



Red Tides, Green Tides, & Brown Tides in the Indian River Lagoon, Florida

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BASIC SCOPE: 1997 - Present

Sampling – 8-12 sites, monthly or twice per month

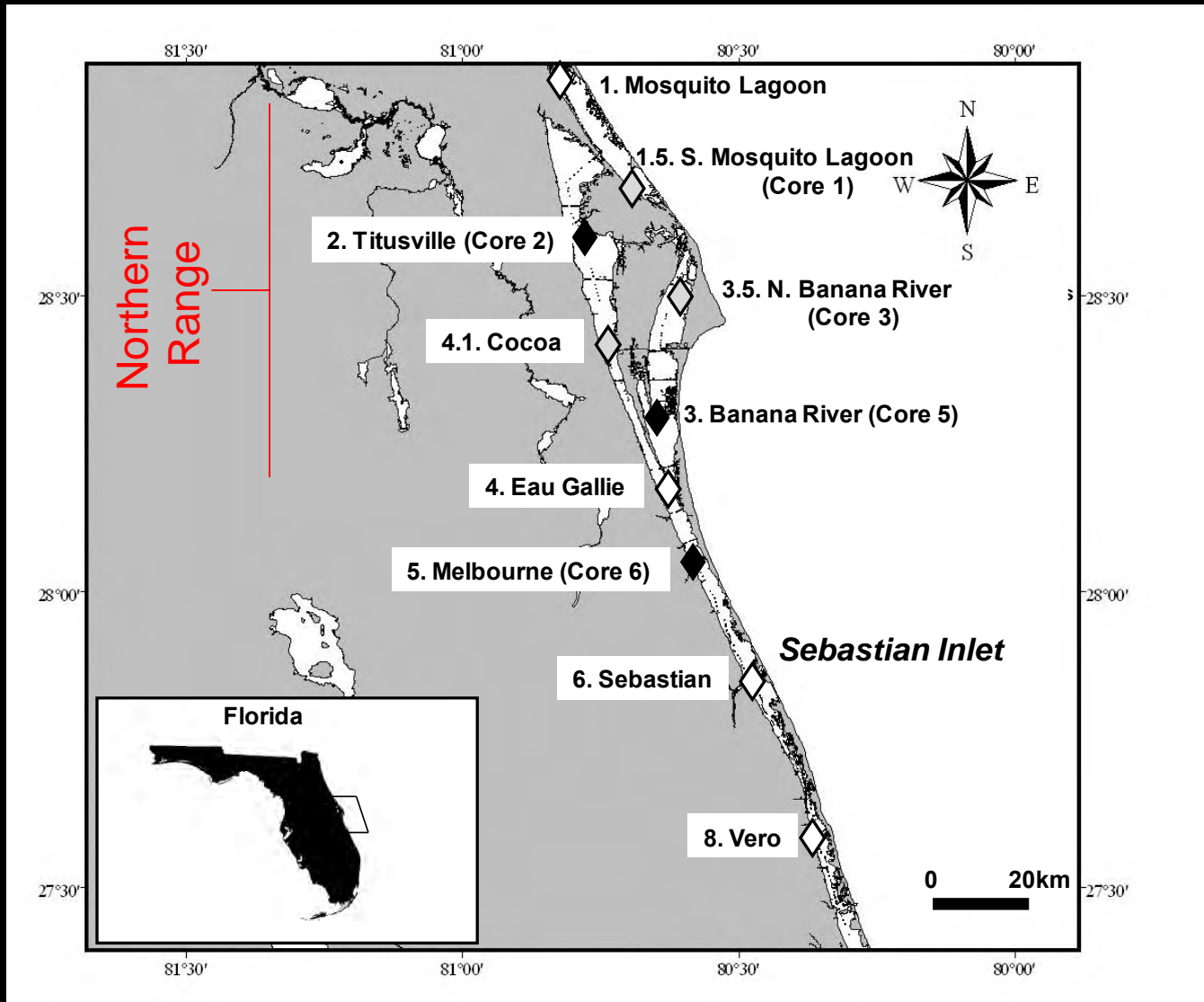
Field parameters – Temperature, oxygen, salinity, light attenuation

Analytical Parameters - Total nitrogen, total phosphorus (some SRP, DIN, Si)

Other – Color, turbidity (some TSS, POC), chlorophyll *a*

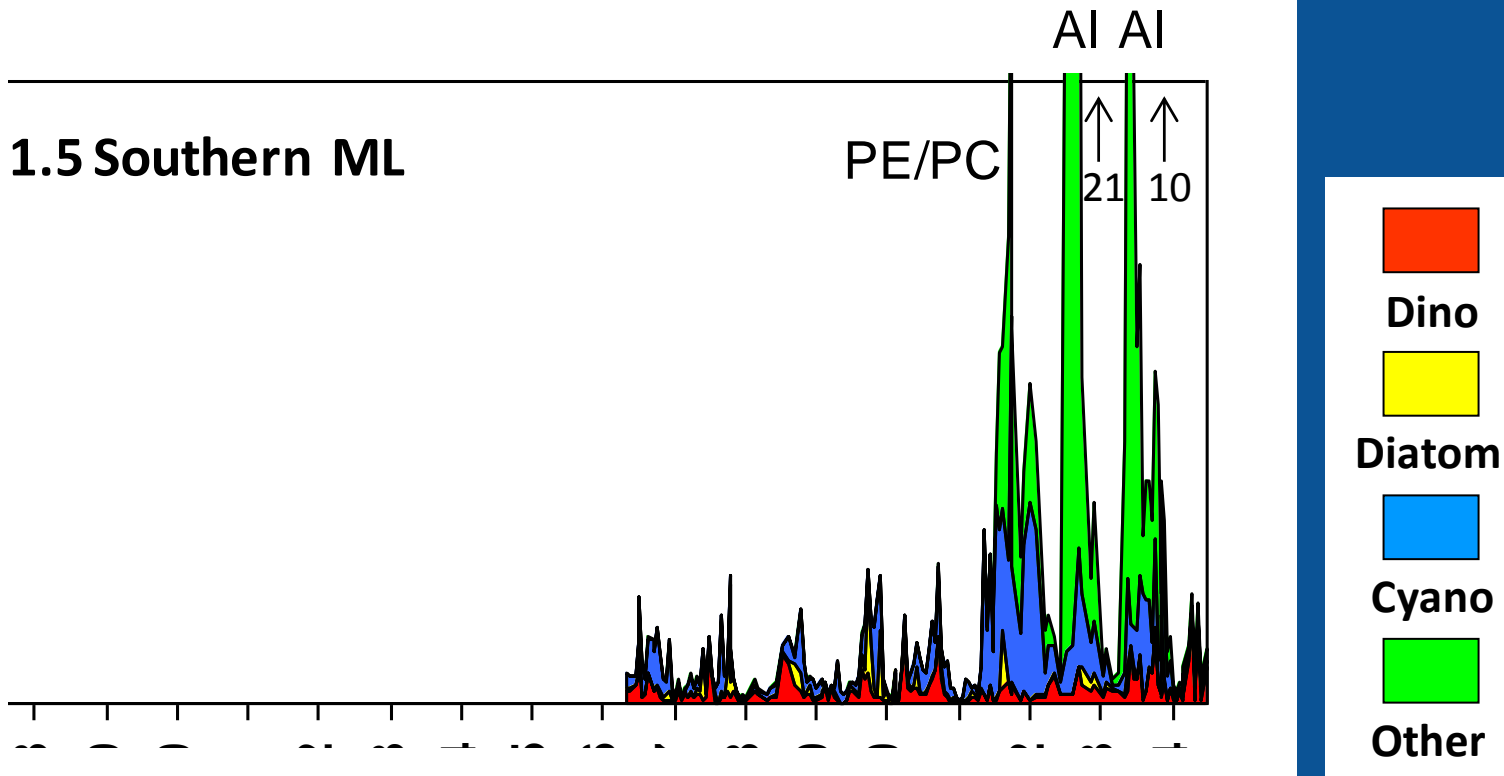
**Plankton – Phytoplankton composition, biovolume, carbon
Some zooplankton and bacterioplankton**

Sampling Regime – 10 Sites



Phytoplankton Biomass – Southern Mosquito Lagoon

Carbon, $\mu\text{g ml}^{-1}$

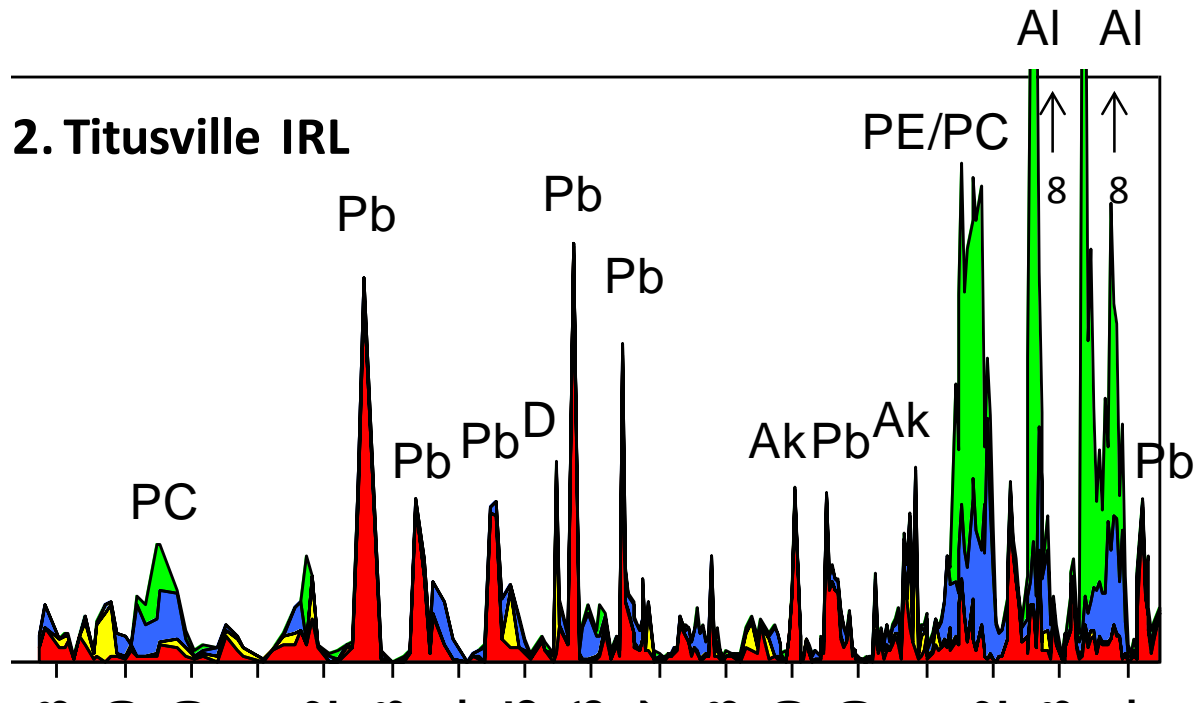


Note: $1 \mu\text{g C ml}^{-1} \approx 15\text{-}25 \mu\text{g Chl } a \text{ L}^{-1}$

Phlips et al.

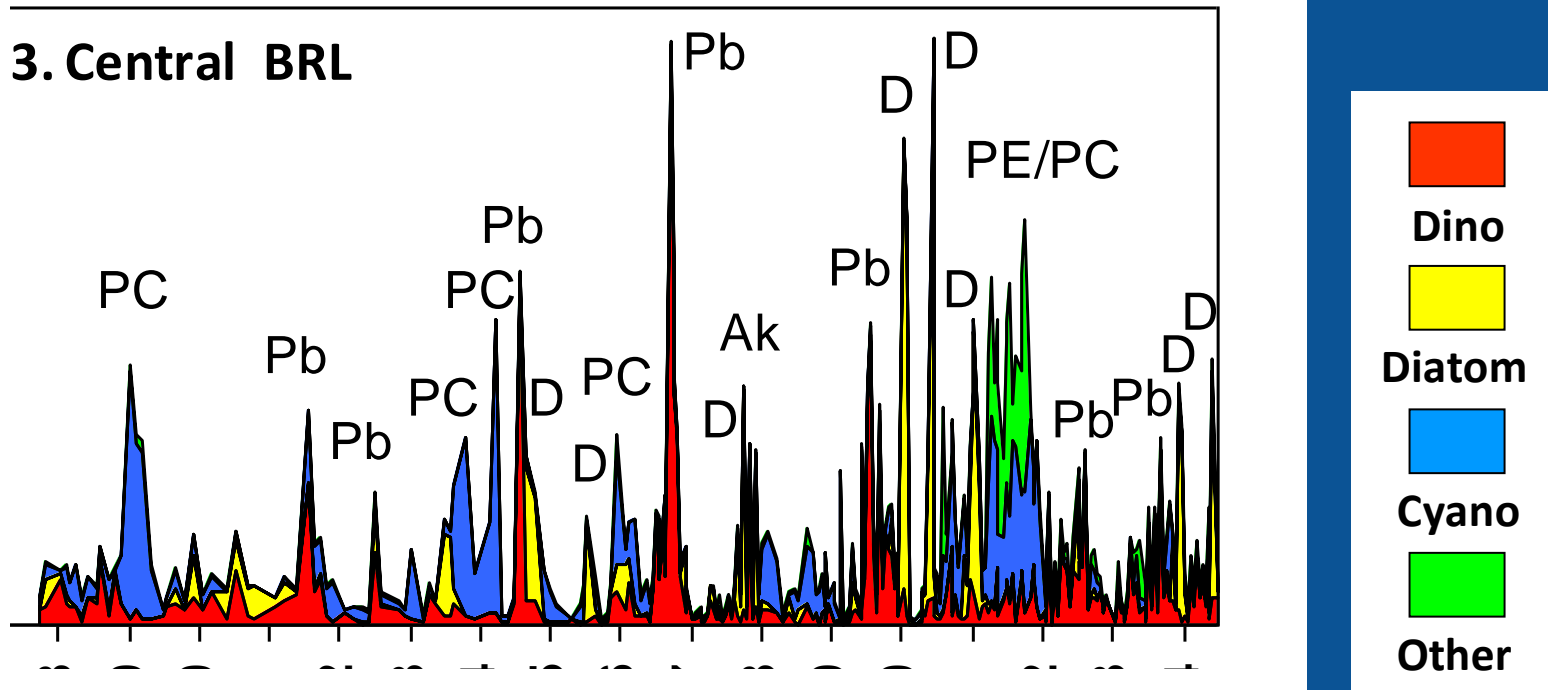
Phytoplankton Biomass – Northern Indian River Lagoon

Carbon, $\mu\text{g ml}^{-1}$



Phytoplankton Biomass – Central Banana River

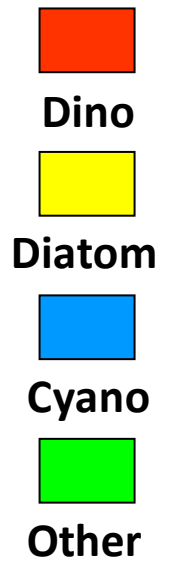
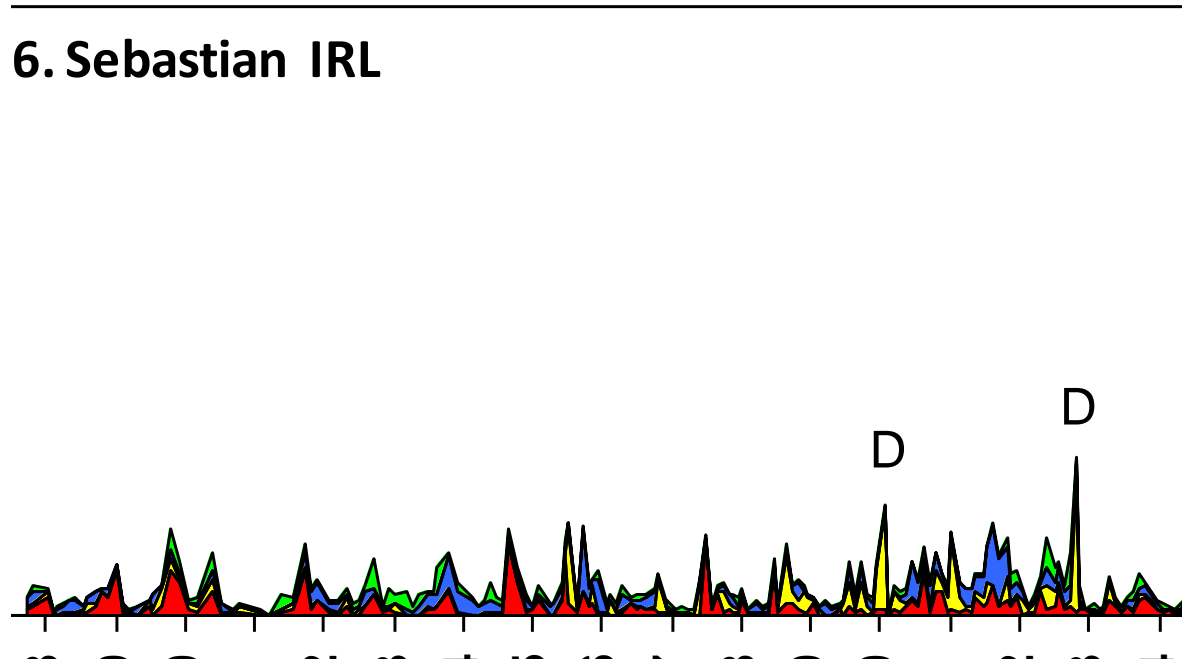
Carbon, $\mu\text{g ml}^{-1}$






Phytoplankton Biomass – Central IRL Sebastian

Carbon, $\mu\text{g ml}^{-1}$

6. Sebastian IRL



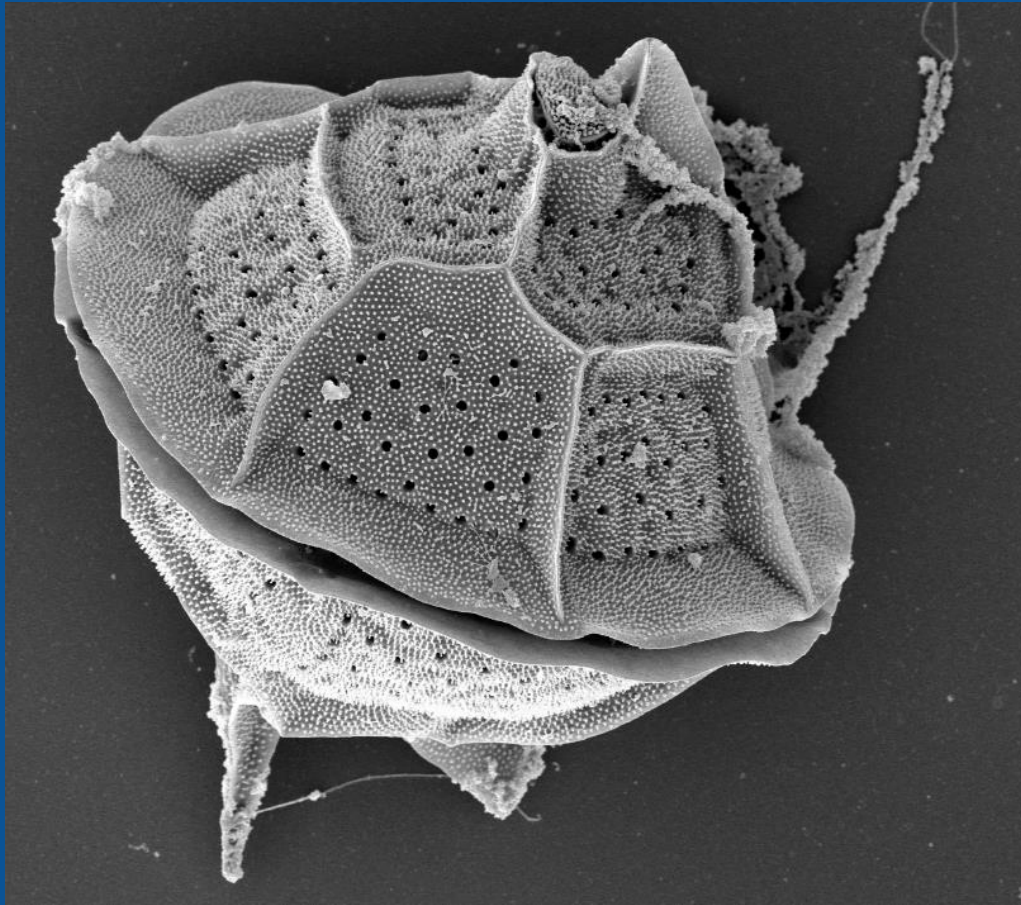
Some Major HAB Species

	Max Biomass*	#Obs. >0.2*	Total Obs.	
 <i>Pyrodinium bahamense</i>	6.0	116	535	— Dinoflagellates
<i>Akashiwo sanguinea</i>	7.3	44	615	
<i>Peridinium quinquecorne</i>	1.7	13	120	
<i>Karlodinium veneficum</i>	0.8	8	817	
<i>Prorocentrum minimum</i>	0.4	5	295	
<i>Cochlodinium polykrikoides</i>	0.4	4	224	
<i>Takayama tasmanica</i>	1.4	3	78	
<i>Kryptoperidinium foliaceum</i>	3.6	3	80	
 <i>Pedinophyceae</i> sp.	4.4	76	295	— Chlorophyte
 <i>Aureoumbra lagunensis</i>	23.0	12	36	— Pelagophyte
<i>Pseudo-nitzschia calliantha</i>	1.5	16	384	— Diatom

* $\mu\text{g C ml}^{-1}$

Phlips et al.

Pyrodinium bahamense var. *bahamense*



Badylak et al. 2004

**Most prolific bloom-former
in the IRL**

Saxitoxin producer

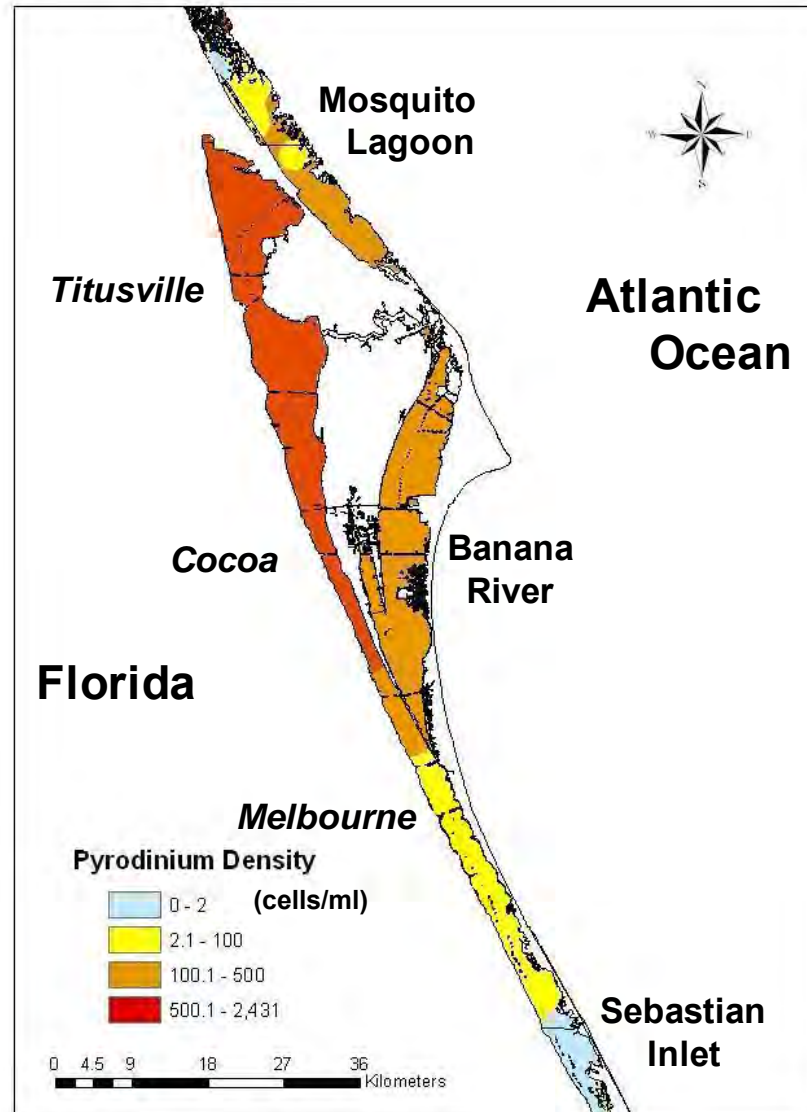
**Source of toxin in some fish
and invertebrates species
in the IRL**

**May be associated with
alterations in food webs**

**Increased light attenuation,
Secchi depths 0.9-1.5 m**

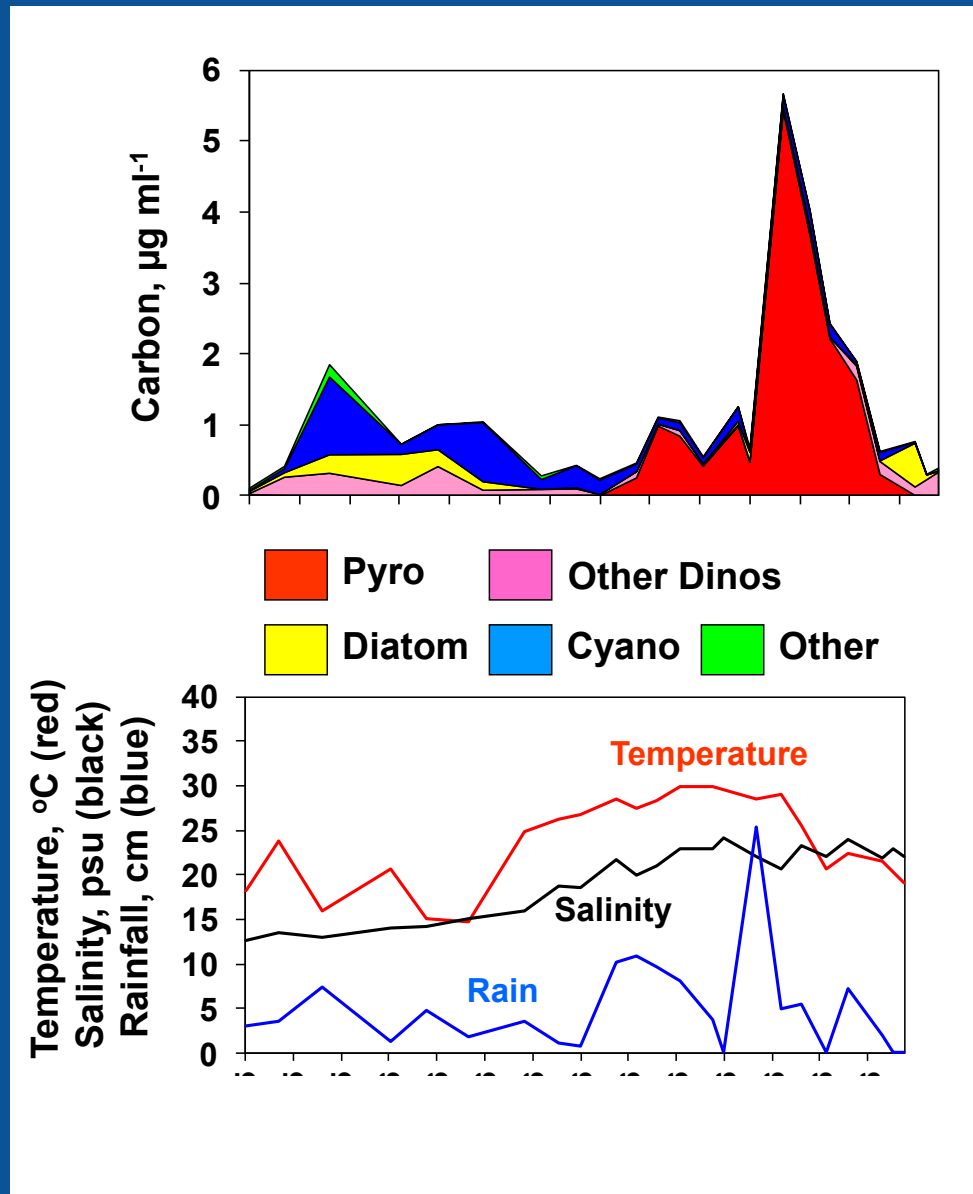
(Phlips et al. 2006, 2010, 2011, 2014;
Badylak et al. 2004, 2007, 2008;
Landsberg et al. 2006)

Pyrodinium bahamense Spatial Distribution – Summer 2009



Phlips et al. 2011

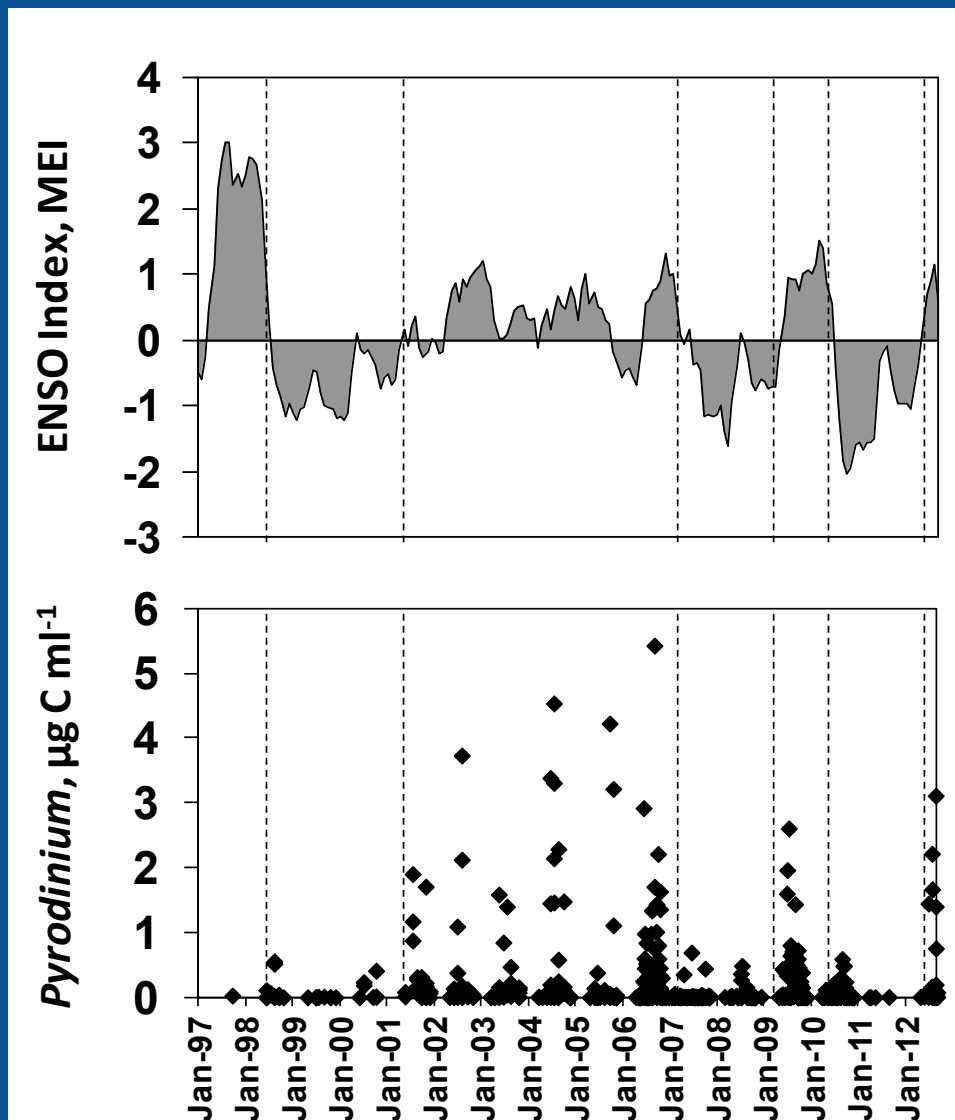
2006 *Pyrodinium* Bloom – Central Banana River



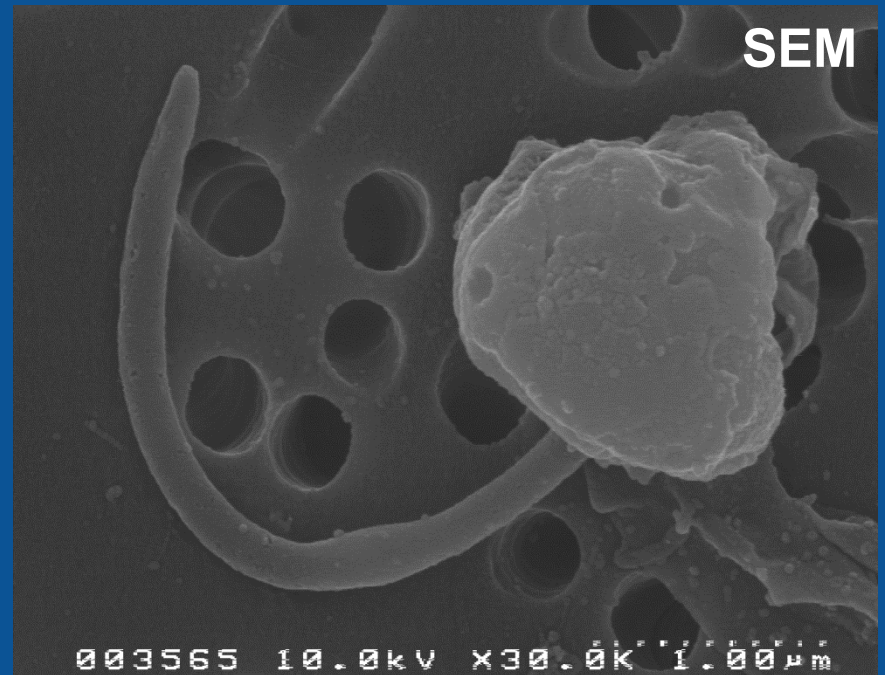
Longevity

High temp
Low salinity
Rain link

El Niño Southern Oscillation Index and *Pyrodinium* Biovolume

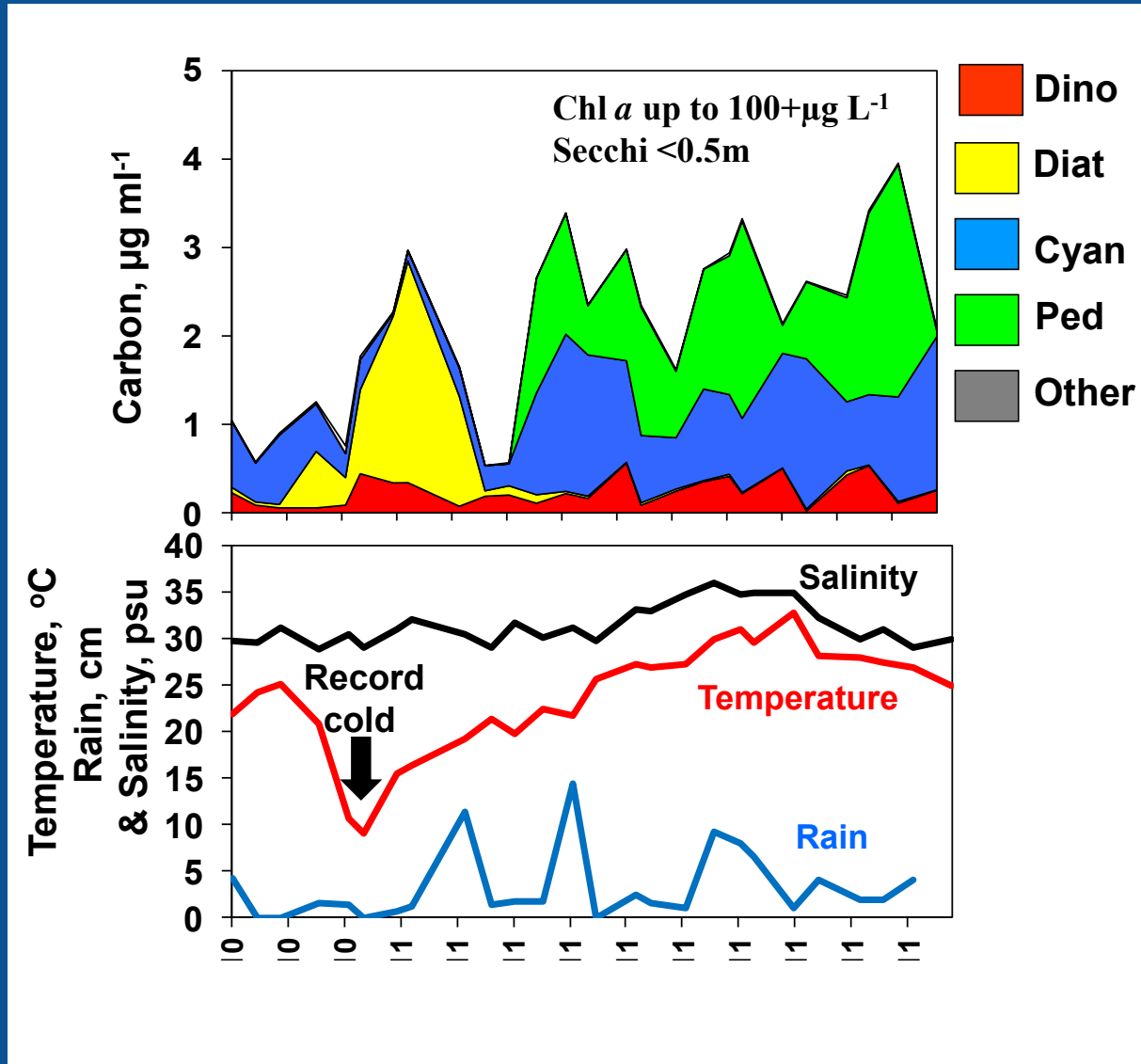


**2011 Green Tide - “Super” bloom
Pedinophyceae sp./Picocyanobacteria**



Badylak, Philips and Kelley

2010/2011- Diatom/Pedinophyceae sp. & Picocyanobacteria Blooms Central Banana River



Longevity

Record cold

Low rainfall

Seagrass
Die off

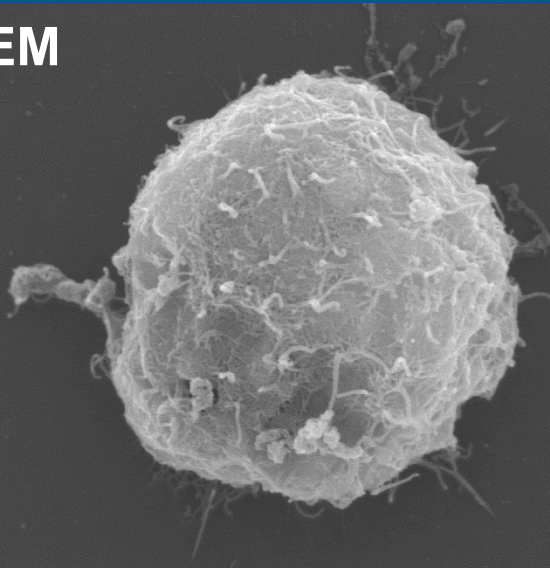
2012 Brown Tide – Mosquito Lagoon Just When You Thought Things Were Getting Better



Kelly Young

2012 Bloom: Pelagophyte sp. (*Aureoumbra lagunensis*)

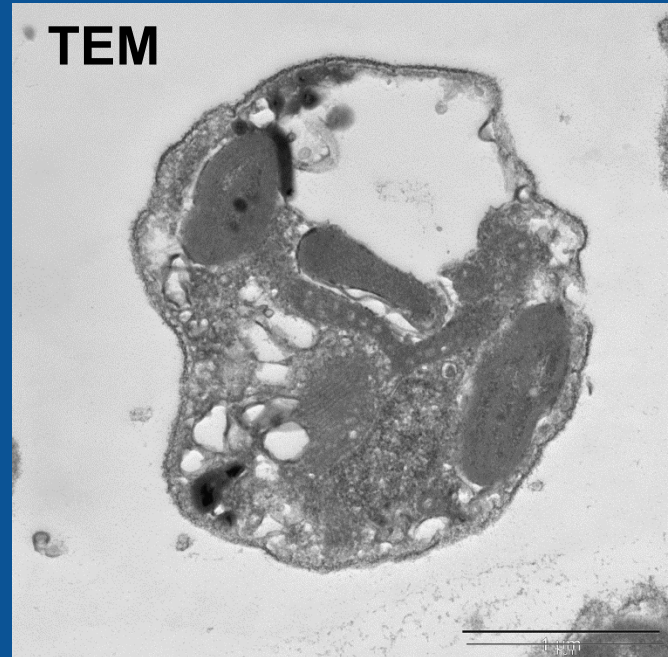
SEM



001653 10.0kV x20.0k 1.50µm

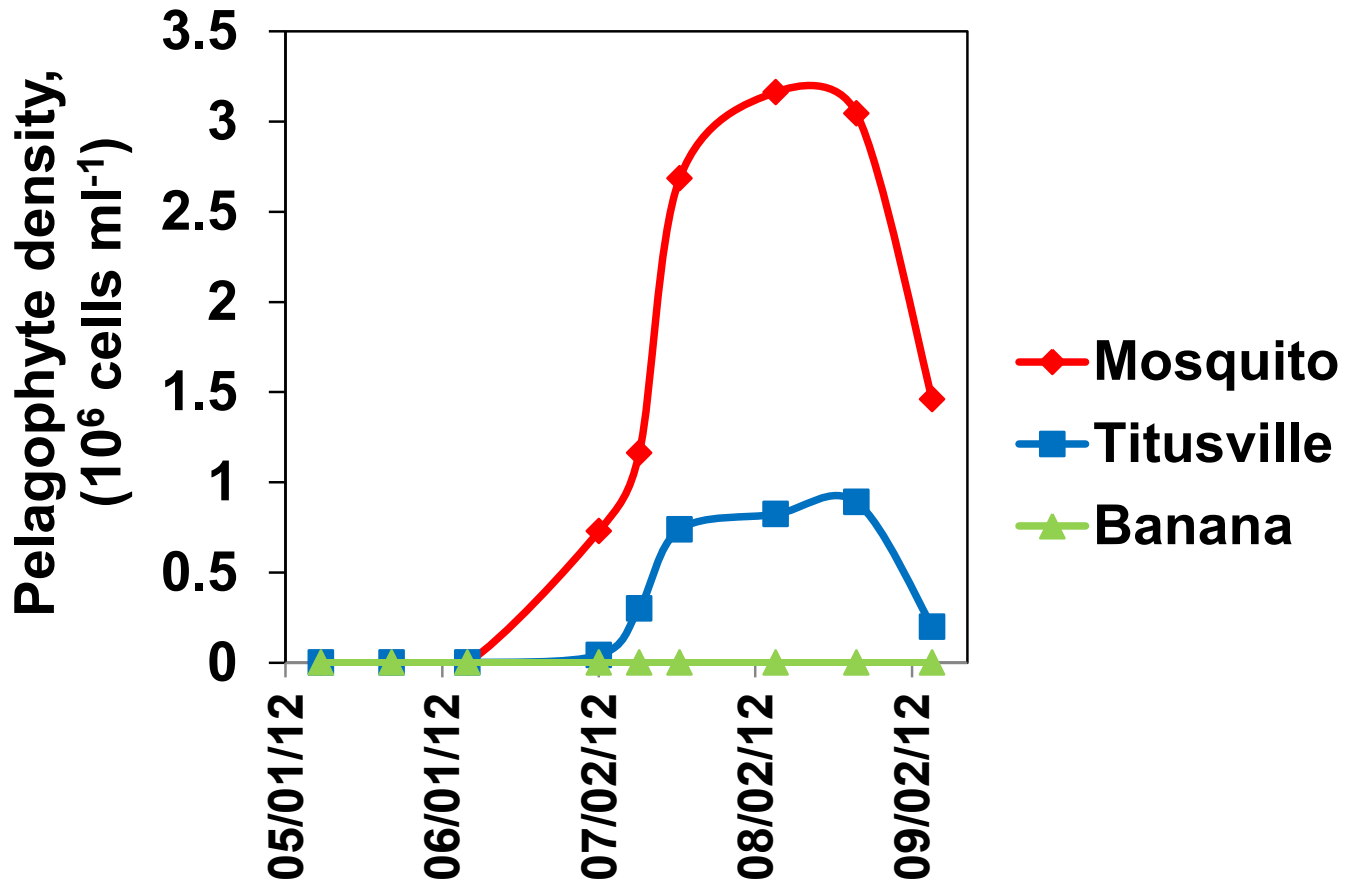
Badylak, Kelley & Phlips

TEM



Badylak, Kelley & Phlips

Summer 2012 Pelagophyte Cell Densities in Mosquito Lagoon, N. IRL and Banana River



Phlips Lab Current Research

Continued phytoplankton monitoring program

Addition of bacterioplankton and zooplankton analyses at selected sites in the northern IRL, Banana River and Mosquito Lagoon

Nutrient uptake experiments with cultures of pico- and nano-plankton

Microzooplankton grazing experiments at selected sites in the northern IRL, Banana River and Mosquito Lagoon