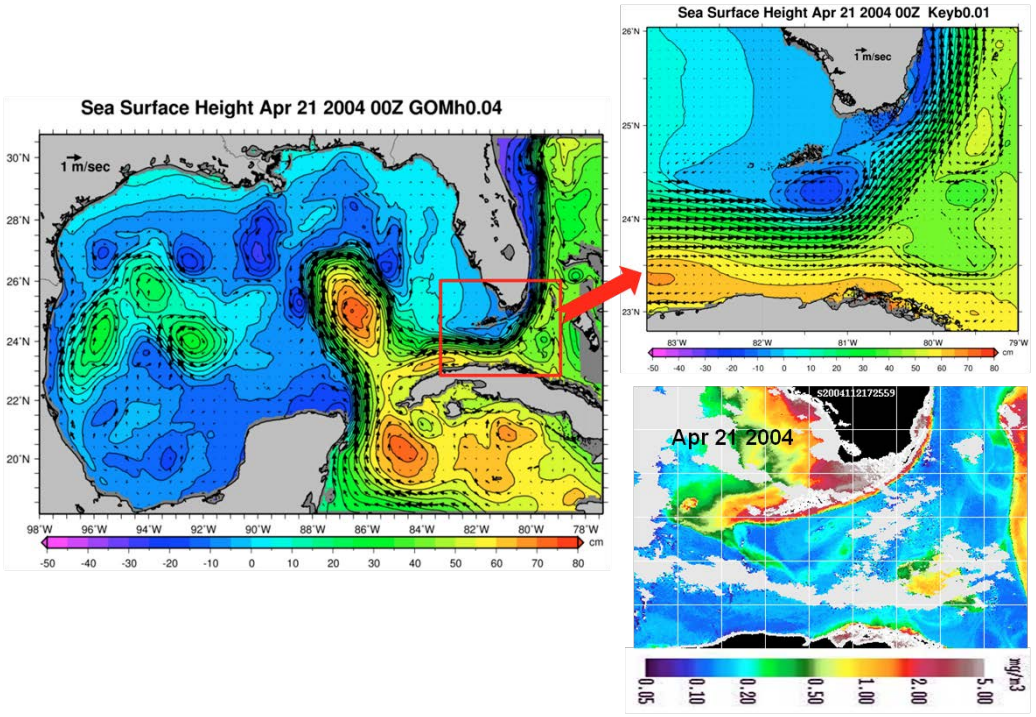




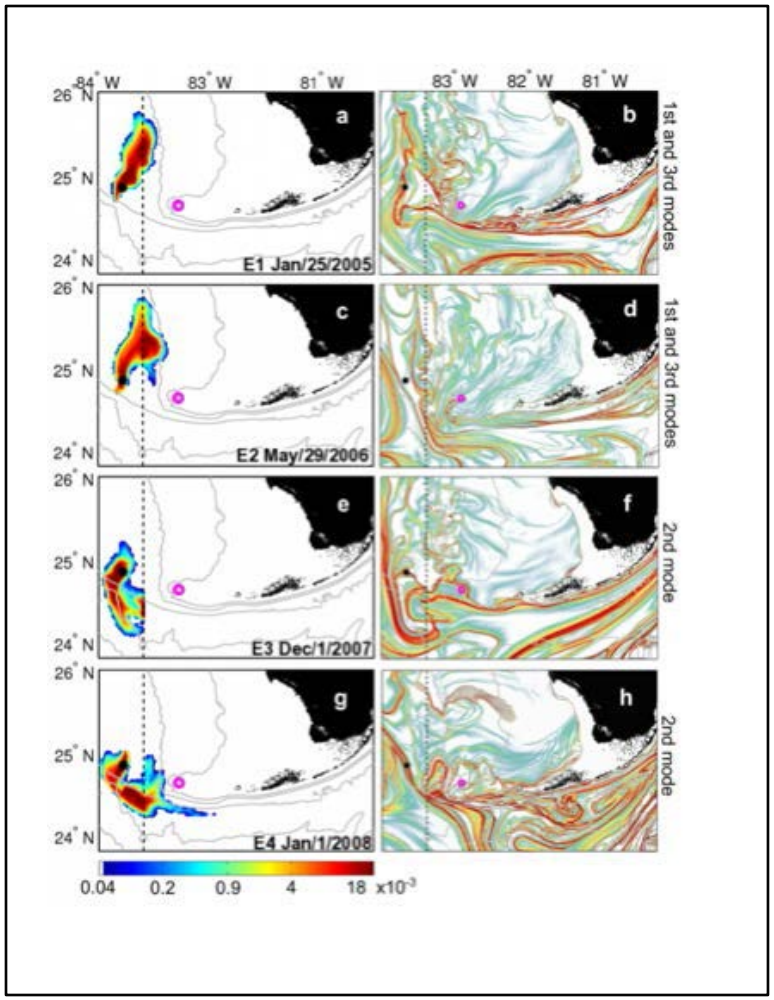




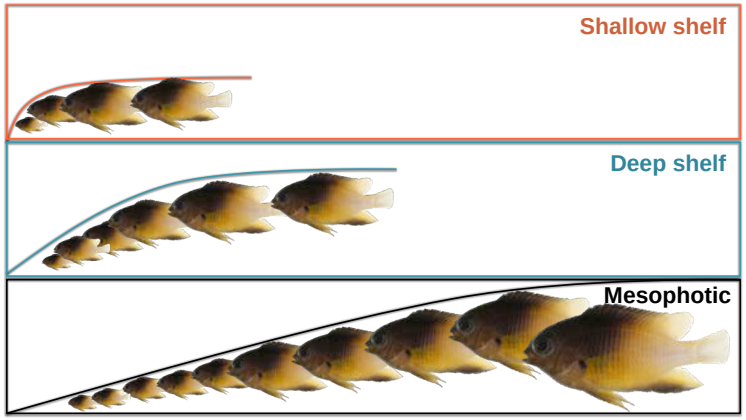

Physical Oceanography - Modeling



Kourafalou et al. 2015, Le Hénaff et al. 2016,
Vaz et al. In review

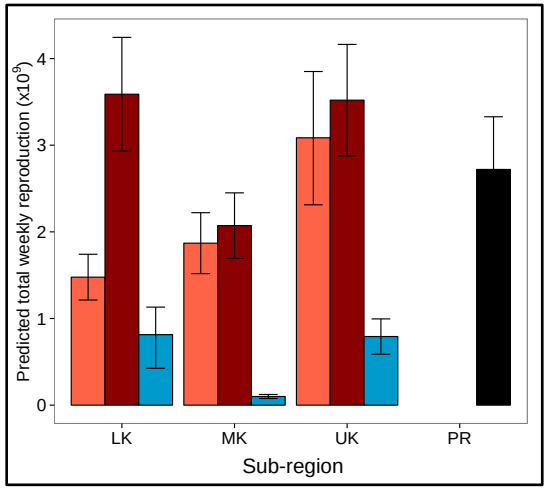


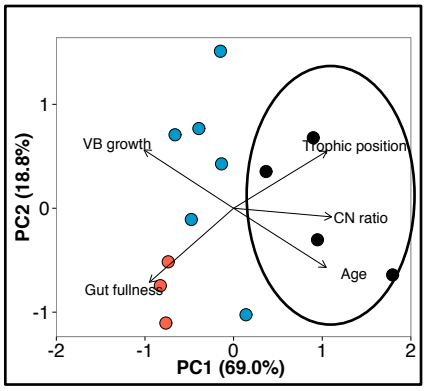
Population Dynamics – Biophysical Connections

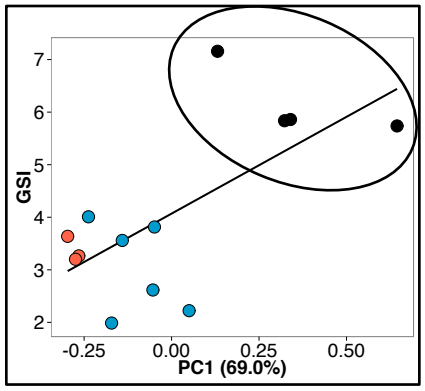


At Pulley Ridge, fish:

- **grow more slowly**
- **live longer**
- **attain larger body sizes**
- **have high individual reproductive output**







Factoring in spatially explicit population densities & area of suitable habitat:

Egg contributions

32% Shallow shelf

46% Mid-shelf

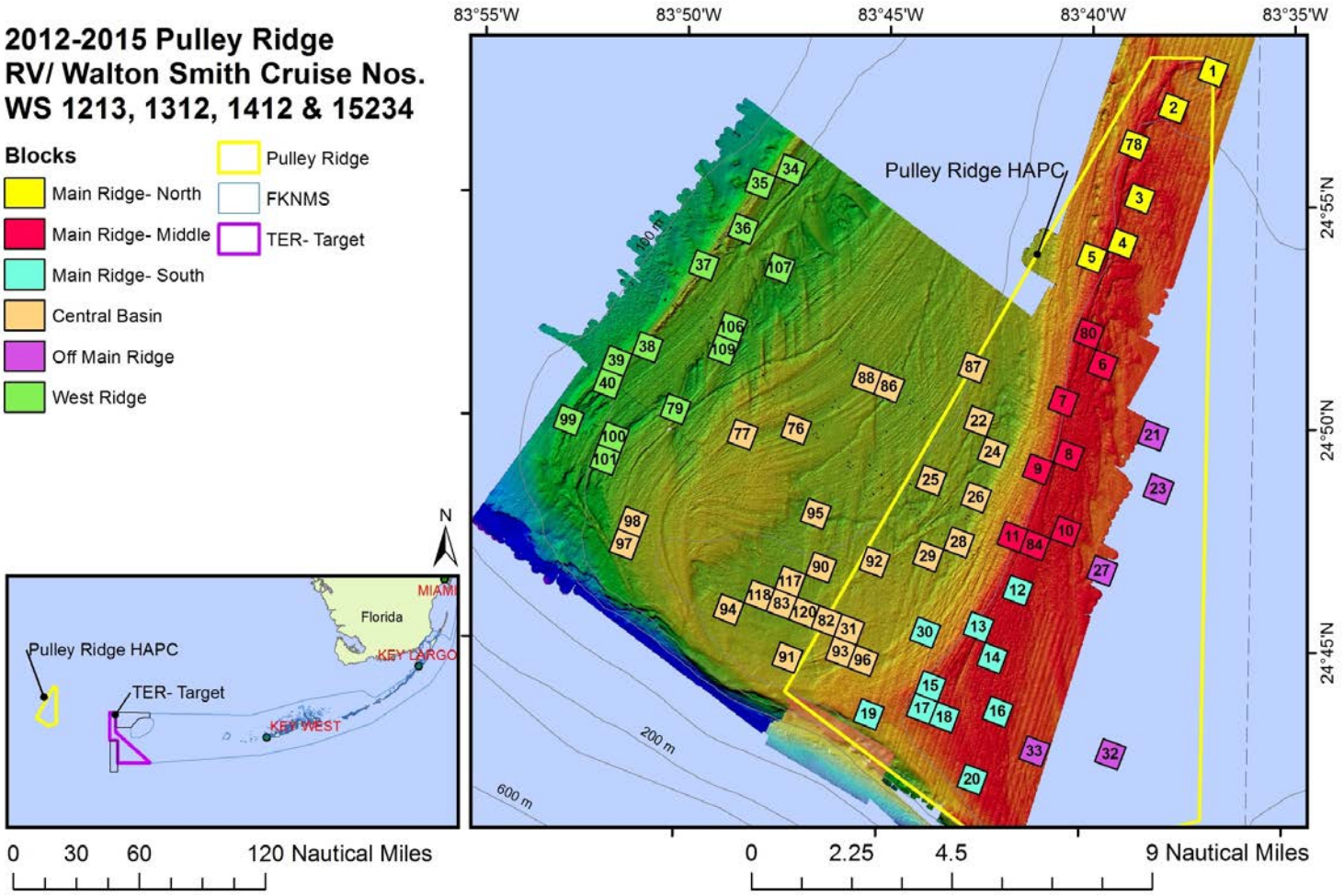
8% Deep shelf

14% Mesophotic

Goldstein et al. *2016a,b; 2017*

Community Structure

Benthic surveys quantified bottom cover and covered new area



Four years of ROV surveys examined 69 1-km^2 random blocks at Pulley Ridge mesophotic reef. Habitat zones by color. (Background MB map, USGS).

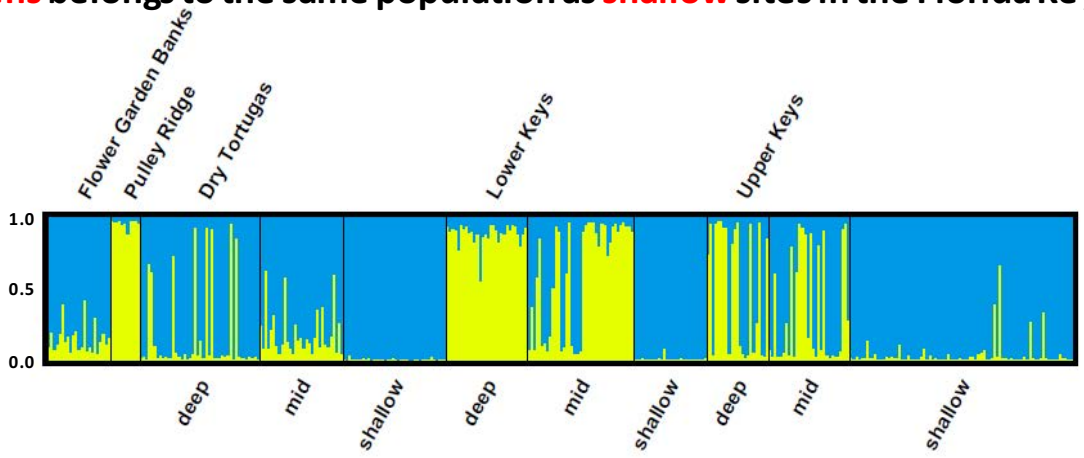
Benthic Surveys

Lionfish populations are continuing to increase, since the first report of that exotic species on PR in 2010

Population Genetics

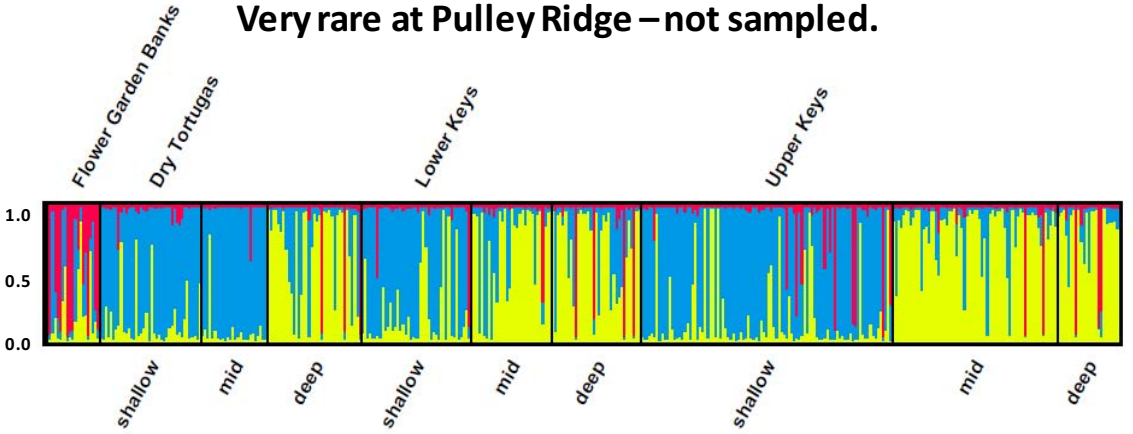
Pulley Ridge belongs to the same population as deep sites in the Florida Keys.
Flower Gardens belongs to the same population as shallow sites in the Florida Keys.

M. cavernosa
(N = 380)



Many *P. astreoides* at Flower Garden Banks are distinct from Florida populations.
Very rare at Pulley Ridge – not sampled.

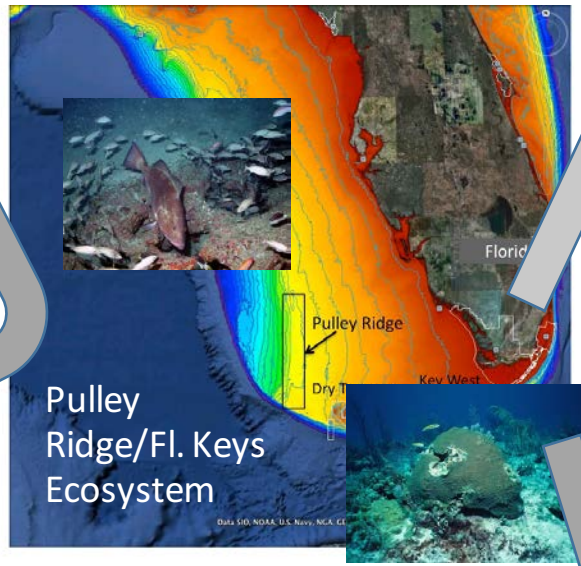
P. astreoides
(N = 425)



Bio-economic Valuation

ECOSYSTEM SERVICES PROVIDED BY REEF SYSTEM

SEAFOOD



RECREATION

HABITAT/ PROTECTION

Todays talks -

- ***Shirley Pomponi*- Coral Ecosystem Connectivity: From Pulley Ridge to the Florida Keys – Community Structure**
- ***Villy Kourafalou* - Physical Connectivity between Pulley Ridge and the Florida Keys**
- ***Su Sponaugle* - Population Connectivity of Shallow, Deep, & Mesophotic Reef Ecosystems: Role of Population Dynamics**
- ***Andrew Baker* - Population genetics of representative reef taxa at Pulley Ridge and upstream/downstream sites**
- ***David Die* – Bio-economics: Past, present and future of fisheries of Pulley Ridge**

Acknowledgements

UM Dive team – Rick Riera-Gomez
UPR Dive Team
Tampa Aquarium Divers

Super tech – Cedric Guigand

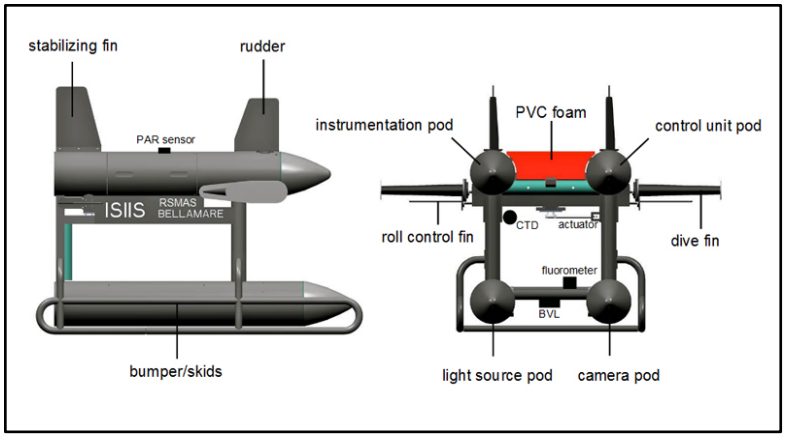
UM Sponsored Team Leader – Fernande Saintillis

Captain and Crews of:
RV Walton Smith
MV Spree

Many many others.....

ISIIS

In Situ Ichthyoplankton Imaging System



http://yyy.rsmas.miami.edu/groups/larval-fish/isiis%20website/isiispage1.htm

Task: Deploy ISIIS on a time available basis