



Final Report

Macroalgae as Bioindicators of Nitrogen Enrichment in Sarasota Bay, FL

Brian E. Lapointe
Harbor Branch Oceanographic Institute
Florida Atlantic University

SBNEP TAC Meeting
April 20, 2012

HARBOR BRANCH

FLORIDA ATLANTIC UNIVERSITY

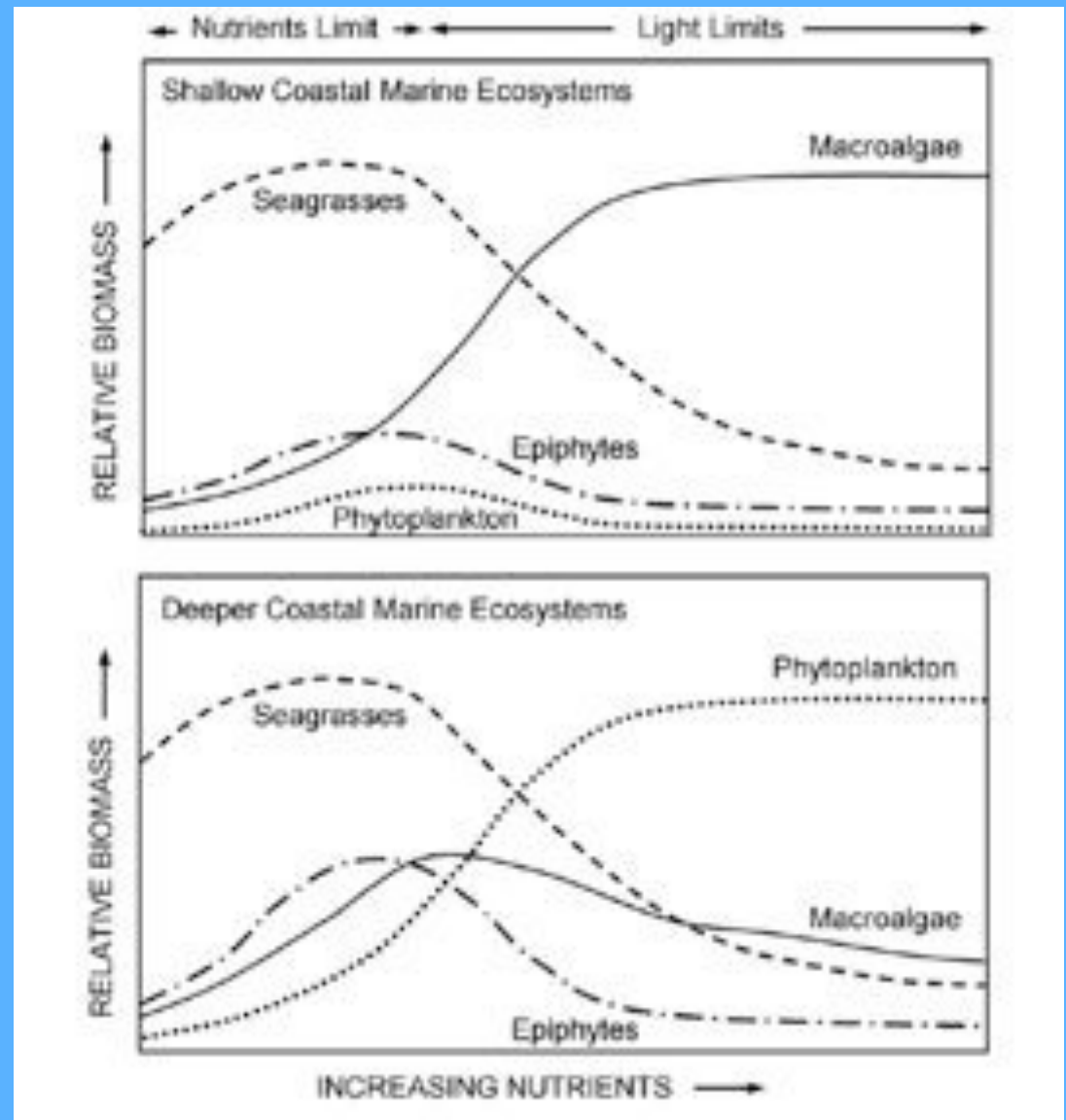
Ocean Science for a Better World™



**SARASOTA BAY
ESTUARY PROGRAM**
Restoring Our Bays

Why Study Macroalgae ?

- important primary producers
- respond to nutrient enrichment, indicators of eutrophication
- no need for a collection permit
- integrate nutrient availability over weeks/months
- ideal “tools” for assessing N sources as they do not fractionate N isotopes
- when combined with N isotope analysis, provide cost-effective method to understand/model estuarine N dynamics and overall health
- improve management



Burkholder et al. 2007

Red Drift Macroalgae Blooms Emerge in Southwest FL



“Smelly seaweed fouling Gulf beaches”

Sarasota Herald Tribune

By Kate Spinner

March 9, 2007

Project Approach

- Collect macroalgae annually from sites representing different areas of Sarasota Bay
- Identify taxa and process for stable N isotope analysis ($\delta^{15}\text{N}$) as an objective tool to identify N source (s)
- Calculate % N, % C, and C:N ratio to gauge the degree of N-limitation of macroalgae
- Collect ancillary environmental data (temp, salinity, % cover of seagrasses/macroalgae, biomass of macroalgae)



Study Sites & Sampling Dates

- 11 stations representing different areas of Sarasota Bay, 2 coastal reference sites
- July 2009
- July 2010
- April 2011
- October 2011 (data not yet available)



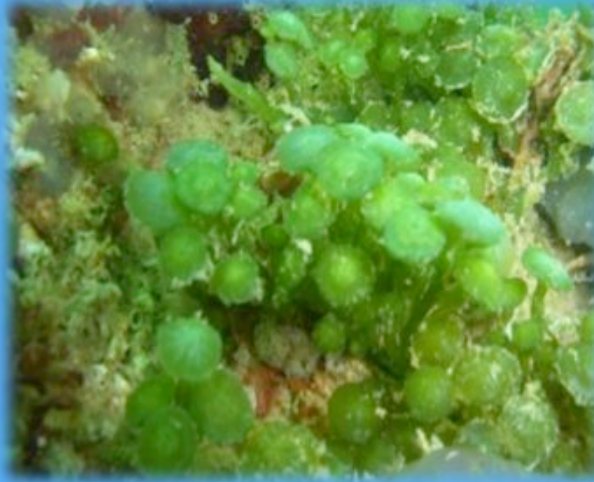
Project Support: Sarasota County, Manatee County



Macroalgae Taxa Collected

		SAMPLING STATIONS													
Division	Sampling Event	Palma Sola Bay		Big Sarasota Bay			Robert's Bay		Little Sarasota Bay		Blackburn Bay		Offshore References		
		PSB1	PSB2	BSB2	BSB3	BSB4	RB1	RB2	LSB1	LSB2	BB1	BB2	ST	LBC	
RHODOPHYTA (red algae)															
<i>Acetabularia spicifera</i>	1,2,4	x	x	x	x	x		x		x	x	x			
<i>Agardhiella subulata</i>	1,2												x	x	
<i>Agardhiella subulata</i>	3												x		
<i>Botryocladia occidentalis</i>	1,2,3												x	x	
<i>Champia parvula</i>	3												x		
<i>Chondria</i> sp.	2	x				x									
<i>Gracilaria boudieri</i>	1,2,3	x					x	x	x	x	x	x			
<i>Gracilaria cylindrica</i>	1,2,3						x	x			x	x			
<i>Gracilaria mammillaris</i>	1,2,3						x						x	x	
<i>Gracilaria</i> spp.	1,2	x	x						x	x	x	x	x	x	
<i>Gracilaria tikvahiae</i>	1,2,3,4	x	x	x		x		x	x	x	x	x			
<i>Halimnion floridanum</i>	2													x	
<i>Hypnea coriacea</i>	3	x	x		x		x				x	x			
<i>Hypnea musciformis</i>	4			x											
<i>Hypnea spinella</i>	1,2,3,4	x			x				x	x	x	x	x		
<i>Hypnea valentiae</i>	1,3,4	x	x			x							x		
<i>Solenastrea filiformis</i>	1												x		
<i>Sporolithus lemaneoides</i>	3					x									
CHLOROPHYTA (green algae)															
<i>Codium mexicanum</i>	1													x	
<i>Codium prolifera</i>	1,2,4									x					
<i>Codium racemosum</i>	1													x	
<i>Codium racemosum</i> v. <i>pubes</i>	2,3												x	x	
<i>Codium verticillatoides</i>	1							x		x	x				
<i>Gelidium (Gelidium) laevis</i>	3			x											
<i>Ulva lactuca</i>	3				x										
PHAEOPHYTA (brown algae)															
<i>Cladophora occidentalis</i>	3	x		x											
<i>Dasyatis pulchella</i>	1				x									x	
<i>Dasyatis</i> spp.	1	x										x			
<i>Macelasma mitchelliae</i>	3		x												
<i>Padina gymnospora</i>	2													x	
<i>Sargassum filiformis</i>	1,2,3											x	x	x	
<i>Sargassum</i> sp.	4												x	x	
TRACHEOPHYTA (seagrasses)															
<i>Halodule wrightii</i>	2,4			x	x		x					x			
<i>Thalassia testudinum</i>	2,3,4			x	x	x	x								

Silvertooth and Long Boat Key Reefs



Palma Sola Bay



Big Sarasota Bay



Little Sarasota Bay



Blackburn Bay

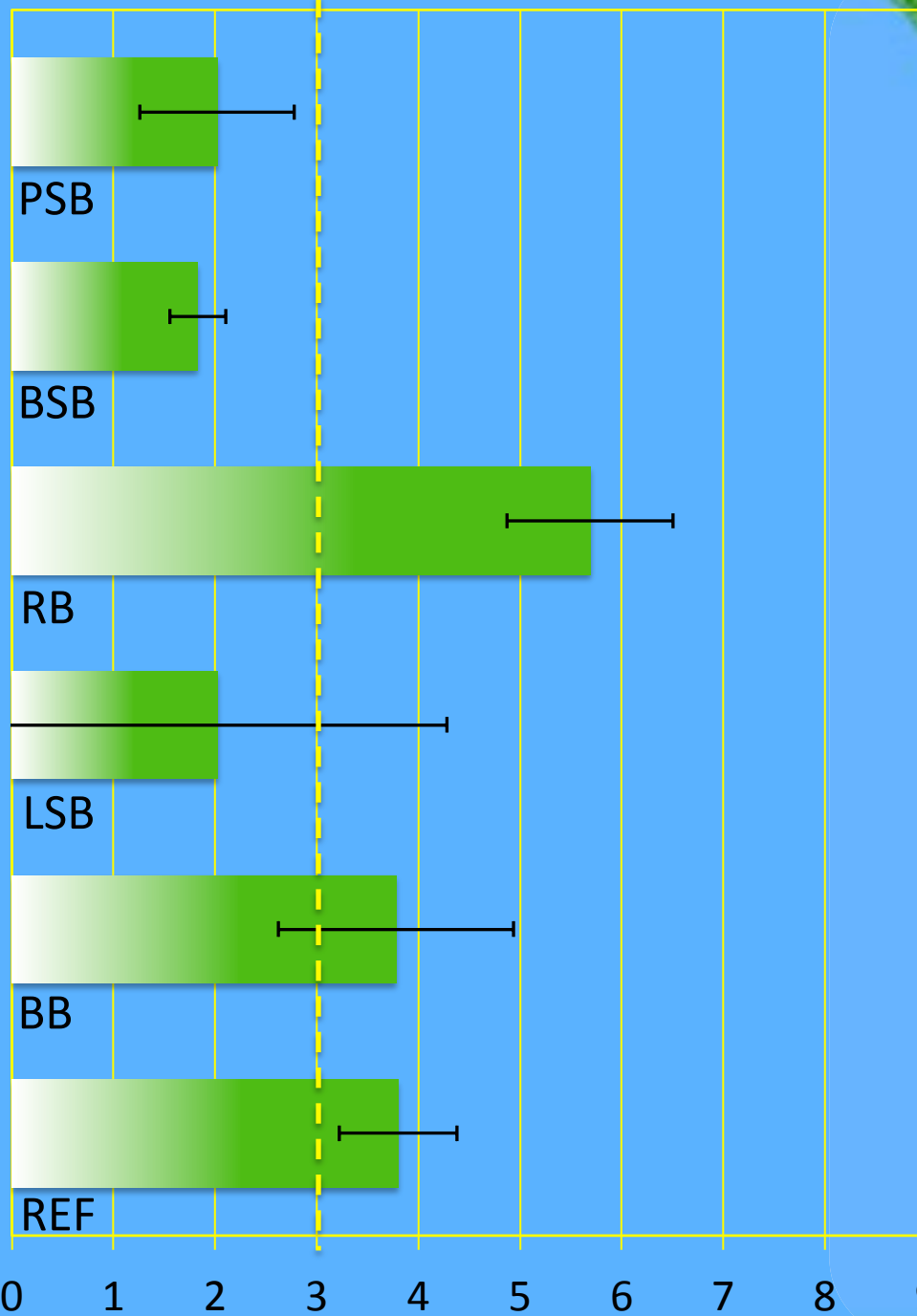


Samples Sorted, Cleaned & Dried at MOTE Marine Laboratory

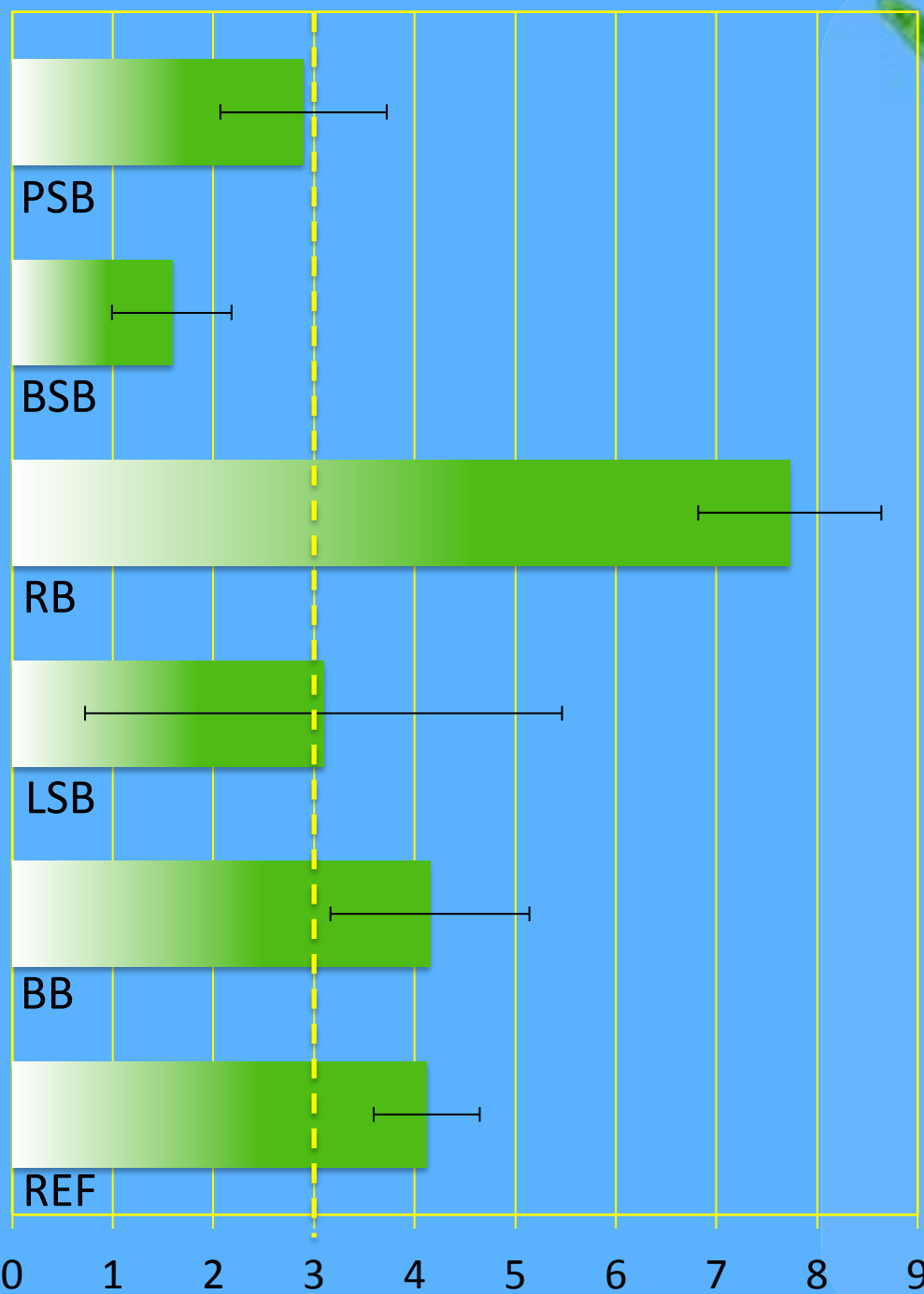


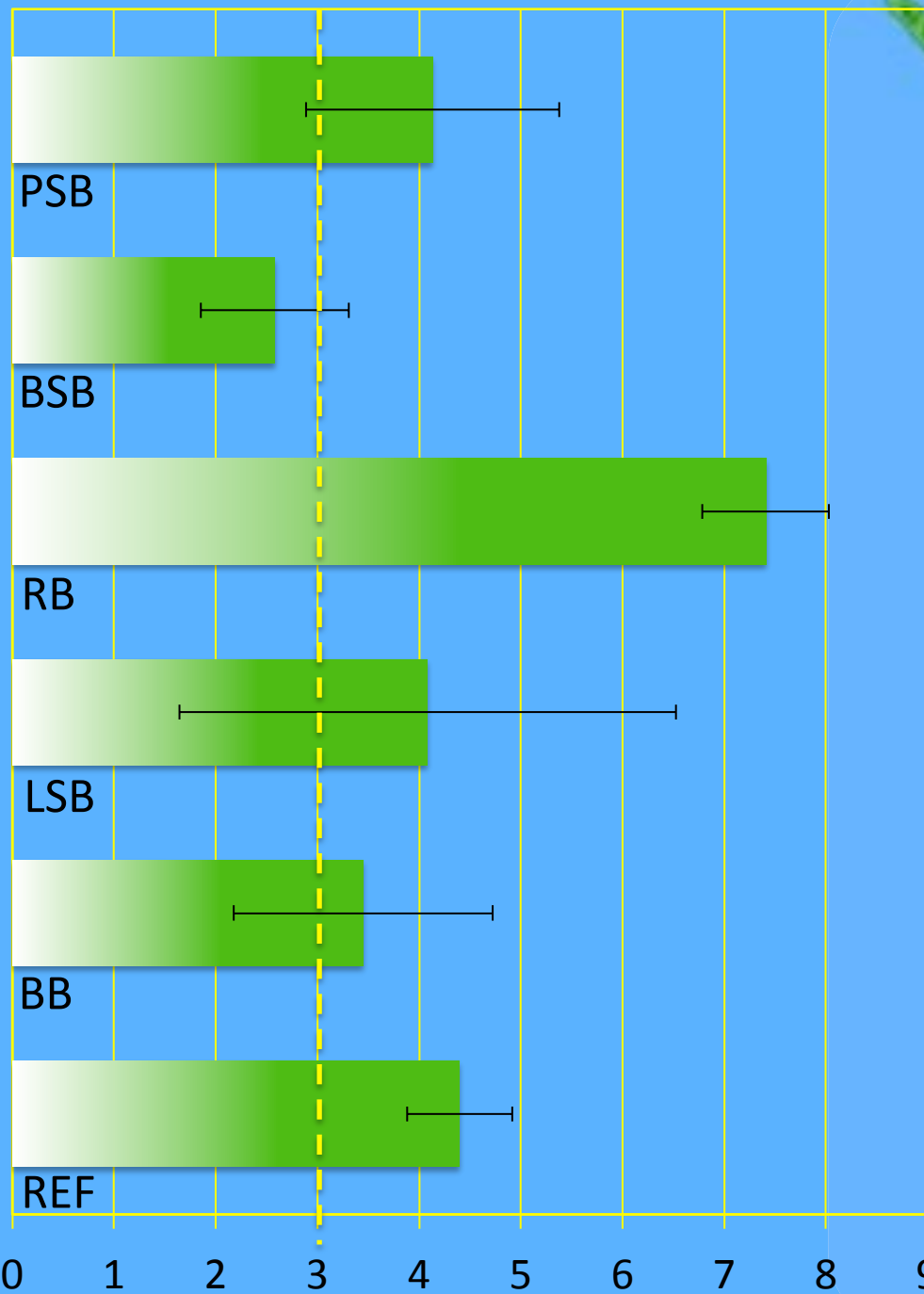
HAB Lab: HBOI at Florida Atlantic University



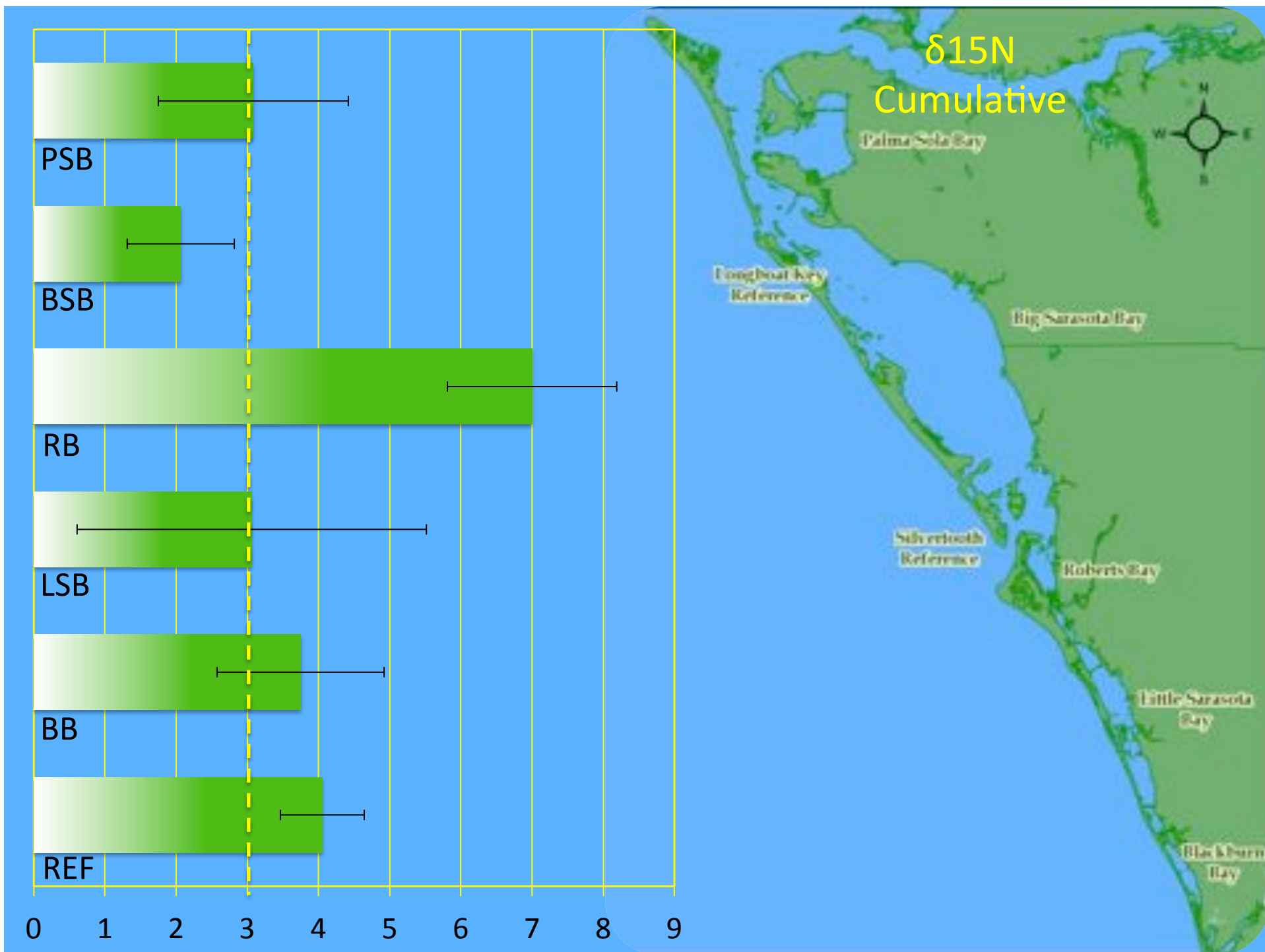


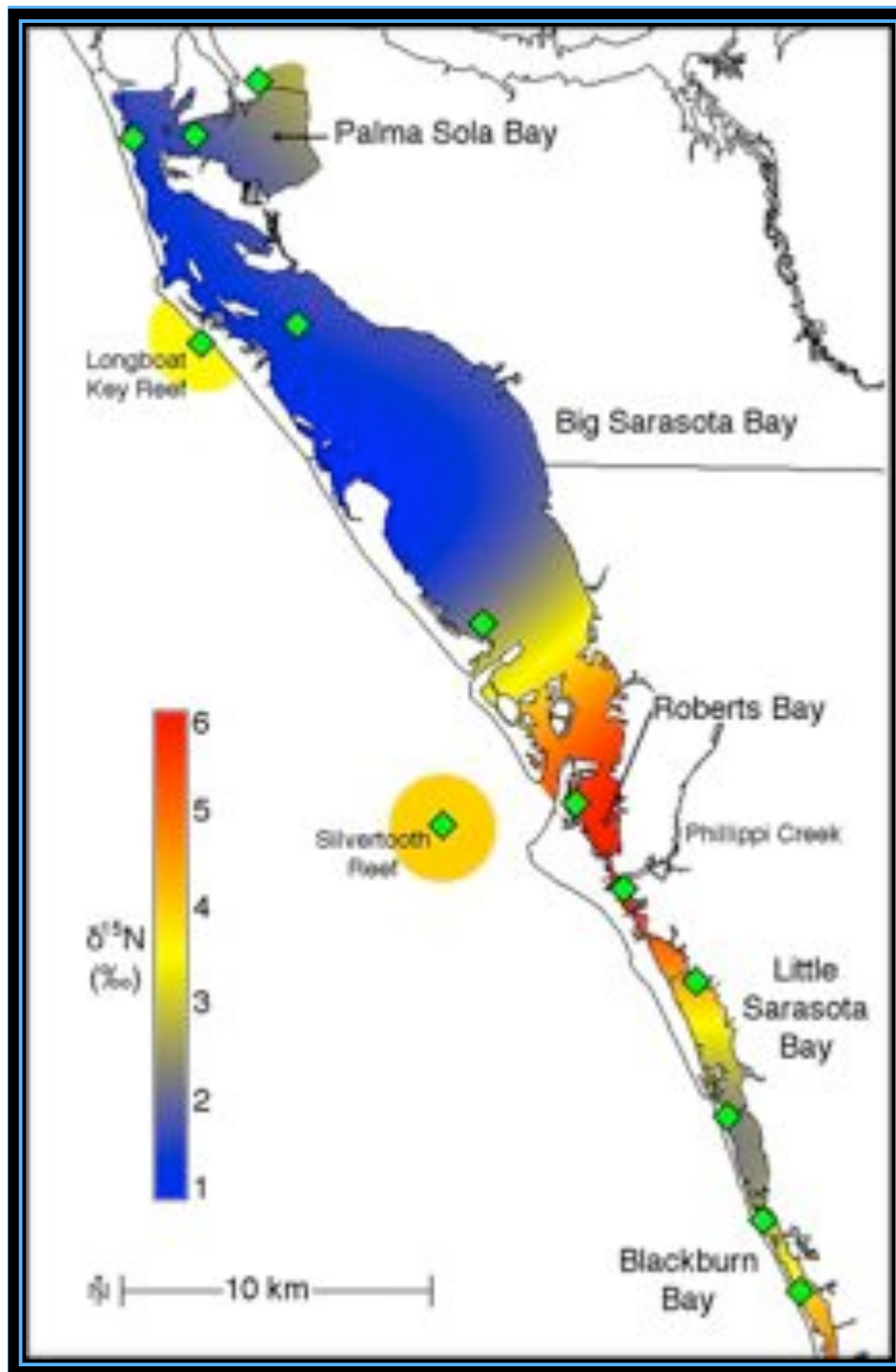
$\delta^{15}\text{N}$
July 2010





$\delta^{15}\text{N}$
April 2011

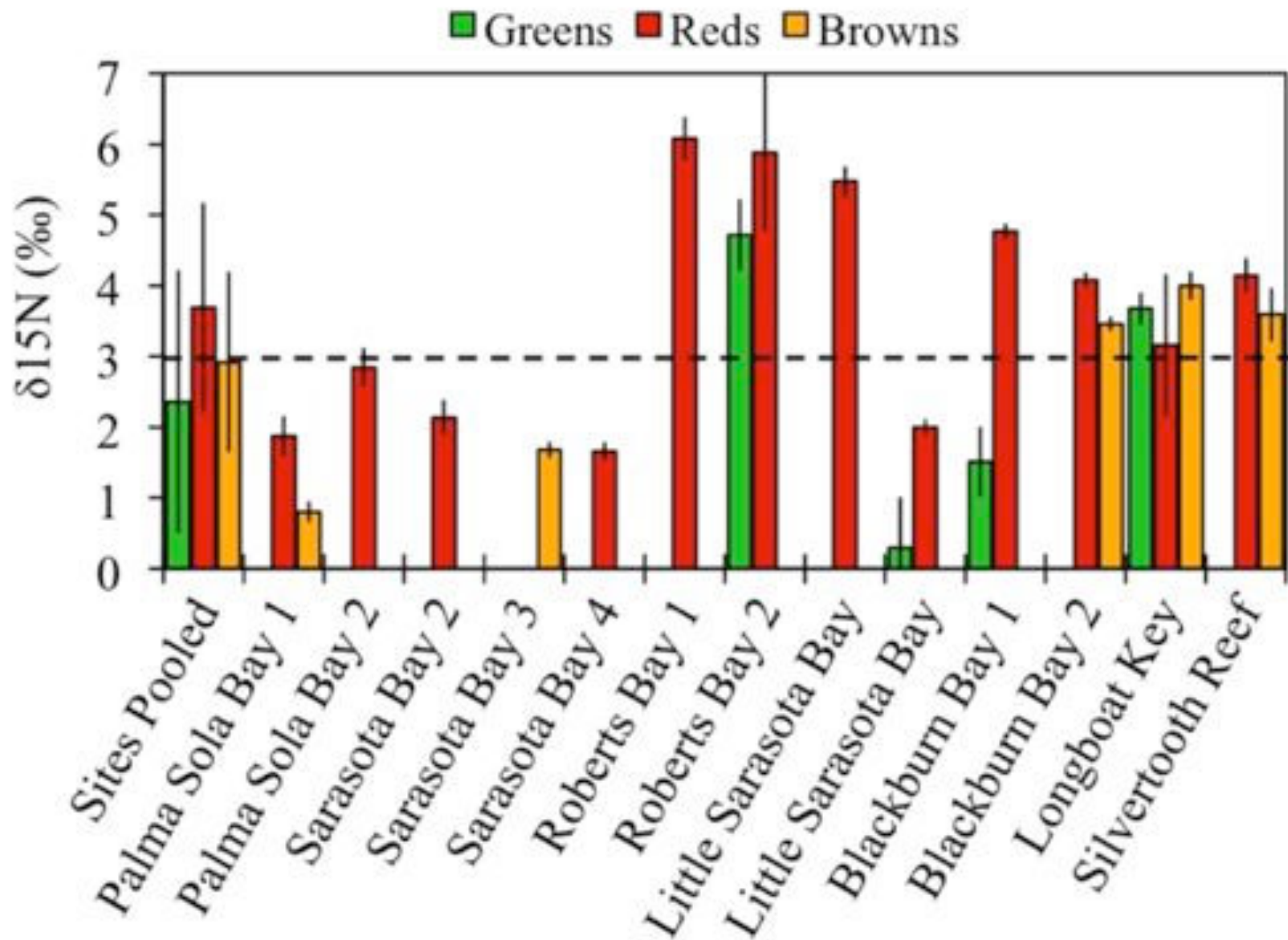


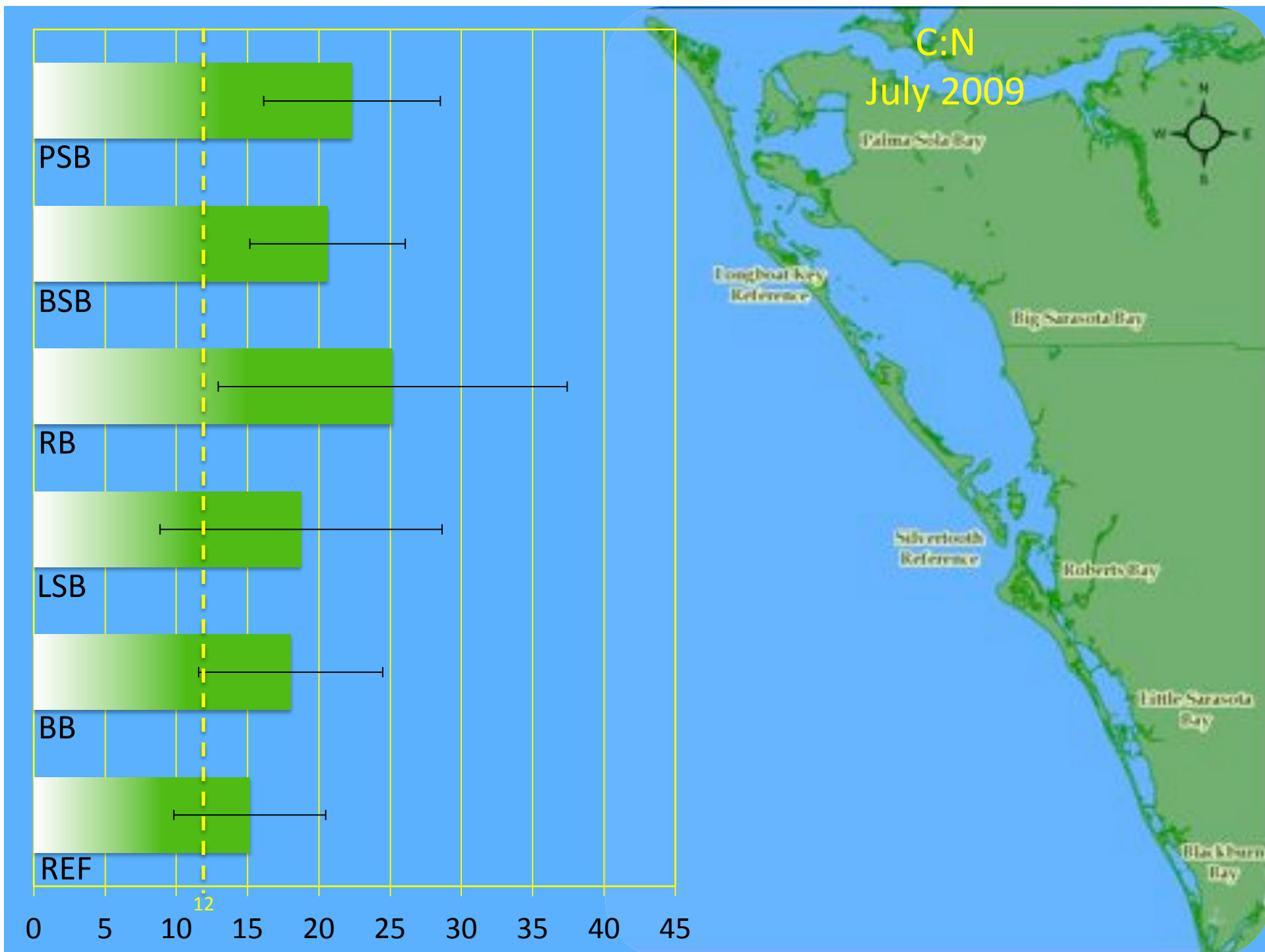


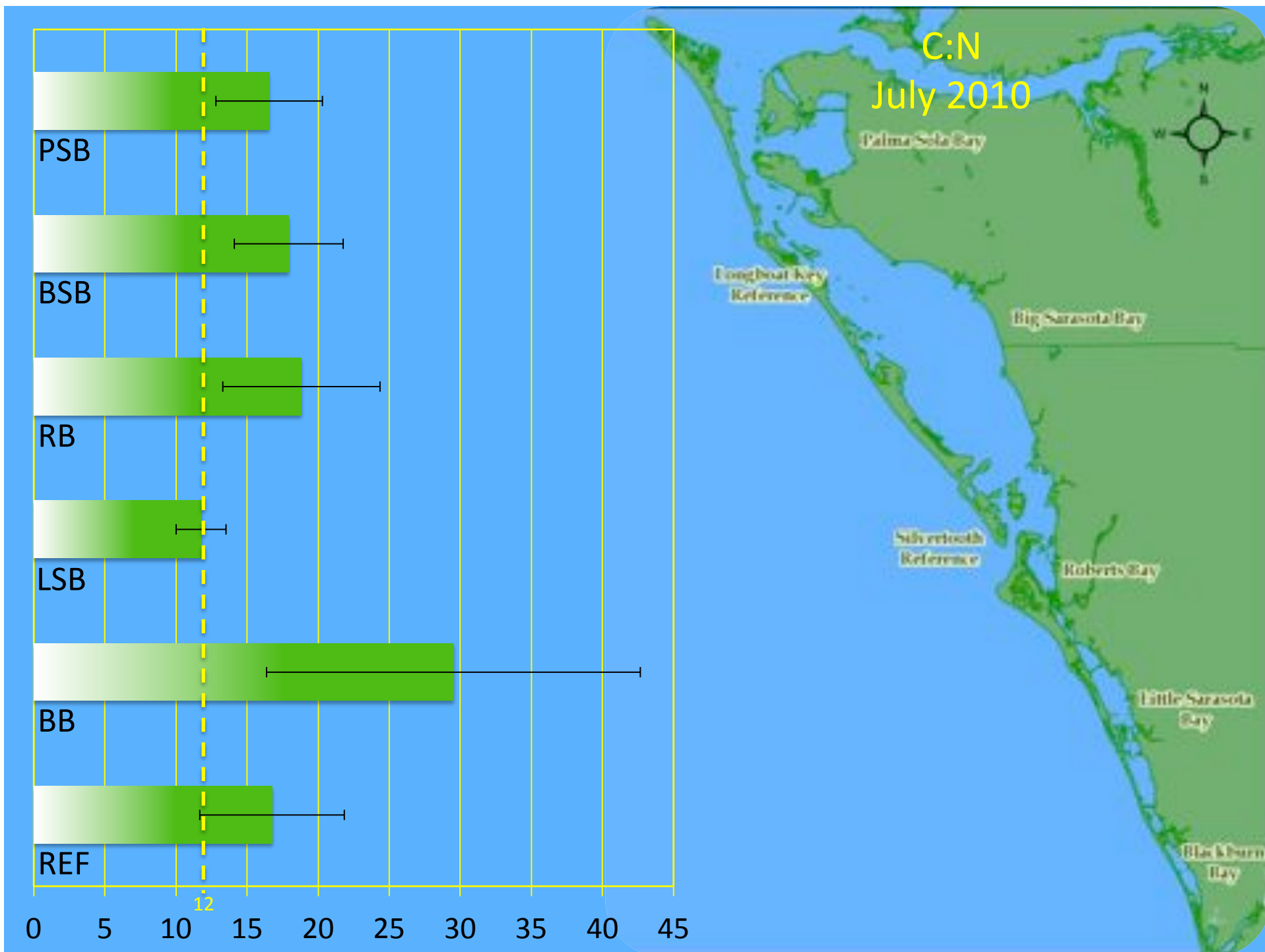
$\delta^{15}\text{N}$
July 2009



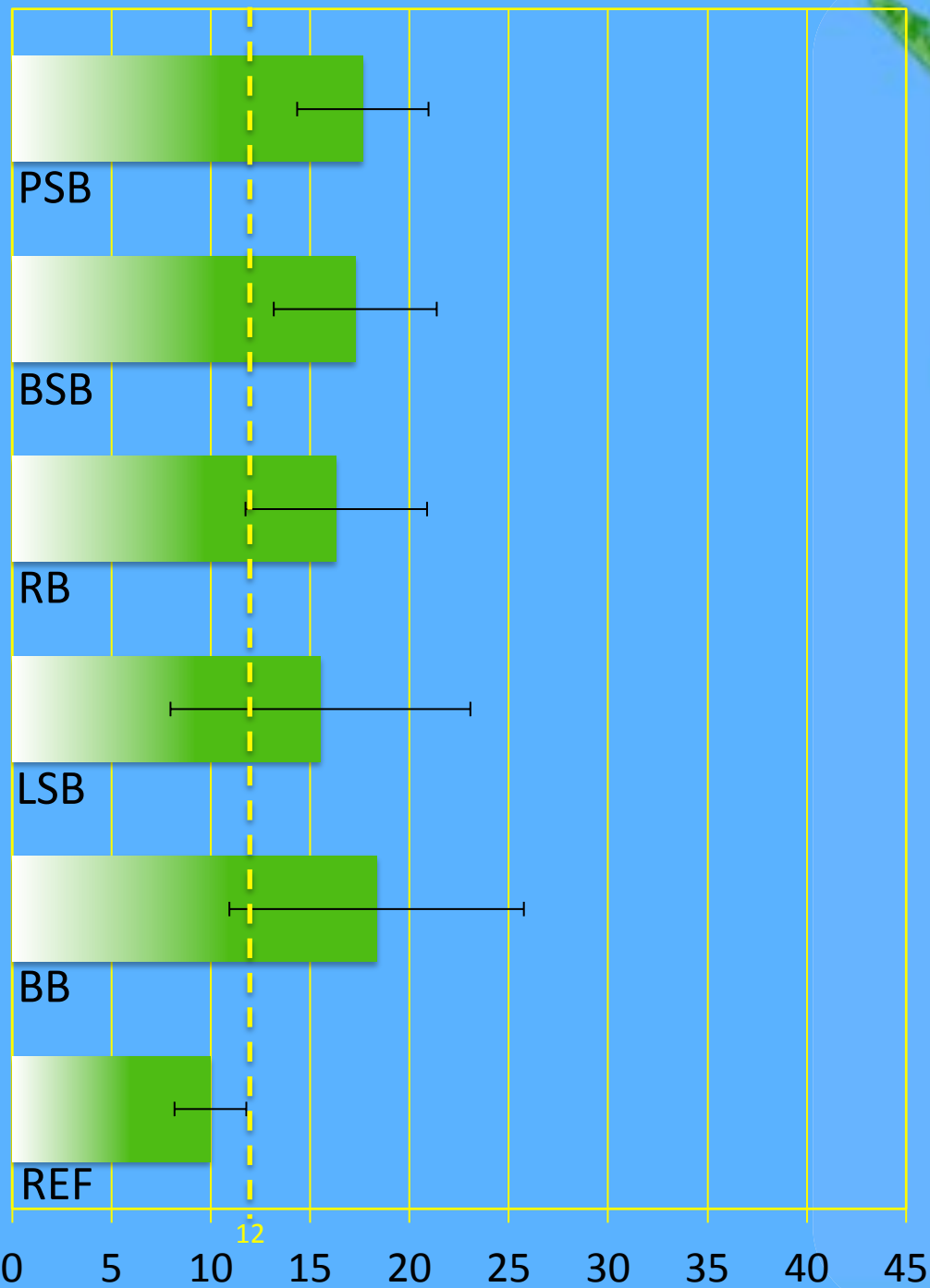
$\delta^{15}\text{N}$ by Phyla:2009

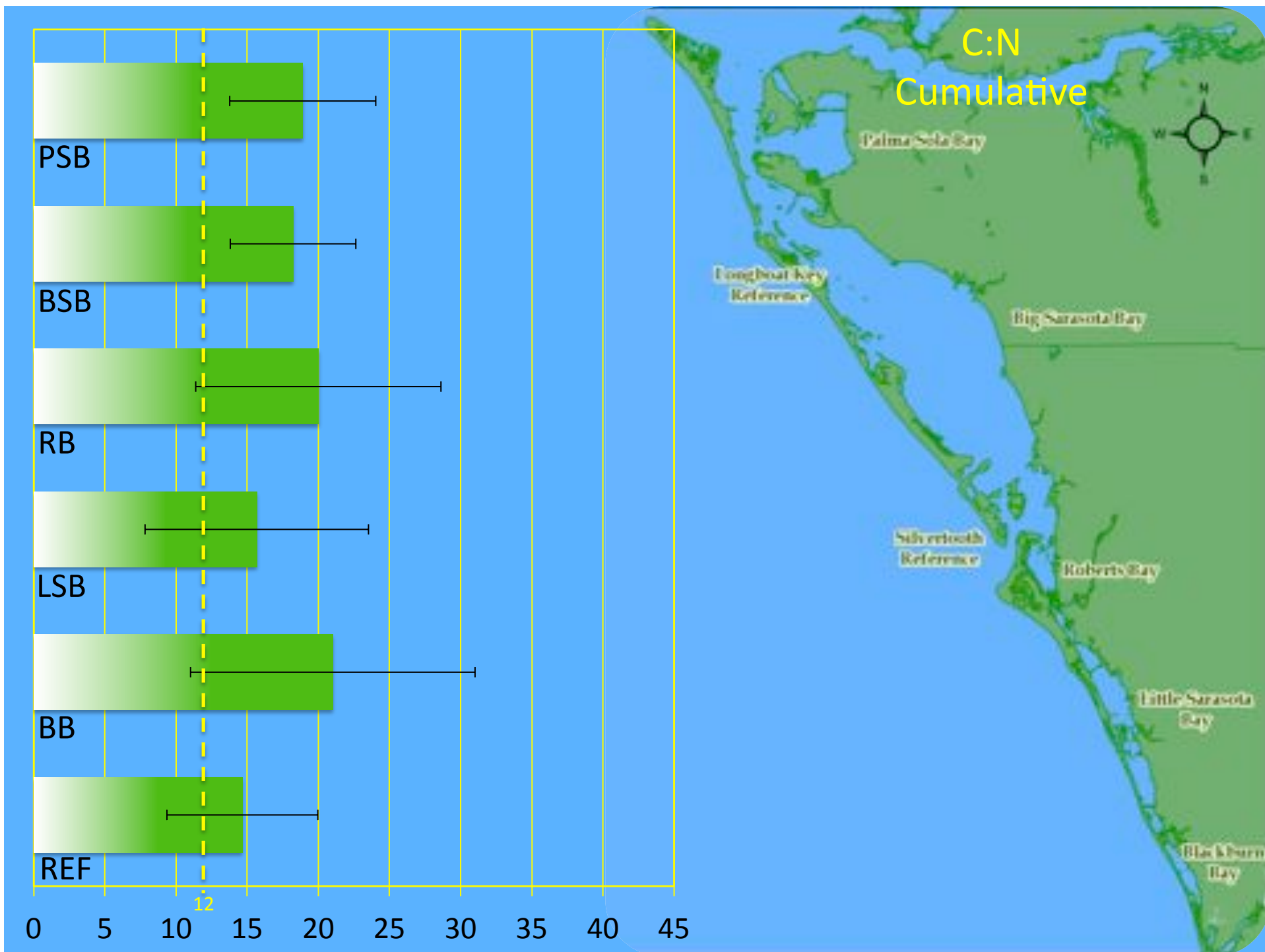


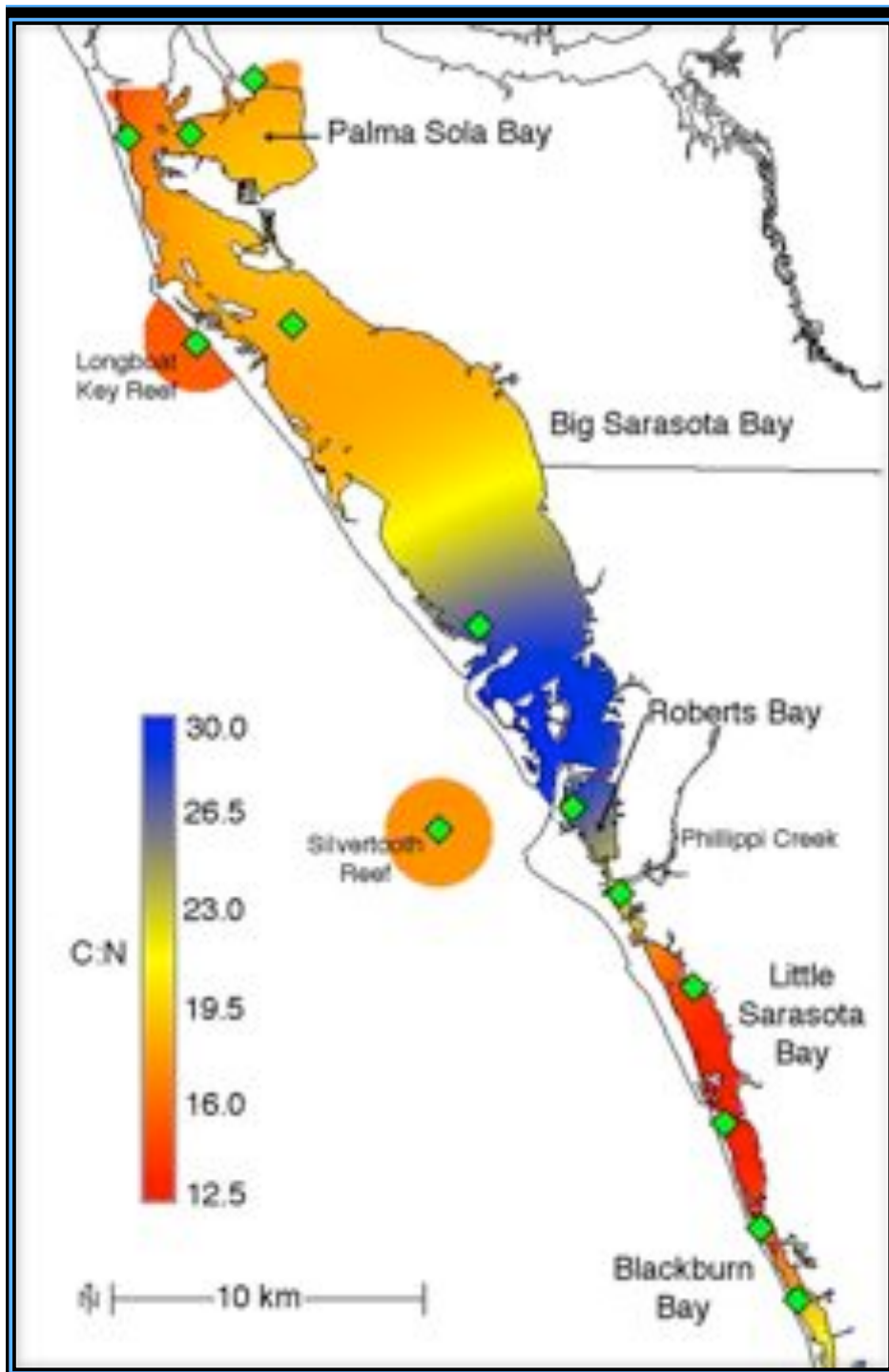




C:N
April 2011



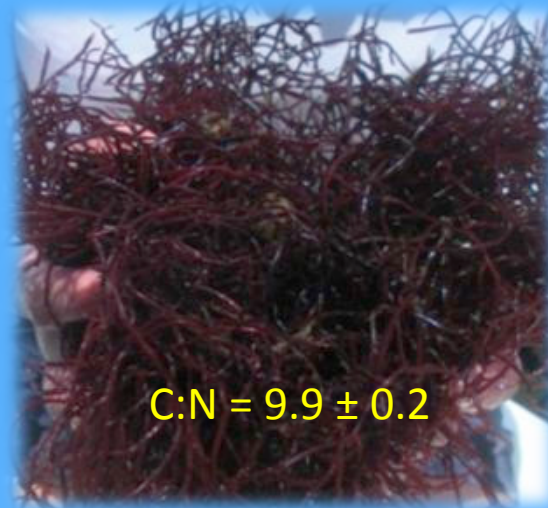




C:N
July 2009

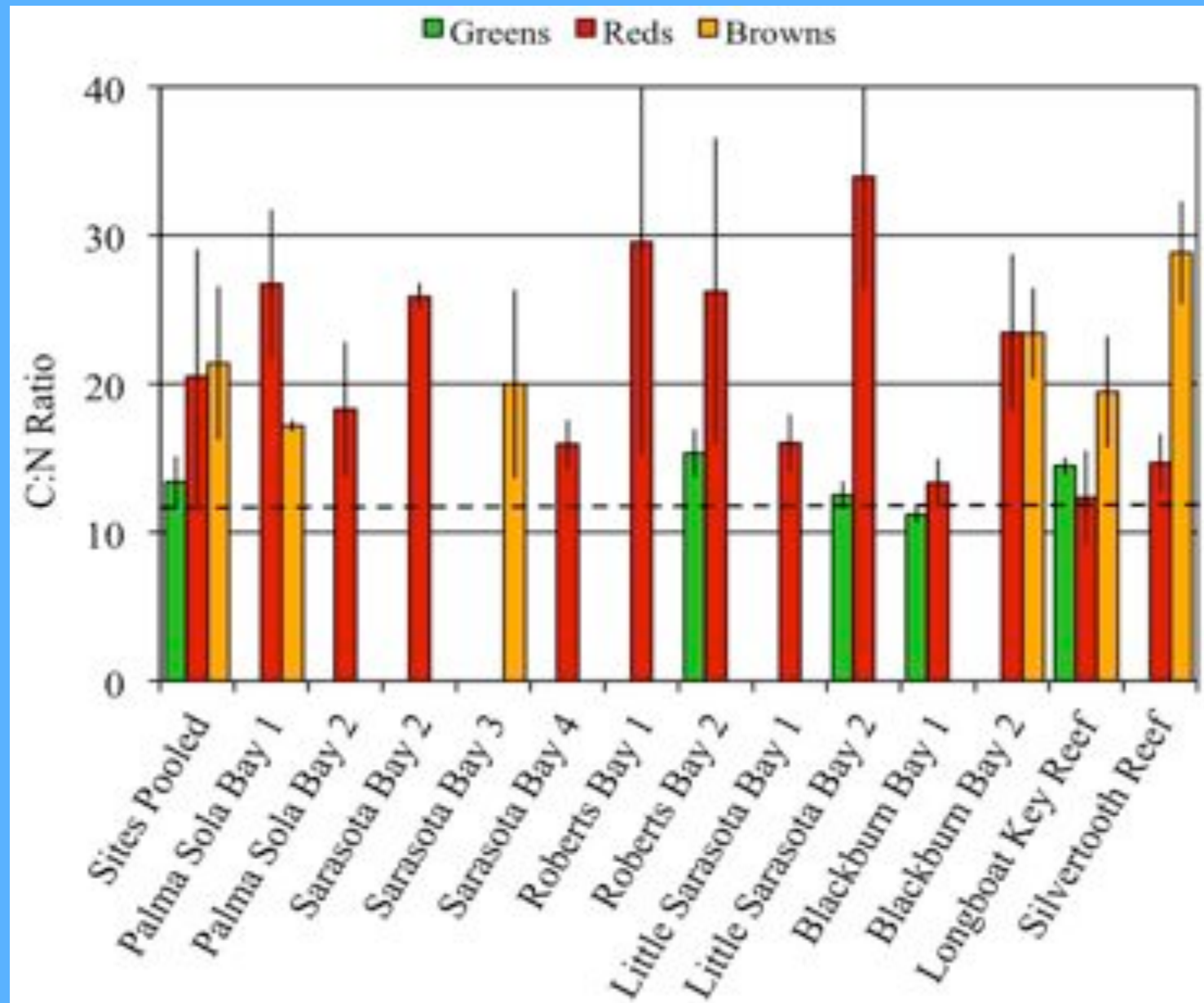


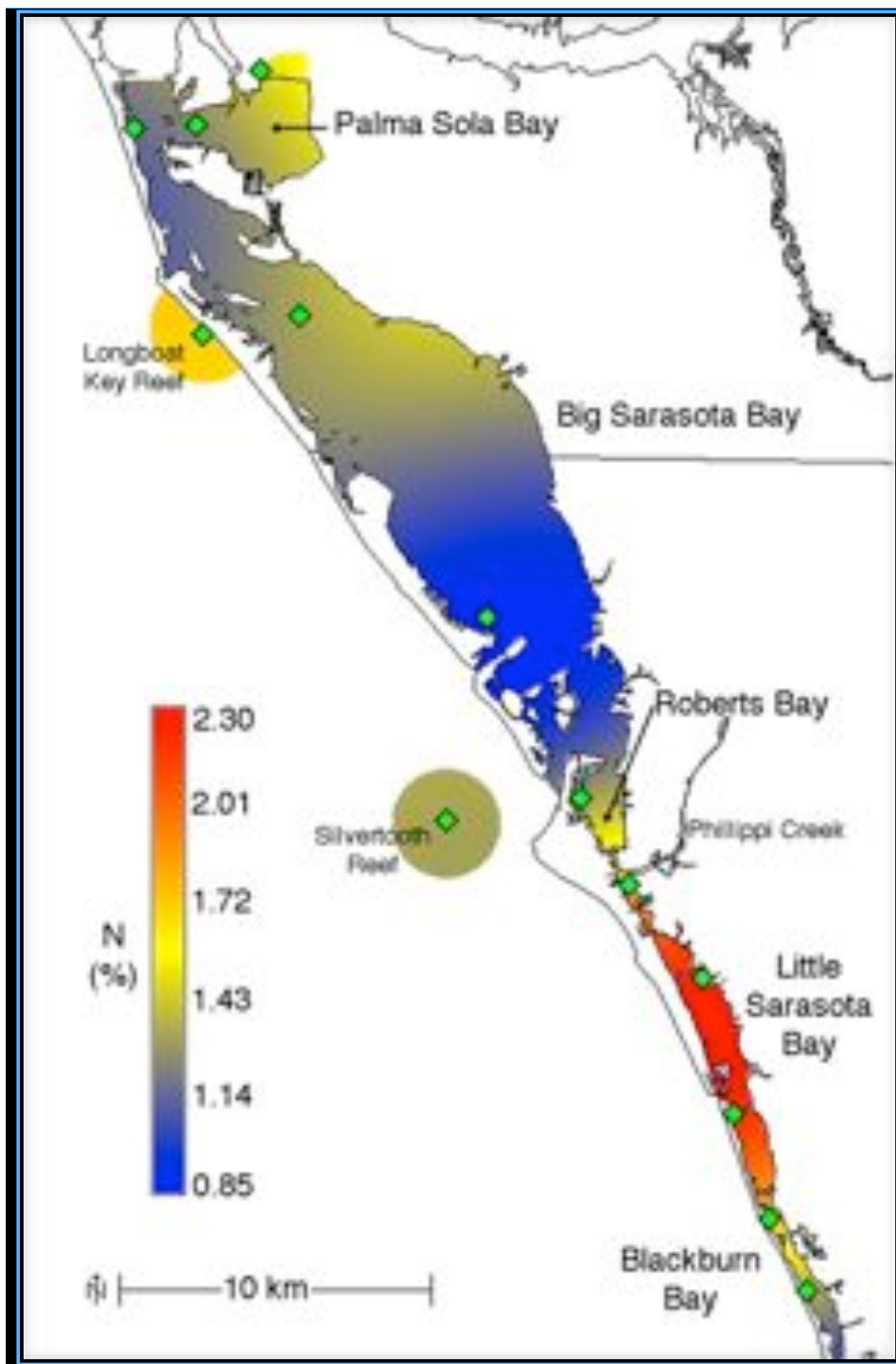
$C:N = 22.3 \pm 2.4$



$C:N = 9.9 \pm 0.2$

C:N by Phyla:2009

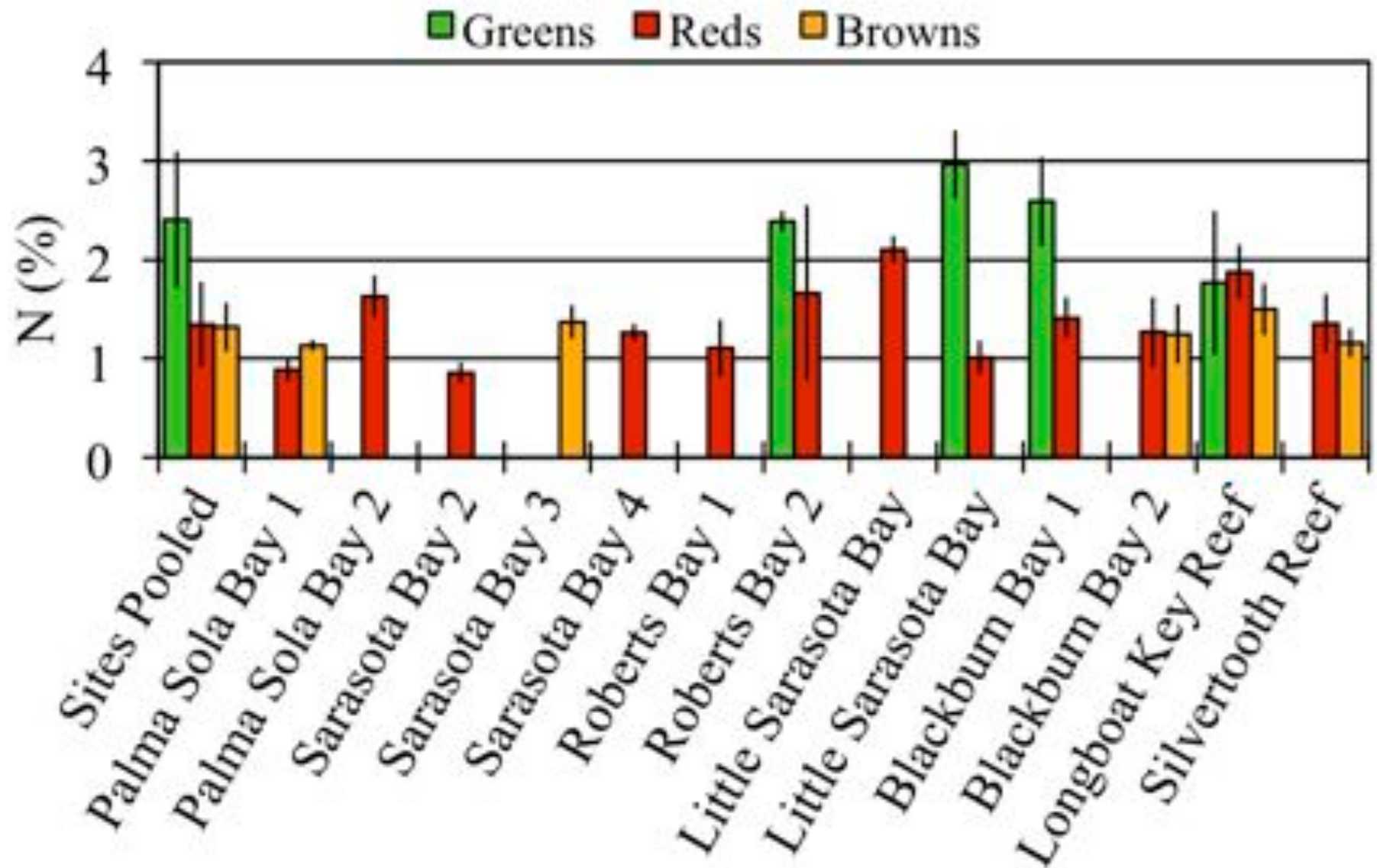




% N
July 2009



% N by Phyla:2009



Marine Biology 80, 161–170 (1984)

Interactions between light and temperature on the physiological ecology of *Gracilaria tikvahiae* (Gigartinales: Rhodophyta)

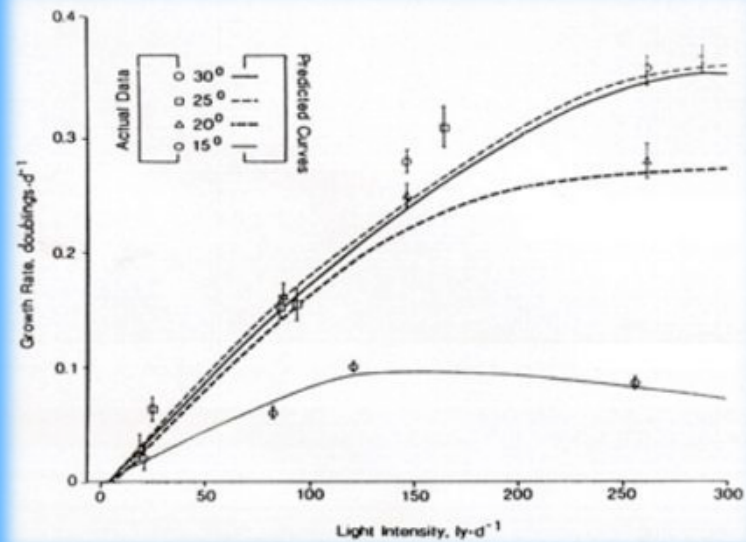
I. Growth, photosynthesis and respiration

B. E. Lapointe^{1, 2, *}, K. R. Tenore¹ and C. J. Dawes²

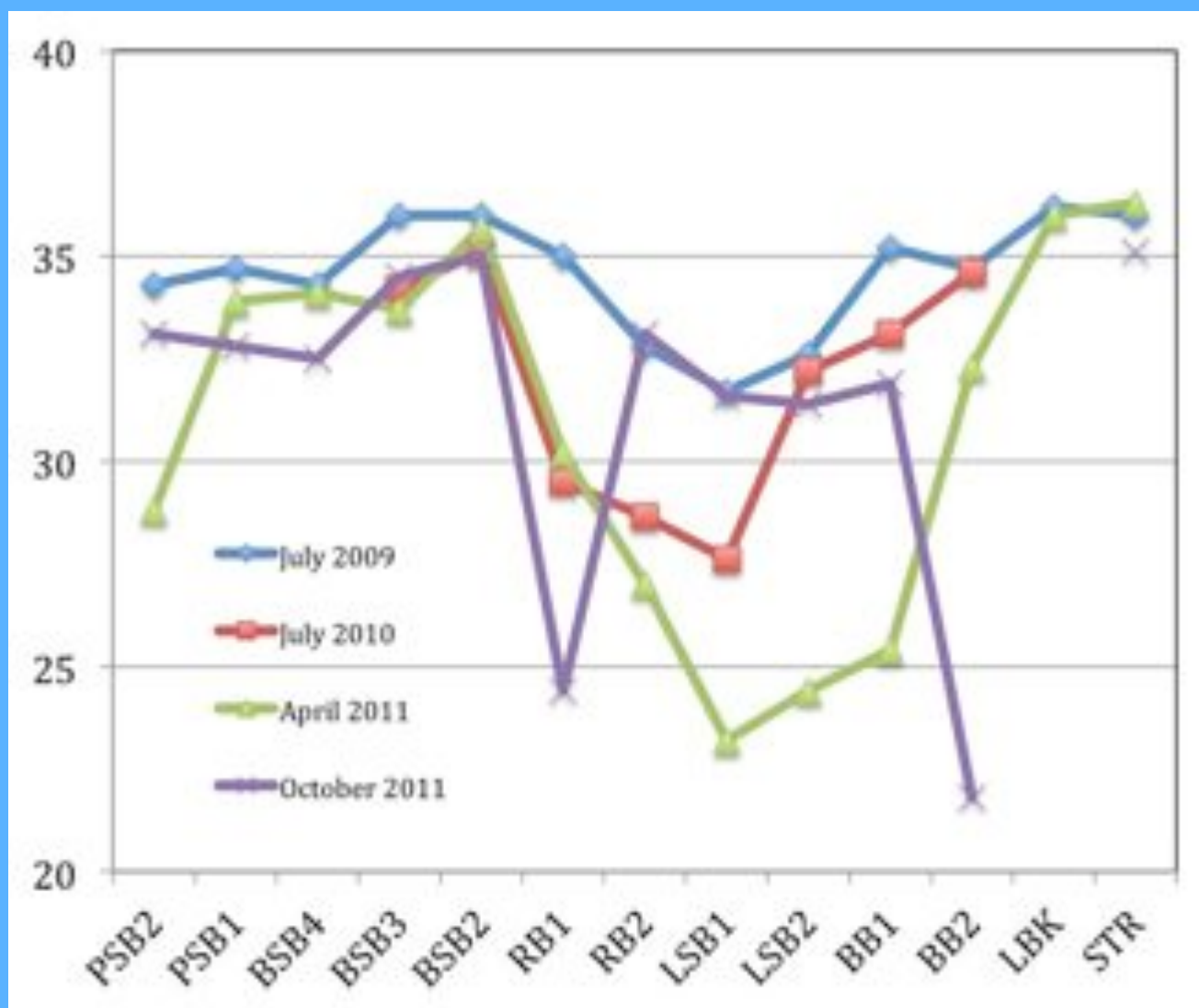
¹ Skidaway Institute of Oceanography; P.O. Box 13687, Savannah, Georgia 31406, USA

² Biology Department, University of South Florida; Tampa, Florida 33620, USA

**Marine
Biology**
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Increase in $\delta^{15}\text{N}$ and Decrease in C:N Ratio Through Study Correlates with Decreasing Salinity



Average salinities $\pm$ SD

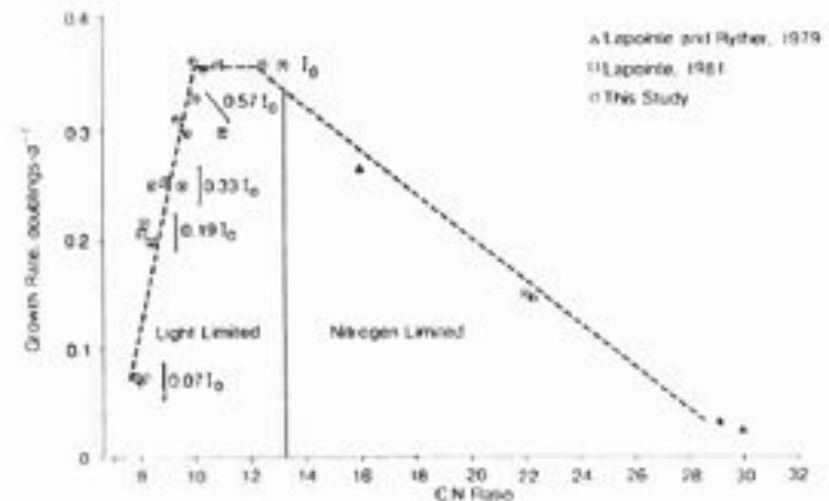
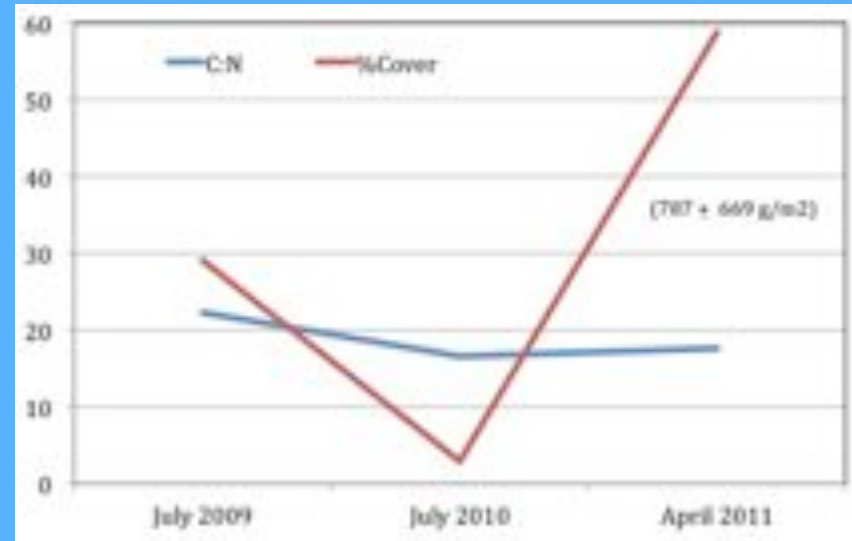
July 2009: 34.3 ± 1.7

July 2010: 31.9 ± 2.9

April 2011: 30.7 ± 4.6

October 2011: 33.0 ± 2.5

Low C:N Ratios Support Blooms of *Gracilaria*: Palma Sola Bay October 2010



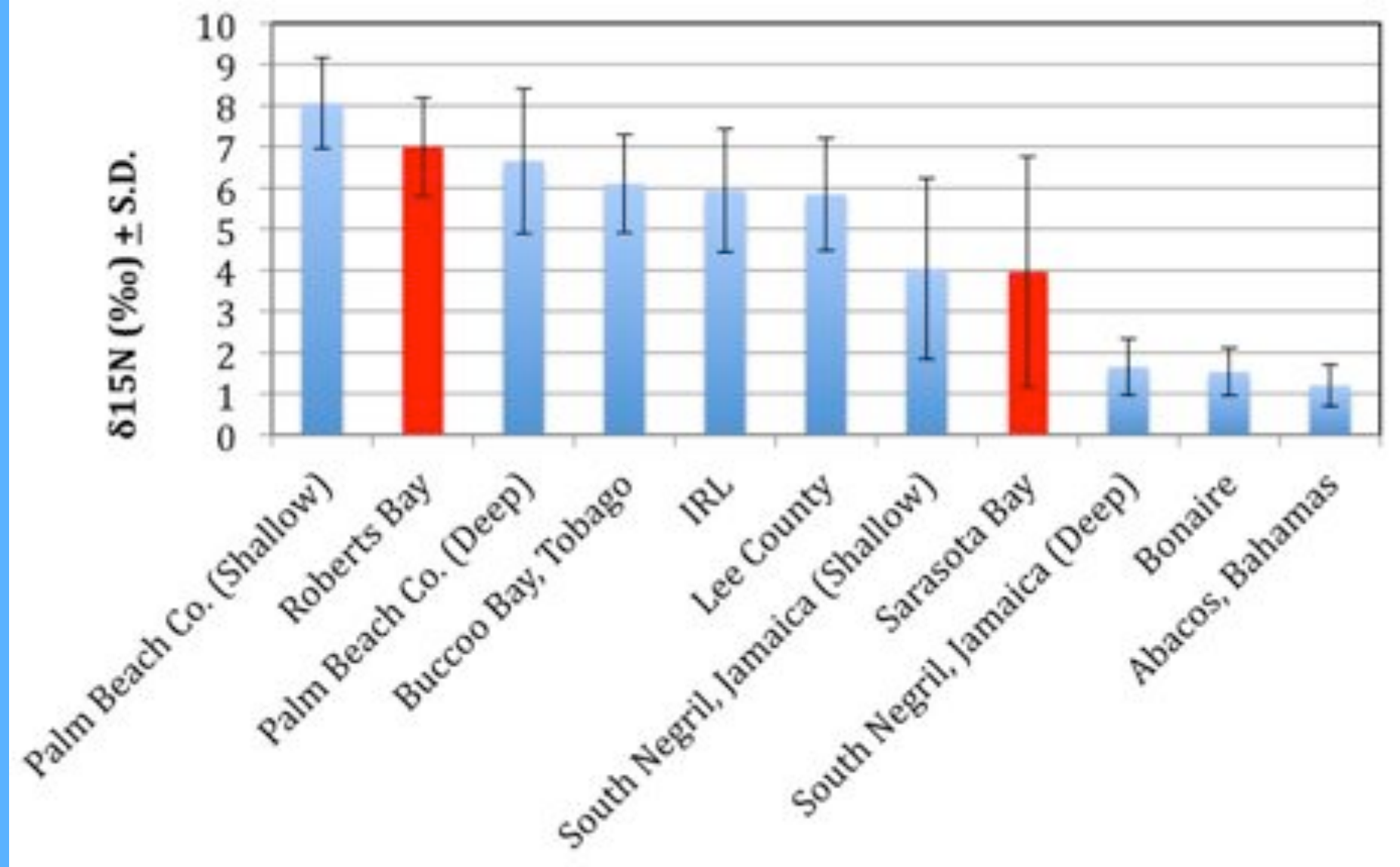
Lapointe and Duke 1984

Low C:N Supports Blooms of *Ulva*: Big Sarasota Bay Feb - April 2011



$\delta^{15}\text{N}$
 $+ 19.2 \pm 0.2 \text{ o/oo} !$

Comparative Wastewater Impacts: $\delta^{15}\text{N}$



Summary

- $\delta^{15}\text{N}$ of Sarasota Bay macroalgae provided a useful tool for assessing source(s) of N inputs and “health” of bay segments
- Increases in $\delta^{15}\text{N}$ through study correlated with decreased salinity and increased rainfall (?)
- Increases in $\delta^{15}\text{N}$ through study correlated with decreased C:N ratio and development of localized blooms, e.g. *Gracilaria*, *Ulva*
- Results illustrate the importance of N-loading from stormwater runoff (septic tanks ?) to initiation of high biomass macroalgal blooms, such as those that occurred following the hurricanes of 2004-2005
- These data can be used to develop basin-specific models of eutrophication for Sarasota Bay, with sensitivity to climate-change

Acknowledgements

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