Modeling cisco stress across Midwest lakes to aid management of cold-water fish habitat

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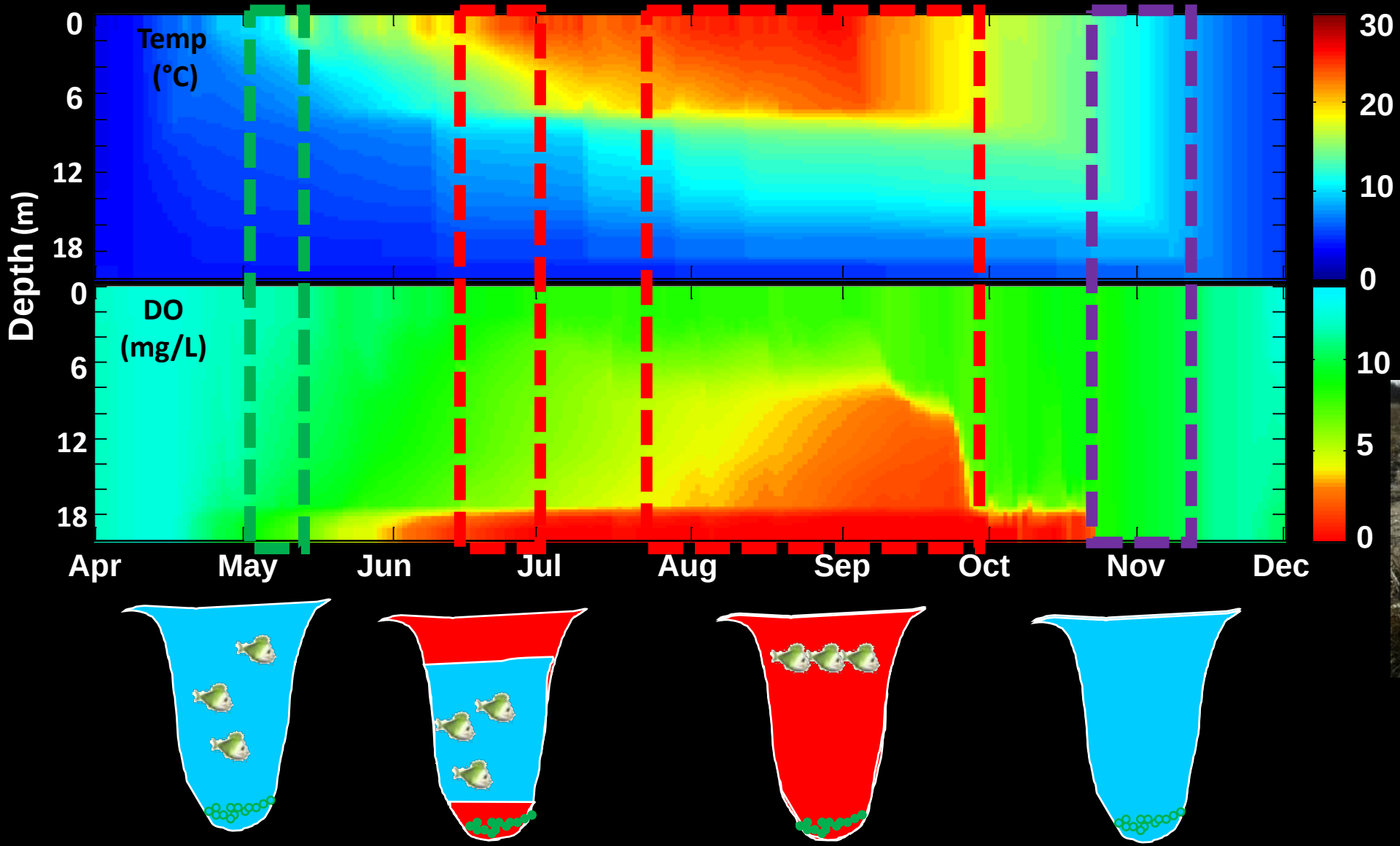
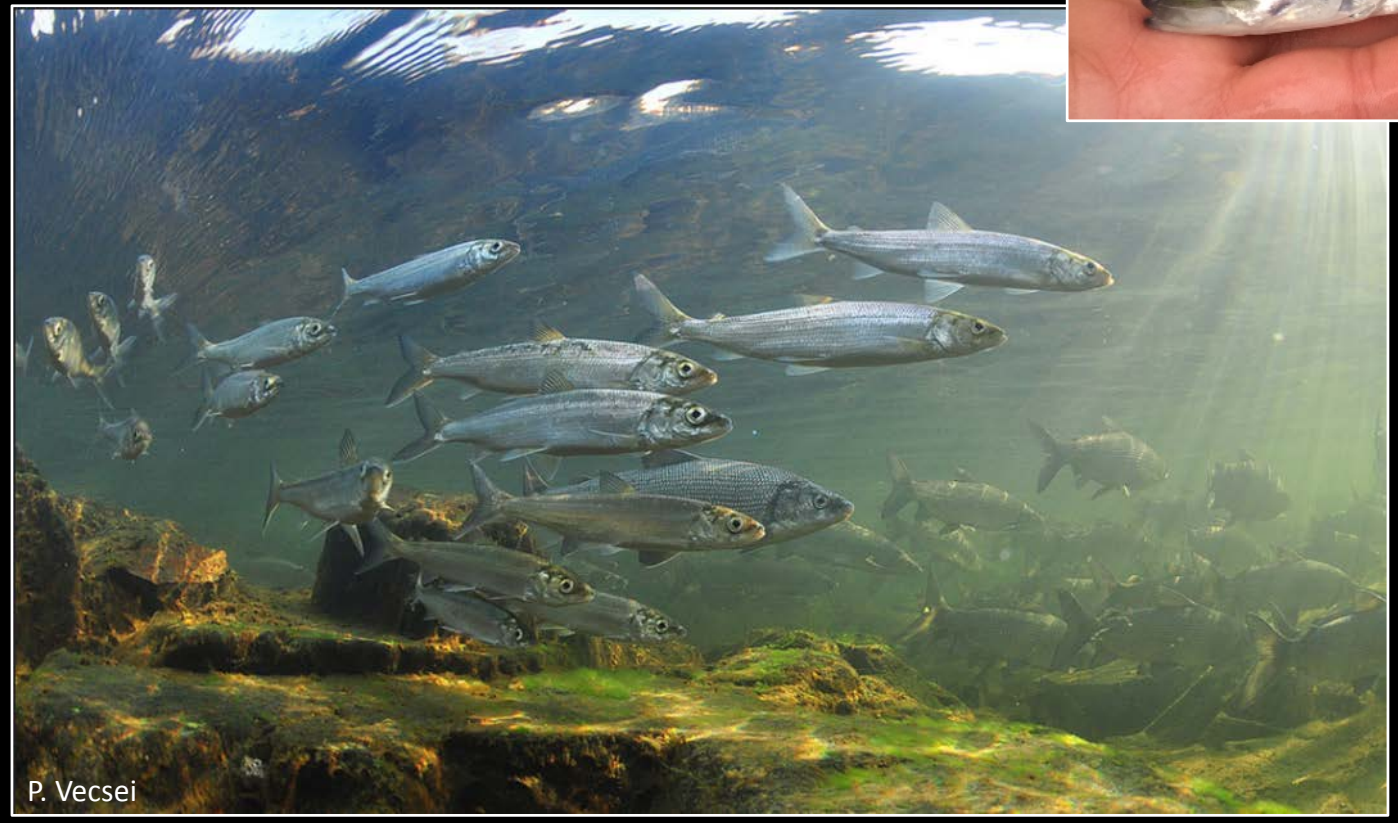
Oxythermal stress (OTS)



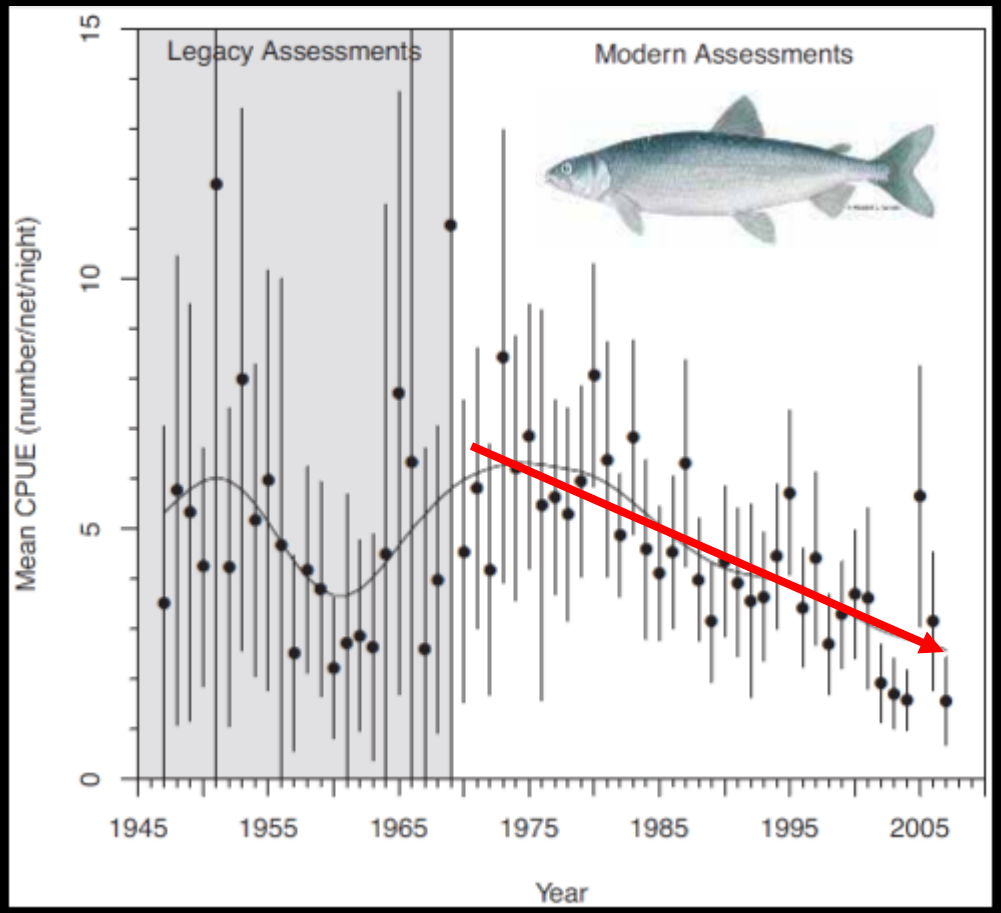
Cisco!

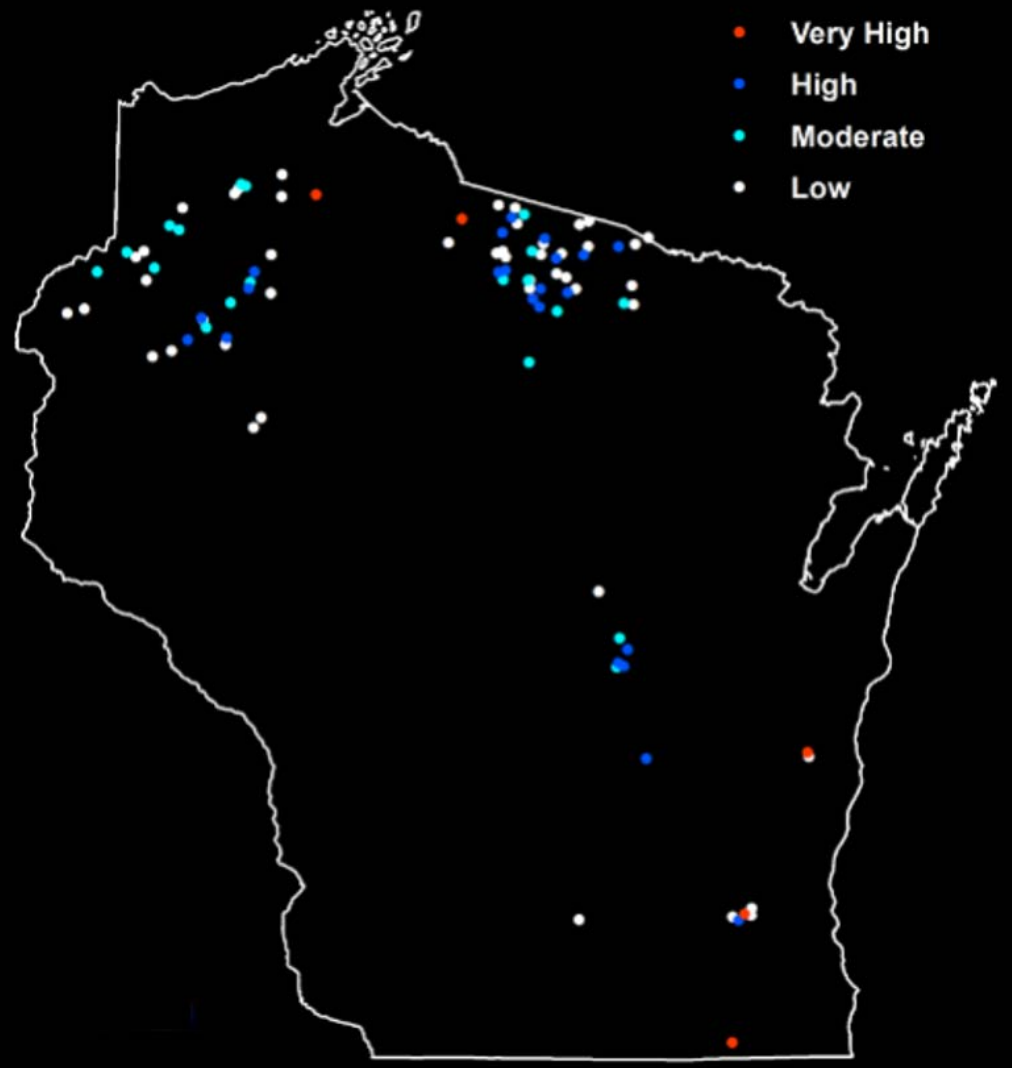


Native forage base

Fishery

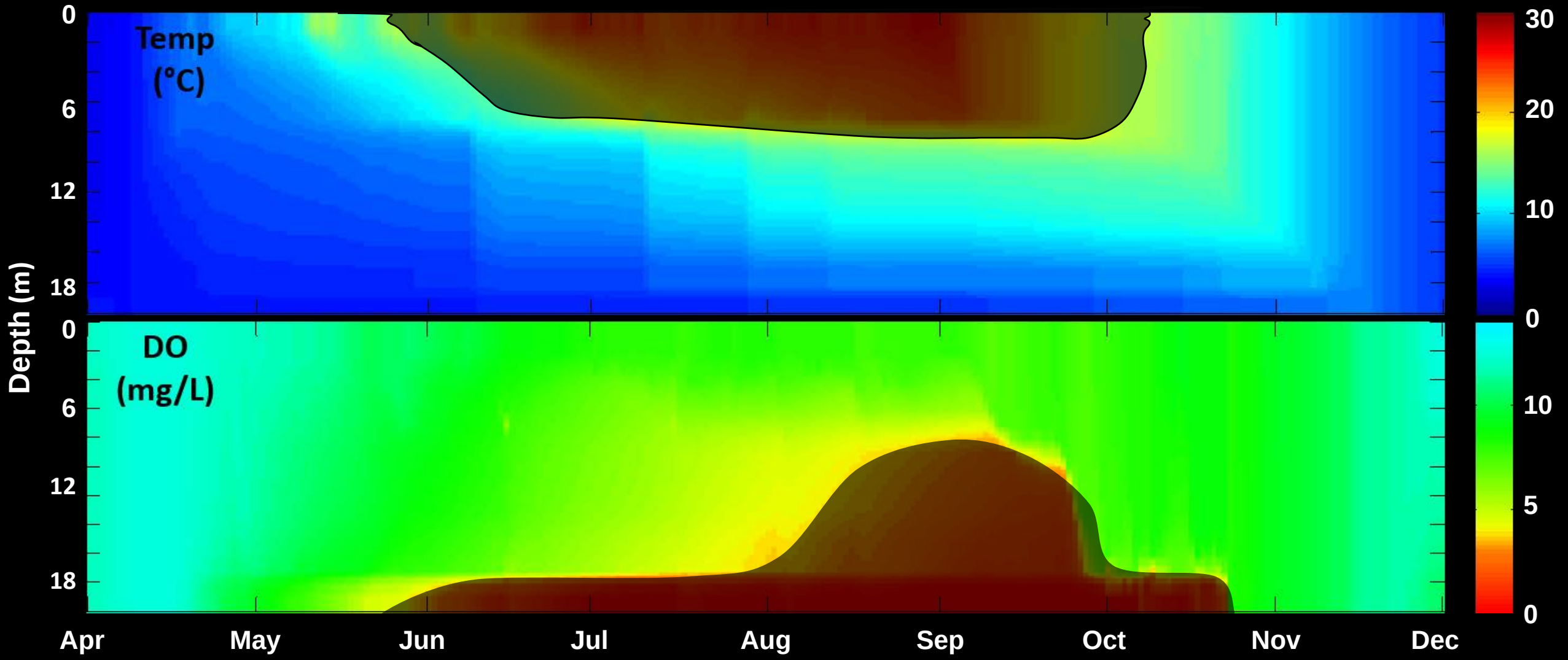
Cisco in Wisconsin



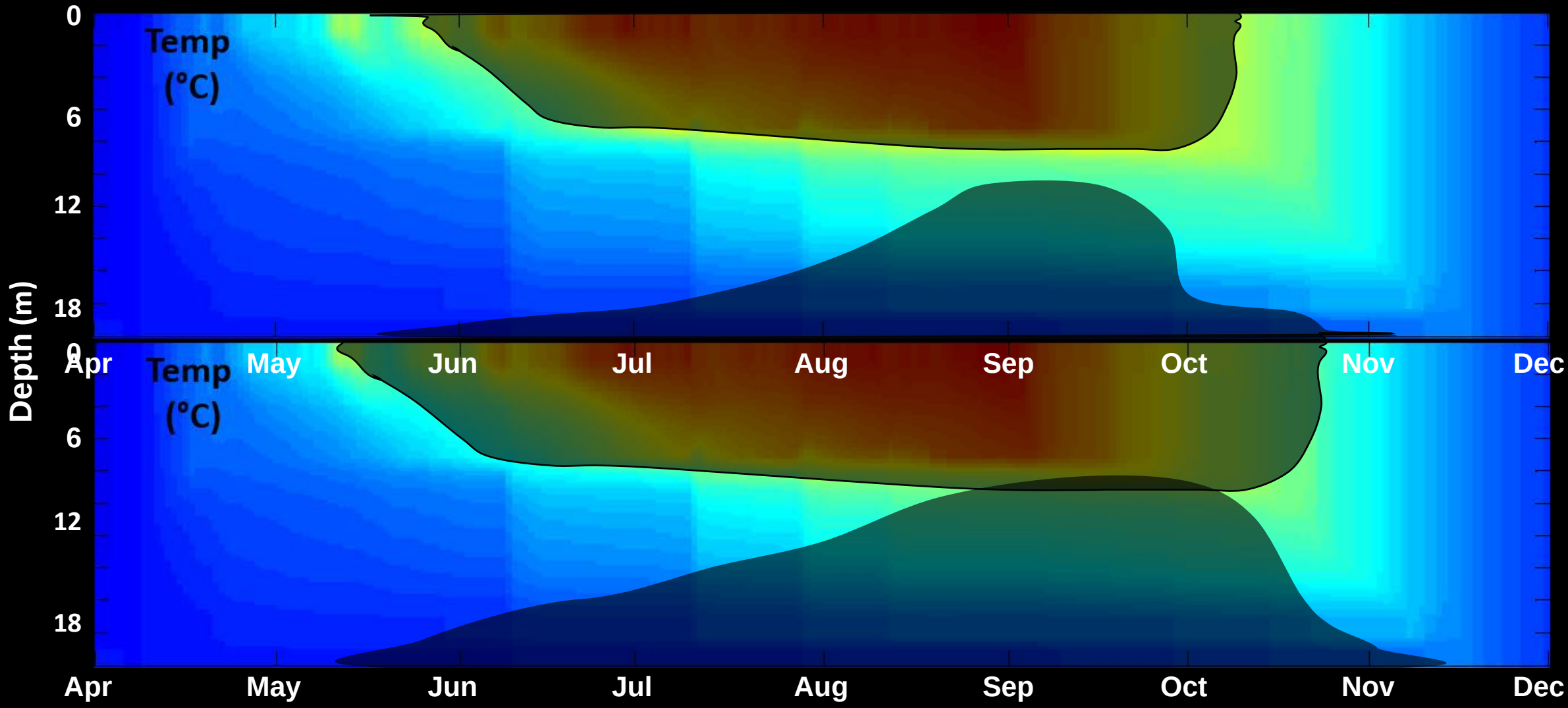


Timothy Parks, WDNR

Drivers of change

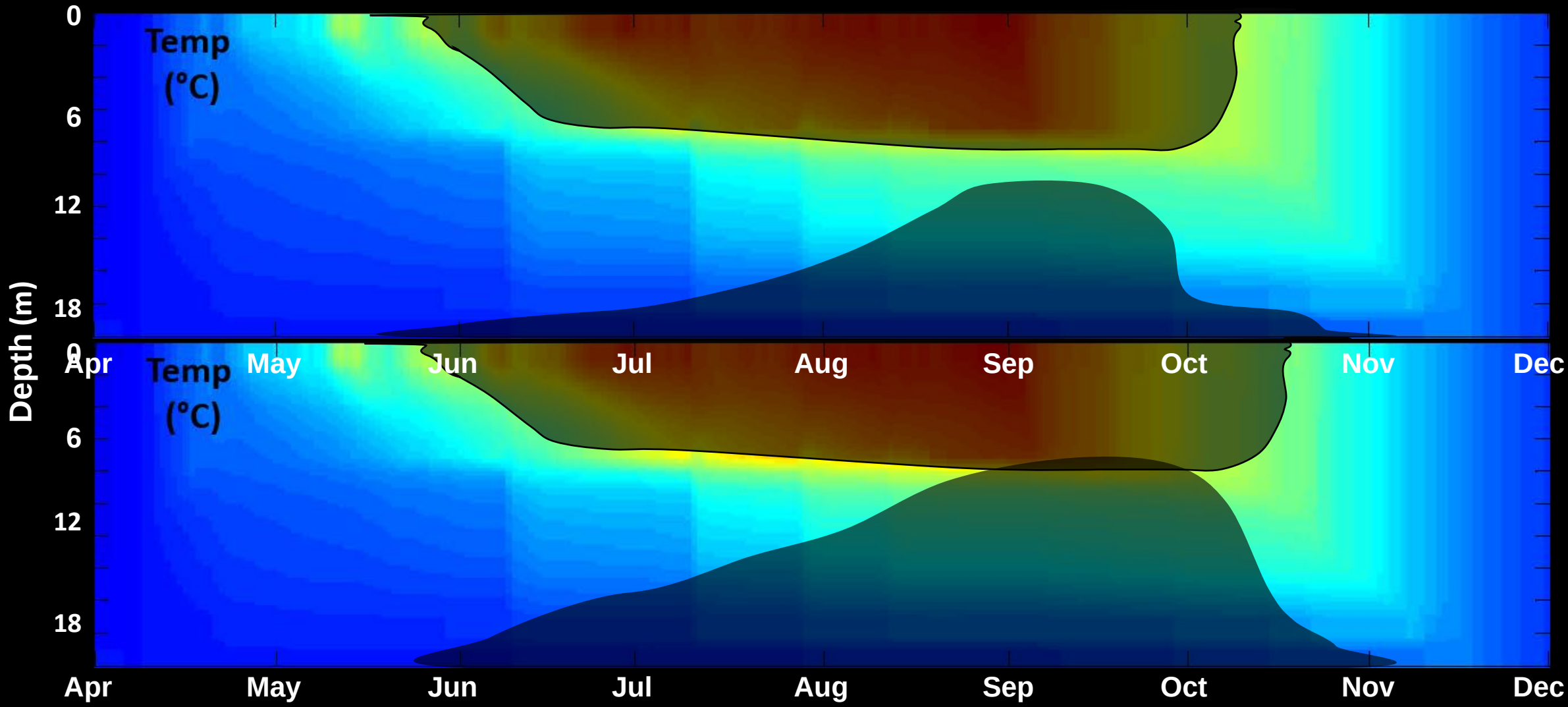


Drivers of change – Increased air temperature



Warmer air temperatures result in less oxythermal habitat

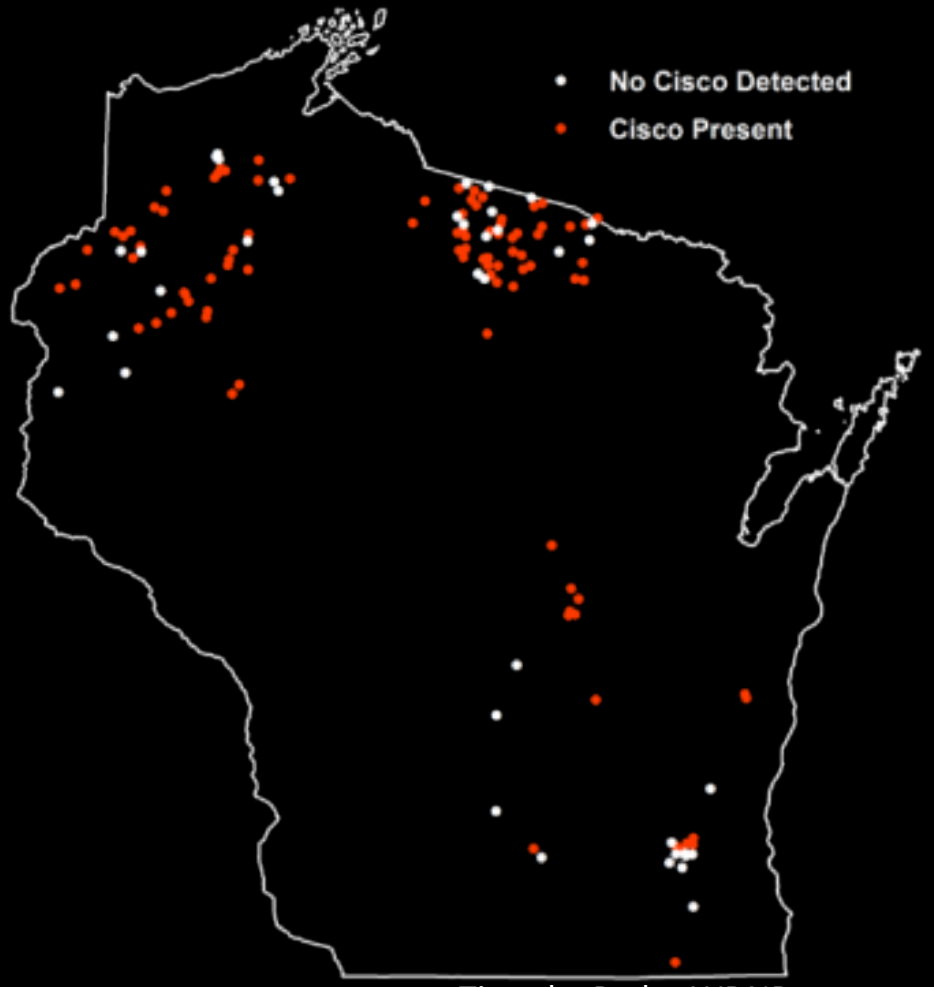
Drivers of change – Eutrophication



Eutrophication (P load) decreases habitat

Modeling habitat across the landscape

How will future changes alter distribution?



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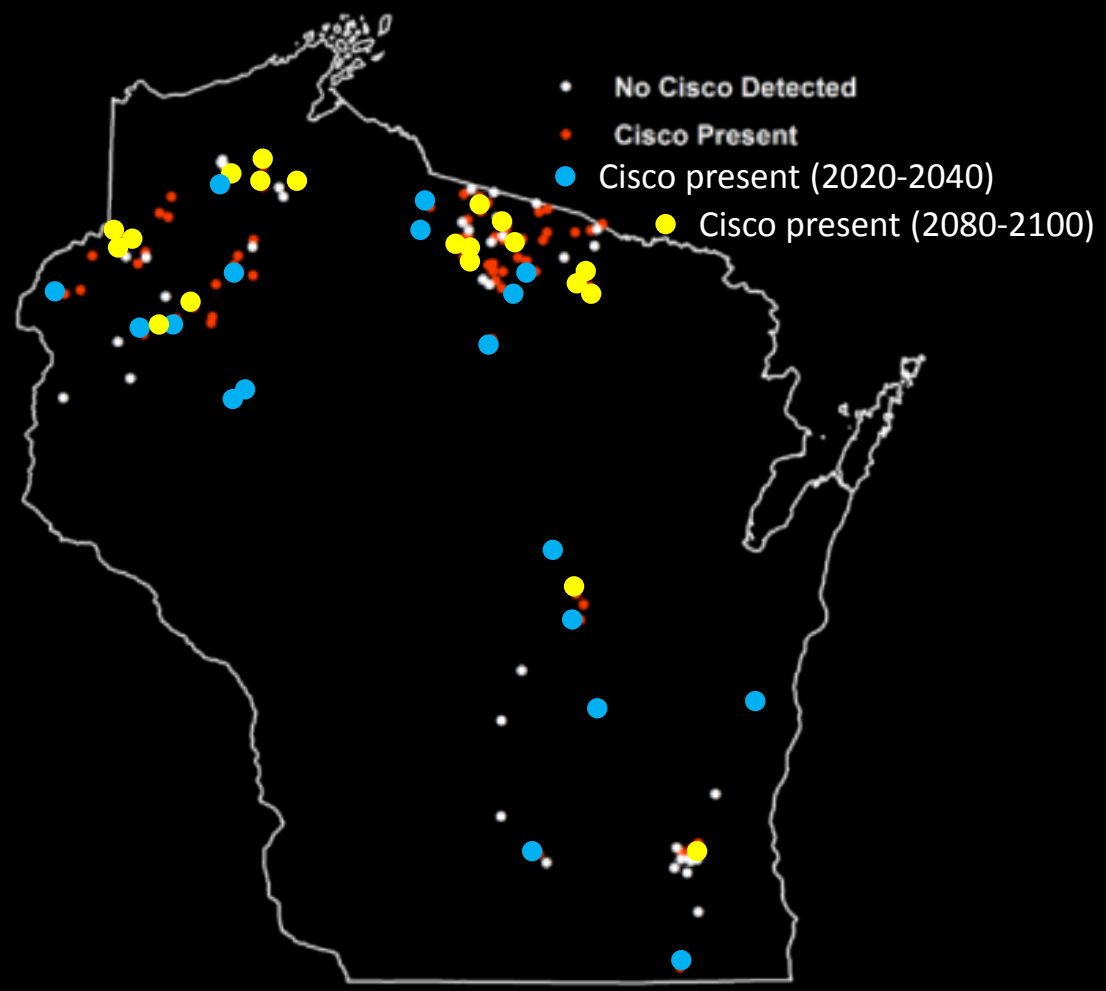
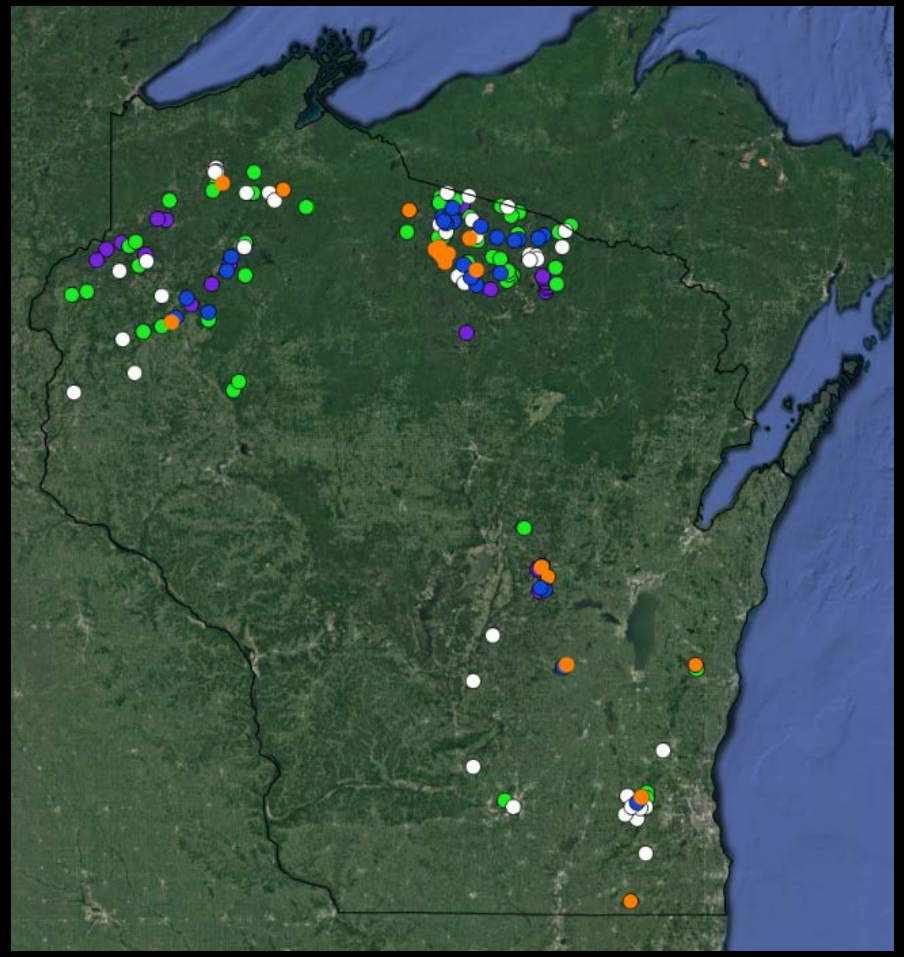


Modeling habitat across the landscape

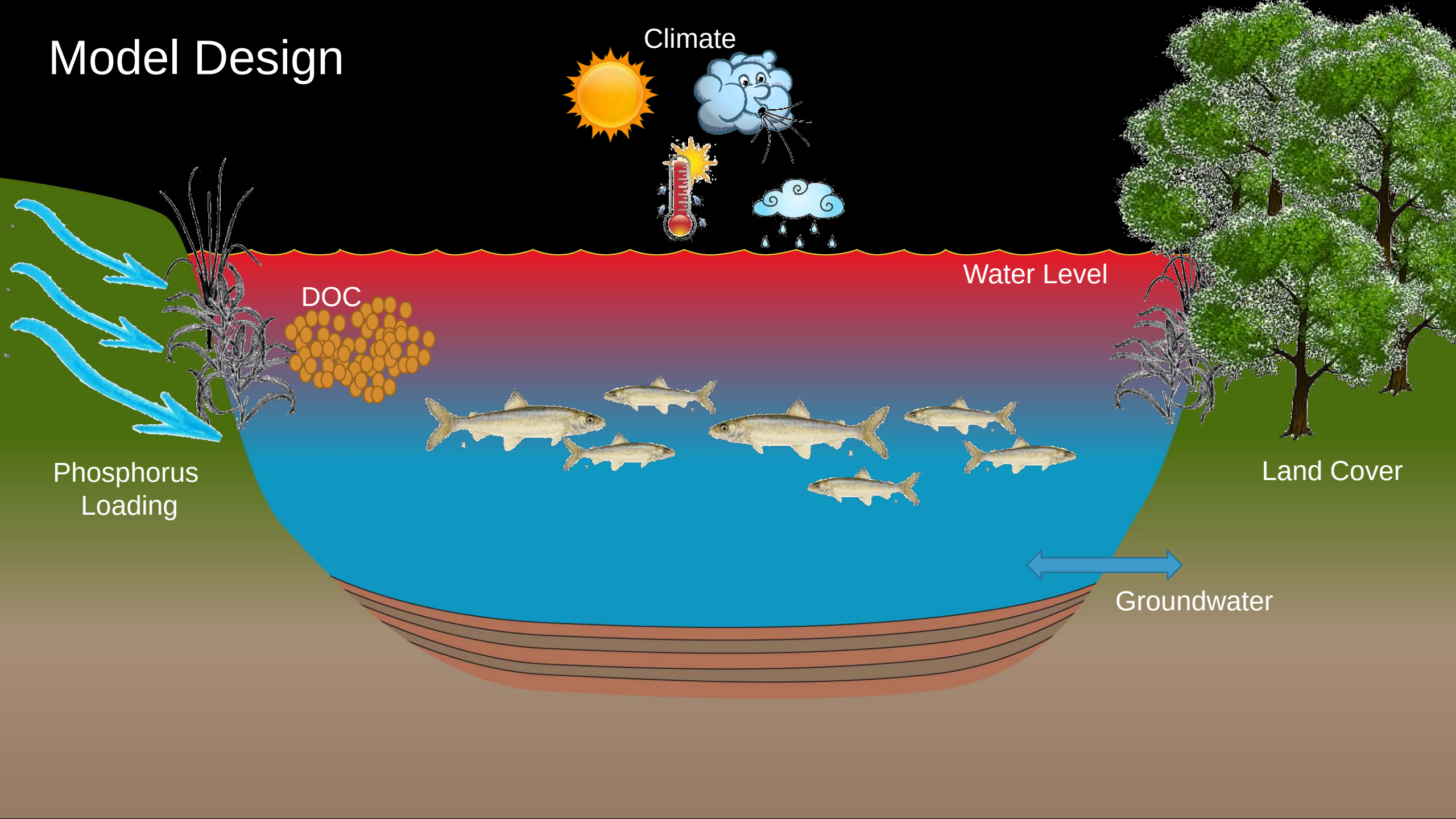
How will future changes alter distribution?

Where can management options effectively offset changes?



- Resilient
- Extirpation
- P reduction
- Land cover
- Engineered Solution

Model Design



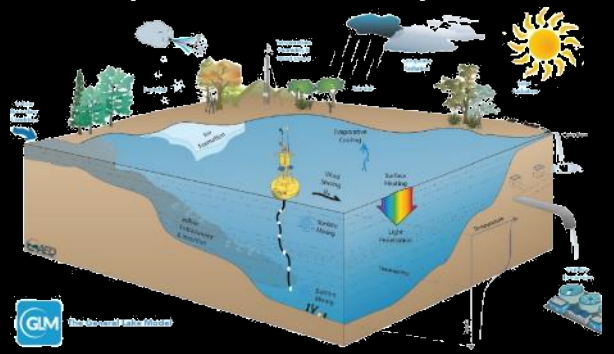
Model Design

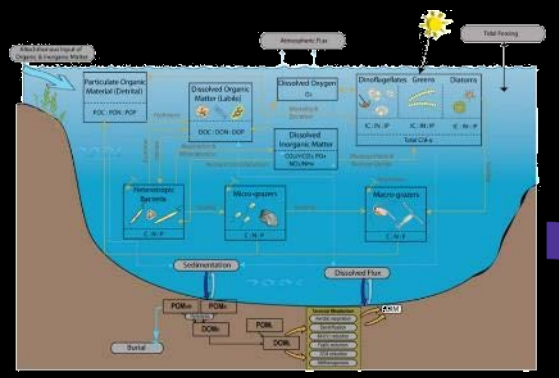
Hypothetical model lakes

Variables	
Surface Area	16
Depth	6
Latitude	1° bin (5)
Drainage type	2
DOC	3
Surface roughness (land cover)	5
Total P	5
72,000 simulation lakes per climate scenario	

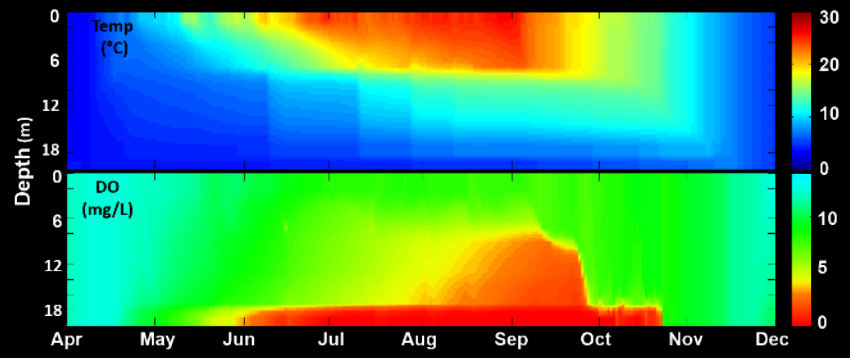
General Lake Model (GLM)

Aquatic EcoDynamics module (AED)





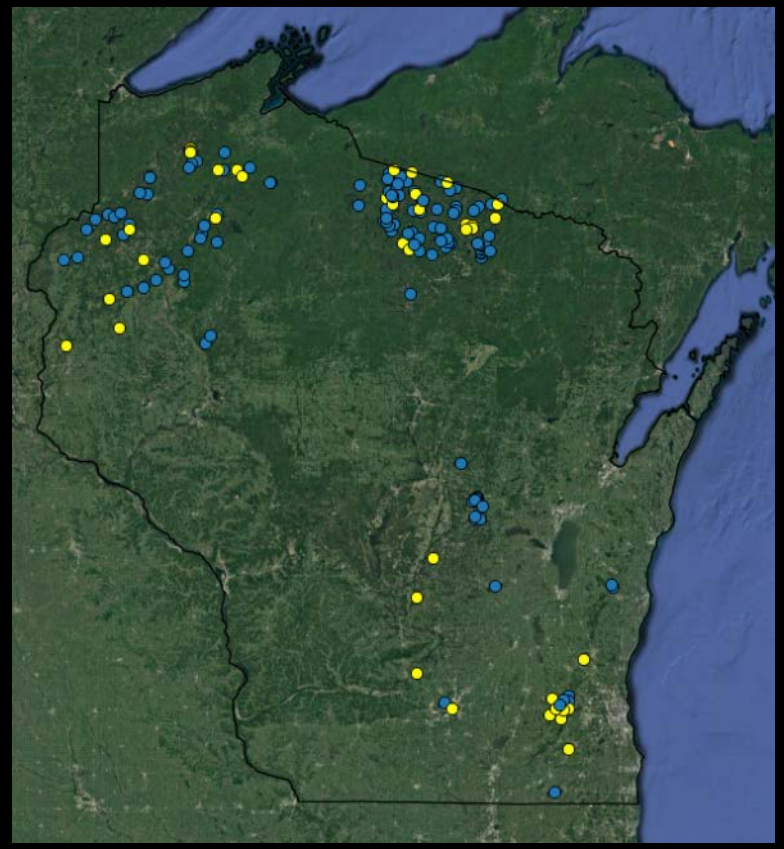
CENTER FOR HIGH THROUGHPUT COMPUTING



Preliminary Results

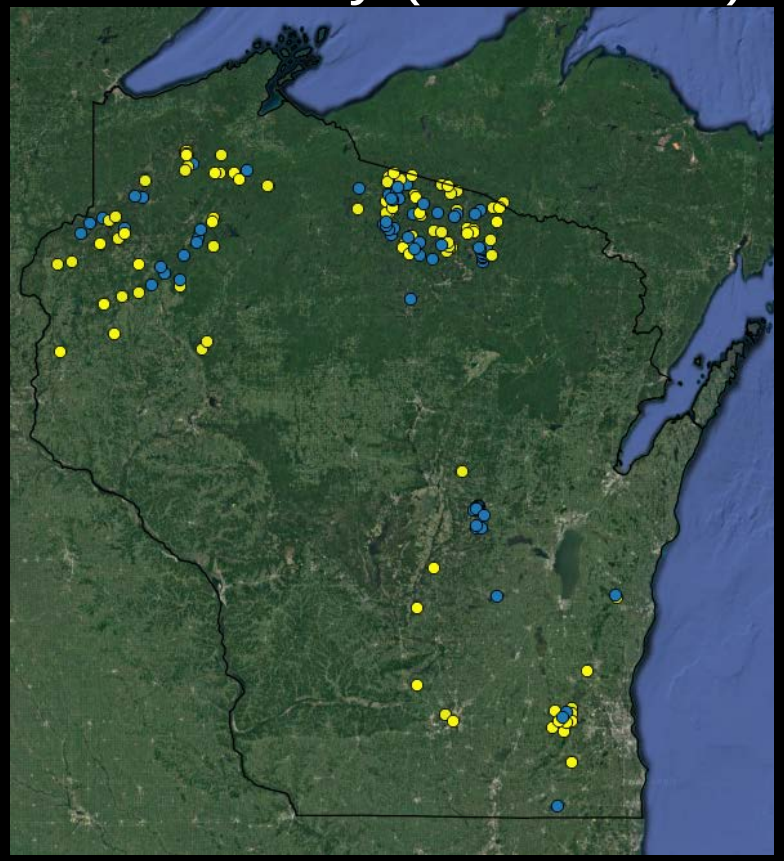
MIROC5 RCP 8.5

Contemporary Period



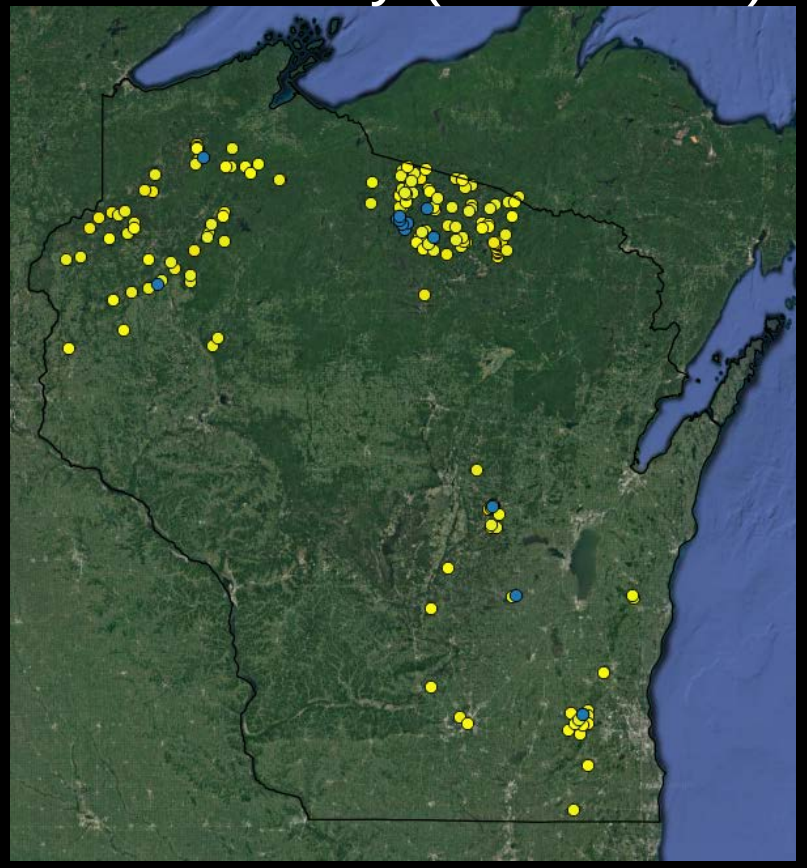
30% no cisco

Mid Century (2020-2040)



64% no cisco

Late Century (2080-2100)

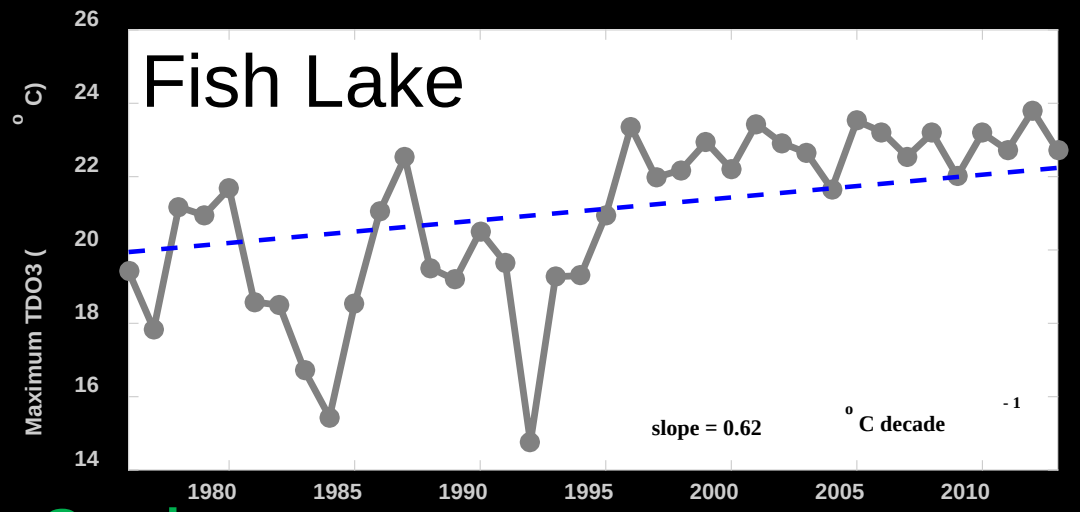


88% no cisco

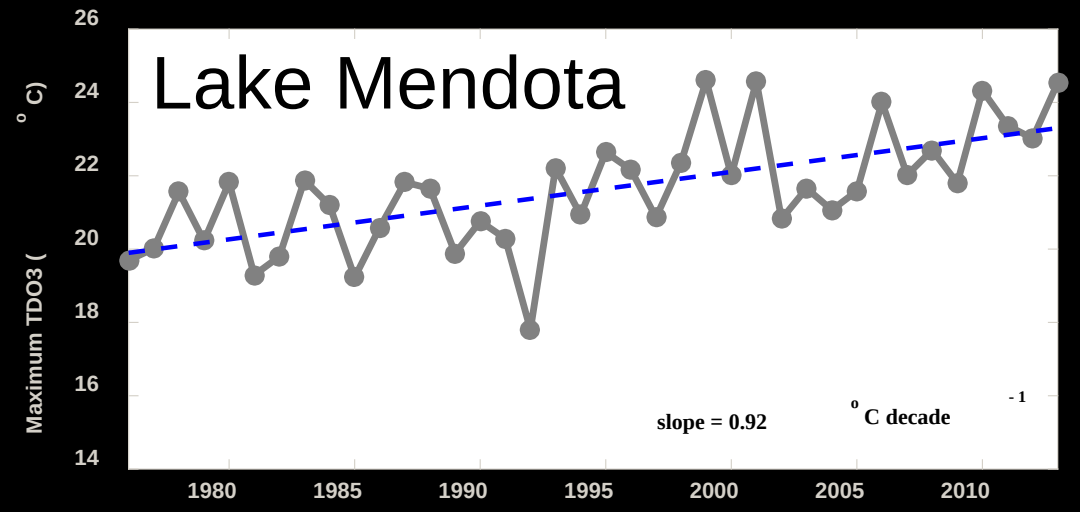
- TDO3 < 17°C (good)
- TDO3 > 17°C (bad)

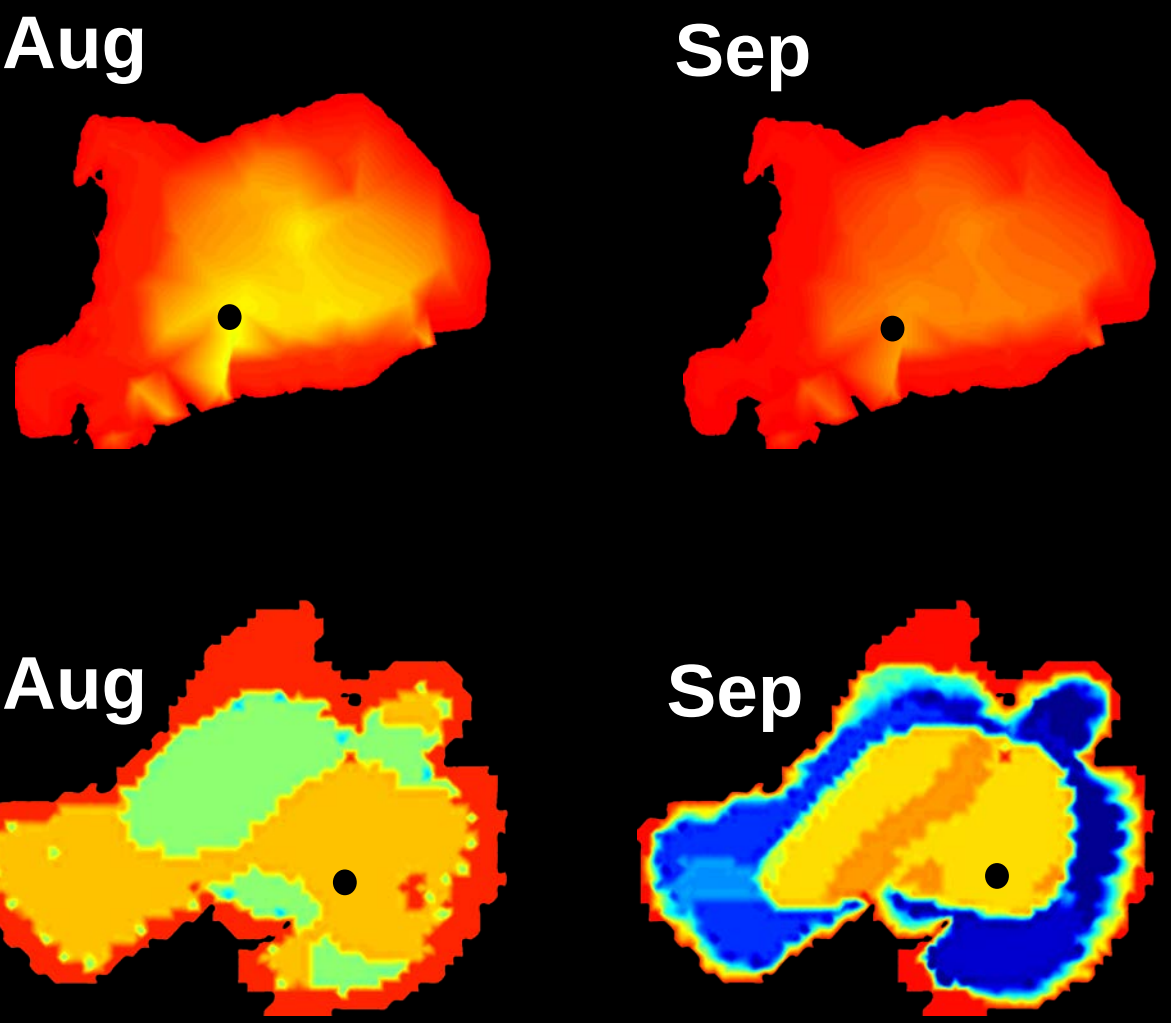
How does climate alter fish habitat?

Bad



Good





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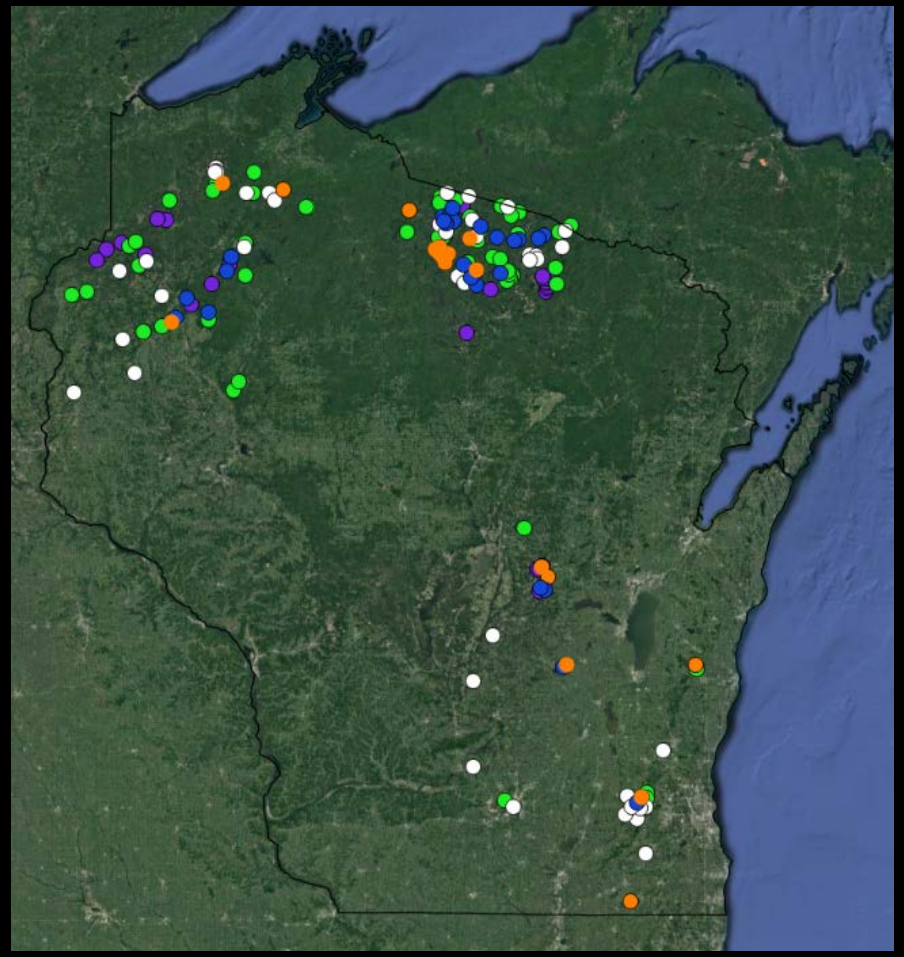

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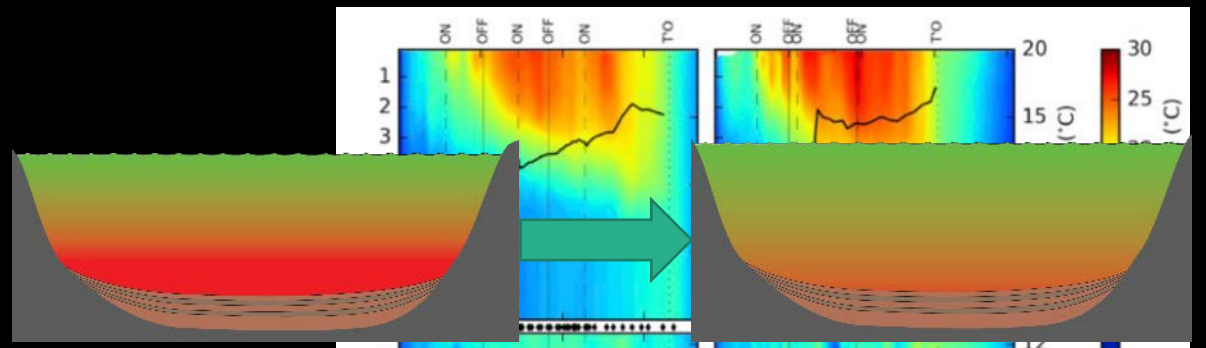
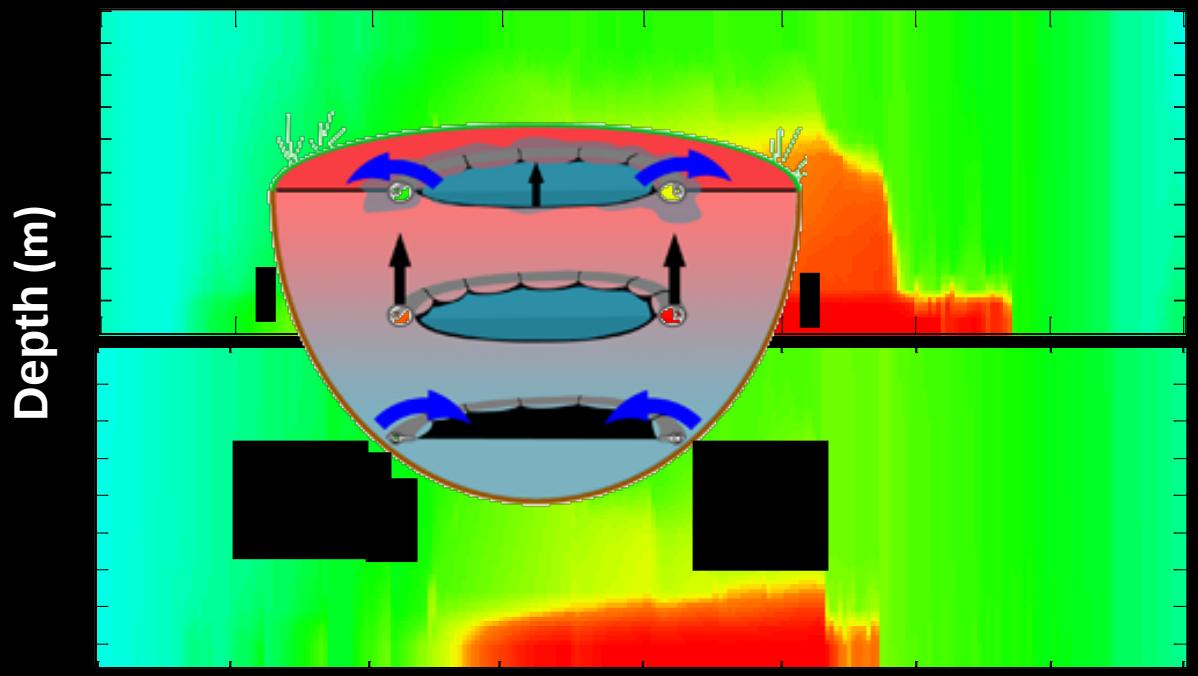
What is the best way to conserve fish habitat?

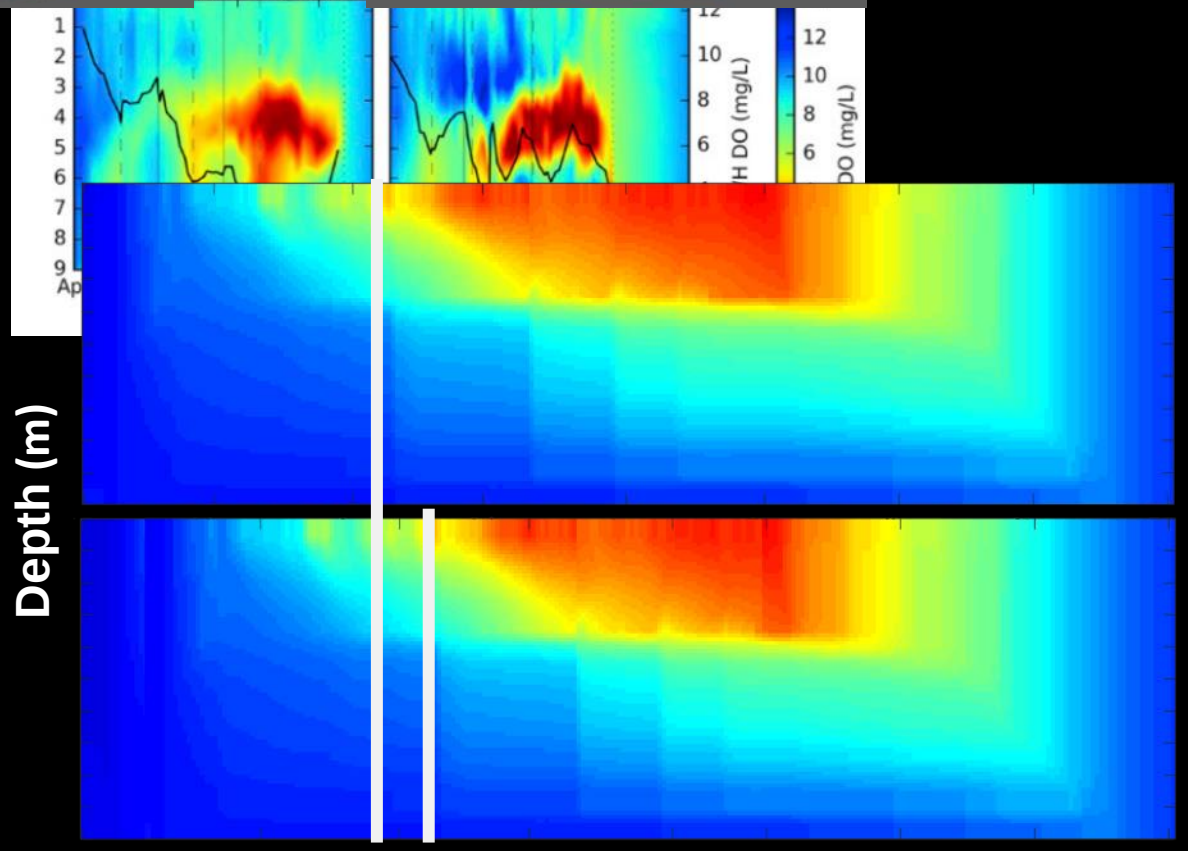
aeration

phosphorus l
reductions



artificial destratification





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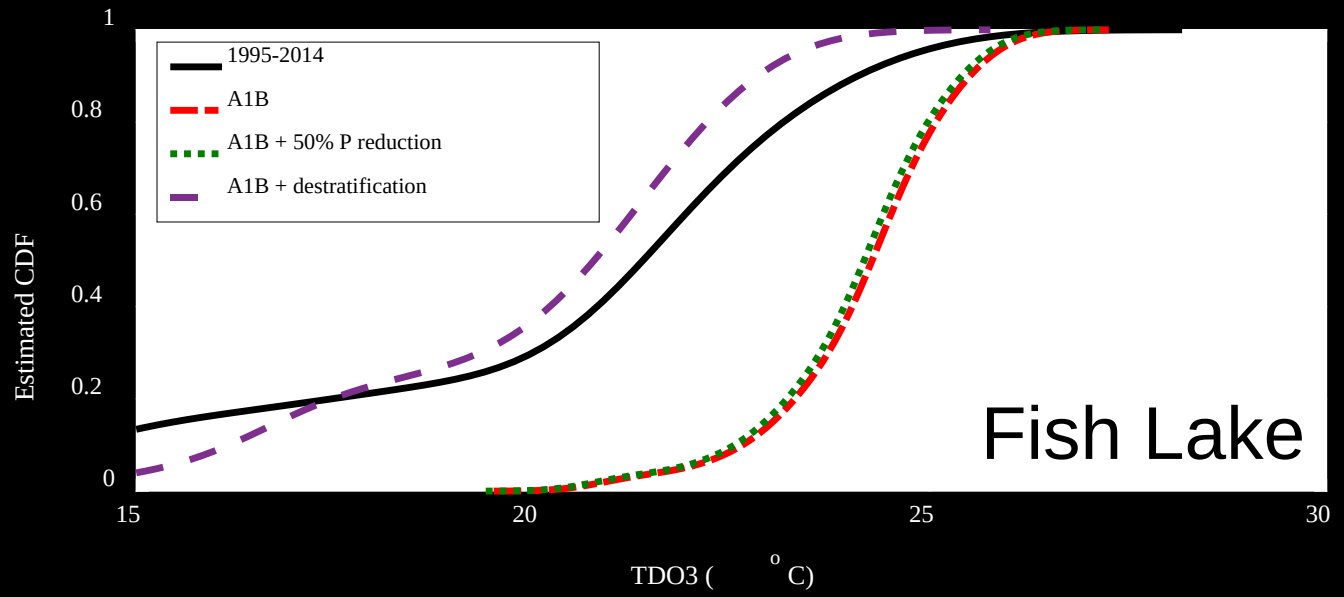
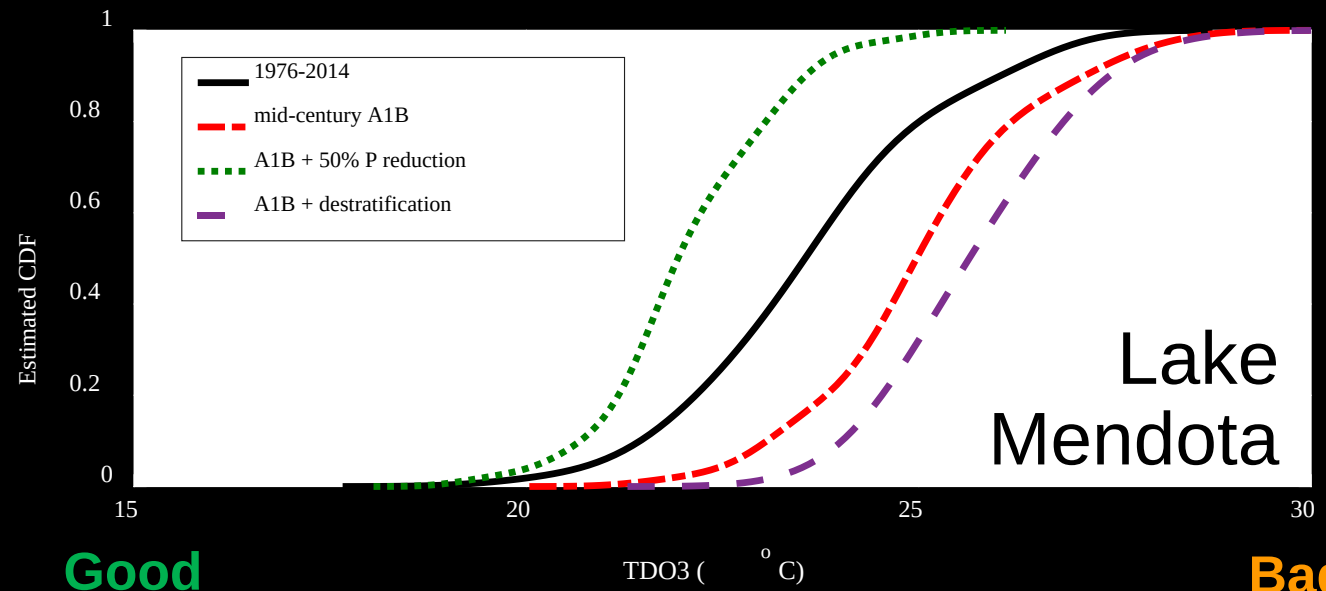


In small, isolated lakes P loading reductions DO NOT improve habitat



In large lakes artificial destratification DOES NOT improve fish habitat

Good **Bad**

Magee et al, *in prep*

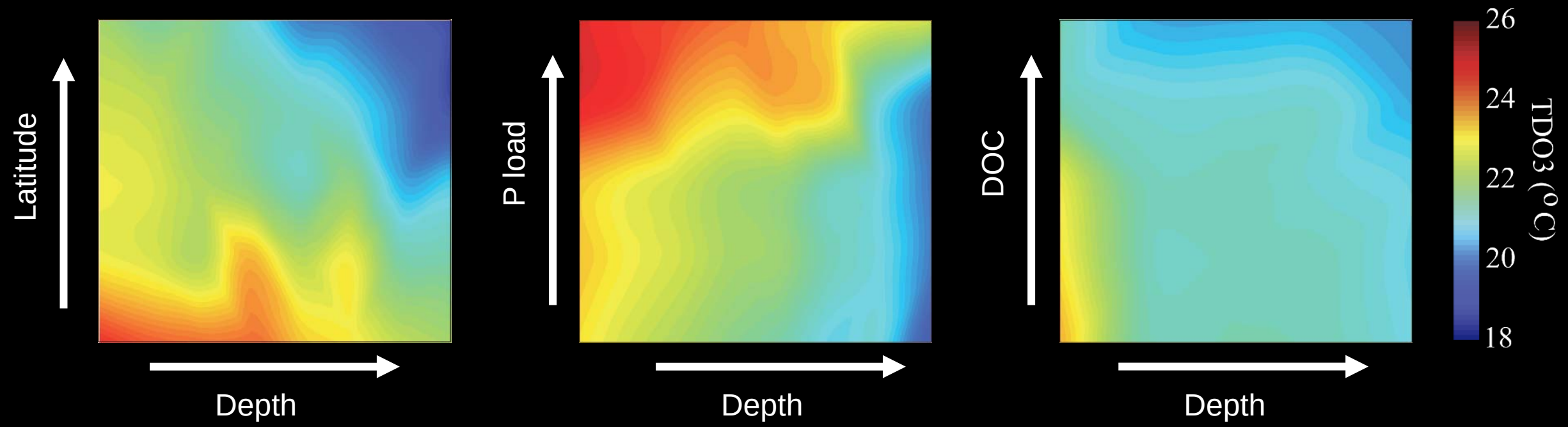
In Progress

- Finish modeling of Wisconsin lakes

In Progress

Finish modeling Wisconsin lakes

Characterize lake resilience

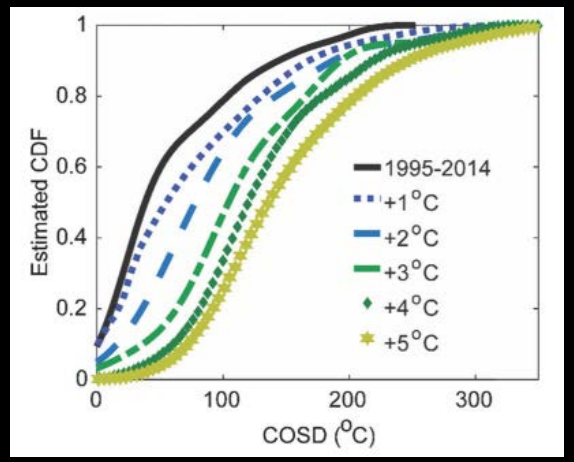


In Progress

- Finish modeling Wisconsin lakes
- Characterize lake resilience

Next Steps

- Analyze cool-water fish species

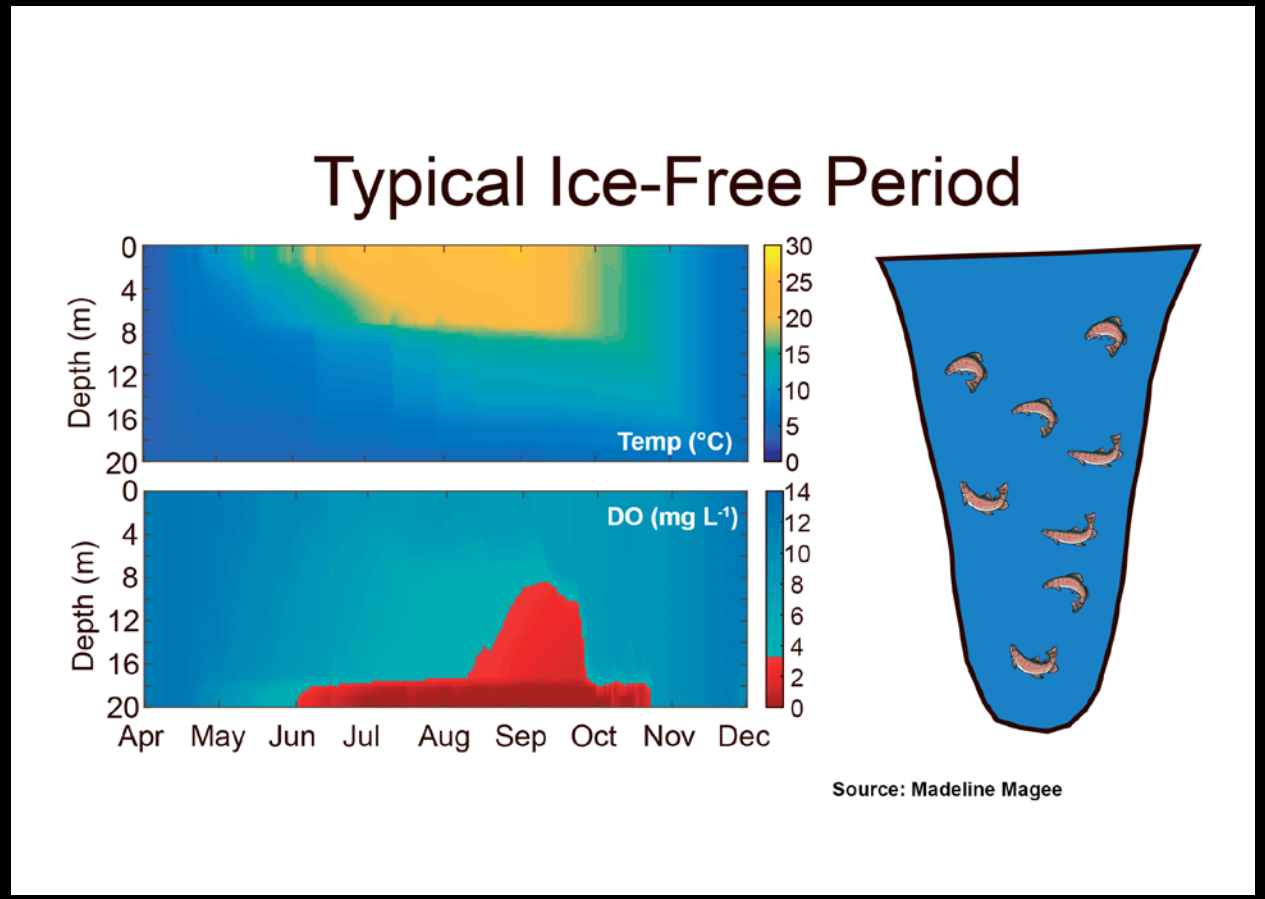


In Progress

- Finish modeling Wisconsin lakes
- Characterize lake resilience

Next Steps

- Analyze cool-water fish species
- Create online tool




Questions?
NE CSC
Northeast Climate Science Center
USGS
science for a changing world
WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON
WISCONSIN
DEPT. OF NATURAL RESOURCES