



# TRACKING LIFE ON THE REEF

## Benthic Communities and Zoning Performance

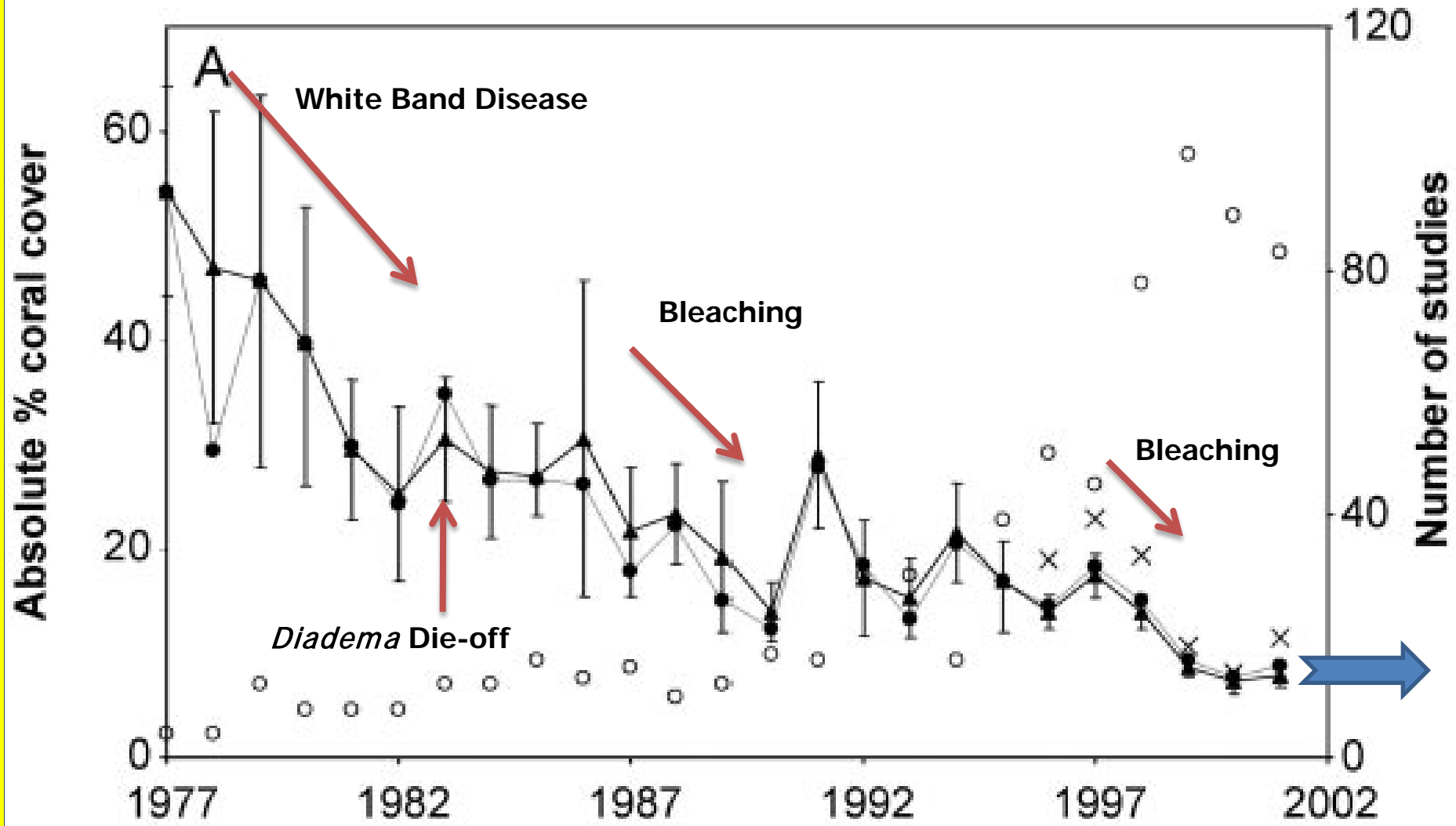
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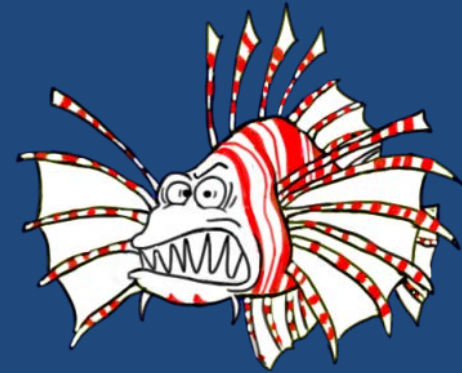


# Caribbean Coral Reef Decline

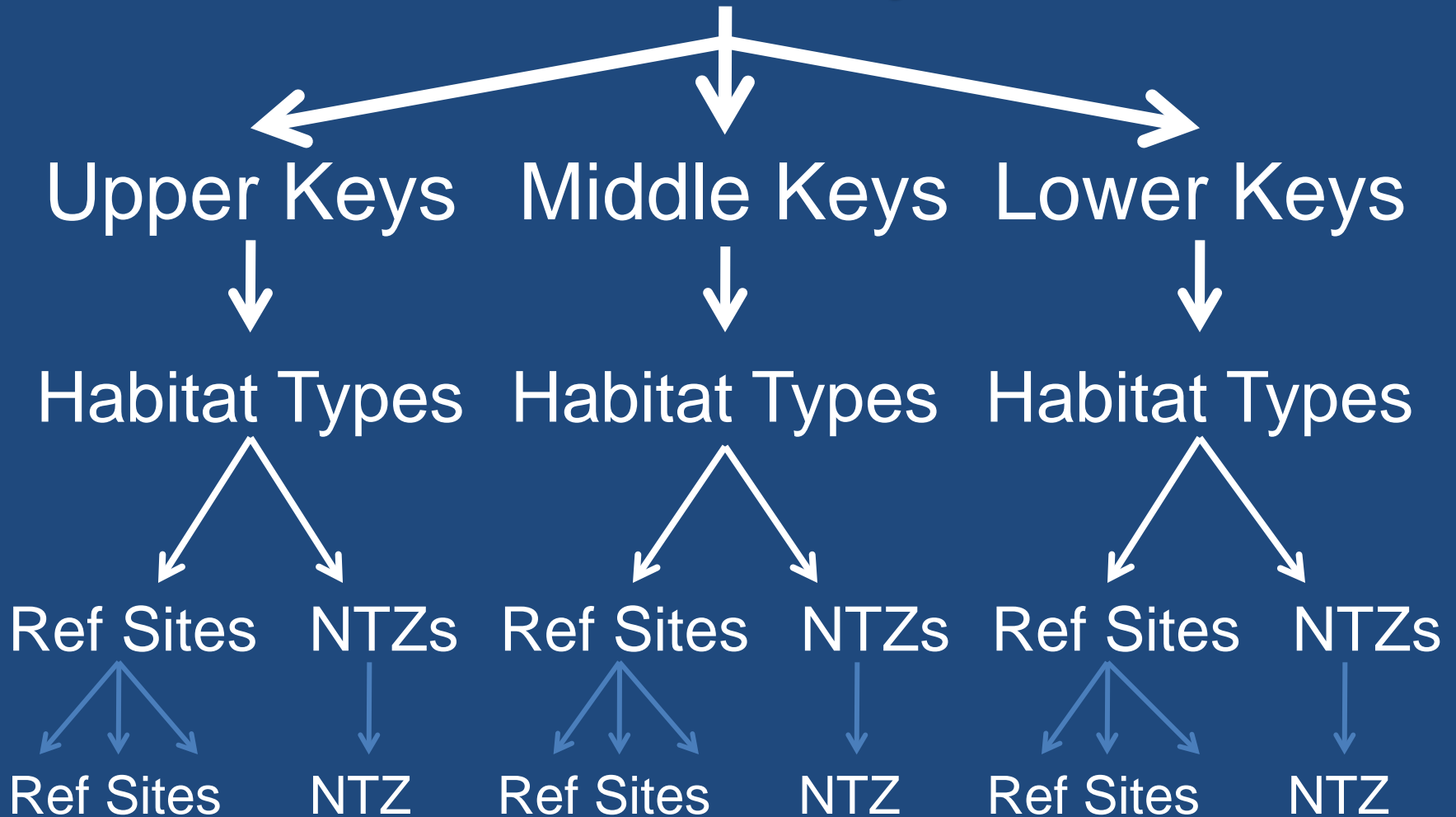


# Factors Affecting Coral Reefs in Florida

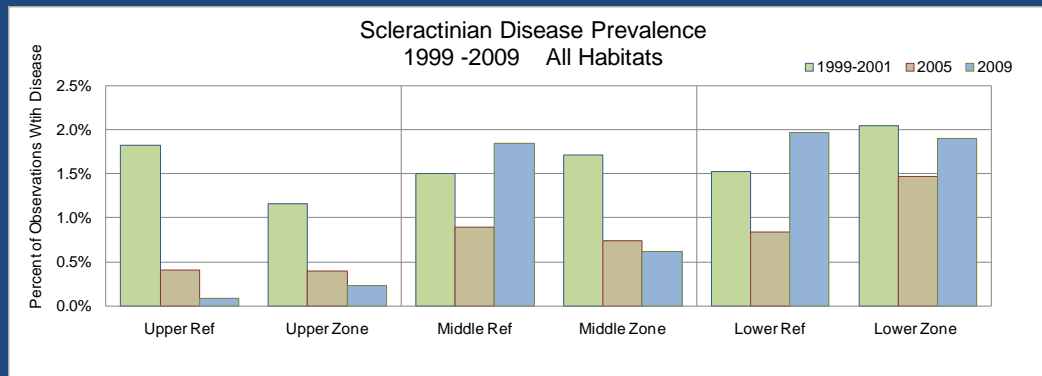
- Geography (winter cold fronts)
- Hurricanes
- Coral Disease
- Coral Bleaching
- Ocean Acidification
- Pollution
- Urchin die-off
- Over-fishing
- Marine zoning - but only if over-fishing is a major driver of change for coral reefs in the FKNMS.



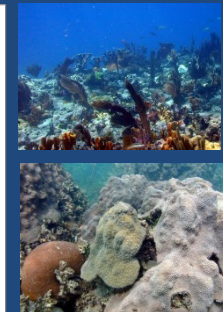
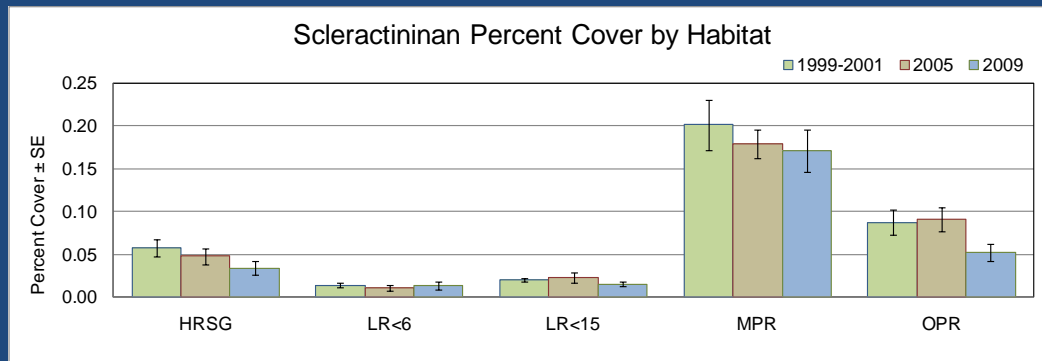
# Florida Keys



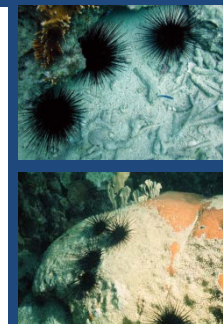
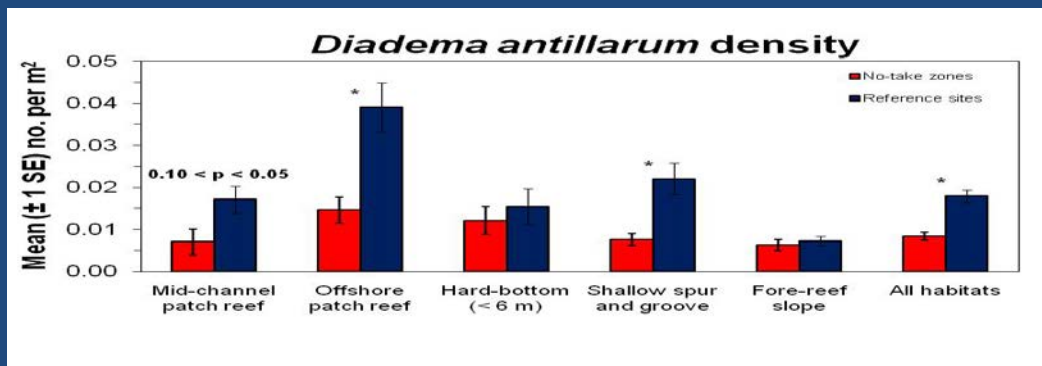
## Regions Matter



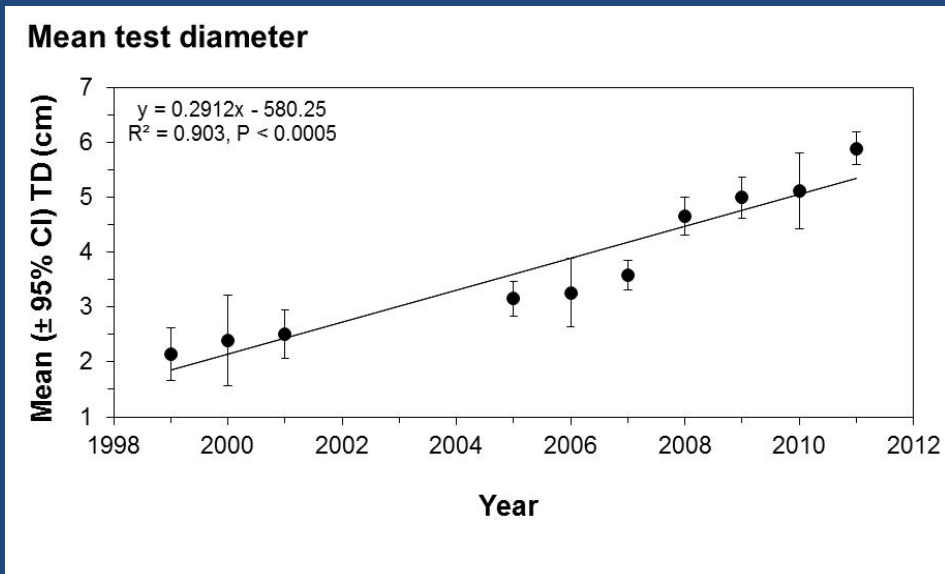
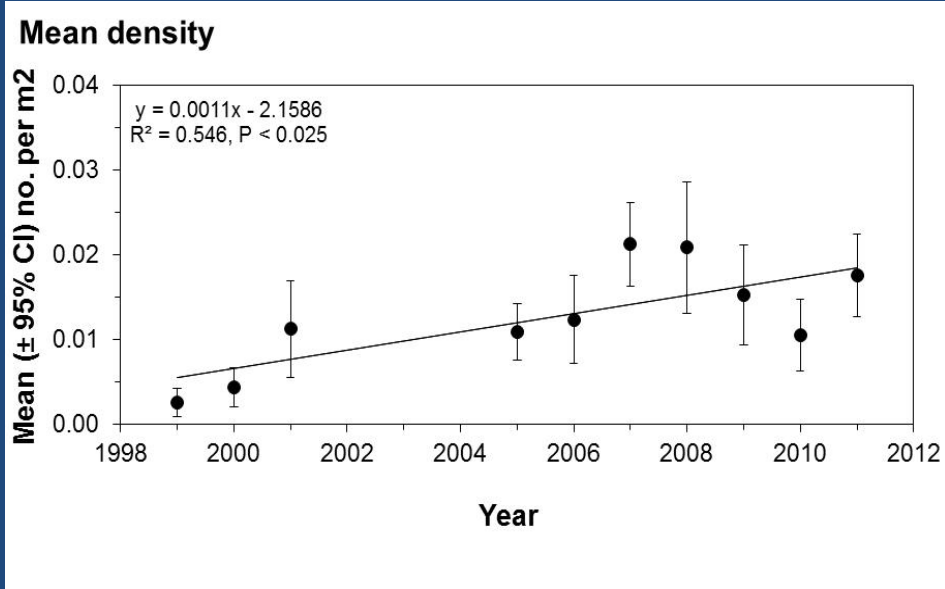
## Habitat Types Matter



## Zones Matter - In some cases



# Population trends for *Diadema*







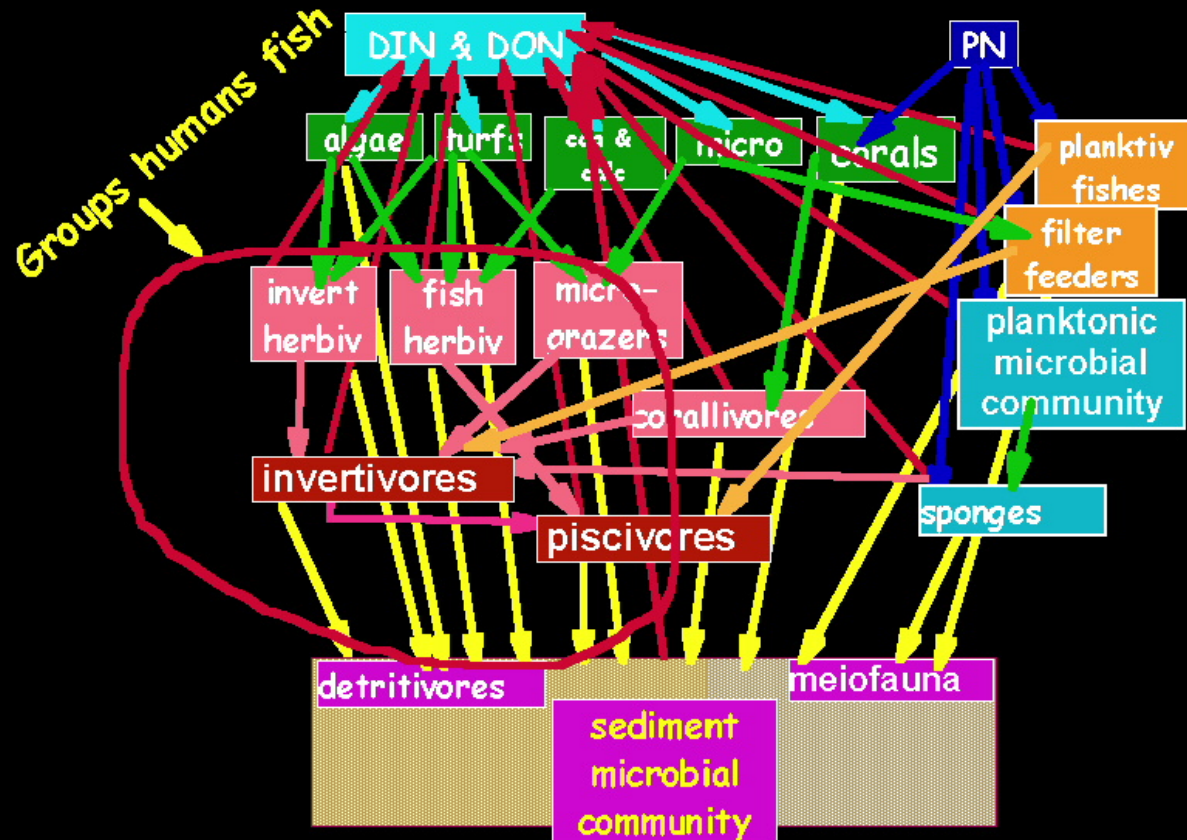
# What do we measure?



1. Topographic Complexity (maximum vertical relief)
2. Coral Cover
3. Coral Density ( $>4\text{cm}$ )
4. Juvenile Coral Density ( $<4\text{cm}$ )
5. Coral Sizes
6. Seaweed Cover
7. Sponge Cover
8. Coral Species Richness
9. Sponge Species Richness
10. Gorgonian Species Richness
11. Gorgonian Density
12. Diadema Density
13. Diadema Sizes
14. Anemones
15. Corallimorpharians
16. Snail densities and sizes
17. Marine Debris
18. Candidate species for listing under the Endangered Species Act
19. Condition (bleaching, disease, and more)
20. More...

# Expectations for NTZ Performance

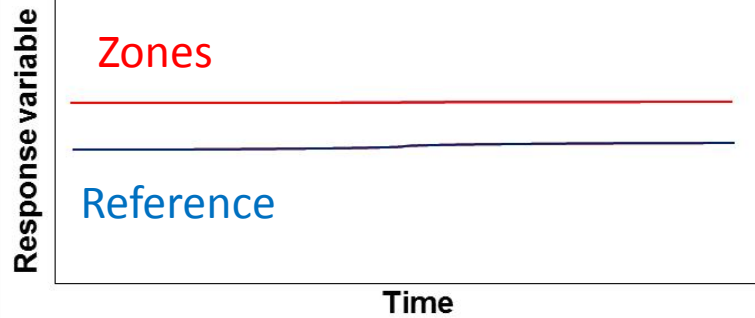
UNDISTURBED CORAL REEF ECOSYSTEM:  
COMPLEX FOOD WEB; HIGH PREDATOR PRESSURE



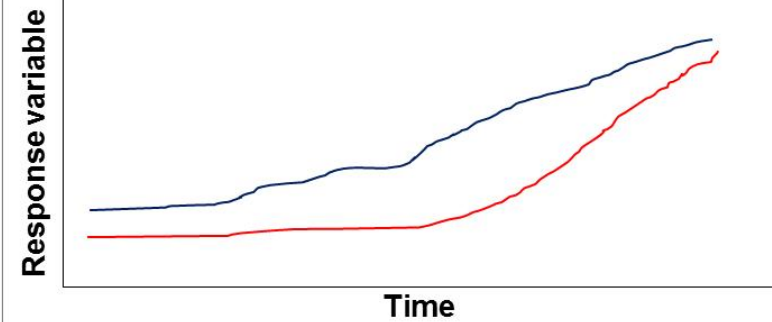


# Expectations for NTZ Performance

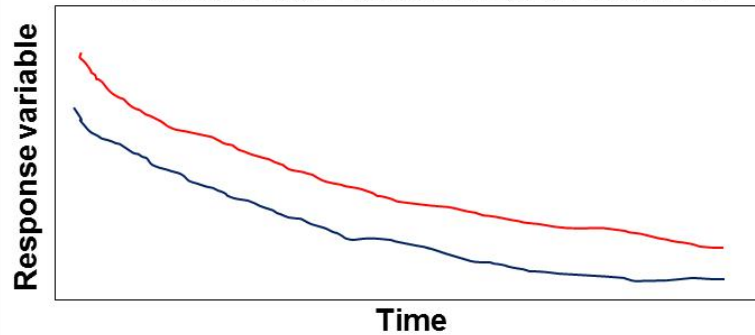
Stasis in Zones and Reference Areas



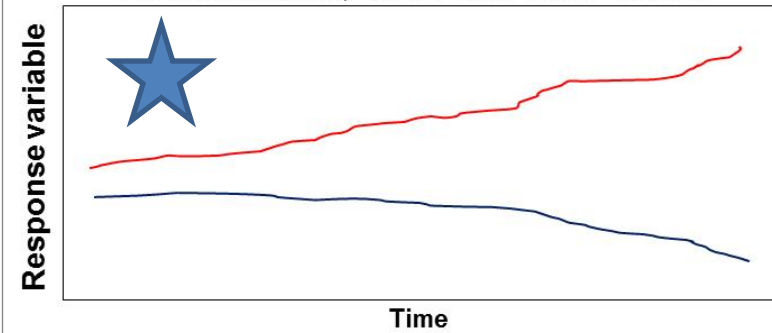
Increase in Zones and Reference Areas



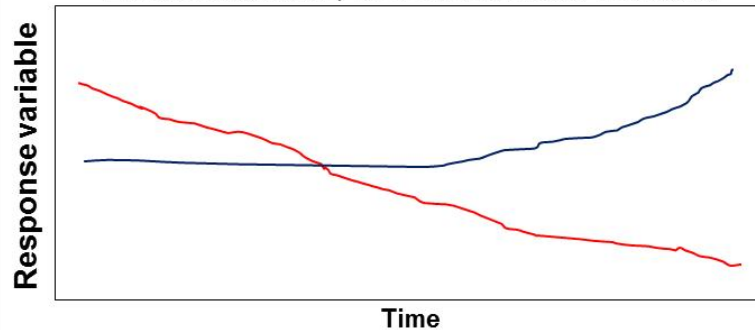
Decline in Both Zones and Reference Areas



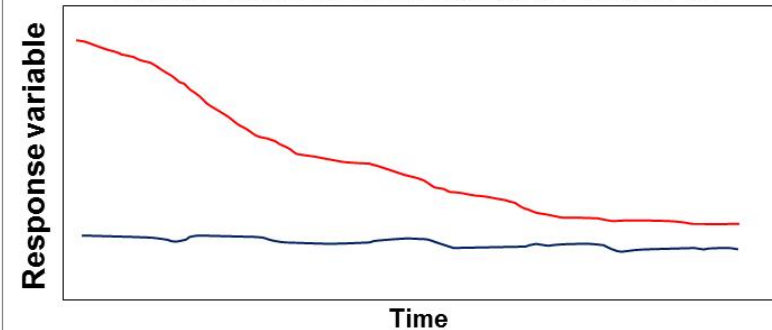
Zones Increase, Reference Areas Decline



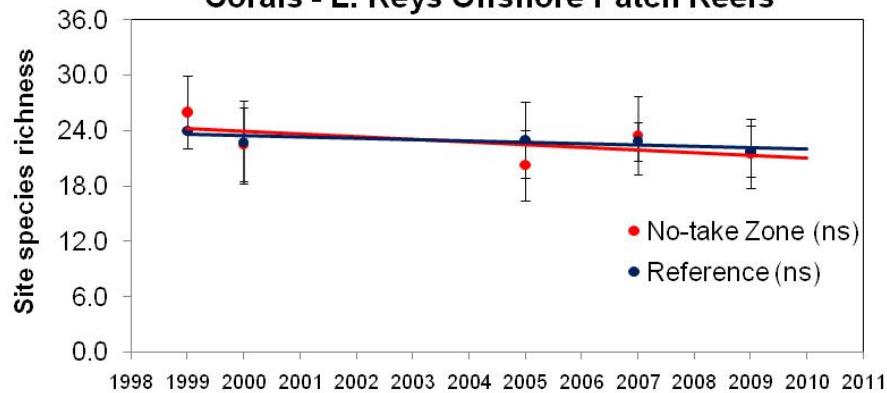
Zones Decrease, Reference Areas Increase



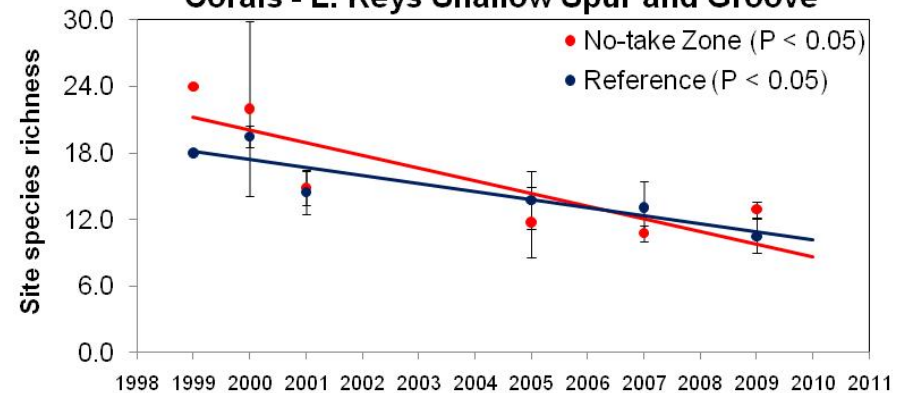
Zones Become Similar to Reference Areas



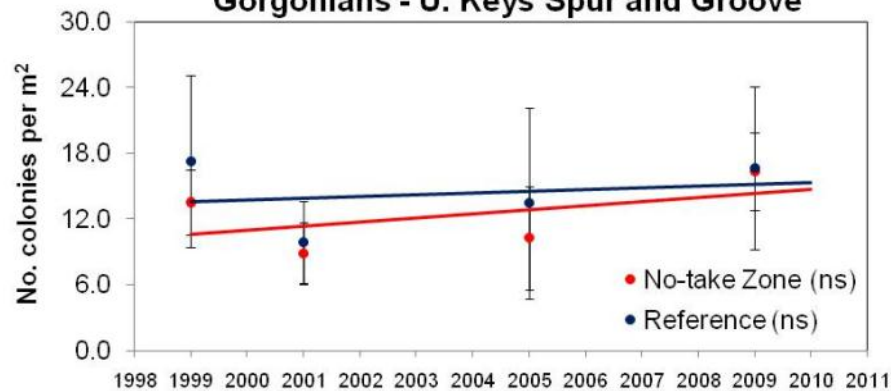
**Corals - L. Keys Offshore Patch Reefs**



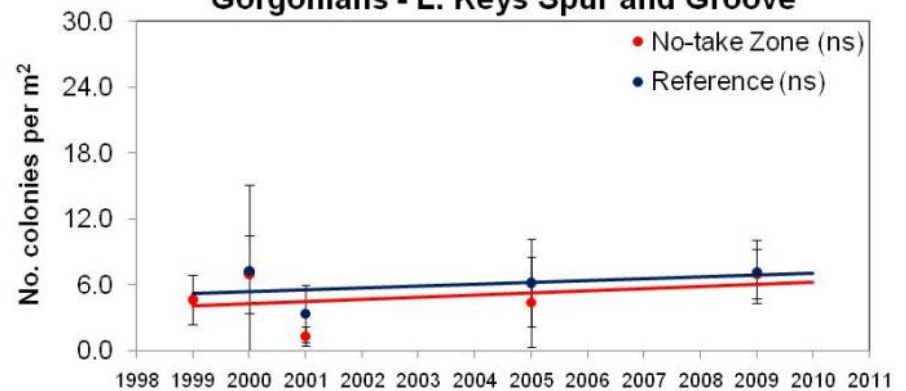
**Corals - L. Keys Shallow Spur and Groove**



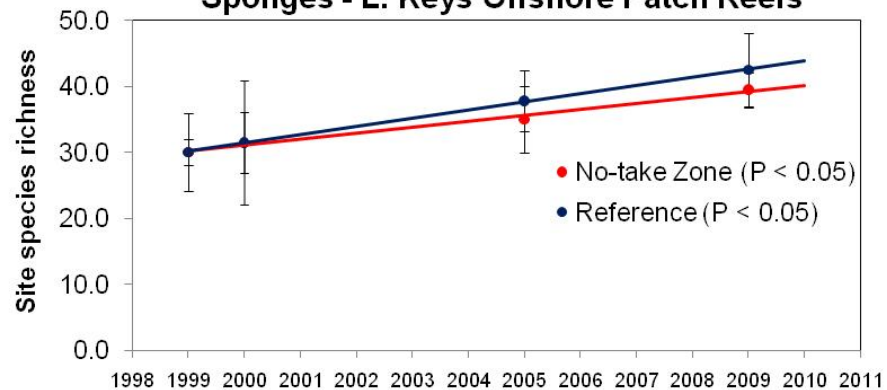
**Gorgonians - U. Keys Spur and Groove**



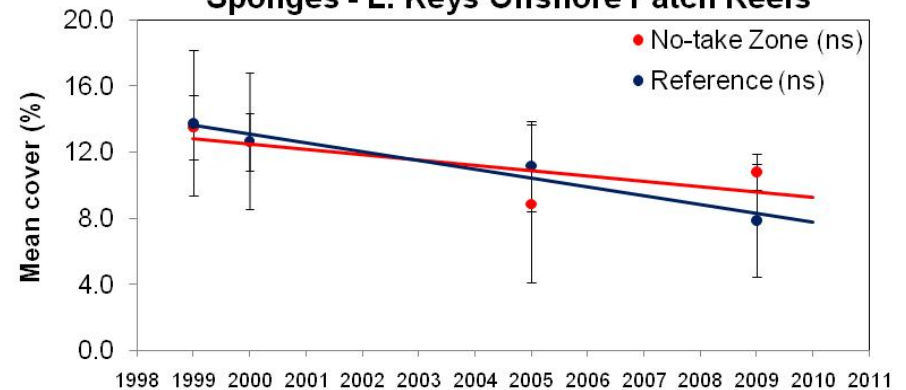
**Gorgonians - L. Keys Spur and Groove**



**Sponges - L. Keys Offshore Patch Reefs**



**Sponges - L. Keys Offshore Patch Reefs**



# Next Steps?

1. How can our results help inform your Work Group?
2. What do you want to accomplish?
  - Recommend *new or modified ecological reserves* to ensure protection of a diversity of resources, including... the *full suite of marine flora and fauna*.
  - Ensure the FKNMS zoning scheme promotes sustainable use of the sanctuary resources and *protects areas that represent diverse habitats* as well as areas important for *maintaining natural resources and ecosystem functions*.
3. Focus might range from *species* (Endangered Species Act, Spiny Lobster Amendment 11), to *individual reefs* (SPAs, ROs), to *ecosystems* (ERs).

# Management: Species-based (Endangered Species Act)

Species	Abundance	Abundance	Protected
D. stokesi	49,735,917	2,154,458.52	4.15%
M. faveolata	27,705,353	3,312,328.99	10.68%
M. annularis	4,397,919	899,013.04	16.97%
M. franksi	3,016,994	426,832.20	12.39%
M. ferox	970,415	61,691.37	5.98%
A. lamarcki	201,936	67,522.89	25.06%
D. cylindrus	151,452	20,256.87	11.80%

Green = Total Abundance Blue = Protected Abundance



Preliminary



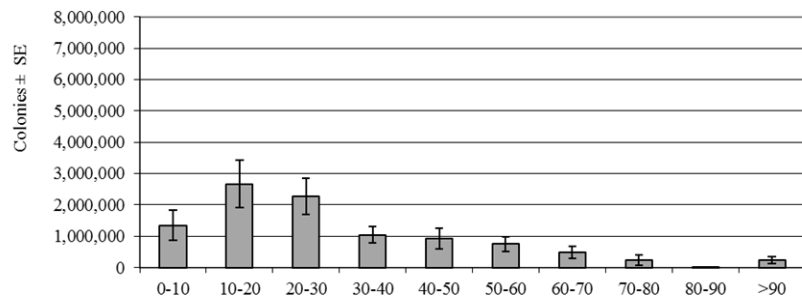
# Acropora abundance



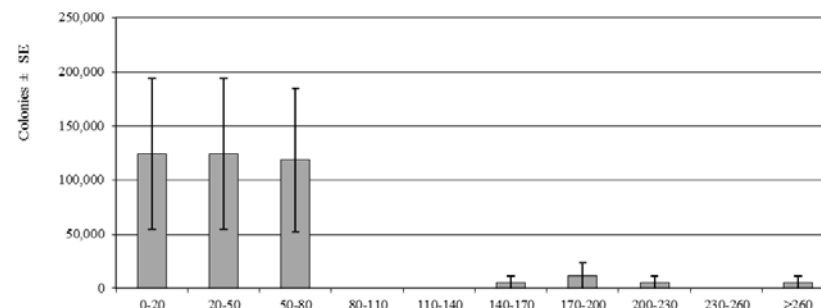
*A. cervicornis*

*A. palmata*

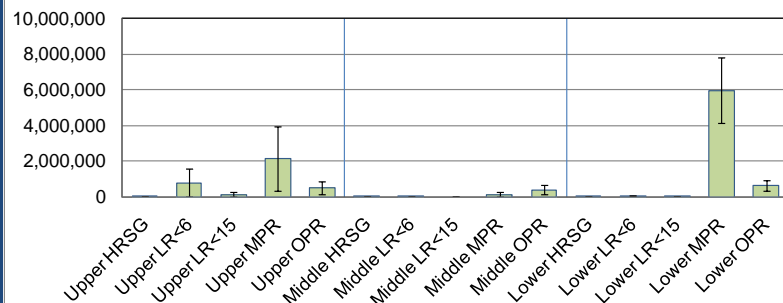
*Acropora cervicornis* Estimated Abundance: Florida Keys 2012  
Binned by Colony Maximum Diameter (cm)



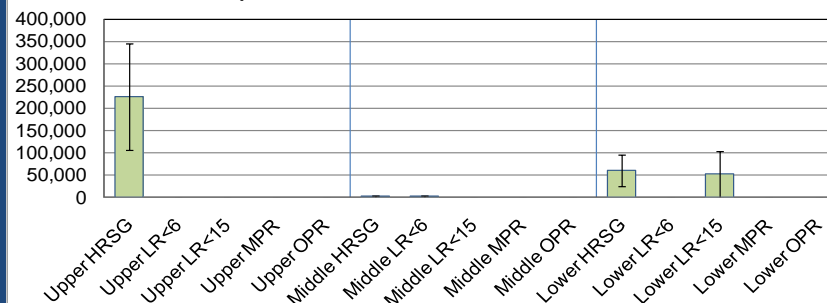
*Acropora palmata* Estimated Abundance: Florida Keys 2012  
Binned by Colony Maximum Diameter (cm)



*A. cervicornis* Abundance 1999-2009



*A. palmata* Abundance 1999-2009



*A. cervicornis* 4.3% Keys-wide protection

*A. palmata* 33.3% Keys-wide protection





Upper Keys



Middle Keys

Manage Places (SPAs, ROs) to include what you think are the best sites, your favorite sites, or important sites?



Upper Keys



Upper Keys



Upper Keys



Upper Keys



Upper Keys



Upper Keys (off Tavernier)

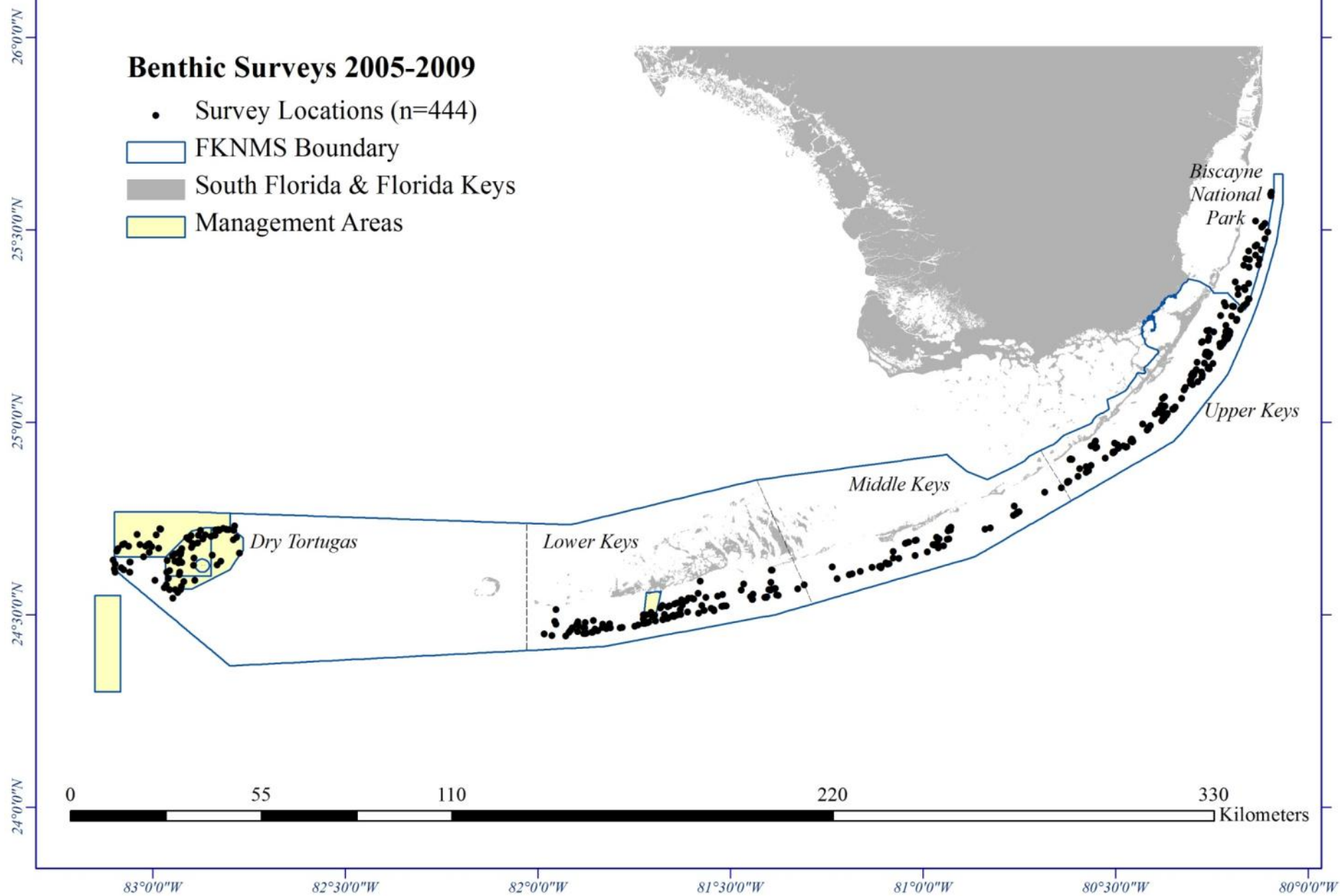


# Results that may help inform zoning interests at the ecosystem-scale

1. Topographic Complexity (maximum vertical relief)
2. Coral Cover
3. Coral Density (>4cm)
4. Juvenile Coral Density (<4cm)
5. Coral Sizes
6. Seaweed Cover
7. Sponge Cover
8. Coral Species Richness
9. Sponge Species Richness
10. Gorgonian Species Richness
11. Gorgonian Density
12. *Diadema* Density
13. *Diadema* Sizes
14. Anemones
15. Corallimorpharians
16. Snail densities and sizes
17. Marine Debris
18. Candidate species for listing under the Endangered Species Act
19. Condition (bleaching, disease, and more)
20. Other

## Benthic Surveys 2005-2009

- Survey Locations (n=444)
- FKNMS Boundary
- South Florida & Florida Keys
- Management Areas

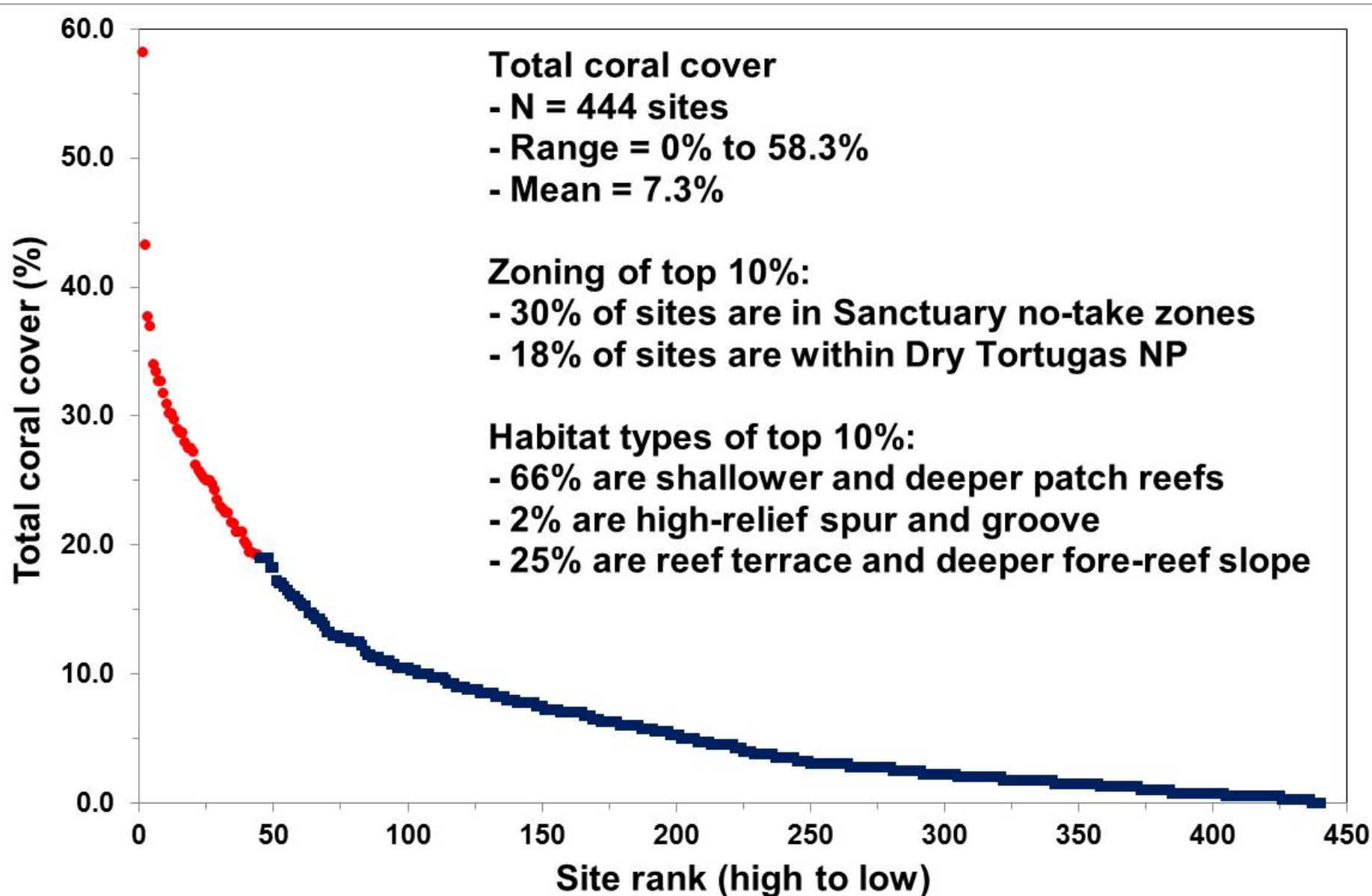


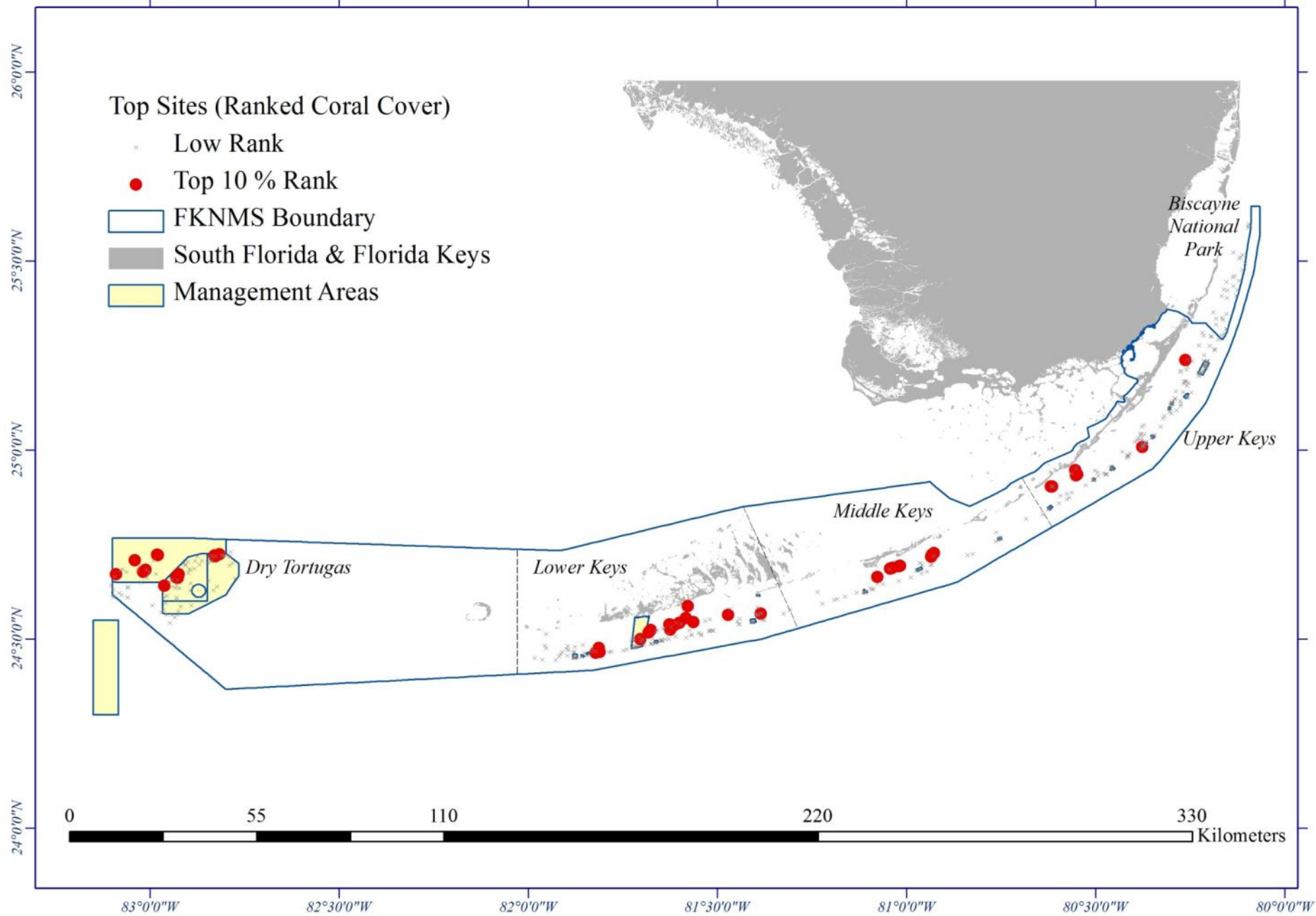
# Coral cover





# Total Coral Cover





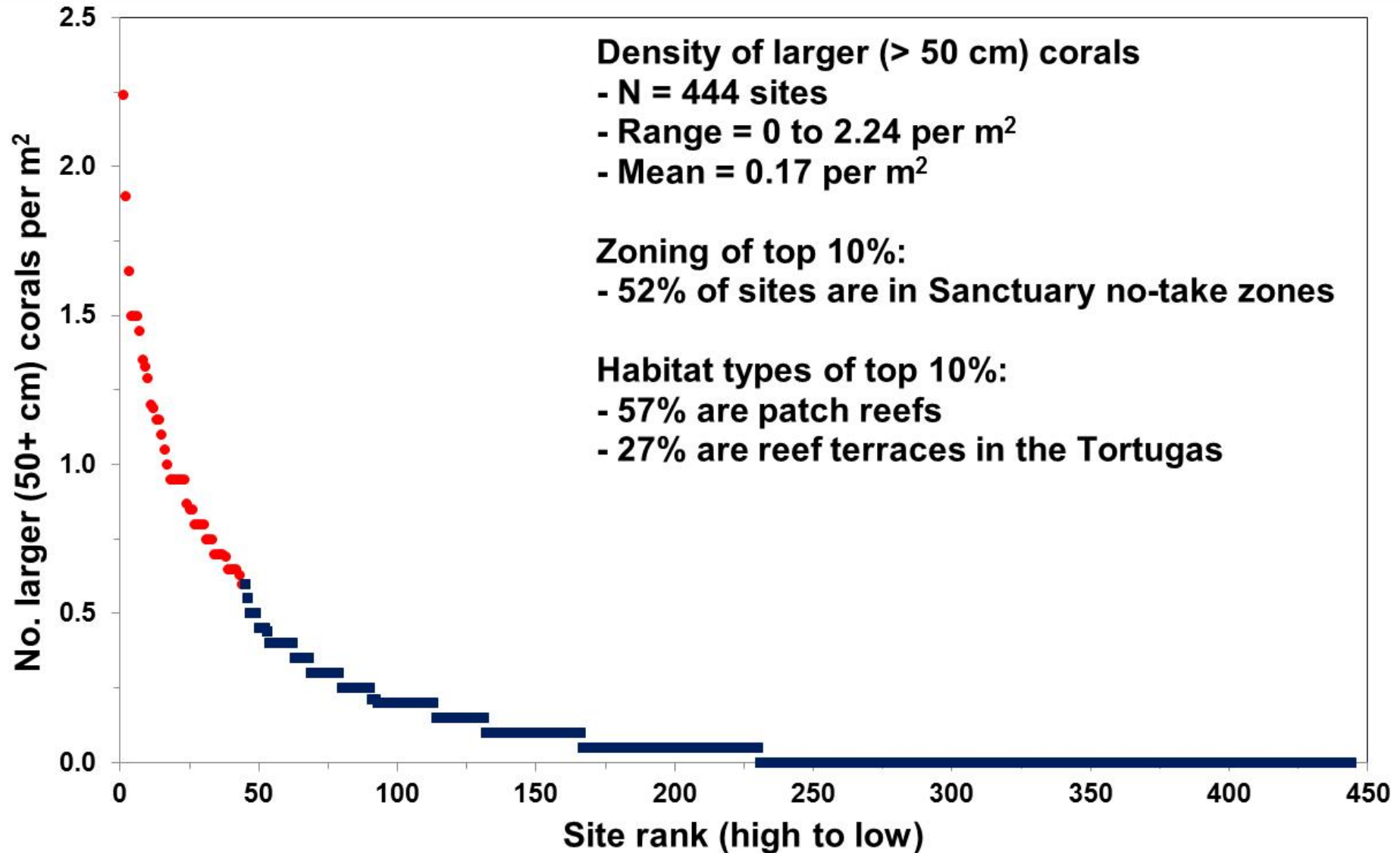


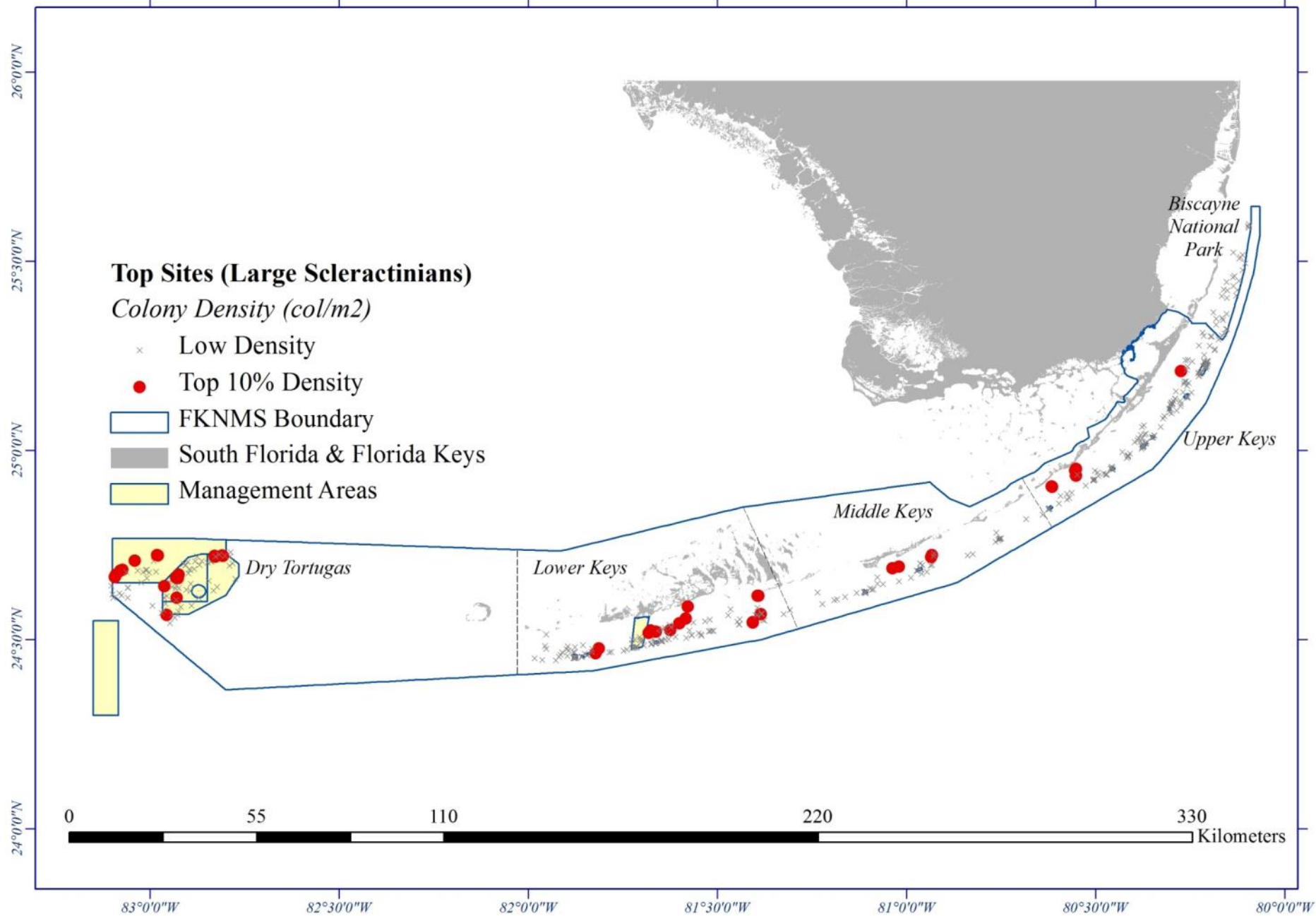


**Abundance: Large Corals**



# Density of larger (50+ cm) corals





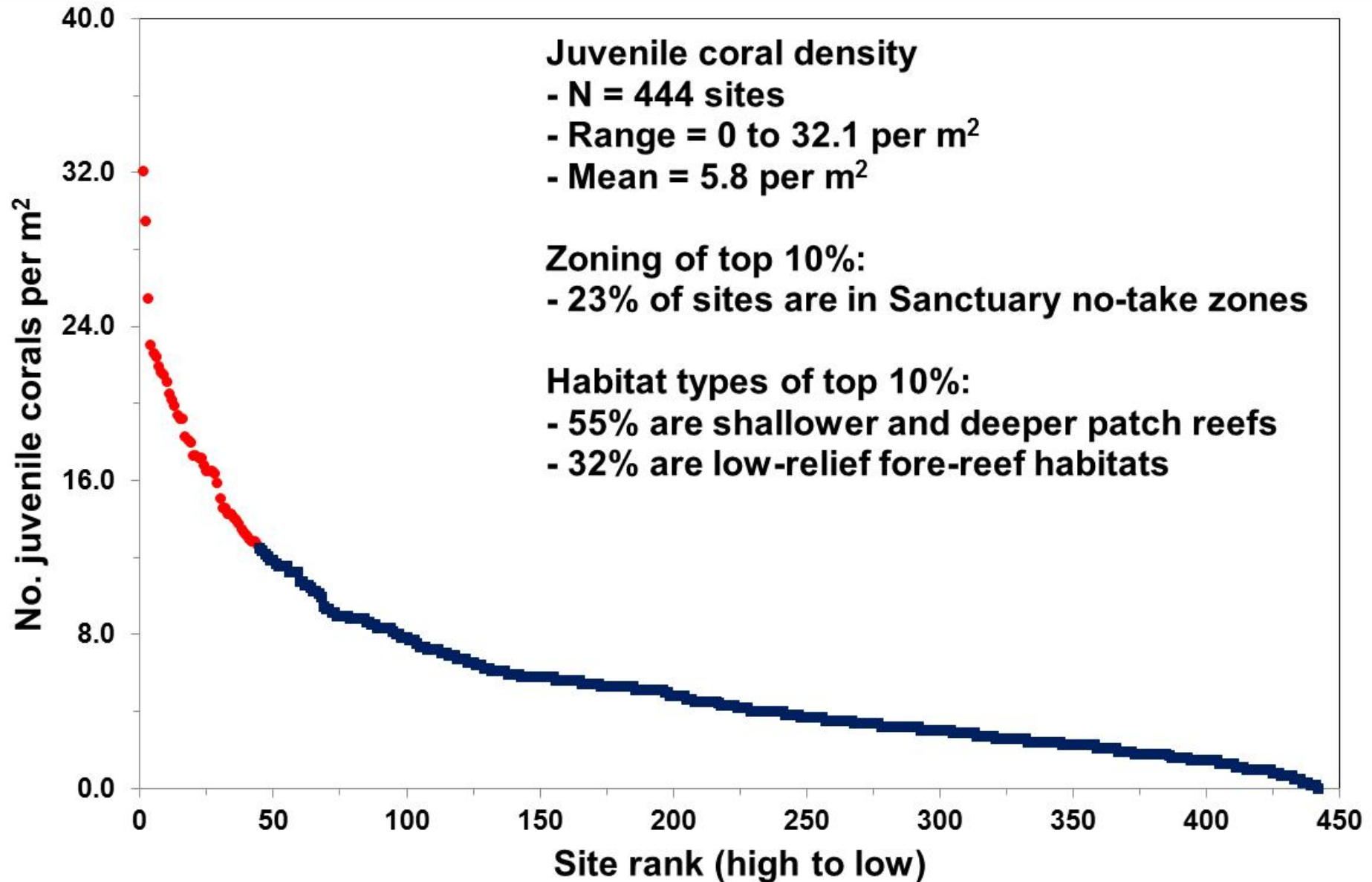


# Juvenile Corals



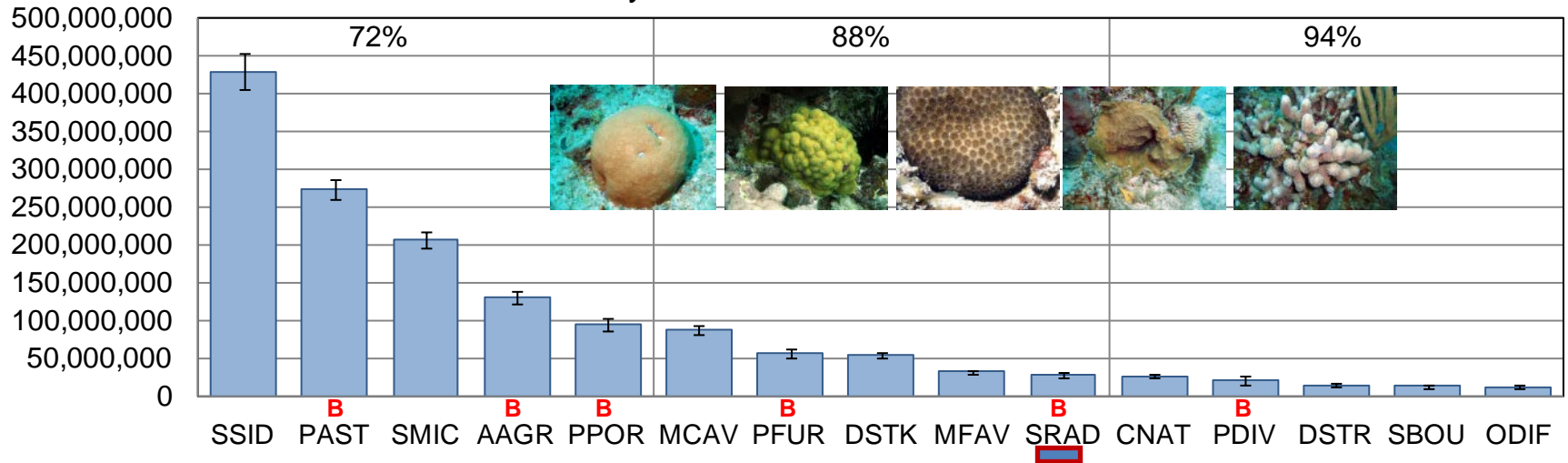


# Juvenile Coral Density



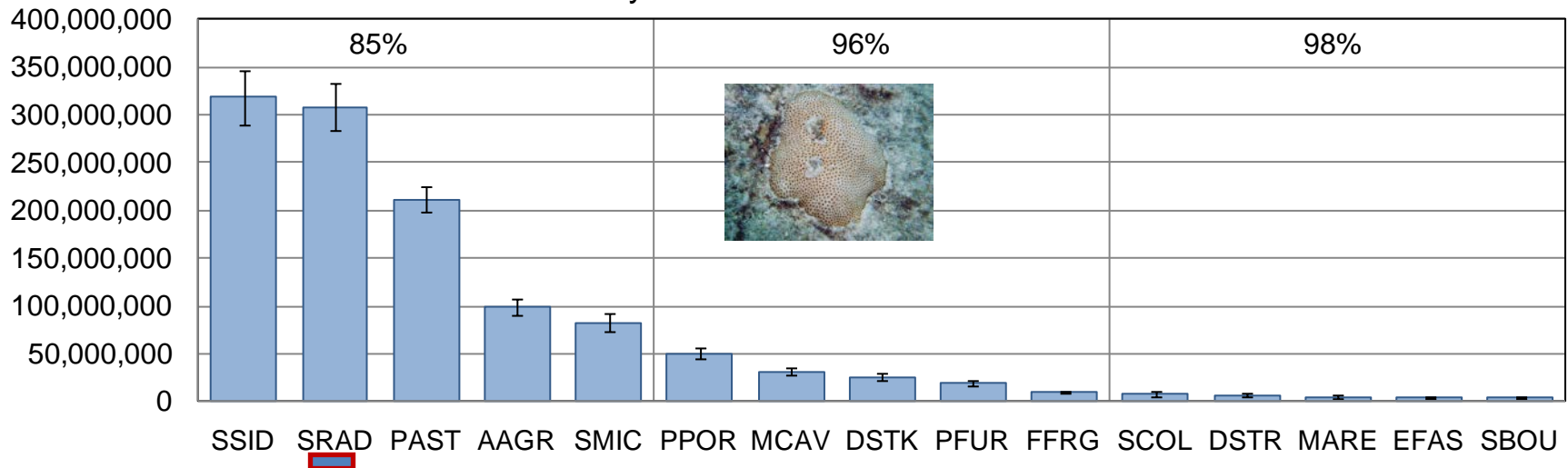
## Scleractinian Abundance: Top 15 species

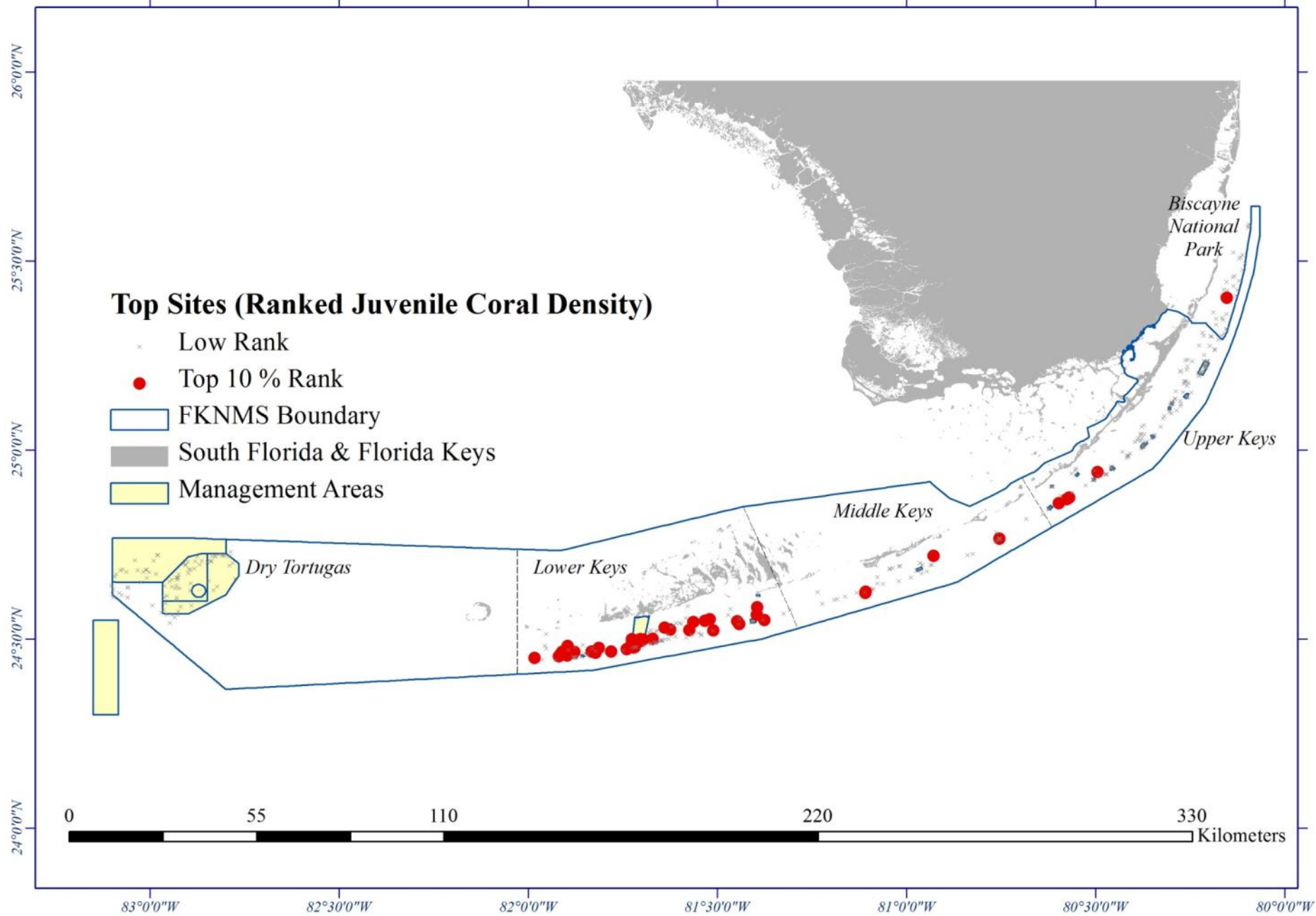
Florida Keys 1999-2009 All Habitats



## Juvenile Scleractinian Abundance: Top 15 species

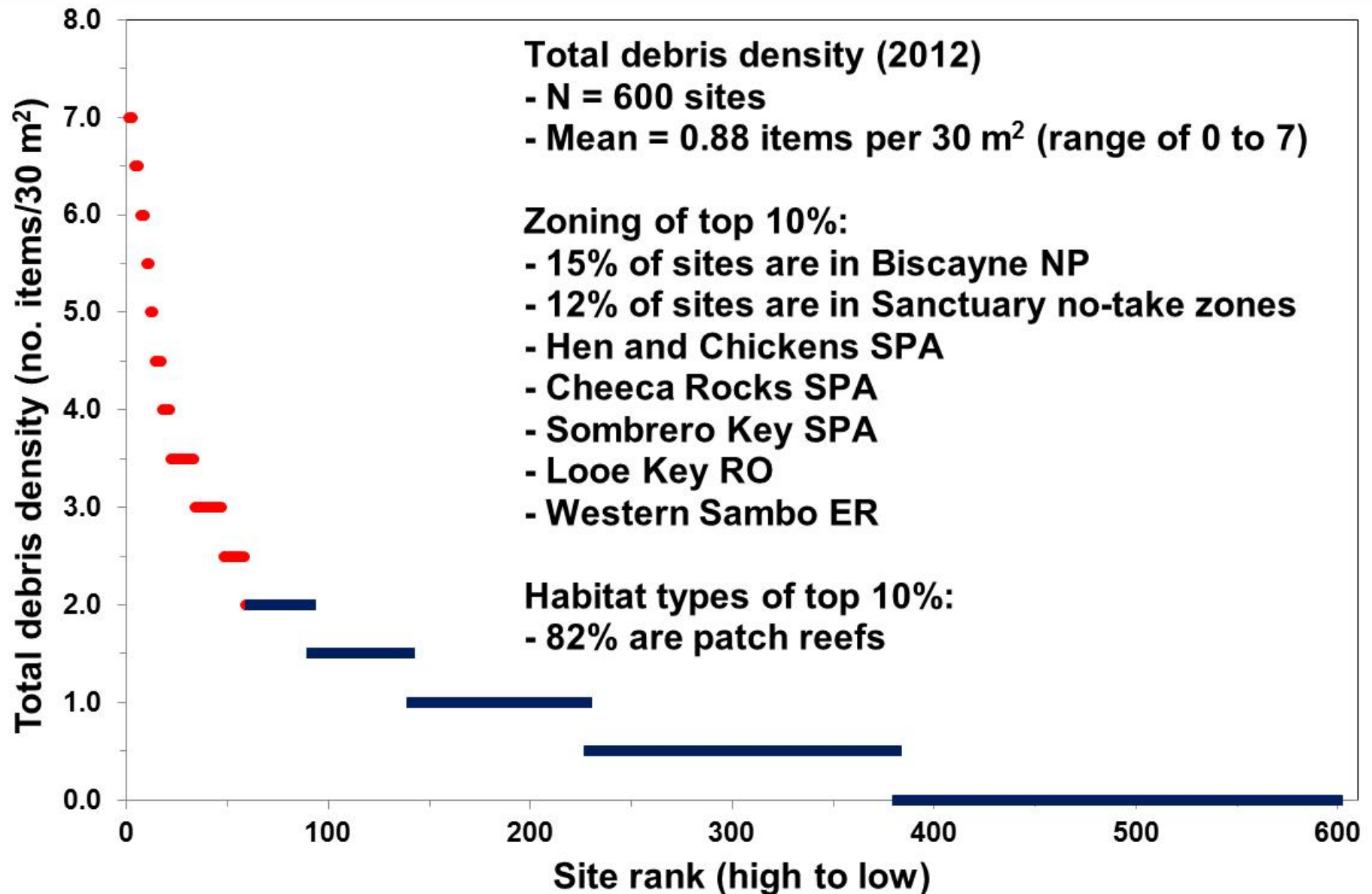
Florida Keys 1999-2009 All Habitats

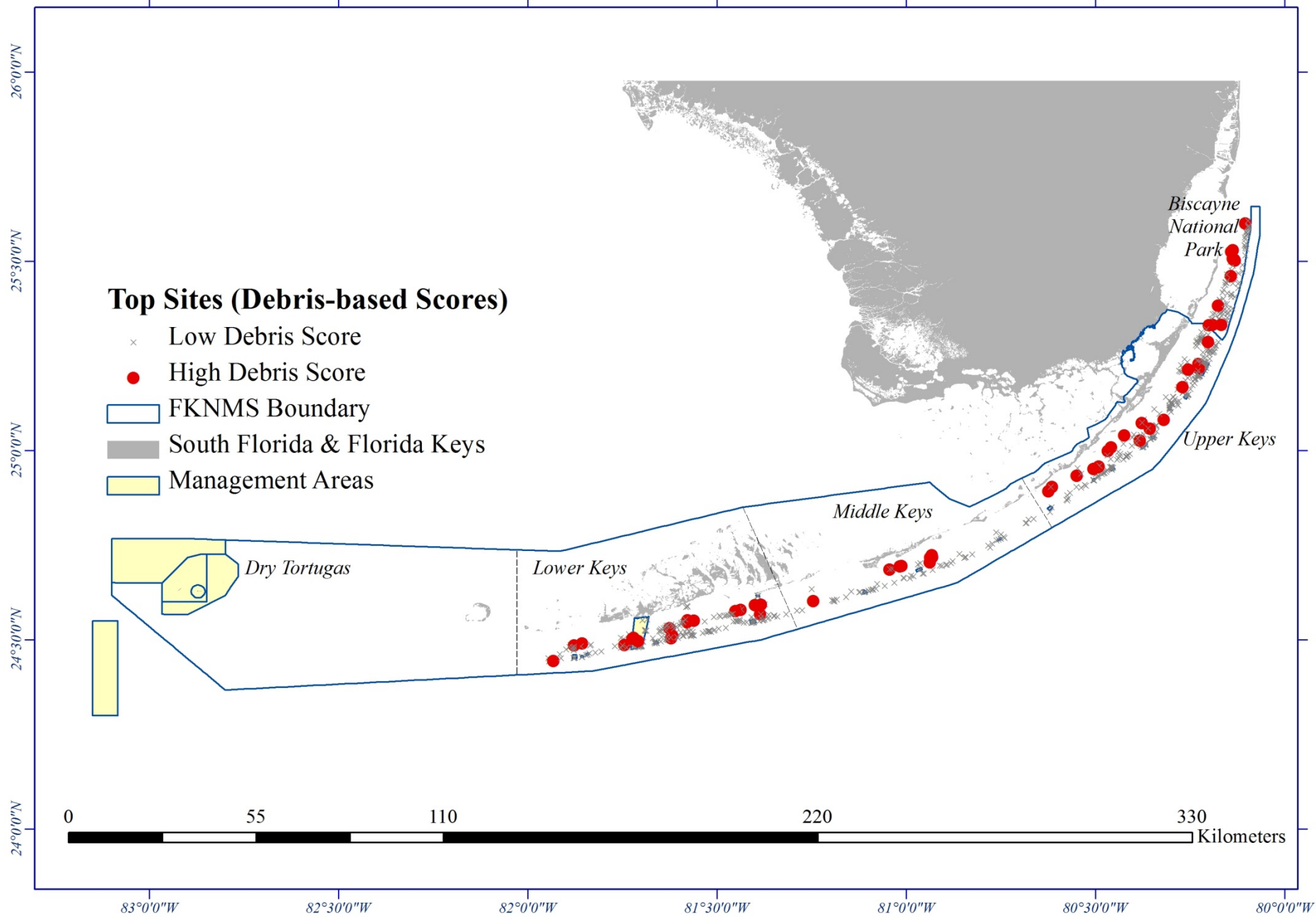


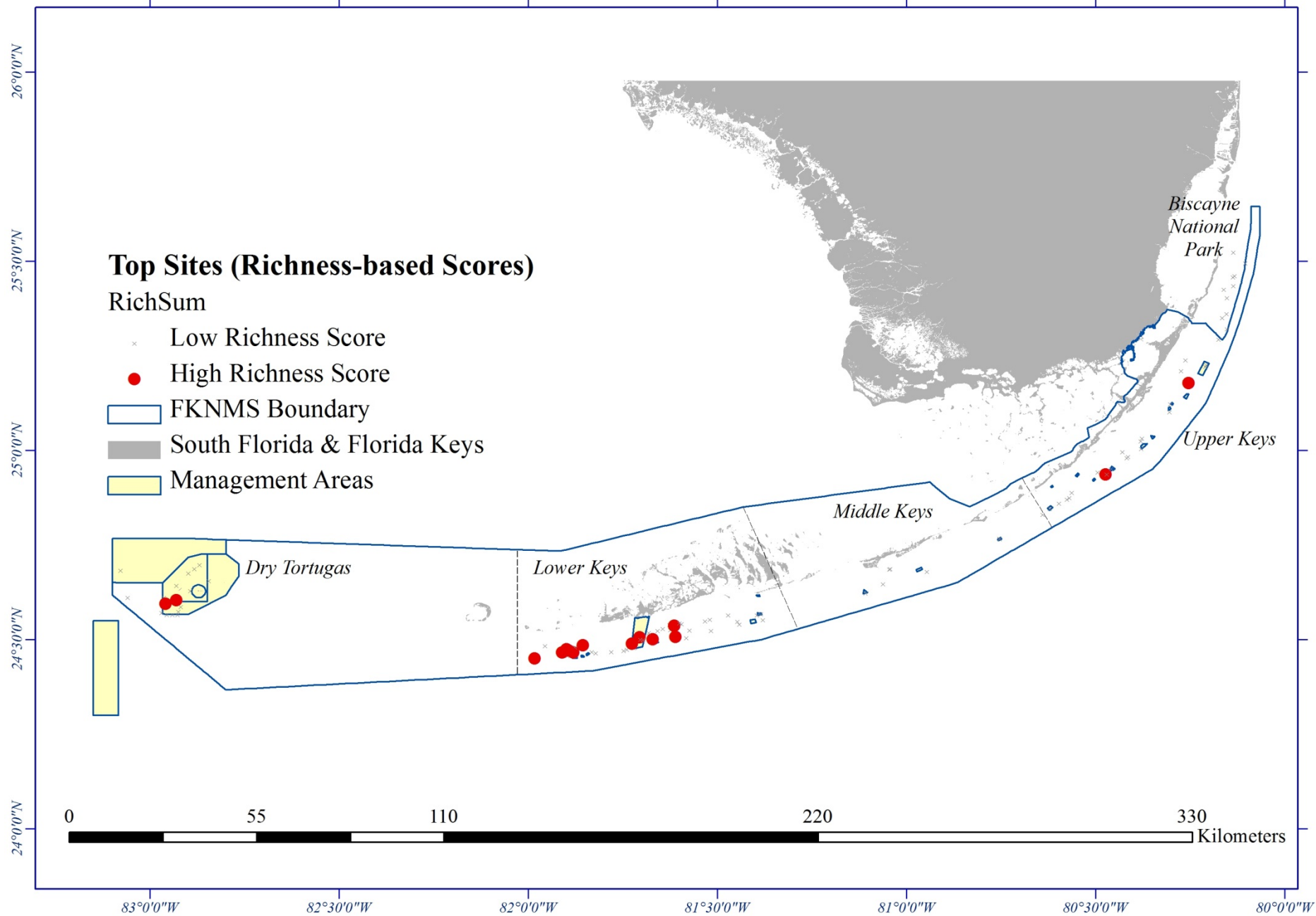


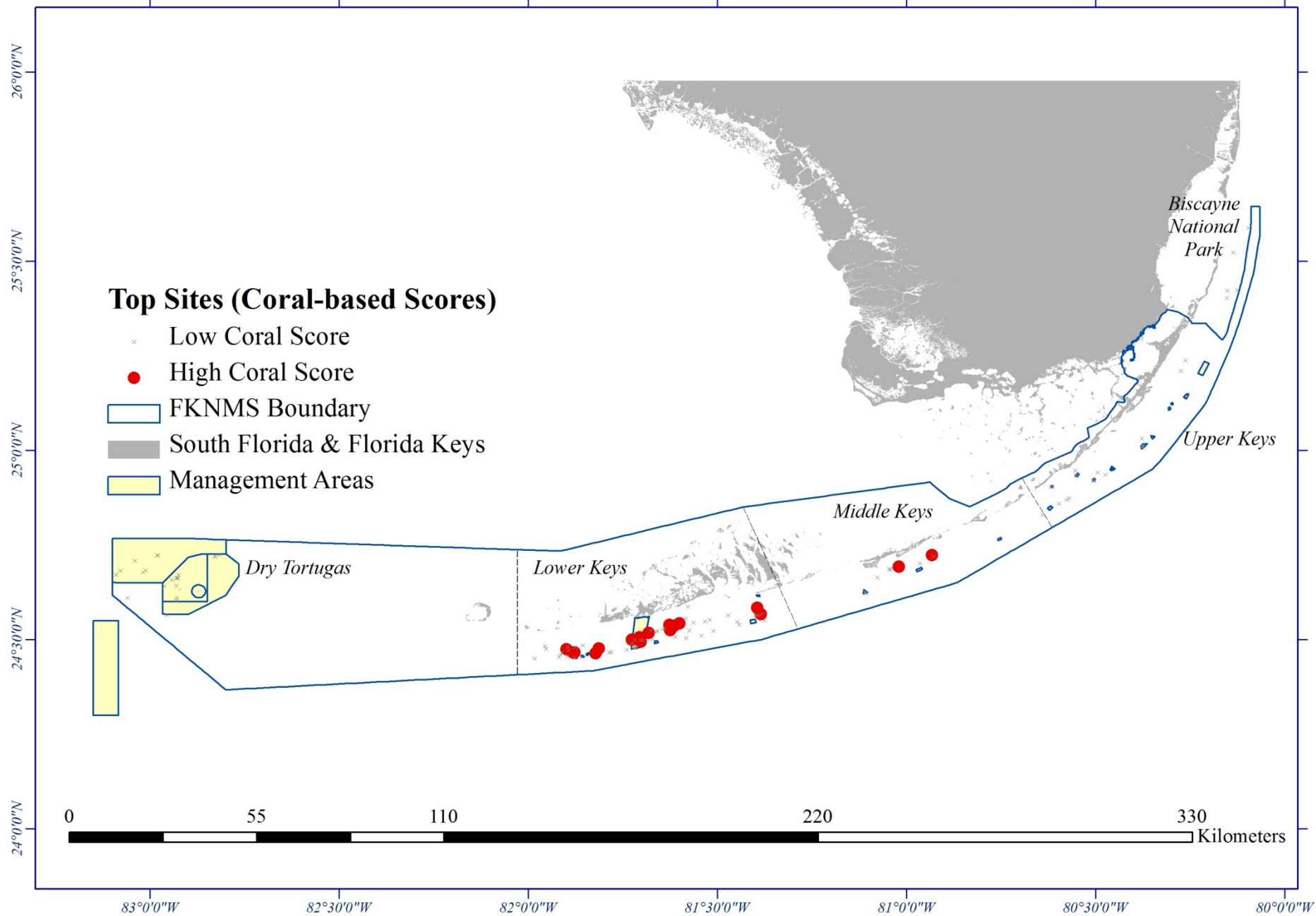


# Total debris density (2012)









# Conclusions

- We have a lot of data. Assembling and synthesizing our data (and data from other programs) to support your efforts to modify existing zones or propose new ones is not easy and it can't be done quickly. You need a plan (Tortugas 2000 is a good model).
- System-wide, related to some of the iconic species found in the sanctuary, such as *Diadema*, and staghorn and elkhorn coral, and even pillar coral, populations are increasing or are relatively stable over the last ten years. This is good news.
- Related to NTZs, it's a mixed bag. Community-level effects are likely to take a long time, if they occur at all. An important next step is to integrate our benthic data with the fish data that will be described in the next presentation.
- Questions? [smiller@nova.edu](mailto:smiller@nova.edu), 305-451-9030



# Acknowledgments

