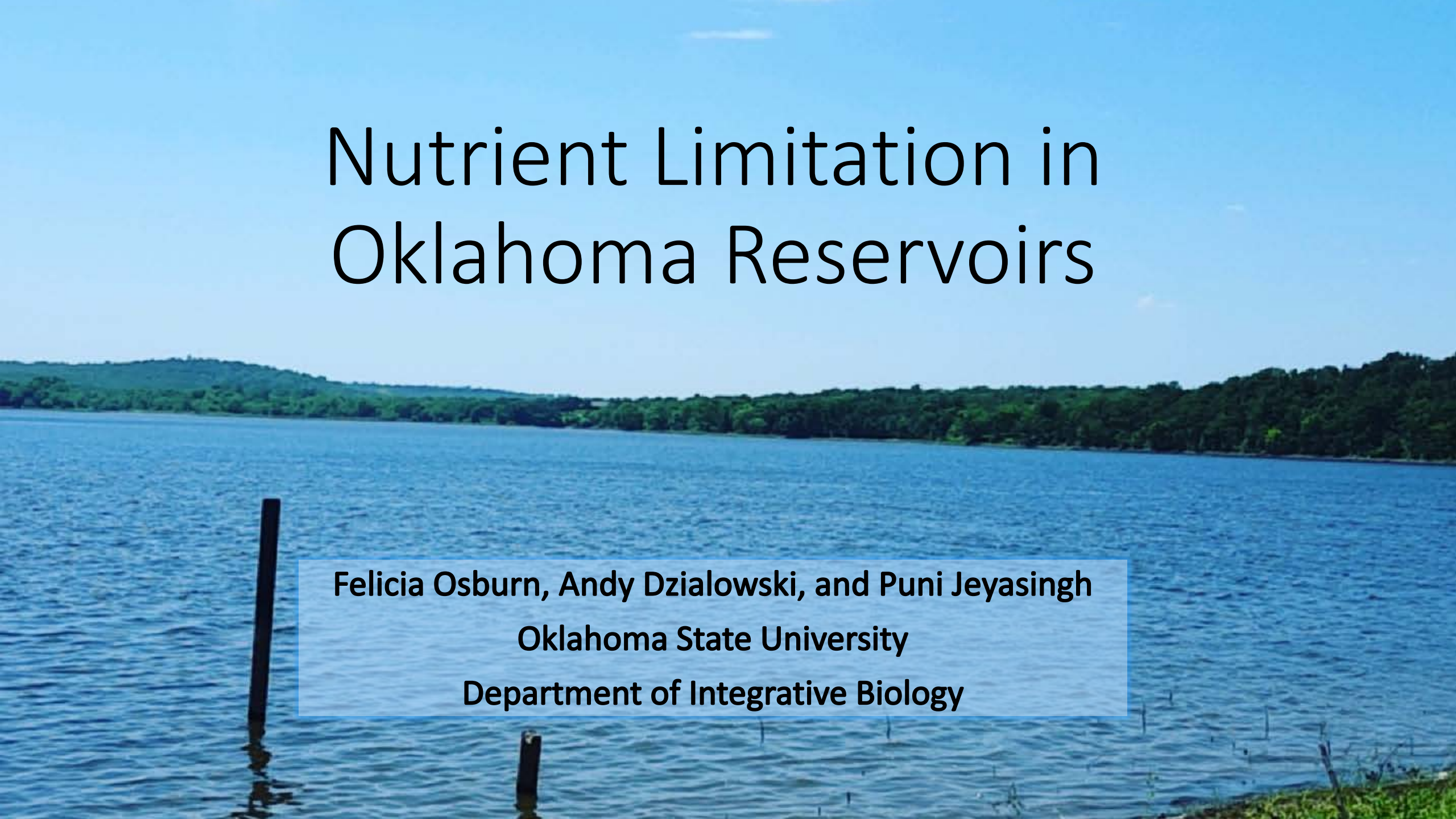
Nutrient Limitation in Oklahoma Reservoirs



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Introduction

Nutrient limitation: The nutrient that is in shortest supply relative to its demand; what is limiting the productivity of the system

Eutrophication of reservoirs can lead to an increase in algae

Issues: Anoxic conditions, increased turbidity, and increased sedimentation

Nutrients:

Phosphorus (P)

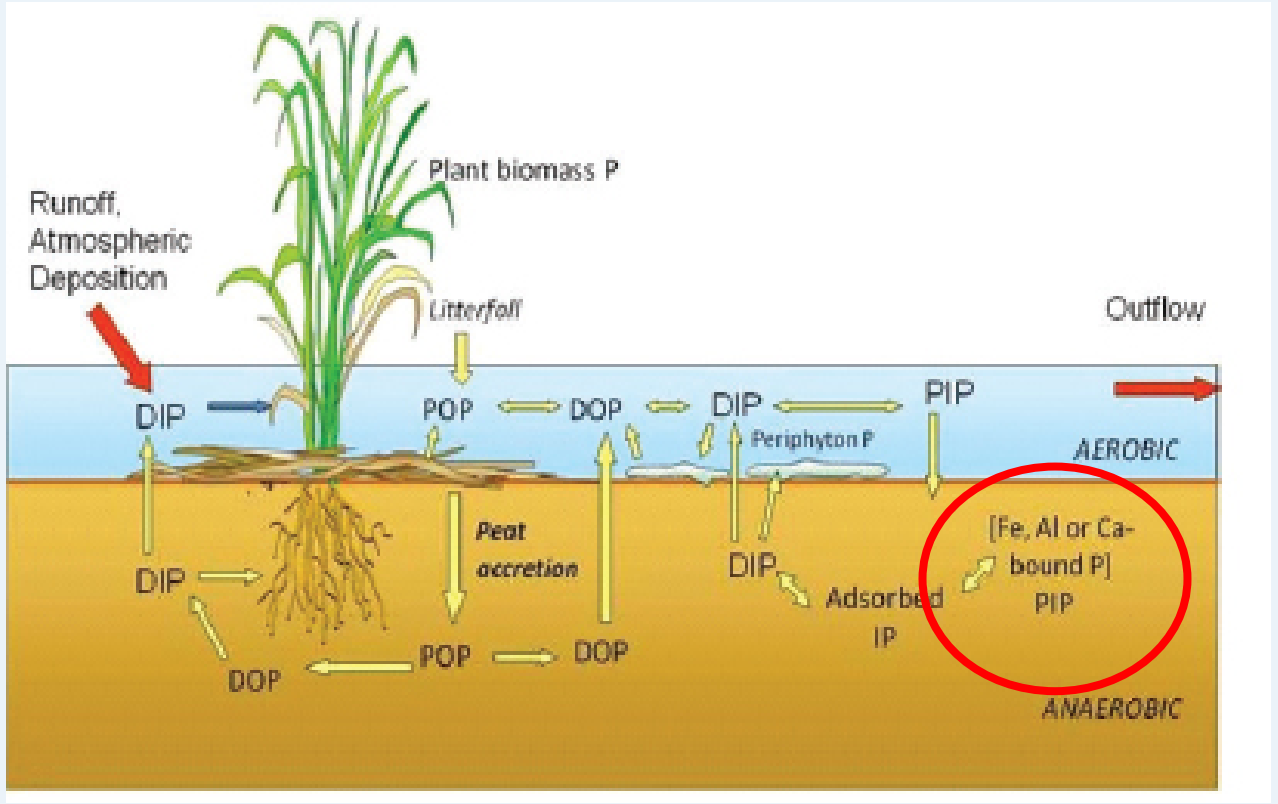
Nitrogen (N)

Also: Iron (Fe)

Potential Importance of Iron

Iron-Phosphorus interactions

Promote cyanobacteria through nitrogenase



Progress Toward Restoring the Everglades: The Fourth Biennial Review, 2012 (2012)
Chapter: 4 Ecosystem Trajectories Affected by Water Quality and Quantity

Watershed influence

Total (T) nutrient	Agricultural	Forested
TN	⬆	⬇
TP	⬆	⬇
TFe	?	?

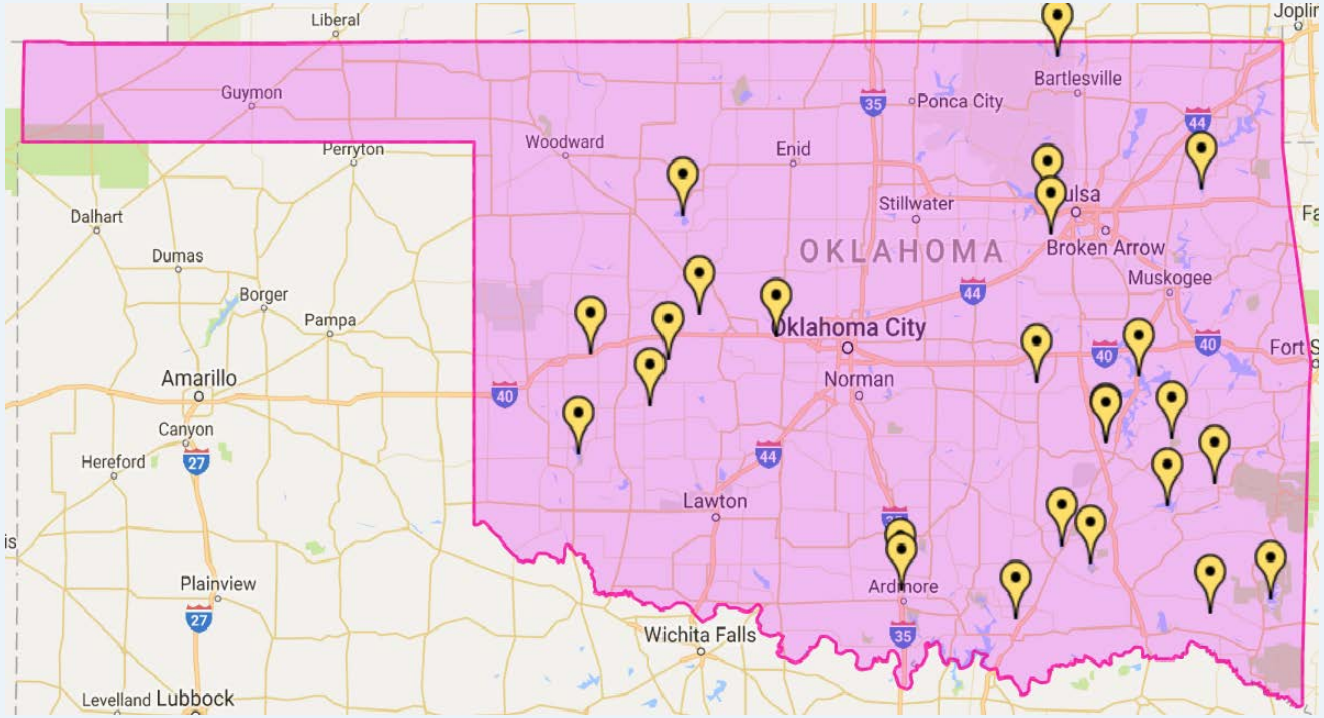
Project Objectives

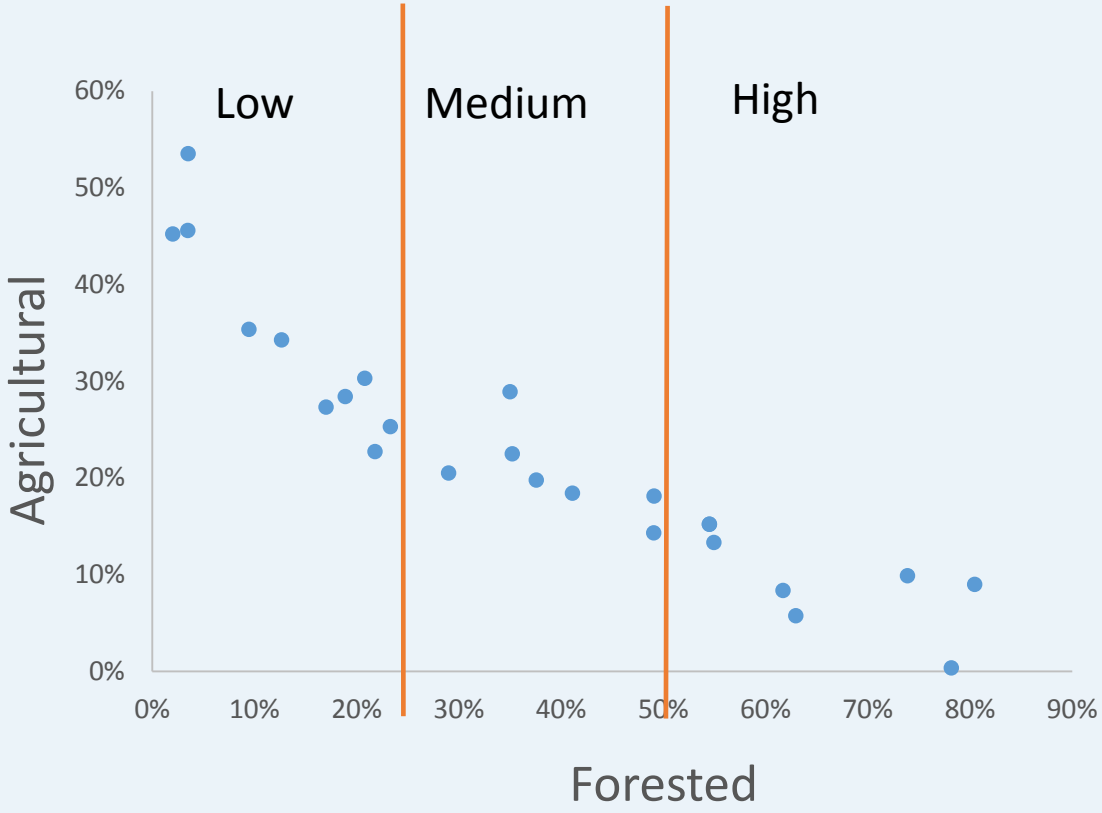
- What are the relationships between watershed land cover (forested vs. agriculture) and reservoir water quality (total nutrient concentrations)
  - Can land cover be used to indicate nutrient limitation?

- What nutrient(s) limits primary production in Oklahoma reservoirs?
  - Does iron play a role?

Methods

OWRB land cover data was used to select 25 reservoirs

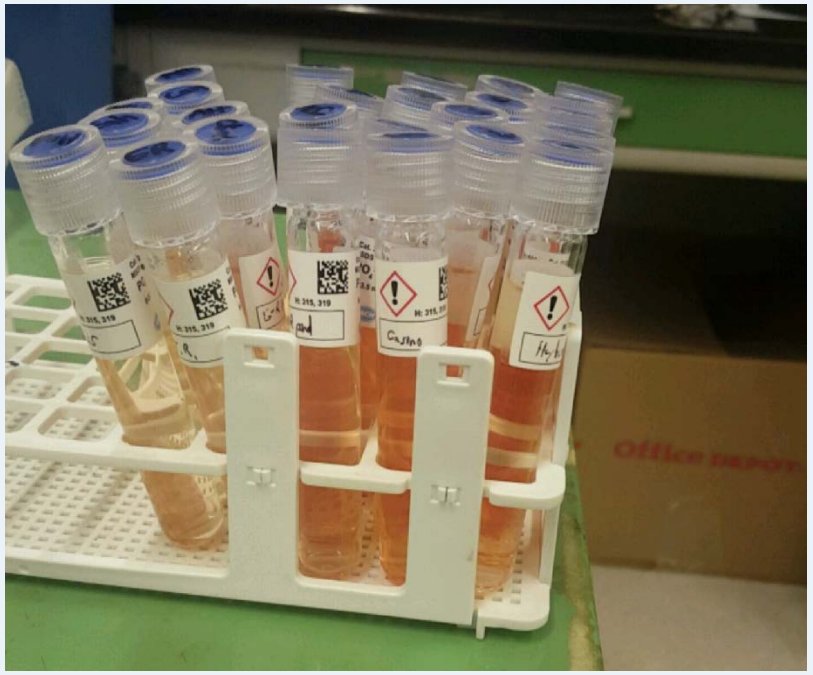




Total nutrients

HACH DR5000 UV-VIS spectrophotometer for TN and TFe

Persulfate digestion method for TP



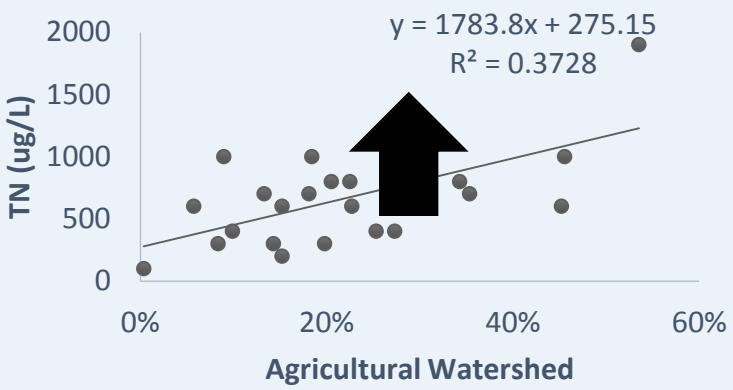
Comparisons of Forested Groups (ANOVA)

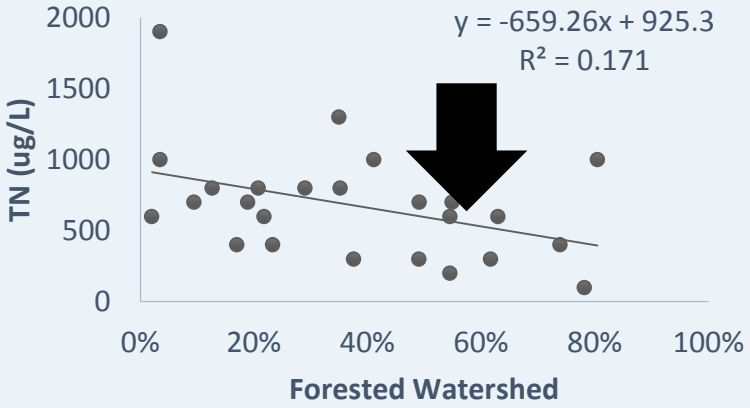
Variable	F value	p-value
TP	F(2,22)= 0.999	0.384
TN	F(2,22)= 2.333	0.121
TFe	F(2,22)= 0.238	0.79
Surface Area	F(2,22)= 0.886	0.427
Starting *Chl-a*	F(2,22)= 2.932	0.074
Final *Chl-a*	F(2,22)= 2.319	0.122
TN:TFe	F(2,22)= 1.831	0.184
TN:TP	F(2,22)= 0.340	0.715
TP:TFe	F(2,22)= 1.565	0.232

Agriculture and Water Quality

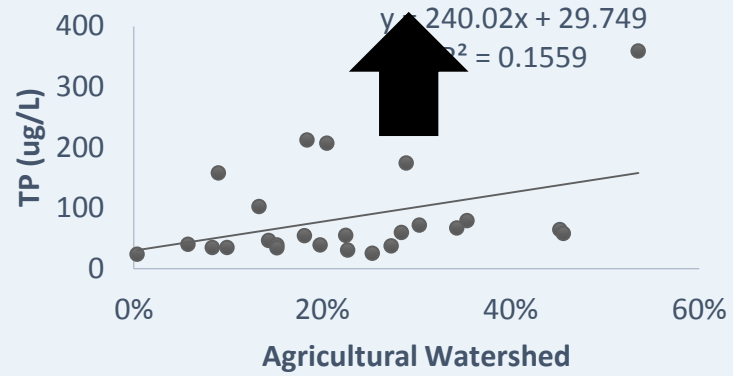
Forest and Water Quality

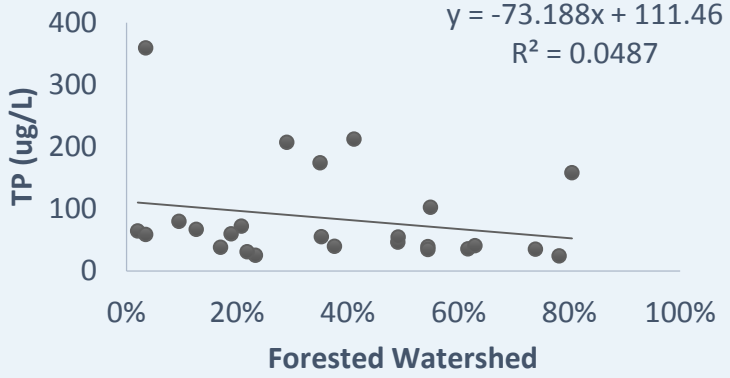
TN



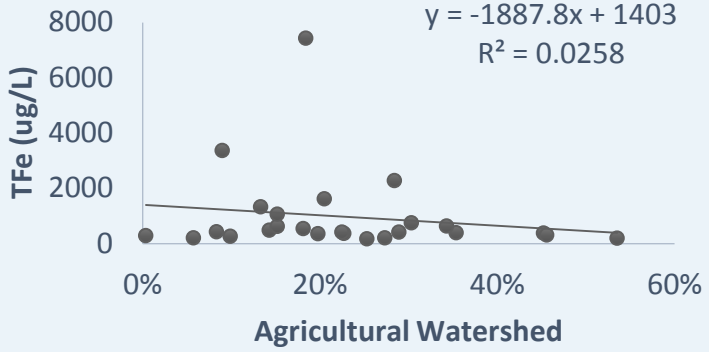


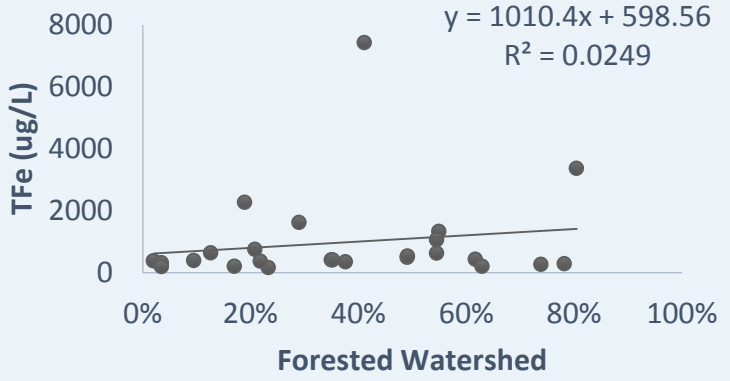
TP

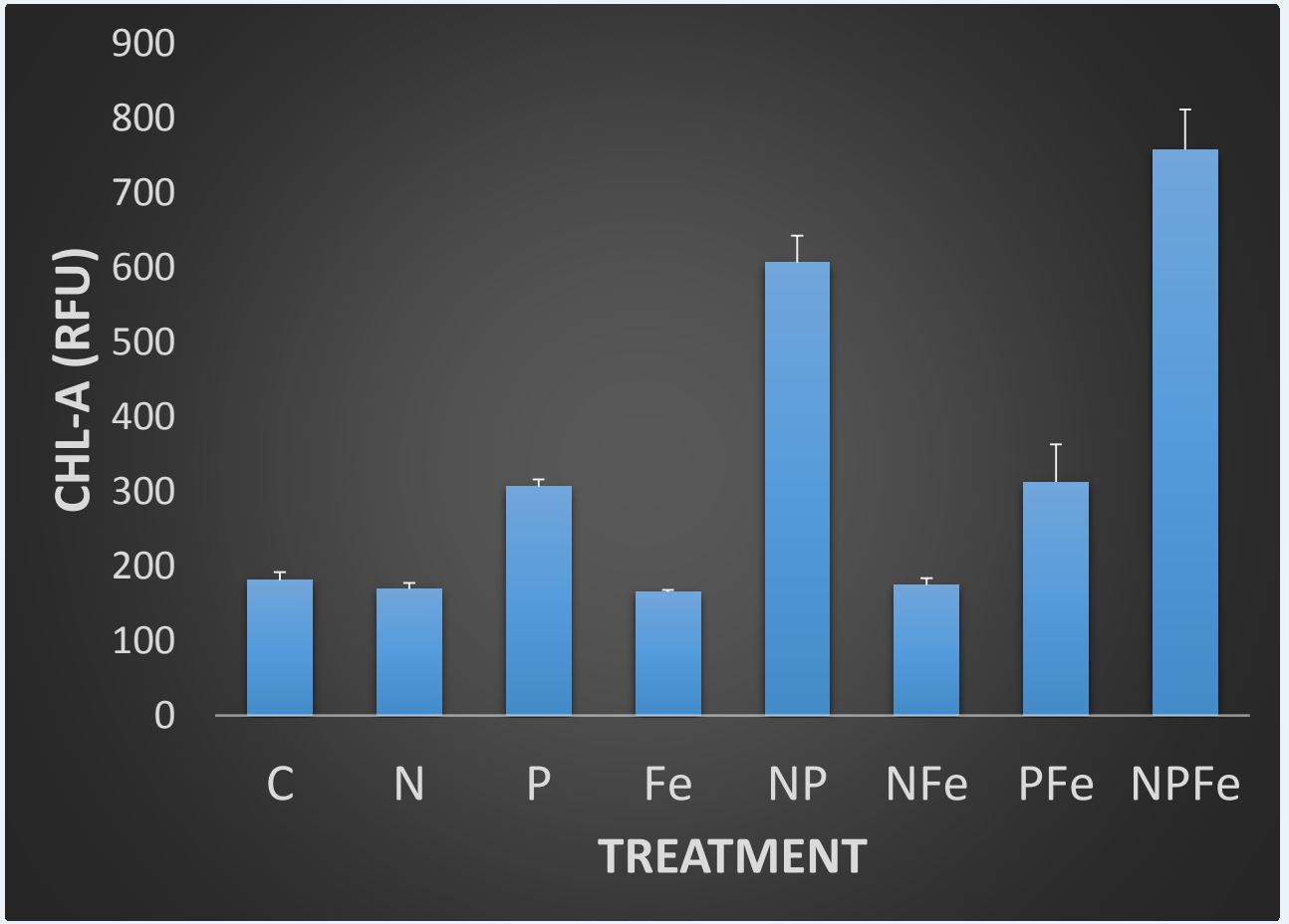


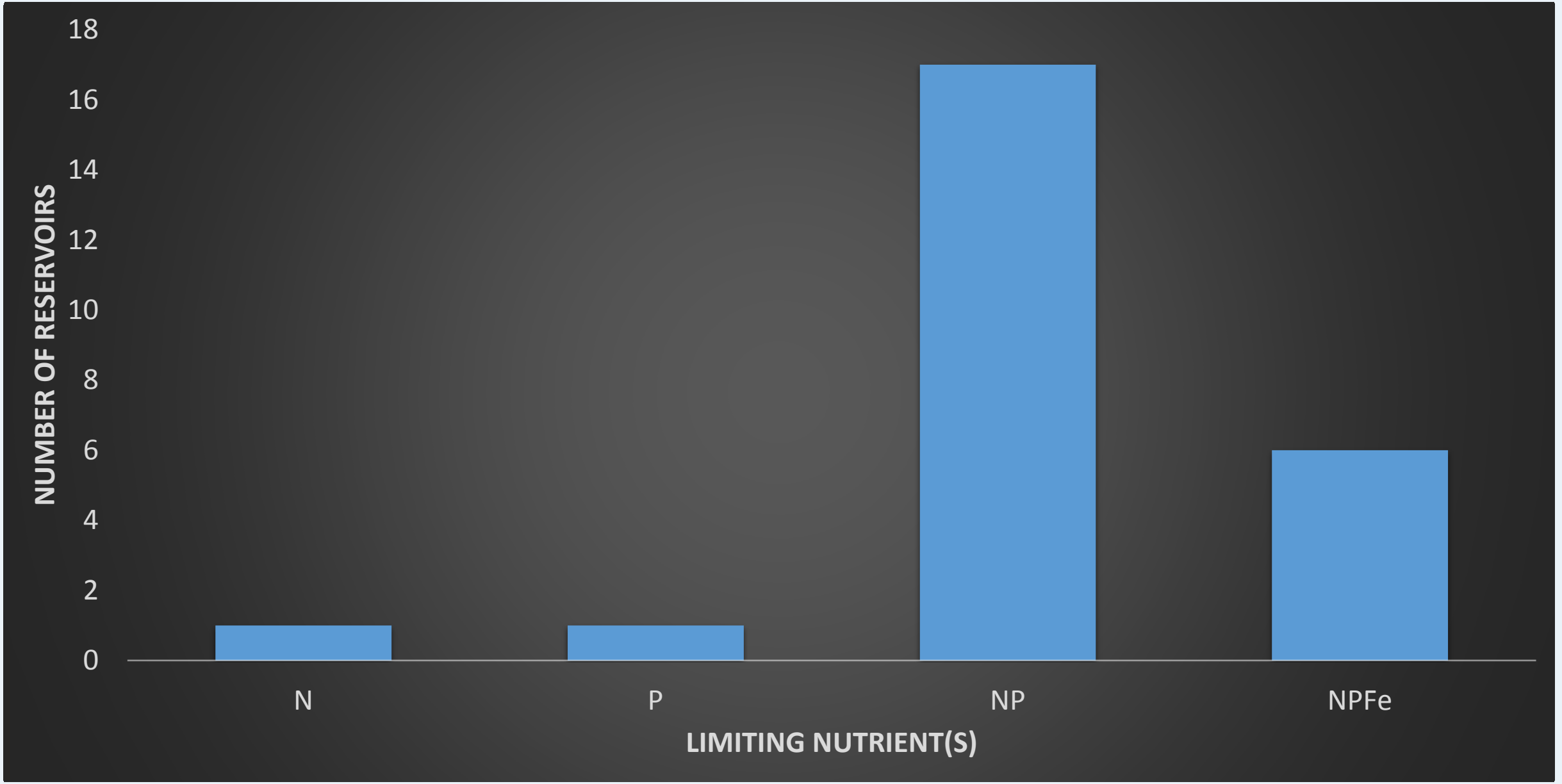


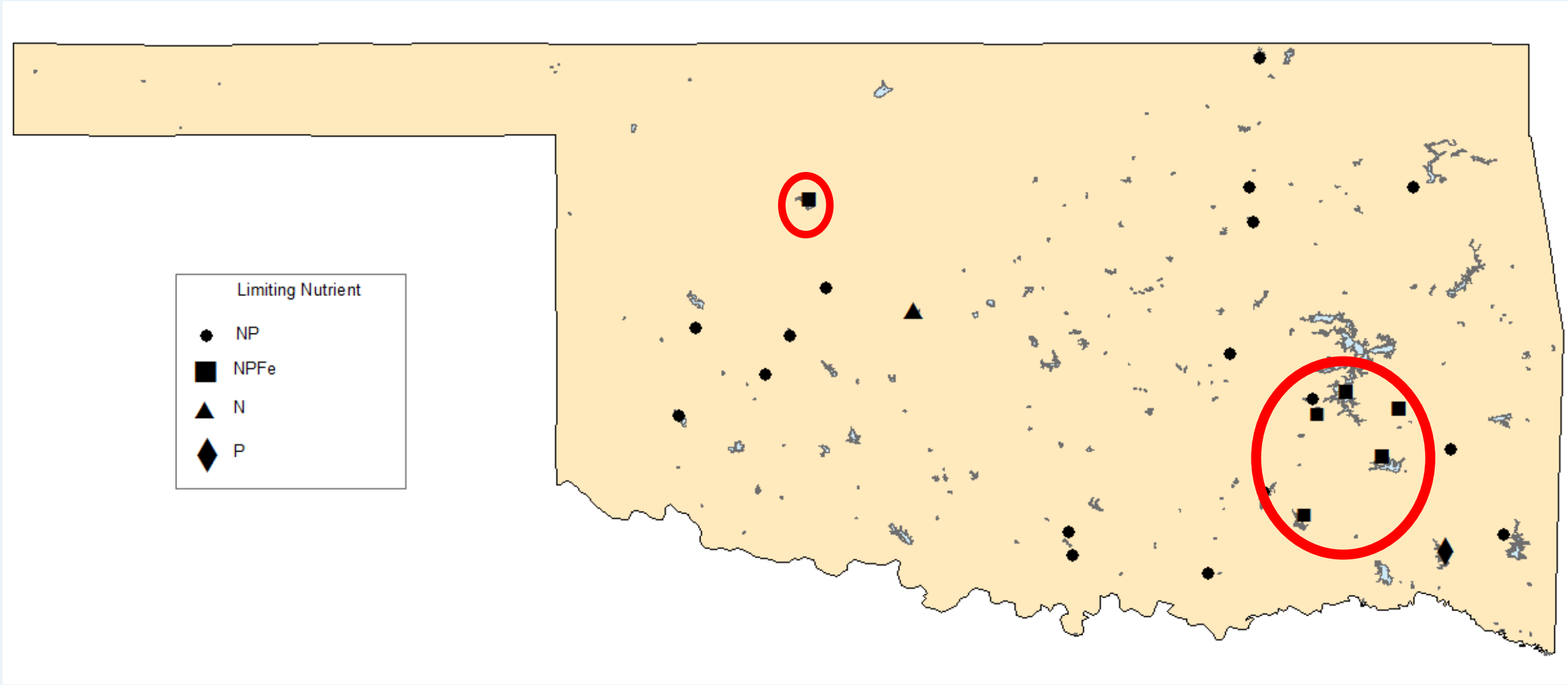
TFe





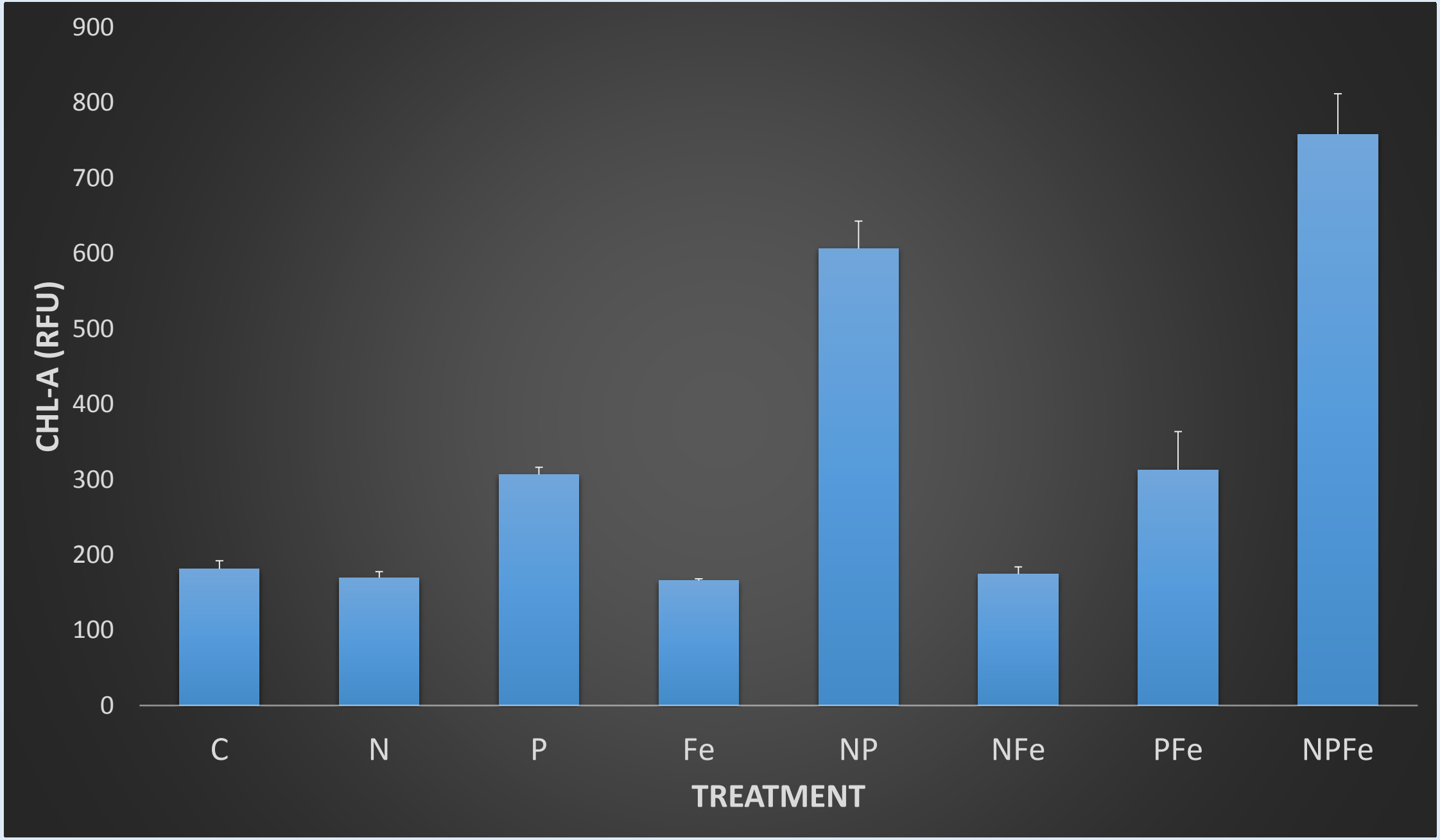

900
800
700
600
500
400
300
200
100
0
CHL-A (RFU)
C
N
P
Fe
NP
NFe
PFe
NPFe
TREATMENT

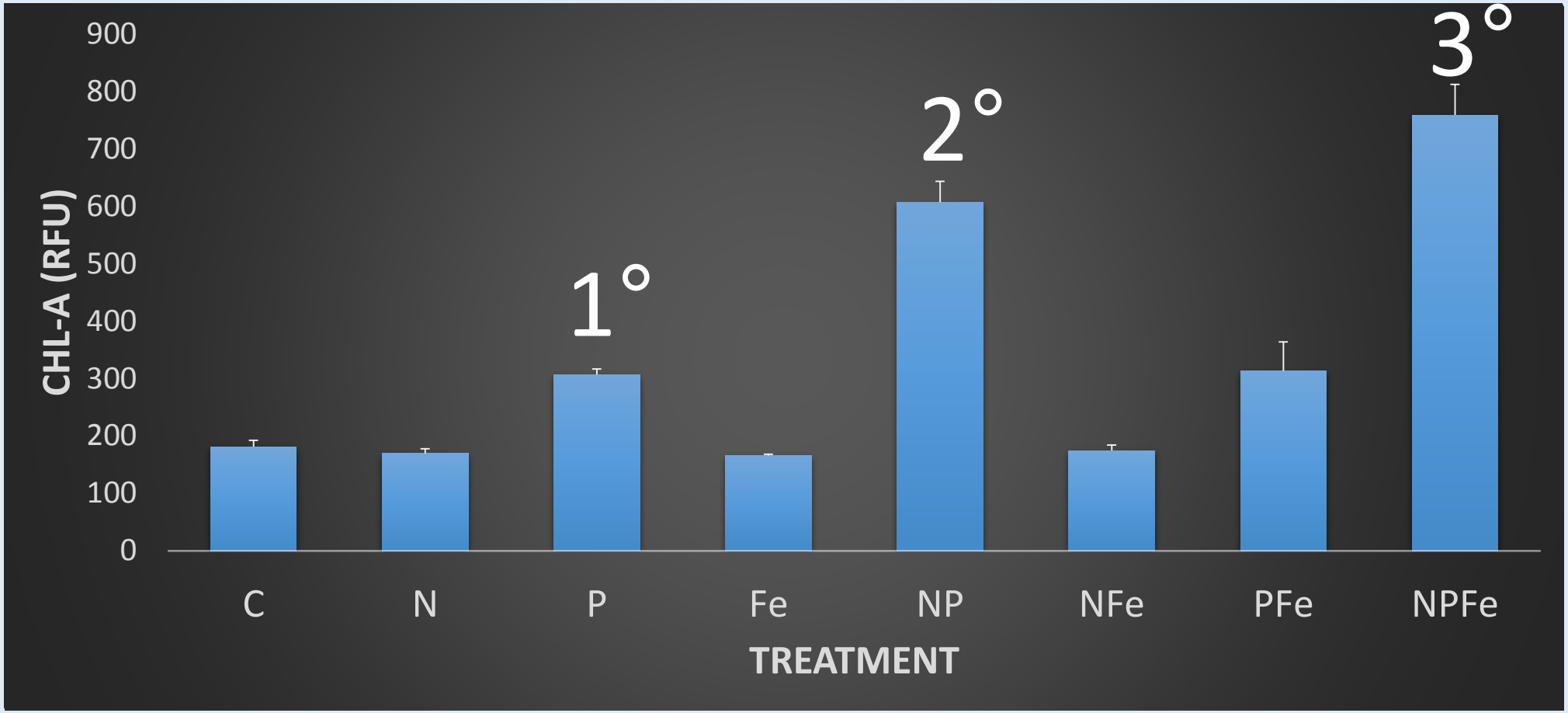

18
16
14
12
10
8
6
4
2
0
NUMBER OF RESERVOIRS
N
P
NP
NPFe
LIMITING NUTRIENT(S)


Limiting Nutrient
NP
NPFe
N
P

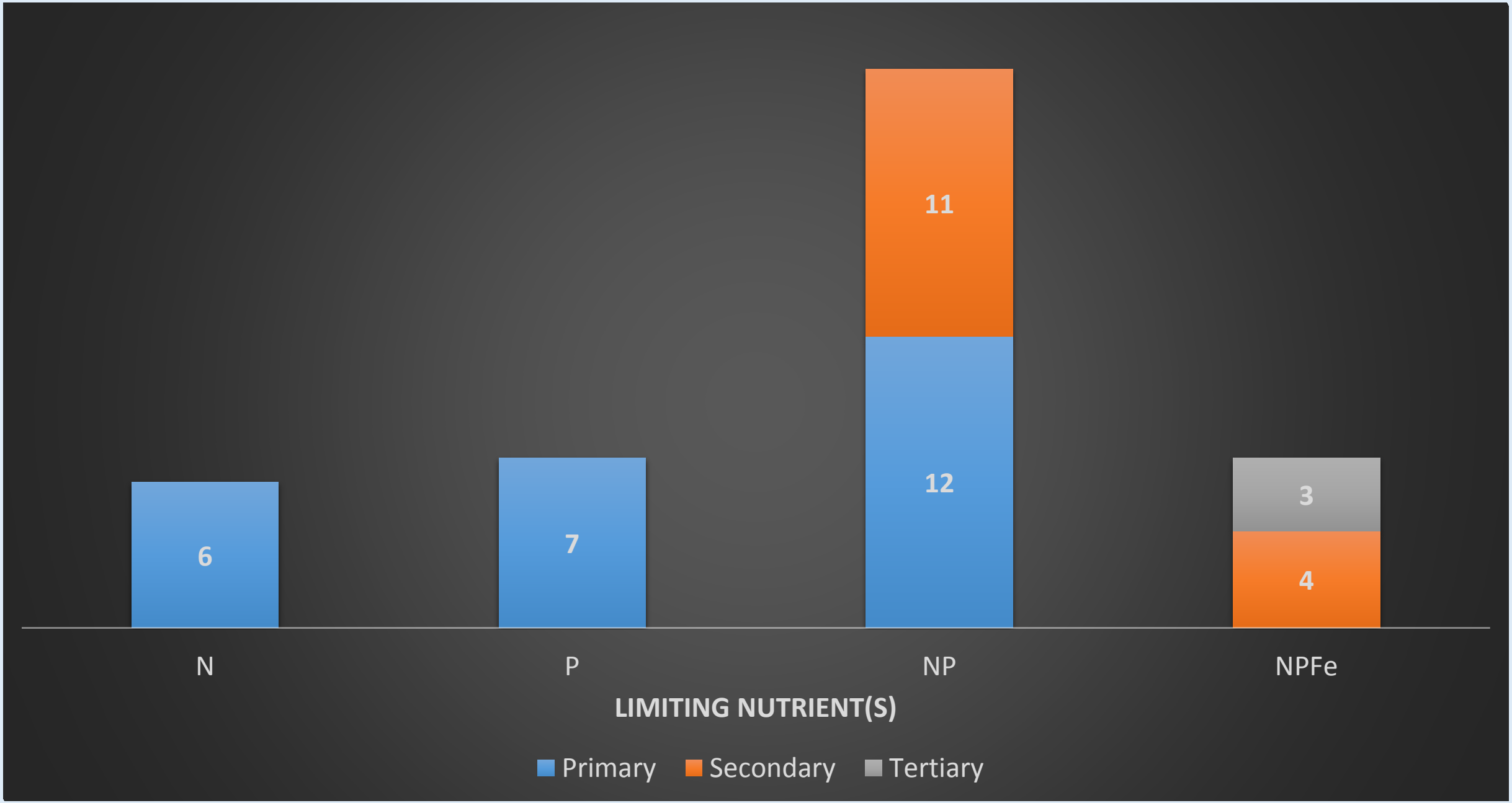
Comparisons of NP and NPFe limited reservoirs (t-test)

Variable	t-test	p-value (two-tailed test)
TP	0.163	0.874
TN	0.603	0.562
TFe	-0.675	0.525
Surface Area	-2.052	0.053
Starting *Chl-a*	2.282	0.034
Final *Chl-a*	-0.791	0.455
Forested Watershed	-1.332	0.215
Agricultural Watershed	1.298	0.220
TN:TFe	1.856	0.078
TN:TP	0.848	0.415
TP:TFe	2.410	0.025


900
800
700
600
500
400
300
200
100
0
CHL-A (RFU)
C
N
P
Fe
NP
NFe
PFe
NPFe
TREATMENT



Categorizing the nutrients into primary, secondary, and tertiary limiting nutrient(s) allows a better understanding of how *chl-a* values respond to the addition of these nutrient(s), both alone and in combination


11
12
6
7
3
4
N
P
NP
NPFe
LIMITING NUTRIENT(S)
Primary
Secondary
Tertiary

Reservoir	Primary	Secondary	Tertiary
Lugert-Altus	N	NP	
Hulah	N	NP	
El Reno	N		
Canton	N	NP	NPFe
Durant	N	NP	NPFe
Talawanda No.2	N	NP	
Sardis	NP	NPFe	
Talawanda No.1	NP	NPFe	
Wayne Wallace	NP	NPFe	
Crowder	NP		
American Horse	NP		
Clinton	NP		
Jean Neaustadt	NP		
Wetumka	NP		
Shell	NP		
Vanderwork	NP		
Ardmore	NP		
Eufala	NP	NPFe	
Sahoma	P	NP	
McGee	P	NP	NPFe
Carl Albert	P	NP	
Atoka	P	NP	
Hudson	P	NP	
Broken Bow	P	NP	
Pine Creek	P		

Conclusion

- Forested watersheds showed a trend towards lower nutrients (TN), however these relationships were not strong
- Multiple nutrients produced higher *chl-a* values than single nutrients in all but two reservoirs
- Iron resulted in higher *chl-a* values only when added in combination with N and P together
  - Lower P:Fe ratios
- However, our collaborative research in Grand Lake suggests that while Fe does not increase algal biomass, it does increase cyanobacteria abundance
- Additional research is needed to better understand the role of Fe in Oklahoma reservoirs

Acknowledgments

- OSU
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- Bill Mausbach
- The Jeyasingh lab

Questions?