

THAT TINGLING SENSATION MEANS IT'S WORKING: SAXITOXIN IN INDIAN RIVER LAGOON DOLPHINS

Spencer Fire¹, Jeremy Browning¹, Wendy Noke Durden², Megan Stolen², Adam Schaefer³, James Sullivan³, Gregory Bossart^{4,5}, Lisa Hoopes⁵, Dwayne Edwards⁶, Kyle Wald⁶, Rich Paperno⁶

¹Florida Institute of Technology

²Hubbs-SeaWorld Research Institute

³FAU/Harbor Branch Oceanographic Institution

⁴University of Miami

⁵Georgia Aquarium

⁶Florida Fish and Wildlife Conservation Commission



Harmful Algal Blooms (HABs)



Trophic Transfer of HAB Toxins

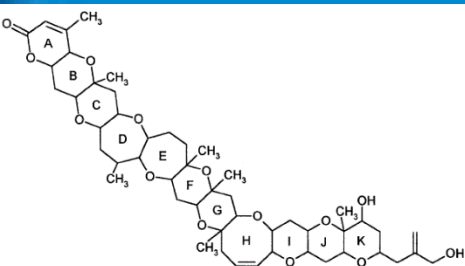


Humans (apex predators)



Filter-feeding organisms (Grazers)

Neurotoxic shellfish toxins



Trophic Transfer of HAB Toxins

Quick Animal Facts:



Dolphins have no clue what's going on

Marine Mammals



Vector organism



HAB Toxins

Marine Mammal Health Impacts

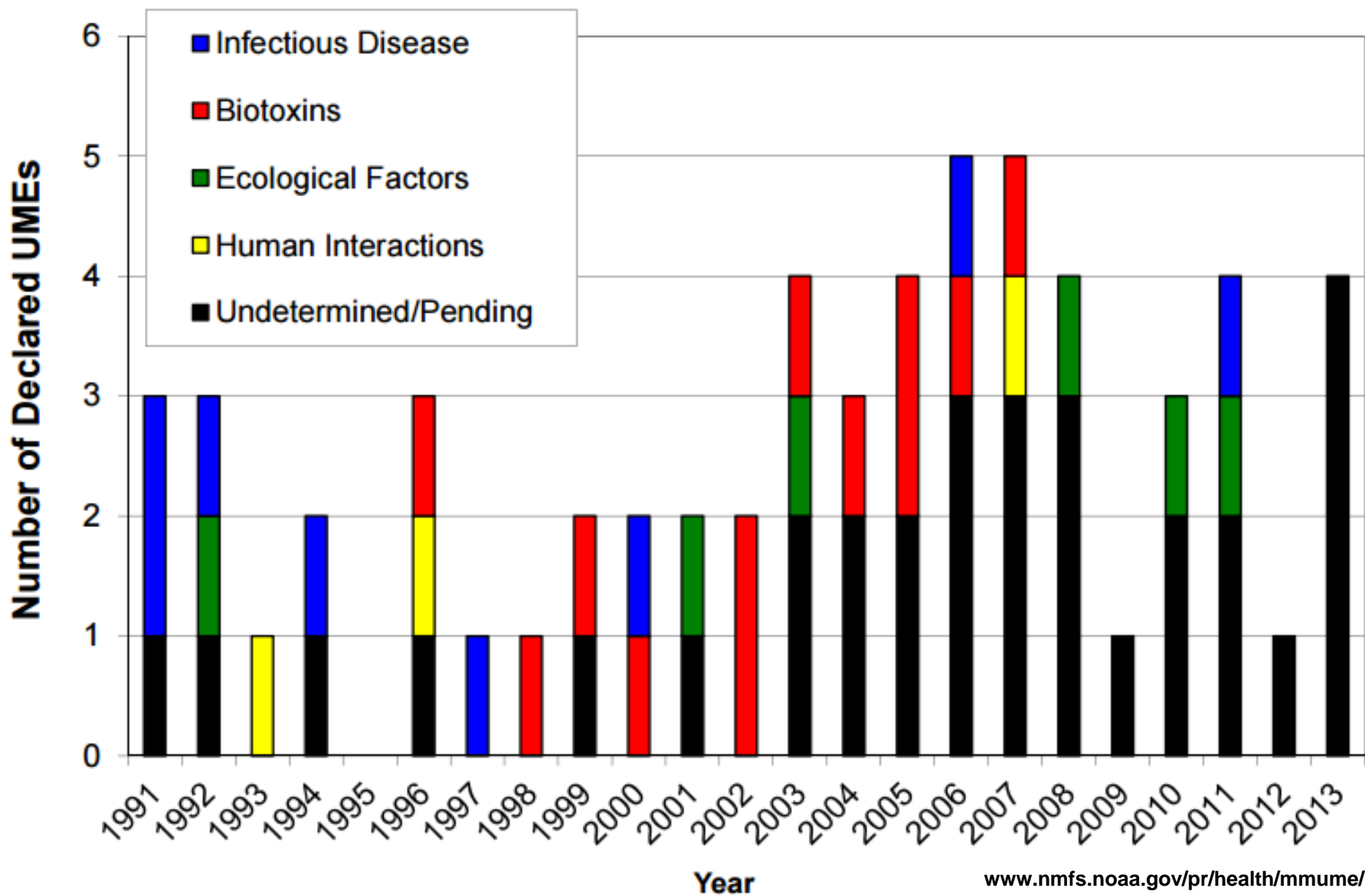


Large-scale mortality events

Marine Mammal Unusual Mortality Events 1991-2013

Number of Declared Events Per Year, by Cause

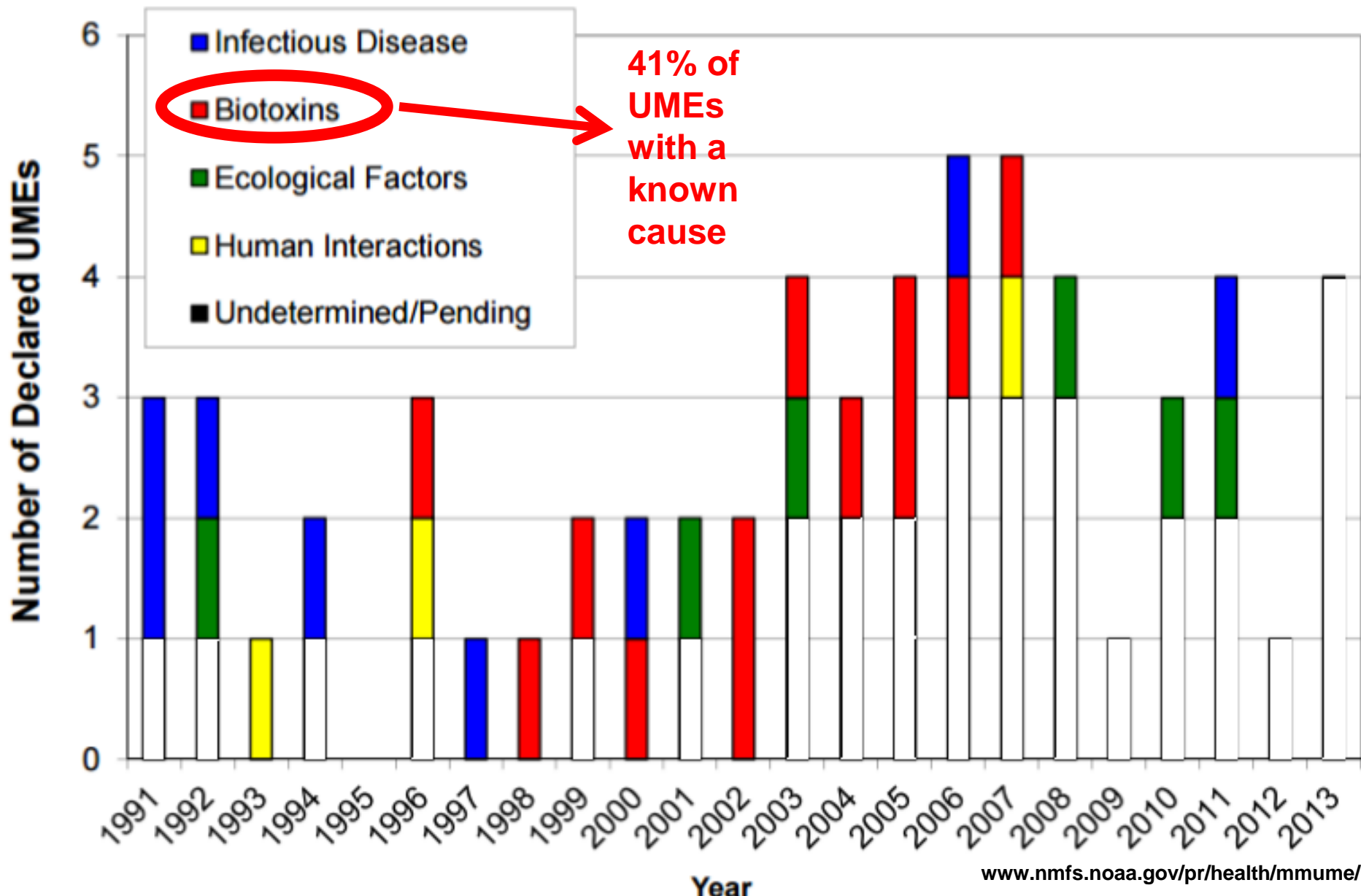
(Total = 60)



Marine Mammal Unusual Mortality Events 1991-2013

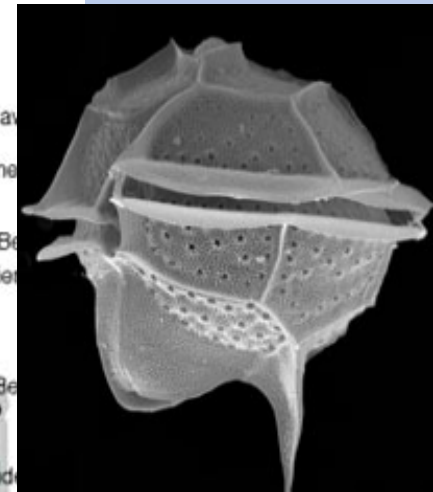
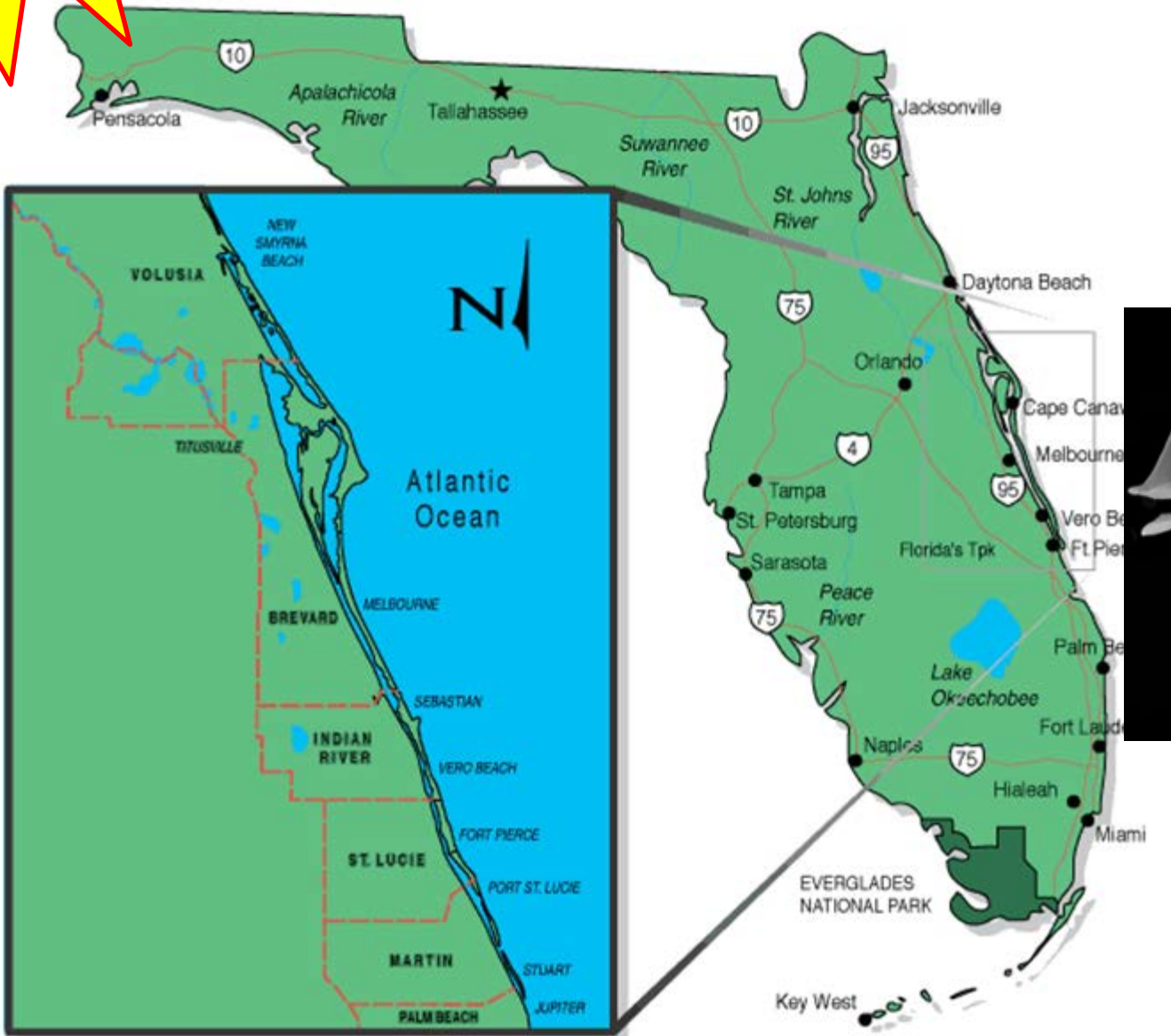
Number of Declared Events Per Year, by Cause

(Total = 60)

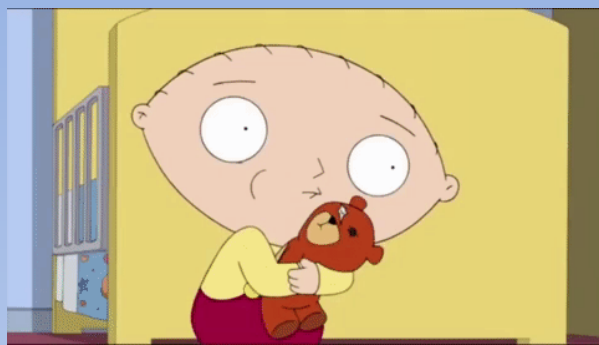


Now with 50% more disease!!

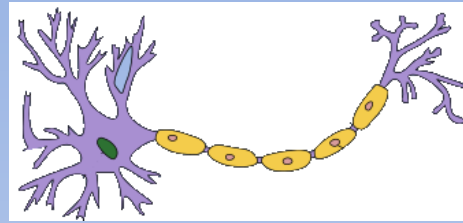
Indian River Lagoon, Florida (IRL)



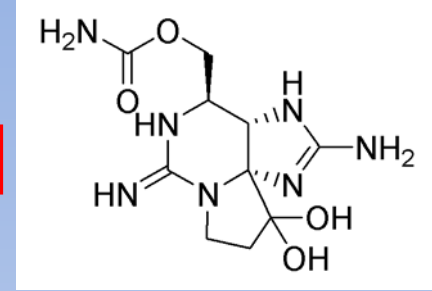
Pyrodinium bahamense



**Paralytic Shellfish
Poisoning**



**Nerve dysfunction:
tingling, skeletal
muscle paralysis**



Saxitoxin (STX)

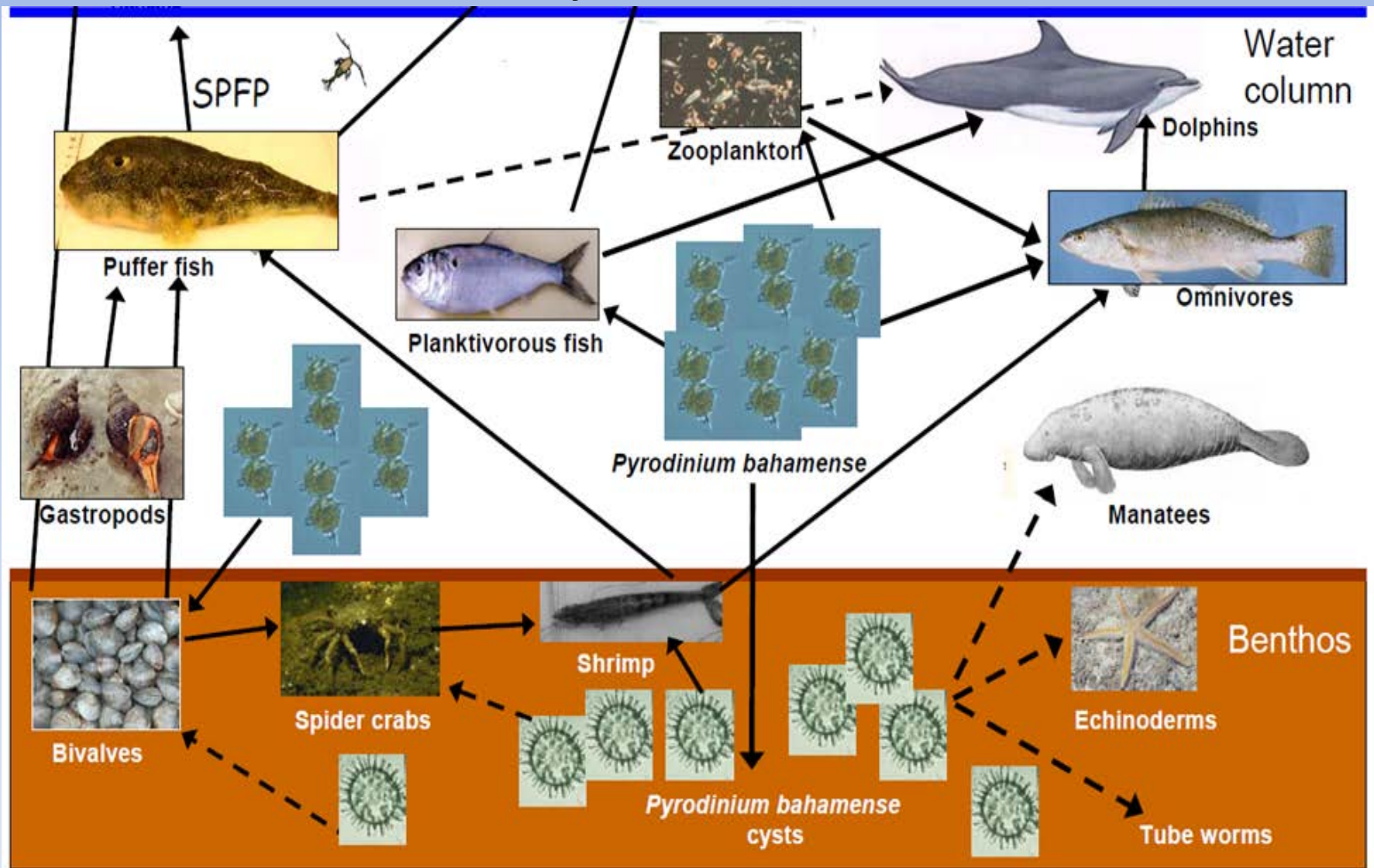


**Annual
*Pyrodinium
bahamense*
blooms**



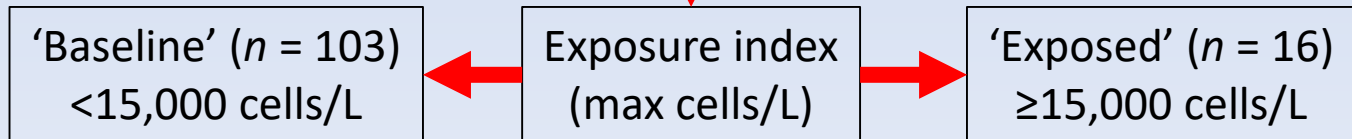
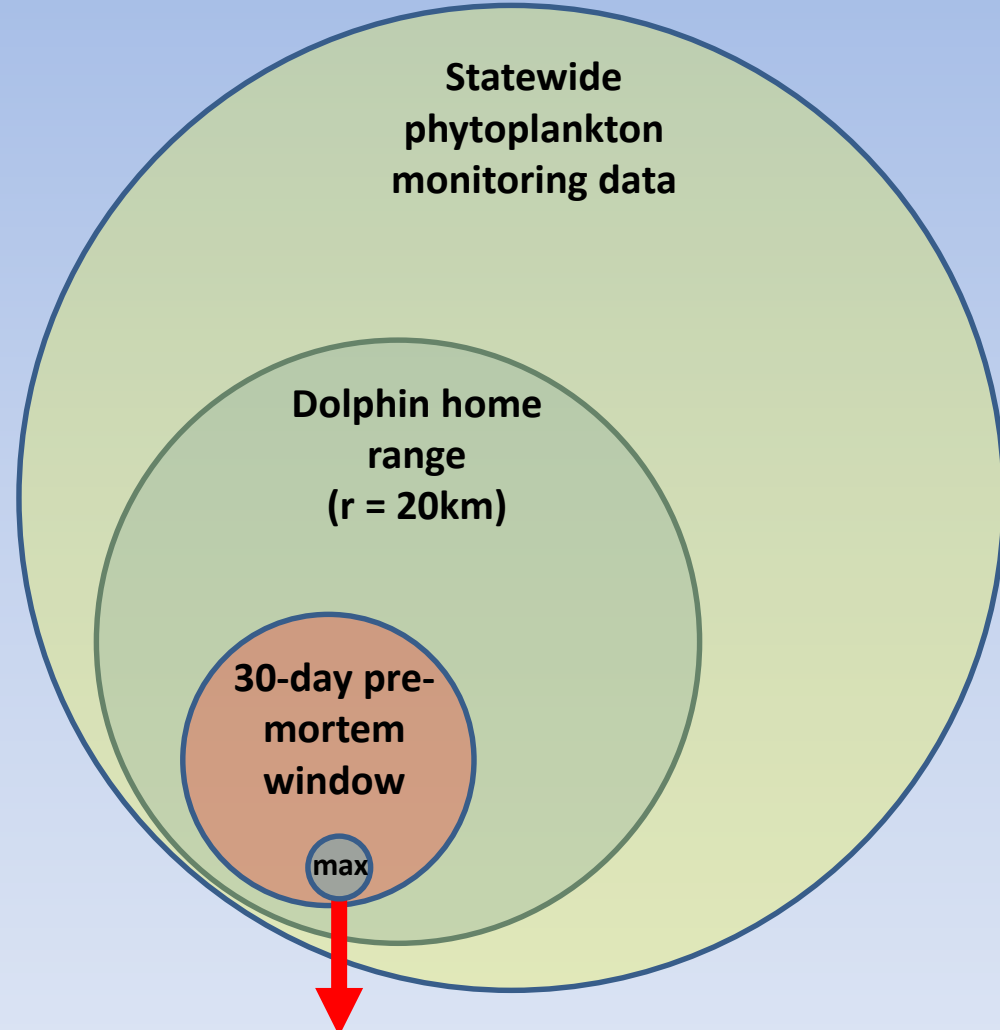
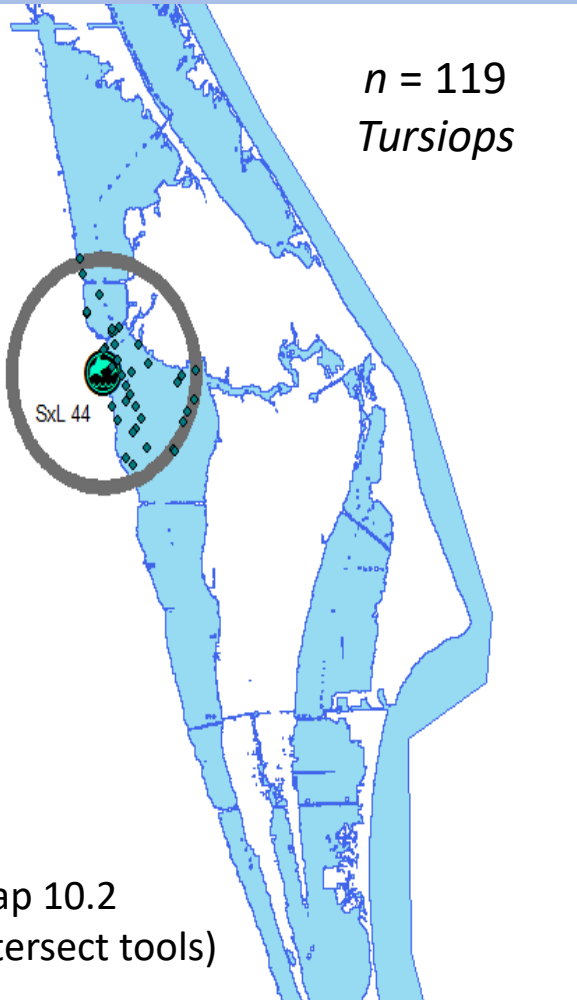
Are IRL Tursiops exposed to STX?

If so, how much?



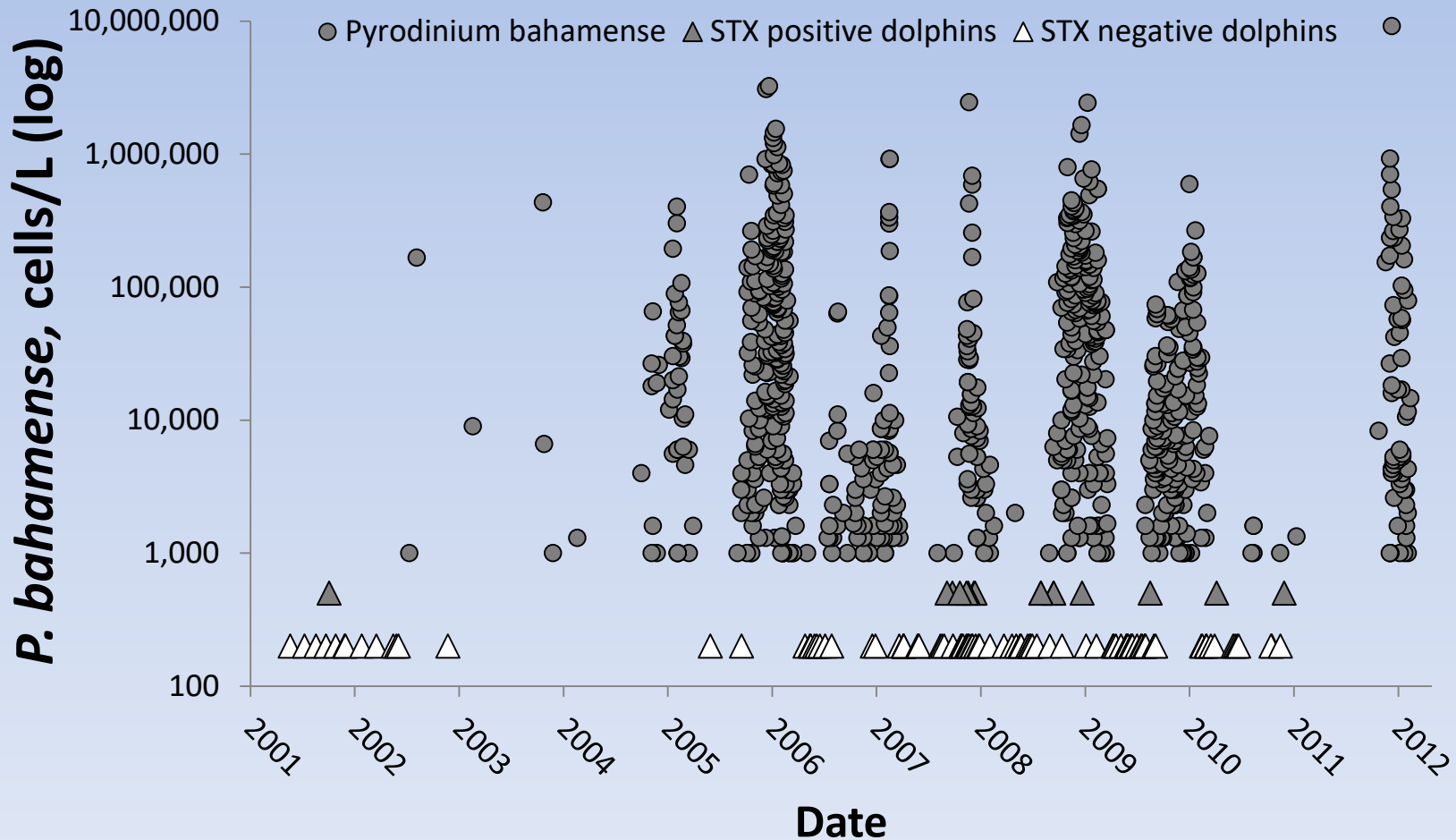
Estimating HAB Exposure

- 2001-2012 Strandings → 'Exposed' vs. 'Baseline' groups



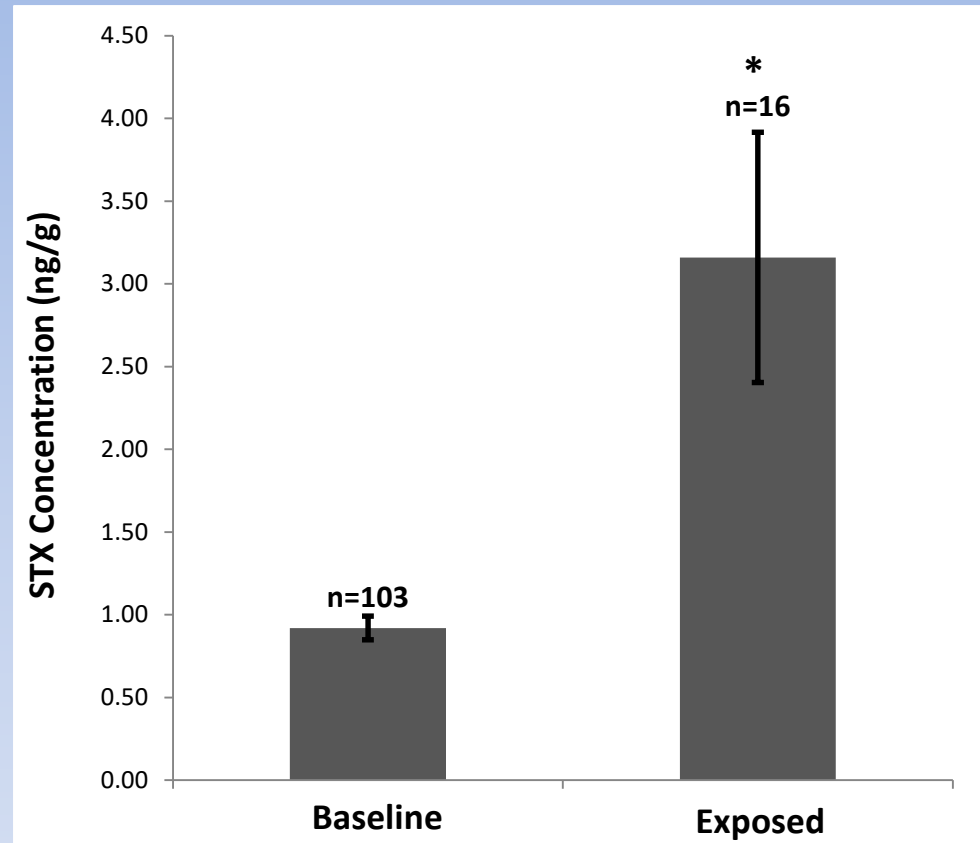
STX analysis via ELISA

- Liver tissue ($n = 119$)
- Antibody-based toxin detection assay



Saxitoxin Exposure

- All IRL dolphins
 - 13% STX-positive
- Exposed
 - 60% STX-positive
 - Range: 0.97 – 9.5 ng/g
- Baseline
 - 7% STX-positive
 - Range: 0.16 – 1.9 ng/g



Welch, $t = 2.4834$, $df = 14.045$, $p = 0.0131$, $1 - \beta = 0.98$

Are IRL Tursiops exposed to STX? **Yes**

STX exposure in other marine mammals

- 1987 Cape Cod - Humpback
 - STX in prey only
- 1997 NW Africa - monk seals
 - 8-280 ng/g liver
- 2008 St. Lawrence Estuary – multi-species
 - 27 ng/g liver (beluga)
 - 31-183 ng/g liver (seals)
- This study
 - <1-10 ng/g liver



If so, how much?

Some

~_(\ツ)_/

STX in live IRL dolphins

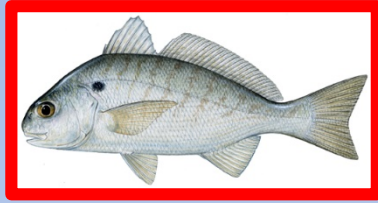
- 2015 HERA Health Assessments

- Gastric 7-37 ng/g
- Feces 11-35 ng/g
- Live animals w/ no significant disease



NMFS Permit No. 14352-03

STX in IRL prey fish



Spot



Striped mullet



Hardhead catfish



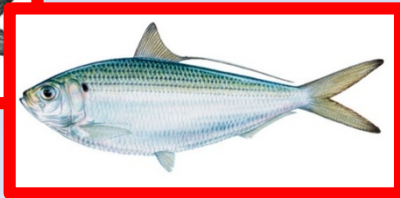
Irish pompano



Ladyfish



Striped mullet



Thread herring

During *Pyrodinium* bloom season

- 7-255 ng/g, viscera
- 1-14 ng/g, muscle

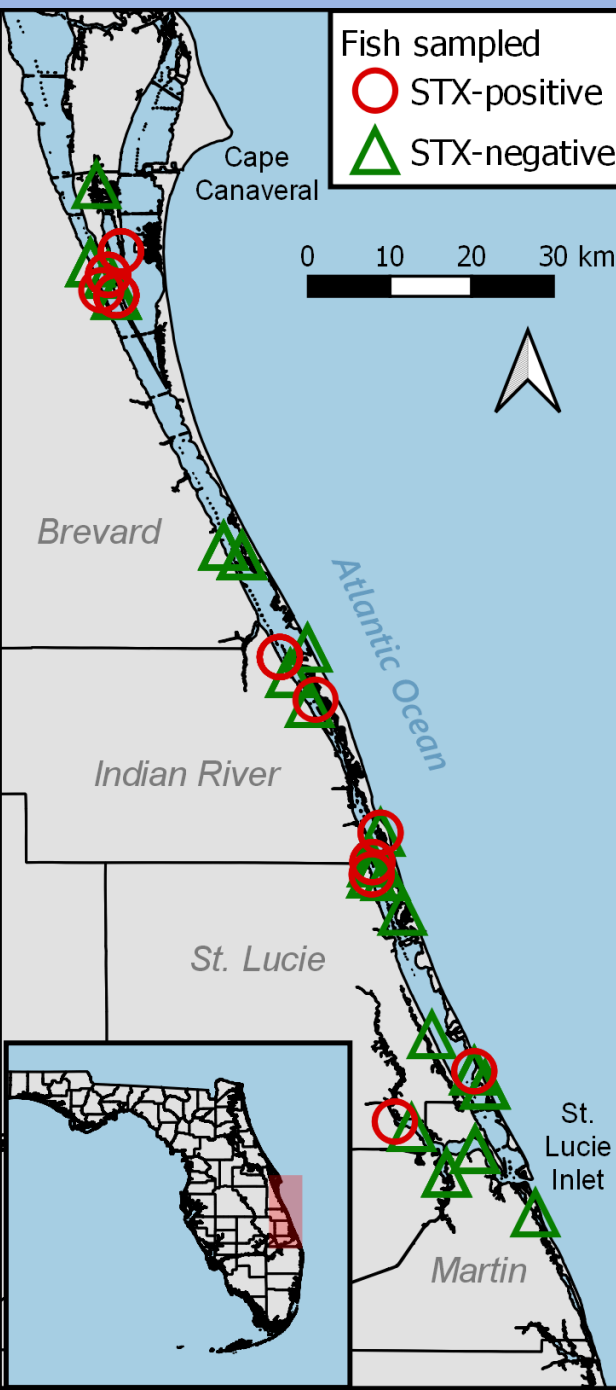
Non-bloom season

- 6-218 ng/g, viscera
- 1-27 ng/g, muscle

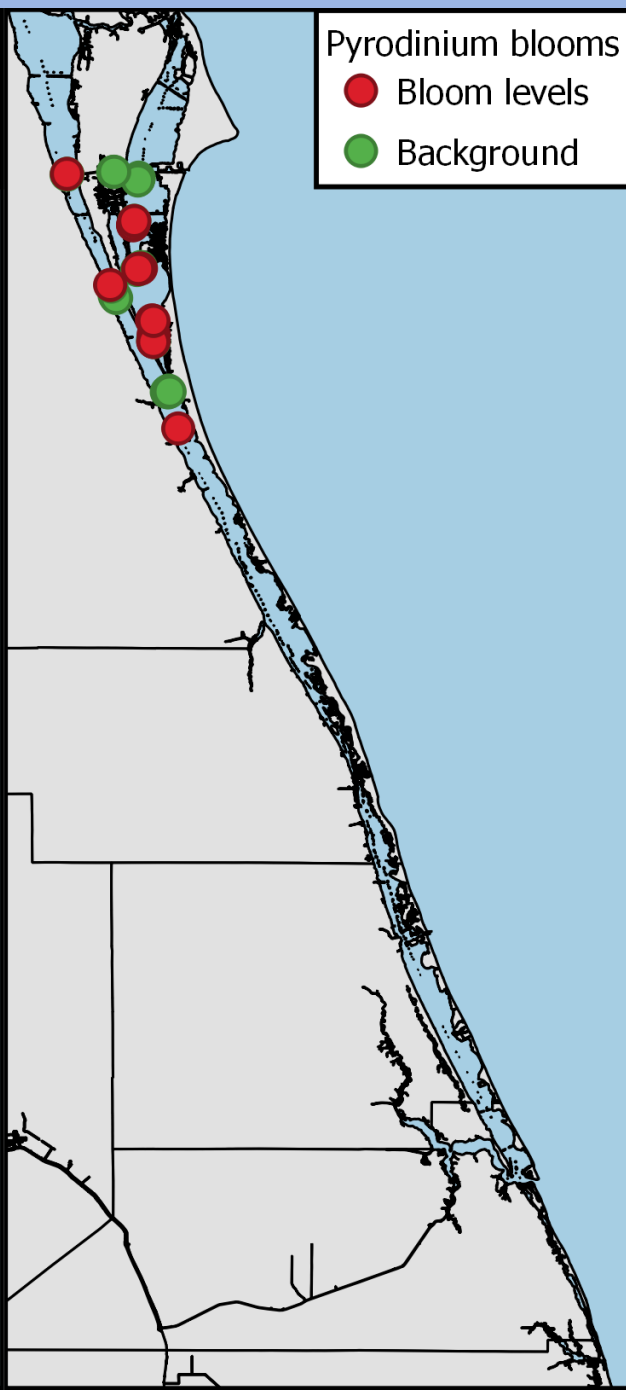


FDA regulatory limit for seafood = 800 ng/g

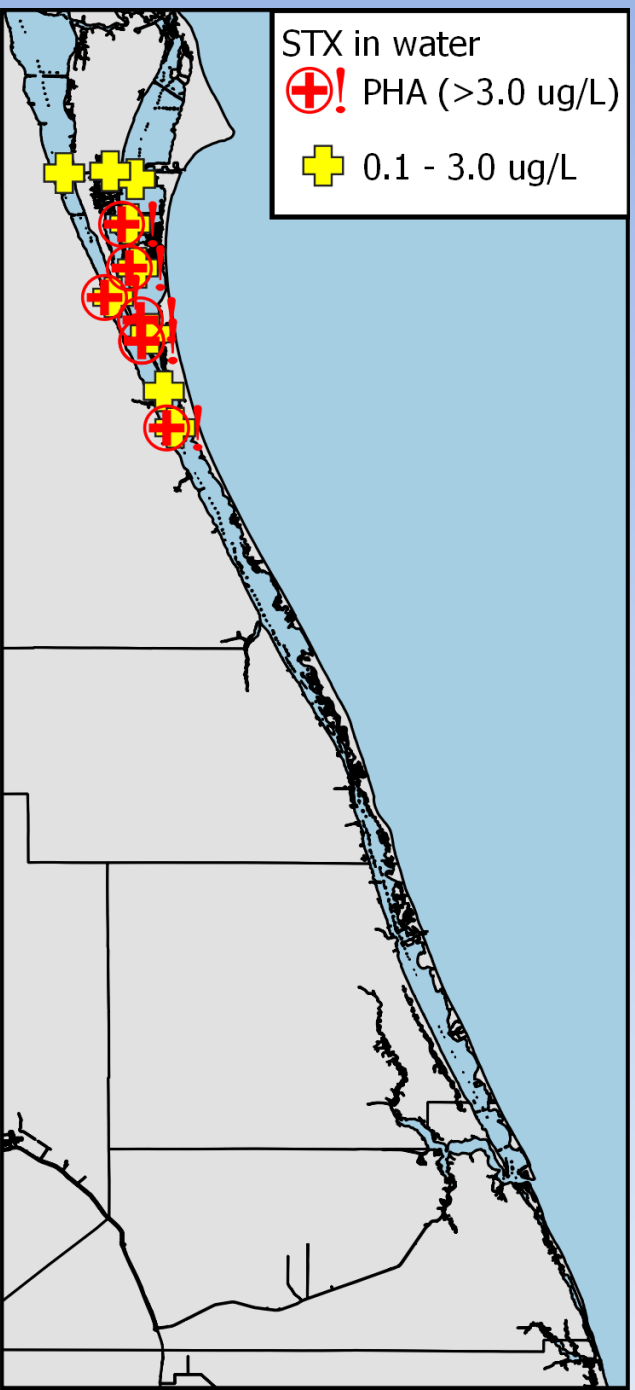
Fish sampled
○ STX-positive
△ STX-negative



Pyrodinium blooms
● Bloom levels
● Background



STX in water
⊕! PHA (>3.0 ug/L)
⊕ 0.1 - 3.0 ug/L



Future work



- Stranding data are only a snapshot
- Need for persistent exposure biomarkers
- Changes in resource utilization (disturbance behaviors?)

This is the end of the talk.

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