

Statewide Data Analysis to Identify Lake Chlorophyll *a* Endpoints & Nutrient Thresholds to Protect Beneficial Uses

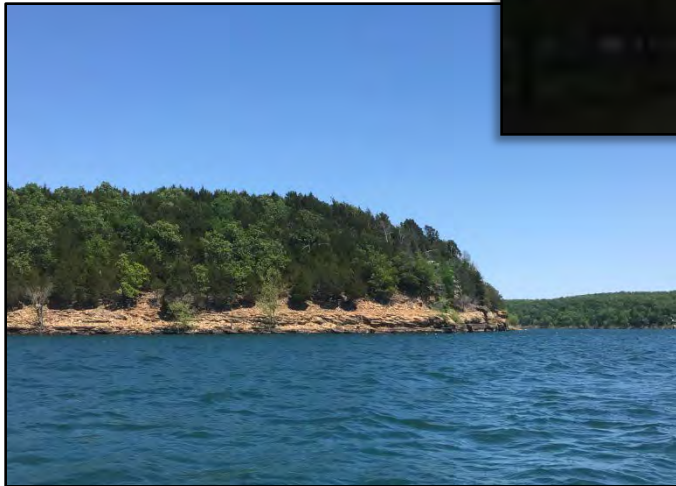
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1) Tetra Tech, Inc. 2) Oklahoma Water Resources Board



OKLAHOMA LAKES

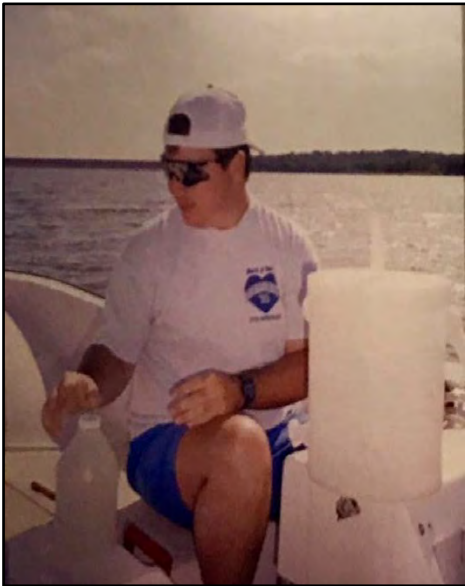


OKLAHOMA LAKES



- Impacts to beneficial uses
 - Public Water Supply
 - Aquatic Life
 - Recreation
- 78% assessed lake acres identified as impaired
- Top 3 impairments
 - Low dissolved oxygen
 - Chlorophyll
 - Turbidity

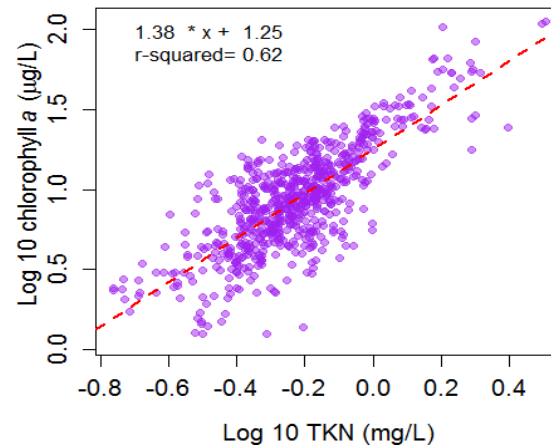
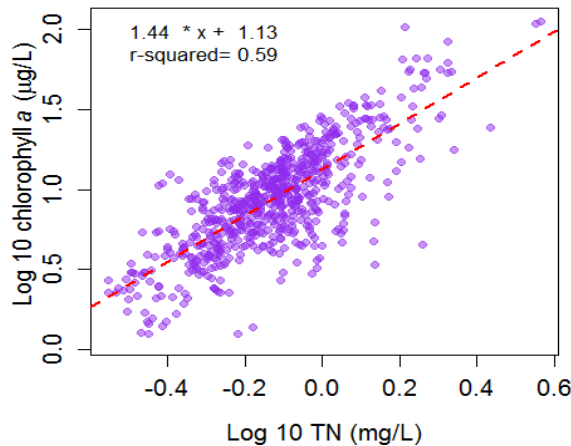
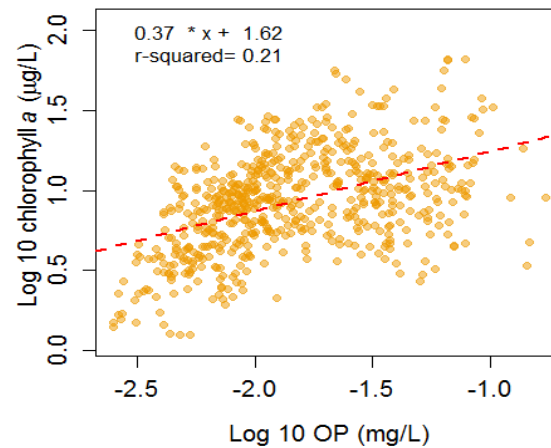
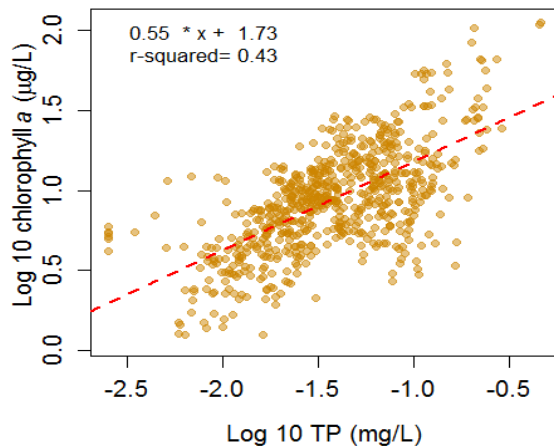
LAKE MONITORING & OUR DATA



Division Chief Training

- Long term statewide Monitoring program
- Data
 - 150 Lakes
 - 835 sample stations
 - 29,000 nutrient & chl. samples
 - 13,000 vertical profiles
 - 440 phytoplankton
 - 650 zooplankton

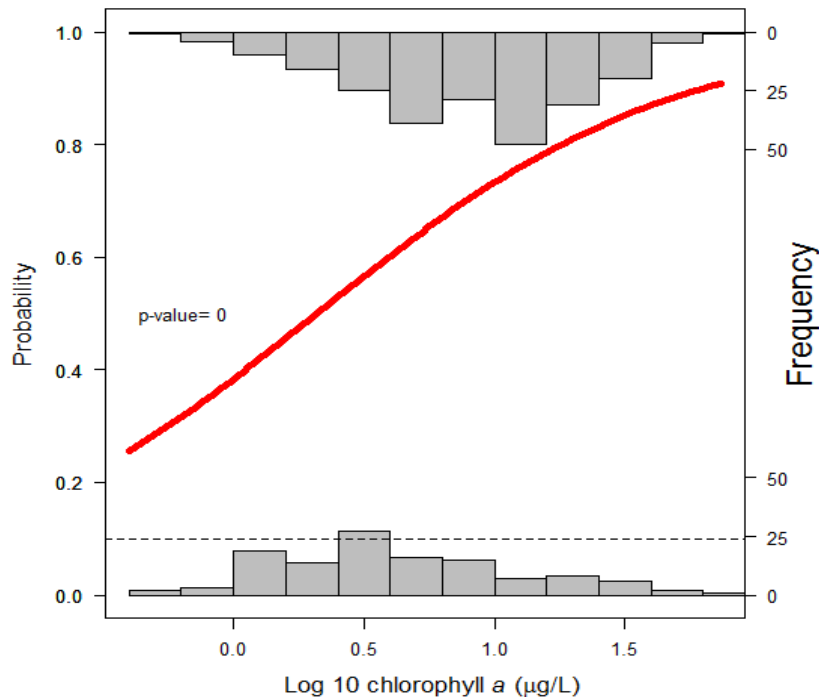
STRESS & RESPONSE



- Long term chlorophyll a response to nutrient concentrations

STRESS & RESPONSE

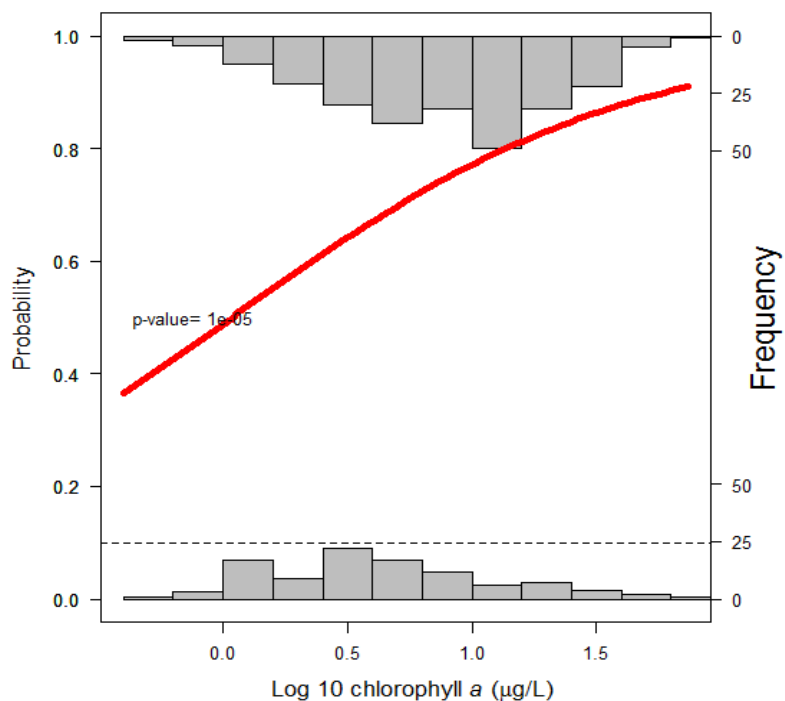
Probability that > 50% of DO samples from hypolimnion are <2 mg/L



- Lake DO decreased with increasing chl.
- at 10 $\mu\text{g/L}$ chl. *a* ~ 80% probability that 50% hypolimnetic DO samples < 2 mg/L

STRESS & RESPONSE

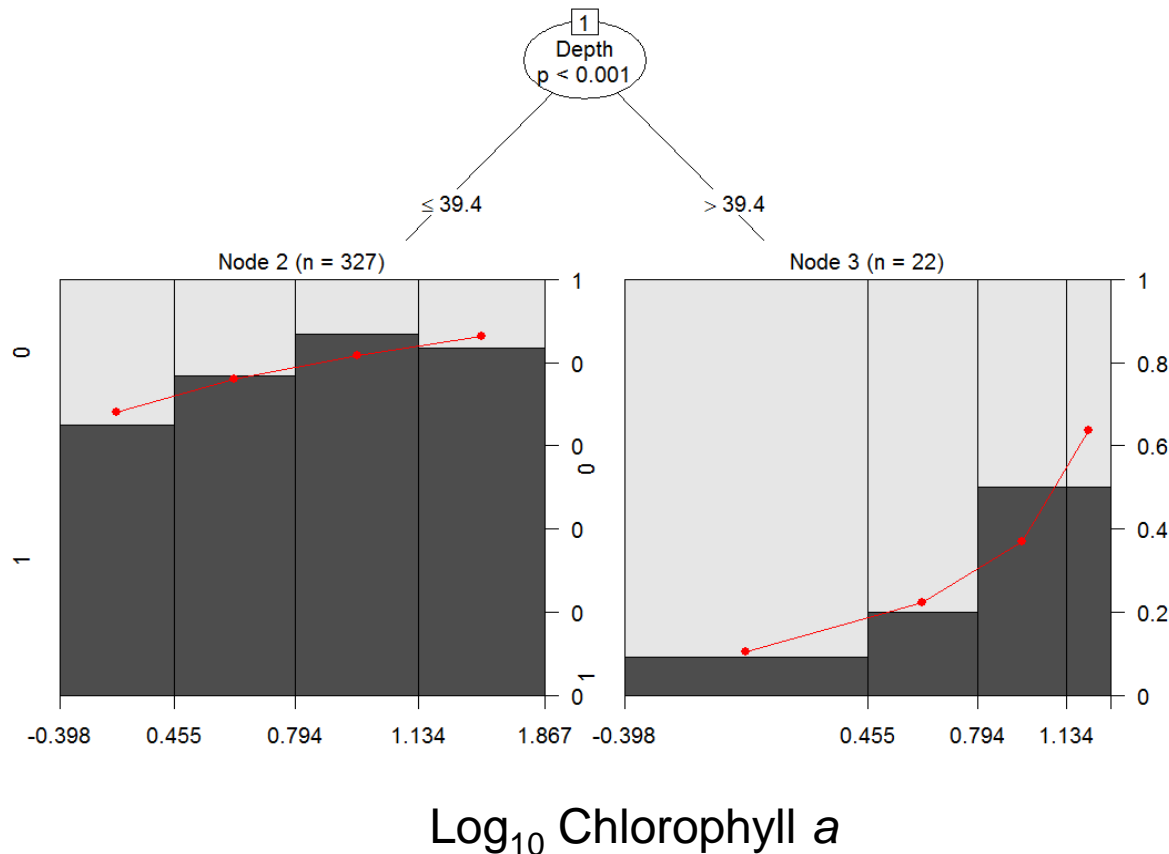
Probability that there is < 1 m of the hypolimnion with DO > 4mg/L



- 1 m depth of hypolimnion with sufficient oxygen for aquatic life

- at 10 µg/L chl. *a* ~ 80 % probability that there is <1 m of hypolimnion with > 4 mg/L DO

DO & MAX SAMPLING DEPTH



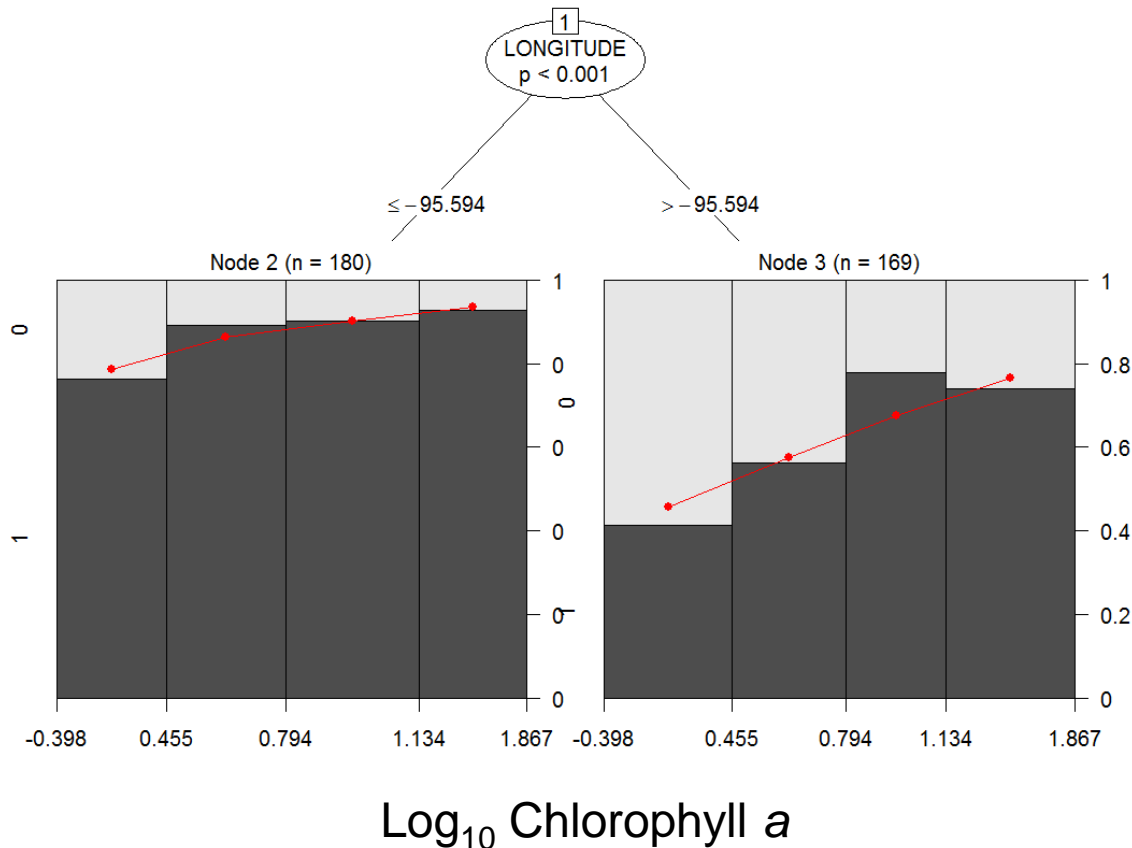
- Do physical attributes affect the chl. vs DO relationship

- Binomial Model based recursive partitioning

- Proportion of hypolimnion < 4 mg/L

- Lakes group around max sampling depth of 39 meters

DO: EAST VS WEST



- Lakes group around 95.6 degrees
~ Tulsa

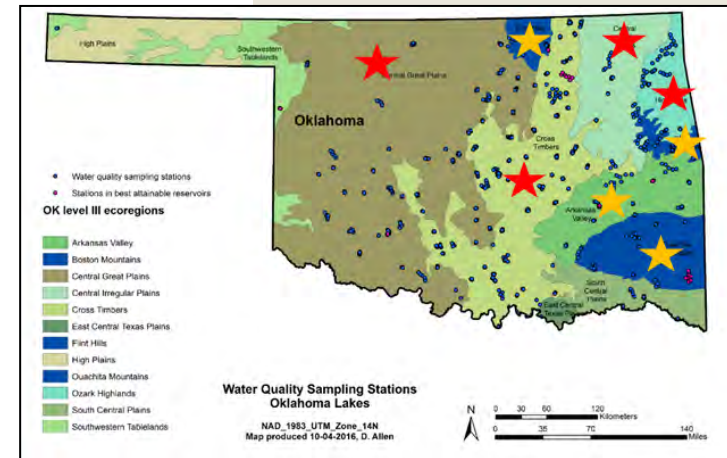
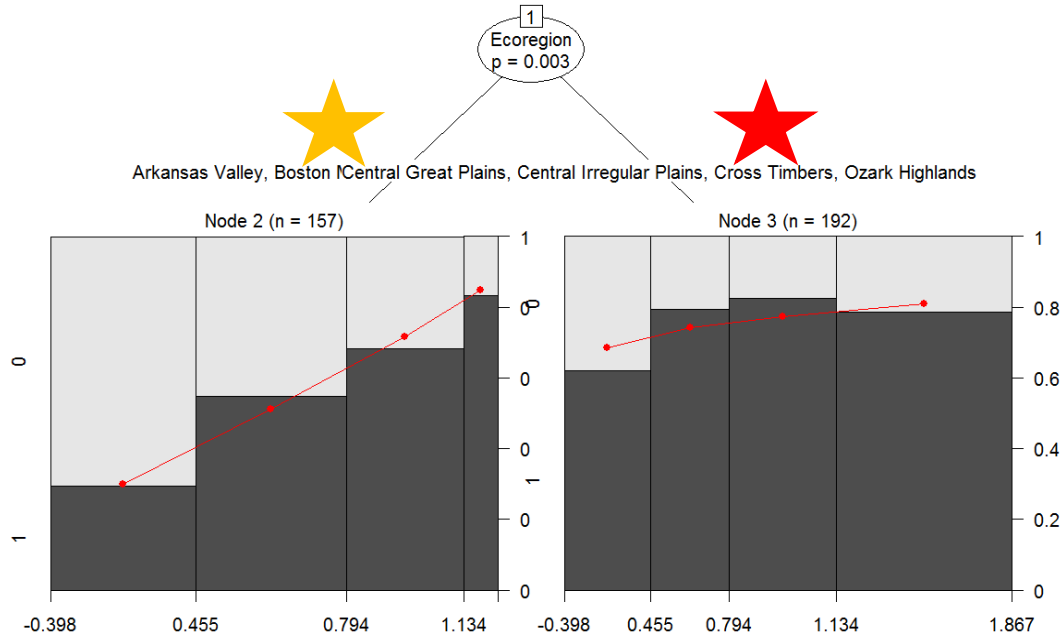
- East steeper response relationship between chl. and hypoxia

- Western lakes higher levels of hypoxia across all levels of chl.

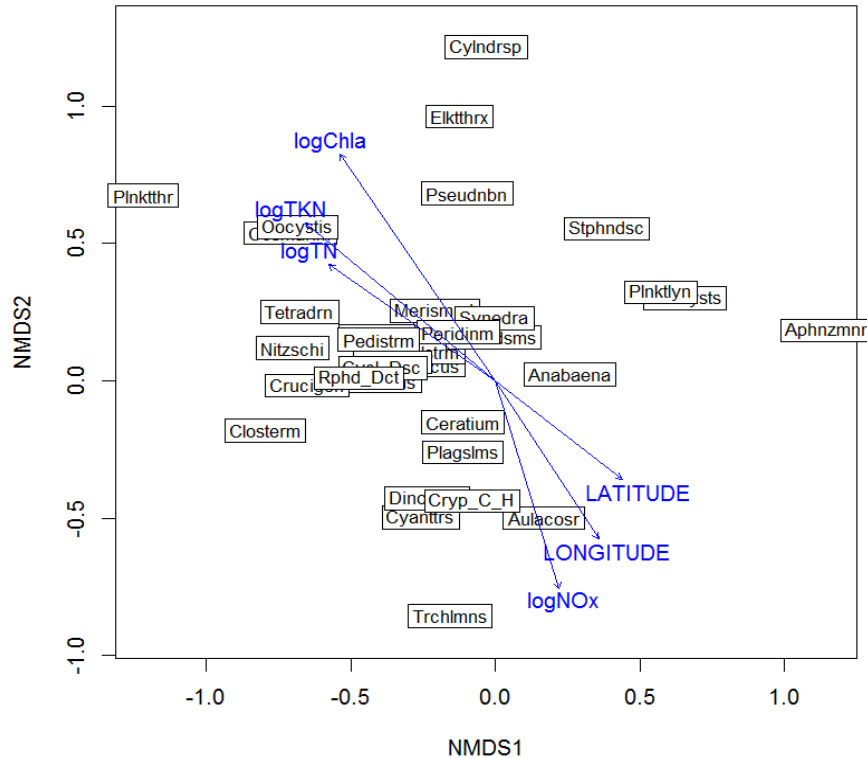
DO: ECOREGIONS

- Ecoregions grouped together based on DO chlorophyll response

Proportion hypolimnion hypoxic (2 mg/L) vs. chlorophyll a, ecoregion split



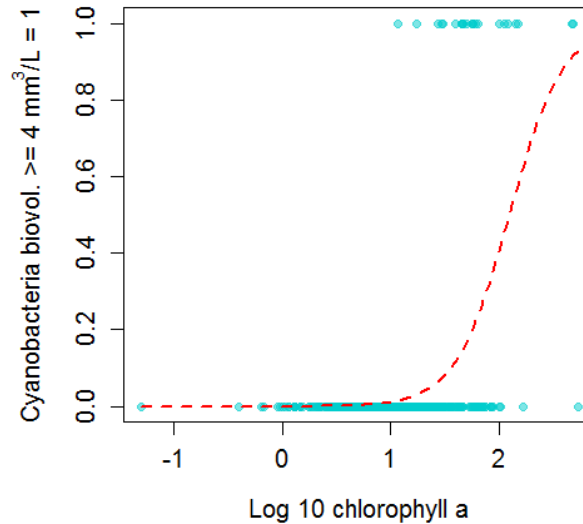
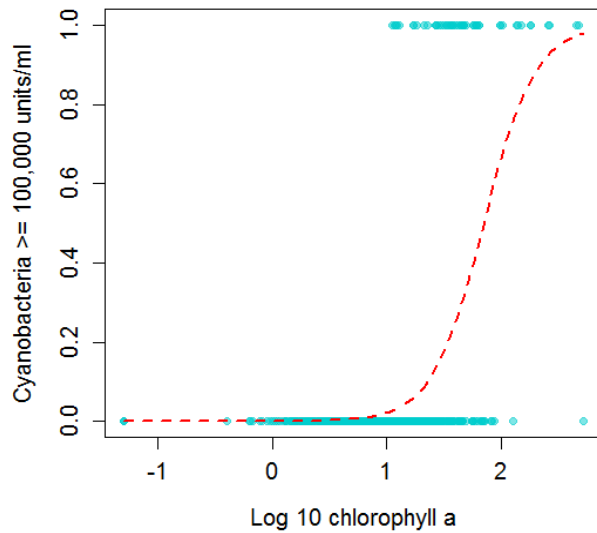
PHYTOPLANKTON ANALYSIS



- Phytoplankton non-metric multidimensional scaling

- Differences in phytoplankton composition associated with differences in N and location

CYANOS & HUMAN HEALTH RISK



Chlorophyll a	Probability of exceeding 4 mm ³ /L threshold
10 µg/L	1%
15 µg/L	2%
20 µg/L	4%
40 µg/L	11%

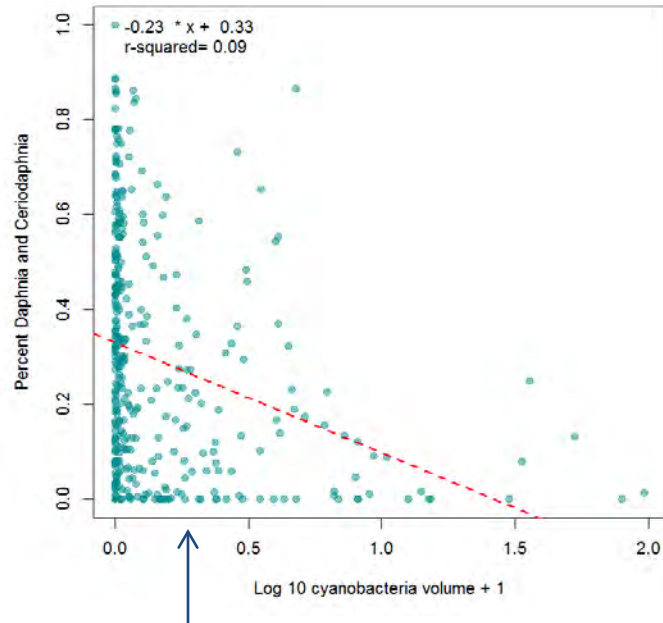
- Link risky/nuisance taxa to chlorophyll and nutrients

- Human Health Target

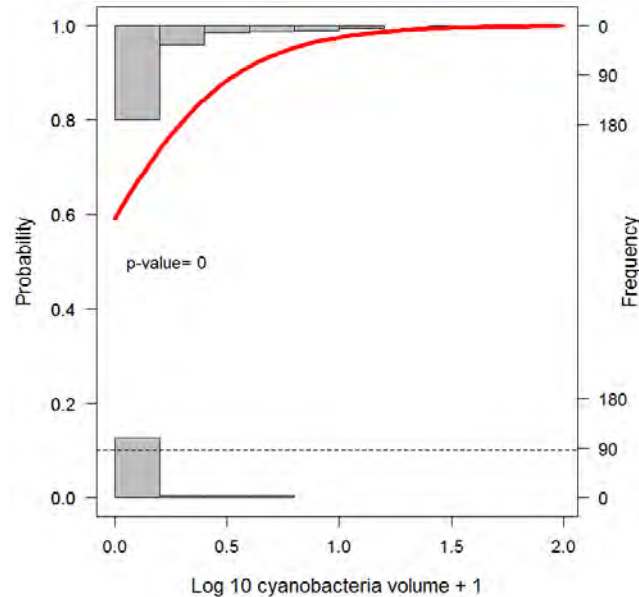
- 100,000 units/mL
- 4 mm³/L

- Risk begins at ~10 µg/L Chl a

ZOOPLANKTON ANALYSIS



About where chl >10 ug/L



- Daphnia & Ceriodaphnia decline with increasing cyanobacteria
- Proportion of preferred prey declines at higher cyanobacteria densities

CONCLUSIONS

- Clear linkage between nutrients & beneficial uses
- DO & chlorophyll relationships
 - Depth matters
 - Longitude matters
 - Ecoregion matters
- Information to establish chlorophyll threshold to protect human health & aquatic life
- Further explore zooplankton

QUESTIONS

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