

Stream Diatom and Macroinvertebrate Community Thresholds in Response to Stressors of Concern in the Austin Metropolitan Area

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Objective:

Evaluate diatom and macroinvertebrate assemblage response to stressors* with the goal of establishing criteria protective of desired ecological condition.

***Stressors**

- Impervious cover
- Flow permanence
- Total Phosphorus
- Total Nitrogen
- Specific Conductance*

Method:

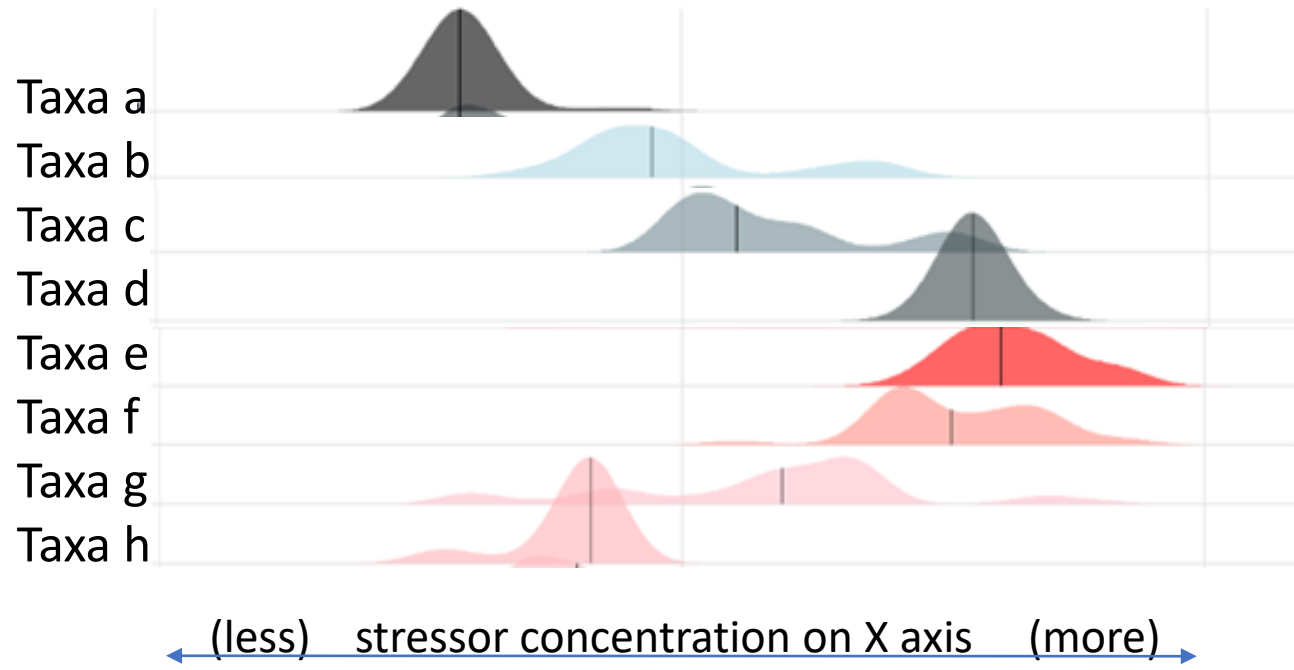
Threshold Indicator Taxa Analysis (TITAN)

Identifies taxa-specific and assemblage level change in frequency and abundance

Data Set:

- Data period 2013-2019,
- Impervious cover, COA and the National Land Cover Data (NLCD)
- Benthic macroinvertebrates and Diatoms
- Flow Permanence Index
- Water chemistry

How the z-score graphs work for taxa-specific responses:



Z-Score
7
6
5
4

Z-Score
16
12
8
4

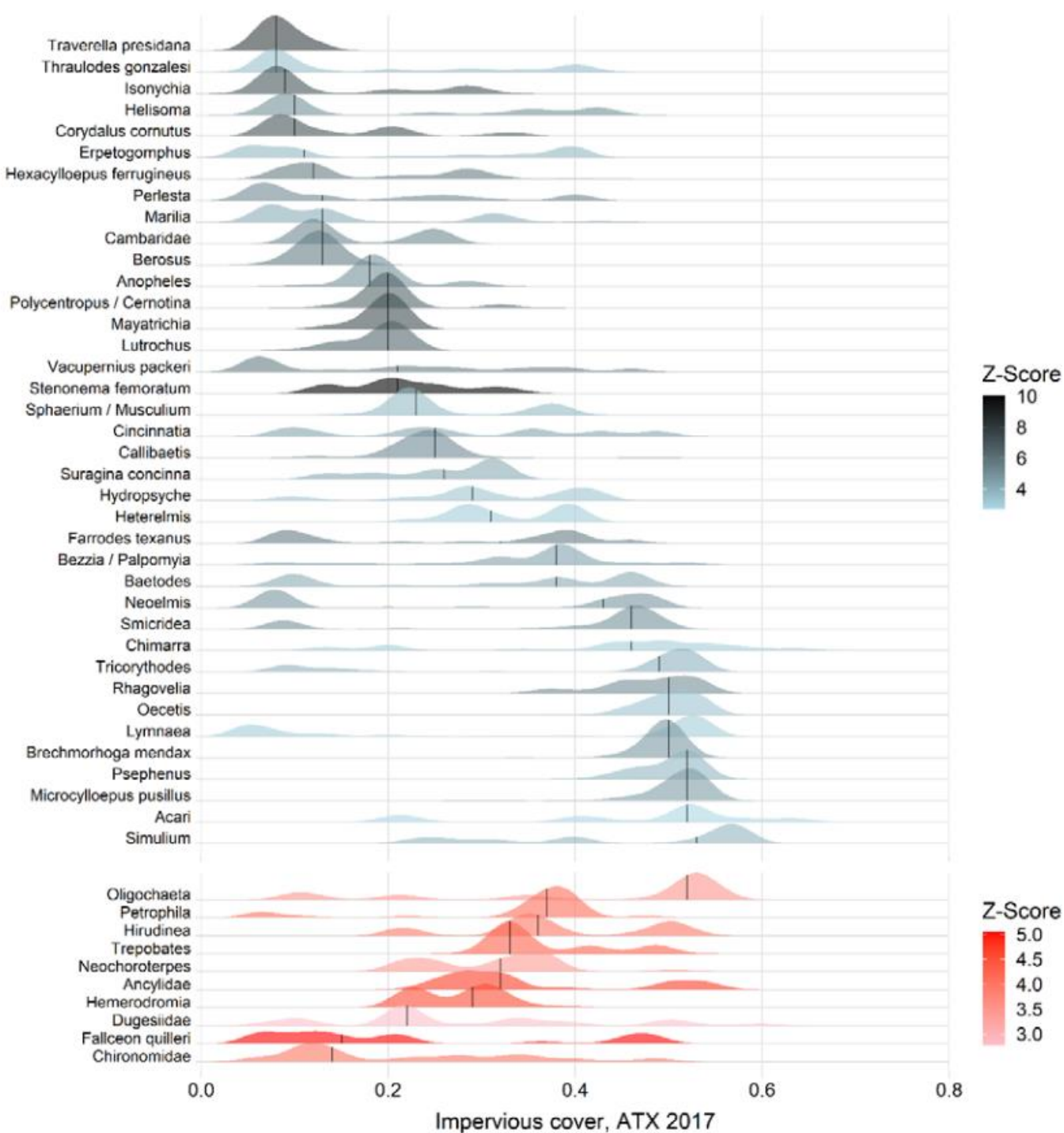
Grey are Taxa Decreasers that show a negative response to the stressor (i.e. taxa becomes lost as stressor increases)
Classic "intolerant taxa"

Red are Taxa Increasers that show a positive response to the stressor (i.e. taxa increases as stressor increases)
Classic "tolerant taxa"

Benthic Macroinvertebrates



Taxa-specific response to Impervious Cover (IC)

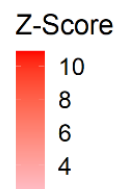
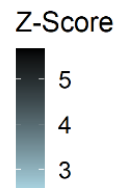
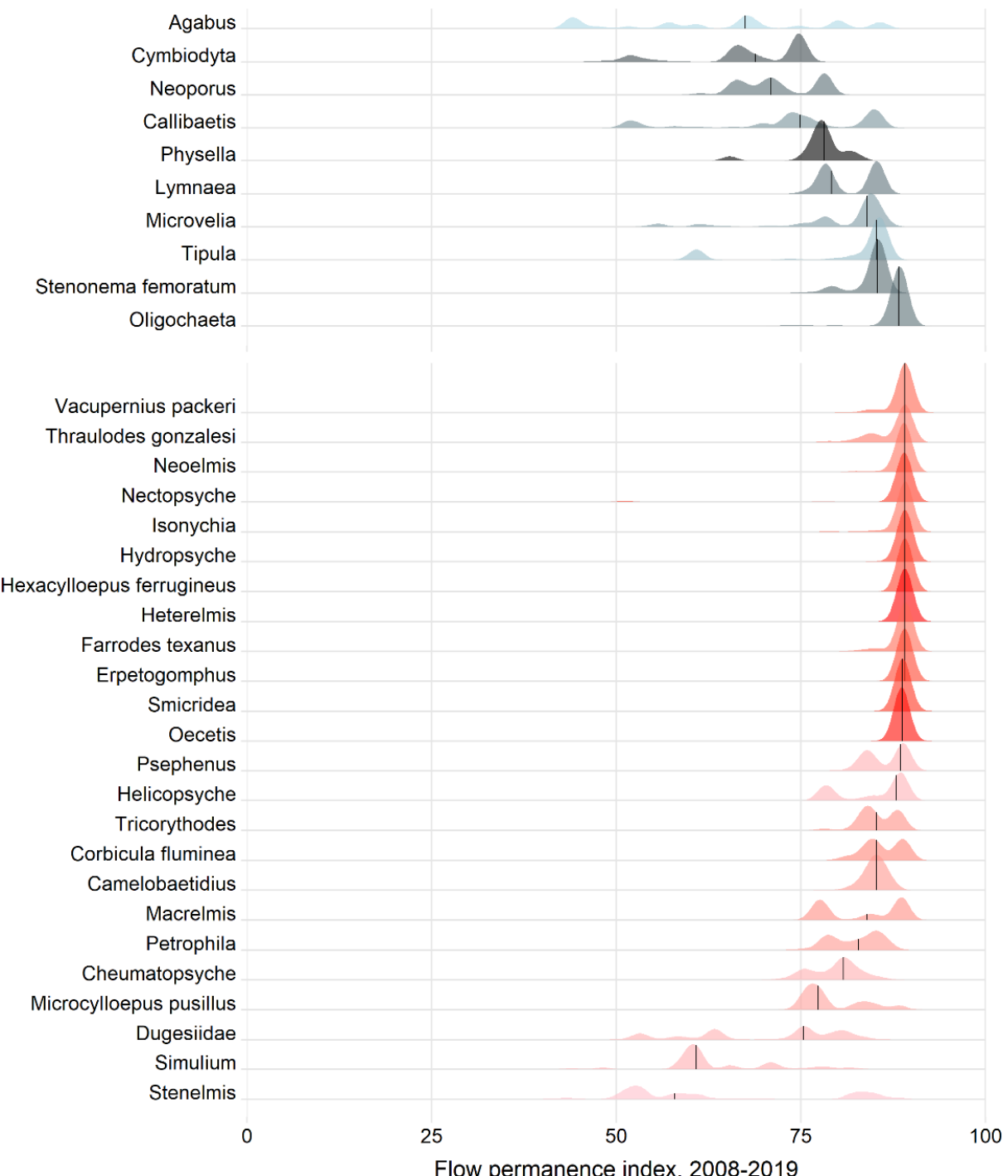


Classic results (as expected)

Benthic Macroinvertebrates



Taxa-specific response to Flow Permanence

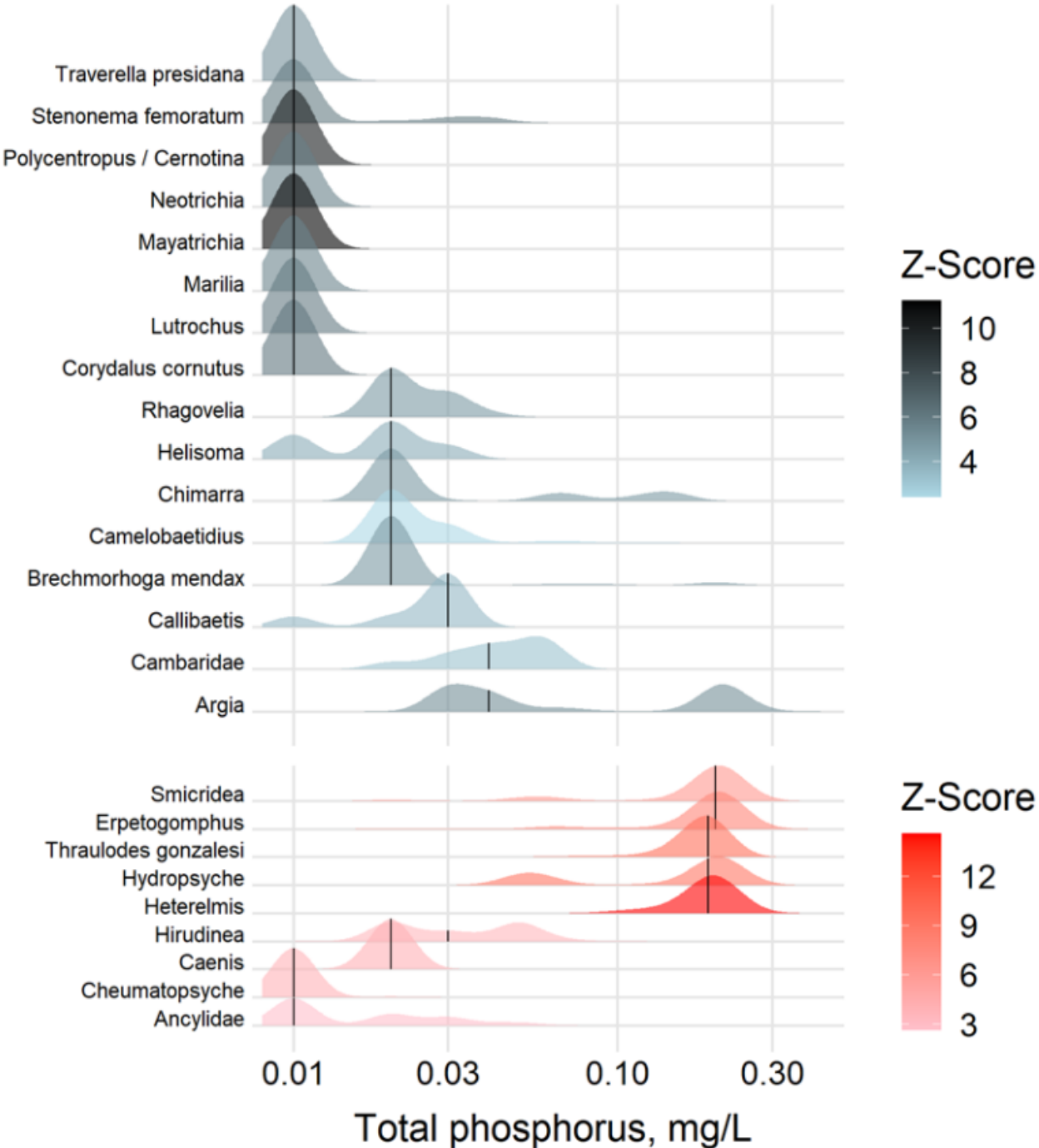


Benthic Macroinvertebrates



Taxa-specific response to Total Phosphorus (TP)

Loss of many sensitive taxa
0.01 mg/l

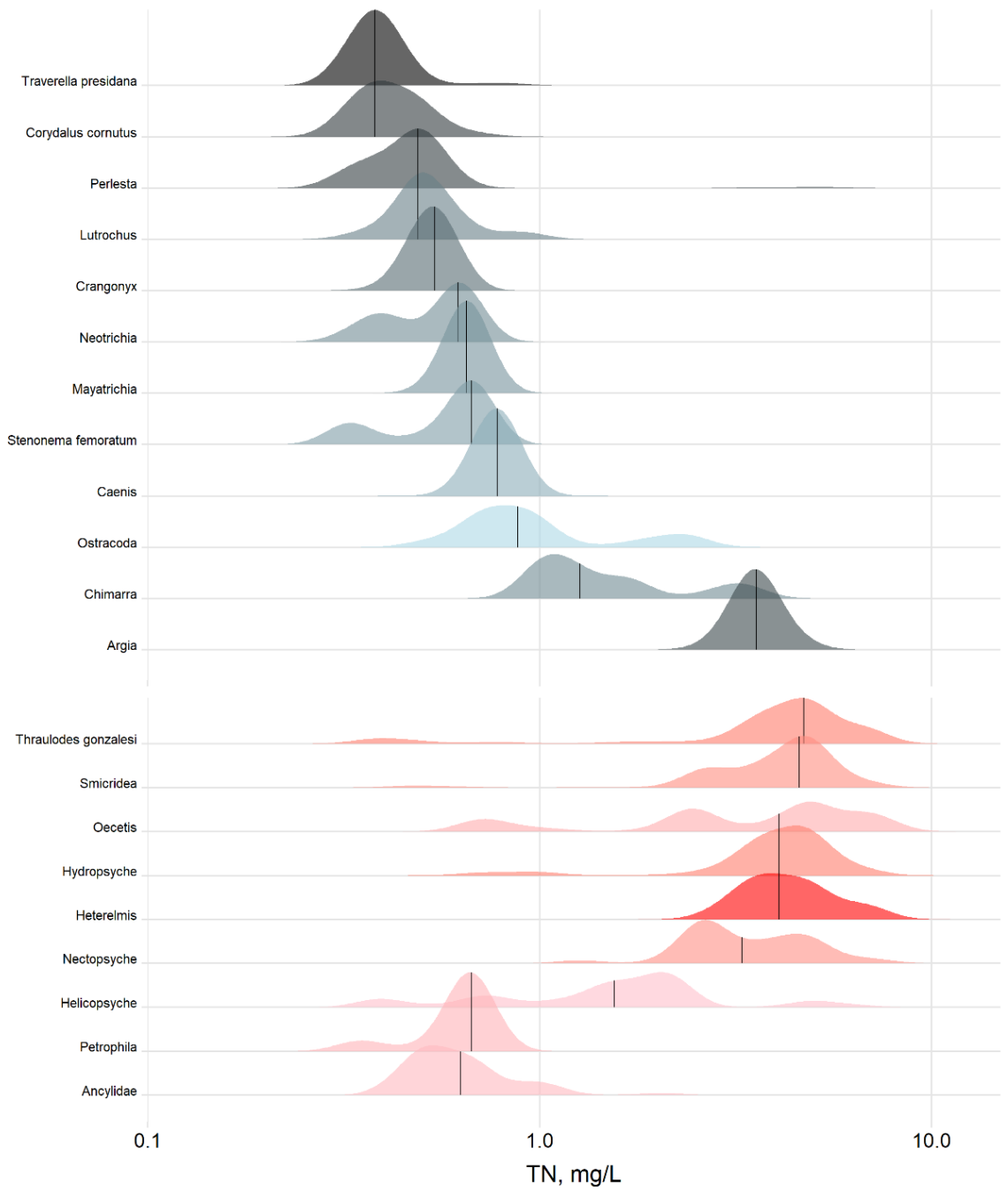


Benthic Macroinvertebrates



Taxa-specific response to Total Nitrogen

Loss of many sensitive taxa
0.5 – 1.0 mg/l

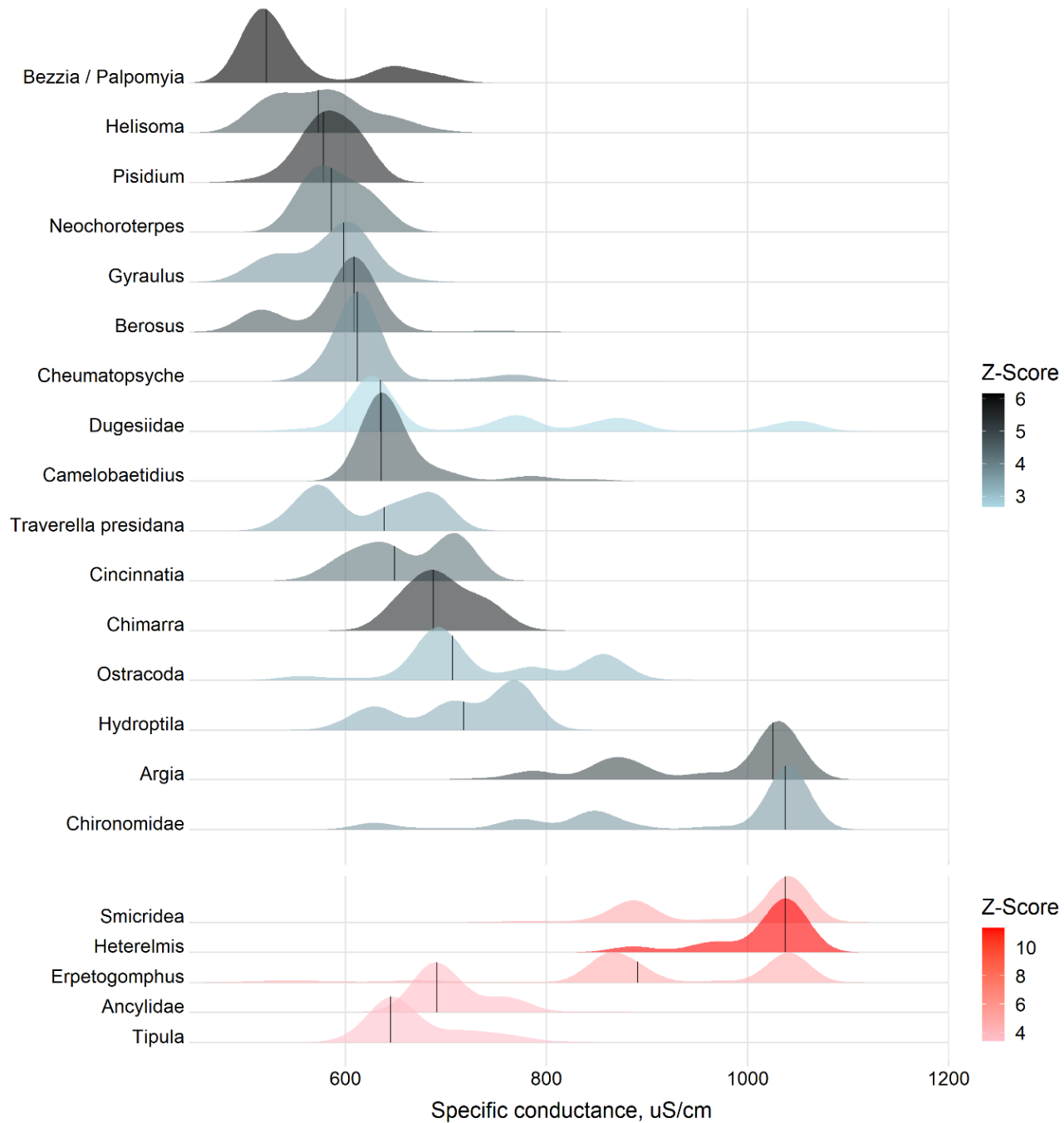


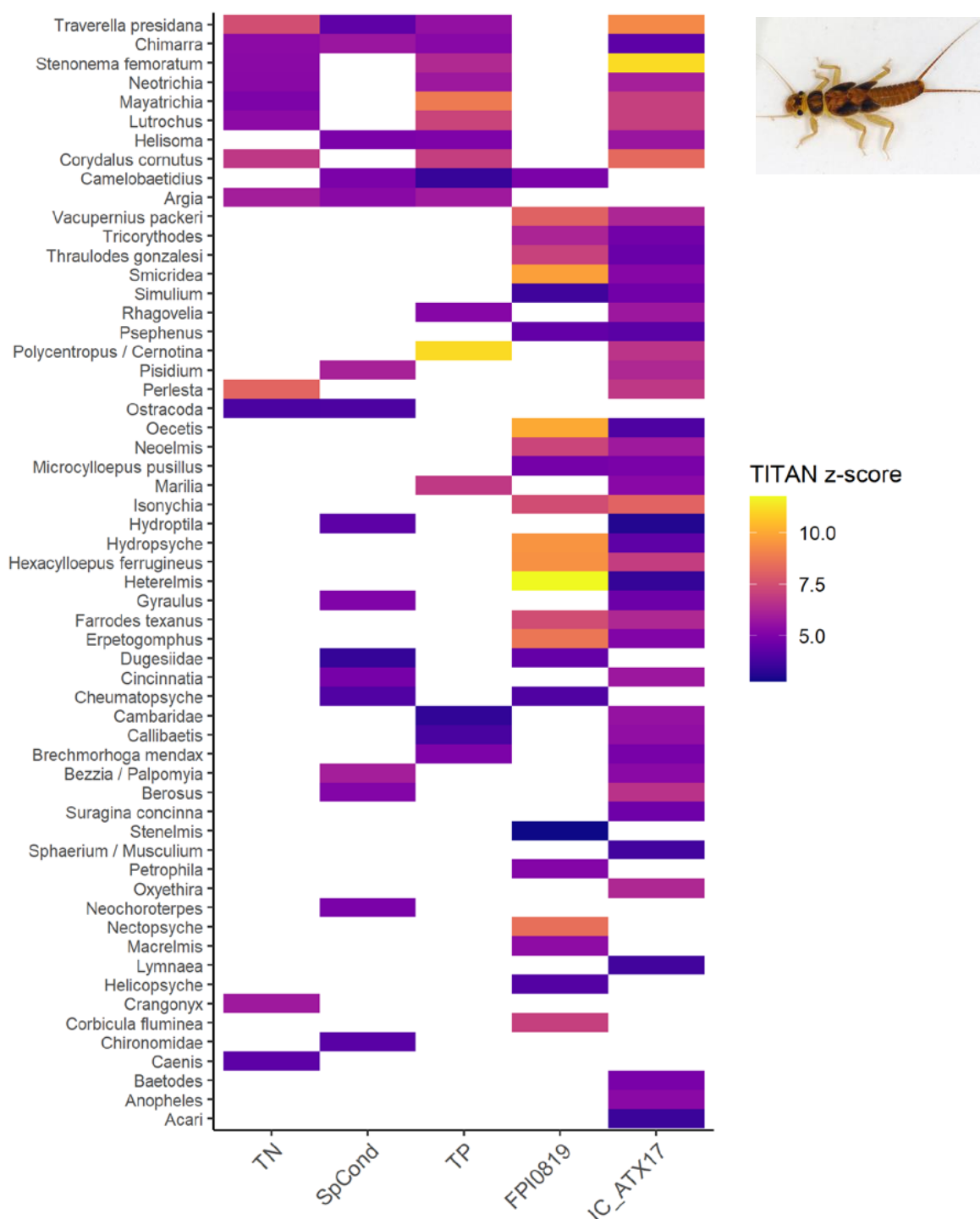
Benthic Macroinvertebrates



Taxa-specific response to Conductivity

Loss of many sensitive taxa
~400-700 $\mu\text{S}/\text{cm}$





Heatmap

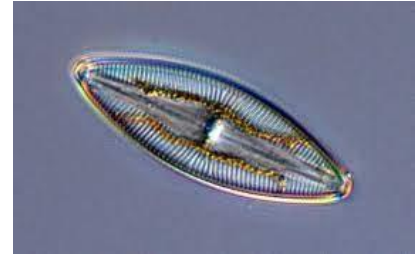
List of taxa that were sensitive to at least one of the 5 stressors

IC had the largest number of sensitive taxa

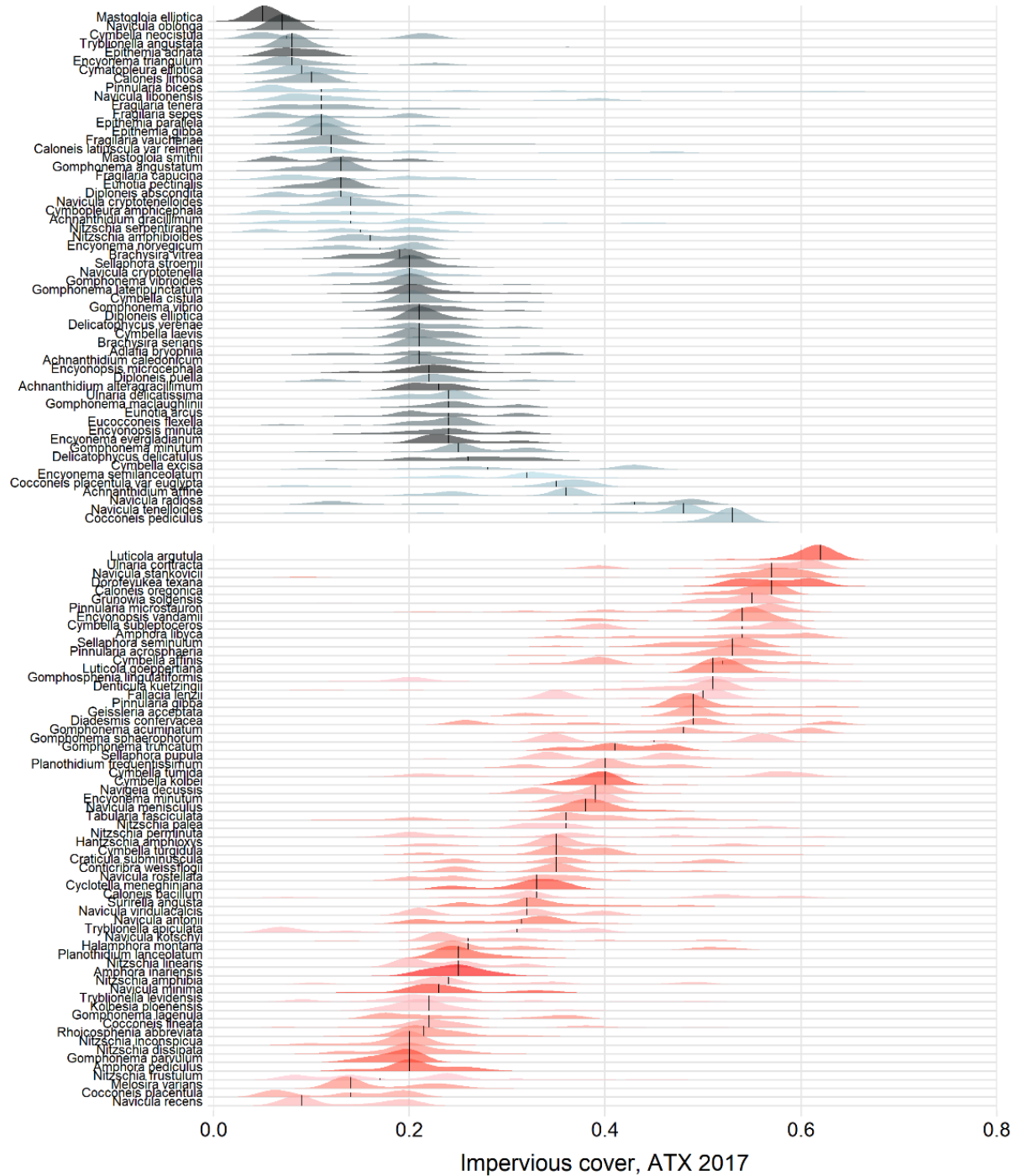
Taxa at top were the most sensitive (Central Texas canaries?)

Colors correspond to the z-score, with brighter colors equating to responses that were larger in magnitude than darker colors

Diatoms



Taxa-specific response to Impevious Cover

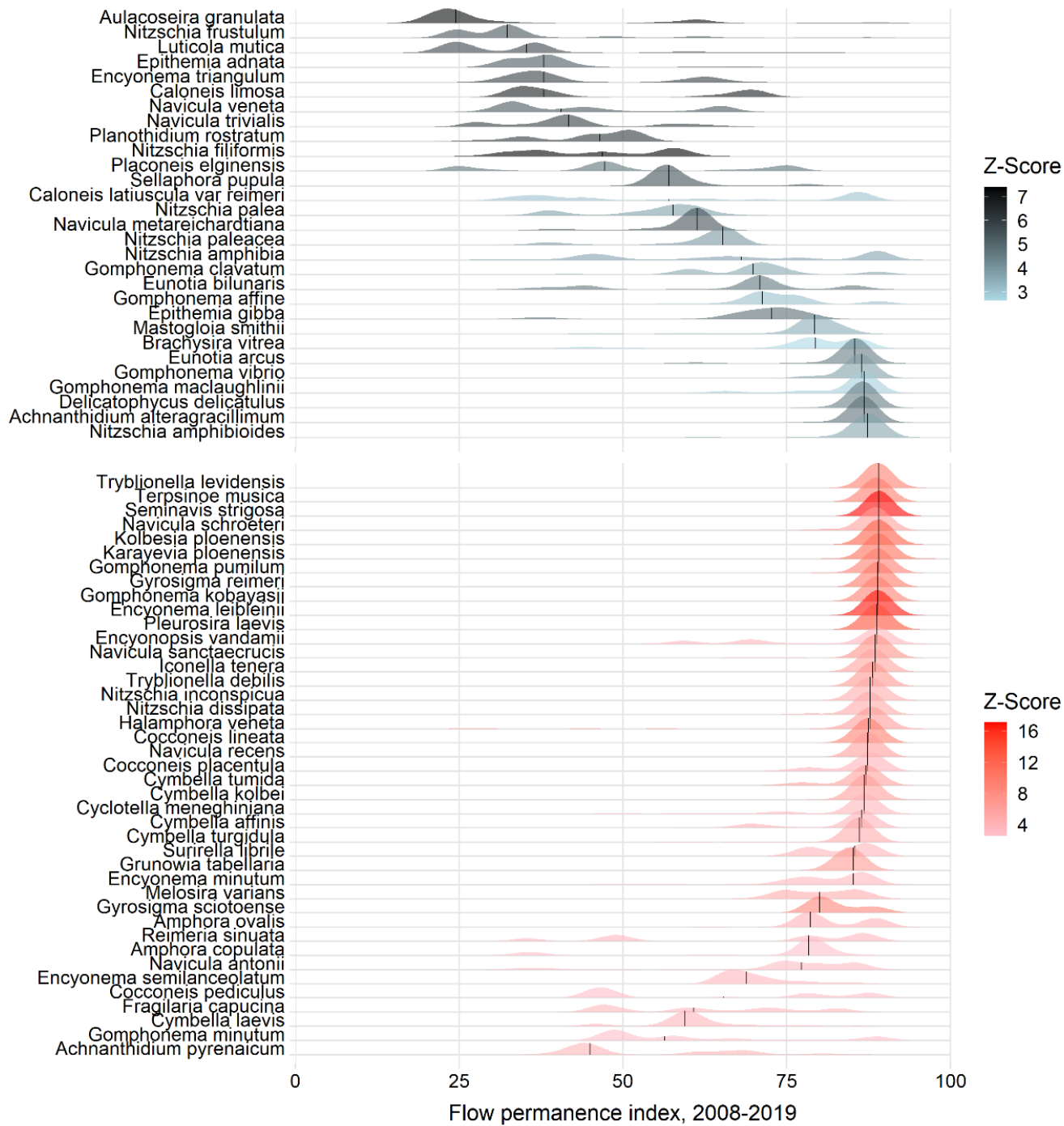


Loss of many sensitive taxa 5-20% IC

Diatoms



Taxa-specific response to Flow Permanence

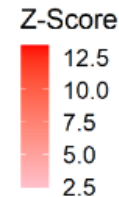
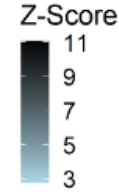
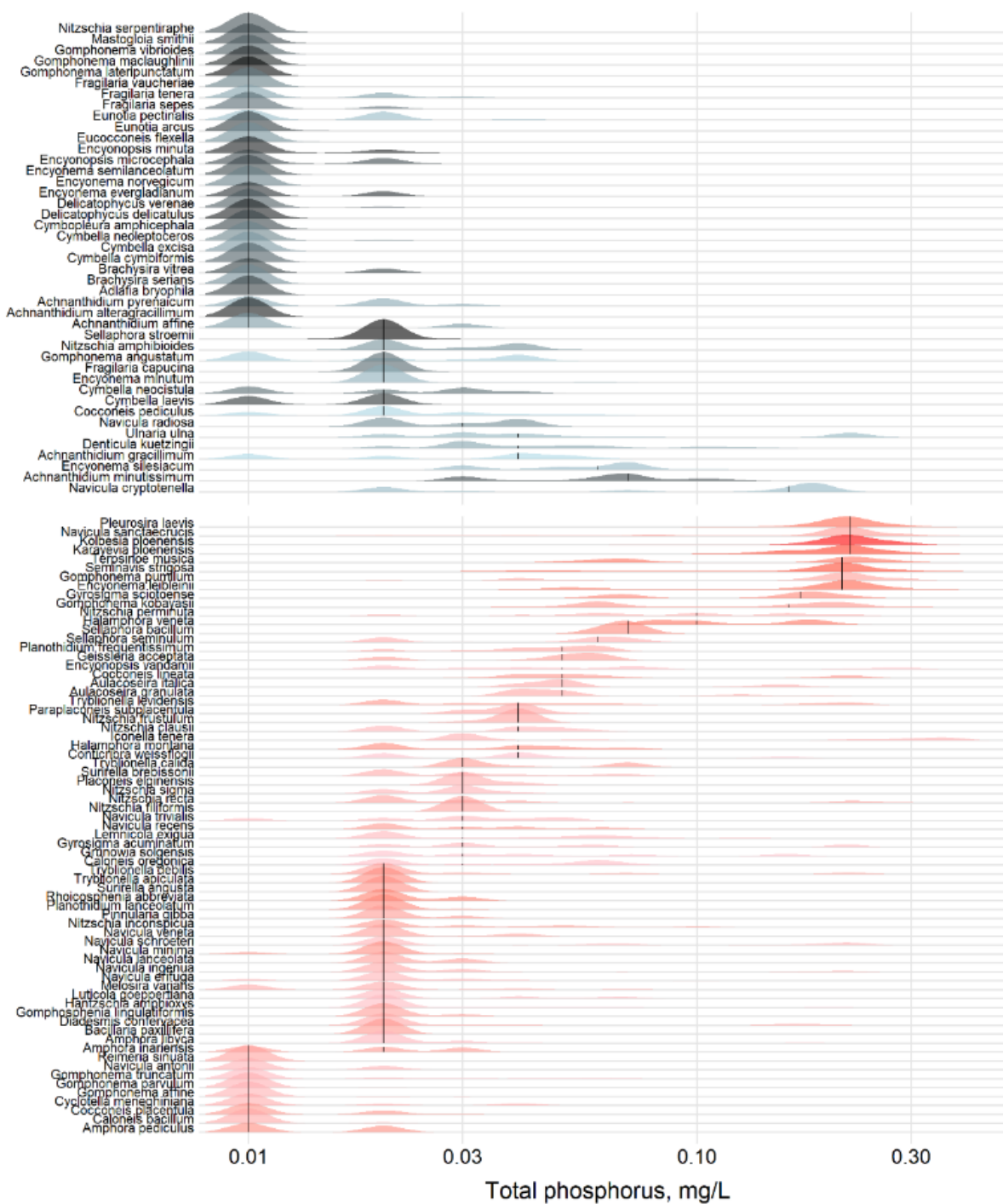




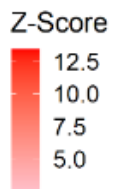
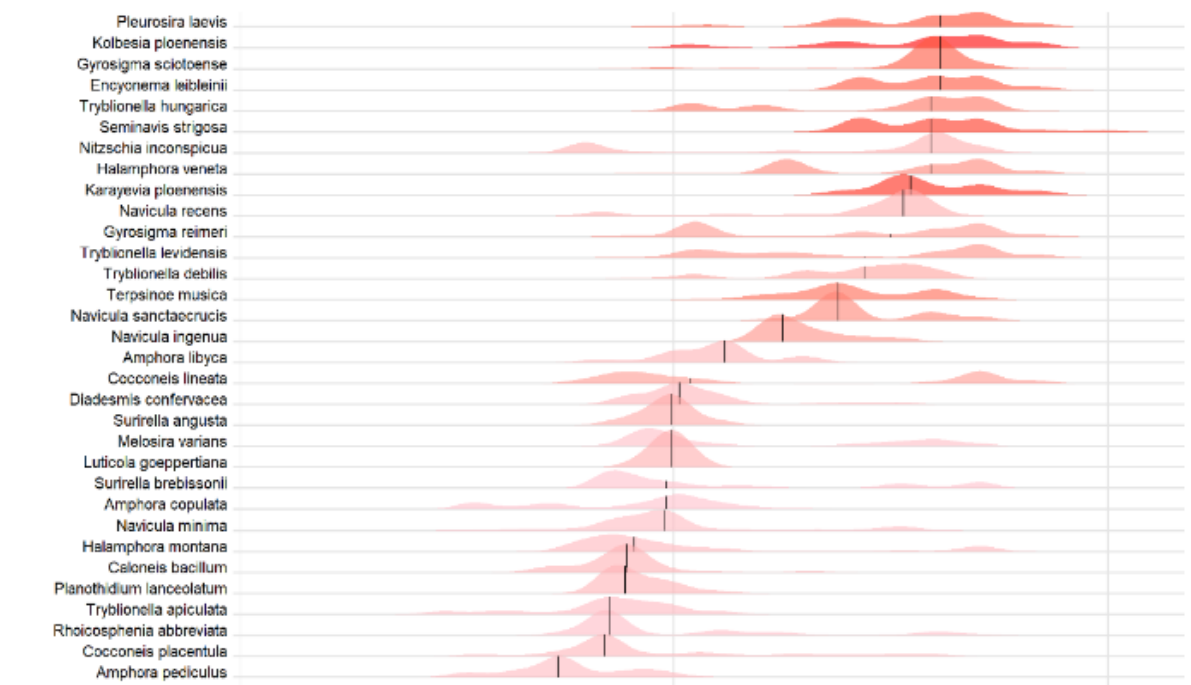
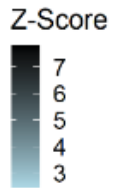
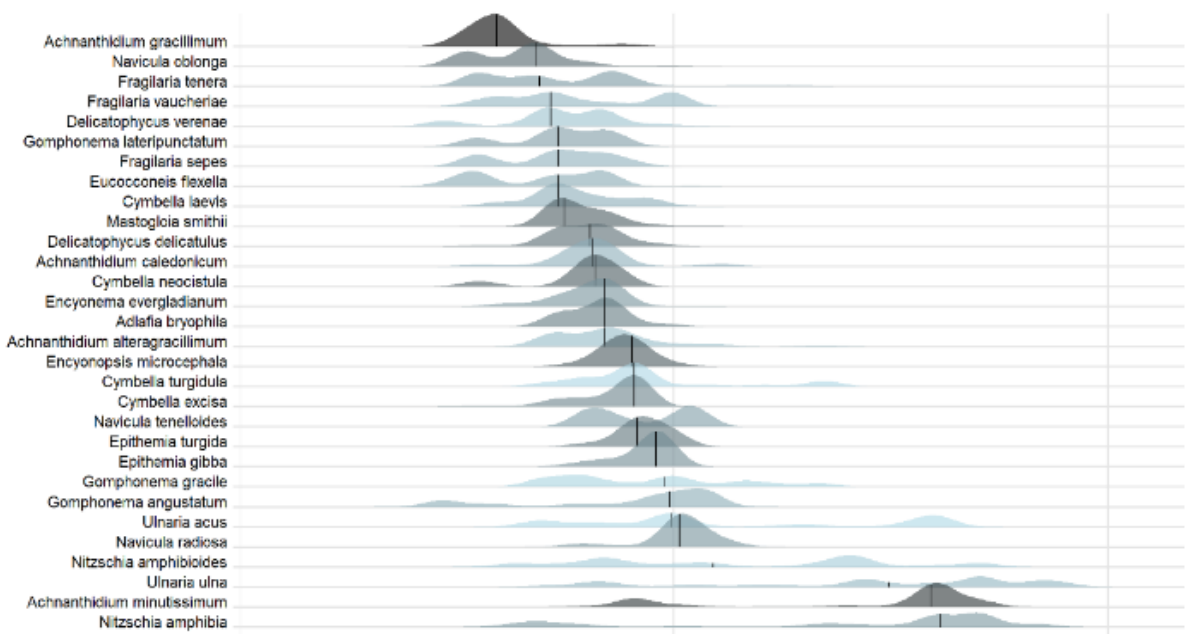
Diatoms

Taxa-specific response to Total Phosphorus (TP)

Loss of many sensitive taxa
0.01 mg/l



Total phosphorus, mg/L



Taxa-specific response to Total Nitrogen (TN)

Loss of sensitive taxa
0.5-1.0 mg/l

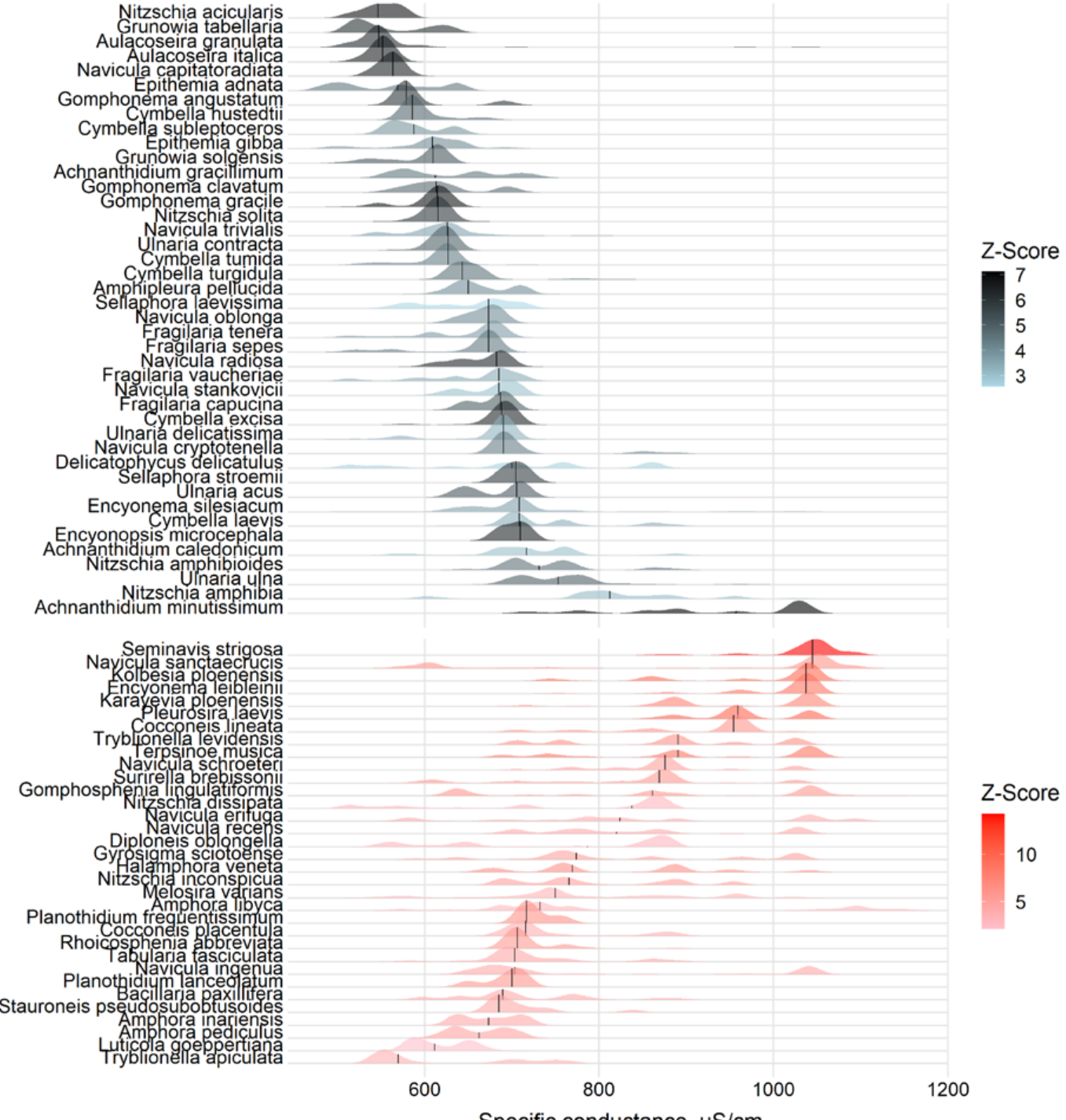
0.1 1.0 10.0

TN, mg/L



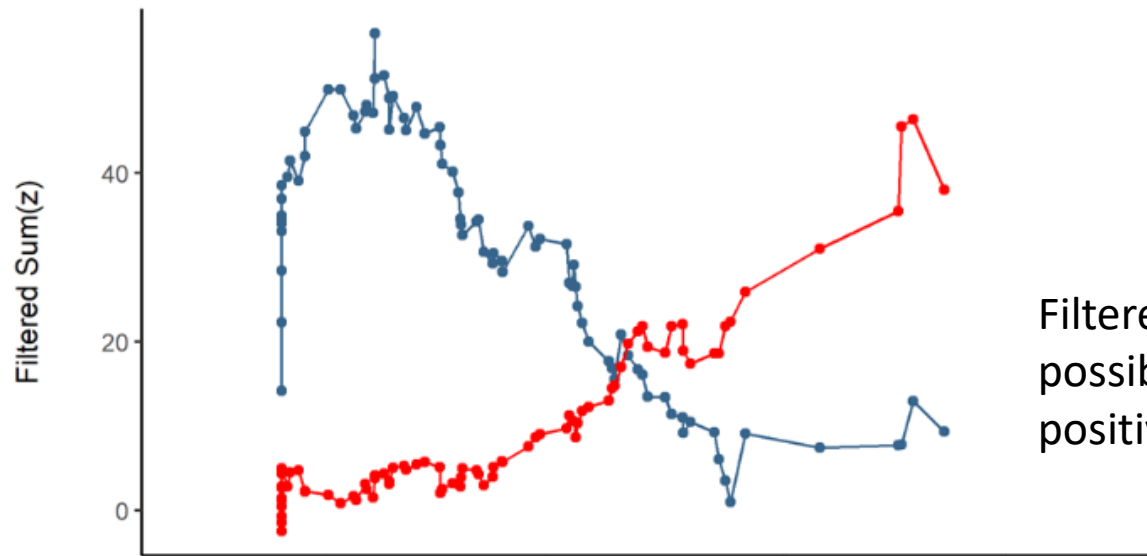
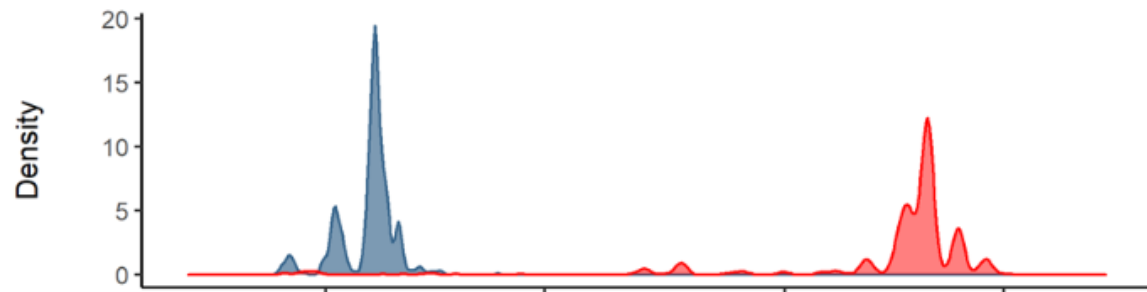
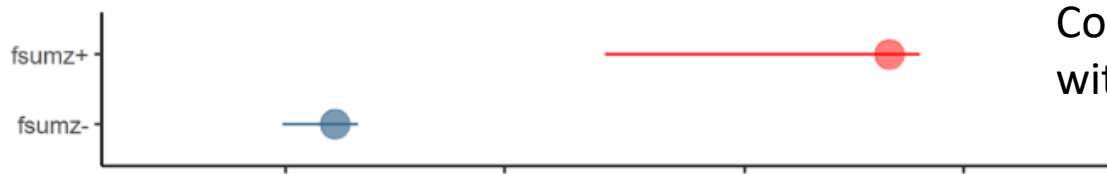
Taxa-specific response to Conductivity

Loss of sensitive taxa
300-700 $\mu\text{S}/\text{cm}$



Sum z-score graphs of 500 bootstrap replicates showing community assemblage response:

- Decreasers (negative response)
- Increases (positive response)

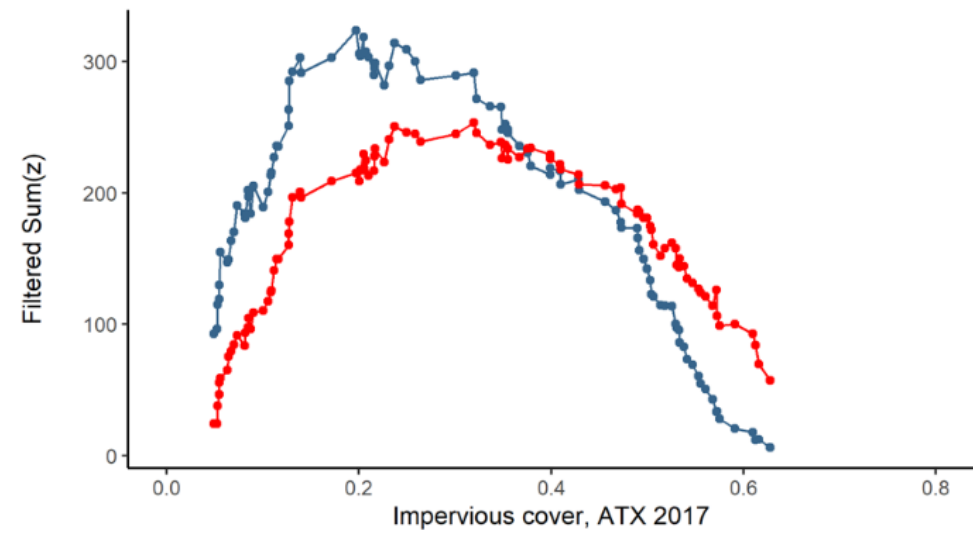
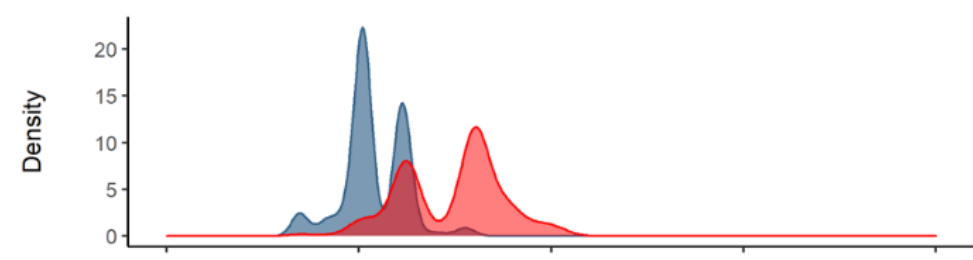
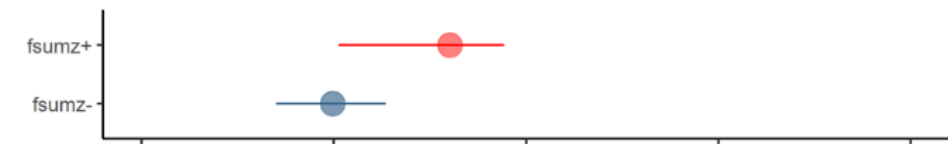
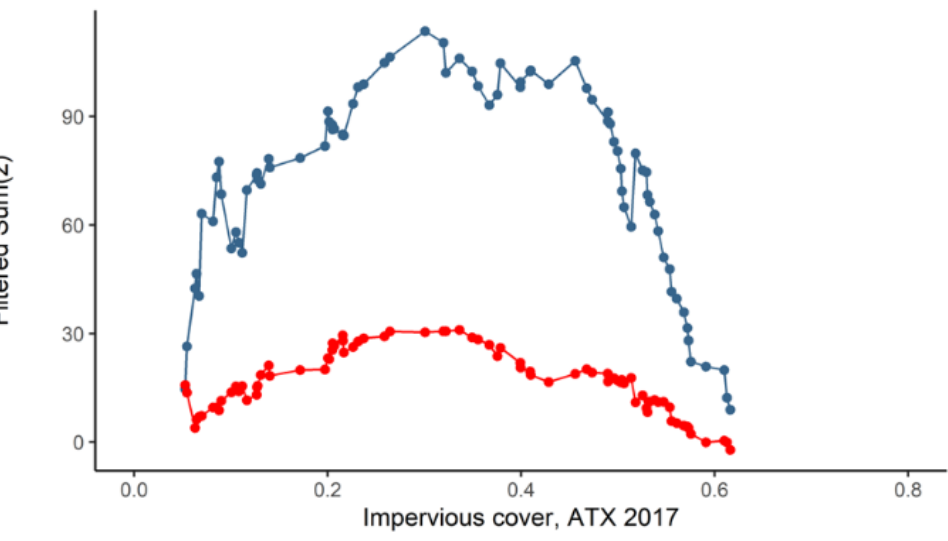
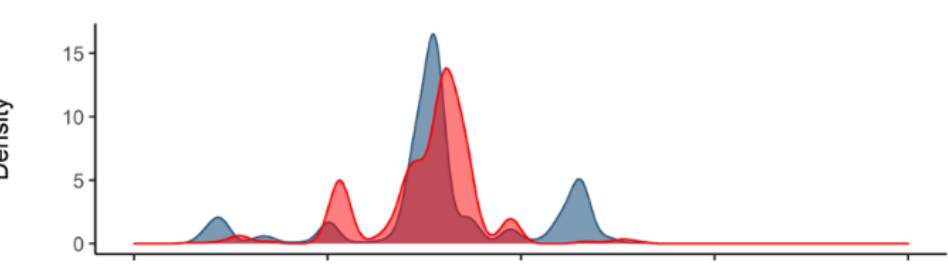
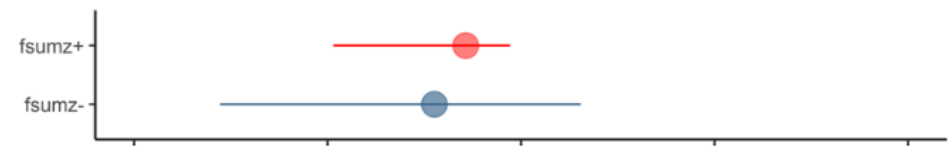


(less) stressor concentration on X axis (more)



SUM Z for community assemblage

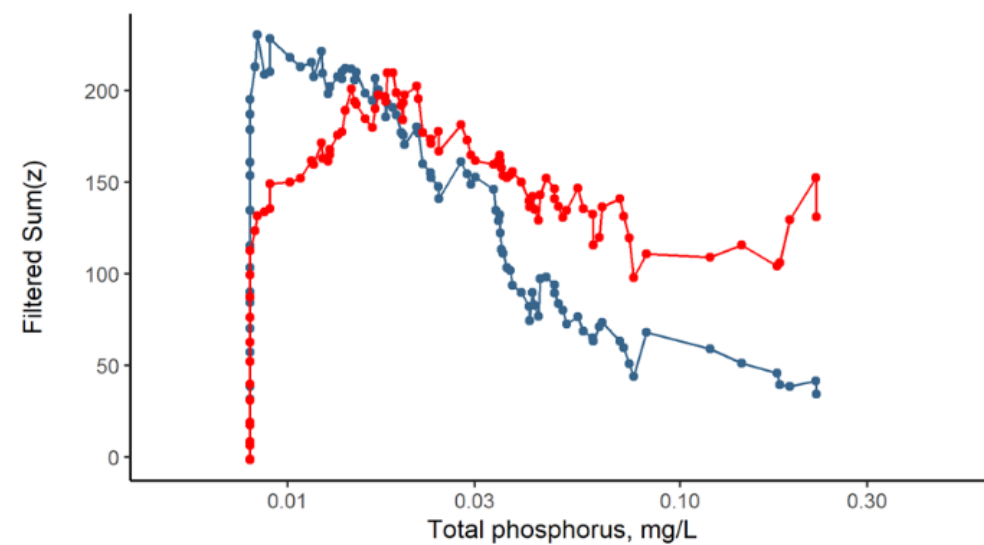
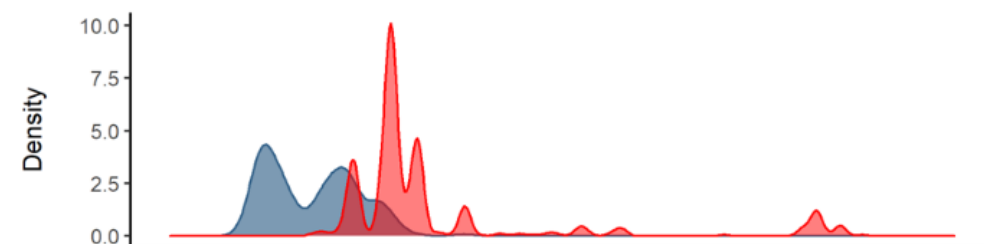
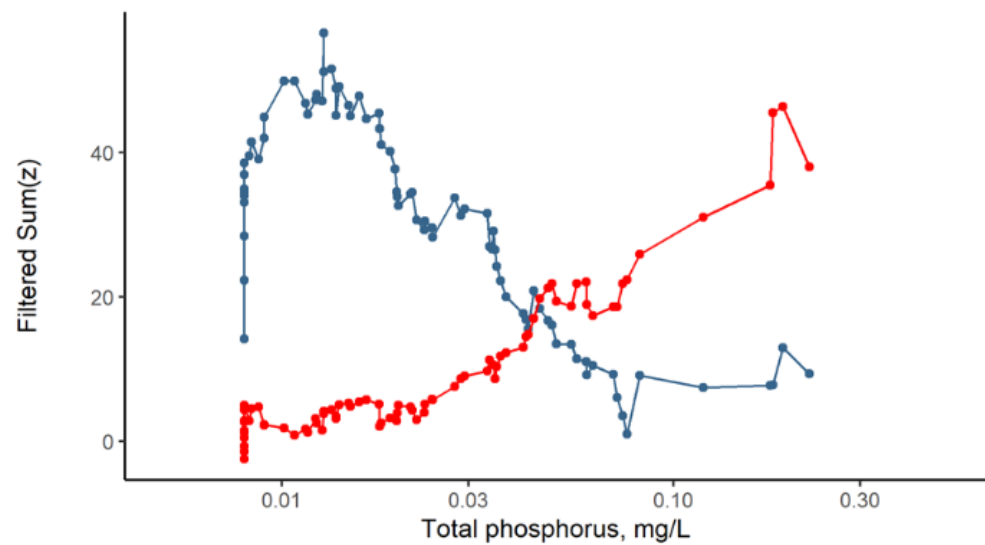
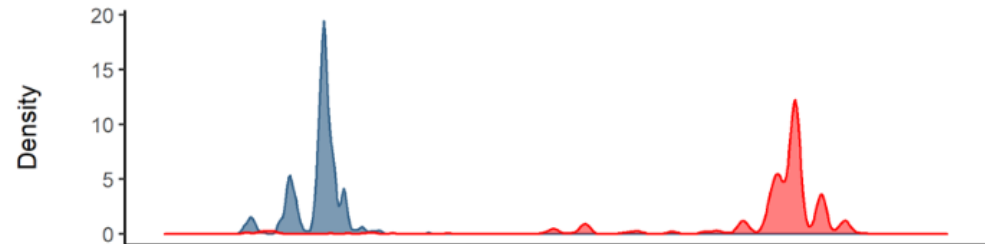
IC





SUM Z for community assemblage

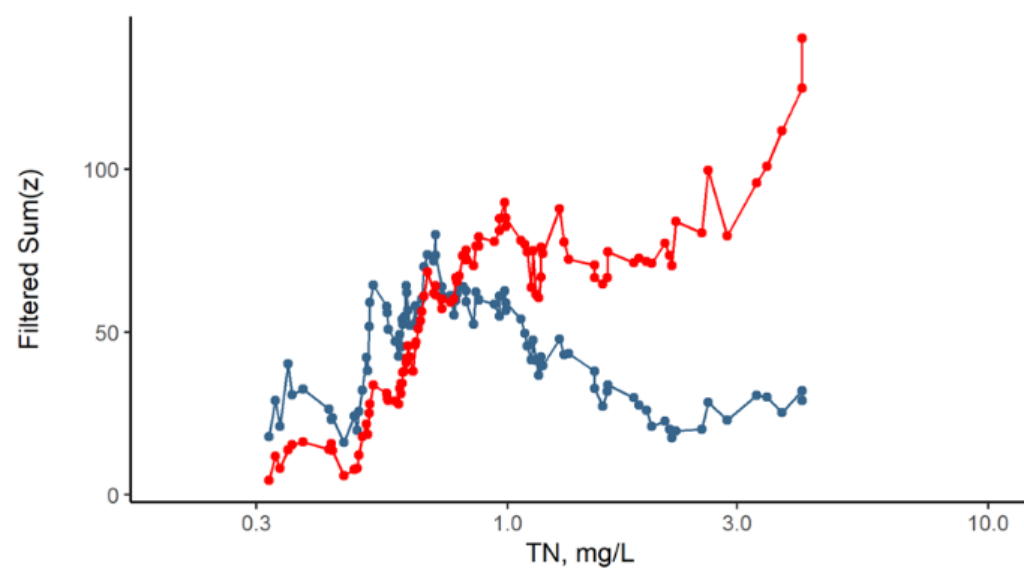
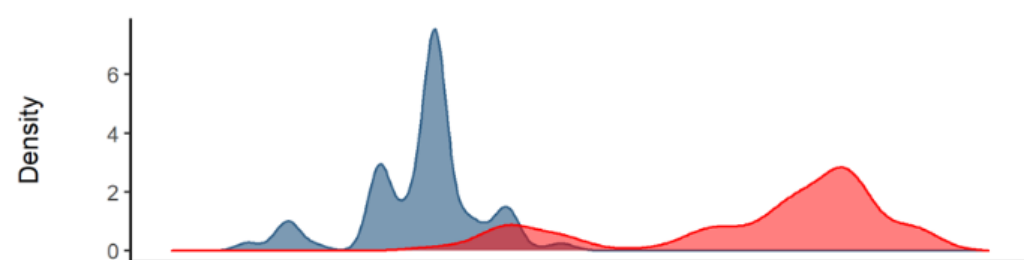
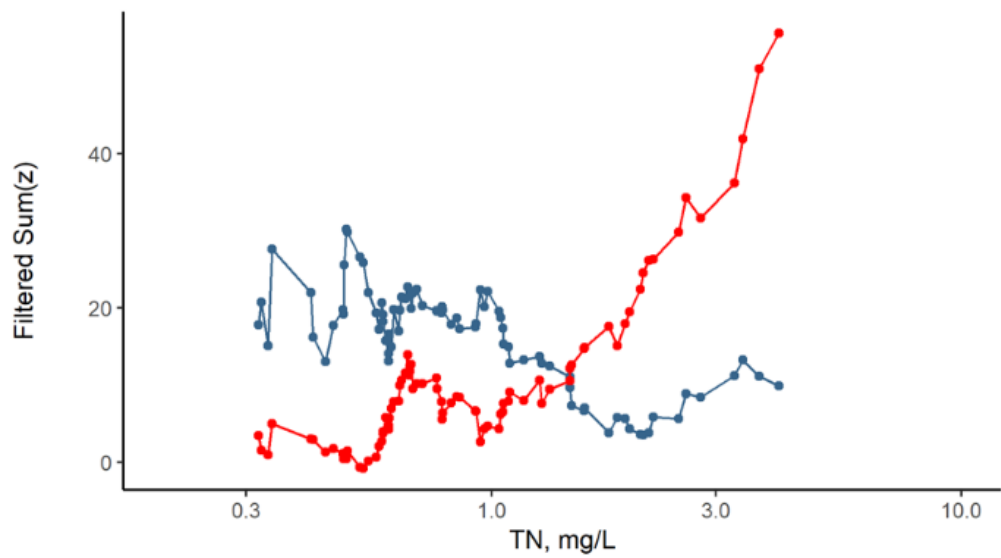
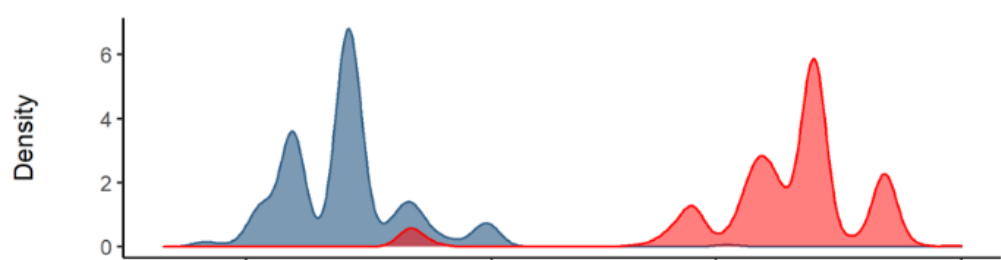
TP





SUM Z for community assemblage

TN



Implications*

Impervious Cover: Taxa begin to decline at less than 5% IC and clearly negatively affected by 8%, but the largest aggregate losses occurs between 15-20% IC for diatoms and 25-35% for macroinvertebrates.

Flow permanence: Many macroinvertebrates preferred streams with high flow permanence, primarily above 75 FPI units. This study shows that TITAN taxa could be used to incorporate FPI into new metrics to adjust the effect on biological potential.

Total phosphorus: Diatom species sharply declined at 0.01 mg/TP, with another wave of at 0.02-0.03 mg/L. These results, when coupled with other regional published studies, strongly imply that TP >0.01-0.03 is likely to cause significant alteration to stream biological integrity.

Specific conductance: > 600-700 may result in ecologically significant alterations

Total nitrogen: > 0.5-0.7 may result in ecologically significant alterations

* For specific conclusions and recommendations please refer to the report that will soon be available on-line through the COA website