National Marine Sanctuaries
National Oceanic and Atmospheric Administration

How can you use the spatial information for the Marquesas?

-natural resources-

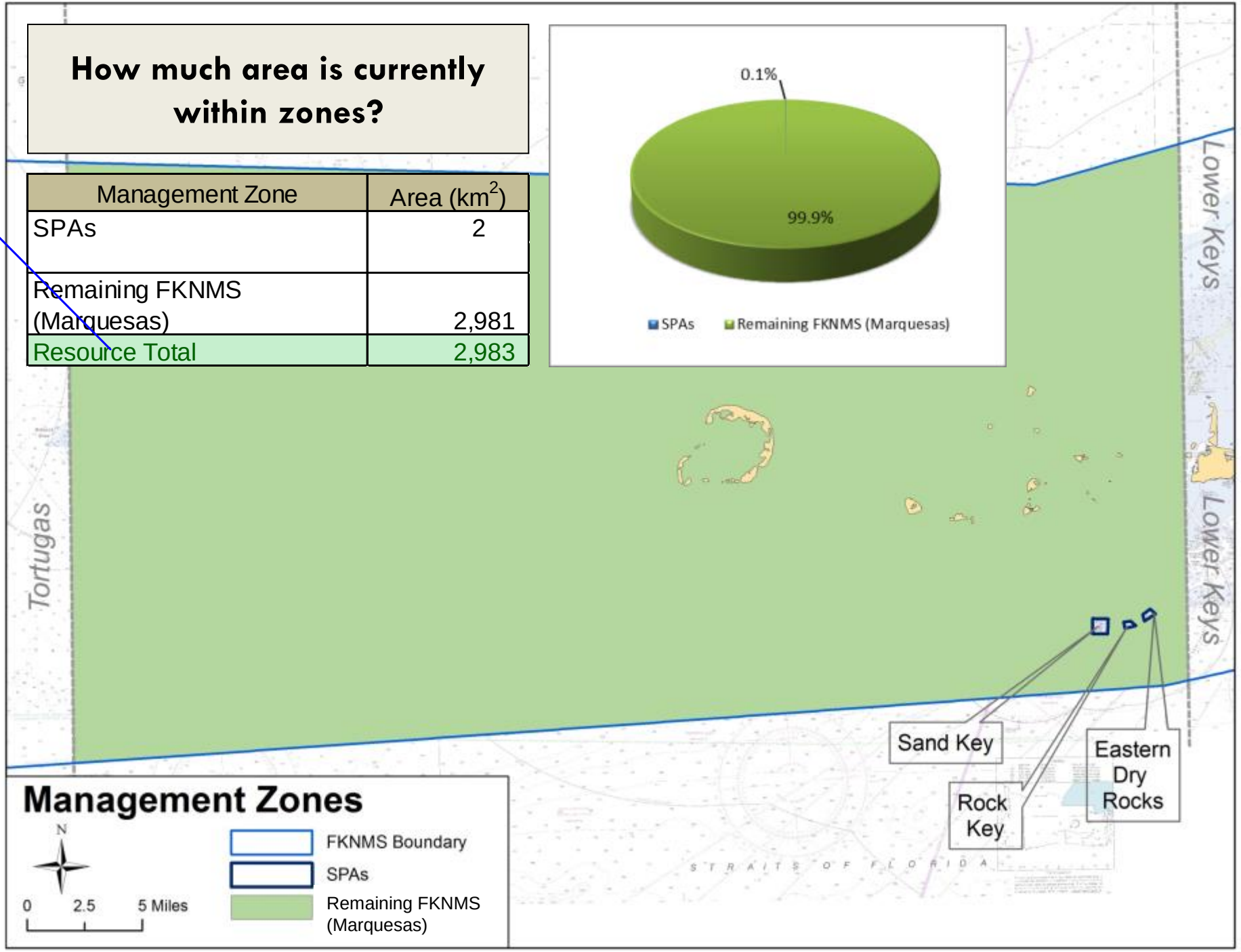
- **NOAA – Florida Keys National Marine Sanctuary**
- **Florida Fish and Wildlife Commission**
- **NOAA – National Centers for Coastal Ocean Science**

Photos courtesy of NOAA photo library

Where are locations of ‘special places’?

How much area is currently within zones?

Management Zone	Area (km^2)
SPAs	2
Remaining FKNMS (Marquesas)	2,981
Resource Total	2,983

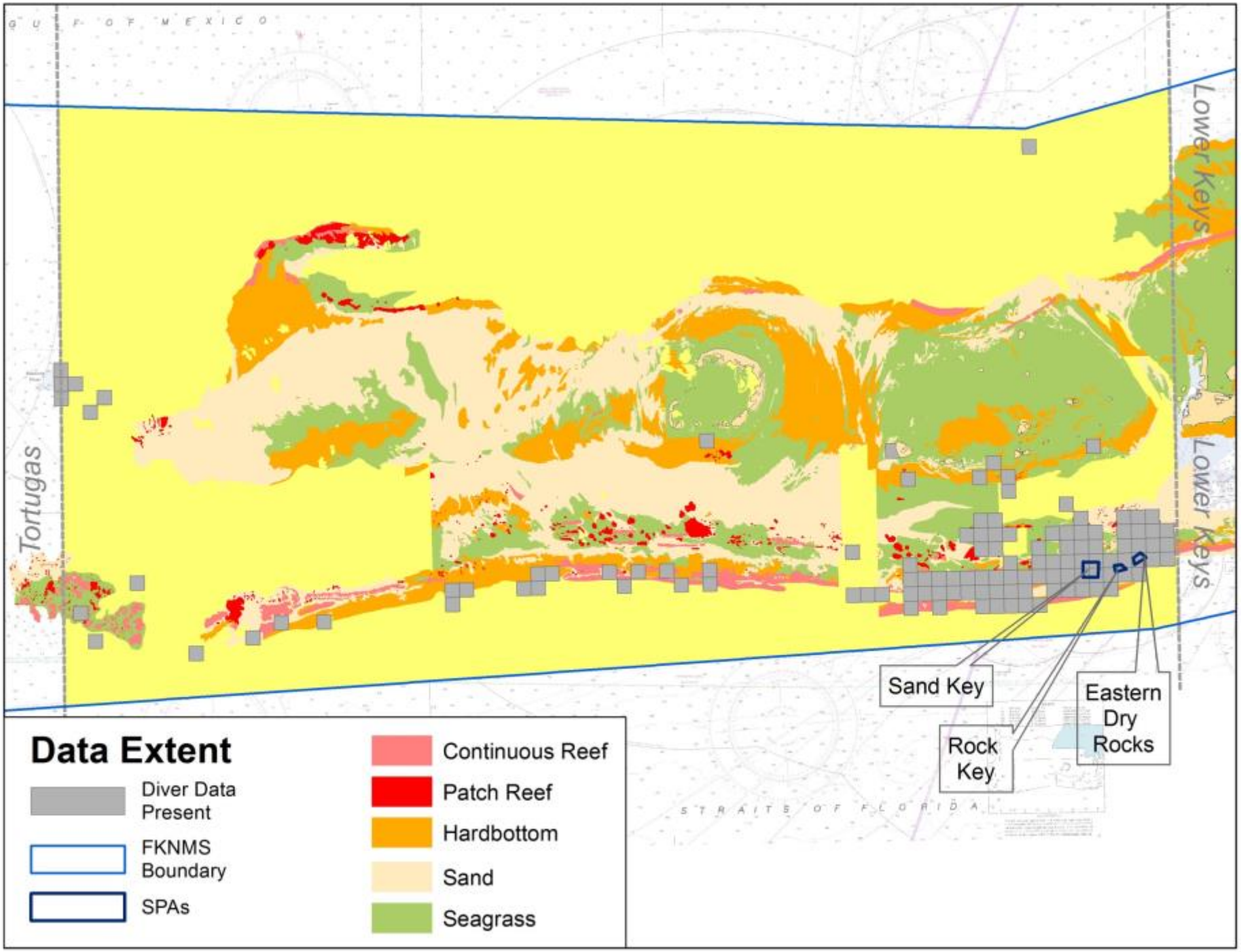


Natural Resource Info

Metrics

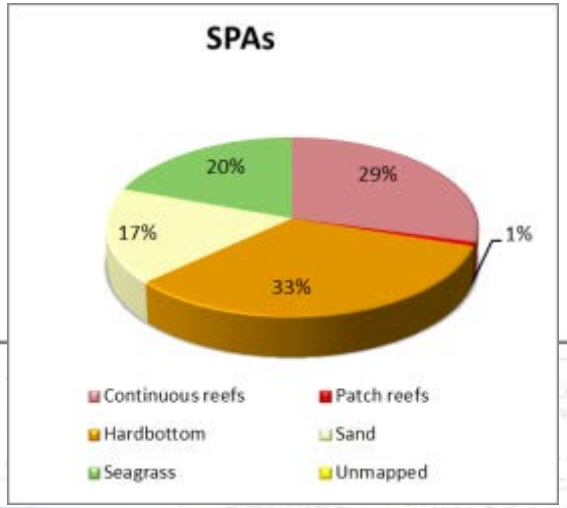
- Habitat
  - Habitat types
  - Patch & linear reef
  - High relief reefs
  - Turtle grass density
- Coral
  - Stony coral
  - Soft coral
  - Resilient reefs
- Fish
  - Reef fish surveys
  - Fish aggregations
- Fauna
  - Conch aggregations
  - Sea turtle sightings

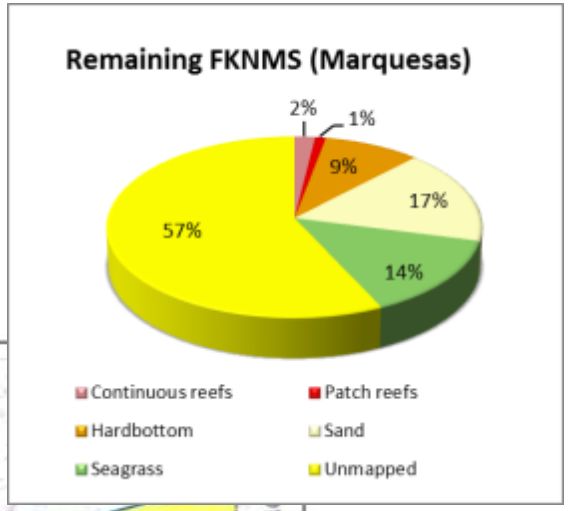
Photos courtesy of NOAA photo library

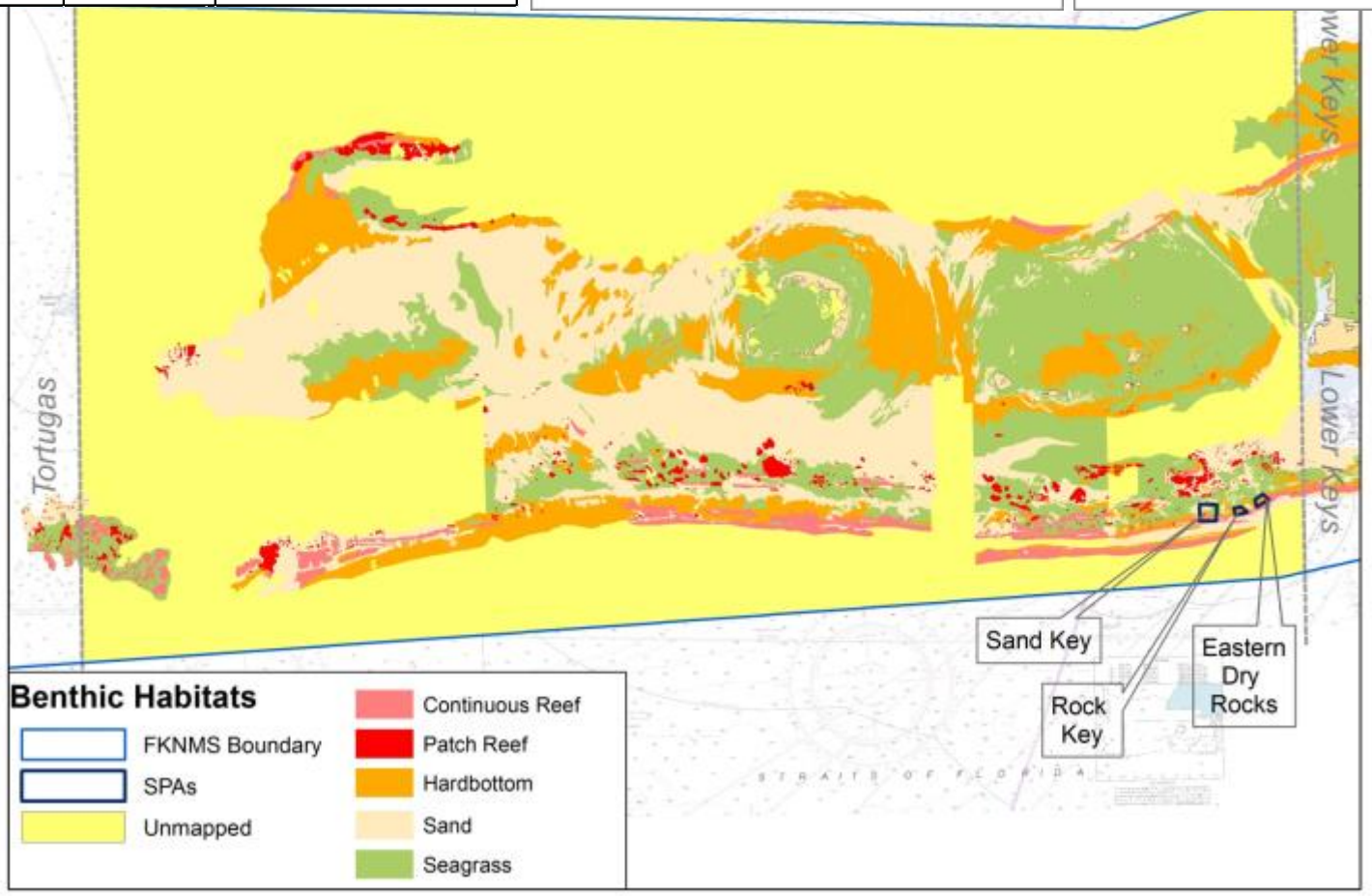

G U L F O F M E X I C O
Tortugas
Lower Keys
Lower Keys
Sand Key
Rock Key
Eastern Dry Rocks
S T R A I T S O F F L O R I D A
Data Extent
Diver Data Present
FKNMS Boundary
SPAs
Continuous Reef
Patch Reef
Hardbottom
Sand
Seagrass

How are habitats distributed?

Habitats	Area (Km^2) SPAs	Area (Km^2) Remaining FKNMS (Marquesas)
Continuous reefs	0.5	57
Patch reefs	0.0	29
Hardbottom	0.6	266
Sand	0.3	492
Seagrass	0.3	408
Unmapped	0.0	1658







High Relief Reefs

Data source

- NMFS diver surveys

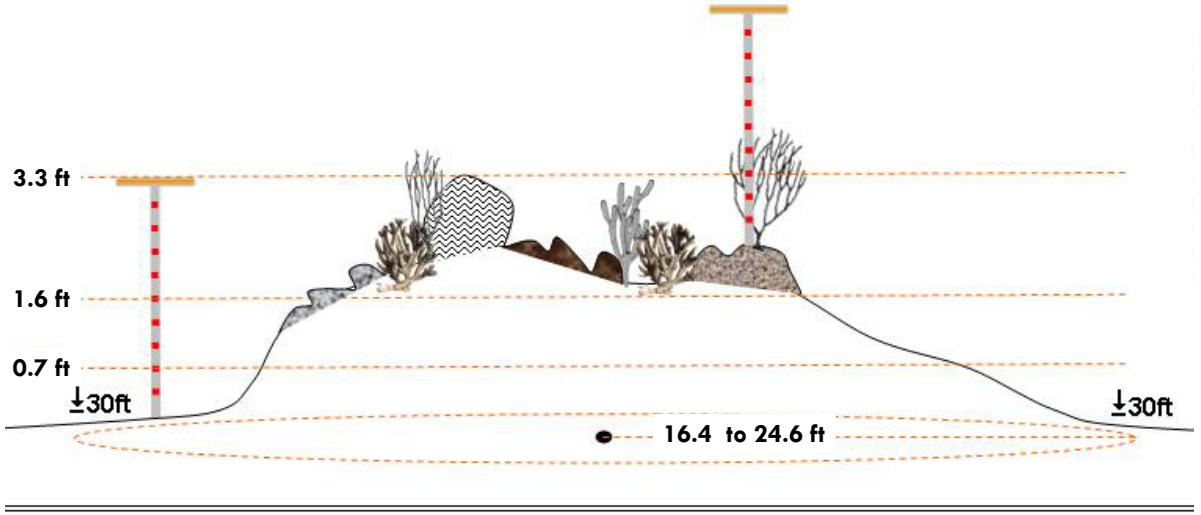
Metric

- **High relief reef**

  Average reef height of 1.6-3.3 ft within a circle 24.6 ft in diameter

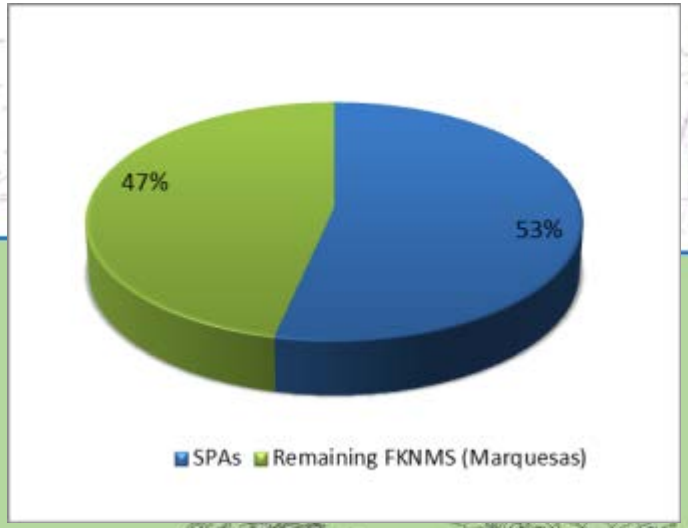
Reference

- Brandt, M. E., N. Zurcher, A. Acosta, J. S. Ault, J. A. Bohnsack, M. W. Feeley, D. E. Harper, J. H. Hunt, T. Kellison, D. B. McClellan, M. E. Patterson, and S. G. Smith. 2009. A cooperative multi-agency reef fish monitoring protocol for the Florida Keys coral reef ecosystem. Natural Resource Report NPS/SFCN/NRR—2009/150. National Park Service, Fort Collins, Colorado.



Where are locations of high relief reefs?

Management Zone	Area (km^2)
SPAs	0.48
Remaining FKNMS (Marquesas)	0.42
Resource Total	1



Tortugas

Lower Keys

Lower Keys

Sand Key

Rock Key

Eastern Dry Rocks

STRAITS OF FLORIDA

High Structural Relief

- High Relief Reef
- Coral Reef and Hardbottom
- FKNMS Boundary
- SPAs
- Remaining FKNMS (Marquesas)

Where are locations of high relief reefs?

Management Zone	Area (km^2)
SPAs	0.48
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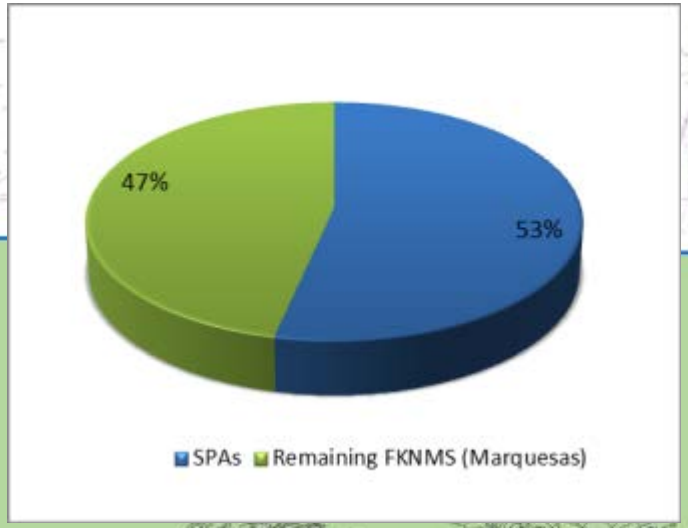


Sand Key

Rock Key

Eastern Dry Rocks

Tortugas

Lower Keys

Lower Keys

STRAITS OF FLORIDA

High Structural Relief

- High Relief Reef
- Coral Reef and Hardbottom
- FKNMS Boundary
- SPAs
- Remaining FKNMS (Marquesas)

Light detection & ranging (LiDAR) mapping: Depth

- Georeferenced spatial information on shape & surface characteristics of the Earth.
- Uses light pulse reflections to calculate distance (depth).
- Produces 3-d representation of shallow seafloor.
- 3-d seafloor complexity was processed to identify high relief in survey area

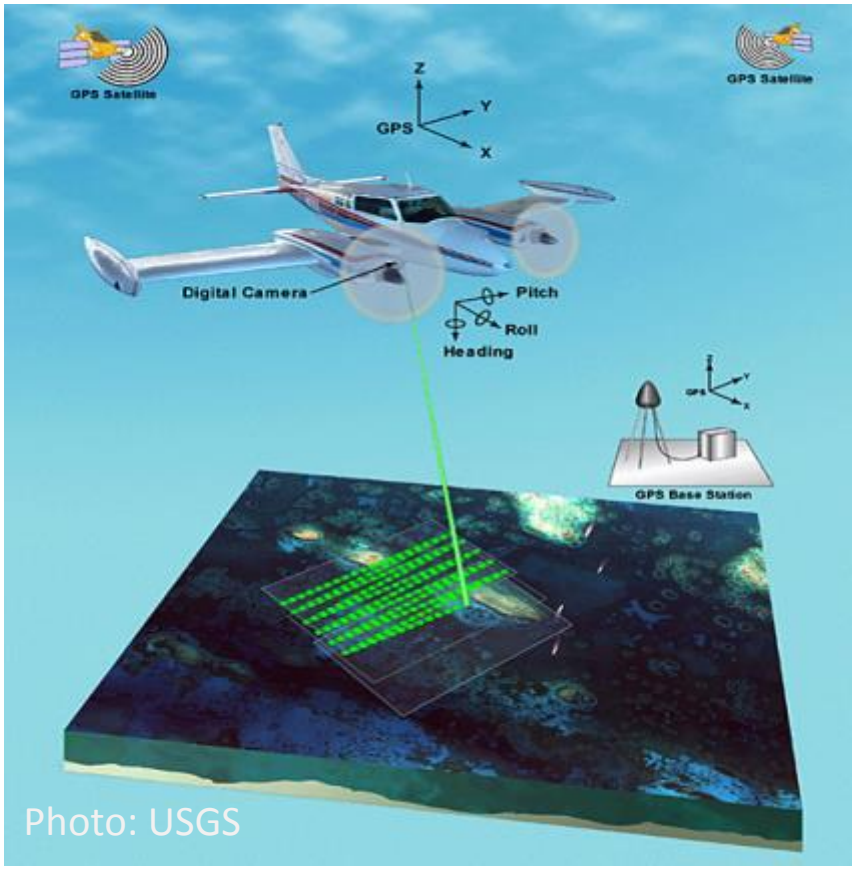
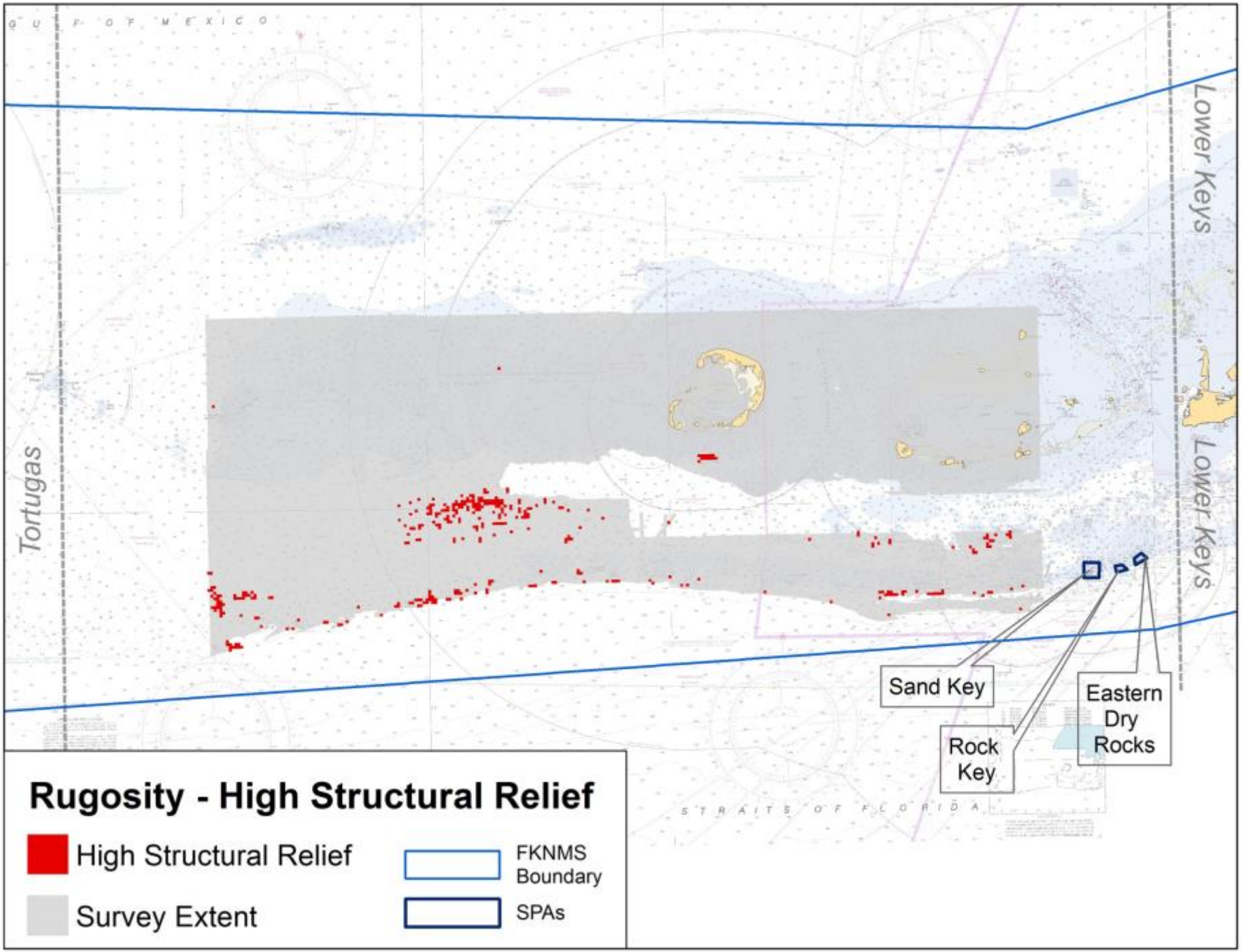


Photo: USGS


G U L F O F M E X I C O
Tortugas
Lower Keys
Lower Keys
Sand Key
Rock Key
Eastern Dry Rocks
S T R A I T S O F F L O R I D A
Rugosity - High Structural Relief
High Structural Relief
Survey Extent
FKNMS Boundary
SPAs

Resilient Reefs

Data source

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

Study Methods

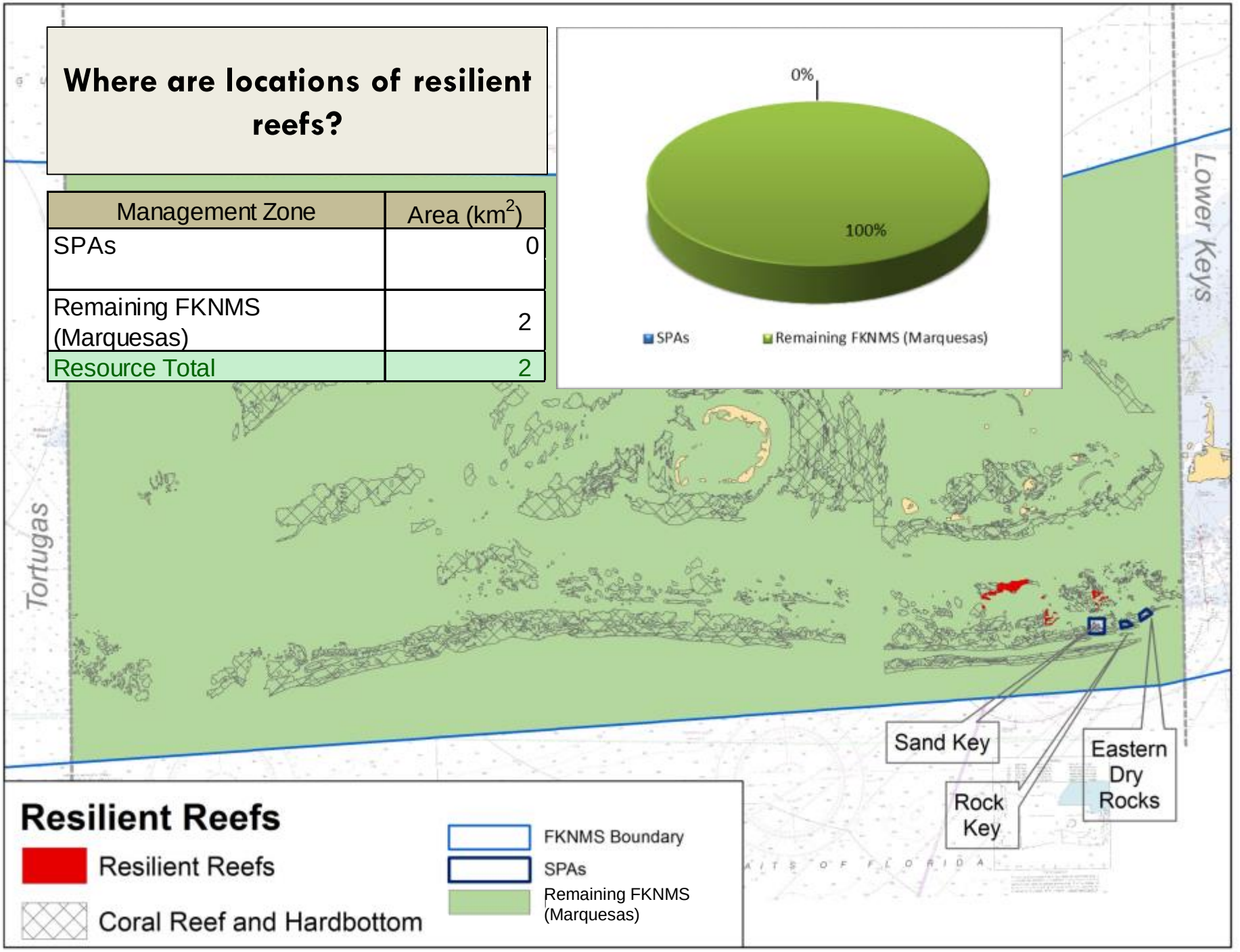
Data selected for high coral colony density, relatively low observations of disease and bleaching

Metrics

- Resilient reefs

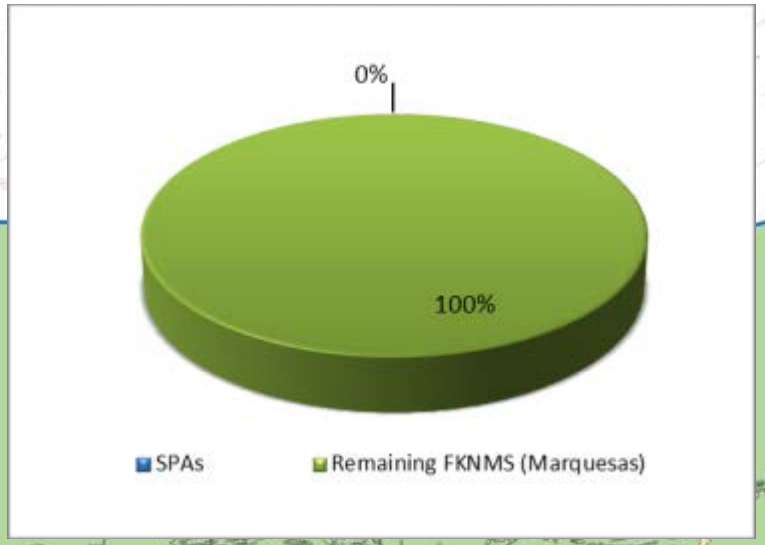
Where are locations of resilient reefs?

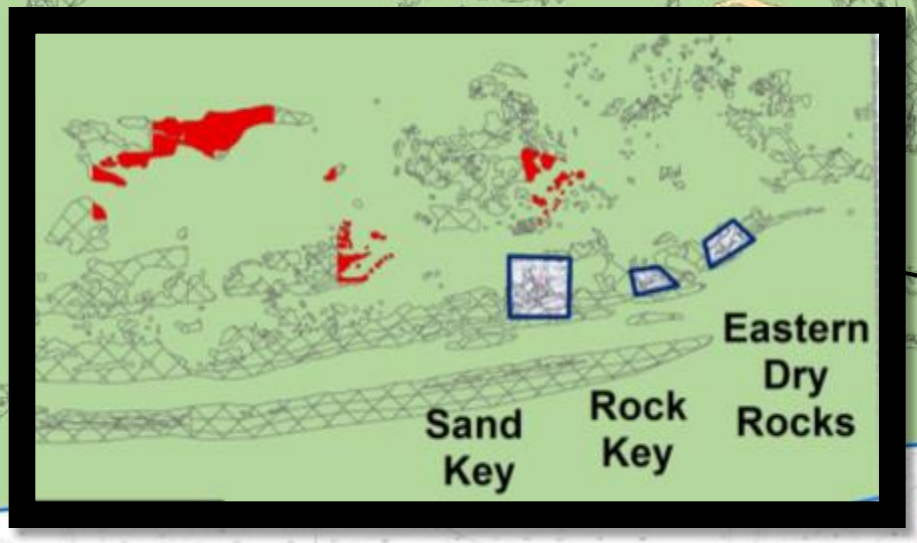
Management Zone	Area (km^2)
SPAs	0
Remaining FKNMS (Marquesas)	2
Resource Total	2



Where are locations of resilient reefs?

Management Zone	Area (km^2)
SPAs	0
Remaining FKNMS (Marquesas)	2
Resource Total	2





Sand Key

Rock Key

Eastern Dry Rocks

Tortugas

Lower Keys

Resilient Reefs

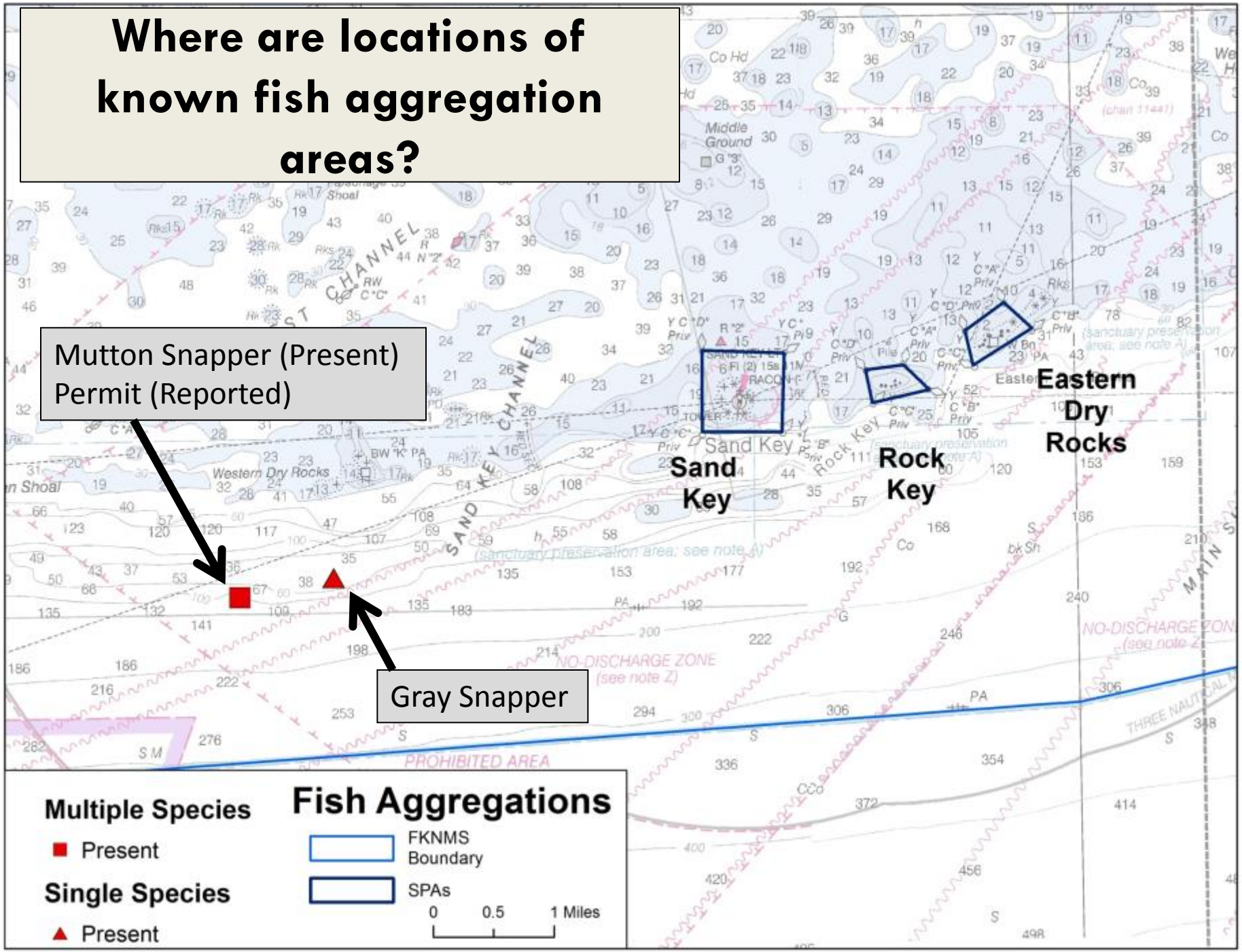
Resilient Reefs

Coral Reef and Hardbottom

FKNMS Boundary

SPAs

Remaining FKNMS (Marquesas)


Where are locations of known fish aggregation areas?
Mutton Snapper (Present)
Permit (Reported)
Gray Snapper
Sand Key
Rock Key
Eastern Dry Rocks
Western Dry Rocks
SAND KEY CHANNEL
CHANNEL
Middle Ground
NO-DISCHARGE ZONE
(see note Z)
PROHIBITED AREA
(sanctuary preservation area; see note A)
Multiple Species
Present
Single Species
Present
Fish Aggregations
FKNMS Boundary
SPAs
0
0.5
1 Miles

Sea turtle sightings

Data sources

- Inwater Research Group, FL

Species

- Loggerhead sea turtle (*Caretta caretta*)
- Green sea turtle (*Chelonia mydas)*
- Hawksbill sea turtle (*Eretmochelys imbricata*)
- Kemp's ridley sea turtle (*Lepidochelys kempii*)

Study Methods

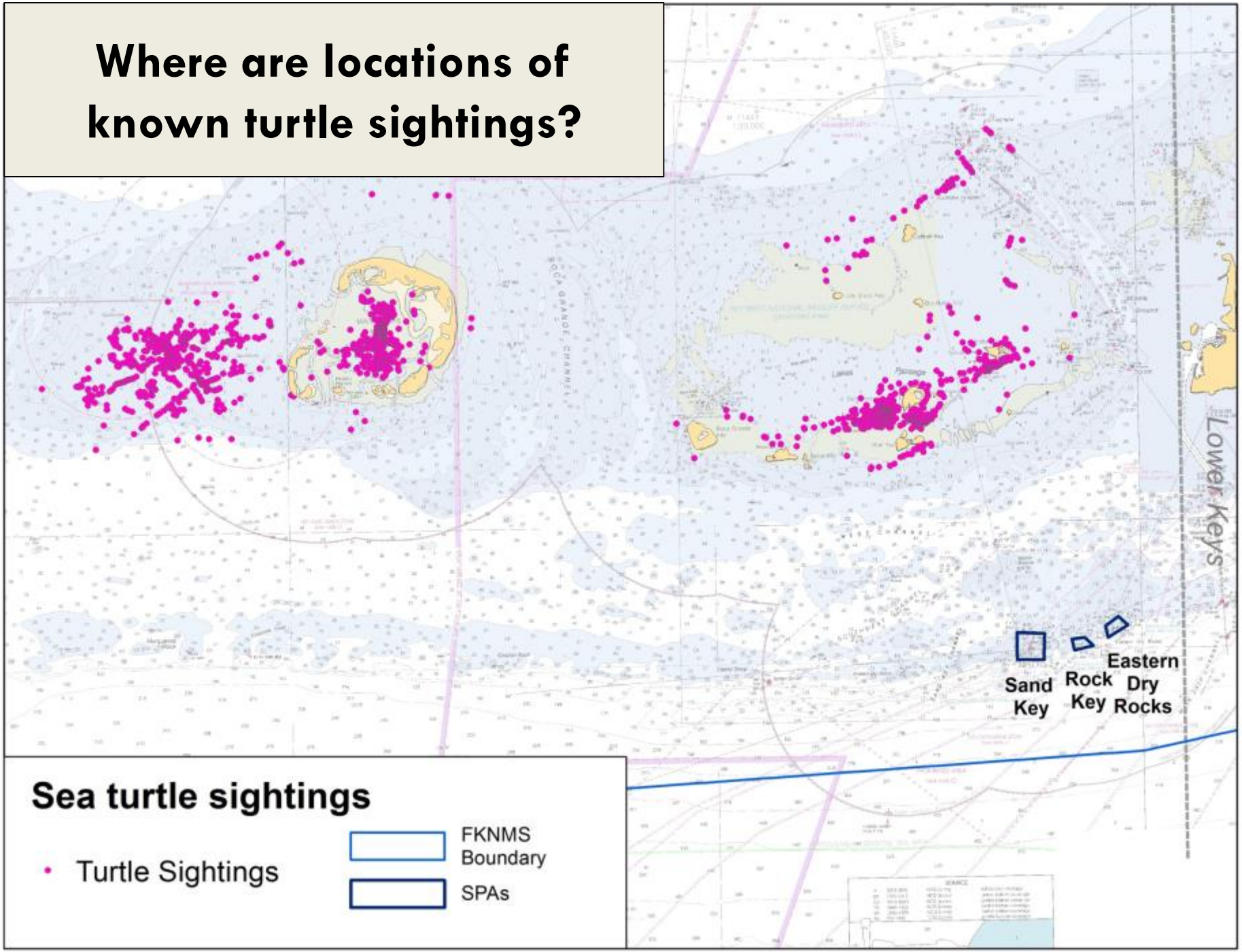
- Visual sightings collected 2006 - 2012

Metrics

- presence

Photo: Joe Marino

Where are locations of known turtle sightings?



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?

Sand Key

Rock Key

Threatened Coral Species

+ Staghorn Coral

▲ Pillar Coral

○ Elkhorn Coral

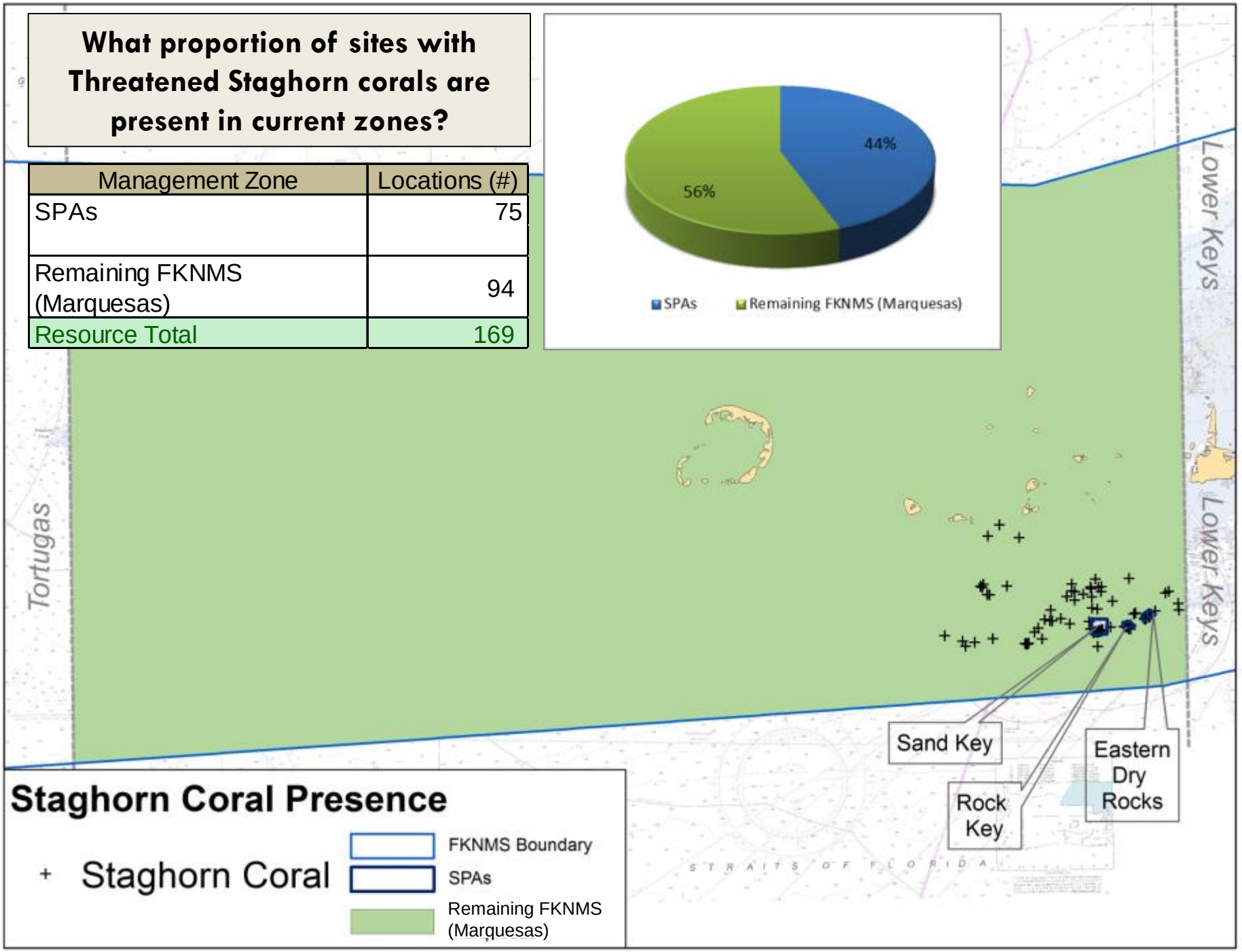
SPAs

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

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

Management Zone	Locations (#)
SPAs	75
Remaining FKNMS (Marquesas)	94
Resource Total	169

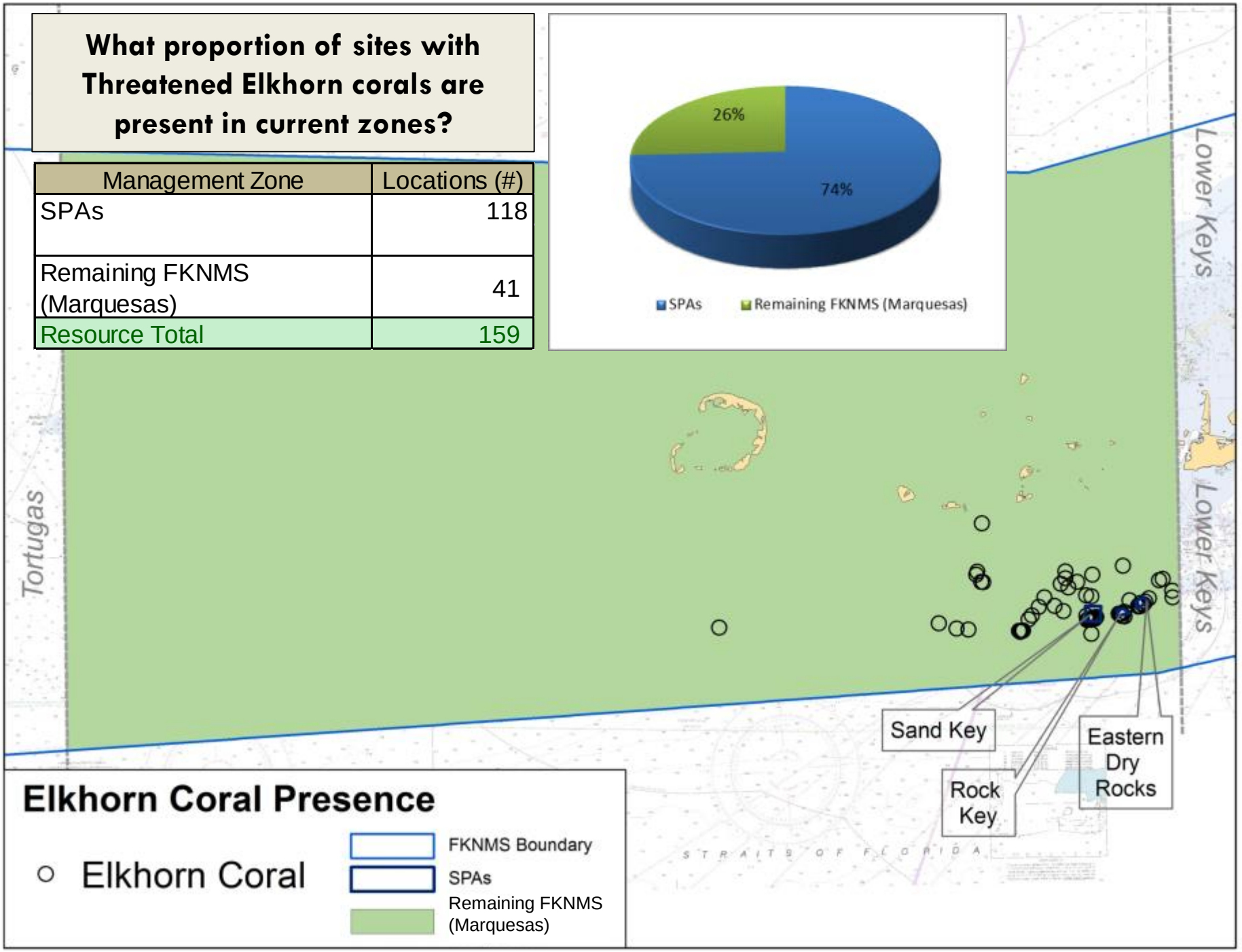


What proportion of sites with Threatened Elkhorn corals are present in current zones?

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

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

Management Zone	Locations (#)
SPAs	118
Remaining FKNMS (Marquesas)	41
Resource Total	159

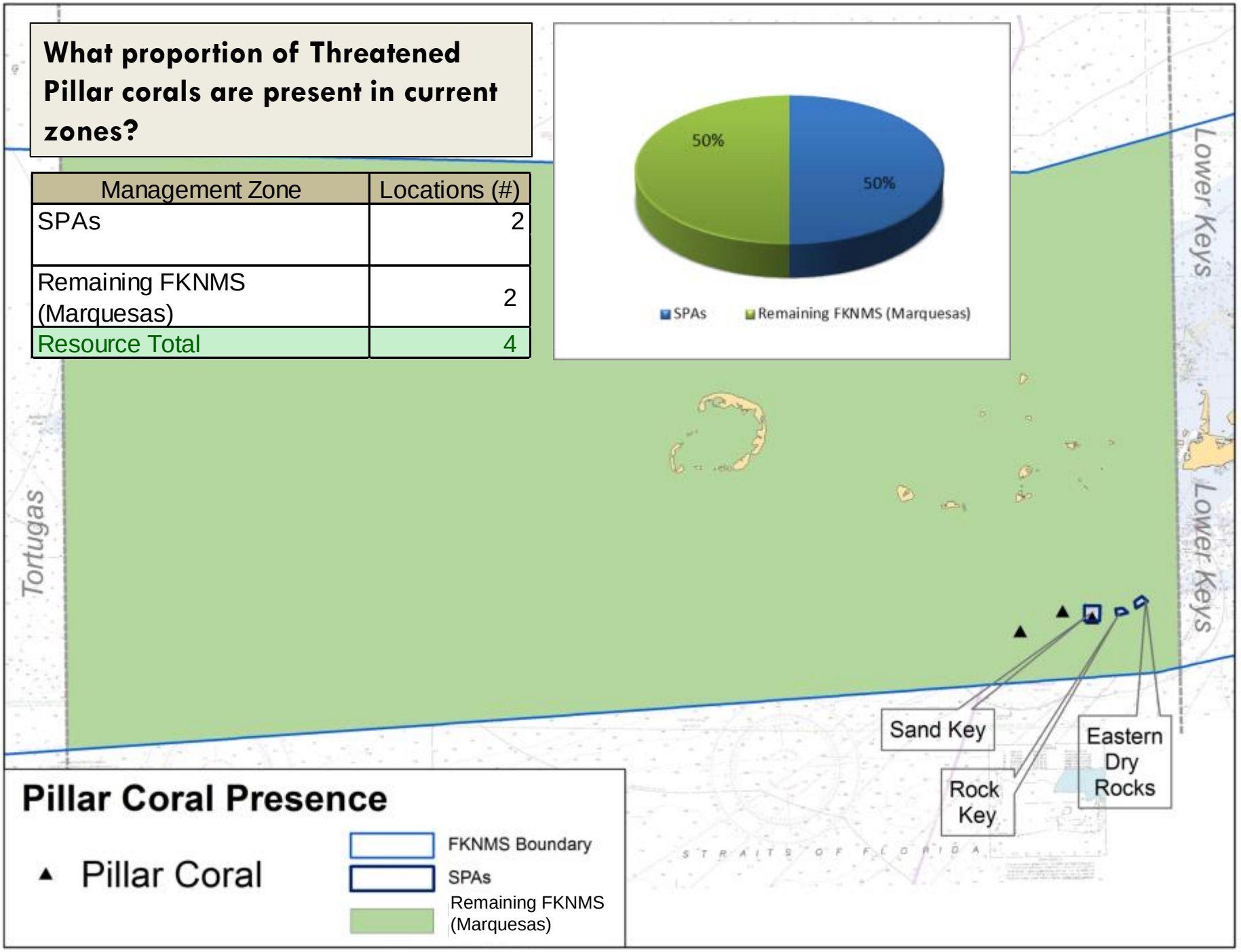


What proportion of sites with Threatened Pillar corals are present in current zones?

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

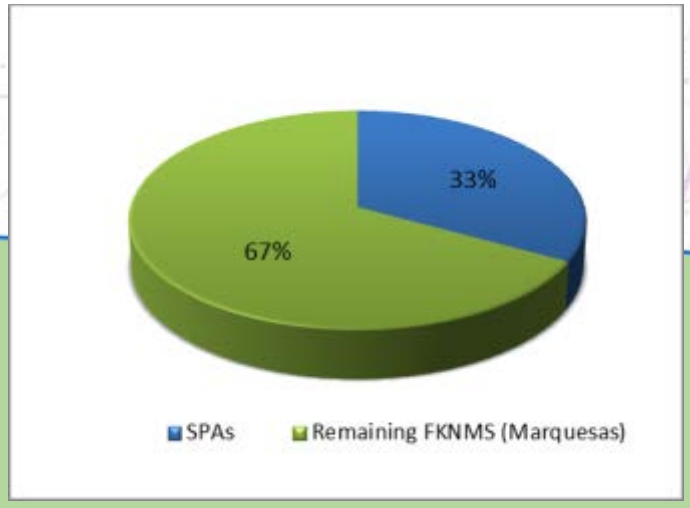
What proportion of Threatened Pillar corals are present in current zones?

Management Zone	Locations (#)
SPAs	2
Remaining FKNMS (Marquesas)	2
Resource Total	4



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

Management Zone	Locations (#)
SPAs	88
Remaining FKNMS (Marquesas)	179
Resource Total	267



Tortugas

Lower Keys

Lower Keys

Sand Key

Rock Key

Eastern Dry Rocks

STRAITS OF FLORIDA

Candidate Coral Presence

- Candidate Coral

FKNMS Boundary

SPAs

Remaining FKNMS (Marquesas)

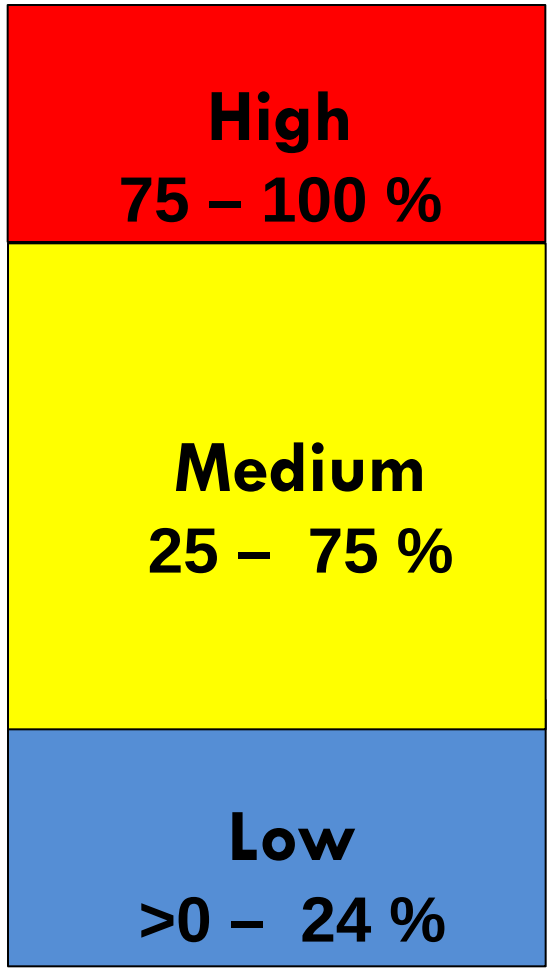
Other ecosystem metrics

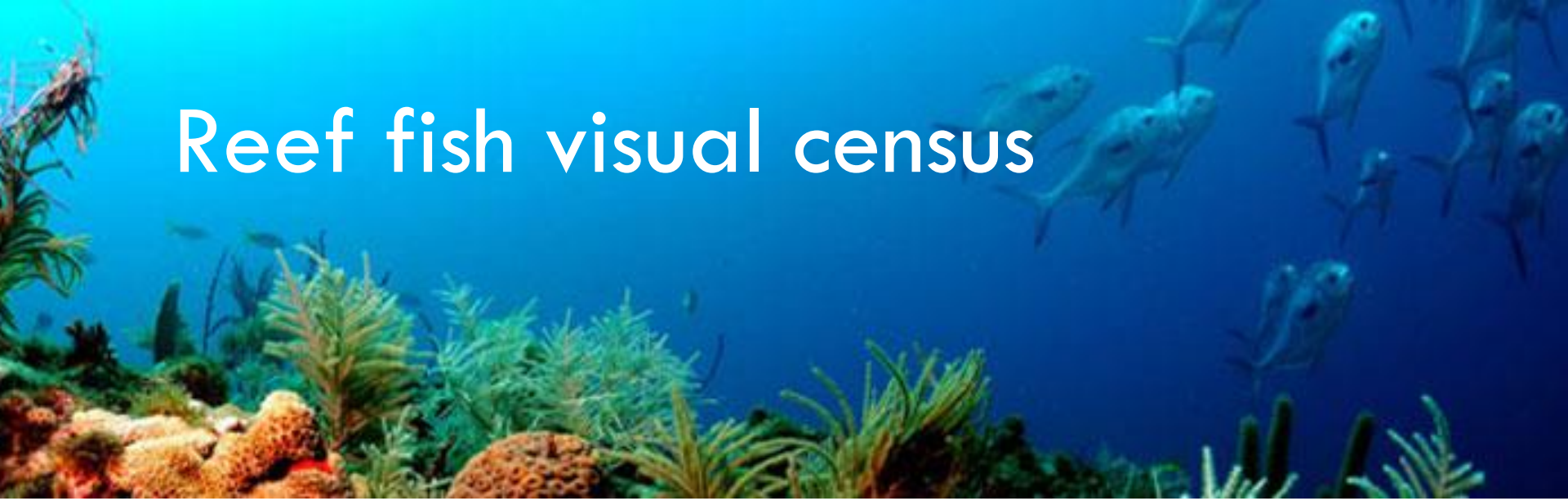
- **Fish abundance**
- **Fish species richness**
- **Stony Coral cover**
- **Stony Coral species richness**
- **Soft Coral cover**
- **Soft Coral species richness**

How can we tell what areas are good?

Rank survey site relative other sites in Marquesas

High	Top 25%
Medium	Middle
Low	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

Photo courtesy of FKNMS

Fish Metrics

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

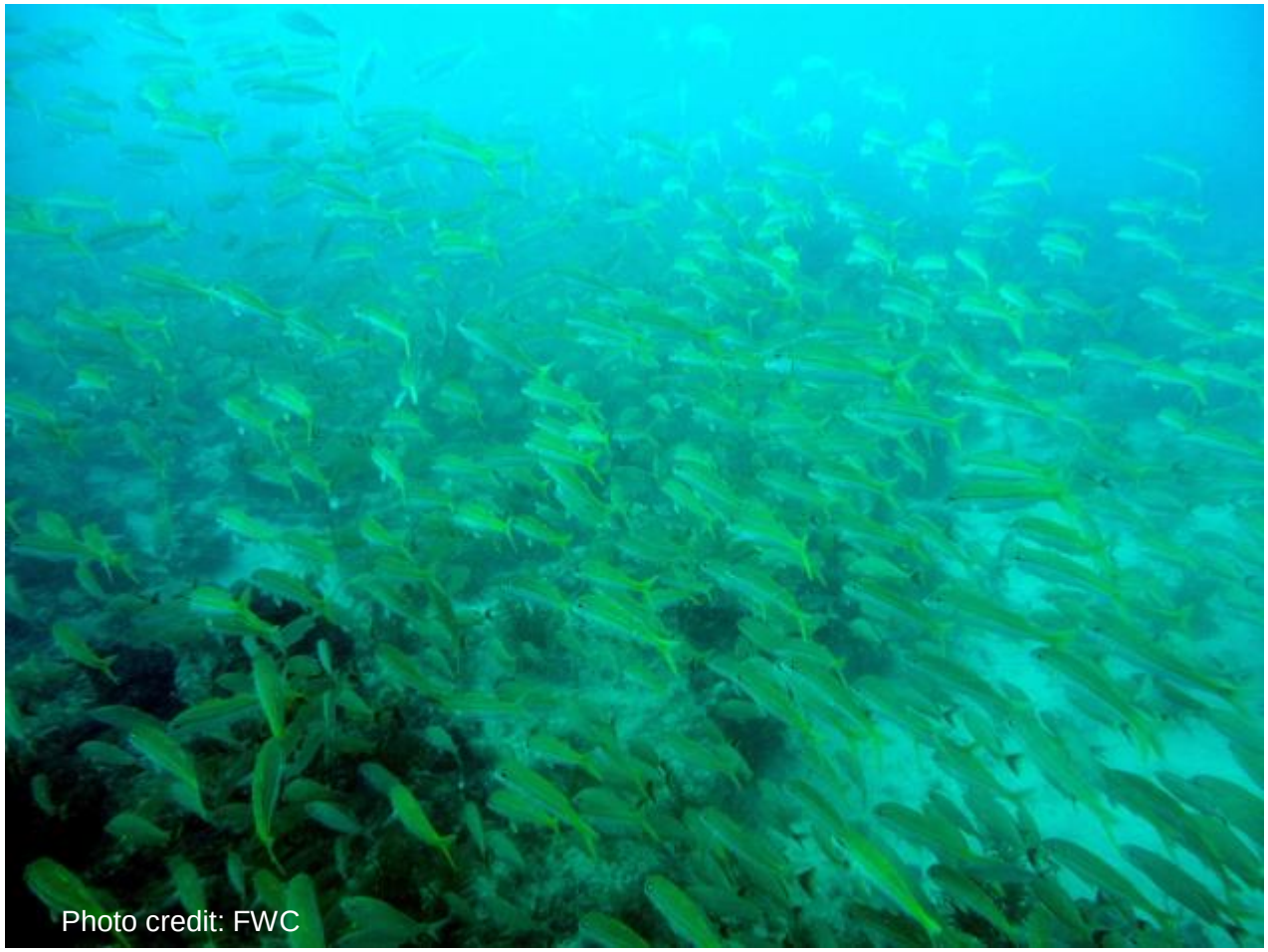
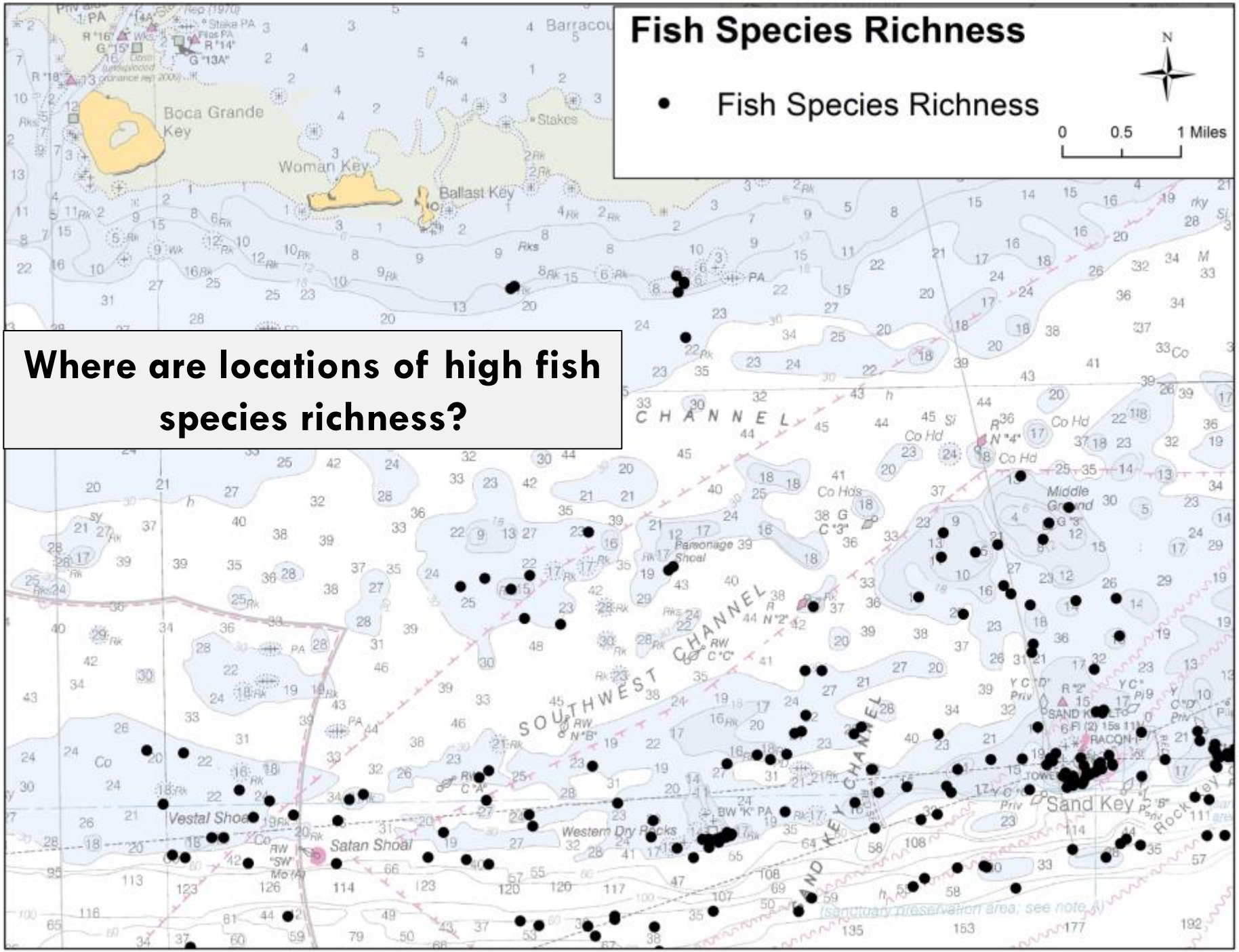
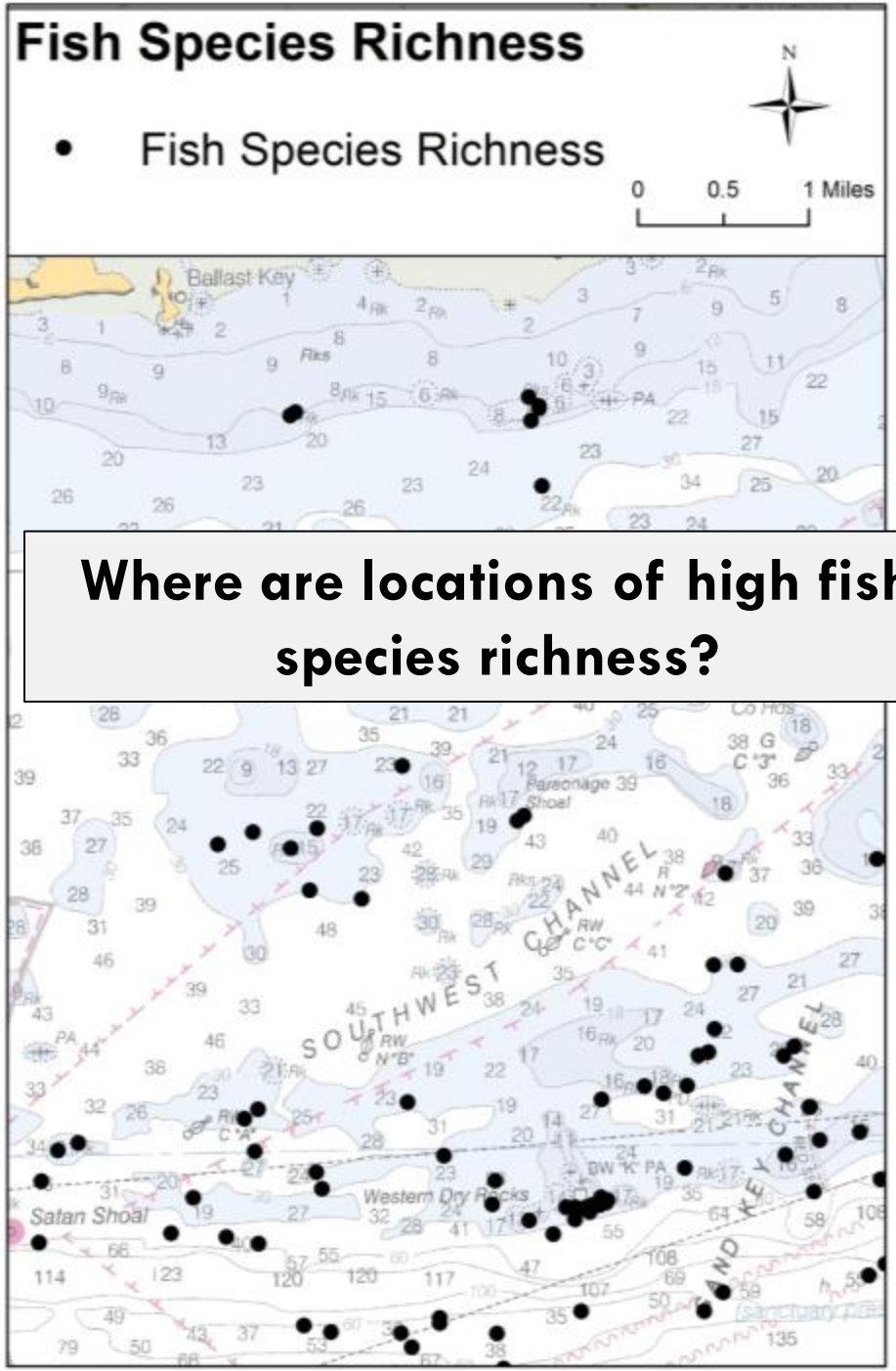


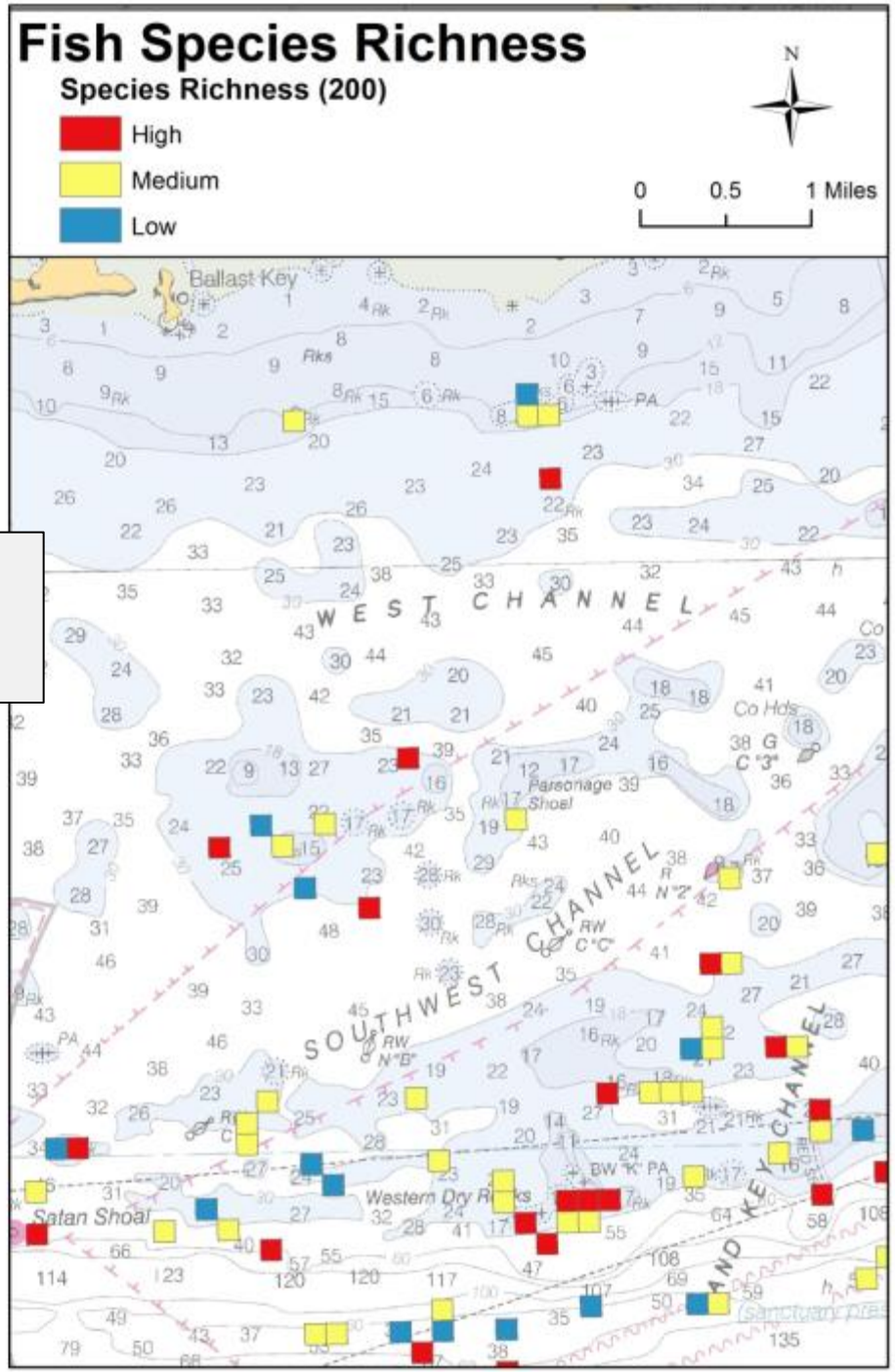
Photo credit: FWC

Photo credit: NOAA


Fish Species Richness
Fish Species Richness
N
0
0.5
1 Miles
Where are locations of high fish species richness?
Boca Grande Key
Woman Key
Ballast Key
Stakes
CHANNEL
SOUTHWEST CHANNEL
SAND KEY CHANNEL
Parsonage Shoal
Middle Ground
Vestal Shoal
Satan Shoal
Western Dry Rocks
Sand Key
Rock Key

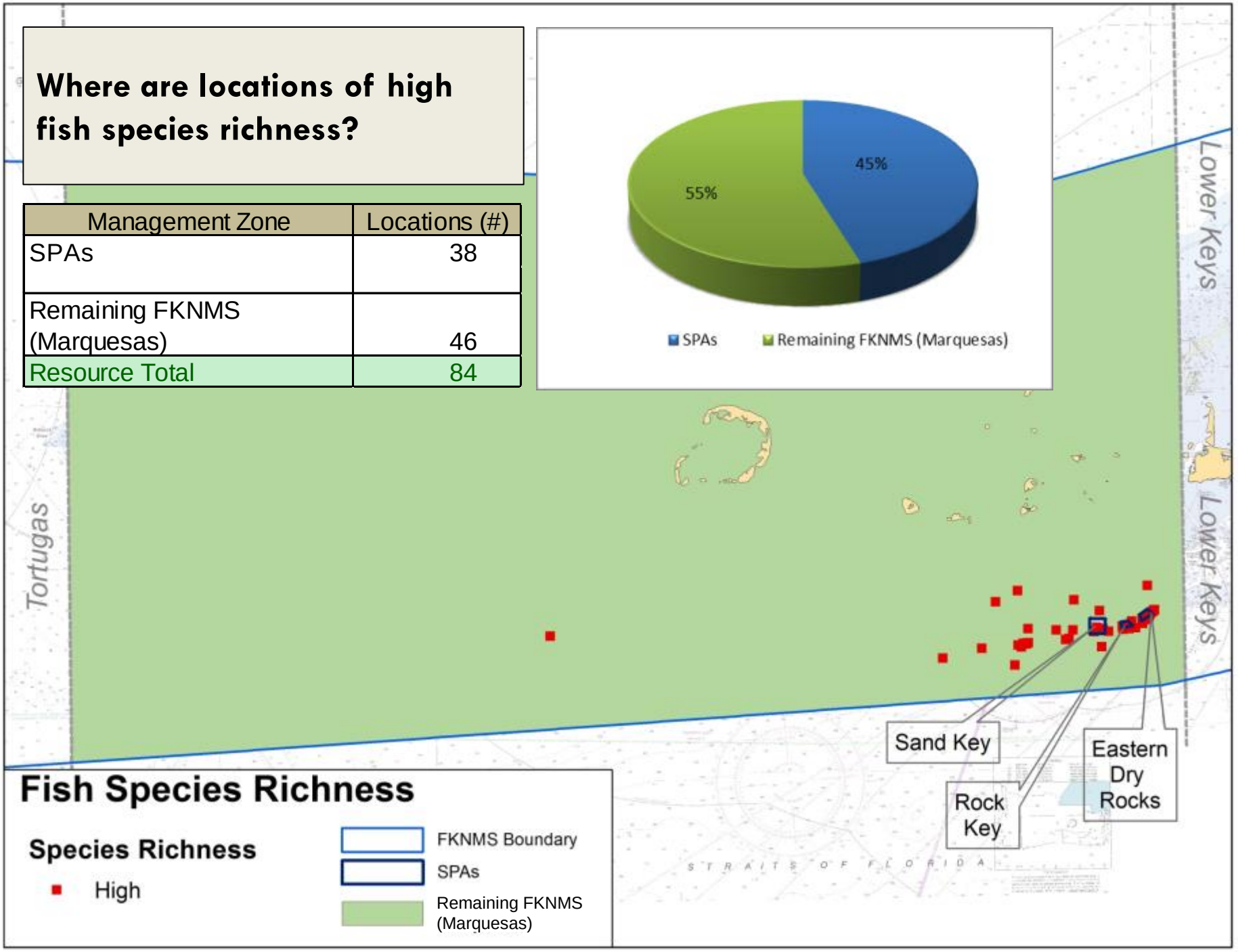


Where are locations of high fish species richness?



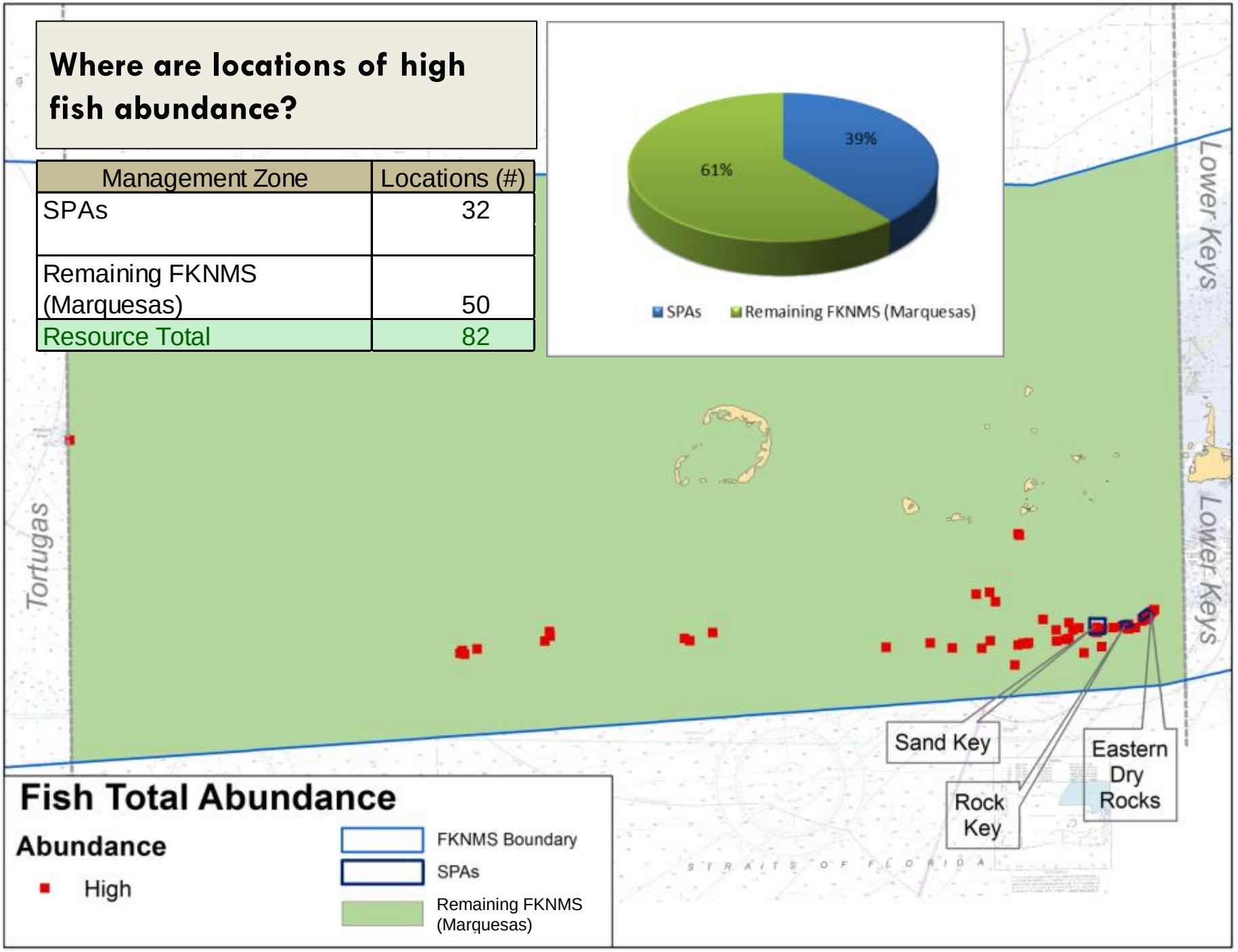
Where are locations of high fish species richness?

Management Zone	Locations (#)
SPAs	38
Remaining FKNMS (Marquesas)	46
Resource Total	84

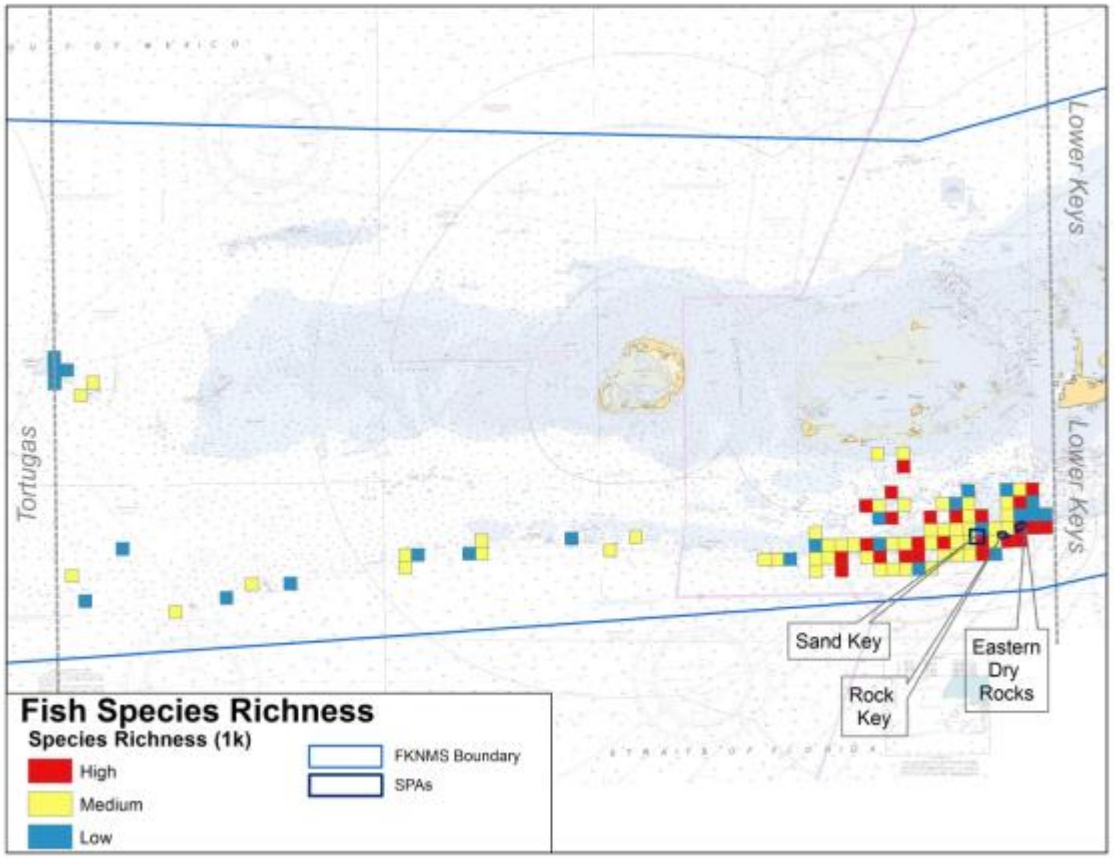


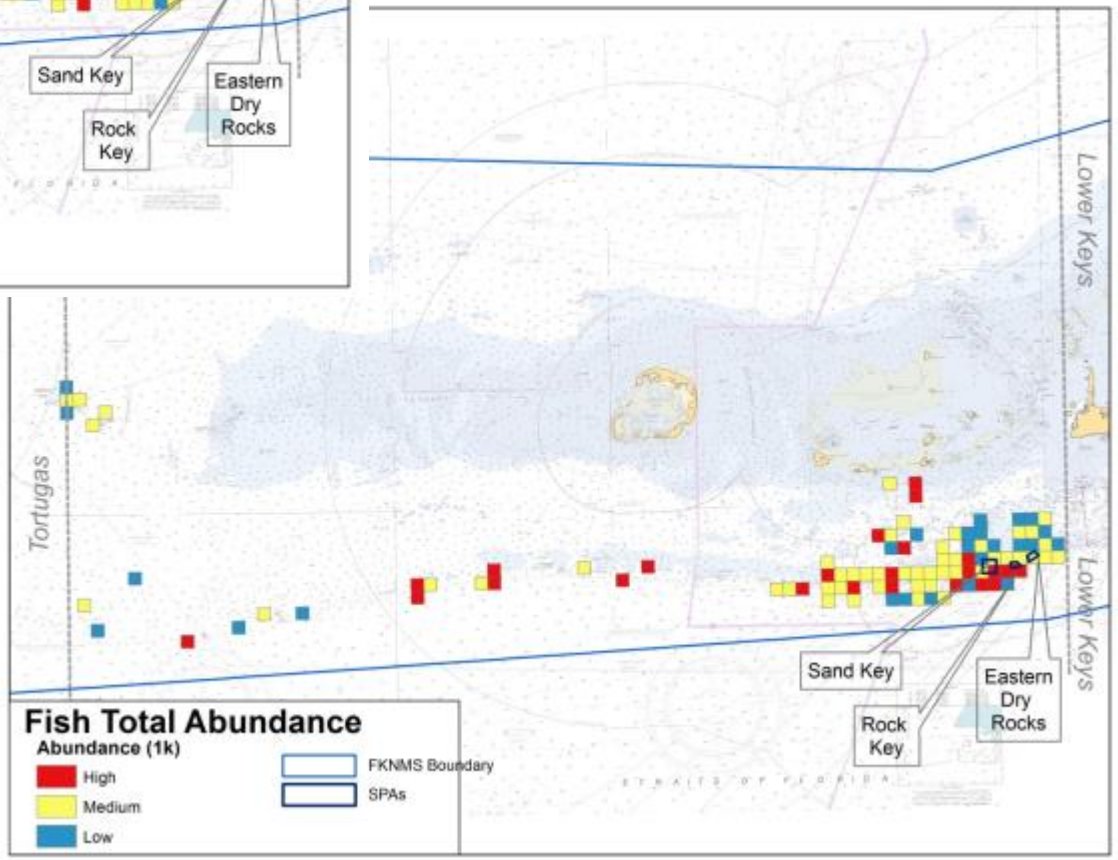
Where are locations of high fish abundance?

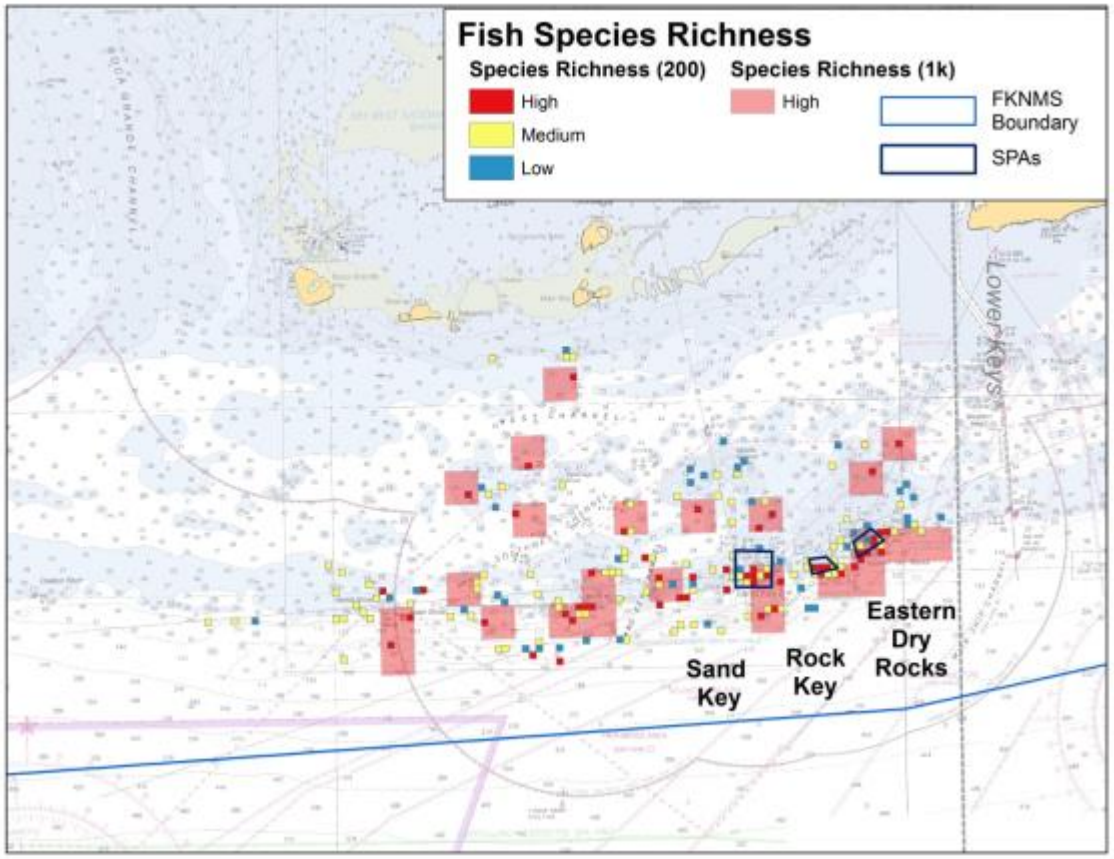
Management Zone	Locations (#)
SPAs	32
Remaining FKNMS (Marquesas)	50
Resource Total	82



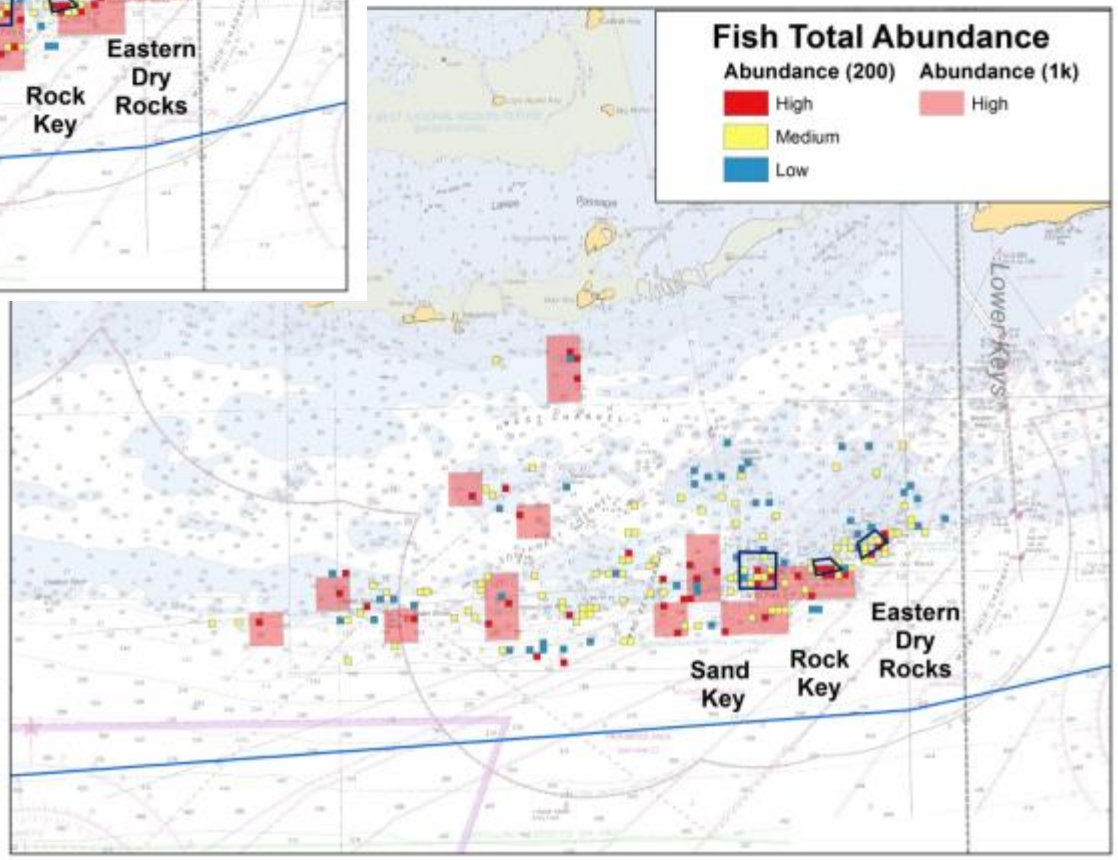
entire
Marquesas region

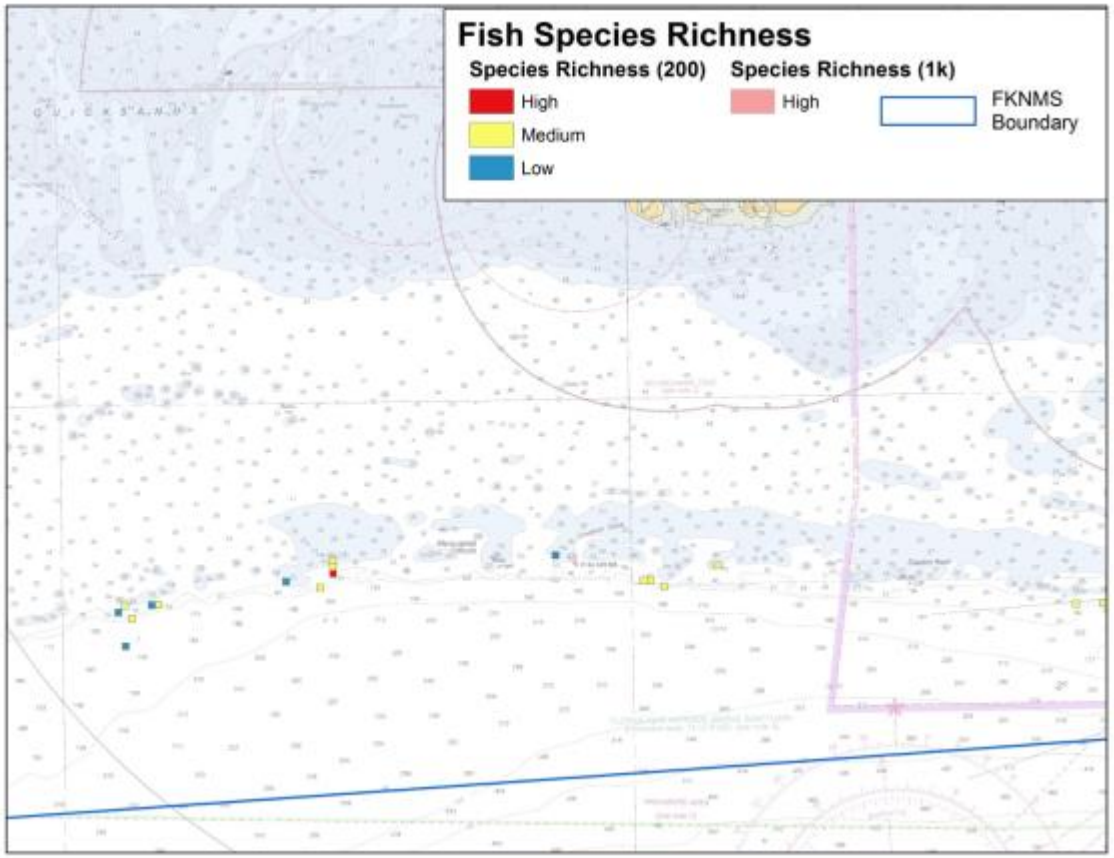




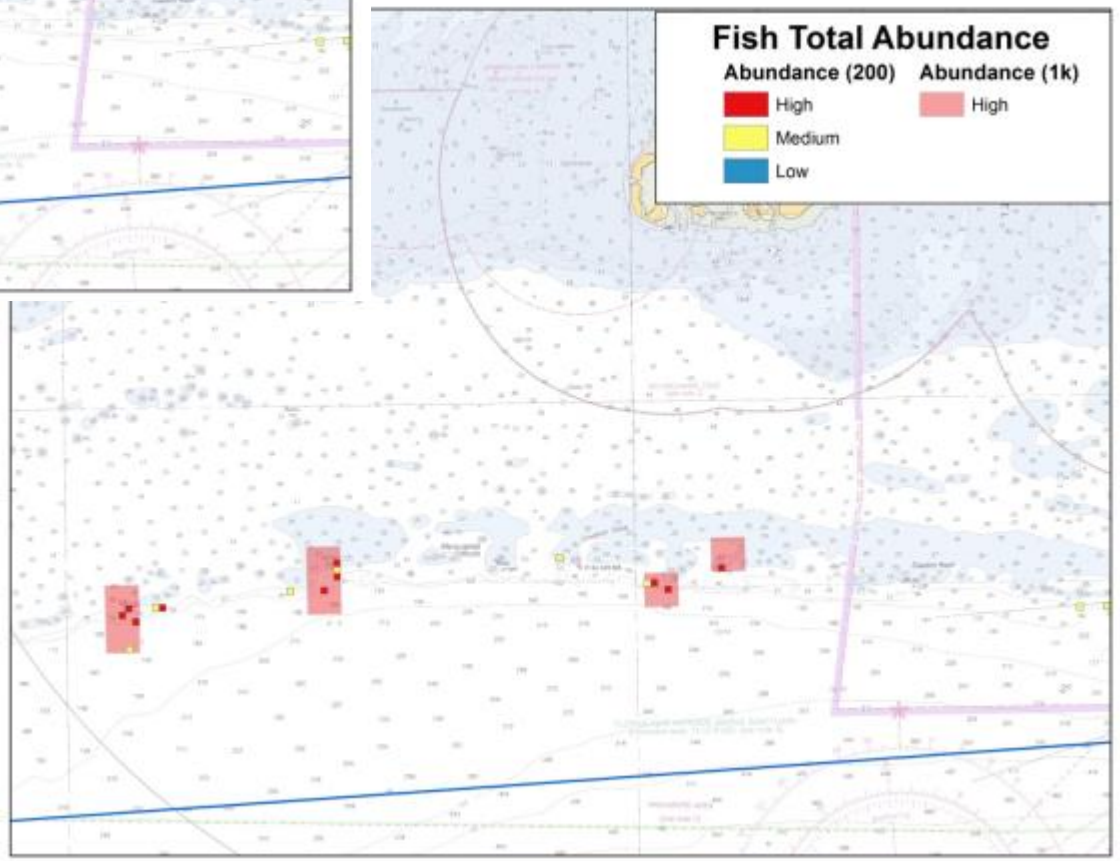


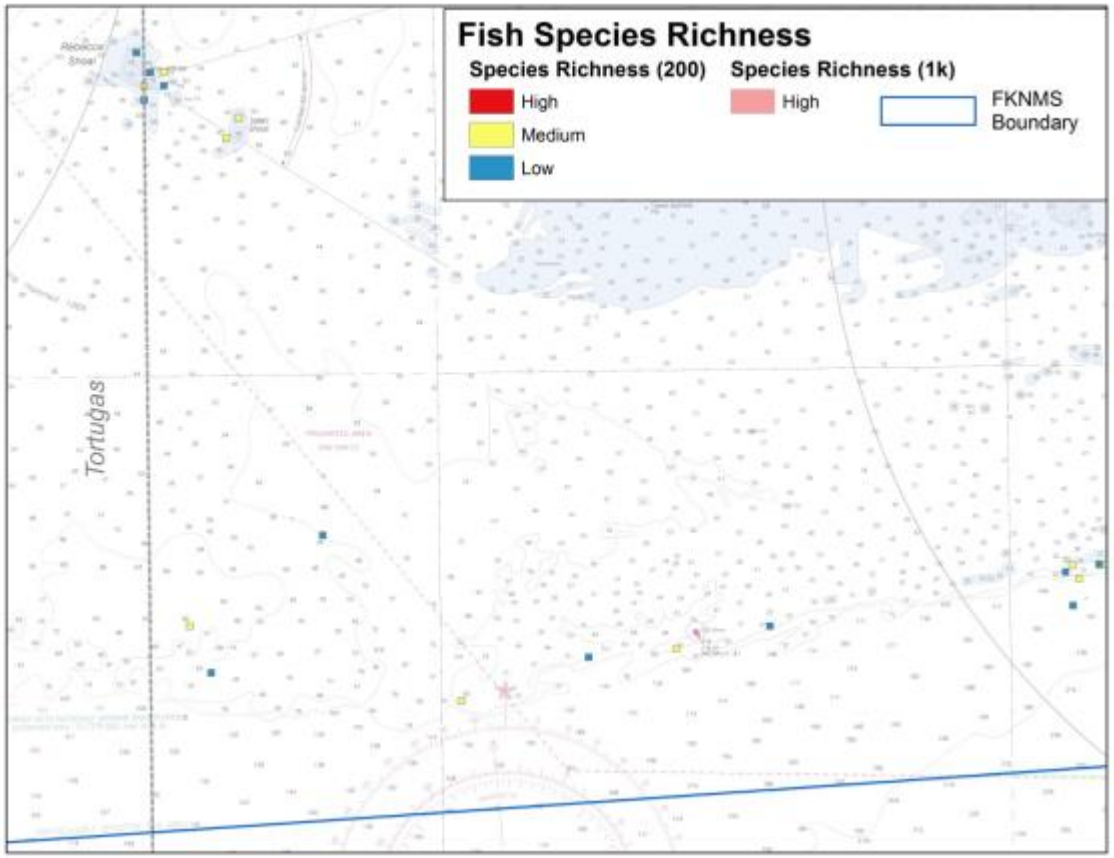
Eastern 1/3 of Marquesas region



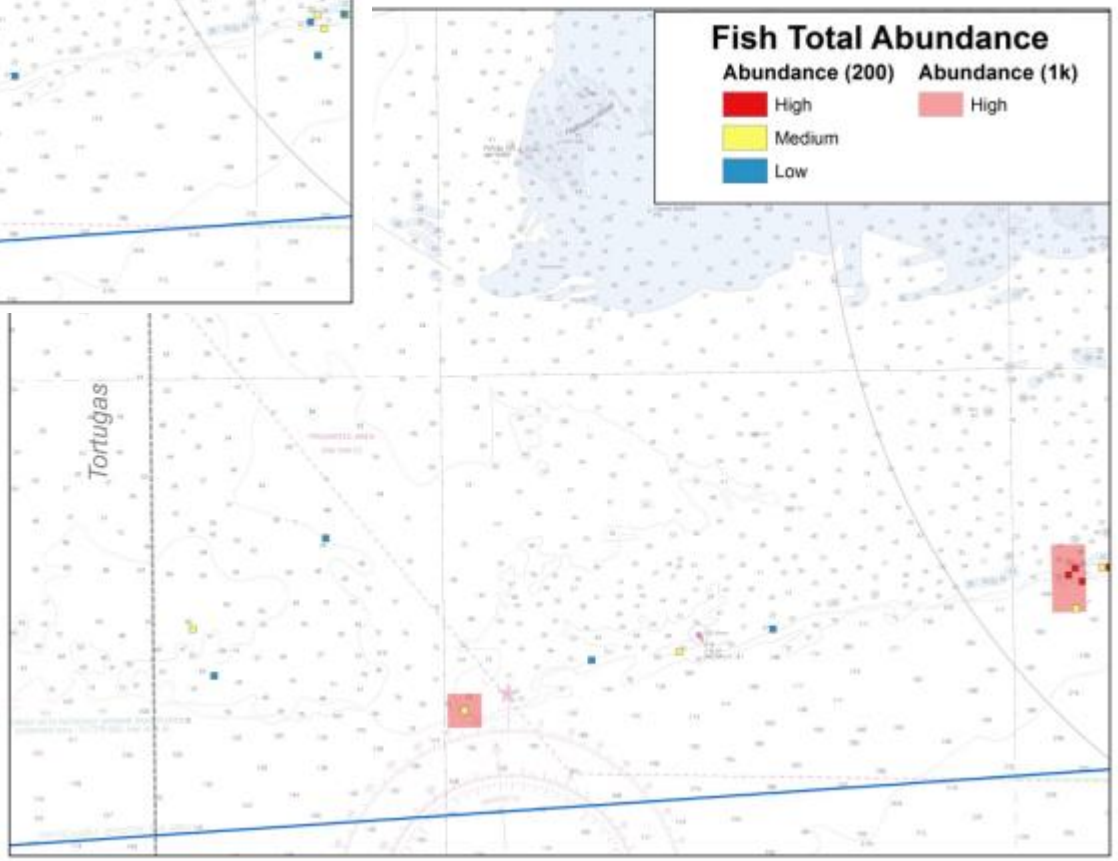


Central 1/3 of Marquesas region

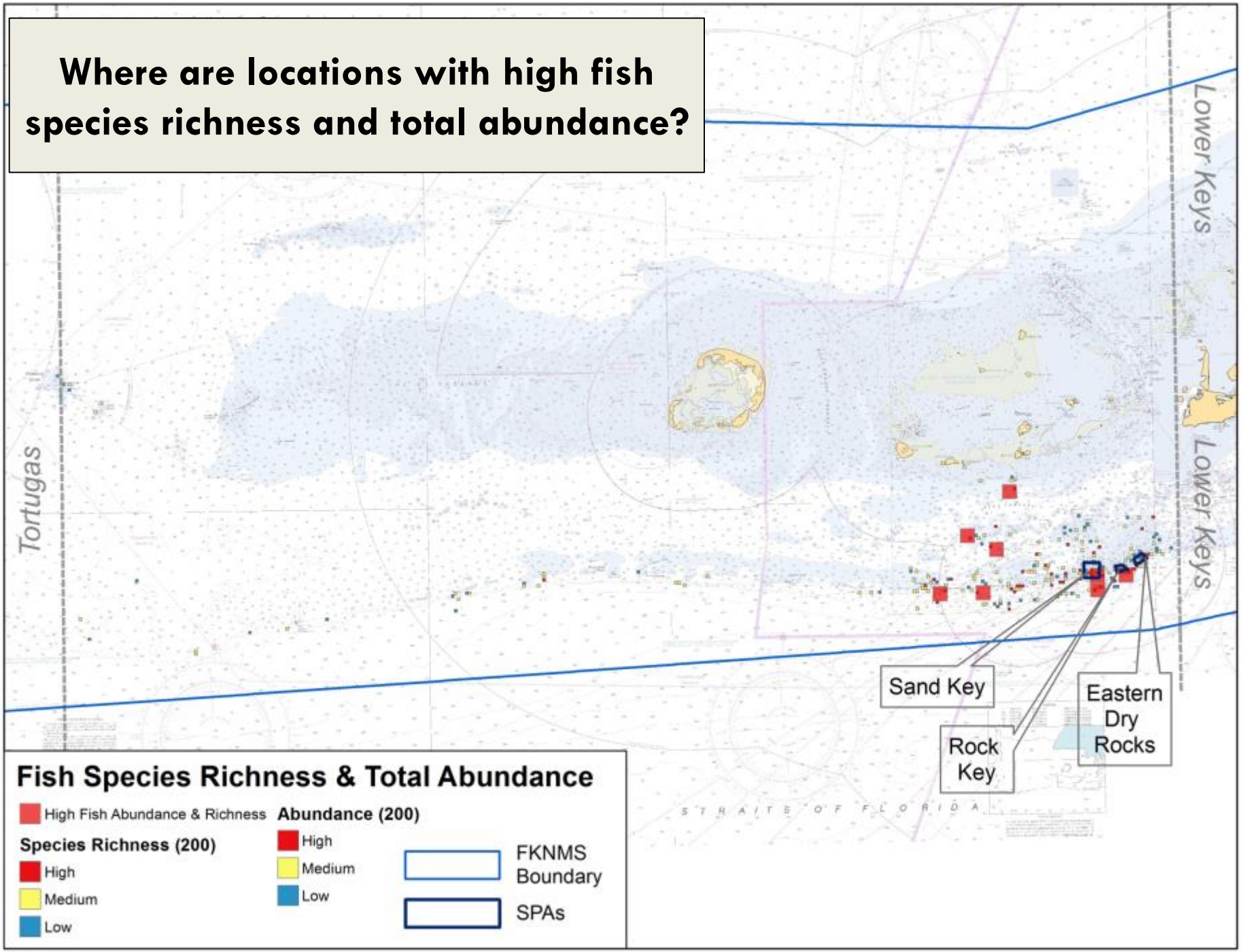




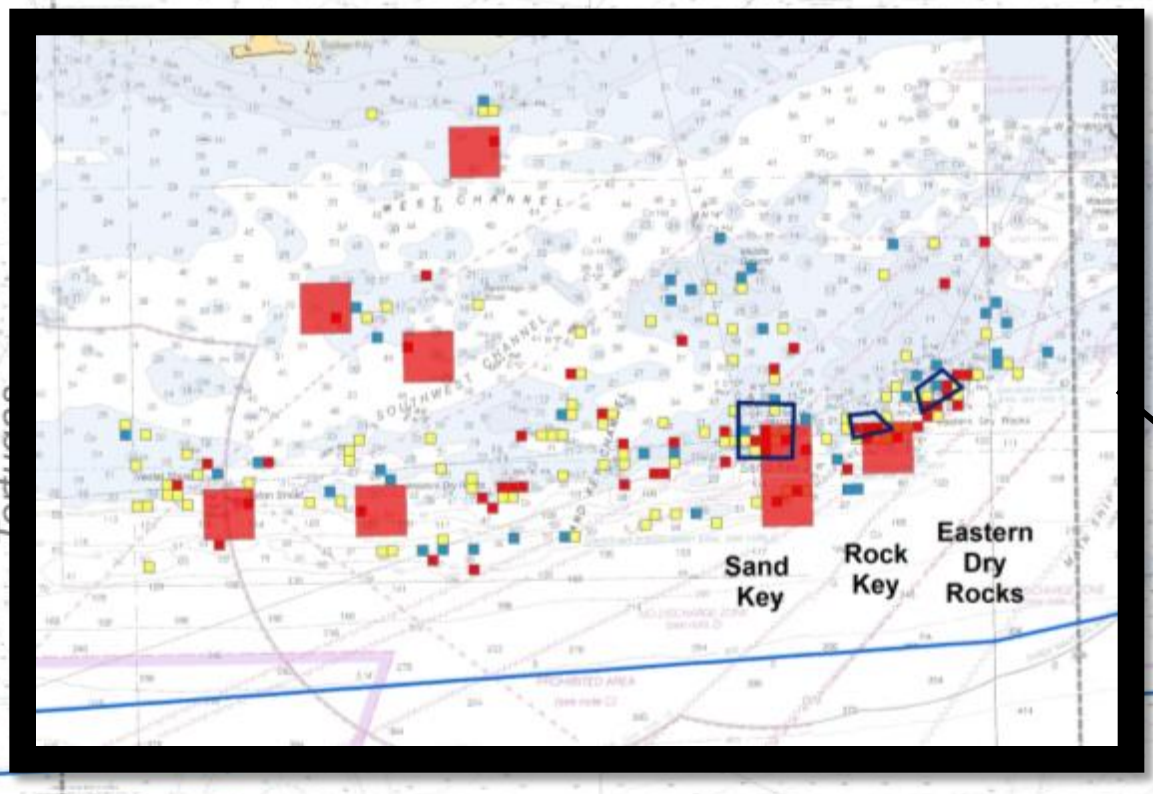
Western 1/3 of Marquesas region

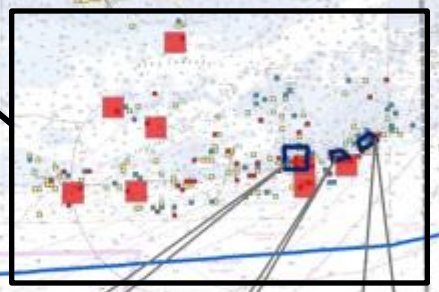


Where are locations with high fish species richness and total abundance?



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





Lower Keys

Lower Keys

STRAITS OF FLORIDA

Fish Species Richness & Total Abundance

High Fish Abundance & Richness

Species Richness (200)
- High
- Medium
- Low

Abundance (200)
- High
- Medium
- Low

FKNMS Boundary

SPAs

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**

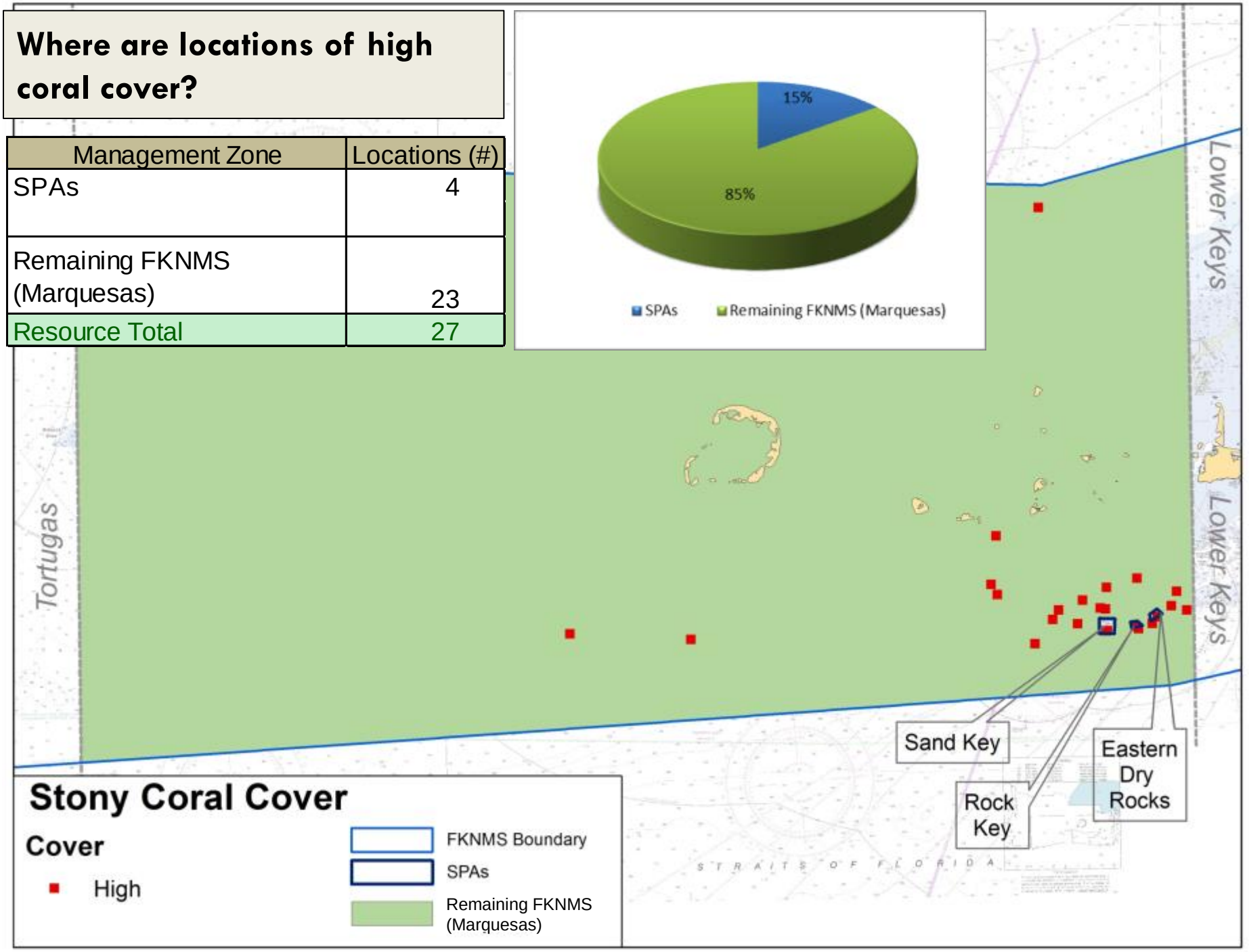
Photo courtesy of TNC

Hard Corals

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

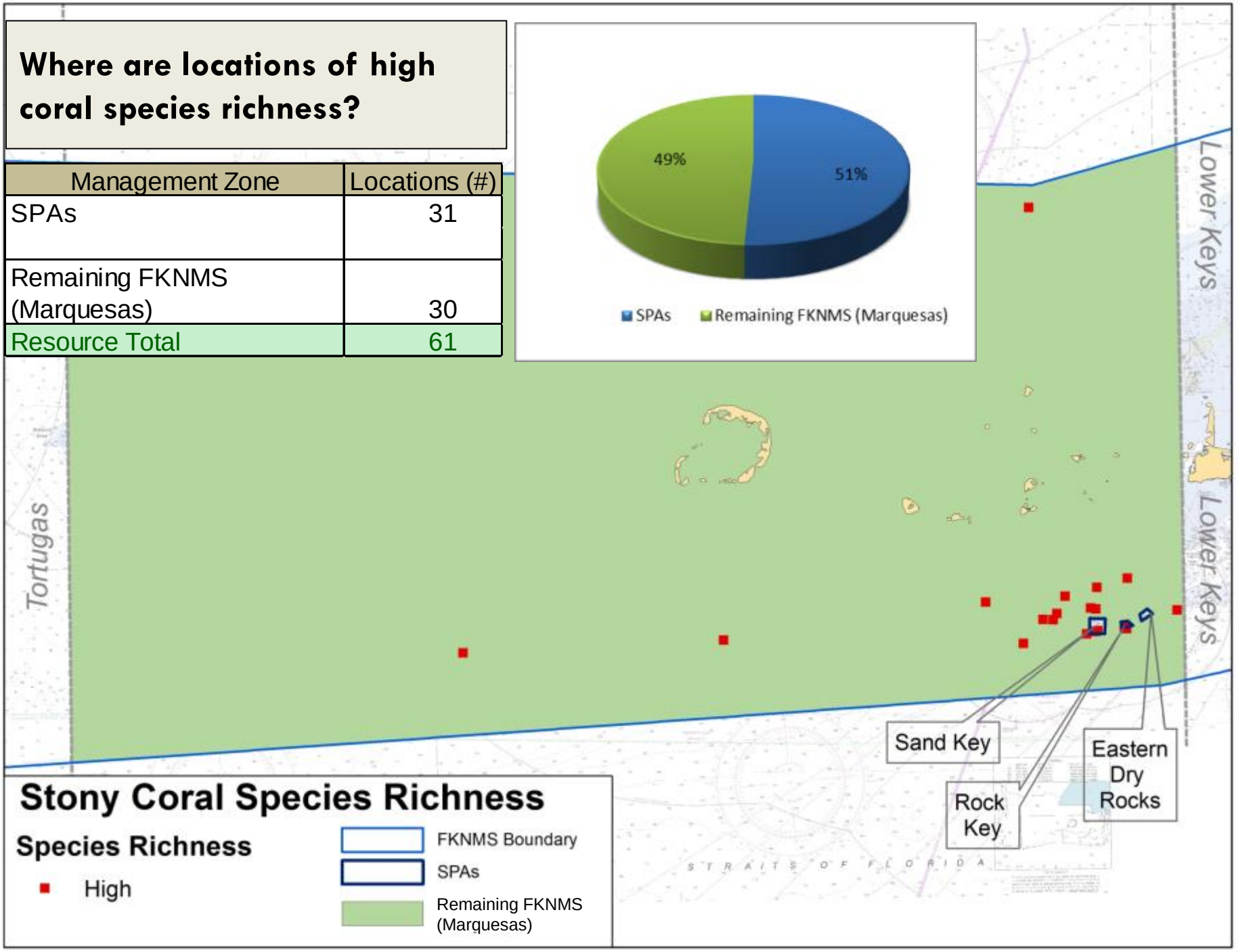
Where are locations of high coral cover?

Management Zone	Locations (#)
SPAs	4
Remaining FKNMS (Marquesas)	23
Resource Total	27

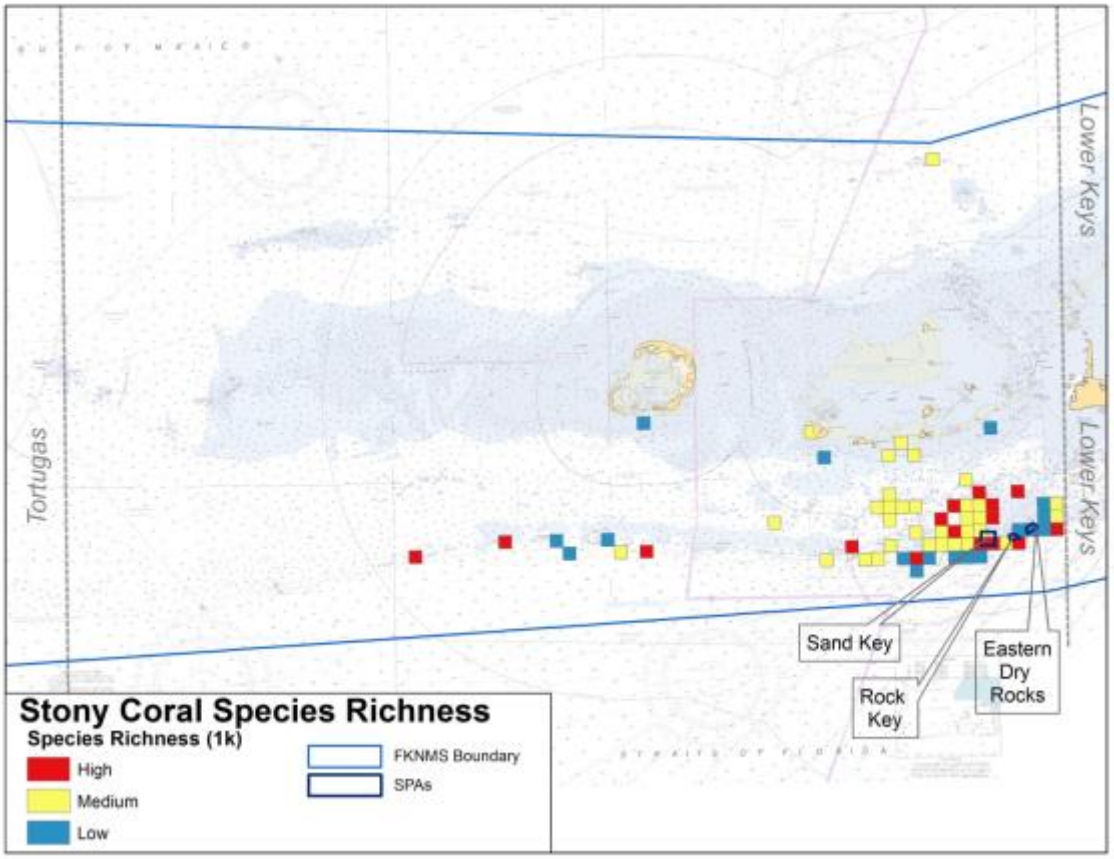


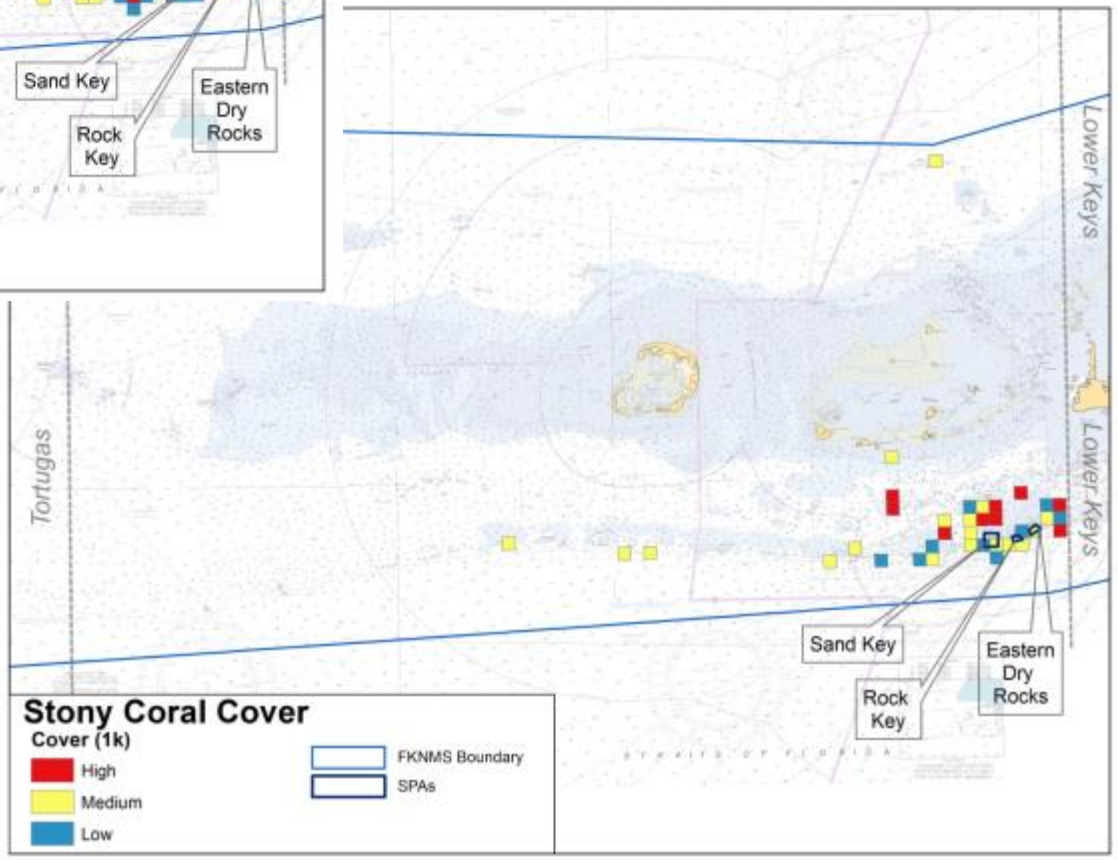
Where are locations of high coral species richness?

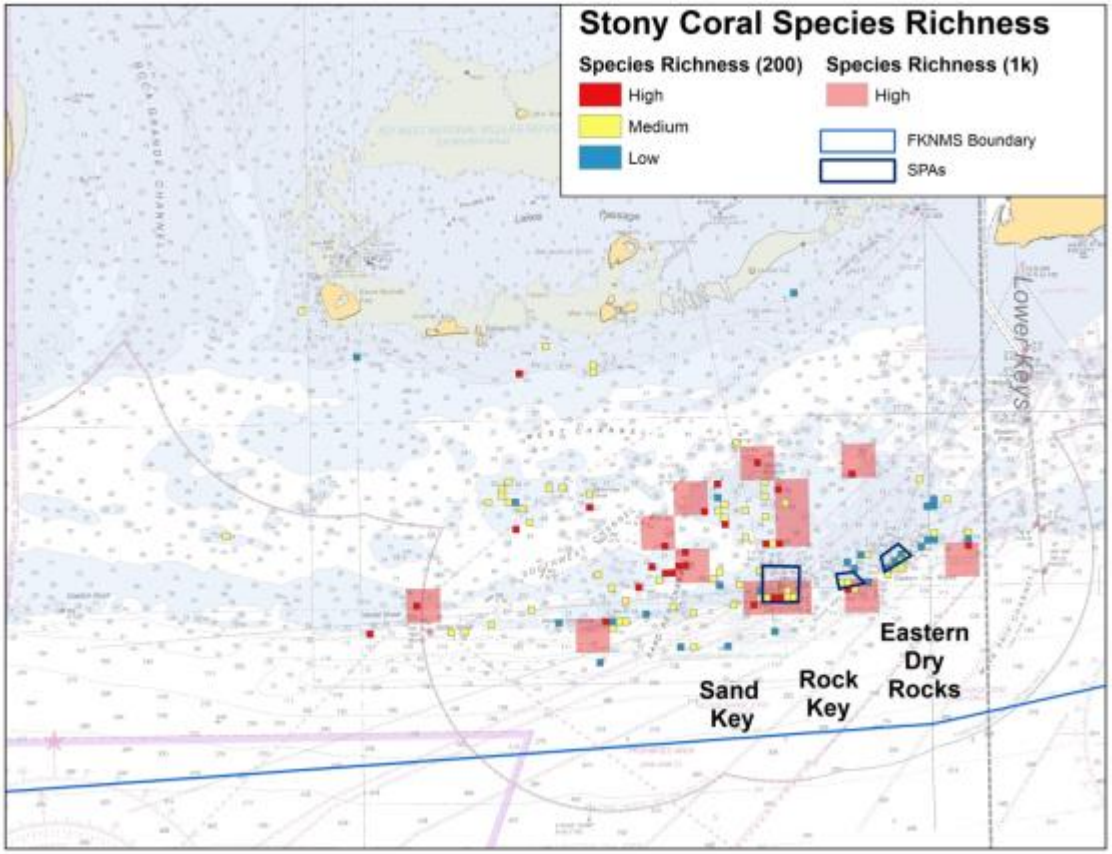
Management Zone	Locations (#)
SPAs	31
Remaining FKNMS (Marquesas)	30
Resource Total	61



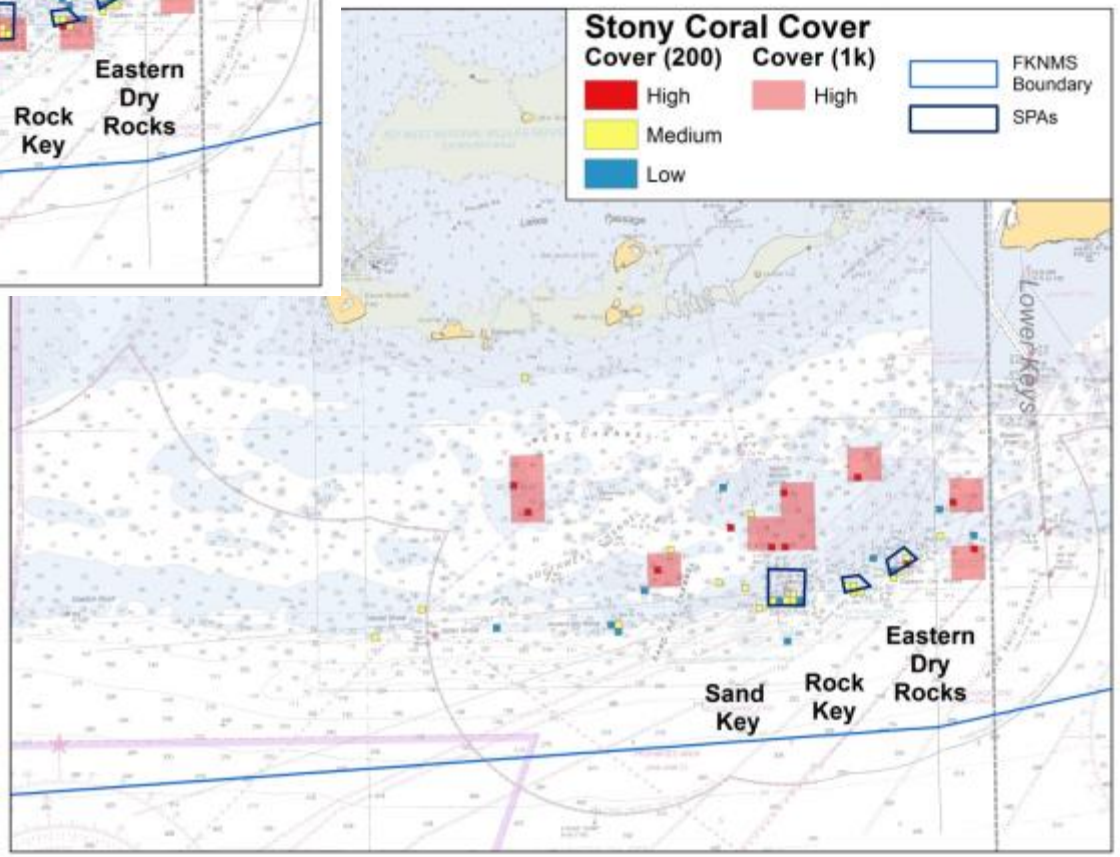
entire
Marquesas region

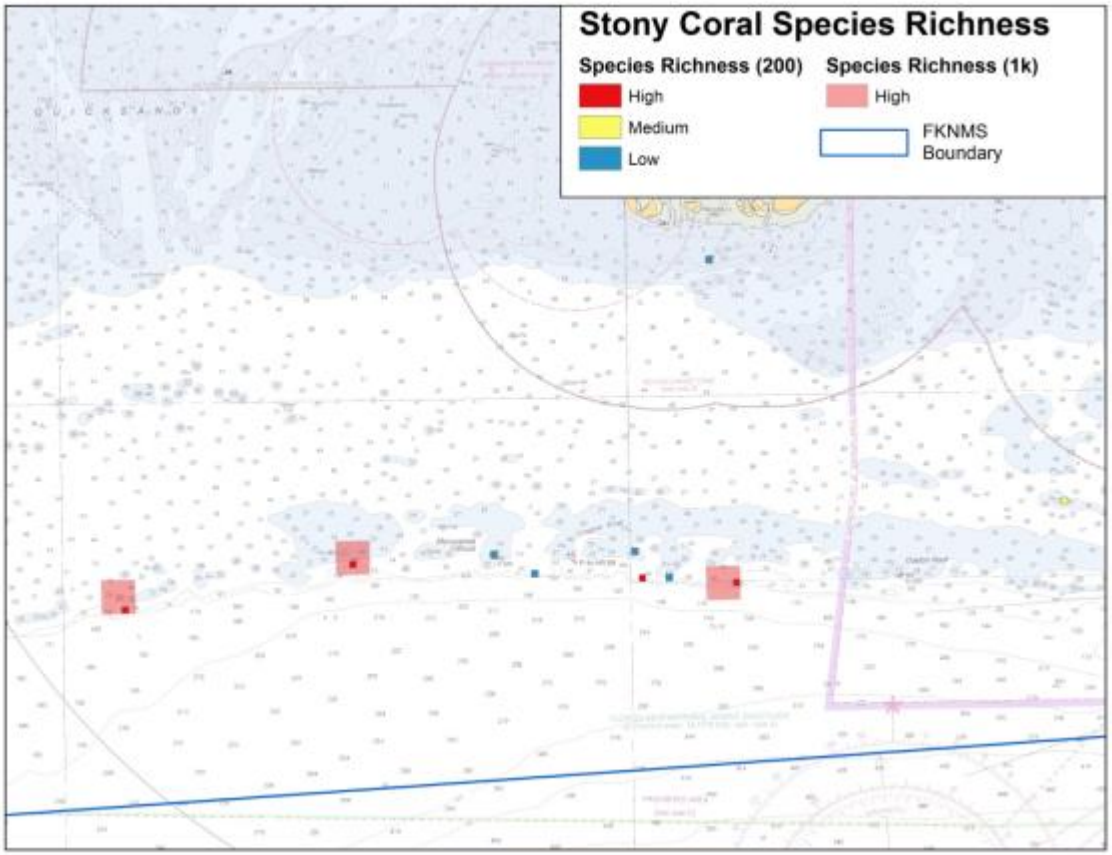




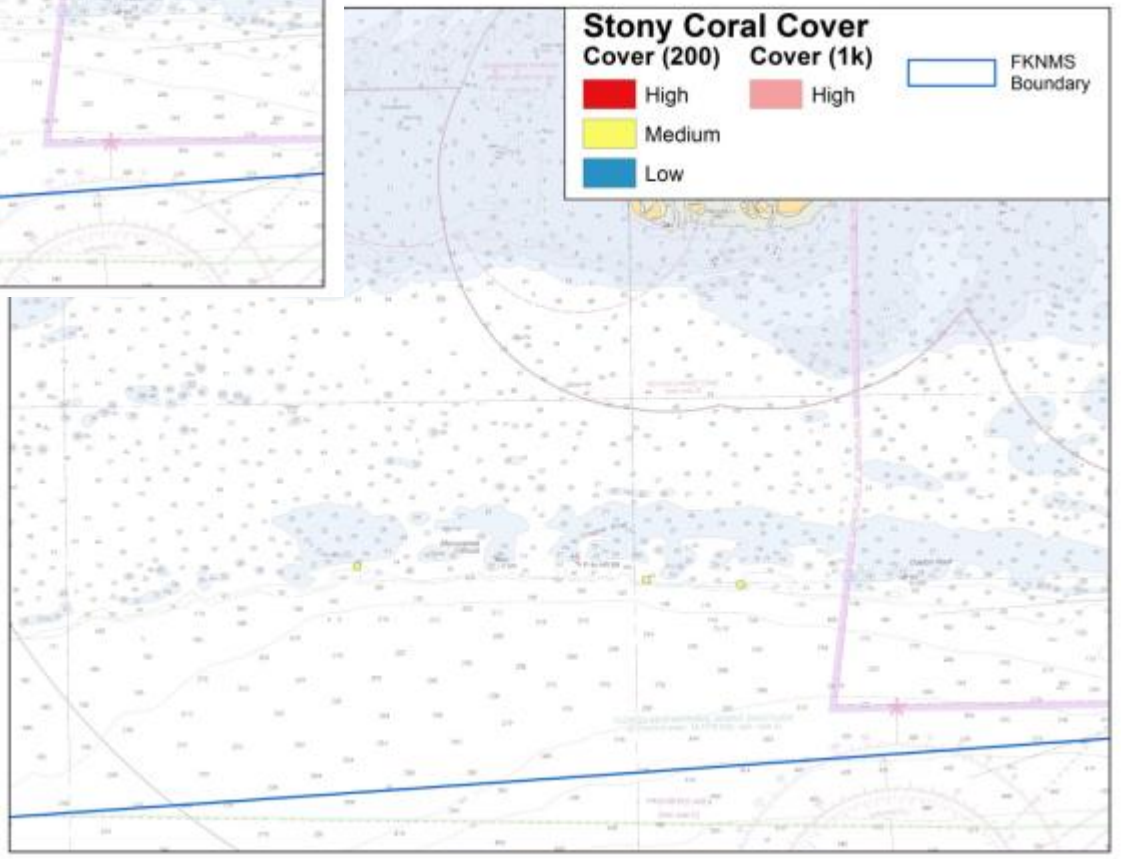


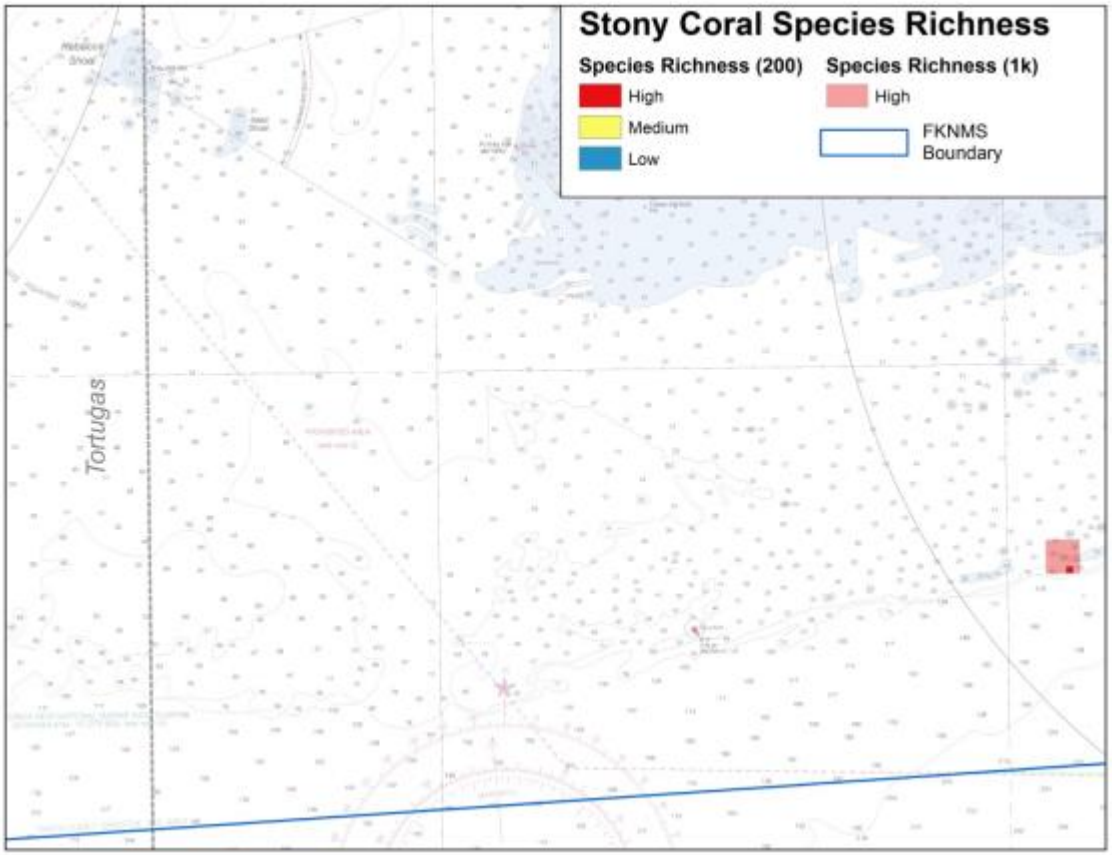
Eastern 1/3 of Marquesas region



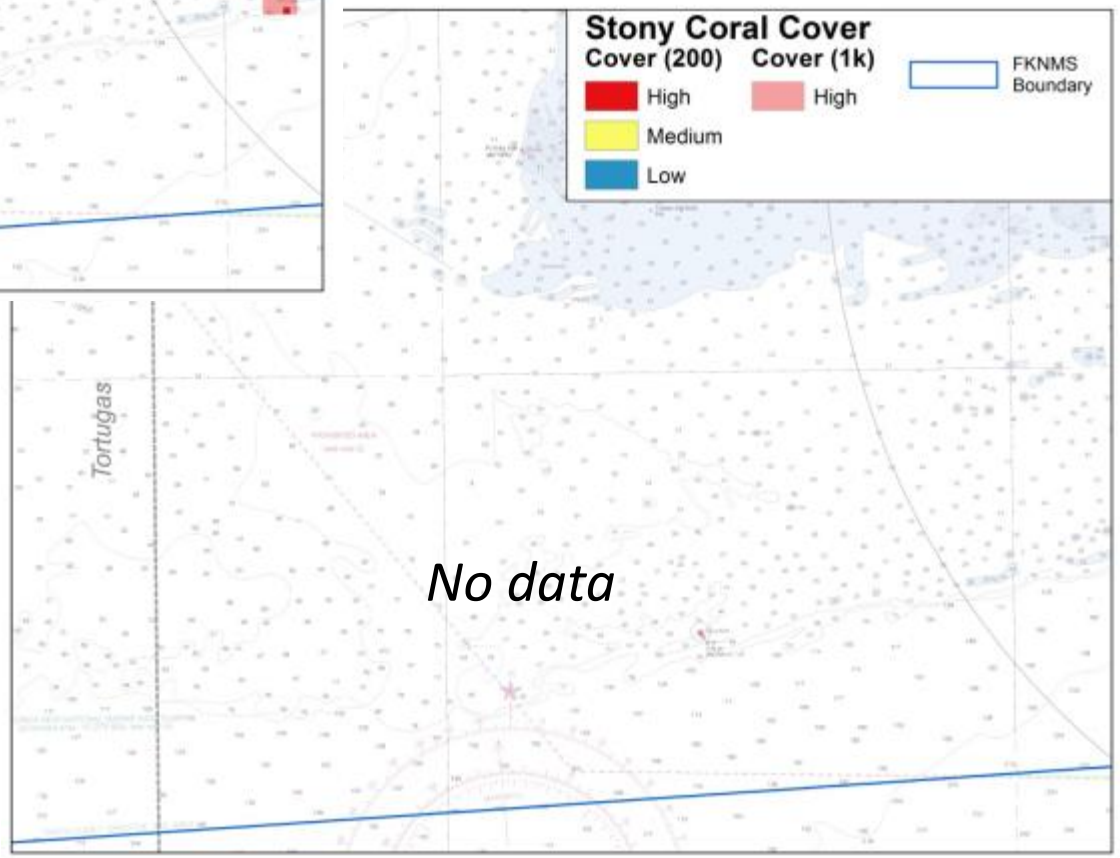


Central 1/3 of Marquesas region



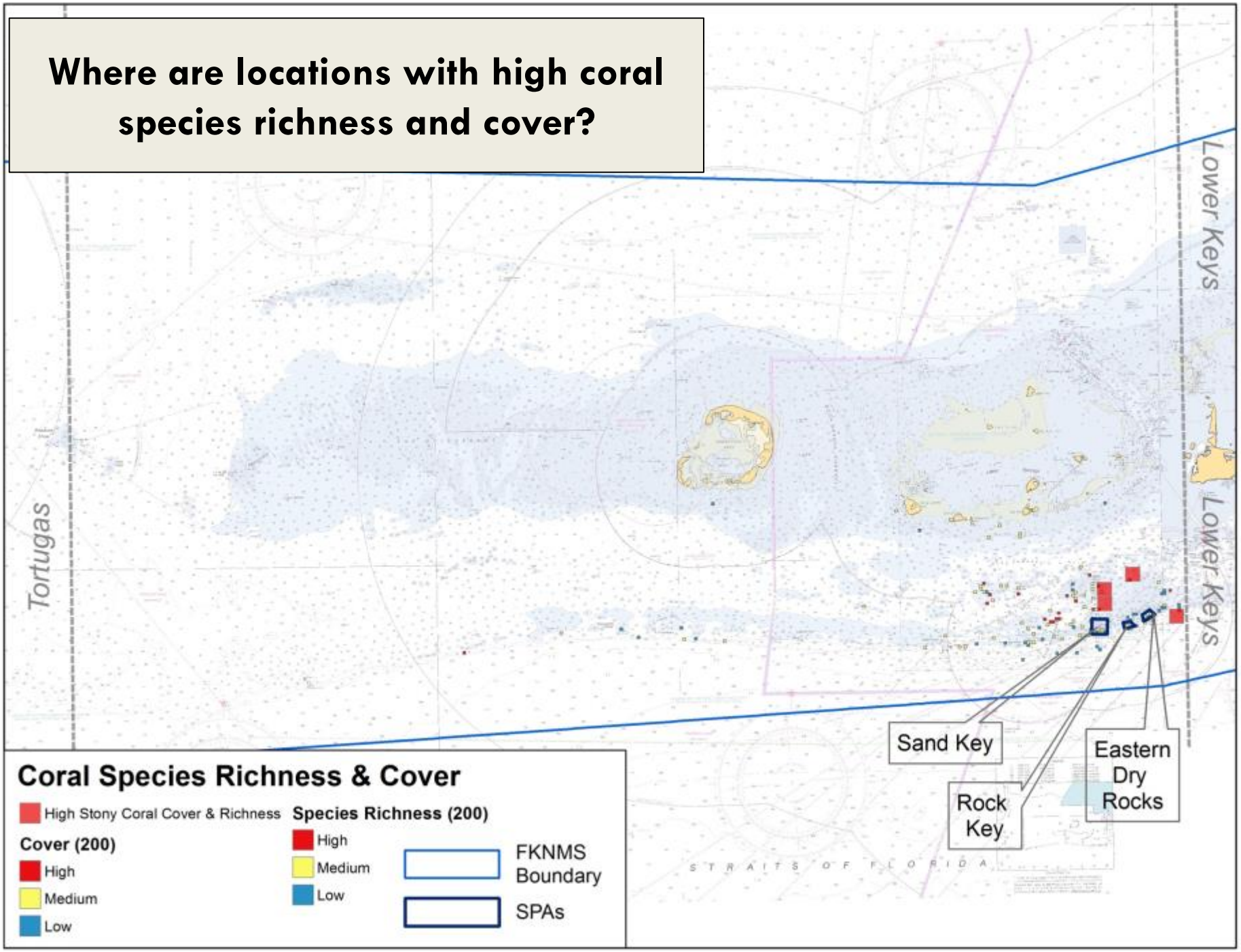


Western 1/3 of Marquesas region

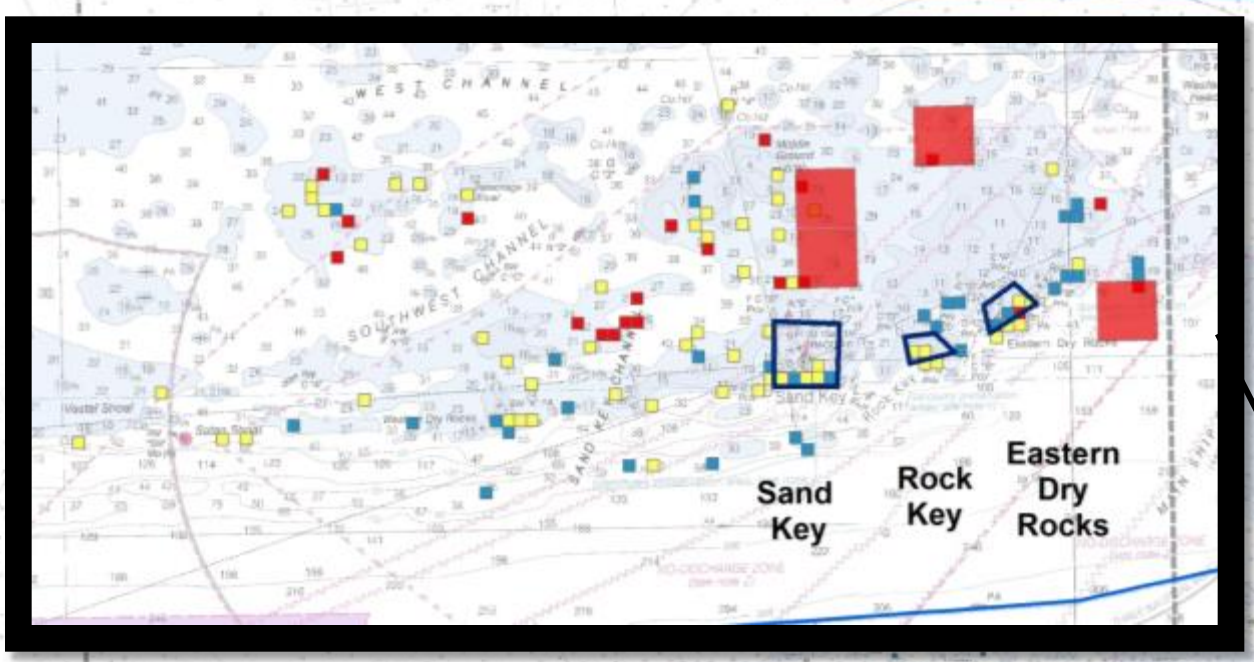


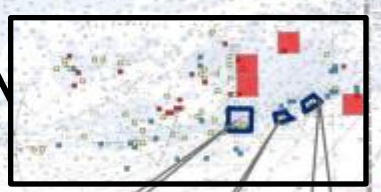
No data

Where are locations with high coral species richness and cover?



Where are locations with high coral species richness and cover?





Sand Key

Rock Key

Eastern Dry Rocks

Lower Keys

Lower Keys

STRAITS OF FLORIDA

Coral Species Richness & Cover

High Stony Coral Cover & Richness

Cover (200)

- High
- Medium
- Low

Species Richness (200)

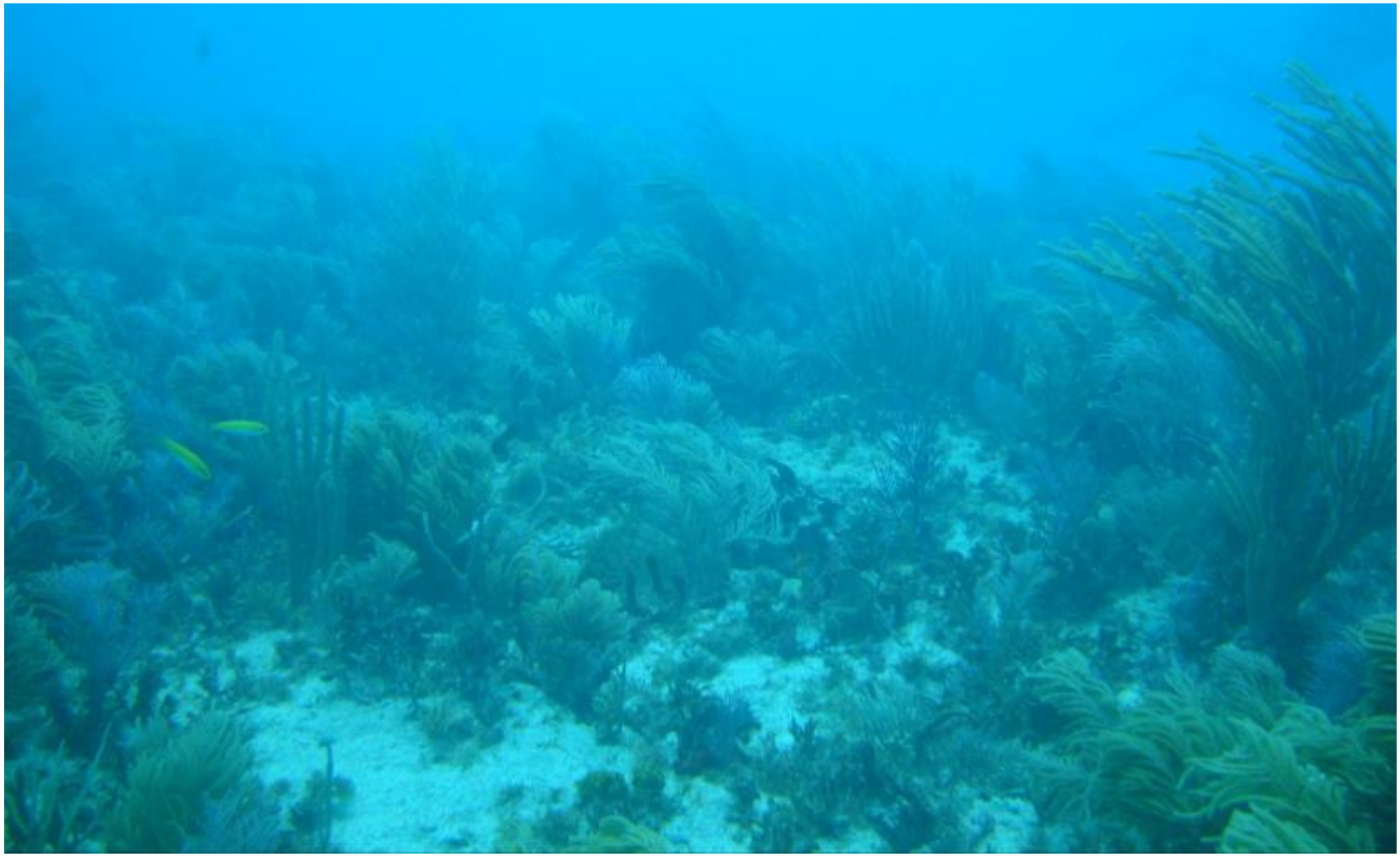
- High
- Medium
- Low

FKNMS Boundary

SPAs

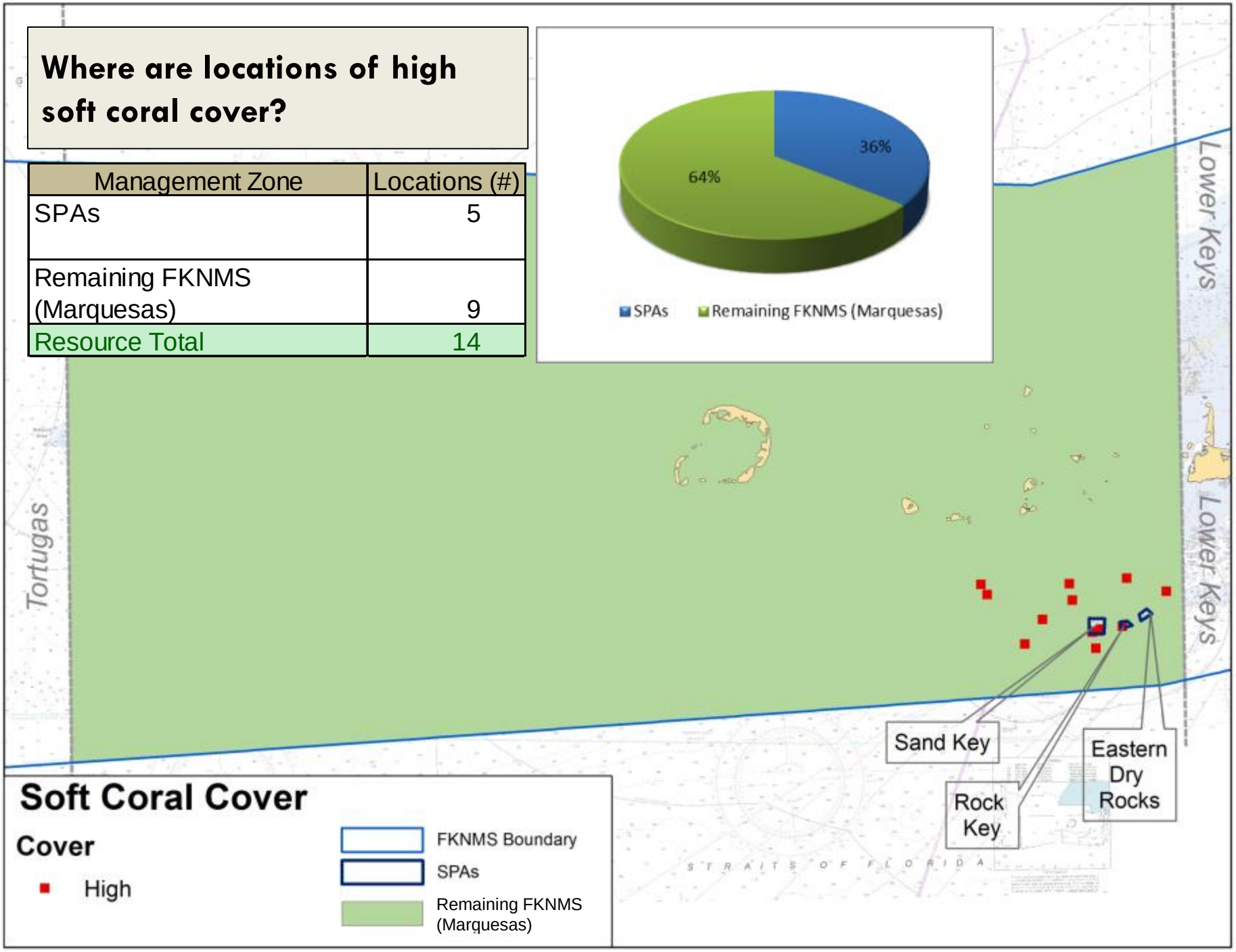
Soft Coral

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



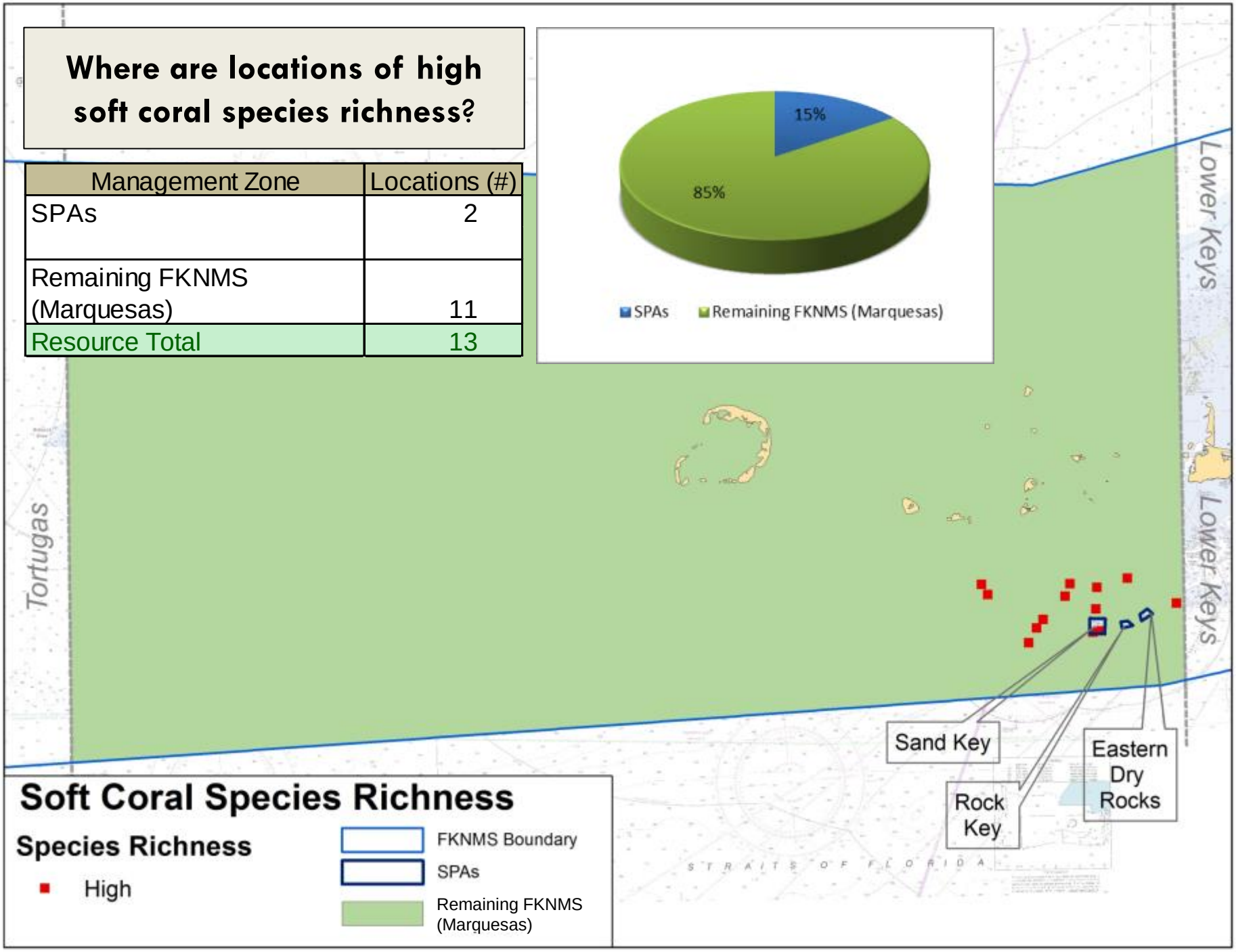
Where are locations of high soft coral cover?

Management Zone	Locations (#)
SPAs	5
Remaining FKNMS (Marquesas)	9
Resource Total	14

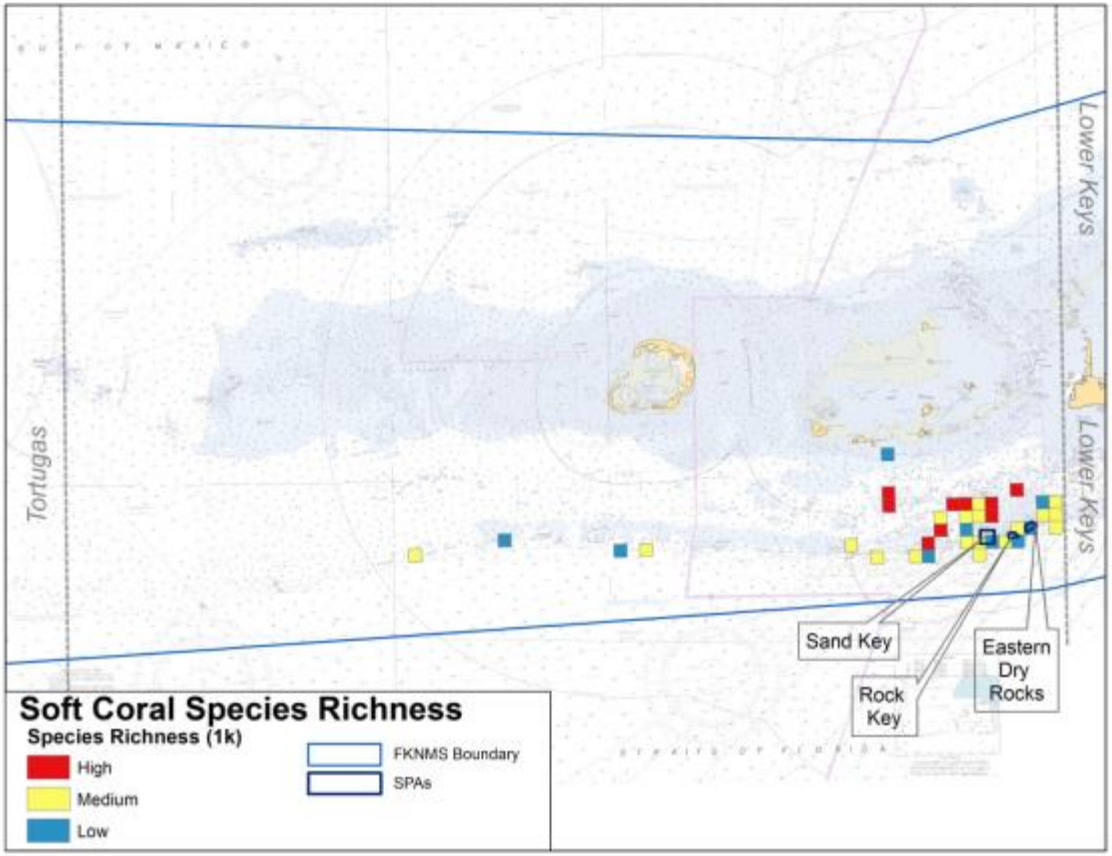


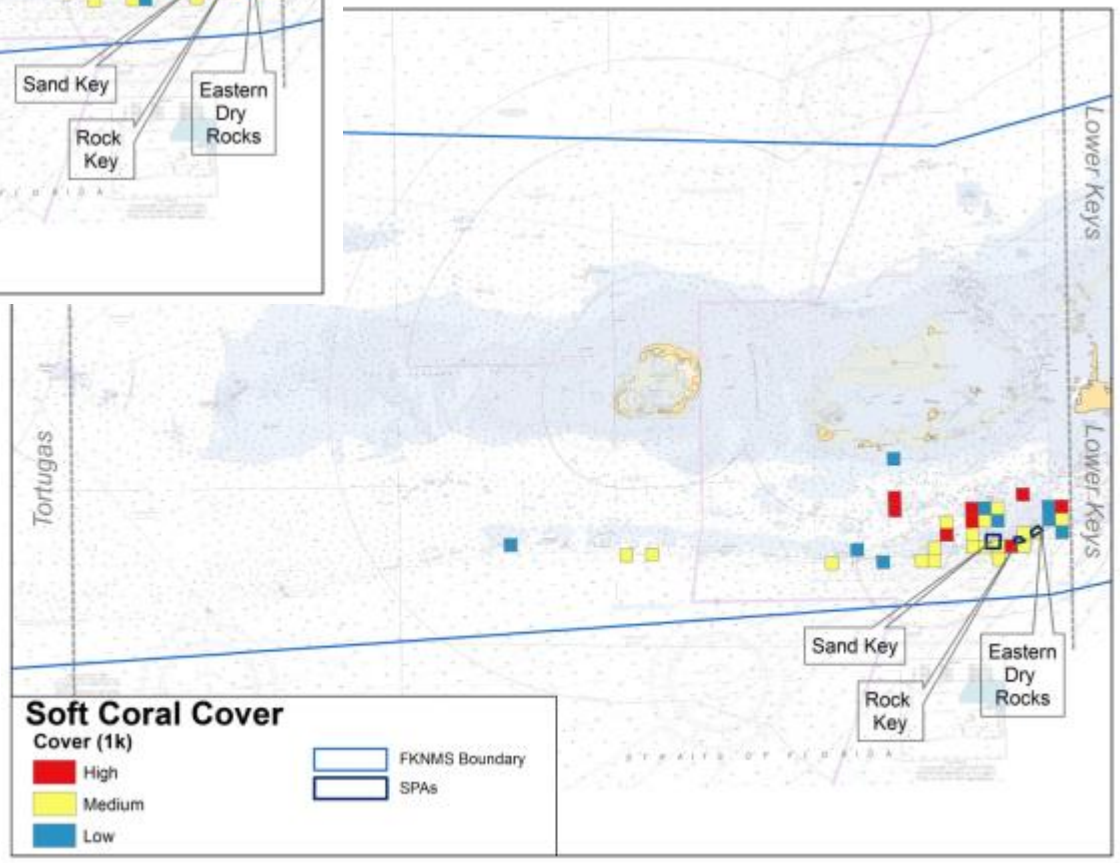
Where are locations of high soft coral species richness?

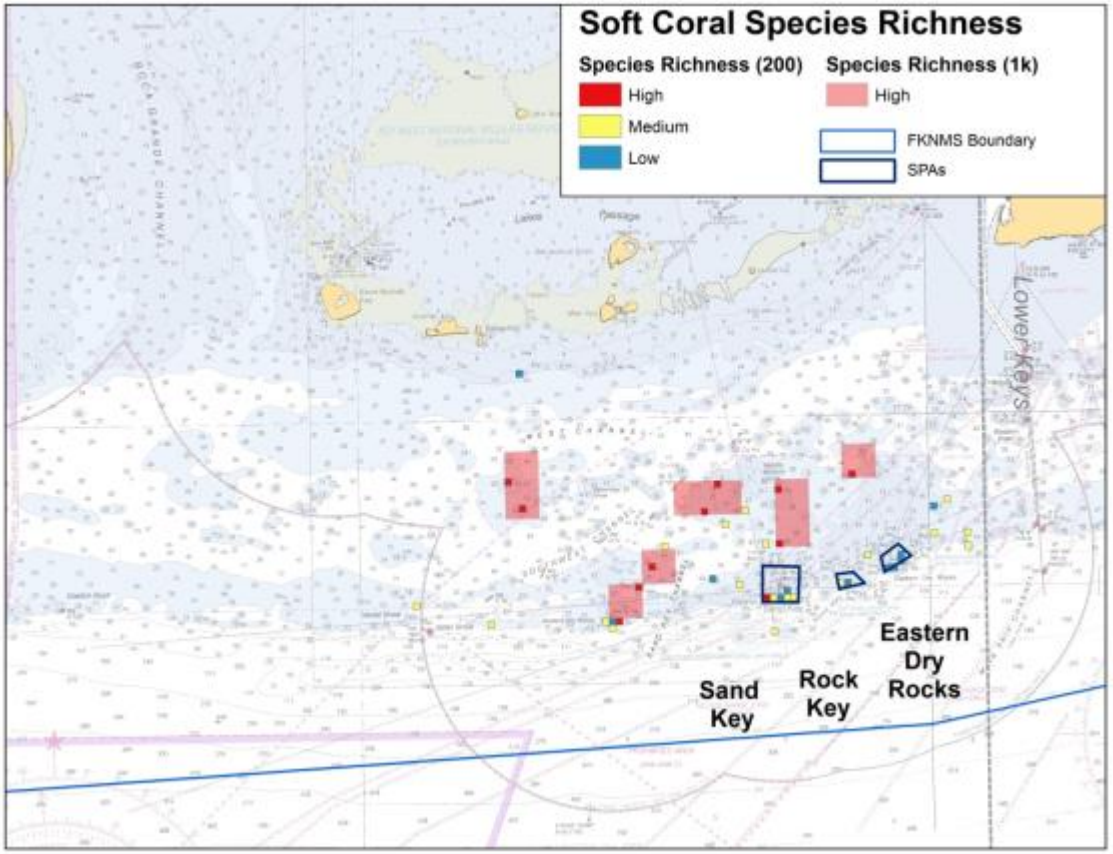
Management Zone	Locations (#)
SPAs	2
Remaining FKNMS (Marquesas)	11
Resource Total	13



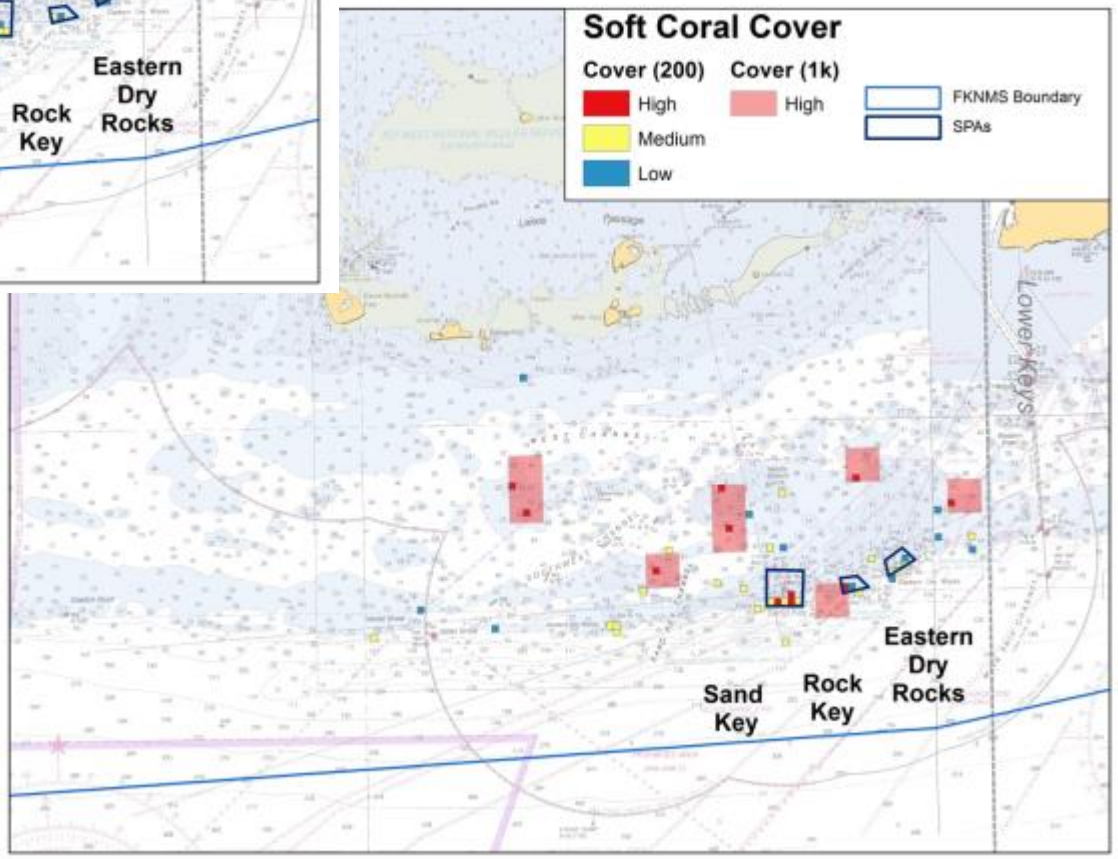
entire
Marquesas region

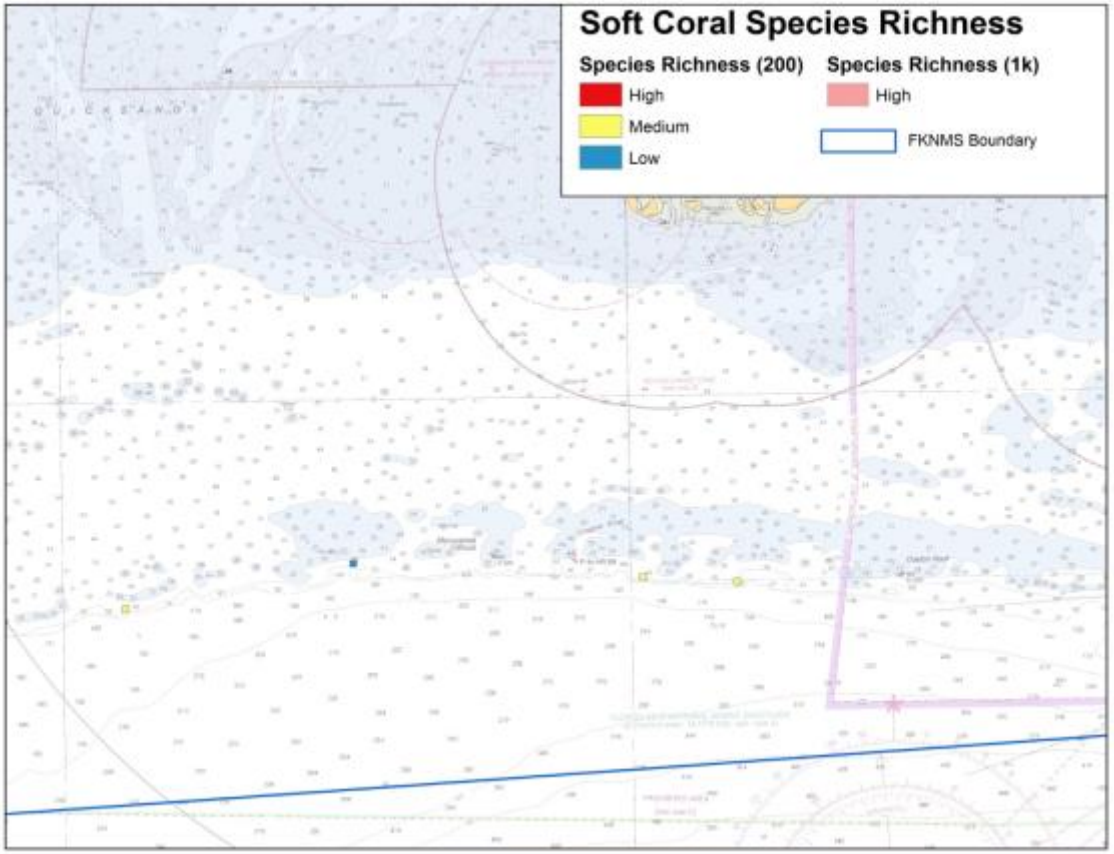




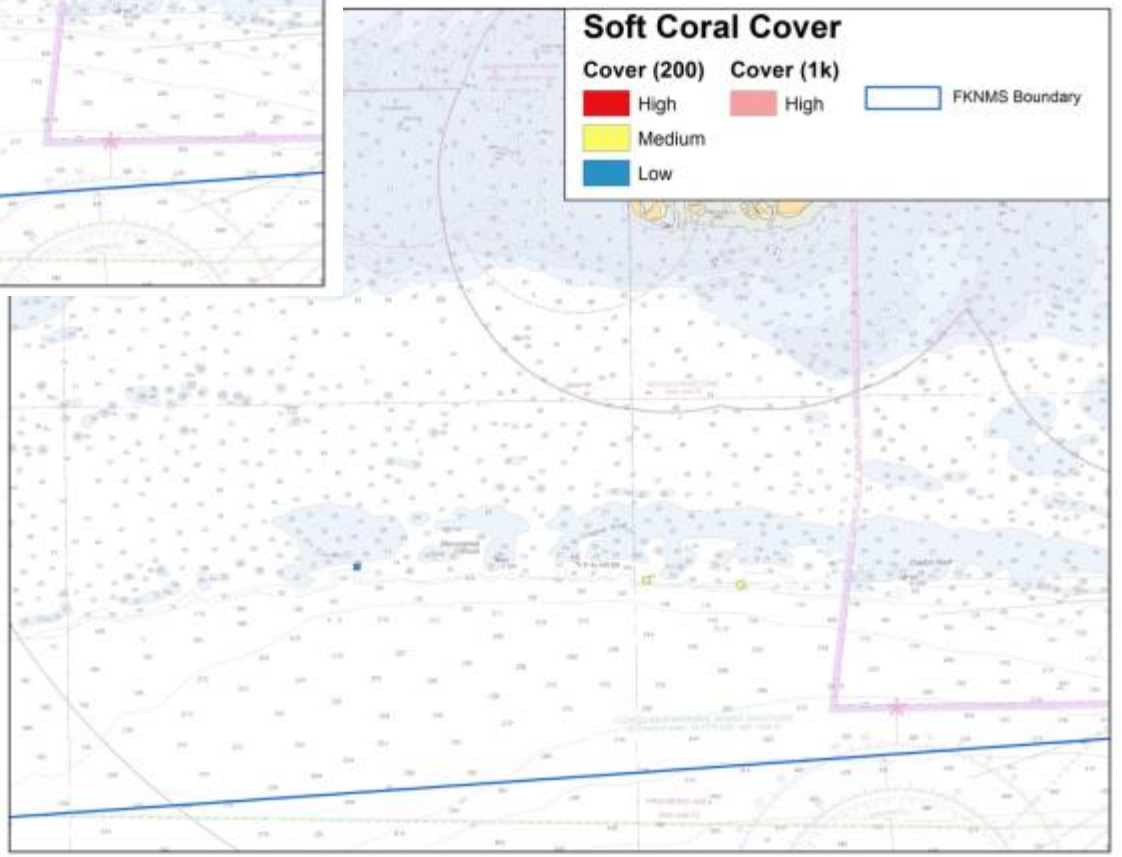


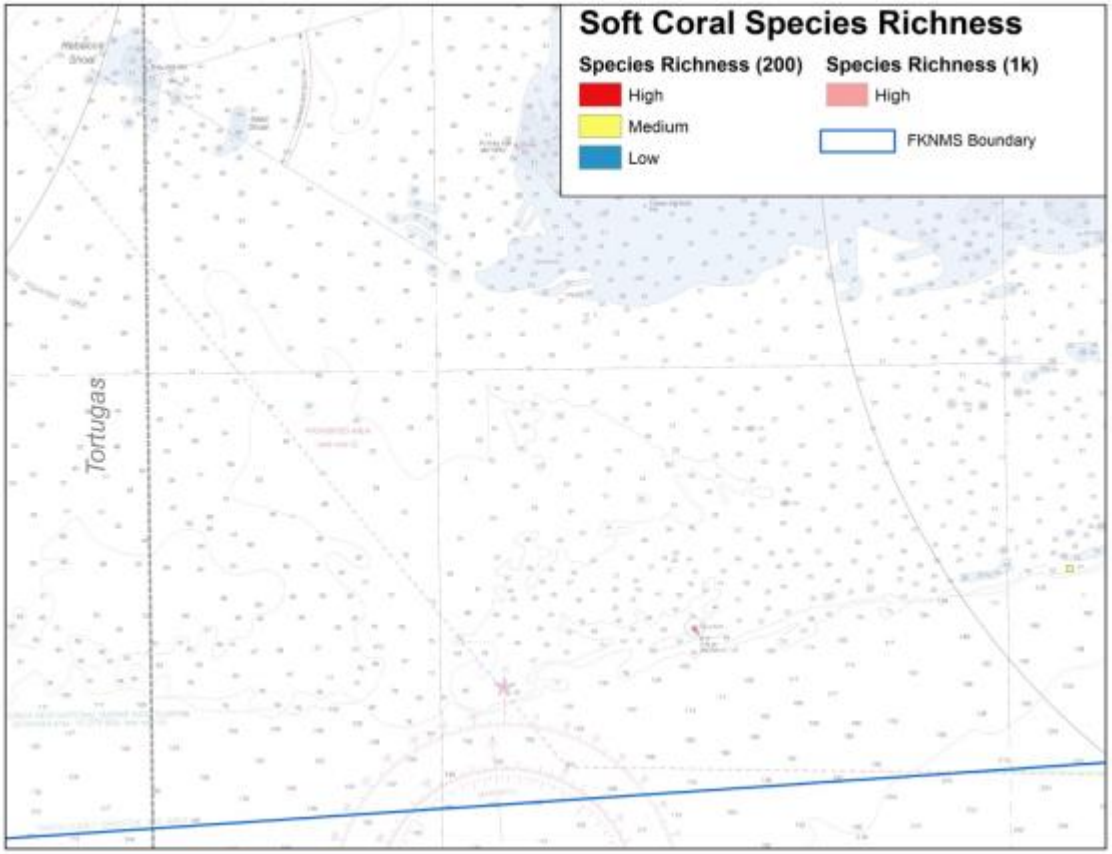
Eastern 1/3 of Marquesas region



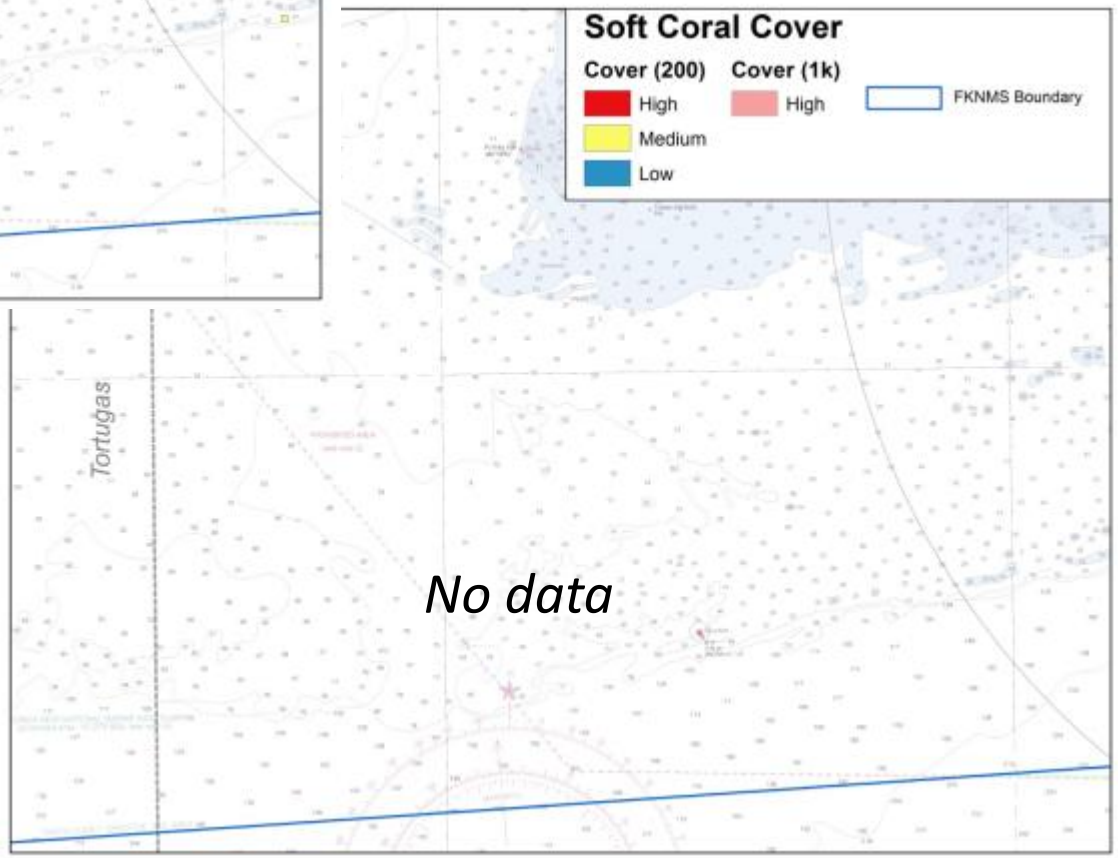


Central 1/3 of Marquesas region

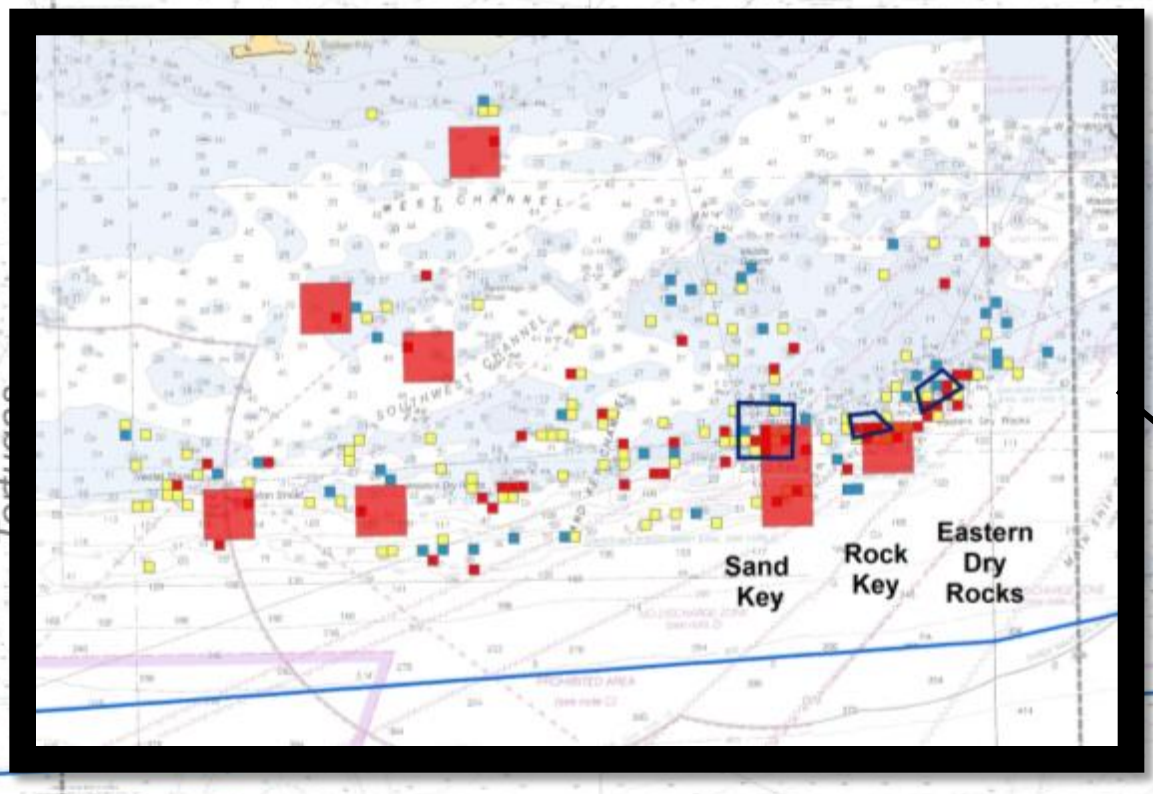


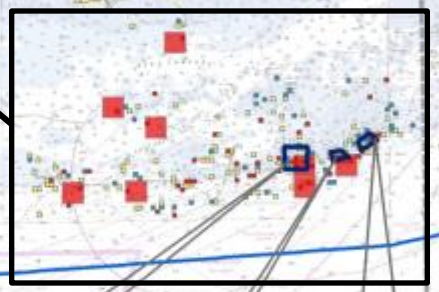


Western 1/3 of Marquesas region



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





Lower Keys

Lower Keys

STRAITS OF FLORIDA

Fish Species Richness & Total Abundance

High Fish Abundance & Richness

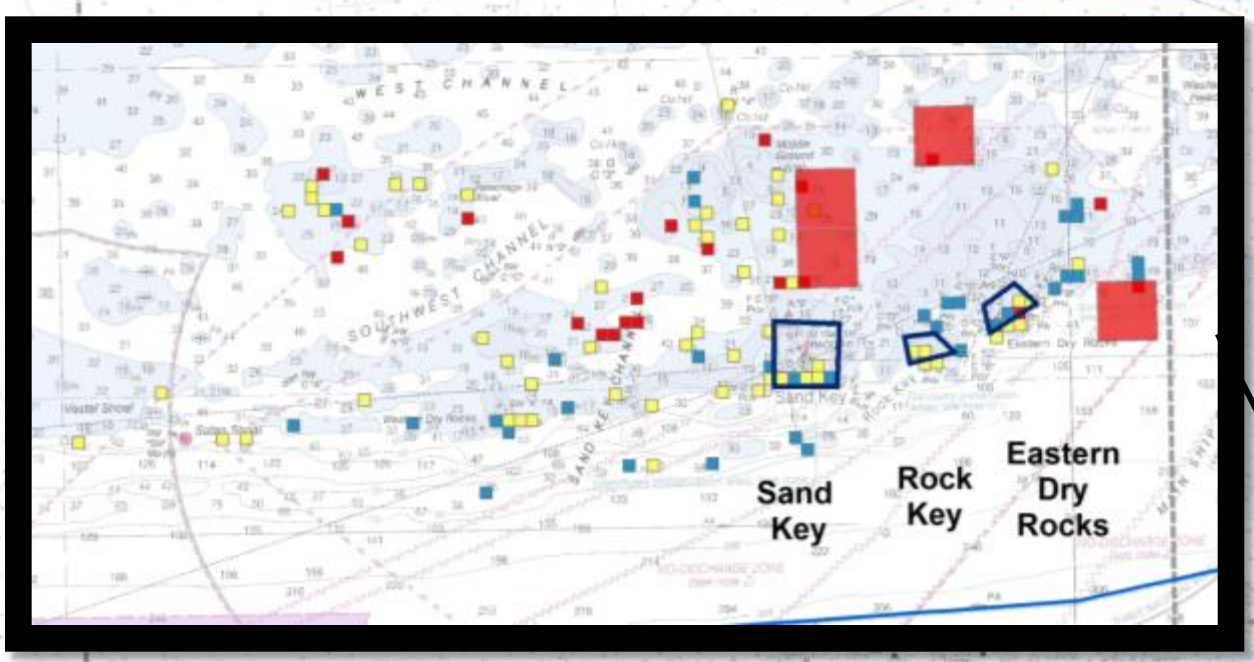
Species Richness (200)
- High
- Medium
- Low

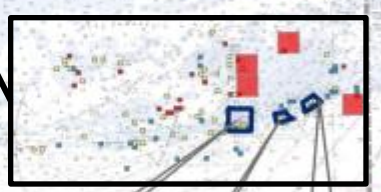
Abundance (200)
- High
- Medium
- Low

FKNMS Boundary

SPAs

Where are locations with high coral species richness and cover?





Sand Key

Rock Key

Eastern Dry Rocks

Lower Keys

Lower Keys

STRAITS OF FLORIDA

Coral Species Richness & Cover

High Stony Coral Cover & Richness

Cover (200)

- High
- Medium
- Low

Species Richness (200)

- High
- Medium
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FKNMS Boundary

SPAs