



LINKING AIR AND LEAVES: DISENTANGLING THE MAIN DRIVERS OF MICROBIAL ASSEMBLY AND EXCHANGE IN THE URBAN PHYLLOSPHERE

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OUTLINE

Introduction

Research Questions

Sampling design

Experimental activity

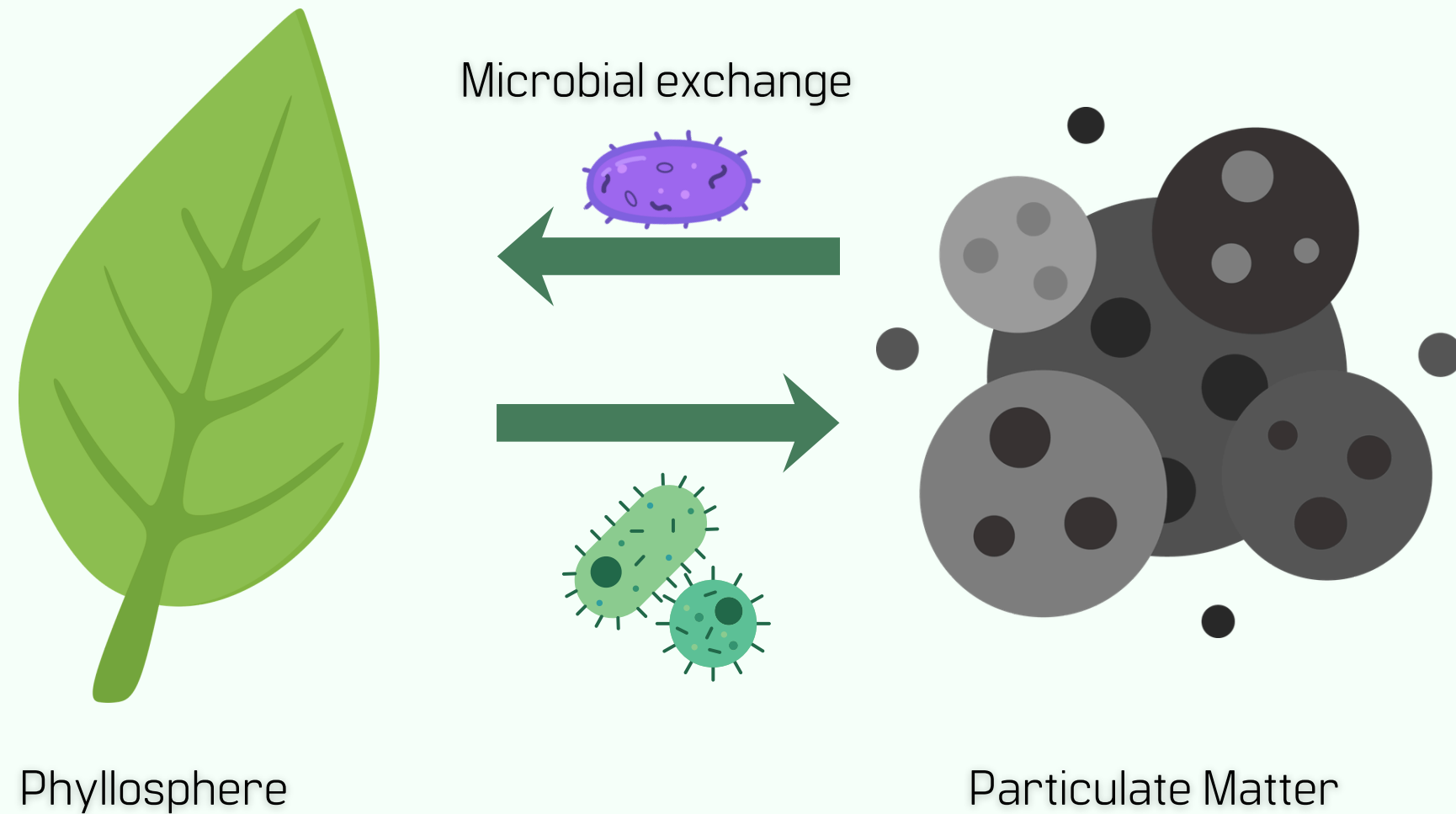
Statistical analysis

Results

Conceptual Synthesis

Conclusions

INTRODUCTION



Why does it matter?

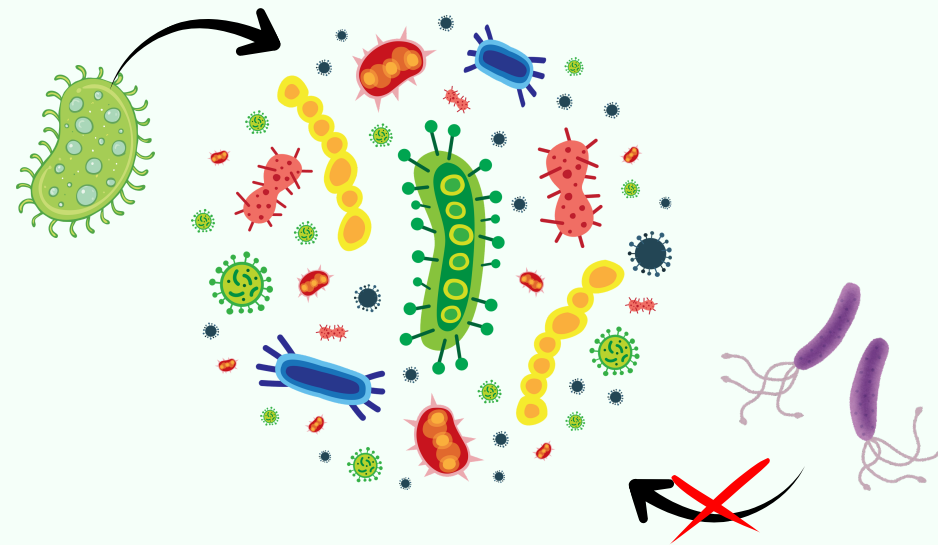
- The phyllosphere is an open system, where a lot of microbes can arrive, but few establish themselves
- Particulate matter can be an important source of microbes, but the main drivers for selection and dispersal are unknown.
- Understanding microbial assembly and exchange is crucial to predict how and when phyllosphere communities can support biodiversity maintenance and ecosystem services, such as the degradation of atmospheric pollutants

How? When?

RESEARCH QUESTIONS

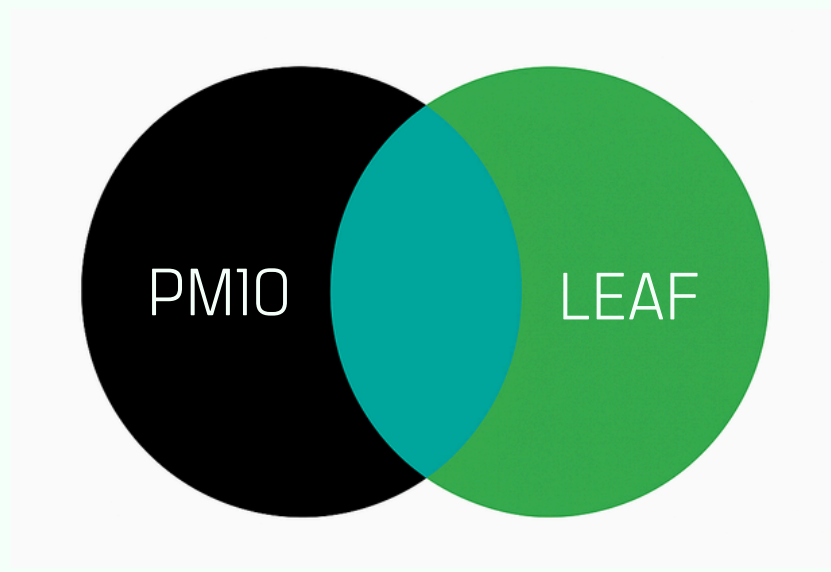
Q1

What drives microbial assembly in the urban phyllosphere and PM?



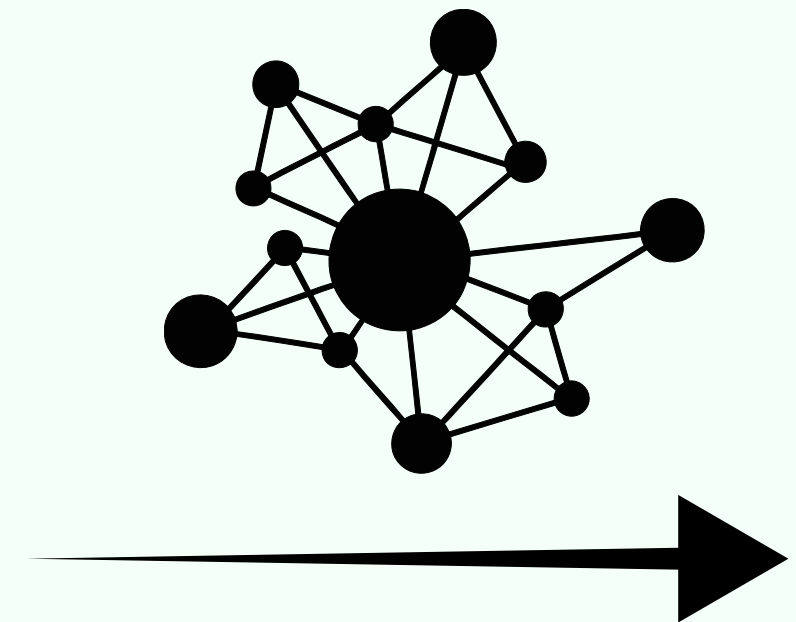
Q2

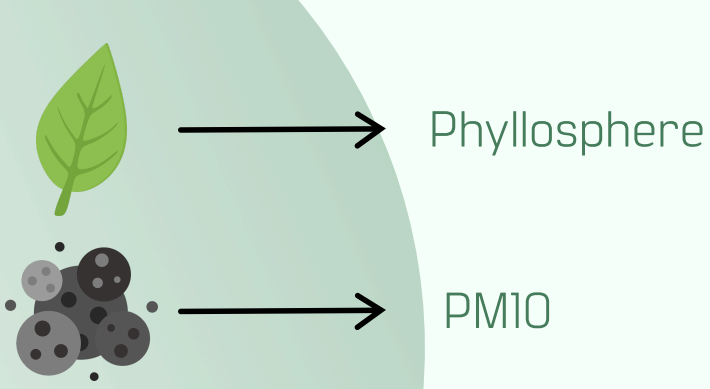
How connected are airborne and leaf-associated microbial communities?



Q3

How are these communities changing over time?





SAMPLING DESIGN

Sampling sites



Parco Nord
Extra-urban park



Indro Montanelli
Urban park



Fulvio Testi
Urban road



Milan-Bicocca
University
Urban site

Plant species

Evergreen species



*Hedera
helix*



*Magnolia
grandiflora*

Deciduous species



*Acer
platanoides*



*Platanus x
acerifolia*



PM10
Quarz-fiber filter
24h sampling using high-volume sampler

Seasons 2024



Winter



Spring



Summer



Autumn



108



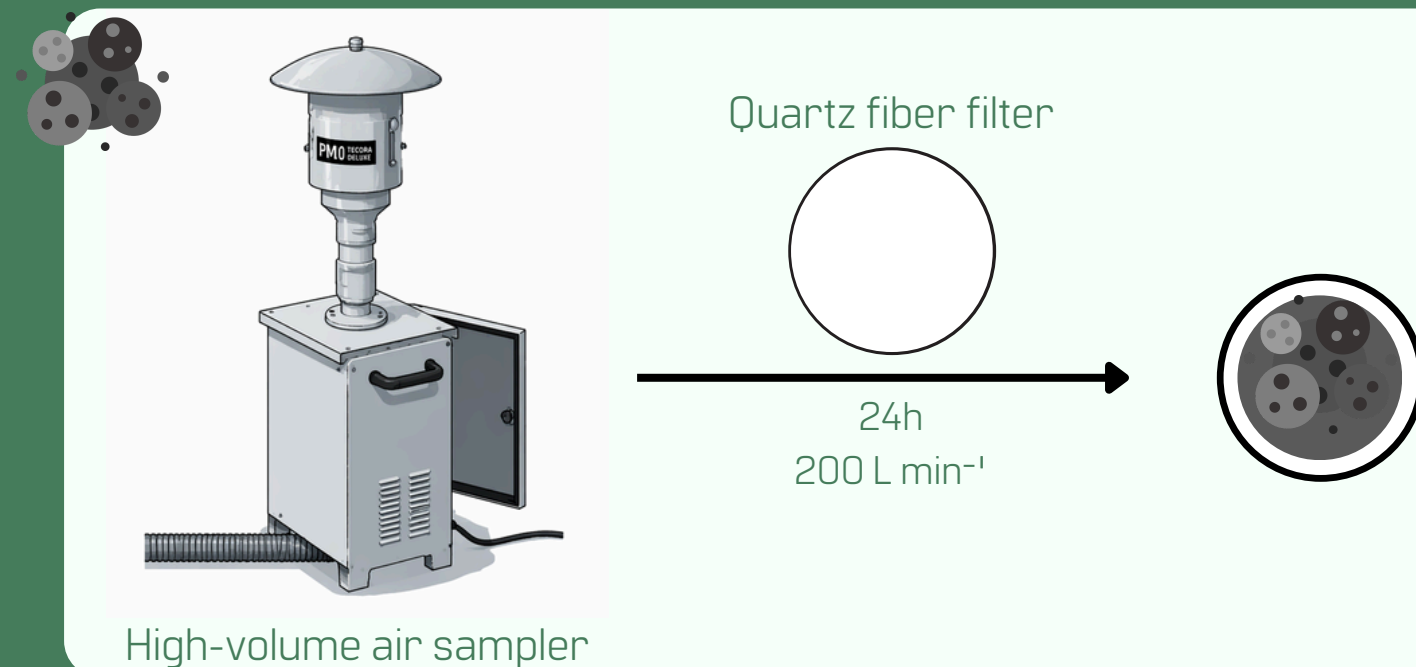
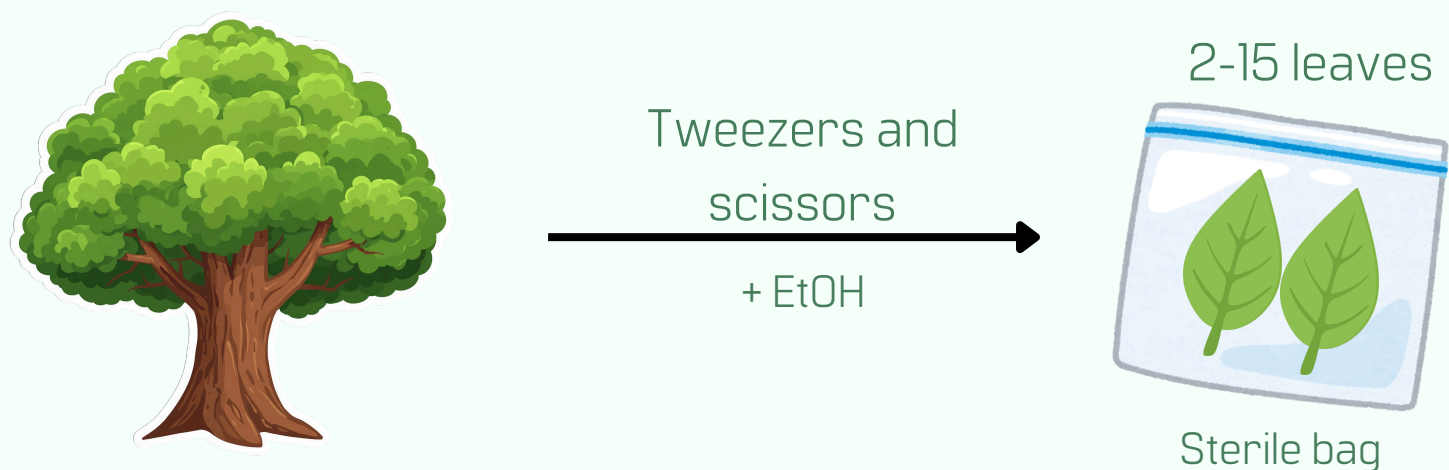
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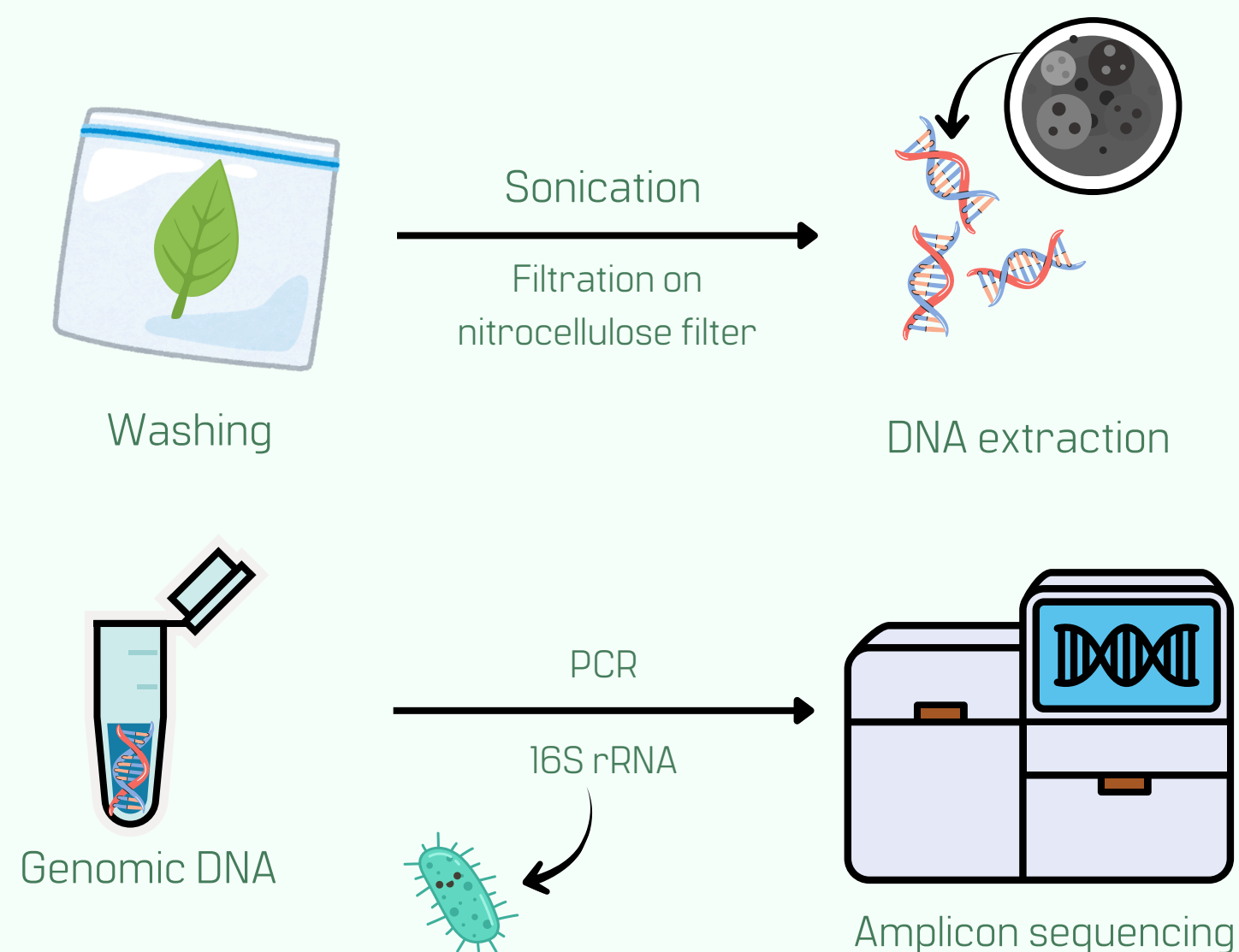
→ Discover our sequencing facility

EXPERIMENTAL ACTIVITY

Sampling activity



Experimental workflow

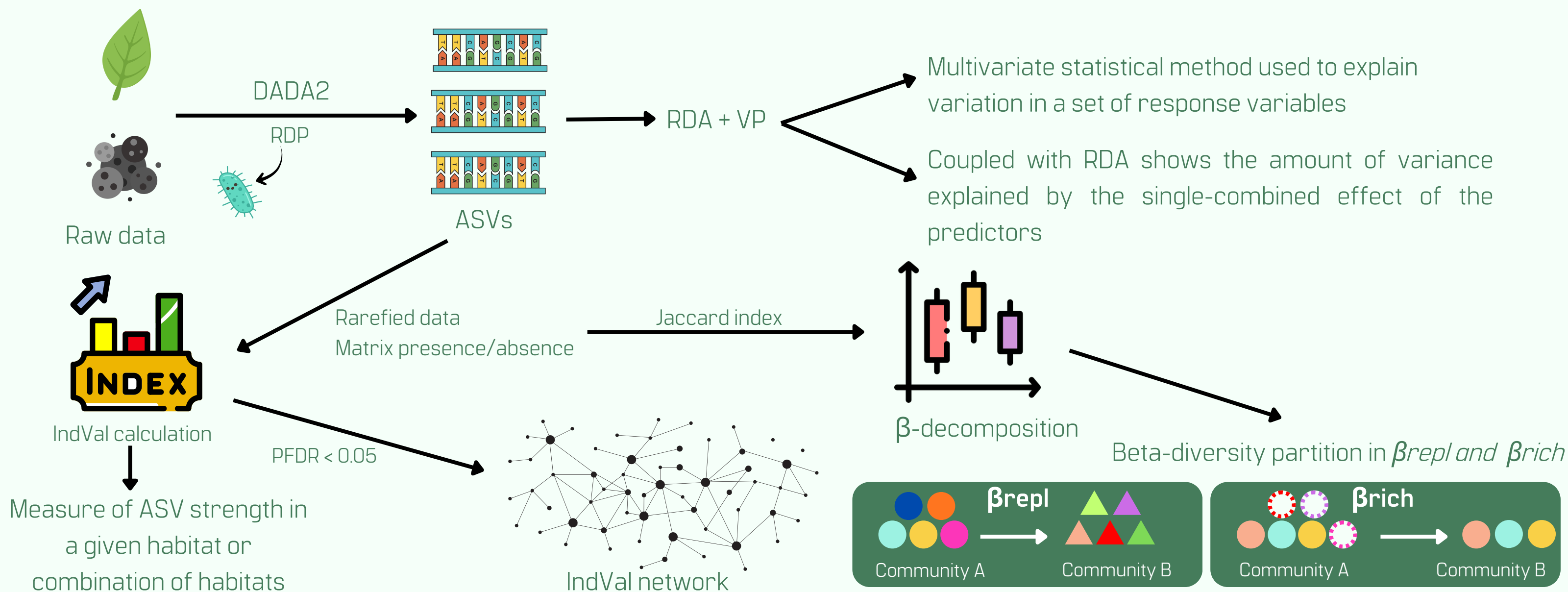


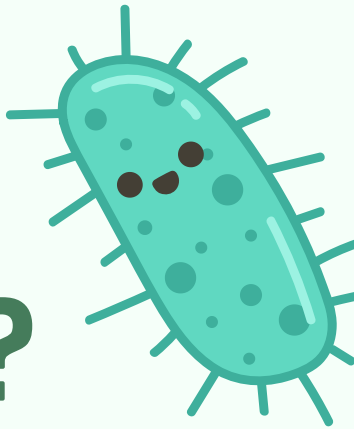


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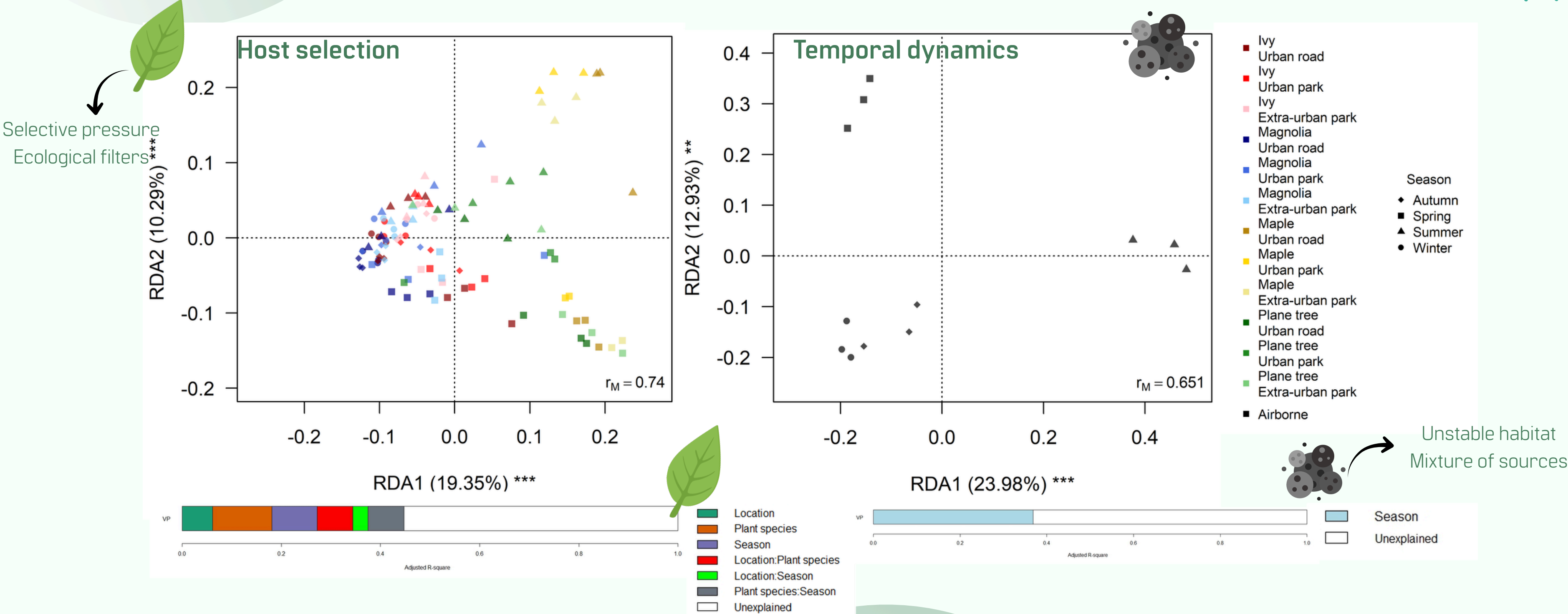
STATISTICAL ANALYSIS

Statistical analysis



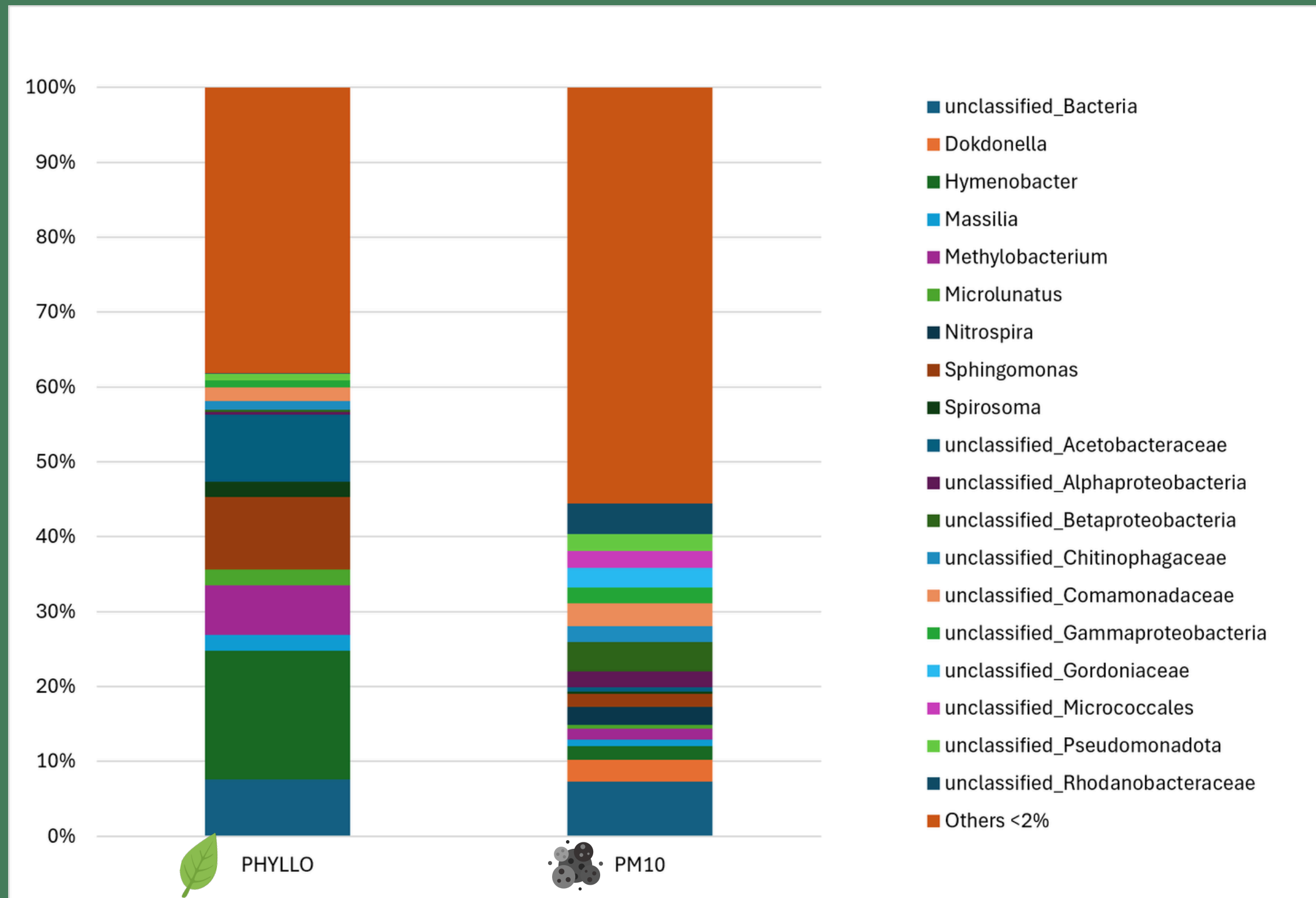


WHICH FACTORS STRUCTURED THE COMMUNITIES?



Host identity, season and site significantly influenced community composition. However, host identity emerged as the strongest determinant for leaf-associated bacteria. Season was the most important driver in shaping the bacterial community for PM10.

AIR AND LEAVES HOST DIFFERENT WORLDS



The leaves hosted 4 main groups:

1. *Hymenobacter*
2. *Methylobacterium*
3. *Sphingomonas*
4. Acetobacteraceae unc.

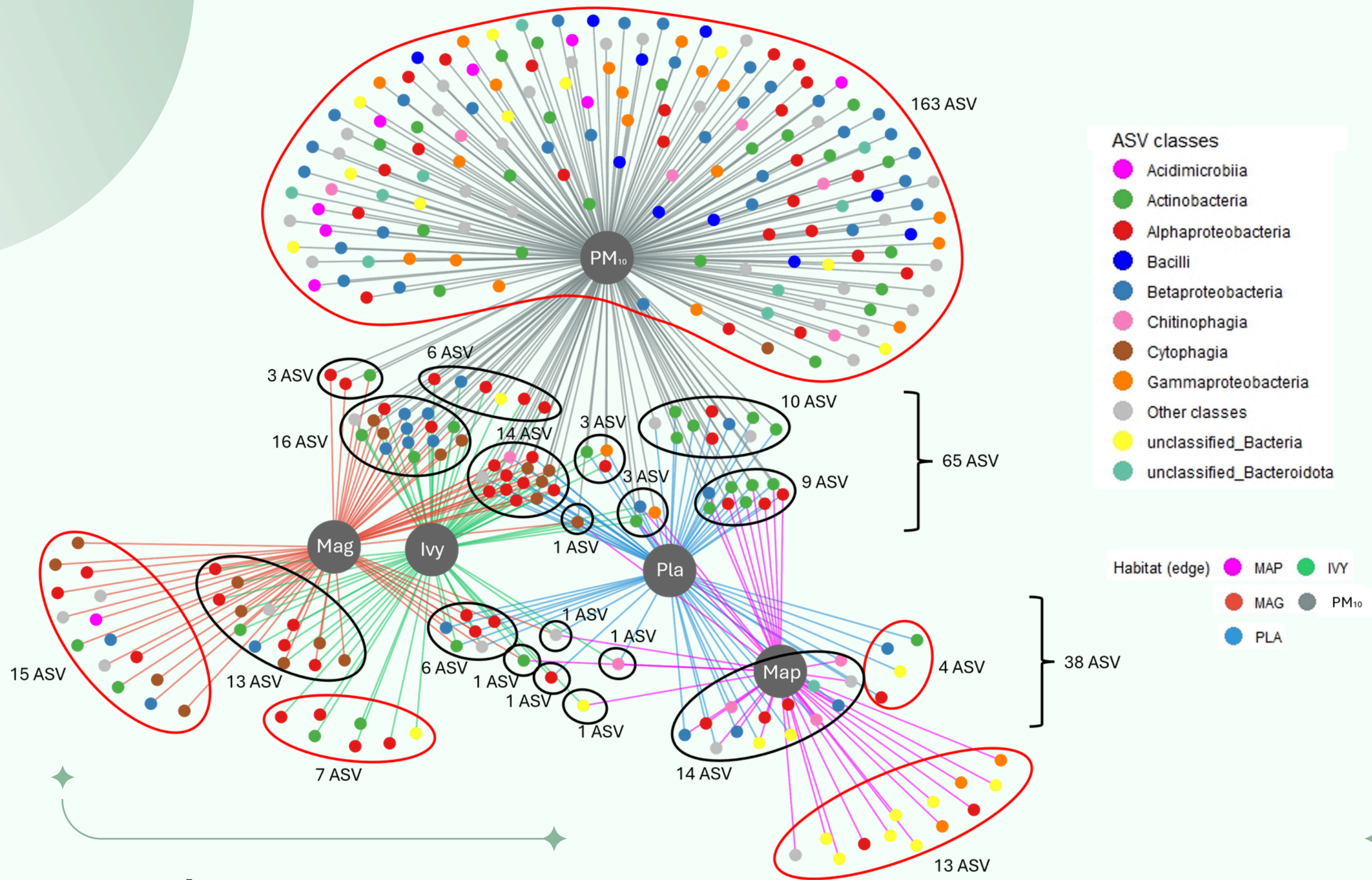
High evenness (50% other genera)

PM10 had a more complex composition, without a real core microbiome.

Larger biodiversity compared to leaves

The particulate matter contains a broader and more variable microbial pool, while leaves select a relatively stable core microbiome while still maintaining high levels of microbial diversity

BUT ARE THEY CONNECTED?



PM₁₀ → Highest number of Indicator TAXA

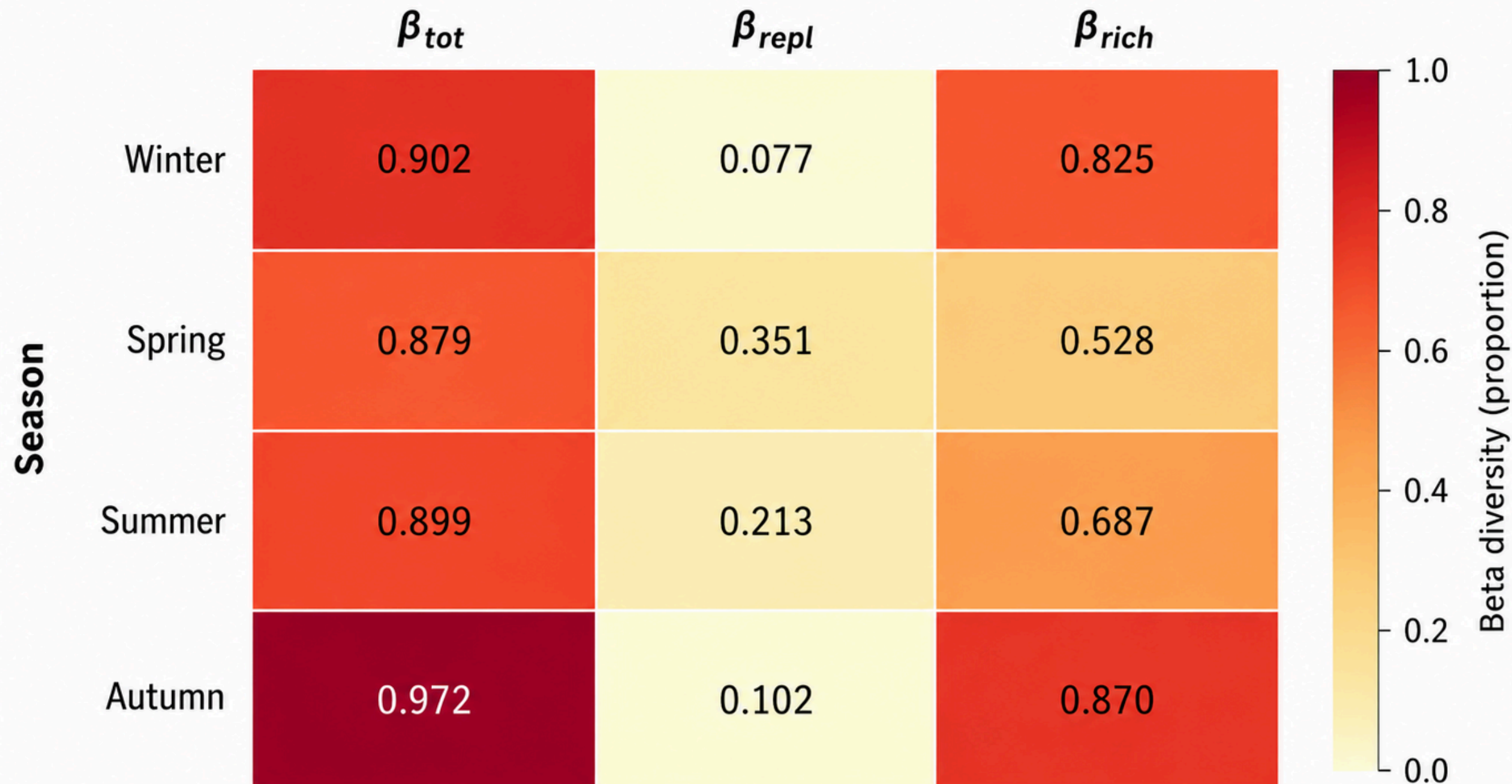
Plant species → different microbial indicators

Including PM₁₀ increased the number of shared indicator taxa among habitats

These results suggest that PM₁₀ may act as a reservoir and dispersal hub connecting phyllosphere communities

COMMUNITIES CHANGED THROUGH SEASONS

Seasonal beta diversity components (Bacteria)

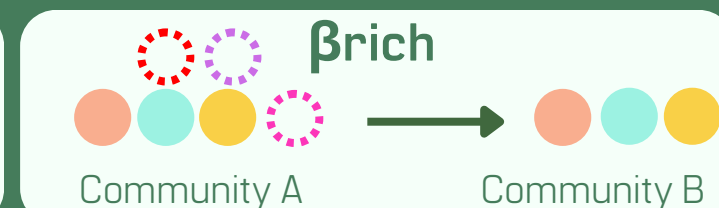
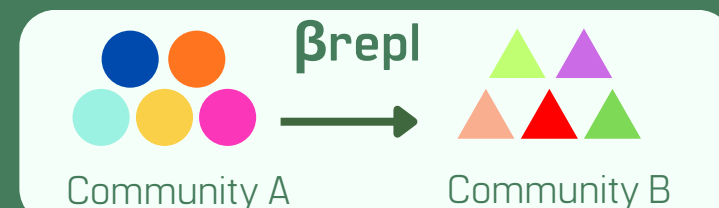


Total beta-diversity between PM10 and leaves → high value during all seasons
→ It means that PM10 and phyllosphere are very different in terms of microbial composition
→ **DISPERSAL**

Cold seasons → highest values of β_{rich} , little influence of replacement
→ Differences in communities due to the number of taxa

Hot seasons → higher β_{repl} compared to cold seasons, but also high values in β_{rich}
→ Increased biological activity and new leaf colonization reshaped community composition.

→ Differences due to composition
→ **SELECTION**



CONCEPTUAL SYNTHESIS



HOST IDENTITY

Strongest determinant for leaf communities



SEASON

Most important driver for PM10 communities



SITE

Significant effect, but secondary

PHYLLOSHERE

Selection of a relatively stable community

- Core microbiome
- High biodiversity
- Strong host filtering

DISPERSAL HUB

PM10 acts as a reservoir and dispersal hub, connecting distinct phyllosphere communities

PM10

Open and variable community

- Highest number of indicator taxa
- No real core microbiome
- Larger biodiversity
- Variable microbial pool through seasons

COLD SEASONS



- Highest β_{rich}
- Differences mainly due to the different number of taxa between compartments

DISPERSAL

HOT SEASONS

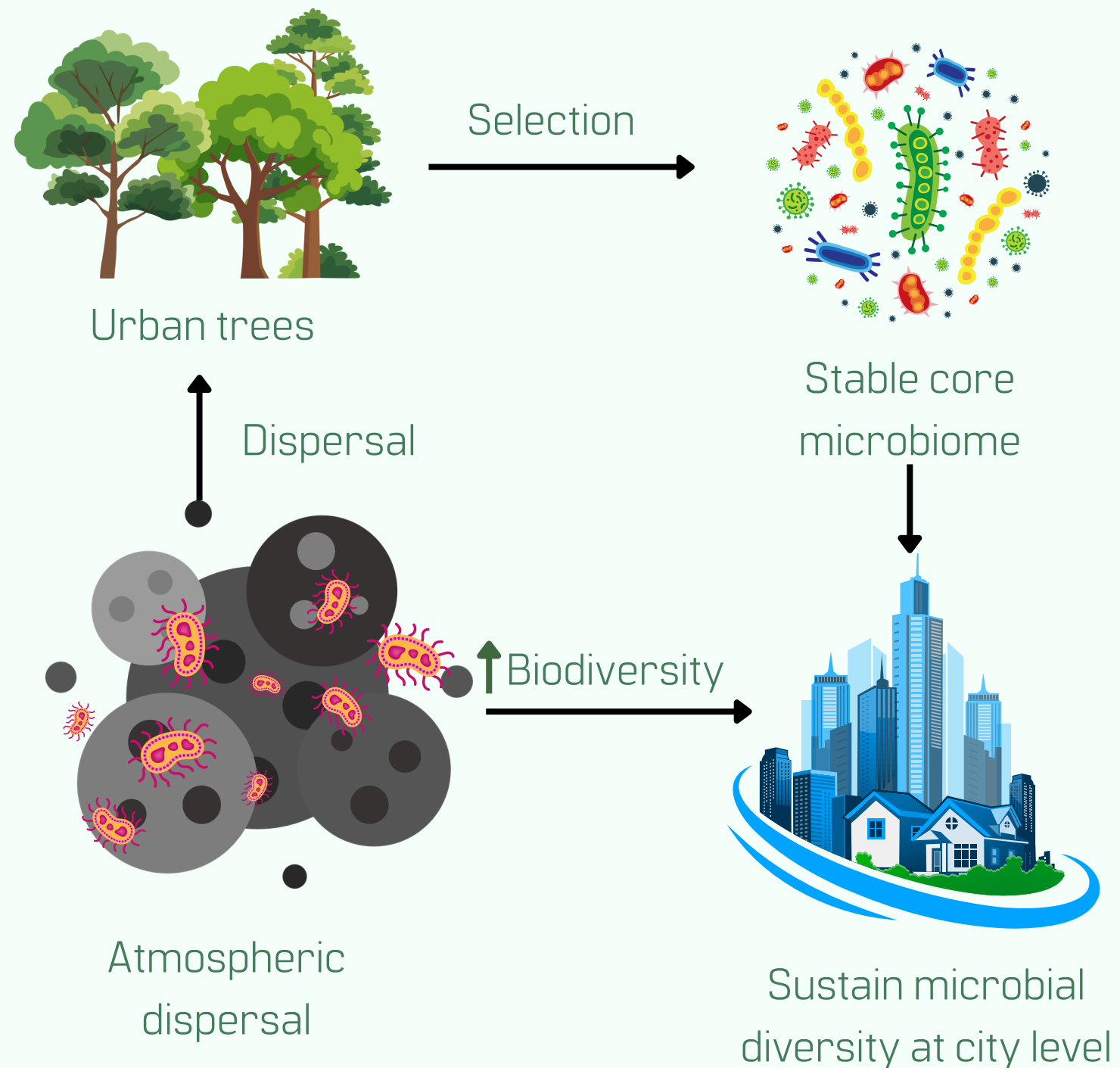


- Higher β_{repl}
 - Increased biological activity and new leaf colonization
- Differences due to the composition or turnover of taxa and richness

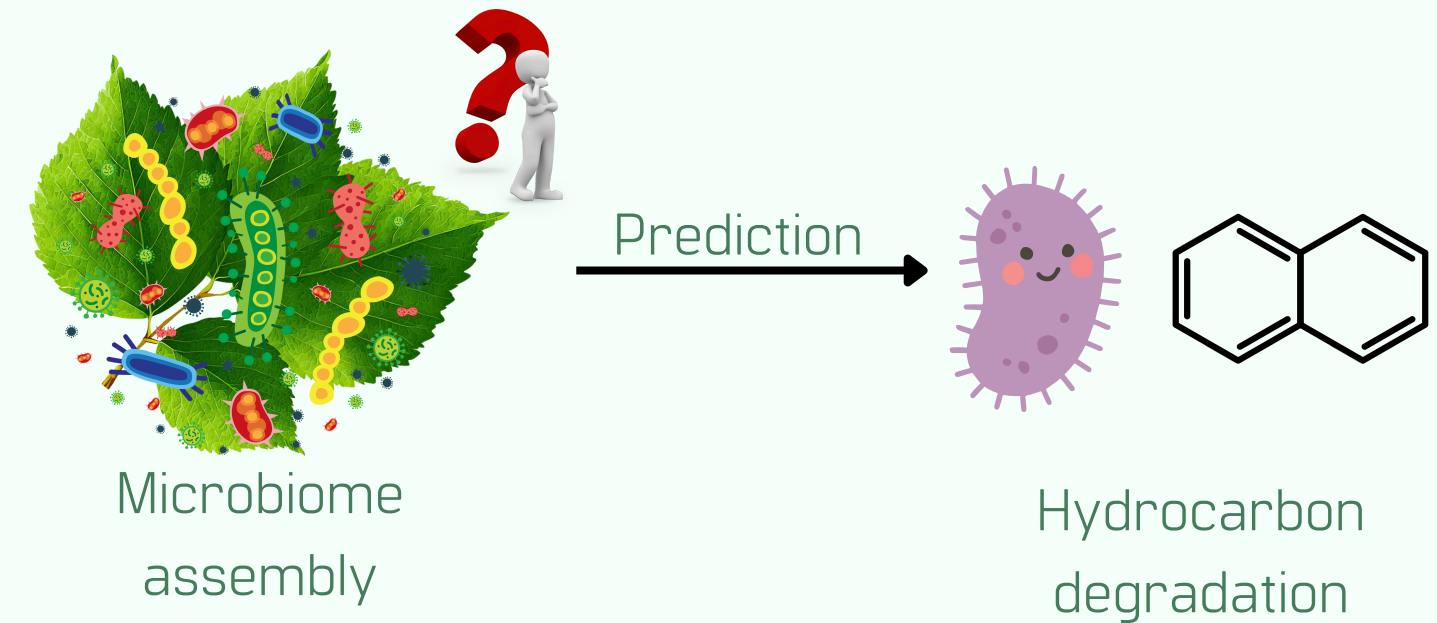
SELECTION

CONCLUSIONS AND FUTURE DIRECTIONS

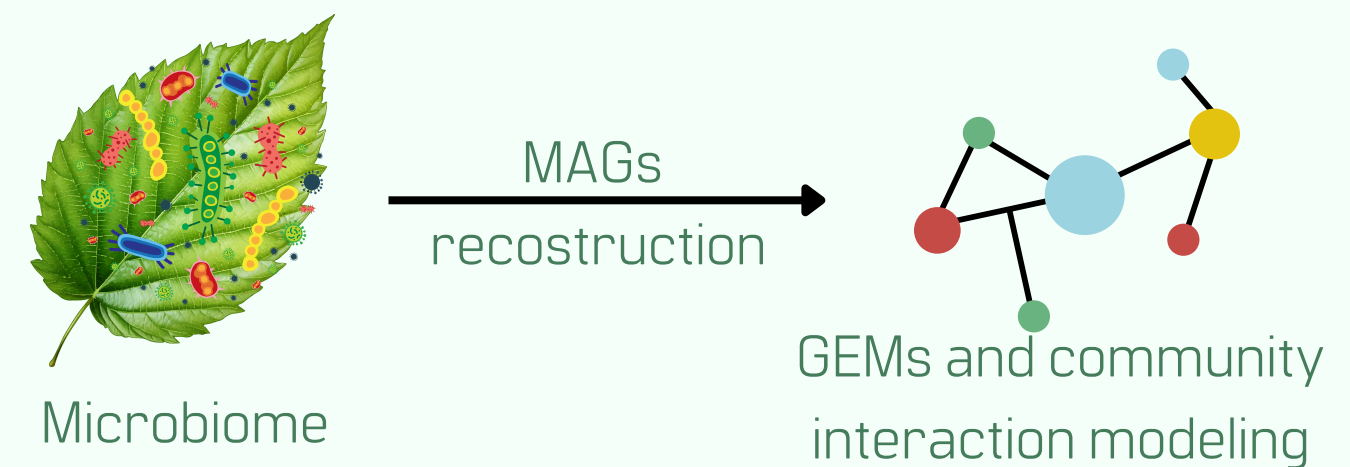
ECOLOGICAL IMPLICATIONS



APPLIED IMPLICATIONS



FUTURE DIRECTIONS





→ Discover our
sequencing facility

THANK YOU!

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→ Riccardo Grimoldi



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Italiadomani

PIANO NAZIONALE DI RIPRESA E RESILIENZA

