The Hangover Effect:
Coupling seagrass loss, macroalgal growth, & water quality in Charlotte Harbor, Florida

Chris J Anastasiou, Ph.D.
Chief Scientist & Seagrass Mapping Program Lead
Surface Water Improvement and Management (SWIM) Program
Southwest Florida Water Management District

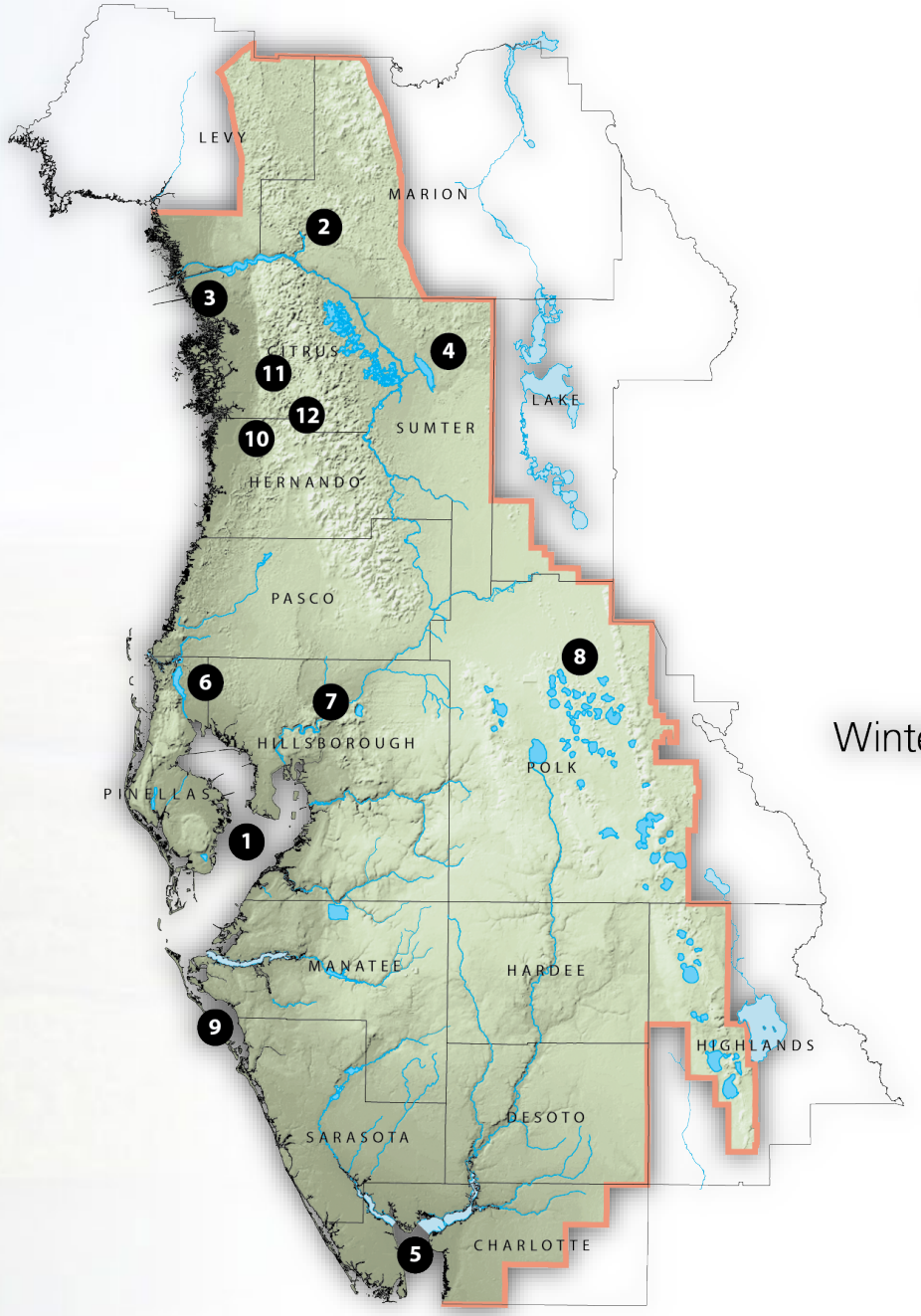
Mark Walton, SWIM SWFWMD
Tara Schiro, SWIM SWFWMD

Sustainable Water Resources
Complex Challenges, Integrated Solutions

8th Biennial UF Water Institute Symposium
February 22-23, 2022

Southwest Florida Water Management District

Surface Water Improvement and Management
SWIM



Tampa Bay	1
Rainbow River	2
Crystal River/Kings Bay	3
Lake Panasoffkee	4
Charlotte Harbor	5
Lake Tarpon	6
Lake Thonotosassa	7
Winter Haven Chain of Lakes	8
Sarasota Bay	9
Weeki Wachee River	10
Chassahowitzka River	11
Homosassa River	12

Charlotte Harbor Estuary

- 2nd largest open water estuary in Florida (~ 700 km^2)
- Large watershed to open water ratio (12:1)
- "Hold the Line" nutrient management strategy (SWIM 2020)
  - From 2000 to 2017 no evidence of:
    - Degrading water clarity
    - Increasing chlorophyll-a
    - Increasing TP
    - Increasing TN

Charlotte Harbor a relatively healthy estuary. . . BUT

Charlotte Harbor Estuary

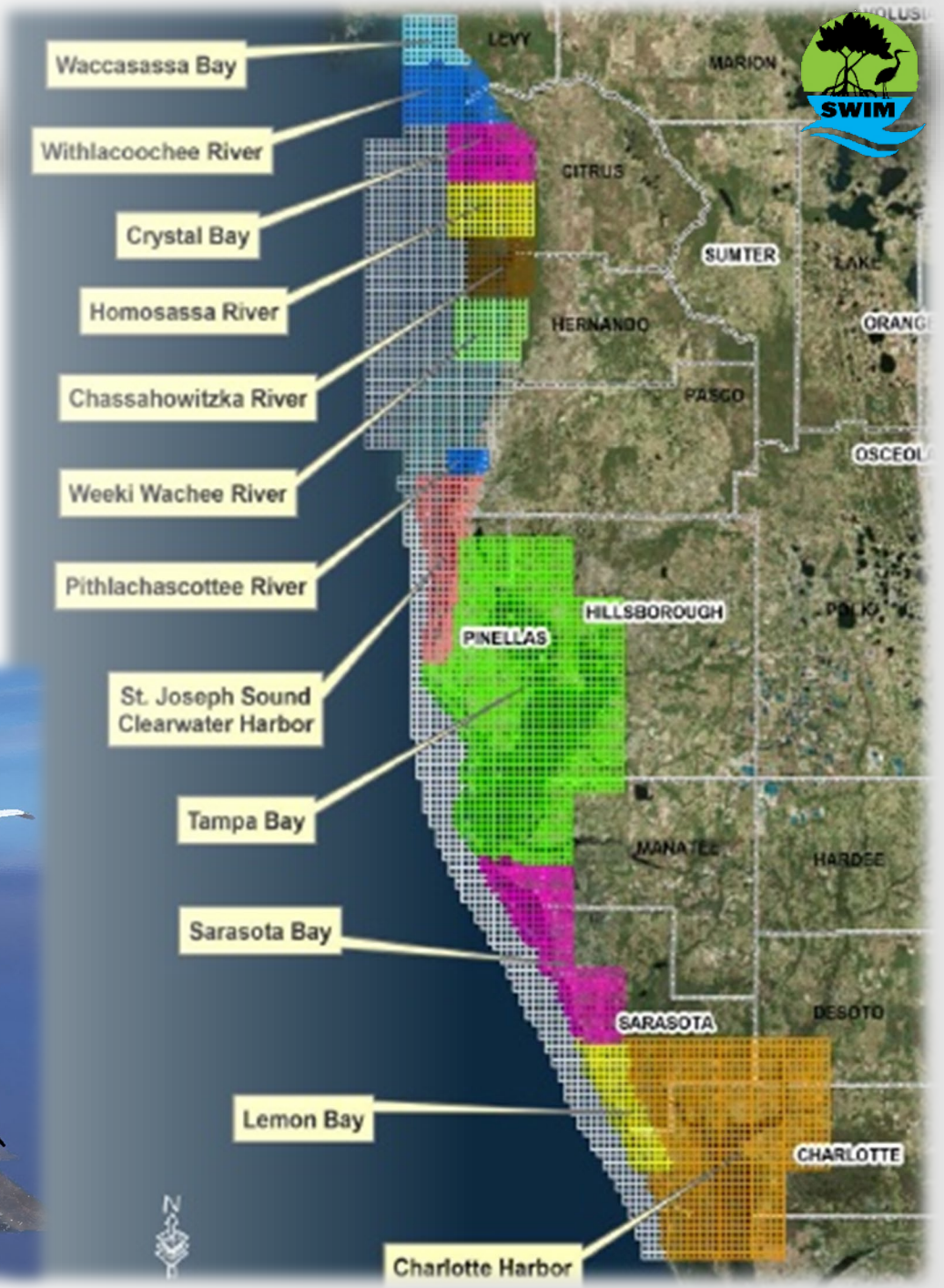
- 2nd largest open water estuary in Florida (~ 700 km^2)
- Large watershed to open water ratio (12:1)
- "Hold the Line" nutrient management strategy (SWIM 2020)
  - From 2000 to 2017 no evidence of:
    - Degrading water clarity
    - Increasing chlorophyll-a
    - Increasing TP
    - Increasing TN

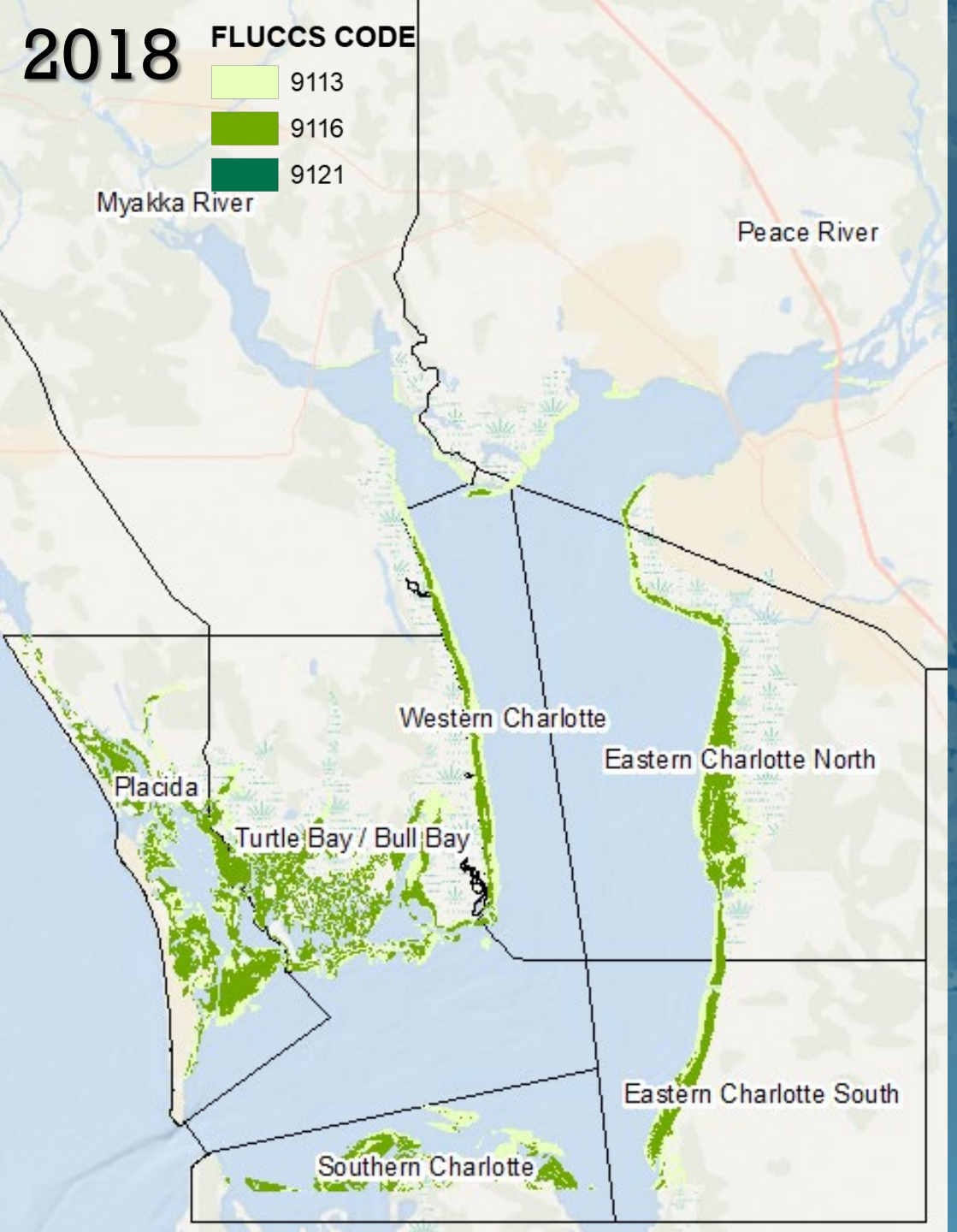
Charlotte Harbor a relatively healthy estuary. . . BUT NOT Pristine

2000 Nitrogen loads 3X greater than in the 1800s (Turner, et al. 2006)

SWFWMD Seagrass Mapping Program

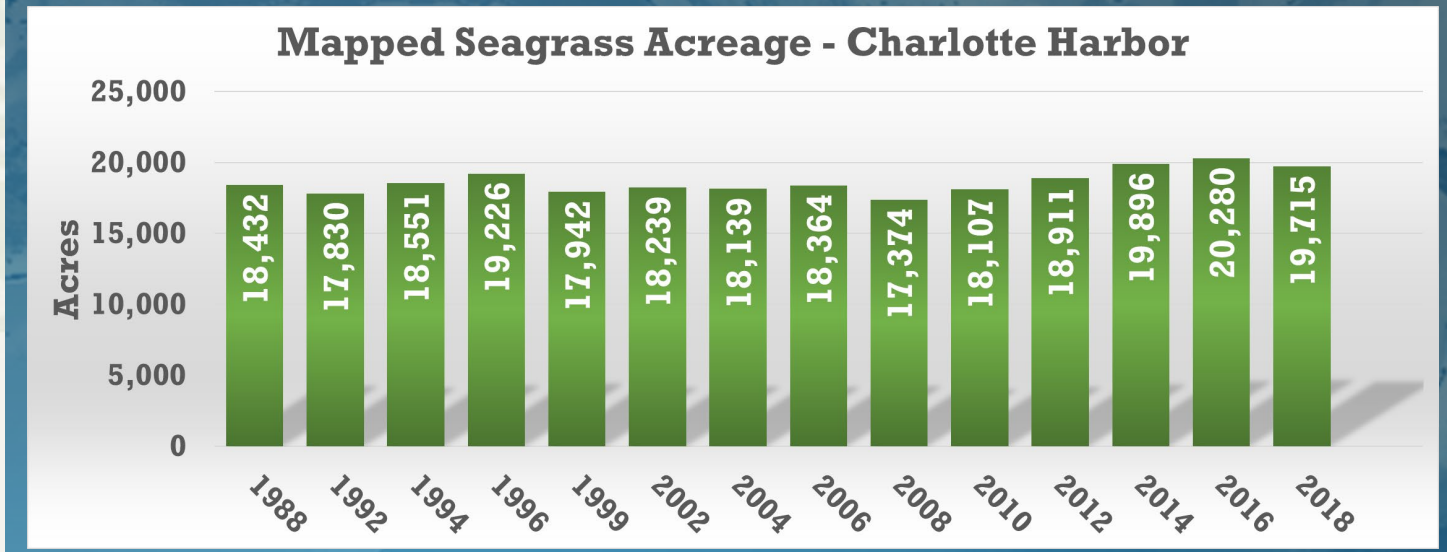
- **1988 – Present**
- **Photointerpretation of aerial imagery**
- **Field Verification (>1,200 points)**
- **Flight coverage area = 9,876 km²**

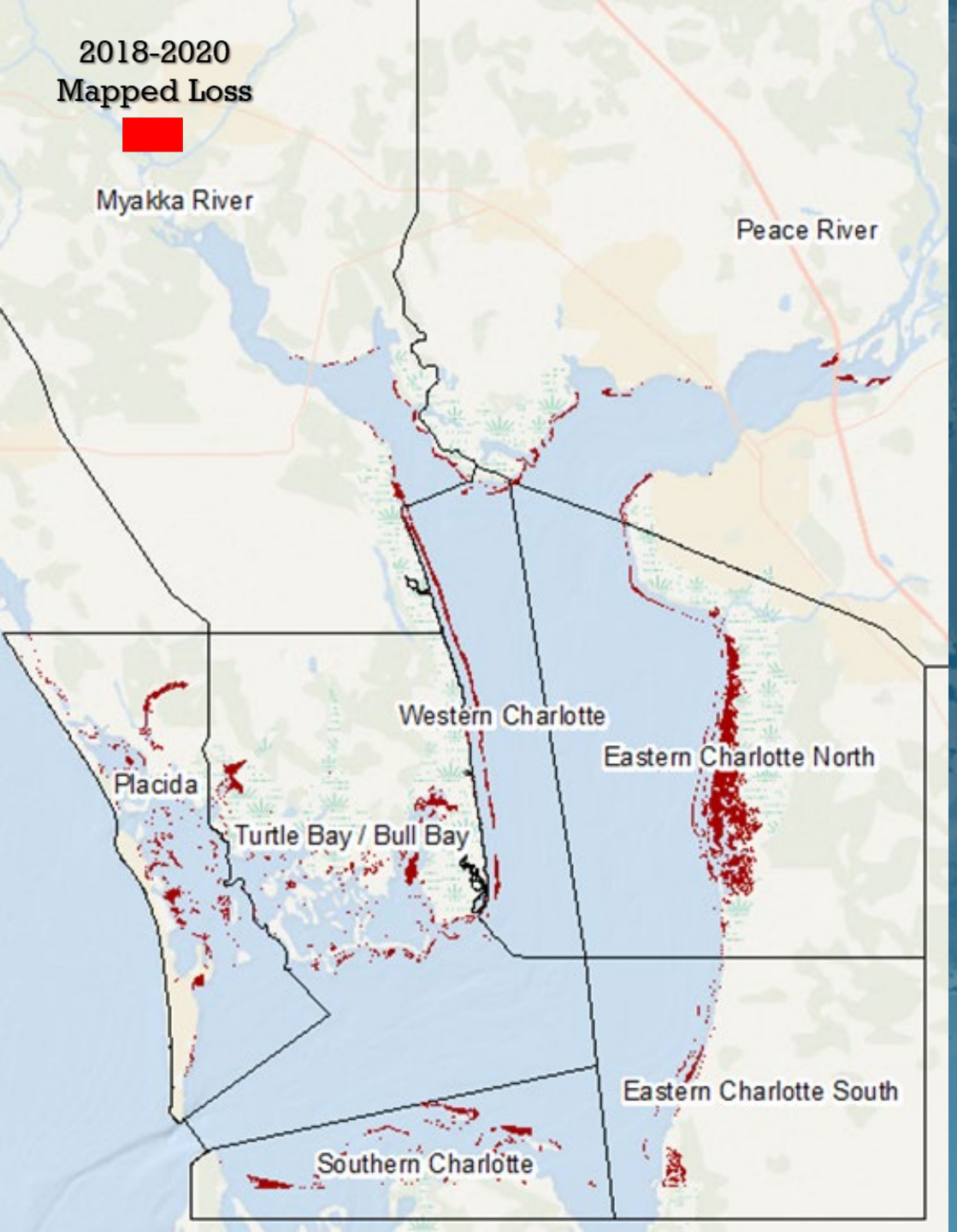




Charlotte Harbor

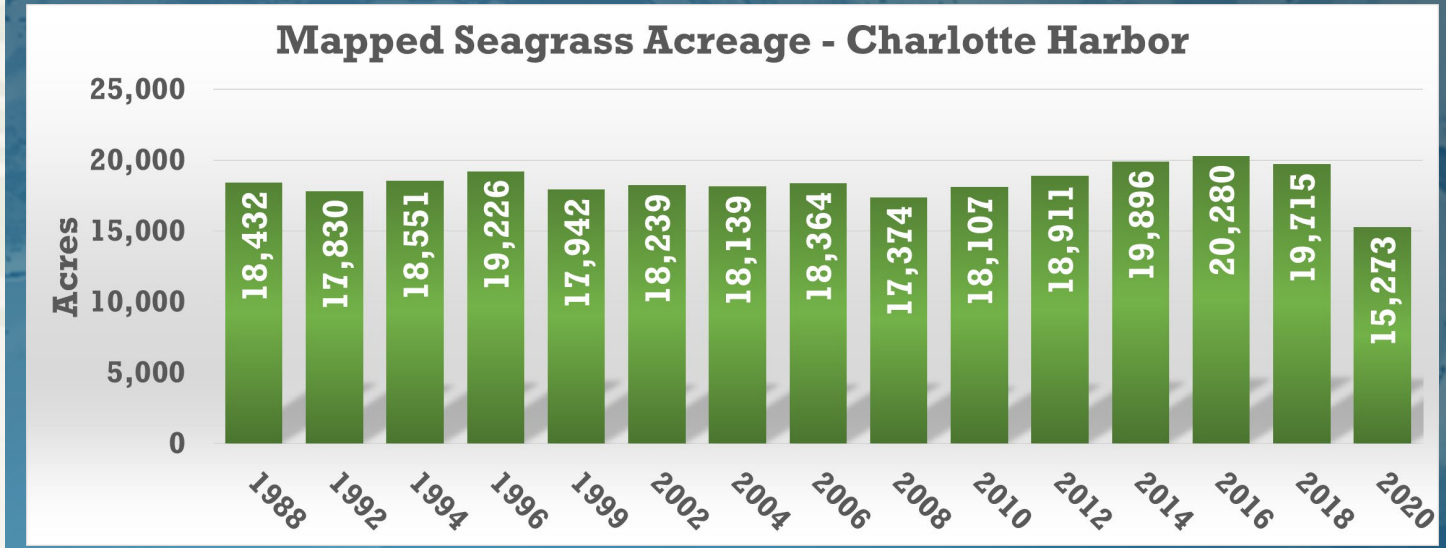
Segments	2018
Eastern Charlotte Harbor N	3,530
Eastern Charlotte Harbor S	1,444
Myakka River	351
Peace River	602
Placida	4,630
Southern Charlotte	2,511
Turtle Bay / Bull Bay	4,811
Western Charlotte	1,835
Charlotte Harbor Total	**19,715**

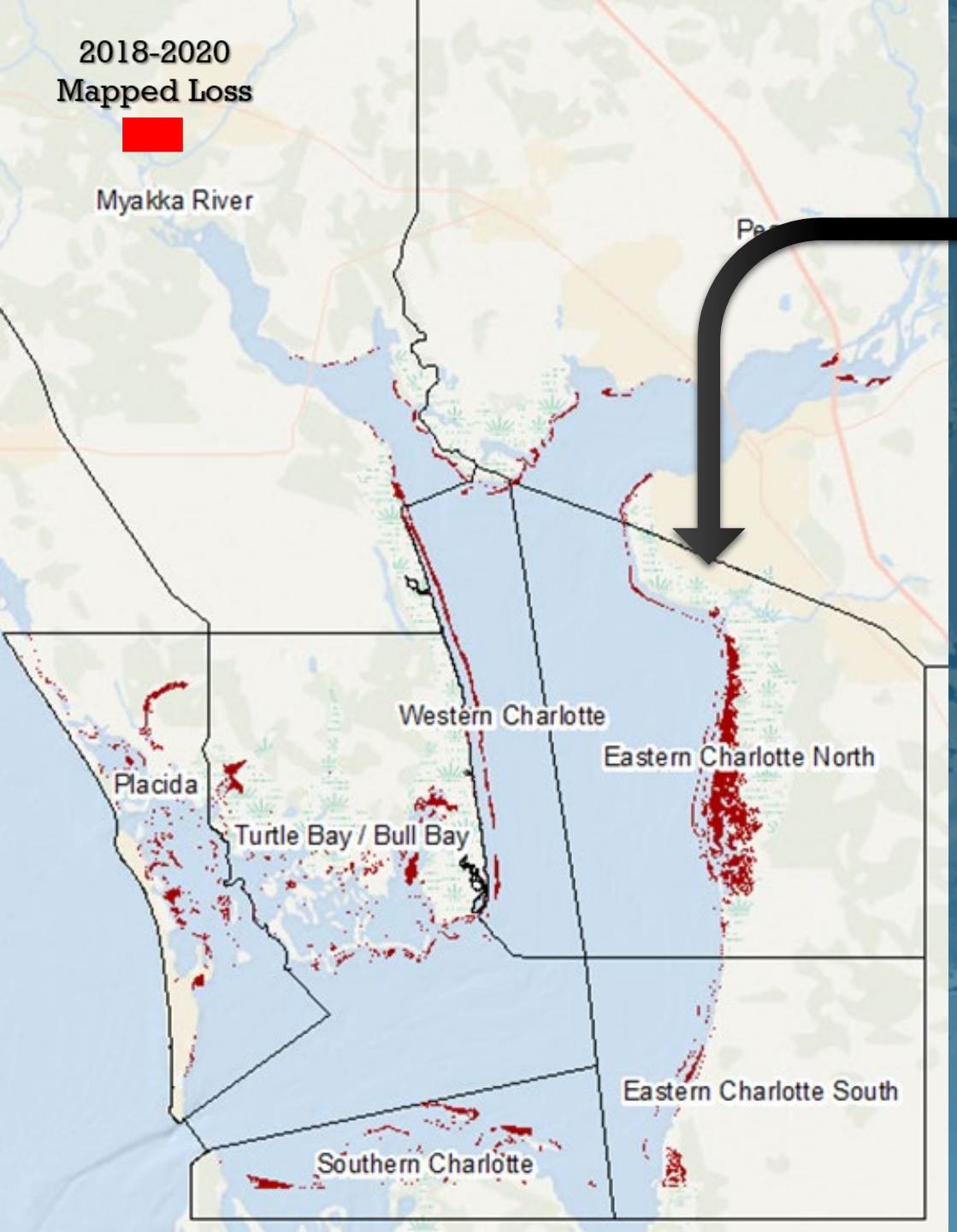




Charlotte Harbor

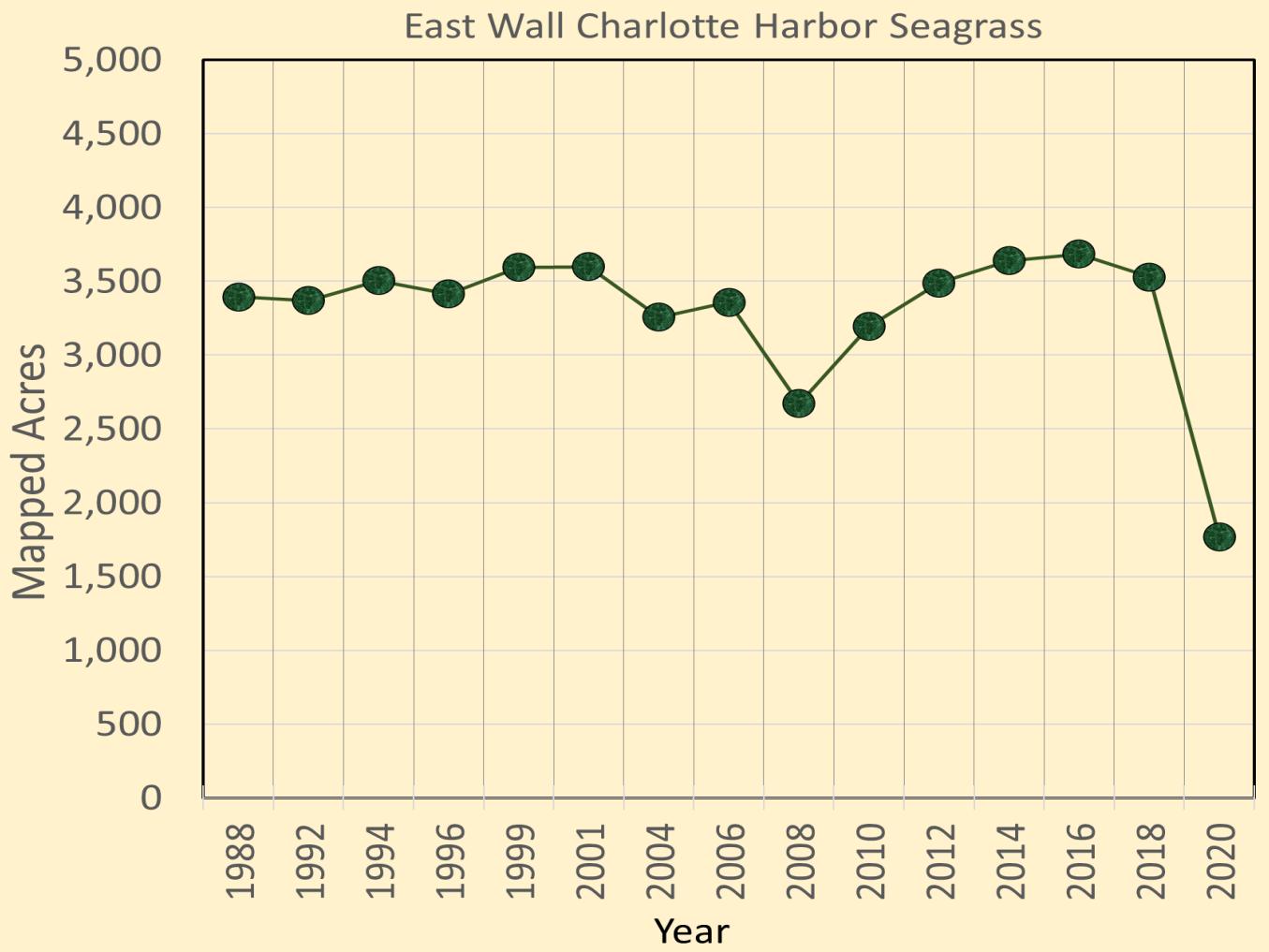
Segments	2018	2020	Δ Acres	% Change
Eastern Charlotte Harbor N	3,530	1,770	-1,760	-50%
Eastern Charlotte Harbor S	1,444	1,258	-186	-13%
Myakka River	351	189	-163	-46%
Peace River	602	349	-253	-42%
Placida	4,630	4,029	-602	-13%
Southern Charlotte	2,511	2,079	-432	-17%
Turtle Bay / Bull Bay	4,811	4,178	-634	-13%
Western Charlotte	1,835	1,421	-414	-23%
Charlotte Harbor Total	**19,715**	**15,273**	**-4,442**	**-23%**





Charlotte Harbor

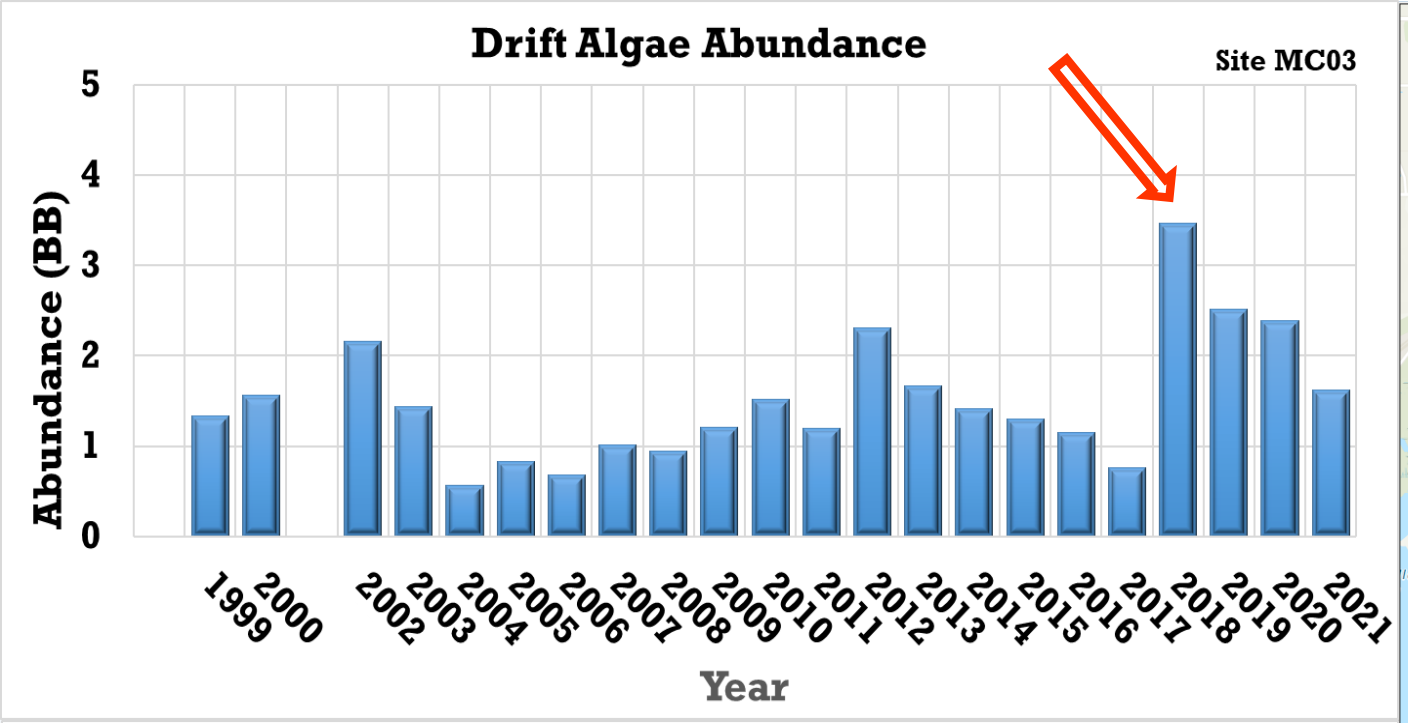
Segments	2018	2020	Δ Acres	% Change
Eastern Charlotte Harbor N	3,530	1,770	-1,760	-50%

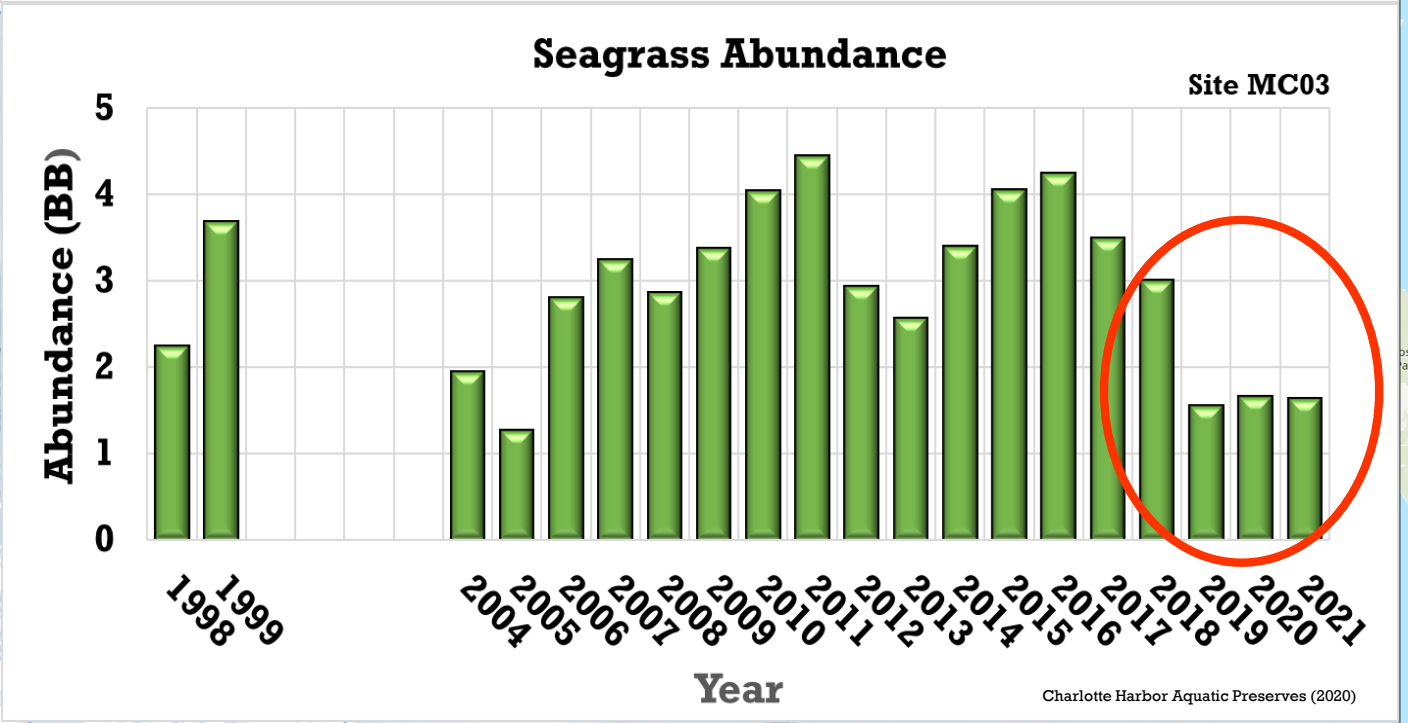


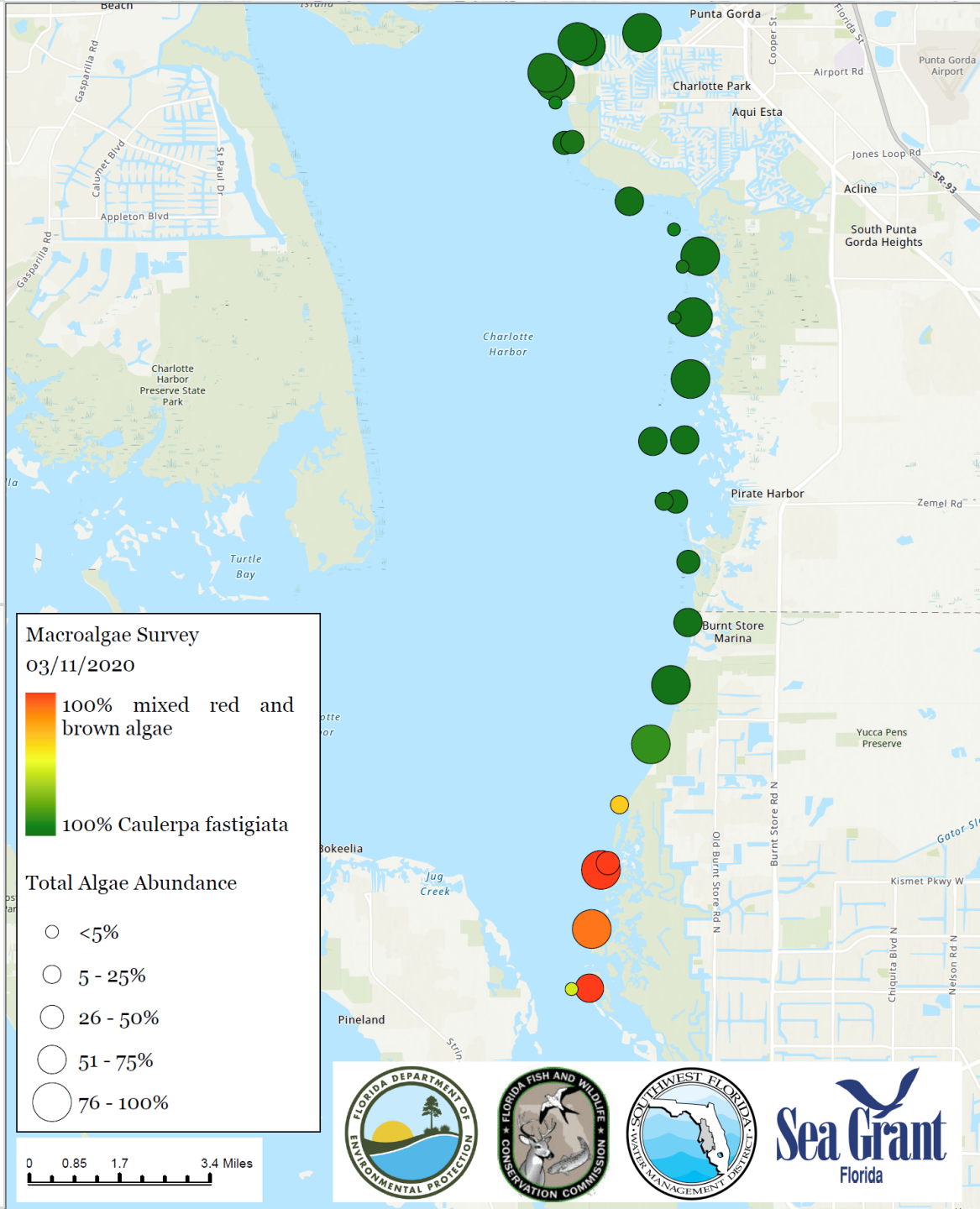
Caulerpa fastigiata Montagne, 1837

Punta Gorda
August 17, 2020

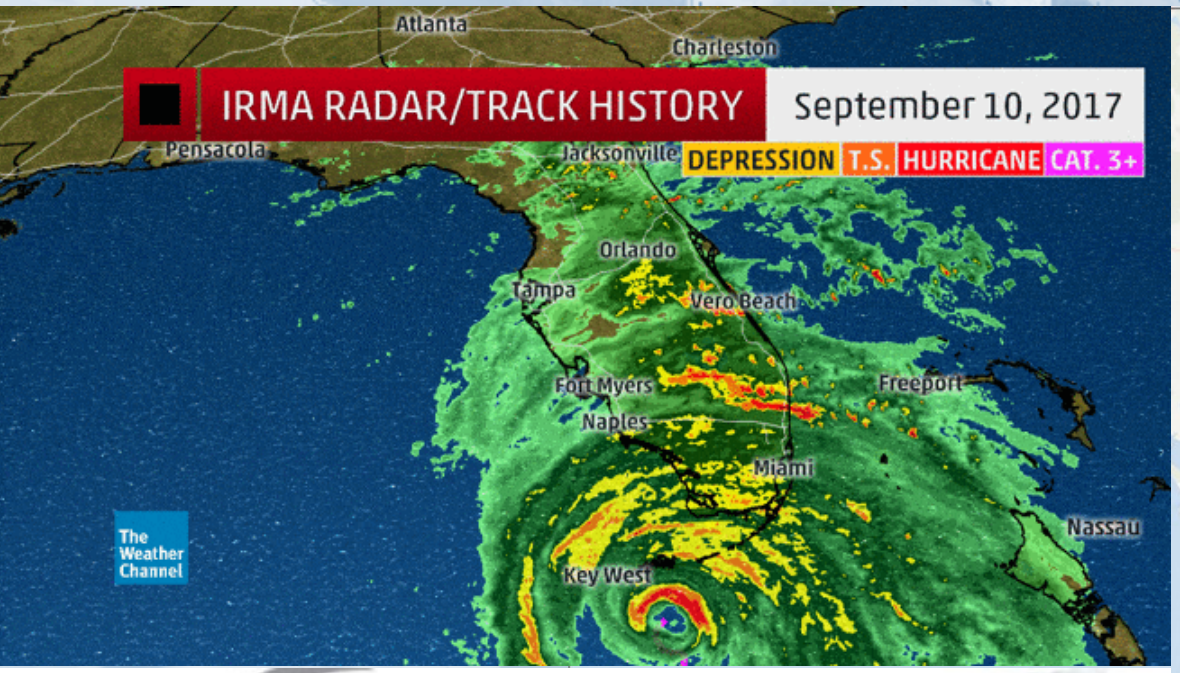
FWC (August 17, 2020)

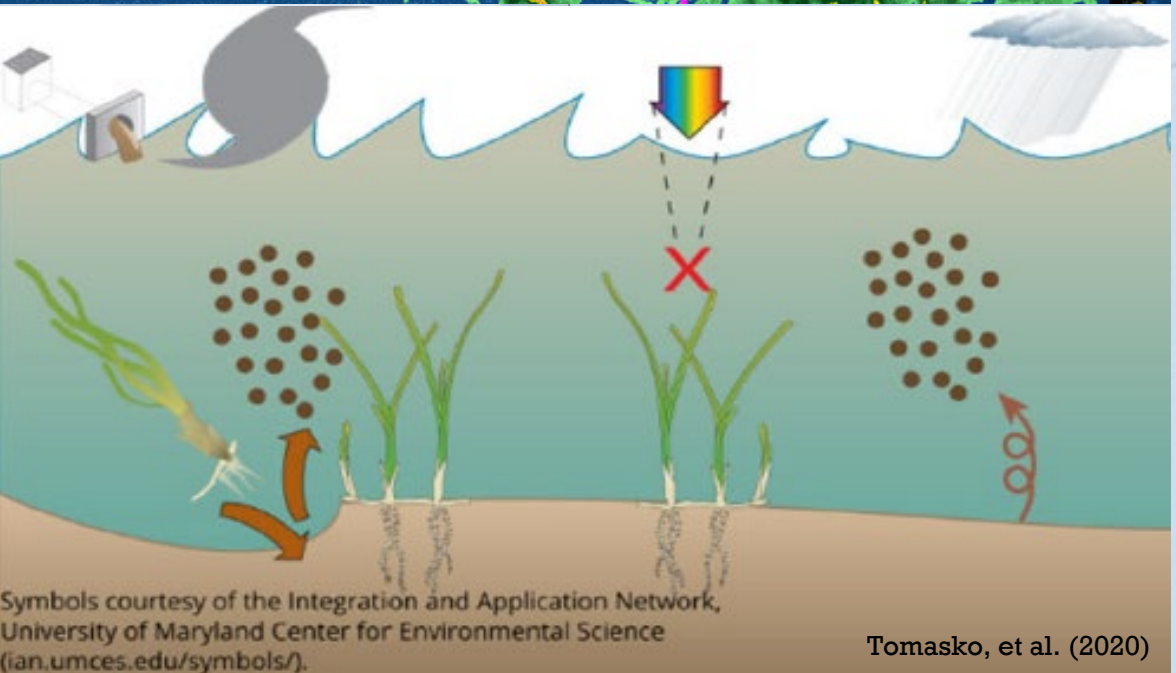

Drift Algae Abundance
Site MC03
Abundance (BB)
0
1
2
3
4
5
1999
2000
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year


Seagrass Abundance
Site MC03
Abundance (BB)
0
1
2
3
4
5
1998
1999
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year
Charlotte Harbor Aquatic Preserves (2020)

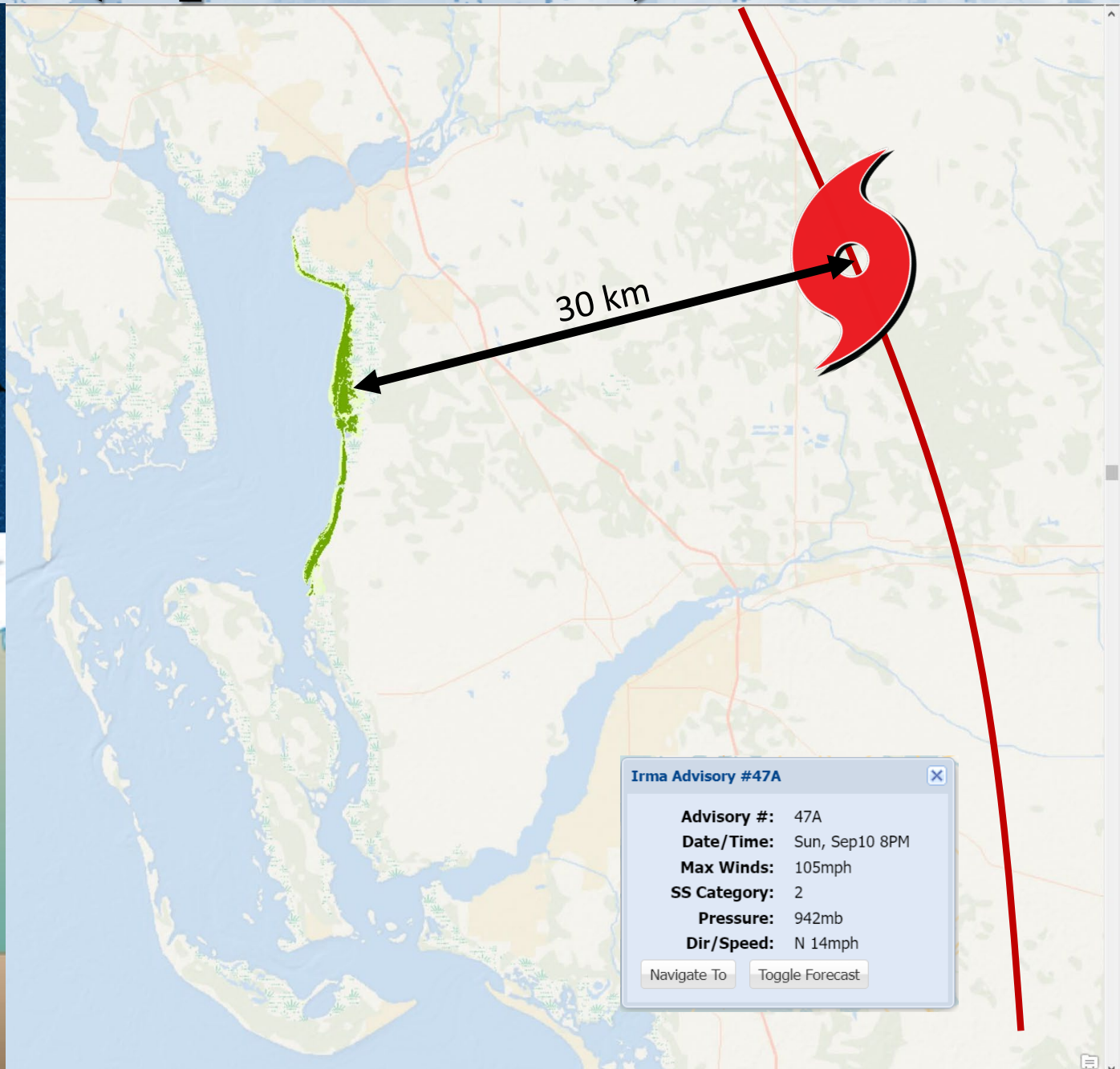

Punta Gorda
Charlotte Park
Aqui Esta
Acline
South Punta Gorda Heights
Pirate Harbor
Burnt Store Marina
Yucca Pens Preserve
Bokeelia
Pineland
Jug Creek
Charlotte Harbor
Charlotte Harbor Preserve State Park
Turtle Bay
Macroalgae Survey
03/11/2020
100% mixed red and brown algae
100% Caulerpa fastigiata
Total Algae Abundance
<5%
5 - 25%
26 - 50%
51 - 75%
76 - 100%
0
0.85
1.7
3.4 Miles
Sea Grant
Florida

Hurricane Irma (September 2017)

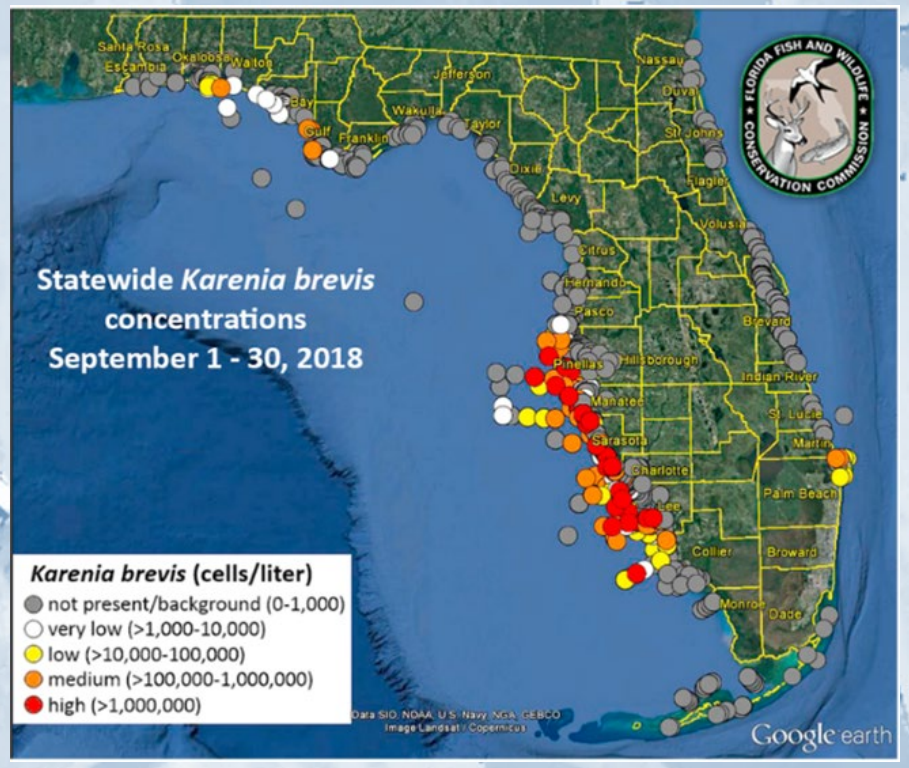




Tomasko, et al. (2020)



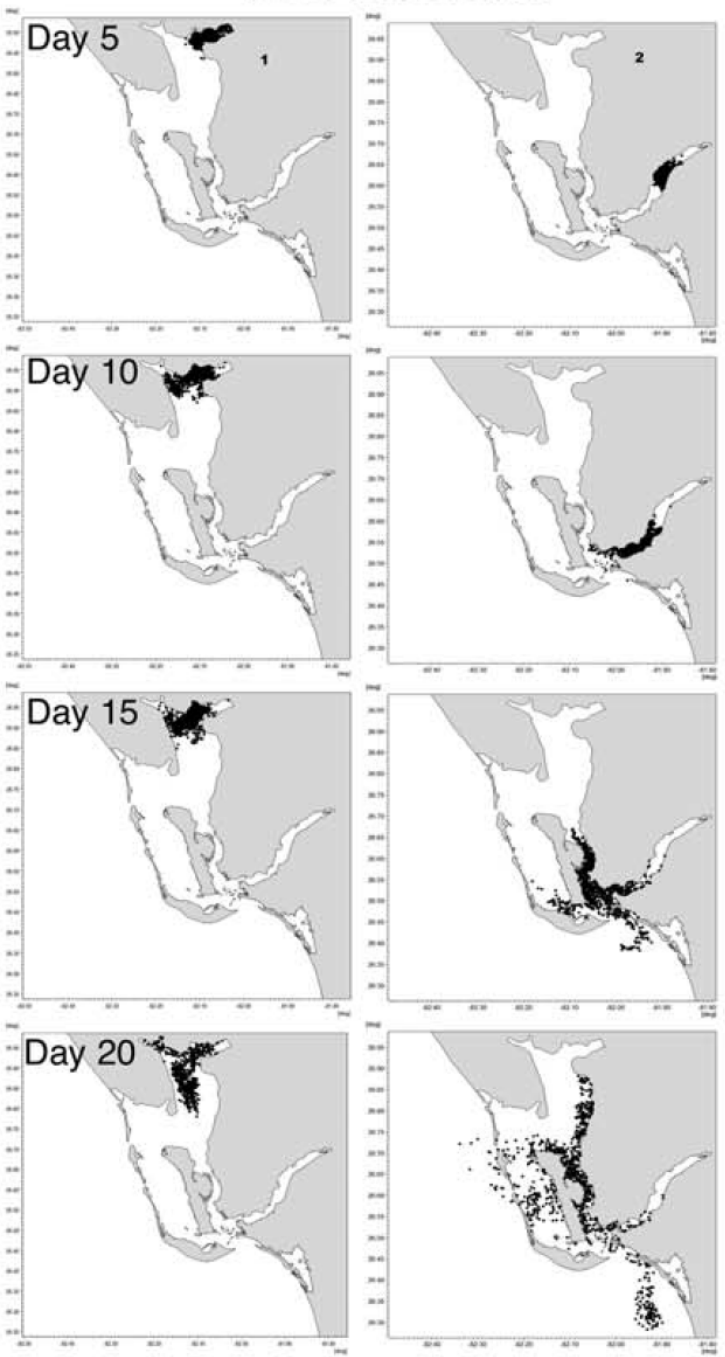
Red Tide (Oct 2017 – Jan 2019)

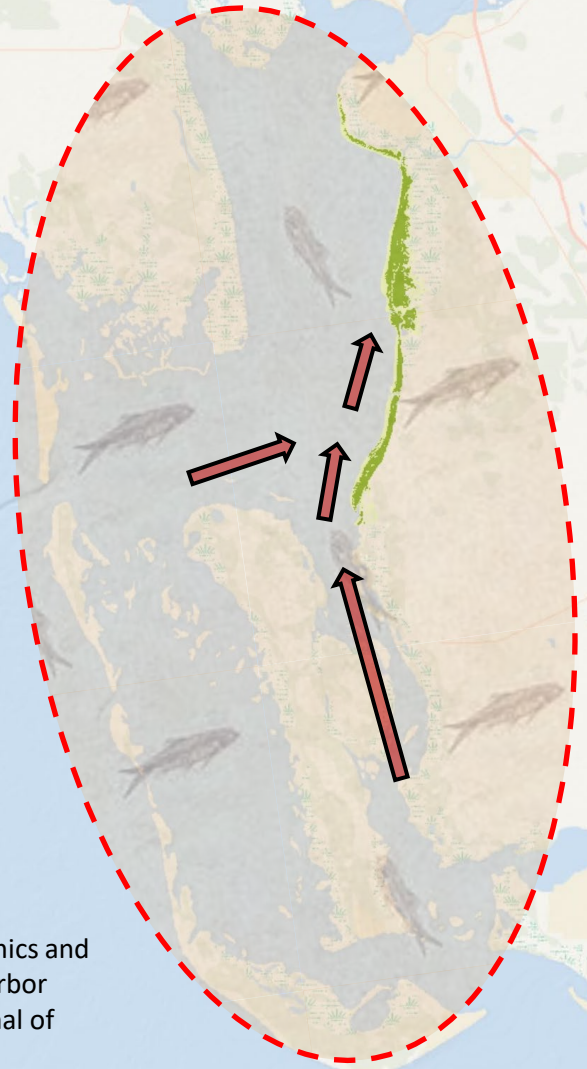


Florida: Harmful Algal Blooms (noaa.gov)

Charlotte Harbor was spared the brunt of the red tide event

Post-Red Tide Decomposition





Dye, B., et al. (2020). "Circulation dynamics and seasonal variability for the Charlotte Harbor estuary, Southwest Florida coast." Journal of Coastal Research 36(2): 276-288.

Red Tide Aftermath

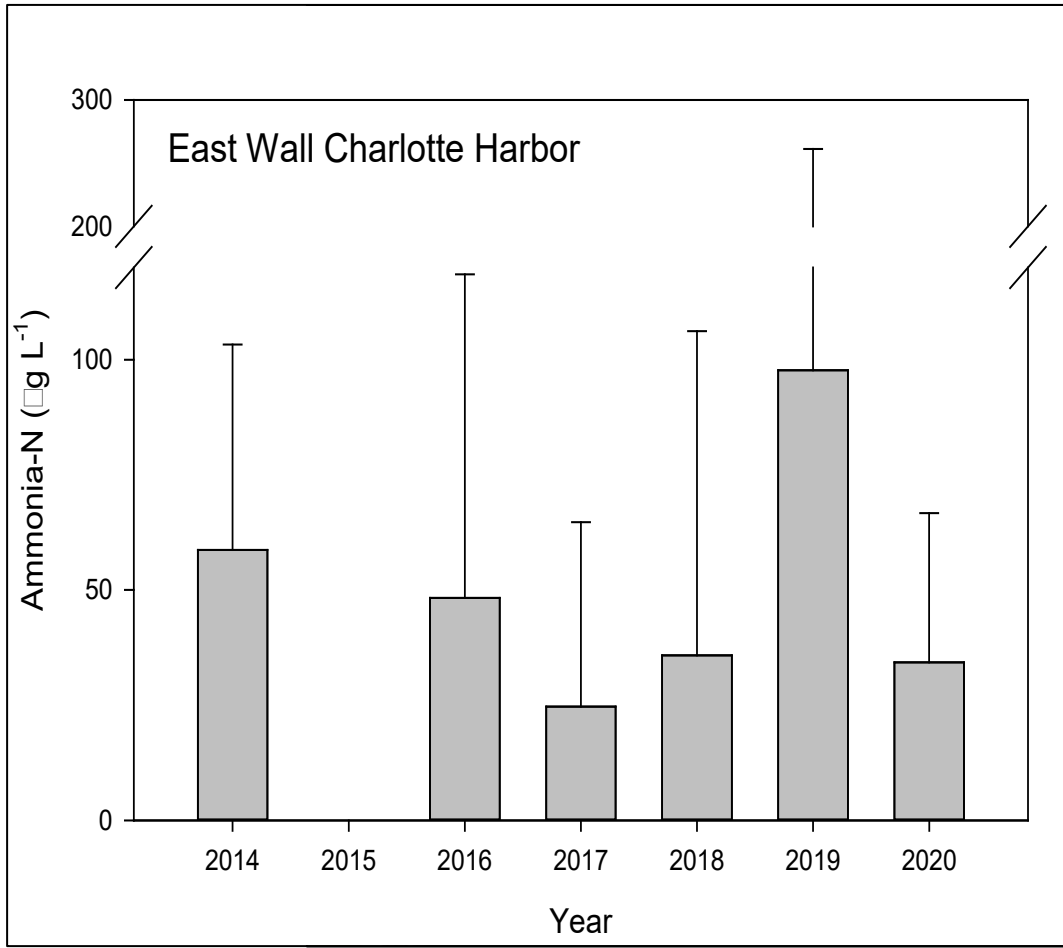
Fish carcasses have the potential to release large quantities of highly bioavailable nutrients, especially Ammonium (NH_4^+)

Killberg-Thoreson, et al. (2014)

Photo Credit: The Guardian, Aug 2018

- Ammonium release from decaying fish can be a significant and acute nutrient source
- *Caulerpa prolifera*: 81% of total nitrogen acquisition in the form of ammonium

Alexandre & Santos (2020)



Potential Nitrogen Load from Decaying Fish

Tons of Dead Fish Collected in Southwest Florida

2,000 Tons

Total Nitrogen Load

12,701 kg dry wt.

Tomasko, et al. (1996)
Fourqurean & Zieman (2002)

Potential Nitrogen Load from Decaying Fish

Tons of Dead Fish Collected in Southwest Florida

2,000 Tons

Total Nitrogen Load

12,701 kg dry wt.

Potential Nitrogen Load from Dead Seagrass

Acres of Seagrass Lost along the East Wall

1,760 Acres

Total Nitrogen Load

6,268 – 13,789 kg dry wt.

Tomasko, et al. (1996)
Fourqurean & Zieman (2002)

The Hangover Effect

- Unprecedented seagrass loss and macroalgal proliferation
- Charlotte Harbor largely spared direct impact from 2017-2018 red tide
- Large increase in ammonia-rich waters occurred after red tide event
- Dead fish + dead seagrass a one-two nutrient punch

Thanks to all our partners!

FLORIDA'S AQUATIC PRESERVES
WATERS THAT WORK, PLAY, AND LIVE

Charlotte Harbor Aquatic Preserves

FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION

COASTAL & HEARTLAND NATIONAL ESTUARY PARTNERSHIP

SARASOTA BAY ESTUARY PROGRAM
Restoring Our Bays

UF | IFAS Extension
UNIVERSITY of FLORIDA

SWIM

Chris J Anastasiou, Ph.D.

Chief Scientist

Surface Water Improvement and Management Program

Southwest Florida Water Management District

(813) 985-7481 x2029

(813) 310-6809

chris.anastaisou@swfwmd.state.fl.us