# Aligning land use and water quality across a gradient of coho mortality in Puget Sound

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W TACOMA

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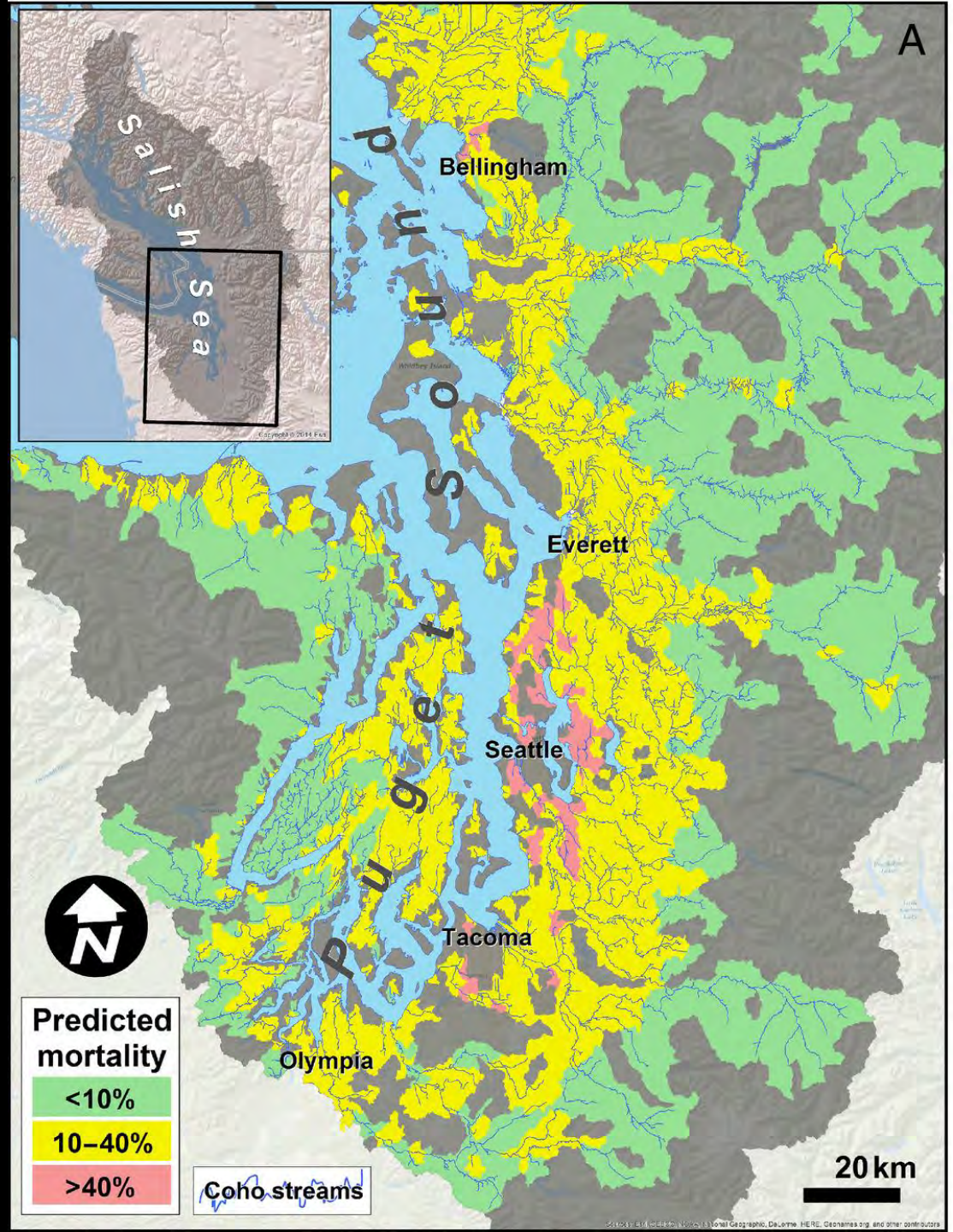



# Coho Pre-Spawn Mortality.

## In urban watersheds, adult coho salmon exposed to urban stormwater die before releasing their eggs.

Feist et al.

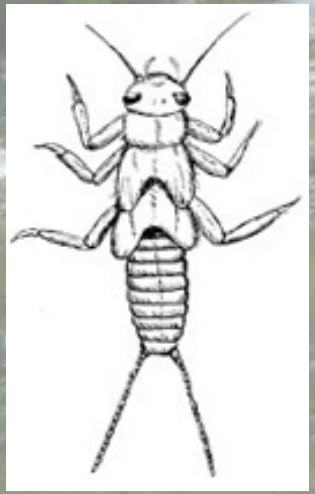
Photo: West Seattle blog

**Water pollution is becoming an increasingly important conservation issue**

**Tools are becoming available to characterize the chemical profile of toxic urban runoff**

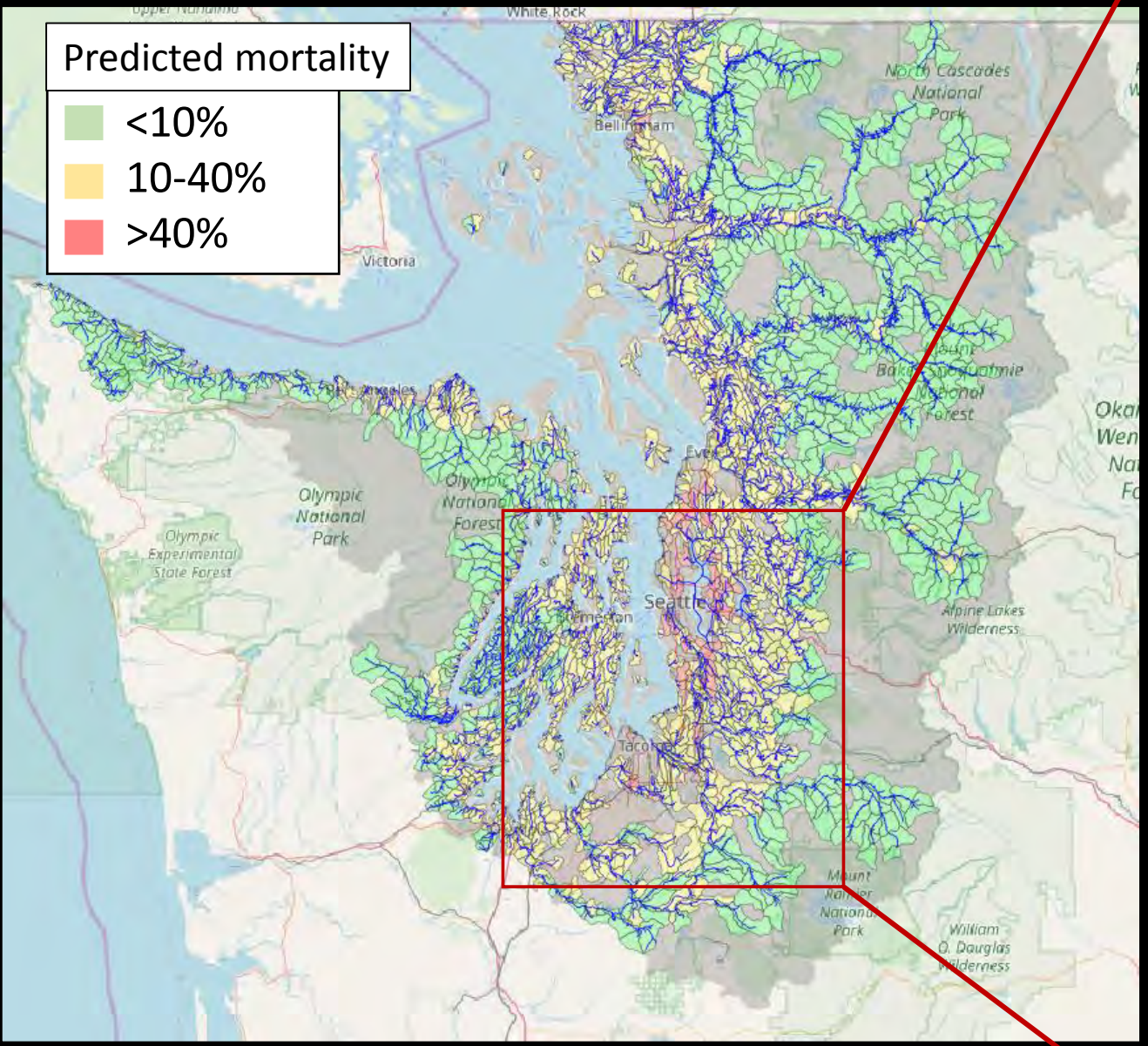
# OBJECTIVE: Align chemical water quality and stream health using biological anchors

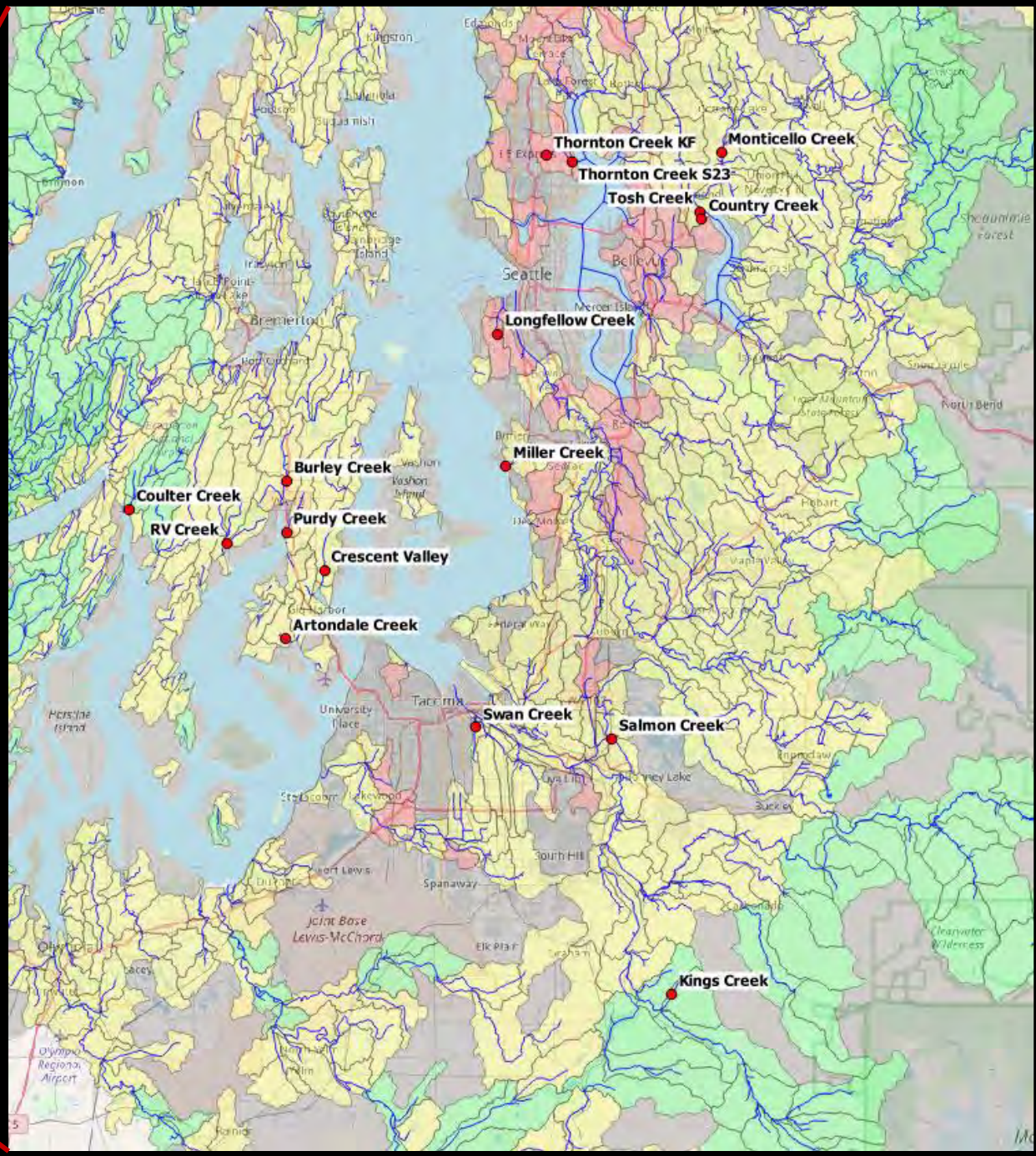
macroinvertebrate richness



coho salmon mortality

Kathy Peters, Ed Kolodziej and team



# n=15 streams; n=65 samples

Baseflow (Sept/Oct; seasonal period of low precipitation) 2017

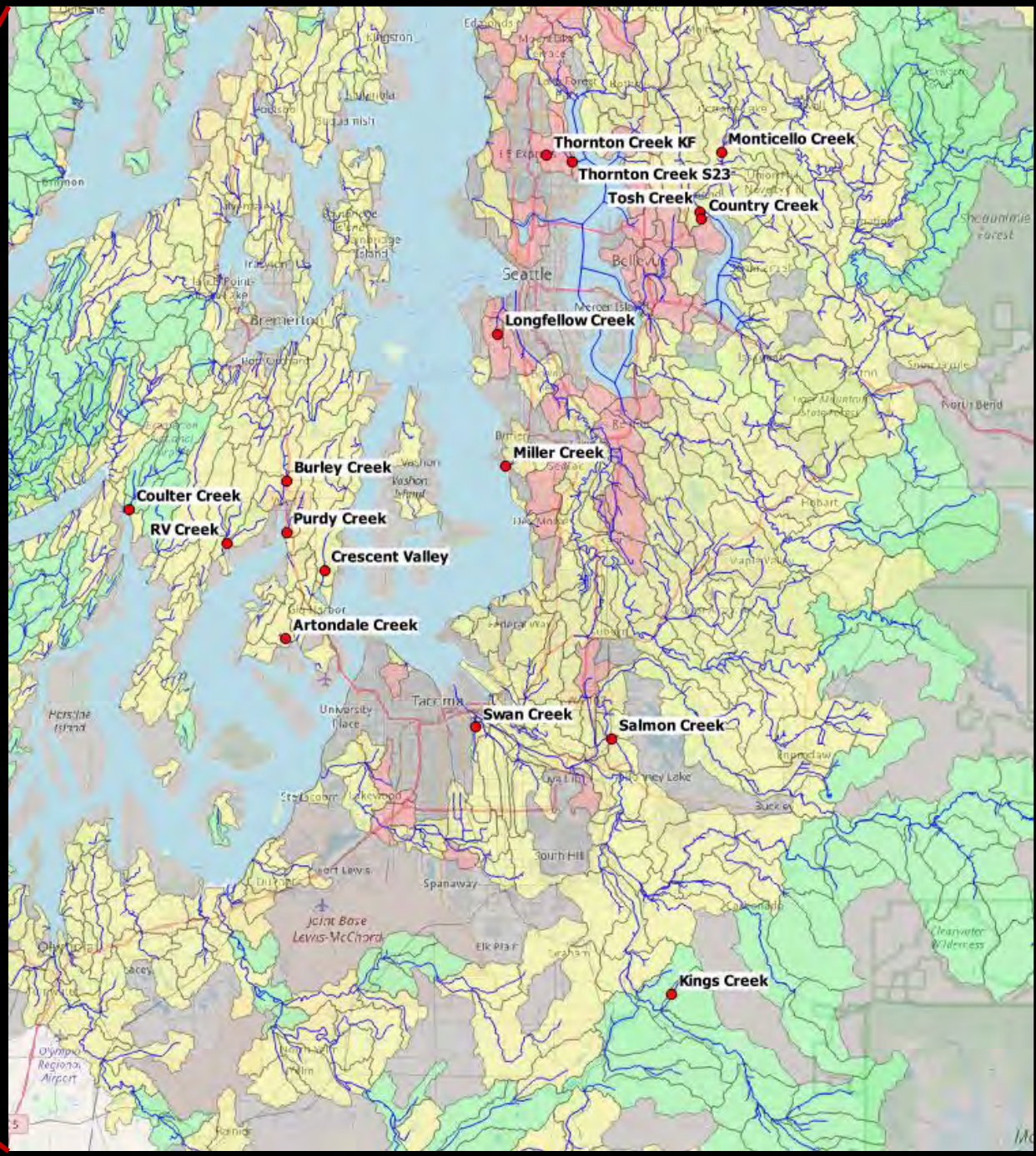
October 2017

November 2017

January 2018

June 2018

November 2018 (5 creeks, Nov 2018 only)



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Baseflow (Sept/Oct; seasonal period of low precipitation) 2017
October 2017
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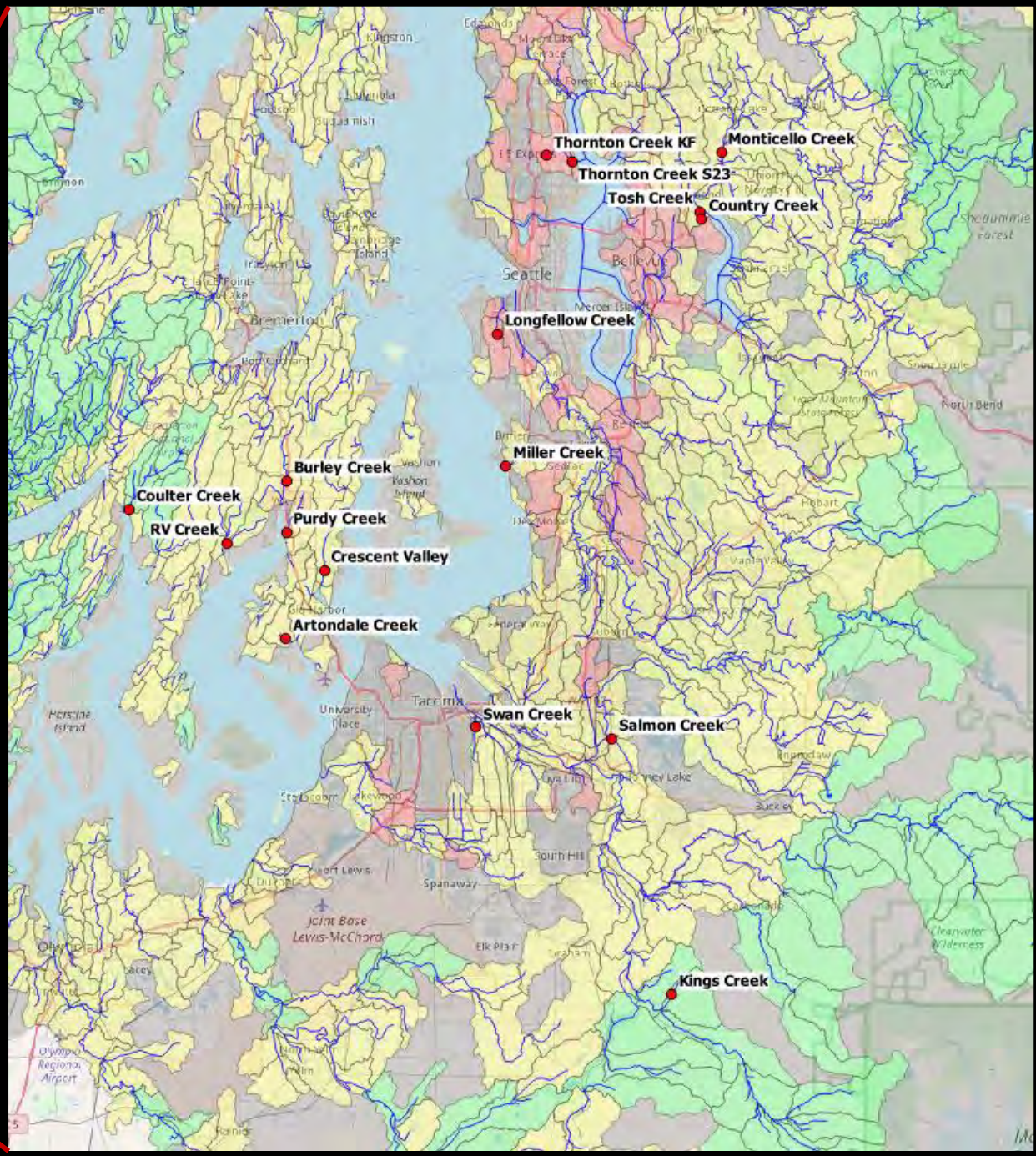
June 2018
November 2018 (5 creeks, Nov 2018 only)

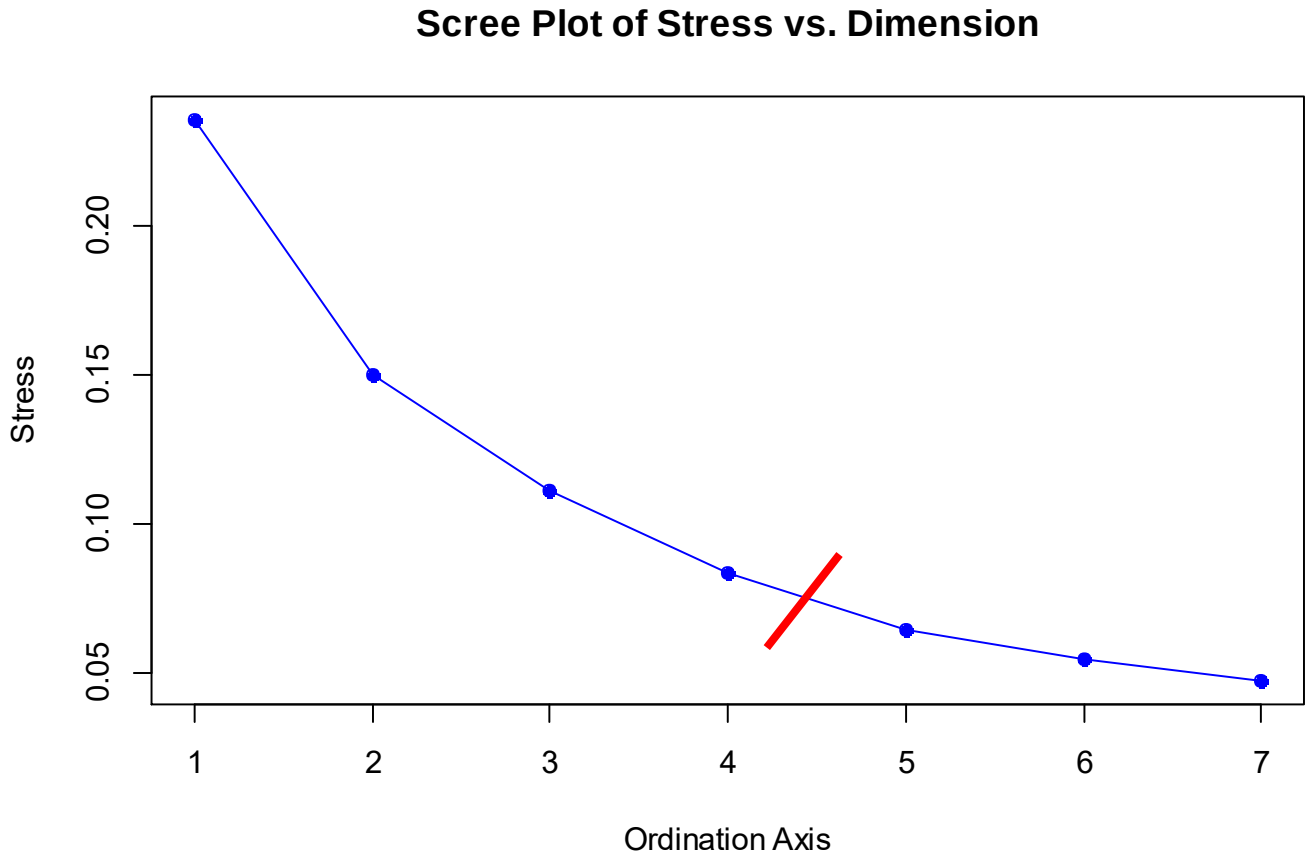
Samples were analyzed using a Quadrupole Time-of-Flight (QTOF) high-resolution mass spectrometry (HRMS)

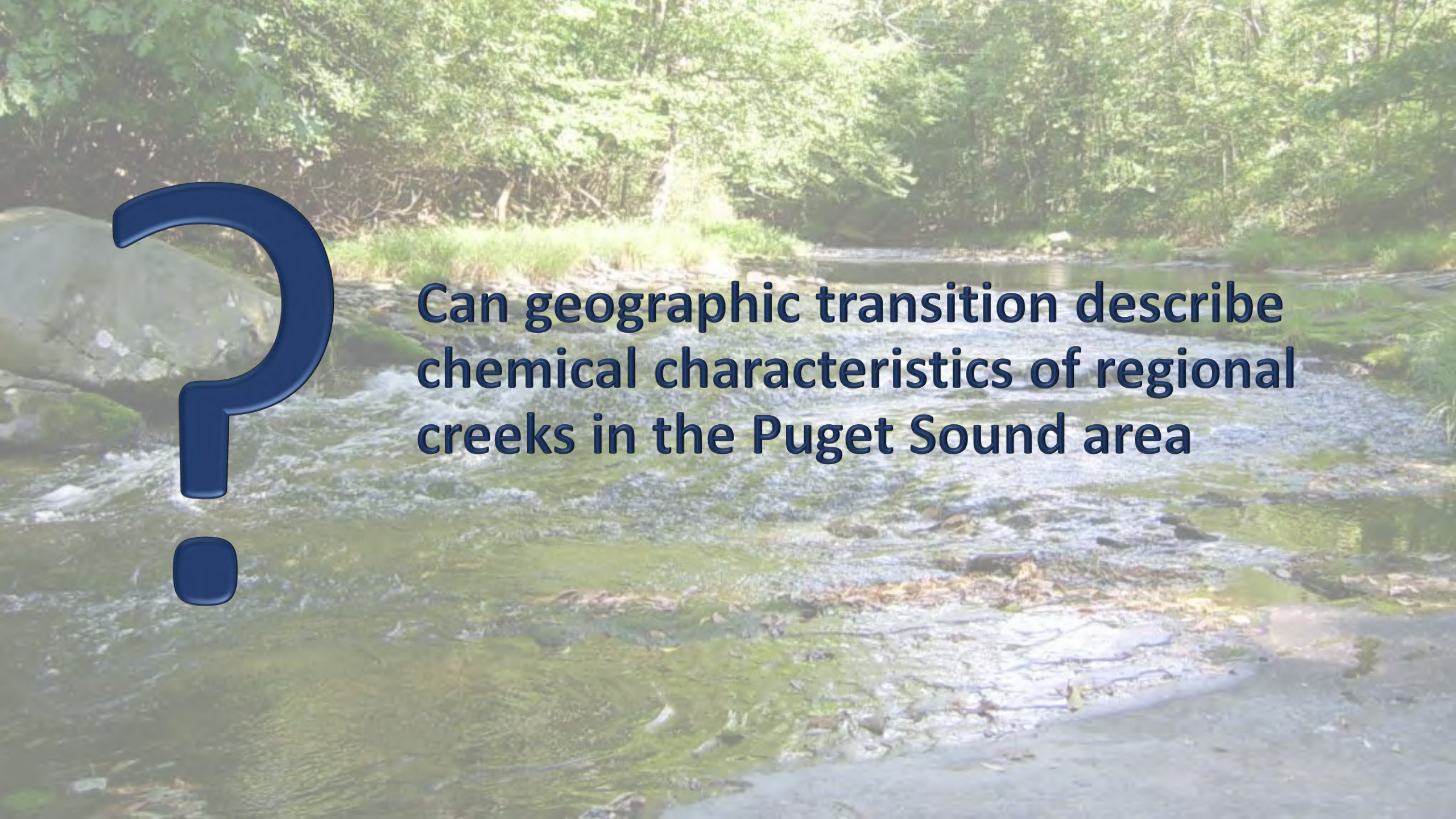
**7,068 unique features** (i.e., unique chemicals, many unidentified) **per stream sample!!**



# Non-metric Multidimensional Scaling (NMDS)

- NMDS reduced the 7,068 correlated features to 4 new data variables (4 dimensions; NMDS1, NMDS2, NMDS3, NMDS4)
- stress value of 0.072 (considered a good score)
- correlation of original variables and new data configuration; p-value <0.01

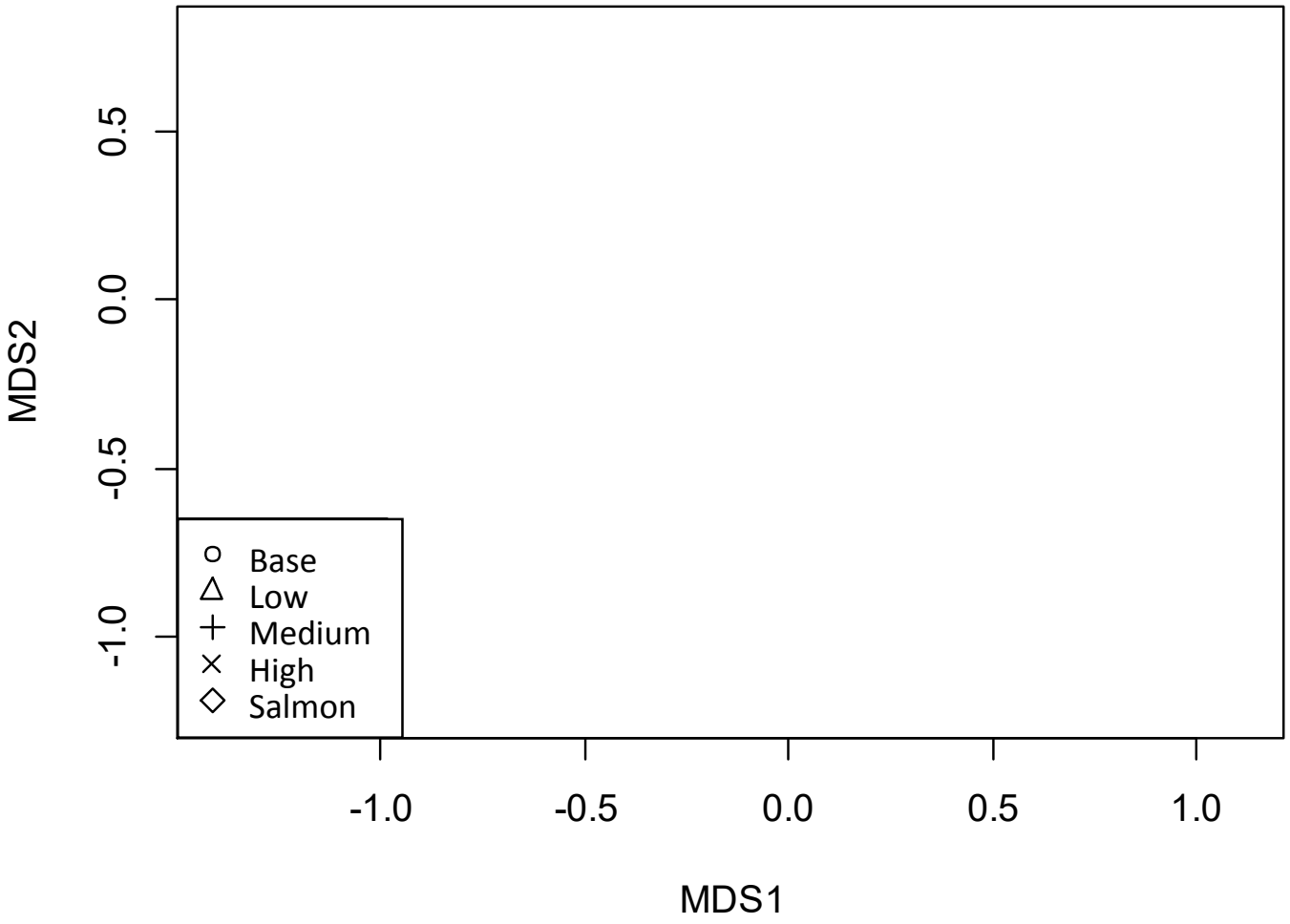




# Can geographic transition describe chemical characteristics of regional creeks in the Puget Sound area

# MDS1 versus MDS2

**All features (n=7,068), all samples (2017-2018; n=65)**



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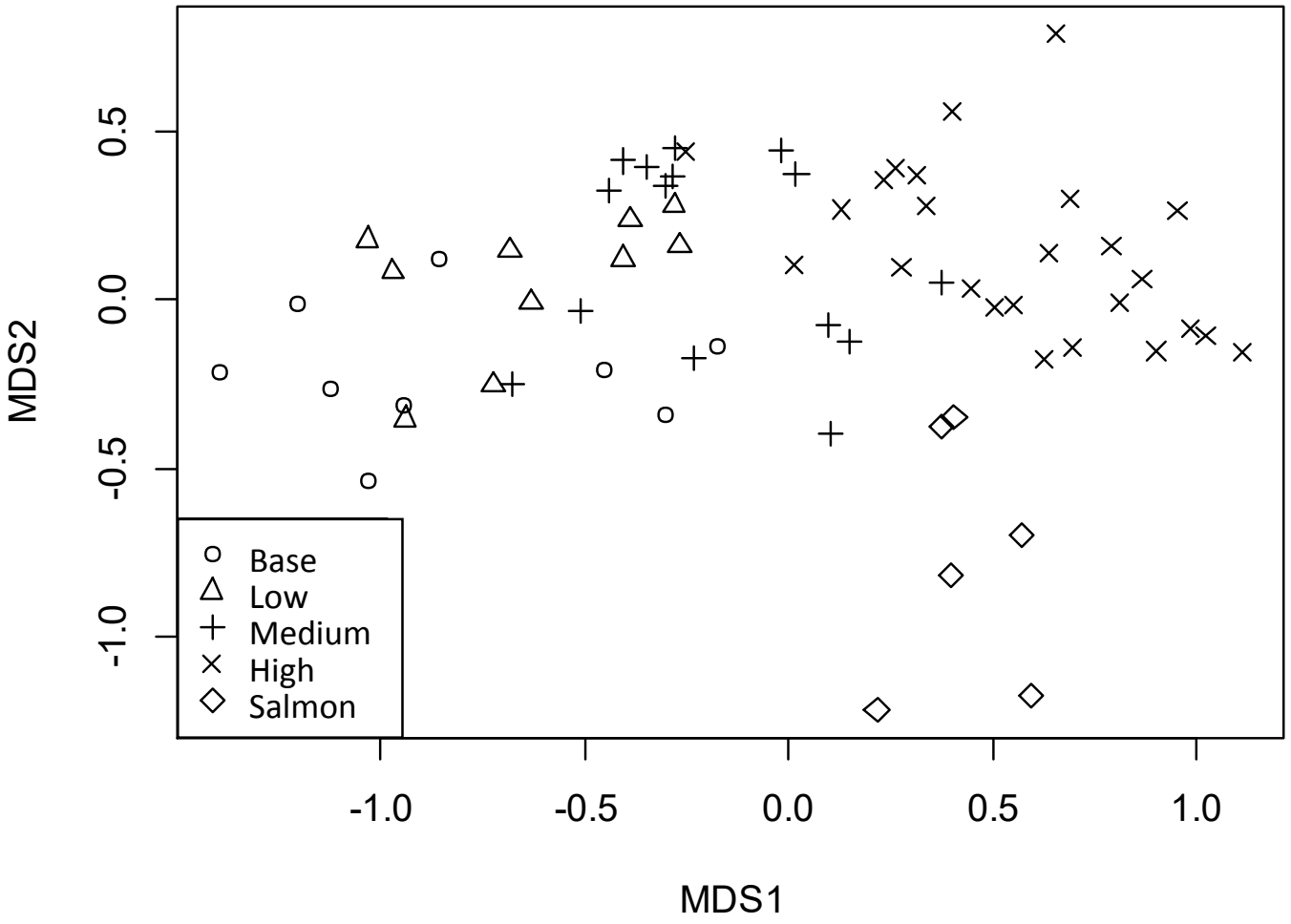

# MDS1, PSM Risk (arrow);
# MDS2, Salmon creek samples (circle)

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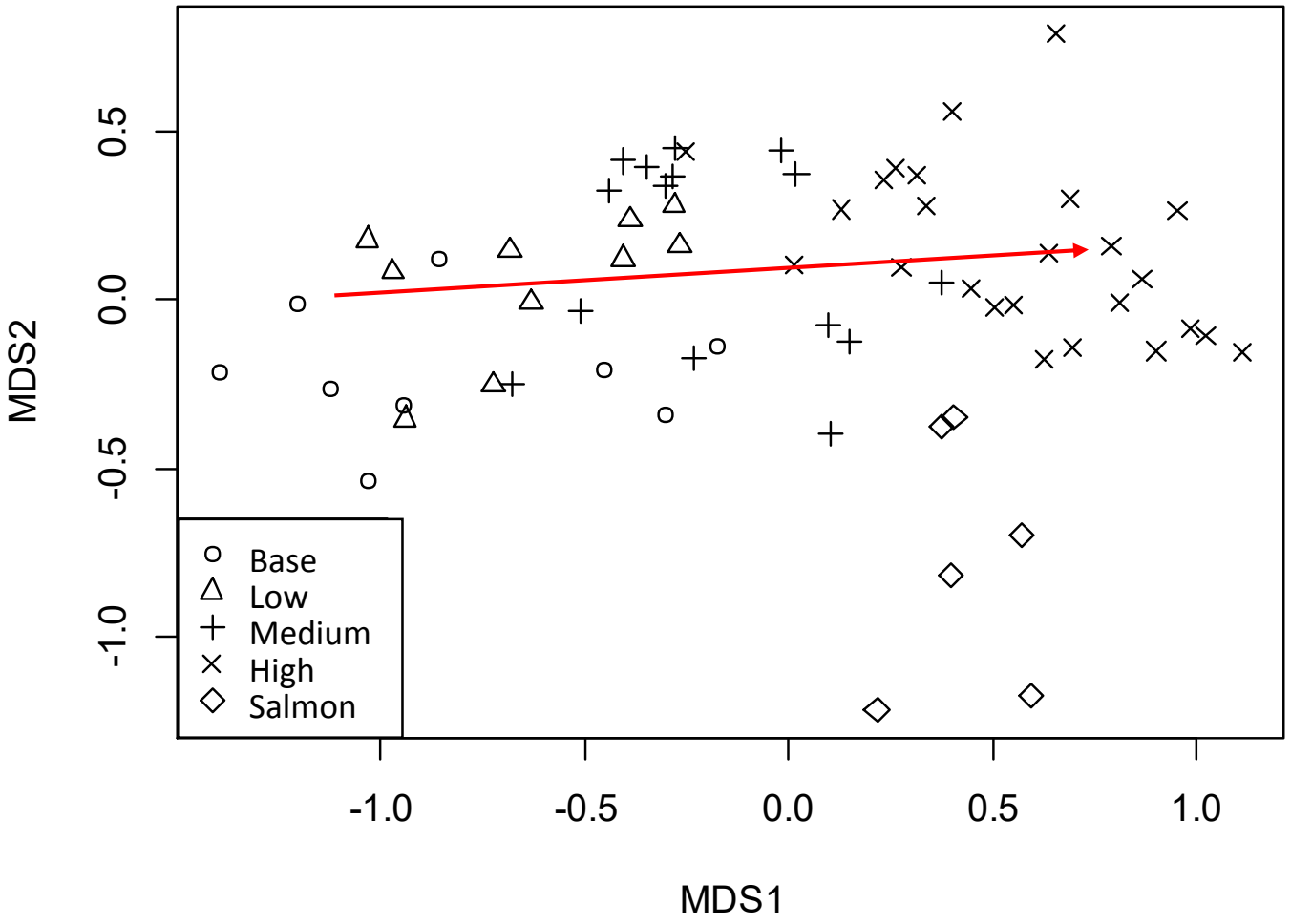

# MDS1, PSM Risk/Urbanization (arrow); MDS2, Salmon creek samples (circle)

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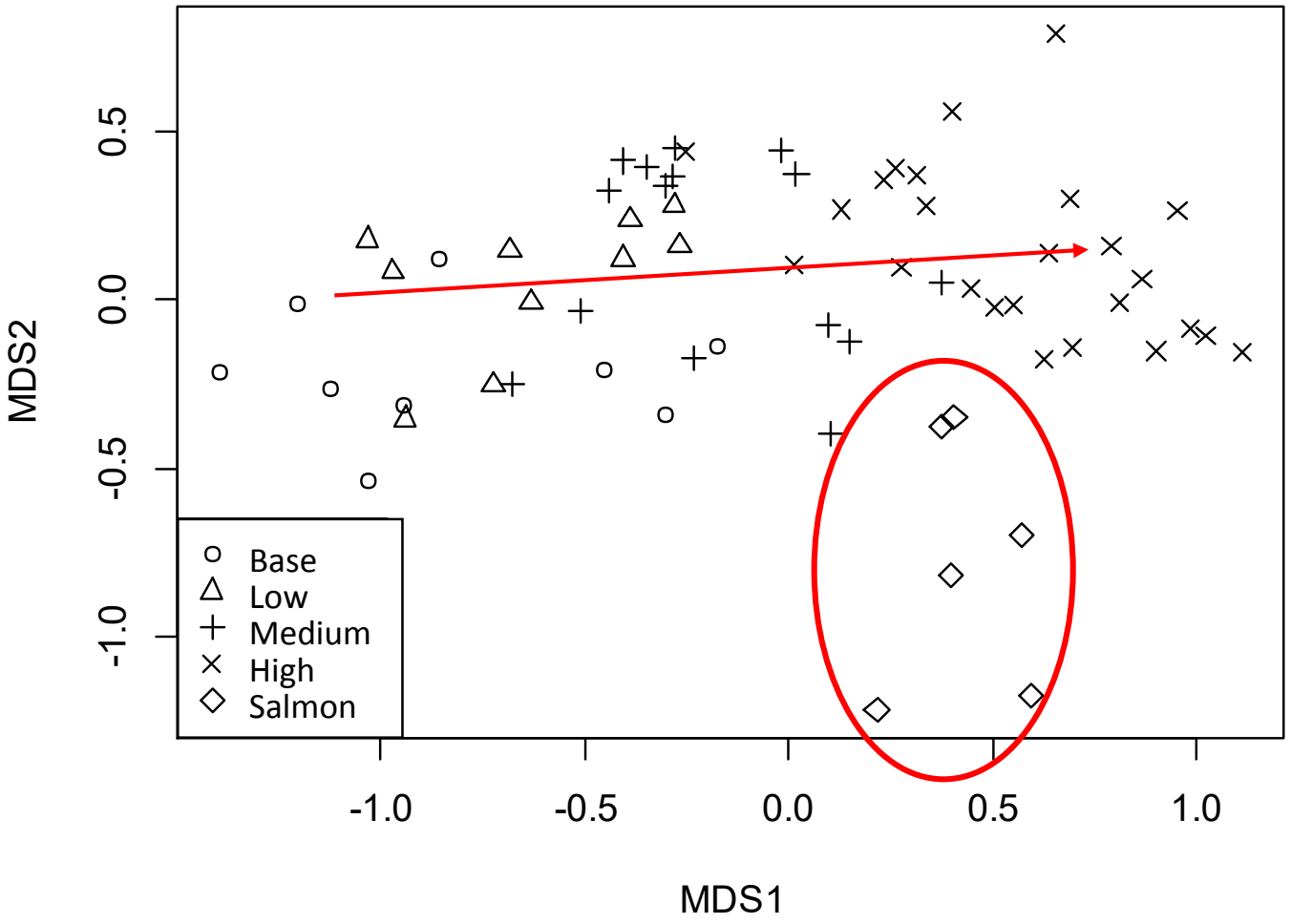
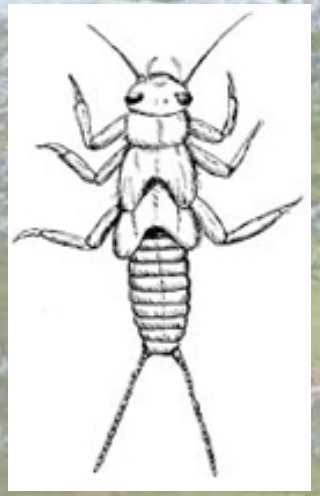
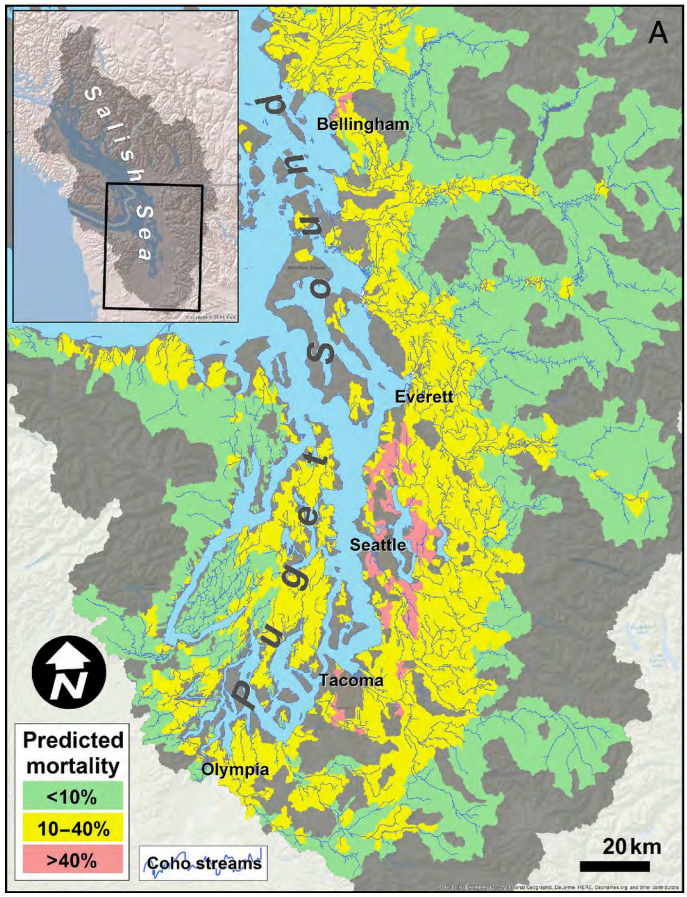



| Permanova analysis of NMDS data | |
|---|---|
| **Landcover characterics** | **F-statistic*** |
| High Intensity Development | 6.83 |
| Medium Intensity Development | 8.72 |
| Low Intensity Development | 9.4 |
| Evergreen Forest | 9.24 |
| Imperviousness | 10.1 |
| Census (Pop/km2) | 8.33 |
| Road class 3 | 7.16 |
| Road class 4 | 5.75 |
| Road class 5 | 8.2 |
| AADT (average annual daily traffic) | 8.54 |

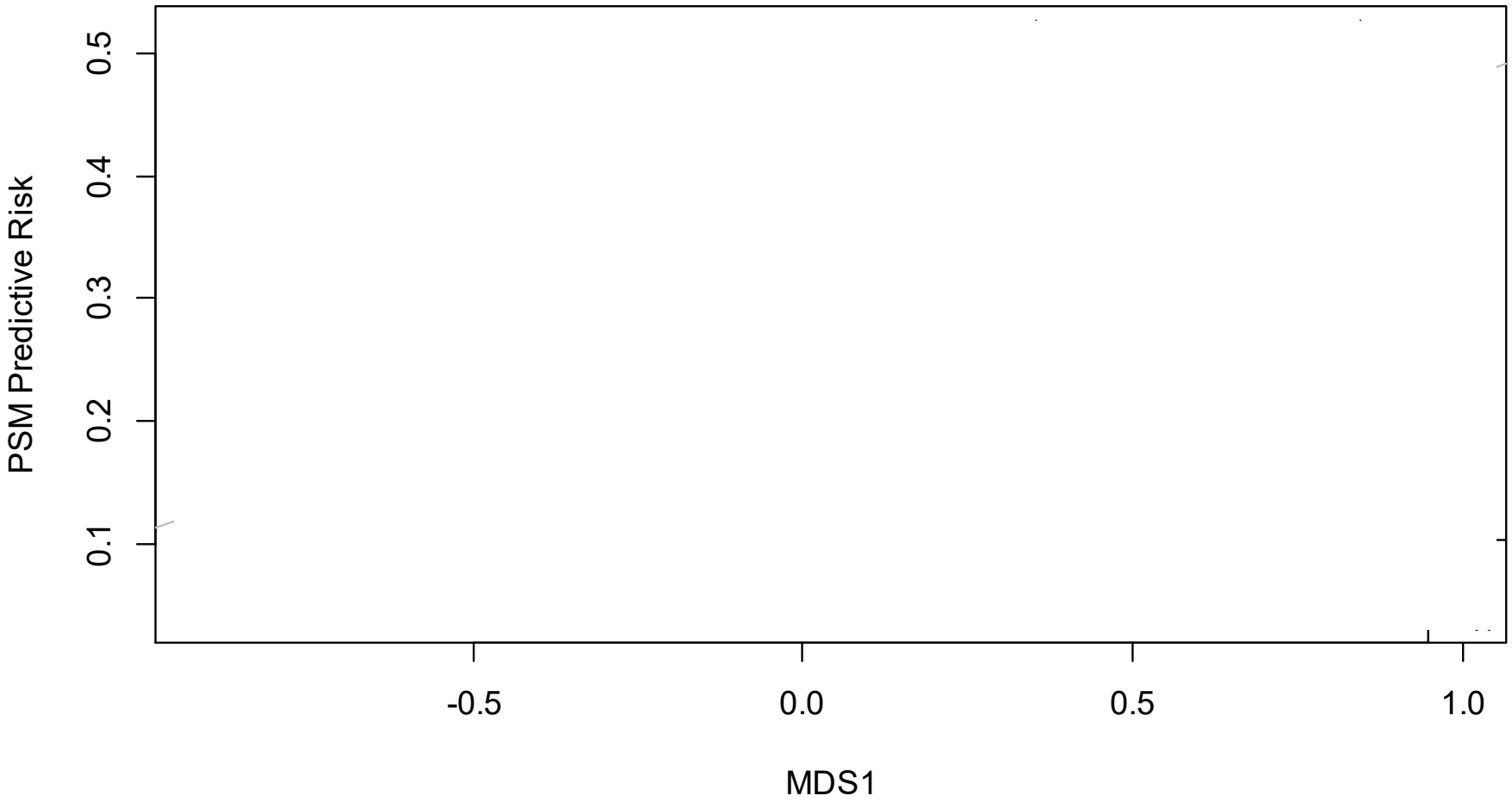
*$p<0.001$

# Can chemical water quality and stream health be aligned using biological anchors

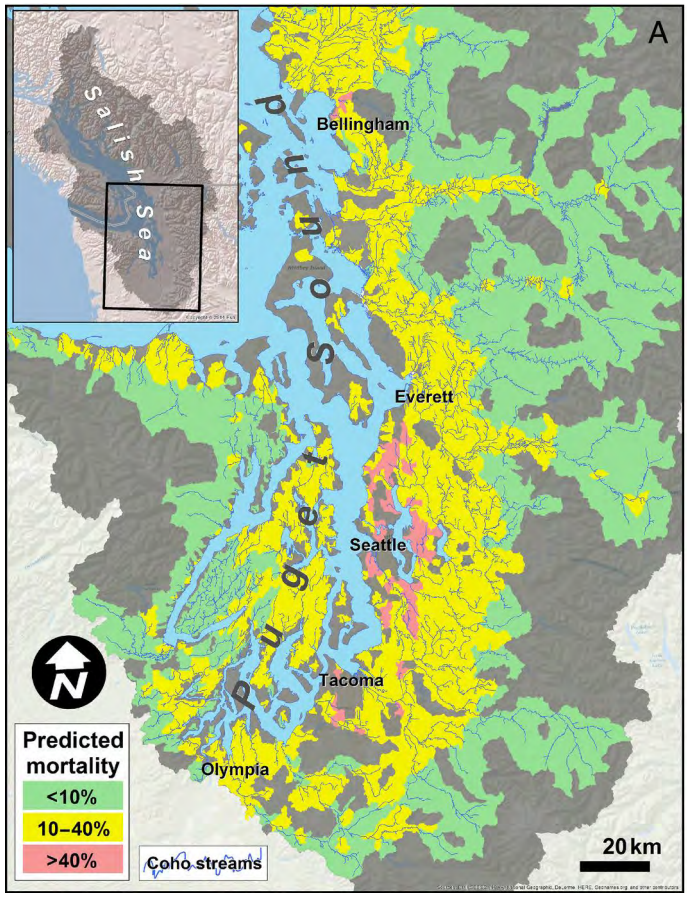



A
Salish Sea
Puget Sound
Bellingham
Everett
Seattle
Tacoma
Olympia
Predicted mortality
<10%
10–40%
>40%
Coho streams
20 km

## NMDS1 vs PSM predictive risk (November samples only), R2 = 0.827, p<0.001




**Urban stream chemical profile**



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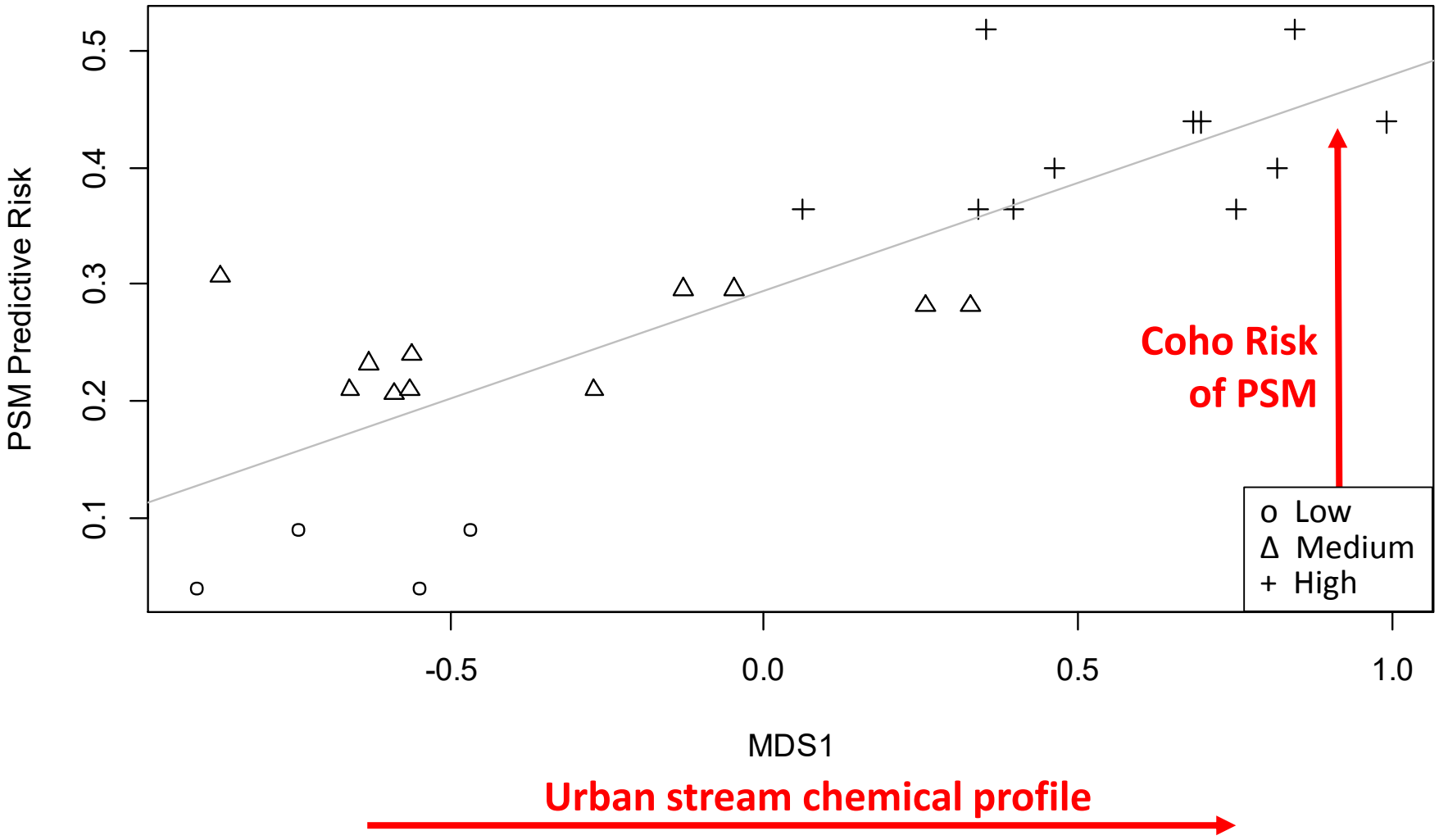


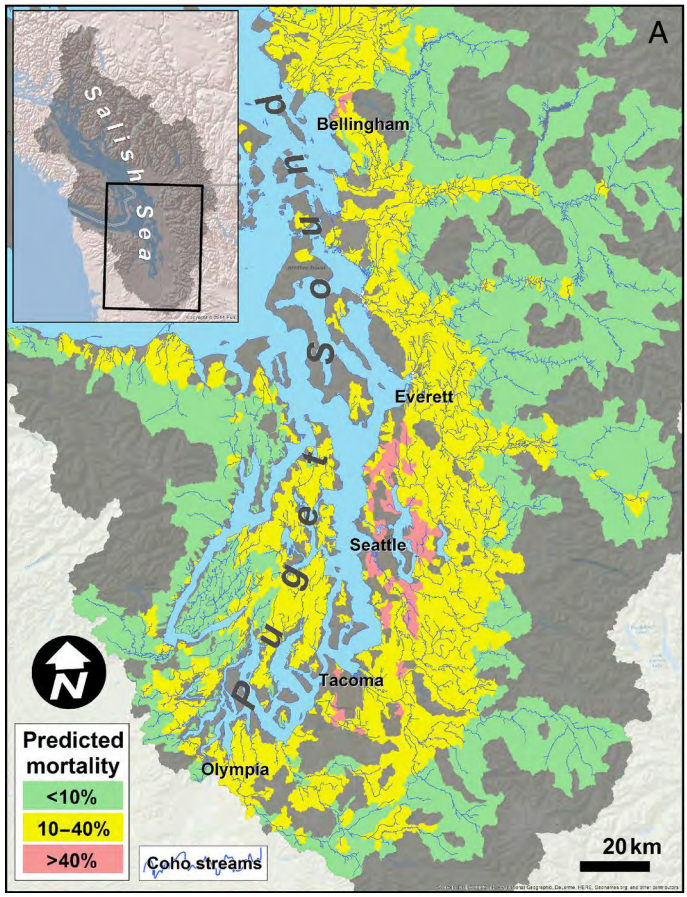

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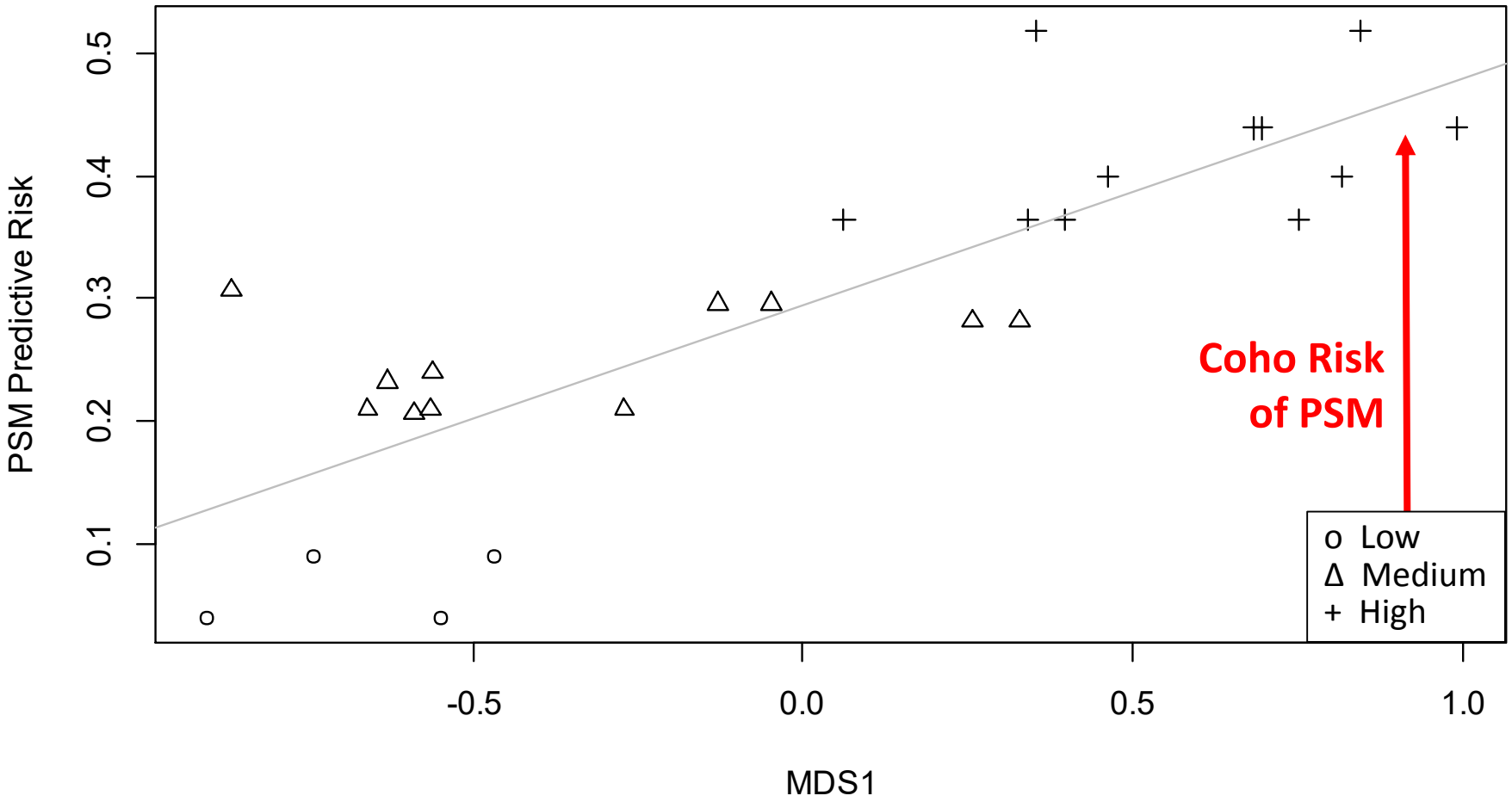


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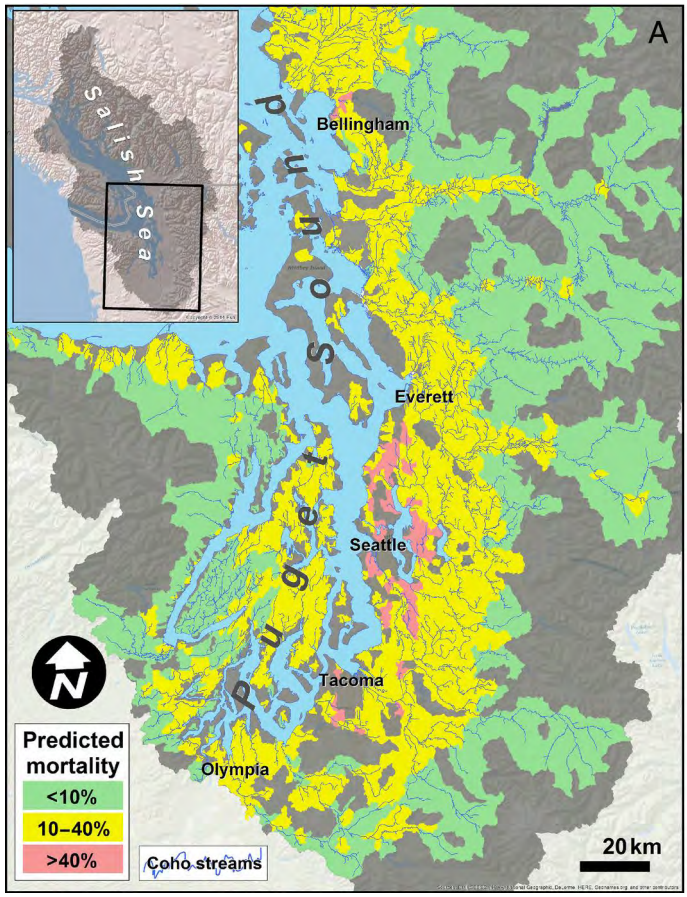
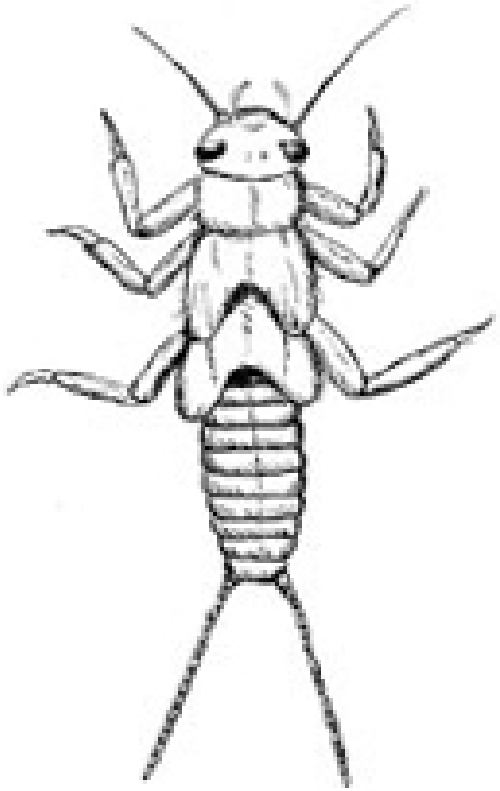
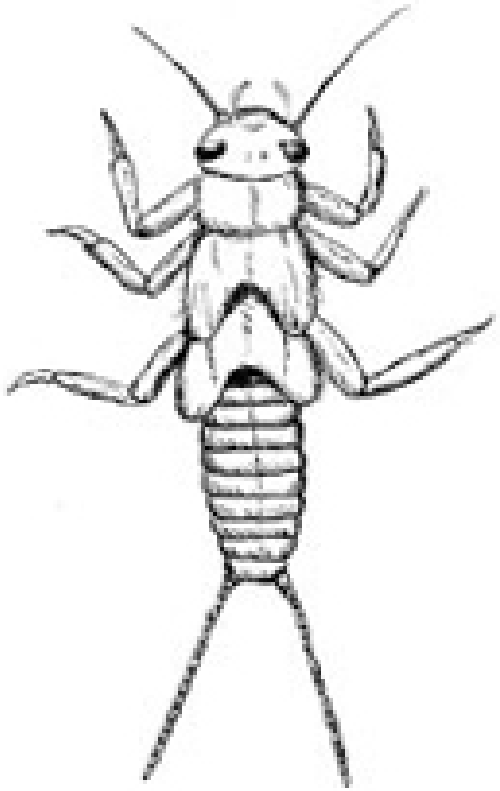



**Permanova analysis of NMDS data: PSM Risk F-statistic = 7.43; p<0.001**



# Benthic Index of Biotic Integrity (B-IBI)

Taxonomic richness and composition, tolerance and intolerance, habit, reproductive strategy, feeding ecology, and population structure.



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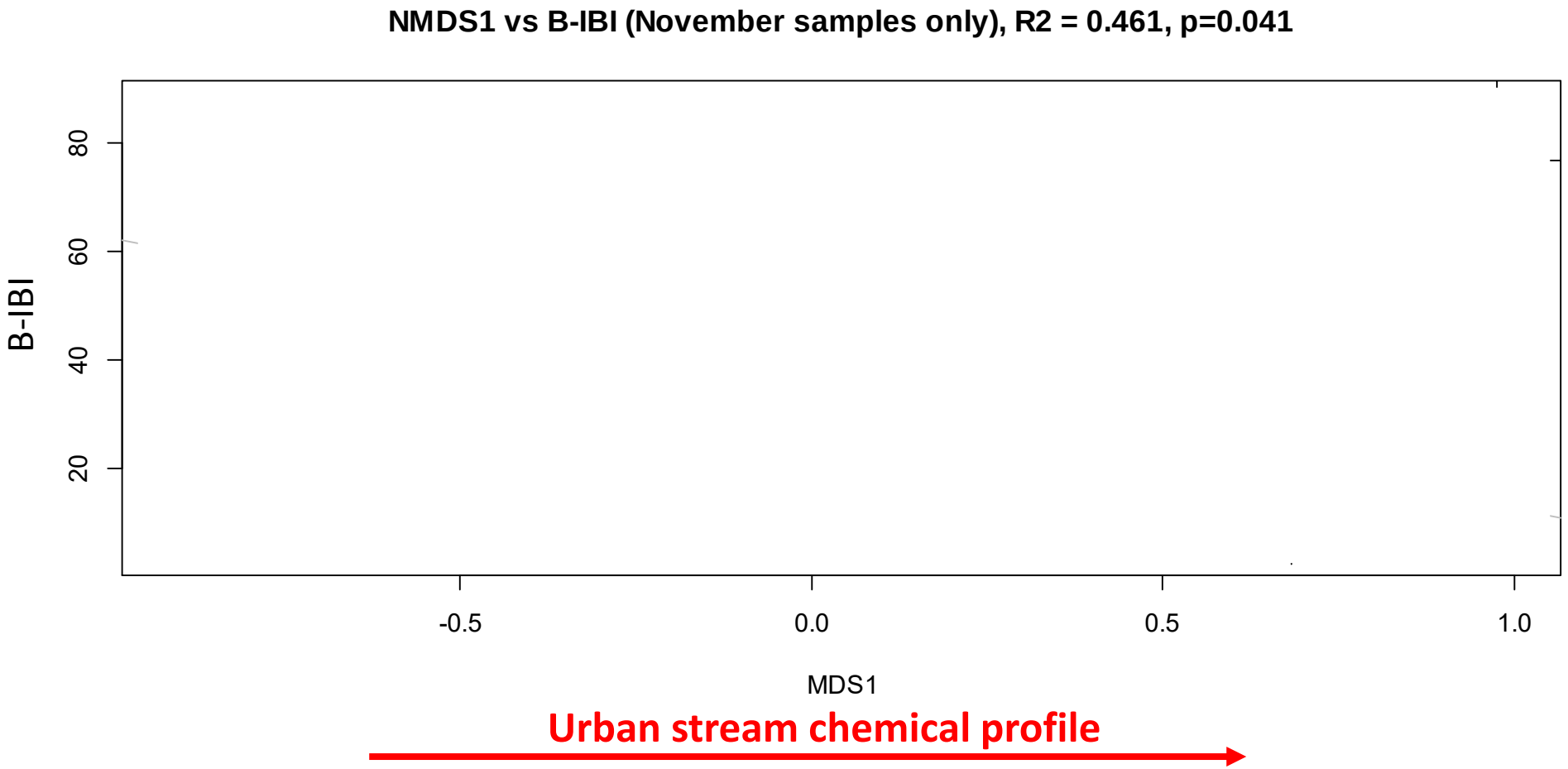

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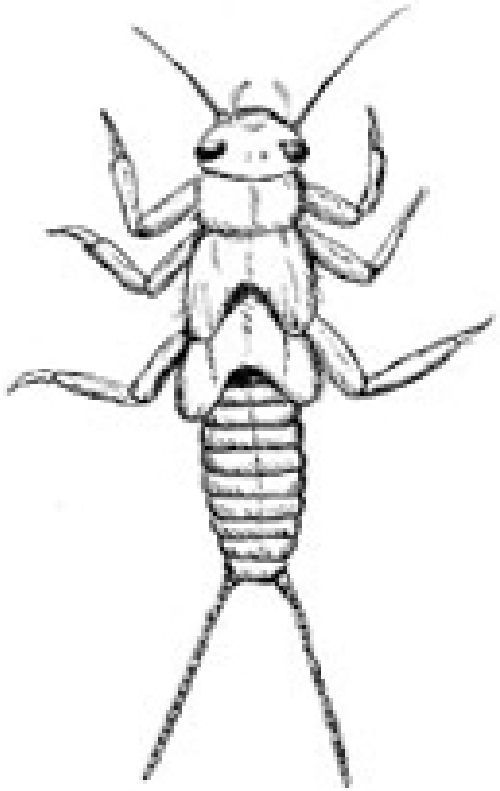

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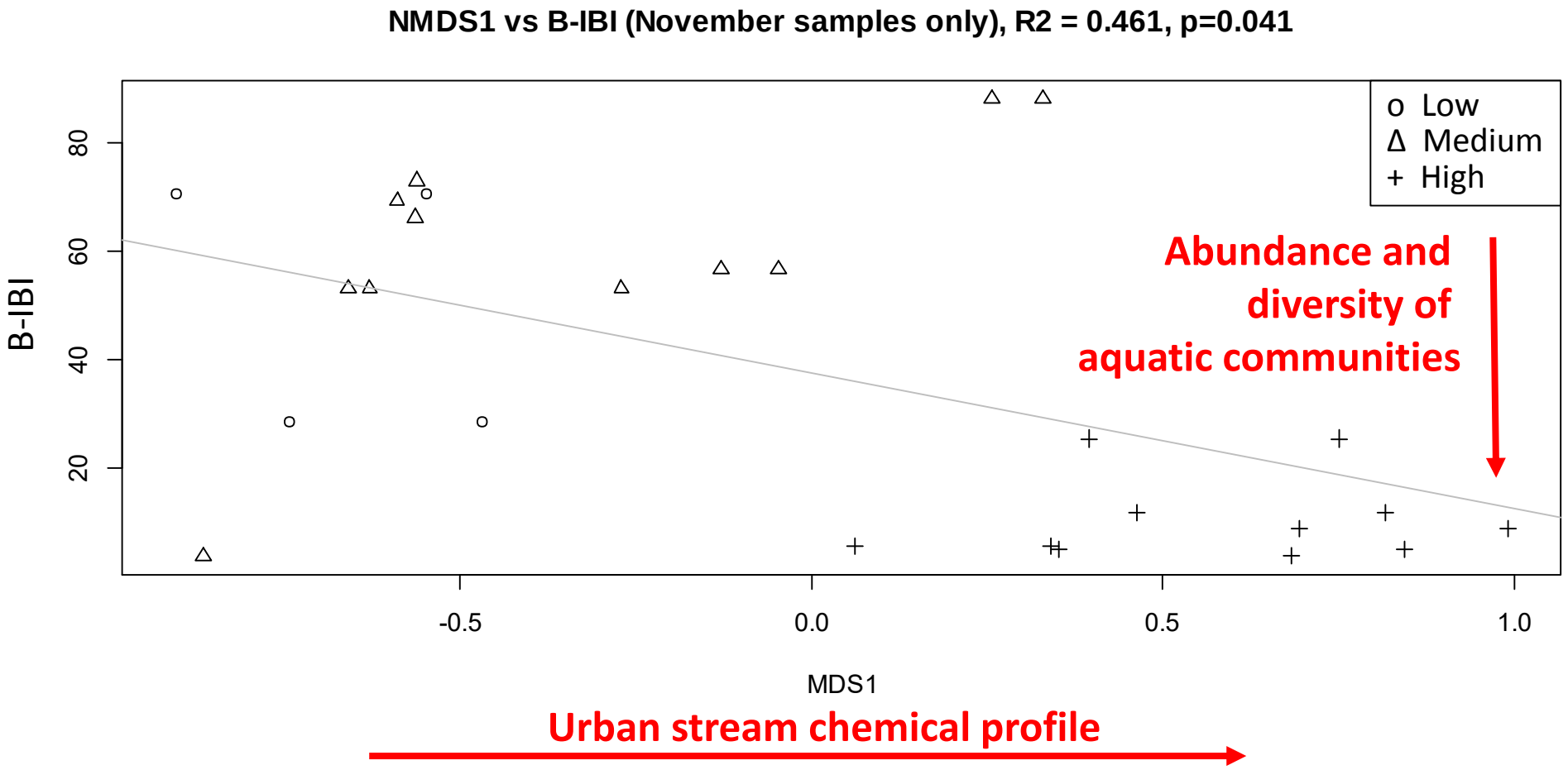

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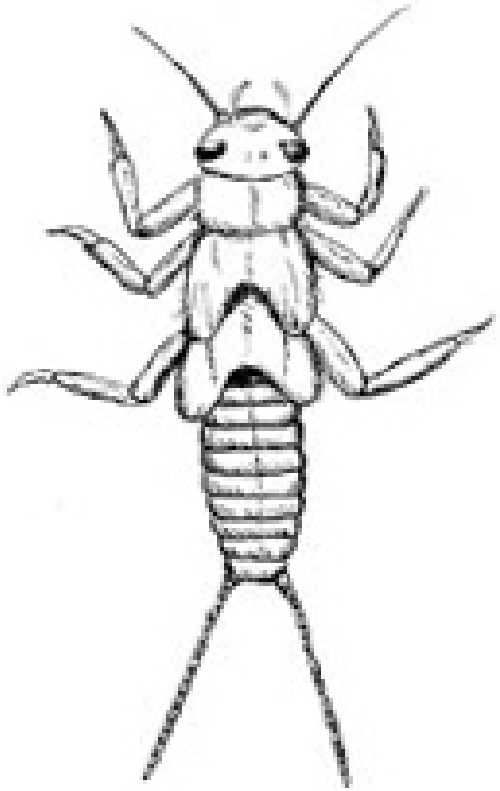

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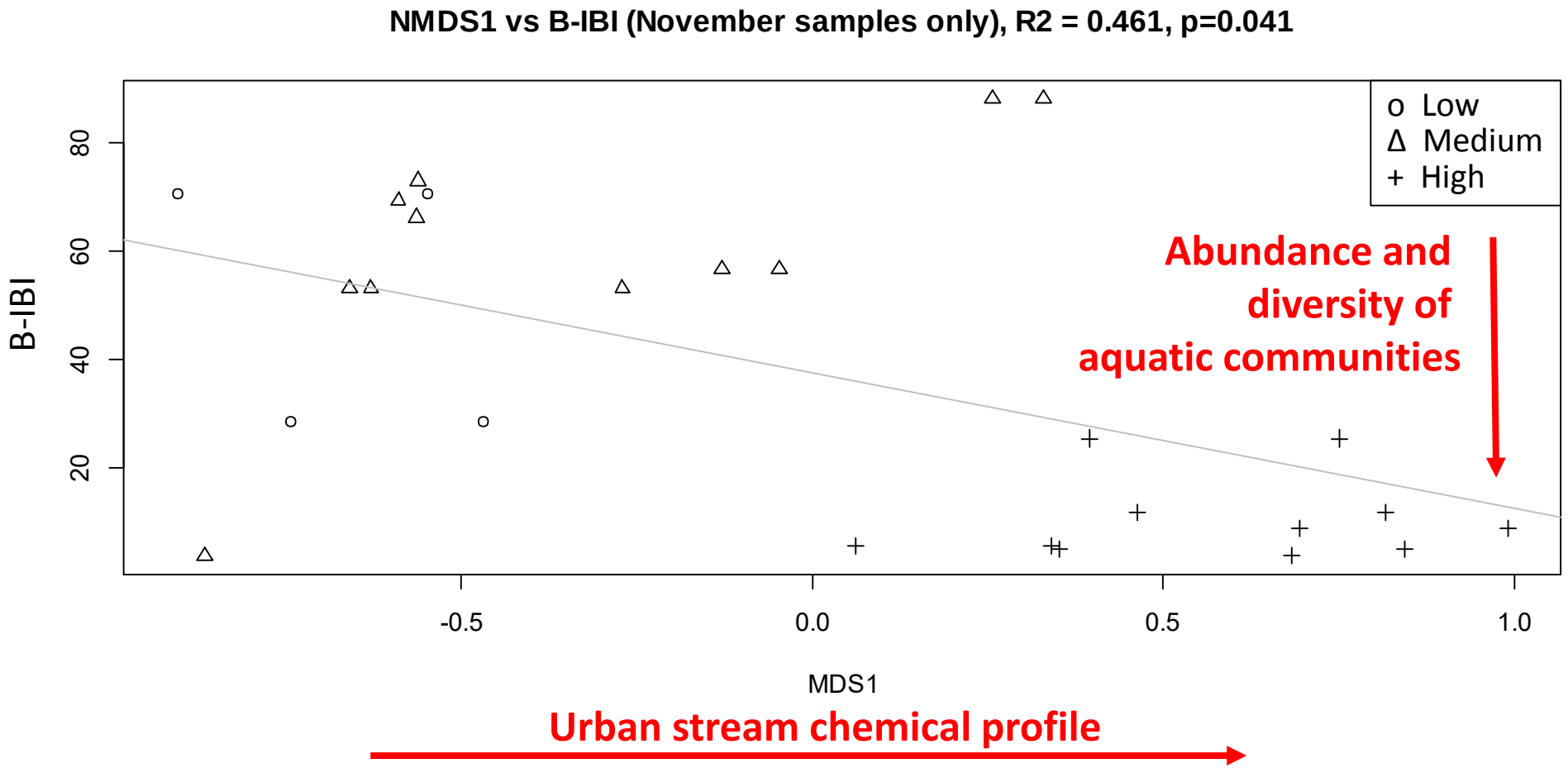


**Permanova analysis of NMDS data: B-IBI F-statistic = 3.13; p=0.006**

# Conclusions

**Water quality is more chemically complex than previously realized, and changes in predictably across a gradient of urban land cover.**

**A better understanding of this urban chemical profile will guide ongoing efforts to conserve high quality salmon habitats and improve water quality.**

# Questions?

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