Calibrating predicted ecotoxicity effects to observed species loss by using ecological models

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Introduction

- **Mixture toxic pressure** can be characterized, but we don’t know **true species loss**
- Species loss key for LCIA (Potentially Disappeared Fraction, PDF)
- We have vast #(bio)monitoring data, and ecotoxicity test data for 12k chemicals
- Predicted (msPAF) and observed (#species loss, #abundance) impacts can be calibrated
- We propose stepwise **ecological modeling** for this

Objectives: towards a PAF-to-PDF calibration

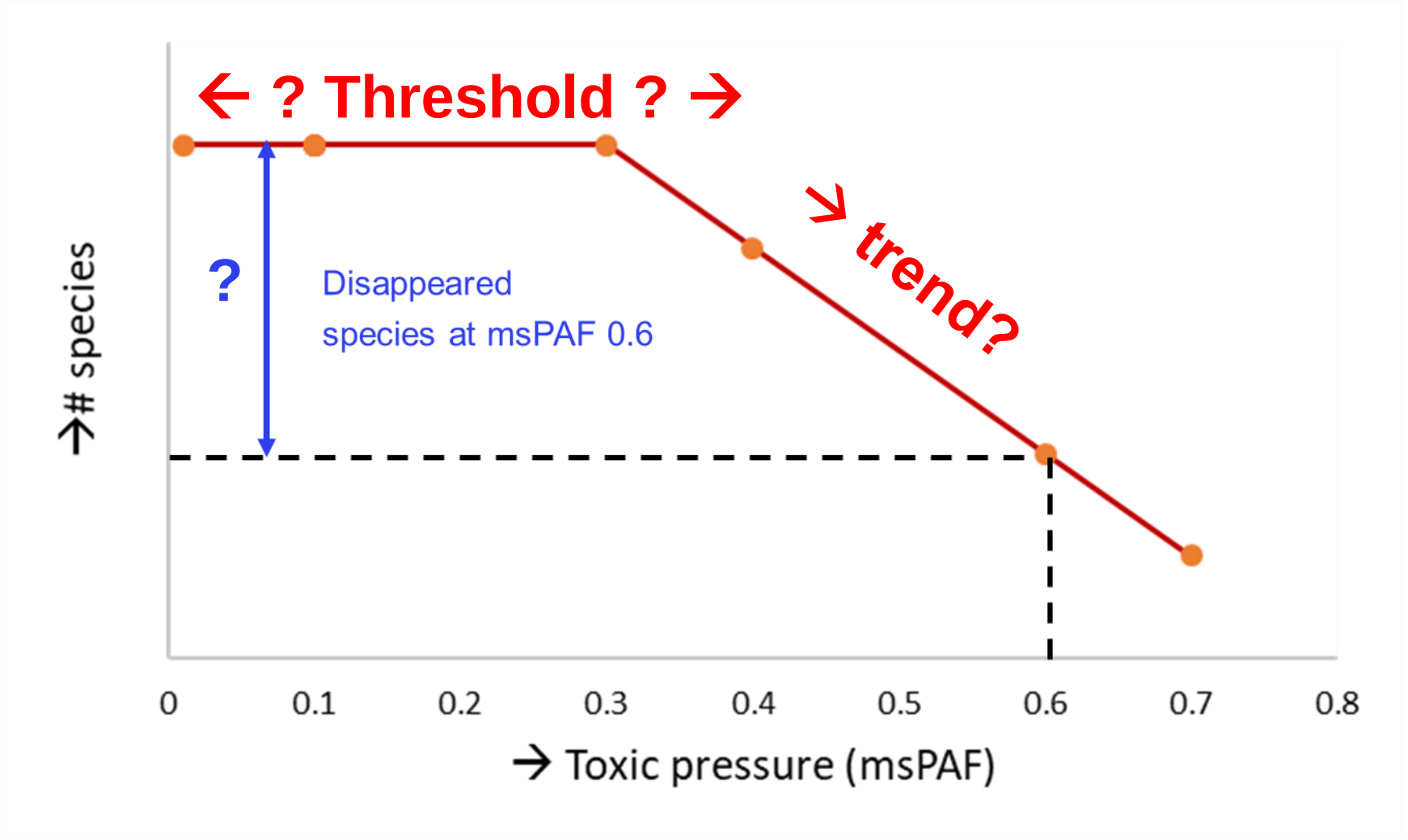
Show a systematic approach with a stepwise analysis of (bio)monitoring data:

1. plot raw data from all sampling sites,

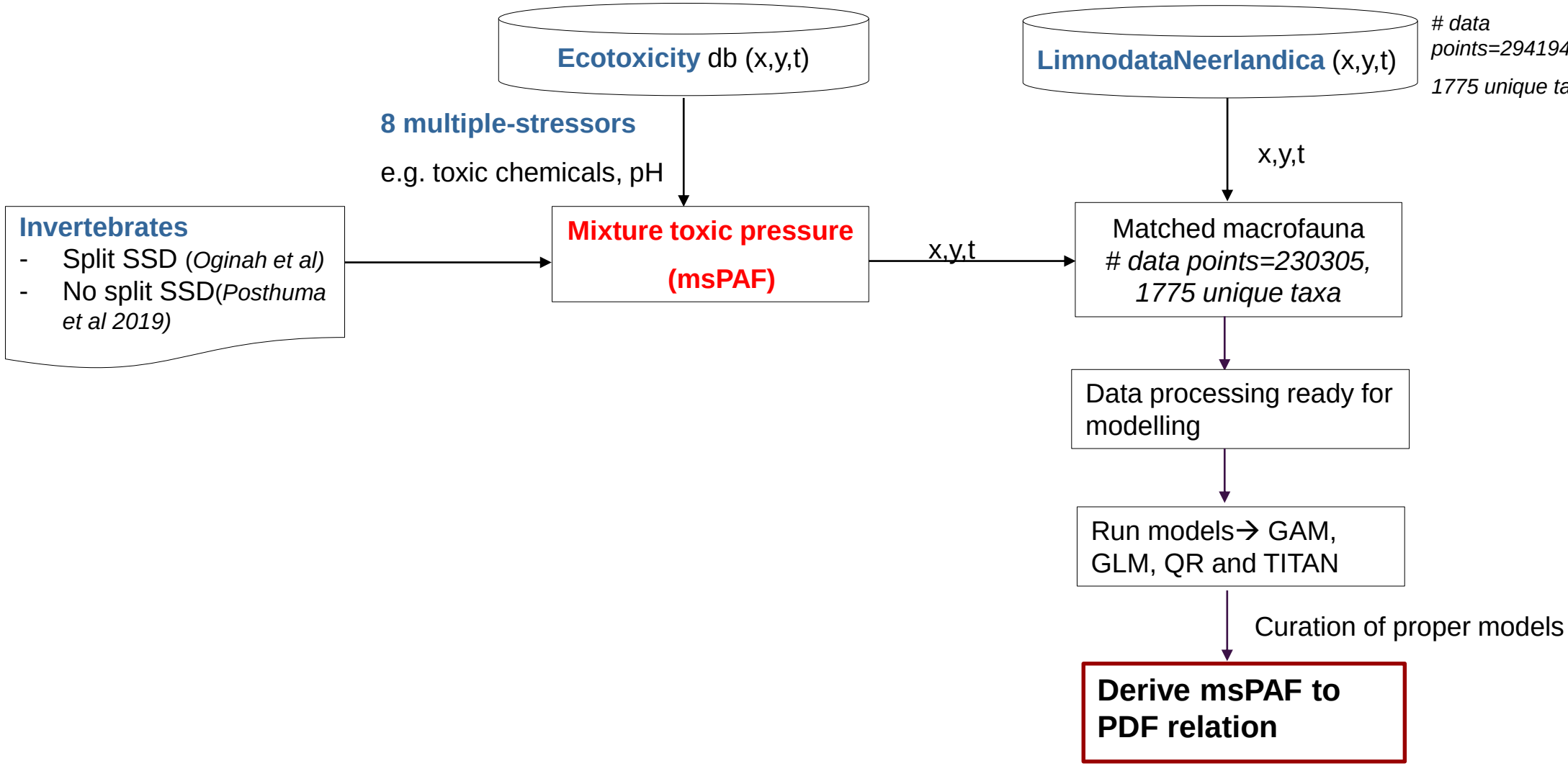
2. derive initial quantitative insights into toxic pressure as a limiting factor for species abundances and biodiversity, and

3. apply refined methods, such as Generalized Linear- and Generalized Additive Models, Quantile regression and TITAN (Threshold Indicator Taxa Analysis), to characterize species loss as PAF-to-PDF relationship

Working Hypothesis: Hypothesis-line PAF-to-PDF



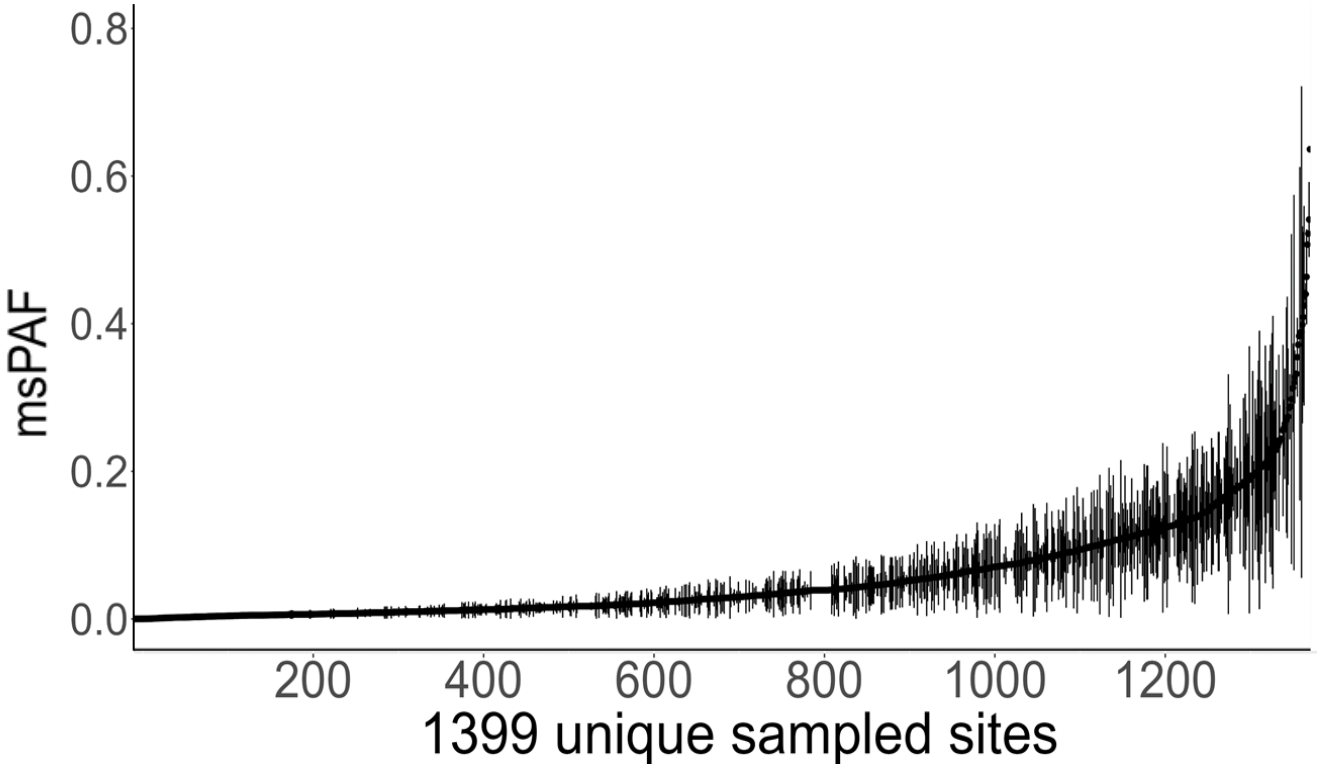
Methods: combining monitoring data and ecotoxicity test data



Oginah et al. Split or no split: Assessing chemical impacts with Species Sensitivity Distributions for specific taxonomic groups (unpublished)

Posthuma et al . 2019. Species Sensitivity Distributions for Use in Environmental Protection, Assessment, and Management of Aquatic Ecosystems for 12386 Chemicals

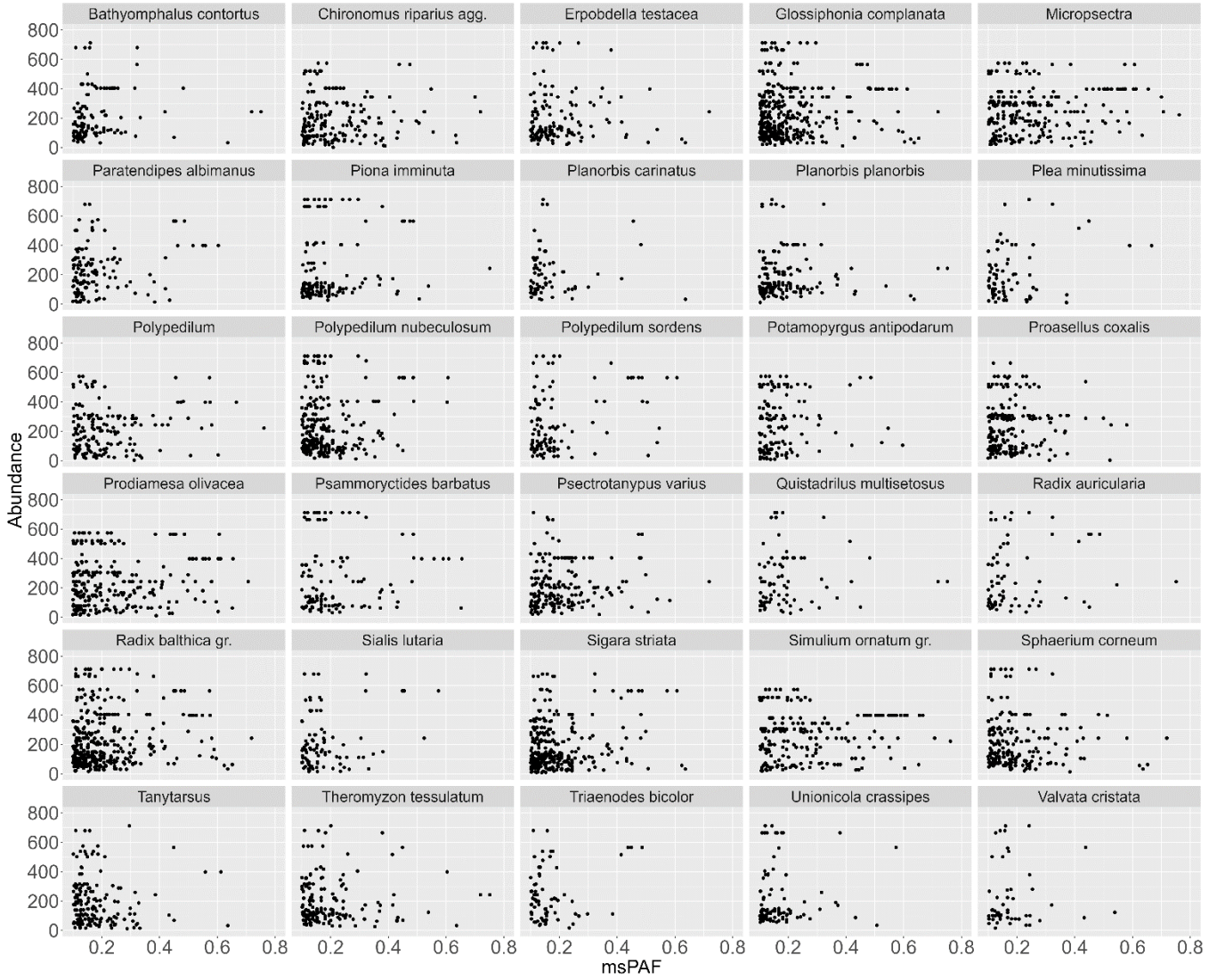
Results: Variability of mixture toxic pressure in the data set (msPAF-EC10eq)



- The data set covers 1775 taxa, 8 co-multiple-stress and 1399 sites
- msPAF ranges from 0 to 0.76
- **Strong indication of potential, gradual biodiversity effects**

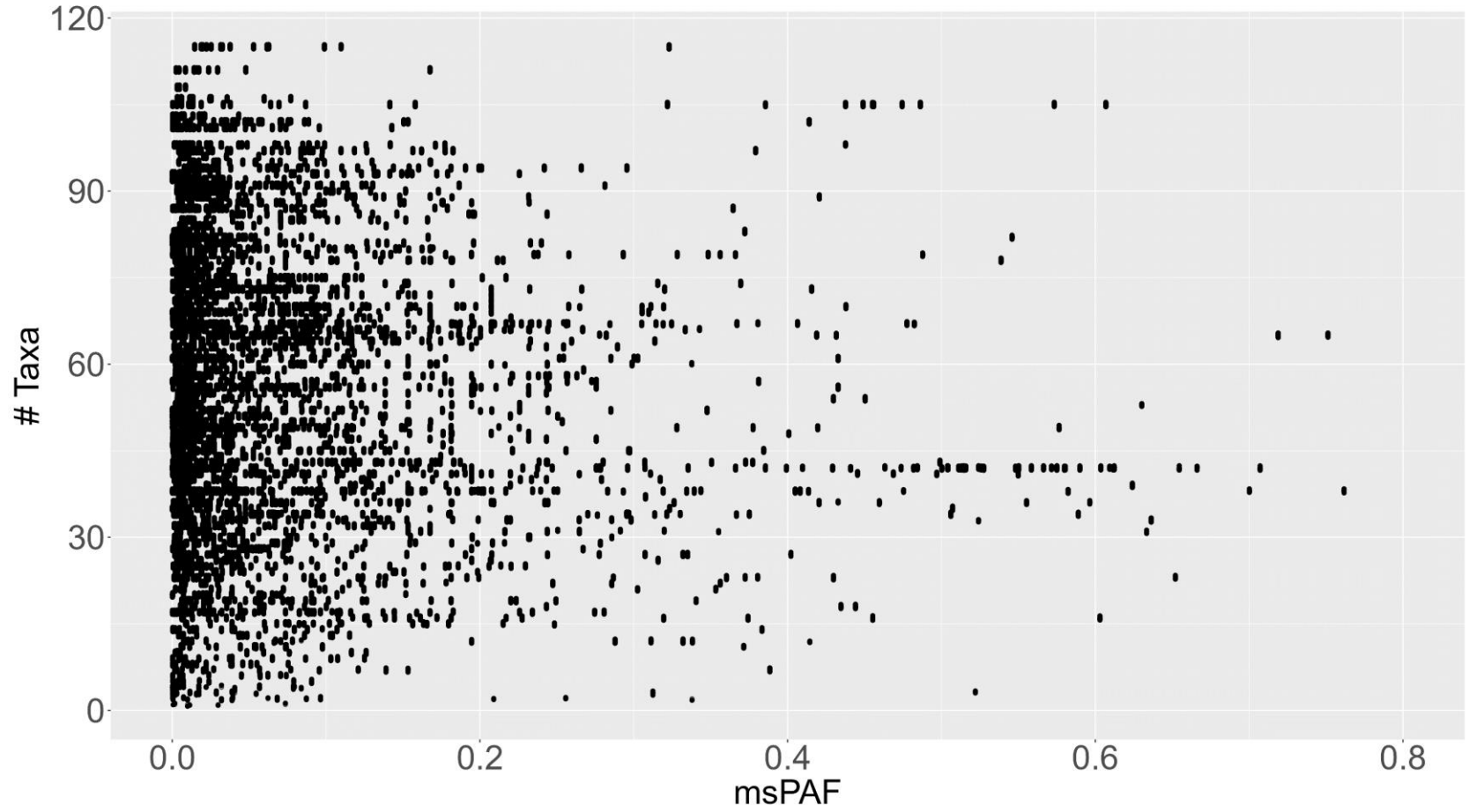
- **msPAF** varies; it is likely that abundances of various species and biodiversity metrics can be affected if increased toxic pressure values occur → **PAF-to-PDF must be in the data**

Results: Array of species (Y=Abundance)



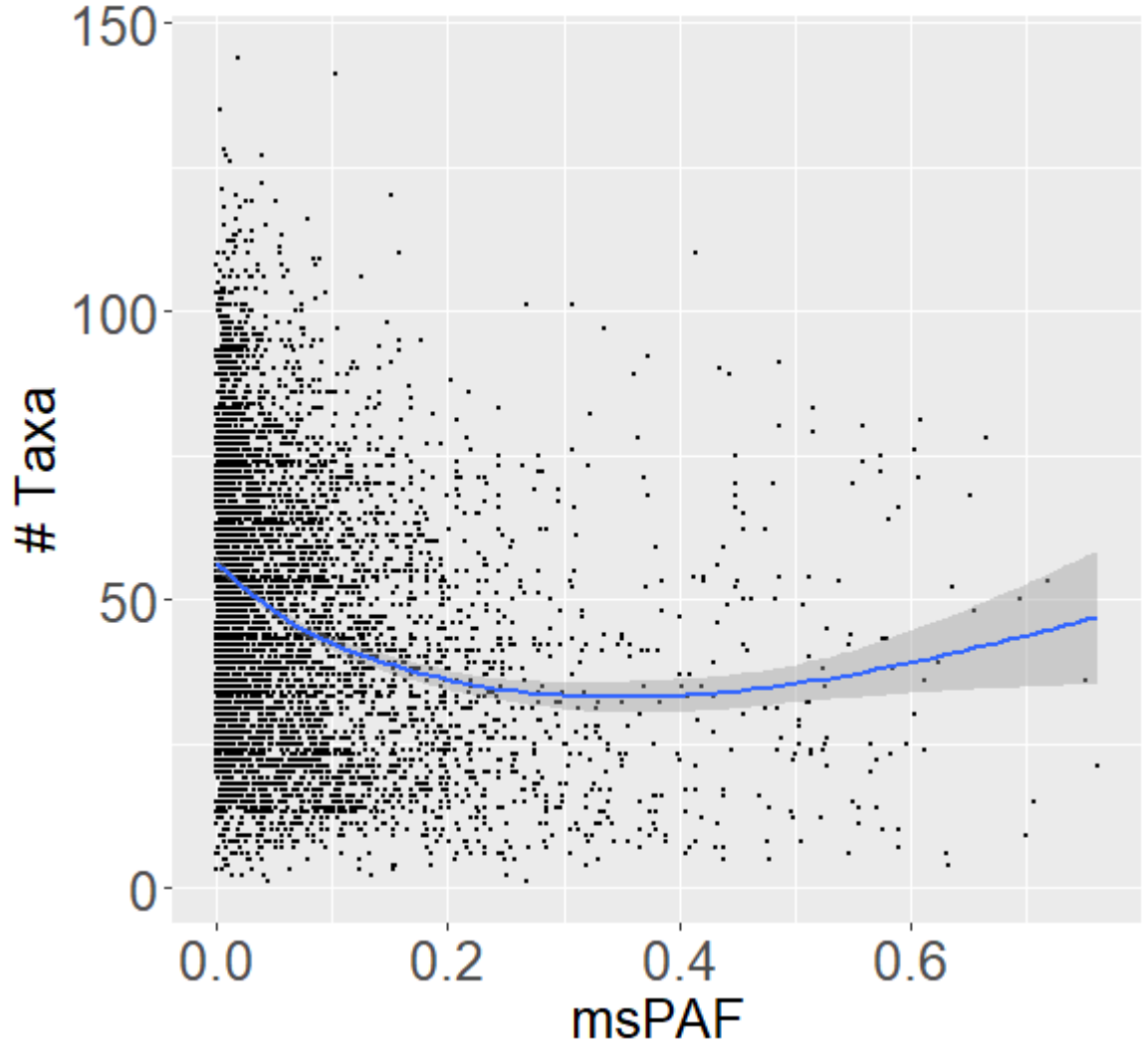
- General trend
- observed occurrences (dot density) decreases with higher X
- **HighX-highY values are absent**
- **Toxic pressure acts as limiting factor**

Results: *Ibidem*, as summary biodiversity metric (Y= #taxa)



- HighX-highY values are absent
- The data contain the PAF-to-PDF relationship
- Next question: *how to characterize that?*

Results: A summary biodiversity metric (Y= Species richness)



- Significant change with increase of X, $p<0.05$
- Generally decline with increasing toxic pressure up to 0.2 msPAF

Conclusions

- Chemical pollution is a limiting factor for biodiversity
- Biodiversity generally decline with increasing toxic pressure
- Ecological models can be used to determine consistent extrapolation factors to derive the effect-to-damage relationships required in different decision-support tools
- What are the next steps?

Thank you for your attention!

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