Exploratory analysis of NCCA 2010 data for WTV and OTI

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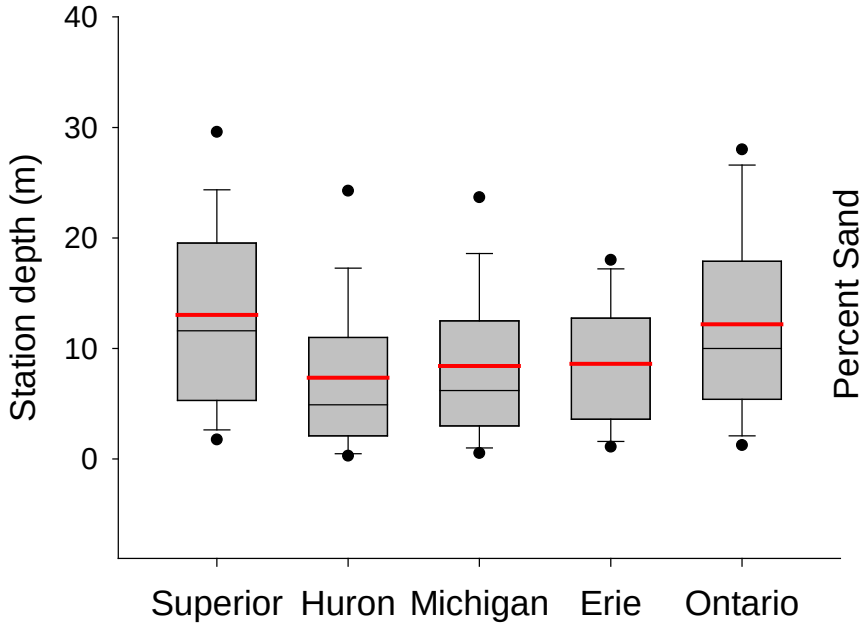
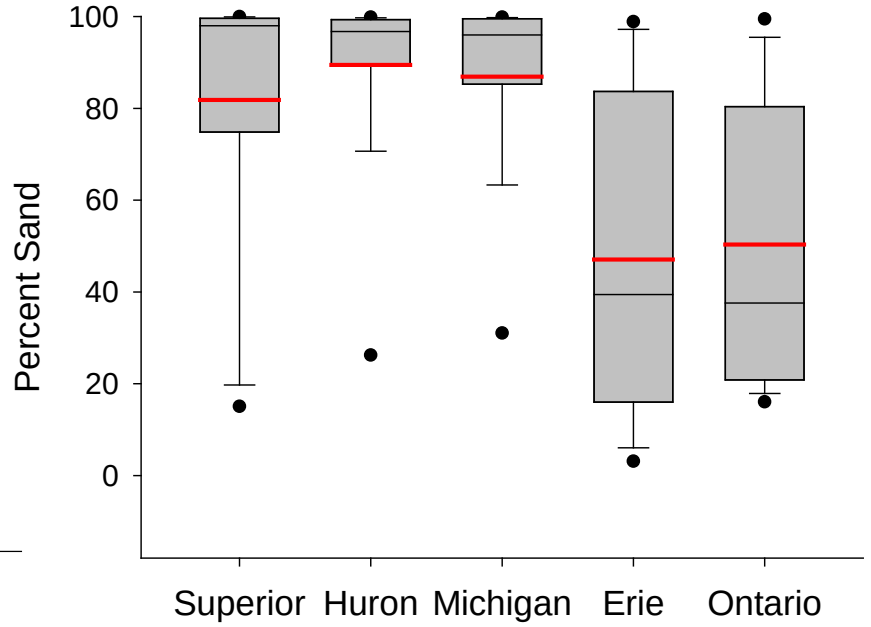
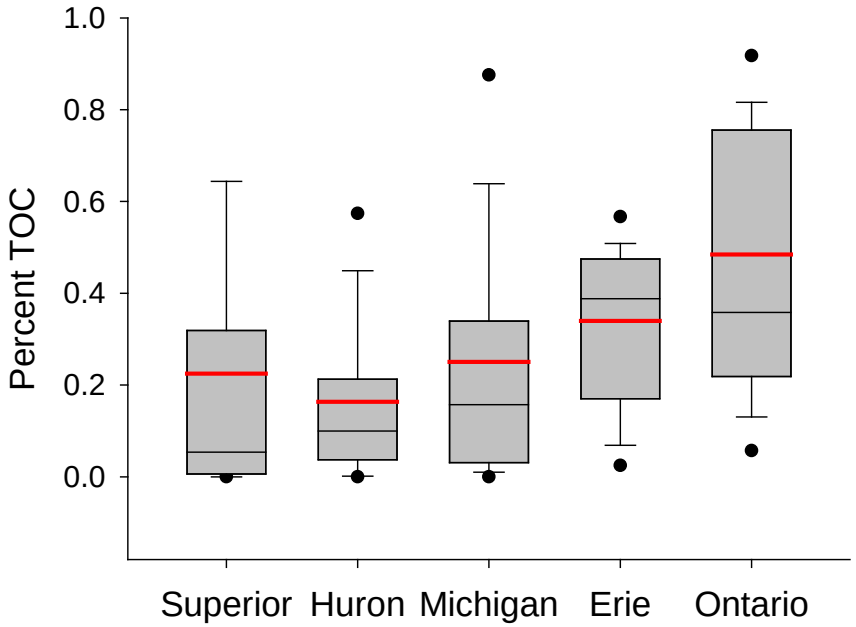
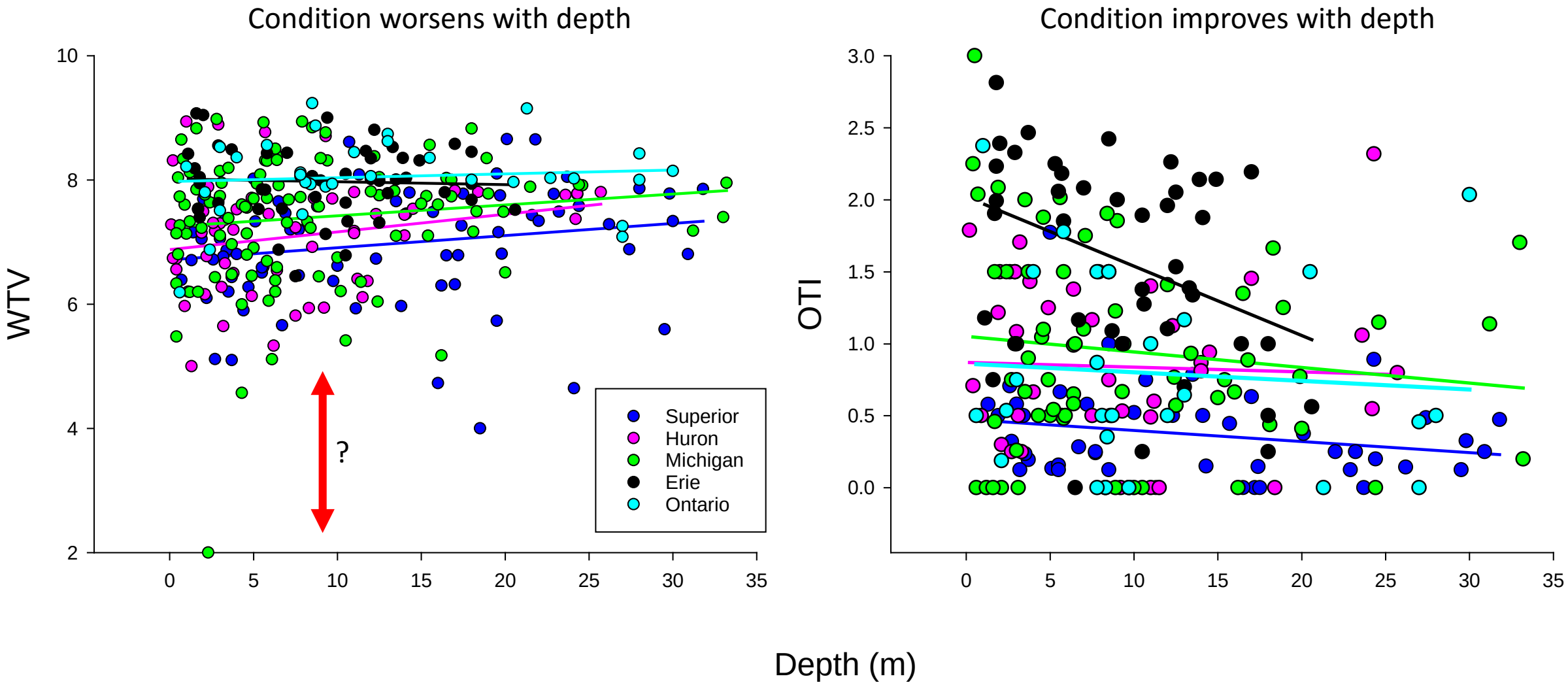
- Weighted tolerance value = Sum (abund of sp *i* * TV of sp *i*) / Total abundance of species with TVs
- Analysis based on data provided by Peg according to my specs
- GLEI stressor gradients from original GLEI provided by Tom Hollenhorst
- Analysis based on raw sample data (not probability weighted)
- Motivated by the idea that depth and substrate are treated differently in other NARS assessments and some GL taxa may have narrow depth range or are depth limited even in shallow range.



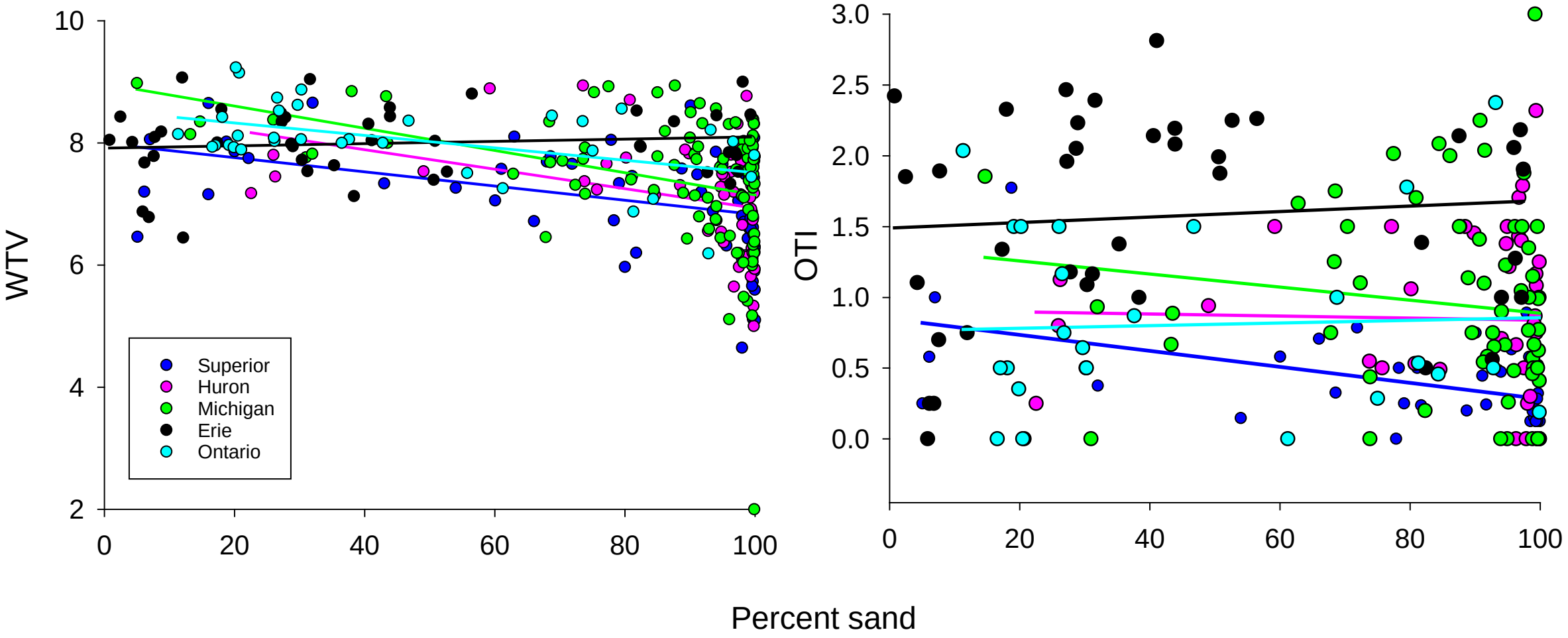




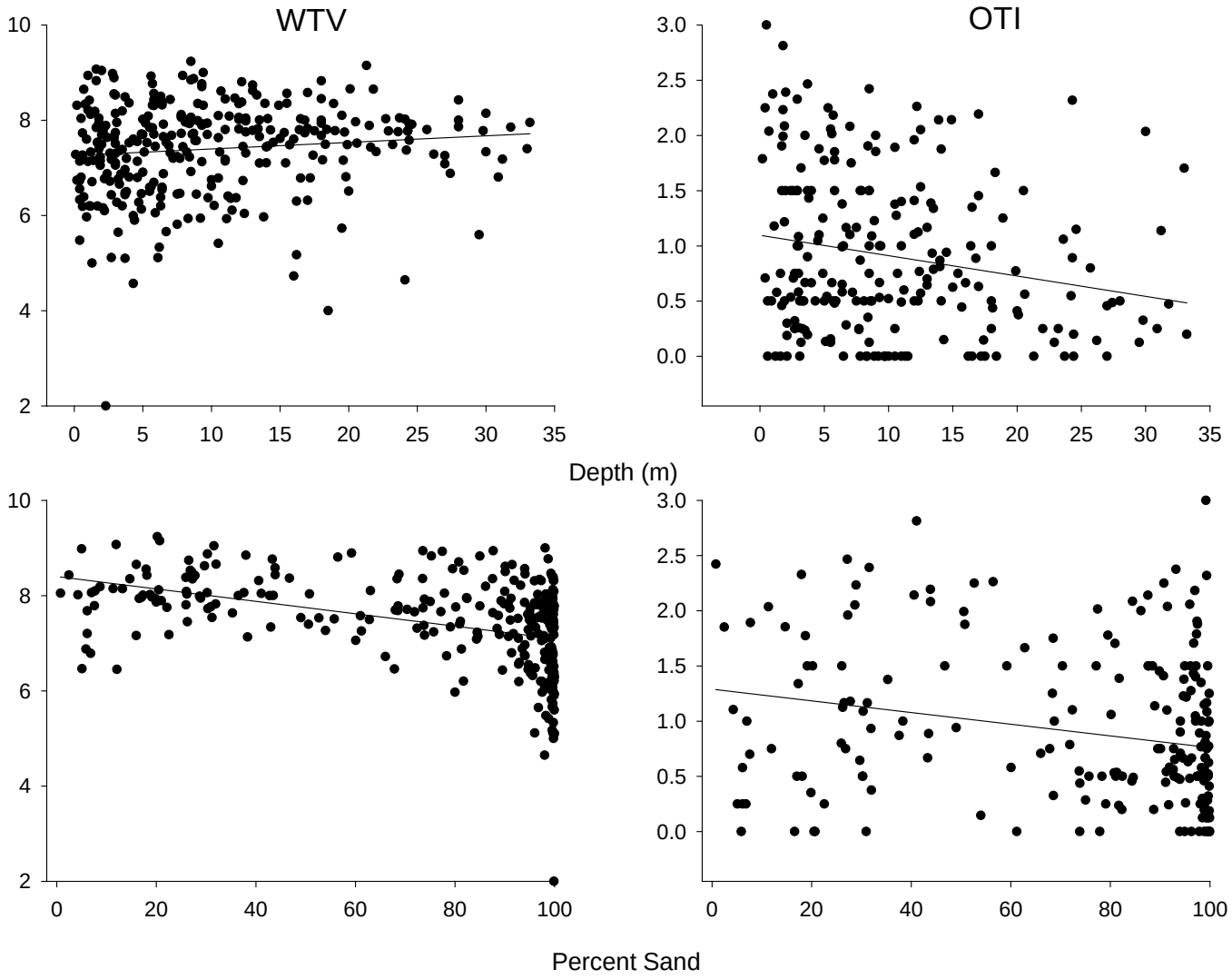
Physical habitat differences among lakes for sample locations in NCCA 2010


Condition worsens with depth
WTV
10
8
6
4
2
0
5
10
15
20
25
30
35
?
Superior
Huron
Michigan
Erie
Ontario
Condition improves with depth
OTI
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Depth (m)

Condition improves with increasing sand



This natural habitat variation can be eliminated using regression residuals



Regression models for correcting depth and sand effects

The REG Procedure
Model: MODEL1
Dependent Variable: OTI OTI

Number of Observations Read	405
Number of Observations Used	215
Number of Observations with Missing Values	190

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	11.16707	5.58353	12.10	<.0001
Error	212	97.79363	0.46129		
Corrected Total	214	108.96069			

Root MSE	0.67918	R-Square	0.1025
Dependent Mean	0.90626	Adj R-Sq	0.0940
Coeff Var	74.94347		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	1.51225	0.13379	11.30	<.0001
STA_DEPm	STA_DEPm	1	-0.01959	0.00587	-3.34	0.0010
SAND	SAND	1	-0.00552	0.00146	-3.77	0.0002

The REG Procedure
Model: MODEL1
Dependent Variable: W_TV W_TV

Number of Observations Read	405
Number of Observations Used	300
Number of Observations with Missing Values	105

Analysis of Variance

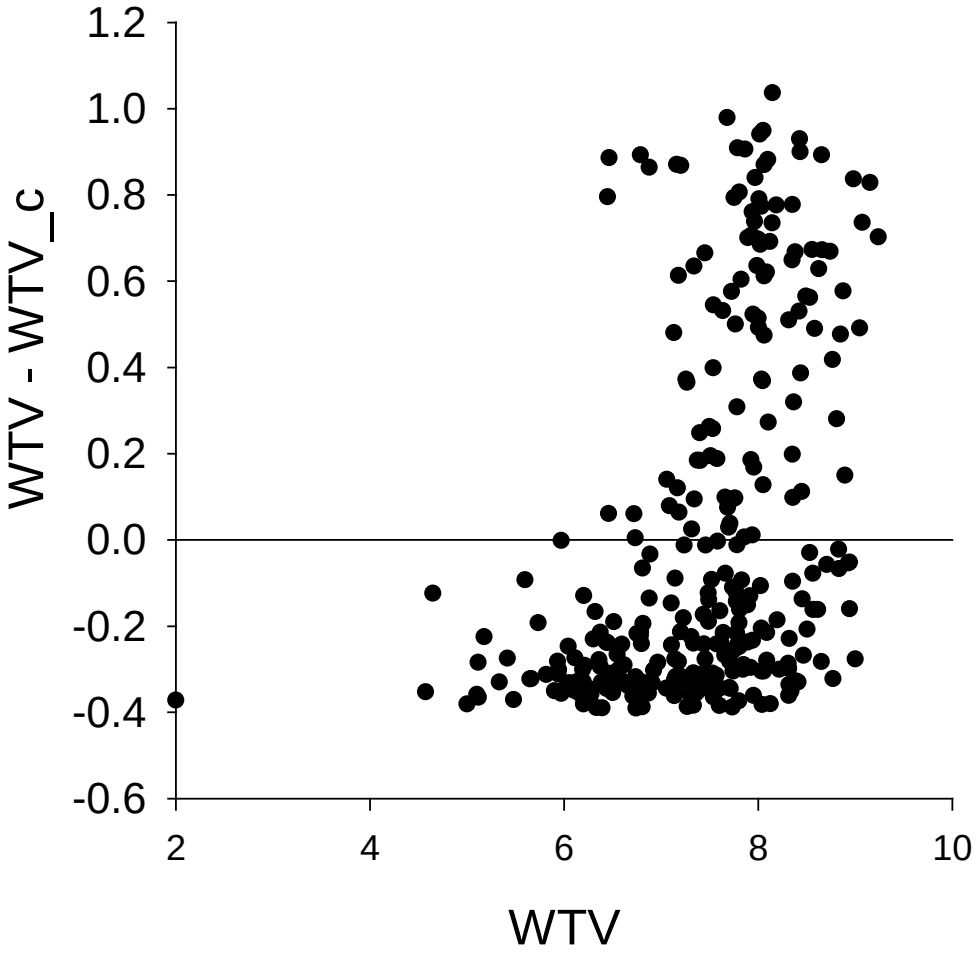
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	51.58209	25.79104	34.25	<.0001
Error	297	223.67372	0.75311		
Corrected Total	299	275.25581			

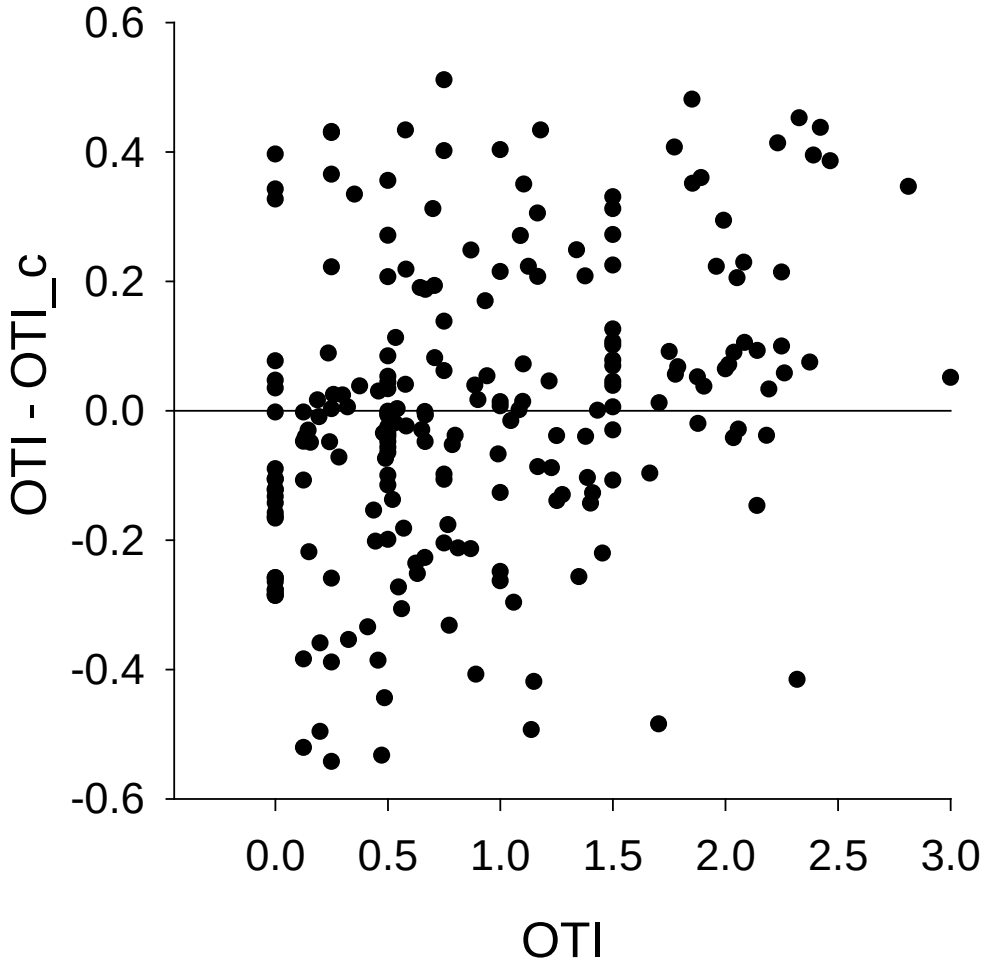
Root MSE	0.86782	R-Square	0.1874
Dependent Mean	7.41502	Adj R-Sq	0.1819
Coeff Var	11.70354		

Parameter Estimates

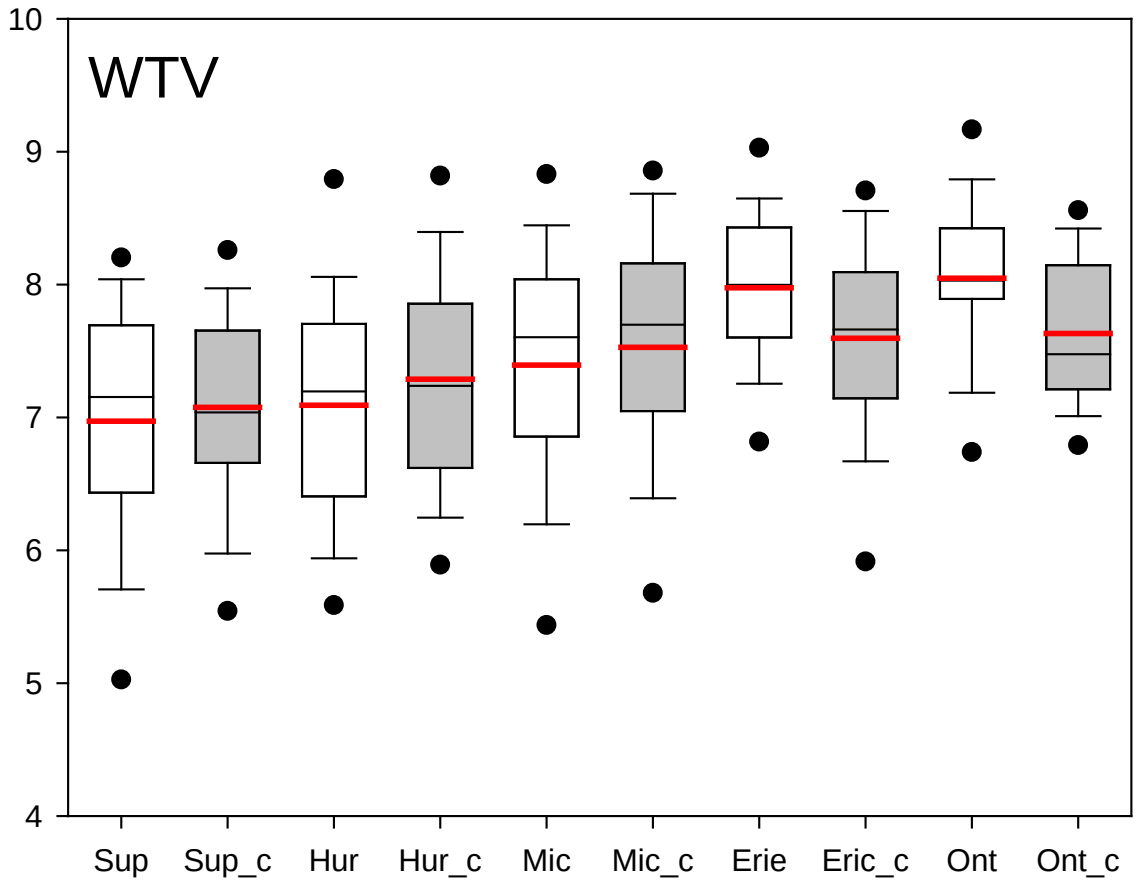
Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	8.27054	0.15362	53.84	<.0001
STA_DEPm	STA_DEPm	1	0.01030	0.00638	1.61	0.1075
SAND	SAND	1	-0.01269	0.00162	-7.82	<.0001

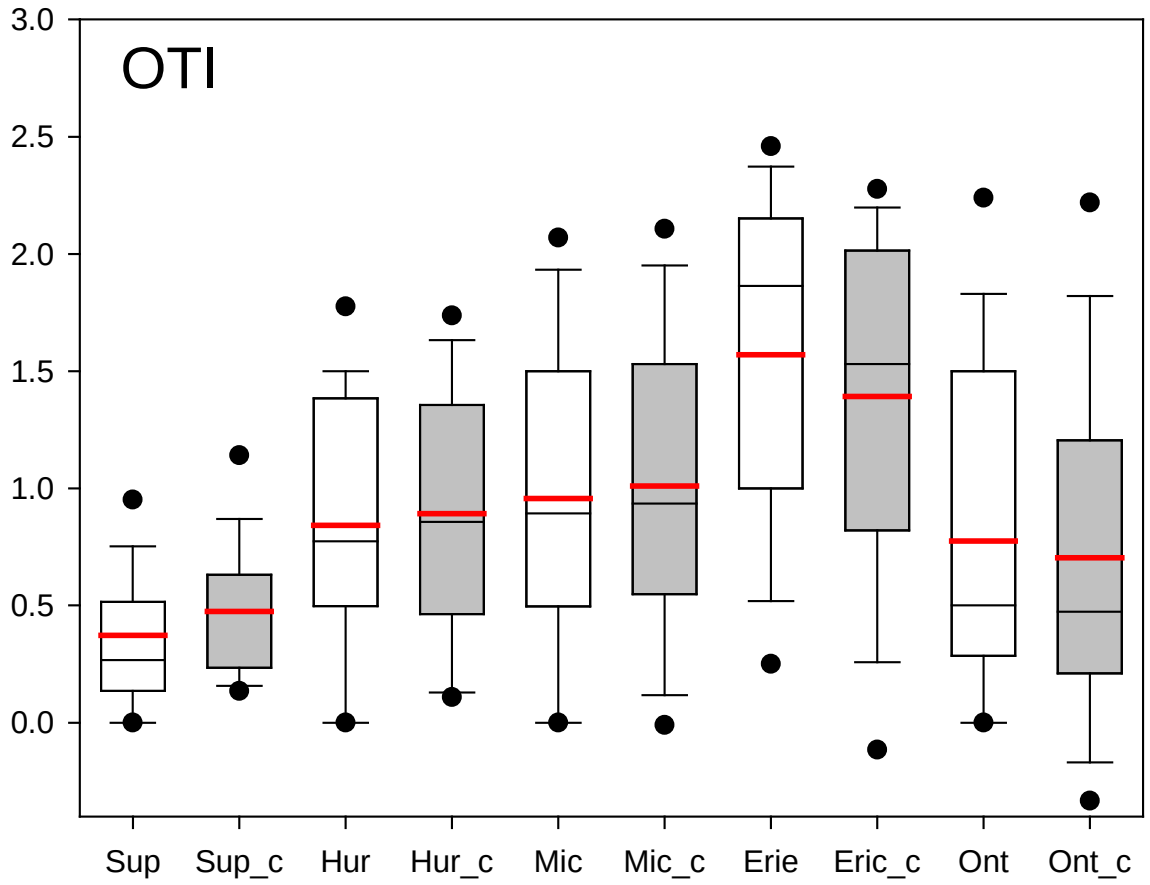
Are values shifted enough to potentially affect condition class of sites?

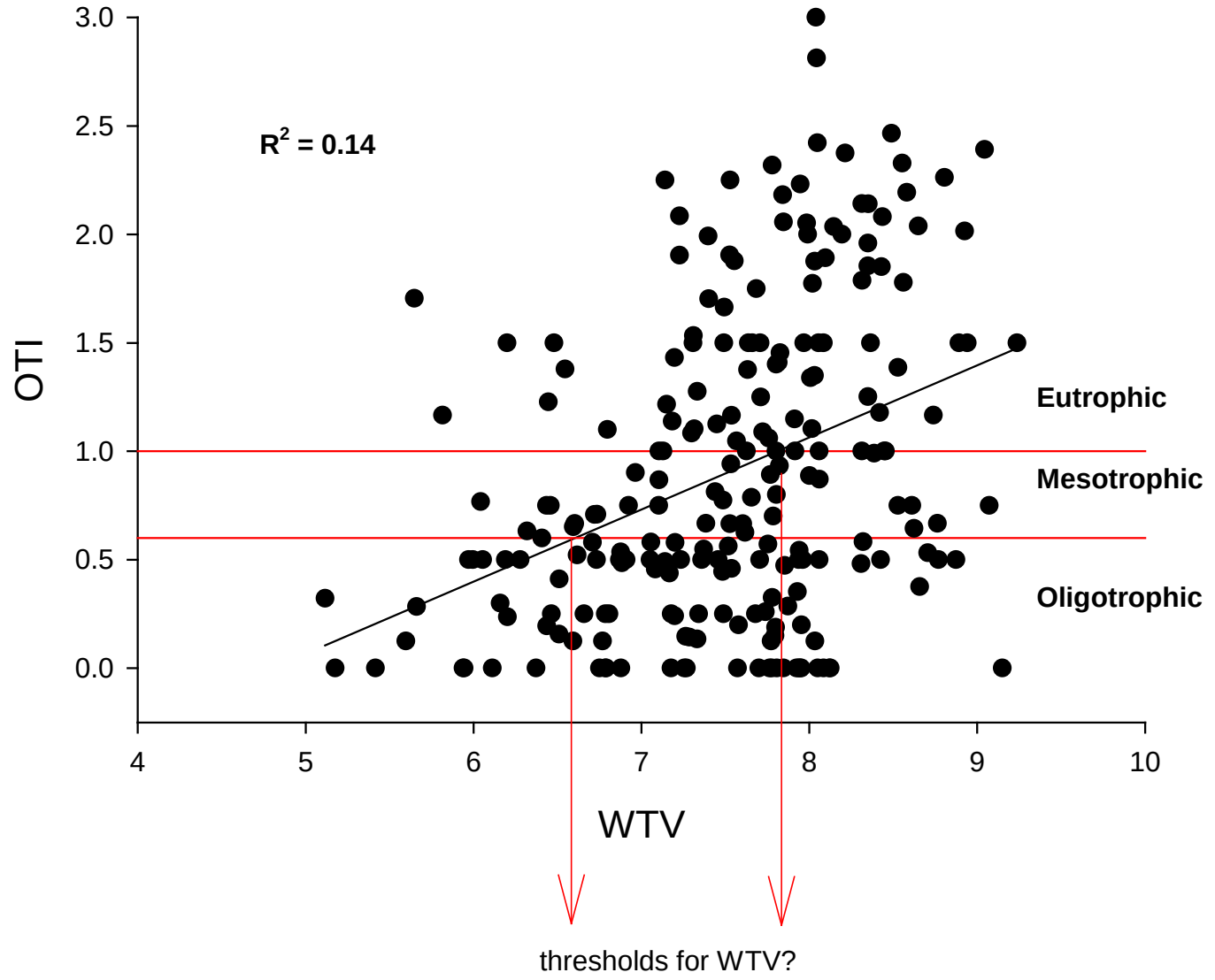


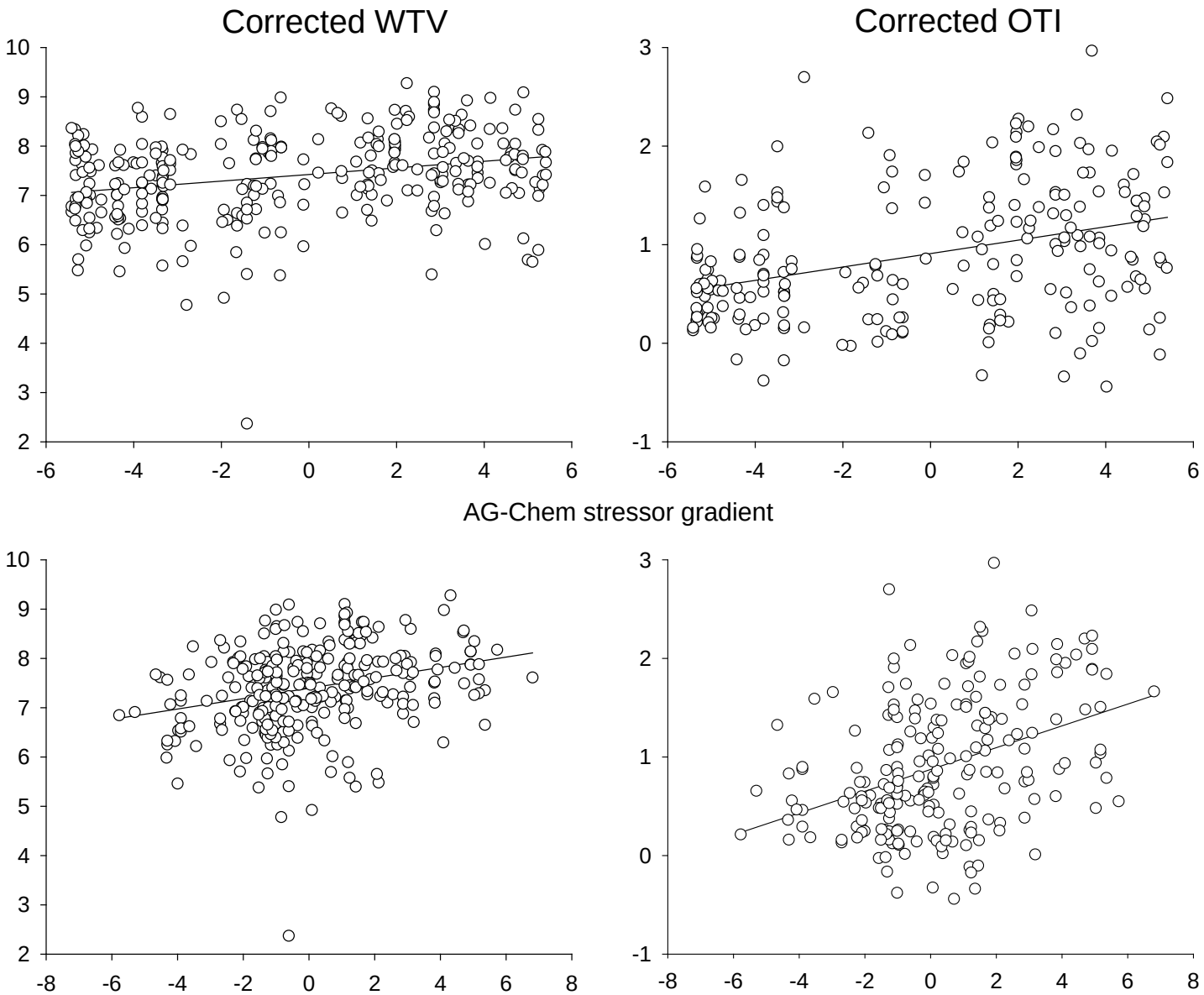


Depth + sand correction generally dampens the difference in condition among lakes






3.0
2.5
2.0
1.5
1.0
0.5
0.0
OTI
R^2 = 0.14
Eutrophic
Mesotrophic
Oligotrophic
4
5
6
7
8
9
10
WTV
thresholds for WTV?


Corrected WTV
Corrected OTI
AG-Chem stressor gradient
Population density stressor gradient

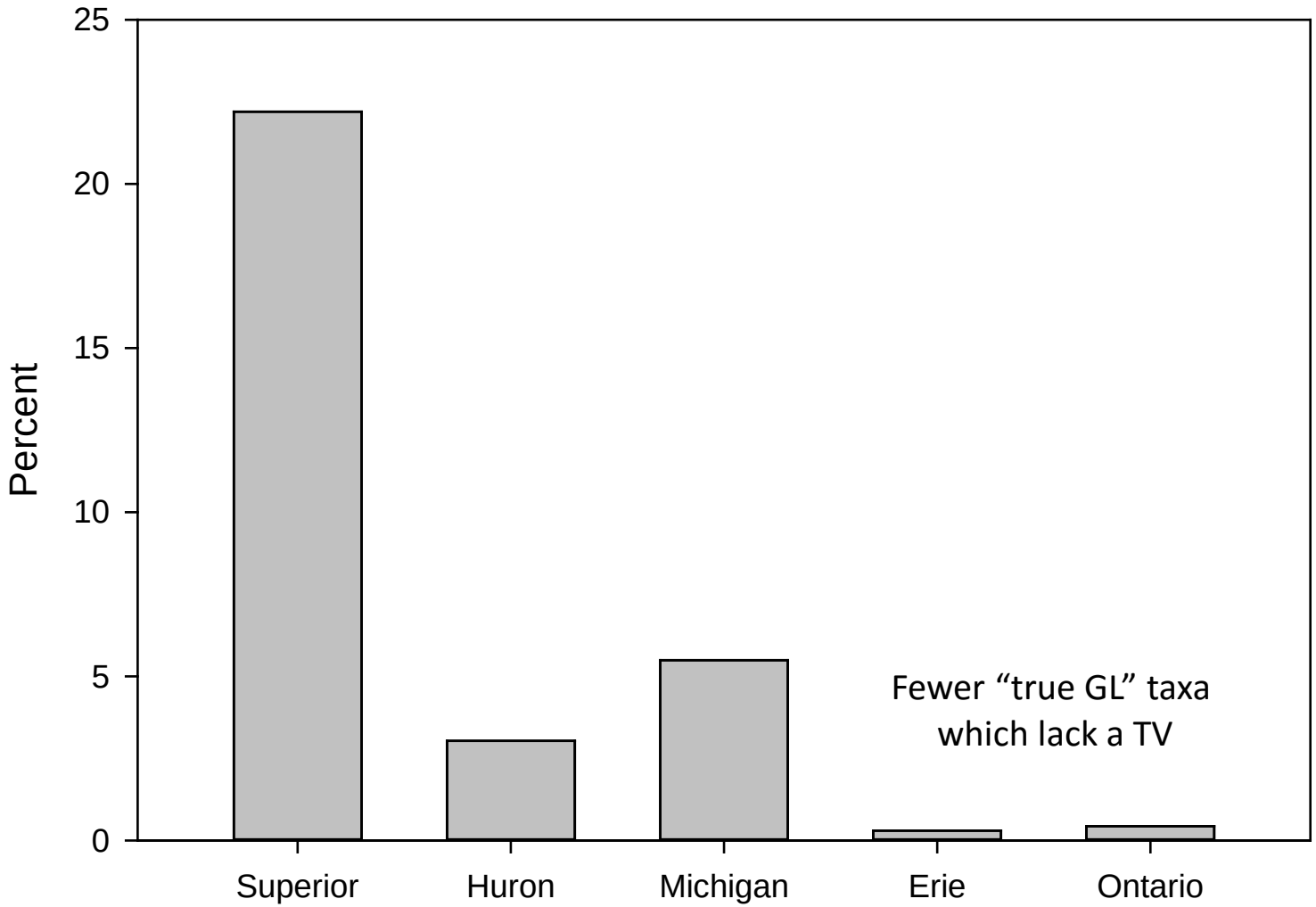
Pearson Correlation Coefficients
Prob > |r| under H0: Rho=0
Number of Observations

	OTI	OTI_c	W_TV	WTV_c	Depth	SAND	LogTOC
ac1	0.44258	0.35730	0.35450	0.27335	-0.11967	-0.27770	0.21443
ac1	<.0001	<.0001	<.0001	<.0001	0.0161	<.0001	0.0001
	225	215	316	300	404	316	317
lc1	-0.37610	-0.27193	-0.35994	-0.22910	0.03432	0.41464	-0.31235
lc1	<.0001	<.0001	<.0001	<.0001	0.4915	<.0001	<.0001
	225	215	316	300	404	316	317
ad1	0.39131	0.29428	0.34077	0.21230	-0.02708	-0.33127	0.25895
ad1	<.0001	<.0001	<.0001	0.0002	0.5873	<.0001	<.0001
	225	215	316	300	404	316	317
pd1	0.46876	0.38513	0.38589	0.27938	-0.03087	-0.34802	0.26014
pd1	<.0001	<.0001	<.0001	<.0001	0.5362	<.0001	<.0001
	225	215	316	300	404	316	317
ps1	0.35834	0.26386	0.21007	0.14762	-0.07415	-0.21901	0.19296
ps1	<.0001	<.0001	0.0002	0.0105	0.1368	<.0001	0.0006
	225	215	316	300	404	316	317
sl1	0.25261	0.21479	0.20867	0.11504	-0.04067	-0.21777	0.09904
sl1	0.0001	0.0015	0.0002	0.0465	0.4149	<.0001	0.0783
	225	215	316	300	404	316	317

Weakest relationships to stressor gradients

Stressor gradients
ac1 - AgChem first PC
lc1 – Landcover first PC
ad1 – Atmospheric deposition first PC
pd1 – population density first PC
ps1 – point source first PC
sl1 – Statsgo soils first PC

Mean percent abundance in sample of taxa for which there is no TV



Conclusions

- Both OTI and WTV vary with depth and percent sand, even over shallow depth range of NCCA
- Easily modeled out if we assume depth and sand not related to stressors
- Depth is the habitat variable least likely to be causally related to any impairment, IMO
- Correction shift is potentially strong enough to change condition class
- Corrected metrics show weaker response to stressor gradients
- But stressors confounded with natural variation (% sand)
- OTI response to stressors is *slightly* stronger than WTV
- OTI does not have the invasive species problem
- WTV can be calculated more often then OTI (2010 data)
- But lots of missing TVs for the upper GL
- WTV value range is elevated for some reason
- Need consensus on TV details (plankton, mites, *Monoporeia*, *Dreissena*)
- Overall confounding effects (sand, depth) greatest for Lake Erie
- IF we go with Index metrics (cf. BEAST, TITAN), WTV could be paired with OTI either as a separate indicator or as part of the mOTI.