

# Reef Fish Spawning Aggregations in the Florida Keys



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# Fish Spawning Aggregations

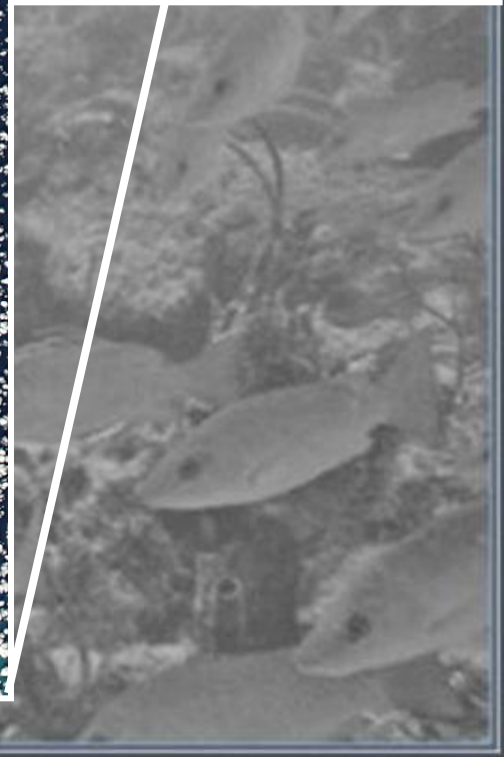
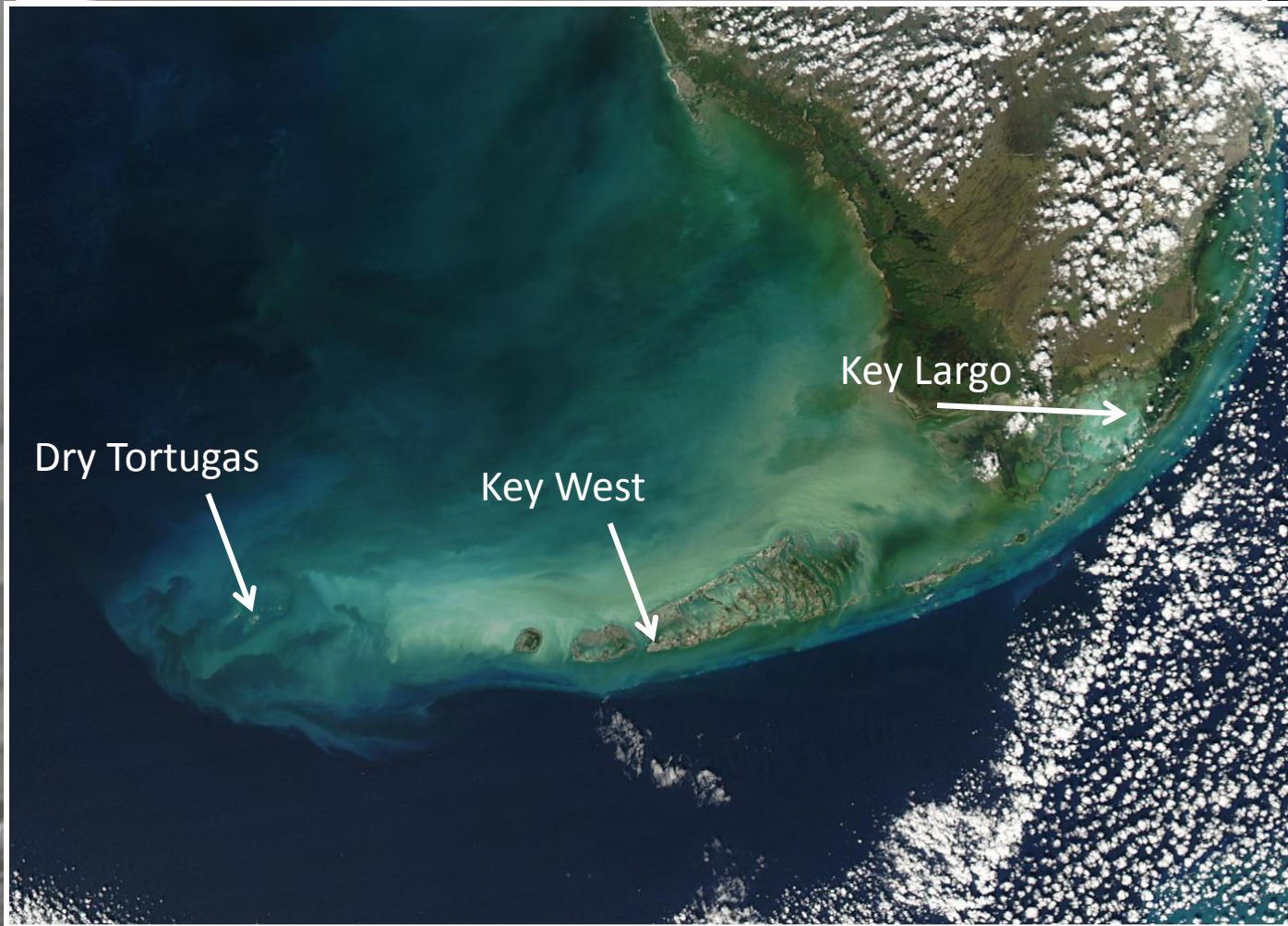
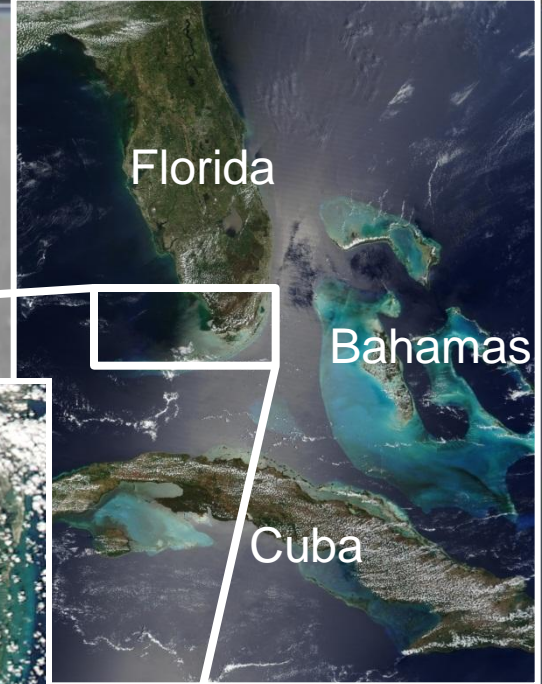
- Brief reproductive events
- Vital part of life cycle for many reef fish species
- Typically happen in conjunction with lunar phases
- Easily exploited; high risk of over-exploitation
- Identifying FSA locations is a critical first step



Photo credit: C. Parsons



# Location, location, location!



# Various approaches to FSA research in the Keys

## Acoustic Tagging

1. Fish movements – migratory patterns
  - Tagging of recreationally and commercially important species
  - Position receiver array to detect movement between protected areas
2. Evaluation of marine protected areas network



## Acoustic Mapping



1. Assess and compare depth and habitat characteristics of the FSAs
  - Creation and analysis of bathymetric maps
  - Are there similar characteristics across sites?
2. Assess reef fish utilization of the sites
  - Split-beam sonar surveys
  - Diver surveys





# Commercially and Recreationally Important Species

***Lutjanus analis***  
**mutton snapper**



***Lutjanus griseus***  
**gray snapper**



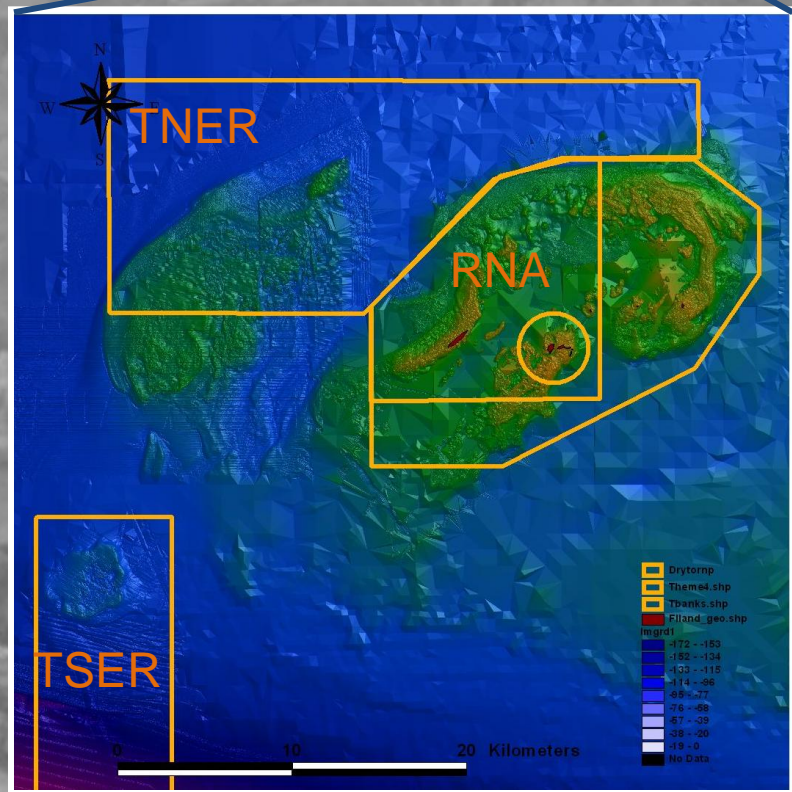
***Ocyurus chrysurus***  
**yellowtail snapper**



***Mycteroperca bonaci***  
**black grouper**



# The Study Area - Acoustic tagging





## Observations of Mutton snapper (*Lutjanus analis*) on Riley's Hump

Date and Station	Numbers observed	Moon phase
28 May–1 June 1999	1 fish in 3 of the 11 dives	Full moon May 30*
31 July–3 Aug 2000	1 fish in 5 of the 6 dives	New moon July 30*
17 July 2001 Station 2	10	3 days before new moon*
27 May 2002 Station 2	75 -100	1 day after full moon*
15 June 2003 Station 2	75 -100	1 day after full moon*
15 June 2003 Station 12	200 +	1 day after full moon*
4 July 2004 Station 12	300	2 days after full moon*
3 July 2007 Station 12	100 +	3 days after full moon**
12 June 2009 (1415-1715 hrs)	~4000	5 days after full moon***

•From: Burton ML, Brennan KJ, Muñoz RC, Parker RO Jr (2005) Preliminary evidence of increased spawning aggregations of mutton snapper (*Lutjanus analis*) at Riley's Hump two years after establishment of the Tortugas South Ecological Reserve. Fish Bull 103:404–410.

\*\* Mike Burton's Trip report

\*\*\* FWC current study

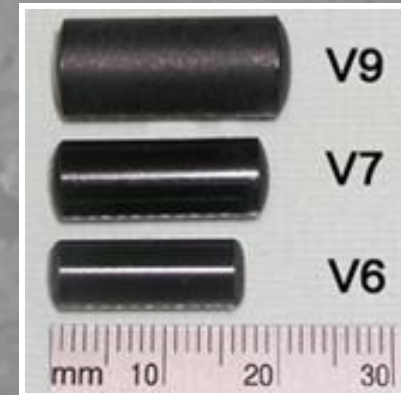
# Acoustic Tagging

## Since 2008:

Yellowtail (18)

Mutton snapper (56)

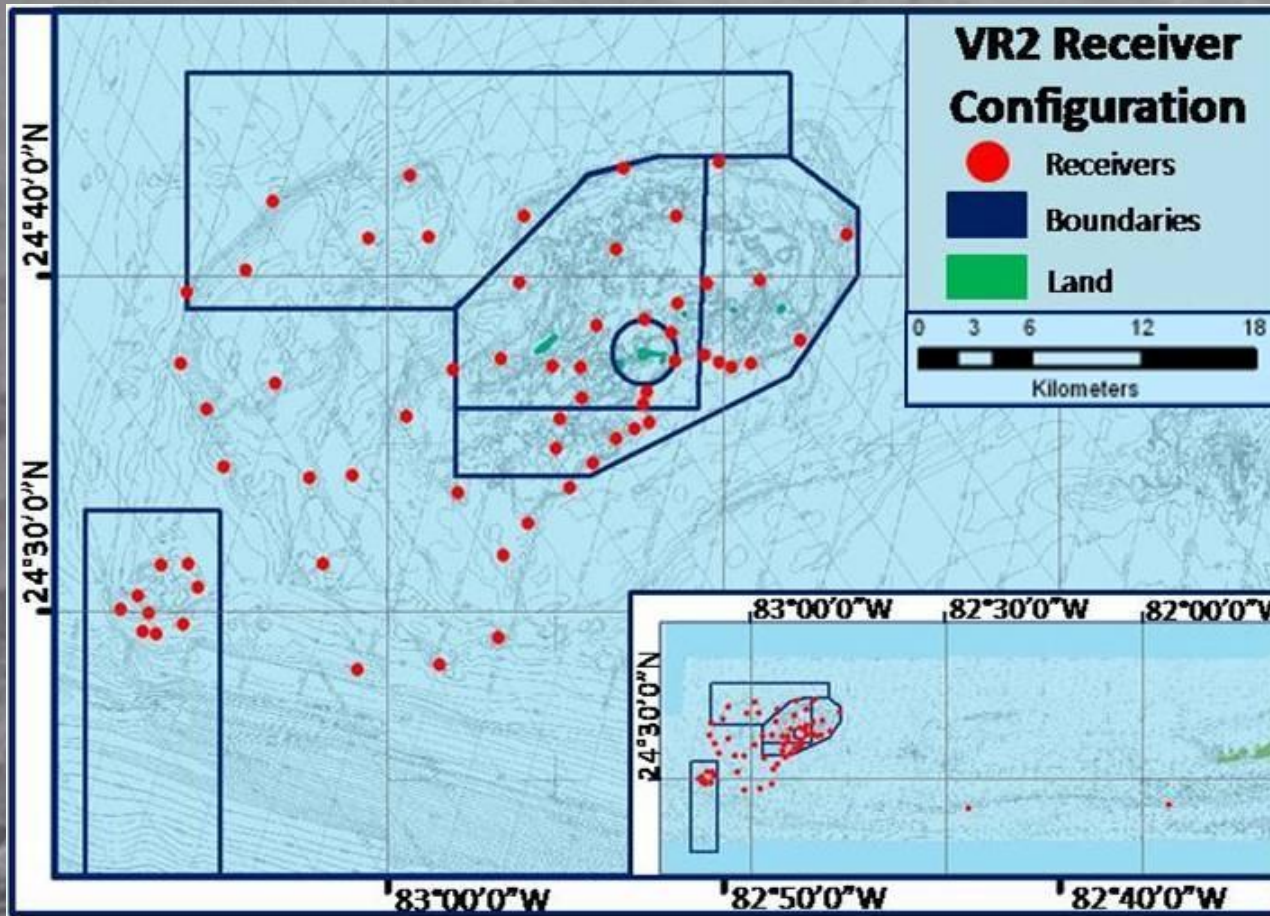
Black grouper (26)

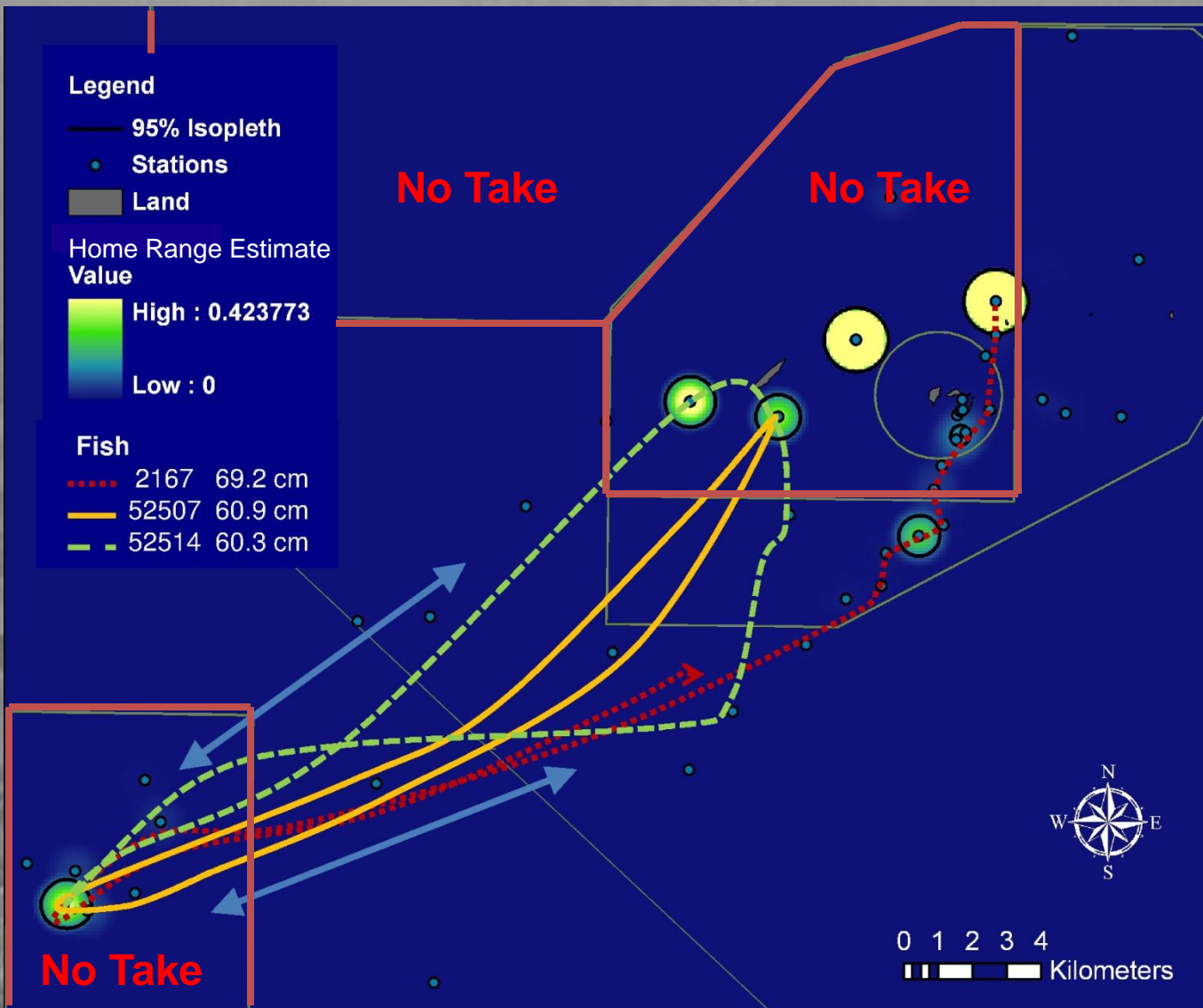




# VR2 Array in the Dry Tortugas

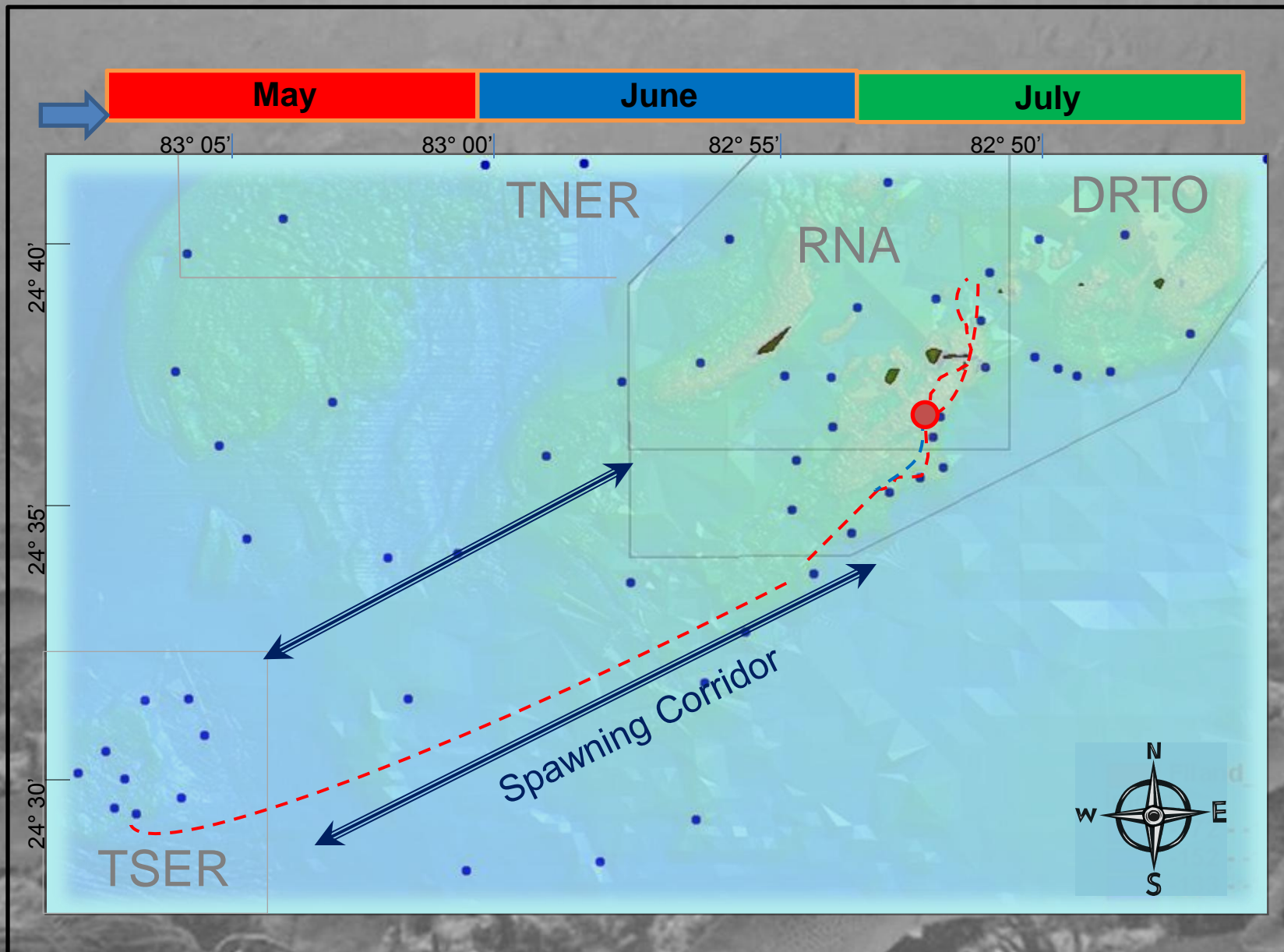
64 receivers in the array



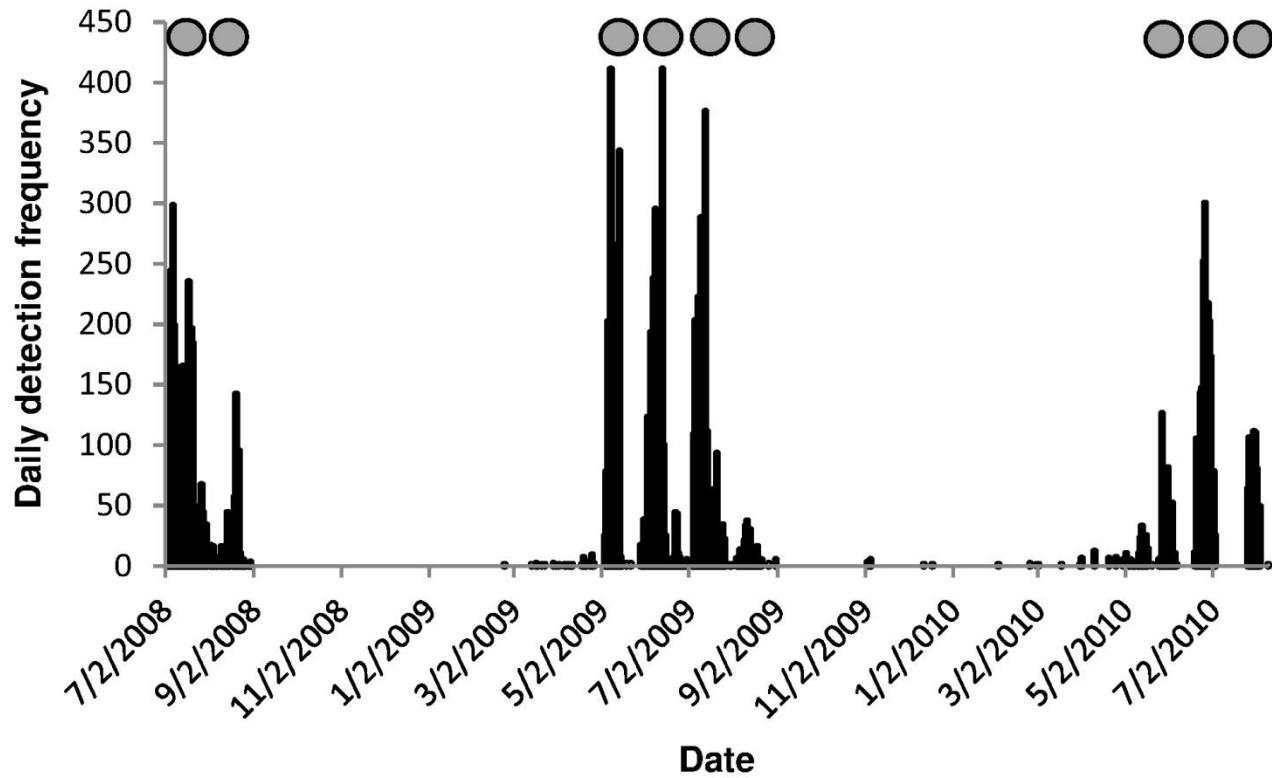




# *L. analis* – 69.2 cm



# Receiver activity at SPA of mutton snapper with full moons shown





An underwater photograph showing a large school of fish swimming over a coral reef. The fish are densely packed in the foreground and middle ground, moving towards the right. The background shows a vast expanse of water with more fish visible in the distance. The overall scene is a natural, marine environment.

# **Acoustic Mapping and FSAs in the Keys**

# Study Locations

- **Upper Keys**

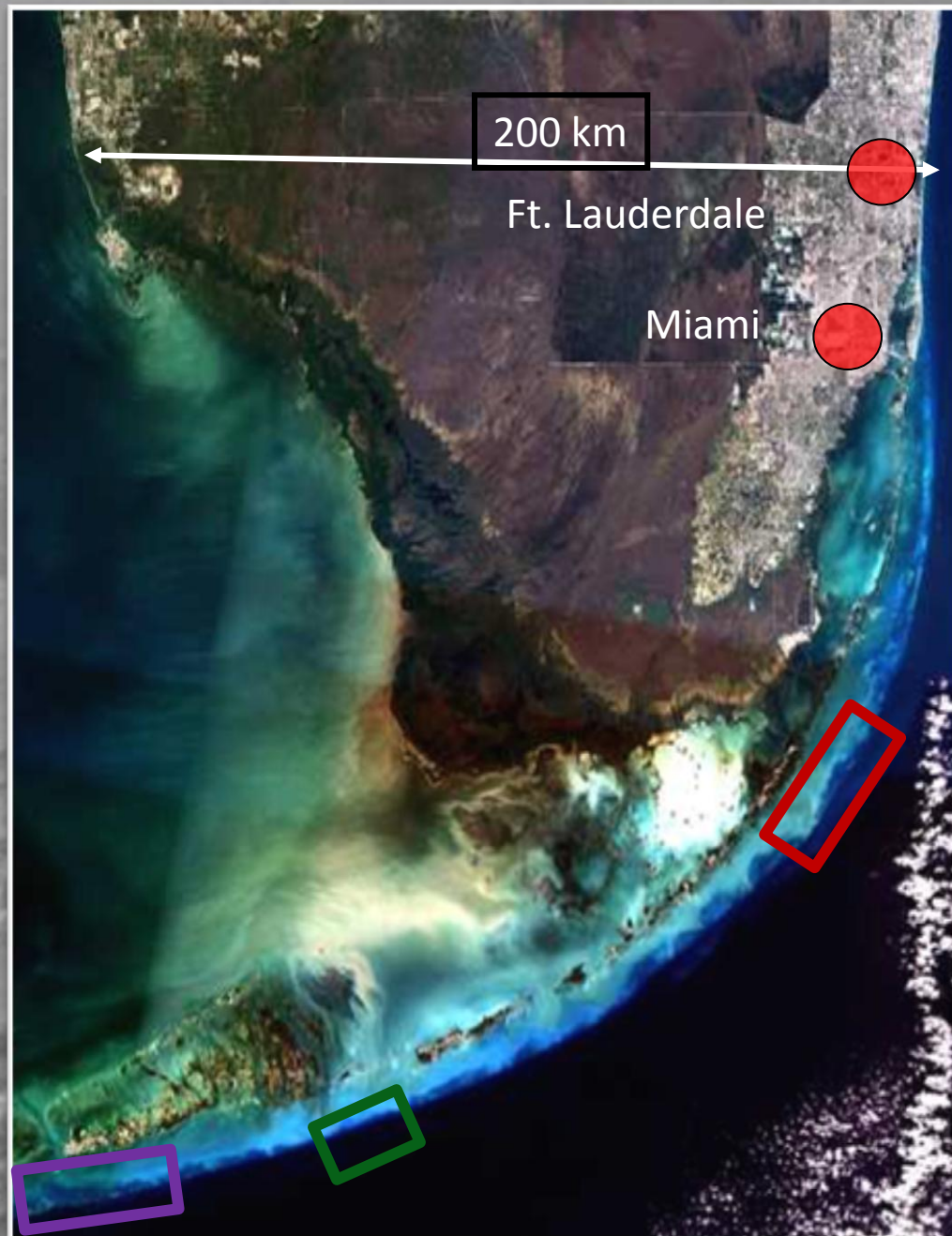
- Initiated in 2007
- FSA sites previously “fished out”

- **Lower Keys**

- Initiated in 2009
- Status of FSA sites unknown

- **Middle Keys**

- Initiated in 2011
- Mapping currently in progress

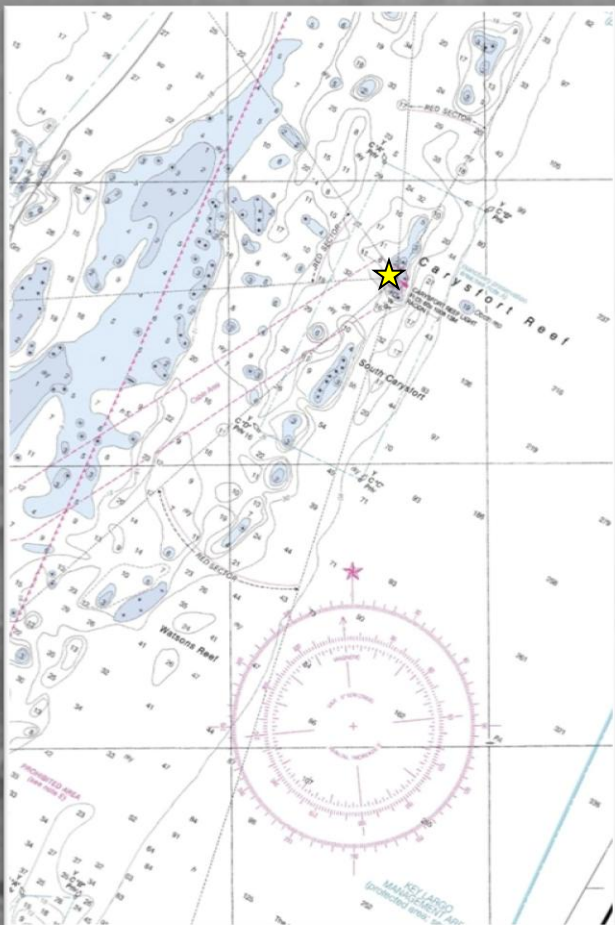




# Best available bathymetry

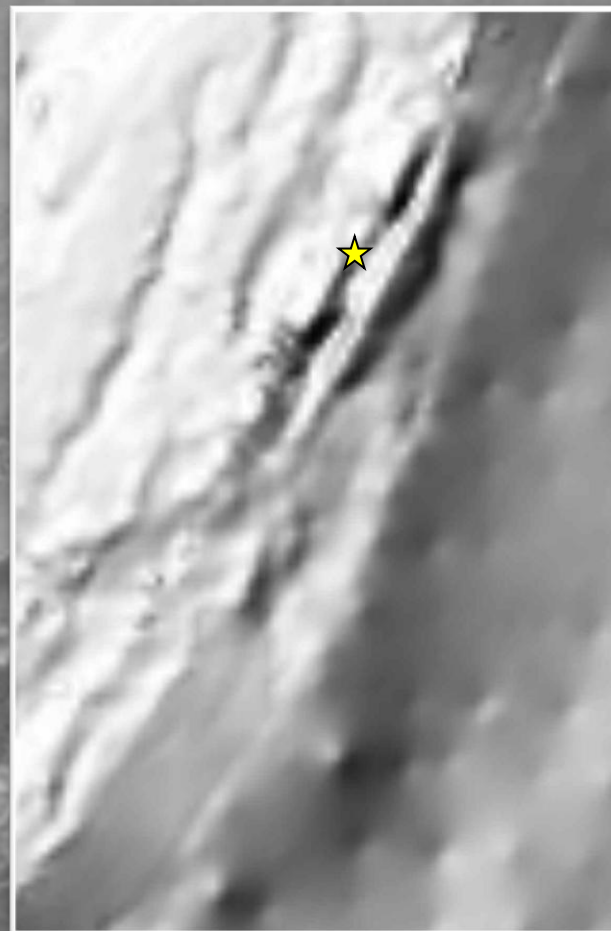
## NOAA Chart 11463

- Contours only



## NGDC gridded bathymetry

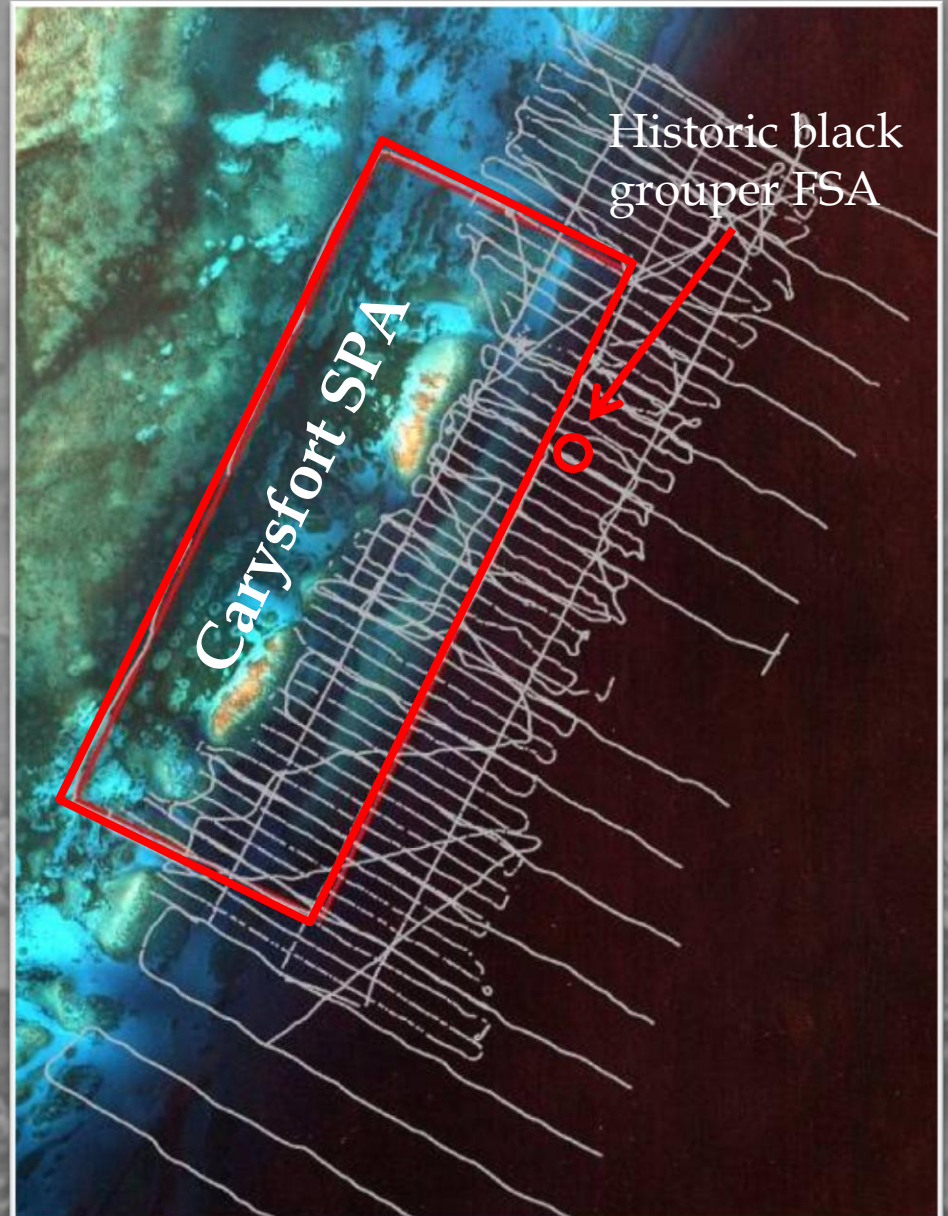
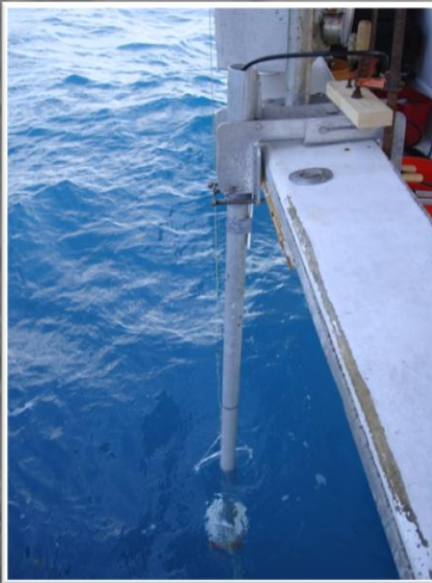
- Digital, 90m resolution



★ = Carysfort  
Lighthouse

# Examining locations

- Utilized both single and split beam transducers mounted to the boat
- GPS tracked position and noted specific sites of interest



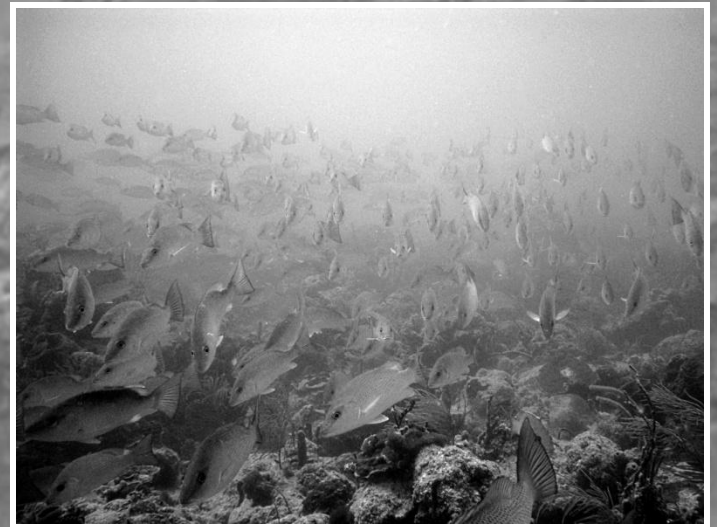
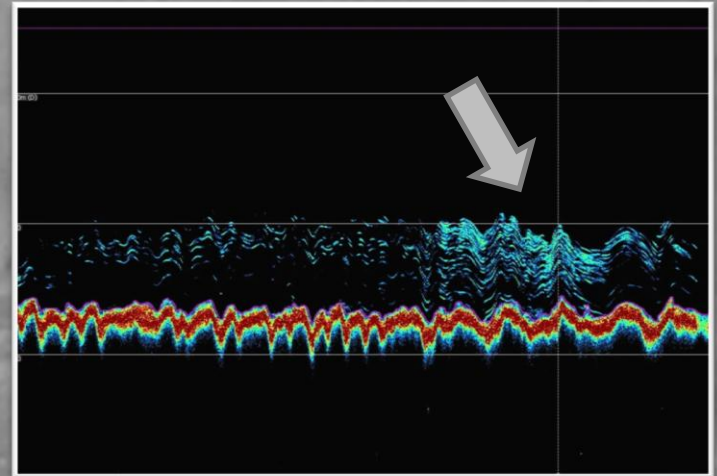


# How to determine a “site of interest”

Return to mapped site during predicted spawning moons

Use splitbeam transducer to closely examine known aggregation area

If large amount of biomass is displayed on monitor, send in divers.

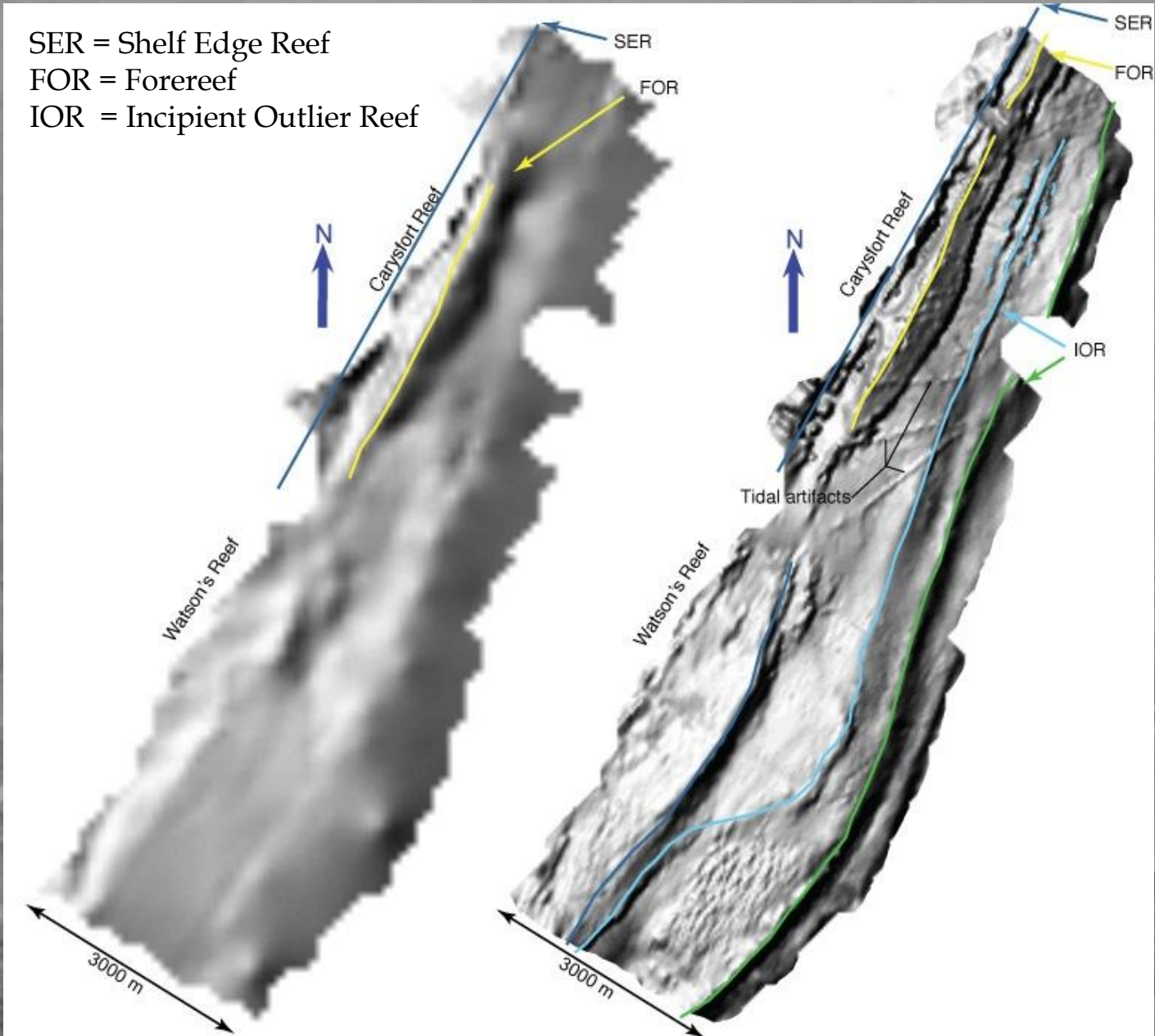


An underwater photograph showing a large school of fish swimming over a coral reef. The fish are densely packed in some areas, particularly around the coral structures. The water is clear, and the lighting is natural, highlighting the textures of the coral and the scales of the fish. The overall scene is a vibrant representation of a healthy marine ecosystem.

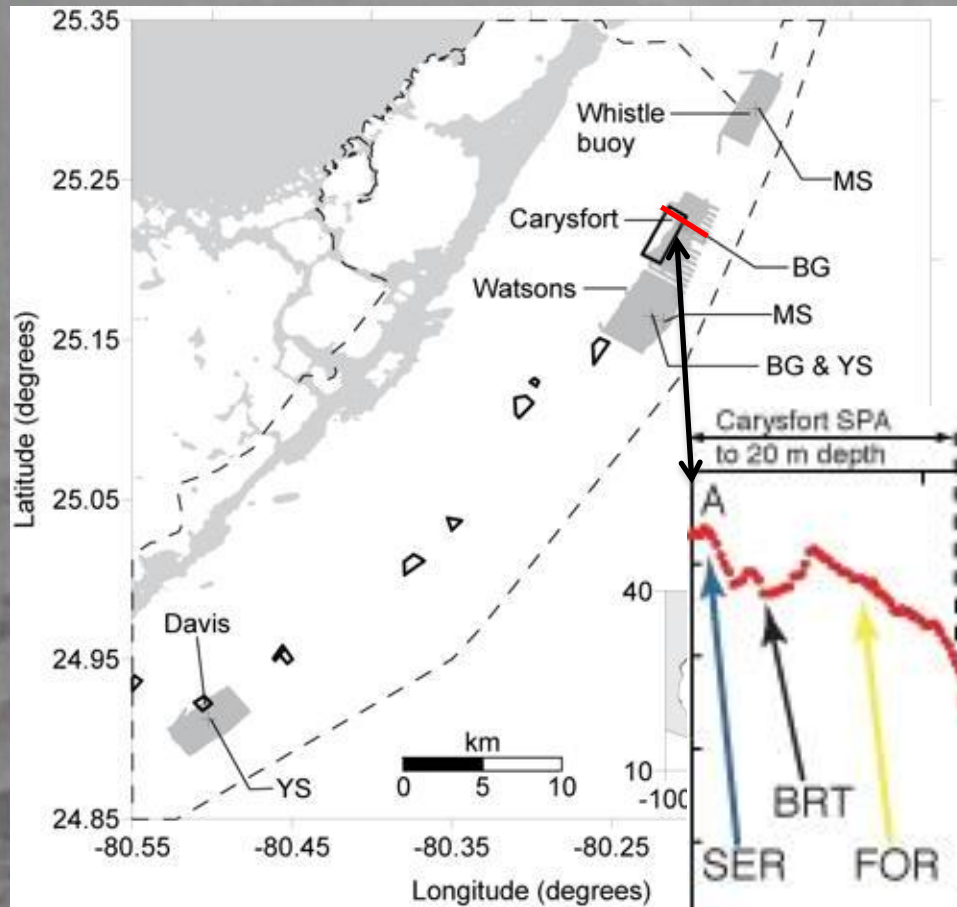
**Preliminary Results from  
Acoustic Mapping**



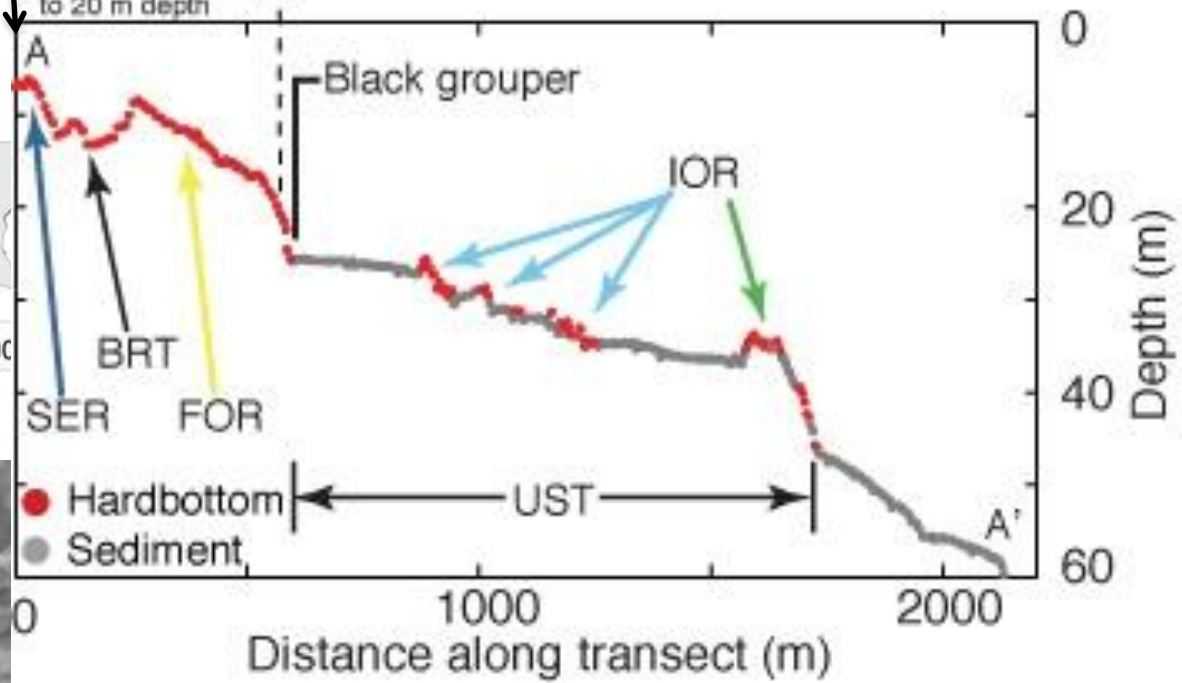
# NGDC bathymetry (left) vs. QTCV bathymetry (right)



# Looking for special geographic features



SER = Shelf Edge Reef  
BRT = Back Reef Trough  
FOR = Forereef  
IOR = Incipient Outlier Reef  
UST = Upper Slope Terrace



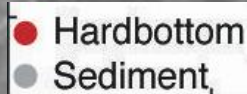
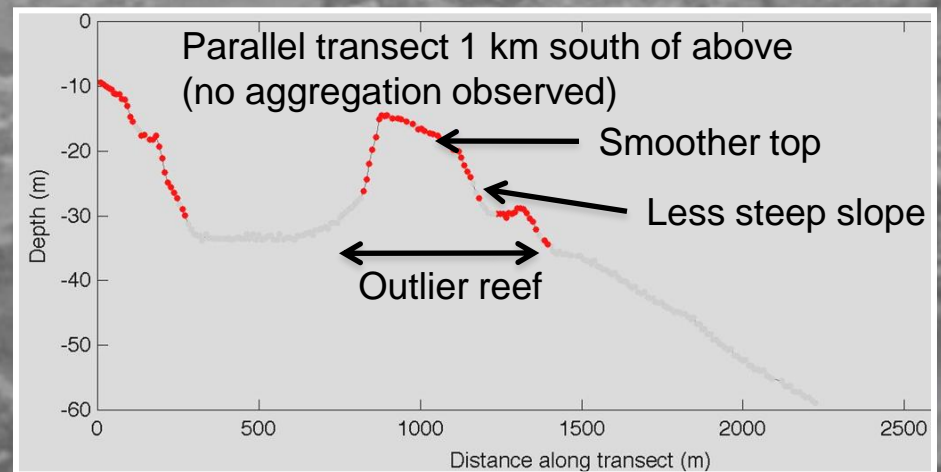
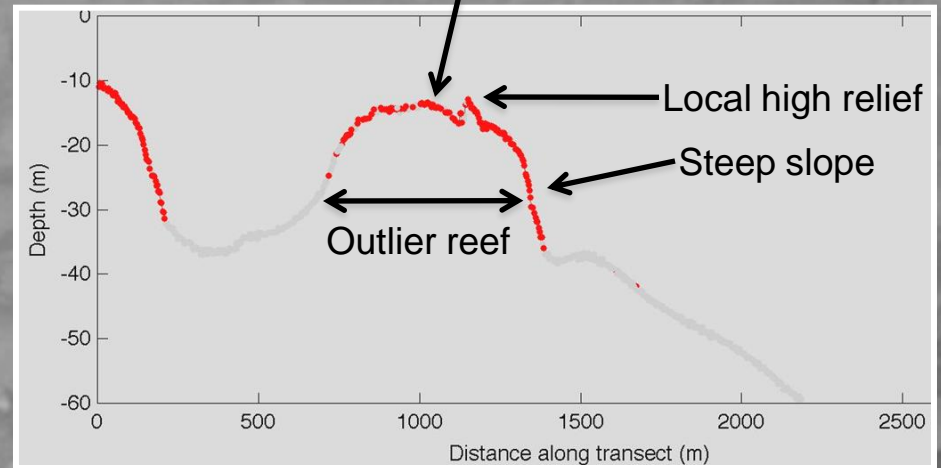


# Preliminary Results in Lower Keys

## Western Dry Rocks grey snapper aggregation

### Lower Keys

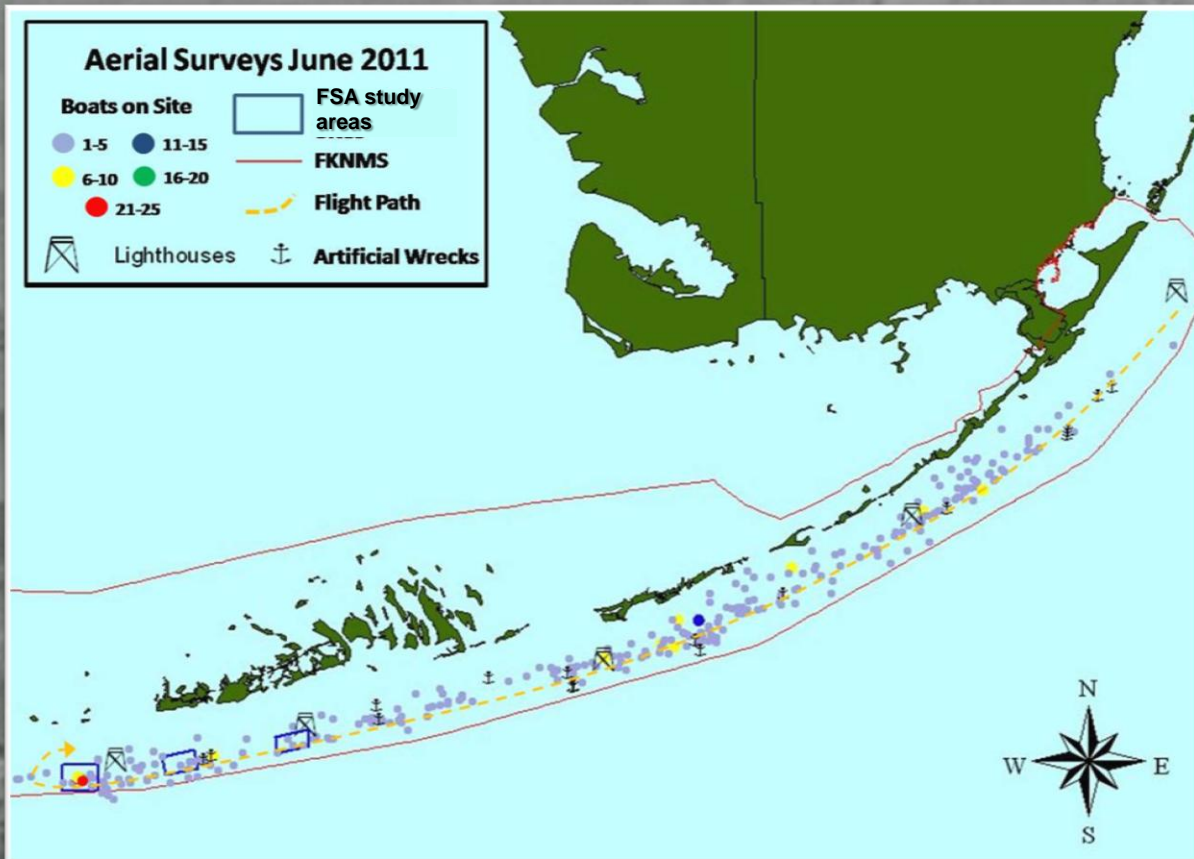
- Aggregations found near steep slopes and locally high rugosity on outlier reefs



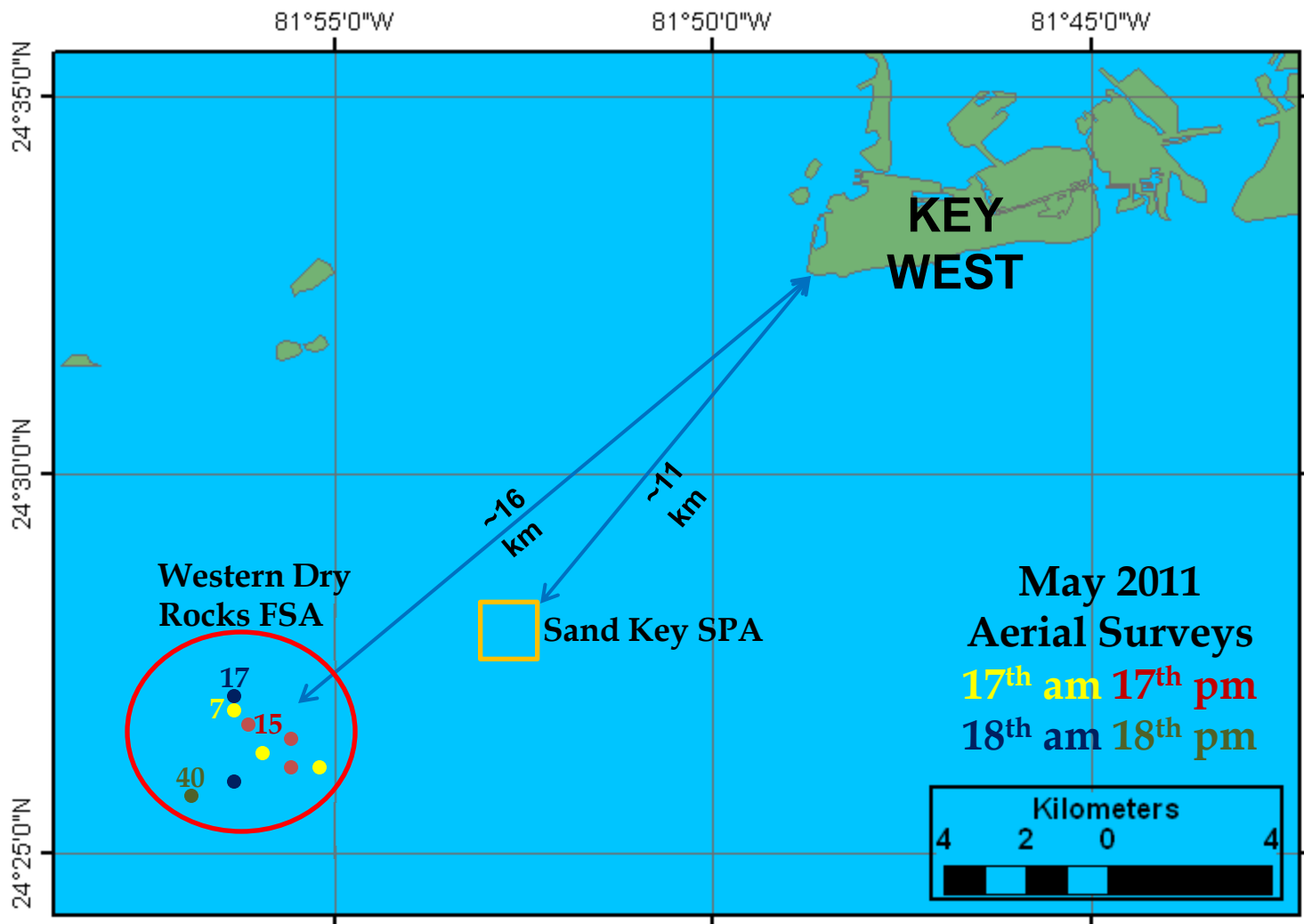
# Aerial Surveys

## Objectives:

- Examine boating pressure on known sites
- Used to identify potential FSAs







81°55'0"W

81°50'0"W

81°45'0"W

24°35'0"N

24°30'0"N

24°25'0"N

**KEY WEST**

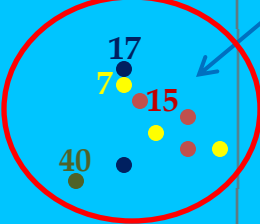
~16 km

~11 km

**Western Dry Rocks FSA**

**Sand Key SPA**

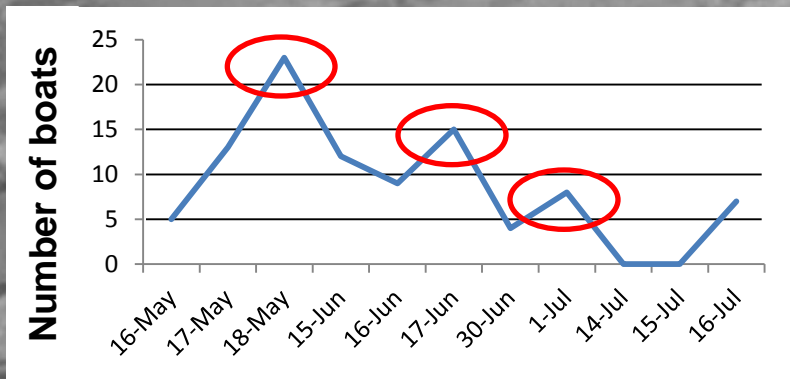
**May 2011  
Aerial Surveys**  
17<sup>th</sup> am 17<sup>th</sup> pm  
18<sup>th</sup> am 18<sup>th</sup> pm



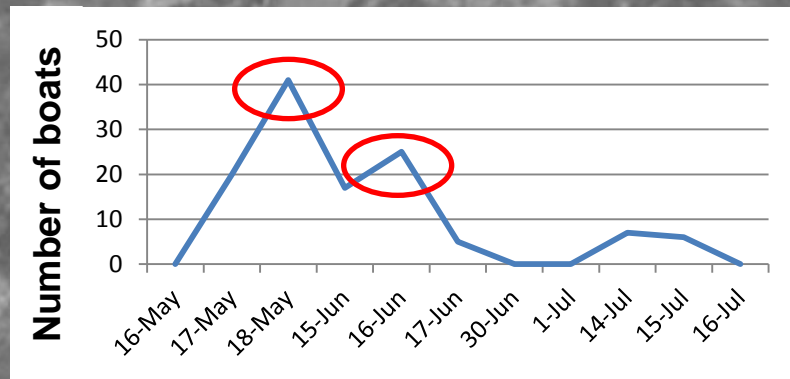
# Aerial Surveys Recording Boating Pressure



## Morning Flights



## Afternoon Flights





# What we will provide to the management process

- Acoustic Tagging:
  - A better understanding of how commercially and recreationally important species utilize no take areas
- Acoustic Mapping:
  - Provide a better understanding of FSAs throughout Keys proper by providing accurate benthic maps and assessing biomass and utilization of these sites



# Thank you photo montage

These projects were executed with the cooperation of many agencies and individuals: John Hunt, Paul Barbera, Ben Binder, Rod Bertelsen, Michelle Dancy, Marie Tellier, Ali Johnson, Erick Ebert, Ori Tzadik, Dave Eaken, Don DeMaria, Sarah Walters, Angela Collins, Jack Javech, Mike Burton, Jim Locascio, Jamie Giganti, Jeff Simonds, Elizabeth Overstreet, the Spree Crew, the Dry Tortugas Park staff, the University of Puerto Rico, the crew of the "Peter Gladding", The Florida Keys National Marine Sanctuary, Bahama Star Air and many, many more...

