Relationship between aqueous and sediment chemistry and biological recovery across a gradient of AMD impairment

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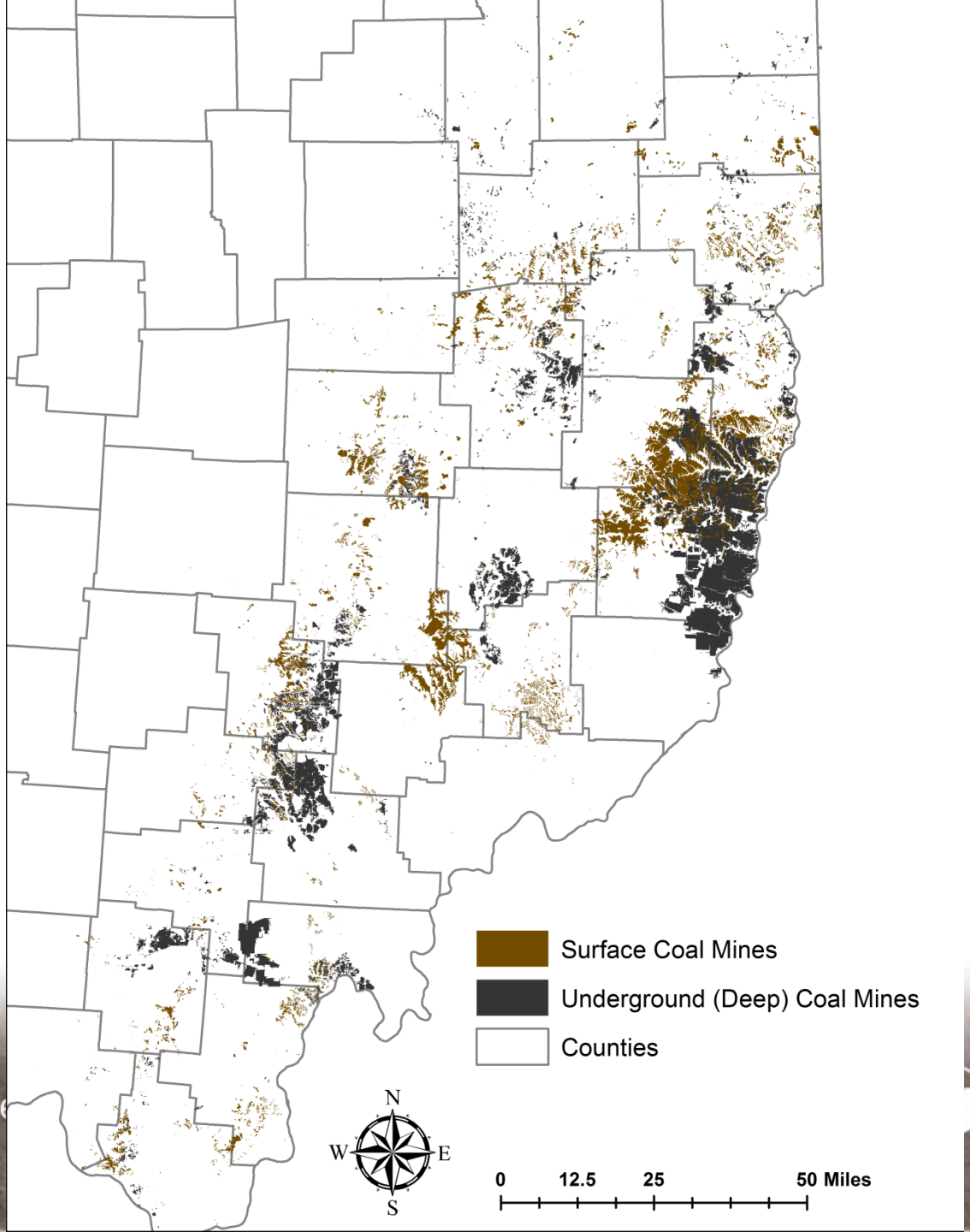
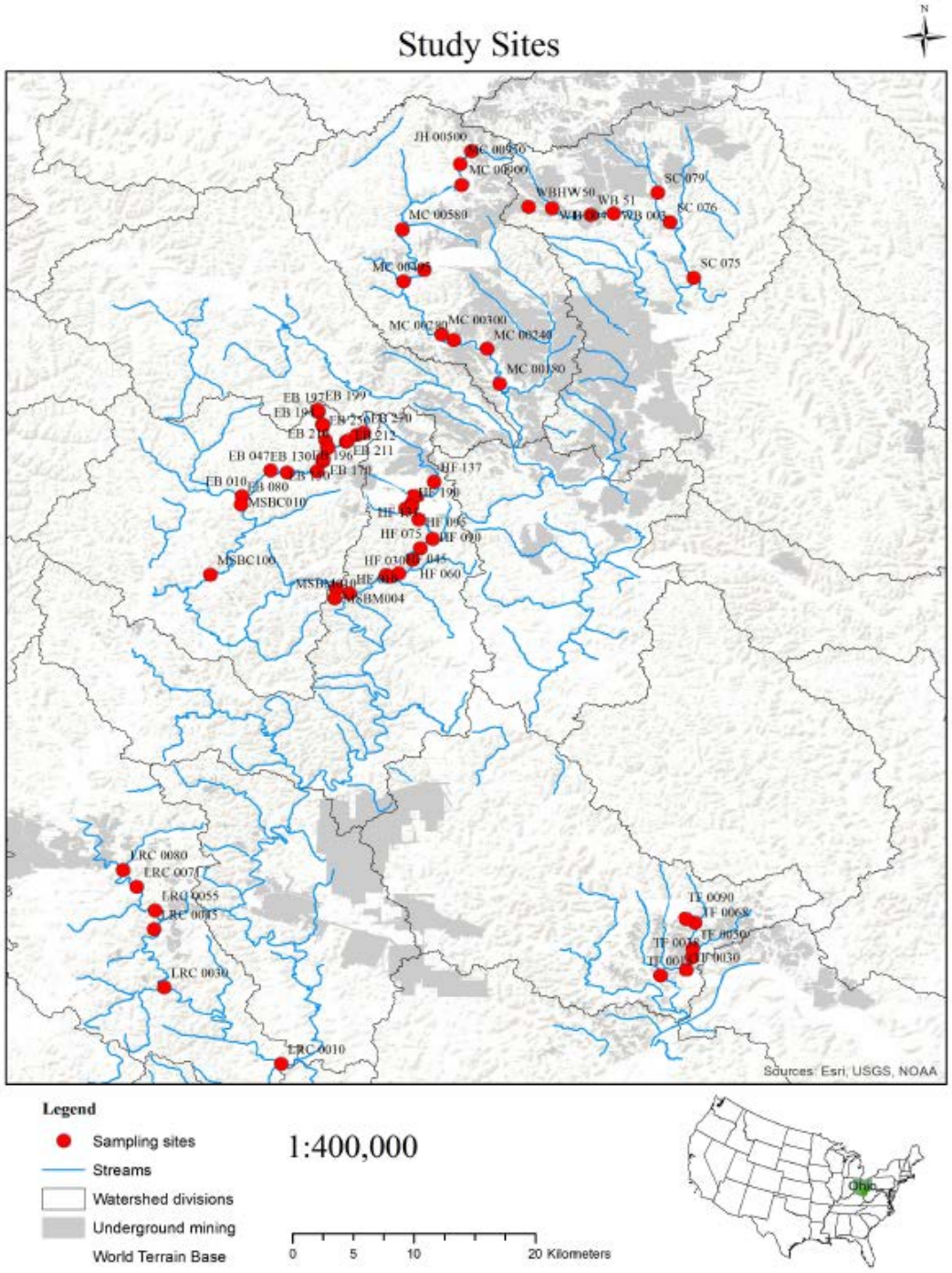



Restoring Ohio's Watersheds
Coal mining and agriculture have taken their toll on the pristine waterways of Ohio. Abandoned mine drainage (AMD), pesticides, fertilizers, erosion, and livestock waste seep into rivers and streams disrupting the delicate balance of their ecosystems. This site compiles and tracks changes in Ohio's watersheds to measure the success of ongoing reclamation efforts.
26,309
Samples Collected Since January 1, 1995
Acid Mine Drainage
Livestock Waste
OHIO
1
2
Huff Run
inset 1
Monday Creek
Monday C.
Sunday C.
Sunday Creek
Leading Creek
Raccoon C.
Leading C.
Raccoon Creek
inset 2

Effect of Metals on Biology??

- Past data suggests some aqueous metals are negatively correlated with macroinvertebrate health
- Little suggestion on the role of sediment metals



62 sites across a gradient of impairment

All have aqueous and sediment chemistry measurements and over 5 years of macroinvertebrate assessment

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Zones of Recovery

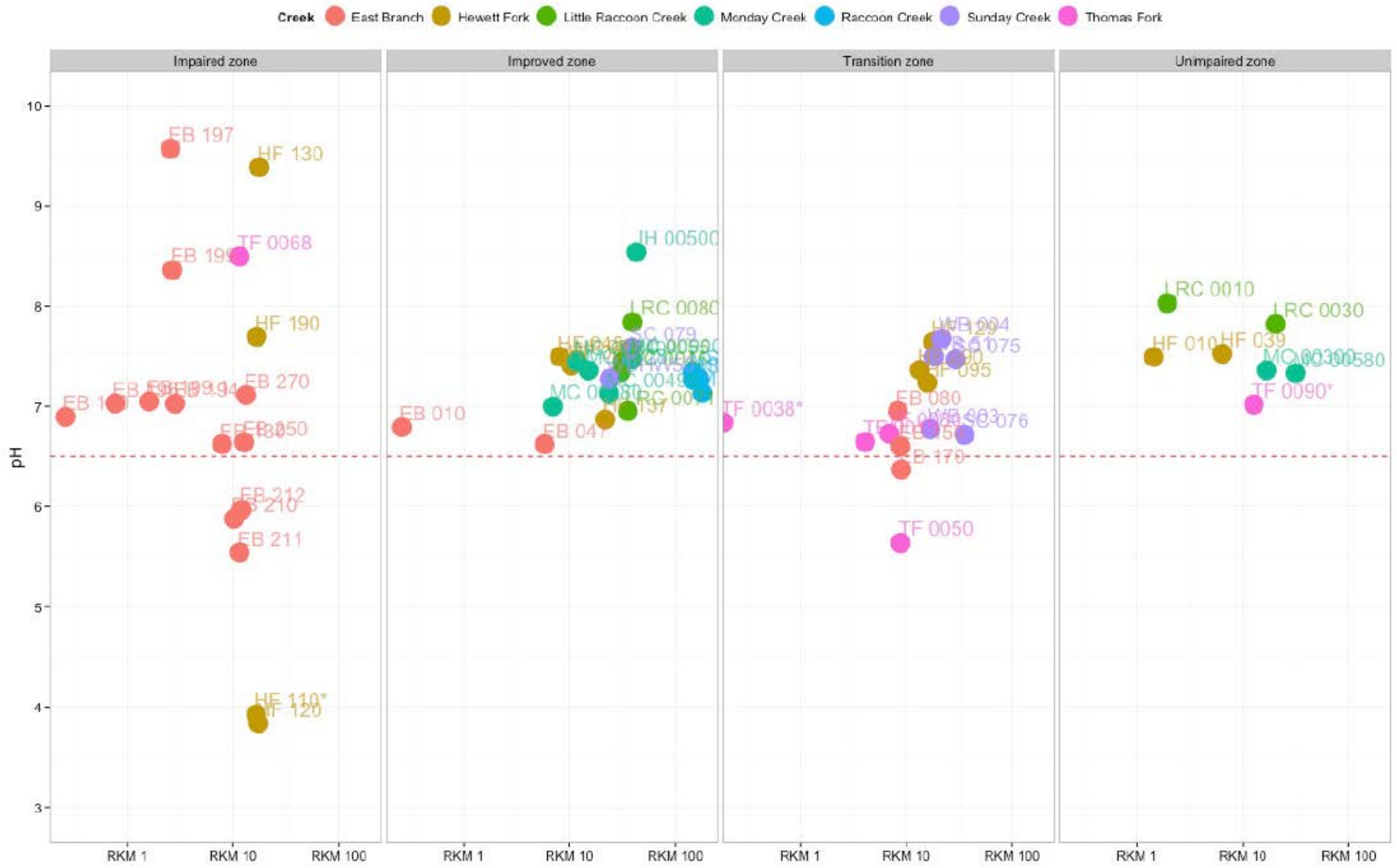
- Unimpaired
- Recovered
- Transition
- Impaired

Aqueous Chemistry

Test of Similarity Between Zones of Recovery

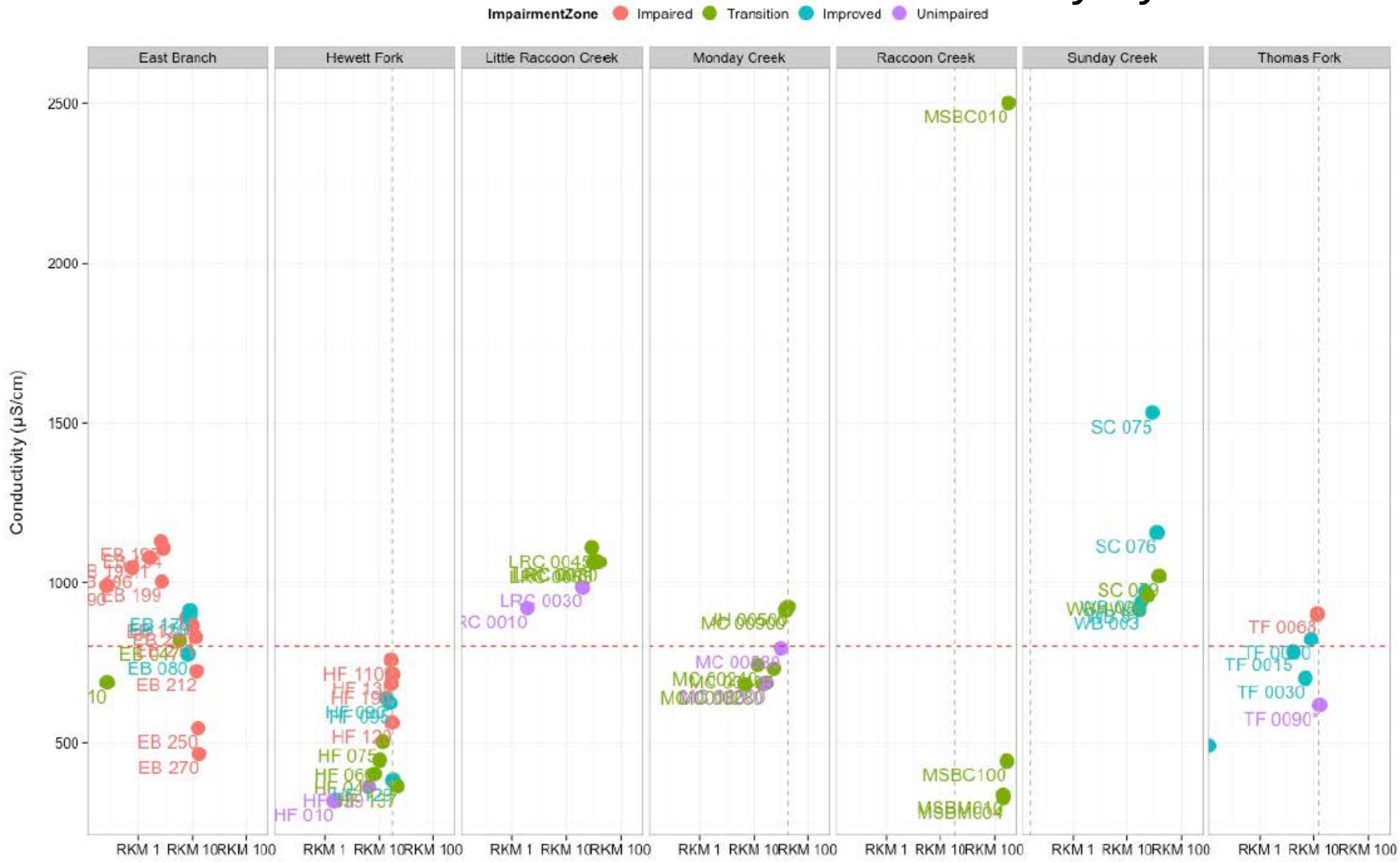
Parameters: 2014 - 2015	pH field	Conduct	Acidity	Alkalinity	ORP	TDS	TSS	Sulfate	Al	Ca	K	Mg	Mn	Fe	Na
P-value (Significance):	0.0059	0.0215	0.02629	0.06037	0.2499	0.0093	2.744e-05	0.0005475	3.451e-07	1.359e-05	0.2051	0.0339	1.256e-06	0.008147	0.005826
Different in 4 zones:	differs	differs	differs			differs	differs	differs	differs	differs		differs	differs	differs	differs
Similar in 4 zones:				same	same						same				

pH by Impairment Zone

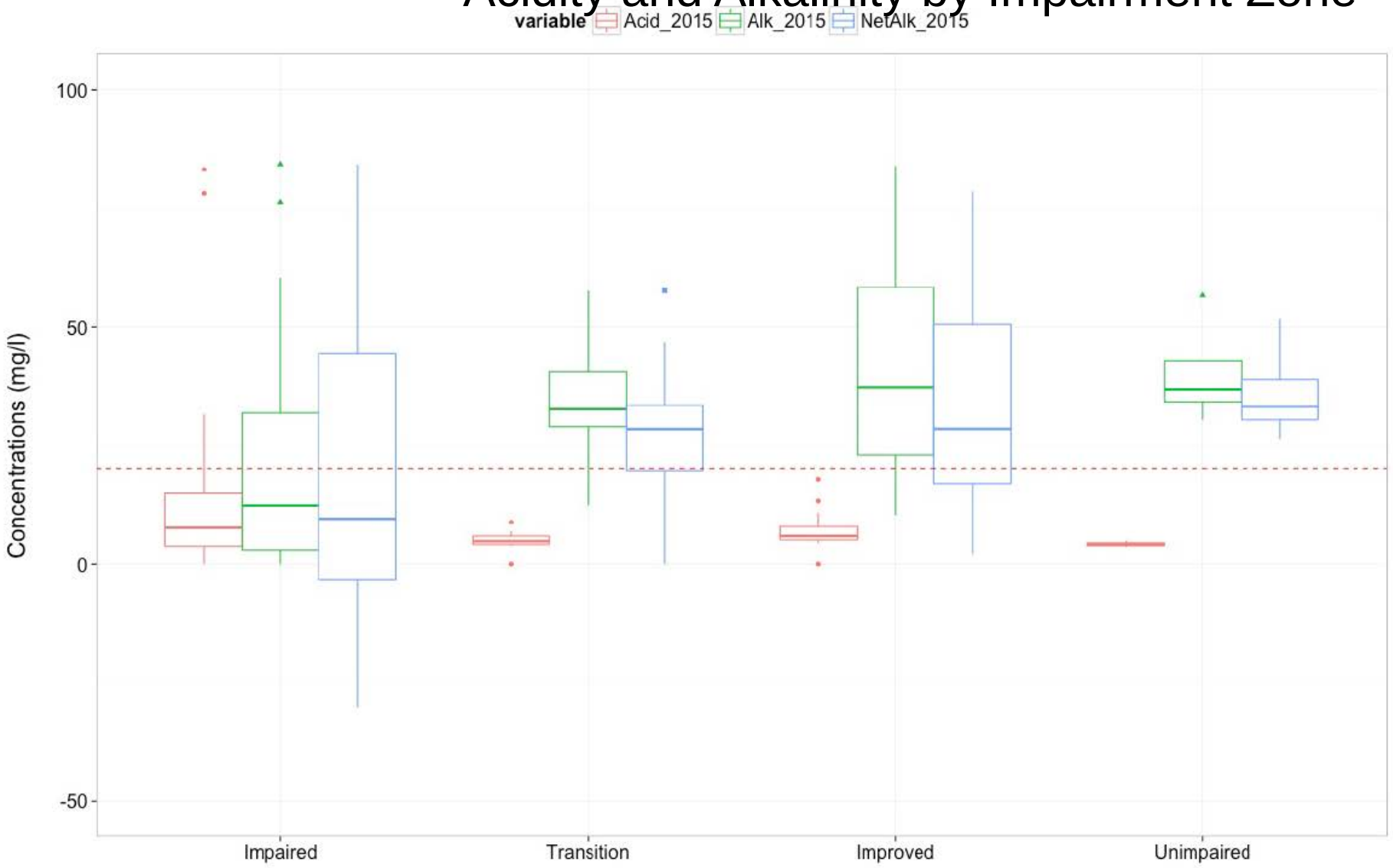


Conductivity by Impairment Zone

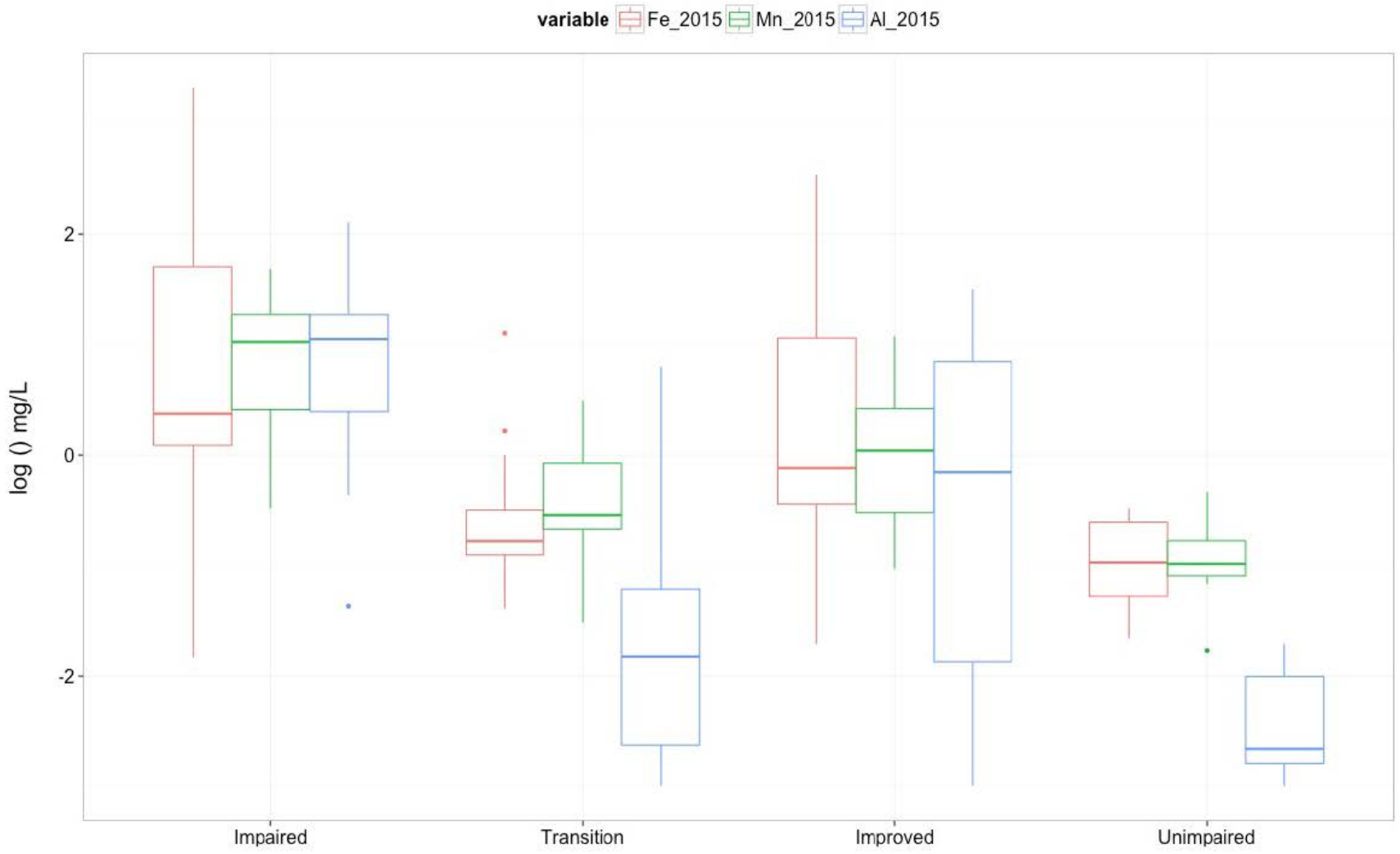
Conductivity by Watershed



Acidity and Alkalinity by Impairment Zone



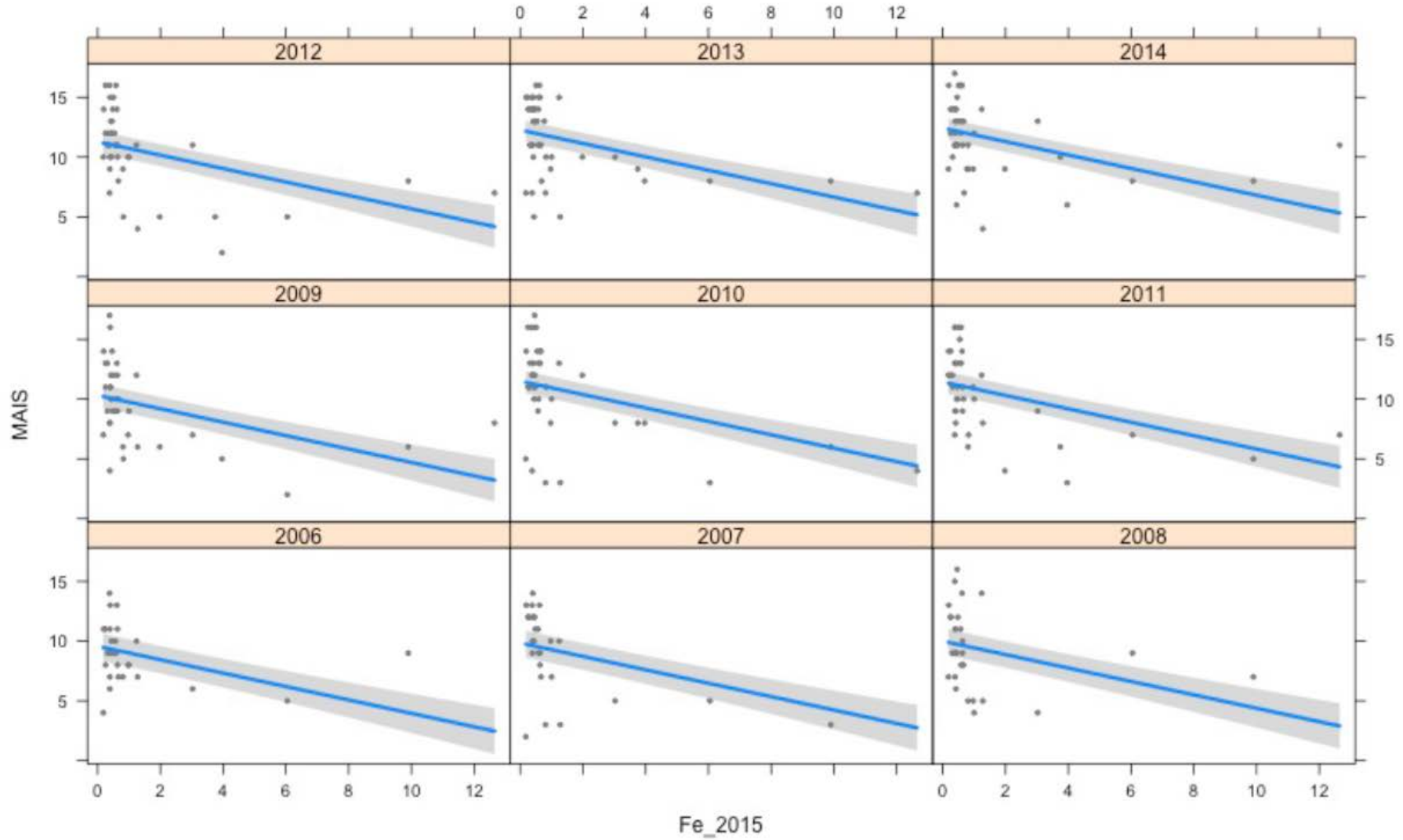
Metals by Impairment Zone



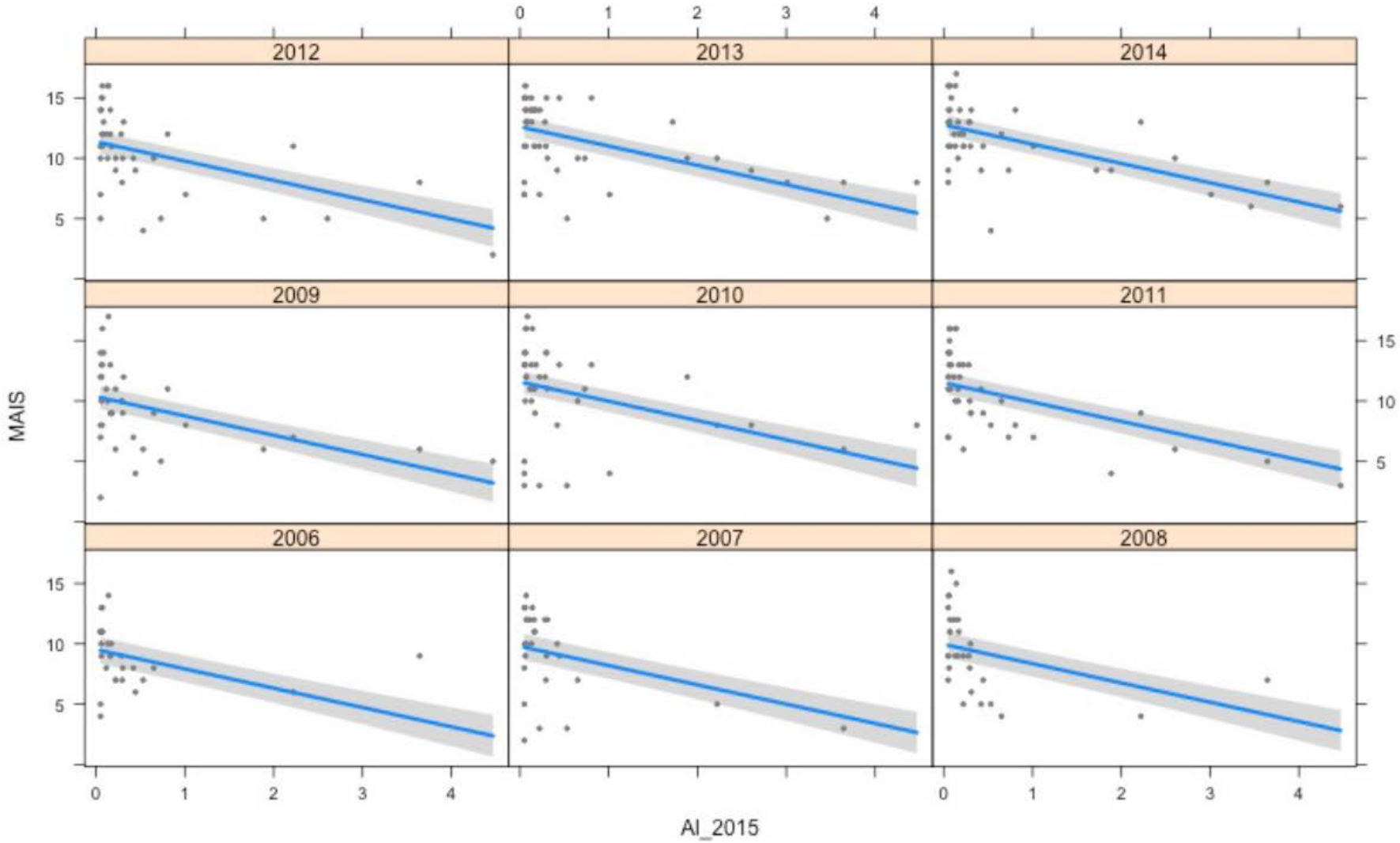
Aqueous Chemistry vs. Macroinvertebrates

- Statistically significant relationships between Fe, Al, Mn, and Acidity with MAIS (Macroinvertebrate Aggregrate Index for Streams) metric

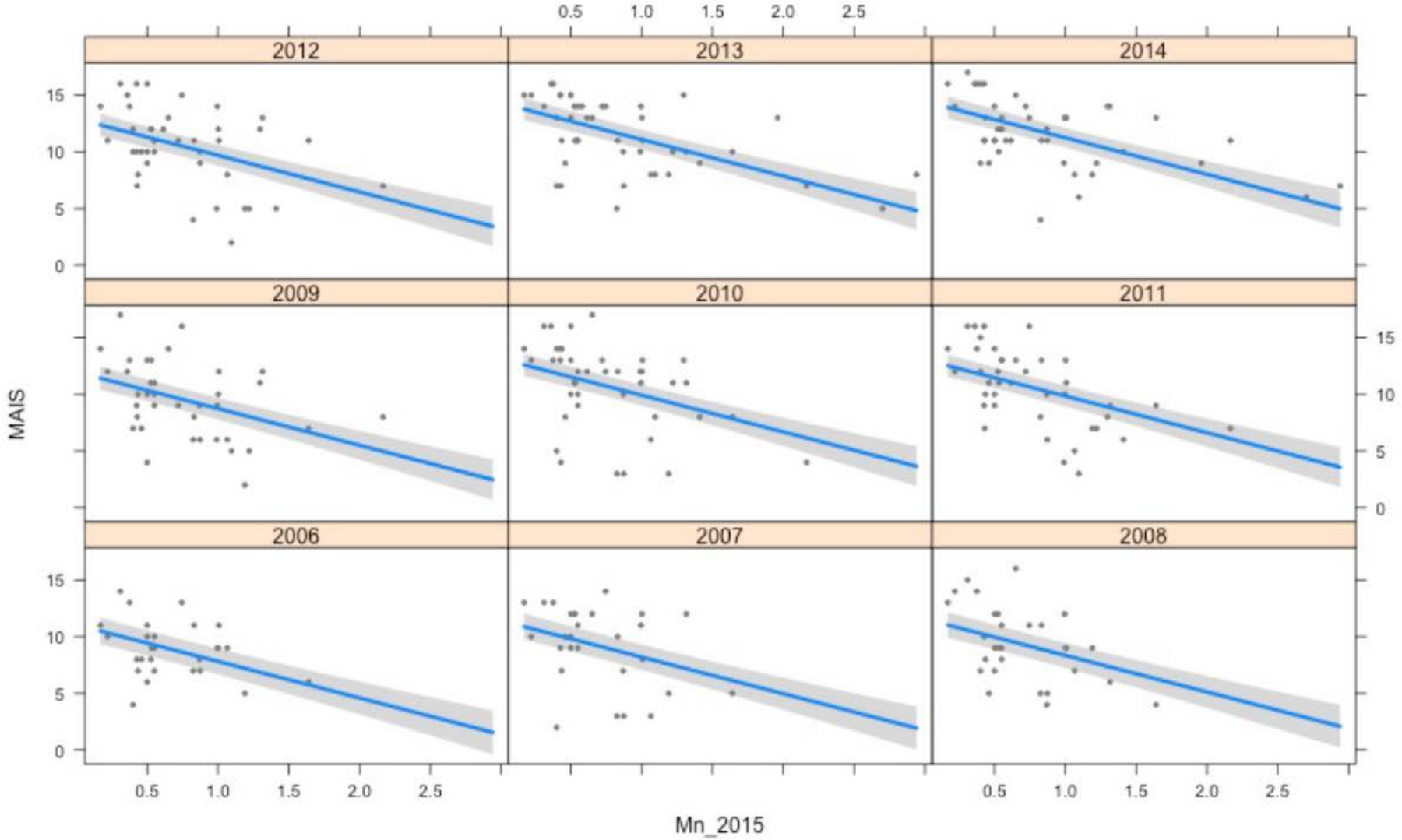
Iron vs MAIS


2012
2013
2014
2009
2010
2011
2006
2007
2008
MAIS
Fe_2015
0
2
4
6
8
10
12
5
10
15

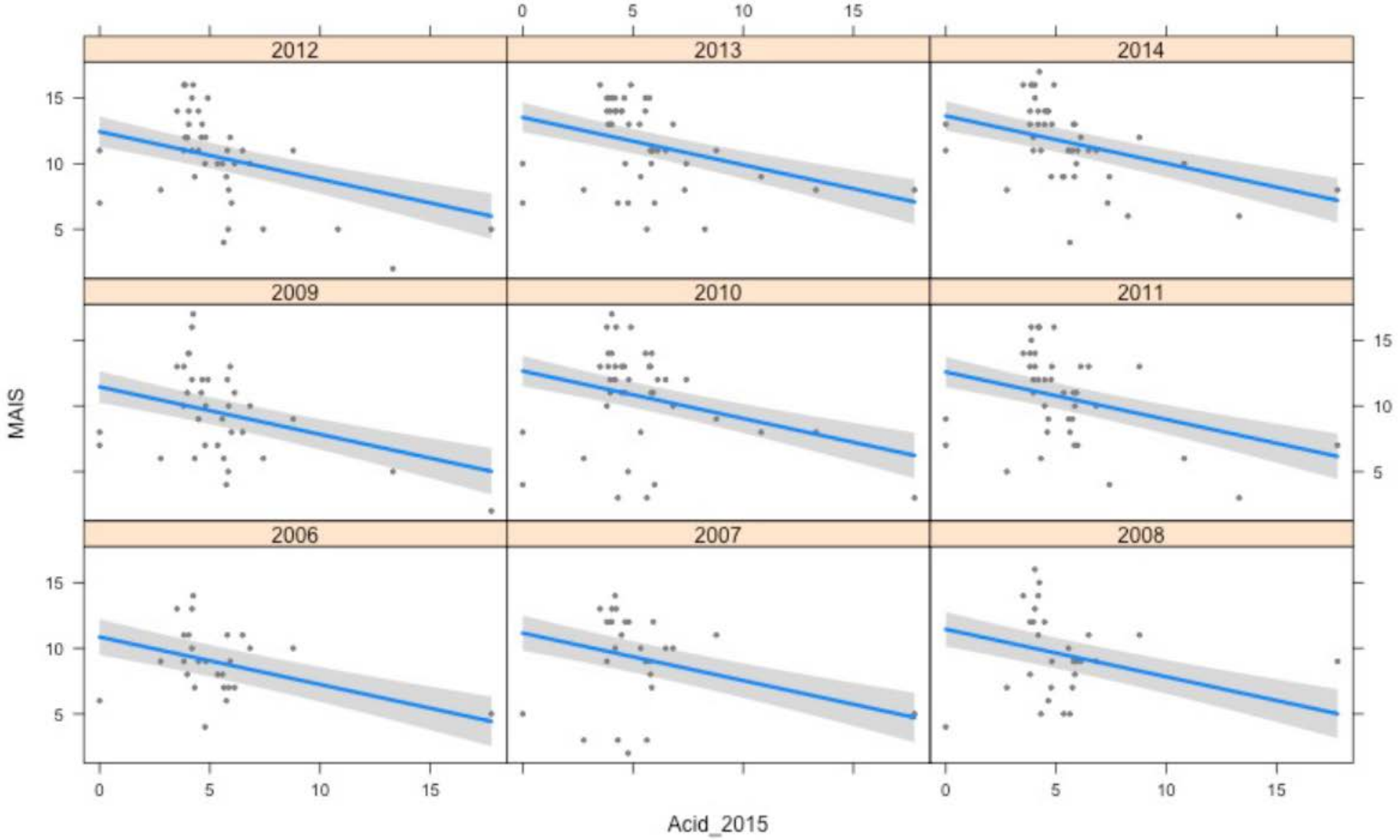
Aluminum vs. MAIS



Manganese vs. MAIS



Acidity vs. MAIS

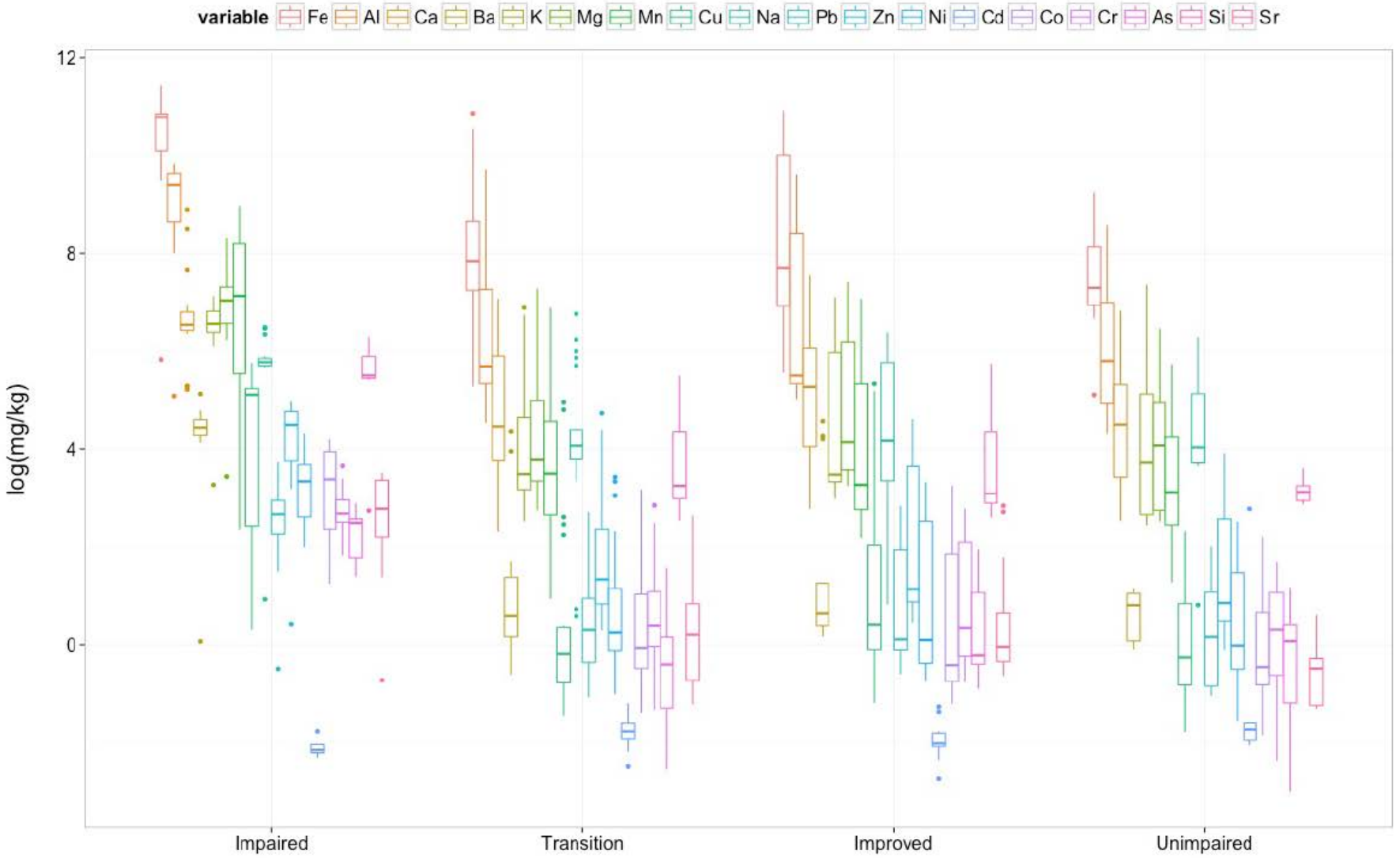


Sediment Chemistry

Test of Similarity Between Zones of Recovery

Parameters	Al	Ba	Ca	Co	Cr	Cu	Fe	K	Mg	Mn	Na	Pb	Ni	Si	Sr	Zn
P-value:	0.0001293	0.0002428	0.0008985	1.64e-05	1.249e-05	7.05e-06	0.0001011	0.0004948	5.668e-05	9.547e-05	0.01608	3.032e-05	3.642e-05	0.0005837	0.000139	0.0001852
Different in 4 zone:	differs	differs	differs	differs	differs	differs	differs	differs	differs	differs	differs	differs	differs	differs	differs	differs
Similar in 4 zone:	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

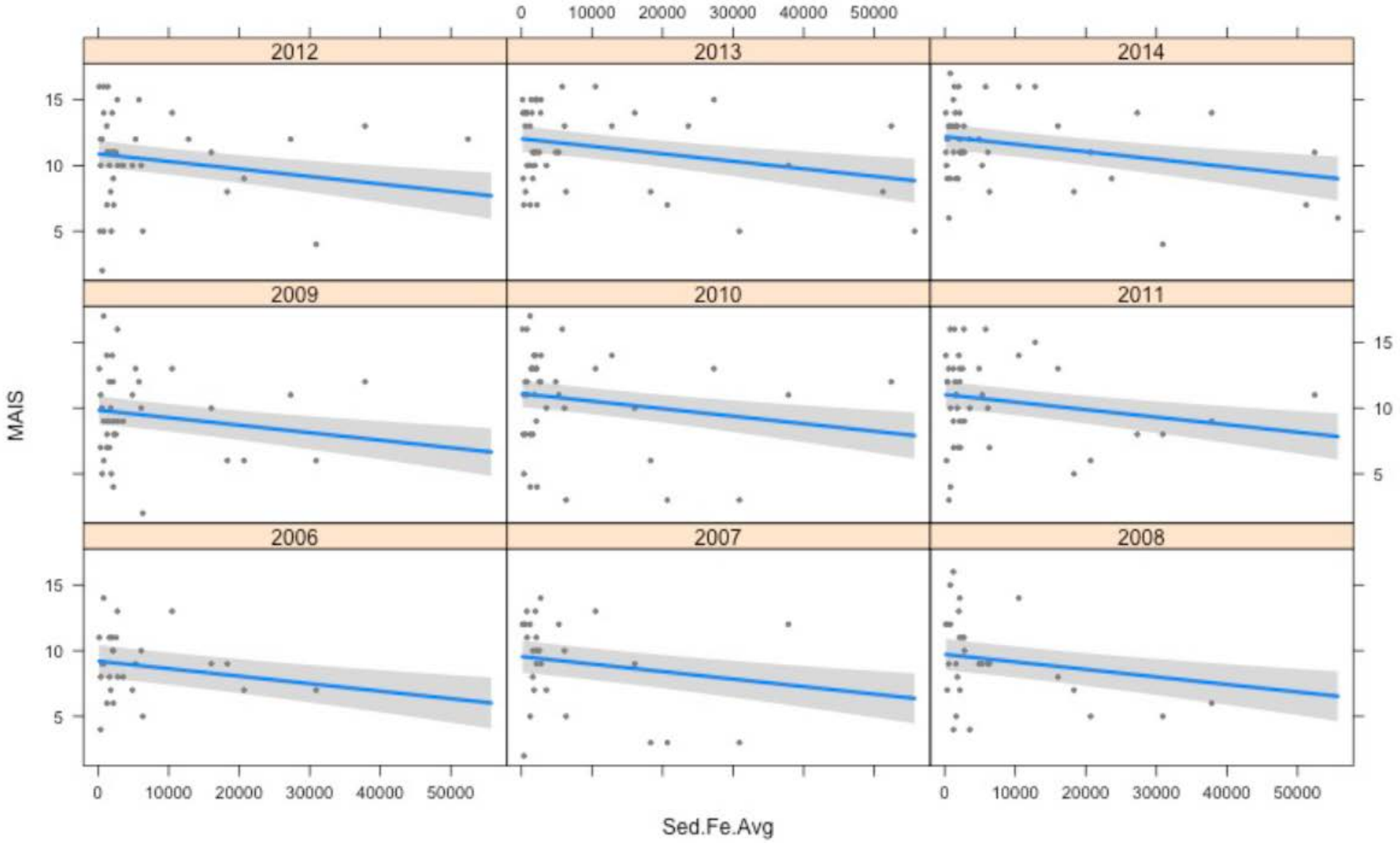
Metals by Impairment Zone



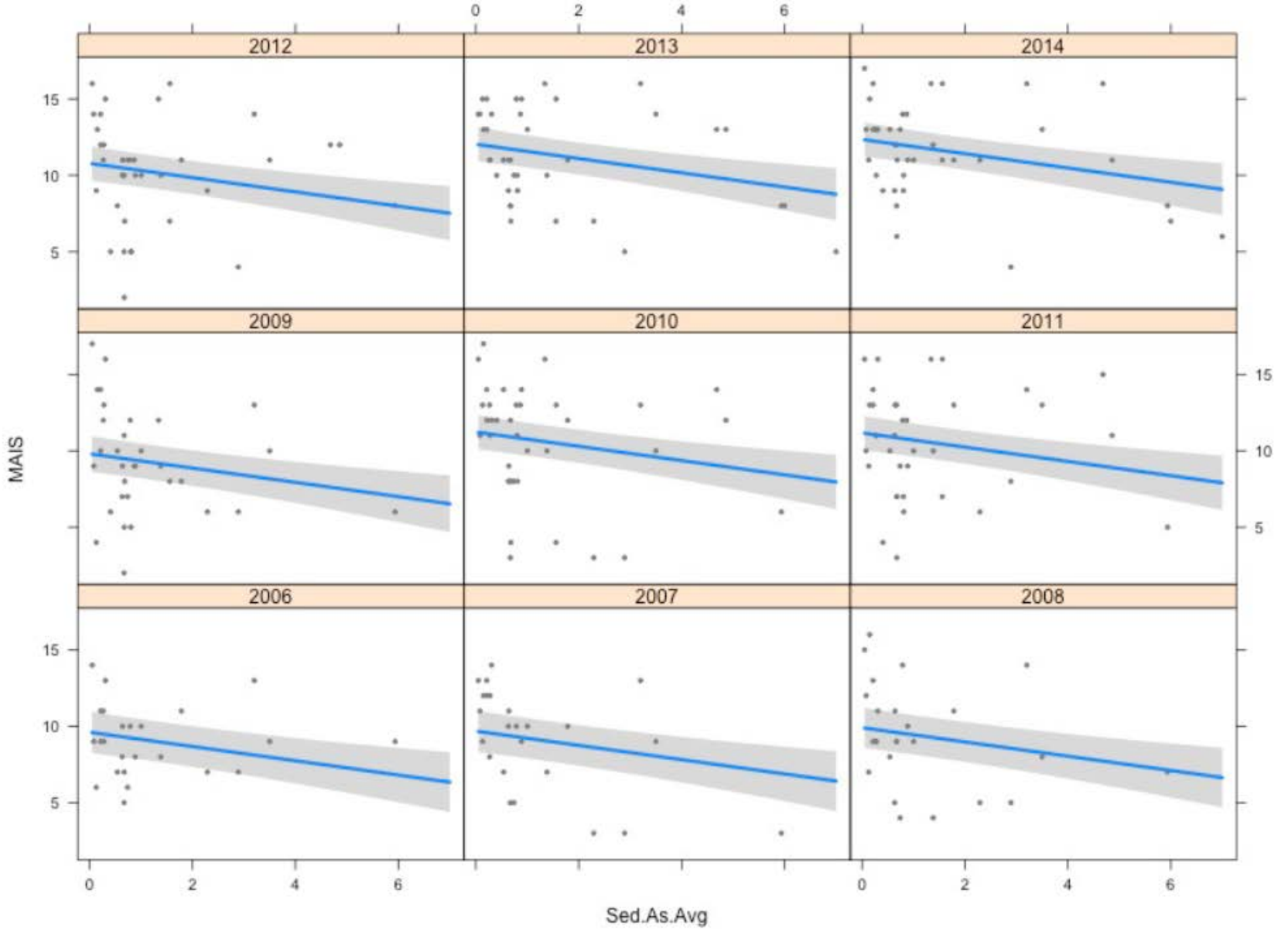
Sediment Chemistry vs. Macroinvertebrates

- Statistically significant relationships between Fe, As, Mn, Cu, and Ca with MAIS (Macroinvertebrate Aggregrate Index for Streams) metric
- Mn, Cu, Ca regressions are nearly flat, so the relationship isn't suggestive

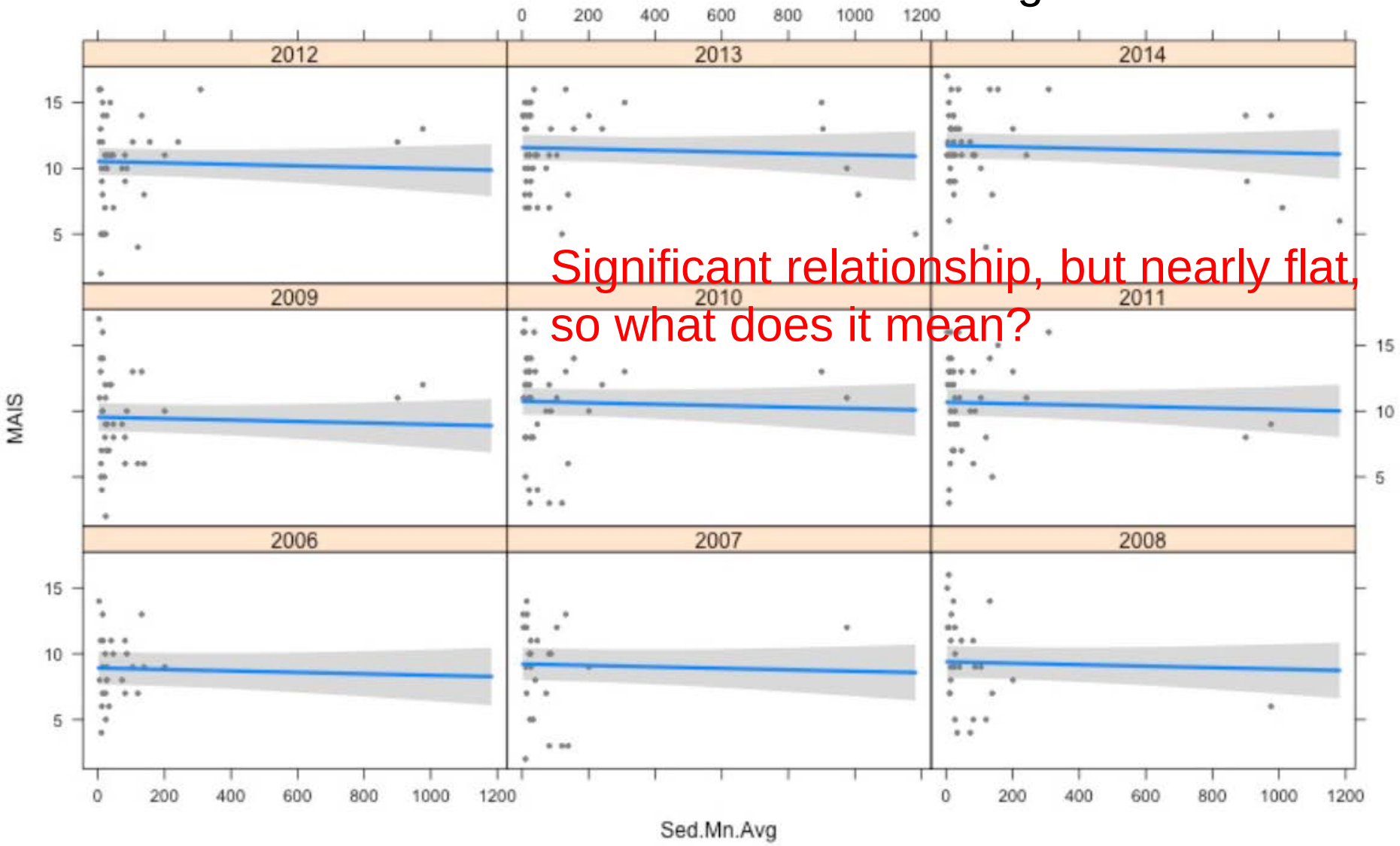
Sediment Iron vs. MAIS



Sediment Arsenic vs. MAIS

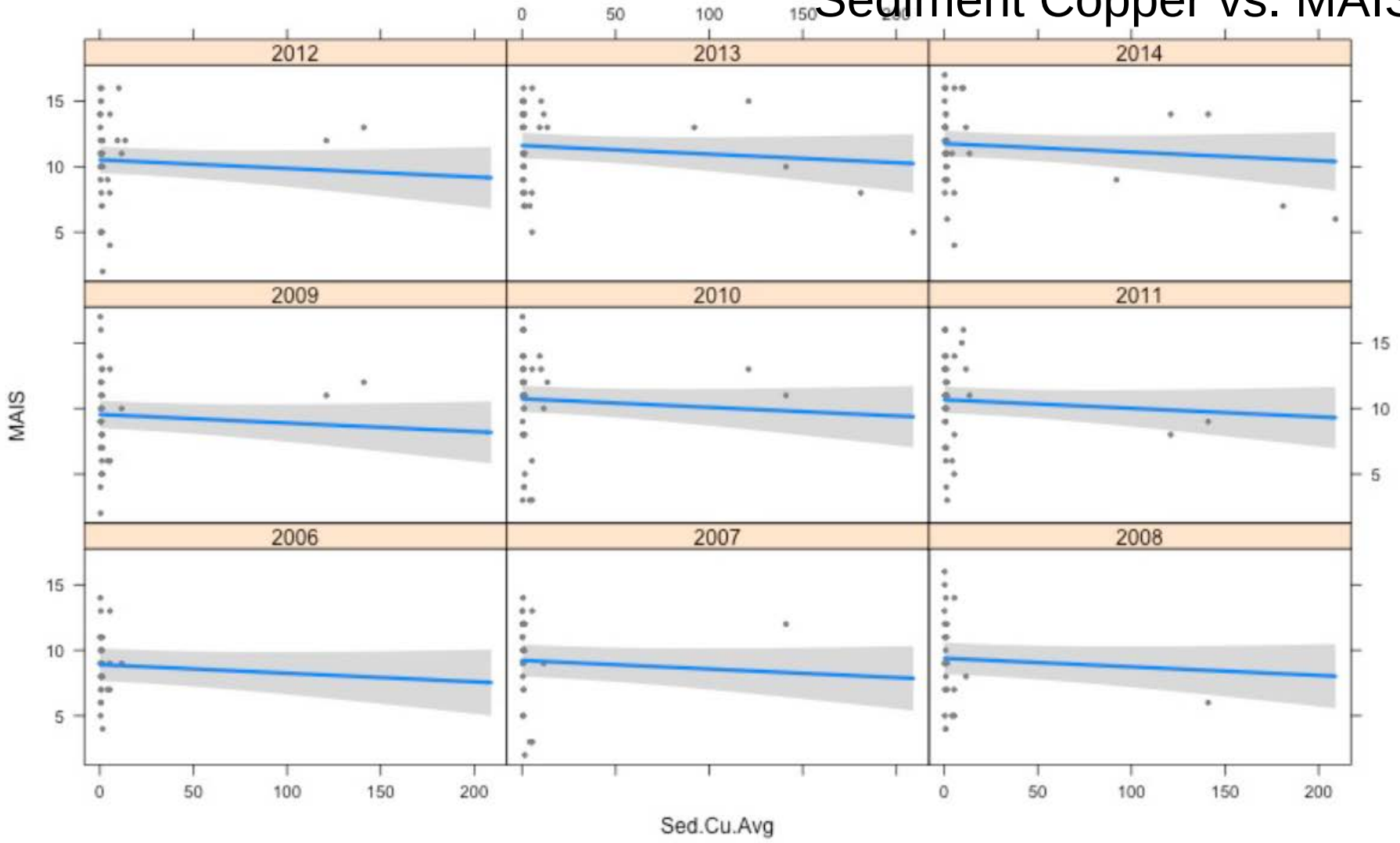


Sediment Manganese vs. MAIS

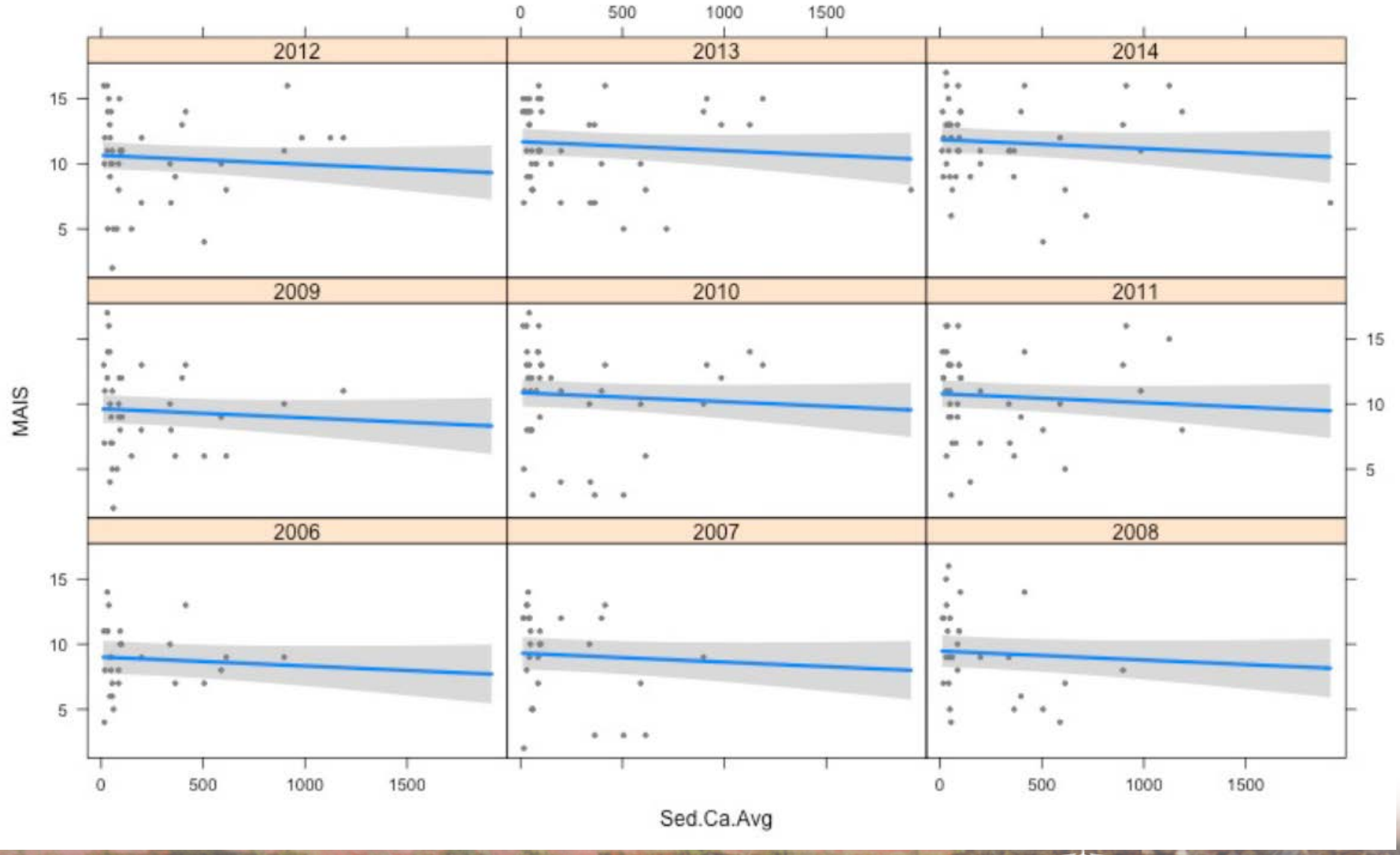


Significant relationship, but nearly flat, so what does it mean?

Sediment Copper vs. MAIS



Sediment Calcium vs. MAIS



Conclusions

- Some aqueous parameters are statistically similar between zones of recovery, while no sediment chemistry parameters are similar
- Strongest relationship between aqueous Fe, Al, Mn, and acidity with MAIS
- Strongest relationship between sediment Fe and As with MAIS

Conclusions, cont.

- Continued focus should remain on aqueous chemistry
- Sediments are the sink for metals – can't ignore them
- Sediment Fe and As have consistently been related with lower MAIS scores
  - They can co-precipitate
  - Could be habitat alteration, food quality, or binding of N and P rather than toxicity

Thank you!

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Voinovich School of Leadership and Public Affairs

Raccoon Creek Partnership

Rural Action

Working Together to Revitalize Appalachian Ohio