



Seasonal Patterns in *Chara* and *Halodule*  
Communities in the Mangrove Lakes and  
Estuaries of the Coastal Everglades:  
Relationships to Environmental Variables

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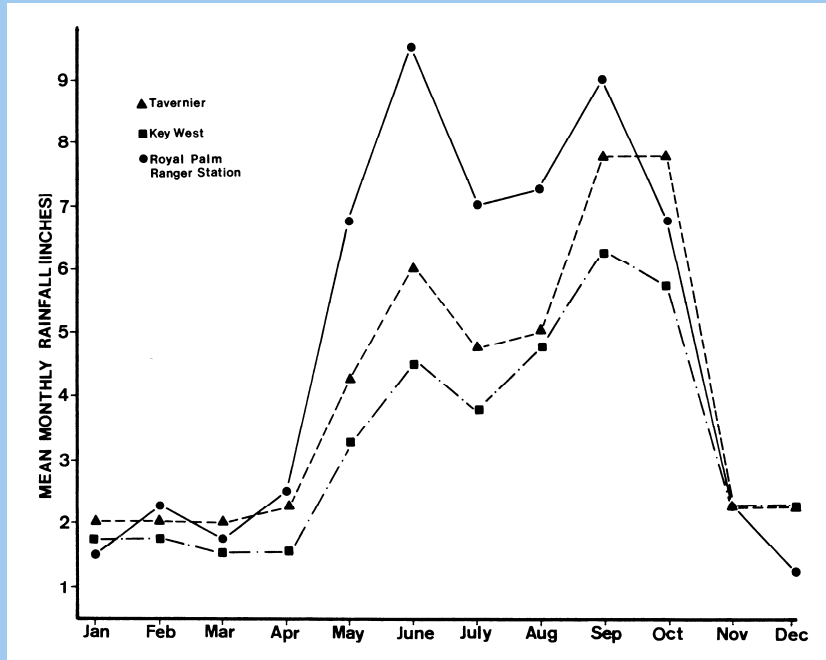
<sup>2</sup> Everglades National Park

<sup>3</sup> South Florida Water Management District

Greater Everglades Ecosystem Restoration Conference  
Jul. 12-16 2010, Naples, Florida

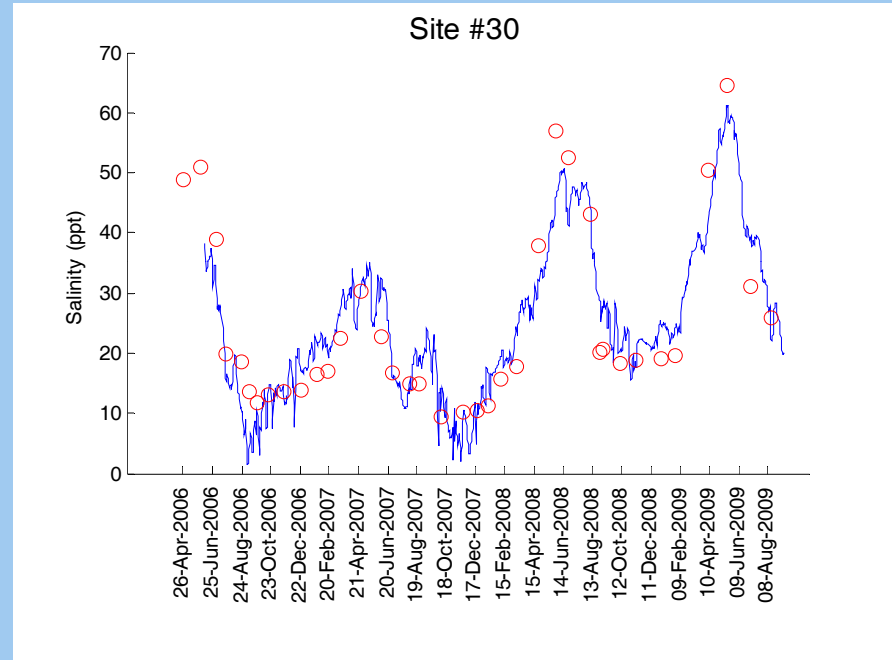
# Climate

## Mean monthly rainfall



Schomer and Drew, 1982

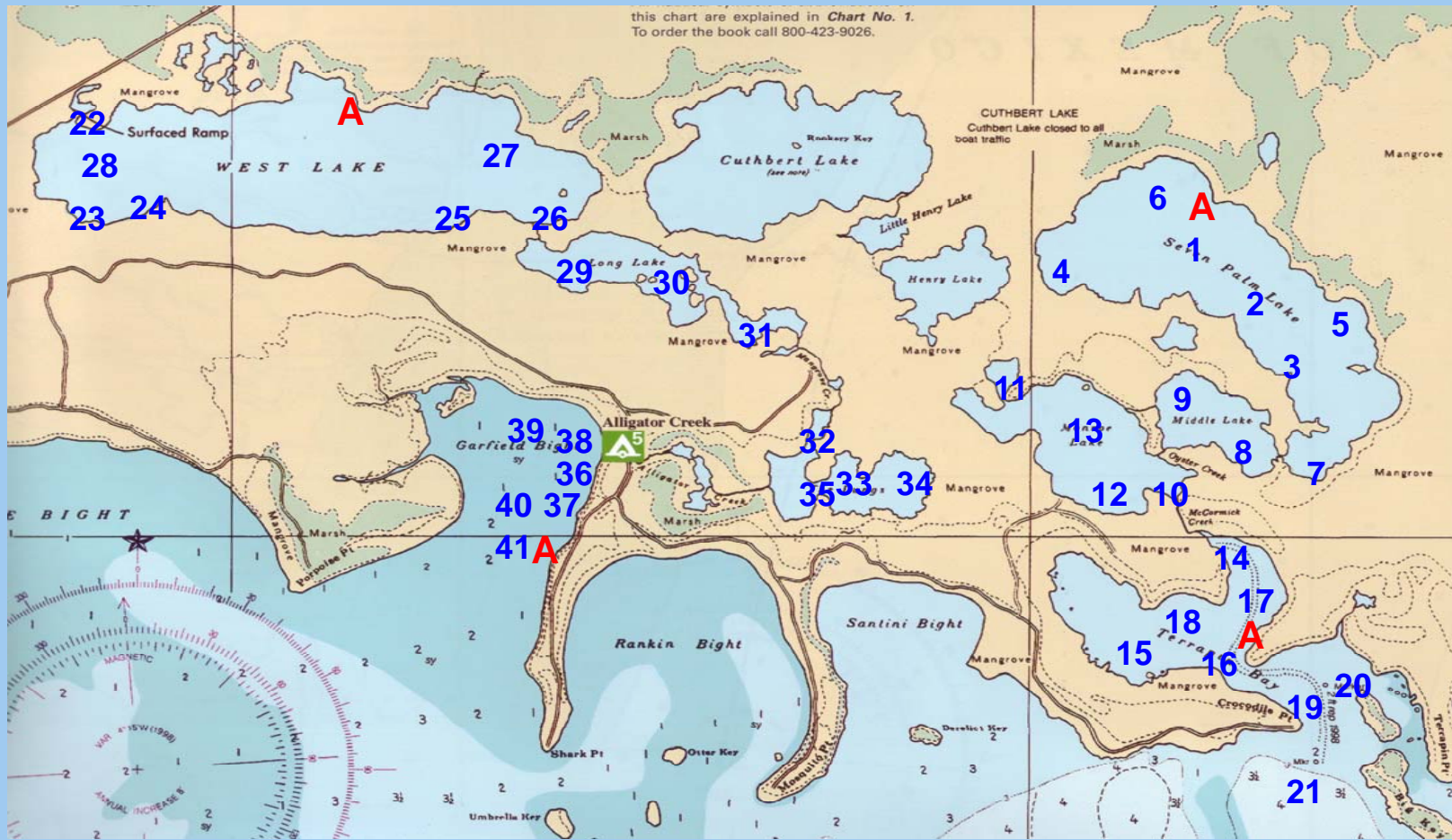
## Surface salinity



Present study

Distinct Wet and Dry seasons characterize the Everglades affecting range of environmental factors

# Study Sites



Study conducted along the ecotone  
between Florida Bay and the Everglades

## Study objectives

To describe emerging seasonal SAV and WQ patterns from first 3 years of data collection

To test for SAV and WQ differences between Wet and Dry seasons



## Methods

**SAV % cover**, quarterly (41 sites)

WQ monitoring, monthly

- TotN, **TotP**, **chl $\alpha$**  - 8 sites)
- temperature, salinity,  
water depth, Secchi depth - 41 sites

**Water temperature**, **salinity**, and **water level**, hourly

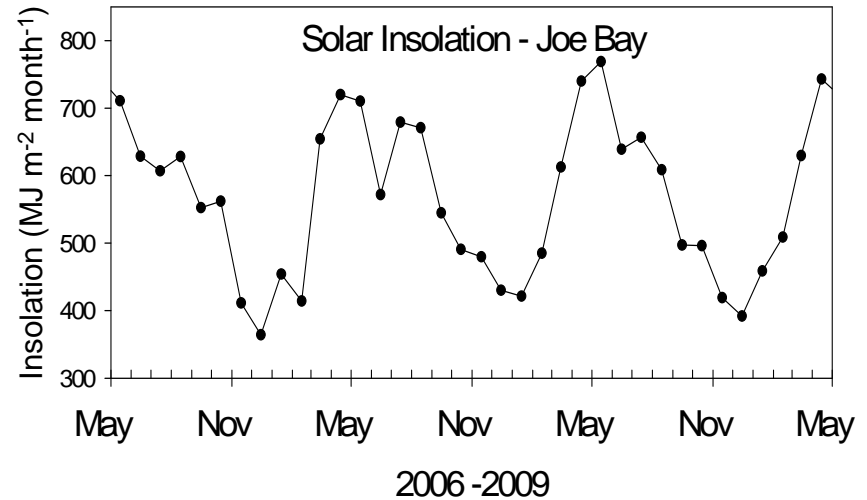
- datasondes in each SAV community zone - 4 sites

Data collection May 2006 - April 2009



## Methods -cont.

**Aquatic insolation** - 41 sites  
estimated from water depth,  
Secchi depth and solar insolation  
Using following relations:

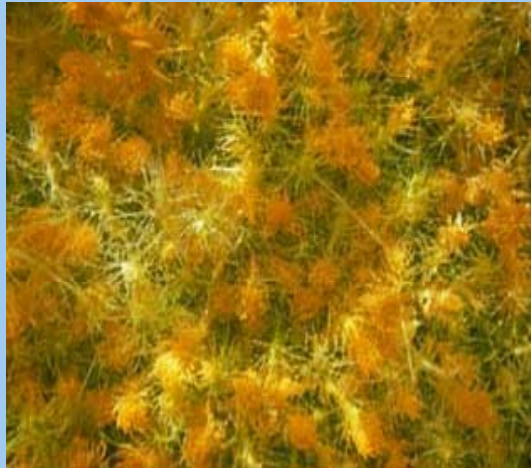


$$K_d = 1.44 / \text{Secchi depth} \quad (\text{Holmes, 1970})$$

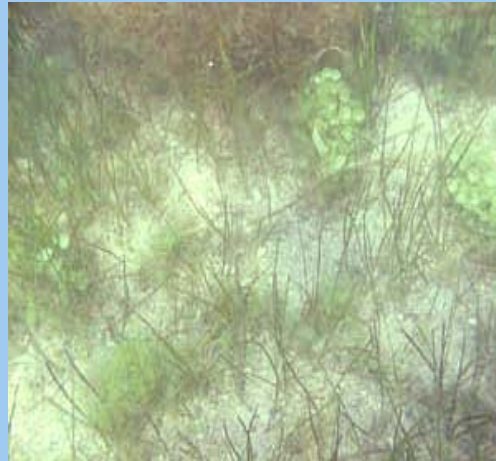
$$\text{Percent light transmission} = 100e^{(-K_d Z)} \quad (\text{Kirk, 1994})$$

$$\text{Aquatic insolation} = \text{percent light transmission} \times \text{solar insolation}$$

## Submerged Aquatic Vegetation (SAV) communities



*Chara hornemannii*



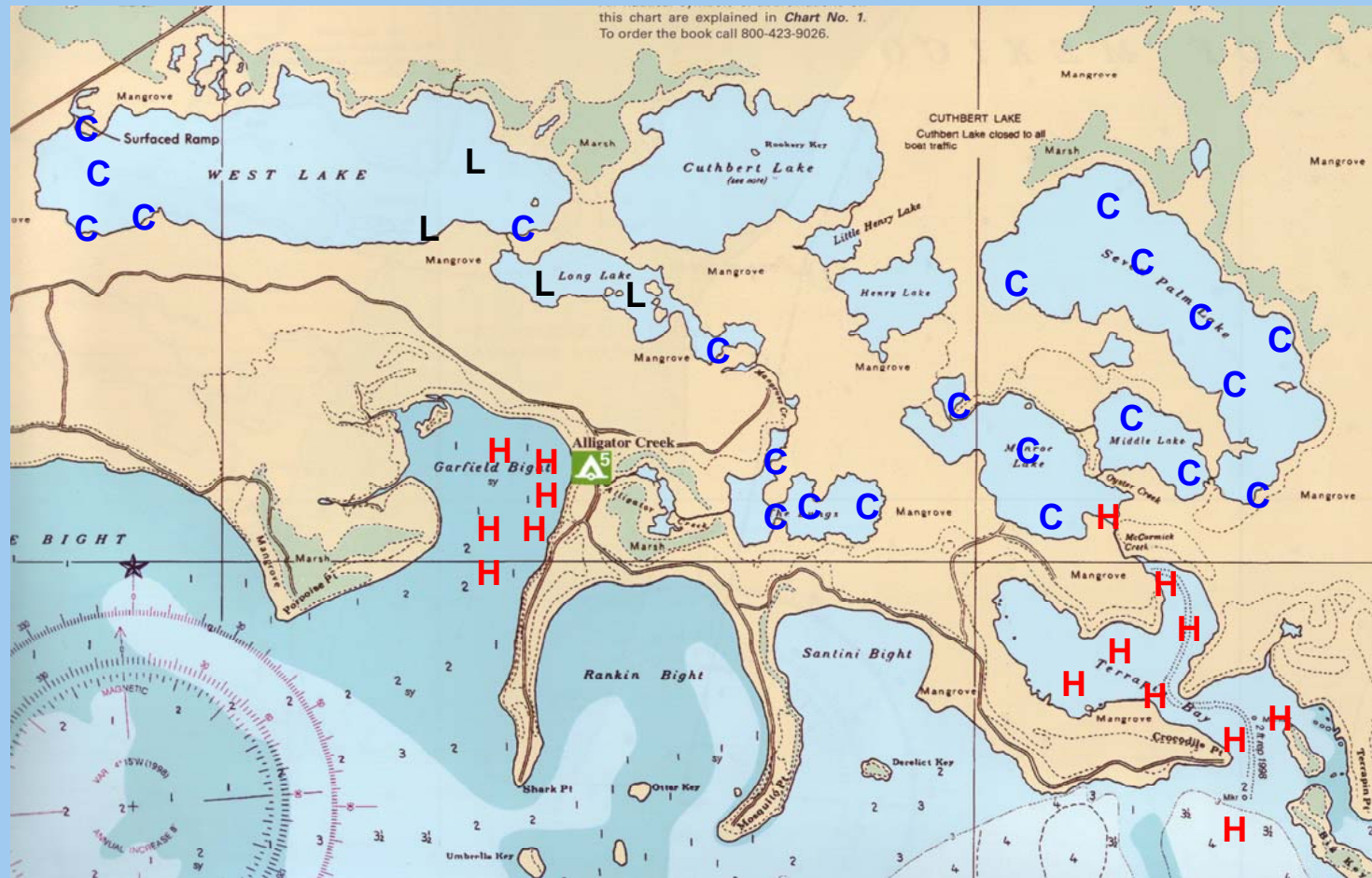
*Halodule wrightii*



**LOW**  
(No SAV)

Benthos characterized by distinct SAV communities

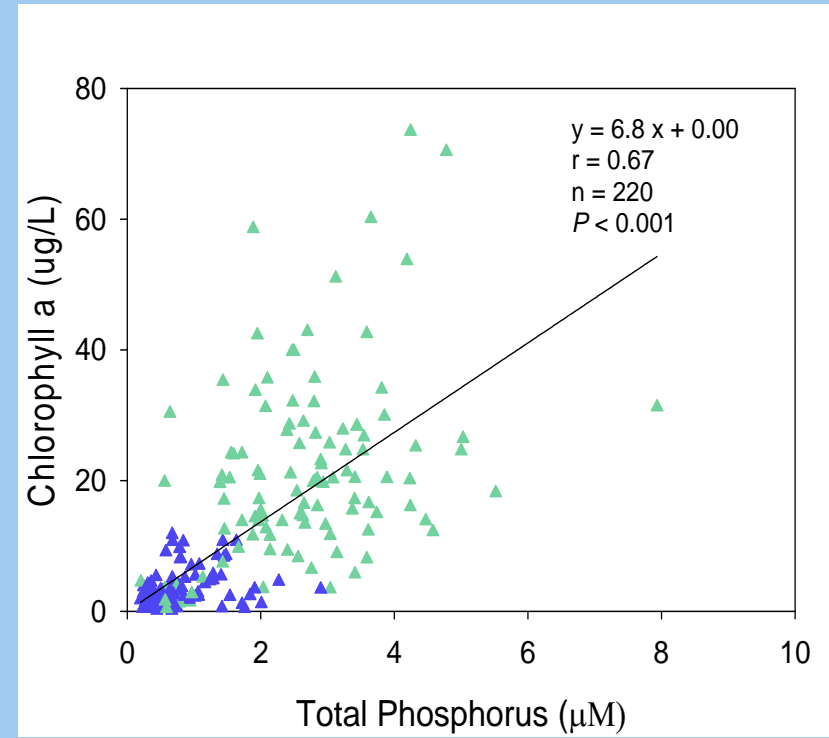
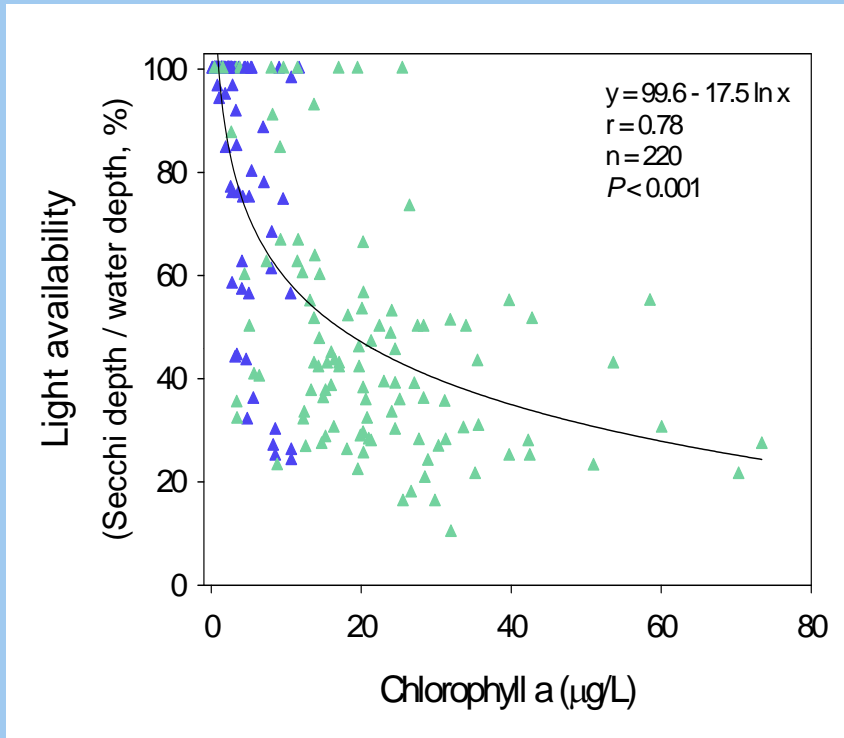
# SAV community distribution



*Chara*, Low occurs in upstream lakes  
*Halodule* occurs in coastal embayments



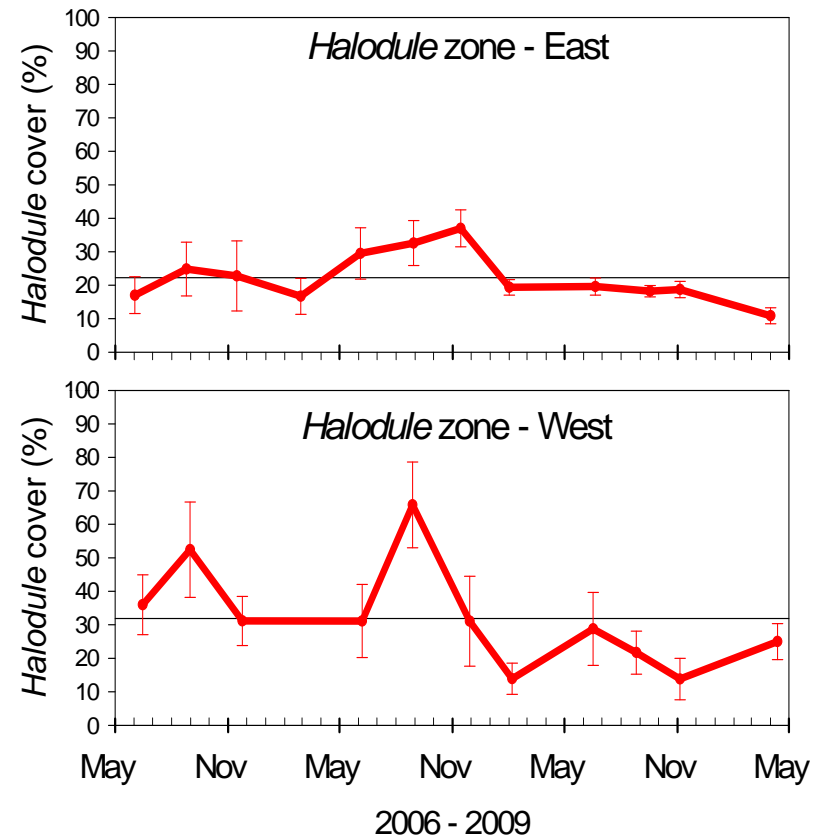
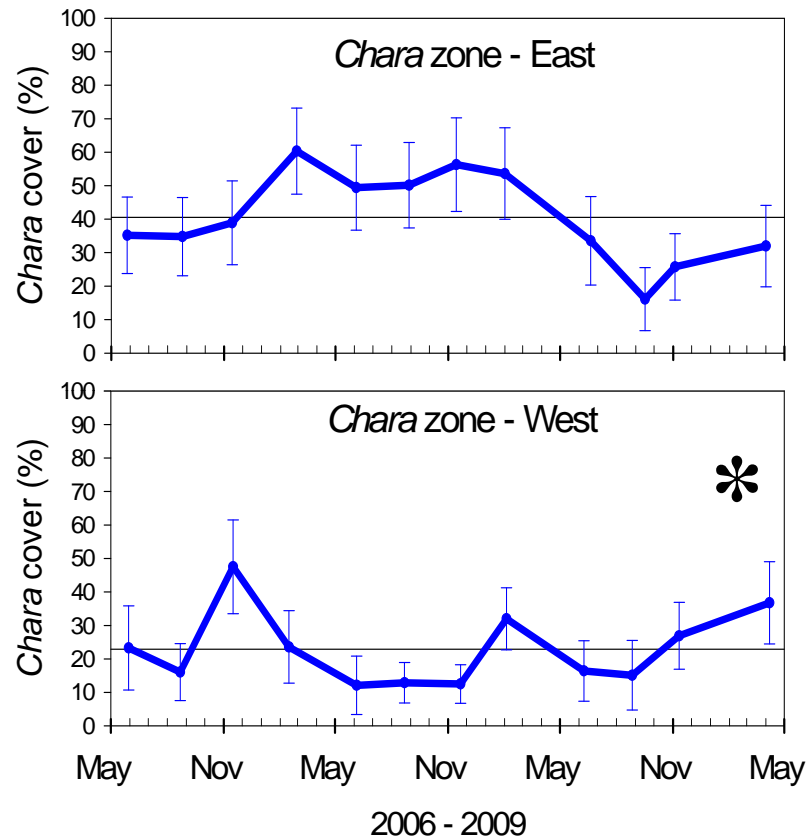
# Water quality distribution



Eastern drainage  
Western drainage

Distinct WQ regimes in eastern and western drainages

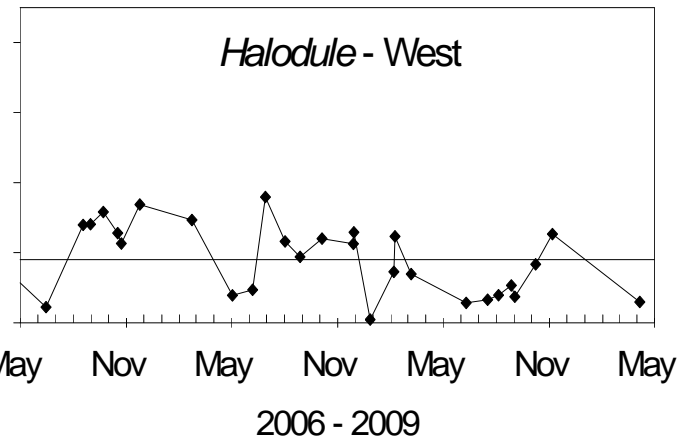
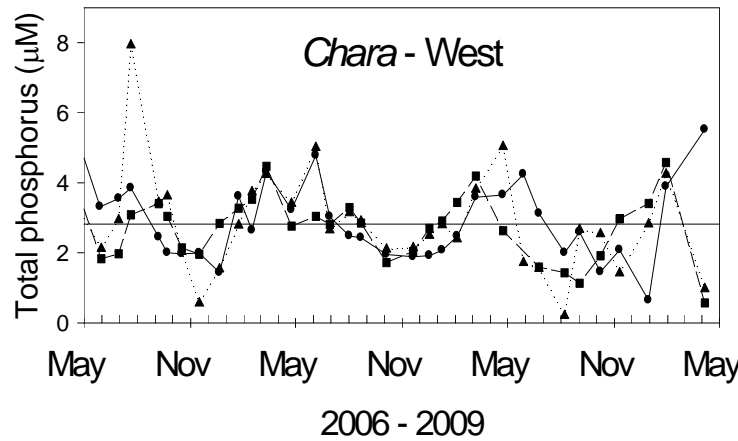
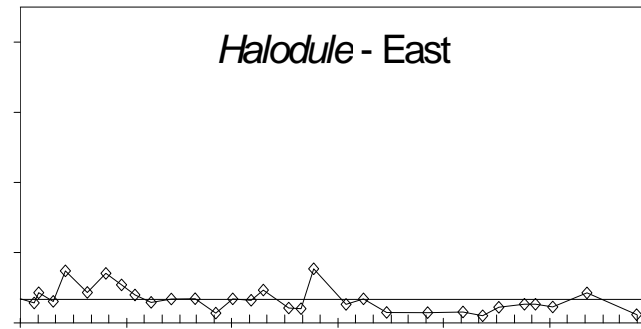
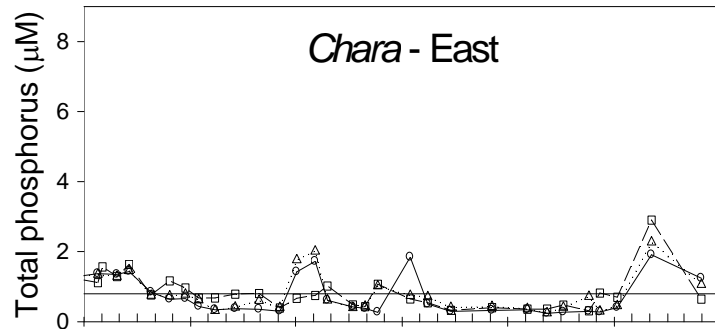
## Results - SAV cover



\* Indicates significant wet vs. dry season differences

SAV cover exhibits inter-annual and seasonal variability

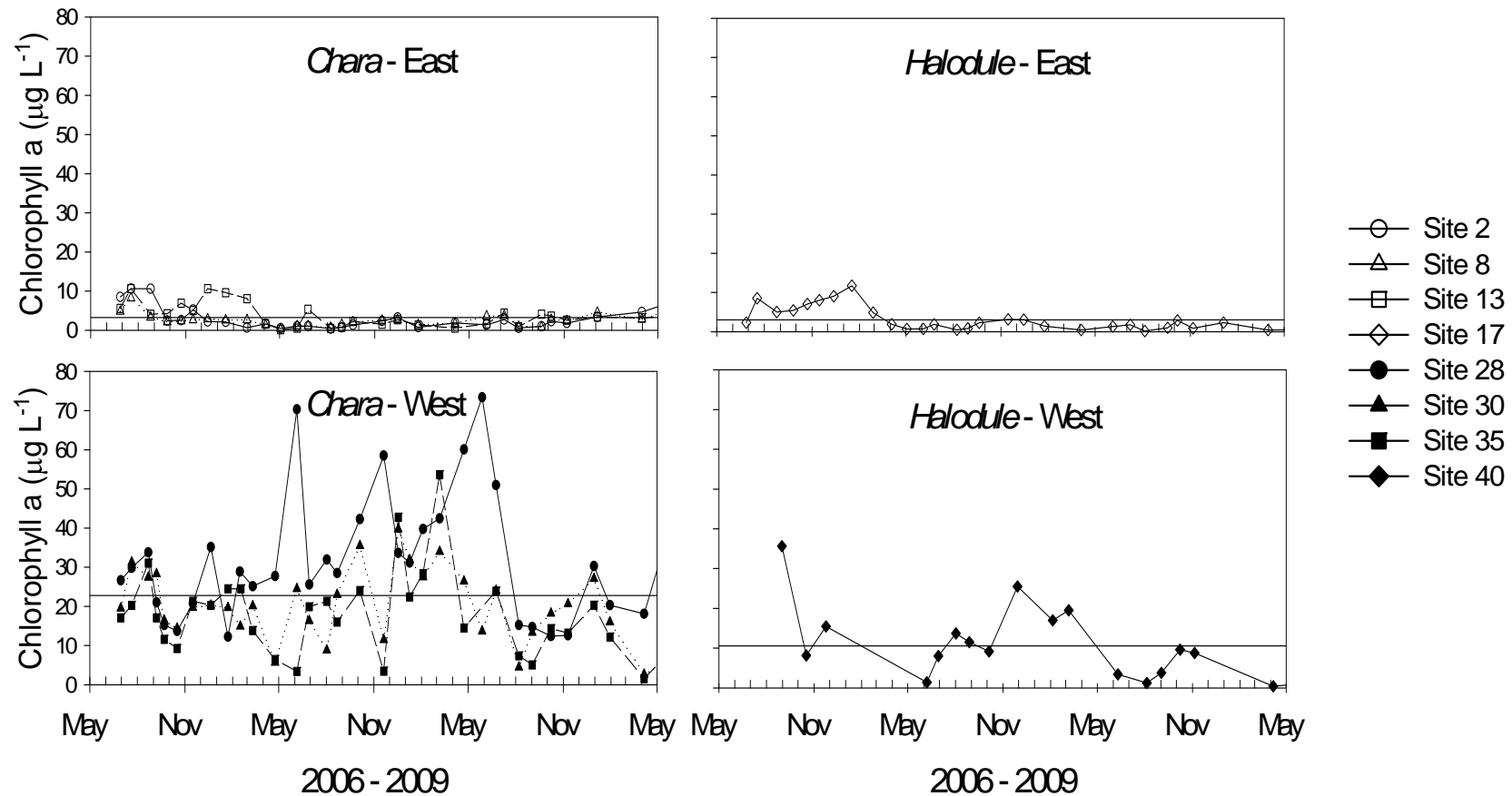
# Results - Nutrients (TP)



- Site 2
- △ Site 8
- Site 13
- ◇ Site 17
- Site 28
- ▲ Site 30
- Site 35
- ◆ Site 40

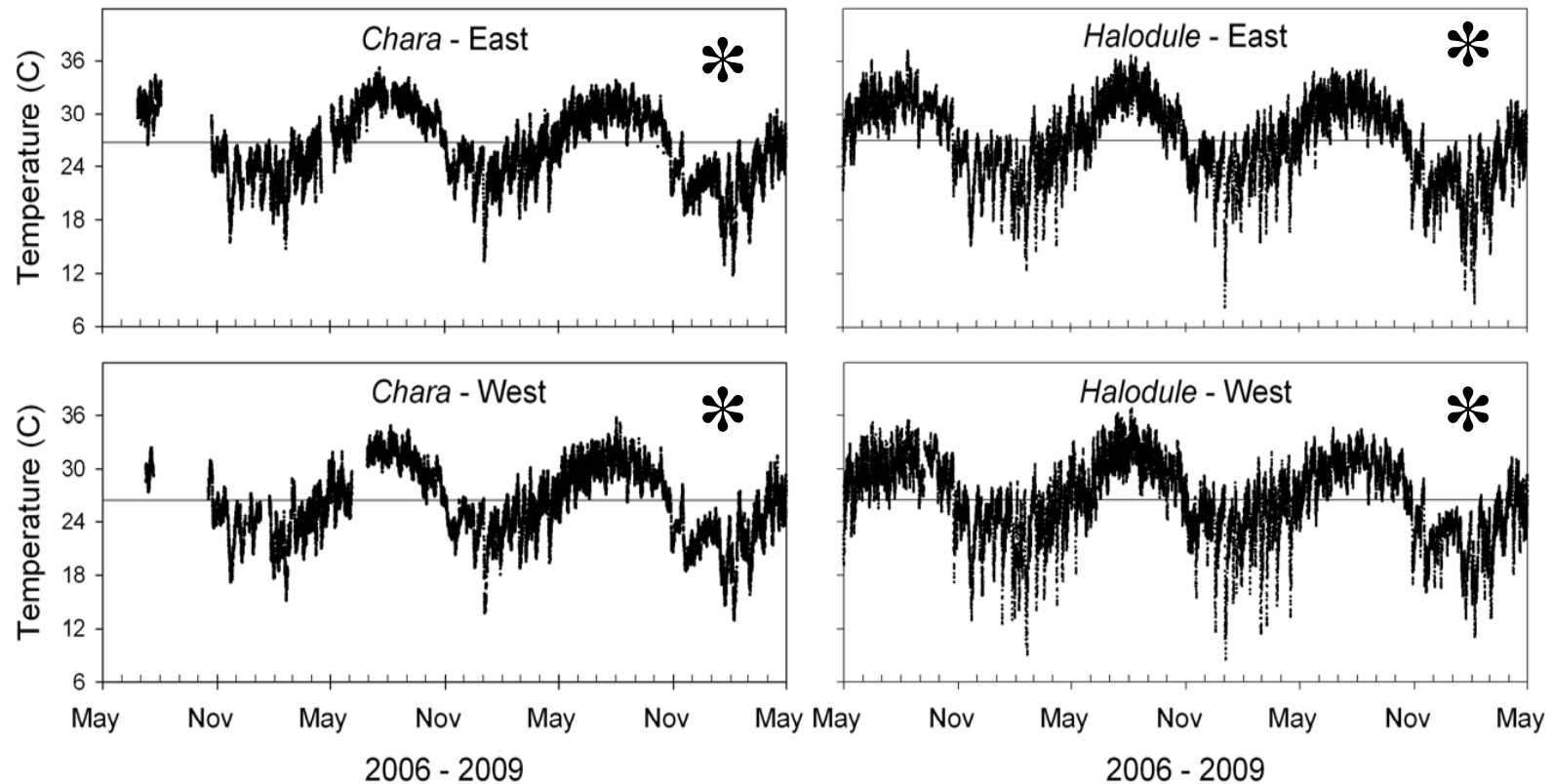
TP did not exhibit inter-annual or seasonal variability

# Results - Phytoplankton



Chlorophyll exhibits inter-annual, but no seasonal variability.

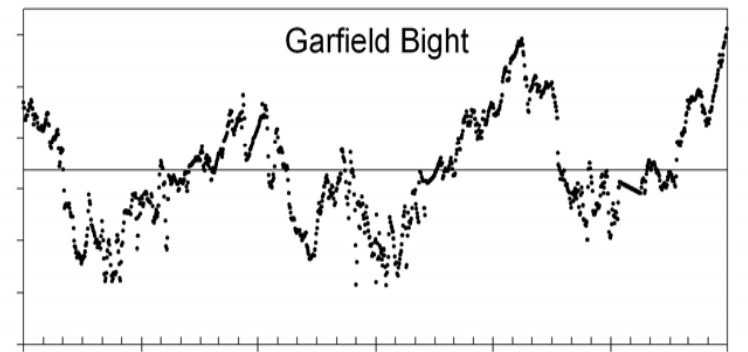
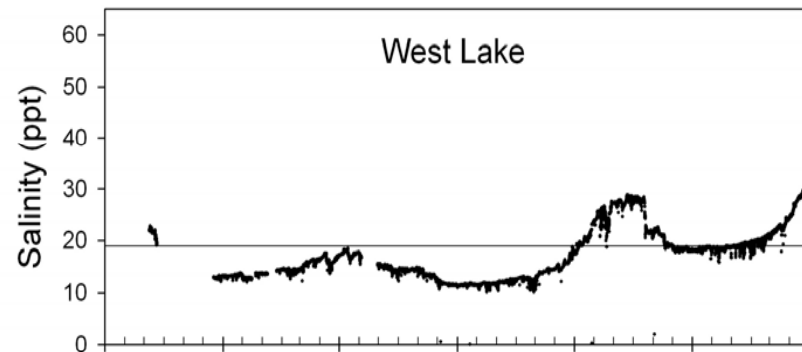
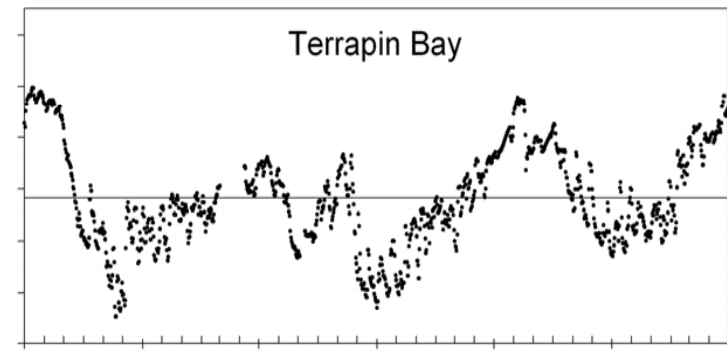
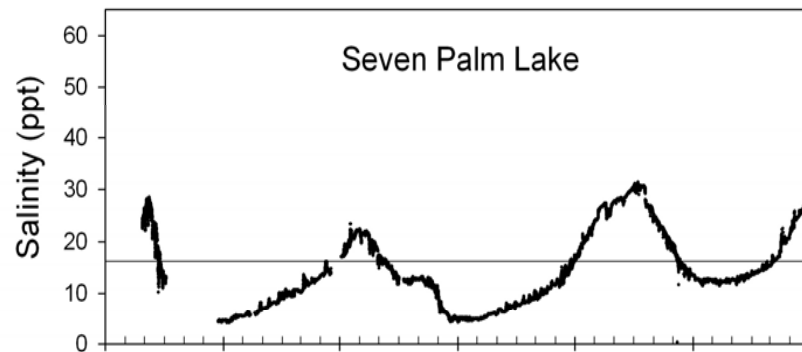
## Results - Temperature



\* Indicates significant wet vs. dry season differences

Temperature exhibits seasonal, but no inter-annual variability.

## Results - Salinity

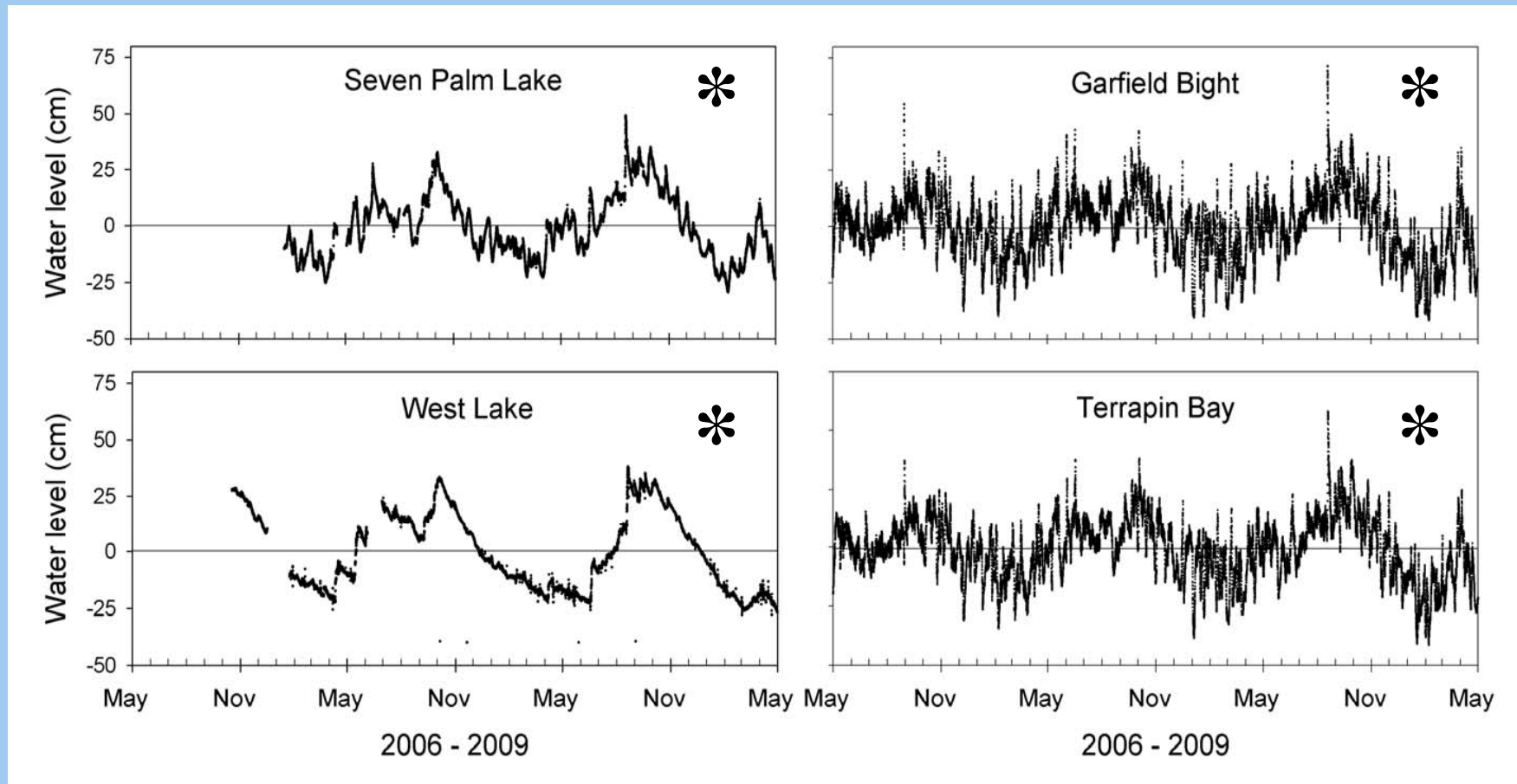


2006 - 2009

2006 - 2009

Salinity exhibits seasonal and inter-annual variability.

## Results - Water level



\* Indicates significant wet vs. dry season differences

Water level exhibits seasonal, but no inter-annual variability.

## Results - Aquatic insolation

		Percent light at bottom	Surface insolation (MJ m <sup>-2</sup> season <sup>-1</sup> )	Bottom insolation (MJ m <sup>-2</sup> season <sup>-1</sup> )
<i>Chara</i> - East				
	Wet	> 23.7	3674	> 871
	Dry	> 23.7	3113	> 738
<i>Chara</i> - West				
	Wet	4.8	3674	<b>33</b>
	Dry	3.6	3113	<b>153</b>
<i>Halodule</i> - East				
	Wet	> 23.7	3674	> 871
	Dry	> 23.7	3113	> 738
<i>Halodule</i> - West				
	Wet	> 23.7	3674	> 871
	Dry	> 23.7	3113	> 738

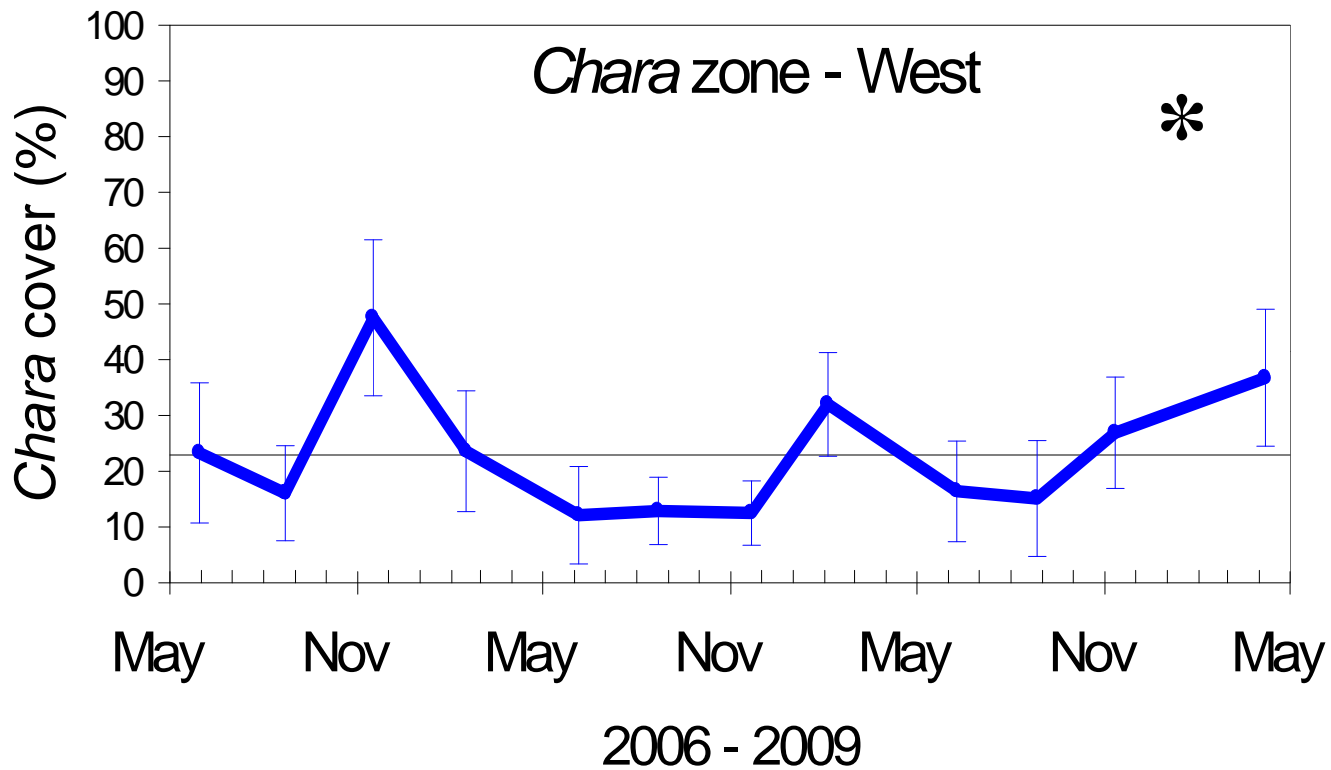
During the Dry season, light availability in  
*Chara* - West was approx. 5x greater.



## Conclusions

Seasonal and inter-annual variability present in SAV and WQ variables

Only *Chara* - West community exhibits wet vs dry seasonal differences



Higher Chara cover during the dry season

## Conclusions

Seasonal and inter-annual variability present in SAV and WQ variables

Only *Chara* - West community exhibits wet vs dry seasonal differences

Greater *Chara* coverage was coincident with:

Lower temperatures

Lower water levels

Higher aquatic insolation

SAV communities with ample light did not exhibit wet vs dry seasonality

		Bottom insolation (MJ m <sup>-2</sup> season <sup>-1</sup> )
<i>Chara</i> - East		
	Wet	> 871
	Dry	> 738
<i>Chara</i> - West		
	Wet	<b>33</b>
	Dry	<b>153</b>
<i>Halodule</i> - East		
	Wet	> 871
	Dry	> 738
<i>Halodule</i> - West		
	Wet	> 871
	Dry	> 738

*SAV* communities with ample light did not exhibit wet vs dry seasonality

## Conclusions

Adequate light availability is essential for the restoration of *Chara* communities along the Everglades ecotone, but previous focus on the role of salinity has overlooked possible importance of light availability and its controlling factors.

## Acknowledgments

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