



# Calcification in a Changing Ocean Environment

Thank you to:  
FKNMS - Brian Keller,  
Joanne Delaney  
NPS - M/V *Ft. Jeff* crew,  
Dave Hallac, PJ Walker



# How is the ocean changing?

- 1) Temperature – warming
- 2) Chemistry – “ocean acidification”

Month	Mean	p-value	Max	p-value	Min	p-value
JAN	+	0.03	+	0.01	=	0.08
FEB	+	0.04	+	0.04	+	0.04
MAR	+	0.05	+	0.04	=	0.06
APR	=	0.30	=	0.24	=	0.51
MAY	=	0.14	+	0.04	=	0.13
JUN	+	0.02	+	0.04	+	0.01
JUL	=	0.20	=	0.06	=	0.71
AUG	+	0.003	+	0.002	=	0.11
SEP	=	0.19	+	0.02	=	0.99
OCT	=	0.59	=	0.74	=	0.51
NOV	=	0.93	=	0.86	=	0.72
DEC	=	0.64	=	0.97	=	0.42

# How is the ocean changing?

- 1) Temperature – warming
- 2) Chemistry – “ocean acidification”

$\text{CO}_2$



$\text{CO}_2(\text{aq})$



$\text{H}_2\text{CO}_3$

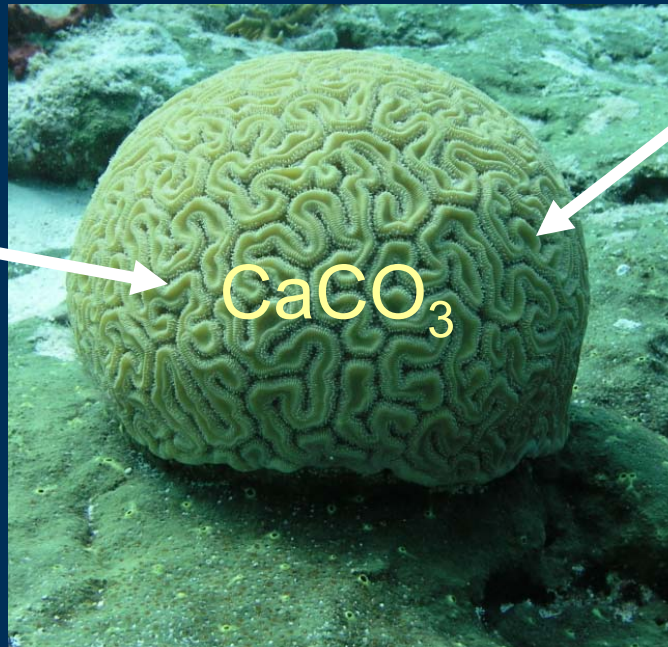


$\text{HCO}_3^- + \text{H}^+$



$\text{CO}_3^{2-} + \text{H}^+$

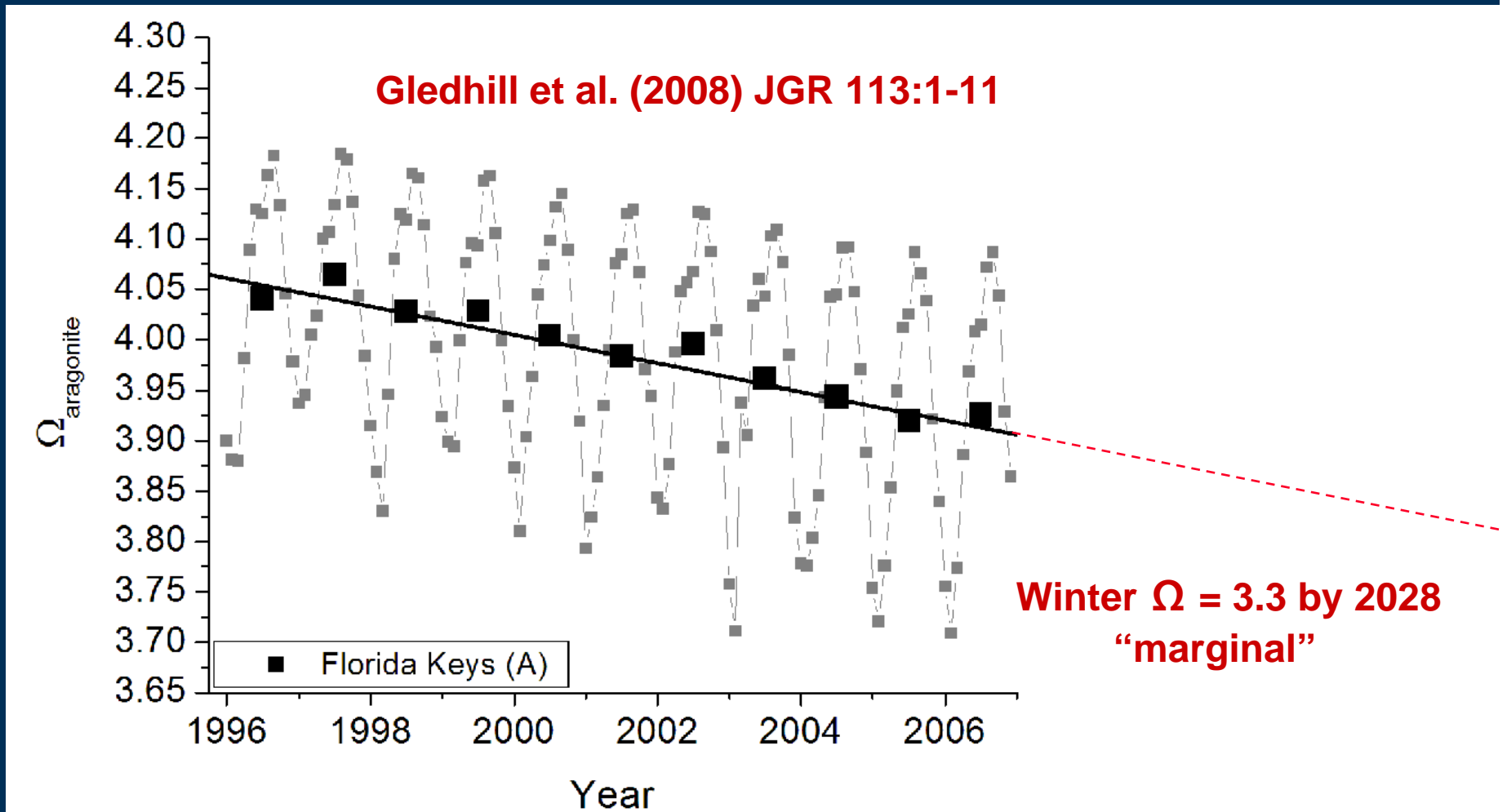
$\text{Ca}^{2+}$

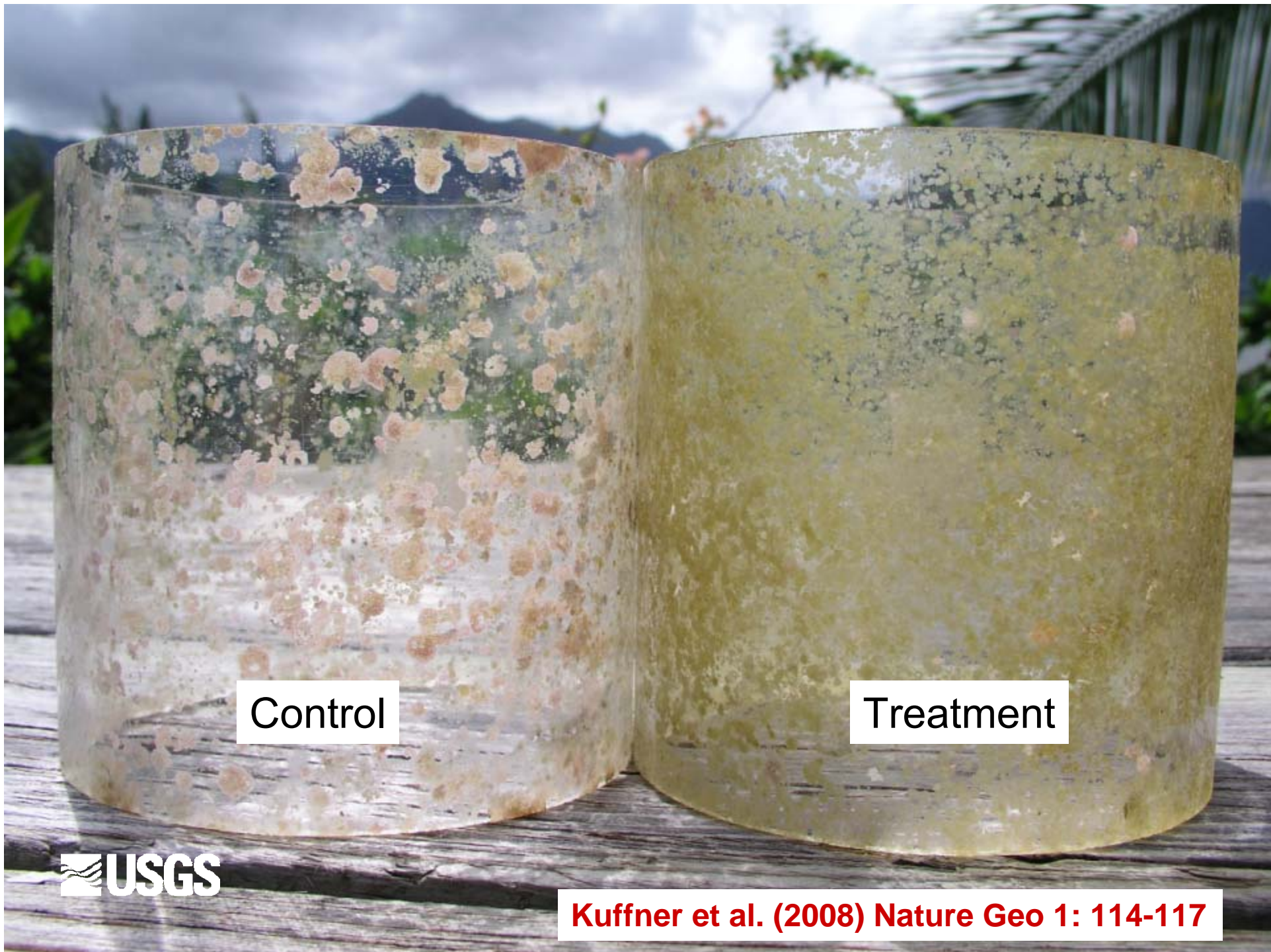


$\text{CaCO}_3$

$$\Omega = \frac{[\text{Ca}^{2+}][\text{CO}_3^{2-}]}{K'_{\text{sp}}}$$

# Declining $\Omega_{\text{aragonite}}$





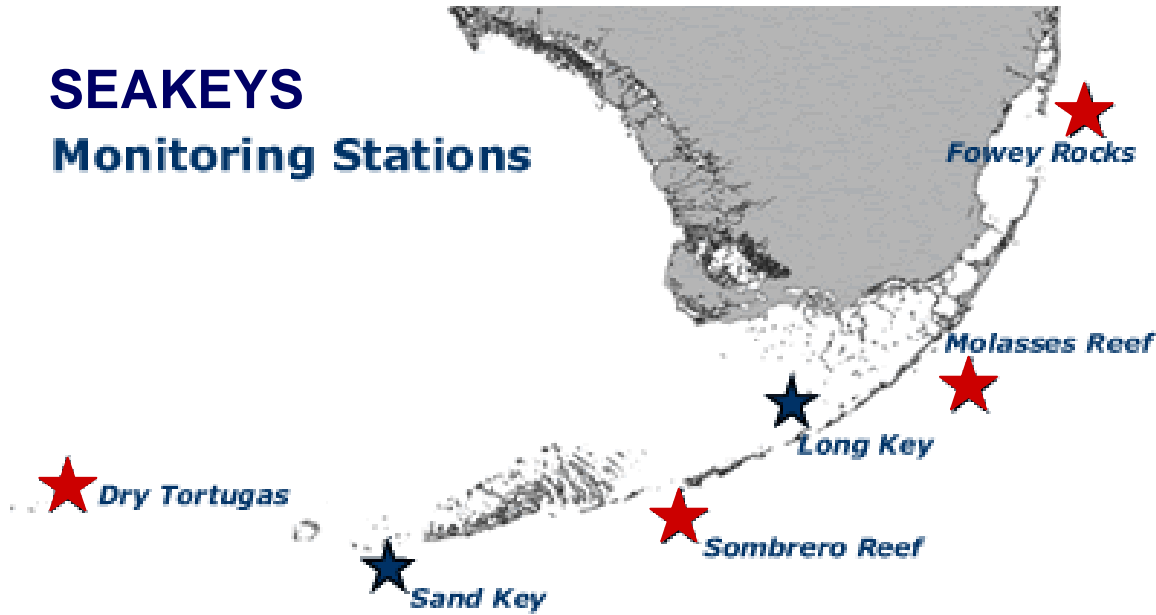
Control

Treatment

 USGS

**Kuffner et al. (2008) Nature Geo 1: 114-117**

# SEAKEYS Monitoring Stations



## Measure:

- Calcification rate
- Linear extension
- Density
- Sr/Ca temp proxy



*Siderastrea siderea*

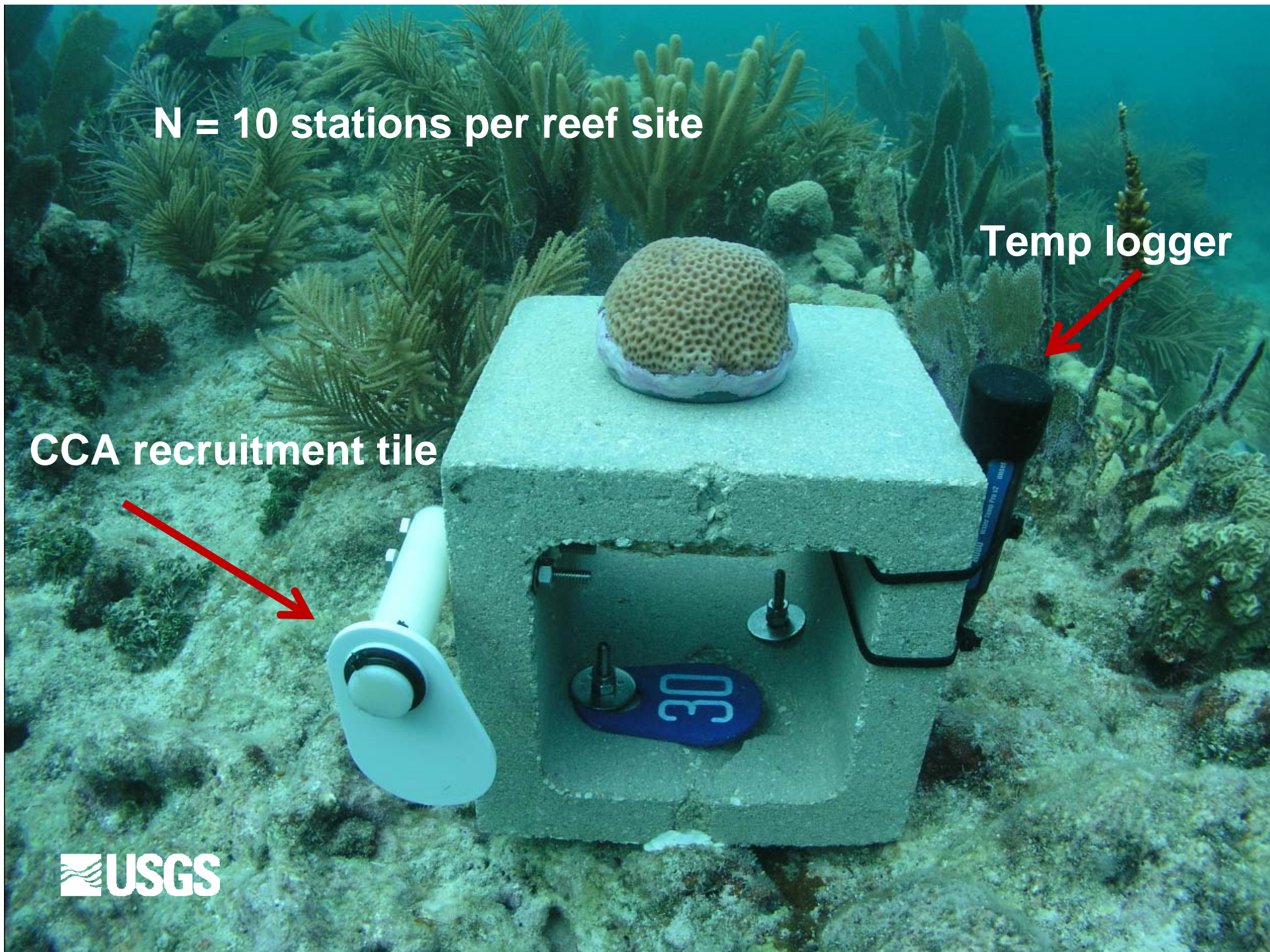


Encrusting community

N = 10 stations per reef site

Temp logger

CCA recruitment tile



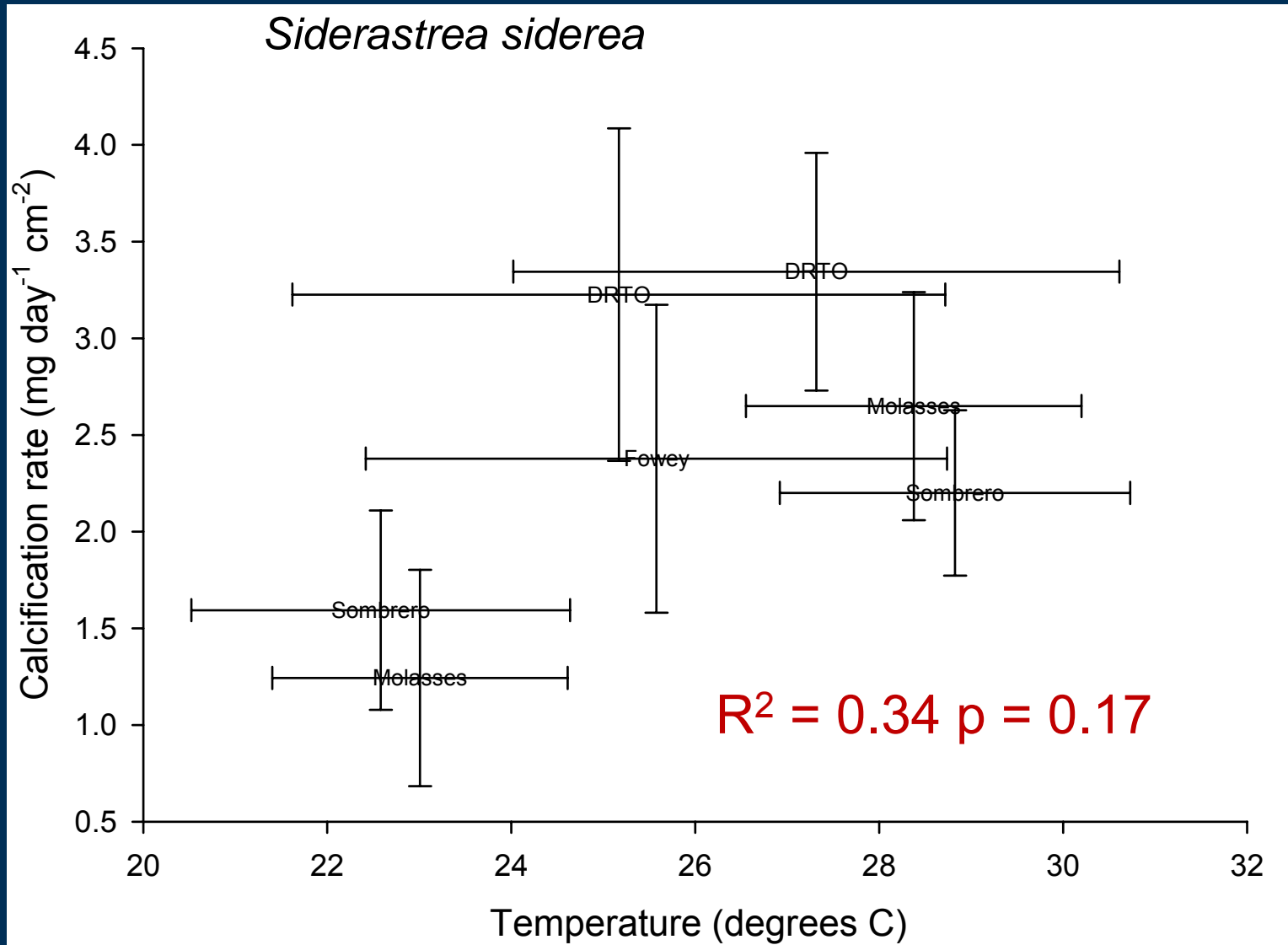


Methods:

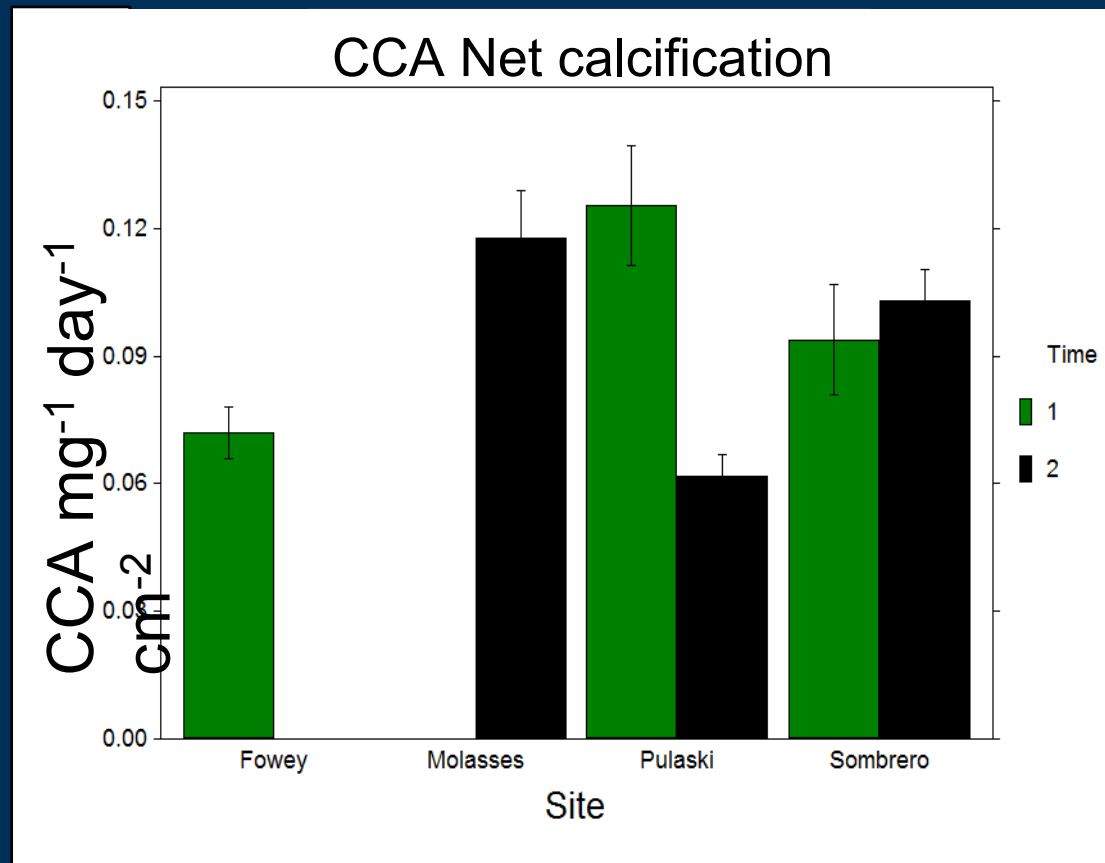




# Results:

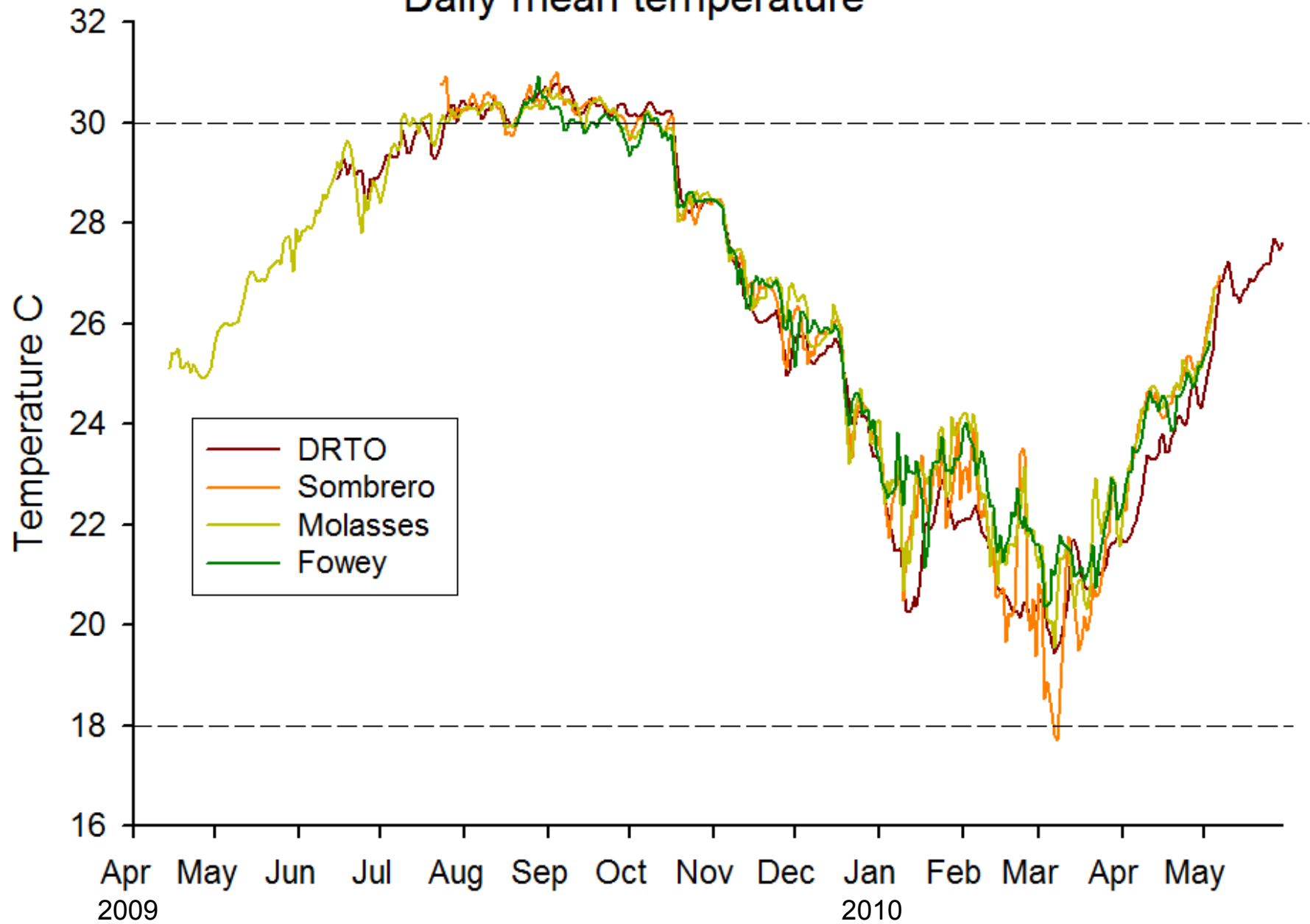


# Results:

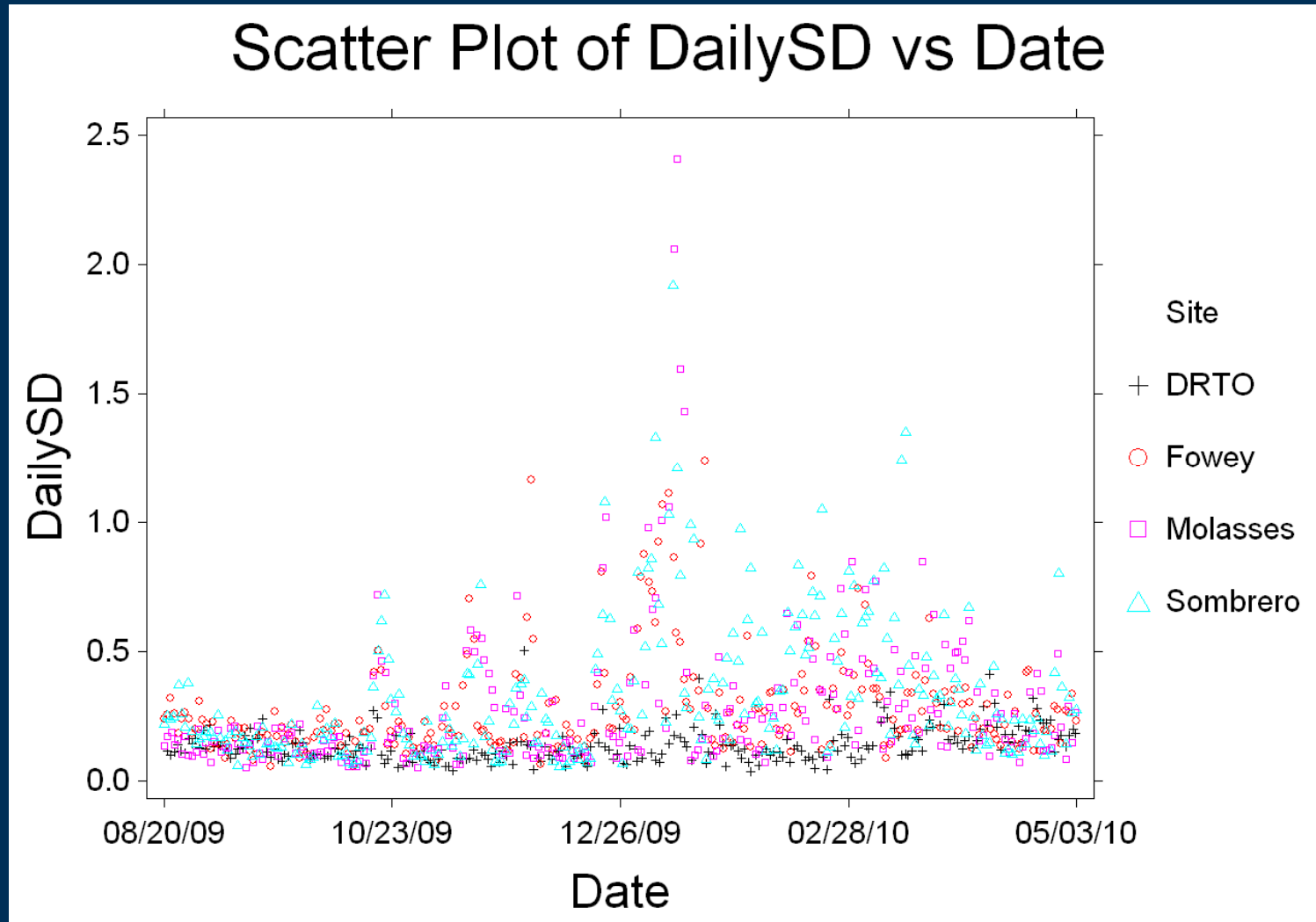


# Results:

## Daily mean temperature



# Results:



# Summary of preliminary results

- Coral calcification seasonal, ~ 35% slower in winter vs. summer
- Coral >> than CCA calcification
- DRTO coral calcification > than other sites
- Temperature less variable on diurnal scale at DRTO