

Compositional and Functional Trends in Activated Sludge Bacterial Communities



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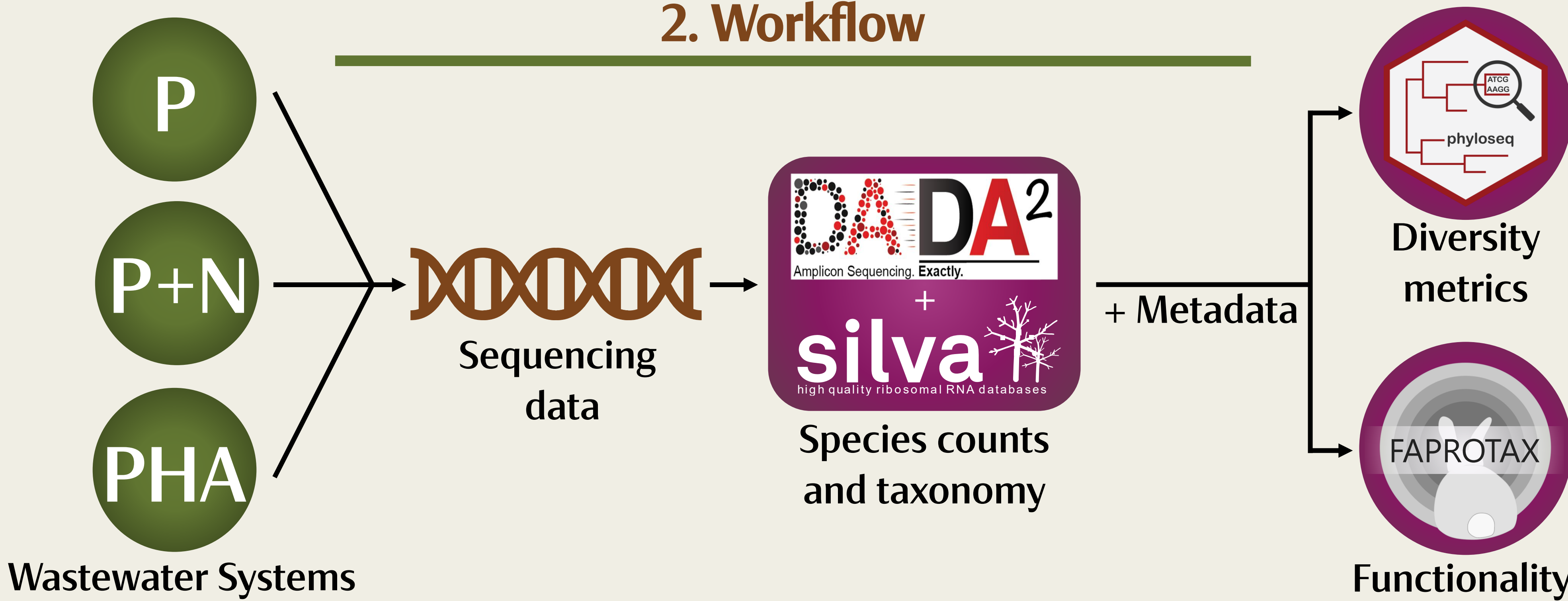


1. Background

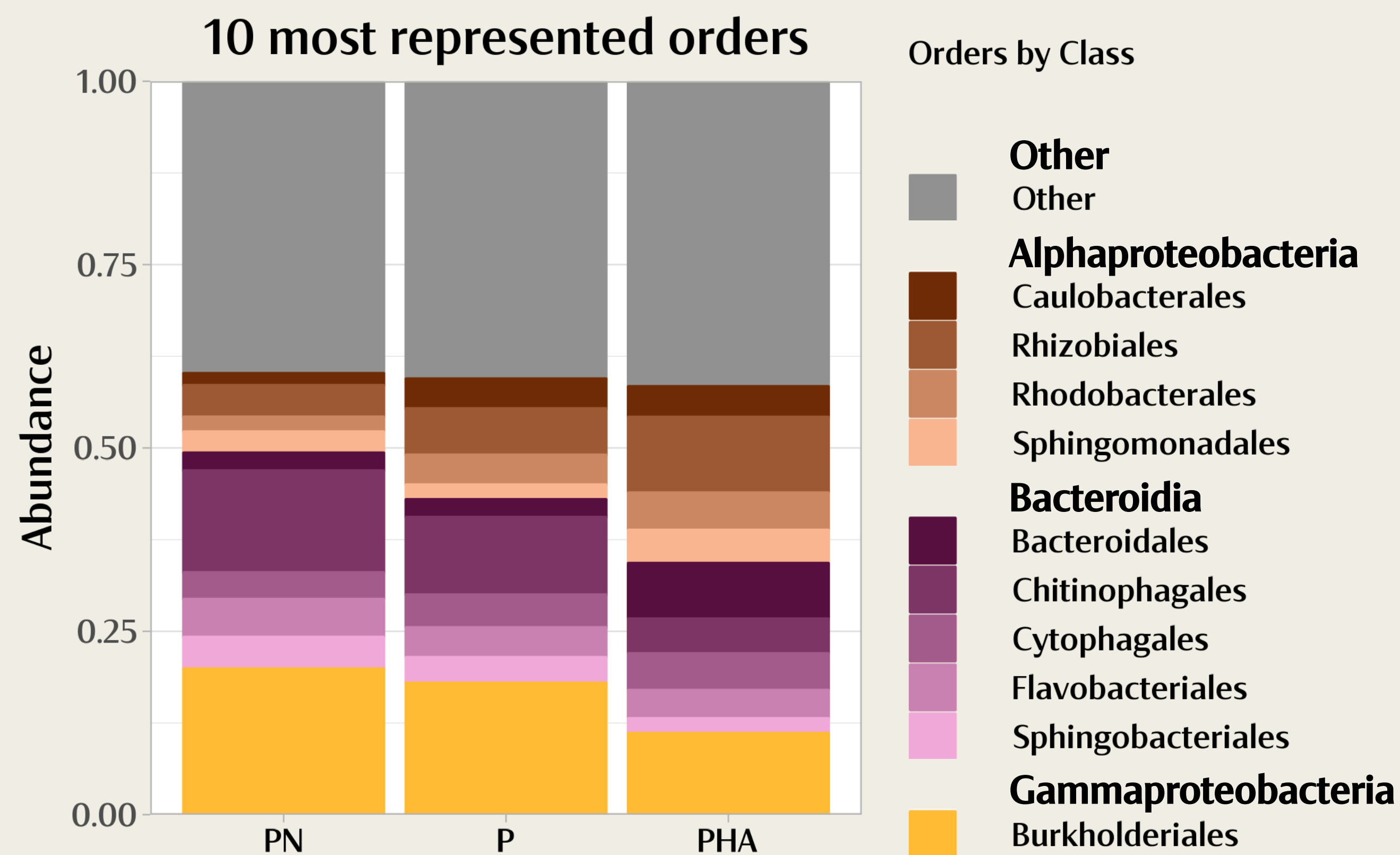
Activated sludge (AS) is a mixture of microbes that is an important component of wastewater treatment (WWT). Bacteria within AS **remove polluting nutrients** such as phosphorus and nitrogen from wastewater before it is released back to the water cycle. AS has also been used for **resource recovery**, namely the production of bioplastic precursor polymers using carbon in wastewater.

Our study explores the **taxonomic composition and functional potential** of these bacterial communities from **phosphorus removal (P)**, **phosphorus and nitrogen removal (PN)**, or **polymer production (PHA)** systems to assess if there are relationships between taxa, their tagged function, and the type of system.

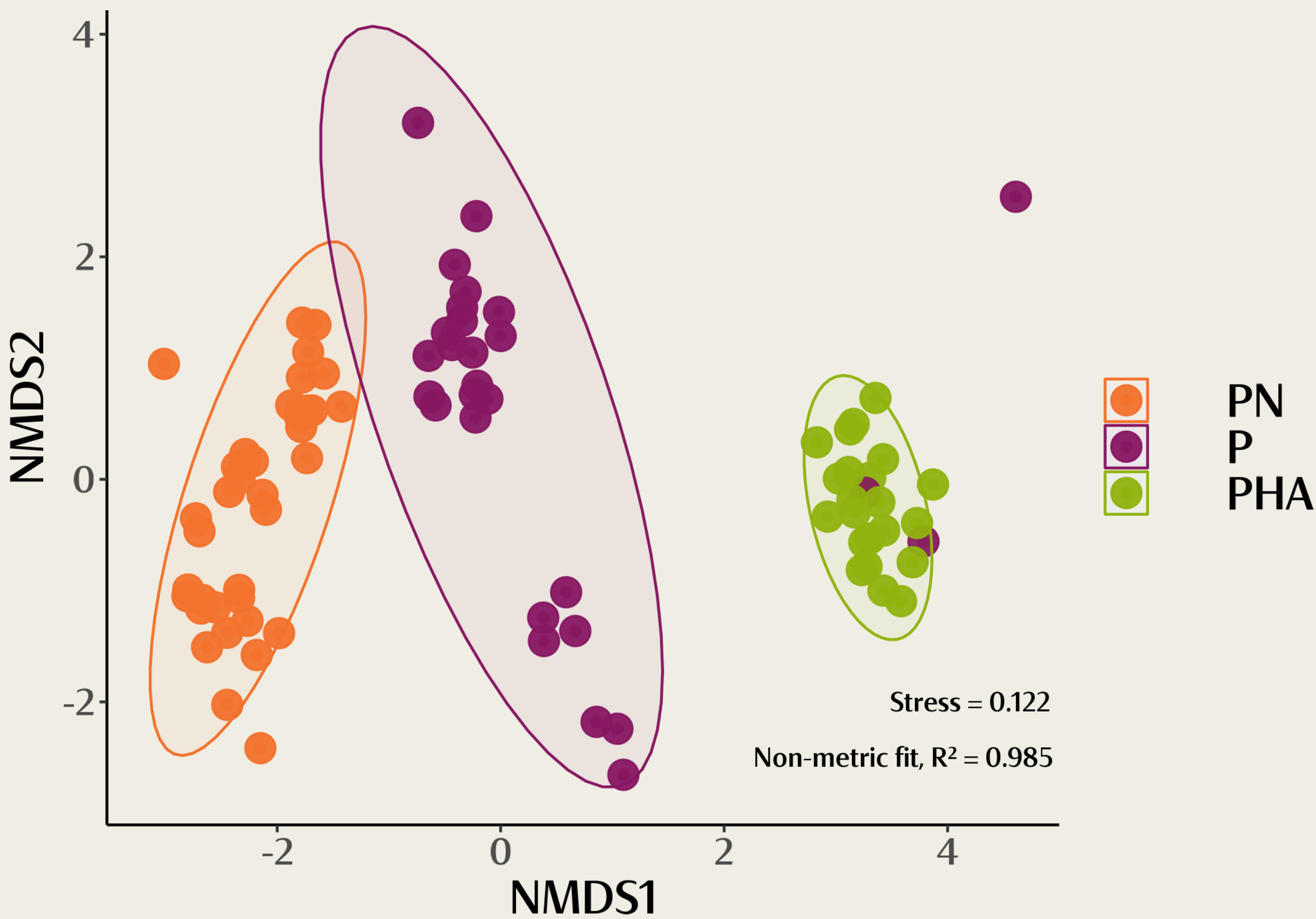
2. Workflow



3. Taxonomic Diversity

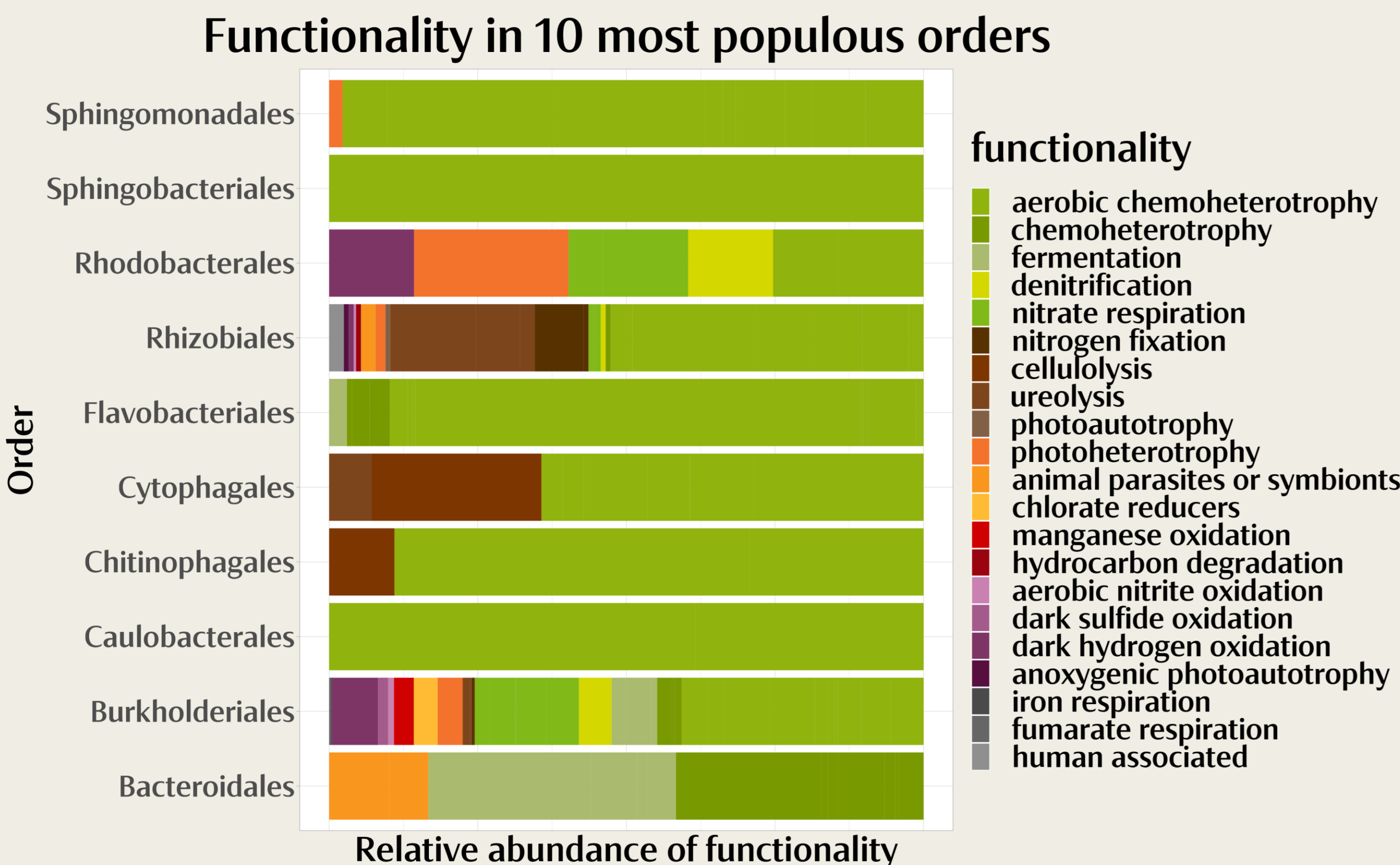


Many predominant orders are differentially abundant in AS. Proportions of the 10 most represented taxonomic orders out of 114 total taxa, by system. Caulobacteriales, Rhodobacteriales, Chitinophagales, Cytophagales, and Sphingobacteriales are differentially abundant between all three systems (ANCOM-BC, $p < 0.001$).

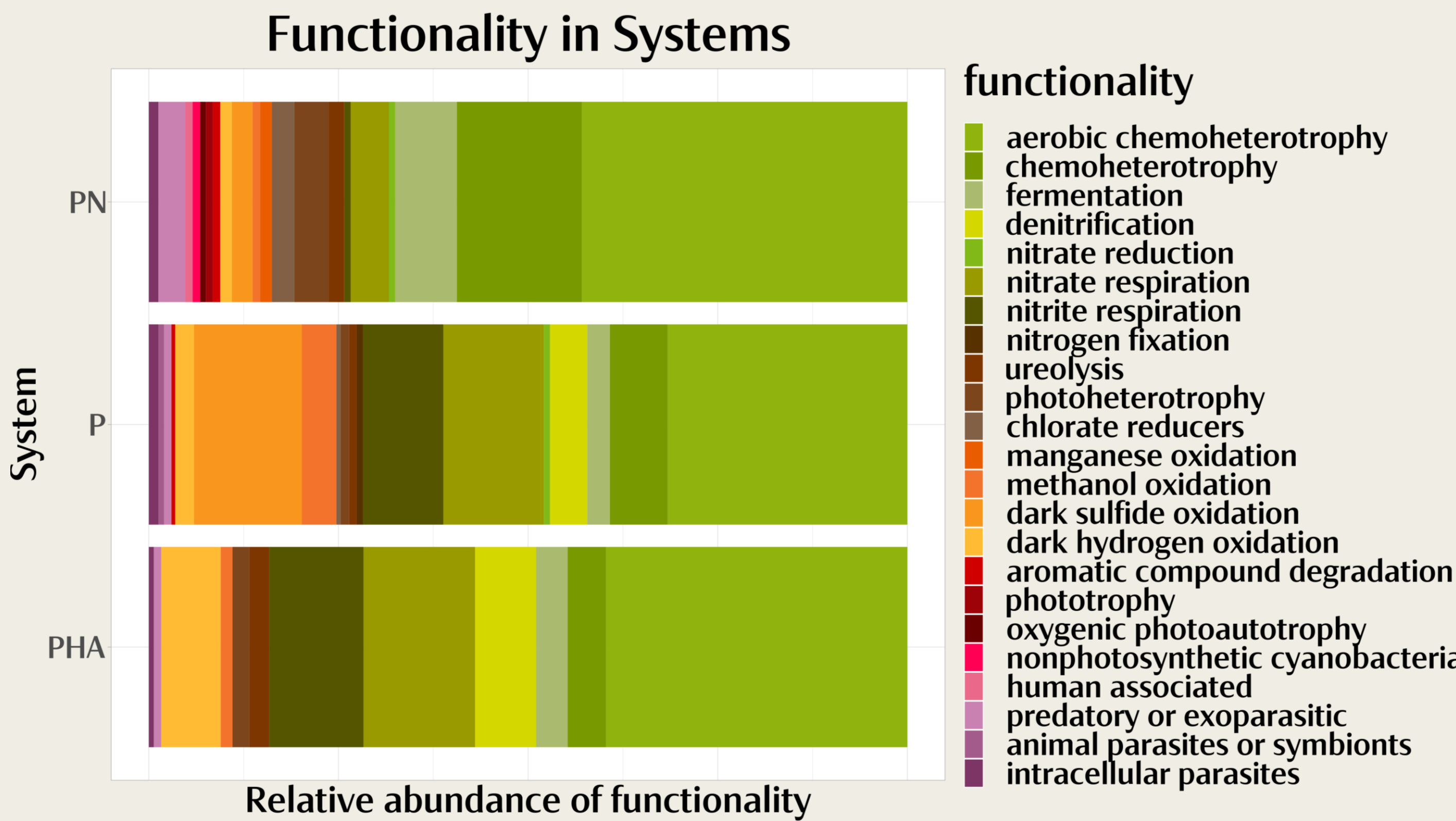


Samples cluster by system. Non-metric multidimensional scaling ordination with Bray-Curtis distances. Samples are points and axes are arbitrary.

4. Functional Potential



The most prevalent functional tags are WWT relevant. Functions directly relevant to WWT, such as P and N removal, are shown in green for the top 10 represented orders (above) and for each system type (below). Functional tags are generated by correlating taxonomy with known functional association in literature using the FAPROTAX database.



5. Conclusions

- There are significant differences in bacterial community structures between different systems.
- Functional potentials of the 10 most common bacterial orders are almost entirely related to wastewater treatment.
- Of the top bacterial orders, some have a wide variety of functional potential, while some are annotated with a single function—suggesting some orders have the potential to fill more roles, or that they are better annotated.
- There is evidence in these systems for functional redundancy, an ecological state in which multiple taxa preform the same function. This is important in WWT to ensure consistent processing across different scales, timepoints, and system configurations.

6. Future Directions

- Correlate system efficiency data with functional potential and taxonomy to search for bacterial taxa with a high individual effect on system performance
- Explore the functional potential of particular orders related to system performance, such as prevalence of PHA synthase genes for bioplastic bioreactors
- Redundancy analysis to identify the effects of other metadata variables on taxonomic composition

Acknowledgements

Thank you to our mentor Maxine Wren for technical support on this project. Data collection and analyses performed by the IIDS Genomics and Bioinformatics Resources Core at the University of Idaho were supported in part by NIH COBRE grant P30GM103324.

References

