

How can you use the spatial information for the Middle Keys?

-natural resources-

- NOAA – Florida Keys National Marine Sanctuary
- Florida Fish and Wildlife Commission
- NOAA – National Centers for Coastal Ocean Science



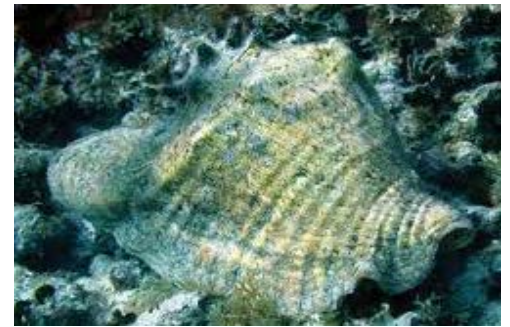


Where are locations of ‘special places’?

Natural Resource Info

Metrics

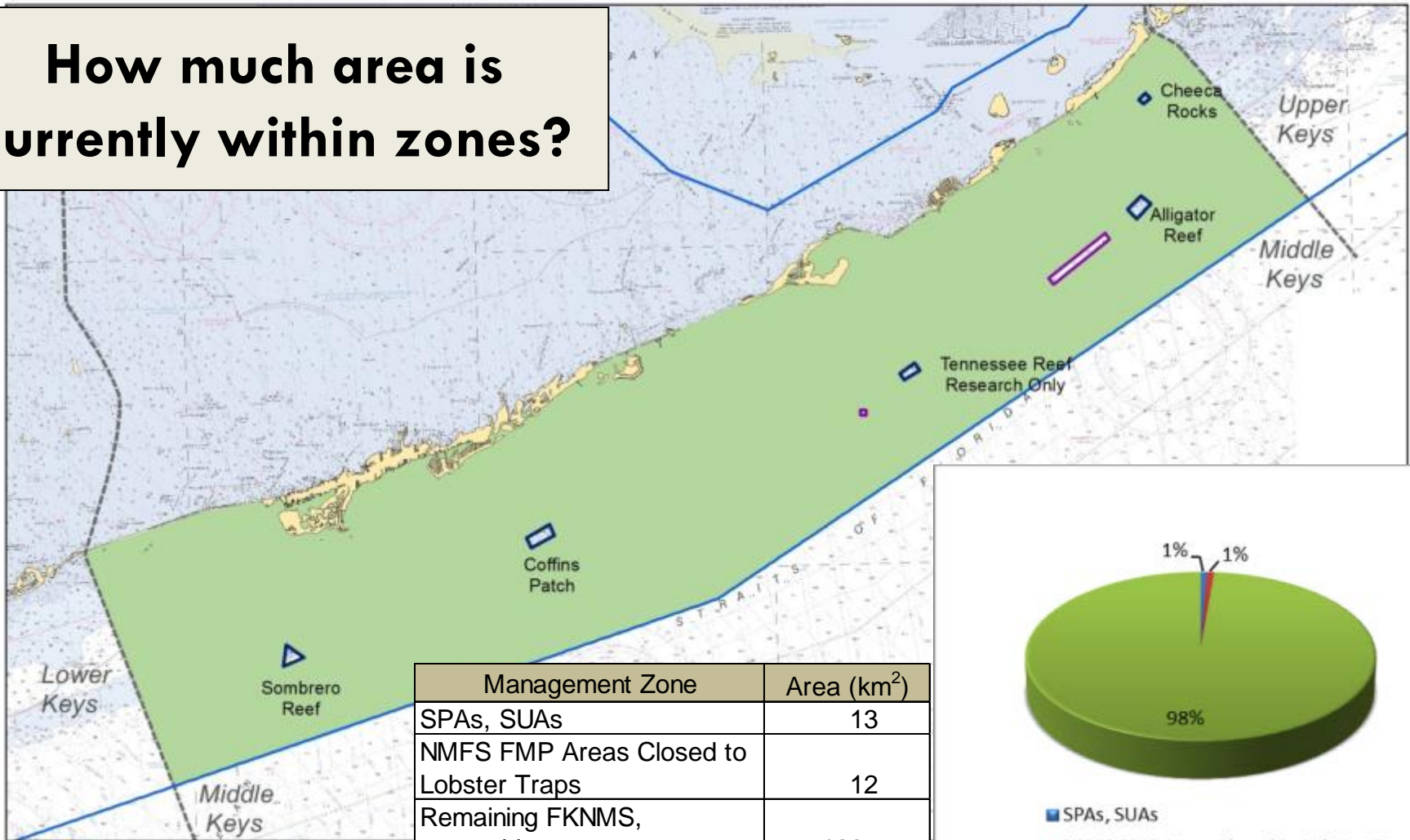
- Habitat
 - Habitat types
 - Patch & linear reef
 - High relief reefs
 - Turtle grass density
- Coral
 - Stony coral
 - Soft coral
 - Resilient reefs
- Fish
 - Reef fish surveys
 - Fish aggregations
- Fauna
 - Conch aggregations



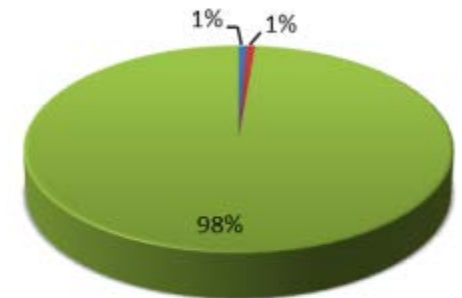
Management Zones




-  FKNMS Boundary
-  SPAs, SUAs
-  NMFS FMP Areas Closed to Lobster Trap Gear

How much area is currently within zones?



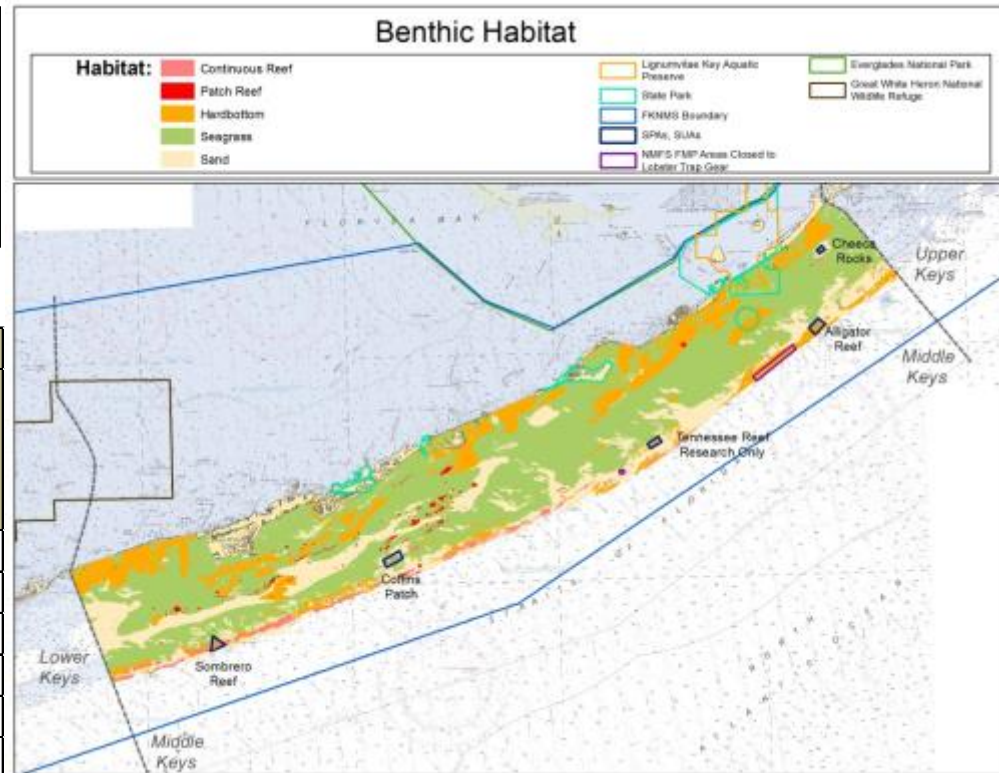
Management Zone	Area (km ²)
SPAs, SUAs	13
NMFS FMP Areas Closed to Lobster Traps	12
Remaining FKNMS, oceanside	1295
Resource Total	1320



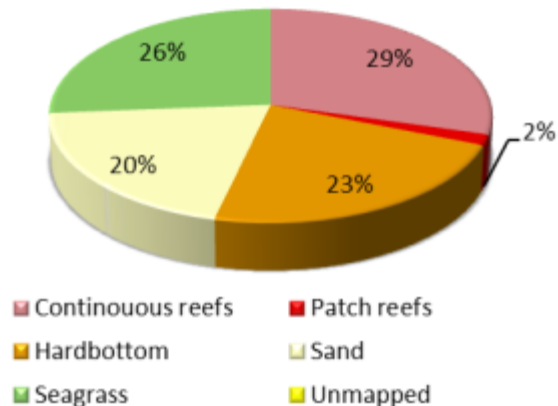
-  SPAs, SUAs
-  NMFS FMP Areas Closed to Lobster Traps
-  Remaining FKNMS, oceanside

How are habitats distributed?

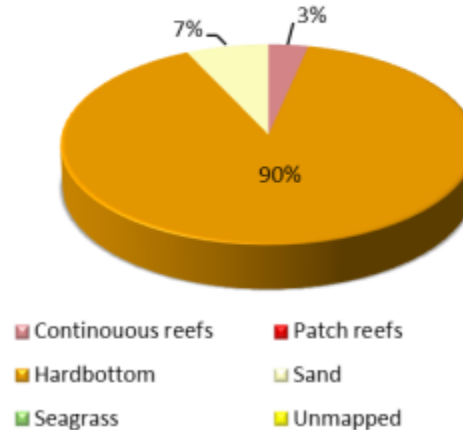
Habitats	Area (Km ²)		
	SPAs, SUAs	NMFS FMP Areas Closed to Lobster Traps	Remaining FKNMS, oceanside
Continuous reefs	0.9	0.1	10
Patch reefs	0.1	0.0	4
Hardbottom	0.7	1.7	107
Sand	0.6	0.1	125
Seagrass	0.8	0.0	364
Unmapped	0.0	0.0	20



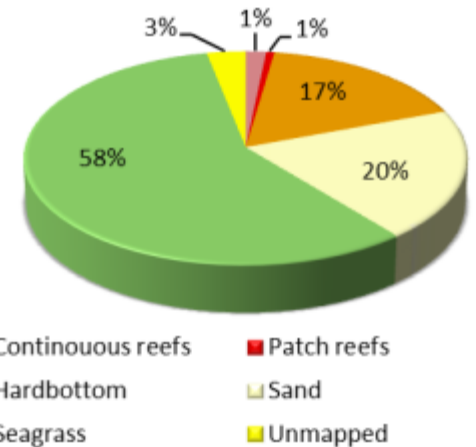
SPAs, SUAs



NMFS FMP Areas Closed to Lobster Traps



Remaining FKNMS, oceanside



High relief reefs

Data source

- NMFS diver surveys

Metric

- High relief reef

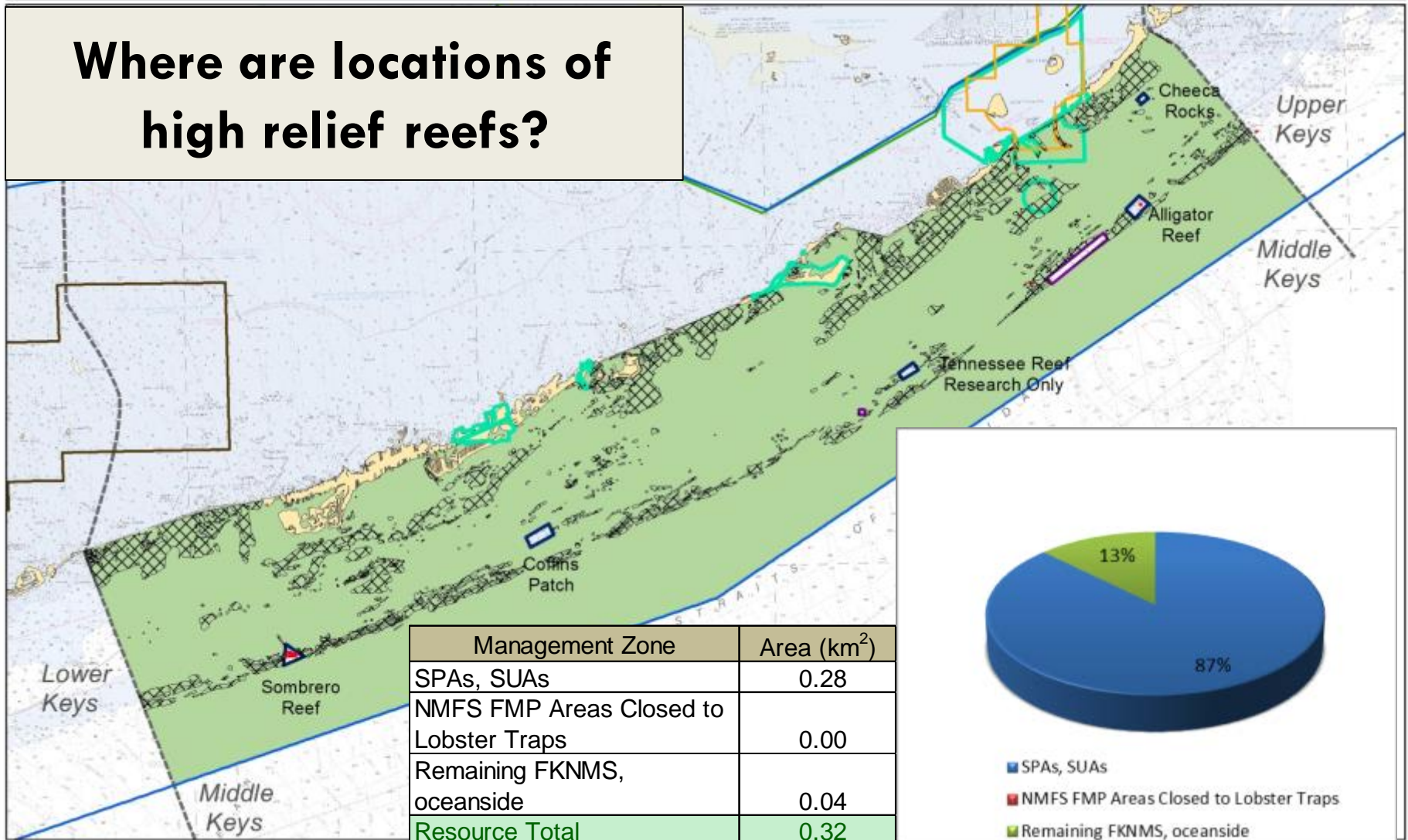


High Structural Relief

- High Structural Relief
- Coral Reef and Hardbottom

- Lignumvitae Key Aquatic Preserve
- State Park
- FKNMS Boundary
- SPAs, SUAs
- NMFS FMP Areas Closed to Lobster Trap Gear
- Everglades National Park
- Great White Heron National Wildlife Refuge
- Middle Keys, Ocean Side

Where are locations of high relief reefs?



Resilient Reefs

Data source

R. Van Woesik analysis of Florida Reef Resilience Program coral surveys, 2005-2010

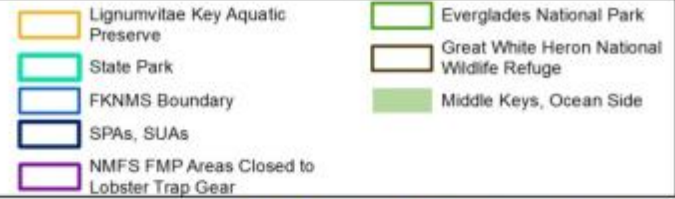
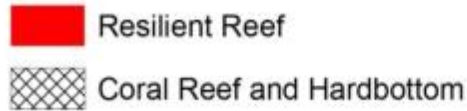
Study Methods

Data selected for high coral colony density, relatively low observations of disease and bleaching

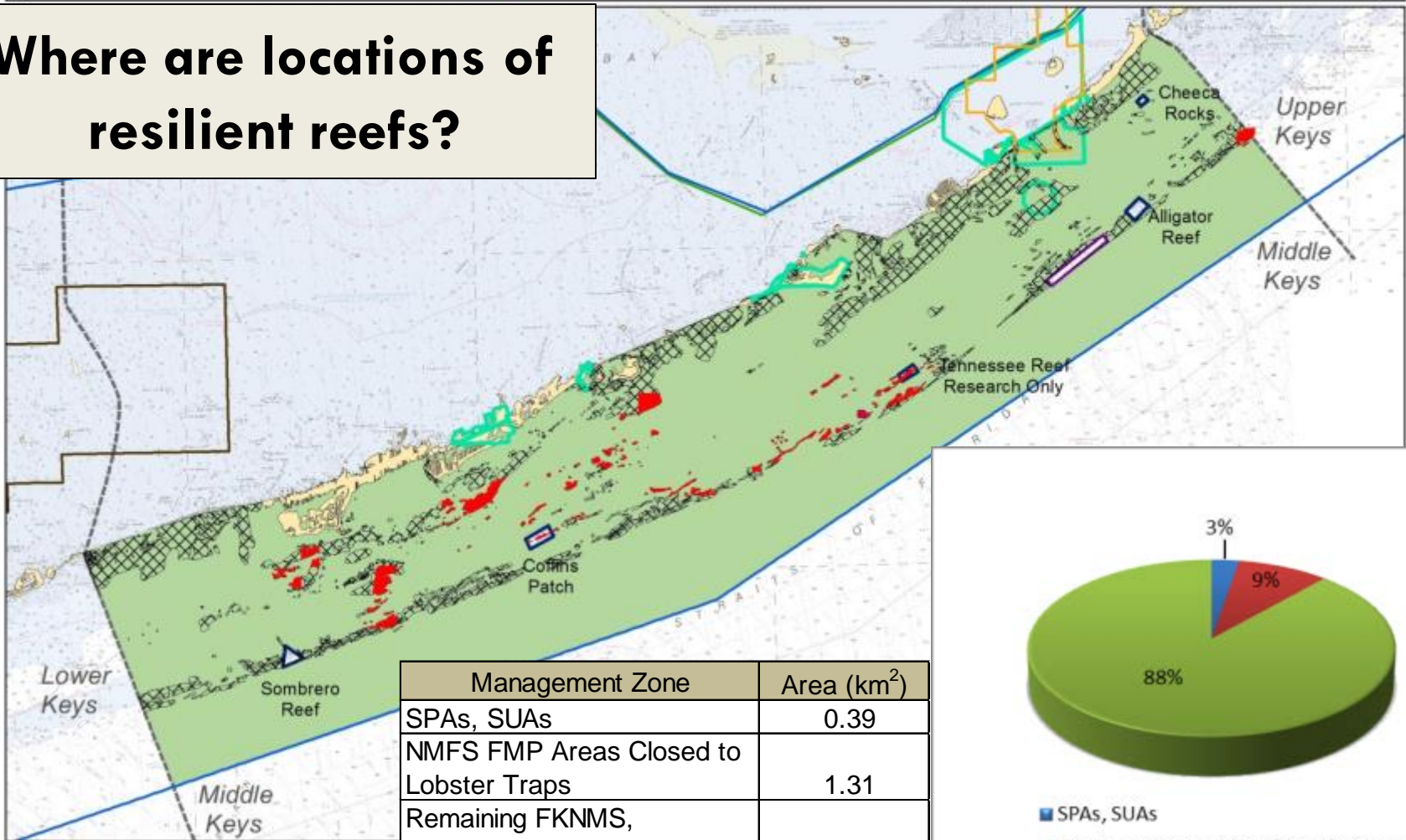
Metrics

- Resilient reefs

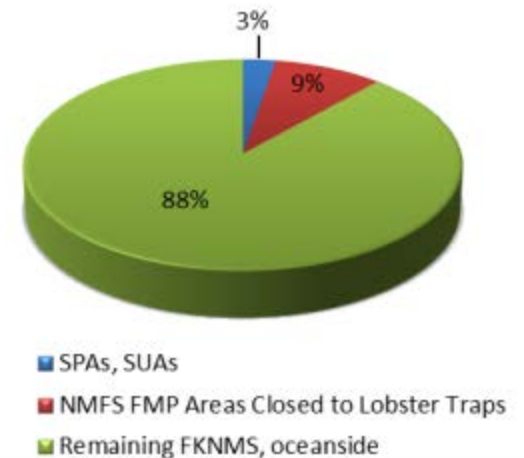
Resilient Reef



Where are locations of resilient reefs?



Management Zone	Area (km ²)
SPAs, SUAs	0.39
NMFS FMP Areas Closed to Lobster Traps	1.31
Remaining FKNMS, oceanside	13.01
Resource Total	14.71



Fish Spawning Aggregations

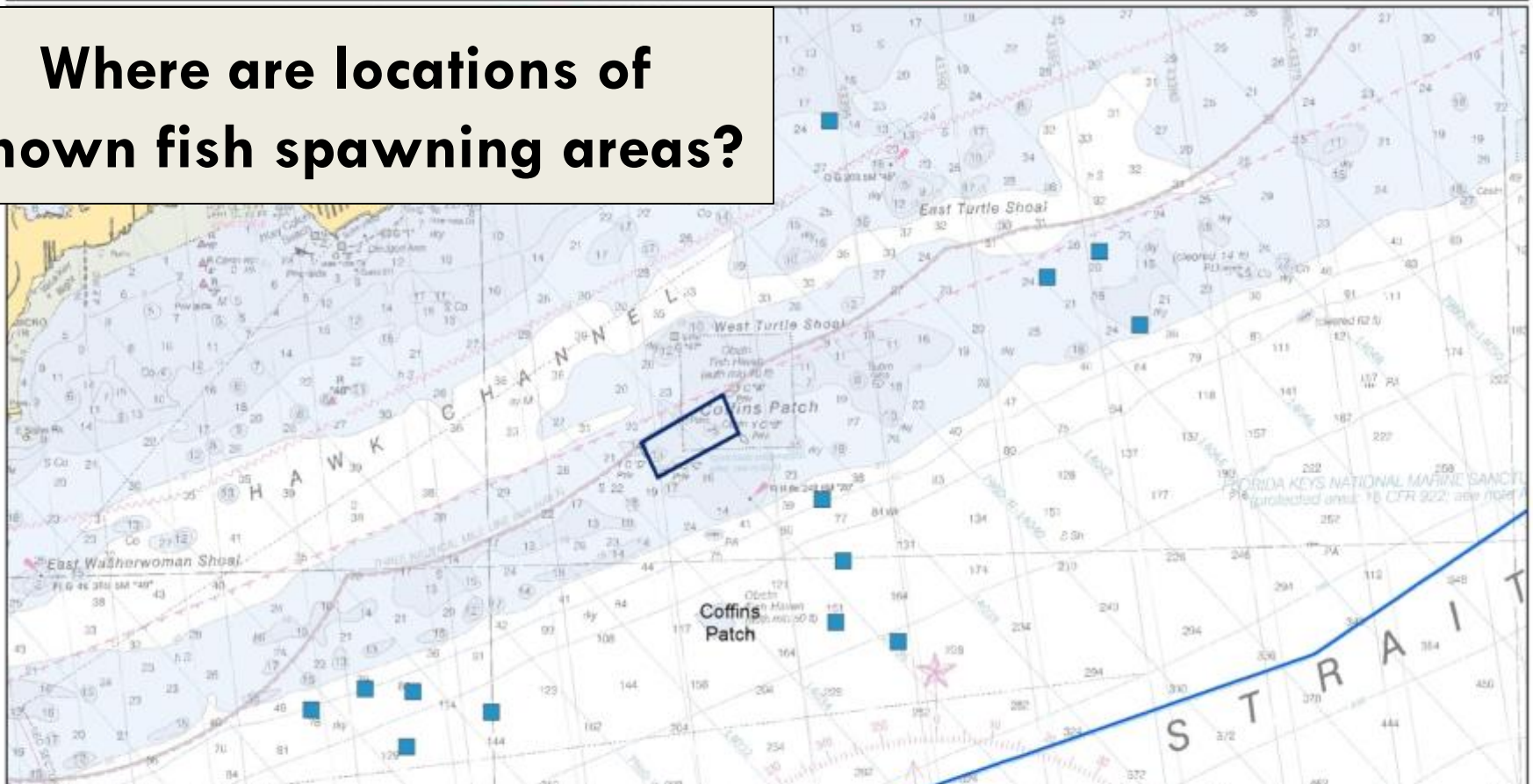
Single Species

■ Reported

■ Lignumvitae Key Aquatic Preserve
■ State Park
■ FKNMS Boundary
■ SPAs, SUAs
■ NMFS FMP Areas Closed to Lobster Trap Gear

■ Everglades National Park
■ Great White Heron National Wildlife Refuge

Where are locations of known fish spawning areas?



*All locations shown here are suggestions from fishers. Fish species are potentially gray snapper. Locations and species have not been confirmed by researchers. Research effort on aggregations in the middle Keys region have been very limited to date.



Coral current and candidate ESA species

Data sources

- Sanctuary Coral Reef Ecosystem Assessment & Monitoring (SCREAM), Nova Southeastern University
- Florida Reef Resilience Program (FRRP)
- Coral Reef Ecosystem Monitoring Program (CREMP), FWC
- NOAA NMFS Protected Resources & FWC ESA monitoring

Species

- ESA Threatened: elkhorn (*Acropora palmata*), staghorn (*Acropora cervicornis*)
- State of FL Threatened: pillar (*Dendrogyra cylindrus*)
- Candidate ESA Endangered: elkhorn, staghorn, pillar, boulder star (*Montastraea annularis*), mountainous star (*M. faveolata*), star (*M. franksii*)
- Candidate ESA Threatened: sheet coral (*Agaricia lamarcki*), elliptical star coral (*Dichocoenia stokesii*)

Metrics

- presence

What proportions of sites with ESA coral species are present in current zones?



Threatened Coral Species

staghorn

+ present

pillar

▲ present

elkhorn

○ present

Benthic Habitat Map

Patch Reefs

Linear Reef

Hard Bottom

Seagrass

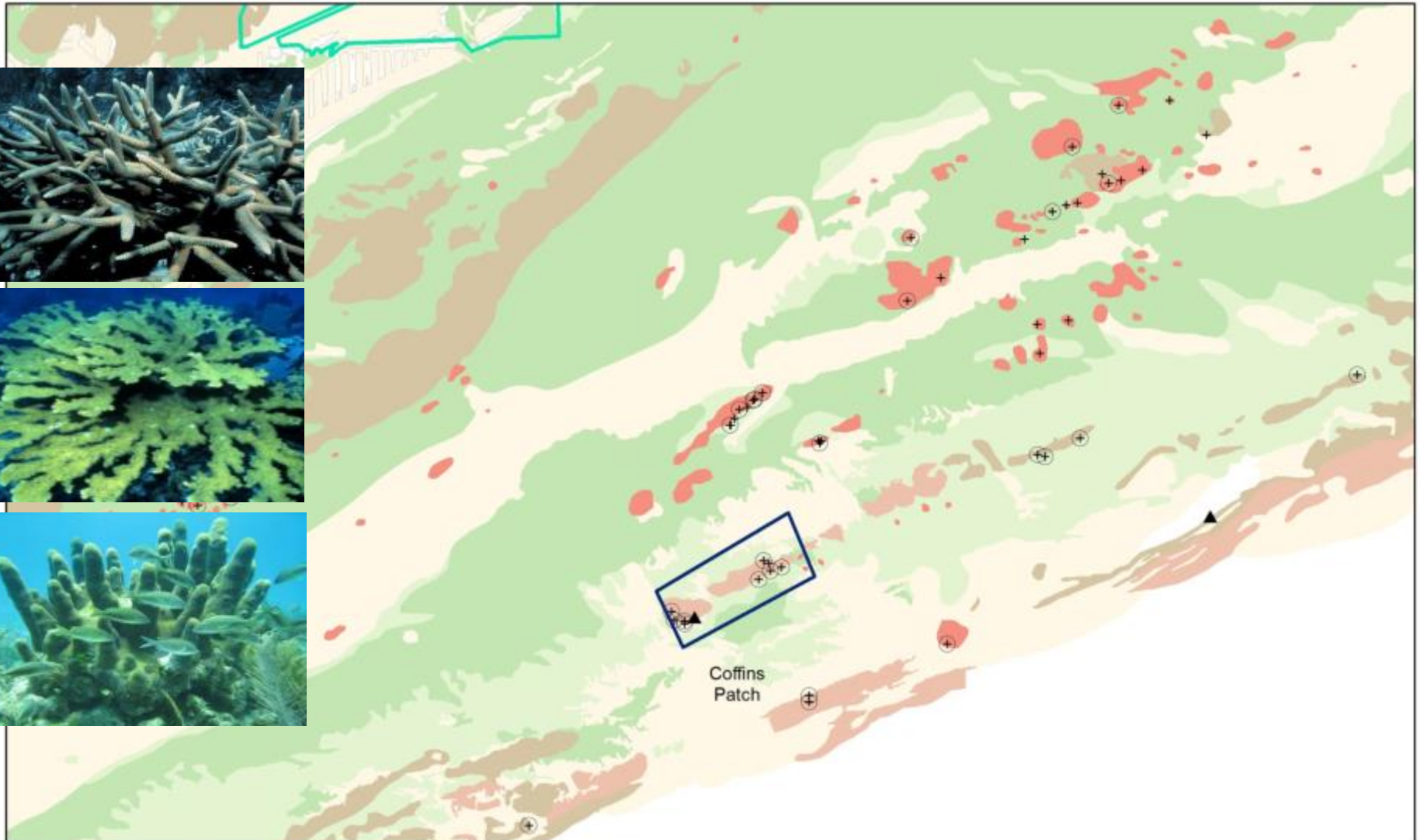
Seagrass

Sand

State Park

FKNMS Boundary

SPAs, SUAs



What proportion of sites with Threatened Staghorn corals are present in current zones?



Greatest colony densities and sizes in mid-channel & offshore patch reefs.
Source: <http://floridakeys.noaa.gov/scisummaries/elkhornstaghorn2013.pdf>

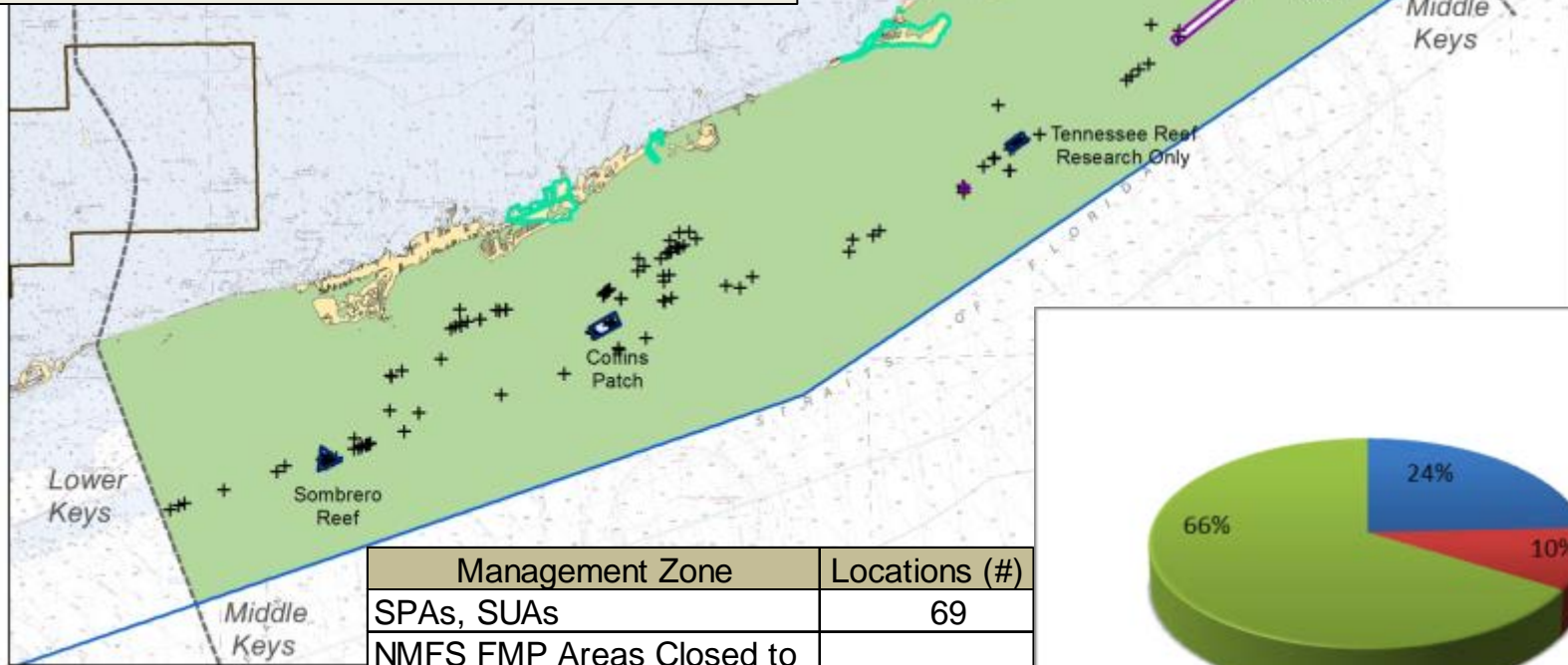
Staghorn Coral Presence

staghorn

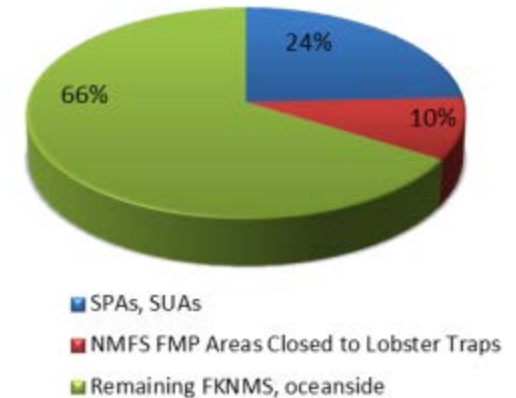
+ present

- Lignumvitae Key Aquatic Preserve
- State Park
- FKNMS Boundary
- SPAs, SUAs
- NMFS FMP Areas Closed to Lobster Trap Gear
- Everglades National Park
- Great White Heron National Wildlife Refuge
- Middle Keys, Ocean Side

What proportion of sites with Threatened Staghorn corals are present in current zones?



Management Zone	Locations (#)
SPAs, SUAs	69
NMFS FMP Areas Closed to Lobster Traps	27
Remaining FKNMS, oceanside	188
Resource Total	284



What proportion of sites with Threatened Elkhorn corals are present in current zones?



Photo credit: FWC

In 2012, nearly 80% of colonies were found in high-relief spur & groove reefs and offshore patch reefs. Coral density, size and occurrence were higher inside SPAs.

Source: <http://floridakeys.noaa.gov/scisummaries/elkhornstaghorn2013.pdf>

Elkhorn Coral Presence

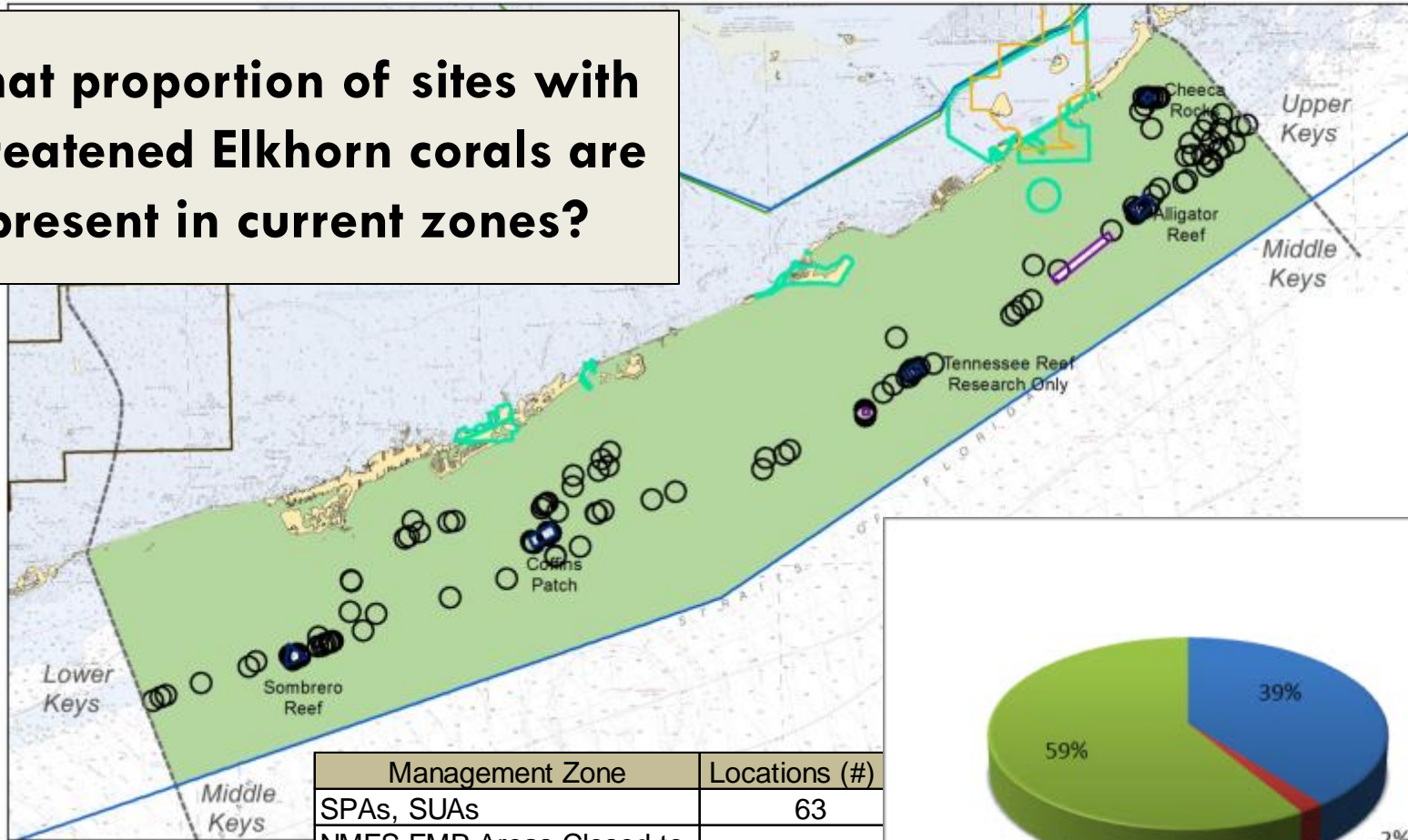
elkhorn

○ present

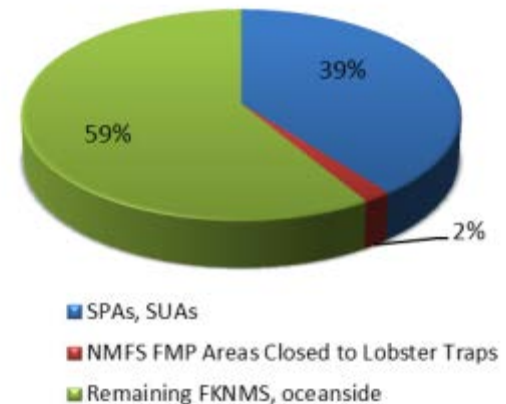
- Lignumvitae Key Aquatic Preserve
- State Park
- FKNMS Boundary
- SPAs, SUAs
- NMFS FMP Areas Closed to Lobster Trap Gear

- Everglades National Park
- Great White Heron National Wildlife Refuge
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What proportion of sites with Threatened Elkhorn corals are present in current zones?



Management Zone	Locations (#)
SPAs, SUAs	63
NMFS FMP Areas Closed to Lobster Traps	3
Remaining FKNMS, oceanside	94
Resource Total	160



What proportion of sites with Threatened Pillar corals are present in current zones?



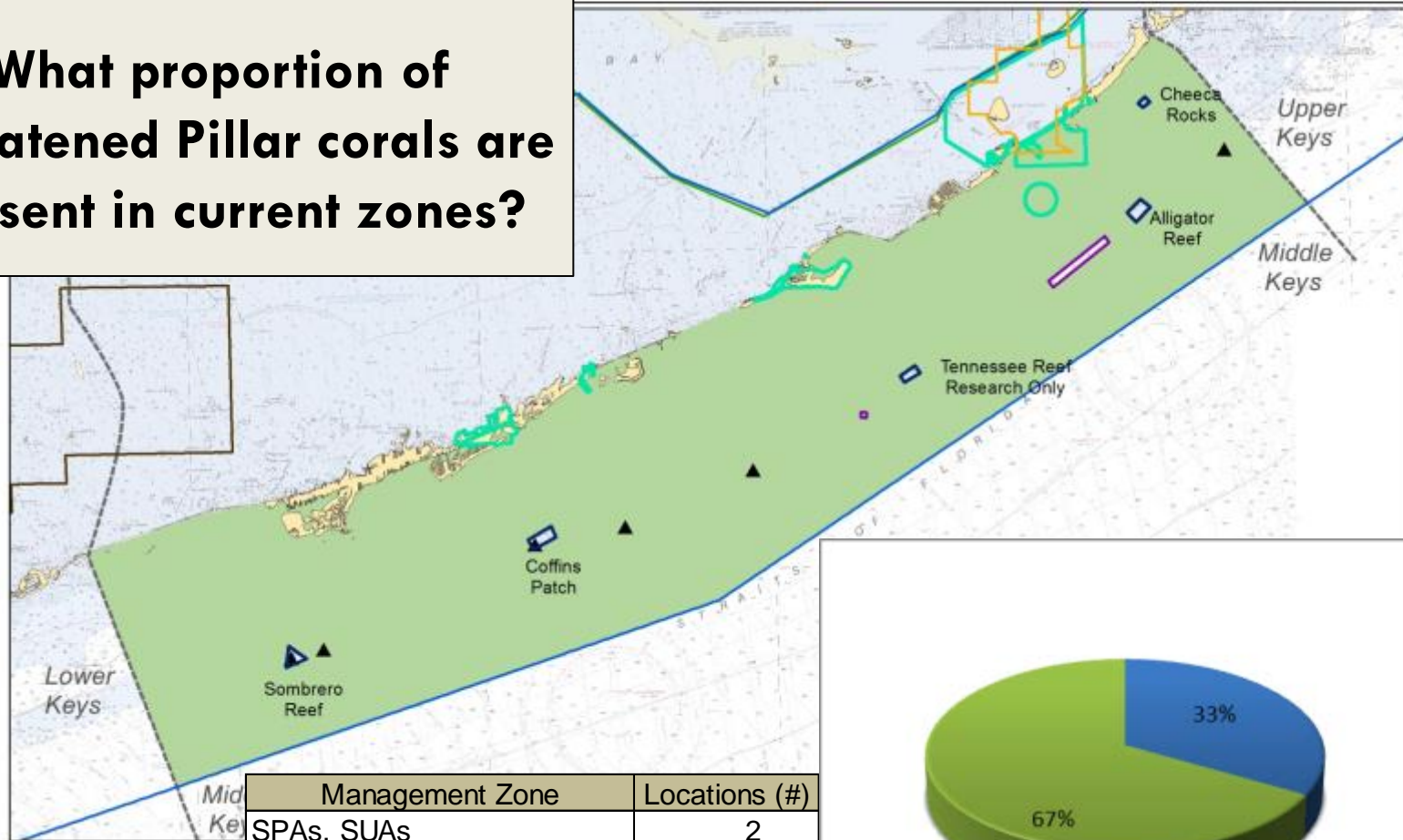
Threatened status – State of FL; ESA candidate Endangered species
81 known sites with pillar coral present in the Florida Coral Reef Tract.
6 known locations are in the middle Keys region.

Pillar Coral Presence

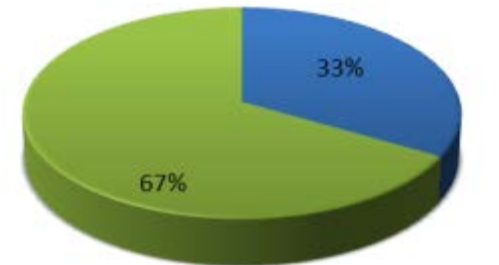
▲ Pillar Coral

- Lignumvitae Key Aquatic Preserve
- State Park
- FKNMS Boundary
- SPAs, SUAs
- NMFS FMP Areas Closed to Lobster Trap Gear
- Everglades National Park
- Great White Heron National Wildlife Refuge
- Middle Keys, Ocean Side

What proportion of Threatened Pillar corals are present in current zones?



Management Zone	Locations (#)
SPAs, SUAs	2
NMFS FMP Areas Closed to Lobster Traps	0
Remaining FKNMS, oceanside	4
Resource Total	6



- SPAs, SUAs
- NMFS FMP Areas Closed to Lobster Traps
- Remaining FKNMS, oceanside

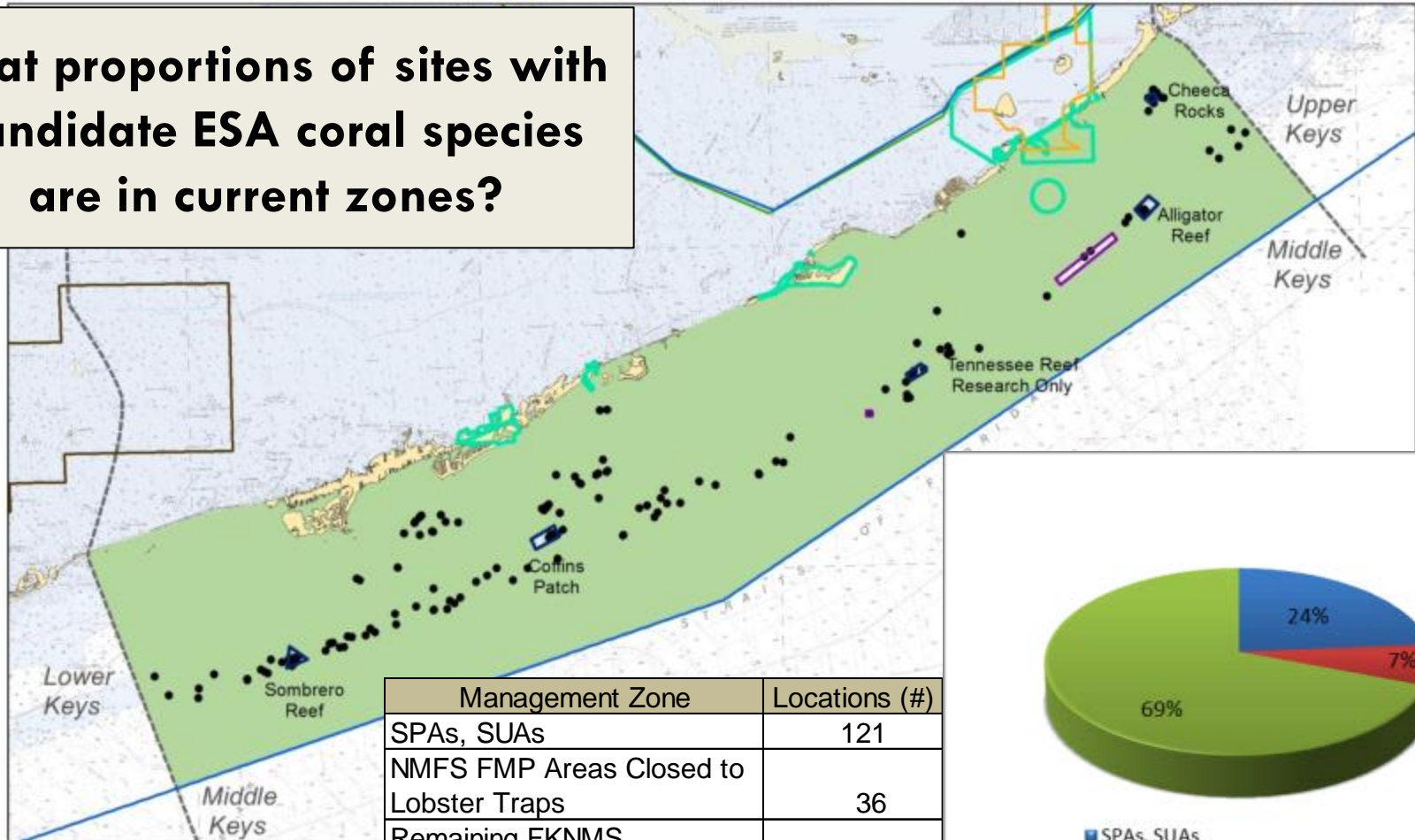
Candidate Coral Presence

Candidate Coral

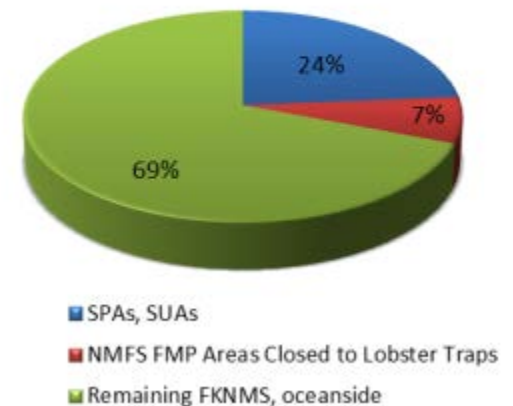
- Present



What proportions of sites with Candidate ESA coral species are in current zones?



Management Zone	Locations (#)
SPAs, SUAs	121
NMFS FMP Areas Closed to Lobster Traps	36
Remaining FKNMS, oceanside	353
Resource Total	510



Other ecosystem metrics

- Fish abundance
- Fish species richness
- Stony Coral cover
- Stony Coral species richness
- Soft Coral cover
- Soft Coral species richness



How can we tell what areas are good?

Rank survey site relative other sites
in middle Keys

High

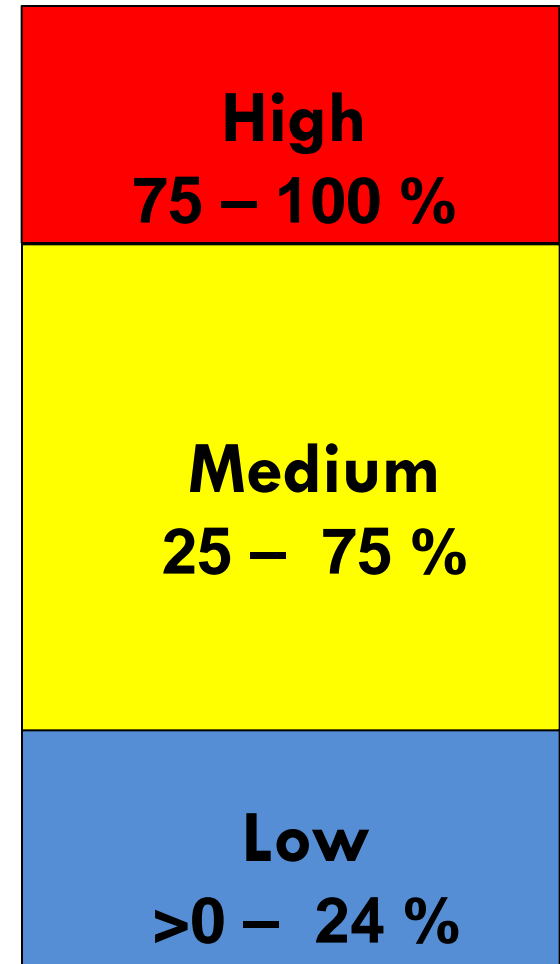
Medium

Low

Top 25%

Middle

Bottom 25%





Reef fish visual census

Data sources

NOAA NMFS and partners including University of Miami, FWC, etc

Study Methods

Diver-based stationary surveys on hardbottom reef

Metrics

- **Fish abundance**
- **Fish species richness**
- Grouper-snapper complex abundance
- Nassau-Goliath grouper abundance
- Marine life fishery fish species abundance
- Top 10 marine life fishery fish species abundance
- Parrotfish abundance
- Barracuda abundance
- Permit abundance

Fish Metrics

- **Fish abundance:** How many fish?
- **Fish species richness:** How many species of fish?



Photo credit: FWC



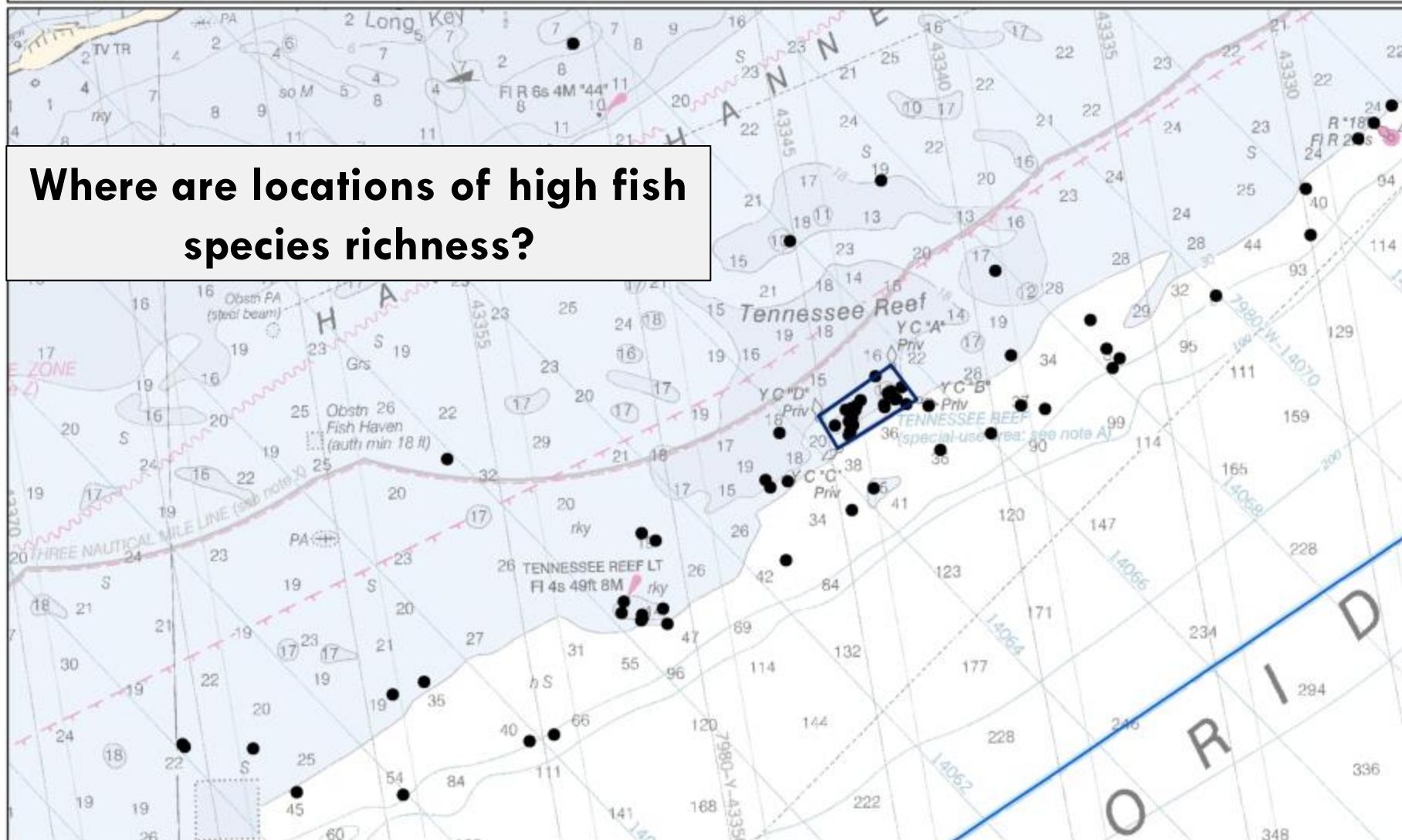
Photo credit: NOAA

Fish Species Richness

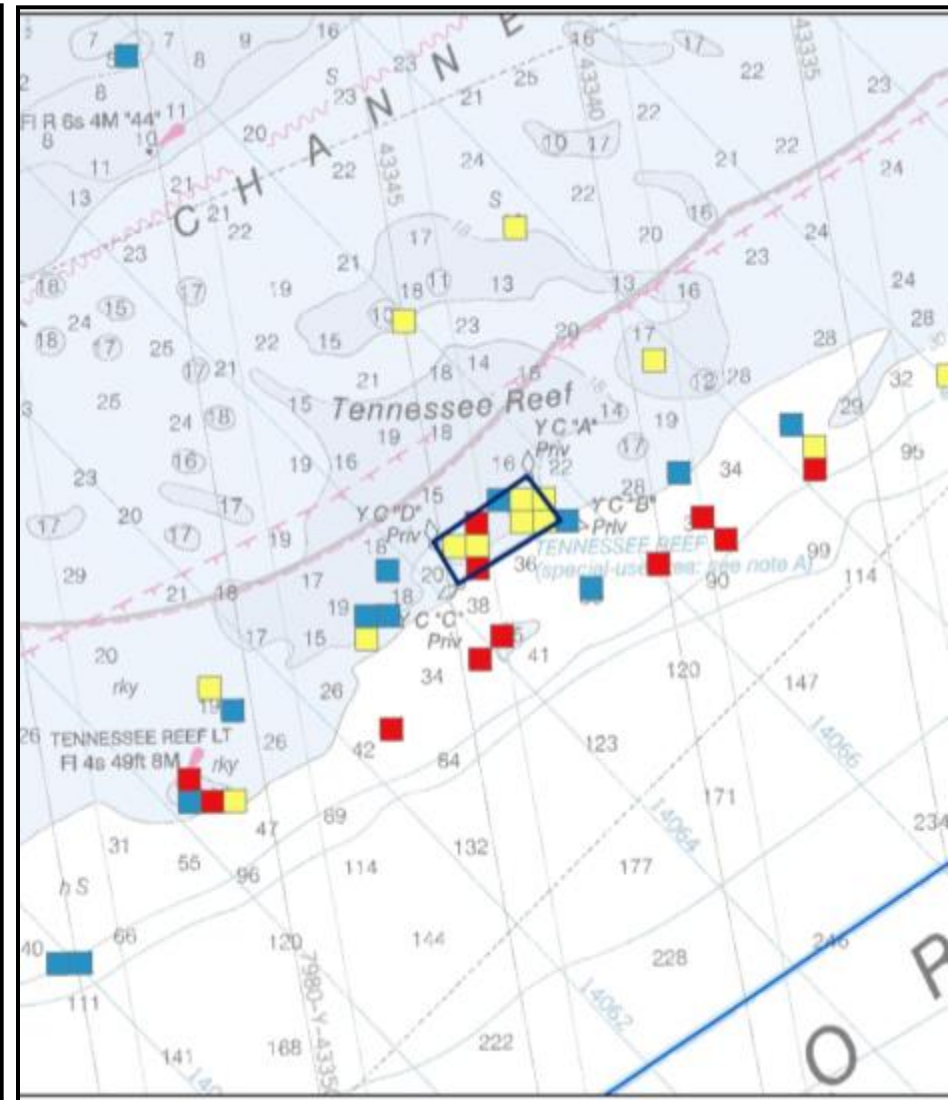
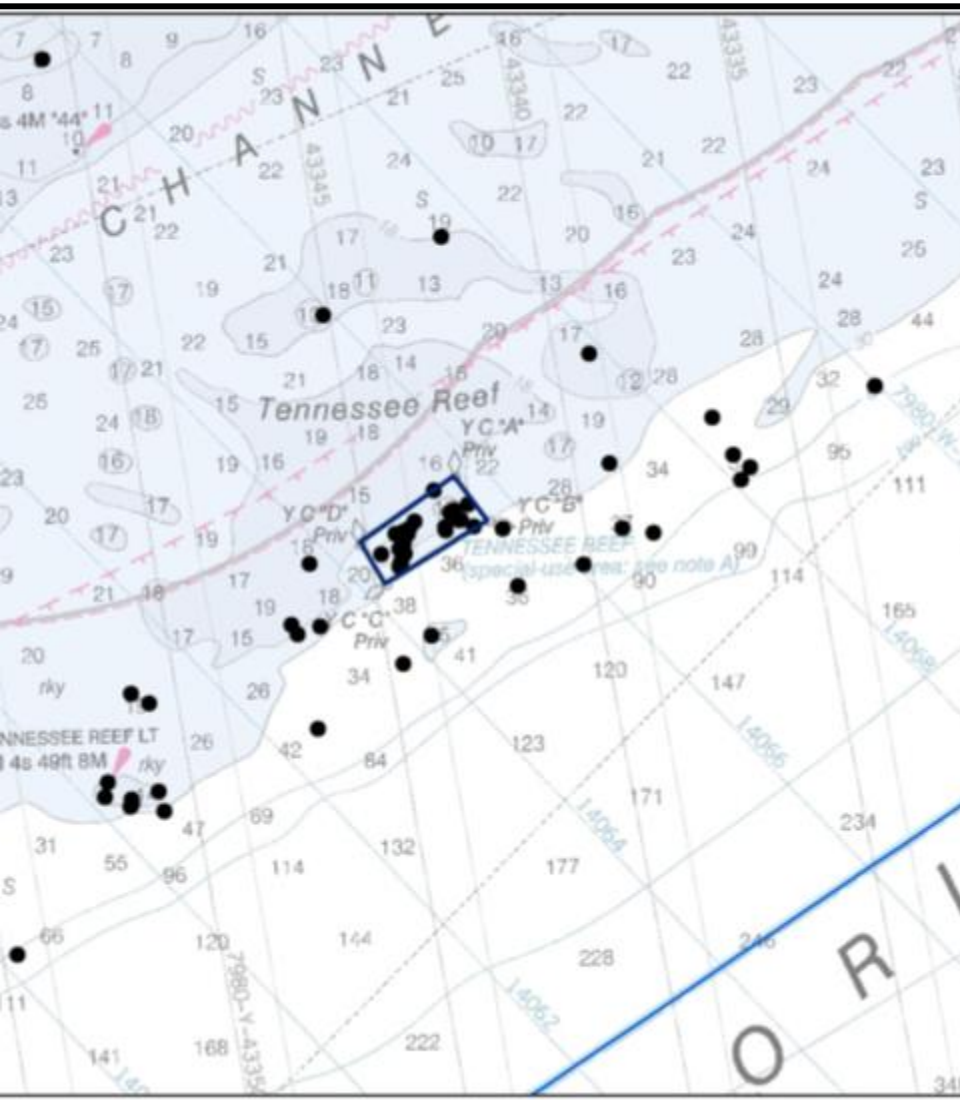
- Fish Species Richness



Where are locations of high fish species richness?



Where are locations of high fish
species richness?



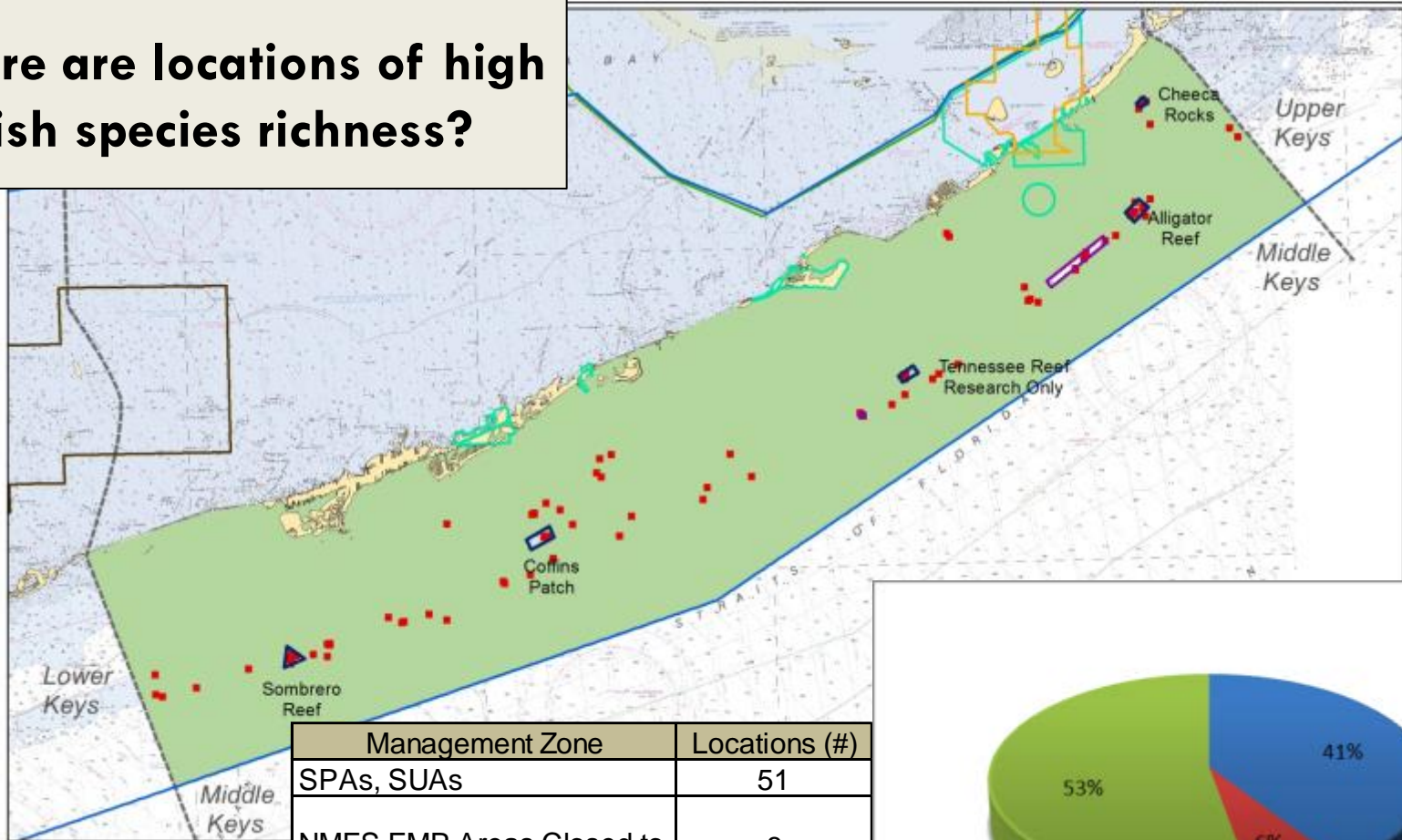
Fish Species Richness

Fish Species Richness

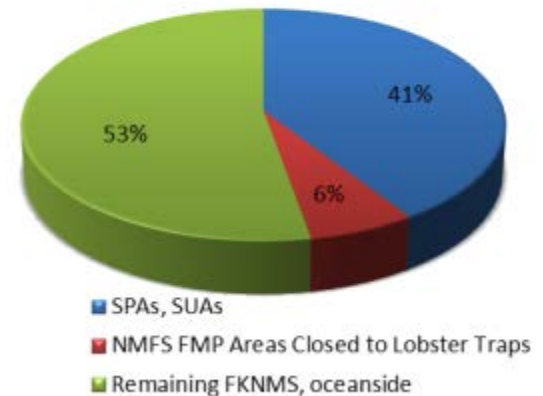
■ High

- Lignumvitae Key Aquatic Preserve
- State Park
- FKNMS Boundary
- SPAs, SUAs
- NMFS FMP Areas Closed to Lobster Trap Gear
- Everglades National Park
- Great White Heron National Wildlife Refuge
- Middle Keys, Ocean Side

Where are locations of high fish species richness?



Management Zone	Locations (#)
SPAs, SUAs	51
NMFS FMP Areas Closed to Lobster Traps	8
Remaining FKNMS, oceanside	66
Resource Total	125



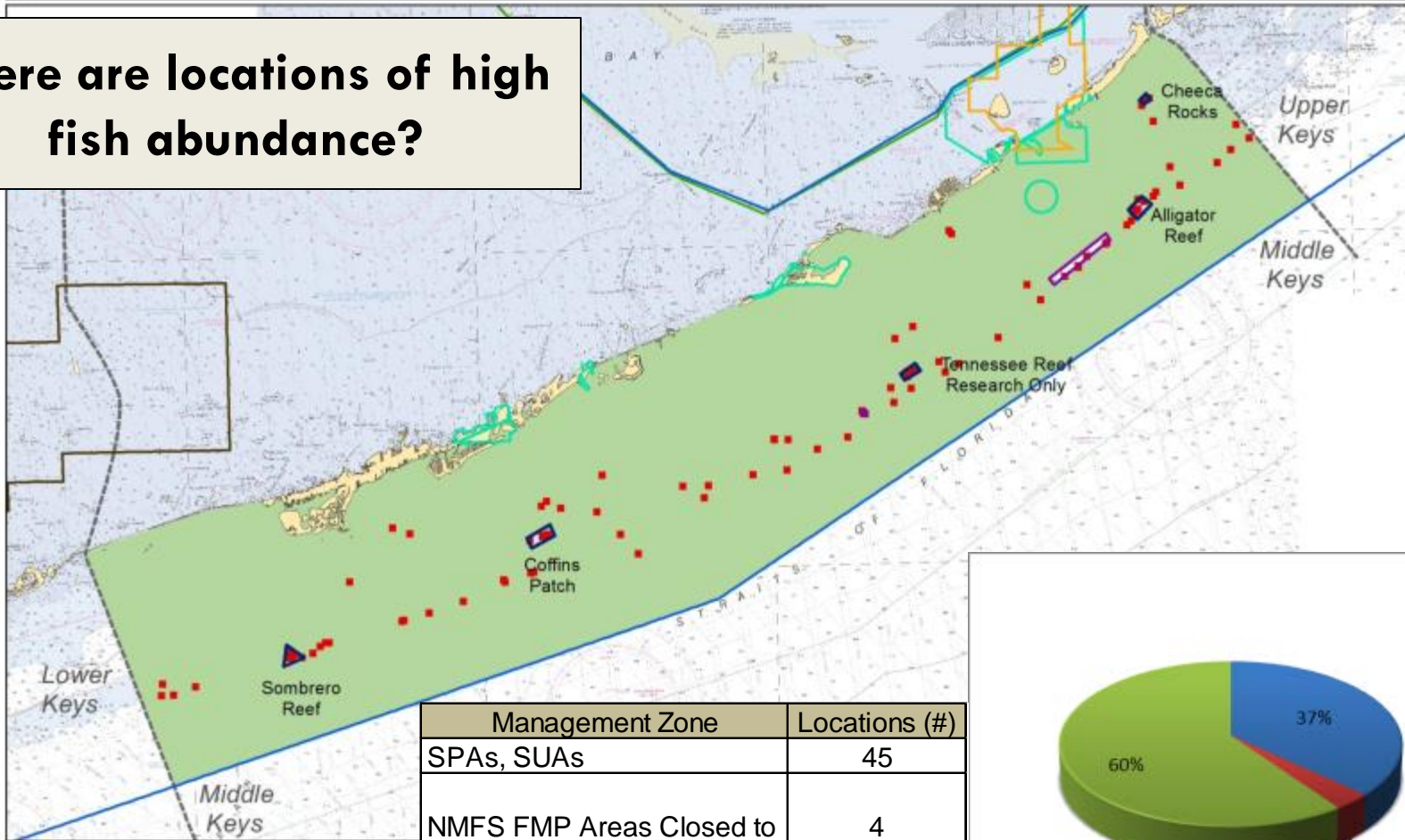
Fish Total Abundance

Fish Abundance

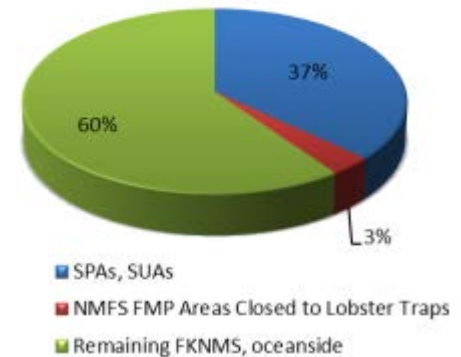
■ High

- Lignumvitae Key Aquatic Preserve
- State Park
- FKNMS Boundary
- SPAs, SUAs
- NMFS FMP Areas Closed to Lobster Trap Gear
- Everglades National Park
- Great White Heron National Wildlife Refuge
- Middle Keys, Ocean Side

Where are locations of high fish abundance?

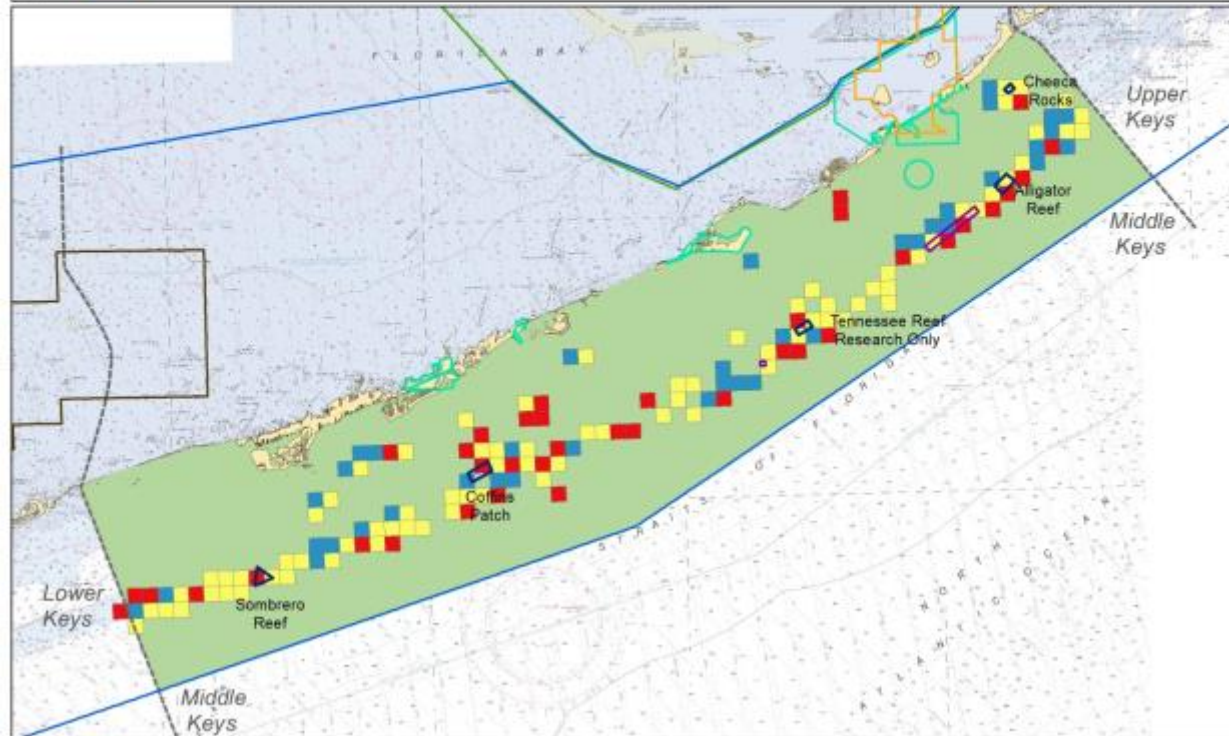


Management Zone	Locations (#)
SPAs, SUAs	45
NMFS FMP Areas Closed to Lobster Traps	4
Remaining FKNMS, oceanside	73
Resource Total	122



Fish Species Richness

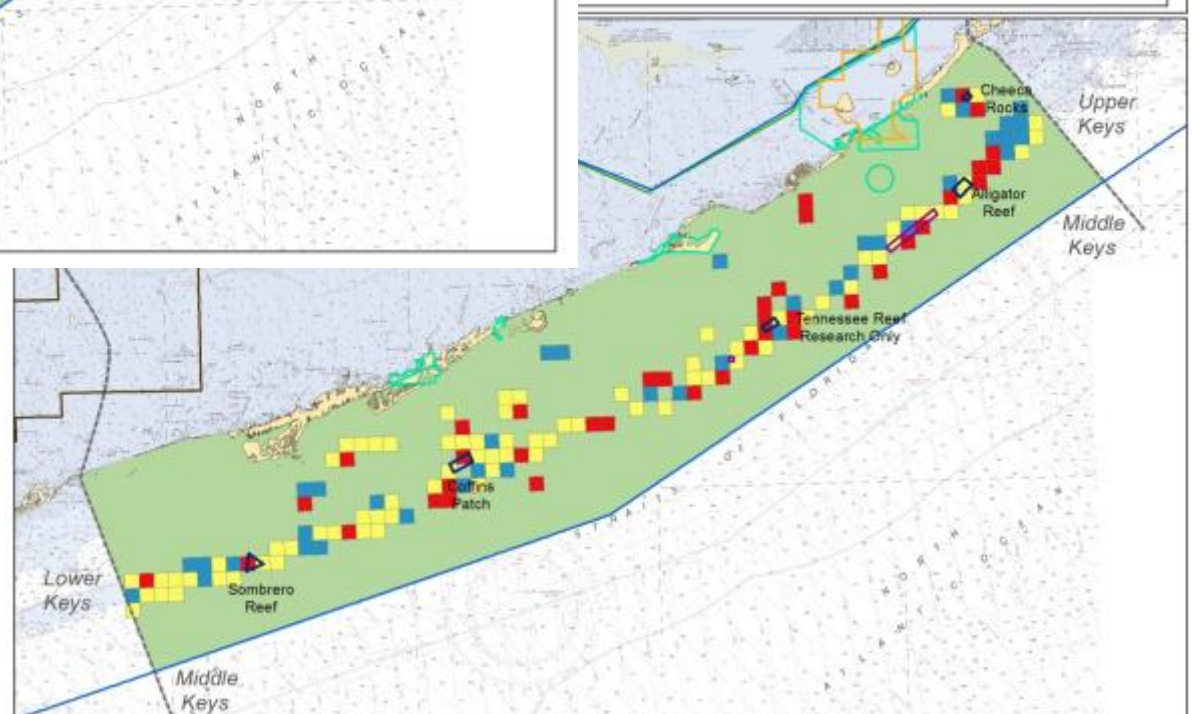
Species Richness (1k)



entire
Middle Keys region

Fish Total Abundance

Abundance (1k)



Fish Species Richness

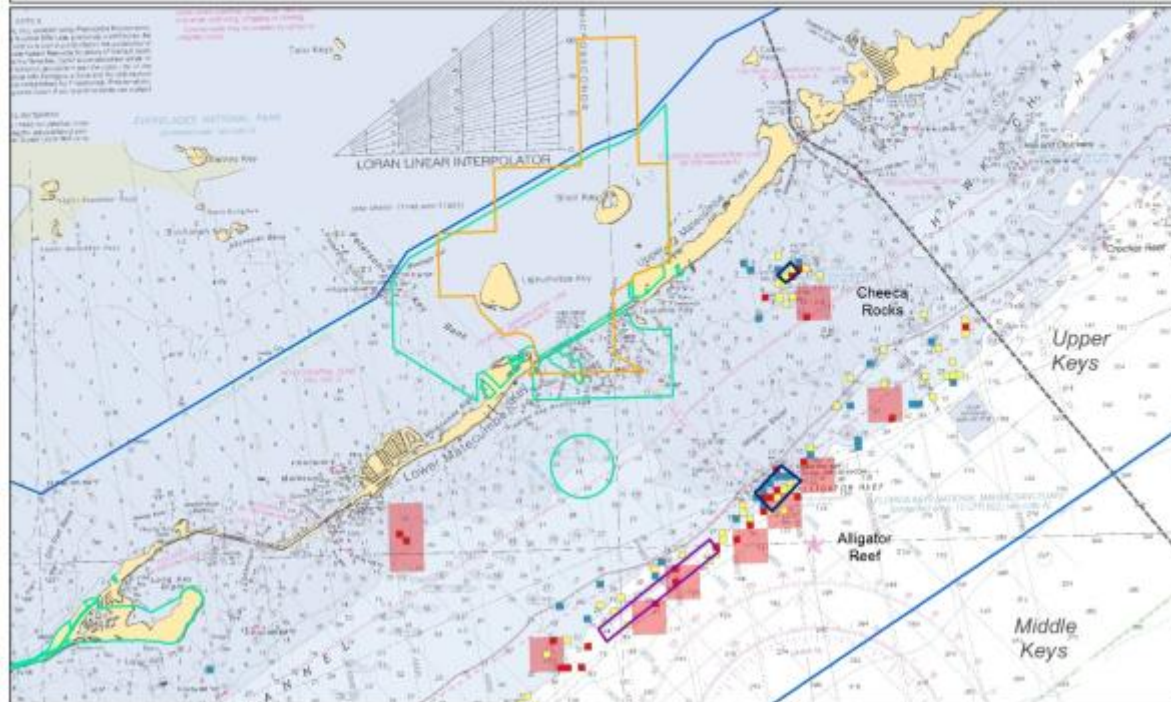
Species Richness (200 m)

High
Medium
Low

Species Richness (1k)

High

Lignumvitae Key Aquatic Preserve
State Park
FKNMS Boundary
SPAs, SUAs
NMFS FMP Areas Closed to Lobster
Trap Gear

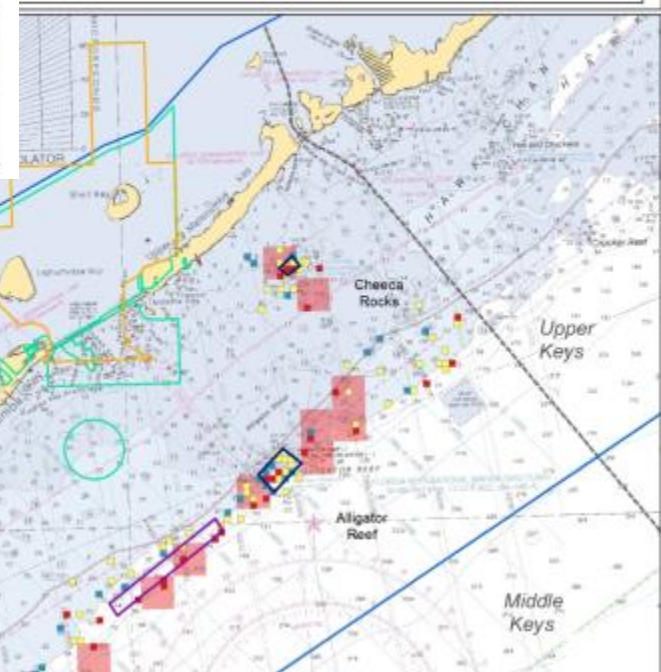


eastern 1/3 of
Middle Keys region

Fish Total Abundance

Abundance (200 m) Abundance (1k)

High
Medium
Low

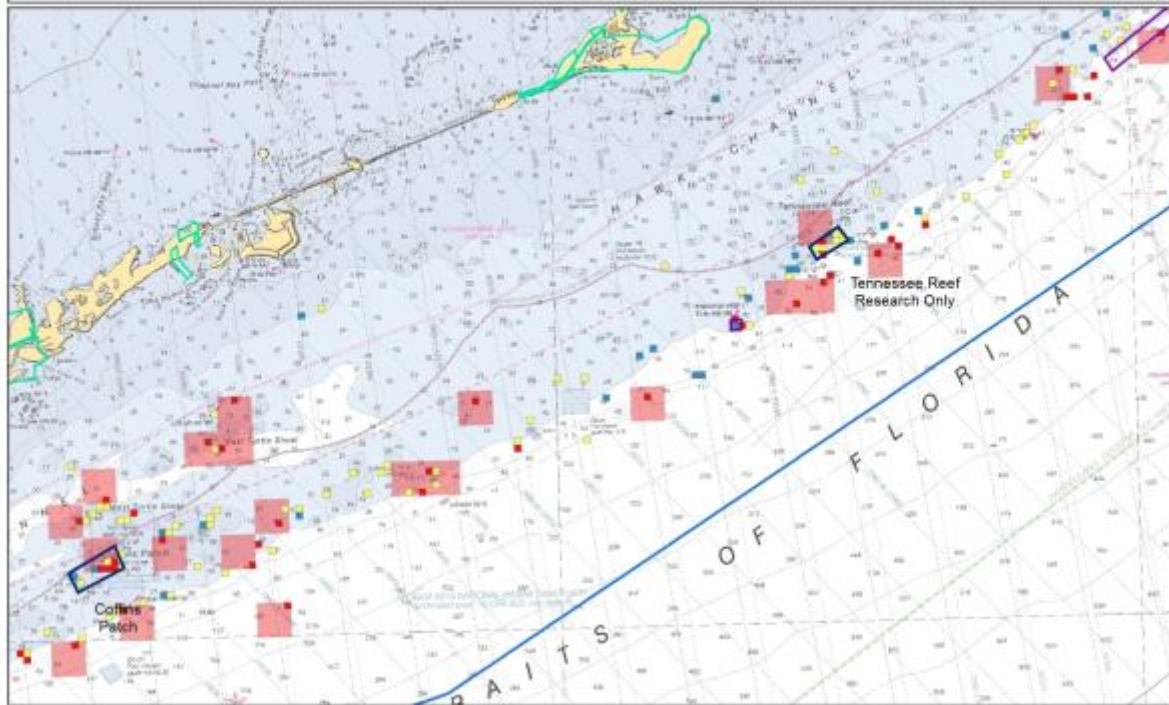


Fish Species Richness

Species Richness (200 m)



Species Richness (1k)



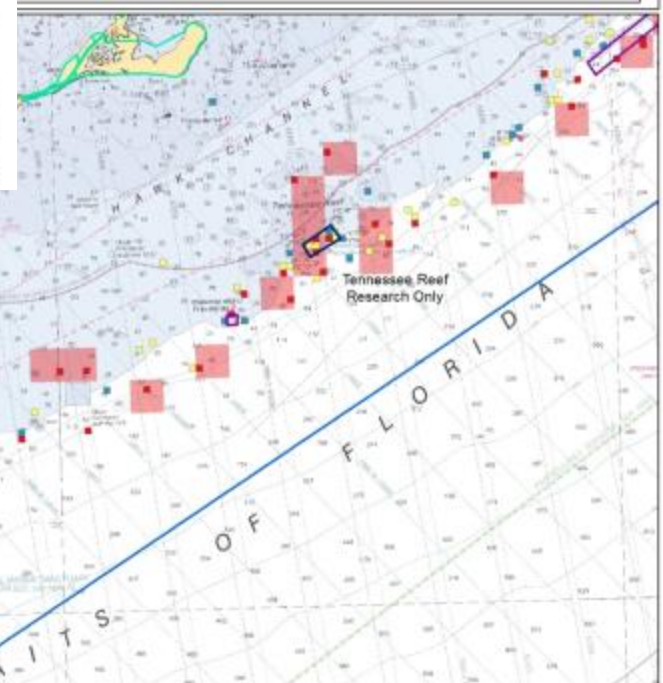
middle 1/3 of
Middle Keys region

Fish Total Abundance

Abundance (200 m)



Abundance (1k)

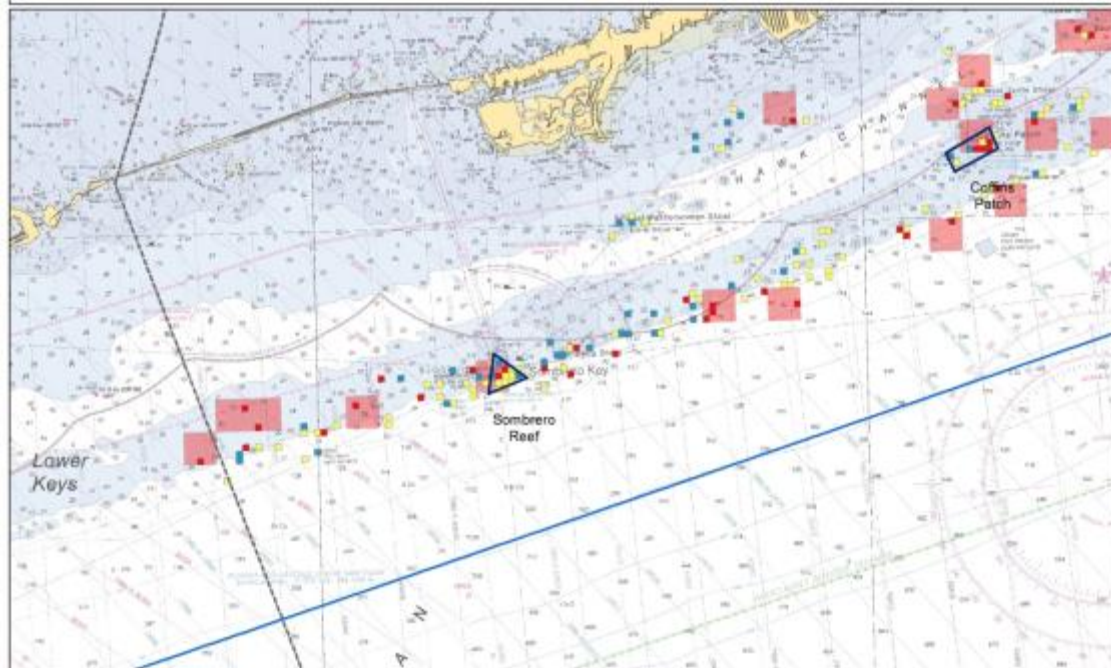
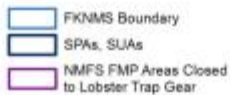


Fish Species Richness

Species Richness (200 m)



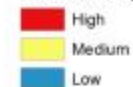
Species Richness (1k)



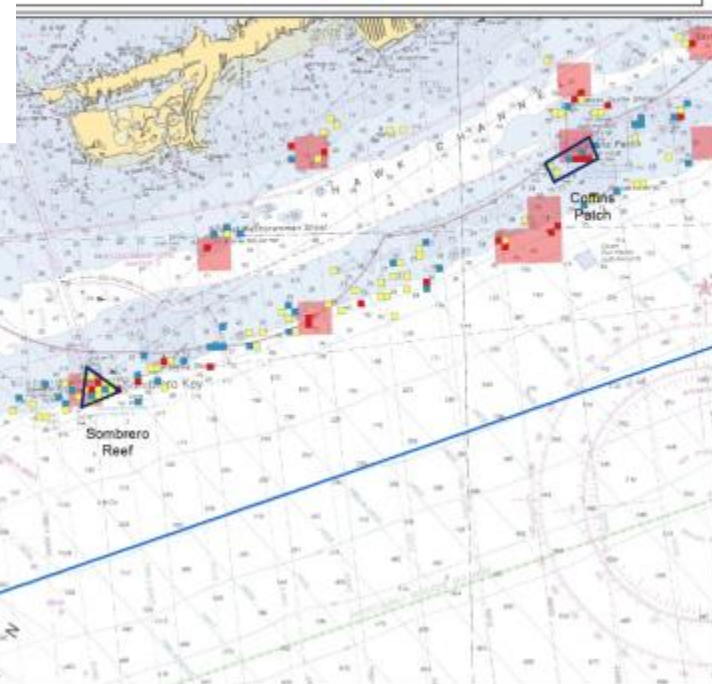
western 1/3 of
Middle Keys region

Fish Total Abundance

Abundance (200 m)



Abundance (1k)



Coral



Data sources

- Nova Southeastern University (SCREAM)
- Florida Reef Resilience Program (FRRP)
- Coral Reef Ecosystem Monitoring Program (CREMP), FWC

Metrics

- Stony coral
 - **Benthic cover (%)**
 - Density
 - **Species richness**
- Soft Coral (Octocoral)
 - **Benthic cover (%)**
 - Density
 - **Species richness**

Hard Corals

- **Stony Coral cover:** How much of the hard bottom is covered in coral?
- **Stony Coral species richness:** How many species?



Photo credit: FWC



Photo credit: FWC

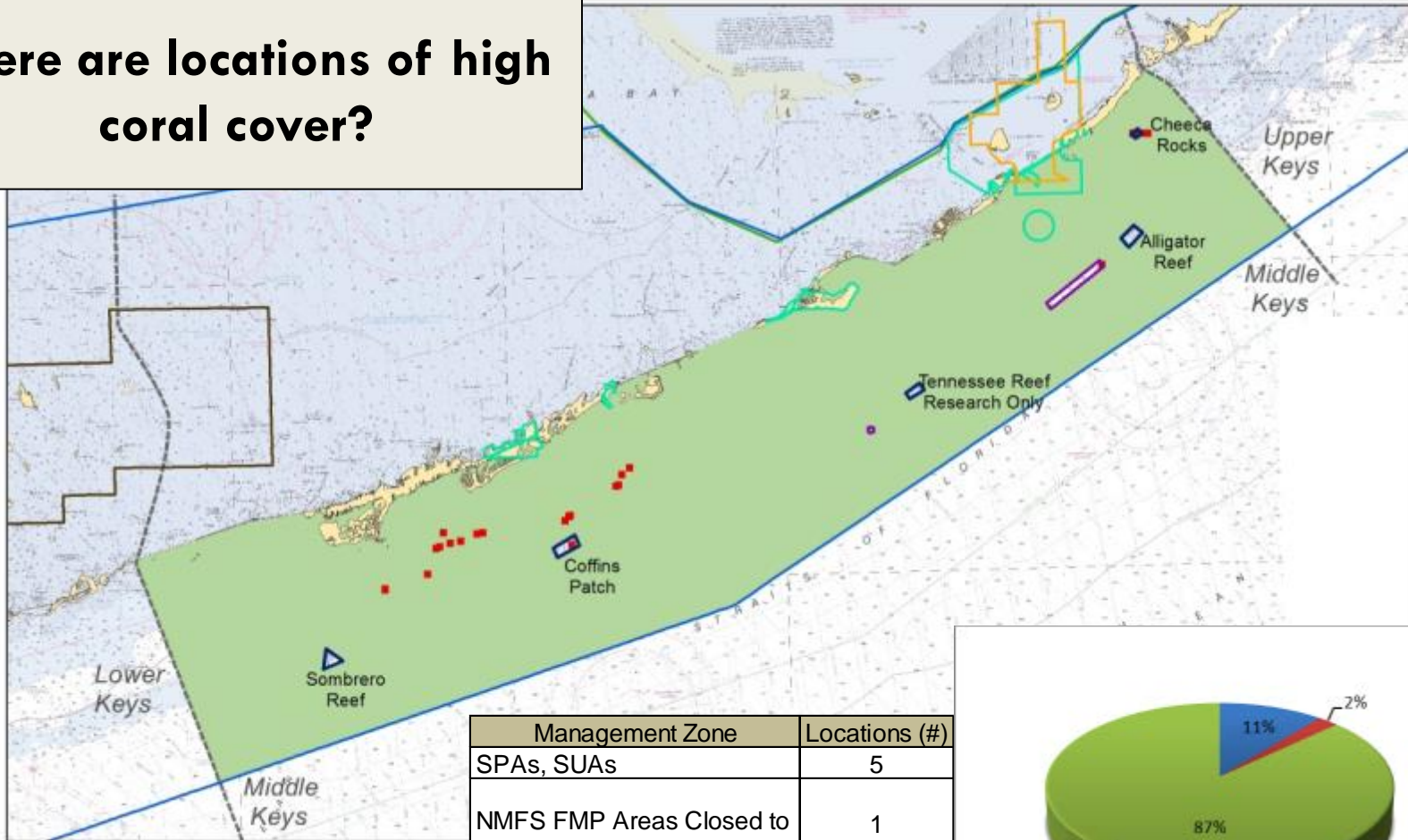
Stony Coral Cover

Stony Coral Cover

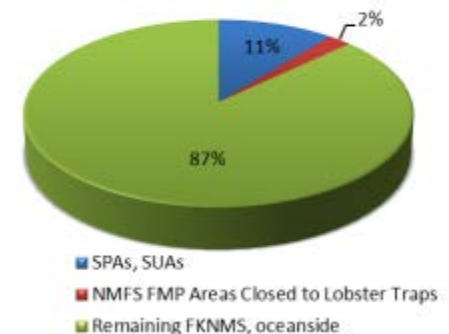
■ High

- Lignumvitae Key Aquatic Preserve
- State Park
- FKNMS Boundary
- SPAs, SUAs
- NMFS FMP Areas Closed to Lobster Trap Gear
- Everglades National Park
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- Middle Keys, Ocean Side

Where are locations of high coral cover?



Management Zone	Locations (#)
SPAs, SUAs	5
NMFS FMP Areas Closed to Lobster Traps	1
Remaining FKNMS, oceanside	40
Resource Total	46



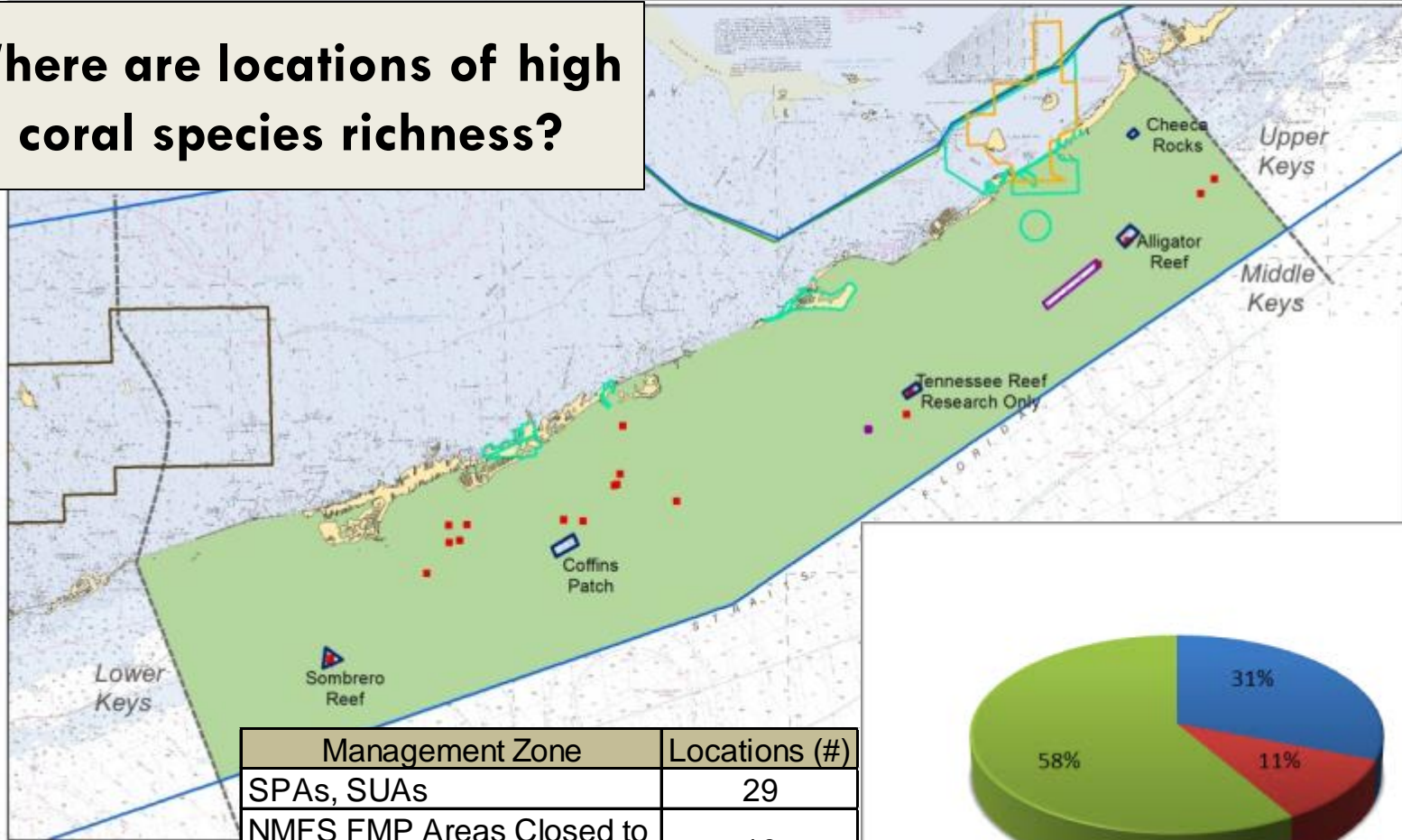
Stony Coral Species Richness

Stony Coral Species Richness

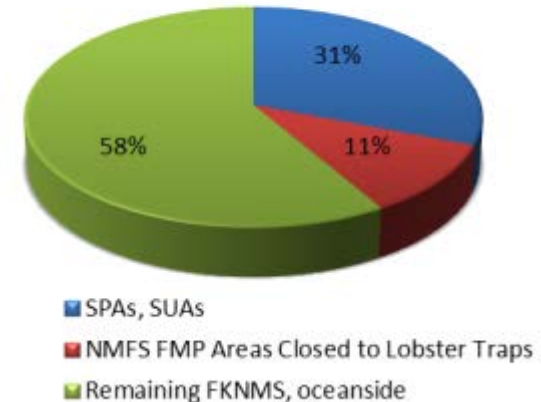
■ High



Where are locations of high coral species richness?



Management Zone	Locations (#)
SPAs, SUAs	29
NMFS FMP Areas Closed to Lobster Traps	10
Remaining FKNMS, oceanside	55
Resource Total	94

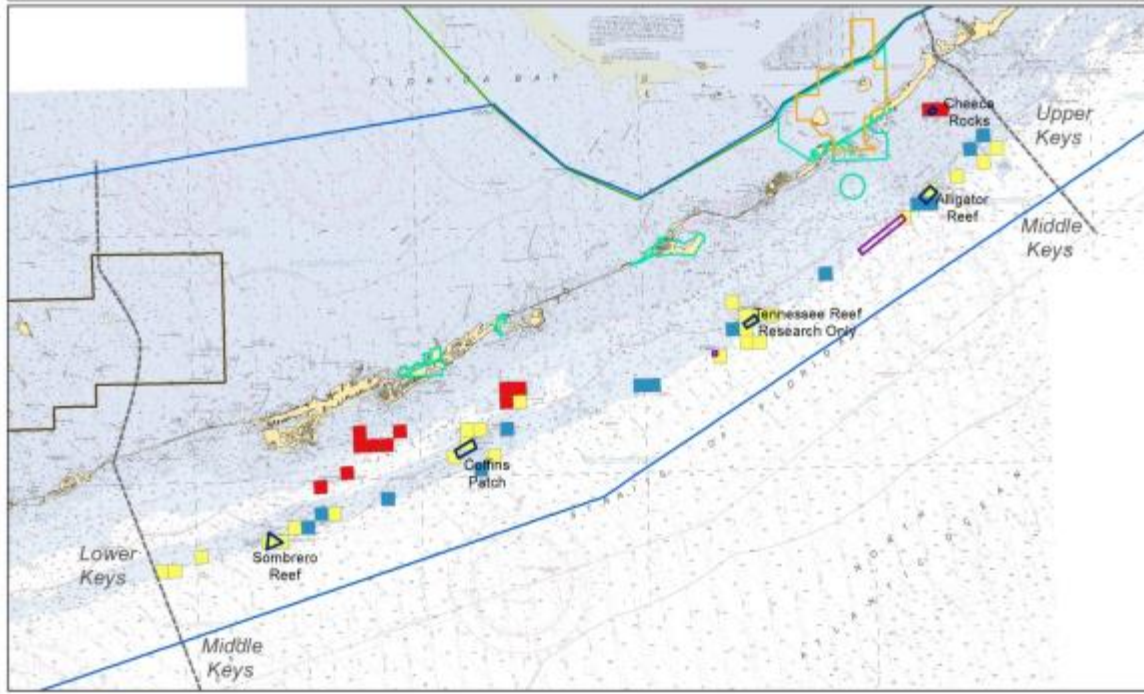


Stony Coral Cover

Stony Coral Cover (1k)

- High
- Medium
- Low

- Upperville Key Aquatic Preserve
- State Park
- FLHRS Boundary
- SPAs, SLAs
- NMFS FMP Areas Closed to Lobster Trap Gear
- Everglades National Park
- Great White Heron National Wildlife Refuge

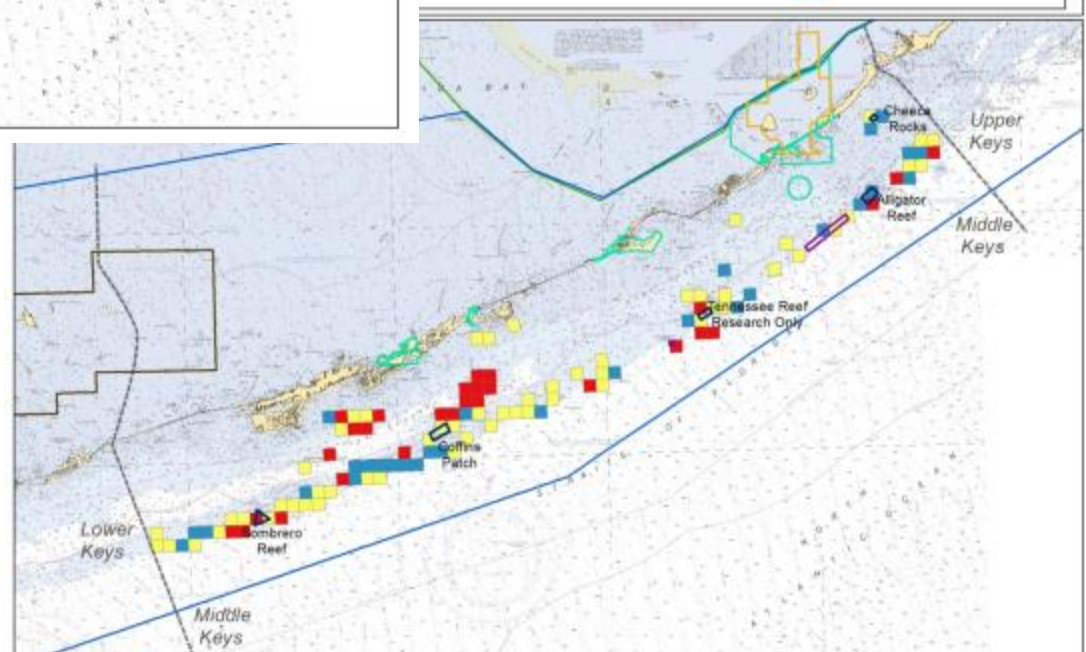


entire
Middle Keys region

Stony Coral Species Richness

Species Richness (1k)

- High
- Medium
- Low

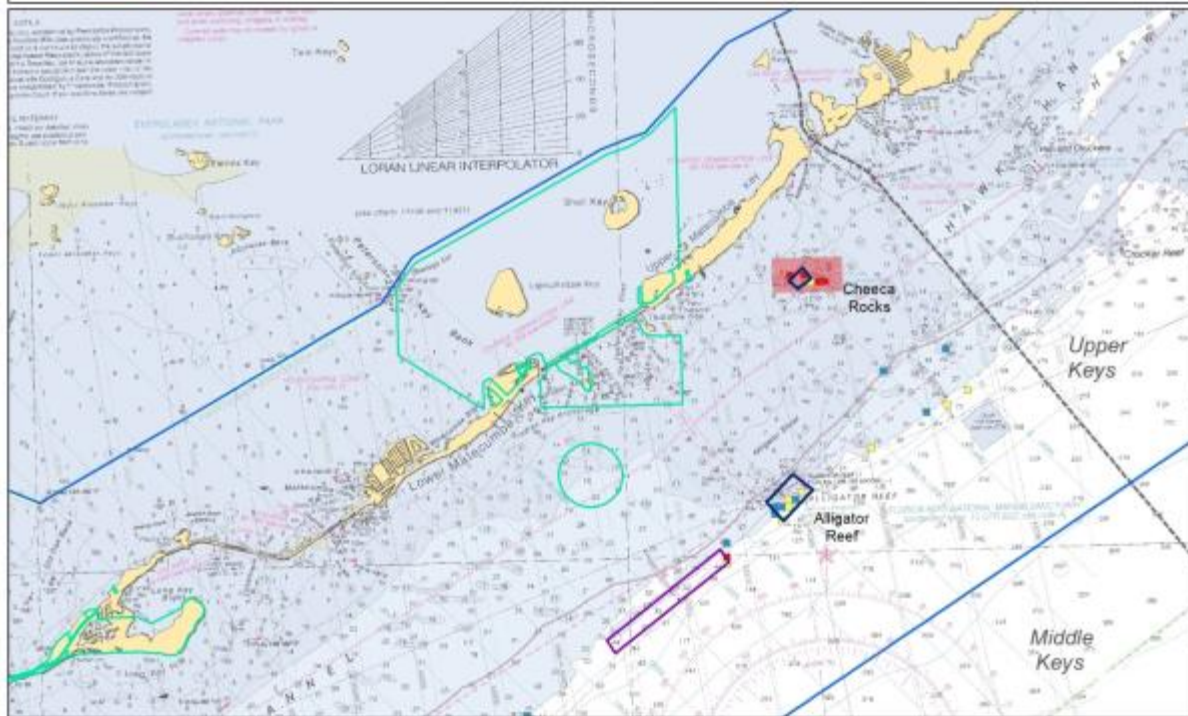


Stony Coral Cover

Stony Coral Cover (200 m)



Stony Coral Cover (1k)



eastern 1/3 of
Middle Keys region

Stony Coral Species Richness

Species Richness (200 m) Species Richness (1k)

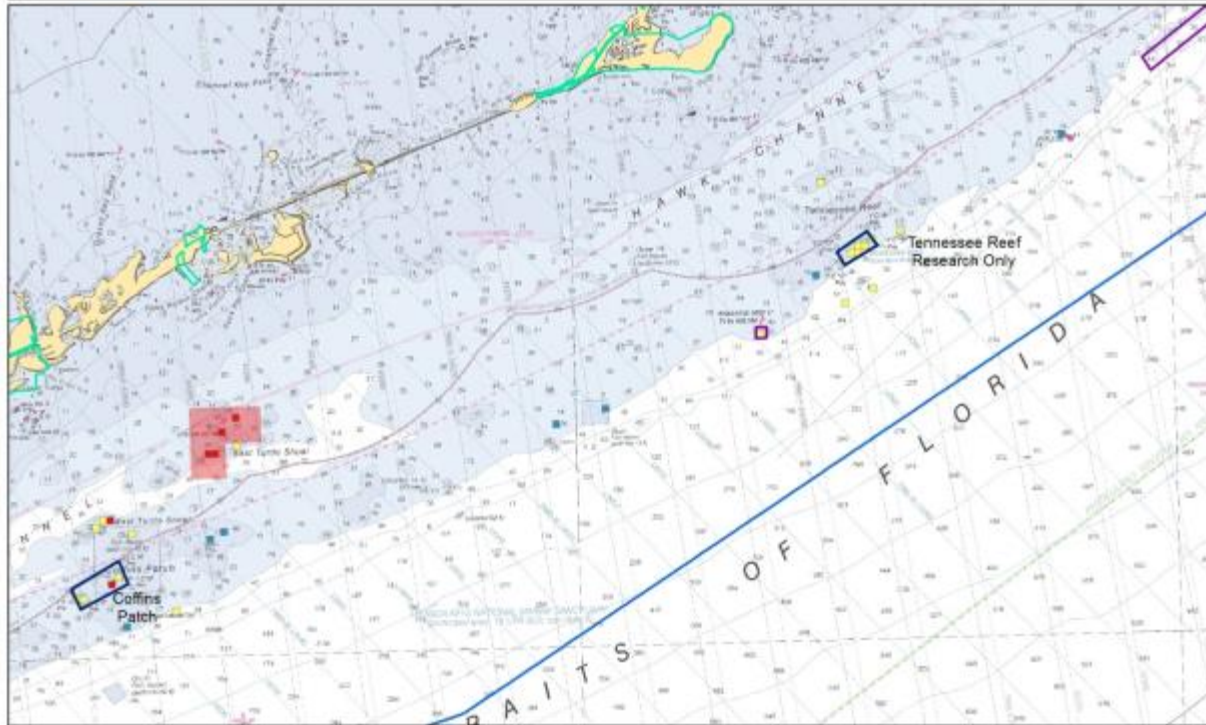


Stony Coral Cover

Stony Coral Cover (200 m)



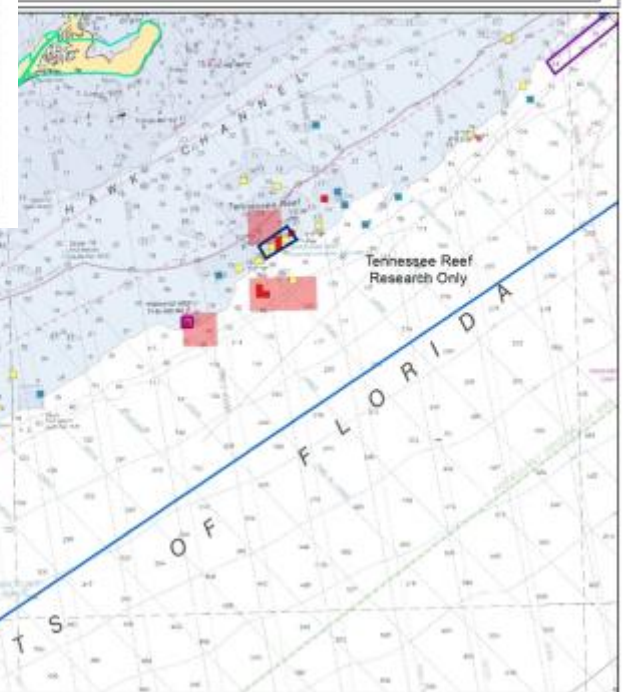
Stony Coral Cover (1k)



middle 1/3 of
Middle Keys region

Stony Coral Species Richness

Species Richness (200 m) Species Richness (1k)

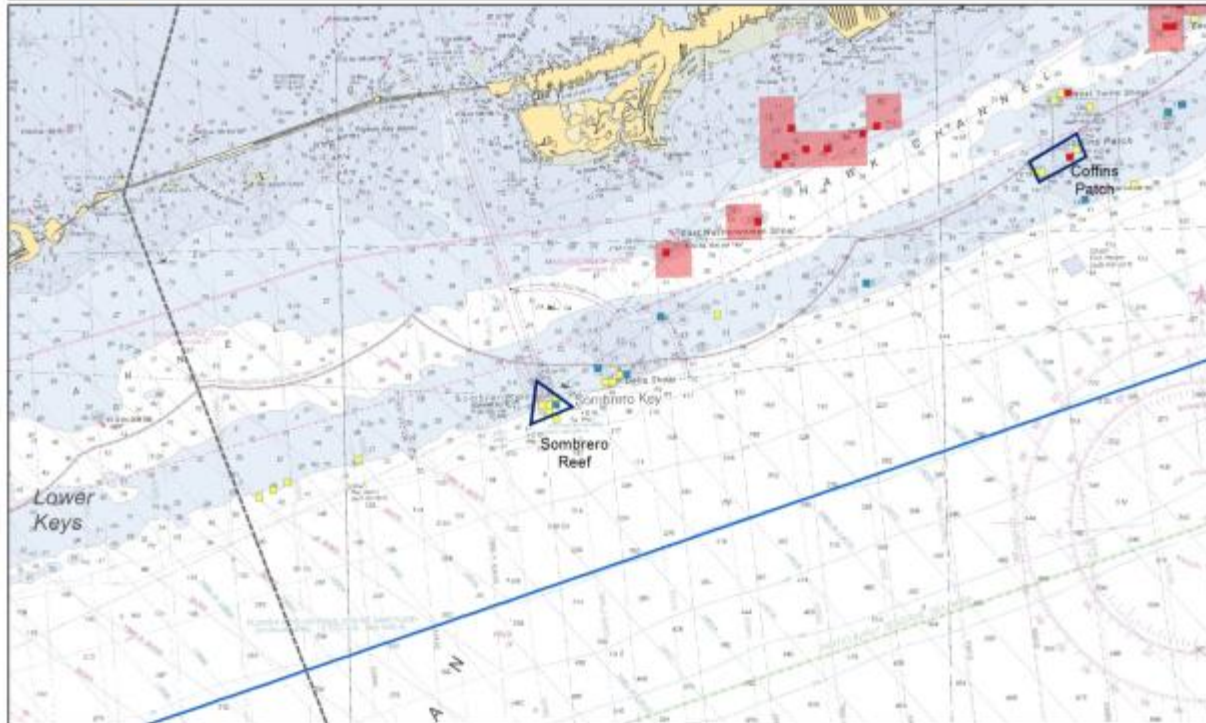


Stony Coral Cover

Stony Coral Cover (200 m)



Stony Coral Cover (1k)



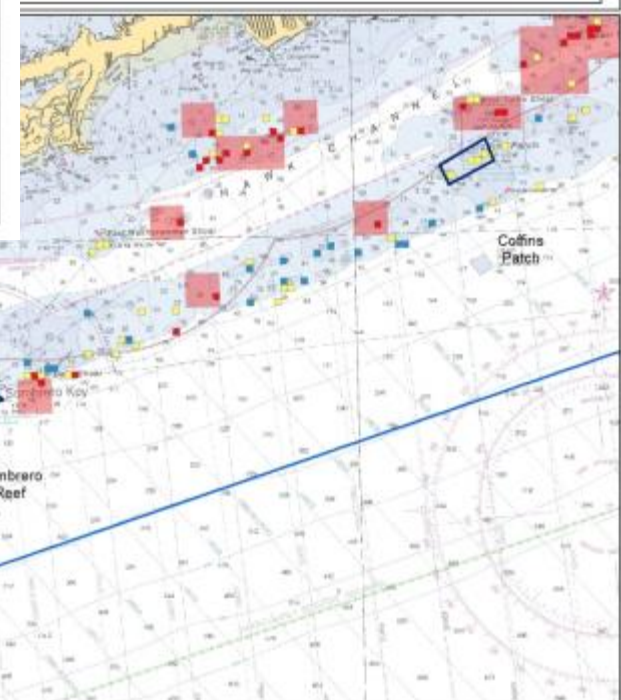
lower 1/3 of
Middle Keys region

Stony Coral Species Richness

Species Richness (200 m)



Species Richness (1k)



Soft Coral

- **Soft Coral cover:** How much of the hard bottom is covered in soft coral?
- **Soft Coral species richness:** How many species?



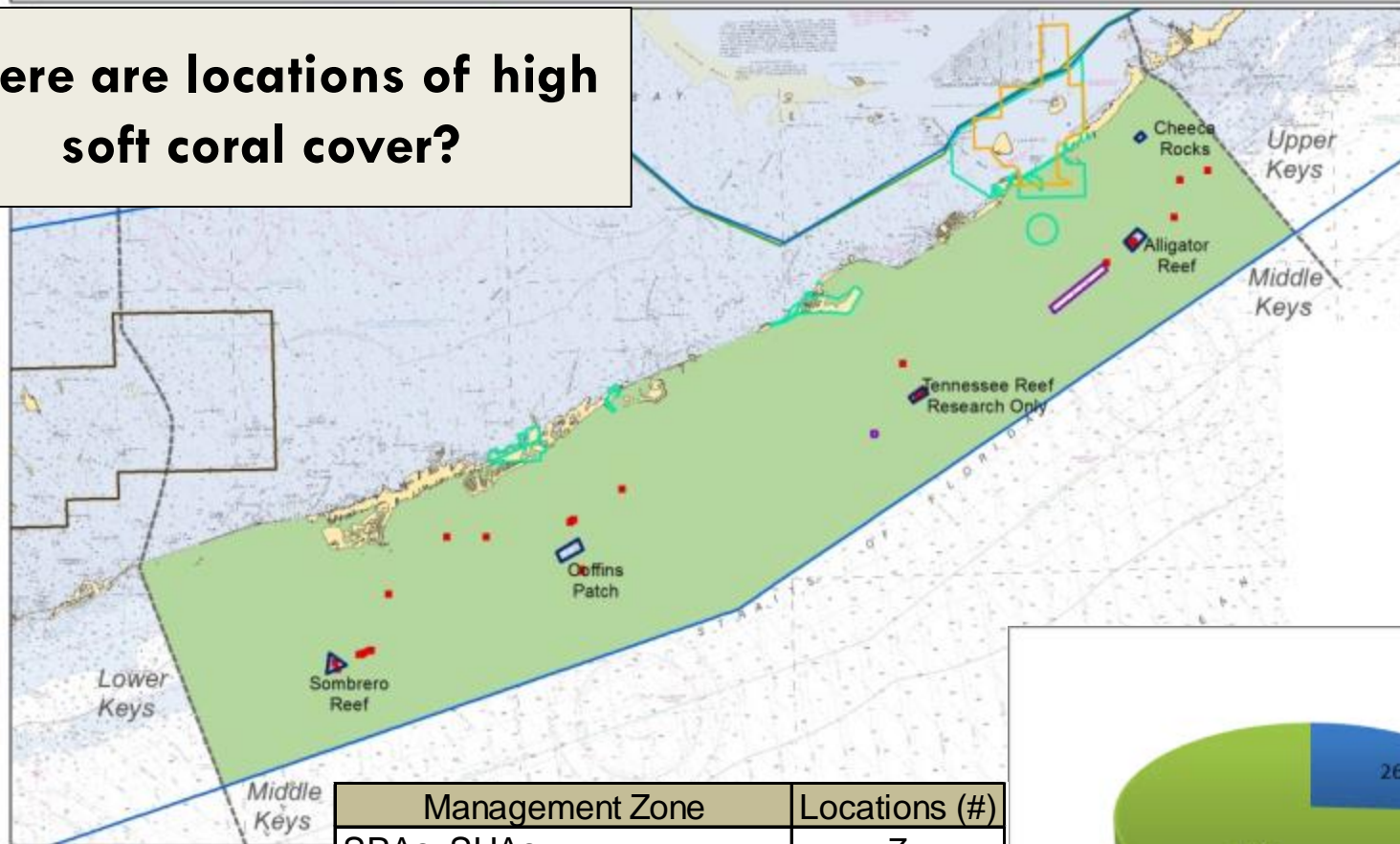
Soft Coral Cover

Soft Coral Cover

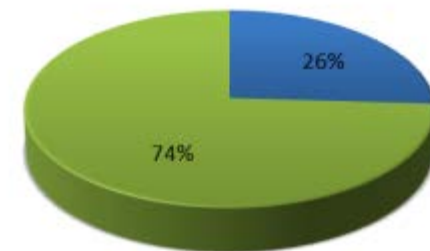
■ High

- Lignumvitae Key Aquatic Preserve
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- Middle Keys, Ocean Side

Where are locations of high soft coral cover?



Management Zone	Locations (#)
SPAs, SUAs	7
NMFS FMP Areas Closed to Lobster Traps	0
Remaining FKNMS, oceanside	20
Resource Total	27



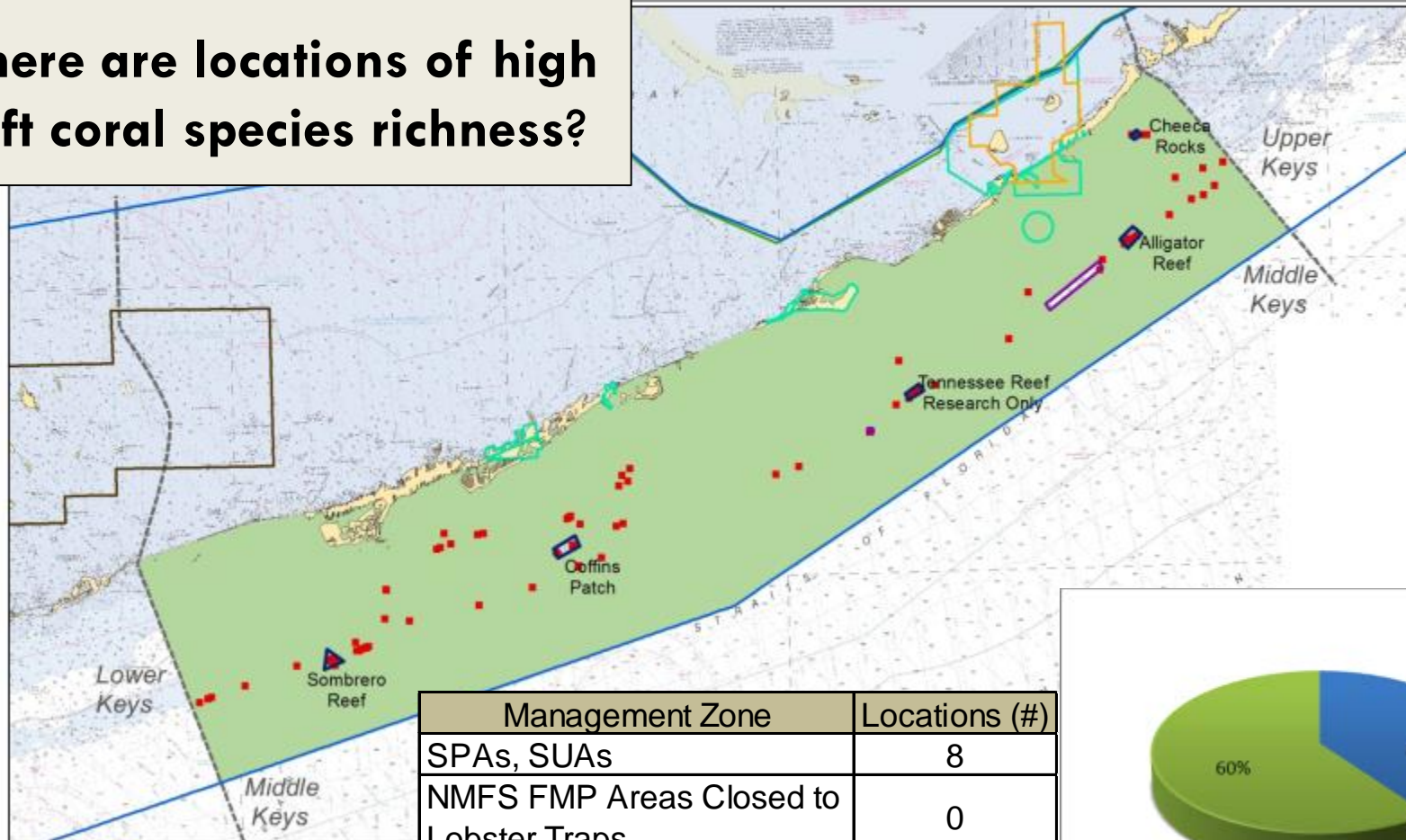
- SPAs, SUAs
- NMFS FMP Areas Closed to Lobster Traps
- Remaining FKNMS, oceanside

Soft Coral Species Richness

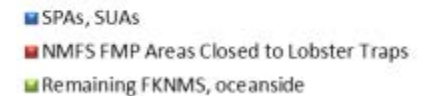
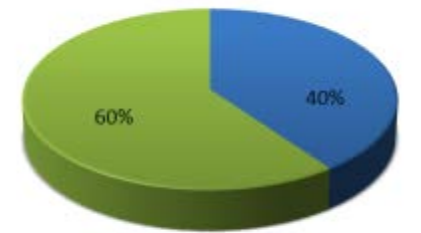
• High Soft Coral Species Richness



Where are locations of high soft coral species richness?

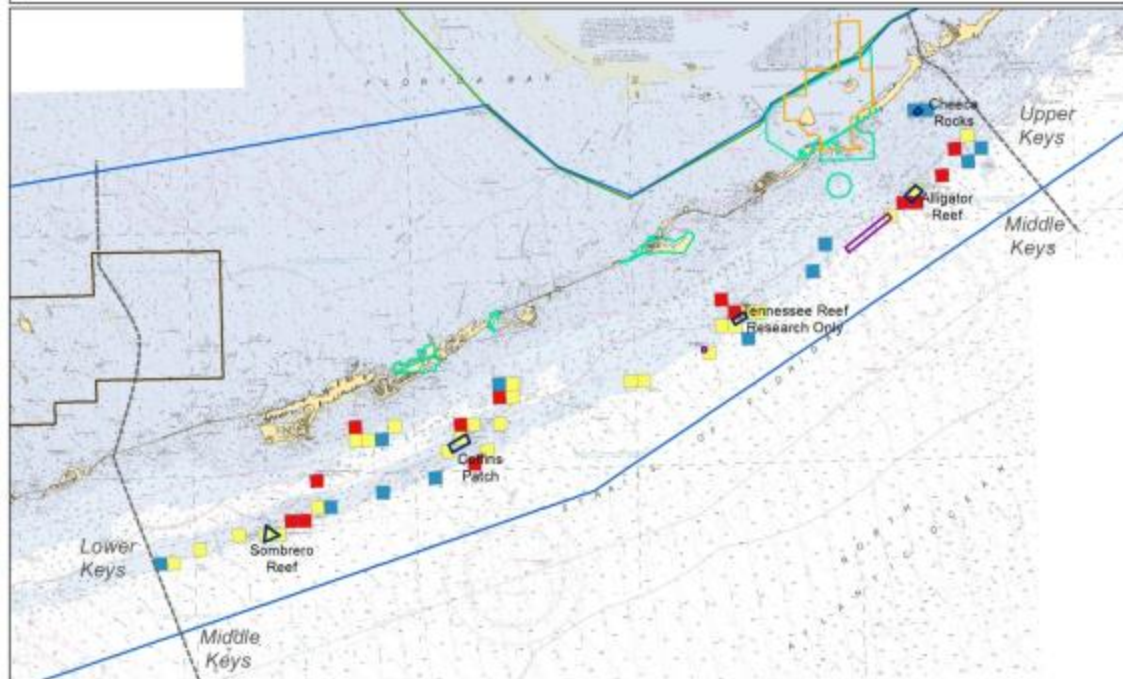


Management Zone	Locations (#)
SPAs, SUAs	8
NMFS FMP Areas Closed to Lobster Traps	0
Remaining FKNMS, oceanside	12
Resource Total	20



Soft Coral Cover

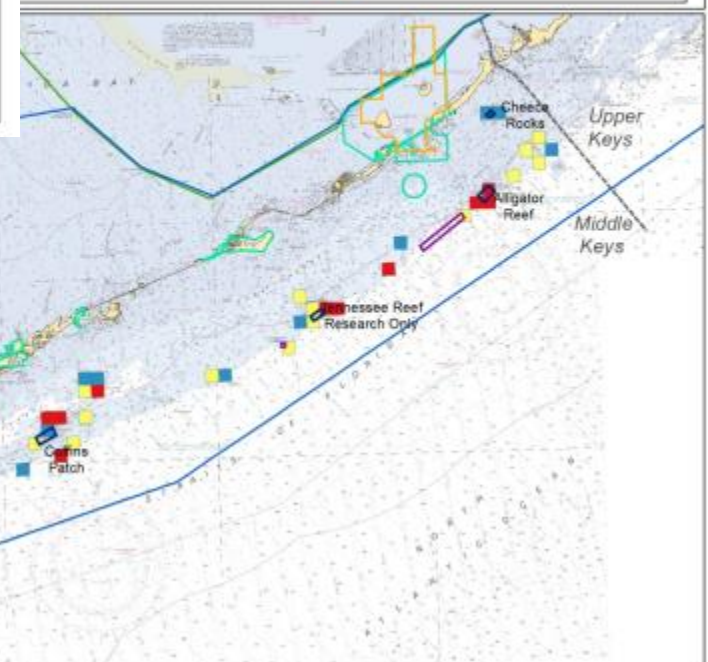
Soft Coral Cover (1k)



entire
Middle Keys region

Soft Coral Species Richness

Soft Coral Species Richness (1k)



Soft Coral Cover

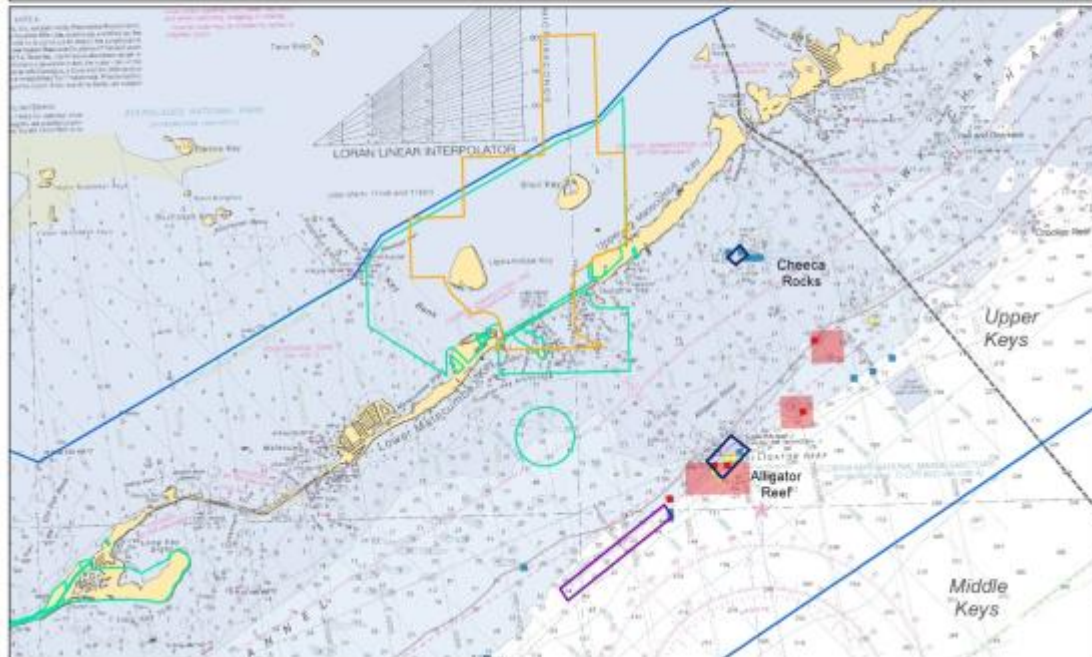
Soft Coral Cover (200 m)

High
Medium
Low

Soft Coral Cover (1k)

High

Lignumvitae Key Aquatic Preserve
State Park
FOWMS Boundary
Shoreline
MUSE FMP Areas Closed to Lobster Trap
Clear



eastern 1/3 of
Middle Keys region

Soft Coral Species Richness

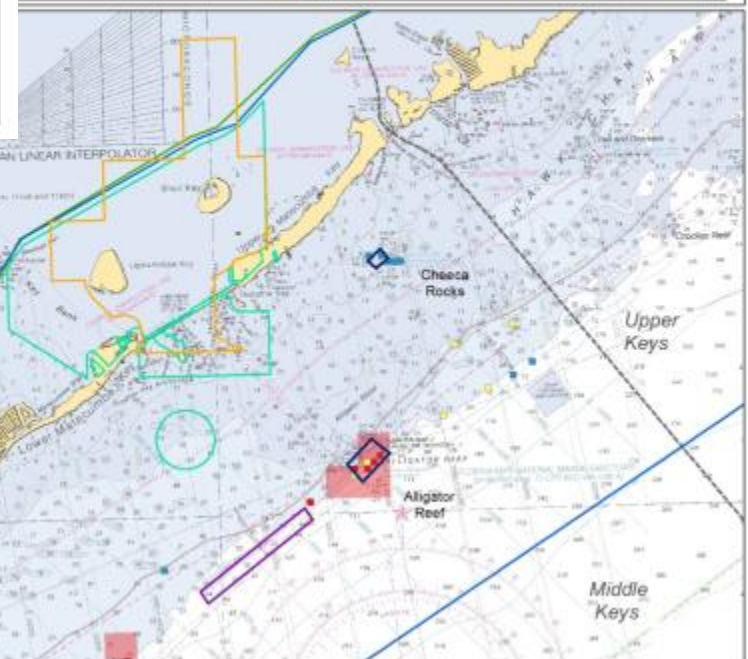
Species Richness (200 m)

High
Medium
Low

Species Richness (1k)

High

State Park
on National Wildlife



Soft Coral Cover

Soft Coral Cover (200 m)

High
Medium
Low

Soft Coral Cover (1k)

High

State Park
FMMO boundary
SPNs, SLMA
100% B FMP Areas Closed to Lobster Trap
Gear



middle 1/3 of
Middle Keys region

Soft Coral Species Richness

Species Richness (200 m)

High
Medium
Low

Species Richness (1k)

High



Soft Coral Cover

Soft Coral Cover (200 m)

High
Medium
Low

Soft Coral Cover (1k)

High

State Park
FMMO boundary
SPNs, SLMA
Soft 5 FMP Areas Closed to Lobster Trap
Gear



western 1/3 of
Middle Keys region

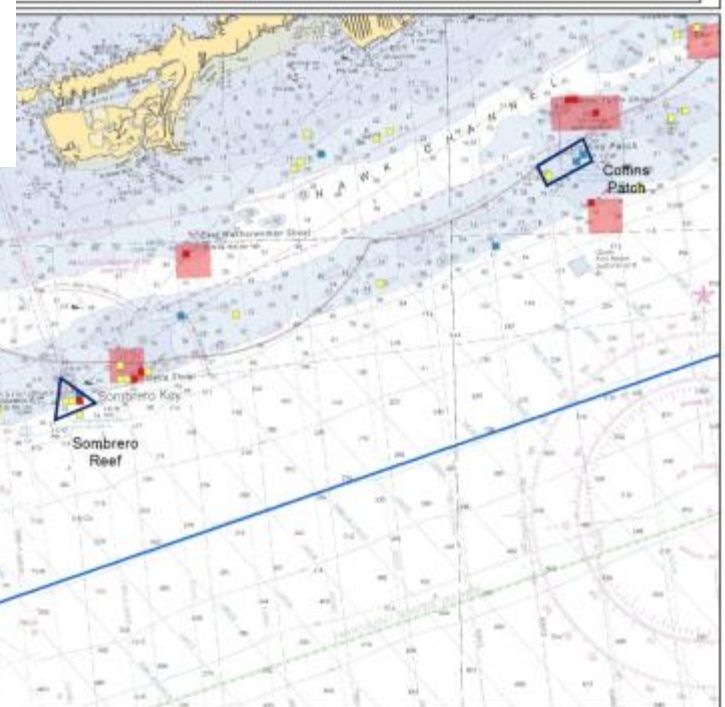
Soft Coral Species Richness

Species Richness (200 m)

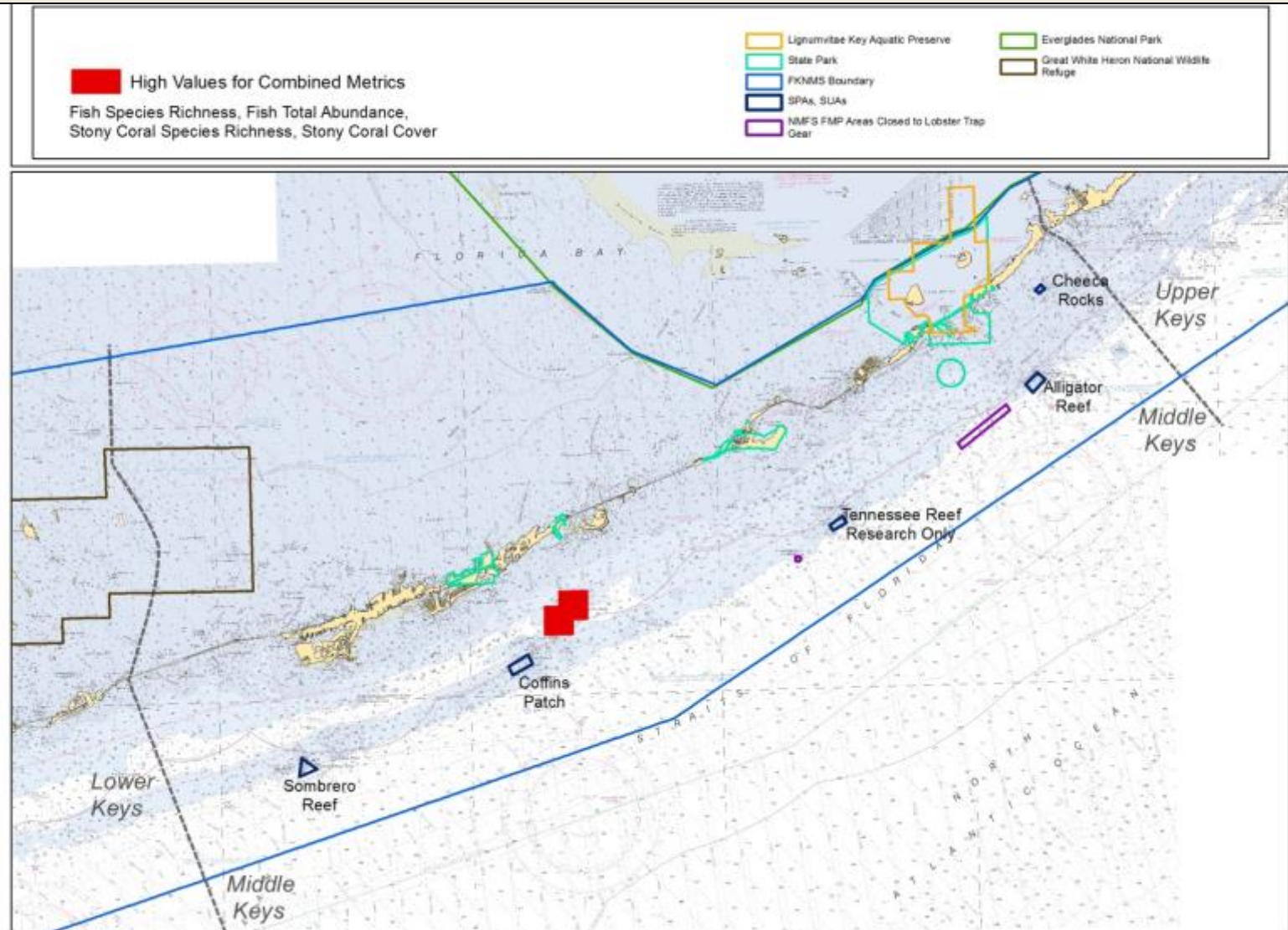
High
Medium
Low

Species Richness (1k)

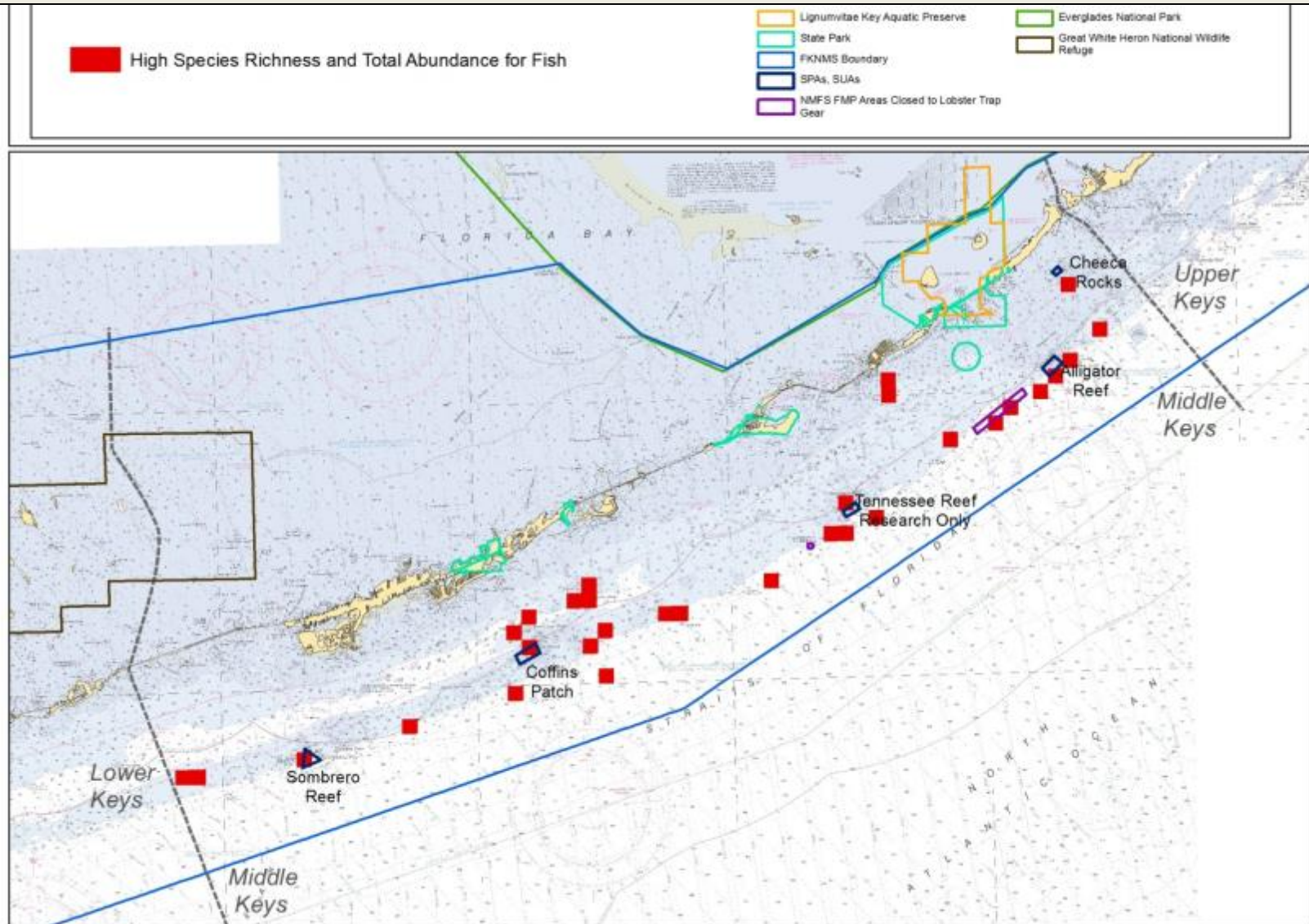
High



Where are locations with high fish species richness, fish total abundance, stony coral species richness and stony coral cover?



Where are locations with high fish species richness and total abundance?



Where are locations with high coral species richness and cover?

