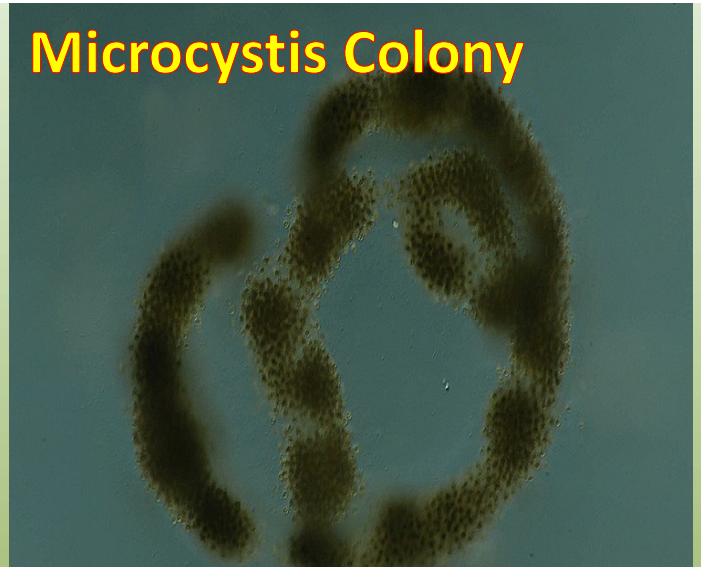
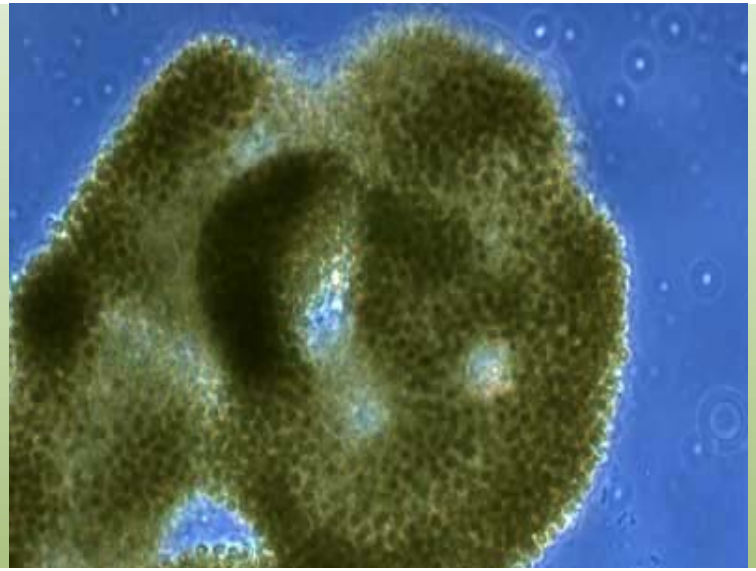
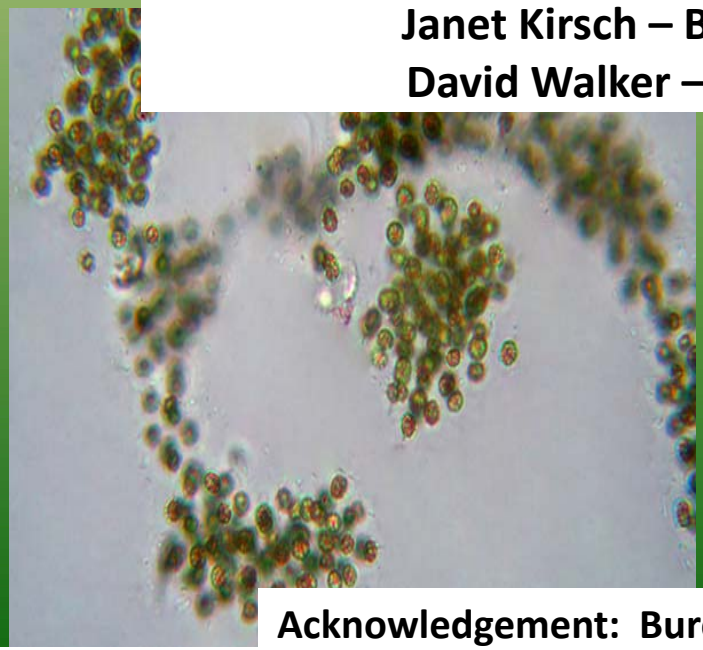
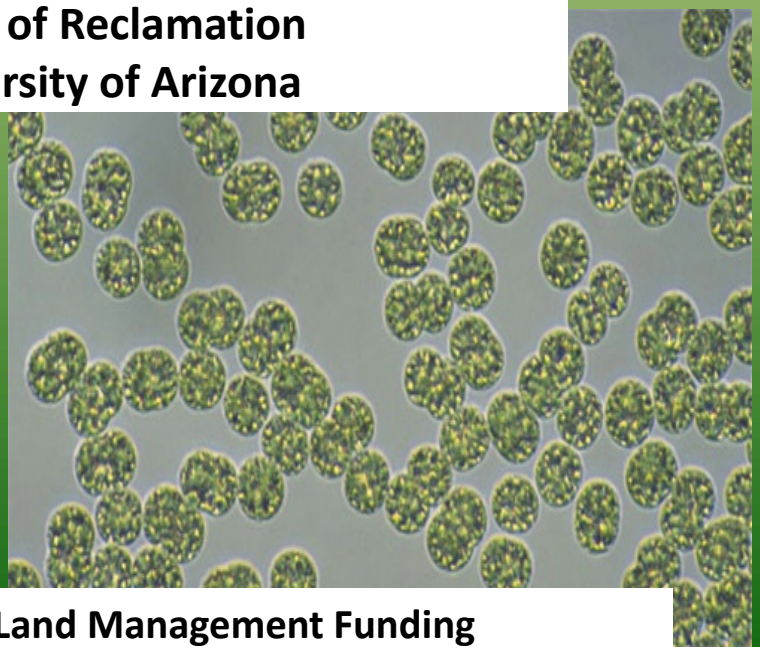




2014-2015 *Microcystis* Outbreak in Lake Havasu

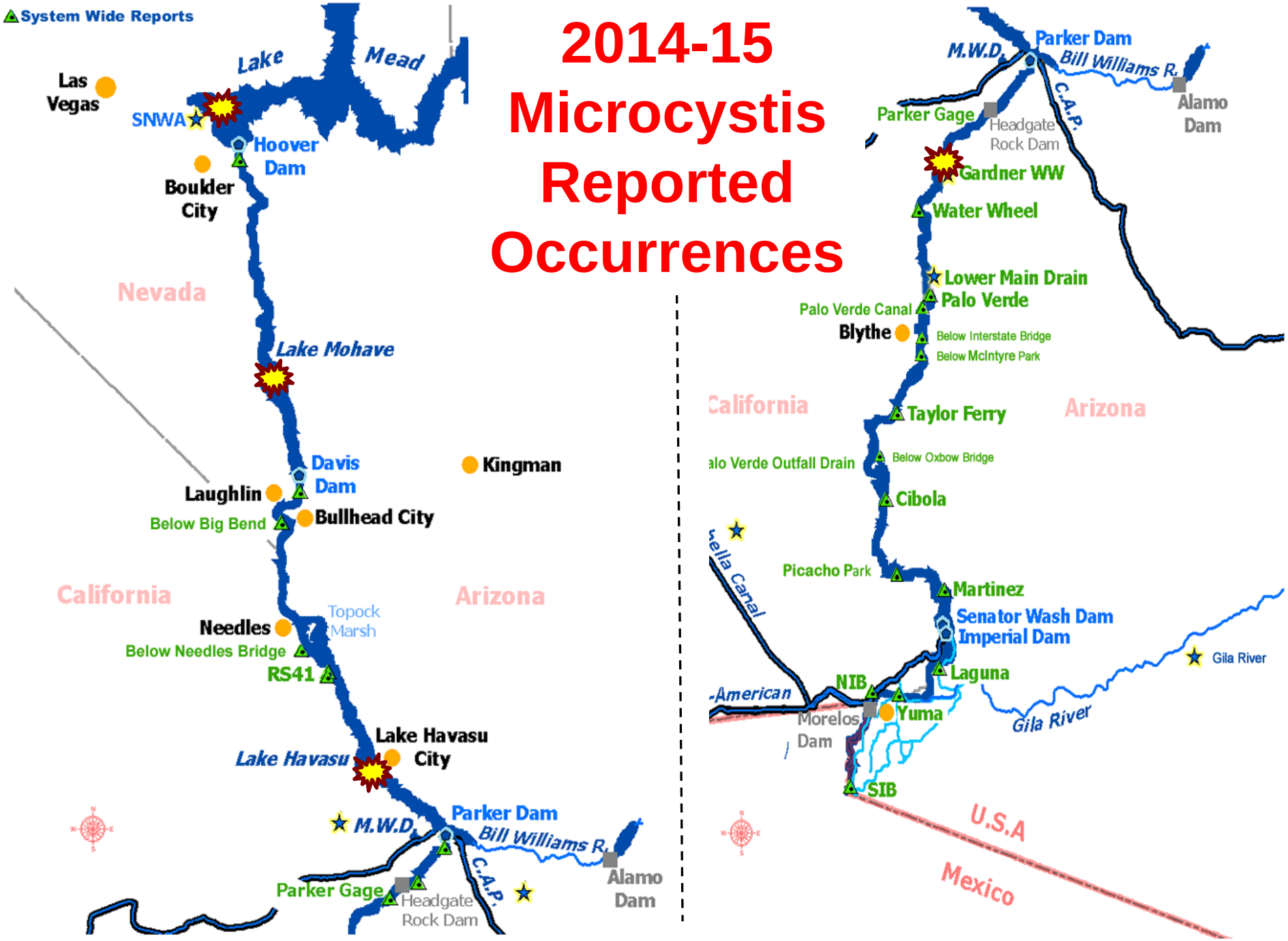
Doyle Wilson - Lake Havasu City and Arizona State University
Heidi McMaster – Bureau of Reclamation
Janet Kirsch – Bureau of Reclamation
David Walker – University of Arizona



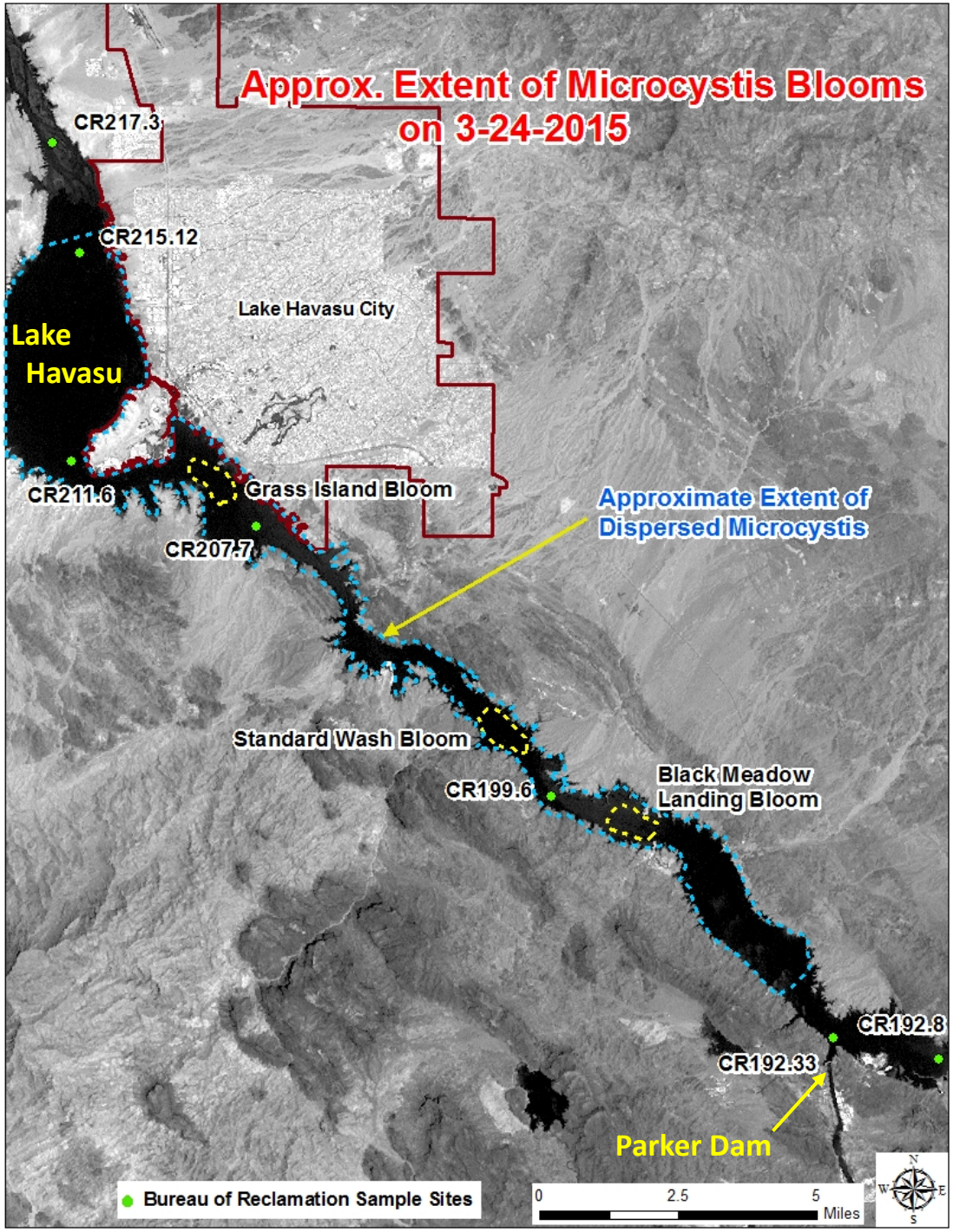


Acknowledgement: Bureau of Land Management Funding

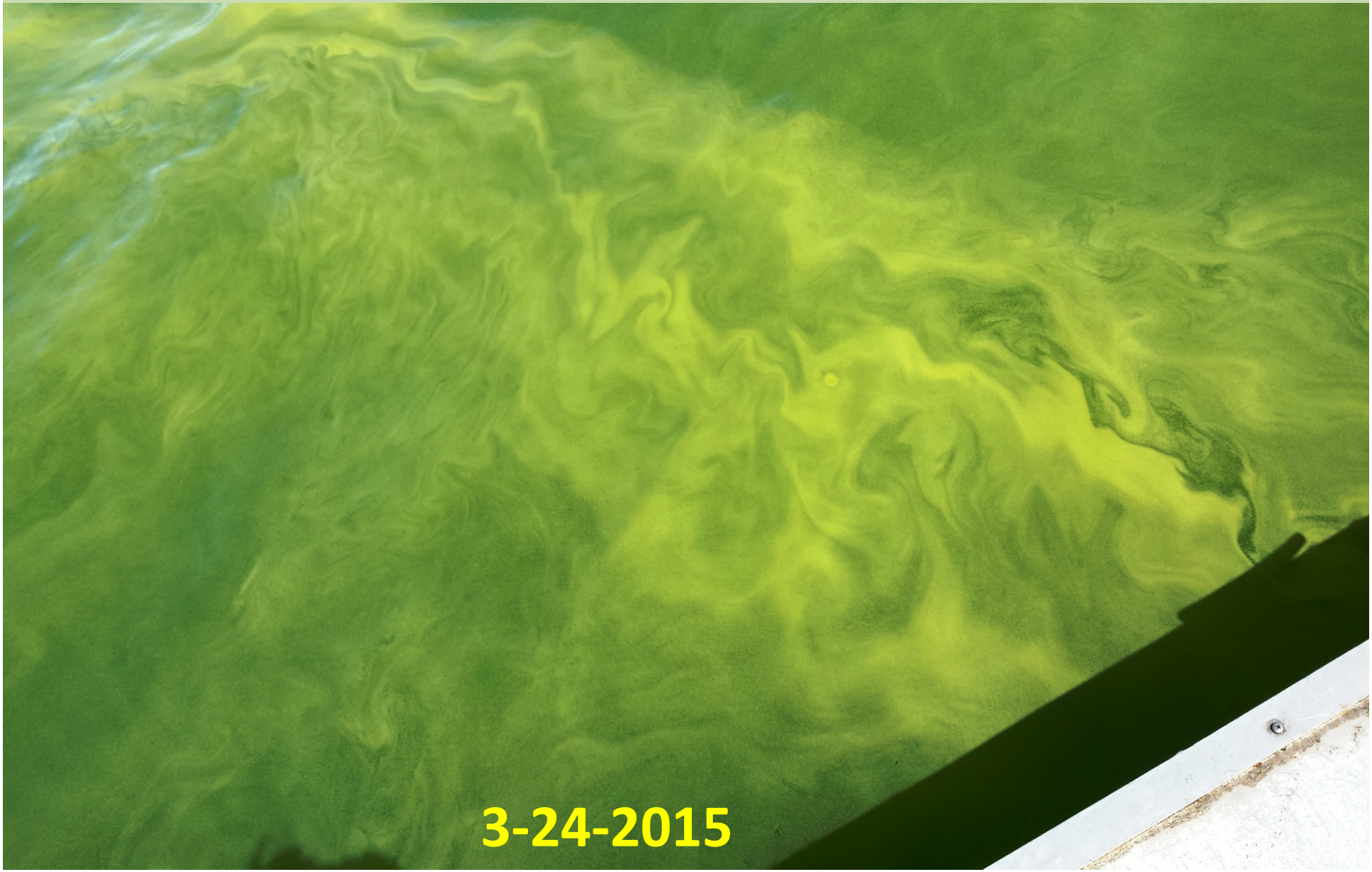
2014-15 Microcystis Reported Occurrences



http://www.usbr.gov/lc/region/g4000/riverdata/gage-map1-img.cfm

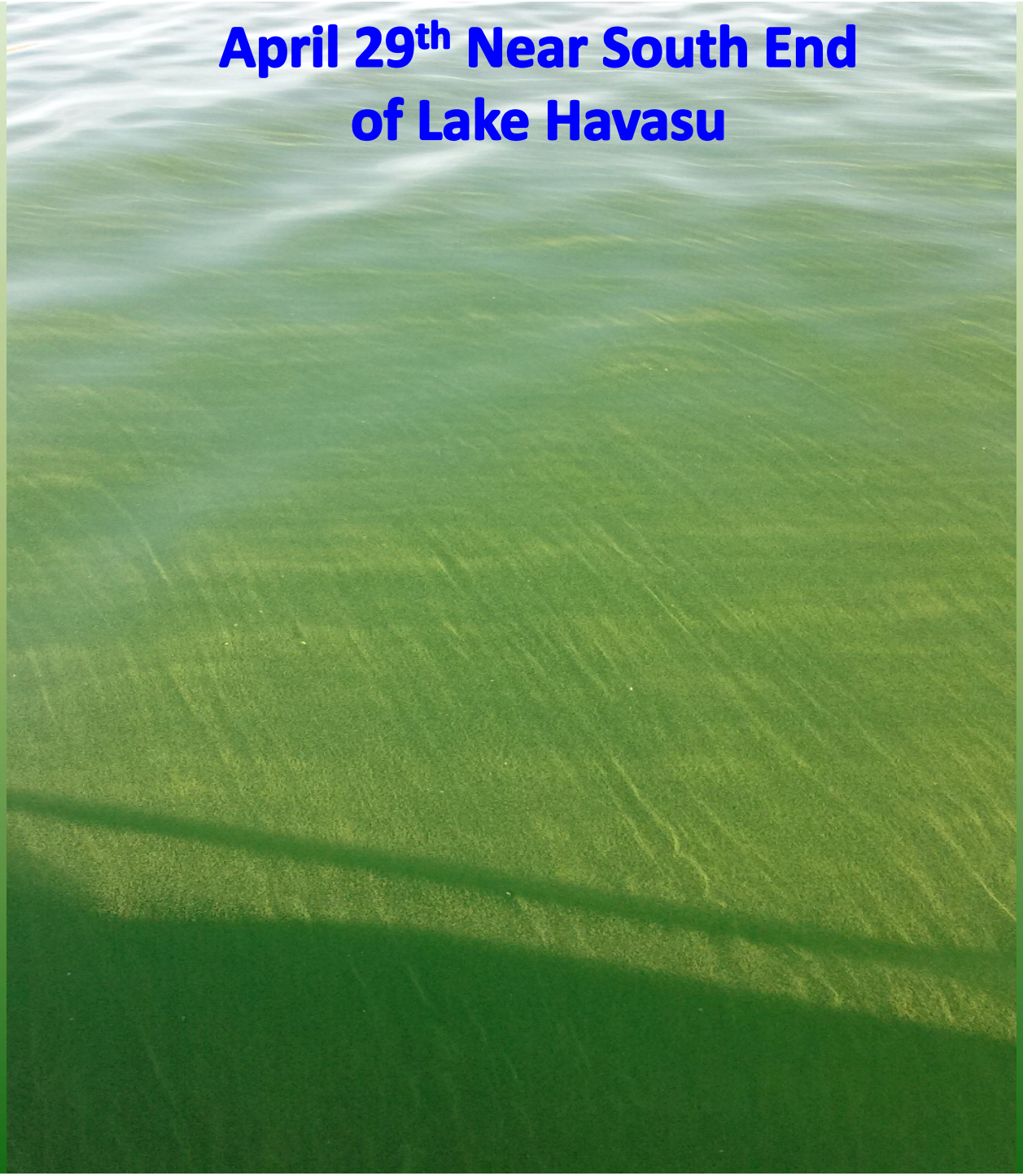

Approx. Extent of Microcystis Blooms on 3-24-2015
CR217.3
CR215.12
Lake Havasu City
Lake Havasu
CR211.6
Grass Island Bloom
CR207.7
Approximate Extent of Dispersed Microcystis
Standard Wash Bloom
CR199.6
Black Meadow Landing Bloom
CR192.8
CR192.33
Parker Dam
Bureau of Reclamation Sample Sites
0
2.5
5
Miles
N
W
E
S

Grass Island Bloom Surface Accumulation



Standard Wash Bloom Showing Decay (Bleaching by UV Radiation)

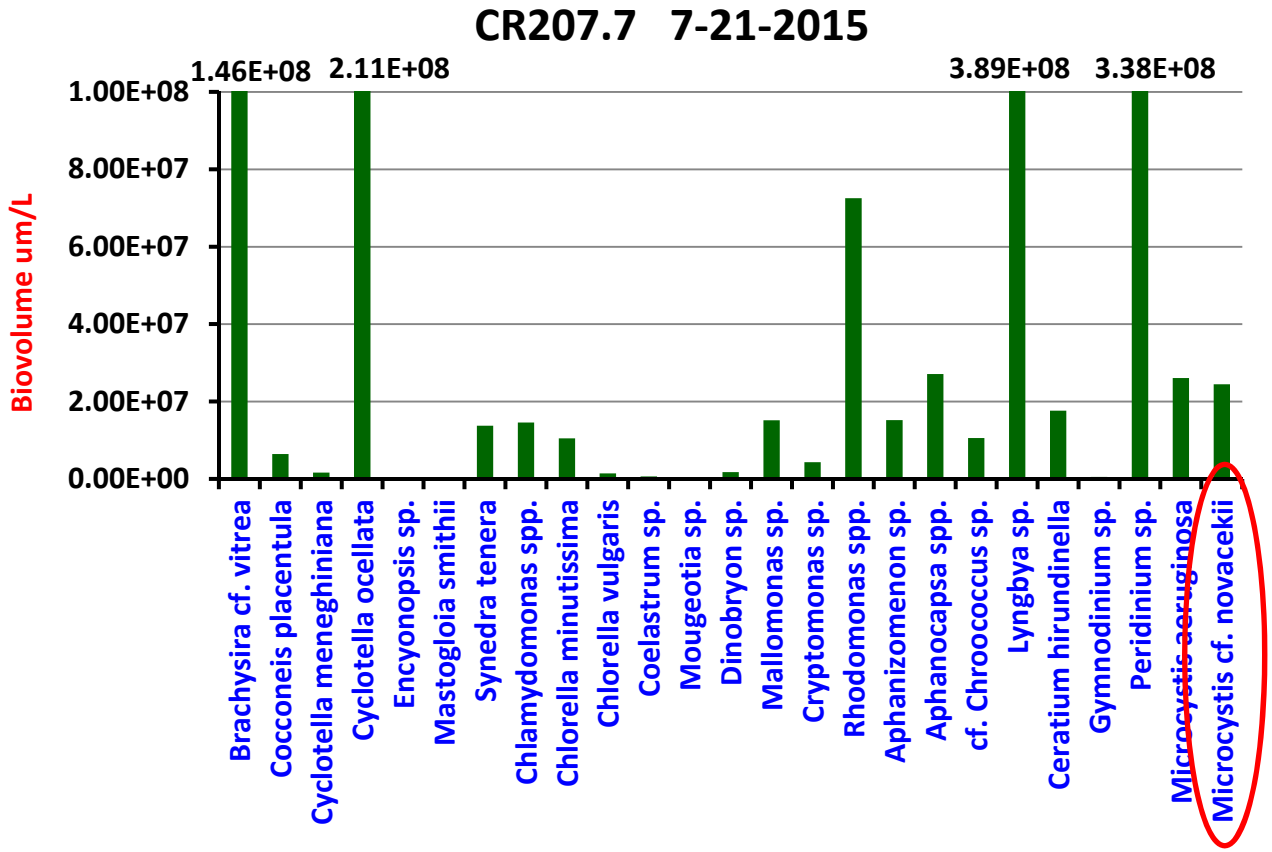
April 29th Near South End of Lake Havasu

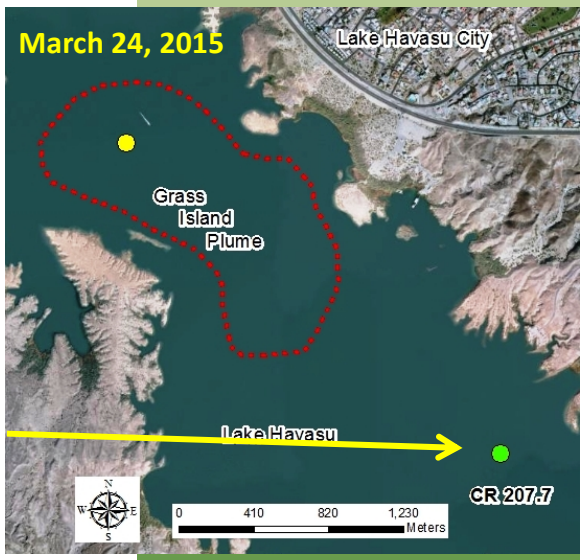


May 19, 2015 Mixed Biota at the Colorado River Inlet to Lake Havasu

May 29th at The Marina in Lake Havasu City

Lake Havasu Phytoplankton Diversity – Example of Changes with Time

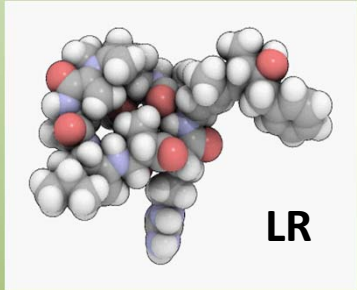




Data courtesy of U. S. Bureau of Reclamation

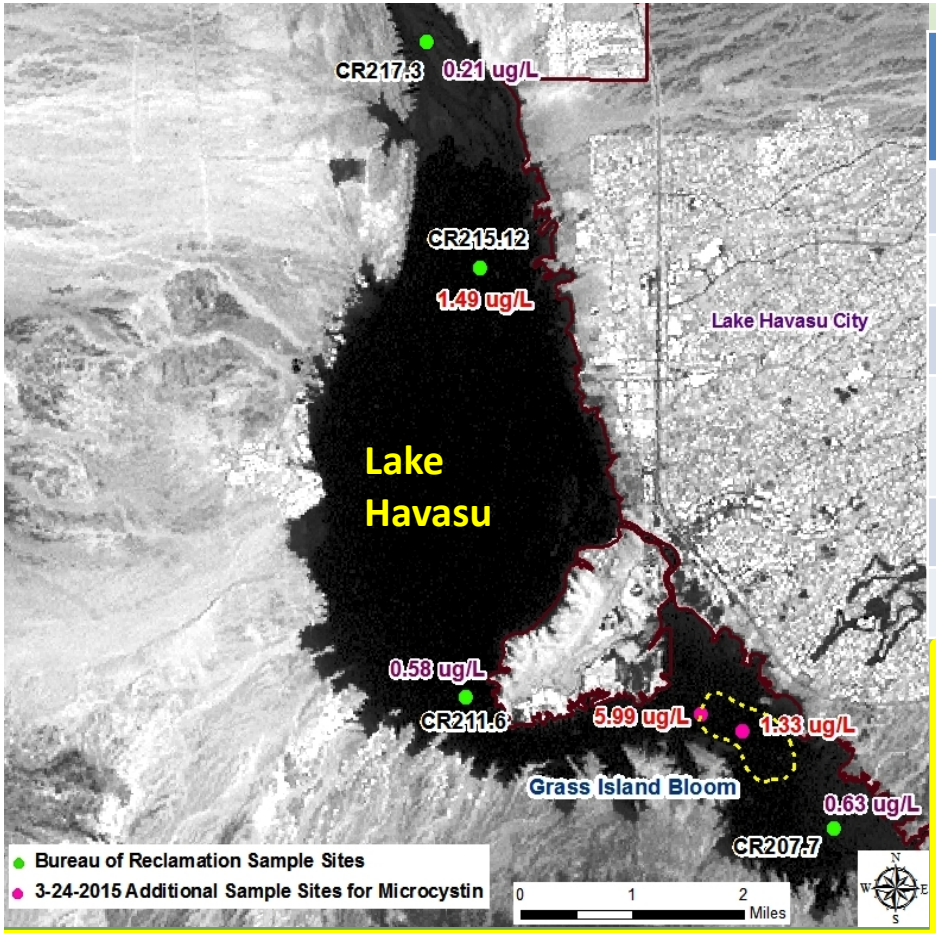
Microcystin

- *Microcystis aeruginosa* is typically associated with Microcystin-LR, a potent hepatotoxin.

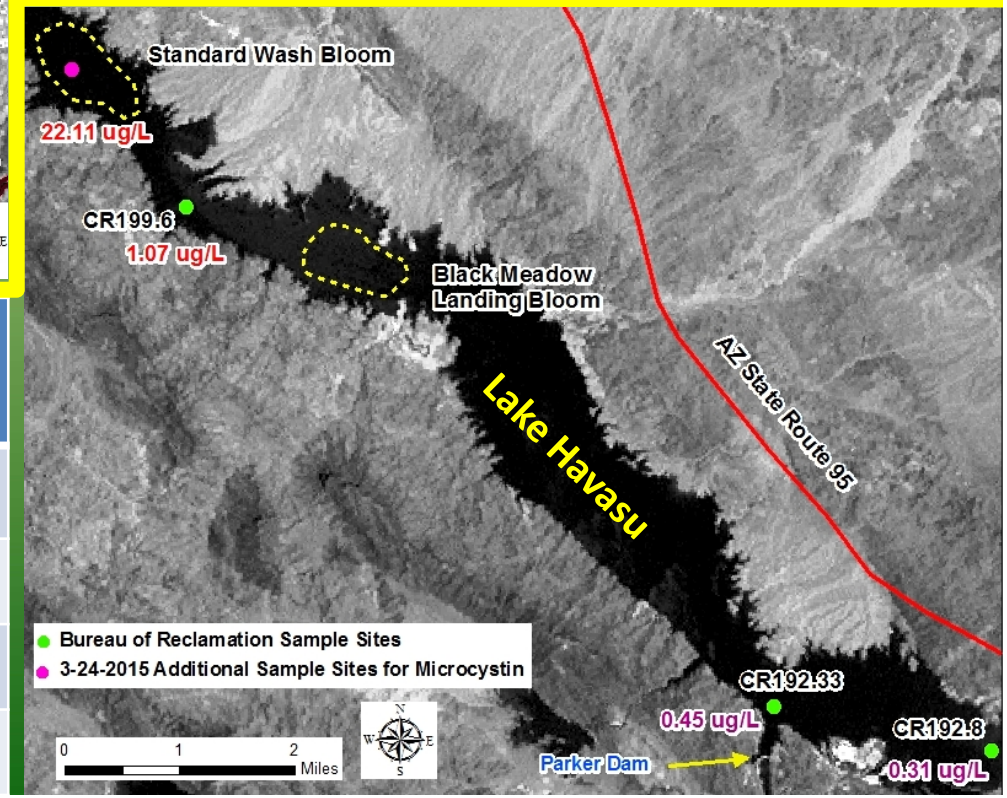


- Can bioaccumulate in fish, zooplankton, and mussels.
- Can kill domestic animals, wildlife, and waterfowl, and affect people through ingestion or dermal contact.
- Microcystin-LR threshold levels to issue health advisories have been established by the World Health Organization and the state of Ohio.
  - 1 µg/L = Do Not Drink (both)
  - 6 µg/L = Recreational Public Health (Ohio only)
  - 20 µg/L = No Contact – (both)
- Microcystins are included in the Cyanotoxins group on EPA's UCMR List 3 and CCLs.

3-24-2015 Microcystin Levels



Site	Microcystin Conc. (µg/L)
CR217.3	0.21
CR215.12	1.49
CR211.6	0.58
Grass Is. Bloom Edge	5.99
Grass Is. Bloom	1.33
CR207.7	0.63



Site	Microcystin Conc. (µg/L)
Standard Wash Bloom	22.11
CR199.6	1.07
CR192.8	0.45
CR192.33	0.31

Data courtesy of U. S. Bureau of Reclamation

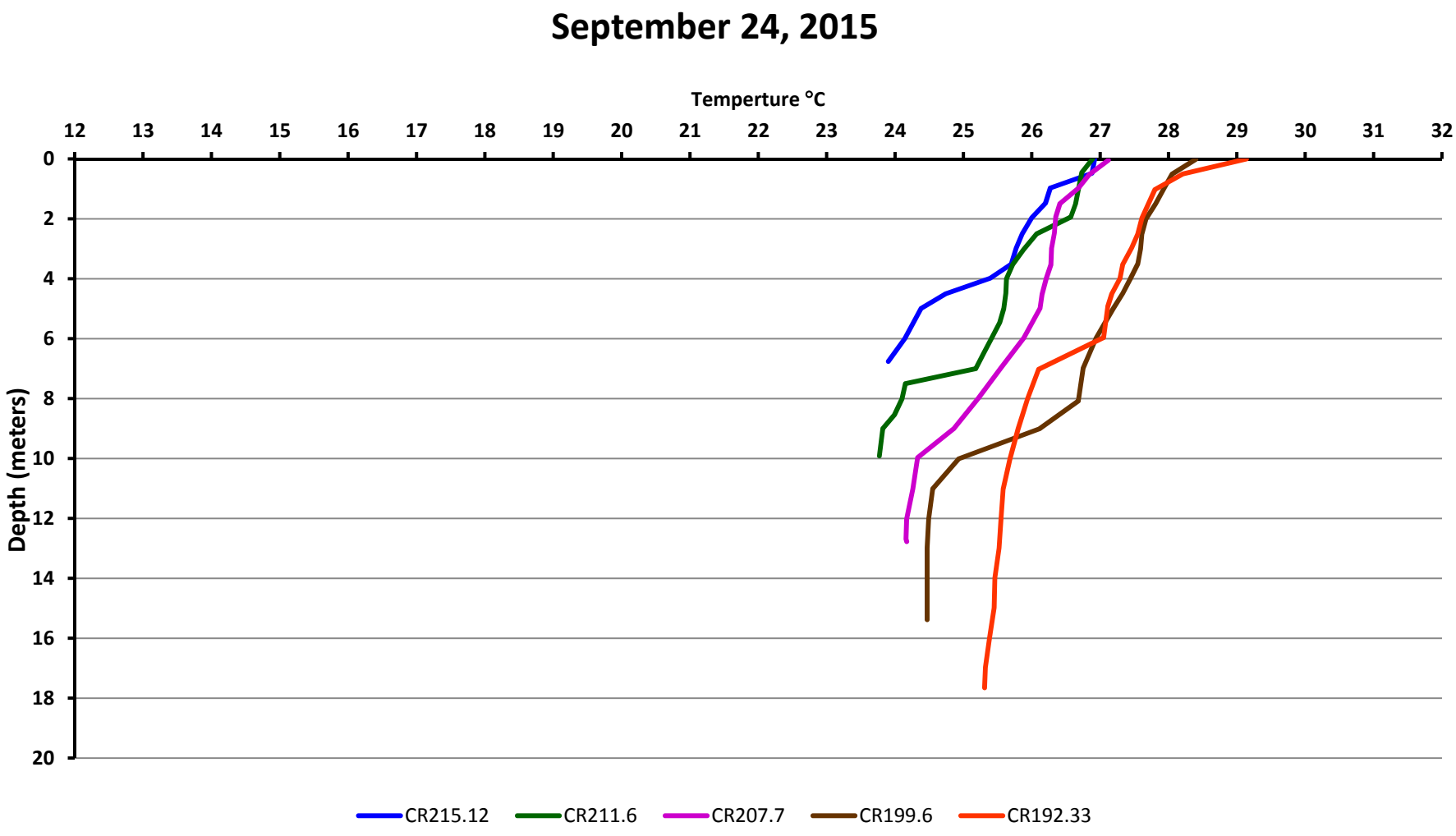
Microcystin-LR

Site ID	May 19, 2015 Water (ug/L)	July 21, 2015 Water (ug/L)	Sept. 1, 2015 Water (ug/L)
CR217.3	0.002	0.30	0.005
CR215.12	0.09	0.73	0.02
CR211.6	0.03	2.04	0.02
CR207.7	0.01	1.55	0.004
CR199.6	0.19	0.49	n/a
CR192.33	0.03	0.20	n/a
CR192.8	0.05	0.61	n/a

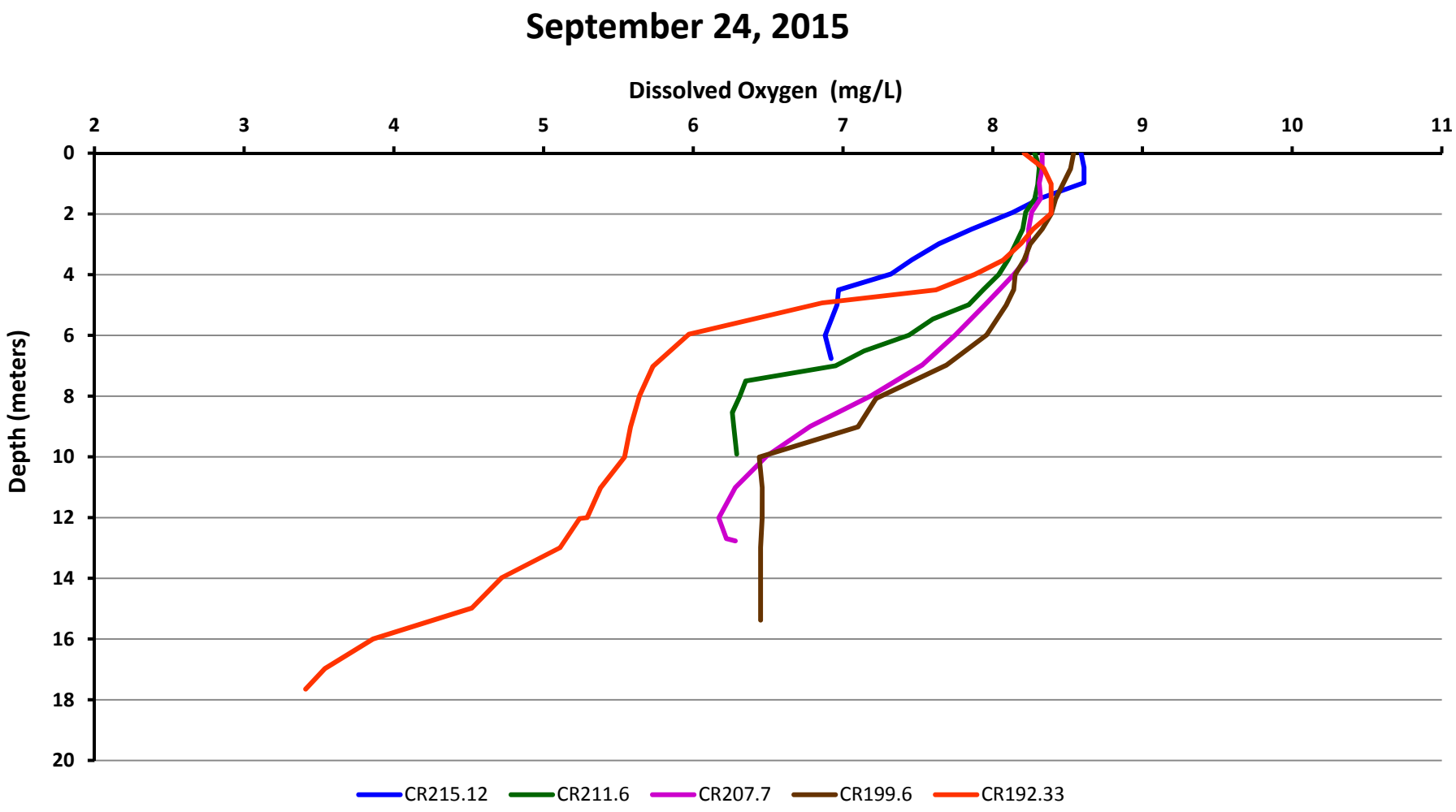
Data Courtesy of U.S. Bureau of Reclamation

Data Courtesy of ADEQ – D. Walker

2014-2015 Water Temperature Profiles in Lake Havasu



2014-2015 Dissolved Oxygen Profiles in Lake Havasu



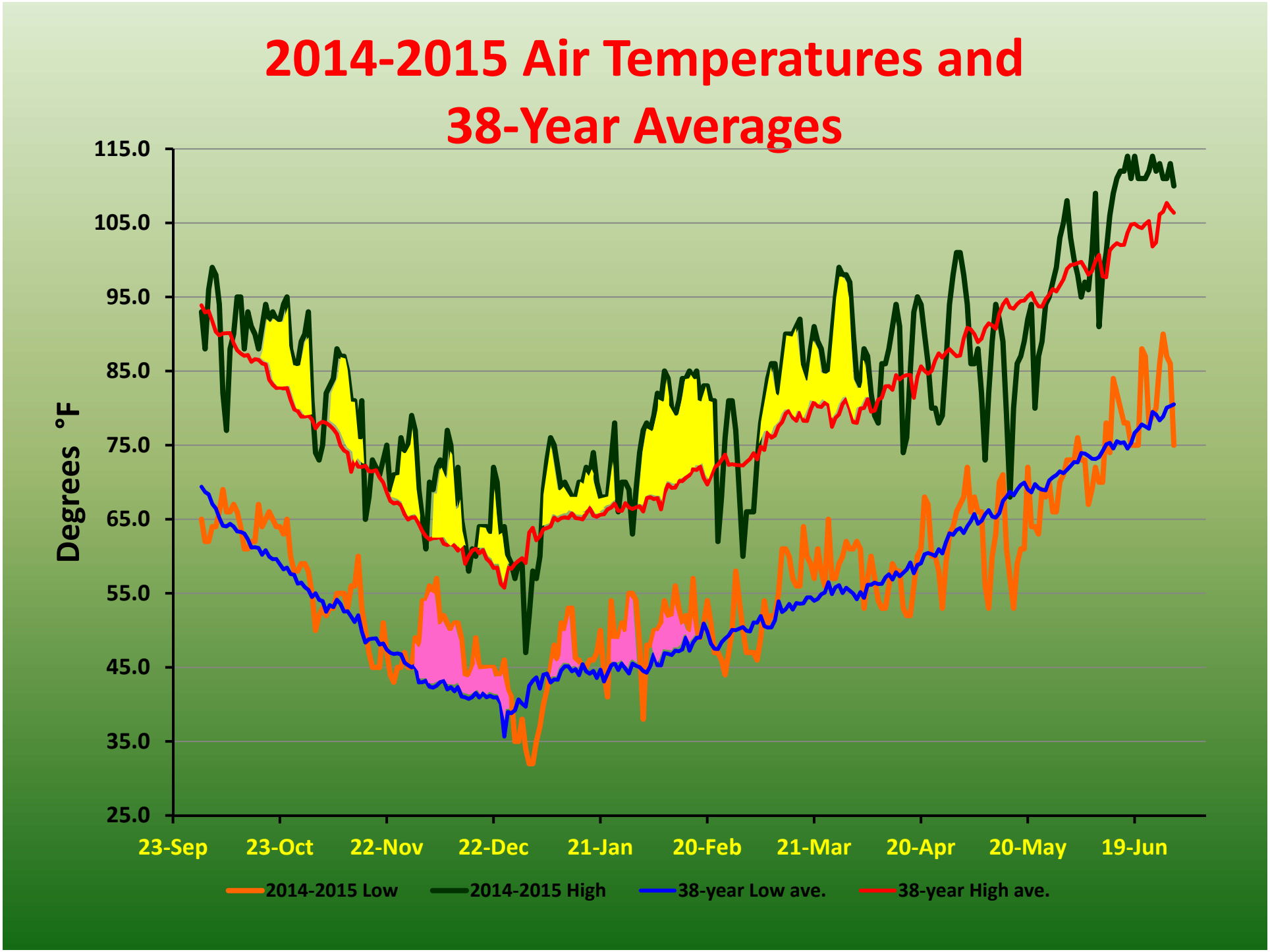
Possible Factors to *Microcystis* Activity for 2014-2015

Probably a Combination of the Following (but not documented):

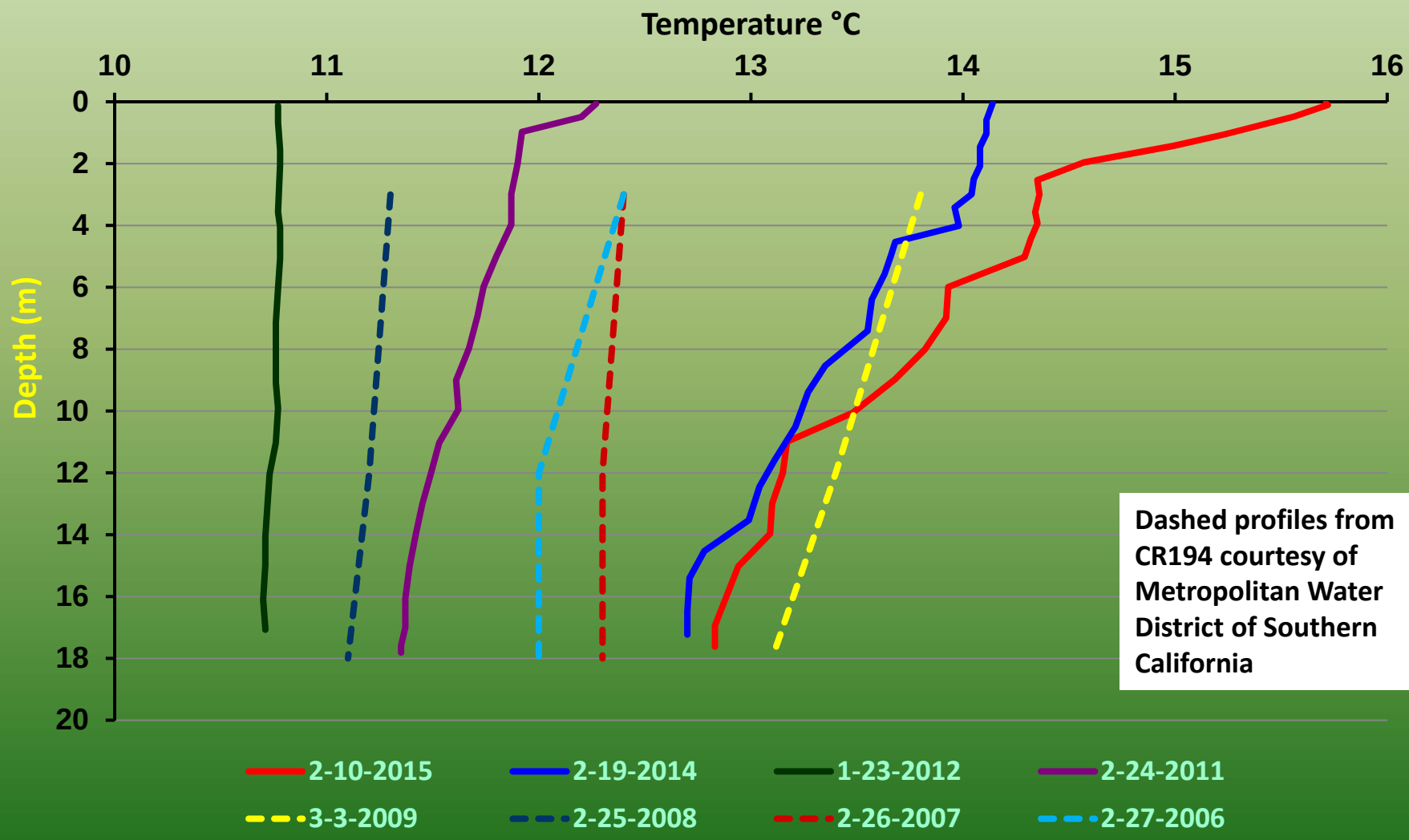
1) **Preferential *Dreissena* sp. Feeding Habits**
   - **Documented in the Great Lakes that most competing algae are preferentially consumed** (Tang et al 2014, Vanderploeg et al 2013).
   - ***Microcystis aeruginosa* rejected from mussels unharmed.**

2) **Warmer than Normal 2014-2015 Winter**
   - **Warmer than 38-yr ave. mean for December (3rd warmest) and January.**
   - **Warmest February and 3rd warmest March on record for this region.**

3) **Nutrient Requirements for this Organism are Low.**
   - **Can store nutrients (Phosphorus and Nitrogen) in the cell.**

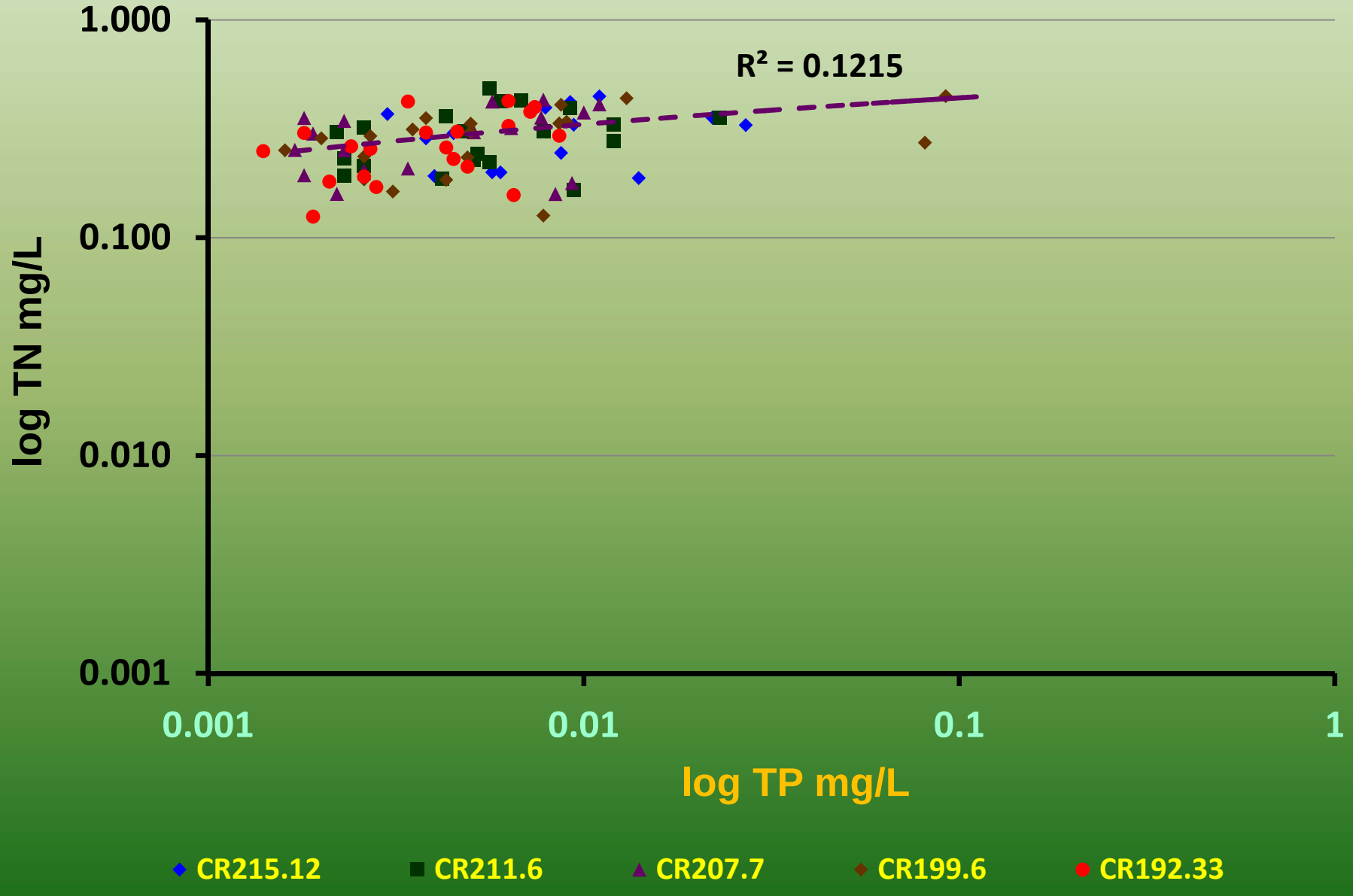

2014-2015 Air Temperatures and
38-Year Averages
Degrees °F
115.0
105.0
95.0
85.0
75.0
65.0
55.0
45.0
35.0
25.0
23-Sep
23-Oct
22-Nov
22-Dec
21-Jan
20-Feb
21-Mar
20-Apr
20-May
19-Jun
2014-2015 Low
2014-2015 High
38-year Low ave.
38-year High ave.

CR192.33/CR194 Winter Temperature Profiles

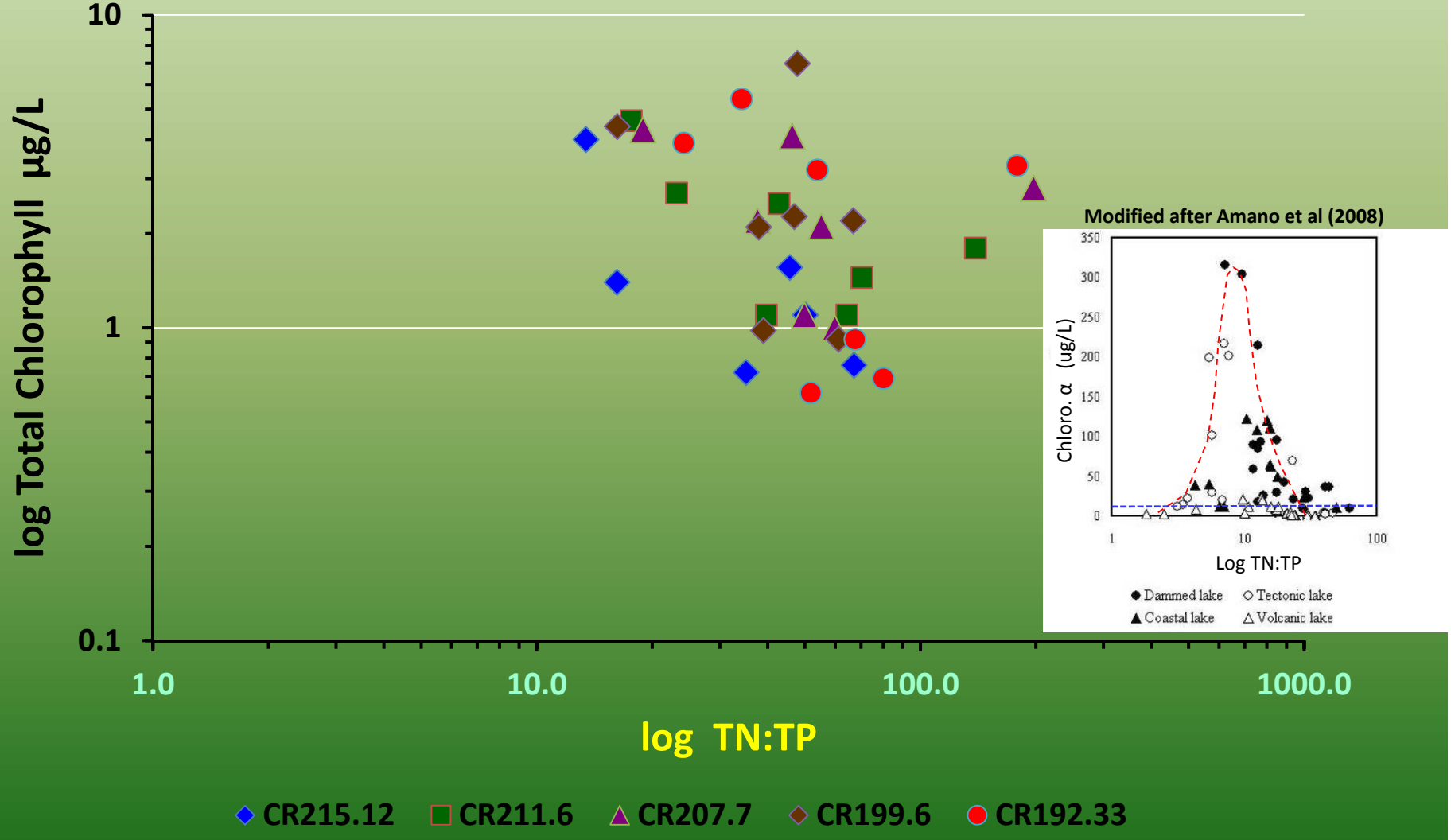


Dashed profiles from CR194 courtesy of Metropolitan Water District of Southern California

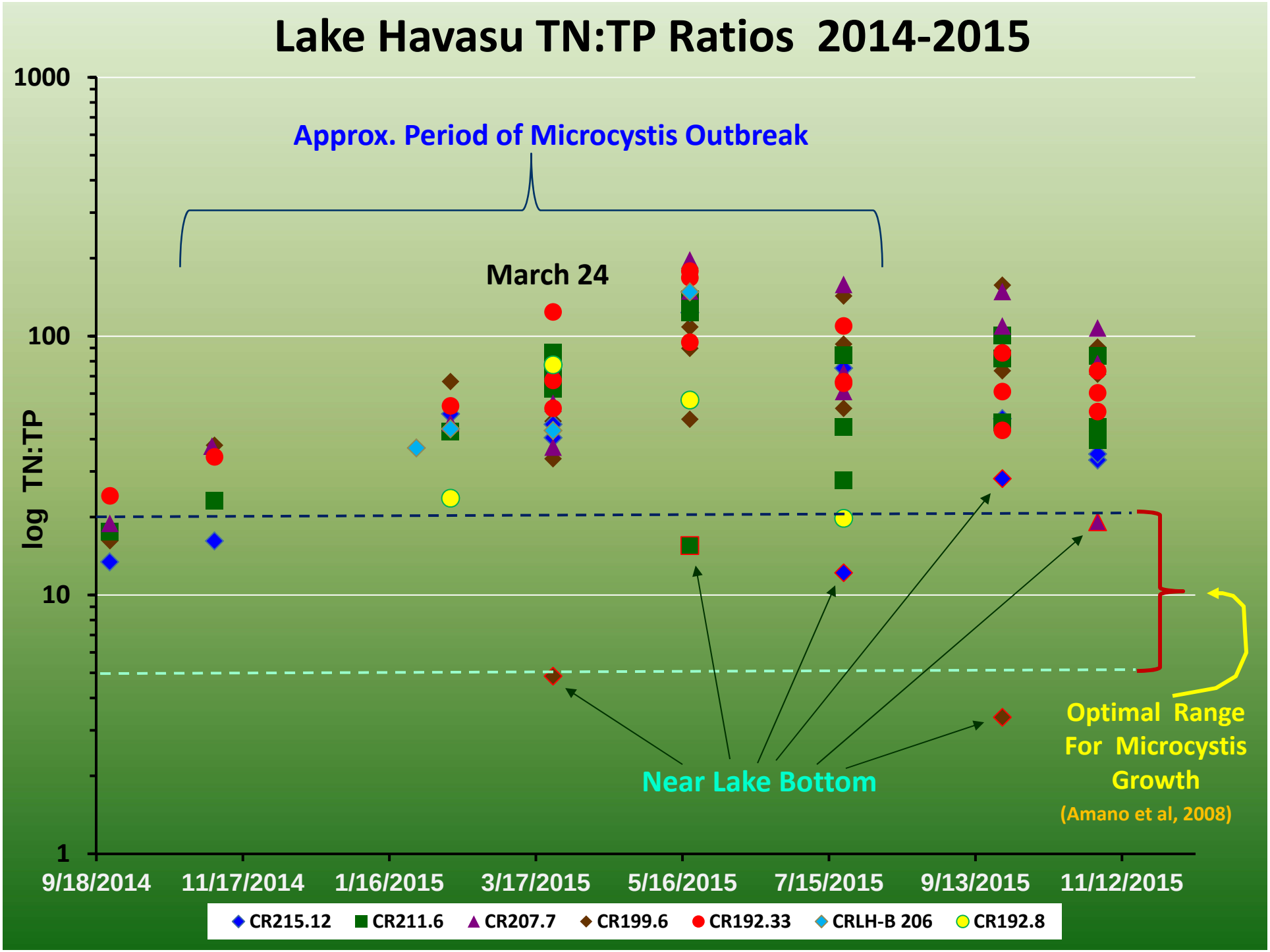
2013-2014 Water Column TN vs TP Conc.



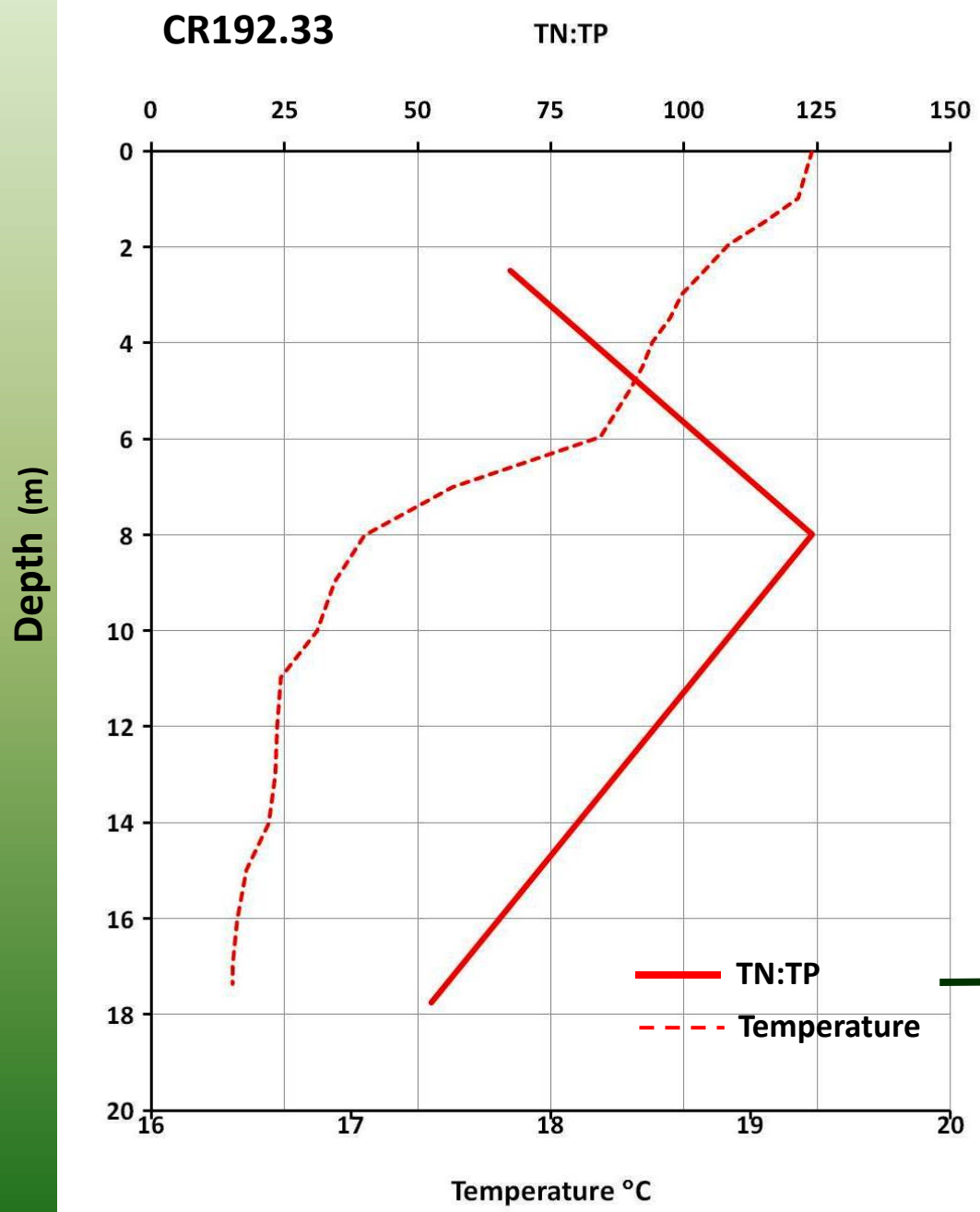
2014-2015 Water Column Total Chlorophyll vs TN:TP

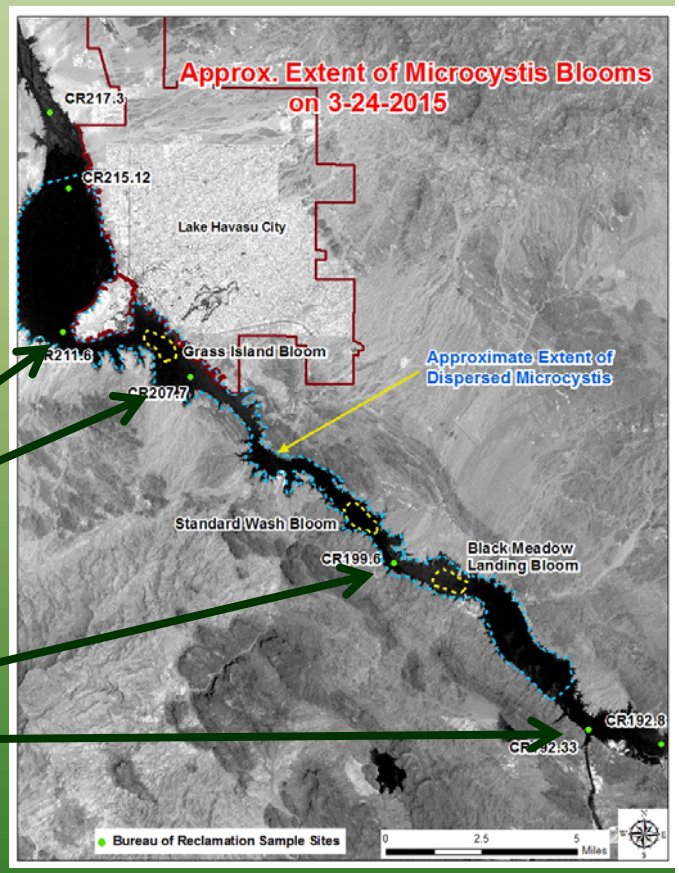


CR215.12 CR211.6 CR207.7 CR199.6 CR192.33


Lake Havasu TN:TP Ratios 2014-2015
1000
100
10
1
log TN:TP
Approx. Period of Microcystis Outbreak
March 24
Near Lake Bottom
Optimal Range For Microcystis Growth
(Amano et al, 2008)
9/18/2014
11/17/2014
1/16/2015
3/17/2015
5/16/2015
7/15/2015
9/13/2015
11/12/2015
CR215.12
CR211.6
CR207.7
CR199.6
CR192.33
CRLH-B 206
CR192.8

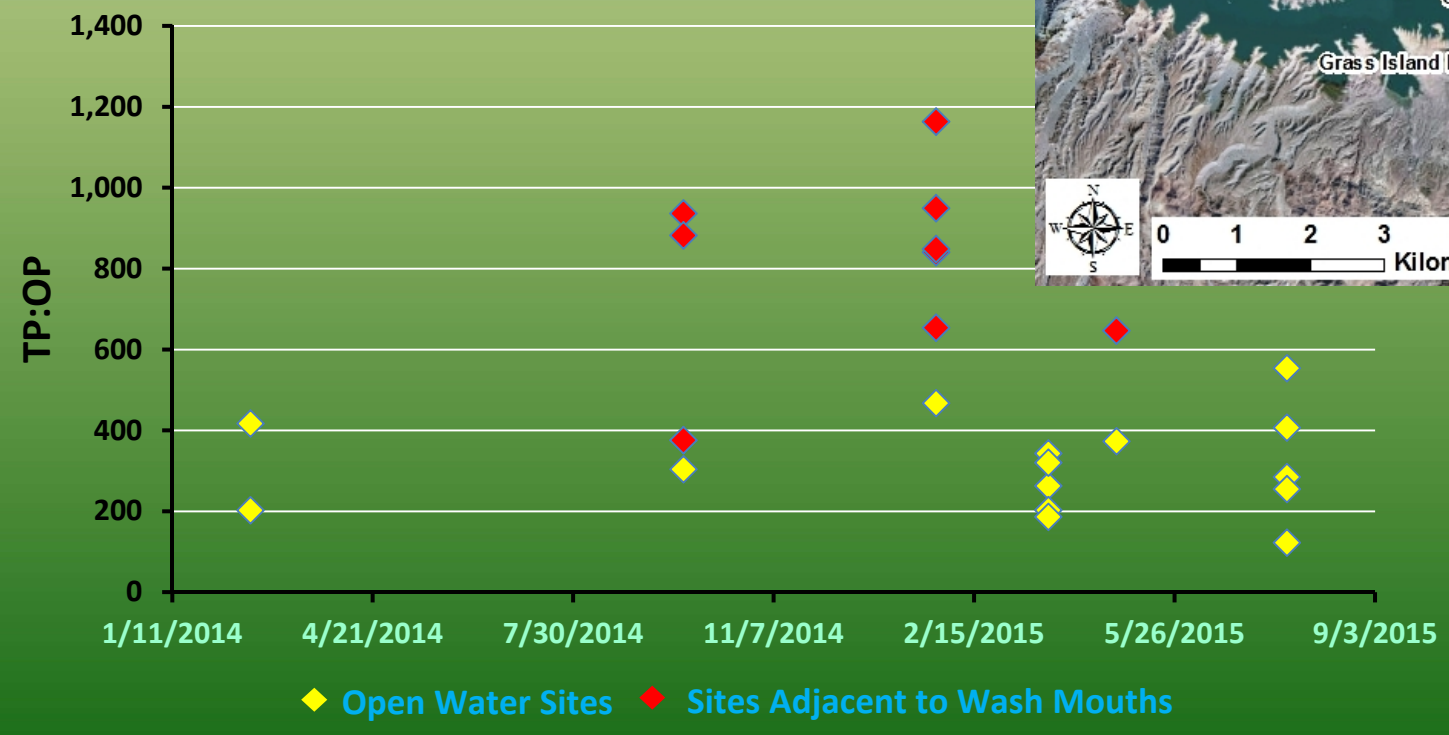
March 24, 2015 TN:TP Ratios and Temperature Profiles

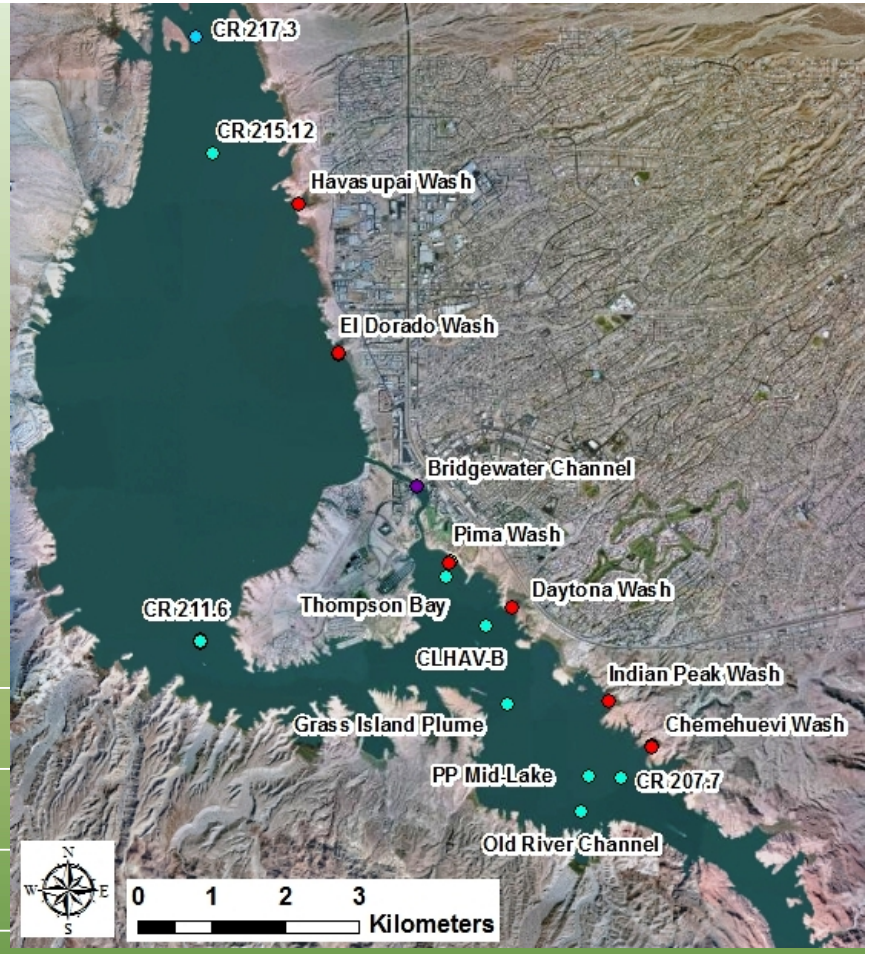




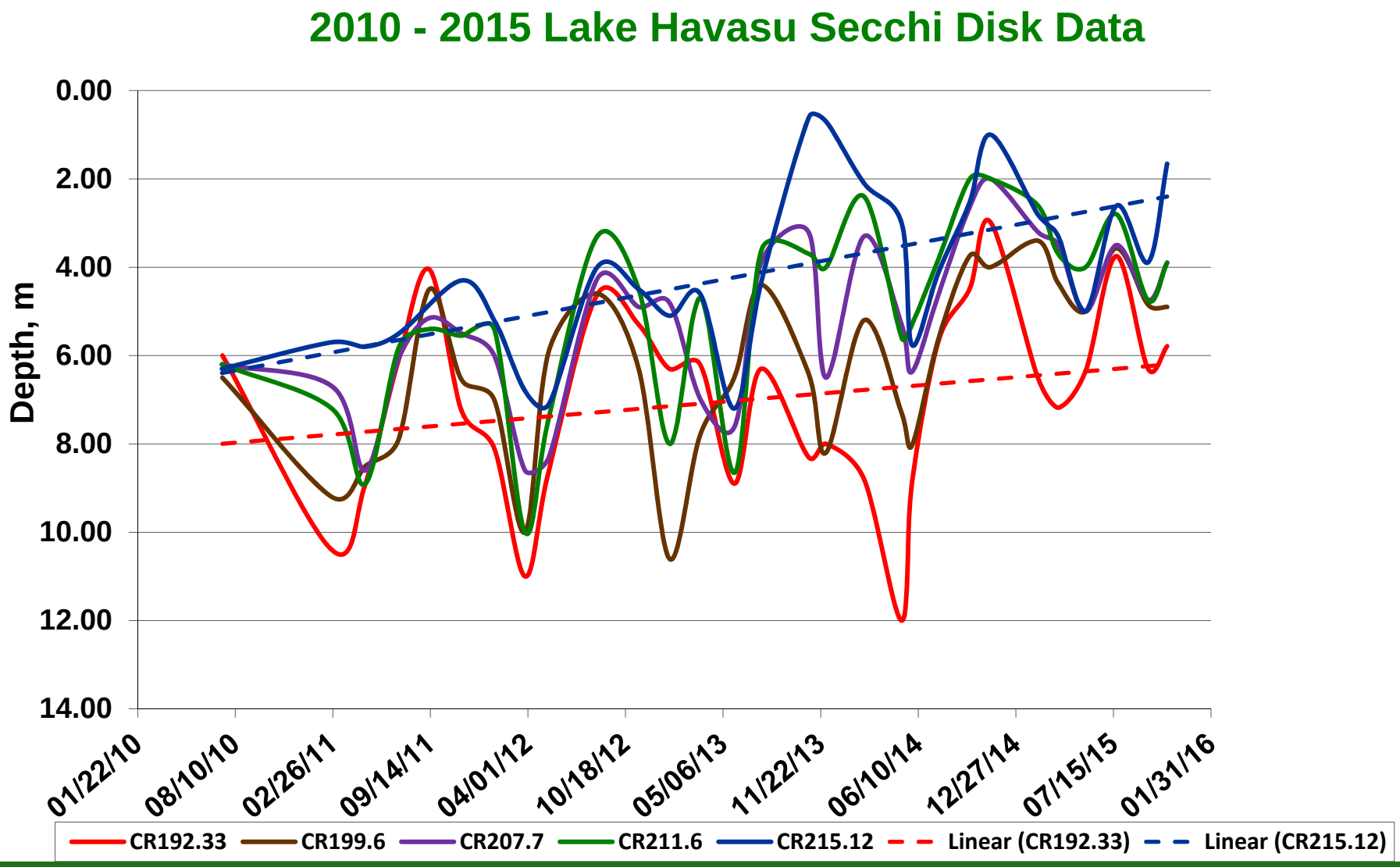
Bottom Sediment Total Phosphate : Orthophosphate Ratios

Total Phosphate range: 9 - 442 mg/kg
Orthophosphate range: non-detect – 1.55 mg/kg





Secchi Disk Comparisons



What Next?

Continue to monitor and take samples (BOR and ADEQ will be doing this into the fall and winter).

Watch for potential impacts to the ecosystem – (i.e. fish kills).

Focused research efforts to identify relationships between microcystis colony growth, nutrient supply and quagga mussel feeding habits are being developed.

Questions??