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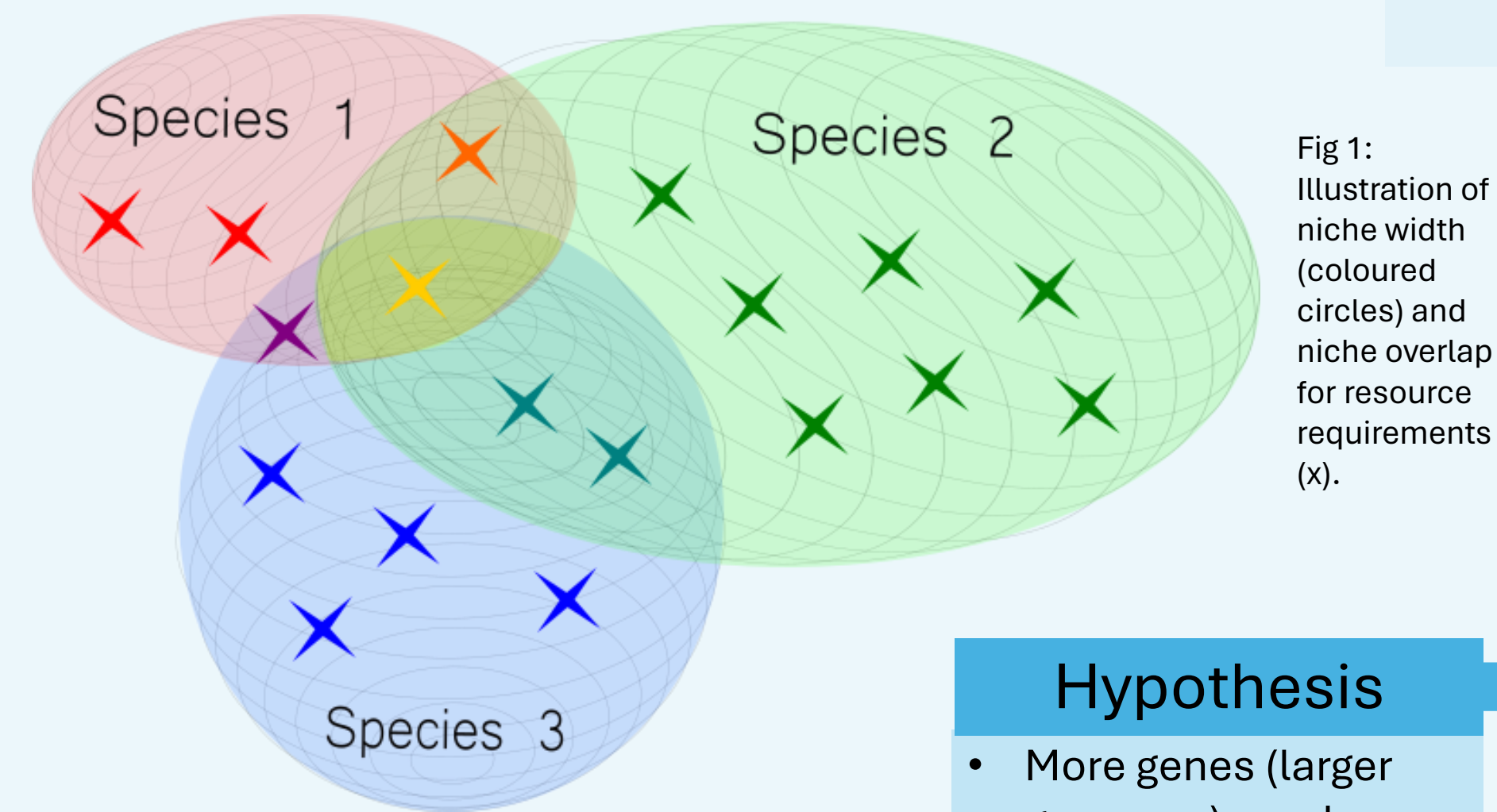


Fig 1: Illustration of niche width (coloured circles) and niche overlap for resource requirements (x).

Background

- The ecological resource niche is the **set of resources an organism requires for growth within its environment** (fig 1). It can be observed by studying media recipes used to culture prokaryotes for optimal growth.
- Expanding on KOMODO¹, the **MediaDive** database² from DSMZ standardizes media recipes with the microbes able to grow on them.
- There is a limited understanding of how the fundamental niche (comprising intrinsic characteristics) effects the realised prokaryotic resource niche.

Hypothesis

- More genes (larger genomes) need more nitrogen and phosphorus resources³ for DNA replication, reducing the number of suitable growth media (**niche width**).
- Fewer genes limit the enzyme repertoire for resource conversion, reducing the number of suitable growth media.
- Species relatedness dictates patterns of resource niche overlap in prokaryotes.

Objectives

- Create a unified framework linking species to their optimal resource media and constituent ingredient requirements.
- For **intrinsic characteristics**: organism genome size, organism GC content, number of genes and number of protein coding genes, are there correlations with niche width and ingredient requirements?

Methods

- Create a combined dataset of prokaryotes and their a) optimal growth media (b) optimal ingredient requirements (c) Intrinsic characteristics, via REST API calls to the NCBI and DSMZ.
- Perform niche width analysis using the number of optimal media against the four intrinsic characteristics.
- Analyze correlations for intrinsic characteristics and ingredient requirements using spearman's ranked correlation coefficient

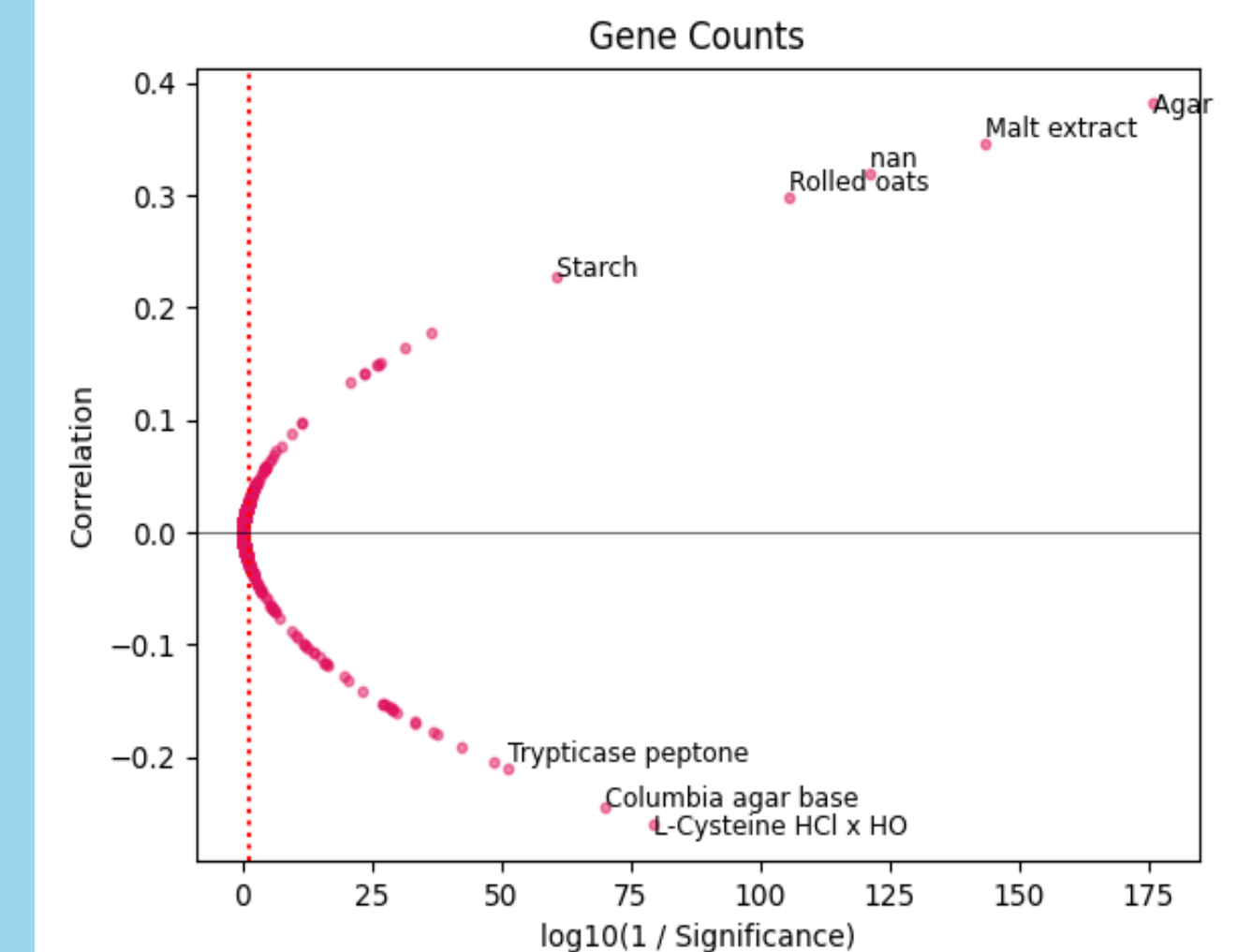


Fig 3: Relationship between $\log_{10}(1/\text{significance})$ and correlation coefficient for ingredient per gene count. Labels = Highly significant correlations, dotted red line = 5% significance level, solid black line = no correlation.

Preliminary Insights

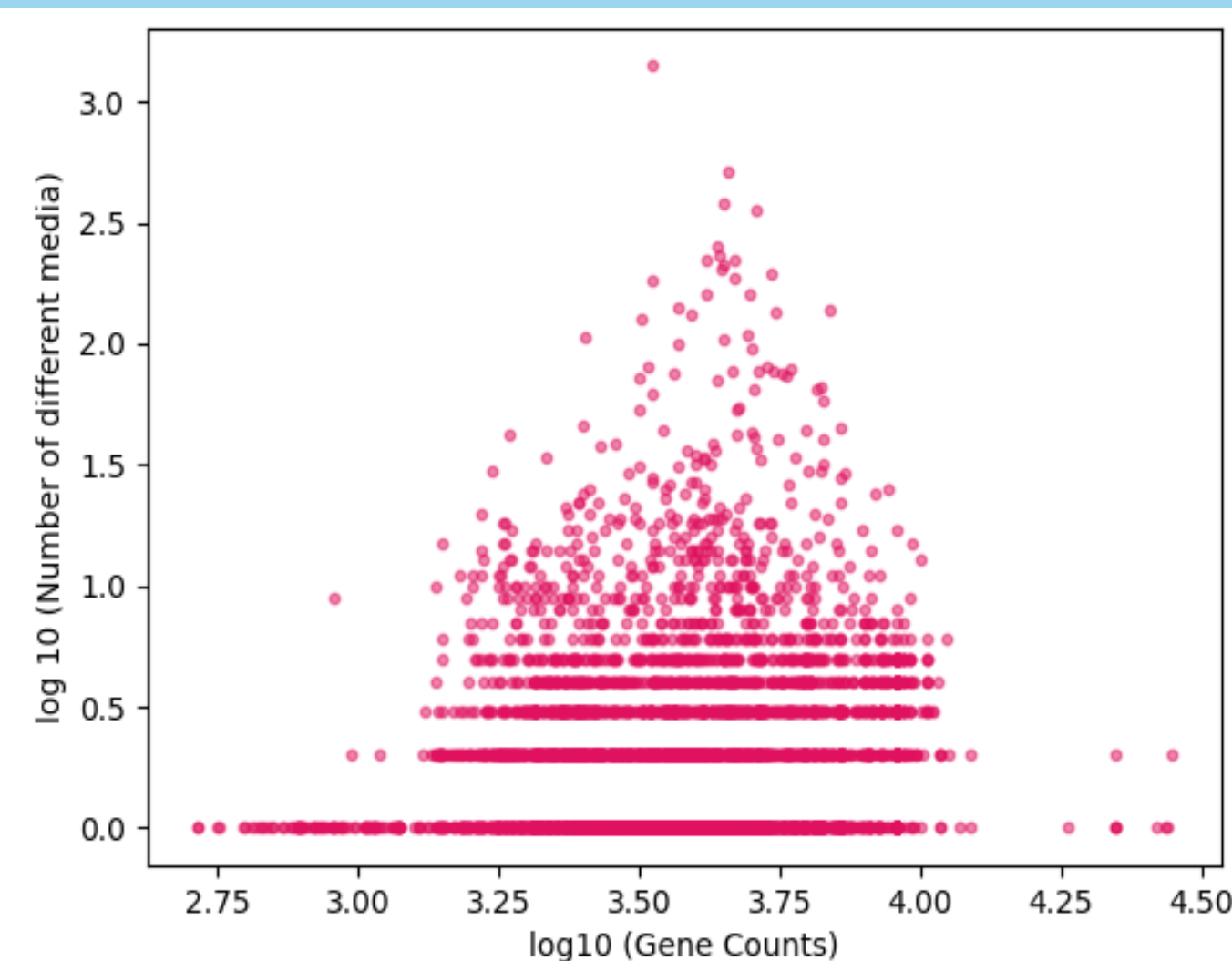


Fig 2: Relationship between \log_{10} scaled genome size and \log scaled niche width (denoted by number of different media). Discrete values on the y-axis are caused by log scaling for lower values.

Next Steps

- Microbes will fall into set life history strategies due to evolutionary trade-offs⁴.
- Investigate whether resource niche clustering occurs based on life-history strategies using PCA.
- Determine phylogenetic causes for the relationships involved.

References

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