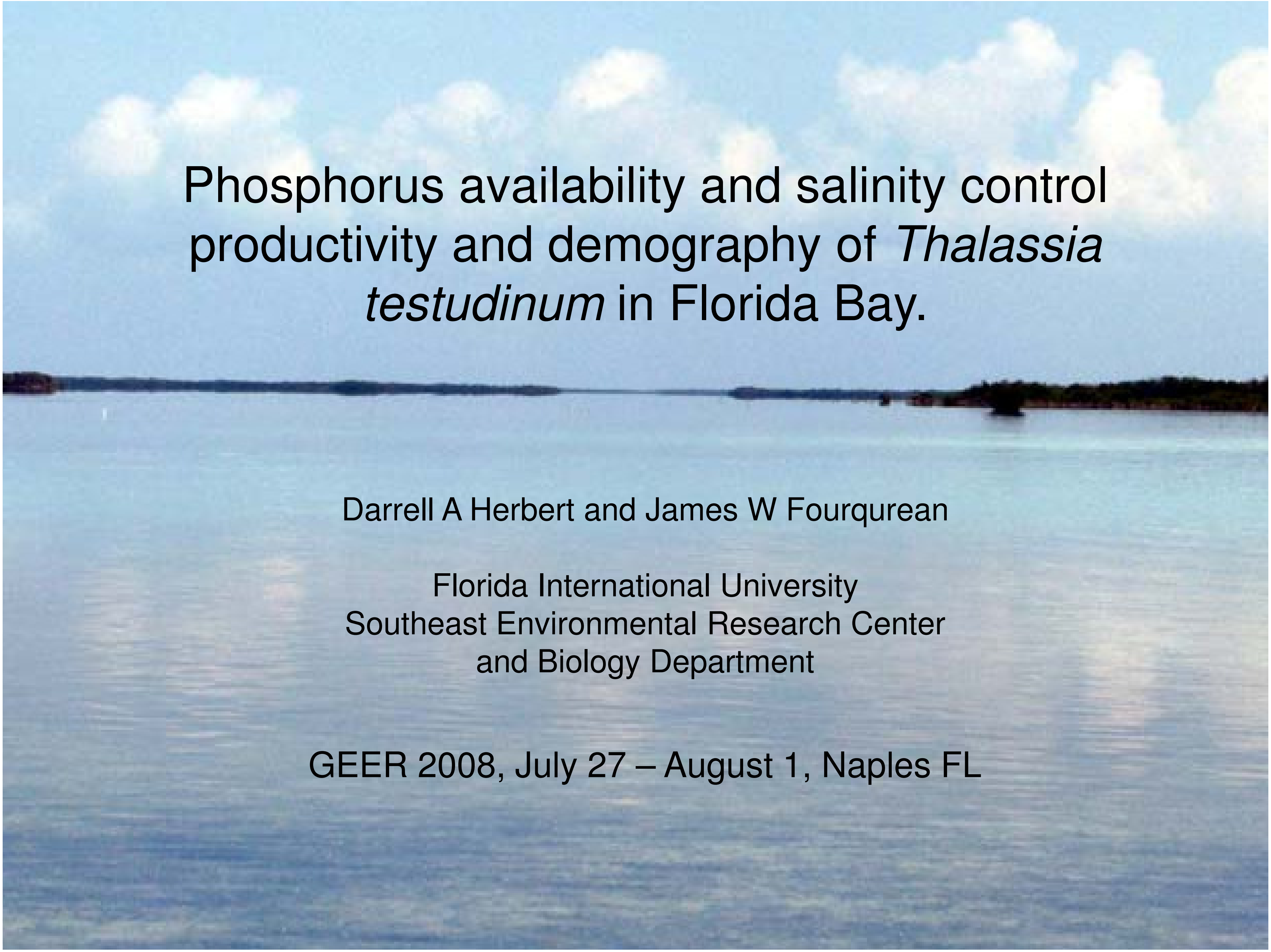


Phosphorus availability and salinity control productivity and demography of *Thalassia testudinum* in Florida Bay.

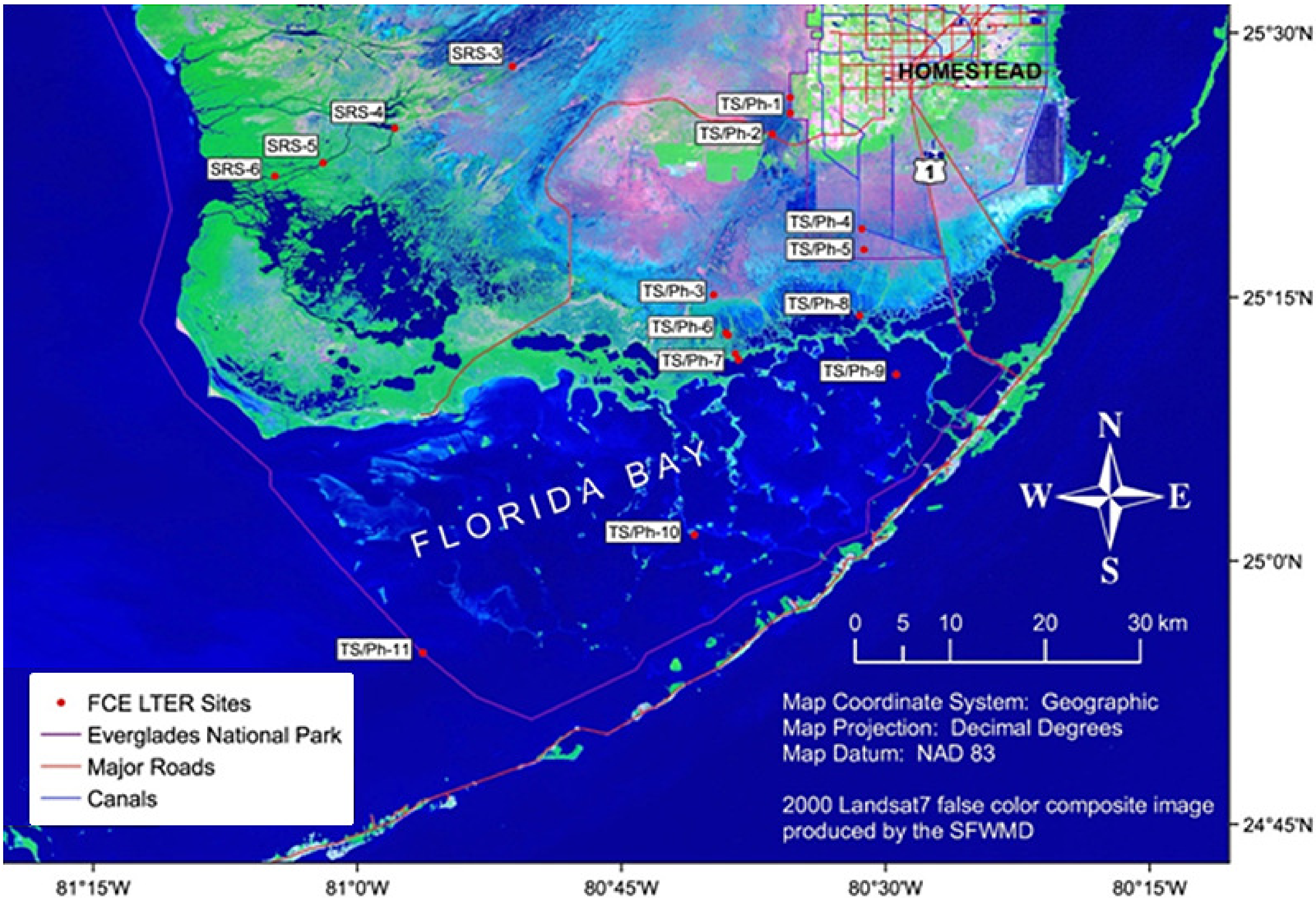
Darrell A Herbert and James W Fourqurean

Florida International University
Southeast Environmental Research Center
and Biology Department

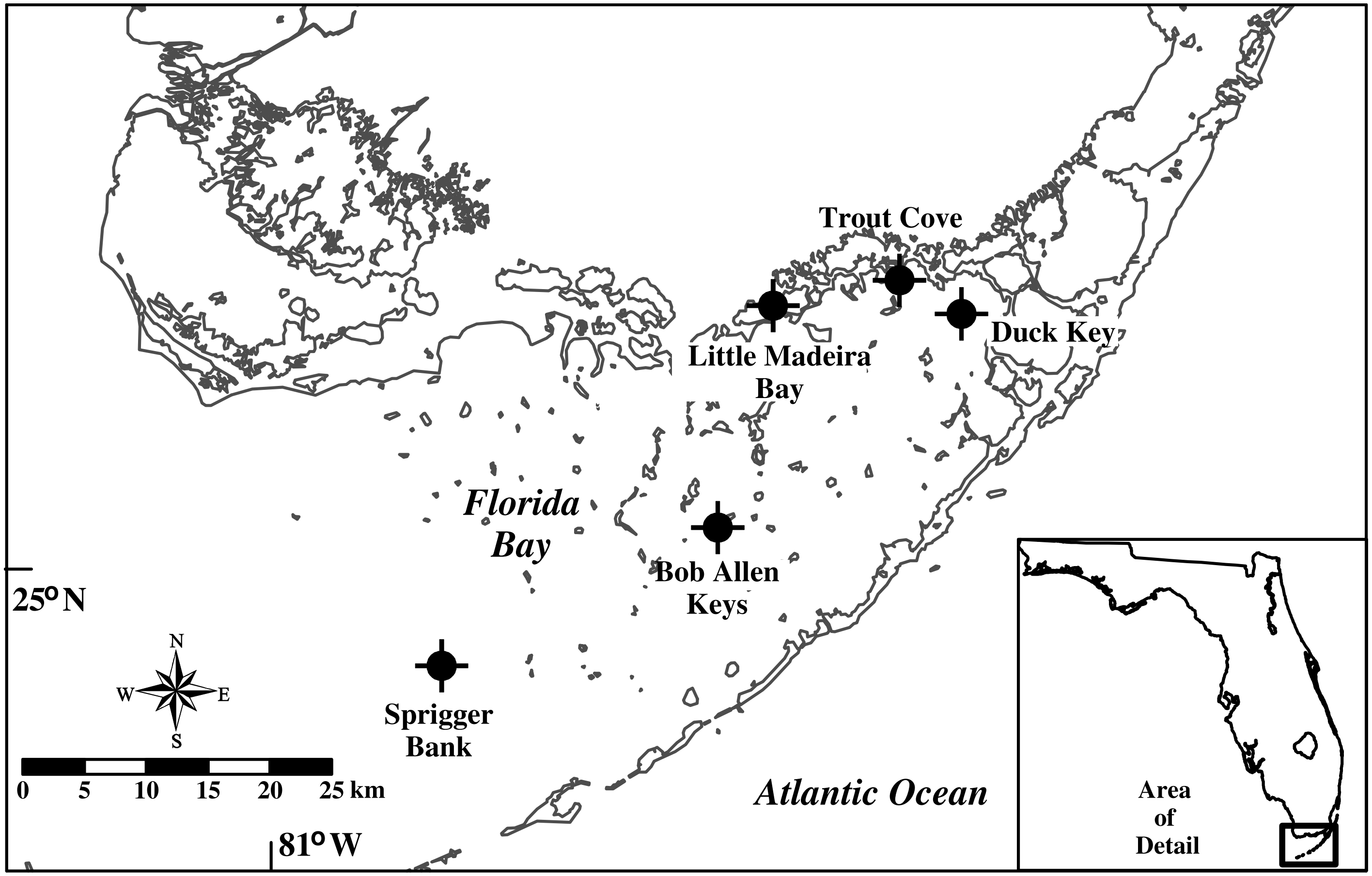
GEER 2008, July 27 – August 1, Naples FL



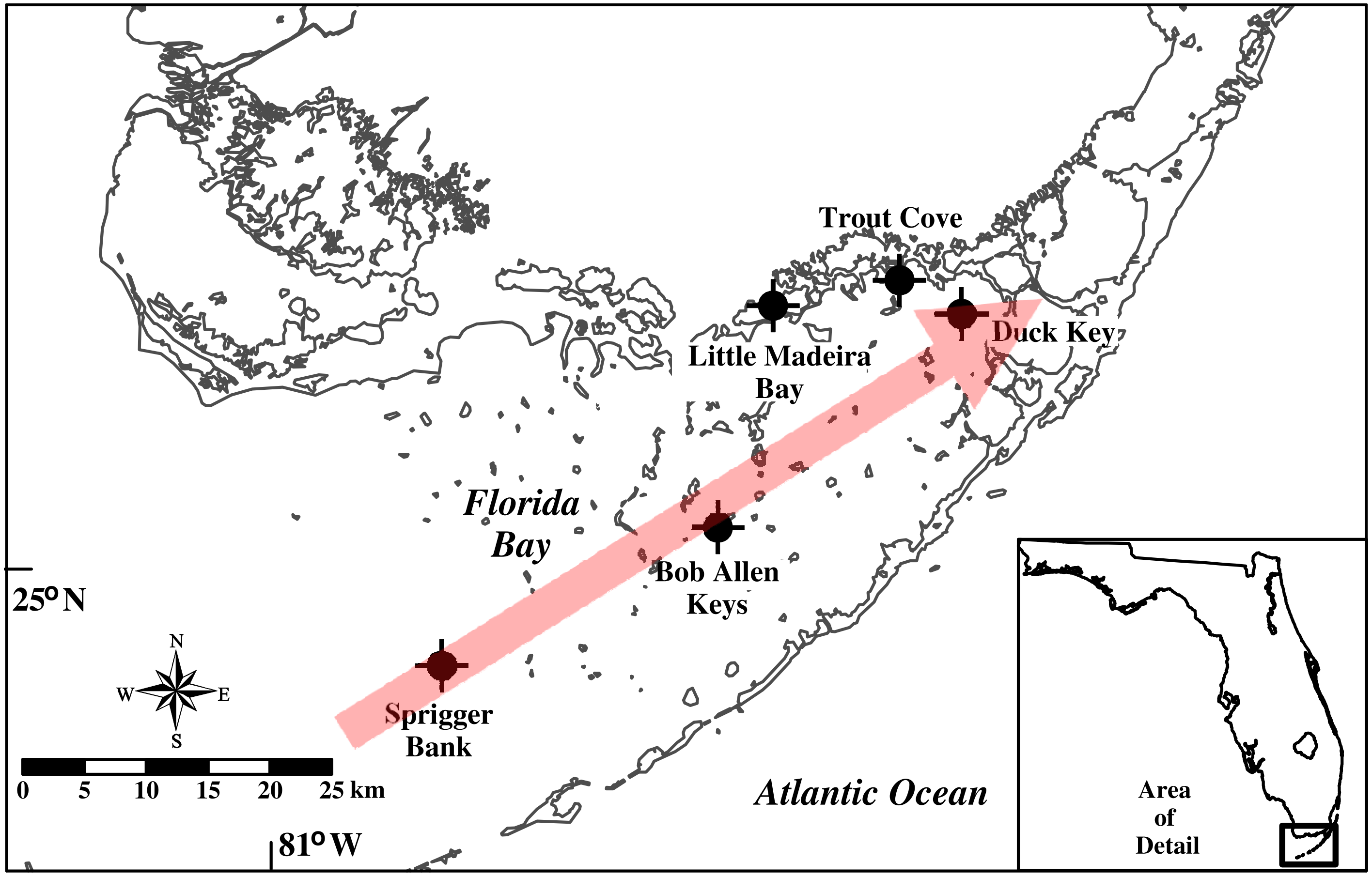

Florida Coastal Everglades LTER

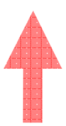


FCE LTER Marine Sites



FCE LTER Marine Sites

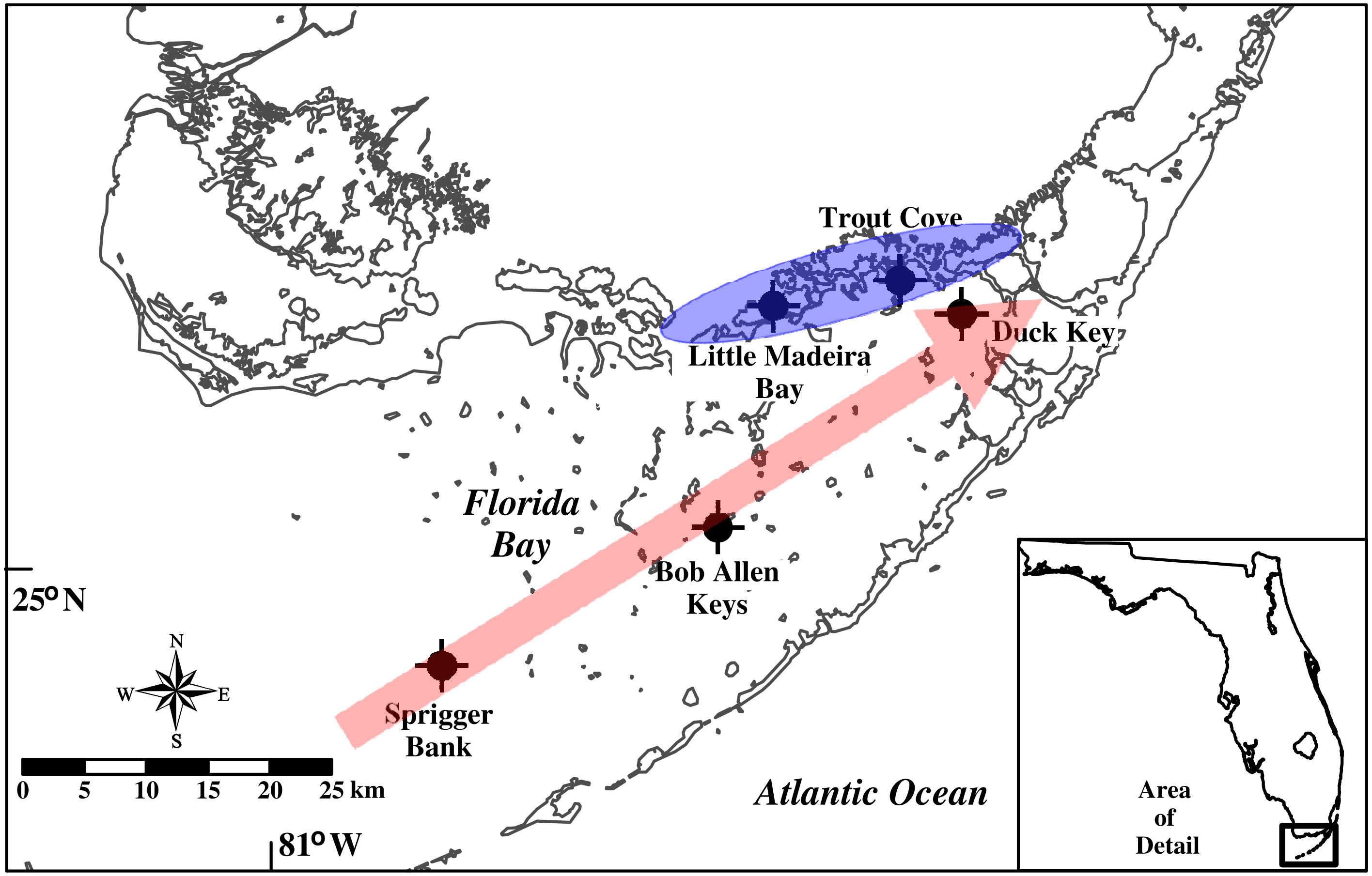




P decreases SW to NE
Salinity variability increases

Fourqurean & Zieman. 2002. *Biogeochemistry*

FCE LTER Marine Sites



P decreases SW to NE
Salinity variability increases

Elevated P from groundwater
Highly variable salinity

Fourqurean & Zieman. 2002. *Biogeochemistry*

Price et al. 2006. *Hydrobiologia*

Objectives

Analyze long-term data spanning a seven year collection of biomass, density, and productivity measurements of *T. testudinum*.

Determine how aboveground and belowground components of biomass and growth change as a function of nutrients and salinity.

Examine relationships between aboveground and belowground biomass, productivity, and ramet demography.

Methods

Data Collections

Collected 6x annually

- Ramet density
- Aboveground biomass
- Leaf initiation & growth
- Leaf N and P content

Single collection

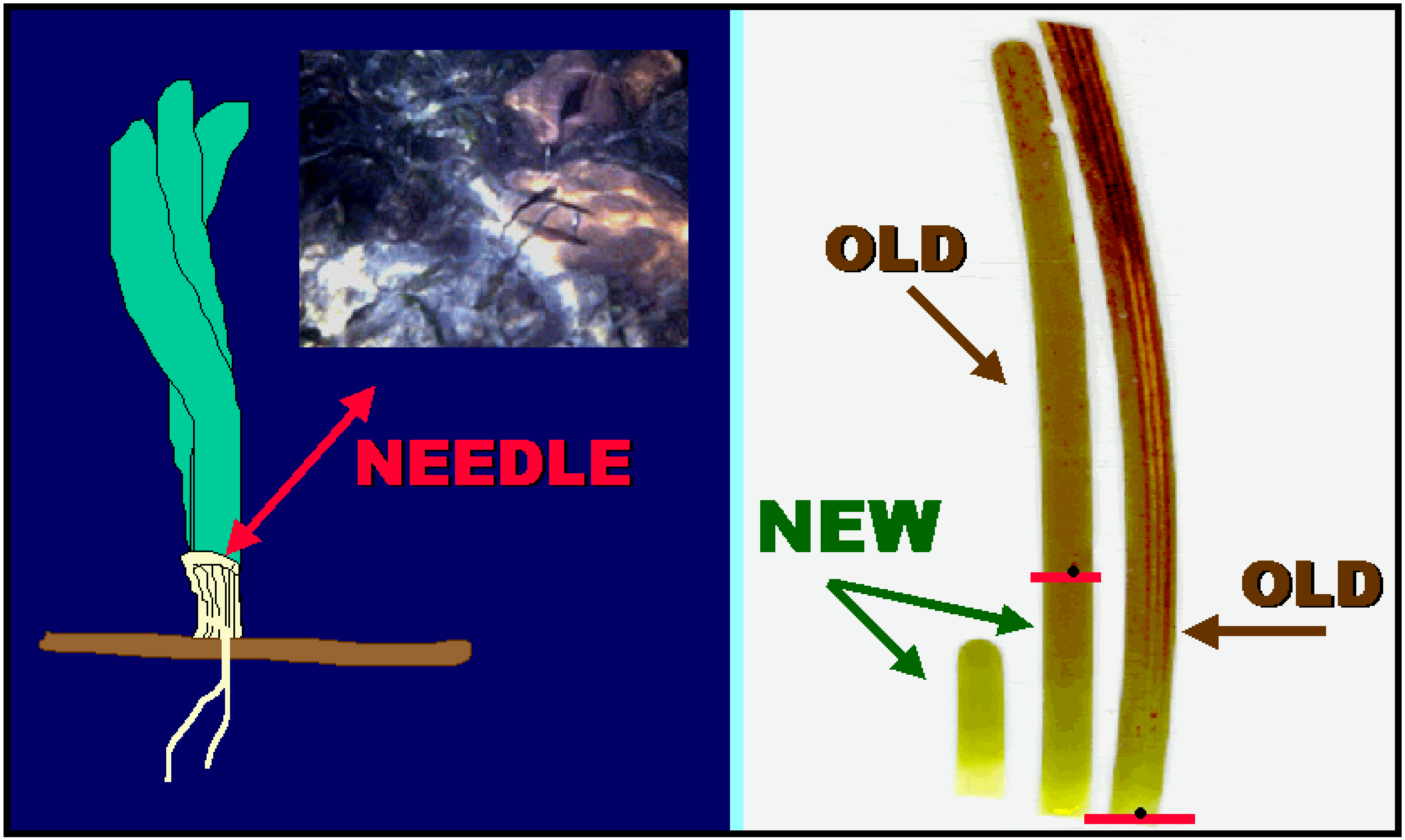
- Ramet, rhizome, & root mass
- Ramet age distributions

Long-term salinity archives

- Water Quality Monitoring Network, SERC, FIU
- Everglades National Park

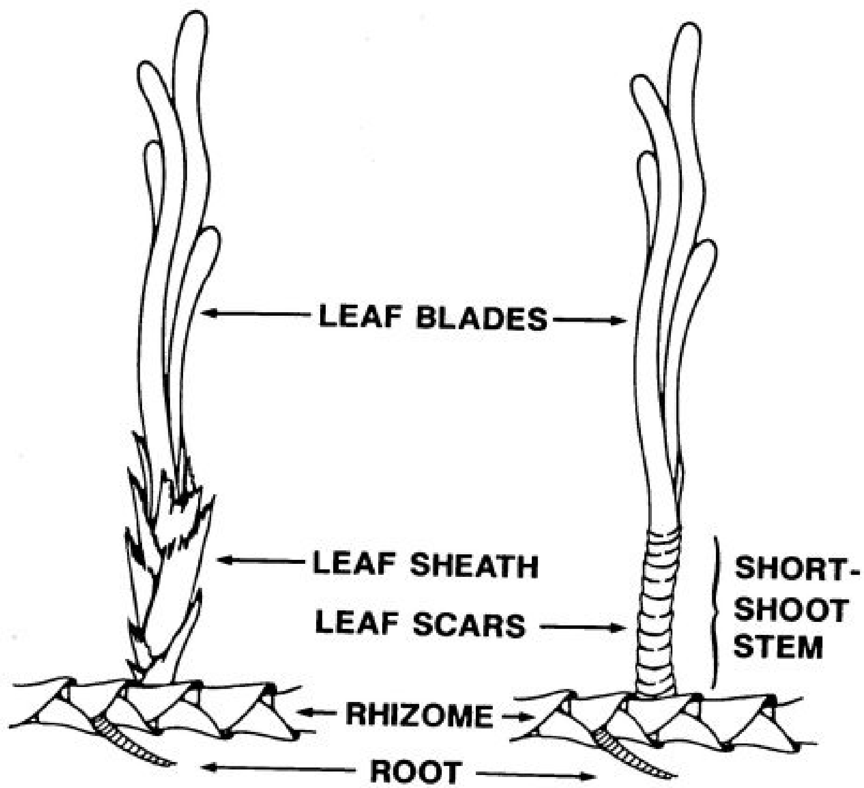
Methods

Thalassia leaf productivity

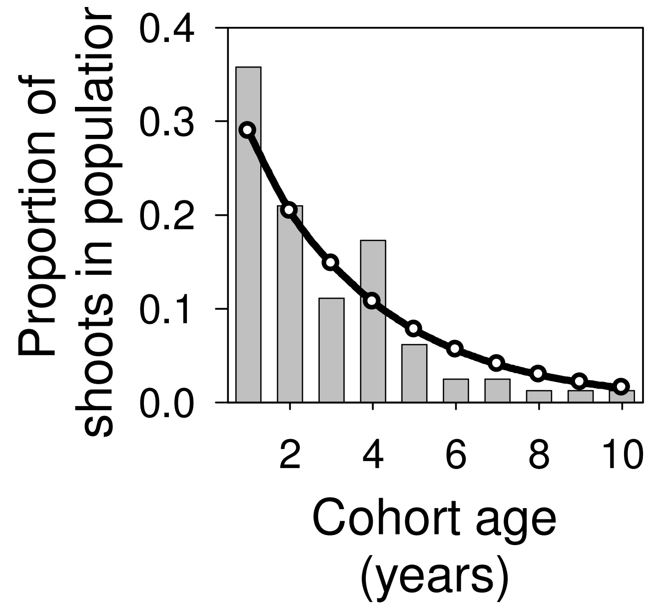


Methods

Thalassia belowground productivity



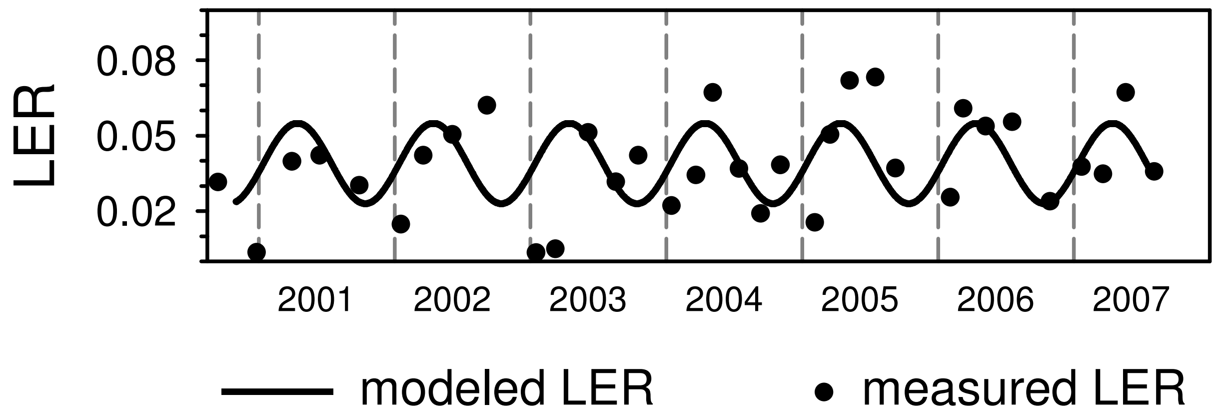
Determination of population structure



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

Methods

Seasonality



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

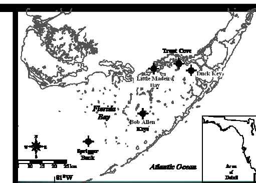
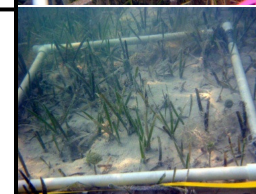
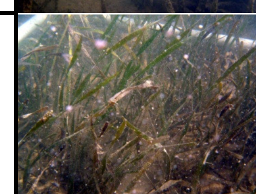
$$Y = \overline{Y} + \alpha\left[\sin\left(DOY + \phi\right)\right]$$

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

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

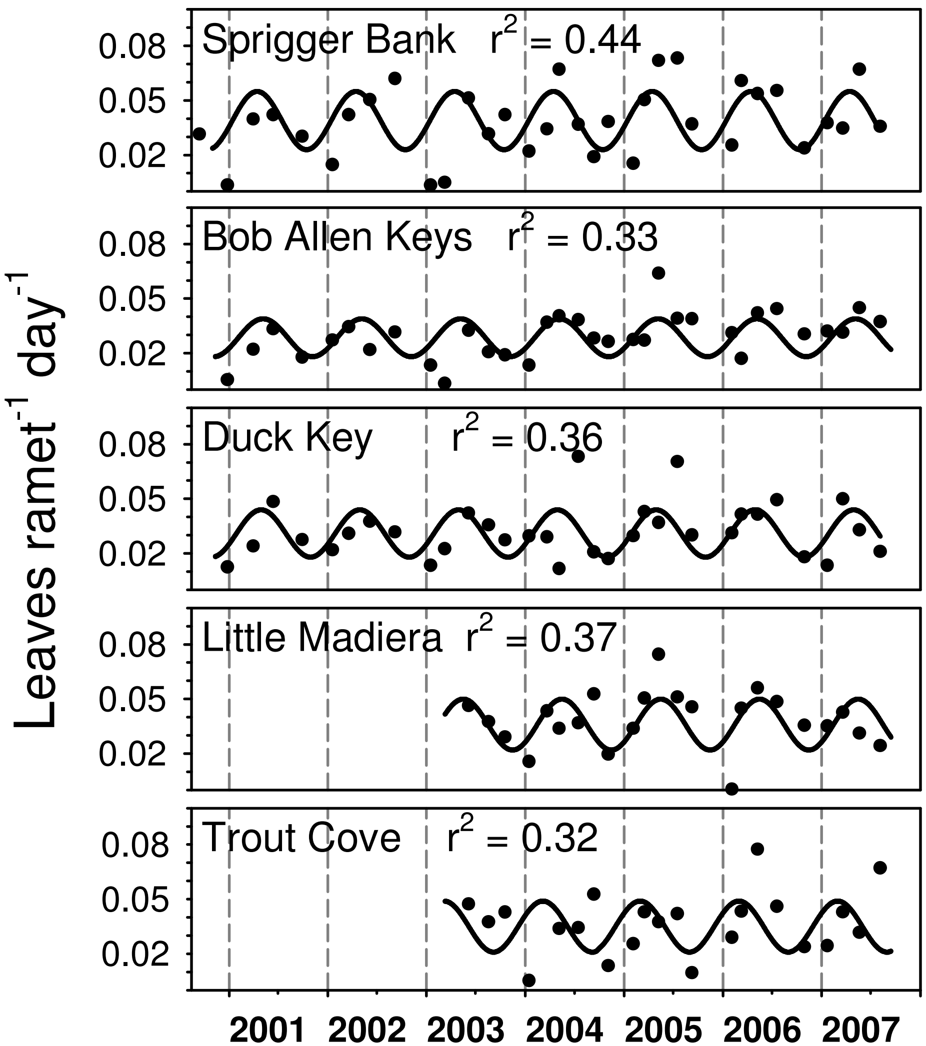
Results

Thalassia characteristics by site

Site	Foliar P (%)	Foliar N (%)	Ramet 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	

Results

Leaf Emergence Rate



PI (days)

25.6 (47.6 – 17.5)

35.5 (52.6 – 25.6)

32.3 (55.6 – 22.7)

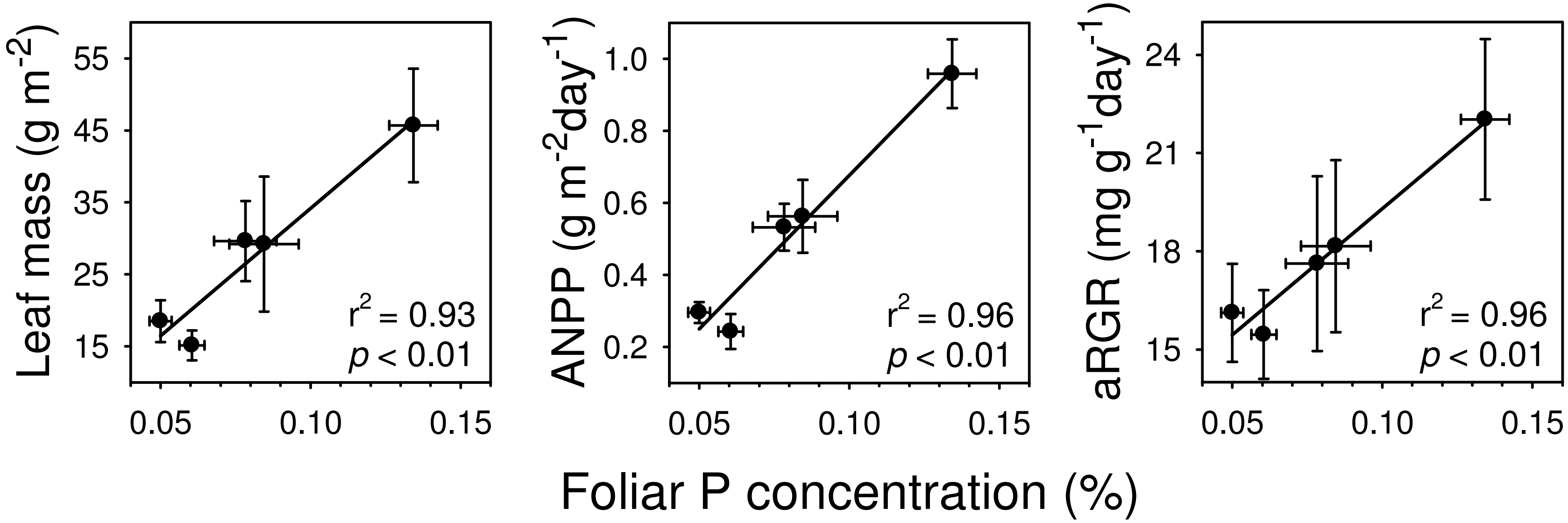
27.8 (45.5 – 20.0)

28.6 (47.6 – 20.4)

LER and seasonal amplitude are correlated with foliar P

Results

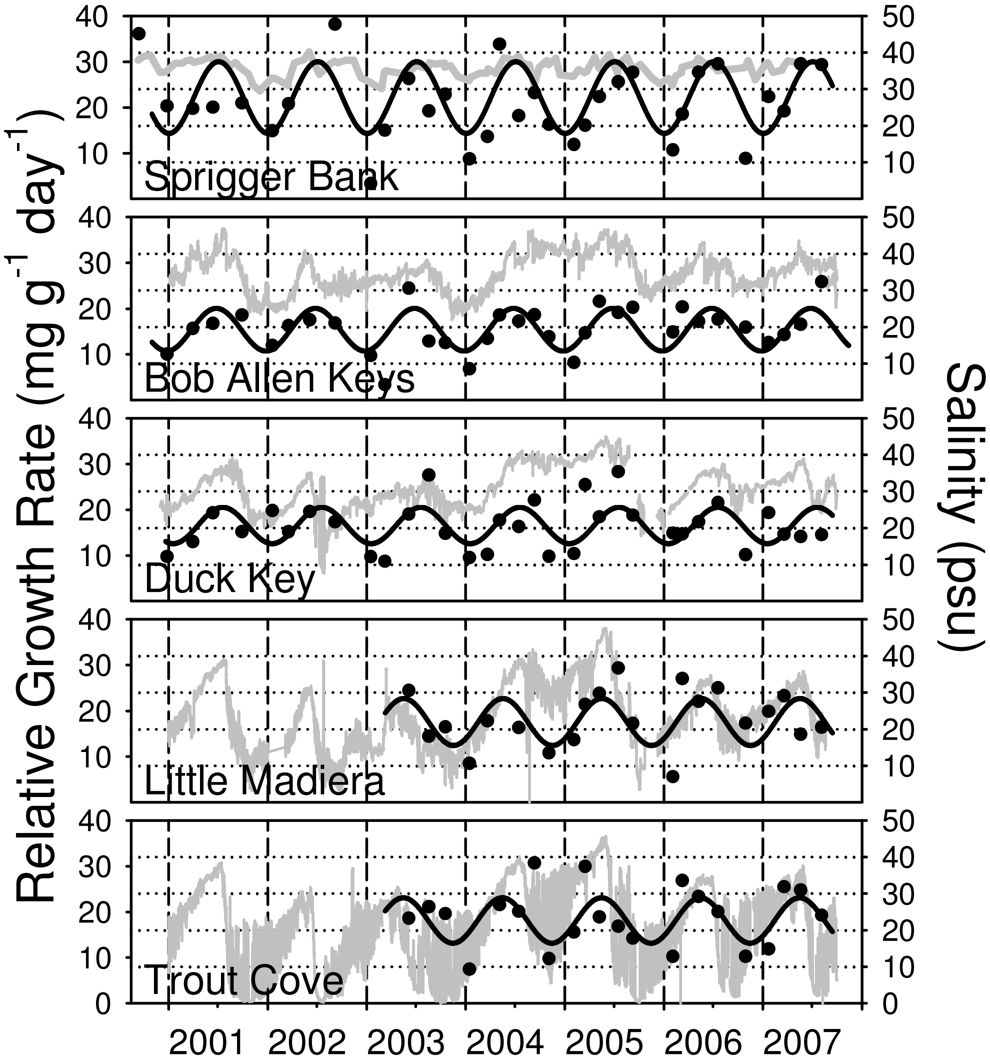
Standing Crop and Aboveground Production vs. P



Leaf standing crop and productivity are correlated with foliar P

Results

Relative Growth Rate and Salinity



$r^2 = 0.41$

$r^2 = 0.46$

$r^2 = 0.40$

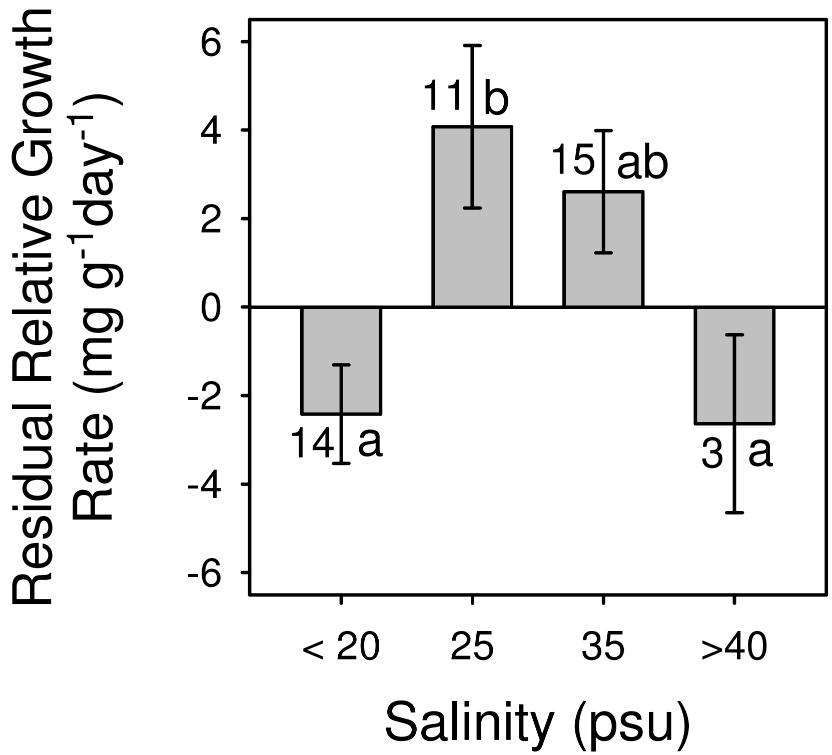
$r^2 = 0.32$

$r^2 = 0.29$

Highly variable salinity reduced the predictability of RGR

Results

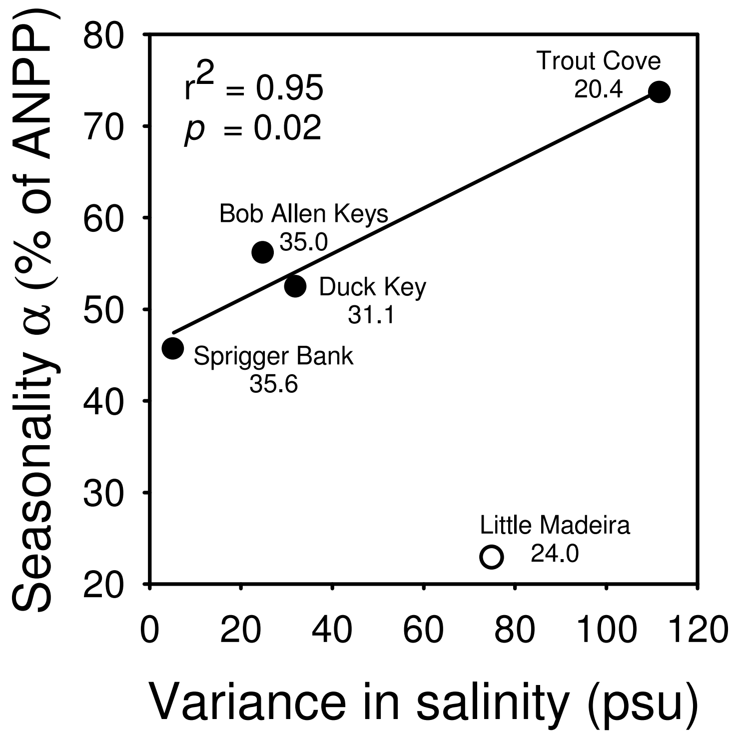
Residual Analysis of Predicted vs. Observed Relative Growth Rate



RGR was depressed at low and high salinities

Results

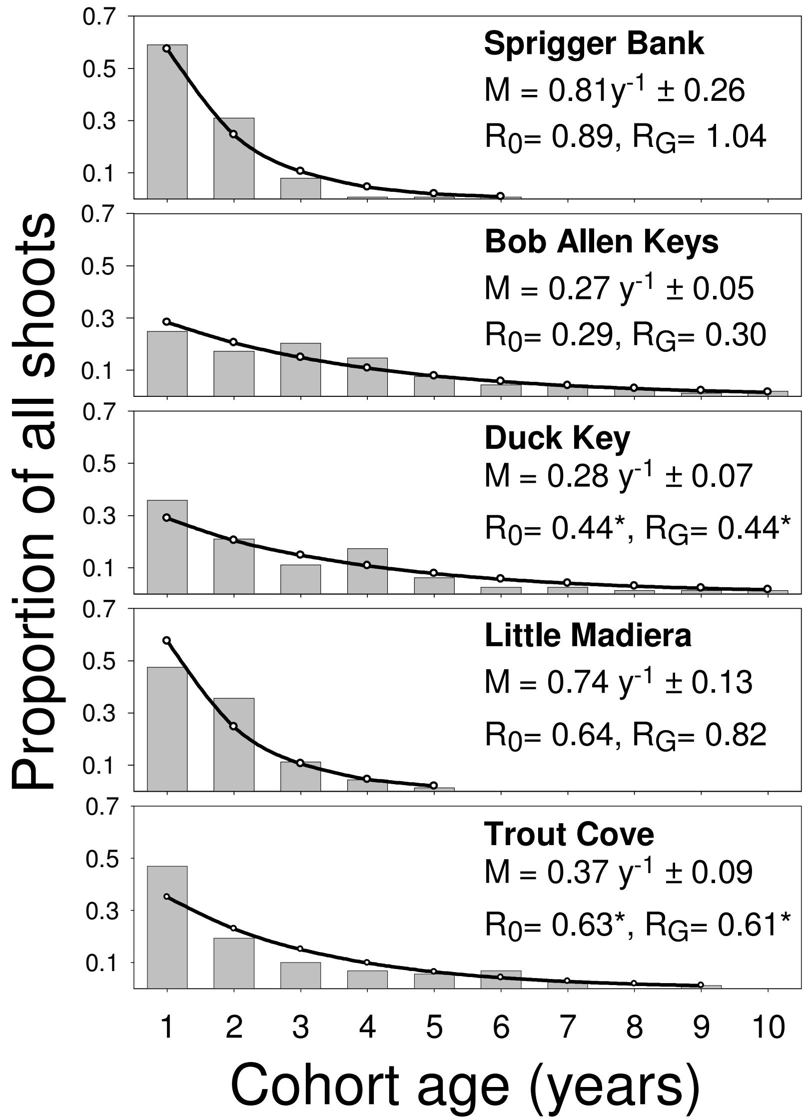
Seasonal Amplitude in Aboveground NPP vs. Salinity Variability



Seasonal amplitude of ANPP increased with salinity variability

Results

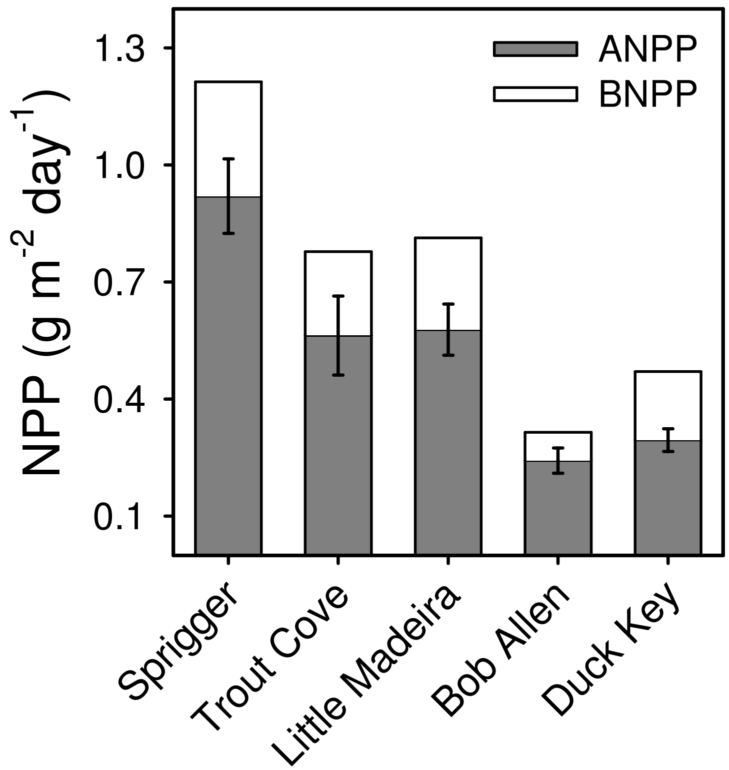
Population Structure, Mortality, and Recruitment



Low rates of mortality and recruitment where P availability is low

Results

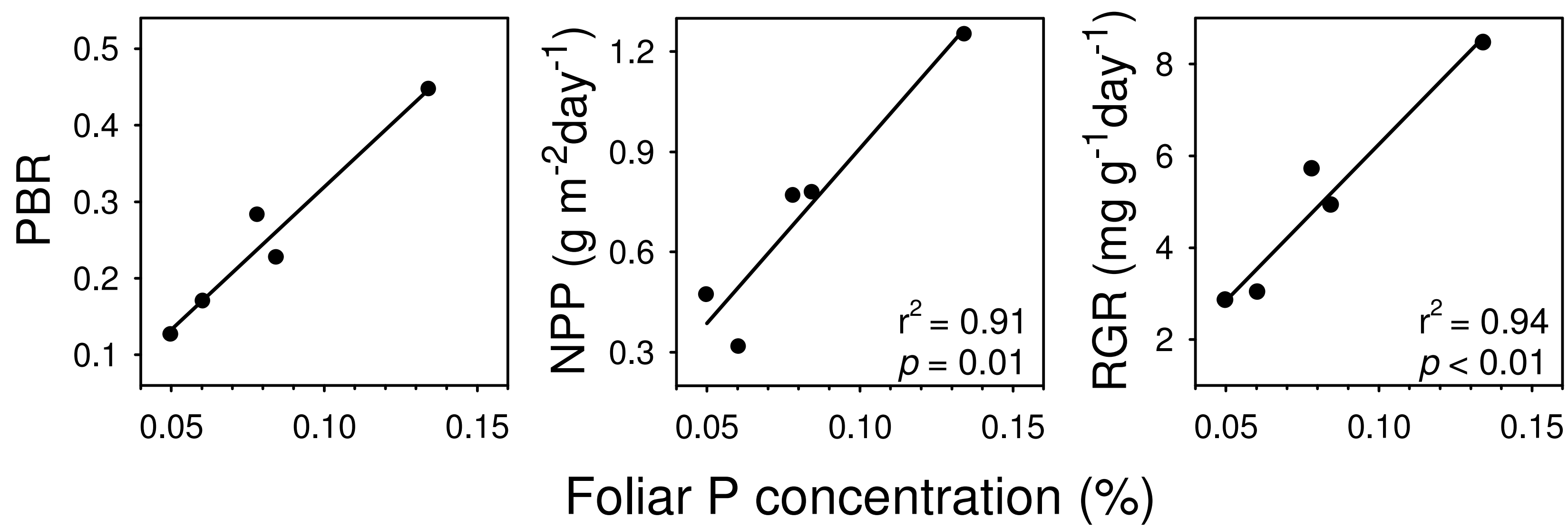
Aboveground and Belowground Productivity



Belowground productivity is 23% - 37% of aboveground productivity

Results

Total Production vs. P



Above vs belowground mass allocation correlated with P

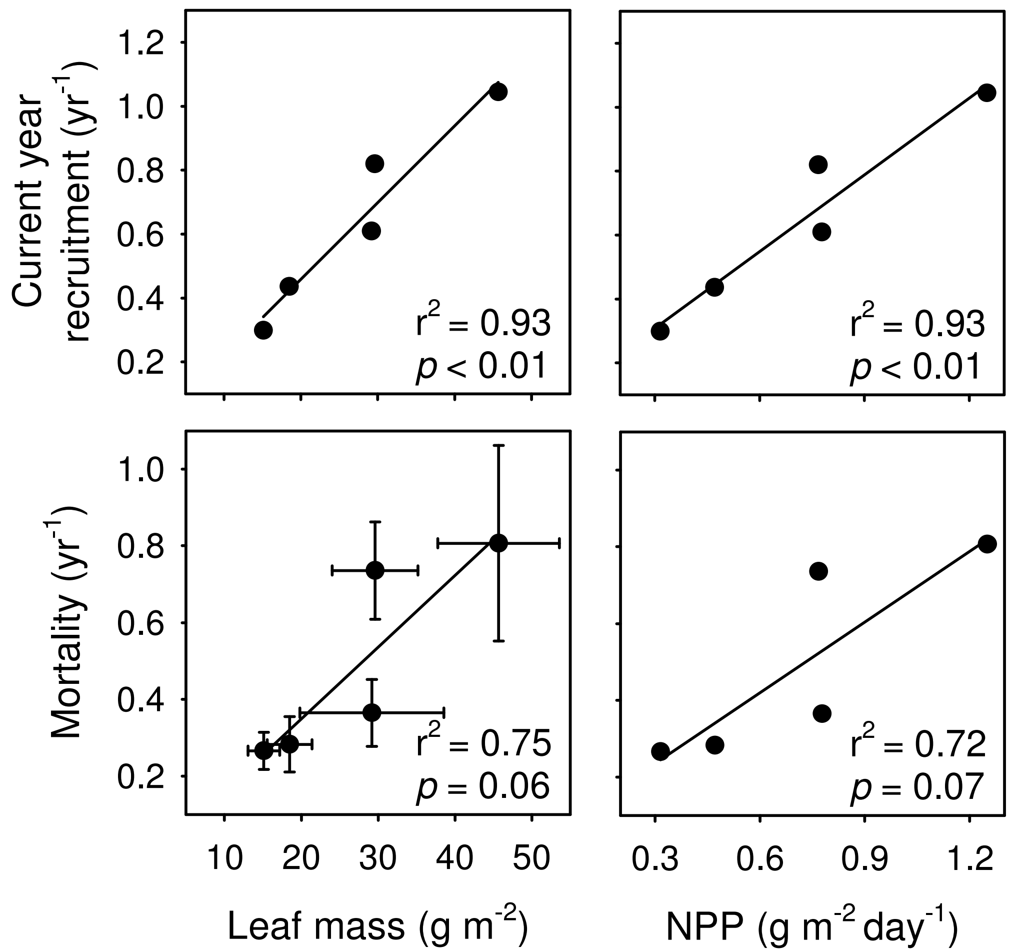
Belowground NPP correlated with leaf standing crop but not P

Belowground RGR correlated with leaf standing crop and P

Indices of total productivity correlated with P

Results

Current Recruitment Rates and Long-Term Mortality Rates



Recruitment strongly correlated and mortality weakly correlated with leaf mass, NPP, and P

Conclusions

P availability controls on *Thalassia testudinum* include:

- Biomass allocation to photosynthetic structures
- Indices of NPP
    - Leaf emergence rates
    - ANPP and aRGR, and to a lesser extent BNPP and bRGR
- Recruitment and mortality of ramets

NPP and mortality are strongly tied to the standing crop of leaves

Belowground NPP allocation is approximately a third of total NPP

Salinity extremes depress site-specific RGR, and the frequency of extreme salinity events appears to be a factor controlling NPP

Acknowledgements

Much of the field data was collected by
Rebecca Bernard, Dorothy Byron, Virginia Cornett, Kevin Cunniff and Bryan Dewsbury.

Laboratory analyses overseen by
Susie Escorcia and Pamela Parker

Funding provided by
The National Science Foundation
Florida Coastal Everglades LTER
Everglades National Park
Florida Sea Grant