

# Major decline in coastal phytoplankton populations and species diversity shift in the Southern California Bight during anomalous warm conditions of 2014-2015

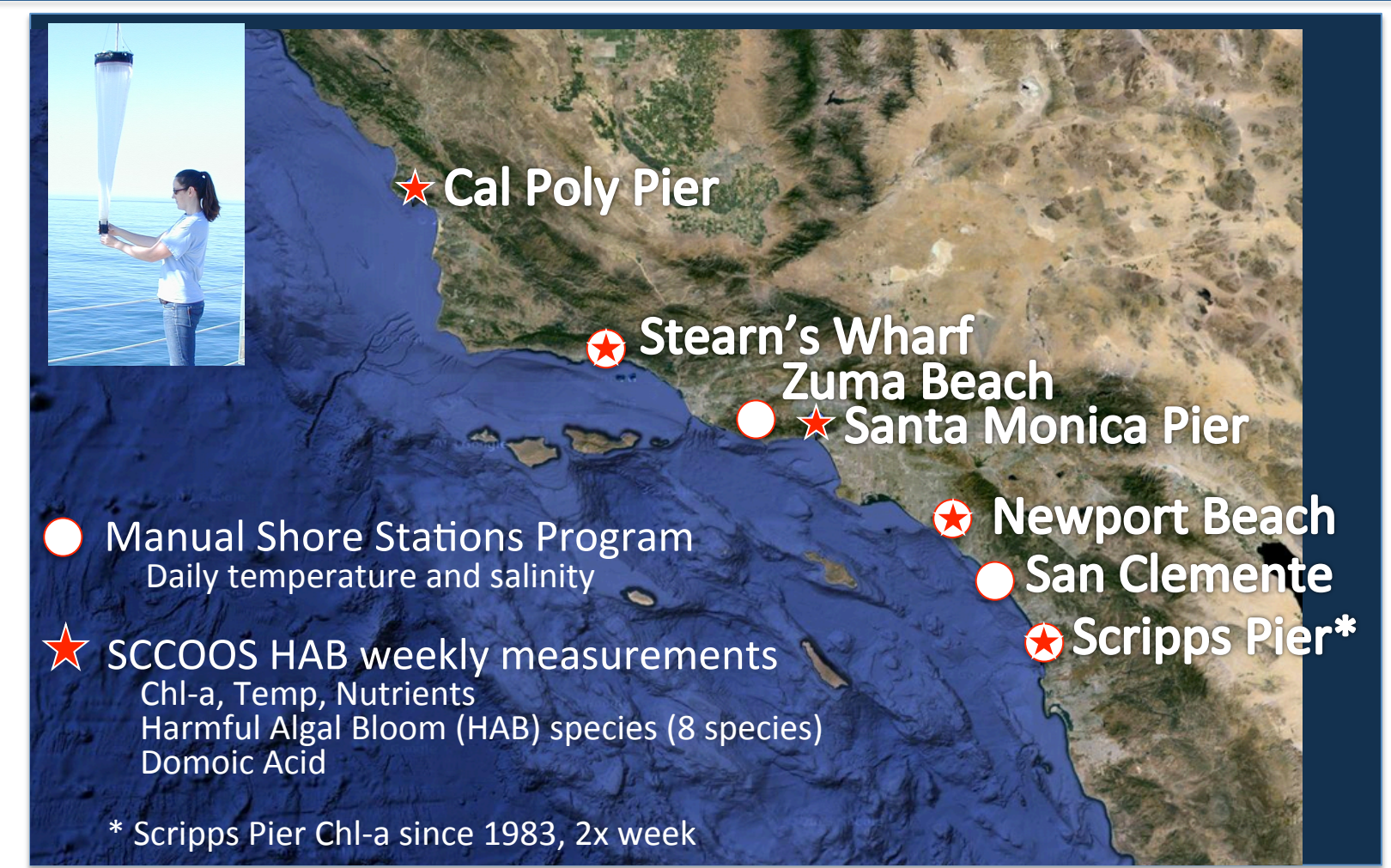
Melissa L. Carter, John McGowan, and Mary Hilbern  
Scripps Institution of Oceanography

## Baseline Data:

Manual Shore Stations Program (MSS)– Scripps Pier since 1916  
Scripps Pier Longterm Datasets – various programs since 1917  
SCCOOS Pier Based HAB Monitoring – 5 piers in SoCal since Aug 2008

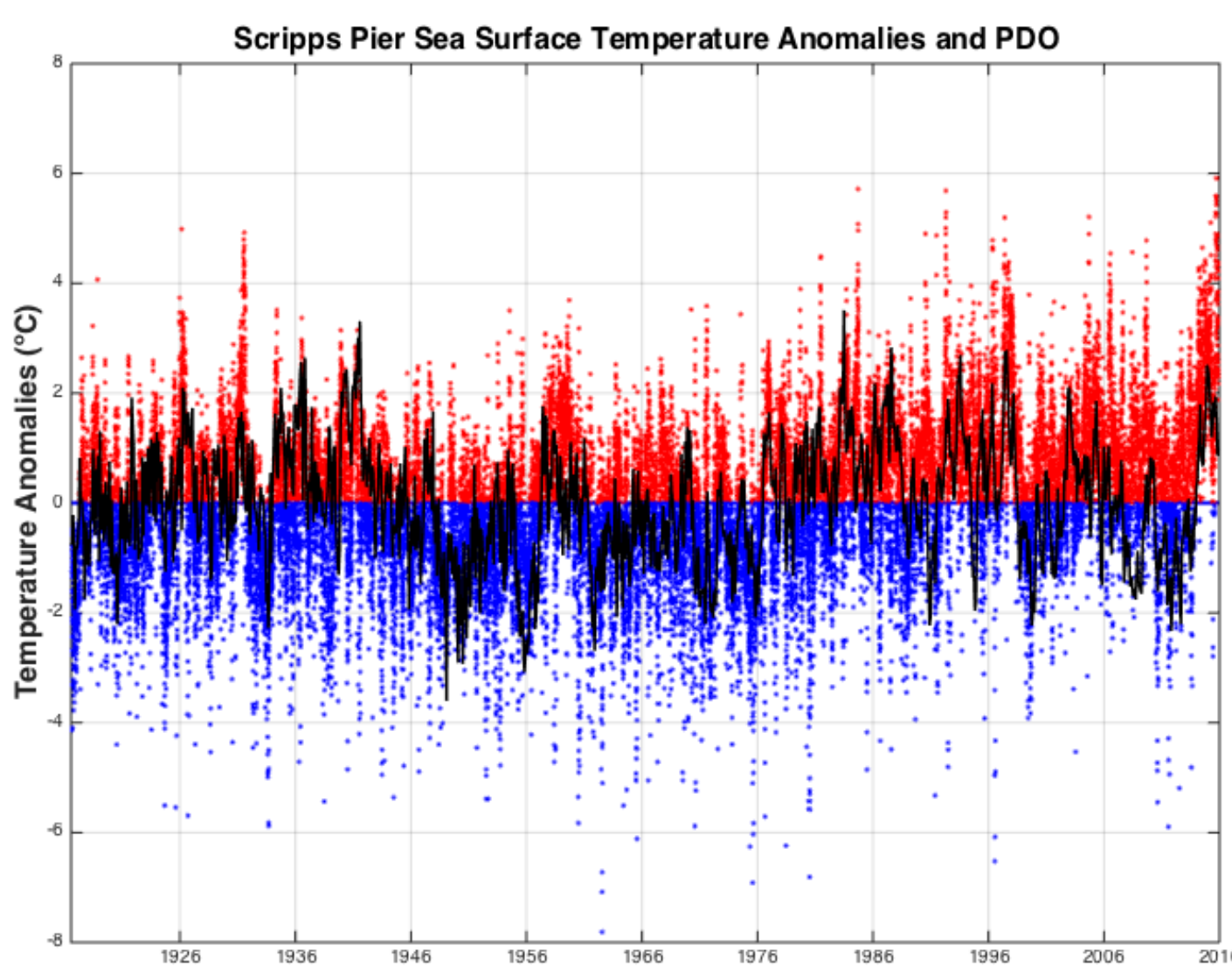
	Cell Counts	Chlorophyll	Nutrients	Temperature	Salinity
Shore Station*	-----	-----	-----	1916-2016	1916-2016
E. W. Allen	1917-1939	-----	-----	MSS	MSS
McGowan et al.	-----	1983-2000	1986-2000	1983-2000	1983-2000
Busse et al.	1992-2000, 2003-2007	2003-2005	2003-2005	2003-2005	2003-2005
SCCOOS HABs	2008-2016	2008-2016	2008-2016	2008-2016	2008-2016

\* Shore Station collection dates for Scripps Pier

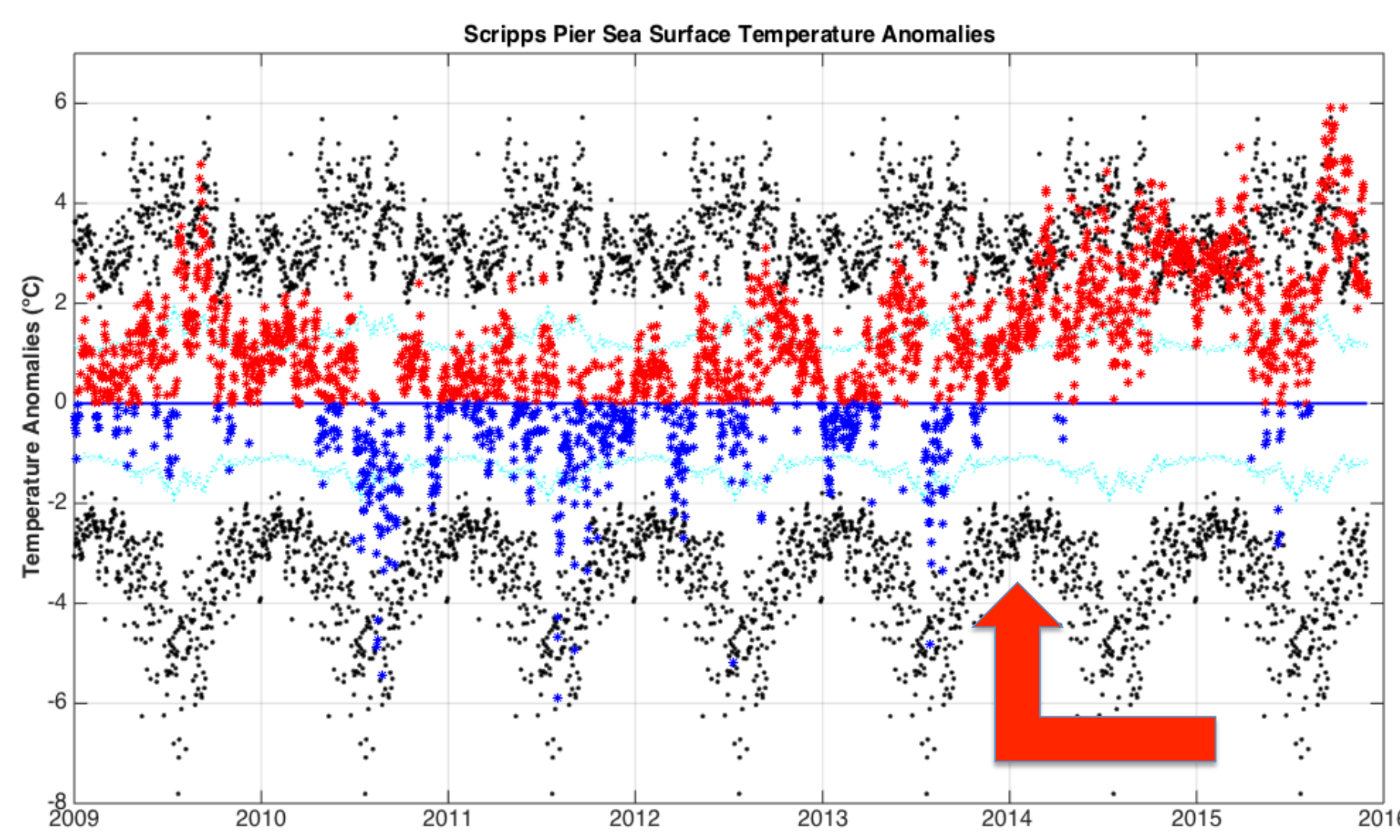


For more information and data access go online:  
Manual Shore Stations <https://shorestations.ucsd.edu>  
SCCOOS Harmful Algal Bloom (HAB) <http://www.sccoos.org/data/habs/>

## Setting the stage...SST conditions at Scripps Pier



SIO temps  
2009 - 2016



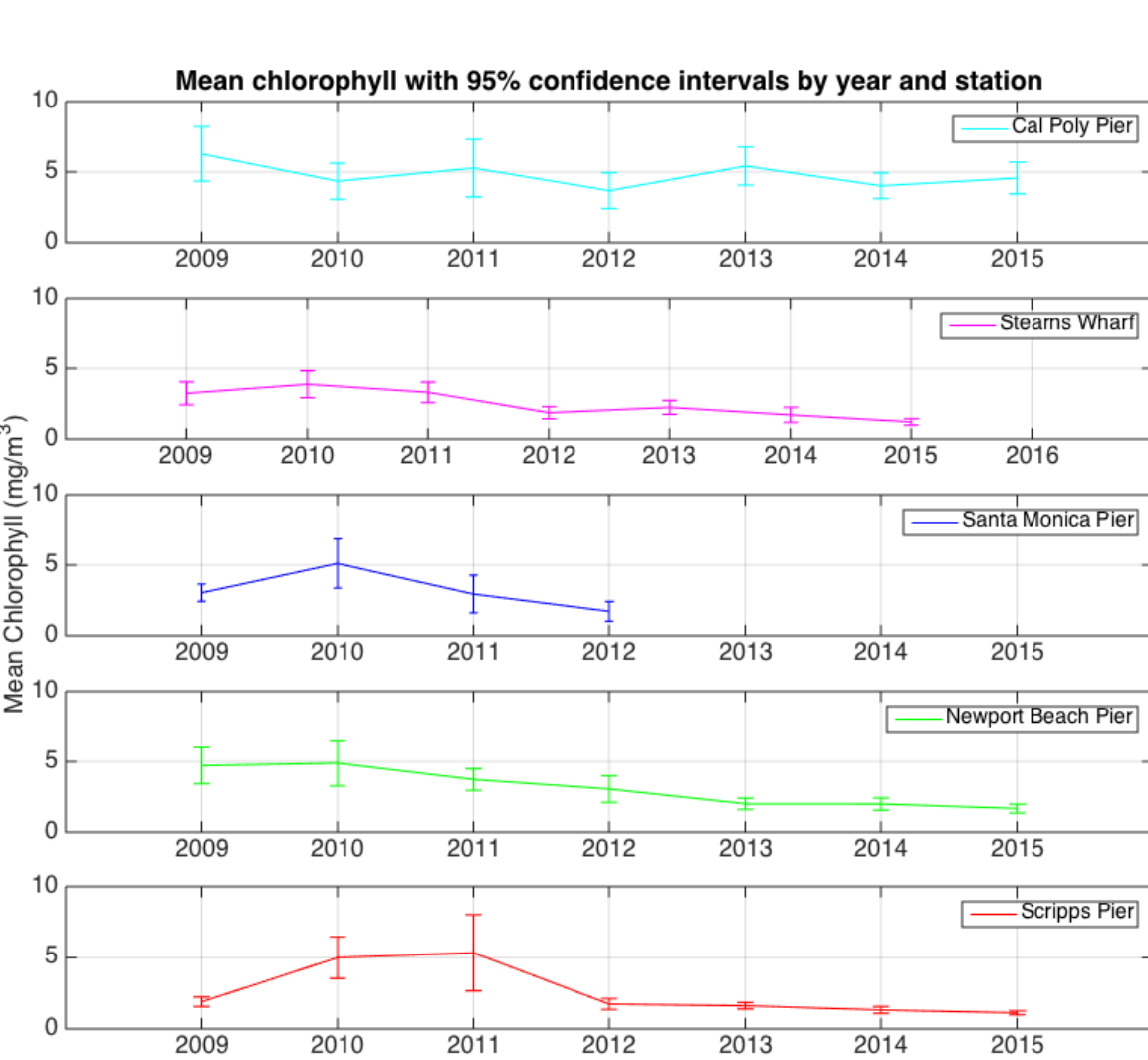
2014 and 2015 had the greatest # of max temp records over 100 years:  
2014 = 98 max records  
2015 = 110 max records

Strong positive anomaly starts ~2014 and continues...

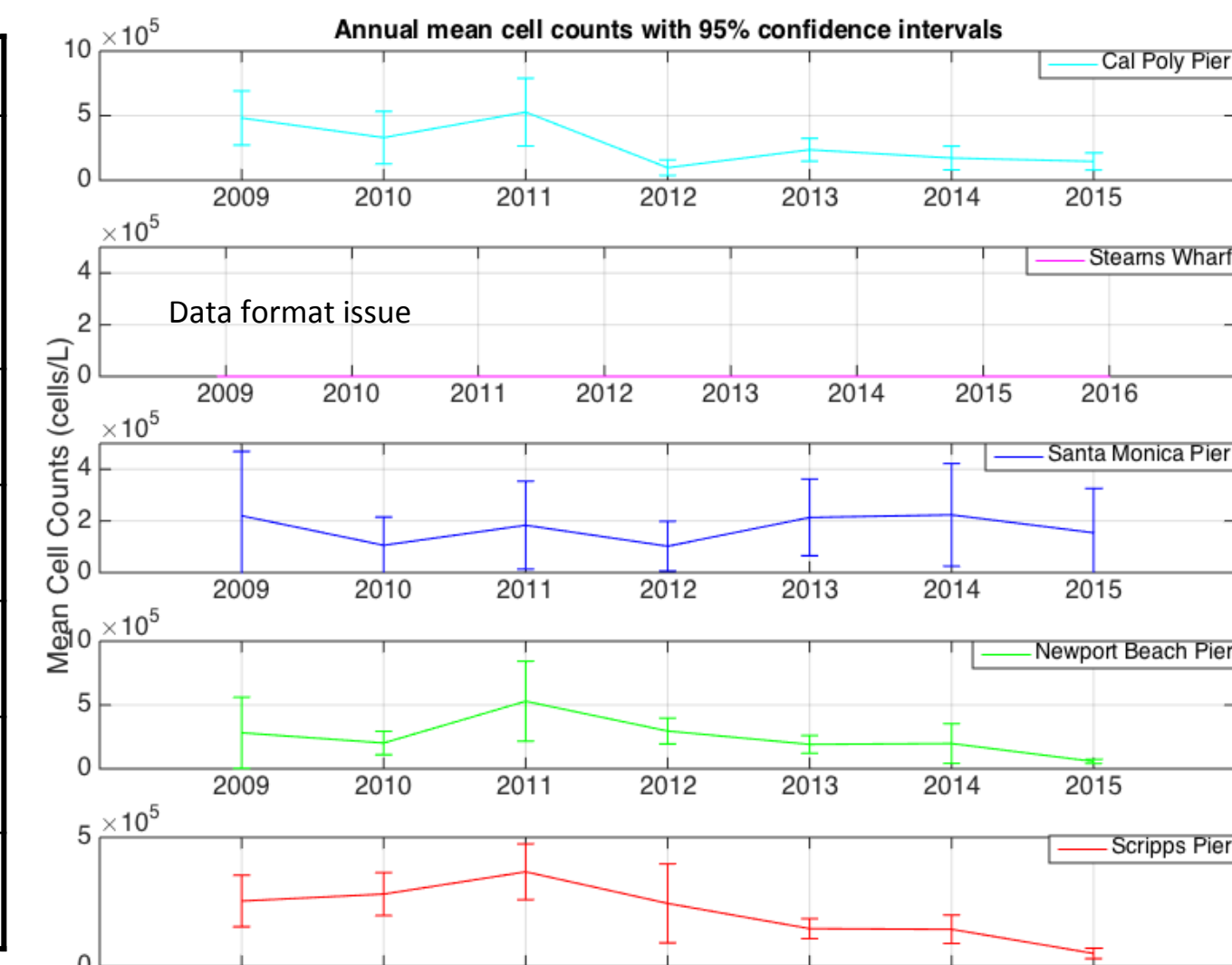
Daily Scripps Pier temperatures anomalies (\*positive; \*negative) plotted with monthly Pacific Decadal Oscillation (PDO, black line).  
Scripps Pier anomalies representative of larger area (McGowan et al., 1998)

Daily Scripps Pier temperatures anomalies (\*positive; \*negative) from 98 year annual cycle, plotted with 98 year maximum and minimum annual cycle (\*repeated annually) and 98 year standard deviation annual cycle (...repeated annually).

## Biological response of phytoplankton to anomalous conditions



	Chlorophyll (mg/L)			Cell Counts (cells/L)		
	5 yr mean Jul 2008 Jul 2013	"warm period" Jan 2014 Dec 2015	% change	5 yr mean Jul 2008 Jul 2013	"warm period" Jan 2014 Dec 2015	% change
Cal Poly Pier	5.92 (n = 191)	4.31 (n = 95)	-27%	358,665 (n = 253)	159,151 (n = 95)	-56%*
Stearn's Wharf	3.04 (n = 251)	1.61 (n = 64)	-47%	----- (n = 251)	----- (n = 99)	-----
Santa Monica Pier	3.42 (n = 230)	---	---	155,023 (n = 259)	190,911 (n = 98)	+19%
Newport Beach Pier	3.84 (n = 251)	1.84 (n = 100)	-52%*	287,711 (n = 252)	129,589 (n = 99)	-55%*
Scripps Pier	3.09 (n = 269)	1.22 (n = 101)	-61%*	246,728 (n = 269)	105,306 (n = 89)	-57%*

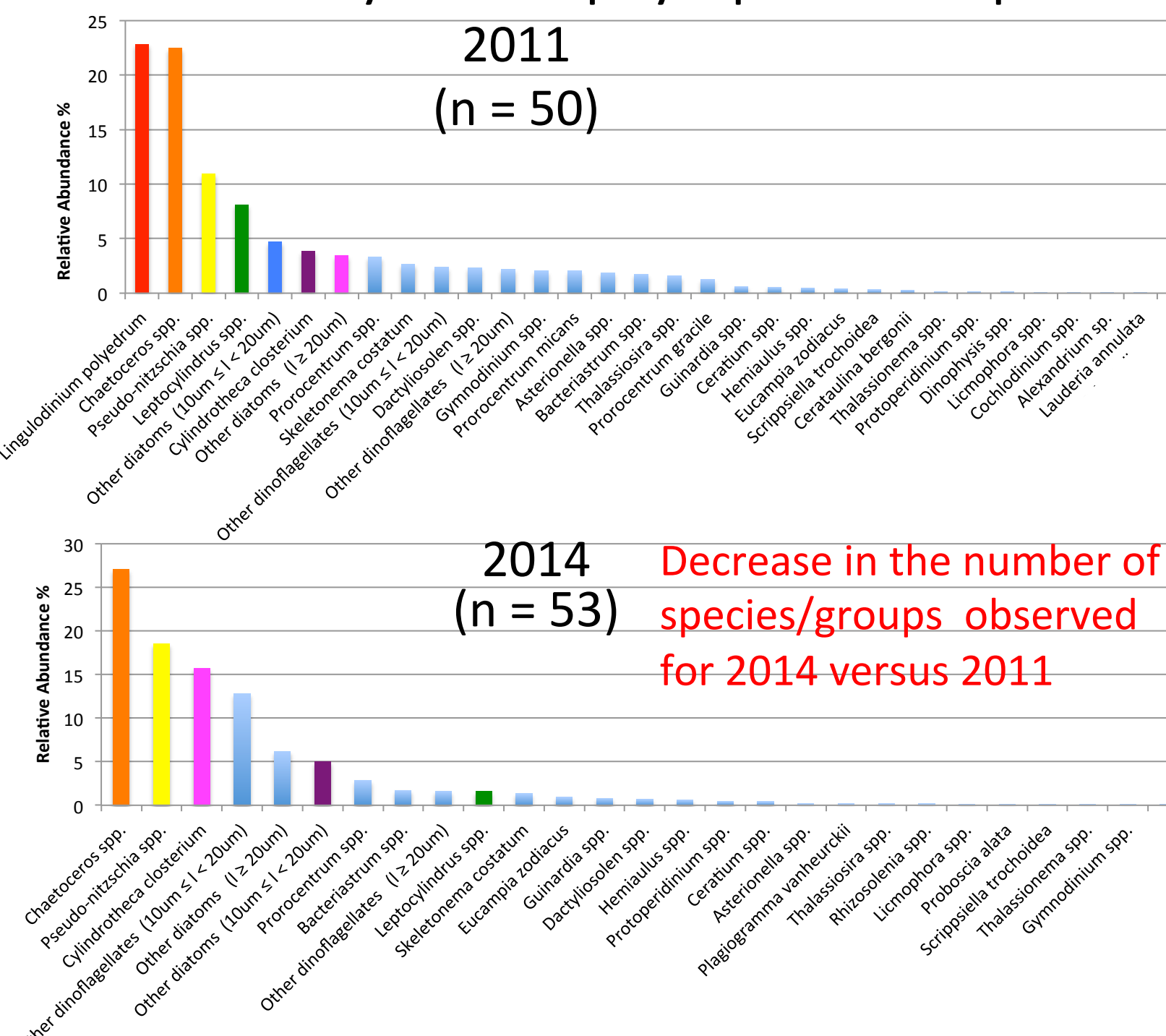


Annual mean chlorophyll concentration (left figures) and cell counts (phytoplankton >20um, right figures) calculated with 95% confidence intervals for each SCCOOS Pier HAB station in southern California

\* Decrease in chlorophyll and cell counts to less than half of the 5yr mean biomass! \*

SCCOOS HAB collaborators include Ian Robbins and Megan Wilson at Cal Poly; Mark Brezinski, Heather McNair and Jo Goodman at Stearn's Wharf (UCSB); Rebecca Shipe at Santa Monica (UCLA); David Caron, Jayme Smith, Erica Seubert and Alyssa Gellene at Newport Beach (USC).

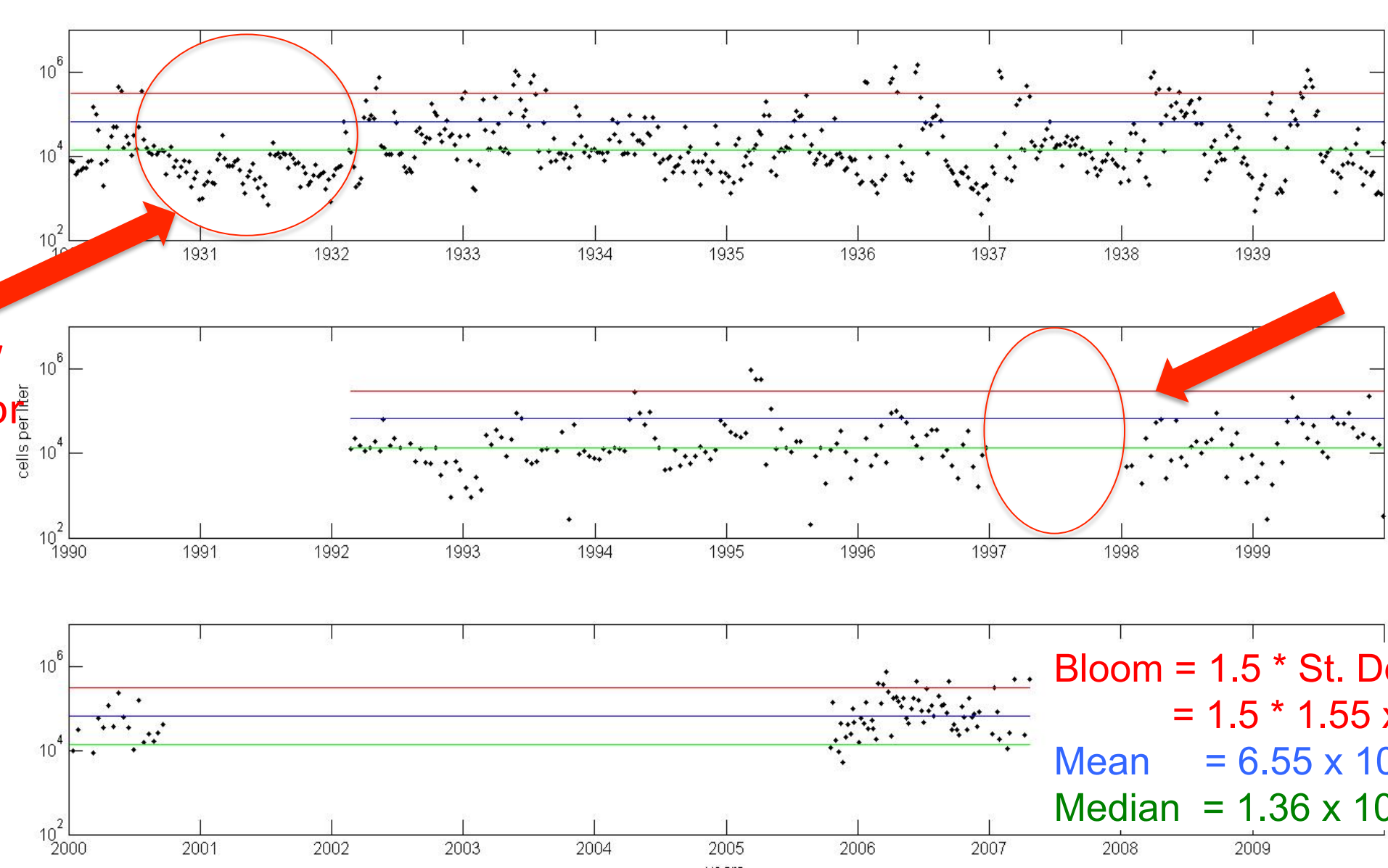
## Preliminary look at phytoplankton species diversity and abundance at Scripps Pier



Decrease in the number of species/groups observed for 2014 versus 2011

Historical and recent decadal phytoplankton cell counts: Looking at other "warm periods" in 1931-32 and 1997-98

Warm period in 1931-32 also associated with decreased cell counts to below median levels for over a year



Large scale L. Poly bloom for 2 months in 1997. Samples bad from storage. April – May  
Chl max = 182 mg/L  
Chl mean = 30.61 mg/L

Bloom = 1.5 \* St. Dev. + Mean  
= 1.5 \* 1.55 x 10<sup>5</sup> cells/L  
Mean = 6.55 x 10<sup>4</sup> cells/L  
Median = 1.36 x 10<sup>4</sup> cells/L