



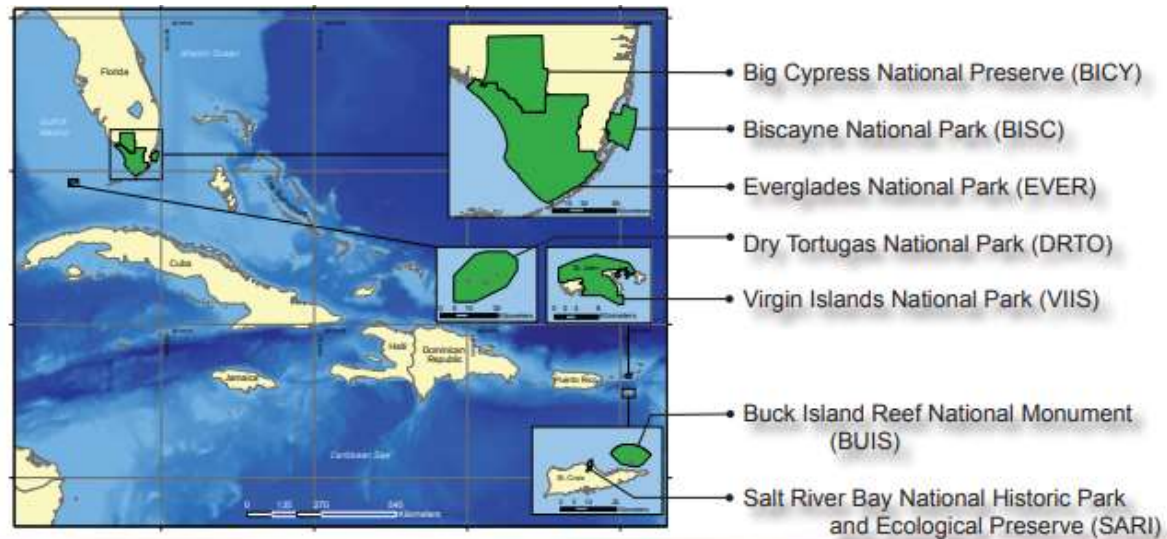
# Investigating spatio-temporal patterns of Double-crested Cormorant breeding colonies in Biscayne National Park

Donna Marain





# South Florida/Caribbean Inventory and Monitoring Network



SFCN Vital Signs			
✓ Network is completely or partially responsible for monitoring			
○ Park staff or other agency is completely or partially responsible for monitoring			
✗ Deferred due to time or monetary constraints			
✓ ○ Marine Benthic Communities	✓ ○ Invasive/Exotic Animals	✗ Land Birds	○ Protected Marine Mammals
✓ ○ Marine Fish Communities	○ Visitor Use	✓ Amphibians	✗ Wetland Substrate
✓ ○ Surface Water Hydrology	✓ ○ Periphyton (Freshwater)	○ Sawfish	✗ Bats - USVI
○ Nutrient Dynamics	✓ ○ Mangrove-Marsh Ecotone	✓ ○ Coastal Geomorphology	✗ Reptiles - USVI
✓ ○ Invasive/Exotic Plants	○ Contaminants	○ Focal Fish Species	✗ Florida Box Turtle
✓ ○ Land-use Change	○ Phytoplankton (Marine)	○ Water Chemistry	✗ Marine Infaunal Community
✓ ○ Colonial Nesting Birds	○ Sea Turtles	✗ Imperiled & Rare Plants	✗ Island Insects
○ Estuarine Salinity Patterns	○ American Crocodile	✗ Butterflies	○ Air Quality - Deposition
✓ ○ Marine Exploited Invertebrates	○ American Alligator	○ Florida Panther	○ Air Quality - Mercury
✓ ○ Marine Invertebrates - Rare, Threatened, and Endangered	✓ ○ Wetland Ecotones & Community Structure	✓ ○ Benthic Communities Extent & Distribution	✓ ○ Forest Ecotones & Community Structure
✓ ○ Vegetation Communities Extent & Distribution	✓ ○ Freshwater Fish & Large Macro-Invertebrates	○ Fire Return Interval Departure	✓ Aquatic Invertebrates in Wet Prairies & Marshes





# Introduction

- Birds as indicators
  - Great Egret, White Ibis, Wood Stork, Snowy Egret, Roseate Spoonbill
  - Visual vs. tactile
  - Searchers vs. exploiters

The image shows a screenshot of a news article from the Miami Herald. The article title is "South Florida wading birds nested like crazy in 2018, a great sign for the Everglades". The author is ELADRIANN BRADLEIGH, and the article was published on MAY 17, 2019, at 10:00 AM, with an update on MAY 17, 2019, at 11:48 AM. The article is categorized under "ENVIRONMENT". Below the article text is a video player with the title "Spoonbills an indicator of health for Florida Bay". The video shows a roseate spoonbill in flight against a blue sky. The video player has a progress bar at 0:00/0:15 and a "SHARE" button. Below the video player, there is a caption: "Dr. Jerry Lorenz, Audubon Florida research director, explains during a visit to South Nest Key why roseate spoonbills, along with other wading birds, are a major indicator of the health of Florida Bay. in CHL 2018".



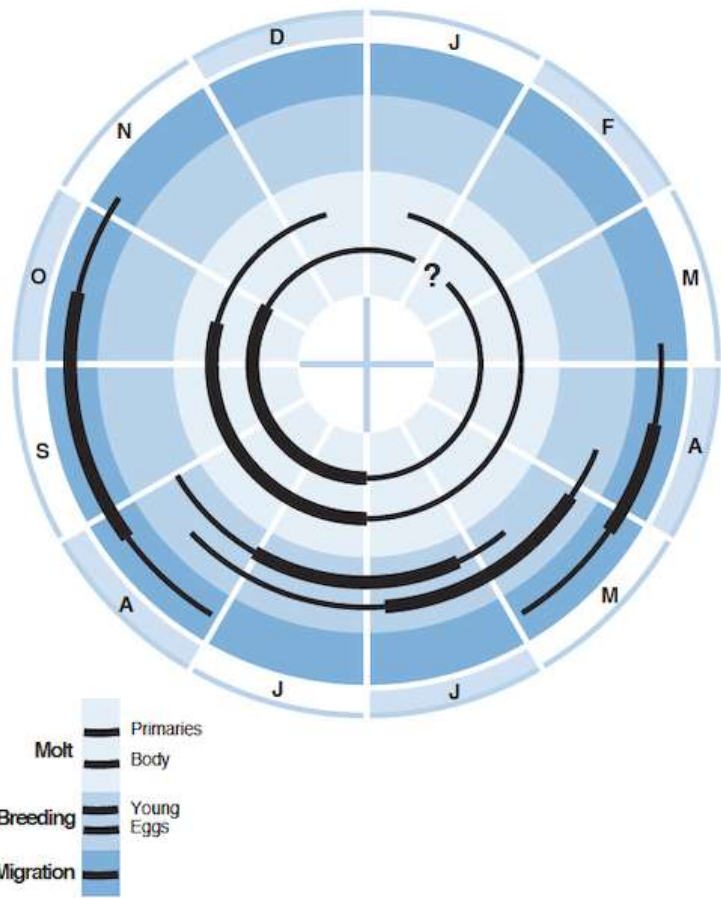


# Methods





# Nesting Cycle and Metrics



- Active nests = nests with eggs, nest with chicks, nest with adult, empty but well-maintained
- Peak nest
- Nesting index





# Biscayne National Park





# Biscayne National Park

Year	Double-crested Cormorant	Great Blue Heron	Great Egret	Great White Heron	Roseate Spoonbill	White Ibis
2010-2011	994	11	14	29	12	78
2011-2012	879	6	14	20	3	28
2012-2013	792	15	18	24	7	49
2013-2014	1336	11	24	18	4	60
2014-2015	802	13	14	18	0	38
2015-2016	1213	11	12	28	3	24
2016-2017	1245	11	16	40	4	95
2017-2018	1135	16	29	45	9	66

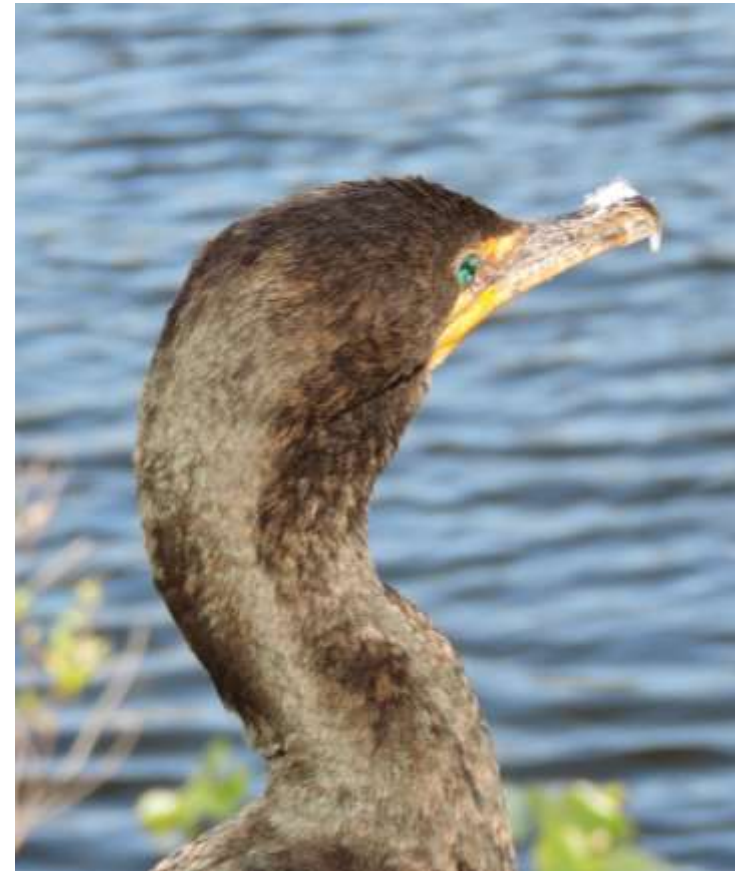




# Double-crested Cormorants

## *(Phalacrocoax auritus)*

- 5 subspecies
- Dive-and-pursuit predators
  - Gulf toadfish (41%), parrotfish (22%), and grunts (13%)
- Breed at 2-3 years of age
- DDT history
- Considered a pest in most of the continental U.S.

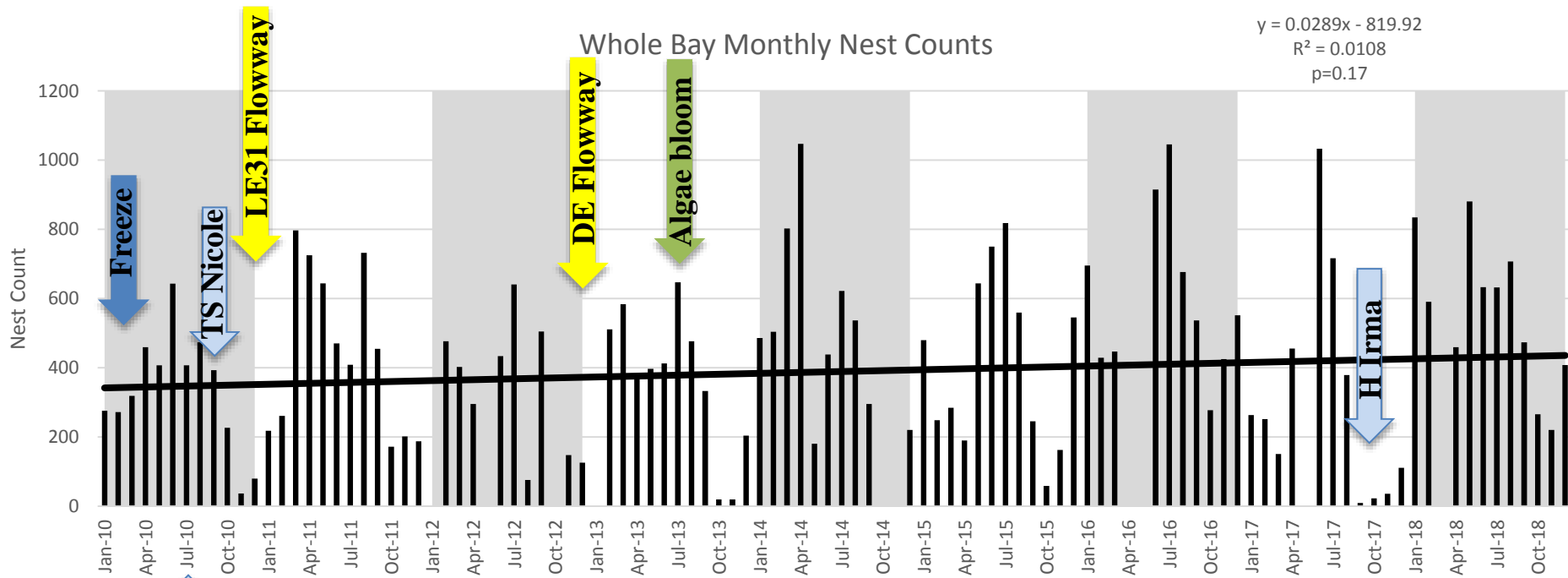






# Findings

- 42,000+ DCCO nests

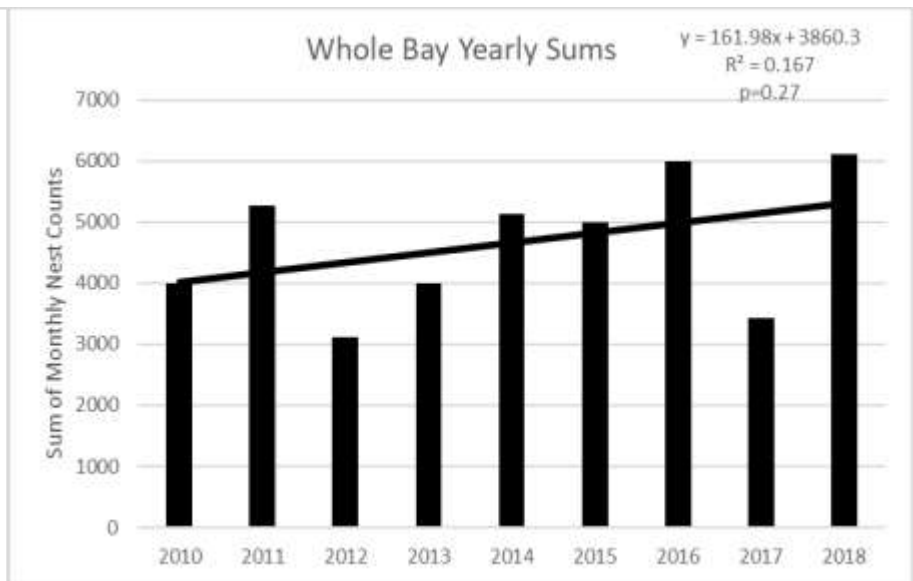
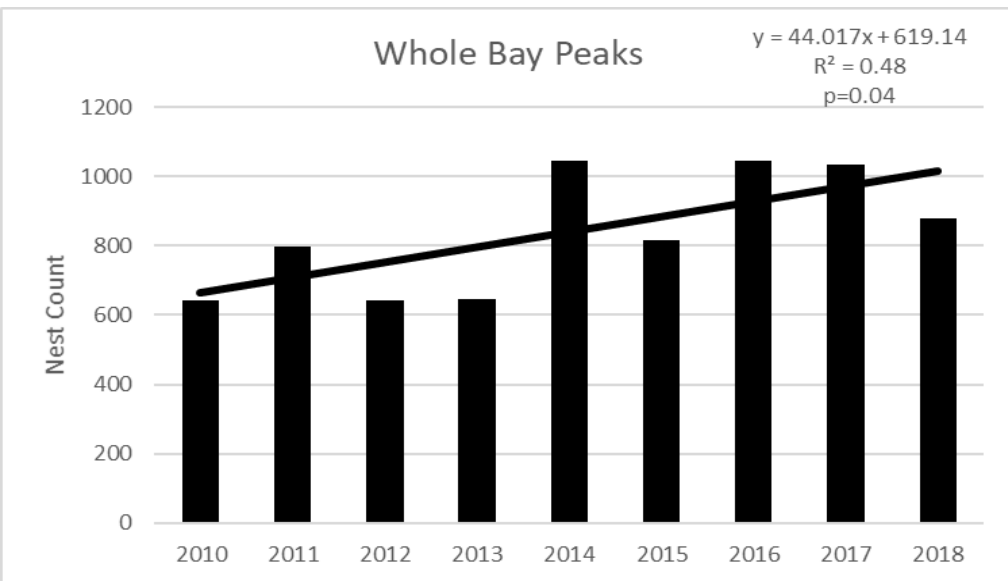


TS Bonnie



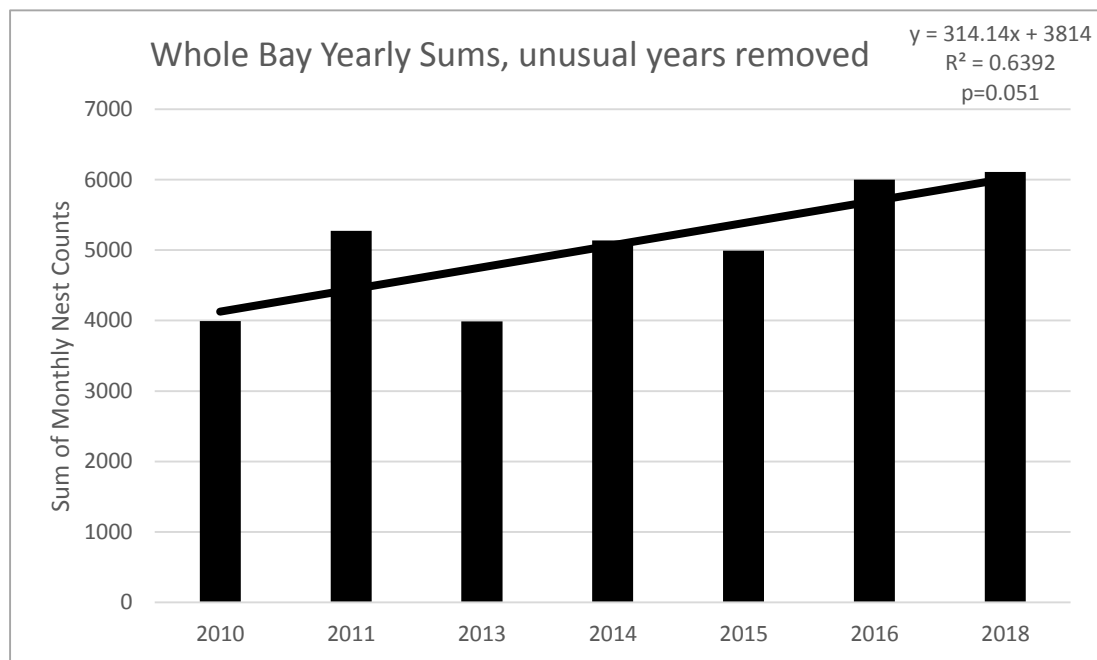


# Findings





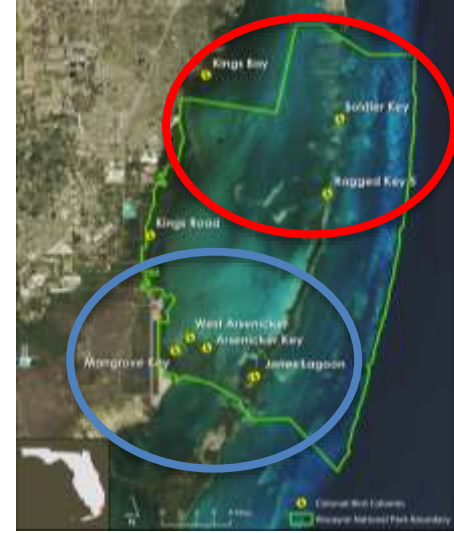
# Findings





# Findings

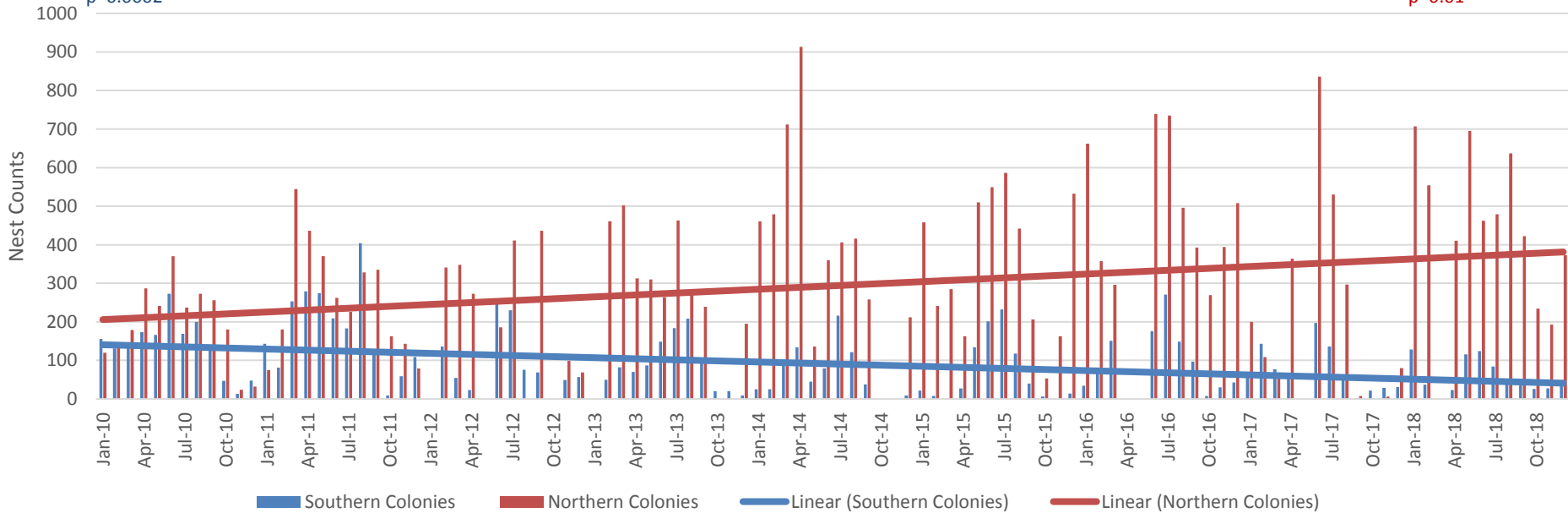
- Northern colonies are growing, south are shrinking



$y = -0.0307x + 1375.6$   
 $R^2 = 0.1235$   
 $p = 0.0002$

Nest Counts

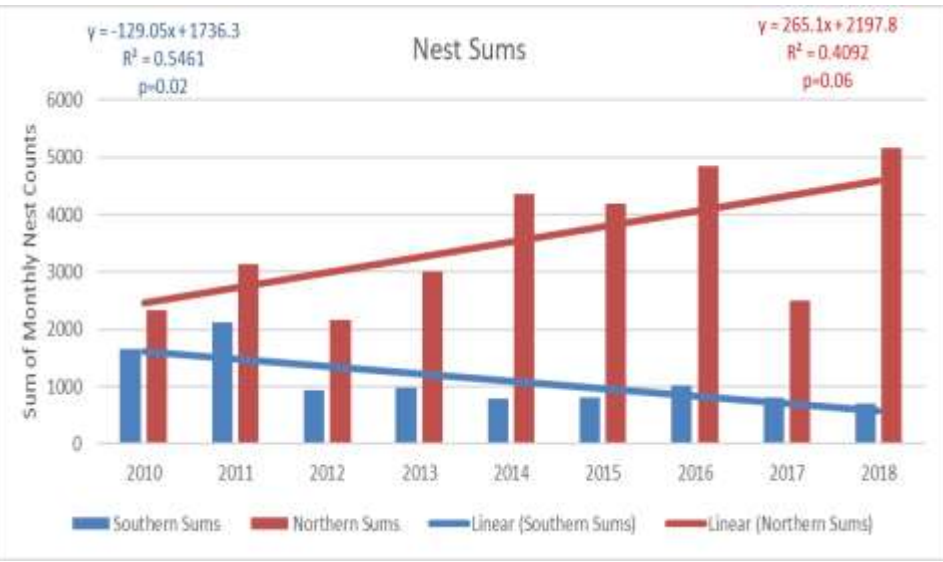
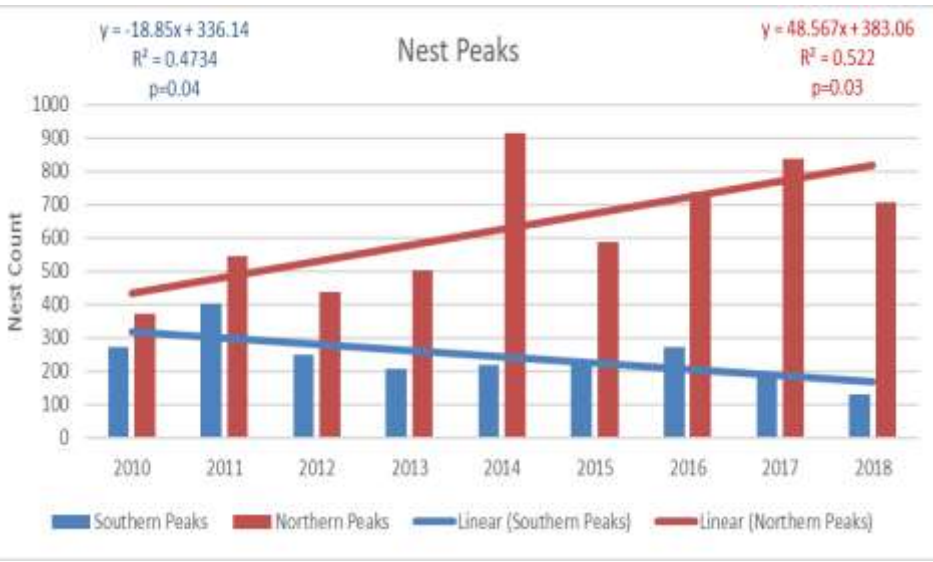
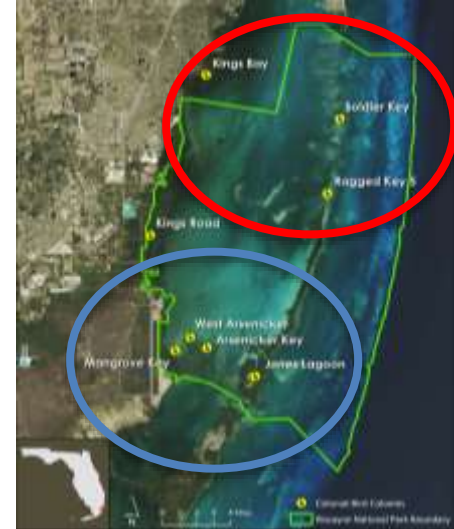
$y = 0.0538x - 1955.9$   
 $R^2 = 0.0567$   
 $p = 0.01$





# Findings

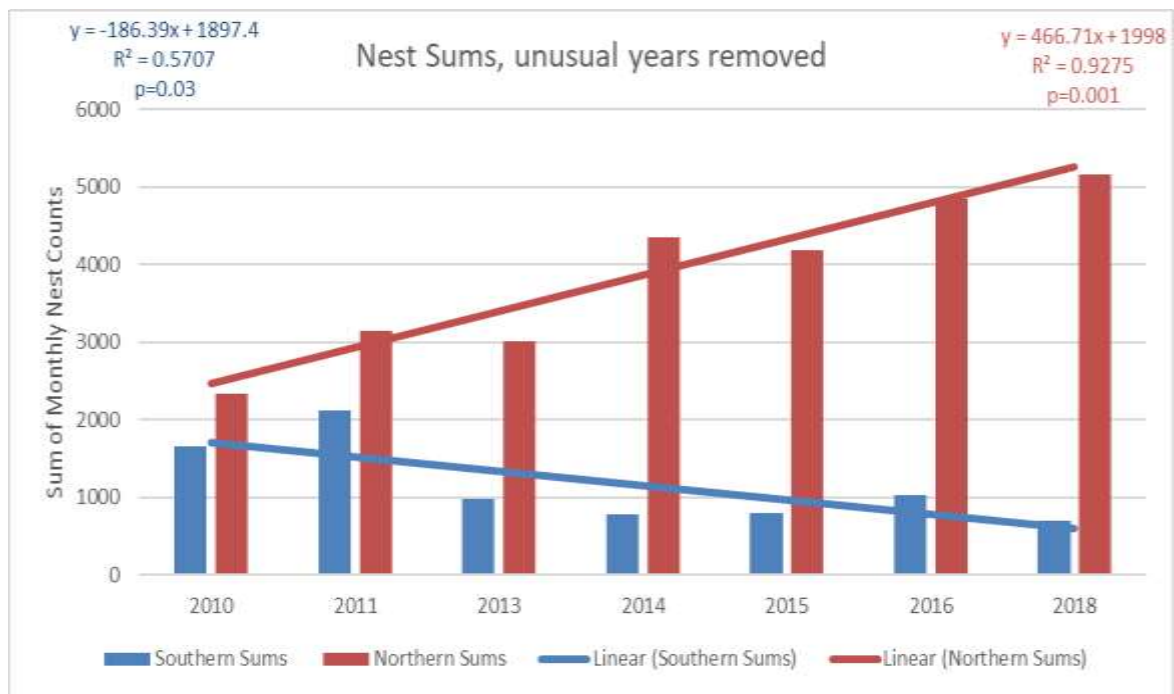
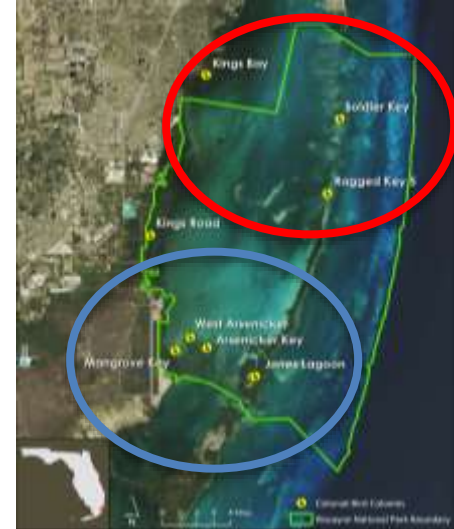
- Northern colonies are growing, south are shrinking





# Findings

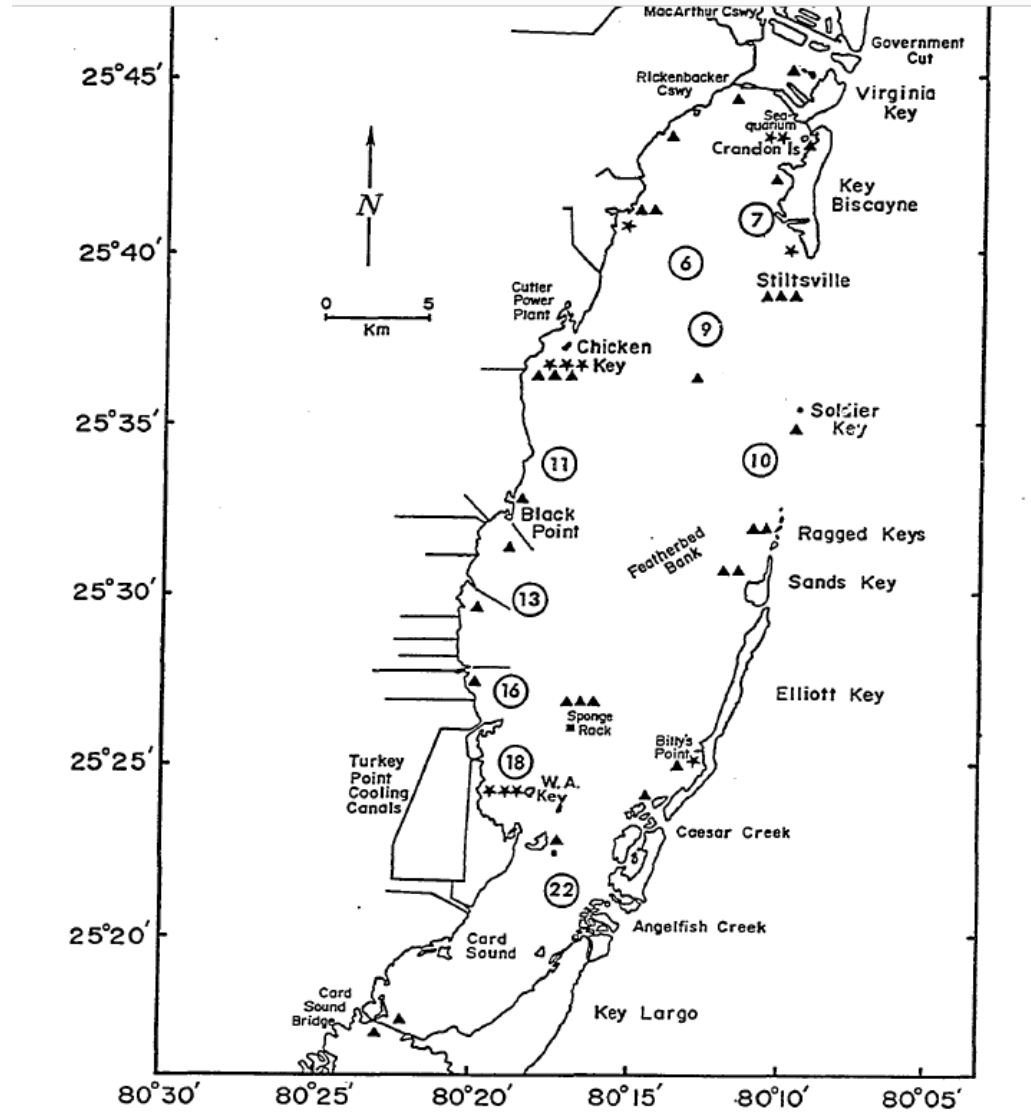
- Unusual years removed





# Discussion

- Social dynamics





# Environmental Characteristics of Colonies

	Arsenicker Key	Jones Lagoon	Mangrove Key	West Arsenicker	Kings Road Island	Kings Bay	Ragged Key 4	Ragged Key 5	Soldier Key
% seagrass	91.4	71.4	67.8	83.7	74.9	N/A	97	95	92.5
Mean water depth in meters (max)	3.3 (4.4)	3.1 (12.4)	2.9 (4.1)	3.5 (3.8)	2.8 (3.5)	N/A	4.3 (9)	4.3 (8.0)	4.2 (7.9)
Size (acres)	6.56	0.76	0.65	28.55	0.74	2.04	4.48	5.05	2.80
Acres used for nesting (% of total)	0.34 (5%)	0.46 (61%)	0.22 (34%)	N/A	0.32 (43%)	1.15 (56%)	0.55 (12%)	1.47 (29%)	0.8 (29%)
Meters of mangrove shoreline	1339.16	583.95	272.33	2779.01	272.49	1236.67	1184.78	1081.16	538.23
Average seagrass density (~% cover)	2.48 (20%)	2.43 (20%)	2 (15%)	2.17 (10%)	2.5 (25%)	3.05 (30%)	4.78 (70%)	4.78 (70%)	4.7 (65%)
Average fish density (/m <sup>2</sup> )	5.11	N/A	5.11	5.11	2.3	4.57	19.09	19.09	N/A





# Discussion

## Currents

- The northern colonies may be better habitat

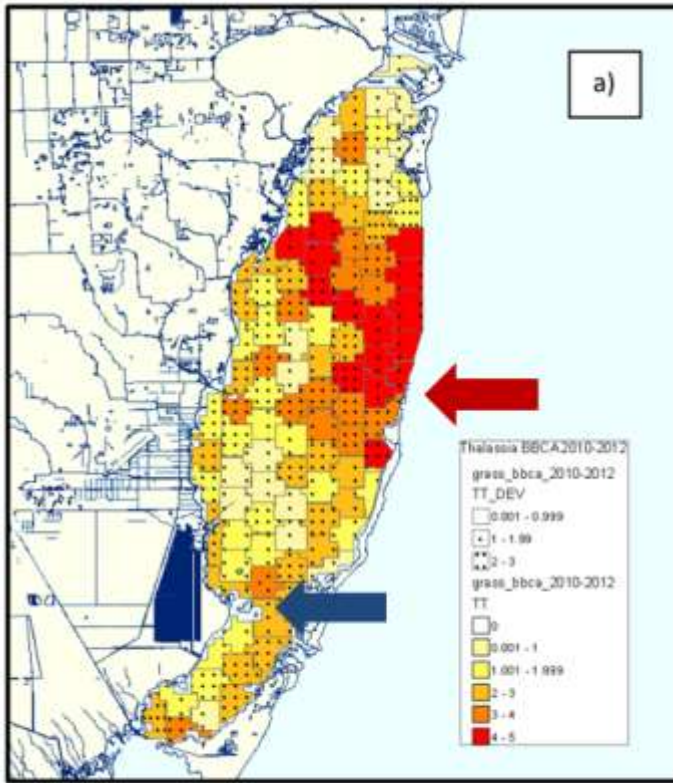
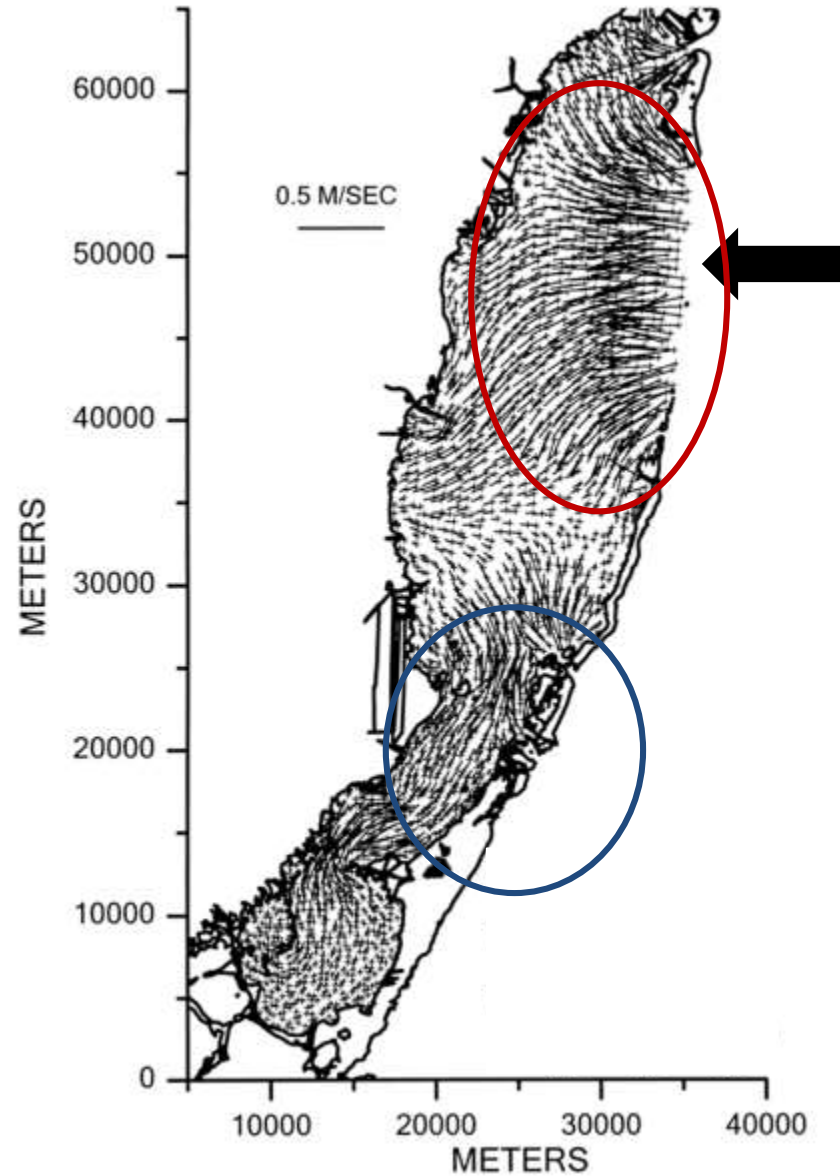


Photo credit: RECOVER (2014)





# Discussion

## Timing

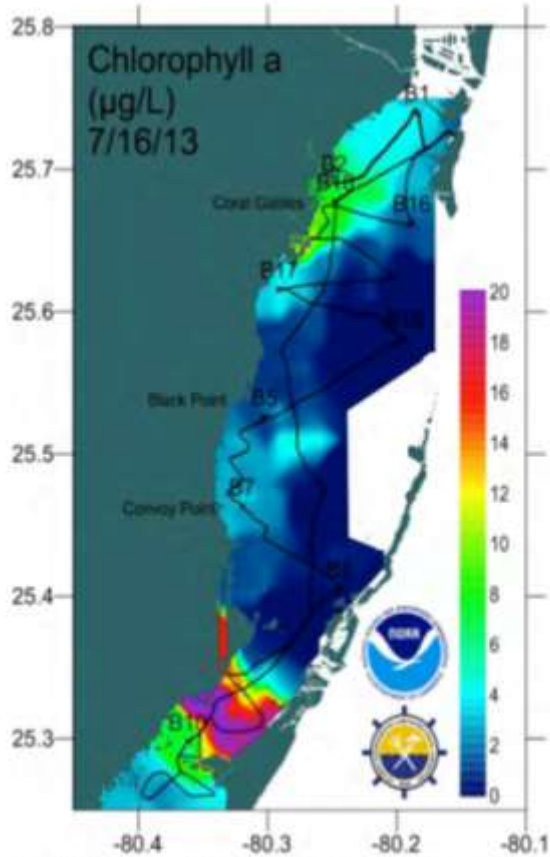


Figure 7-20. Chla concentrations in Biscayne Bay on July 16, 2013. The black line within the bay shows the survey's boat track of continuous-flow water quality analysis.

Photo credit RECOVER (2014)

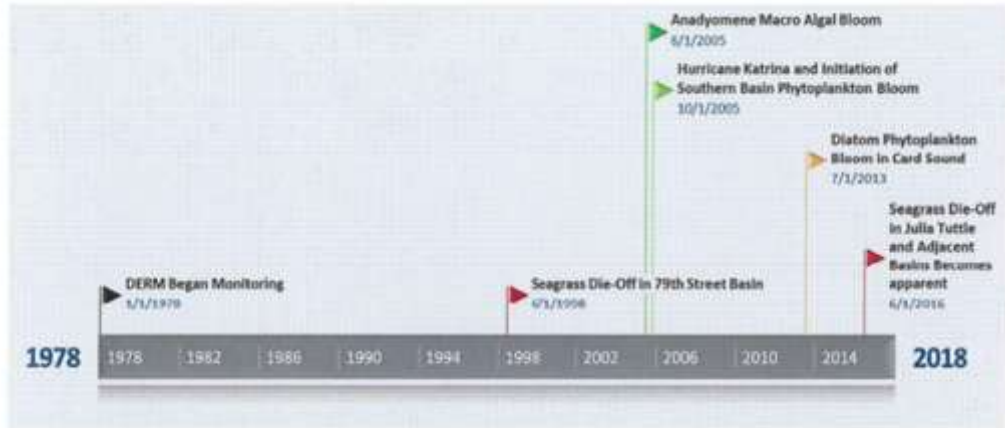
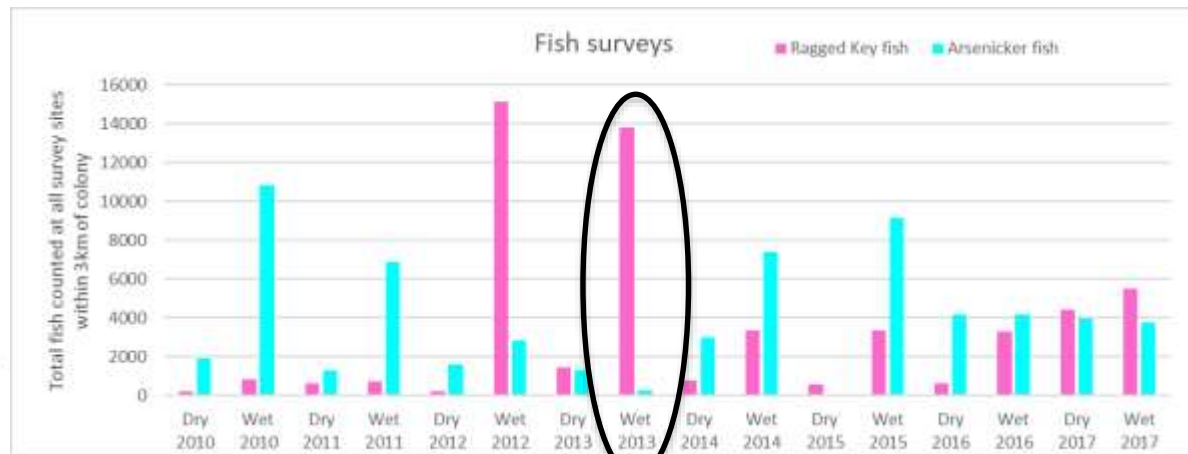


Photo credit: Miami-Dade DERM (2019)





# Findings

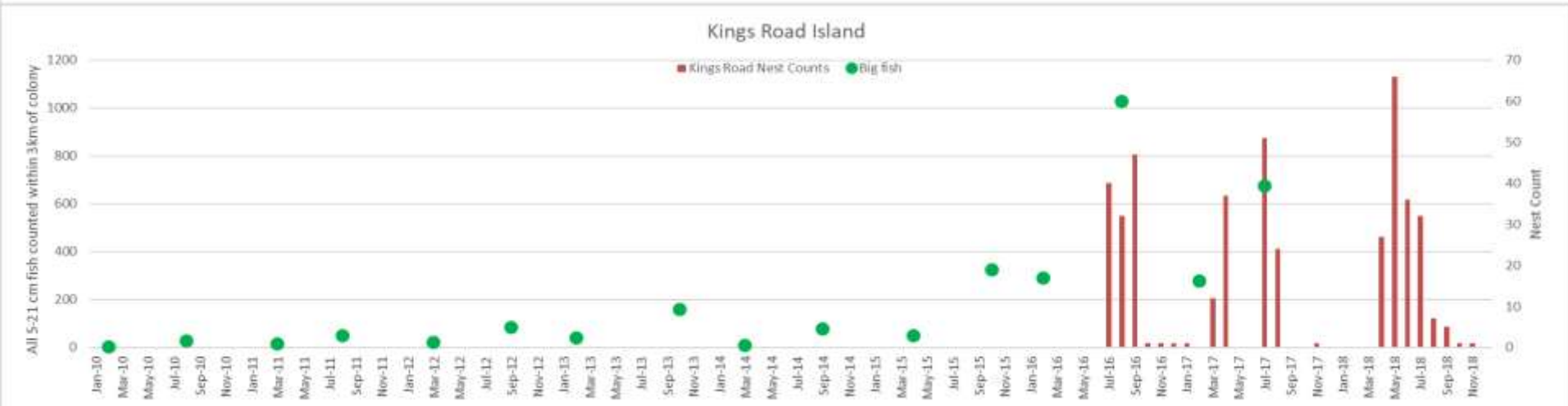
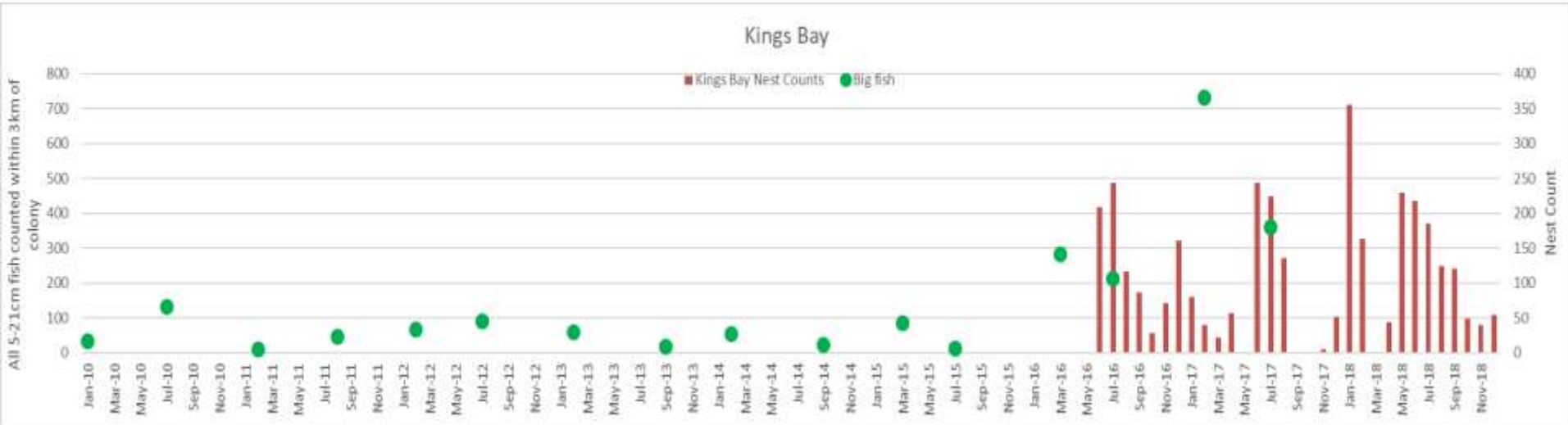
## New Colonies

- Biscayne Bay Coastal Wetlands - Comprehensive Everglades Restoration Plan (CERP)



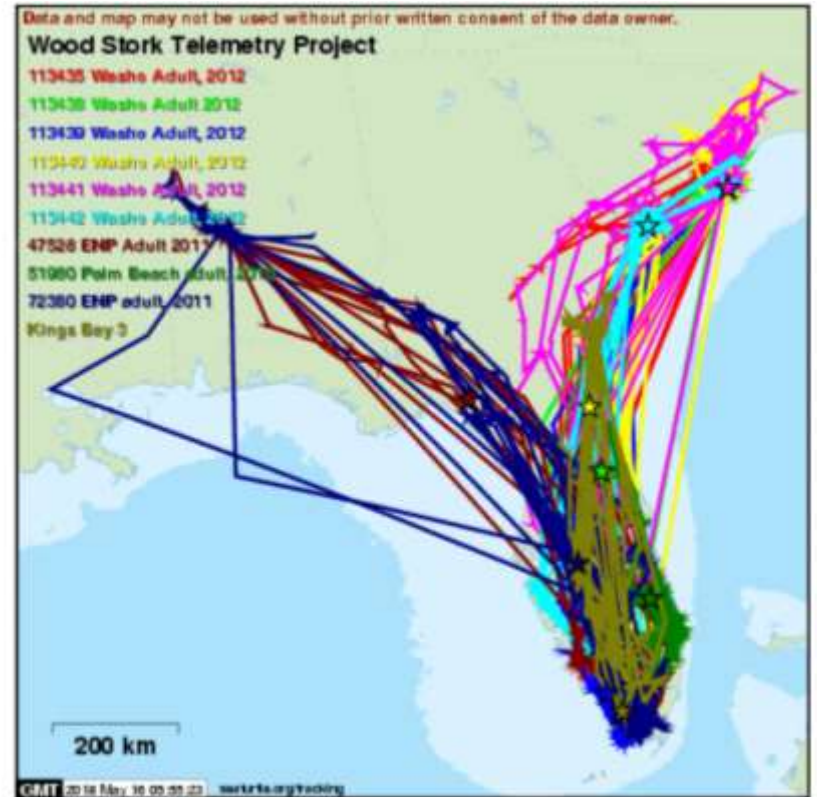


# Fish increase at the same time as bird colonies





# Further Studies





# Acknowledgements

- Dr. Kevin Whelan, Robert Muxo, Raul Urguelles, Mario Londono, Craig Perry – SFCN
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- Lima Soto, Paige Lambert – Mosaics in Science



# Questions?



Environment  
for the Americas



Greening Youth  
FOUNDATION



# References

- Cummings, M. V. (1989). The feeding energetics of the double-crested cormorant in Biscayne Bay, Florida. Ph.D. Dissertation, University of Miami, Miami, Florida.
- Gawlk, D. E. (2002). The effects of prey availability on the numerical response of wading birds. *Ecological Monographs*, 72(3), 329-346
- Lirman, D., Browder, J., & Serafy, J. (2018). *6th Annual Report: IBBEAM—Integrated Biscayne Bay Ecological Assessment and Monitoring*. NOAA-NMFS-SEFSC-PRBD-2018-0?.
- Miami-Dade County, Department of Regulatory and Economic Resources. 2019. *Report on the Findings of the County's Study on the Decline of Seagrass and Hardbottom Habitat on Biscayne Bay – Directive No. 171537*.
- Muxo, R., K. R. T. Whelan, R. Urgelles, J. Alonso, J. M. Patterson, and A. J. Atkinson. 2015. Biscayne National Park colonial nesting birds monitoring protocol, v. 1.00. Natural Resource Report NPS/SFCN/NRR—2015/994. National Park Service, Fort Collins, Colorado.
- Patterson, M. E., A. J. Atkinson, B. D. Witcher, K. R. T. Whelan, W. J. Miller, R. J. Waara, J. M. Patterson, B. I. Ruttenberg, A. D. Davis, R. Urgelles, and R. B. Shamblin. 2008. South Florida/Caribbean Network Vital signs monitoring plan. Natural Resource Report NPS/SFCN/NRR—2008/063. National Park Service, Fort Collins, Colorado.
- RECOVER. 2014. *2014 System Status Report*. Restoration Coordination and Verification, c/o U.S. Army Corps of Engineers, Jacksonville, Florida, USA, and South Florida Water Management District, West Palm Beach, Florida, USA. Retrieved from [https://evergladesrestoration.gov/ssr/2014/ssr\\_full\\_2014.pdf](https://evergladesrestoration.gov/ssr/2014/ssr_full_2014.pdf)
- Wang, J. D., Luo, J., & Ault, J. S. (2003). Flows, salinity, and some implications for larval transport in south Biscayne Bay, Florida. *Bulletin of Marine Science*, 72(3), 695-723.

