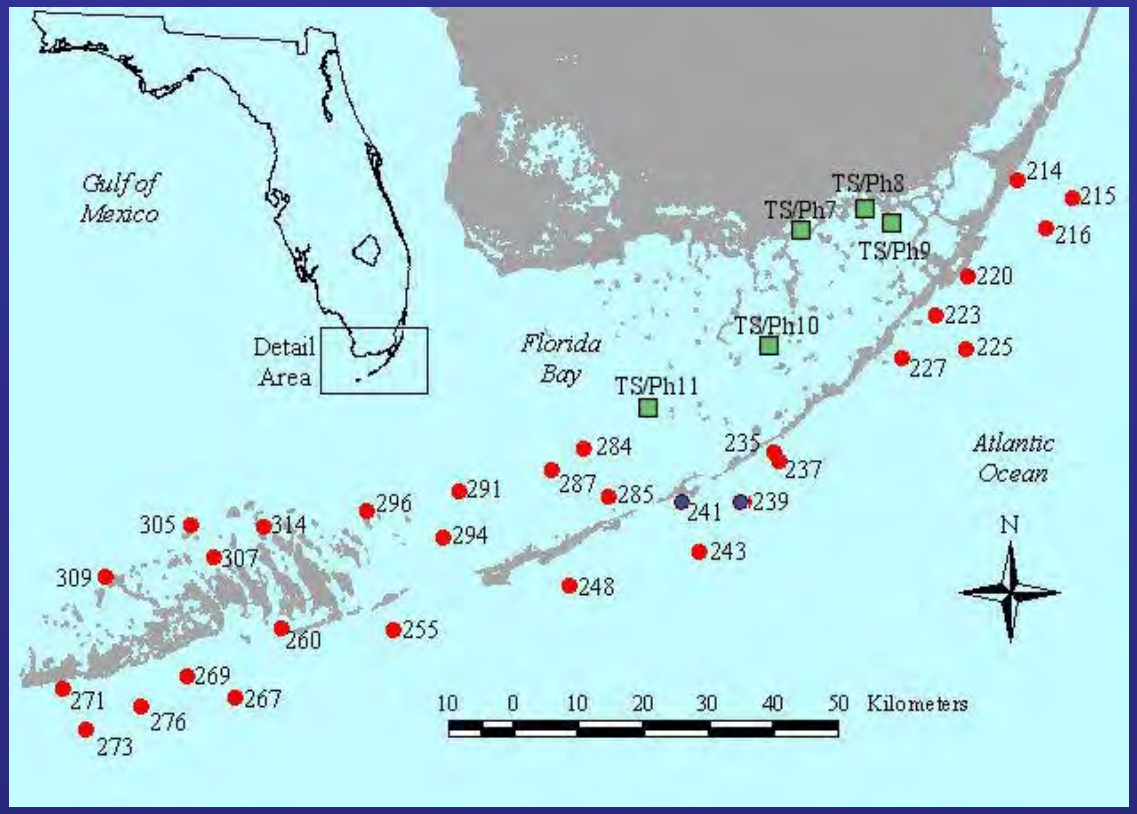
Long-term observations and experiments in seagrass beds of Florida Bay

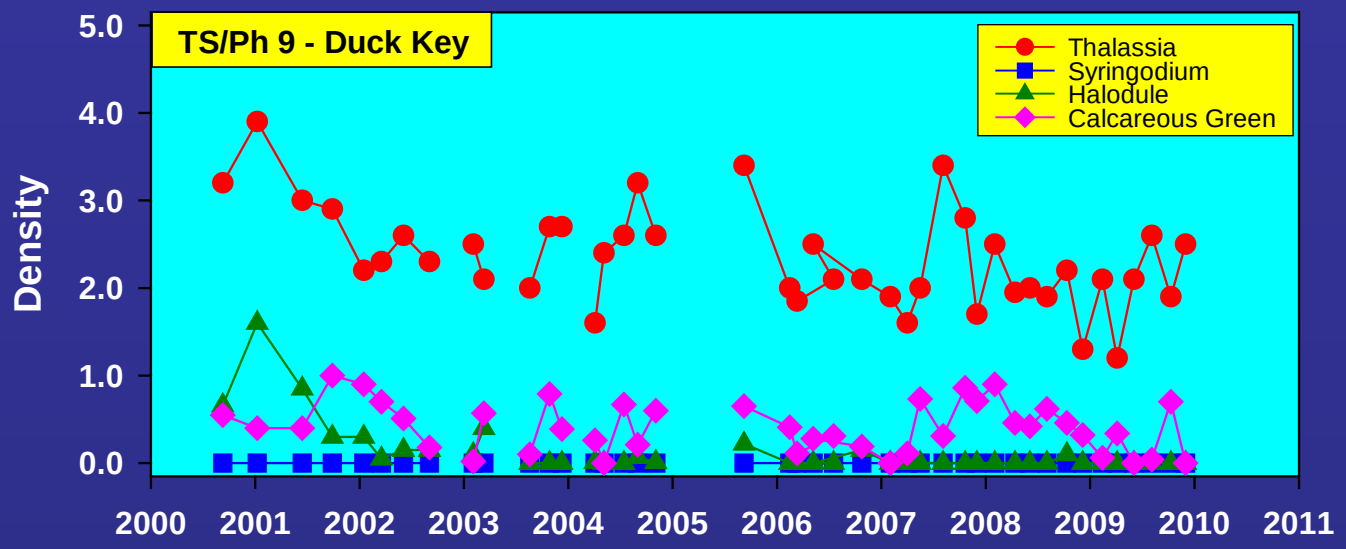
ENP Seagrass workshop, Homestead, March 29, 2010

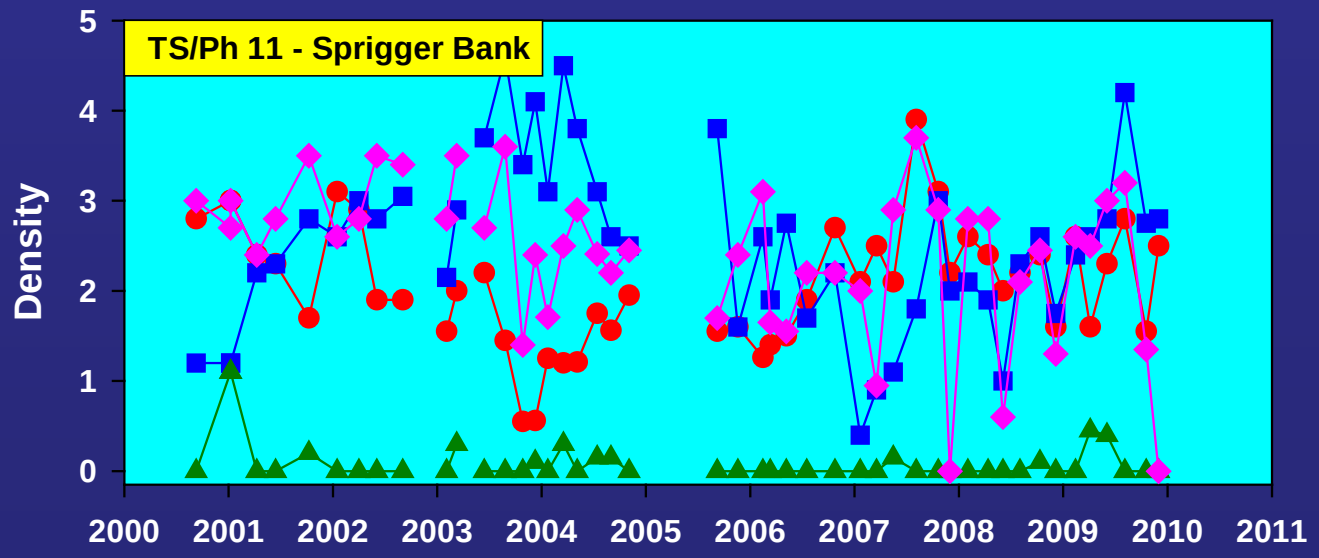


Beginning in 2000, bimonthly measures of:

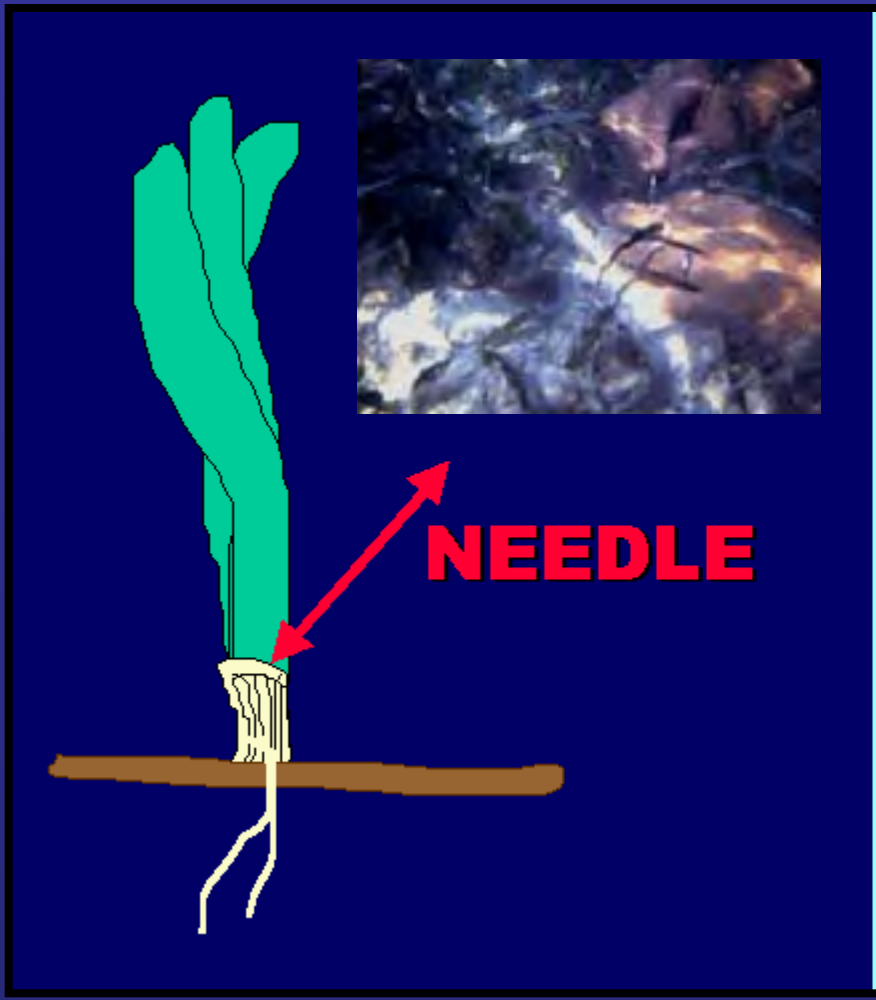
- **Seagrass community species composition**
- **Elemental and stable isotopic content of seagrasses**
- **Primary productivity of *Thalassia testudinum***

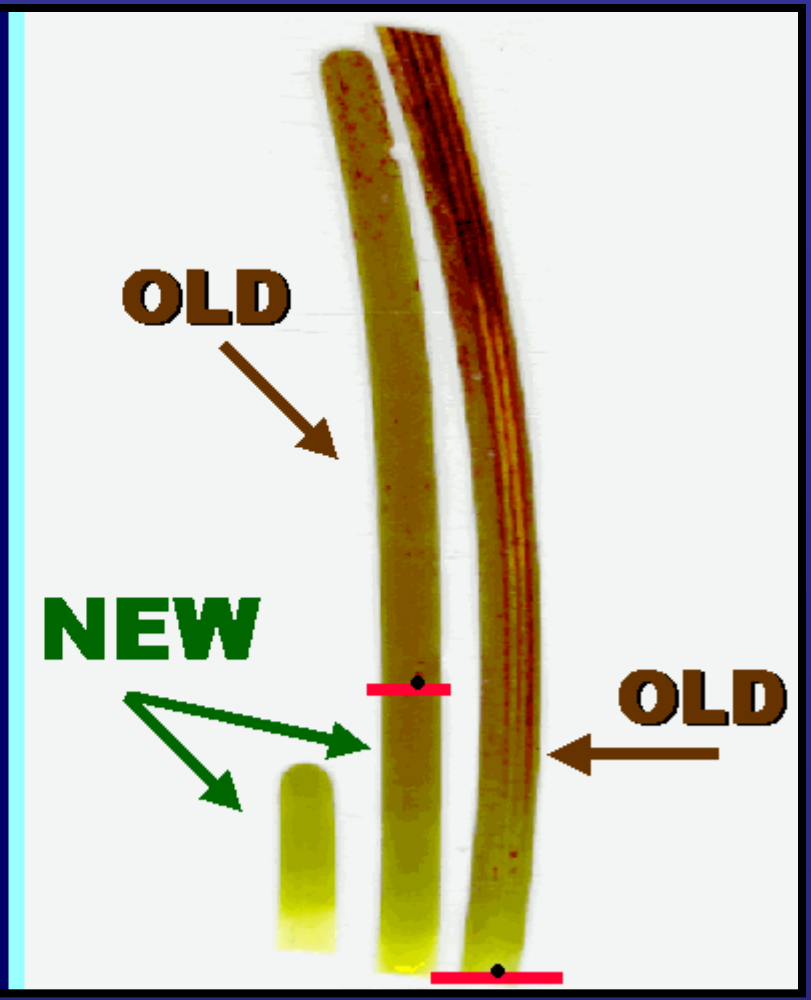
For data: www.fiu.edu/~seagrass

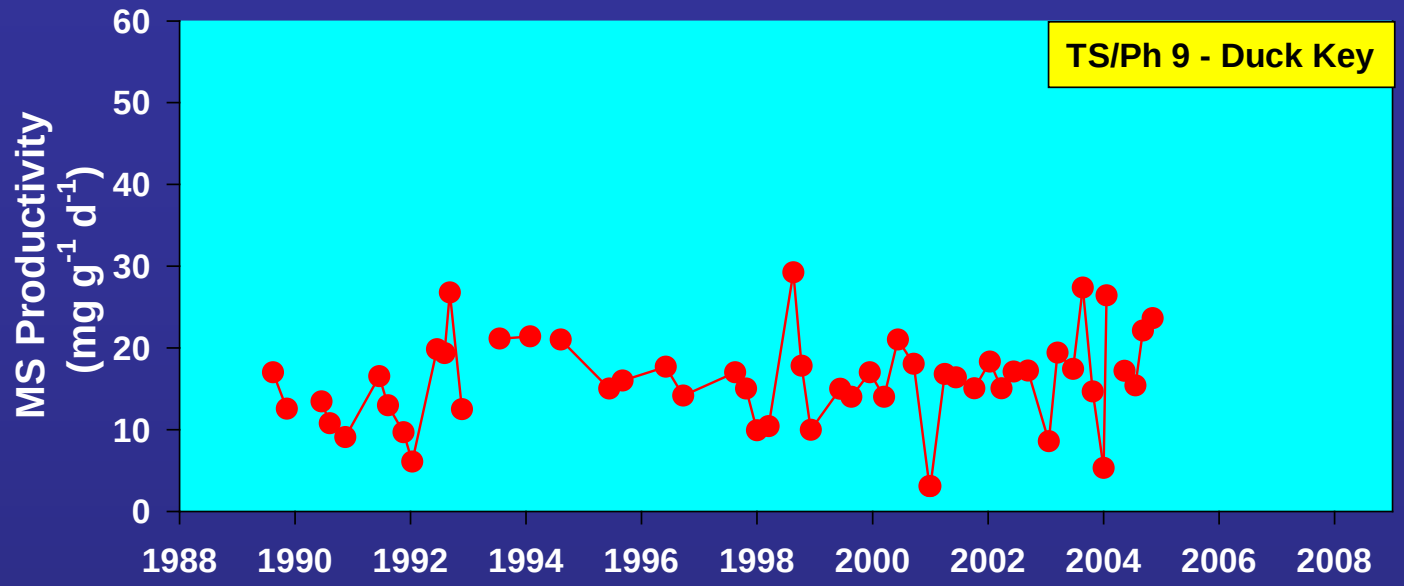

TS/Ph 9 - Duck Key
Thalassia
Syringodium
Halodule
Calcareous Green
Density
5.0
4.0
3.0
2.0
1.0
0.0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011

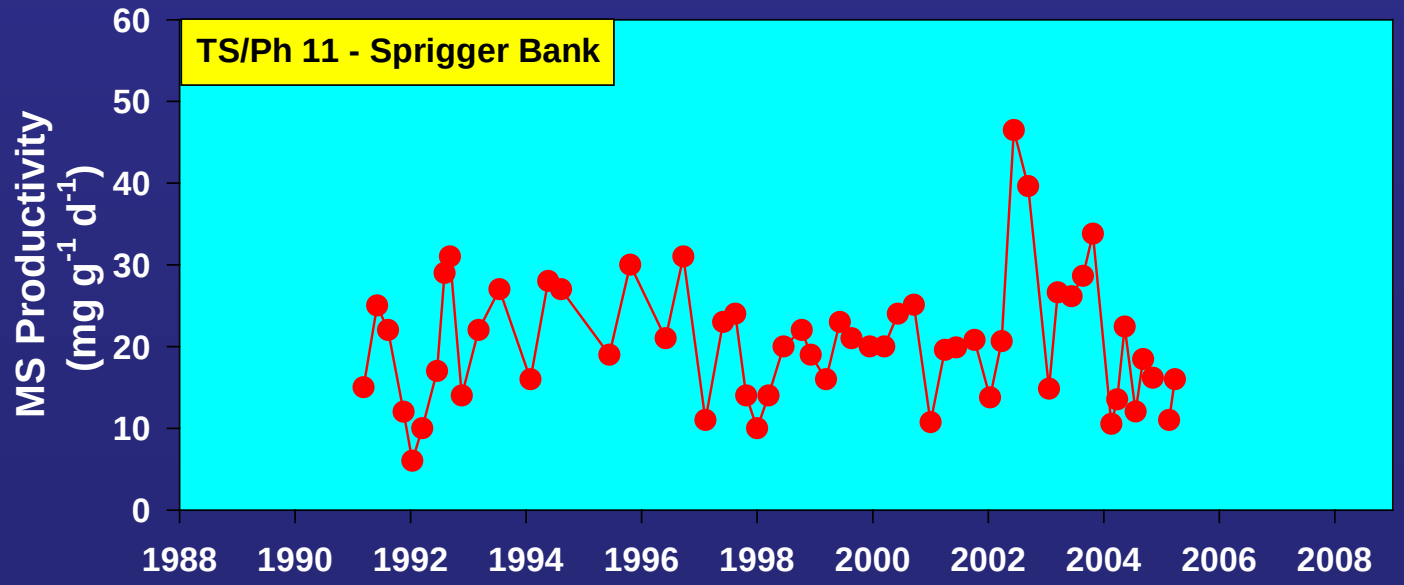

TS/Ph 11 - Sprigger Bank
Density
5
4
3
2
1
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011

Thalassia leaf productivity

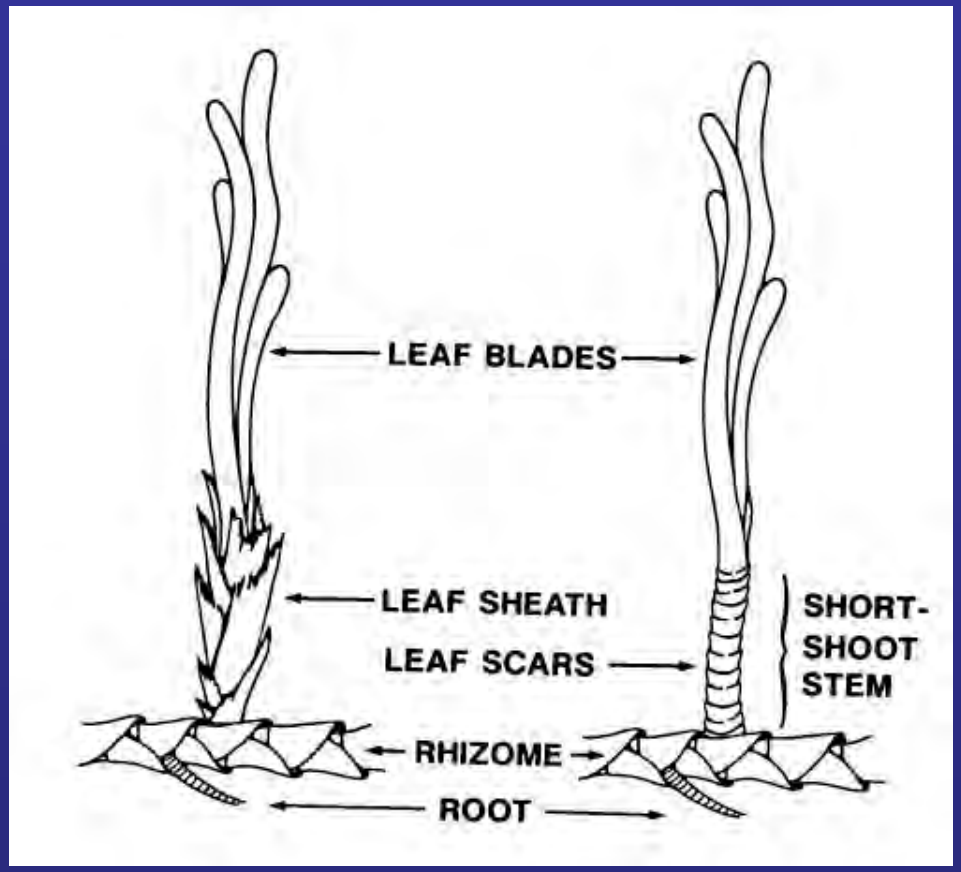




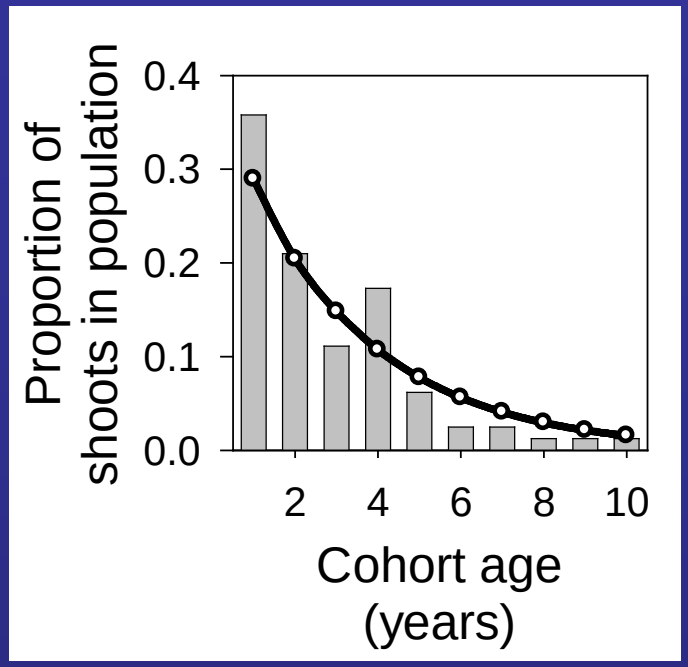

TS/Ph 9 - Duck Key
MS Productivity
(mg g-1 d-1)
0
10
20
30
40
50
60
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008


TS/Ph 11 - Sprigger Bank
MS Productivity
(mg g-1 d-1)
0
10
20
30
40
50
60
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008

Thalassia belowground productivity

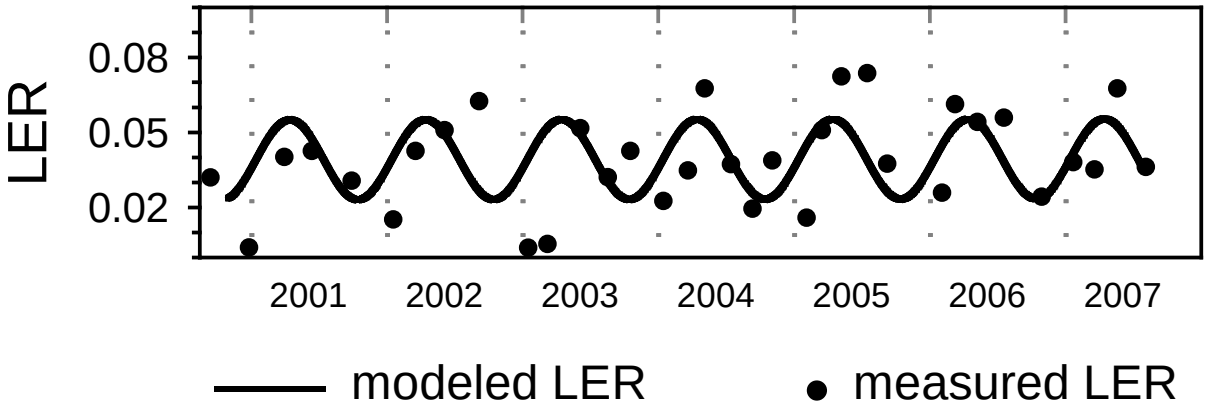


Determination of population structure



Belowground productivity estimated from recruitment rate, assuming equilibrium population structure.

Seasonality



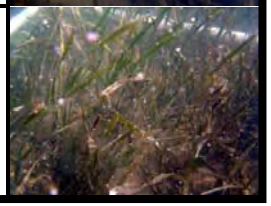
$\hat{Y} = 0.039 \pm 0.005$
$\alpha = 0.018 \pm 0.008$
$\phi = 4.99 \pm 0.38$
$r^2 = 0.44$

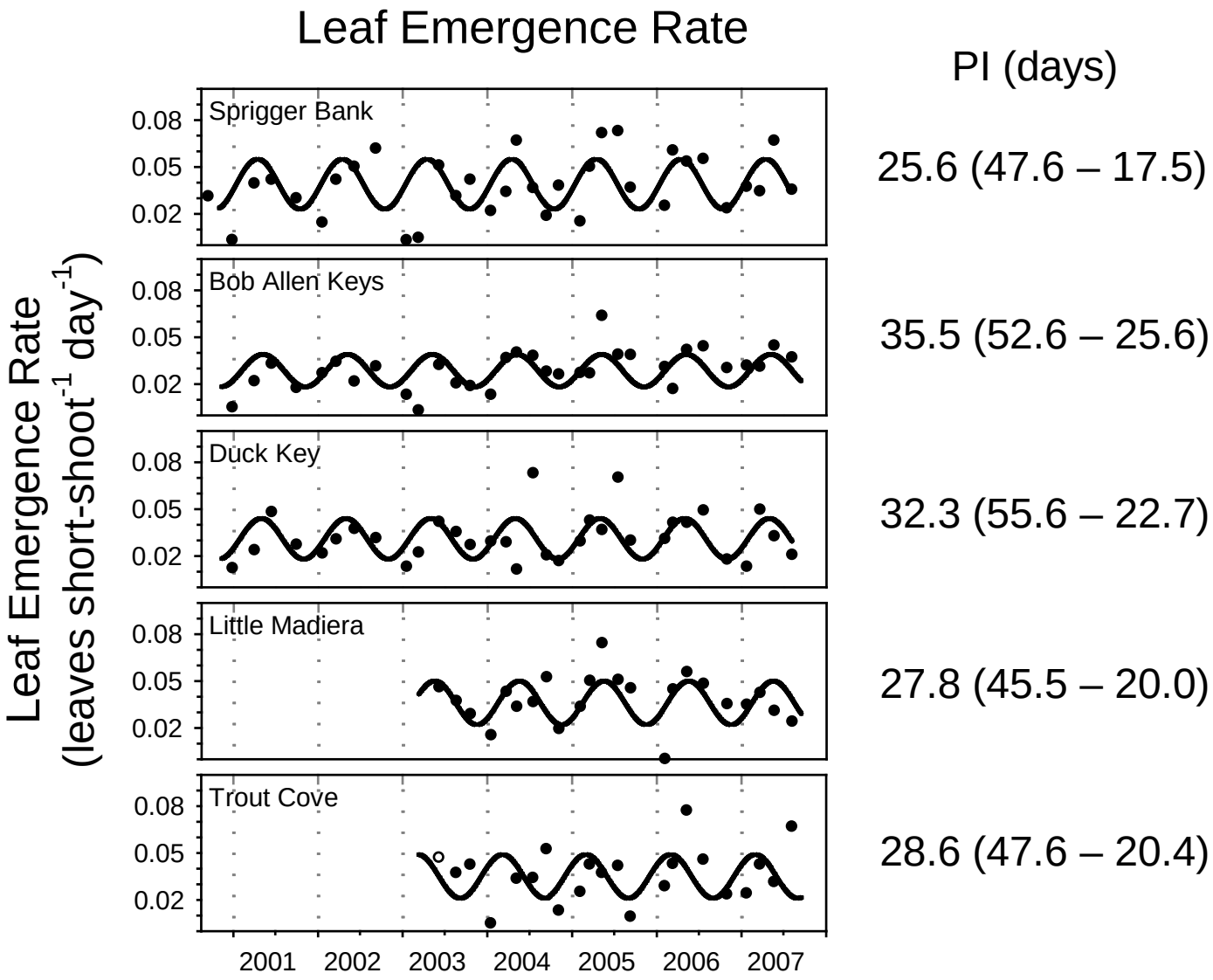
$$Y = \overline{Y} + \alpha\left[\sin\left(DOY + \phi\right)\right]$$

$\overline{Y}$ = mean of the time series
α = amplitude of the sine wave
ϕ = phase angle
DOY = day of year in radians

$\overline{Y}$ ± 95% confidence interval and α describe site means and seasonality

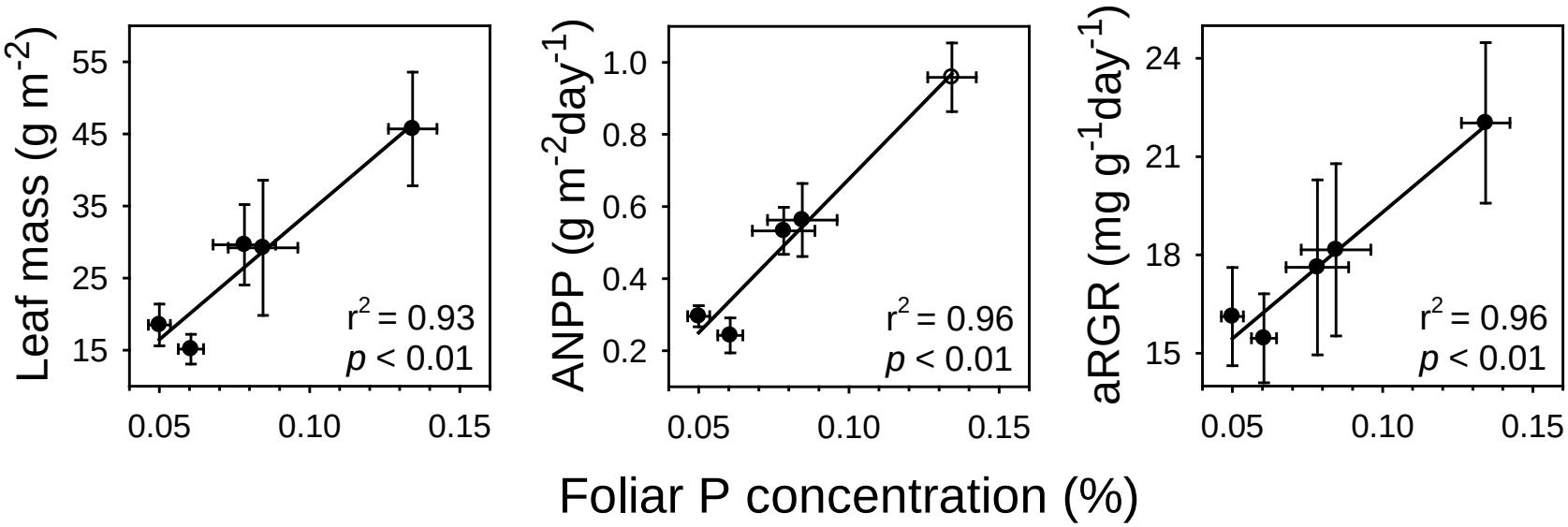
Thalassia characteristics by site

Site	Foliar P (%)	Foliar N (%)	Shoot density (m^{-2})	Dry mass (mg $ramet^{-1}$)				Total mass (g m^{-2})	P_s biomass ratio	
				Leaves	Ramet	Rhizome	Root			
Sprigger Bank	0.134	2.05	221	213	71.6	355	36.7	148	0.447	
Bob Allen Keys	0.061	2.53	295	54.1	62.1	227	18.4	104	0.167	
Duck Key	0.050	2.31	612	30.8	38.1	167	35.4	165	0.126	
Little Madeira	0.078	2.29	525	55.6	28.7	153	18.2	134	0.282	
Trout Cove	0.085	2.46	470	59.9	79.3	153	41.8	158	0.227	



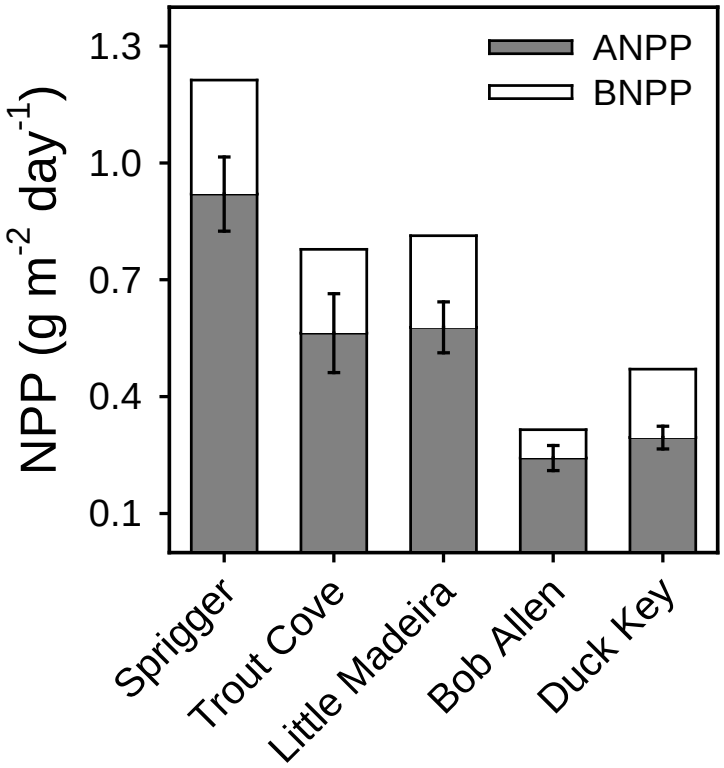
LER and seasonal amplitude are correlated with foliar P

Standing Crop and Aboveground Production vs. P

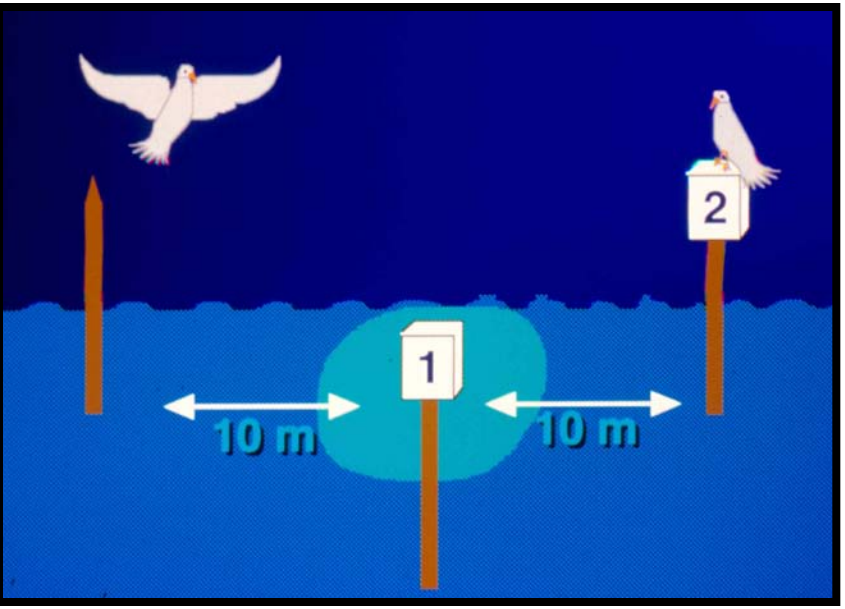


Leaf standing crop and productivity are correlated with foliar P

Aboveground and Belowground Productivity



Belowground productivity is 23% - 37% of aboveground productivity



Original Treatments - 1983

Discontinued: Five perches made unavailable to birds after 28 months

Chronic: Five new perches

Control: A sharp stick

simple blocked design

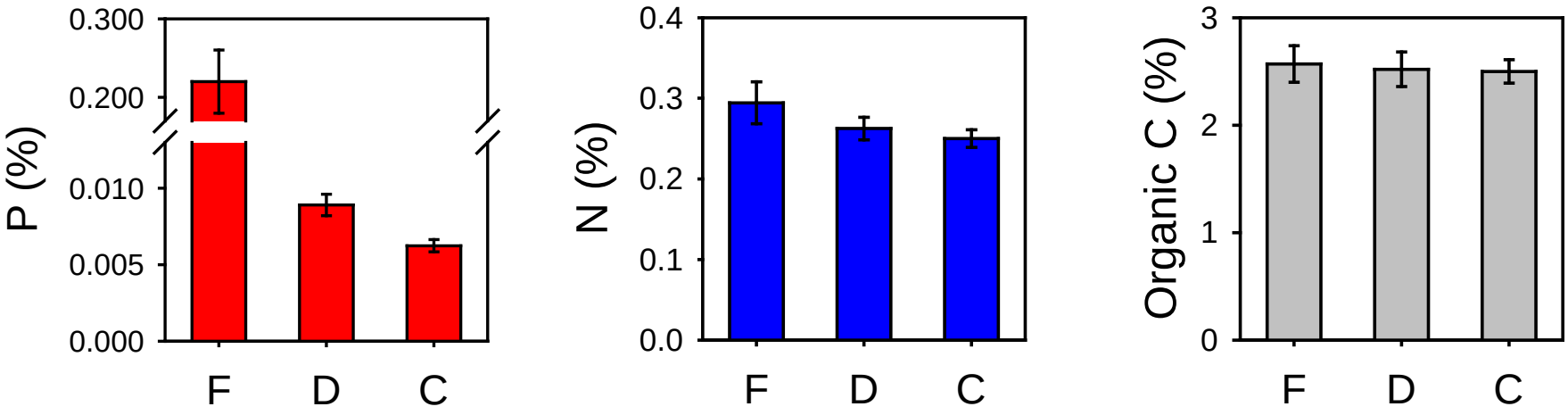
Hypotheses

Because of the affinity of P for carbonate it is likely that P remains elevated in the discontinued treatments.

Elevated P in a P-limited ecosystem, if available to plants, will alter structure and function.

Structure: species composition and biomass.
Function: gross production and respiration.

Sediment C, N, P concentration 0 – 5 cm



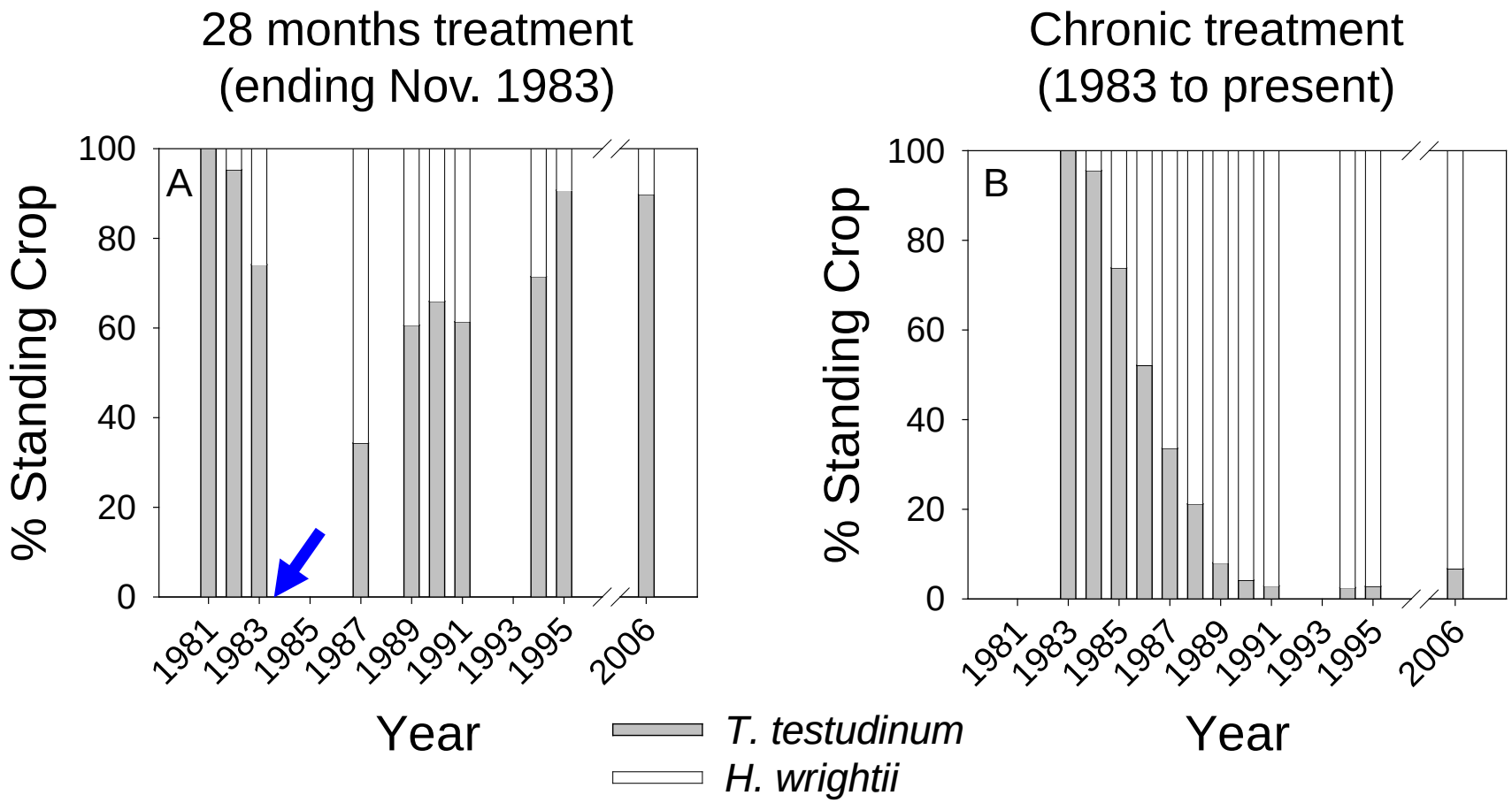
D has 44% more phosphorus than control

Nitrogen not different between D and control

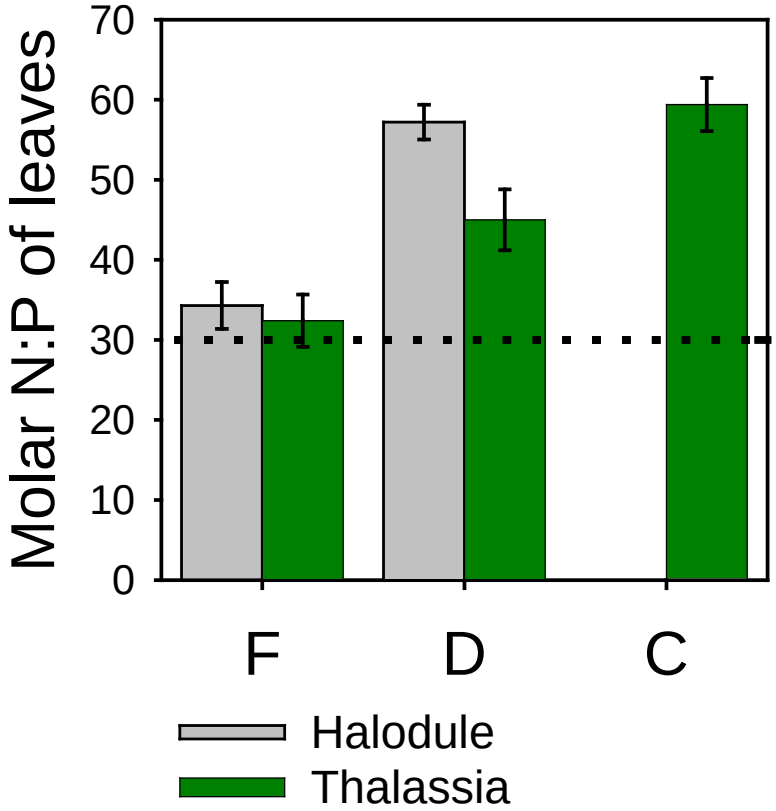
Sediment organic carbon not different between treatments

F = chronic fertilization; D = discontinued fertilization; C = Control

Changes in seagrass species composition



Release from phosphorus limitation

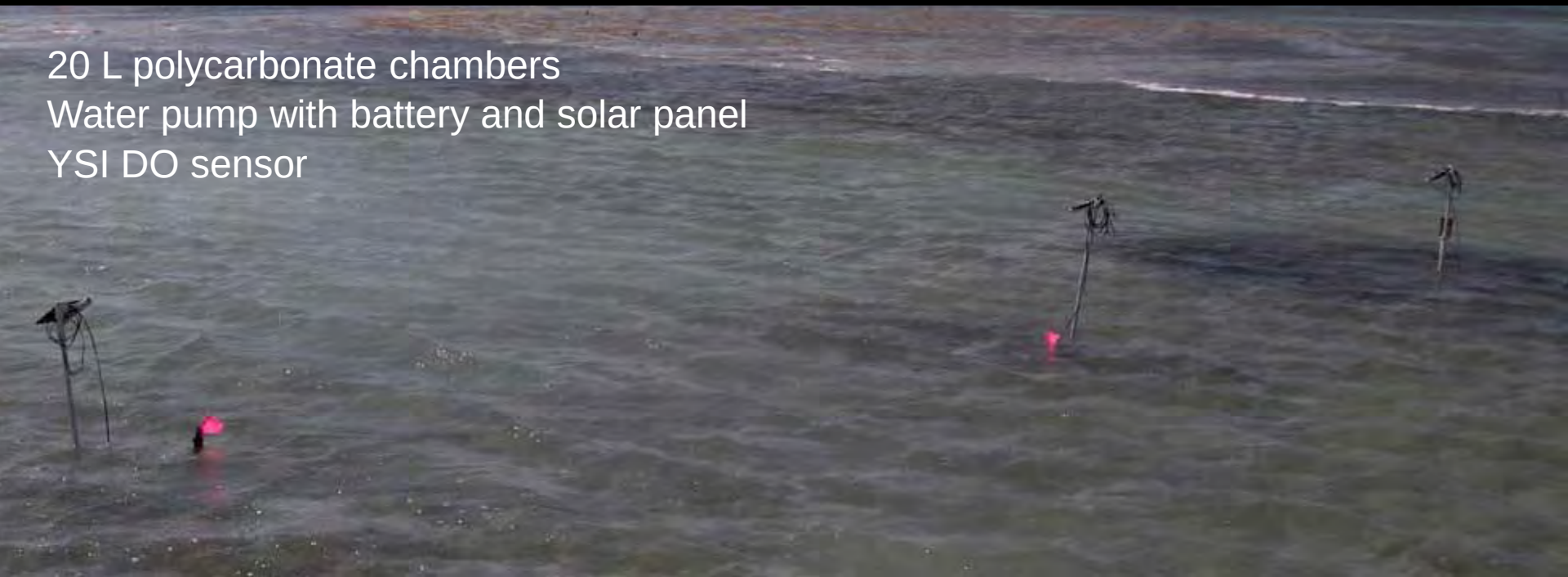


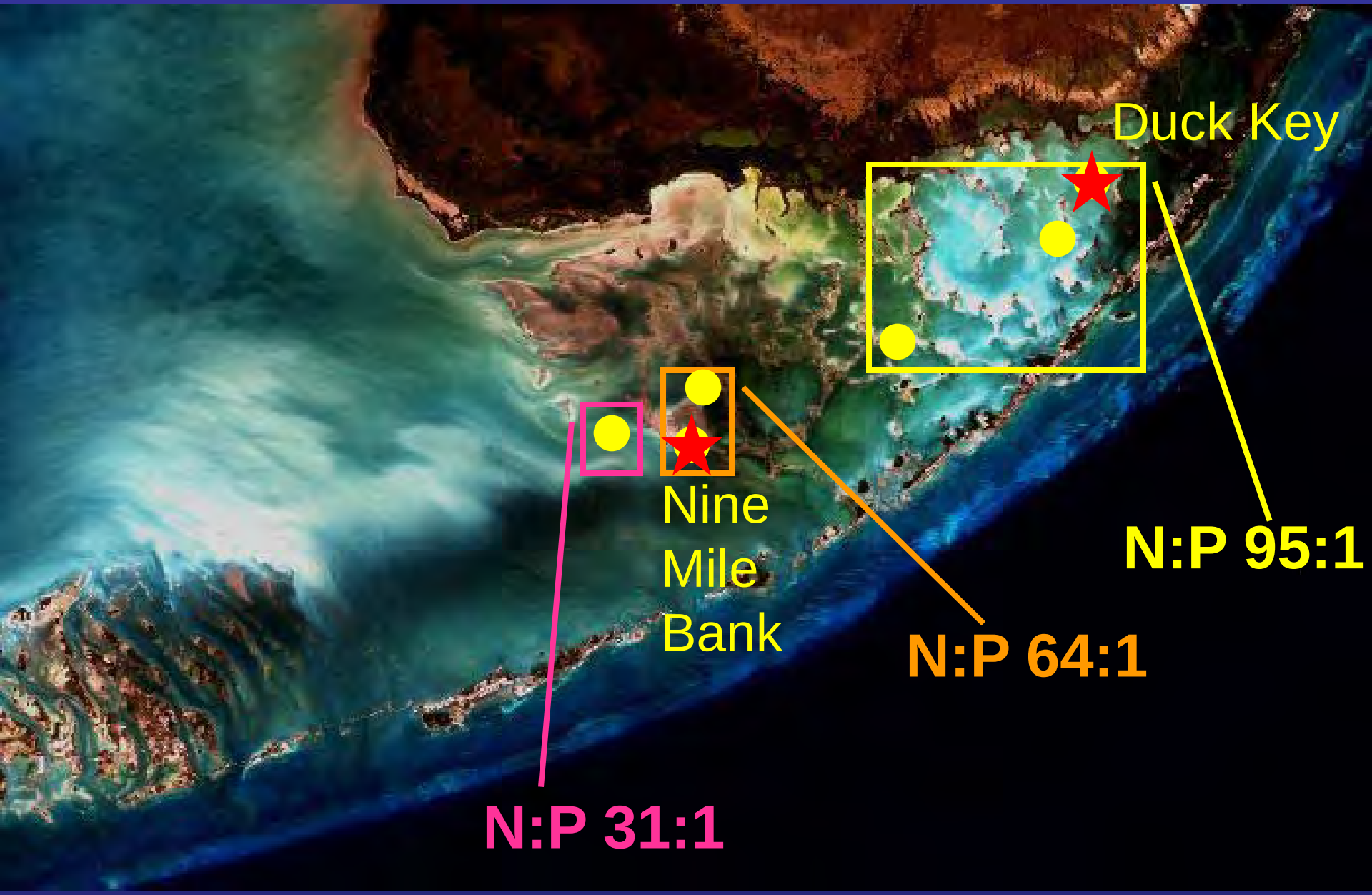
Reference = adjusted Redfield ratio for vascular macrophytes

F = chronic fertilization; D = discontinued fertilization; C = Control

Ecosystem Function
Dissolved O_2 production & Consumption

20 L polycarbonate chambers
Water pump with battery and solar panel
YSI DO sensor

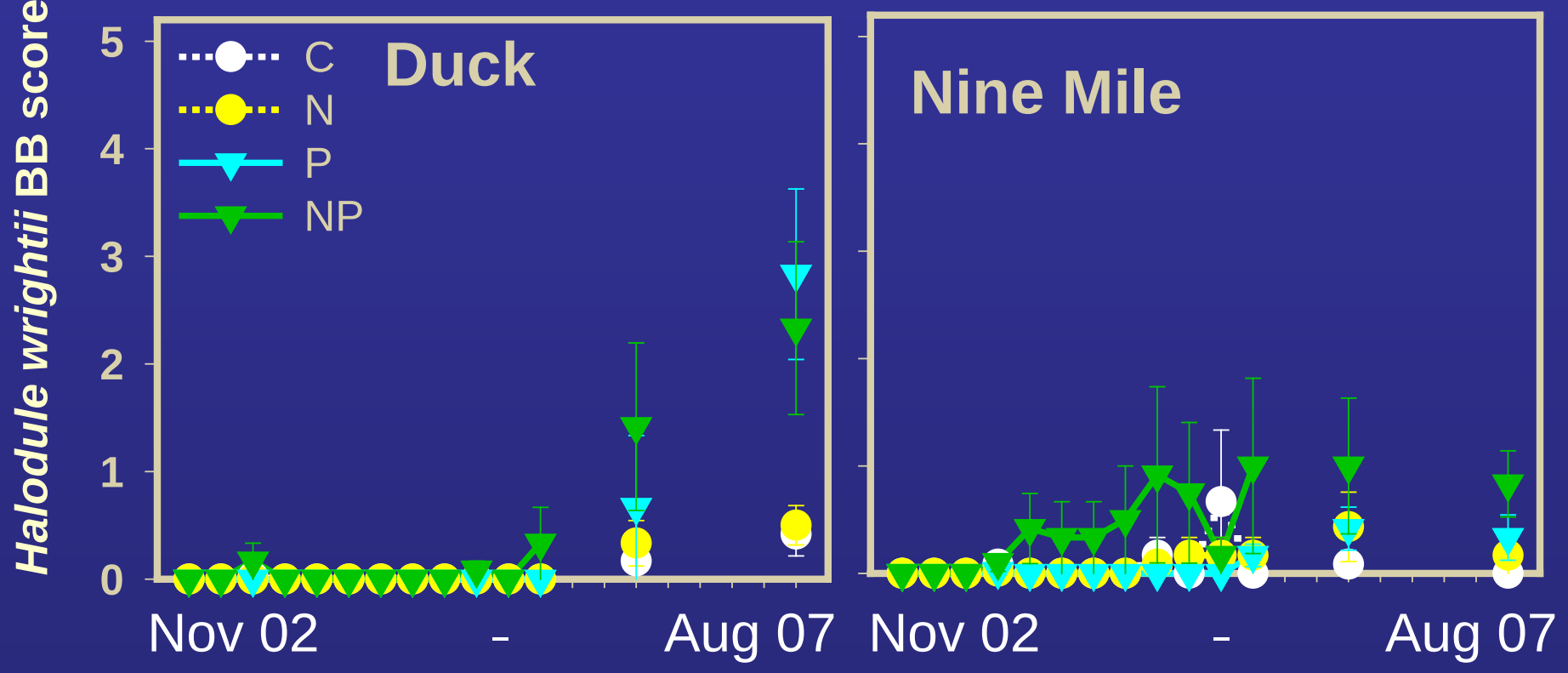



Duck Key
Nine
Mile
Bank
N:P 95:1
N:P 64:1
N:P 31:1

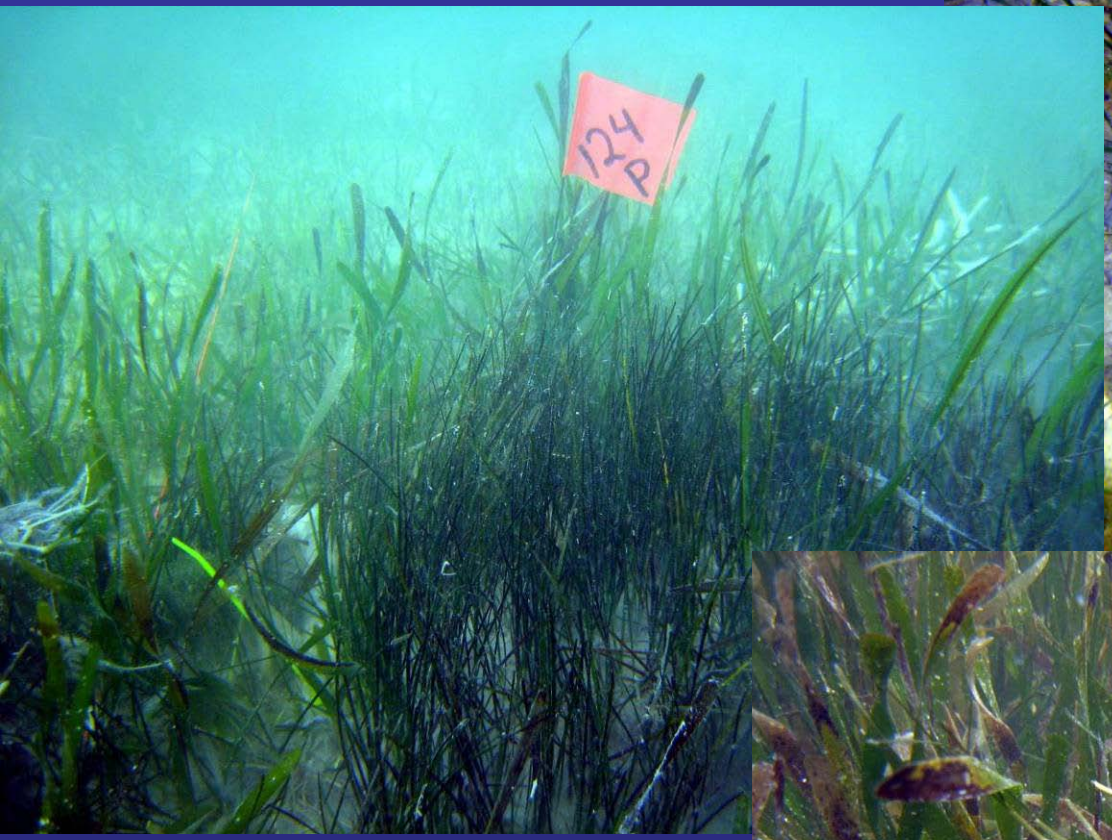
C	P	NP	C	N
N	C	N	NP	P
C	NP		P	N
N	P	NP	C	NP
NP	C	P	N	P

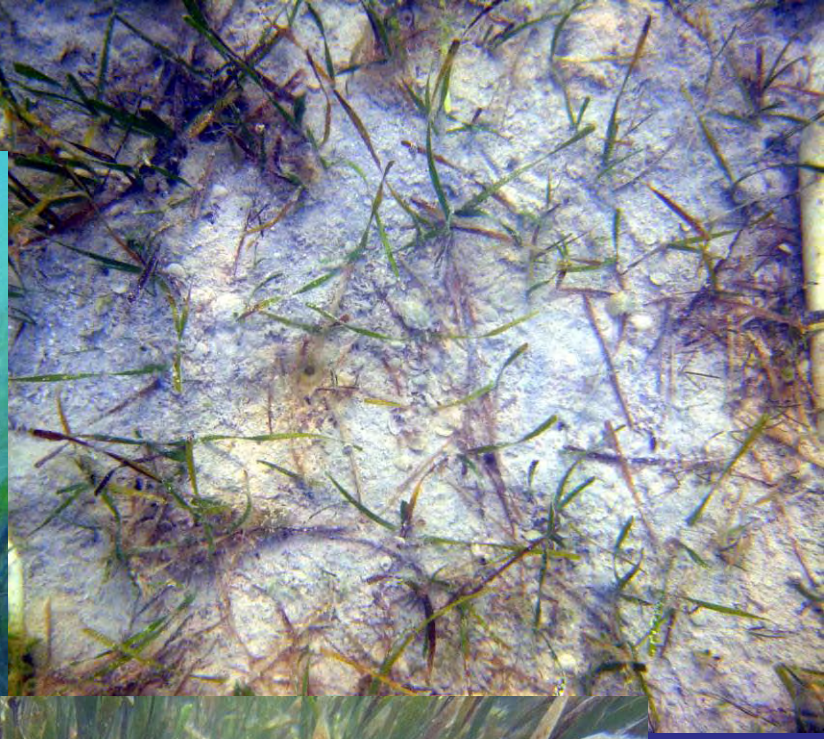
- 5 years
- Producer responses
- Consumer responses

Enrichment - *Halodule* colonization

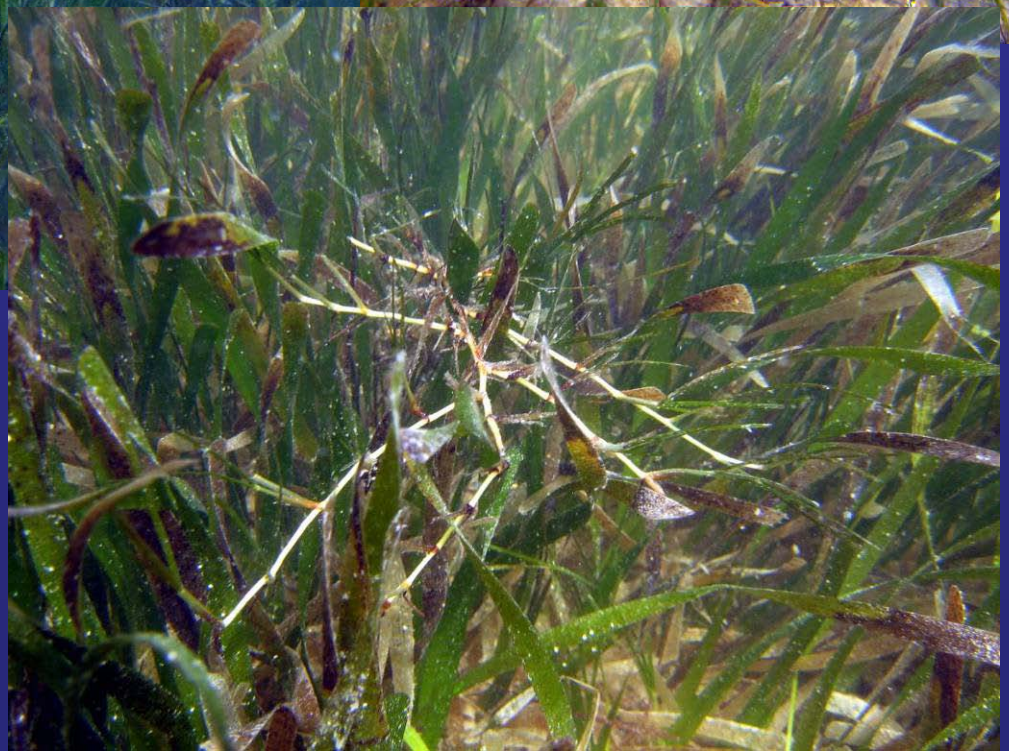


Duck Control



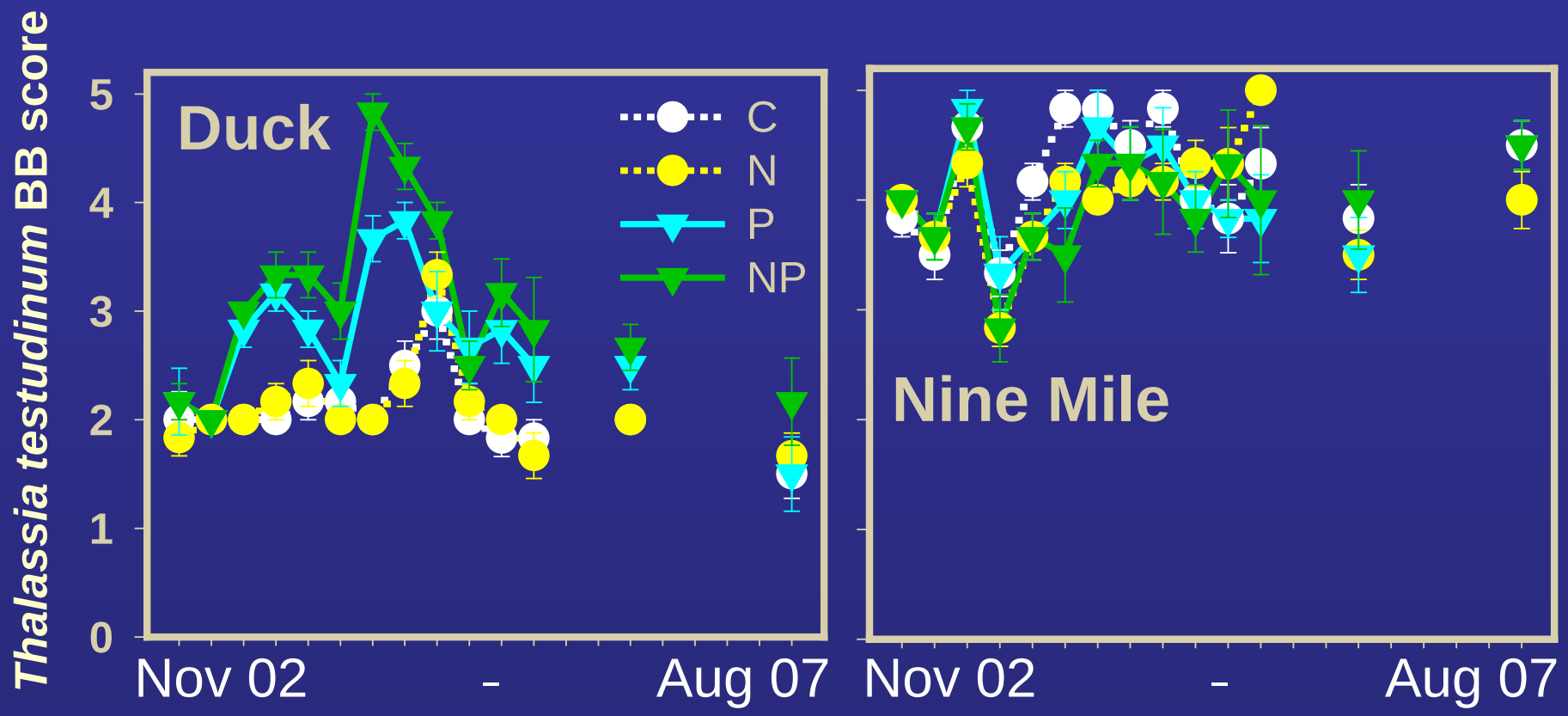


Duck +NP



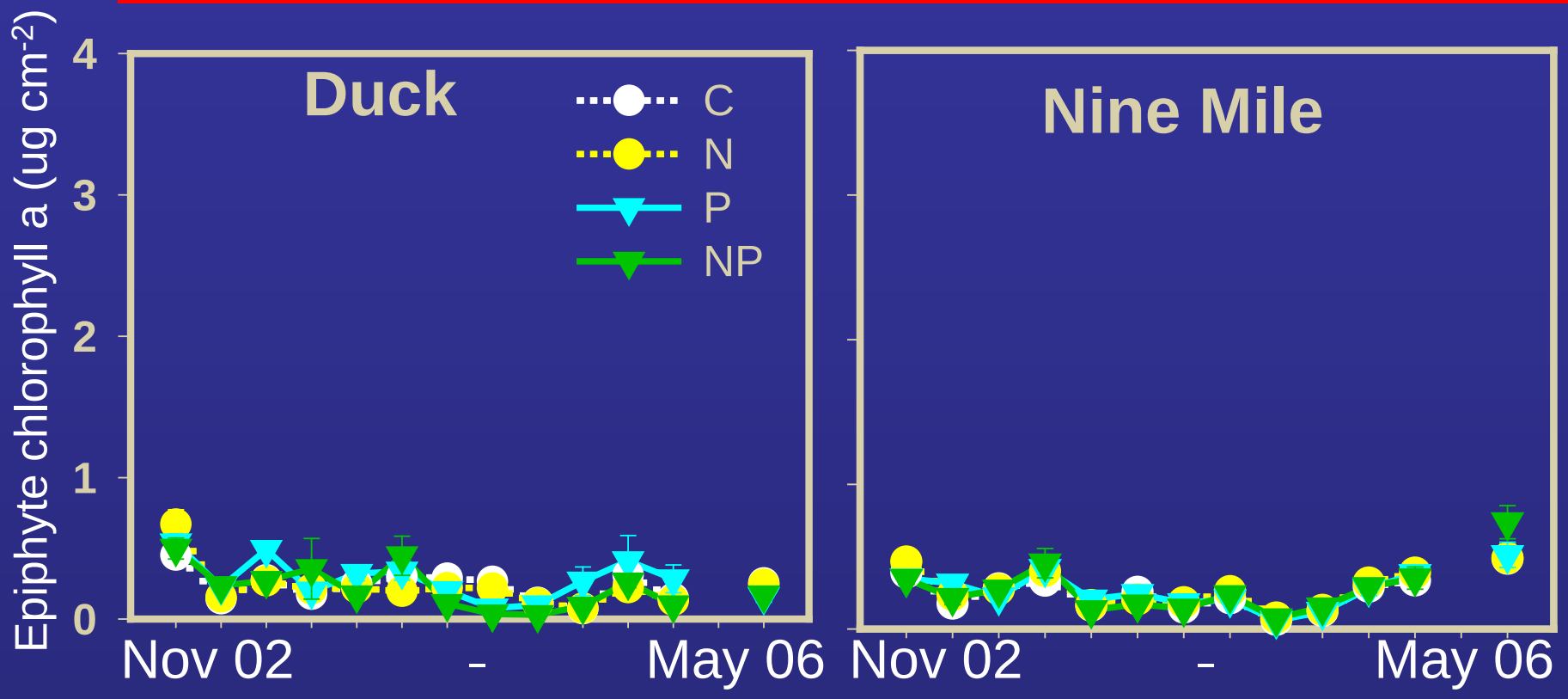
Nine Mile +NP

Enrichment – *Halodule* replaces *Thalassia**



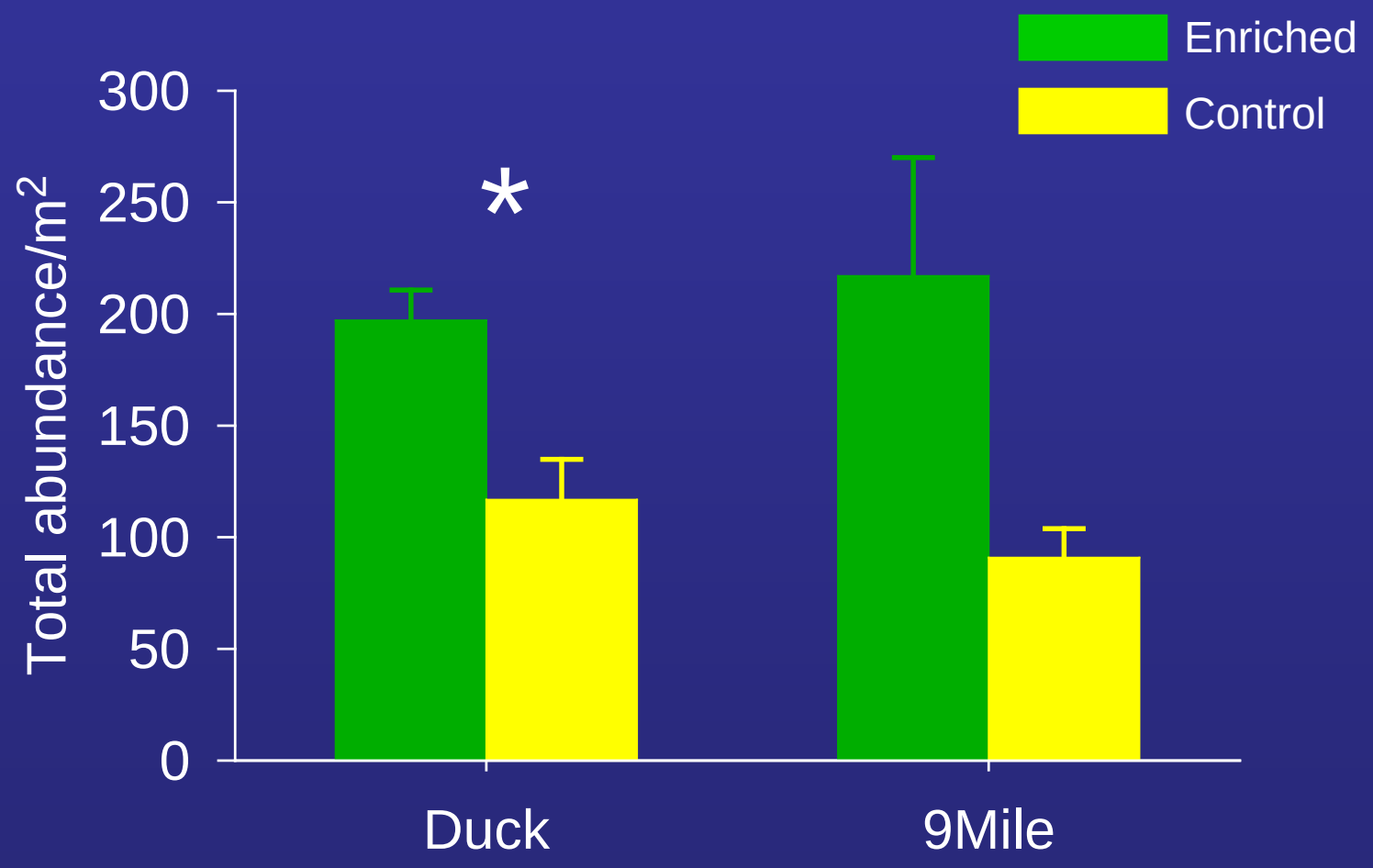
*Not yet reflected in decreased *Thalassia* biomass

No evidence of epiphytic or macroalgal overgrowth

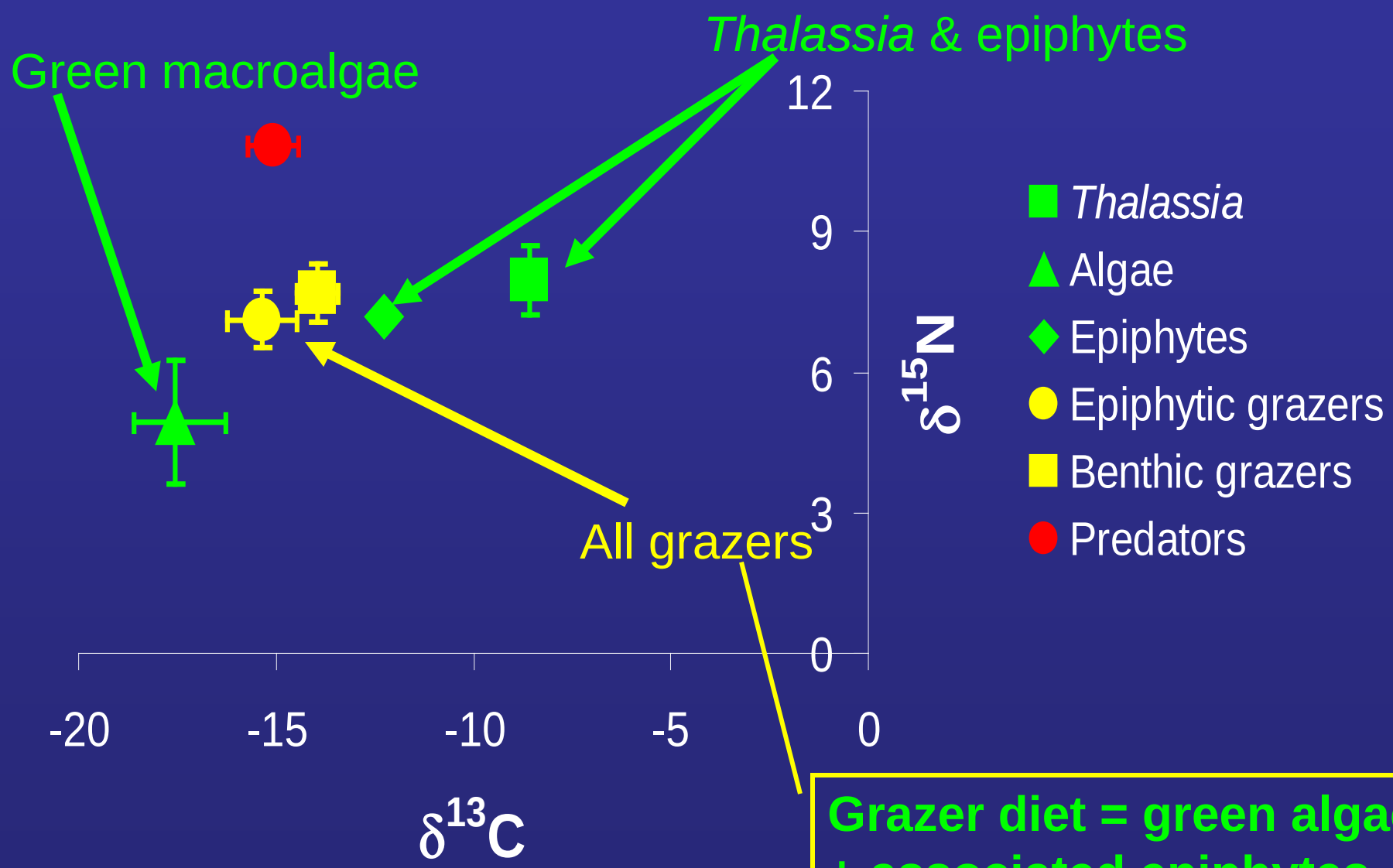


- Are grazers controlling algae?
- Are macroalgae too seasonal to overgrow seagrasses in this area?

Enrichment – Increased grazing crustacean density

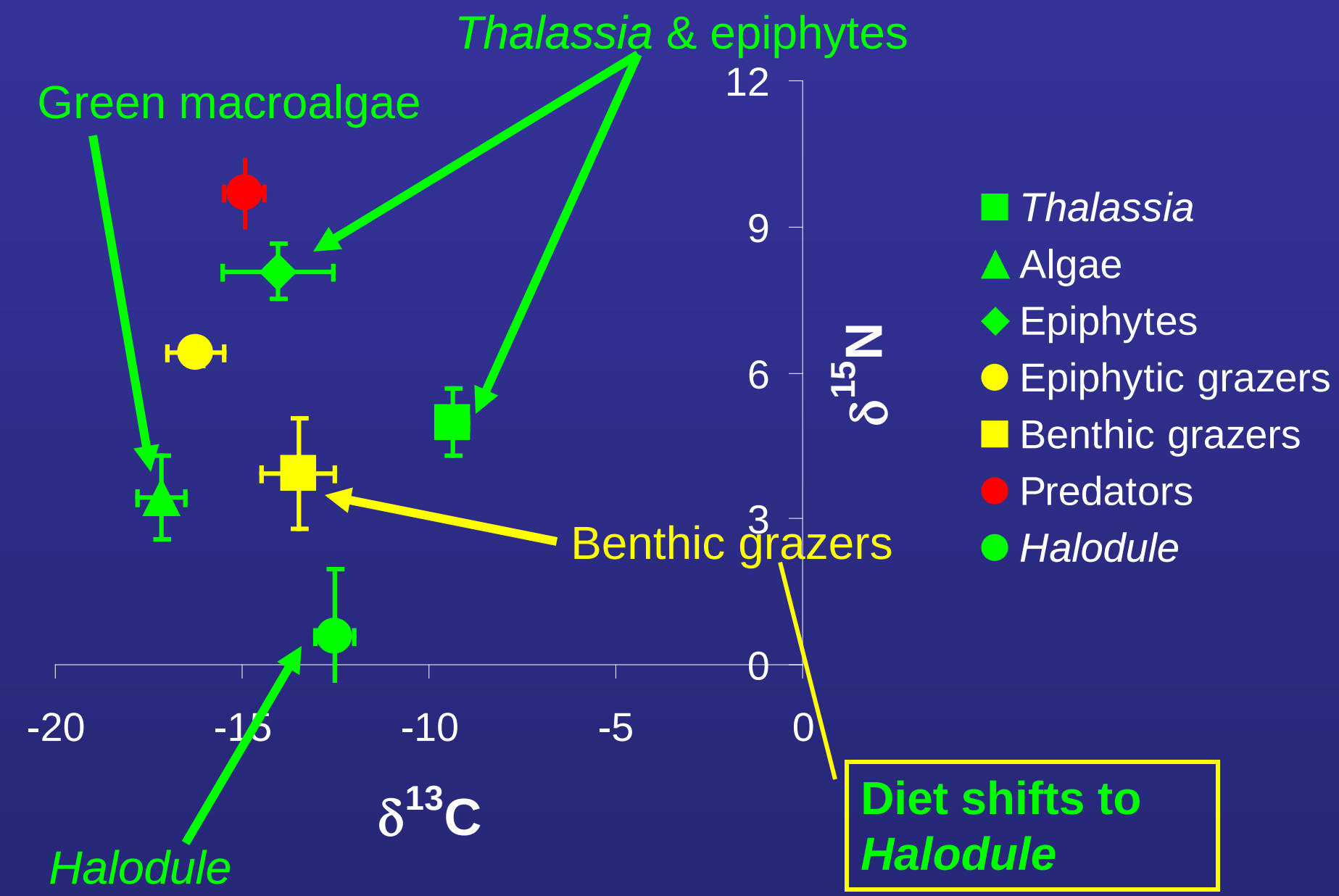


Duck: Control



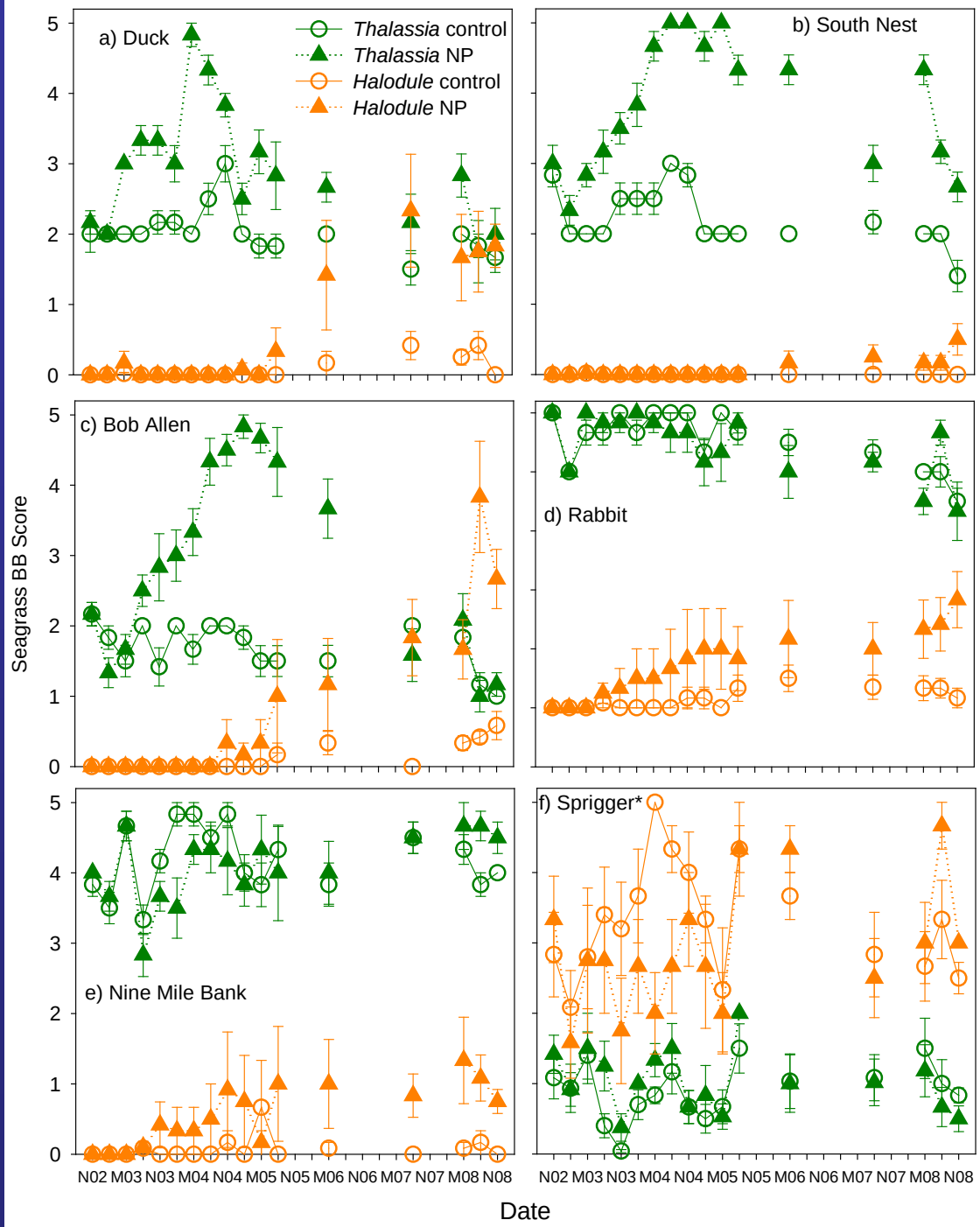
Grazer diet = green algae + associated epiphytes

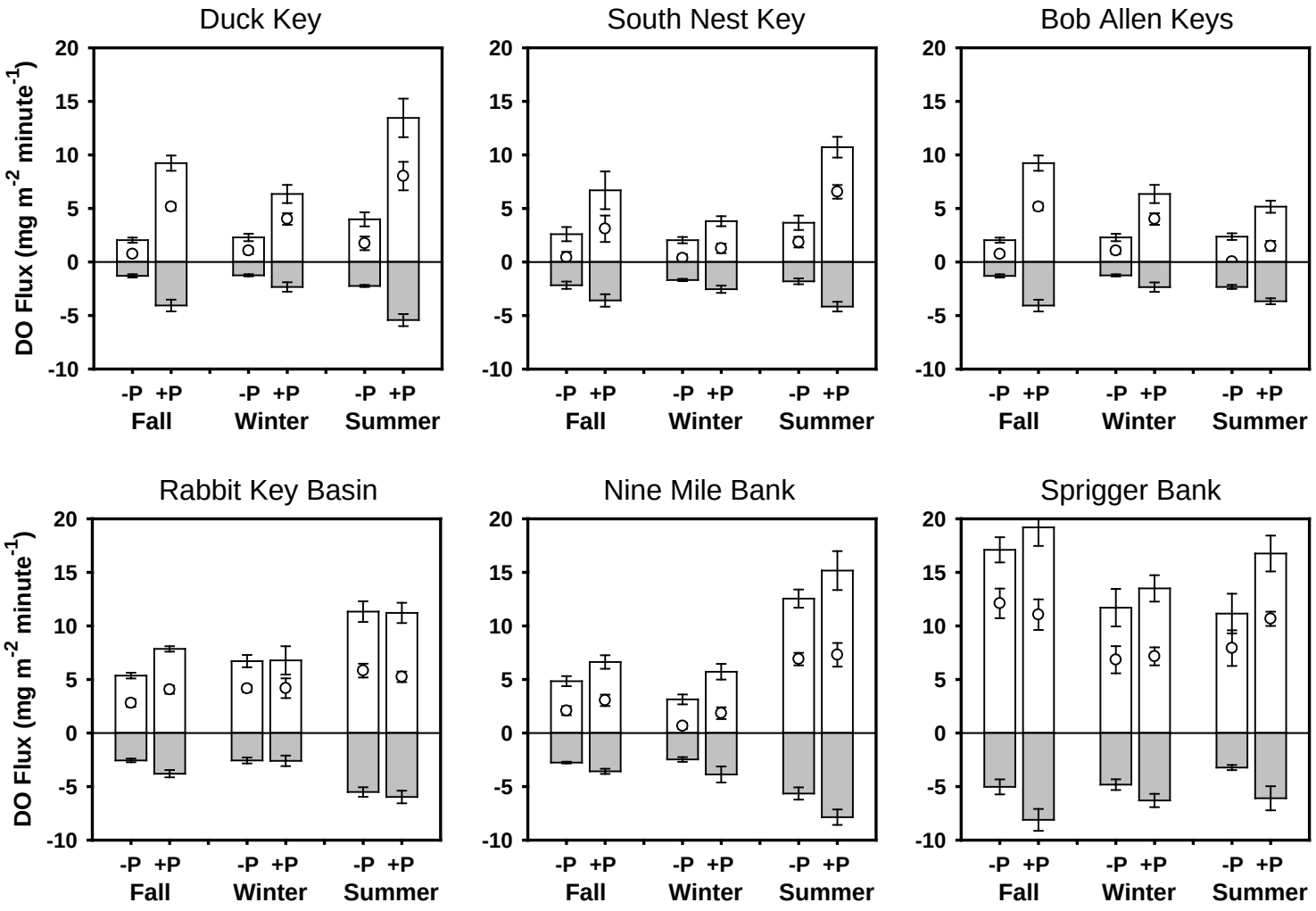
Duck: Enriched



Diet shifts to *Halodule*

We have continued sampling these experiments through the present – changes are still occurring7 years after initiation of the experiment




Duck Key
South Nest Key
Bob Allen Keys
Rabbit Key Basin
Nine Mile Bank
Sprigger Bank
DO Flux (mg m-2 minute-1)
20
15
10
5
0
-5
-10
-P +P
Fall
Winter
Summer