Oregon DEQ Water Quality Program

Updates on the Oregon HAB Strategy and Upper Deschutes HAB Project

US EPA R10 Virtual Roundtable on Nutrients
May 3, 2022

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Thanks to:

- **DEQ HABs Coordination Team**
- **Steve Hanson (DEQ)**
- **Sam Doak (DEQ)**
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- **Gene Foster (DEQ)**
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- **Lori Campbell (PGE)**
- **Kurt Carpenter (USGS)**
- **Amalia Handler (EPA)**
- **Rochelle Labiosa (EPA)**

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Advisory levels for HABs in Oregon

Note: Harmful Algal Bloom (HAB) = CyanoHAB = Harmful Cyanobacterial Bloom (HCB)

Recreational Use Guidance Values:

Table 2. Health advisory RUVs for cyanotoxins in Oregon recreational waters (µg/L)

*RUVs**	*Microcystin*	*Anatoxin-a*	*Saxitoxin*	*Cylindrospermopsin*
	8	15	8	15

EPA and Oregon have established Health

Cyanotoxin	For Vulnerable People (ppb)	For Age 6 and Above (ppb)
Total Microcystins	0.3	1.6
Cylindrospermopsin	0.7	3

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303(d) Category 5 listings for HABs in Oregon

Any public health advisory issued by the Oregon Health Authority (OHA), in conjunction with other federal, state, county, city or local agencies, within the data window (5 years prior) which;

1. is a permanent advisory;
2. has reoccurred for two or more HABs seasons; or
3. only occurred once but had cyanotoxin values above OHA guidelines for water contact recreation
4. finished water exceeds the advisory for vulnerable people AND where the waterbody is the source of water for a public water system
5. where there is a livestock watering use, only occurred once but had a microcystin value above livestock watering levels of 2.3 µg/L
6. Recreational advisories shall be associated with impairments of the water contact recreation use. Drinking water advisories shall be associated with impairments of the domestic water supply use. Exceedance of the reference concentration for livestock shall be associated with impairment of the livestock watering use.

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Updating the Oregon HAB Strategy

- DEQ HAB strategy originally published in 2011
- Project to update the DEQ HAB strategy initiated in 2020
- Draft strategy ready for managerial review; expected approval by the end of 2022

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Why are we updating the DEQ strategy?

- Outline the current workflow of DEQ monitoring, analysis, and response to HABs
- Clearly define DEQ roles and responsibilities versus those of partner agencies, collaborators, and other groups
- Update current monitoring and analysis techniques
- Identify immediate and near-term resource needs and focal areas

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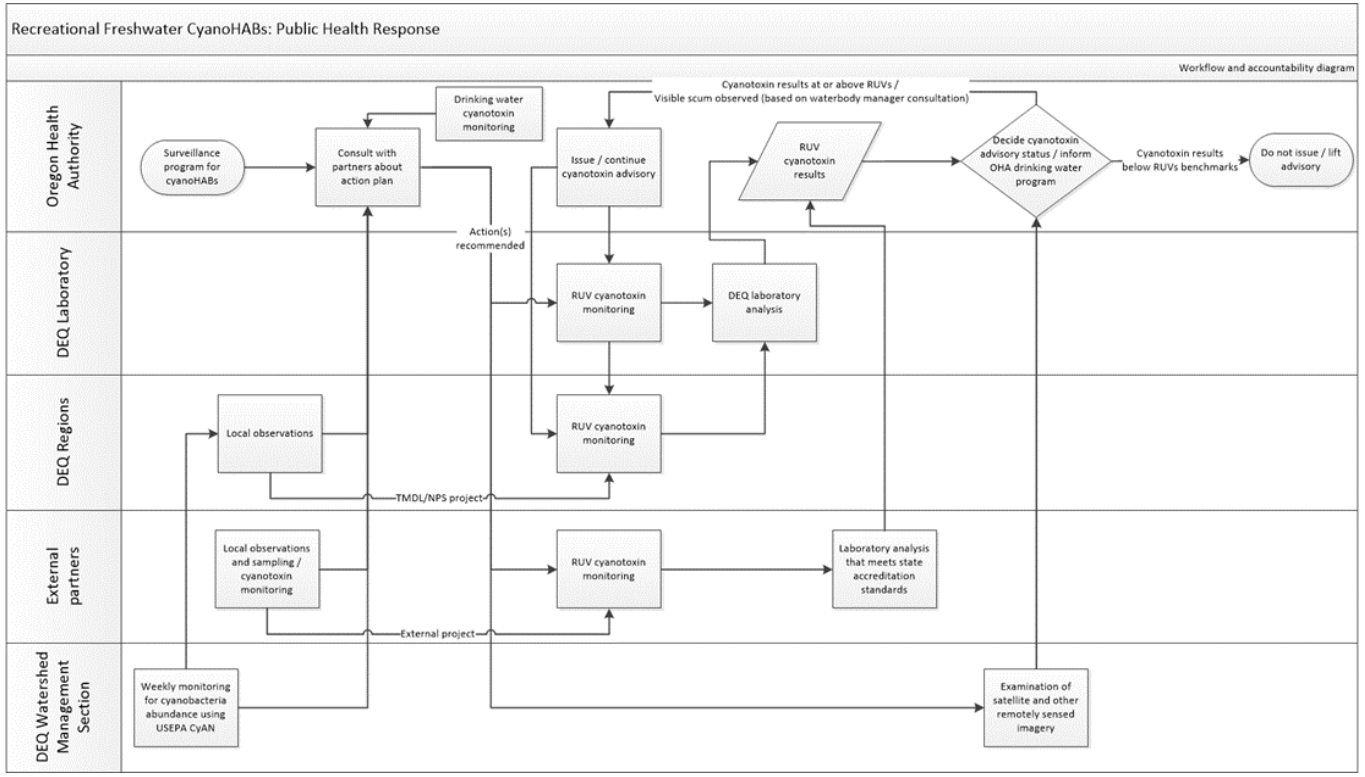
Updated DEQ strategy

- Primary goal:
  - Outline the approach DEQ takes to detect, monitor, assess, and manageHABs as an agency and in coordination with partner agencies and stakeholders
- Strategy components:
  - Drinking Water
  - Recreational Use
  - Clean Water Act
- Interactive, web-based



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Initial take home messages

- More resources should be devoted to proactive detection of blooms using remote sensing, genetic, and other techniques

- An approach to identify and implement management strategies for HABs needs to be developed and standardized

- Aspects and concepts of climate change and environmental justice need to be better incorporated into the strategy

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Satellite imagery and HABs DEQ projects

- Identify and monitor HABs in Oregon using satellite imagery
- Develop early warning system(s) for HABs using a combination of satellite and *in situ* continuous data
- Use satellite imagery to help identify factors contributing to HABs

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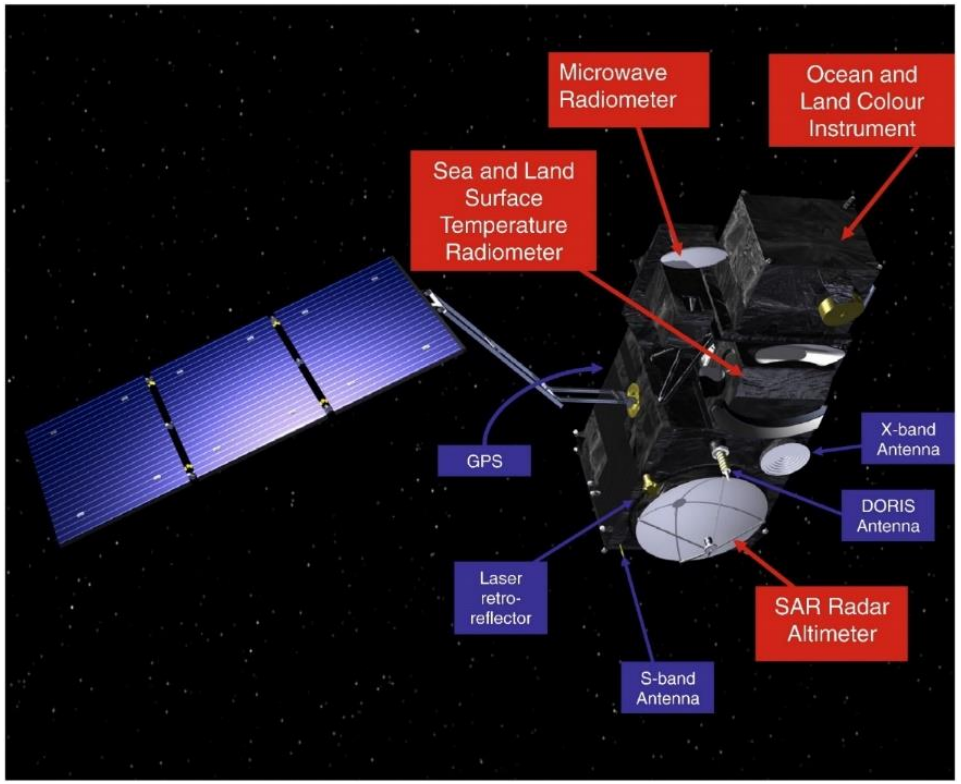
CyAN Imagery from the US EPA

Sentinel-3 OLCI

- 300 m pixels
- Optimal spectral bands
- From 2016 (June)
- 1-2 day return time
- Uses both Sentinel 3a and 3b



42 'resolvable' lakes within Oregon

Data:

- **Cyanobacteria abundance in cells/mL**
- Spectral Shape Algorithm focusing on phycocyanin
  - (Wynne *et al. 2008; 2010*)
- Includes error detection (for exploratory purposes)
  - Water adjacent to shorelines, snow/ice, stray light
- ~85% correlation of blooms (> 100,000 cells/ml) with advisories throughout US

- https://www.epa.gov/water-research/cyanobacteria-assessment-network-cyan

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Project in the Upper Deschutes Basin

- Test the capacity of satellite imagery to identify, predict, and monitor cyanobacteria blooms

- Compare satellite derived estimates of cyanobacteria abundance with *in situ* water quality measurements

- Determine how a combination of satellite imagery and *in situ* measurements can help identify factors contributing to blooms

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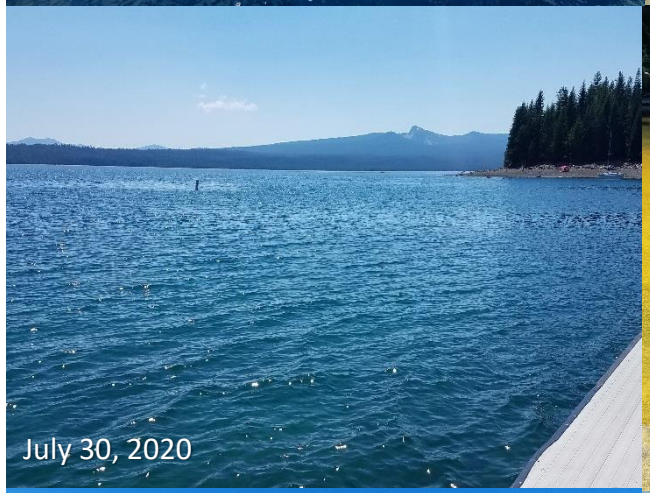
Lake Billy Chinook: 2021
(not presented here)
Sweet Home
Redmond
Prineville
Bend
LAVA RIVER CAVE
LAVA CAST
Oakridge
97
La Pine
GREAT SANDY DESERT
Diamond Peak
HOLE IN THE GROUND
Crane Prairie Reservoir: 2020-21
Odell Lake: 2019-21
Crescent Lake: 2019-21


Portland
Oregon


Crescent Lake
June 27, 2019


Odell Lake
July 26, 2019


July 30, 2020


July 30, 2020


September 30, 2021


August 19, 2021

Upper Deschutes Project Methods

- Conducted from spring/summer to fall in 2019, 2020, and 2021

- Collected continuous (15-minute interval) data:
  - Chlorophyll *a*
  - Phycocyanin
  - Dissolved Oxygen
  - pH
  - Temperature
- Collected biweekly microcystin and nutrient (N, P, and Si) grab samples
  - Vertical profile sampling (2019 & 2020)
- Compare field data with satellite estimates of cyanobacteria abundance derived from Sentinel 3 satellites

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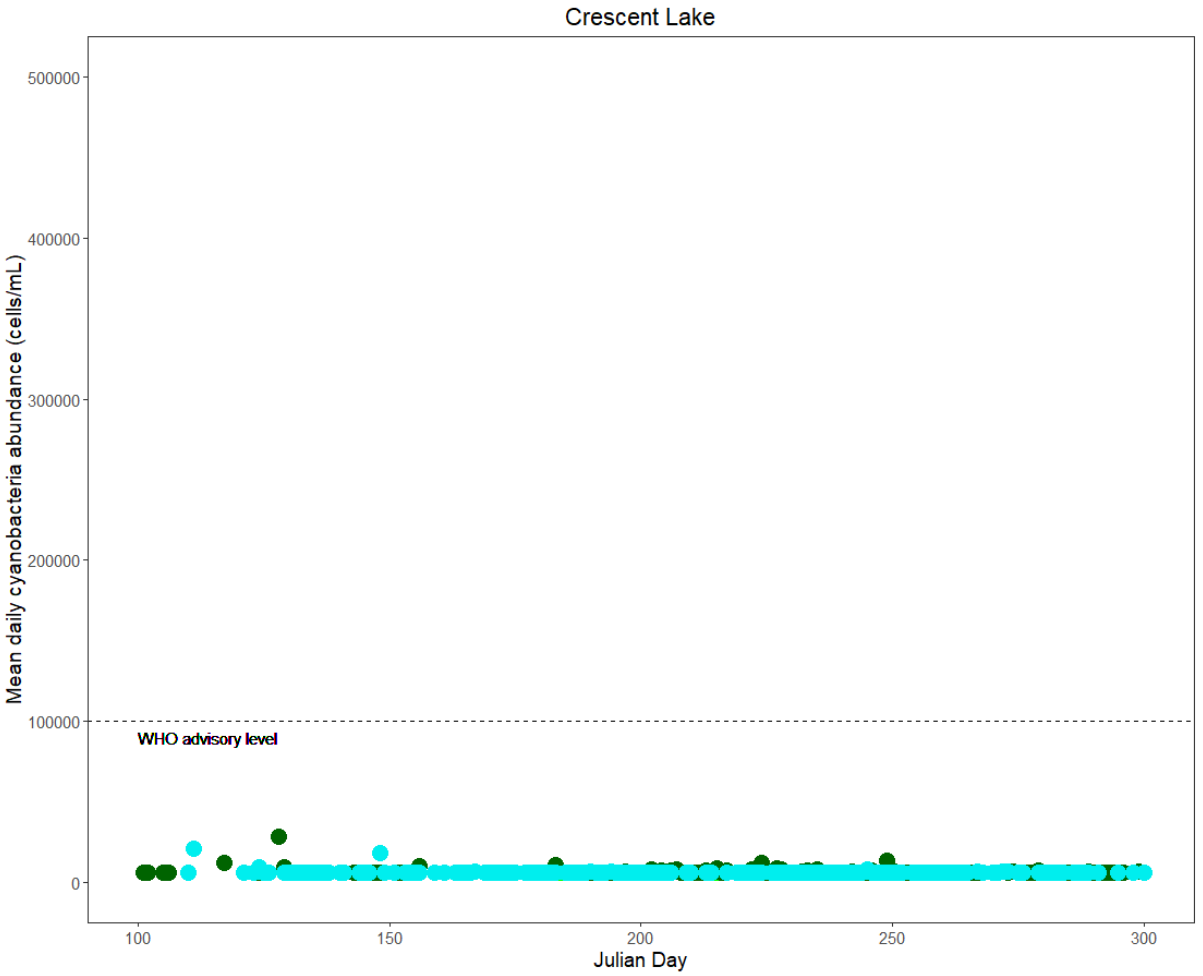
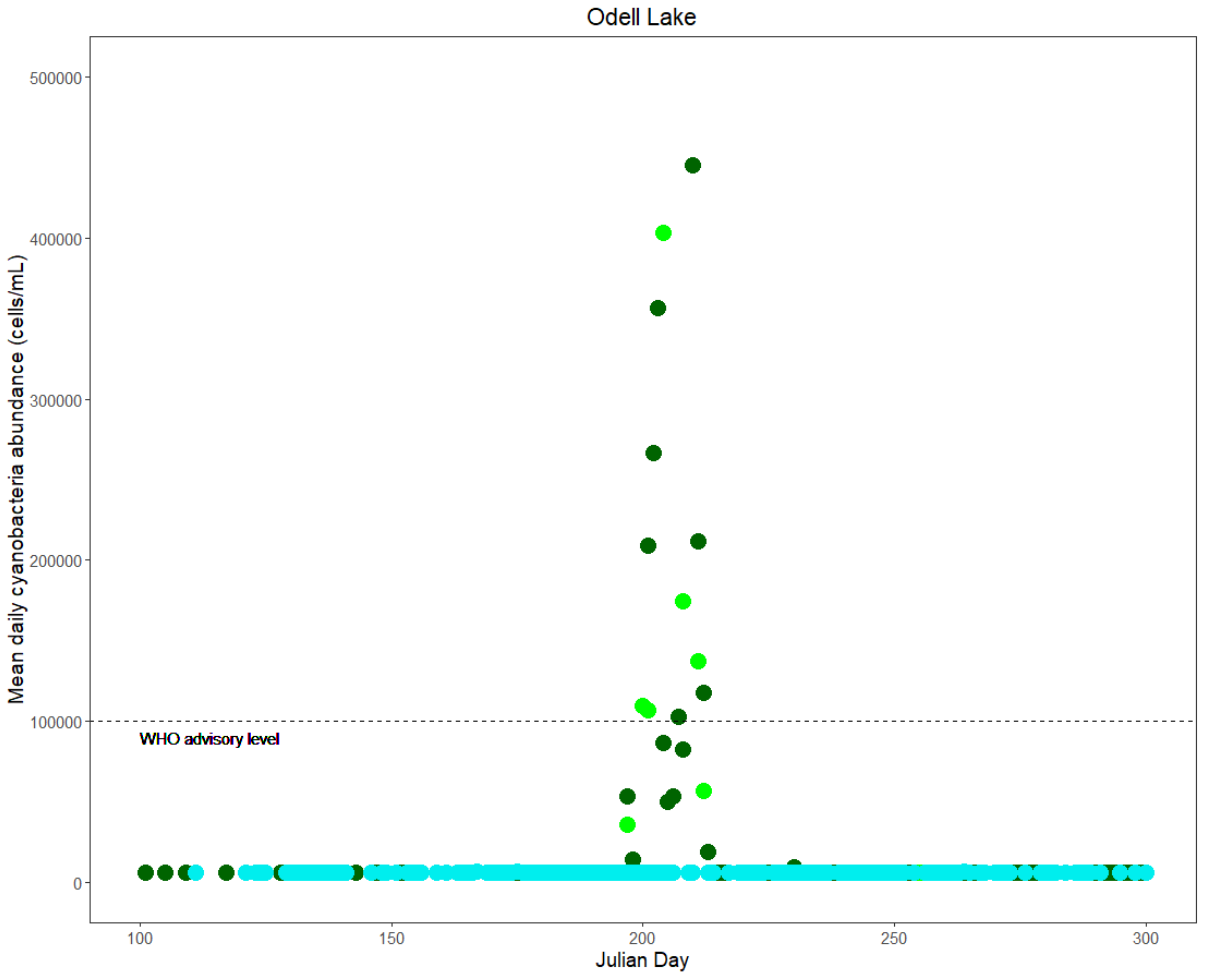
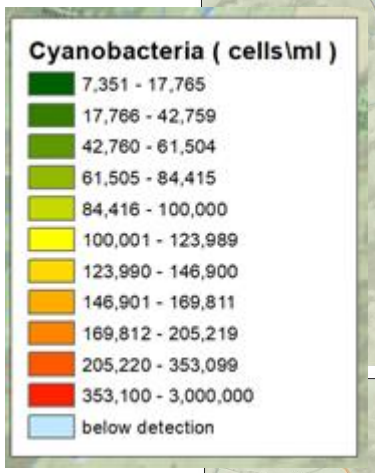
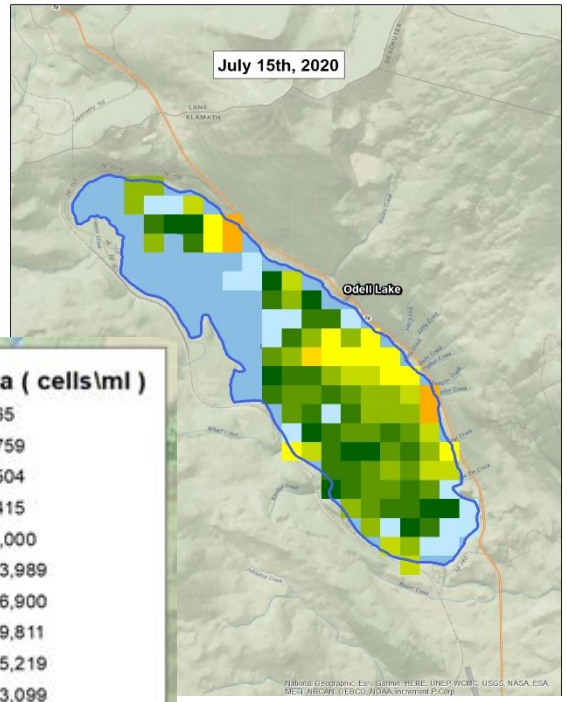
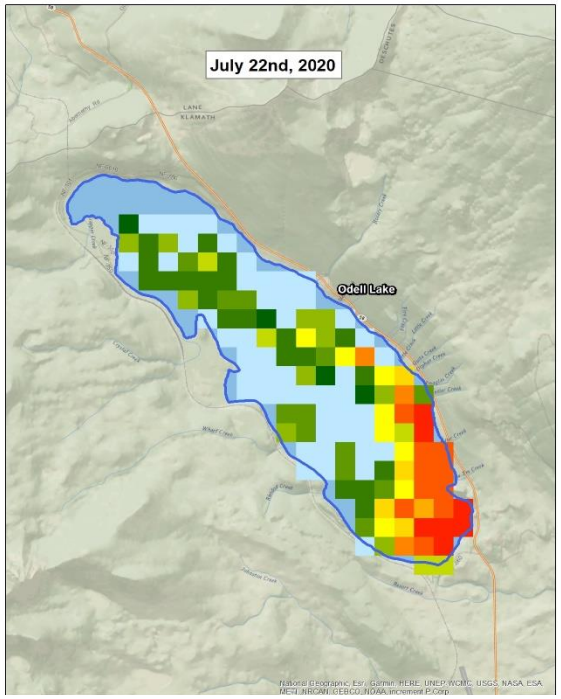
Satellite Imagery

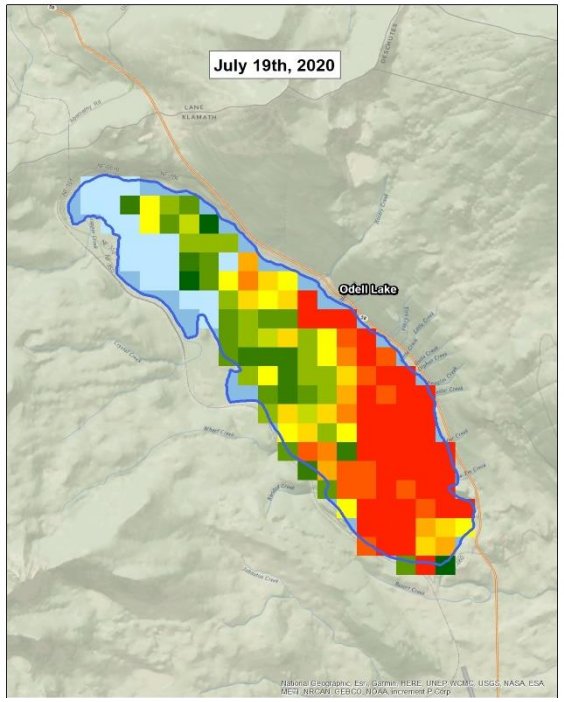


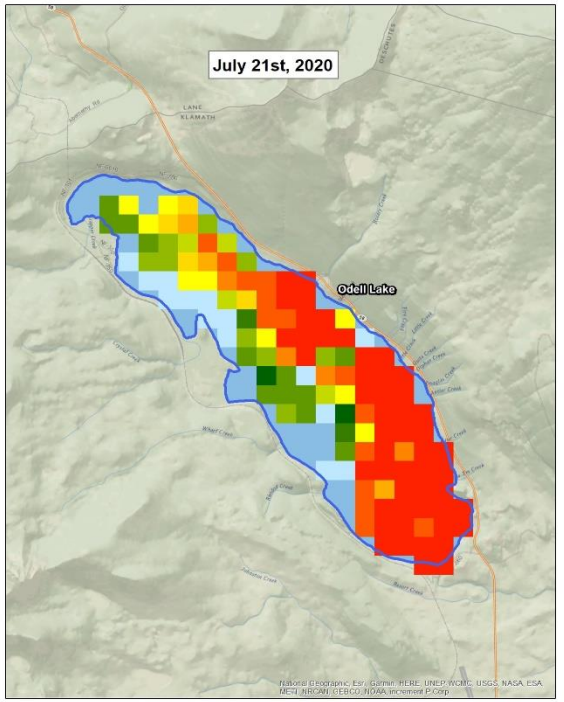


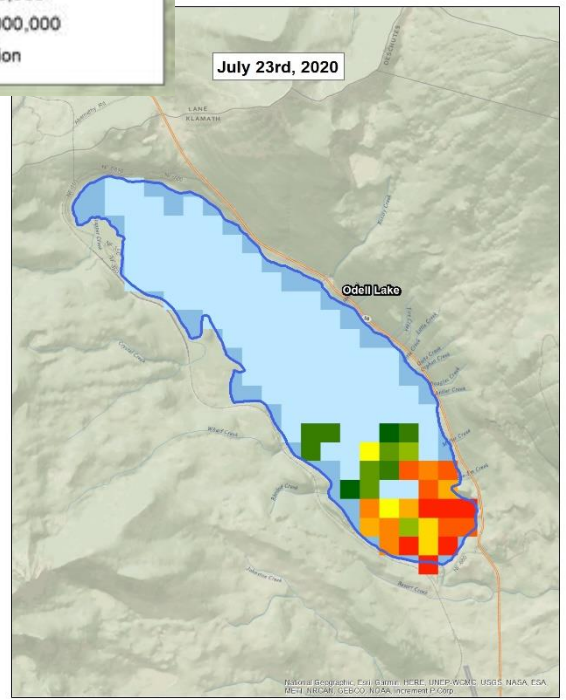

Cyanobacteria (cells\ml)
7,351 - 17,765
17,766 - 42,759
42,760 - 61,504
61,505 - 84,415
84,416 - 100,000
100,001 - 123,989
123,990 - 146,900
146,901 - 169,811
169,812 - 205,219
205,220 - 353,099
353,100 - 3,000,000
below detection

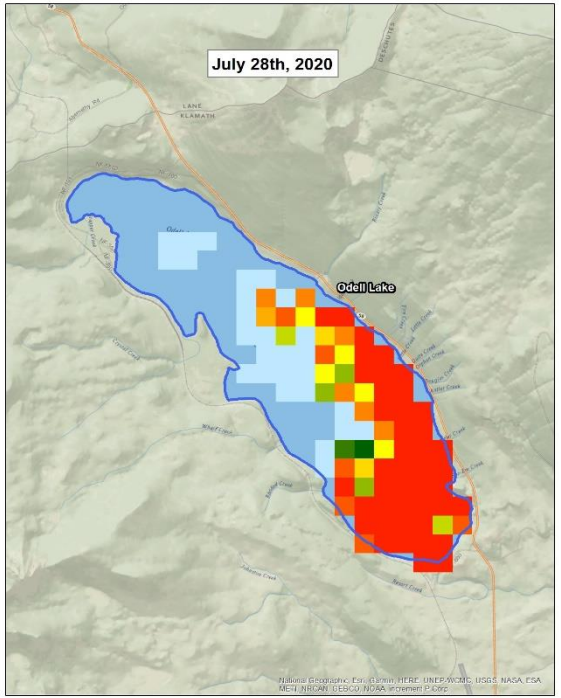

July 15th, 2020
Odell Lake


July 22nd, 2020
Odell Lake


July 19th, 2020
Odell Lake


July 21st, 2020
Odell Lake


July 23rd, 2020
Odell Lake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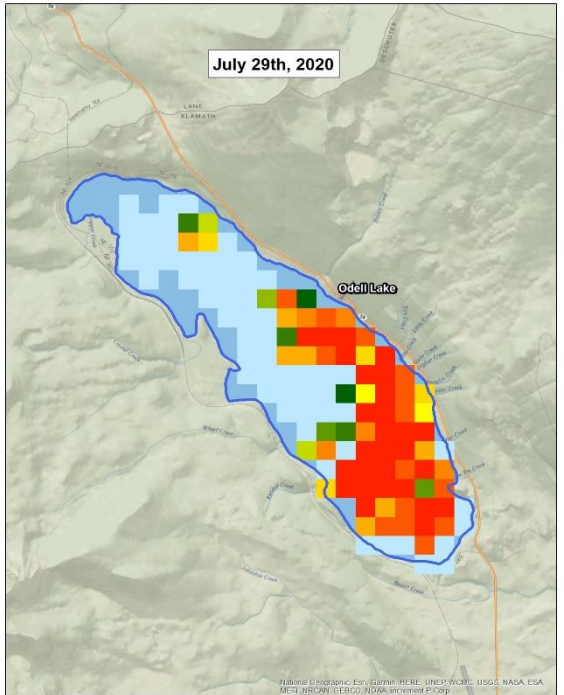
Odell Lake


July 29th, 2020
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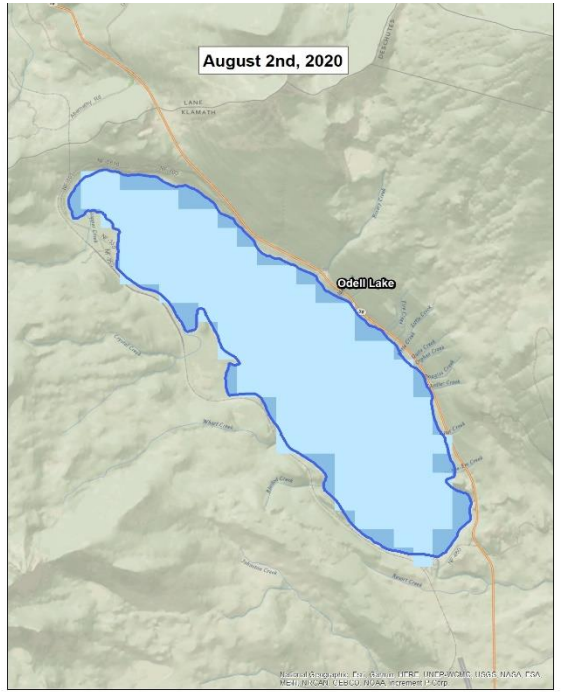
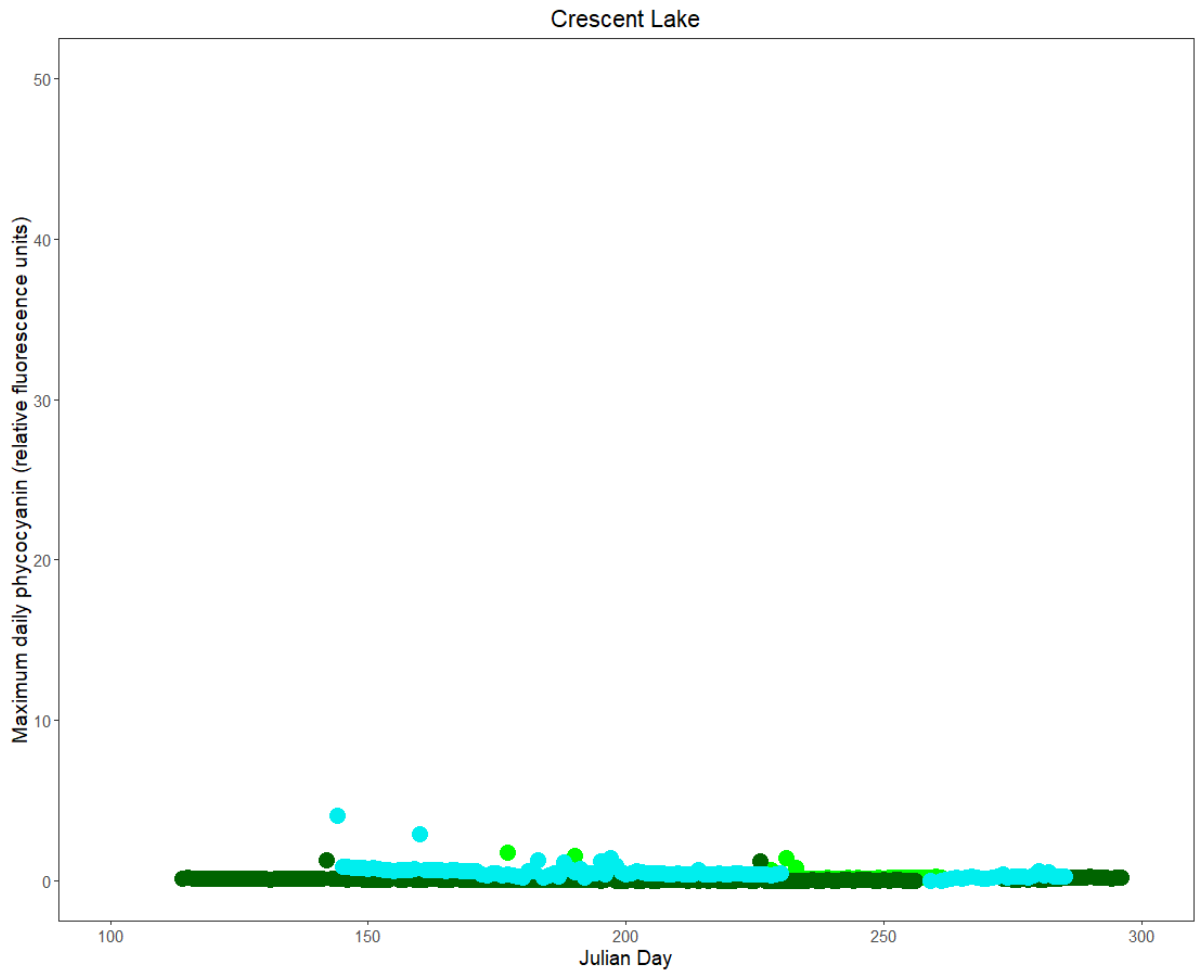
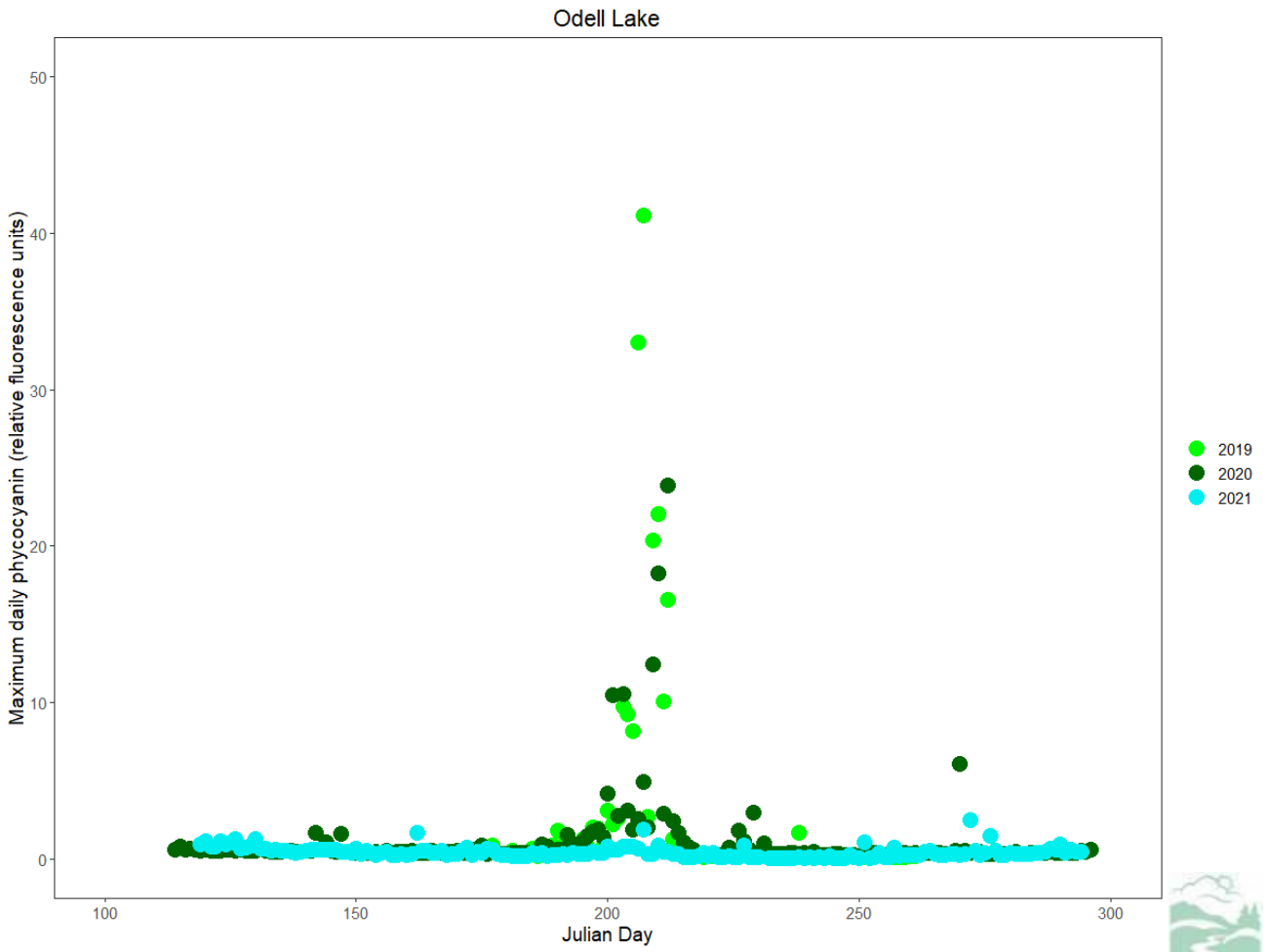

August 2nd, 2020
Odell Lake

Continuous Monitoring - Phycocyanin





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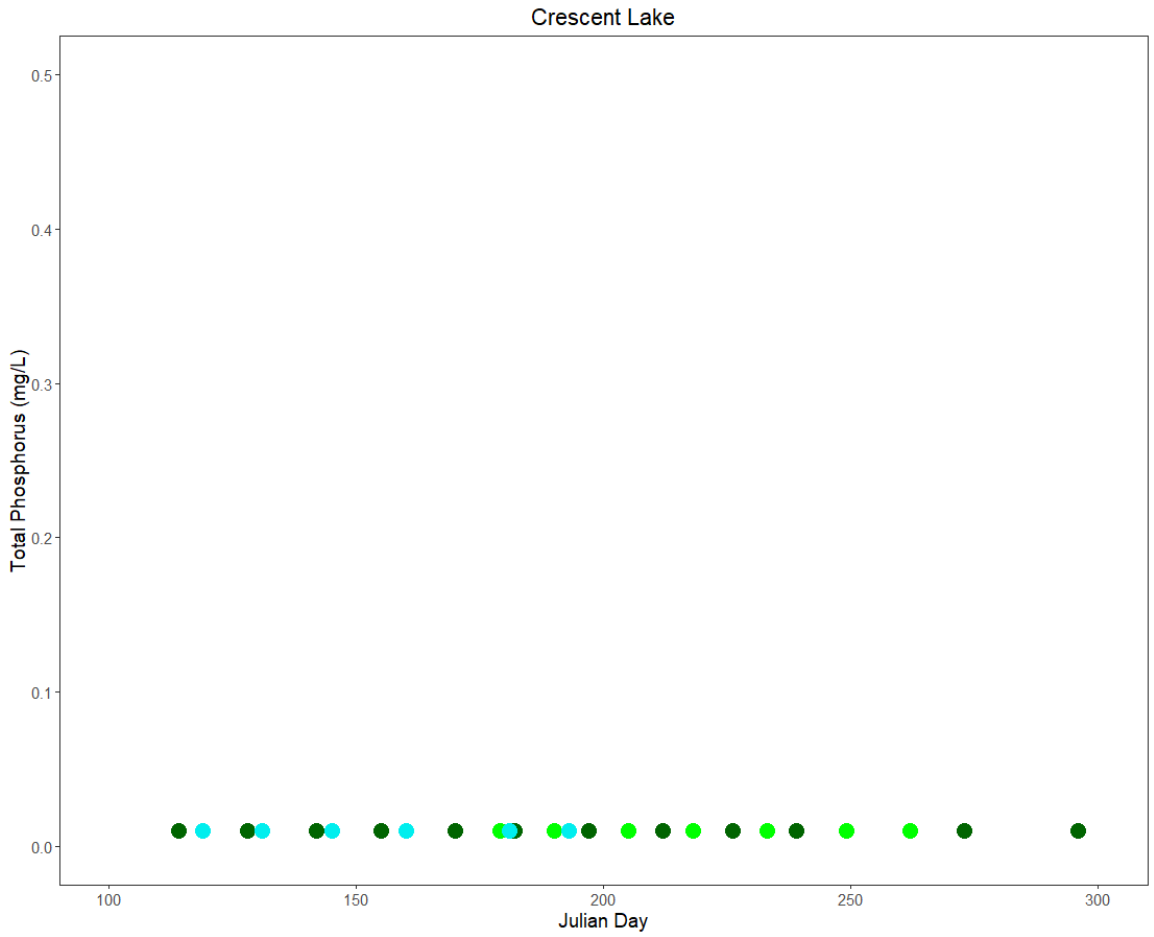
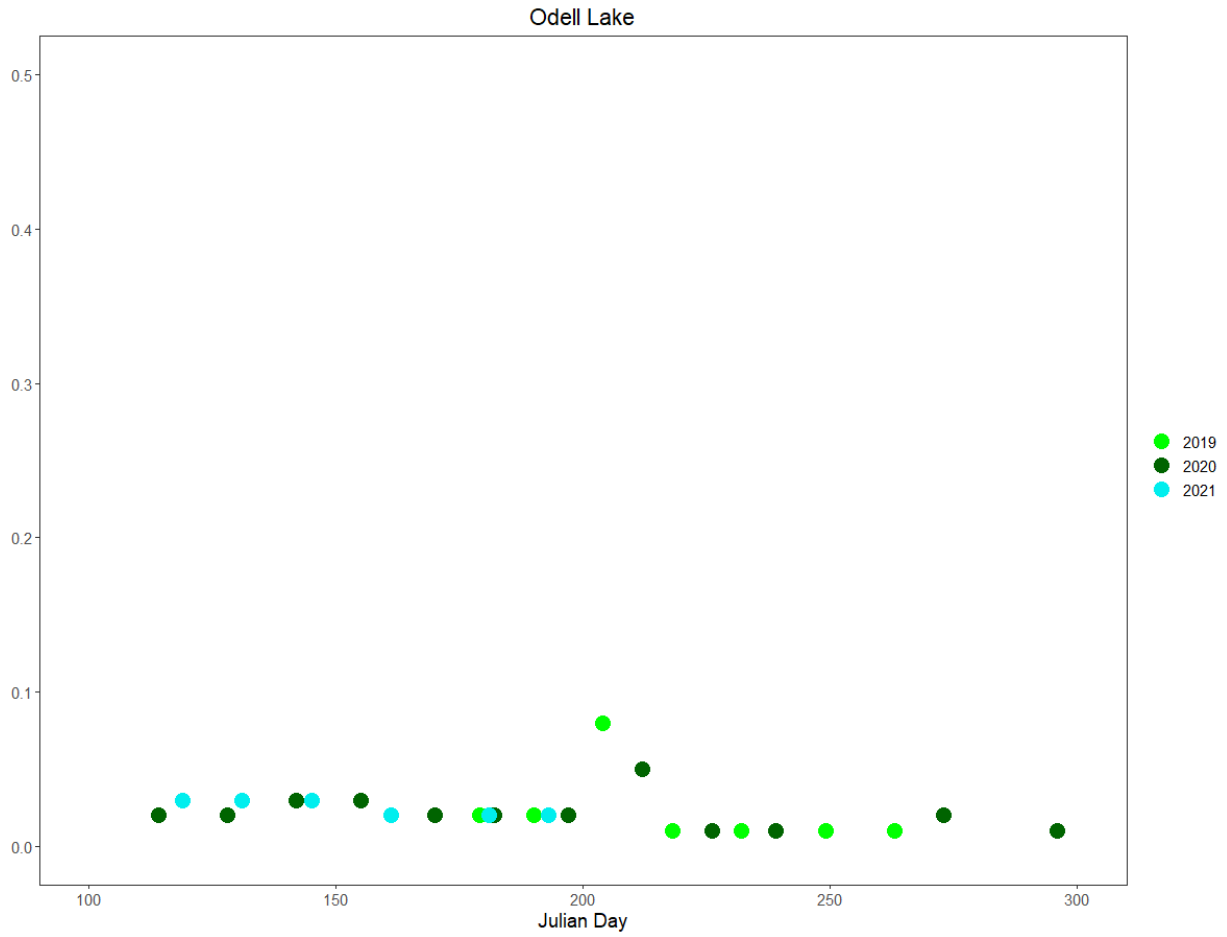
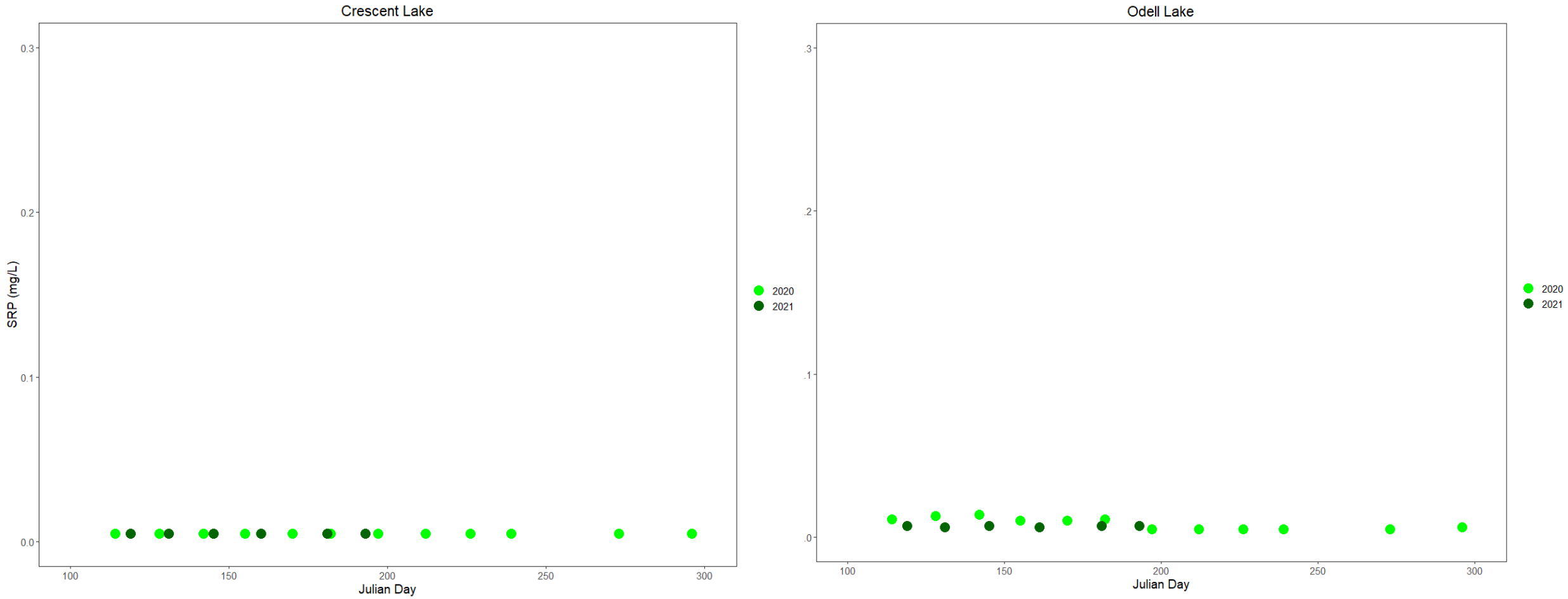
Total Phosphorus





Soluble Reactive Phosphorus



Takeaways thus far

- **<u>Satellite estimates and water quality measures of HABs correspond</u>**

- Correlations seem to vary by waterbody and possibly year
  - Difference between waterbody summary vs. point measurements
  - Calibration of monitoring equipment

- Could help identify sources of nutrients (external vs. internal recycling)

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Future work

- Continue Upper Deschutes Project in 2022
  - Continue sampling on previously sampled waterbodies
  - Expand sampling to evaluate ‘non-resolvable’ lakes
  - Collaborate with PSU, OSU, and USGS
- Expand comparisons to other Oregon waterbodies as resources allow
- Investigate how ‘bottom-up’ and ‘top-down’ factors interact in these waterbodies to improve management
  - Nutrients
  - Temperature
  - Fish abundance and community composition

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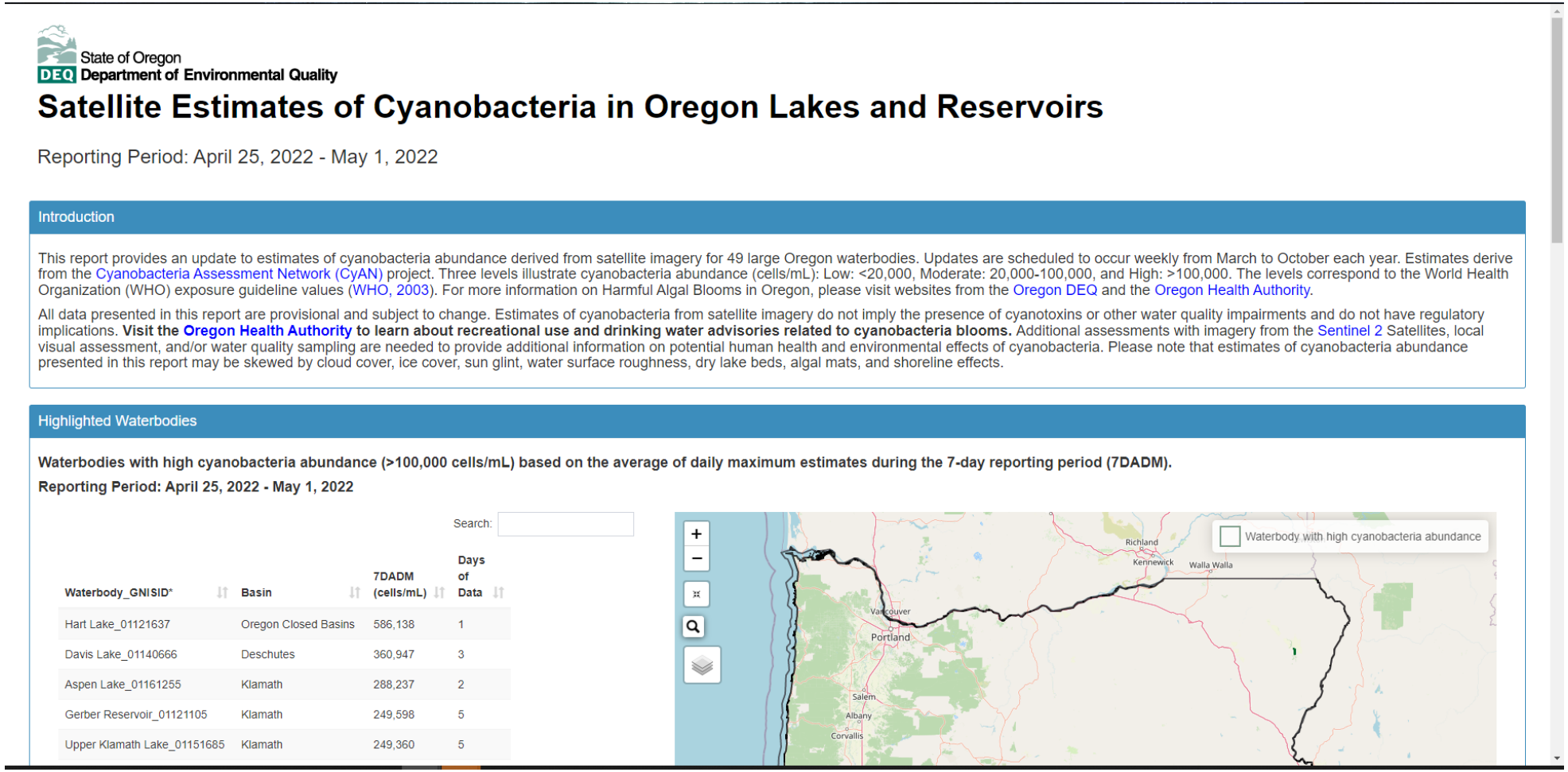
New for 2022: Web-Based Weekly Reports

https://rstudioconnect.deq.state.or.us/Oregon-cyanobacteria-satellite-report/



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Satellite Estimates of Cyanobacteria in Oregon Lakes and Reservoirs

Reporting Period: April 25, 2022 - May 1, 2022

Introduction

This report provides an update to estimates of cyanobacteria abundance derived from satellite imagery for 49 large Oregon waterbodies. Updates are scheduled to occur weekly from March to October each year. Estimates derive from the Cyanobacteria Assessment Network (CyAN) project. Three levels illustrate cyanobacteria abundance (cells/mL): Low: <20,000, Moderate: 20,000-100,000, and High: >100,000. The levels correspond to the World Health Organization (WHO) exposure guideline values (WHO, 2003). For more information on Harmful Algal Blooms in Oregon, please visit websites from the Oregon DEQ and the Oregon Health Authority.

All data presented in this report are provisional and subject to change. Estimates of cyanobacteria from satellite imagery do not imply the presence of cyanotoxins or other water quality impairments and do not have regulatory implications. **Visit the Oregon Health Authority to learn about recreational use and drinking water advisories related to cyanobacteria blooms.** Additional assessments with imagery from the Sentinel 2 Satellites, local visual assessment, and/or water quality sampling are needed to provide additional information on potential human health and environmental effects of cyanobacteria. Please note that estimates of cyanobacteria abundance presented in this report may be skewed by cloud cover, ice cover, sun glint, water surface roughness, dry lake beds, algal mats, and shoreline effects.

Highlighted Waterbodies

Waterbodies with high cyanobacteria abundance (>100,000 cells/mL) based on the average of daily maximum estimates during the 7-day reporting period (7DADM).

Reporting Period: April 25, 2022 - May 1, 2022

Search:

Waterbody_GNISID*	Basin	7DADM (cells/mL)	Days of Data
Hart Lake_01121637	Oregon Closed Basins	586,138	1
Davis Lake_01140666	Deschutes	360,947	3
Aspen Lake_01161255	Klamath	288,237	2
Gerber Reservoir_01121105	Klamath	249,598	5
Upper Klamath Lake_01151685	Klamath	249,360	5

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Continuous Monitoring - Temperature