Please Take the Driver's Seat:
A Cyanobacteria Monitoring Program For Your Needs

An Emerging Concern-Cyanobacteria in Freshwater Ponds April 5, 2019

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Cyanobacteria Monitoring Collaborative

Proverbial Jim Haney quotes

"All monitoring is local"

"Keep it simple, we have an army to train"

"It's their data, show them how to use it"

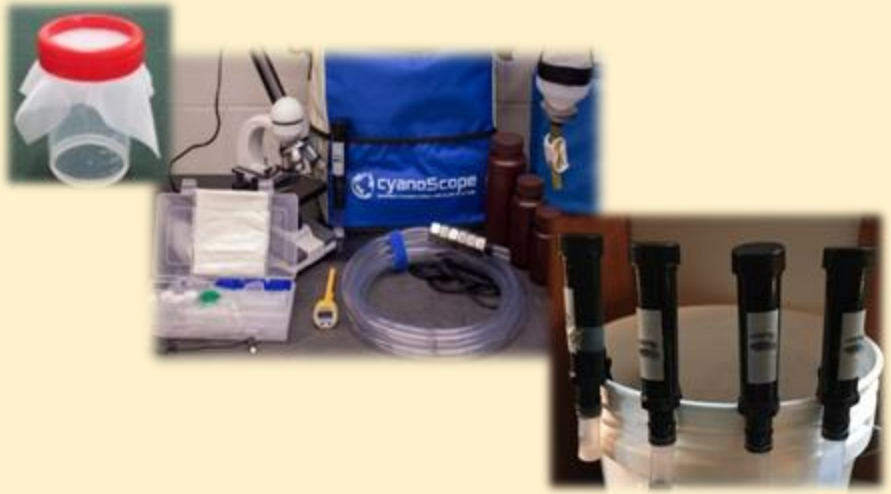
WHY ???

Citizen Scientists

Advocates, local staff, researchers

Equipment

<50 µm, WLW, BFC isolates



Methods

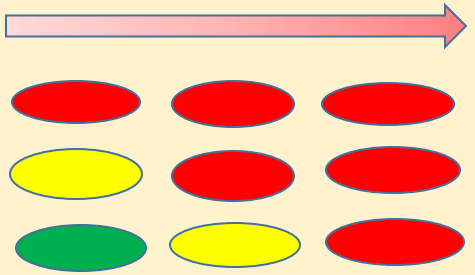
Fluorometry:
Single Freeze-Thaw (SFT)

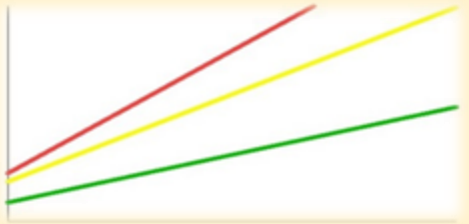
ELISA analysis:
Speed-vac (2-20X)

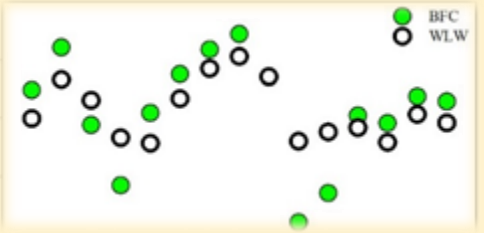
Cape Cod, MA

2017-6 sites

2018-34 sites

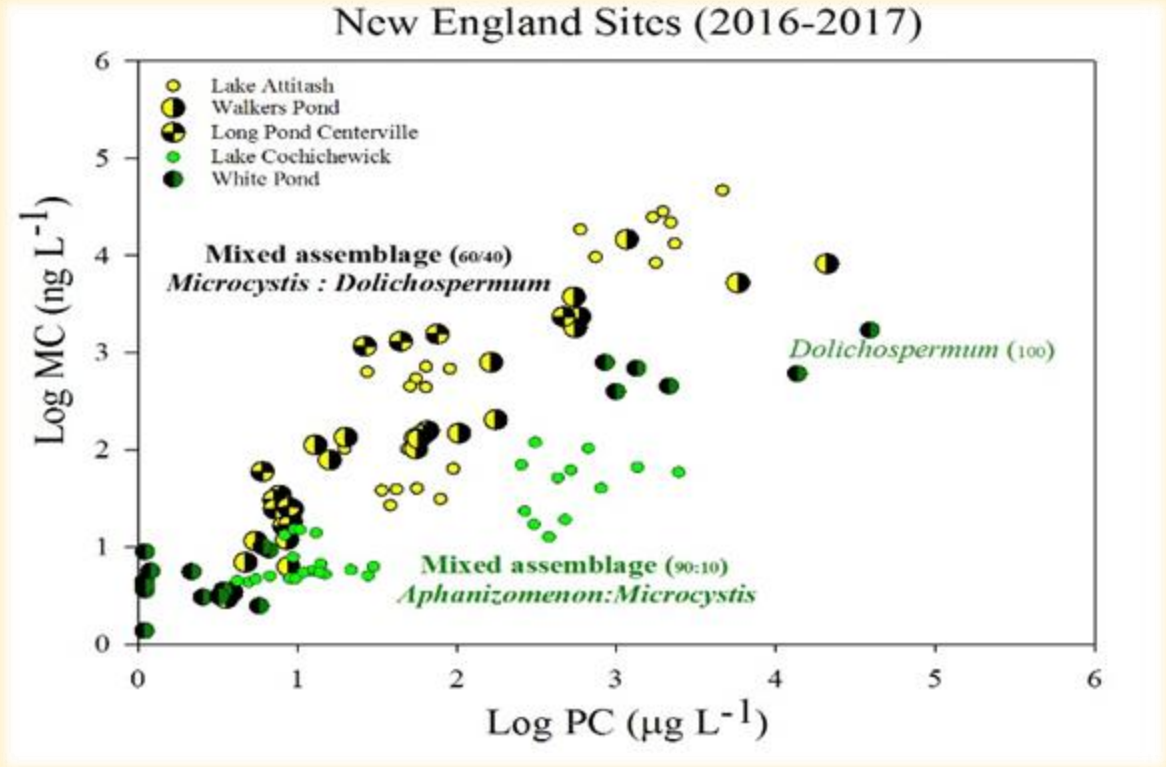




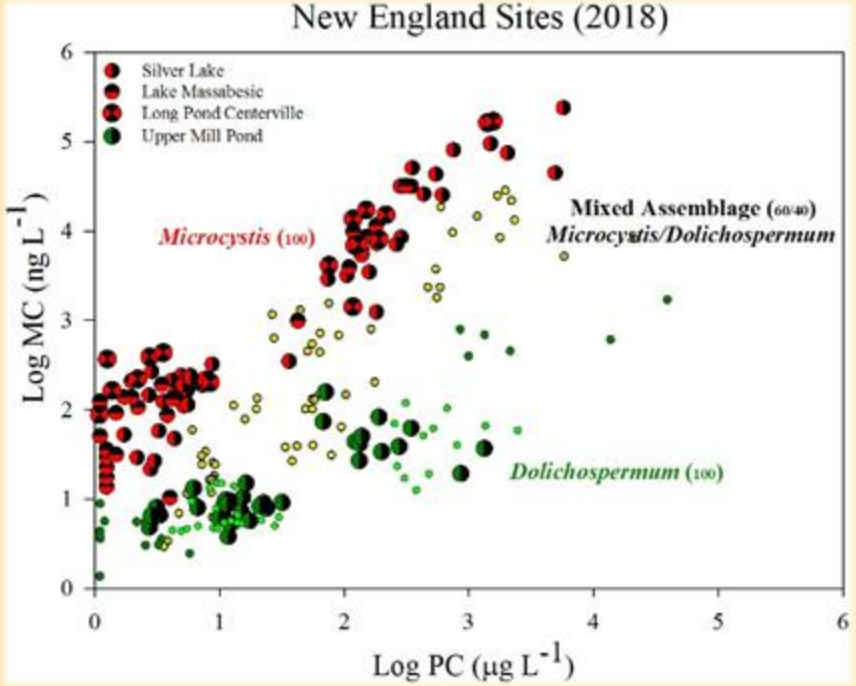


<u>This is where we started</u>

Composition



This is where we are
Composition and Dominance

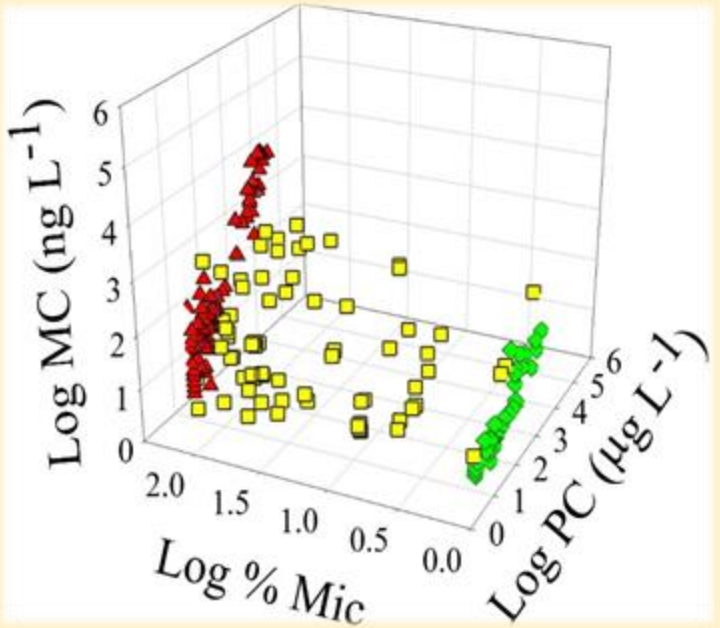


The BFC Data Sheet

Semi-Quantitative Analysis for Bloom Forming Cyanobacteria (BFC's)

Count (1st 100 observations)

Observed Dominance (%)



Log % Mic
Log MC

Log PC

This is where we're going

Composition, Dominance and Growth

Growth Rate (GR) or Resilience Indicators (RI)

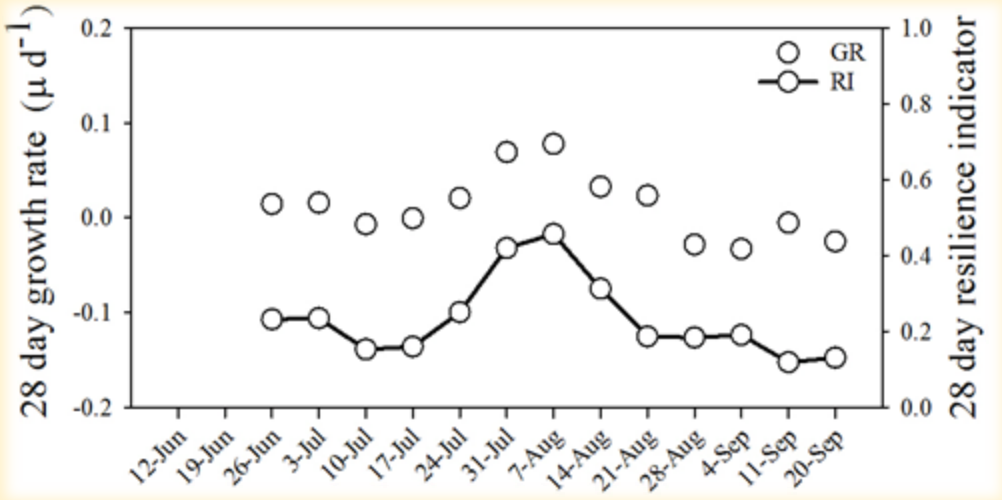
Variance of environmental indicator increases during critical transitions

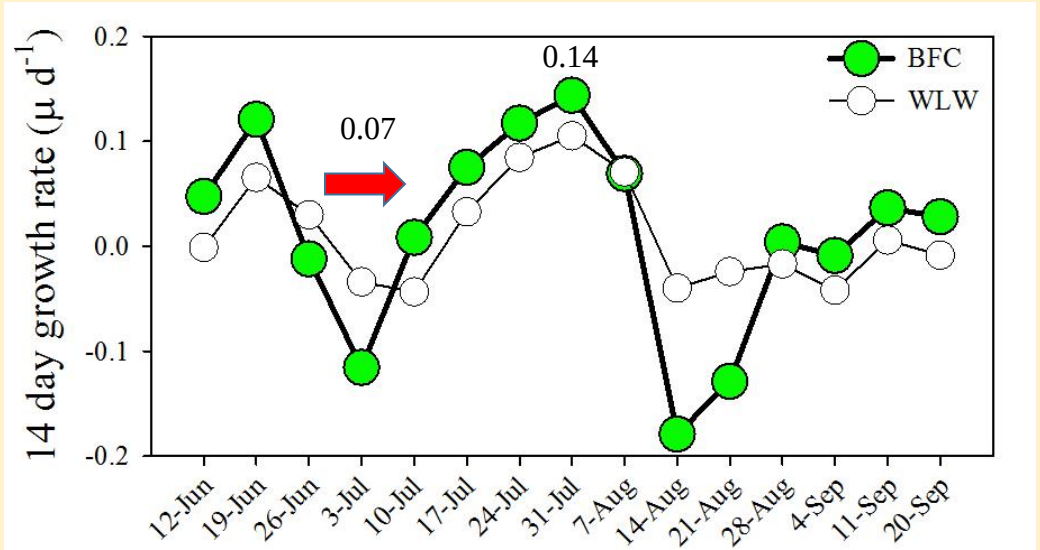
Annual Growth rate

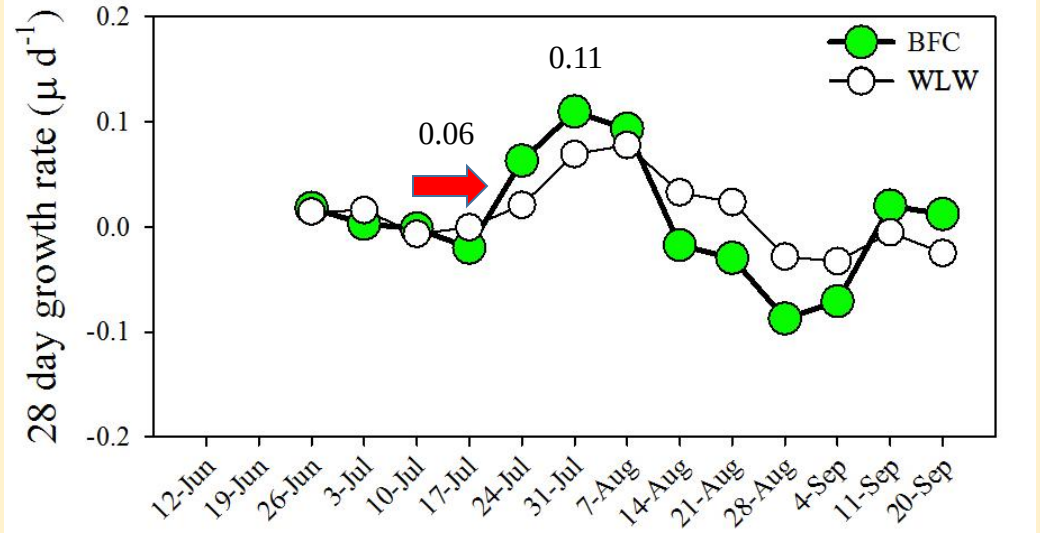
$\mu\ d^{-1} = \ln (PC_2) - \ln(PC_1)/t_2 - t_1$

Resilience Indicator

RI = 28 day PC SD

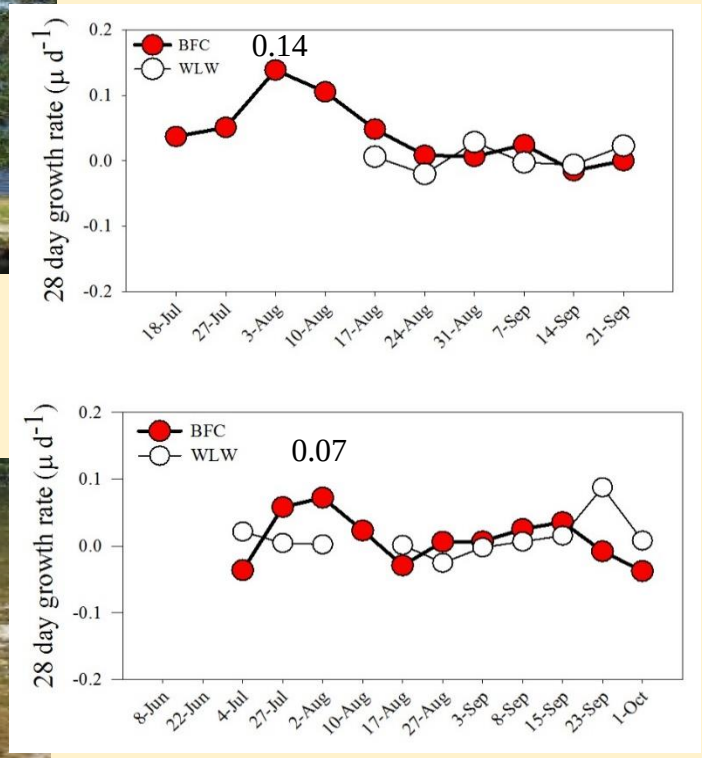




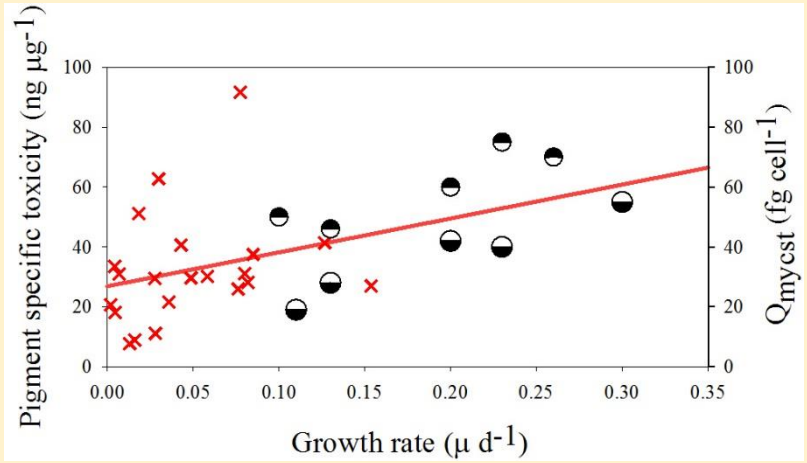


State transitions:

<u>Variance</u> decreases as ecosystem transitions from one state to another



<u>?? What about toxicity ??</u>



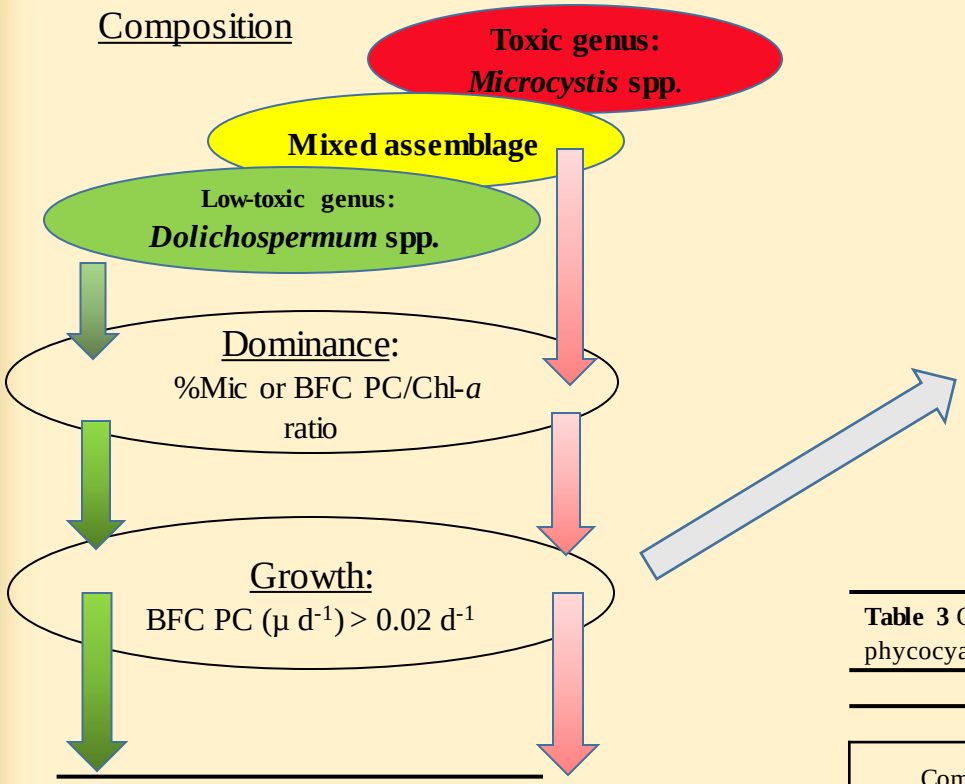


Table 1. Regressions between cyanobacterial biomass and total microcystins in *Microcystis* spp. dominated systems, where Log Y = a + b * Log X where Y = Log MC (ng/L) and X = Log PC (μg/L)

Microcystis spp. dominated lakes					
	a	b	Adj. r^2	n	p
Silver Lake	1.341	1.148	0.942	39	<0.001
Gooseberry Pond	1.899	0.923	0.791	16	<0.001

Cyanobacterial populations

Regression coefficients between cyanobacterial population size structure, biomass and total microcystins where Log Z = a + b*Log X + c *Log Y where Z = Log MC (ng/L), X = Log % Mic and Y = Log PC (μg/L)

a	b	c	Adj. r^2	n	p
-0.123	0.939	0.787	0.780	196	<0.001

Table 2. Cyanobacterial biomass growth rates (GR) and doubling times (DT).

Growth rate (μ d^{-1})	Doubling time (days)
0.02	34
0.05	14
0.07	10
0.1	7
0.2	3

DT = 0.693/GR

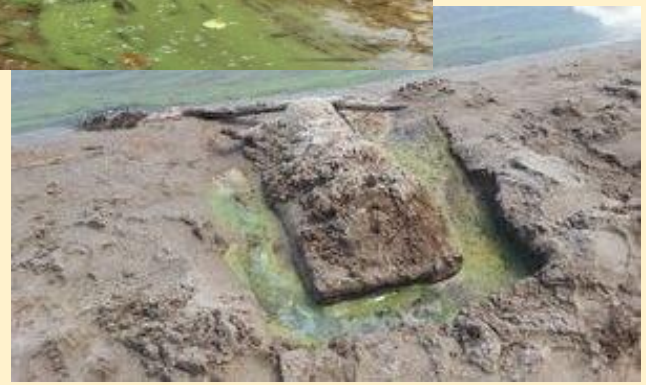
Table 3 Cyanobacterial population size structure, growth rates and toxin production measured using cyanobacterial biomass as phycocyanin. Values as mean of observed positive growth rates and toxin production.

		Sample Type			
		WLW		**BFC**	
Community Composition	Growth category*	Growth rate (μ d^{-1})	MC/PC (ng μg^{-1})	Growth rate (μ d^{-1})	MC/PC (ng μg^{-1})
Microcystis spp.	Low	0.01	24.0	0.02	47.72
	Med	0.05	37.7	0.04	53.90
	High	0.10	34.6	0.14	69.64
Mixed assemblage	Low	0.01	18.2	0.01	15.24
	Med	0.03	9.9	0.05	15.87
	High	0.10	10.4	0.18	14.81
Dolichospermum spp.	Low	0.01	0.31	0.01	0.37
	Med	0.05	0.75	0.04	0.42
	High	0.12	0.44	0.13	0.17

Low = < 0.02 d^{-1}, Medium = 0.02-0.07 d^{-1}, High = > 0.07 d^{-1}*

* Orr & Jones et al (1998), Kurmayer et al (2003), Chan et al (2004), Briand et al (2012), Chang et al (2012).

How do our results compare to other locations?

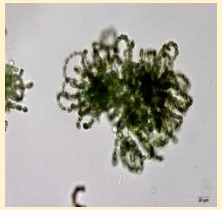


WLW & BFC Samples
Washington State

June 15

PC ($\mu g\ L^{-1}$)	MC ($\mu g\ L^{-1}$)	PST ($ng\ \mu g^{-1}$)
19.7	0.96	48.7

June 29



PC ($\mu g\ L^{-1}$)	MC ($\mu g\ L^{-1}$)	PST ($ng\ \mu g^{-1}$)
125.5	0.16	1.3

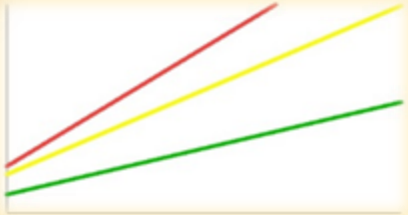
June 15

PC ($\mu g\ L^{-1}$)	MC ($\mu g\ L^{-1}$)	PST ($ng\ \mu g^{-1}$)
9584	75.6	7.9

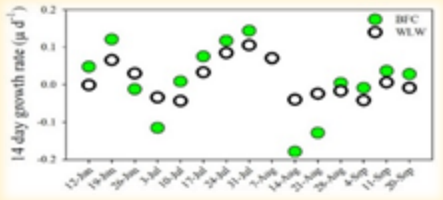
June 29

PC ($\mu g\ L^{-1}$)	MC ($\mu g\ L^{-1}$)	PST ($ng\ \mu g^{-1}$)
7628	8.7	1.2

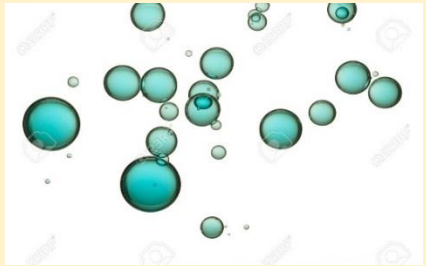
Regressions



State transitions



Spectral Niche



Aerosols

Bioaccumulation

Why??

Thank you! Any Questions?

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