

Can a microbial community be artificially evolved to degrade plastic?

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MICRO2018
@RobynJWright



Can a microbial community biodegrade PET?

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Introduction



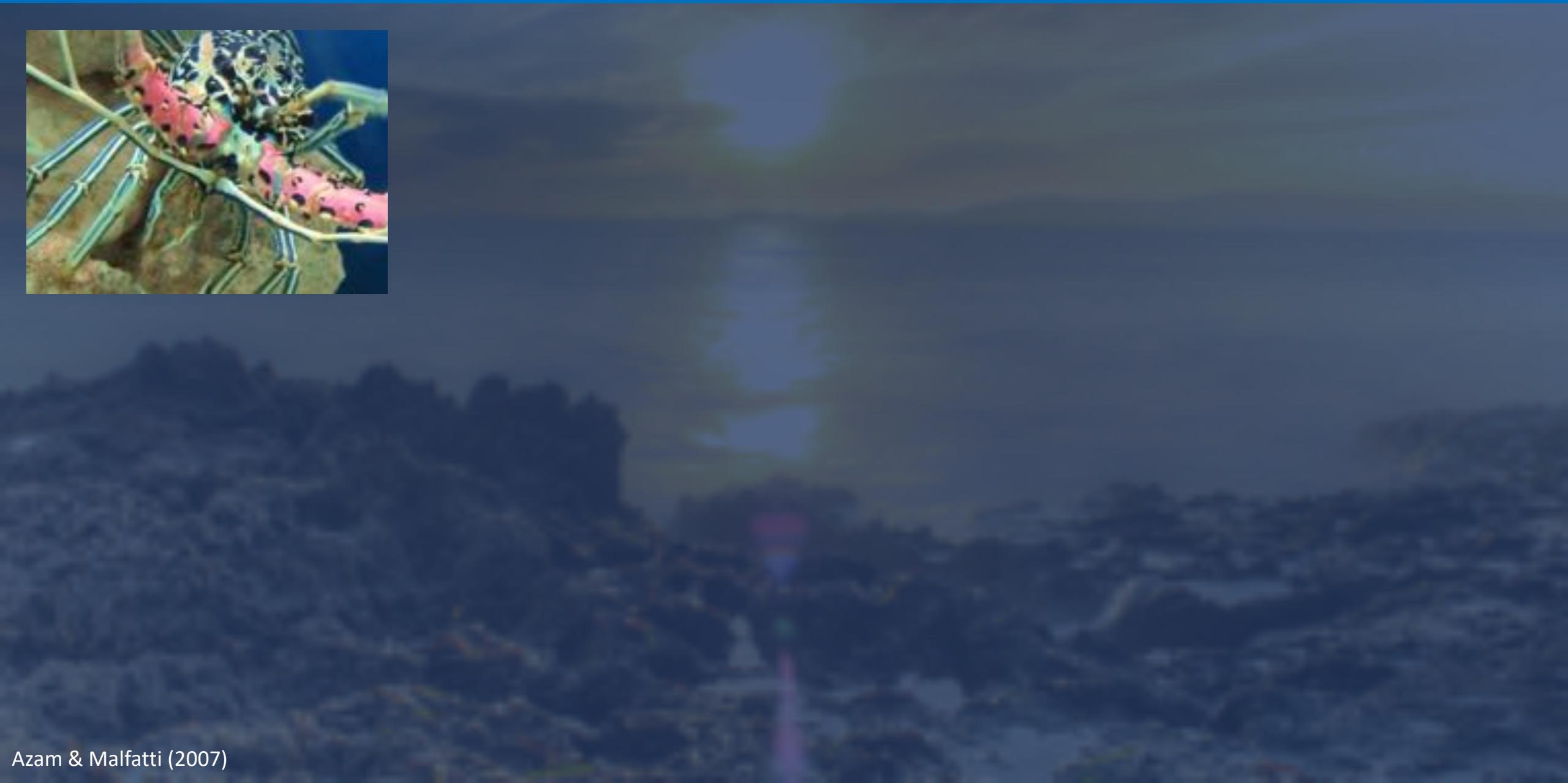
Introduction



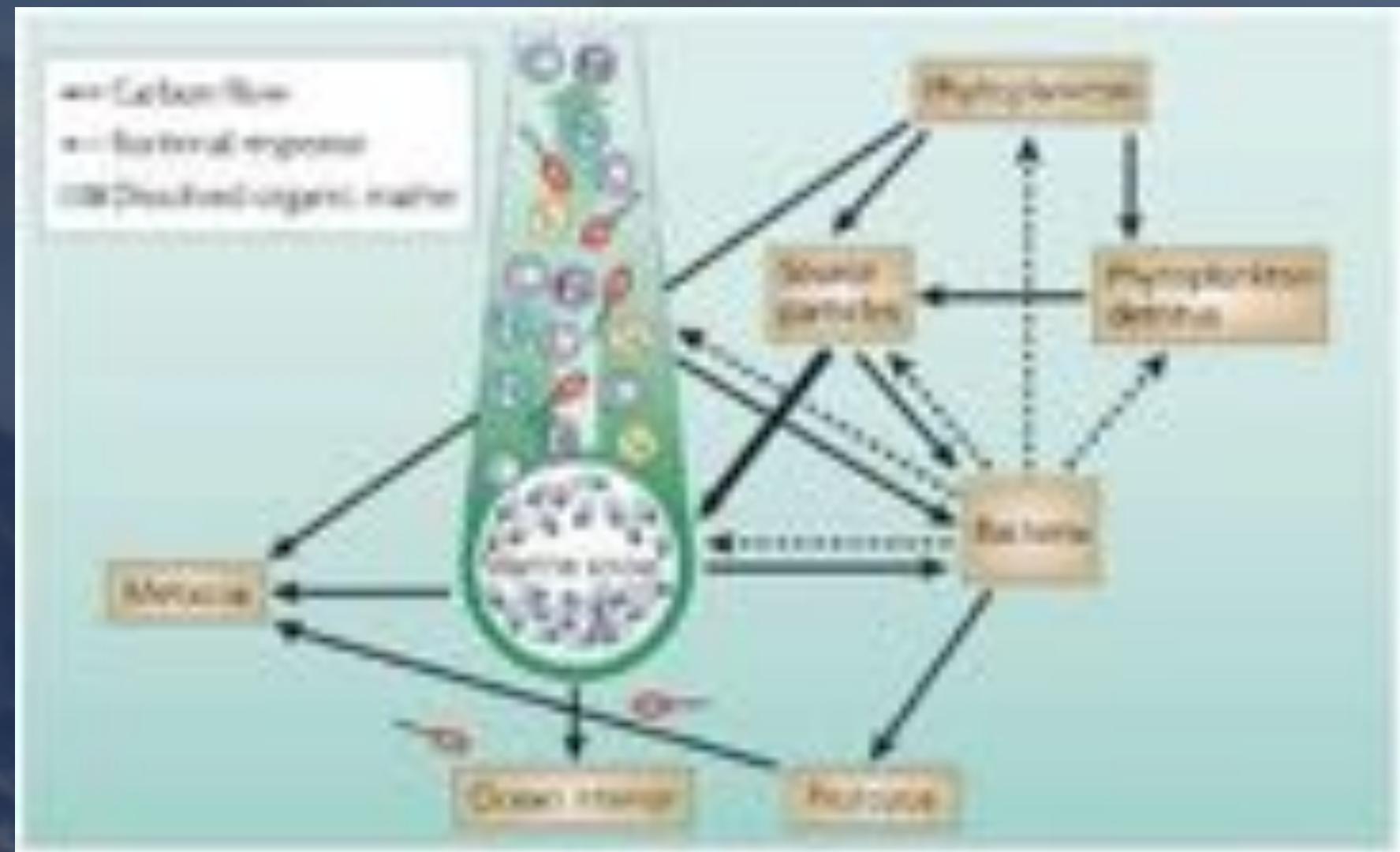
Ideonella sakaiensis – PET degrader



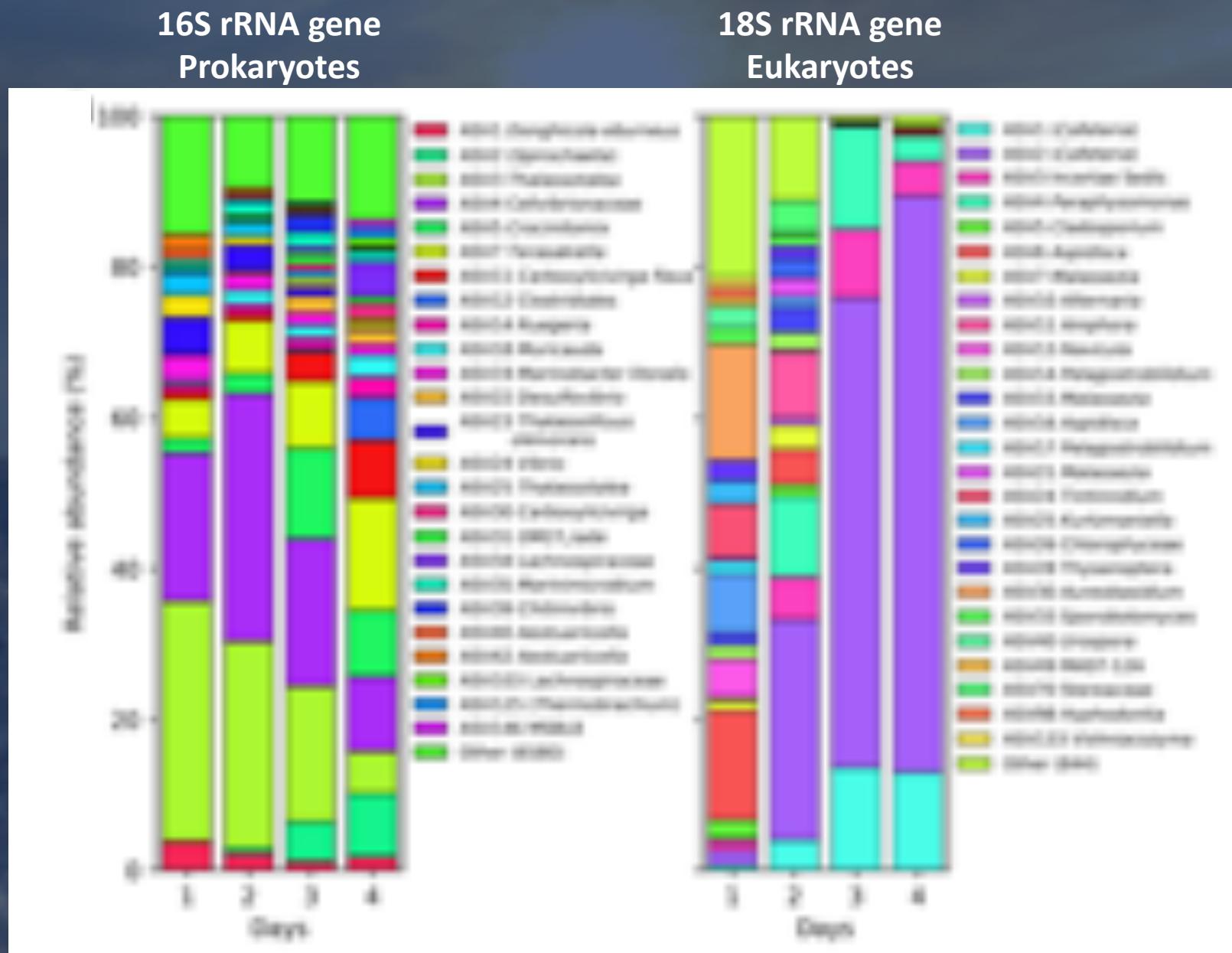
Introduction



Introduction



Chitin community succession



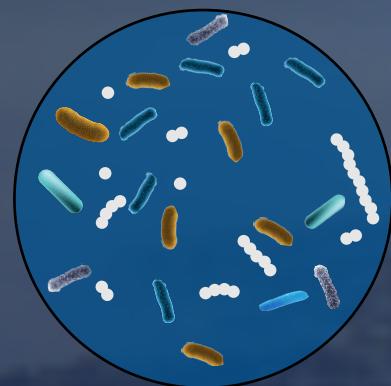
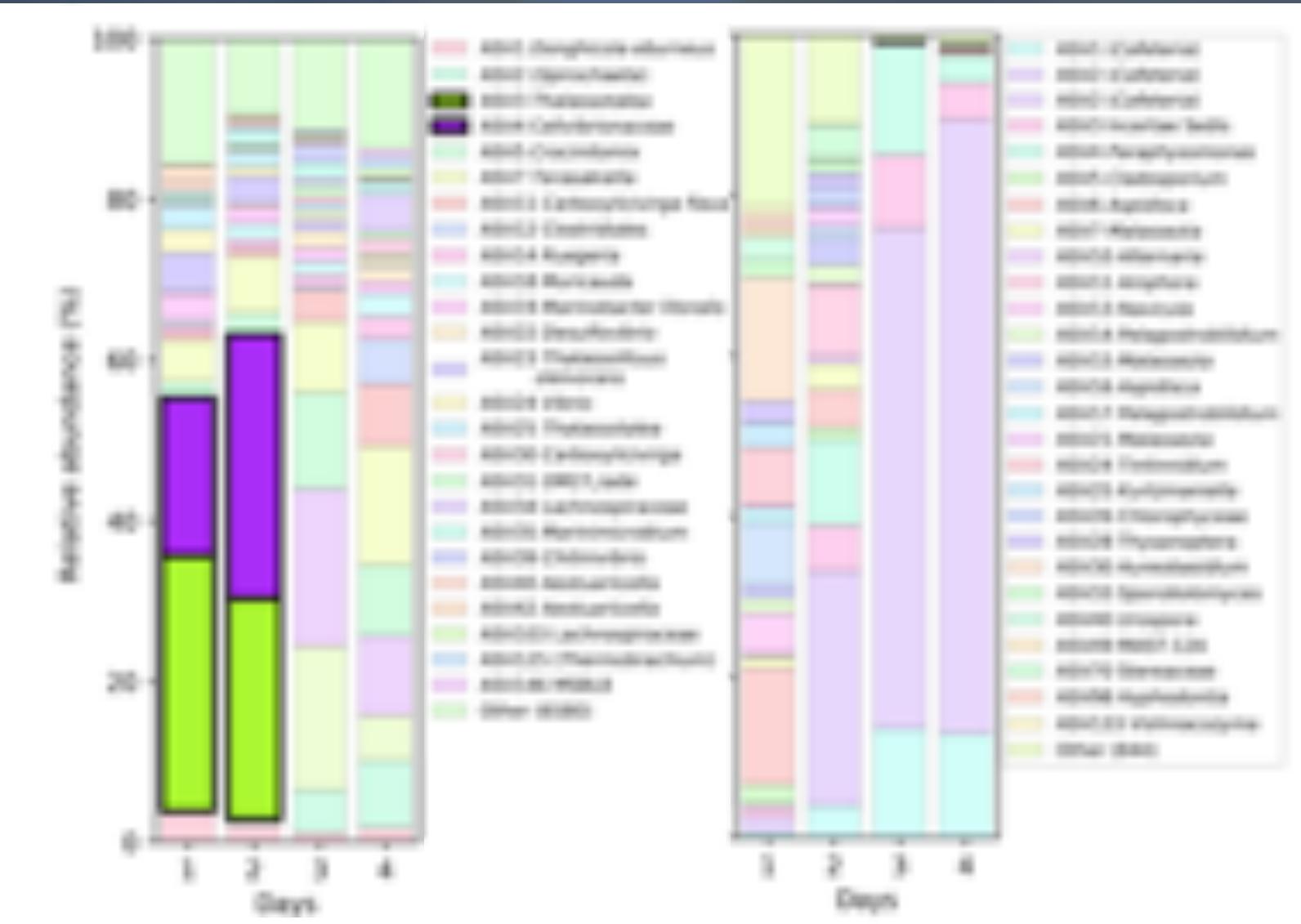
Chitin community succession

16S rRNA gene

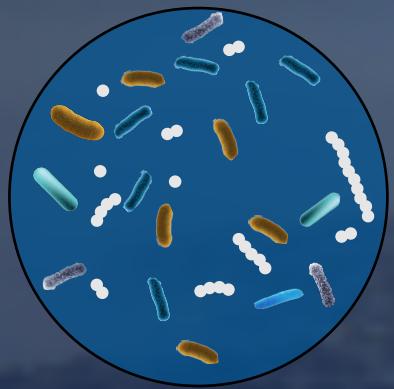
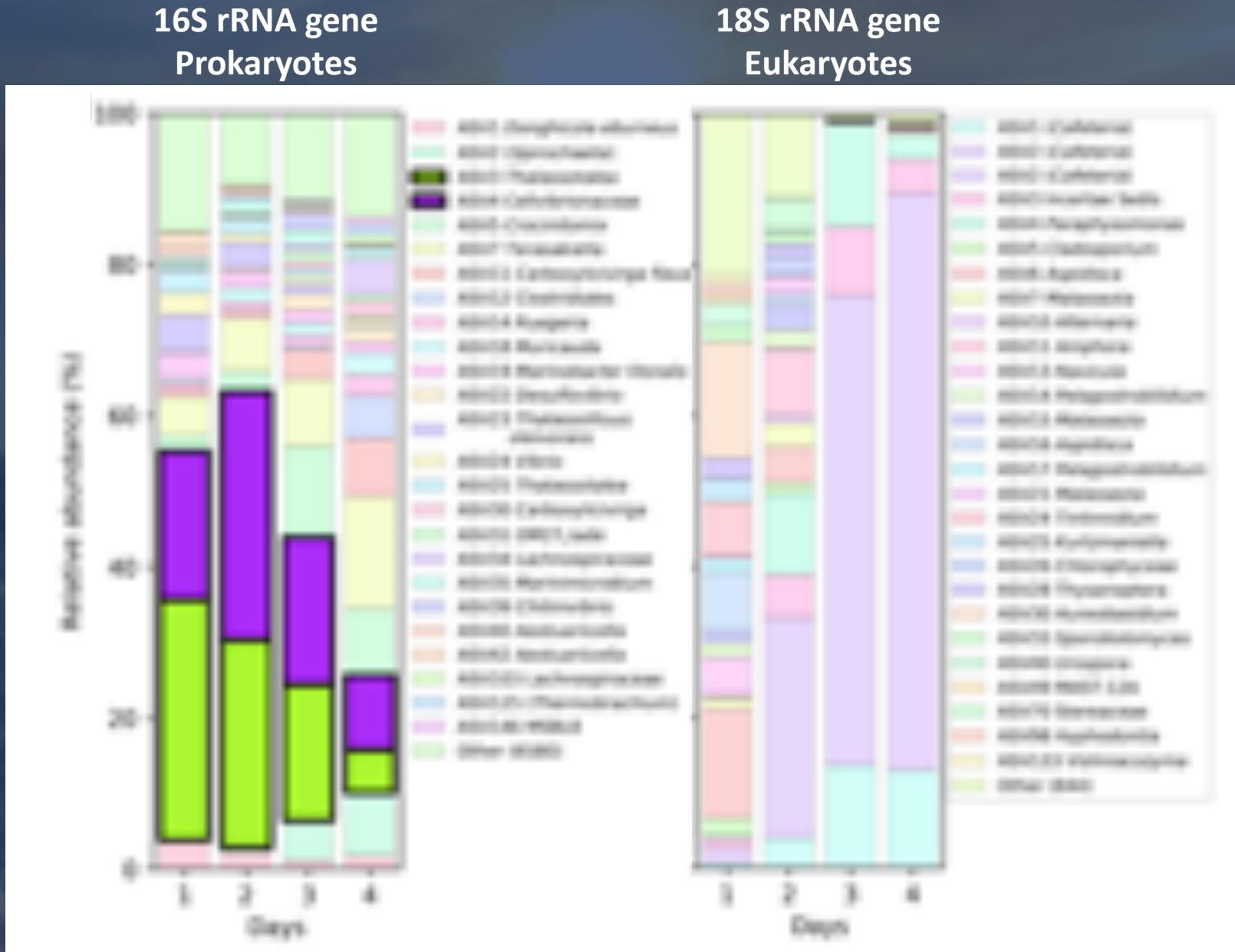
Prokaryotes

18S rRNA gene

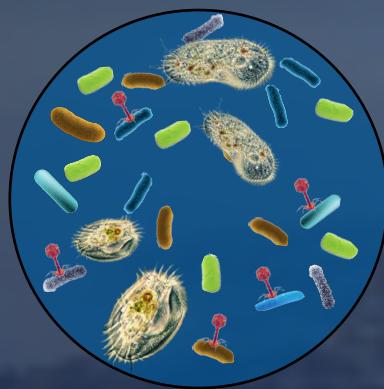
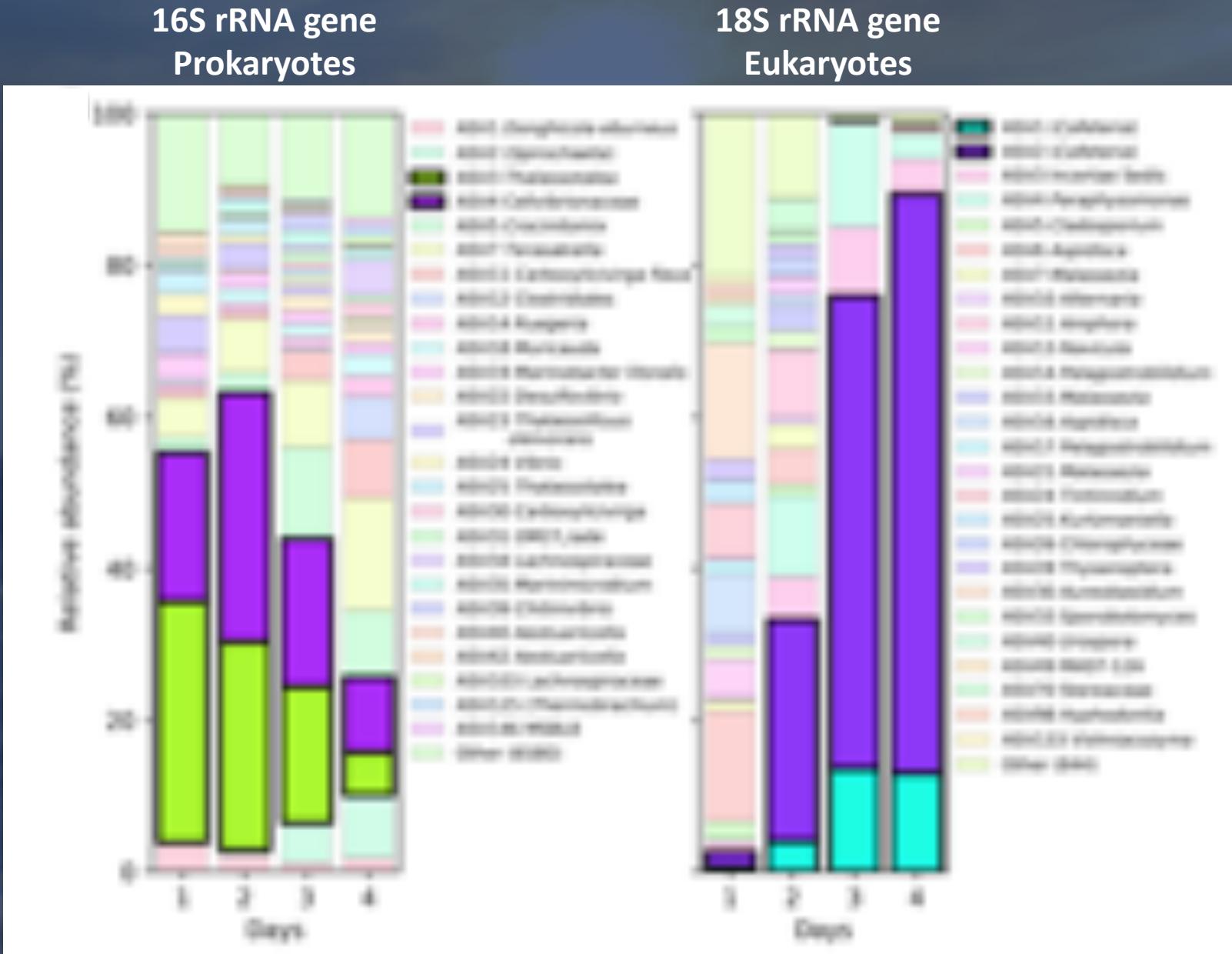
Eukaryotes



Chitin community succession



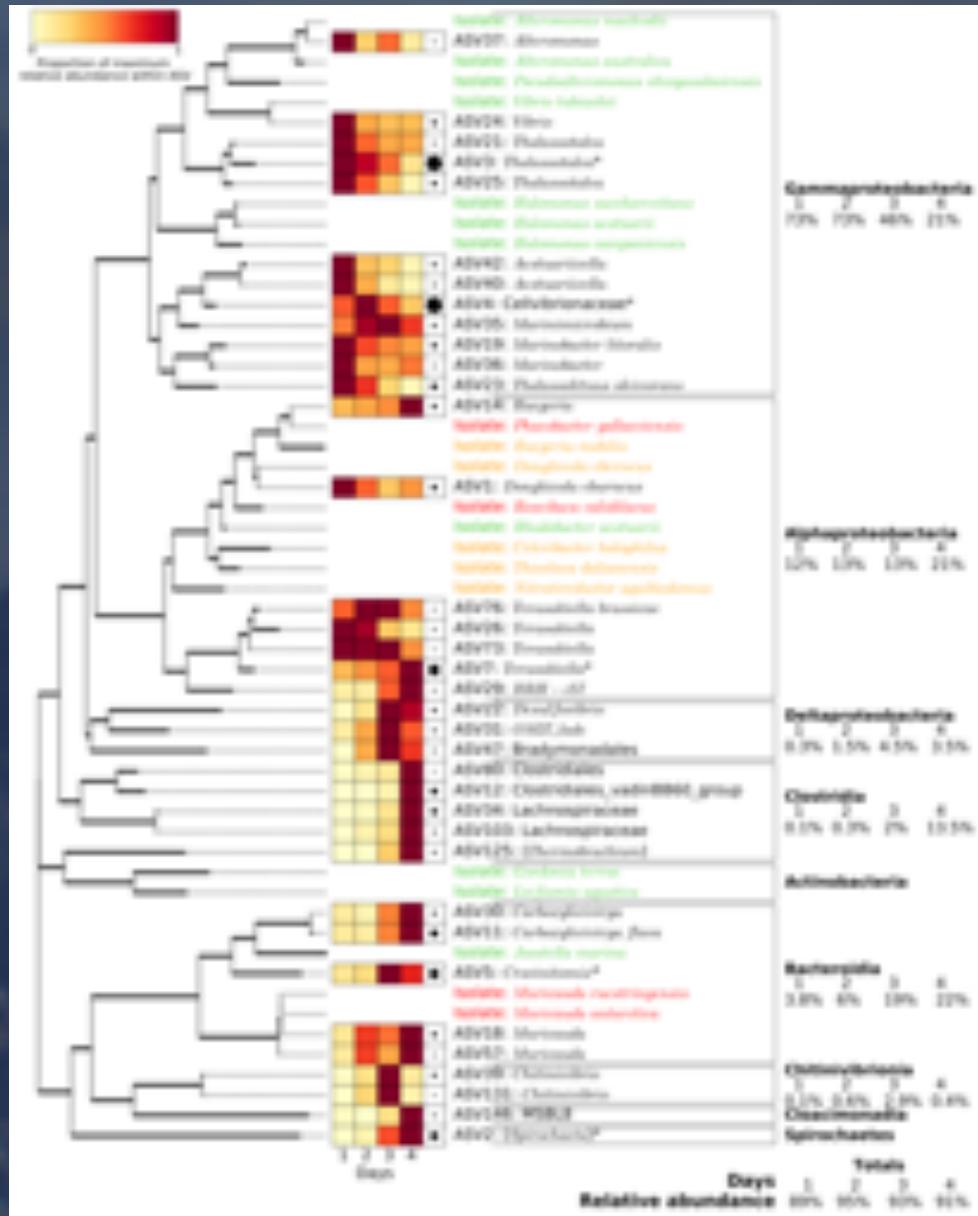
Chitin community succession



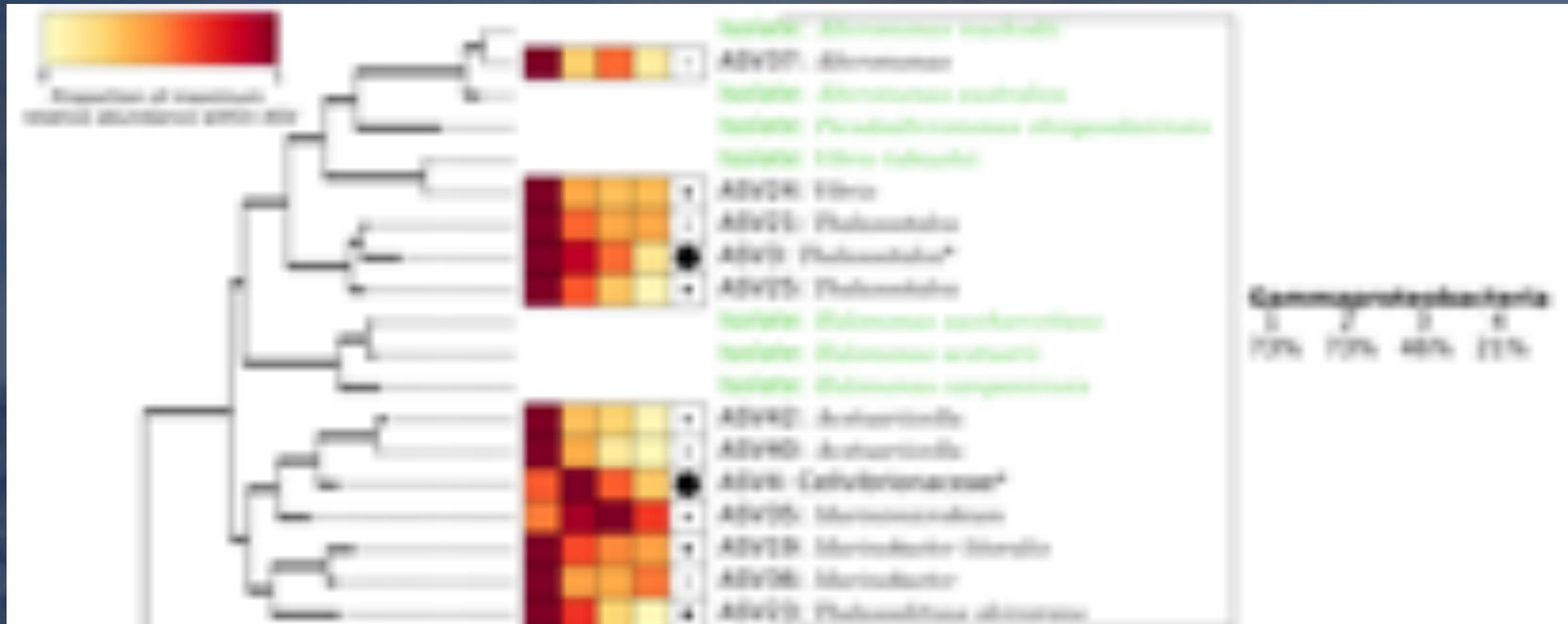
Chitin community succession

Growth with chitin

Growth with chitin monomer



Chitin community succession



Growth with chitin

Growth with chitin monomer

Growth with neither

Chitin



Microbial community
composition good indicator of
degradation ability

PET

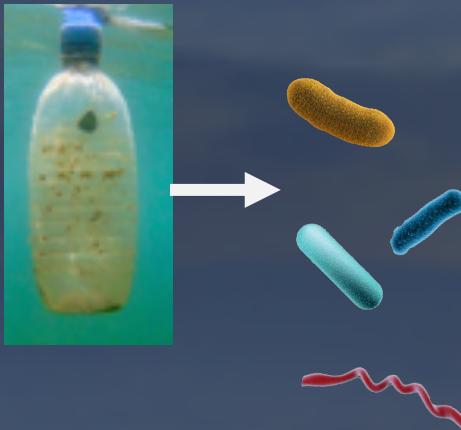


?

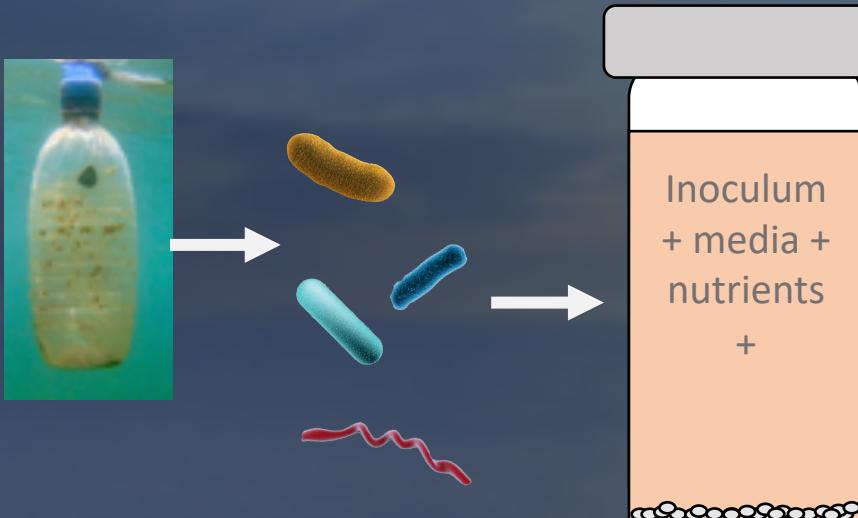
Method: PET community succession



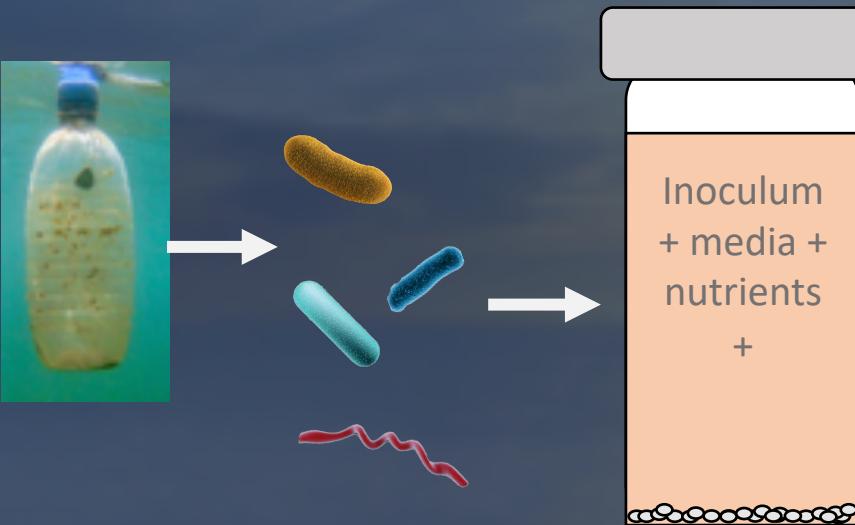
Method: PET community succession



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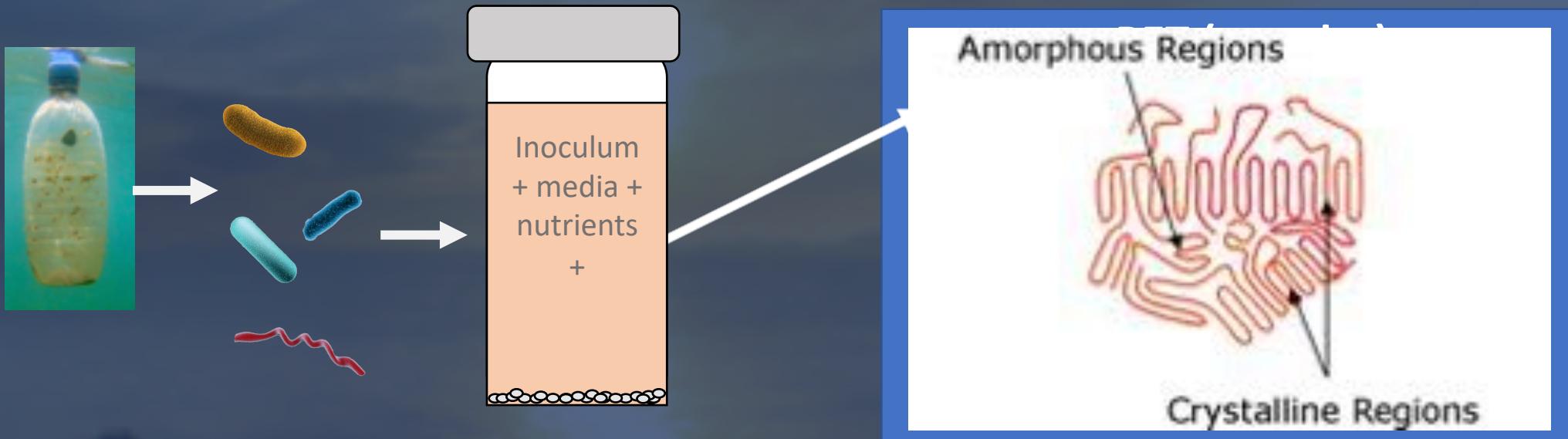


Method: PET community succession

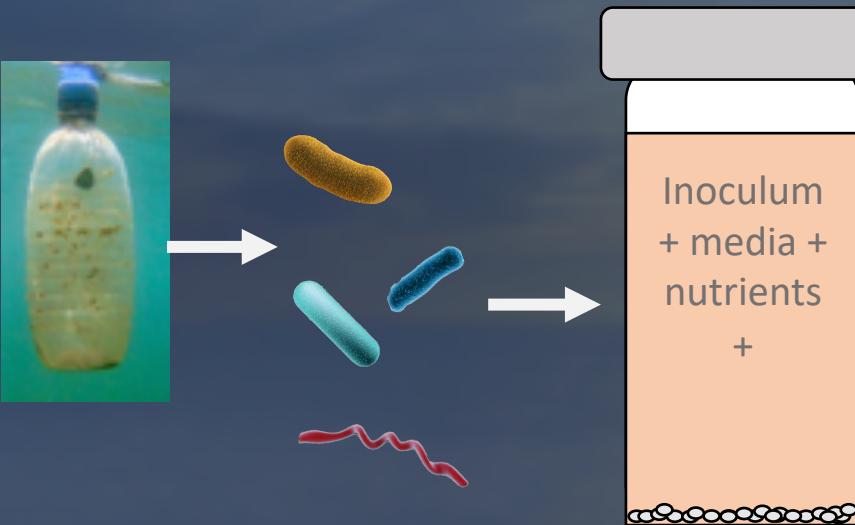


- PET (powder)
- Weathered PET (powder)
 - 80°C for 6 months
- Low crystallinity PET (pieces)
 - Planktonic and biofilm
 - BHET
 - Breakdown product
 - No Carbon

Method: PET community succession

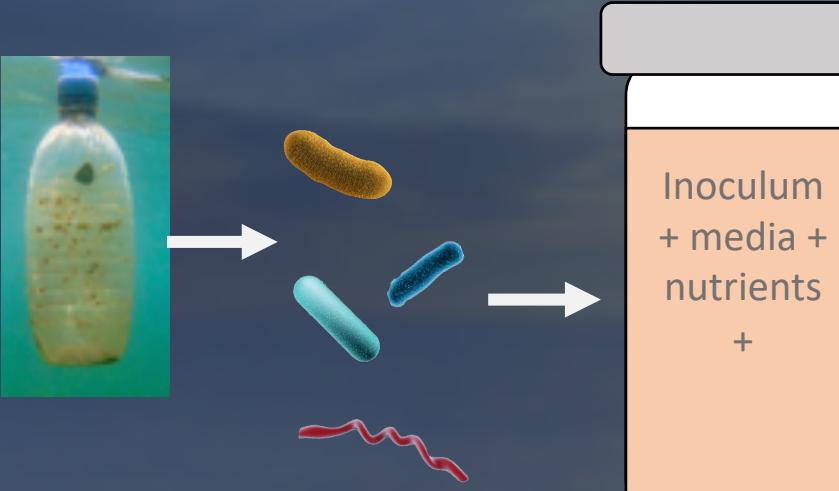
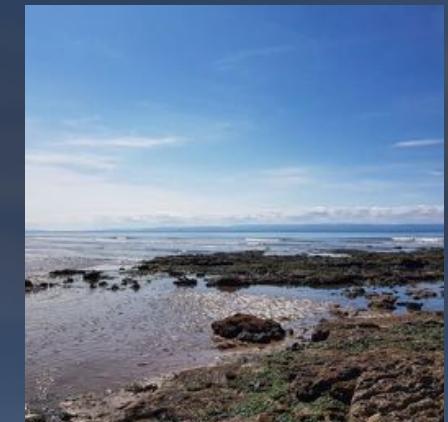


Method: PET community succession



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Method: PET community succession



Sample (day):

1

3

7

14

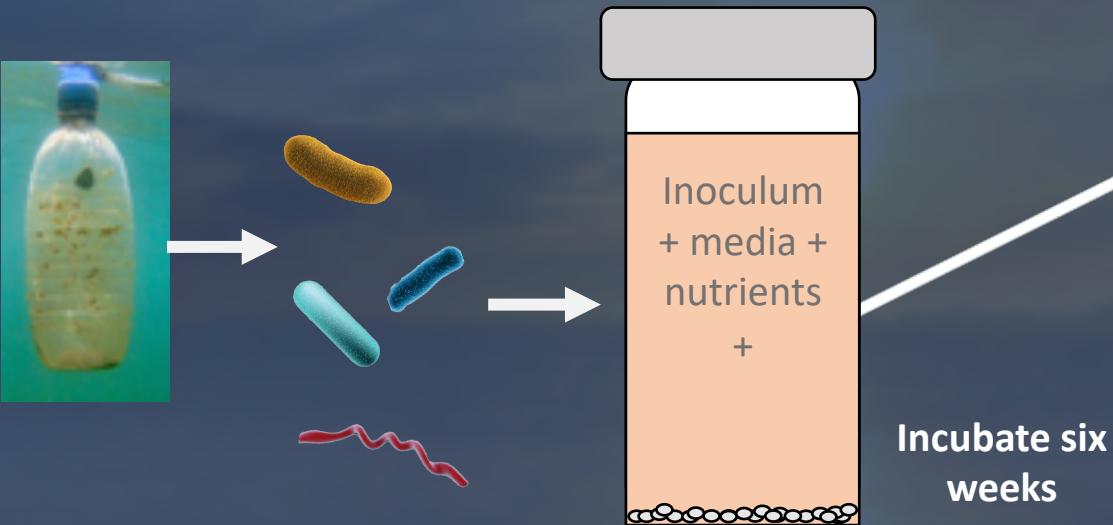
21

30

42

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Method: PET community succession

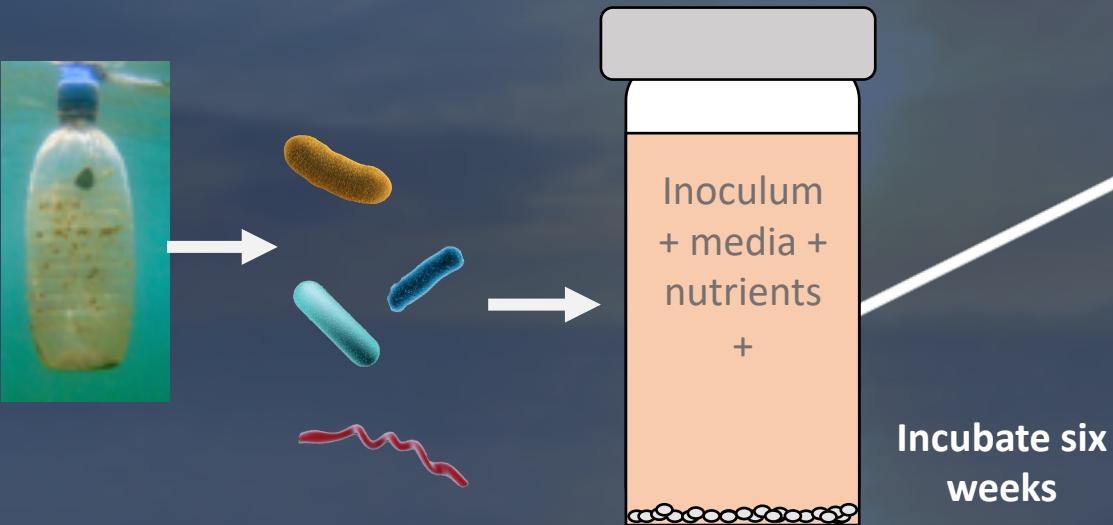
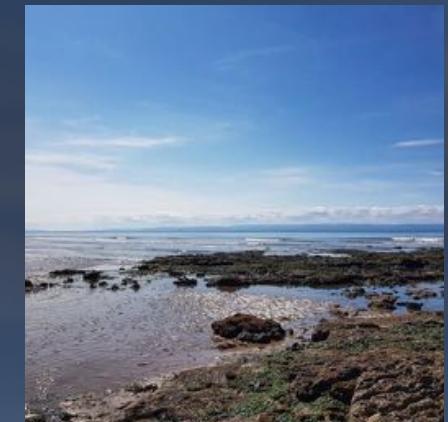


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→ Prokaryotic community analysis

- MiSeq amplicon sequencing
- LC-MS
- PET breakdown products

Method: PET community succession

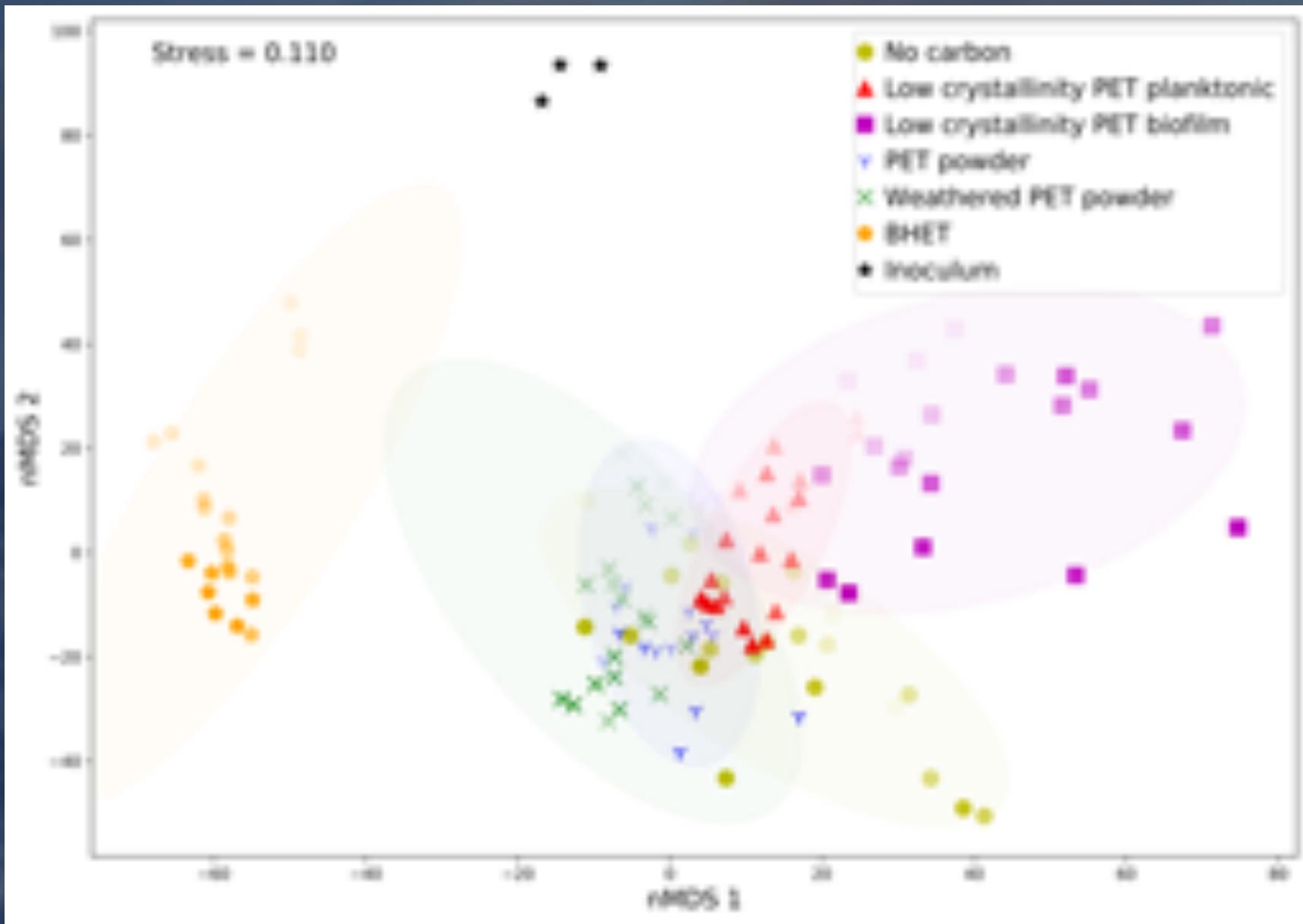


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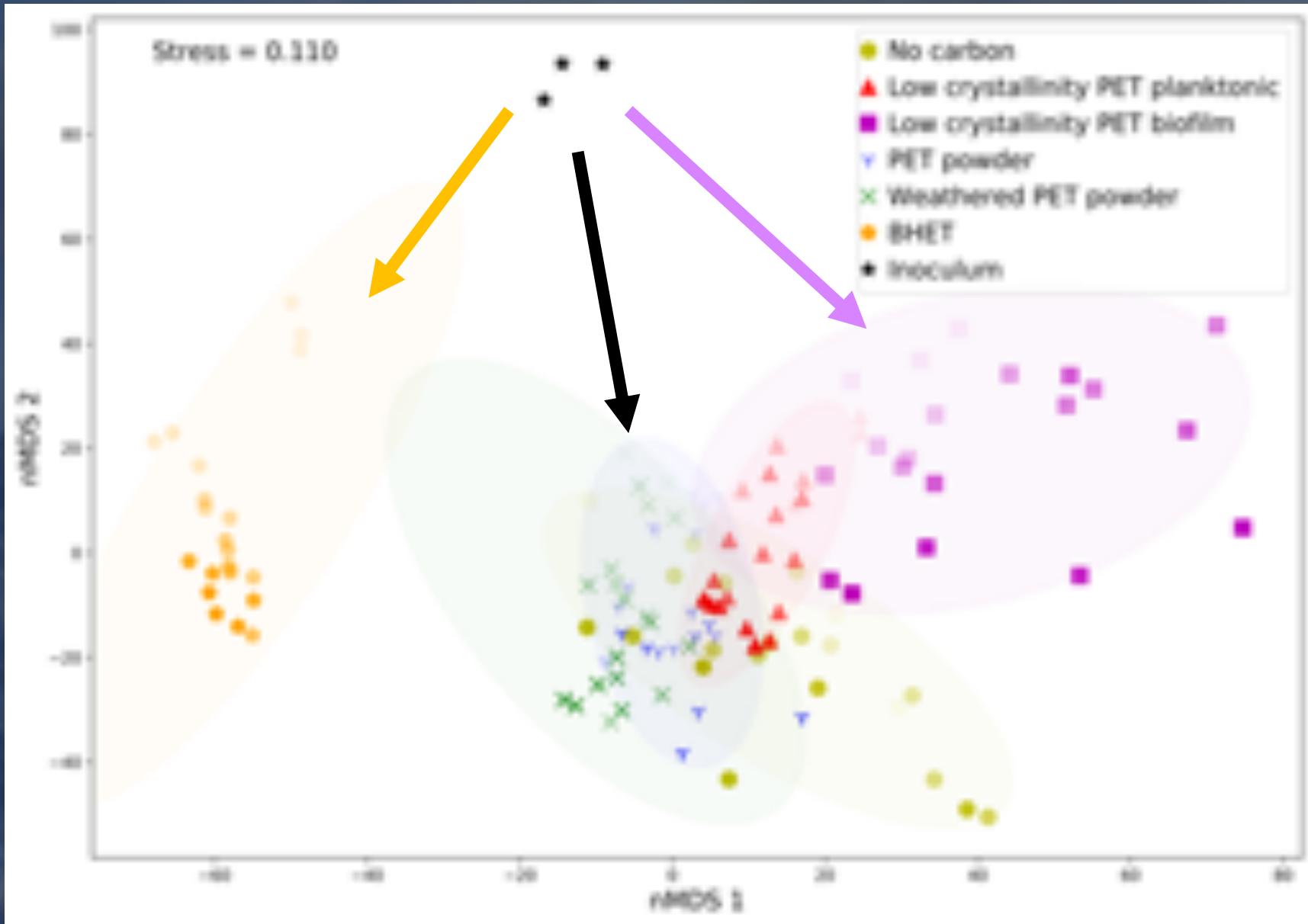
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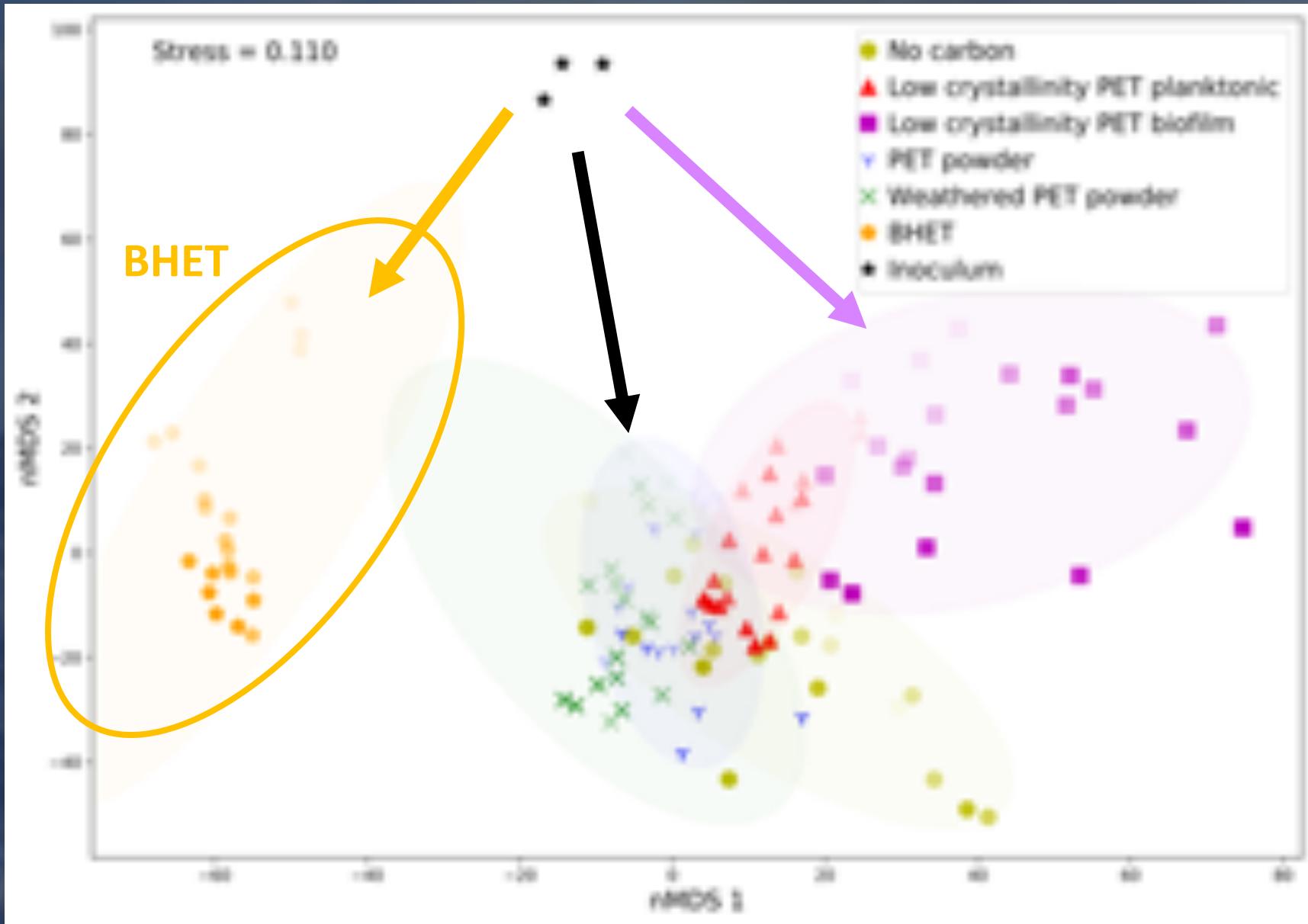
PET community succession



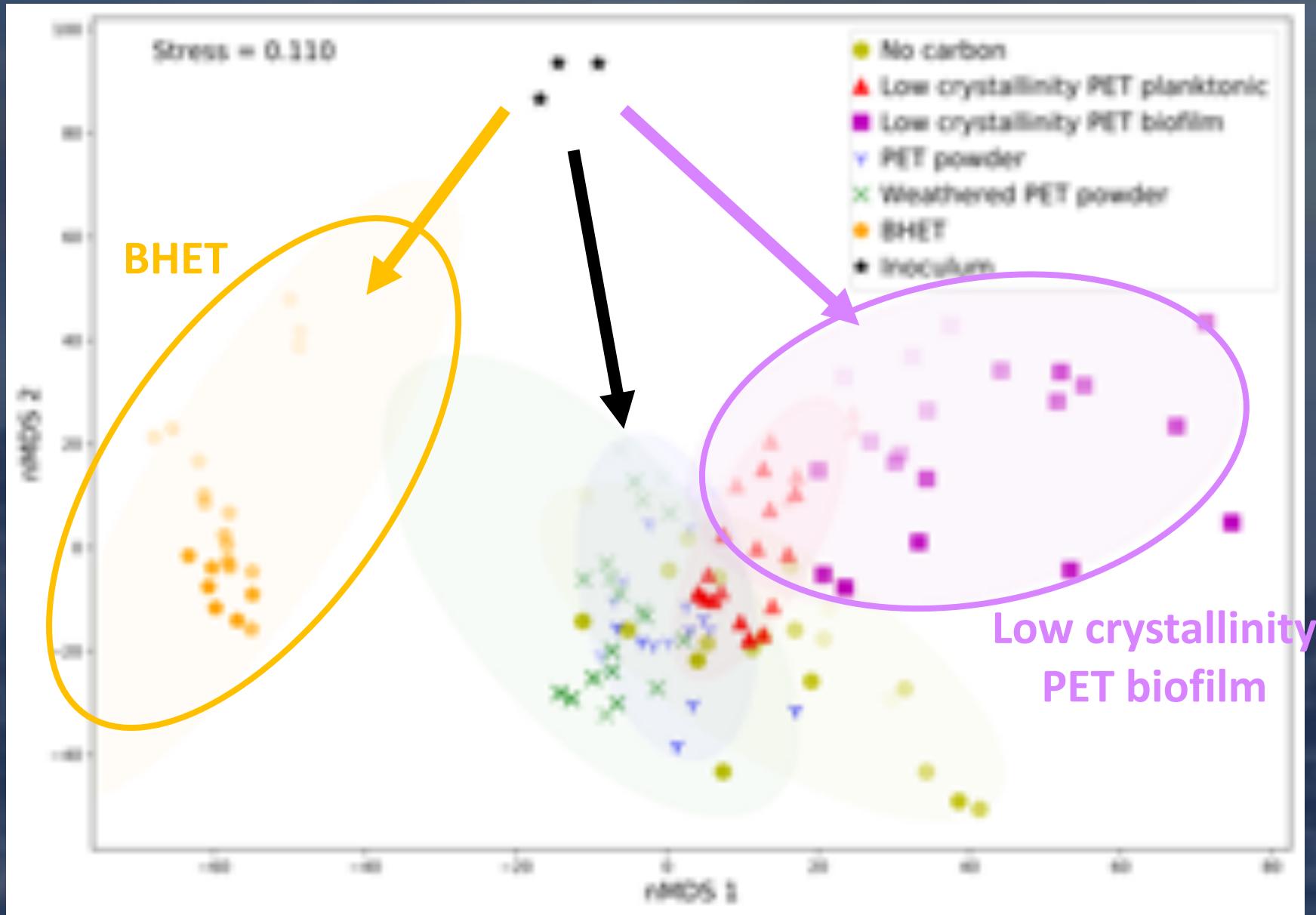
PET community succession



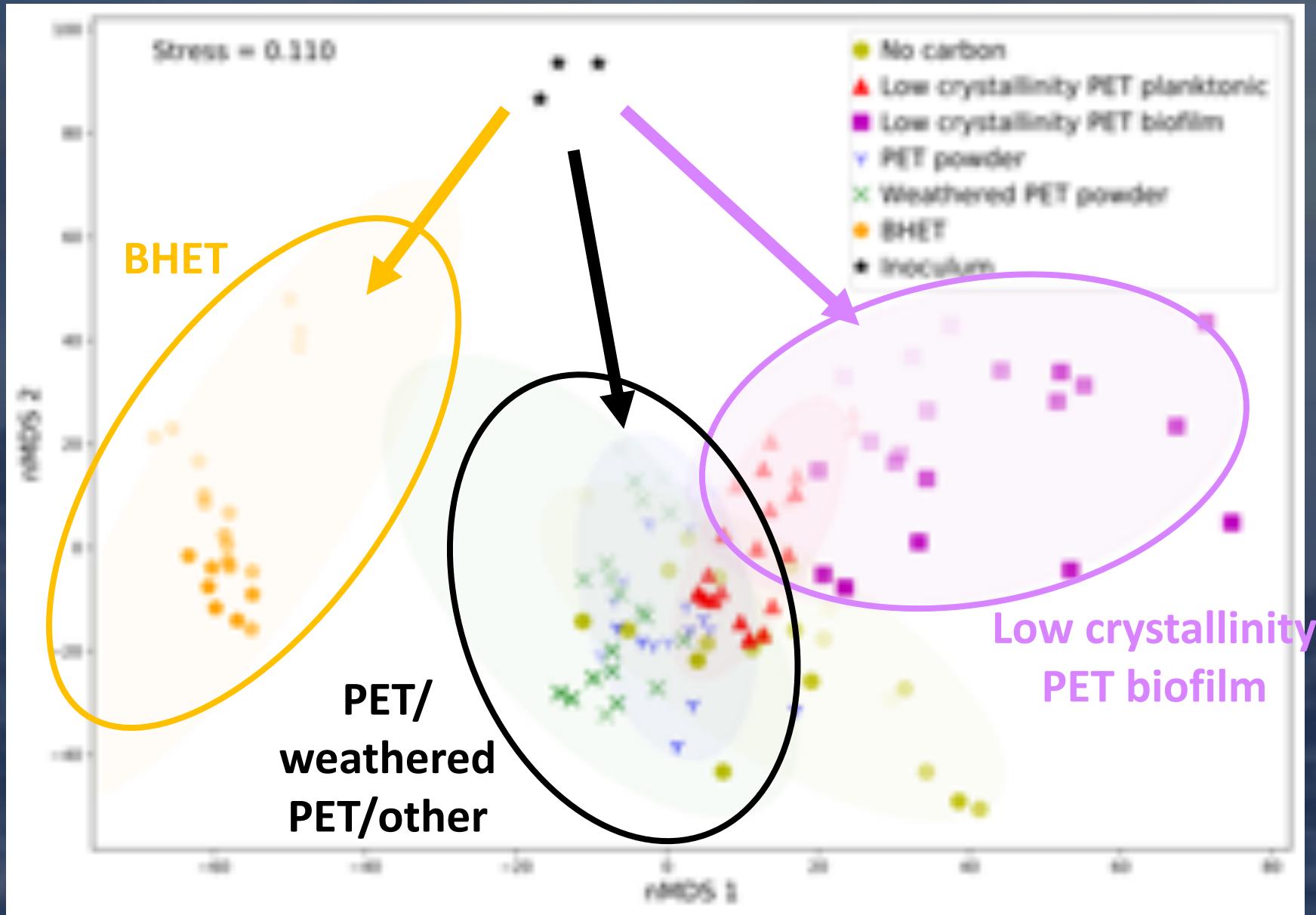
PET community succession



PET community succession



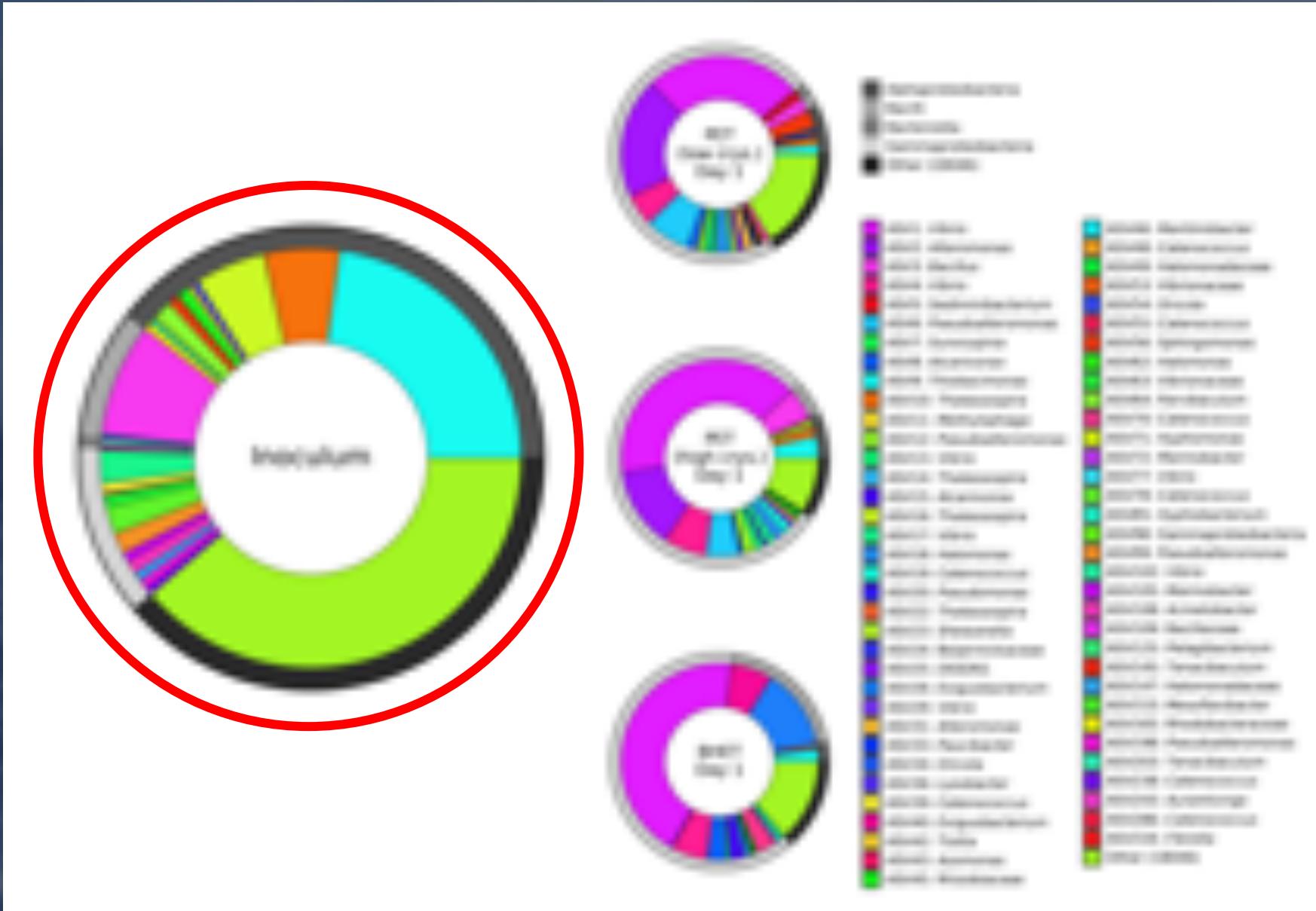
PET community succession



PET community succession



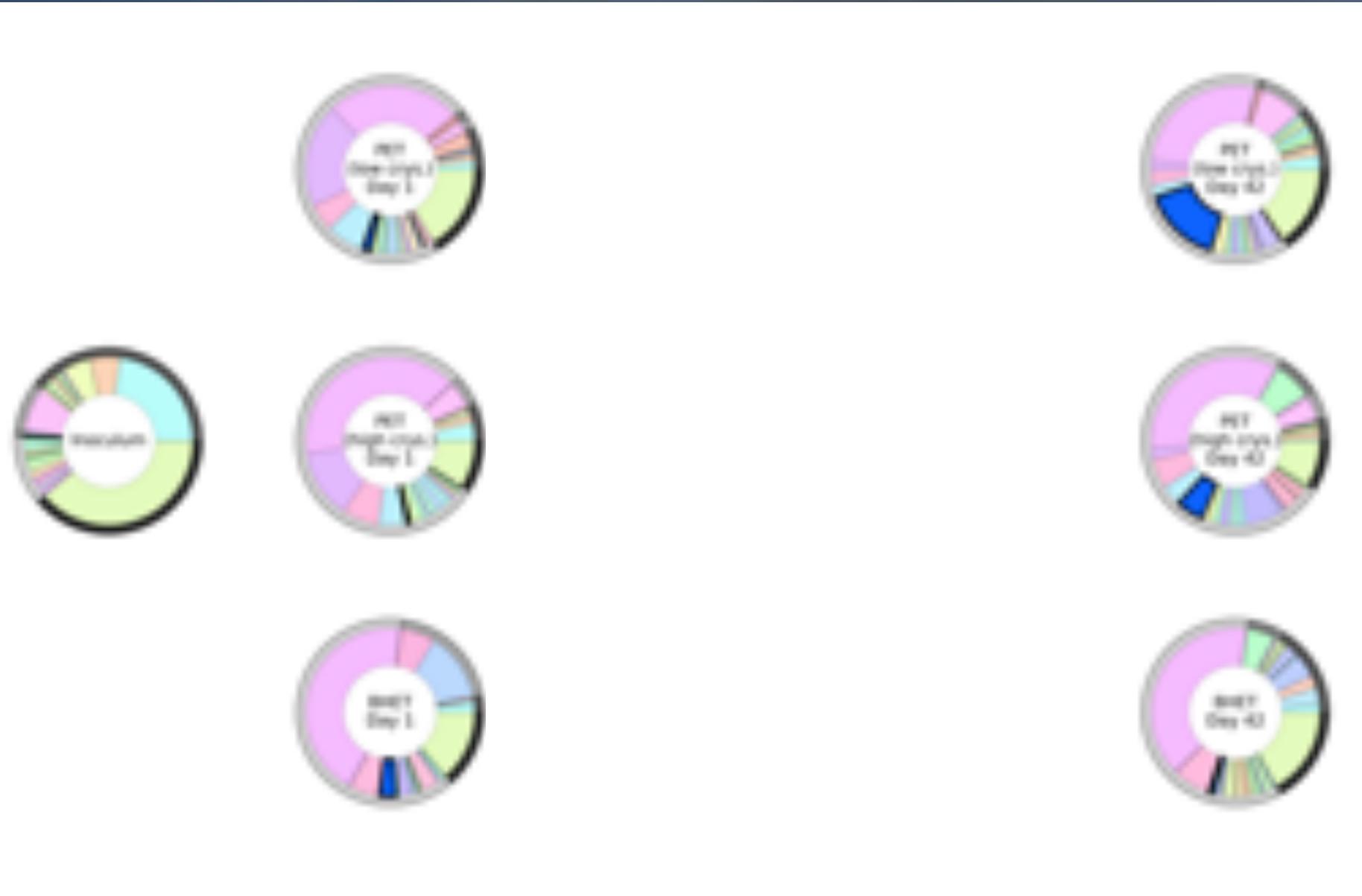
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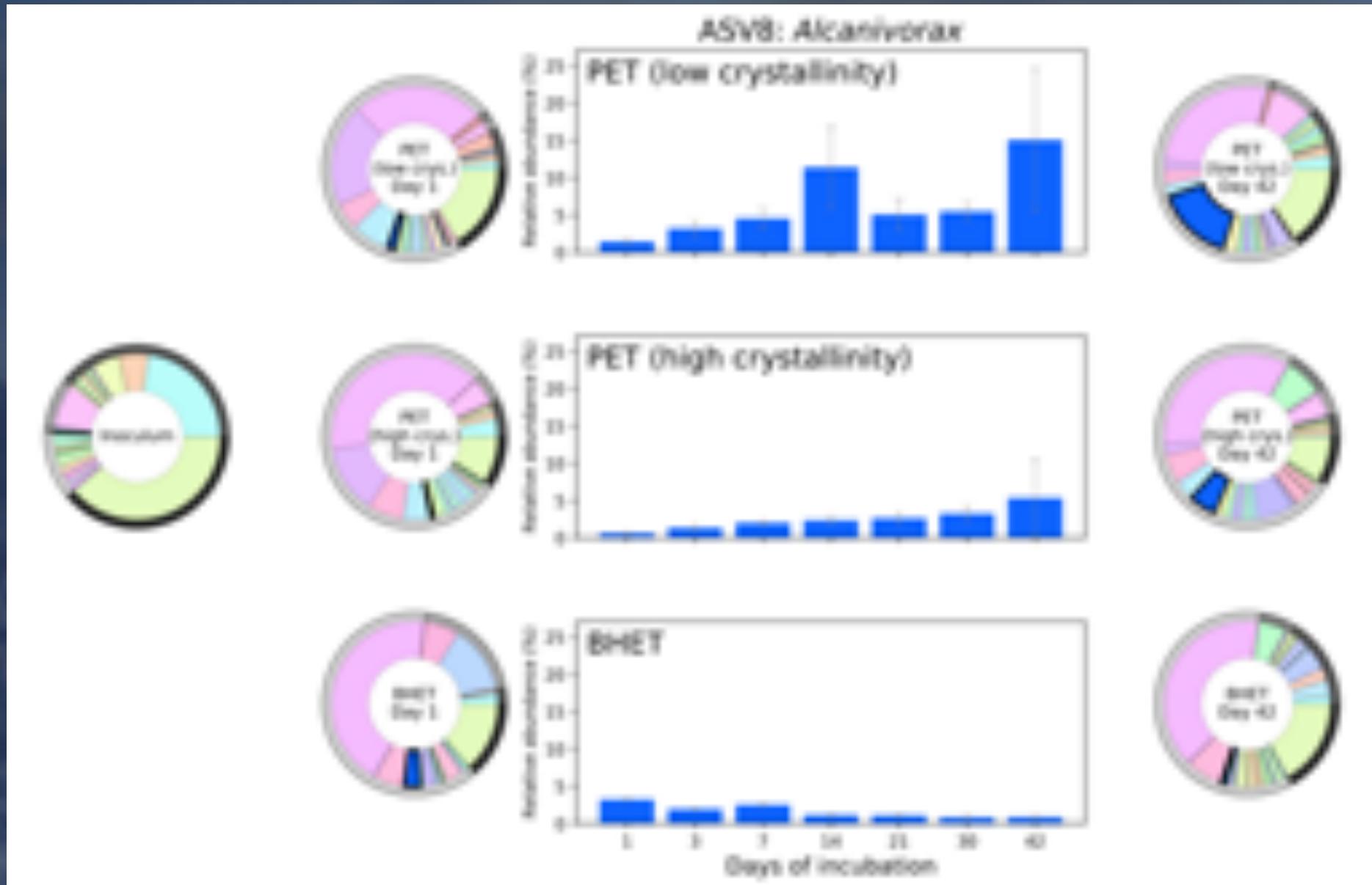
PET community succession



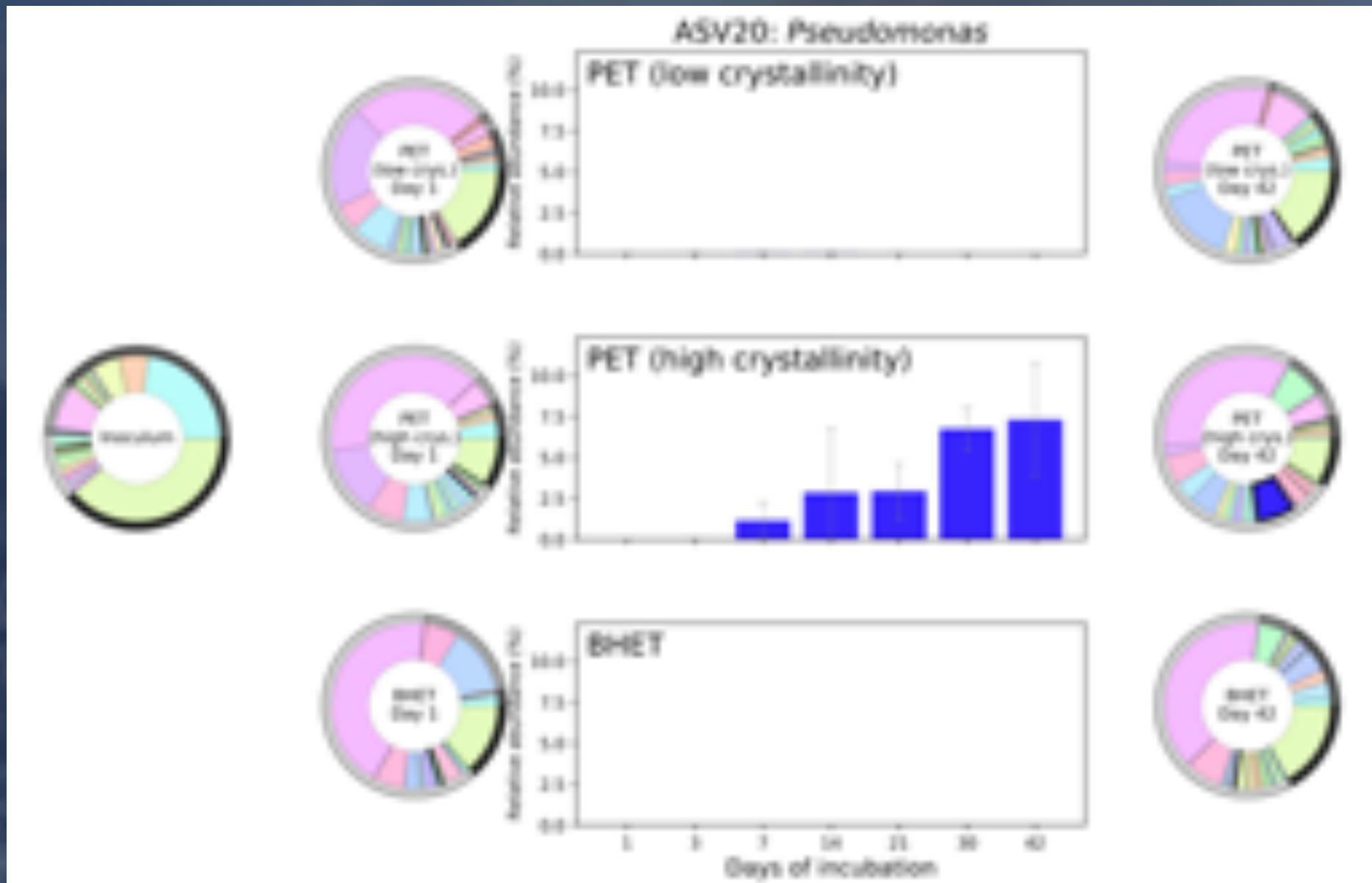
PET community succession: *Alcanivorax*



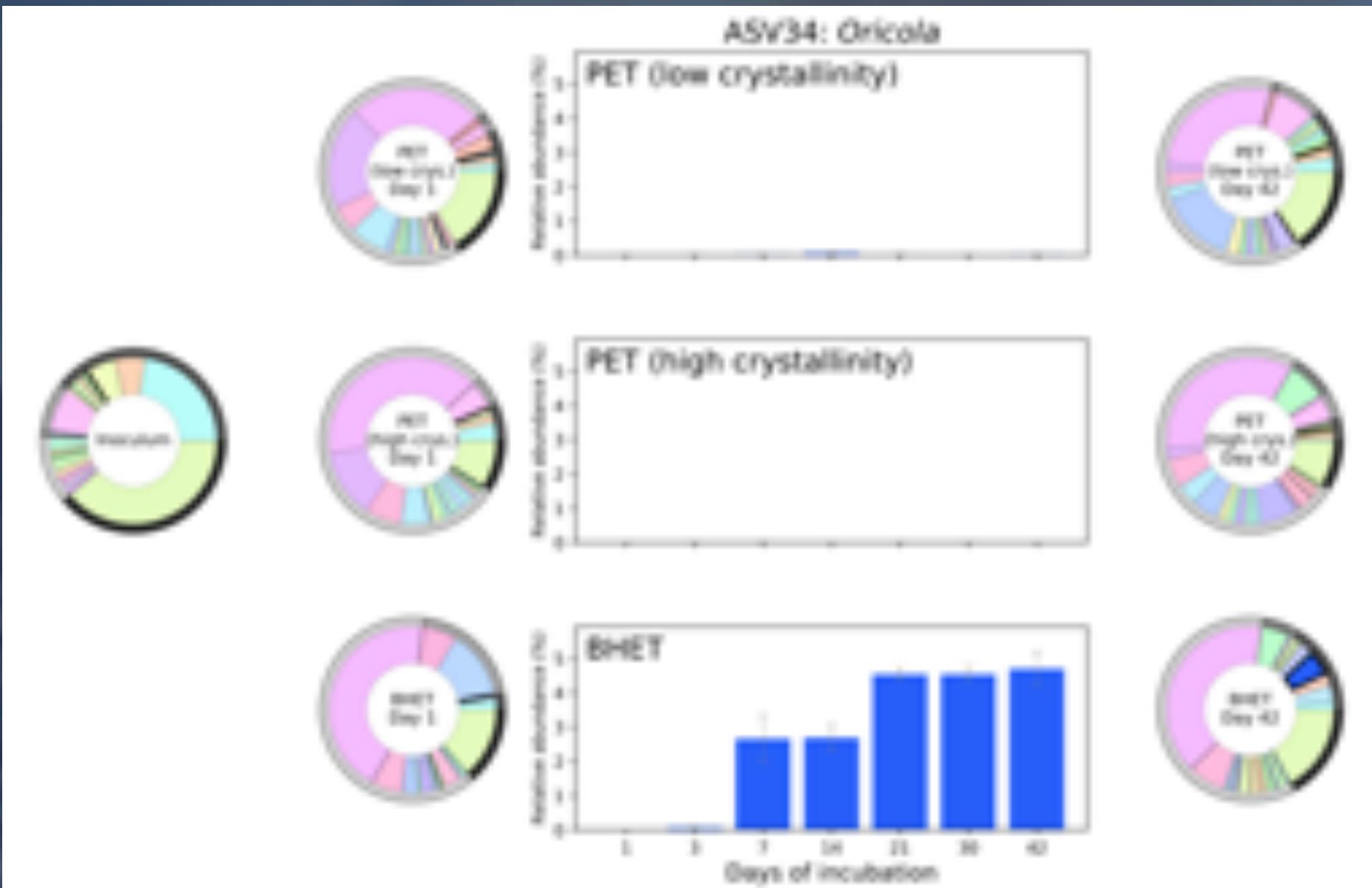
PET community succession: *Alcanivorax*



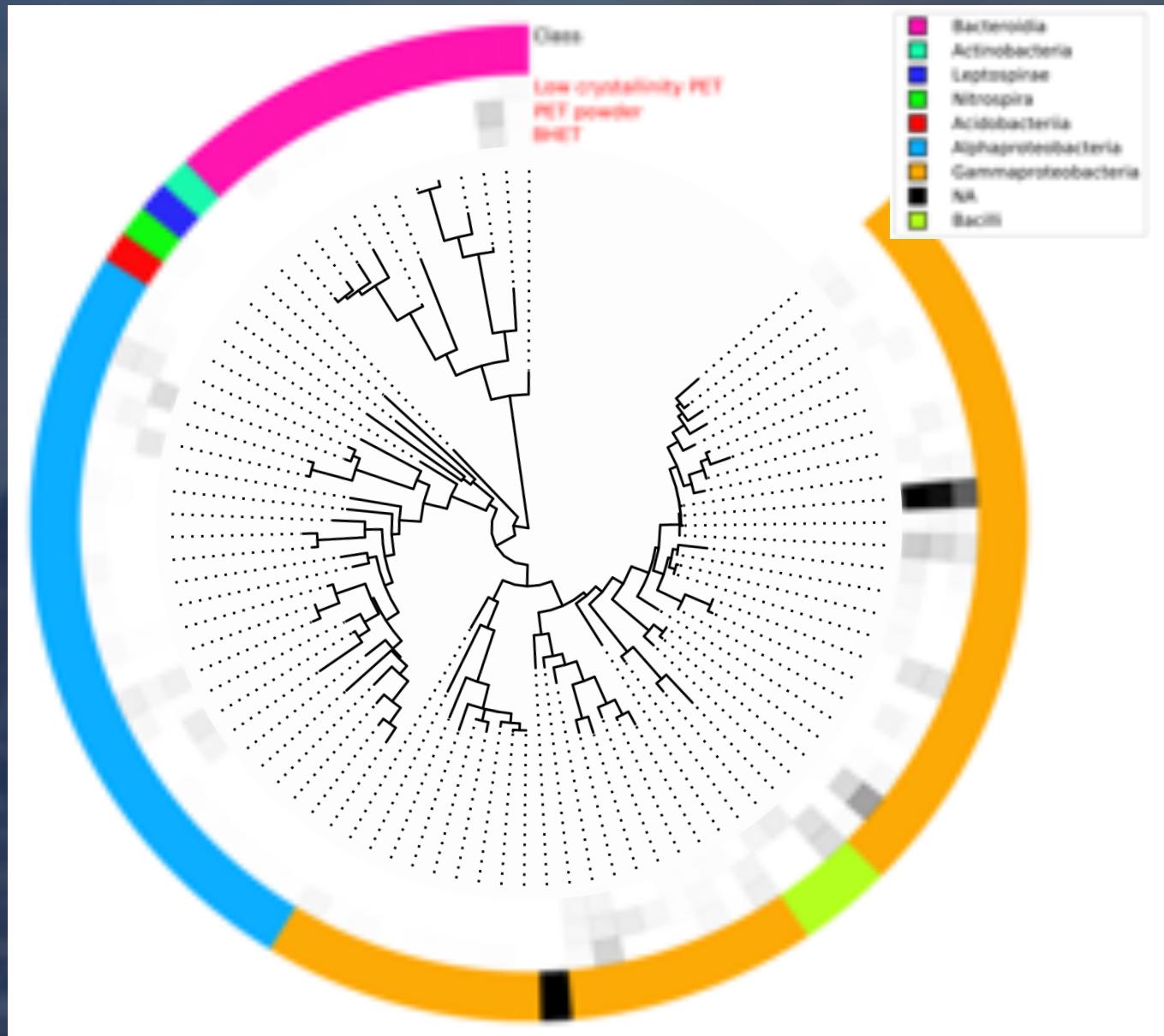
PET community succession: *Pseudomonas*



PET community succession: *Oricola*



PET community succession



Comparison of community degradation with isolates

Fast growing bacteria isolated using BHET (PET breakdown product) agar plates

Thioclava sp.

(Alphaproteobacteria)

- Has enzymes similar to *I. sakaiensis*
(Betaproteobacteria) PETase

Bacillus sp.

(Bacteroidetes)

- Not similar to *I. sakaiensis*

Comparison of community degradation with isolates

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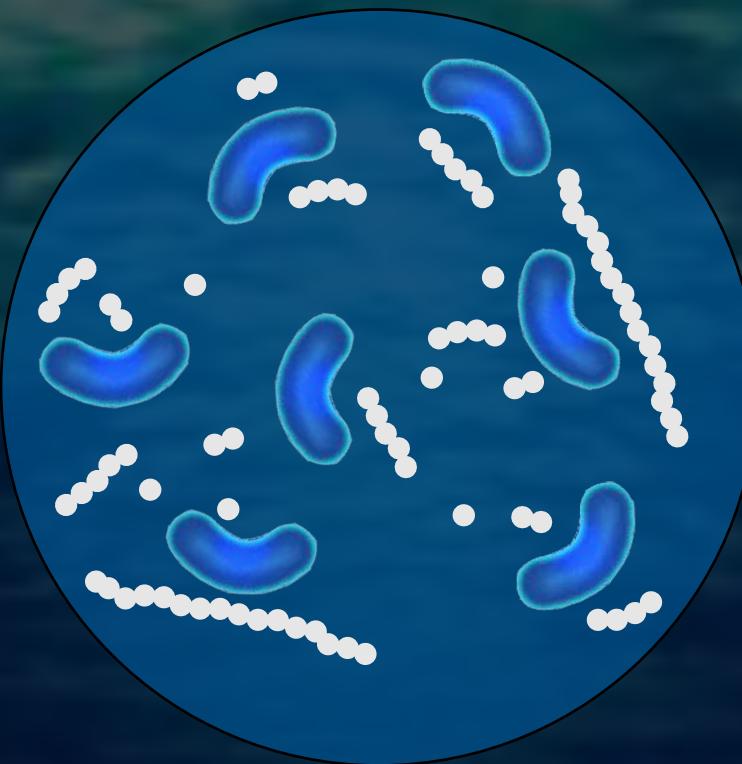
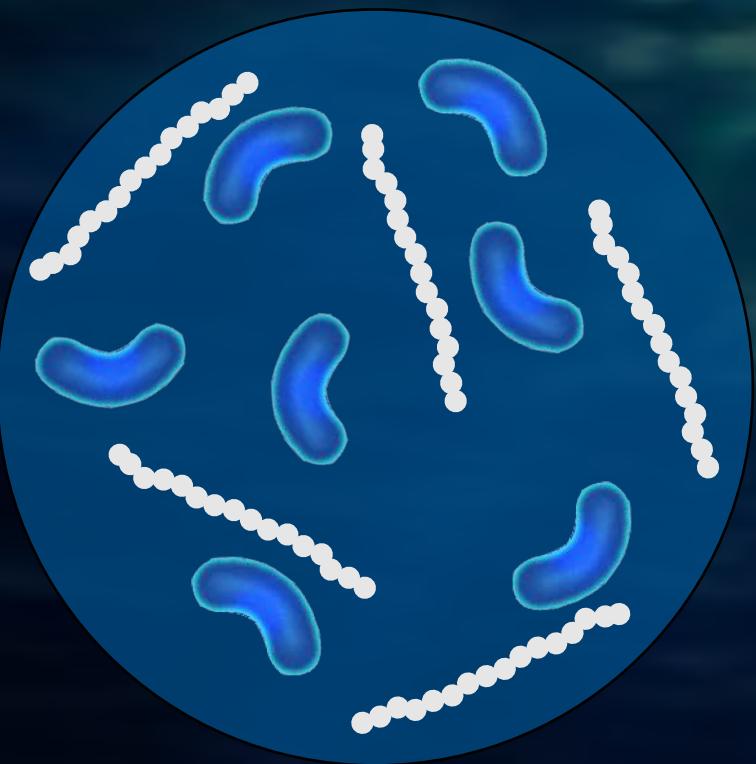
(Bacteroidetes)

- Not similar to *I. sakaiensis*

ISOLATE

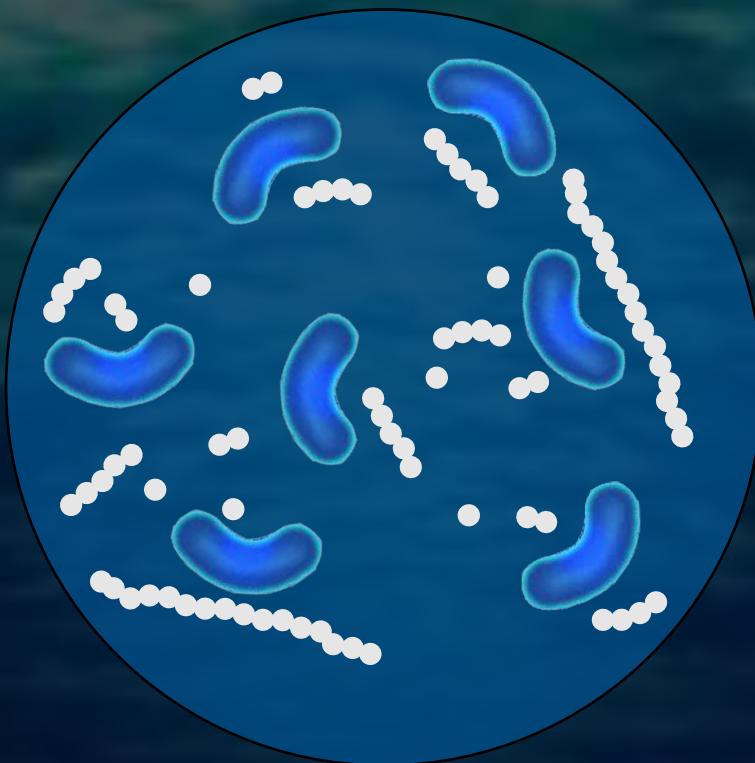


ISOLATE

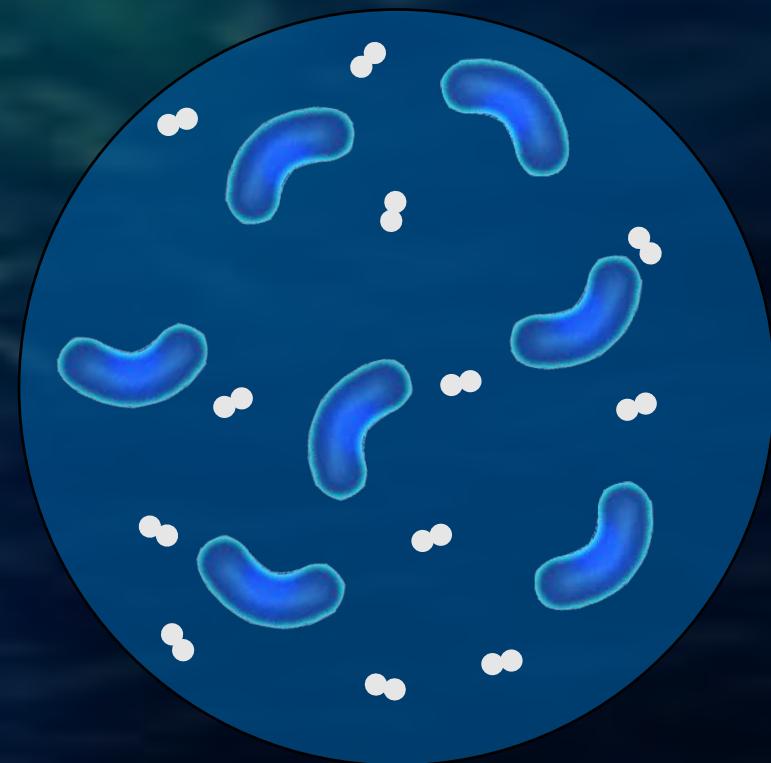


Degradation to intermediates and
end products

ISOLATE

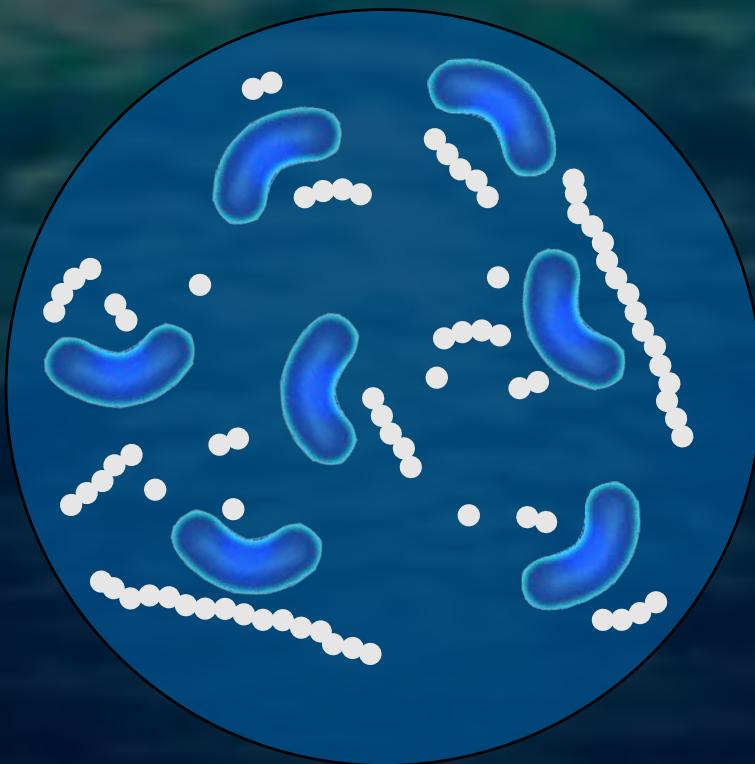


Degradation to intermediates and
end products

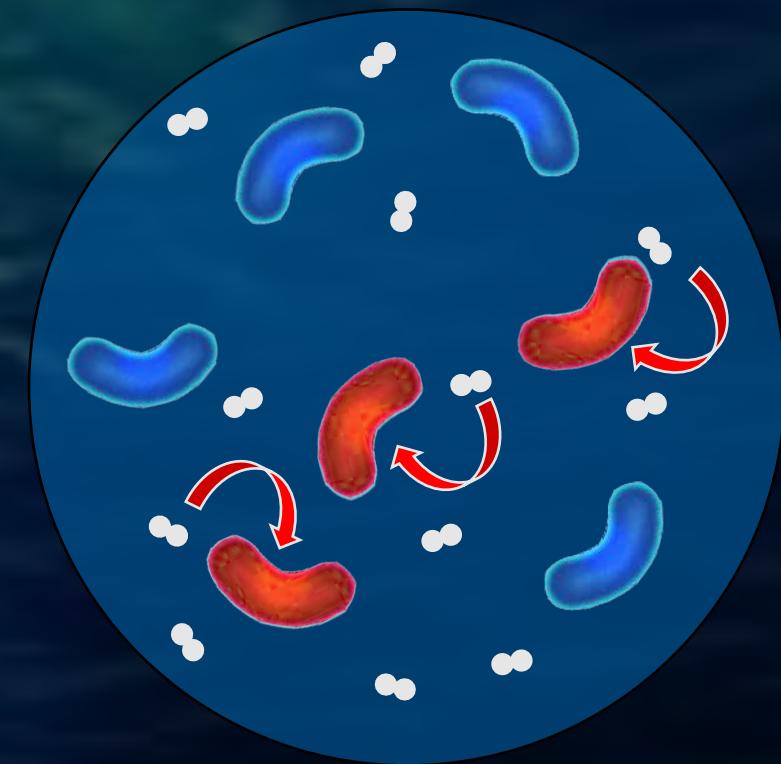


Buildup of toxic end products

ISOLATE

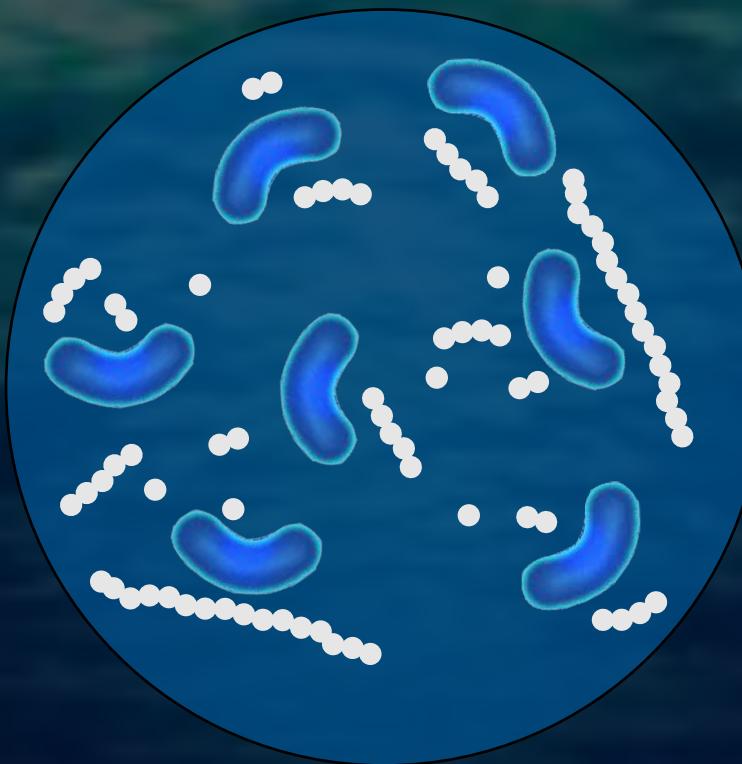
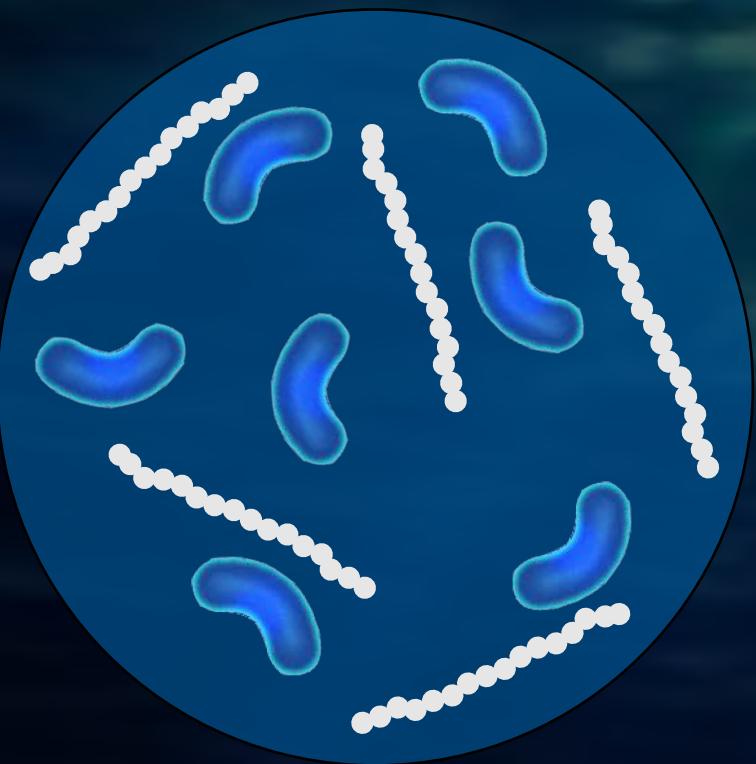


Degradation to intermediates and
end products

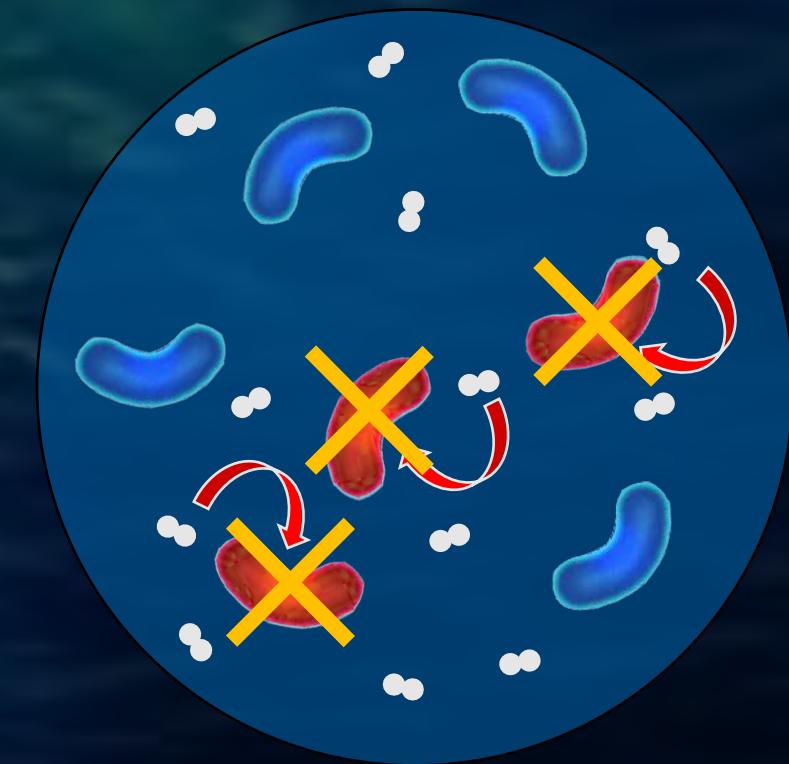


Buildup of toxic end products

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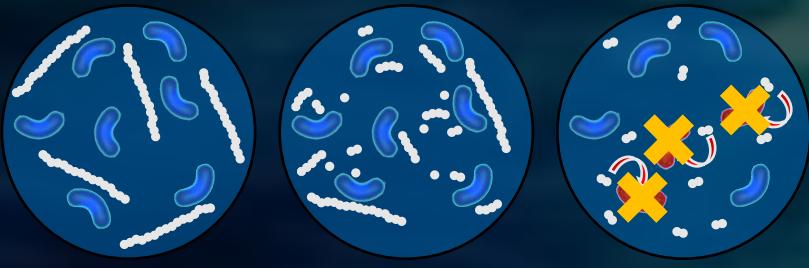
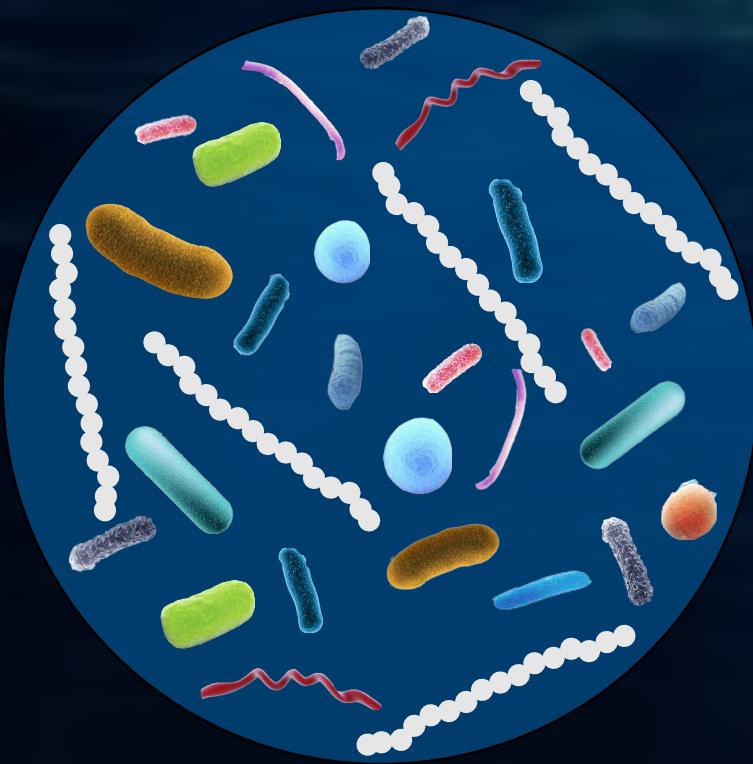


Degradation to intermediates and
end products

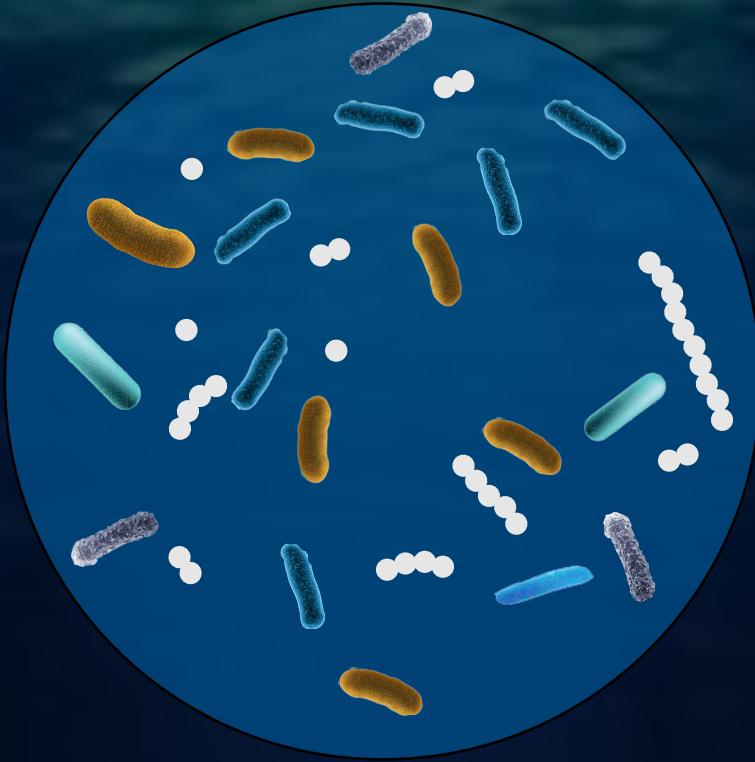
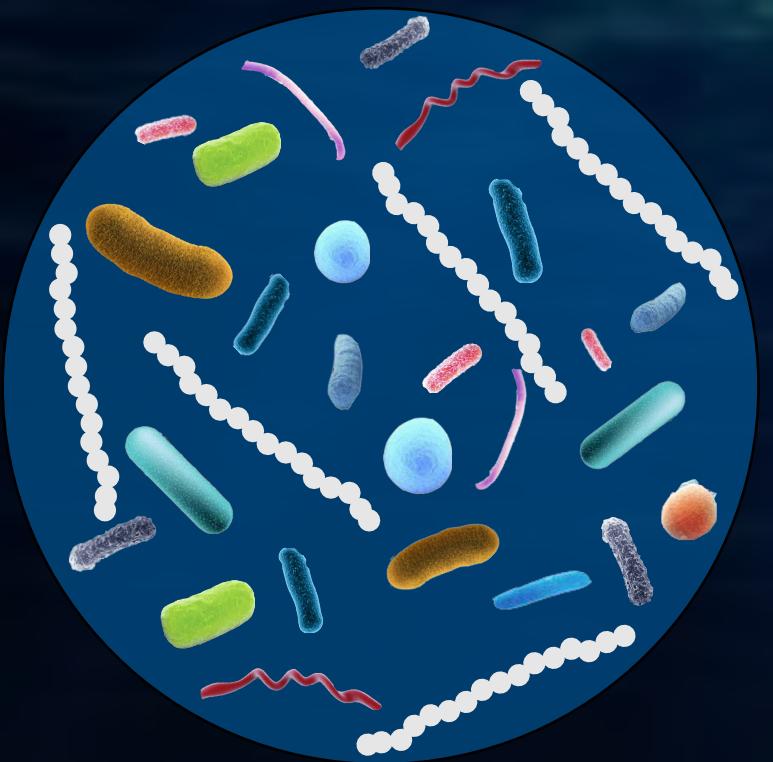
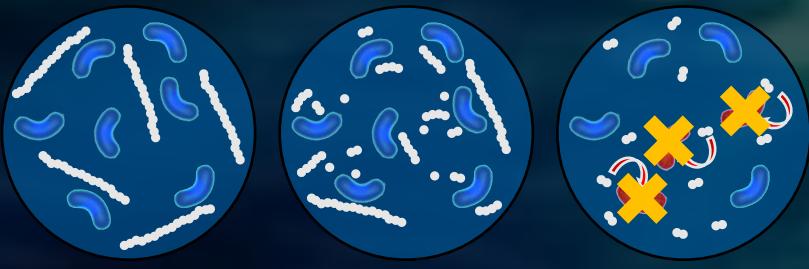


Buildup of toxic end products

COMMUNITY

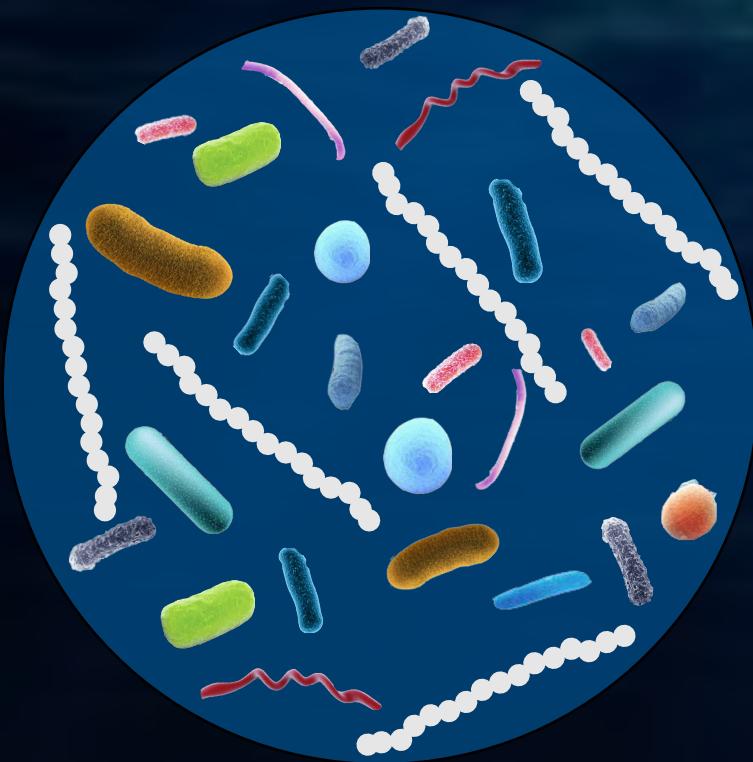


COMMUNITY

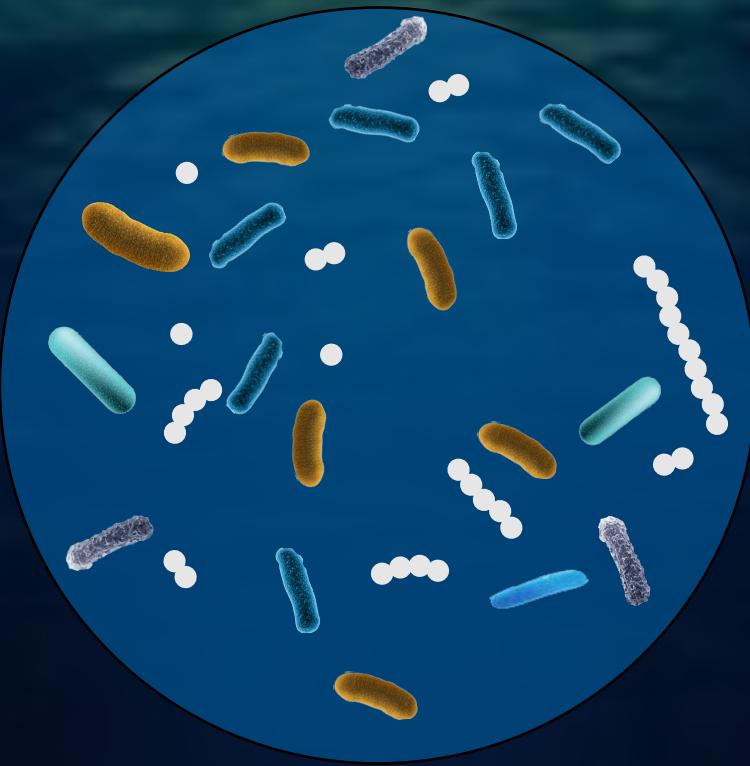


Enrichment of members that can
degrade

COMMUNITY



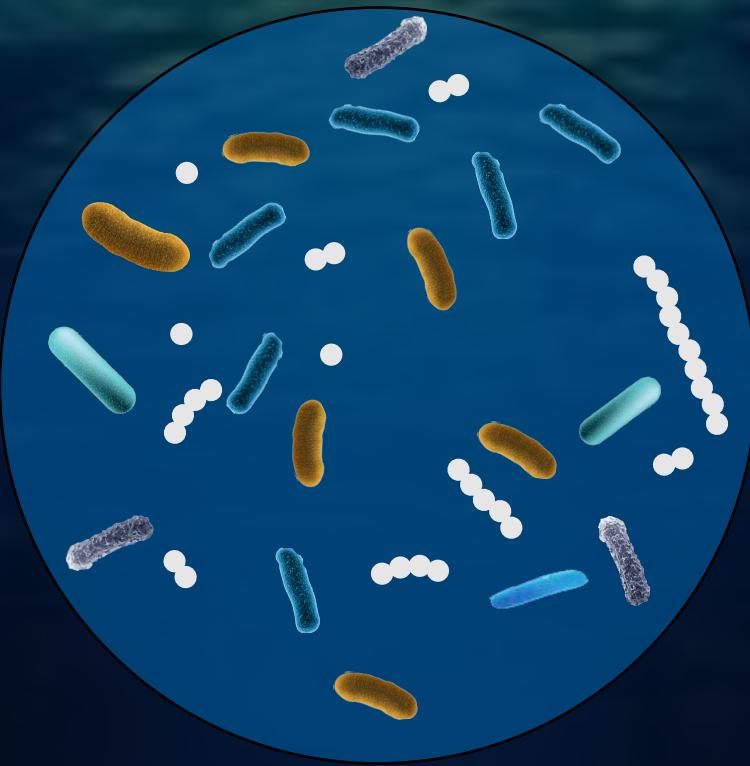
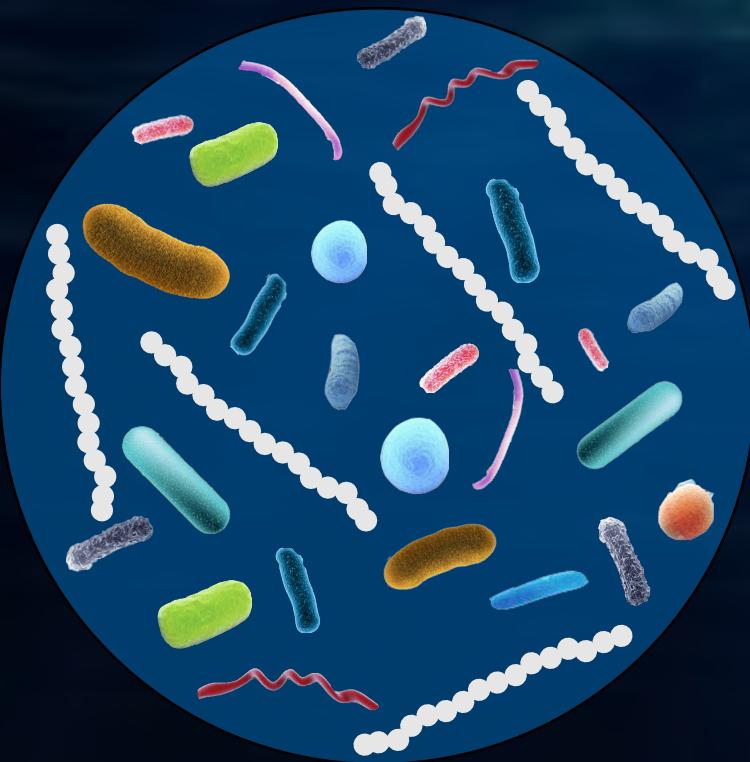
Enrichment of members that can
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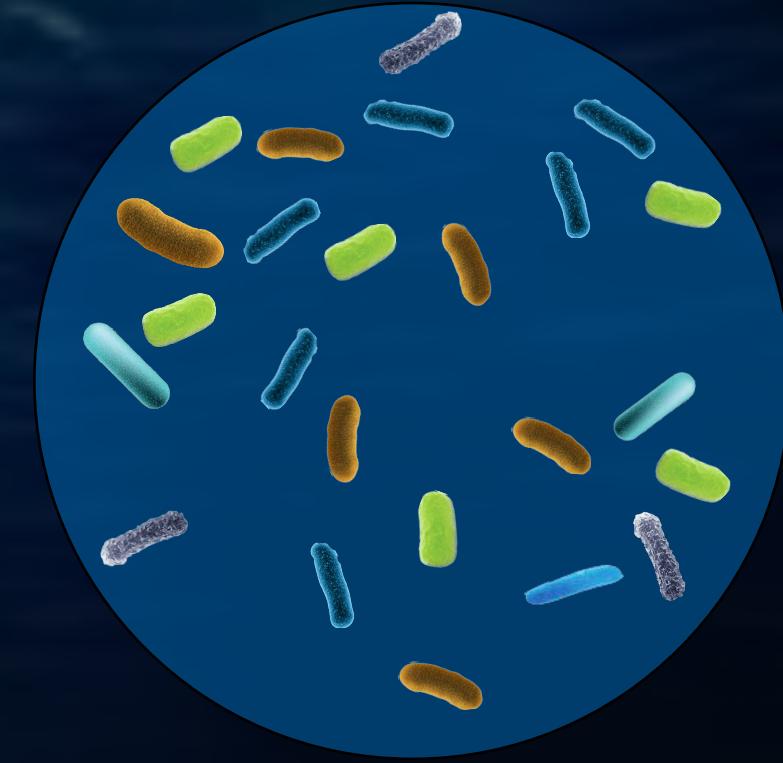
Community succeeded by:



COMMUNITY

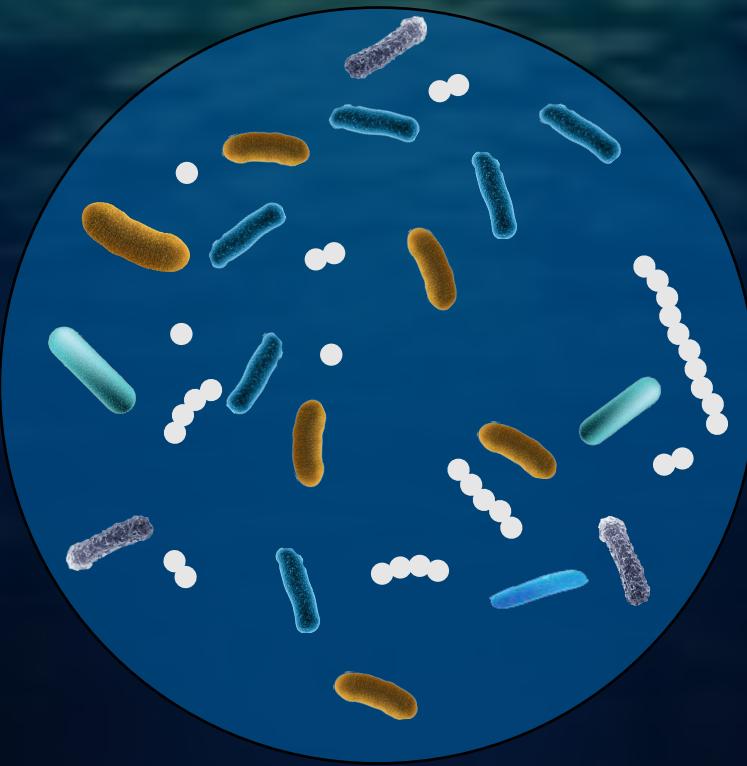
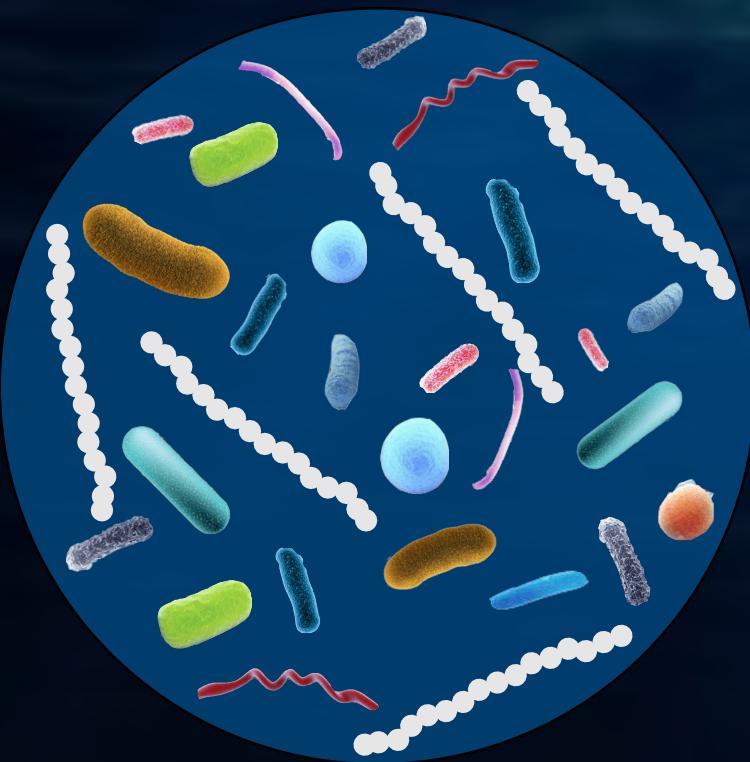


Enrichment of members that can
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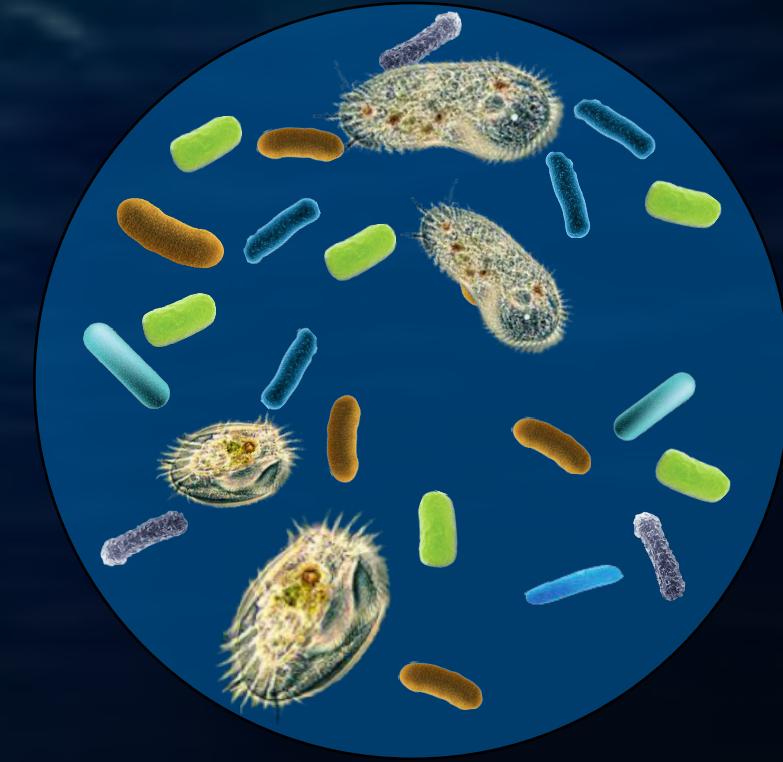


Community succeeded by:
• Cheaters

COMMUNITY

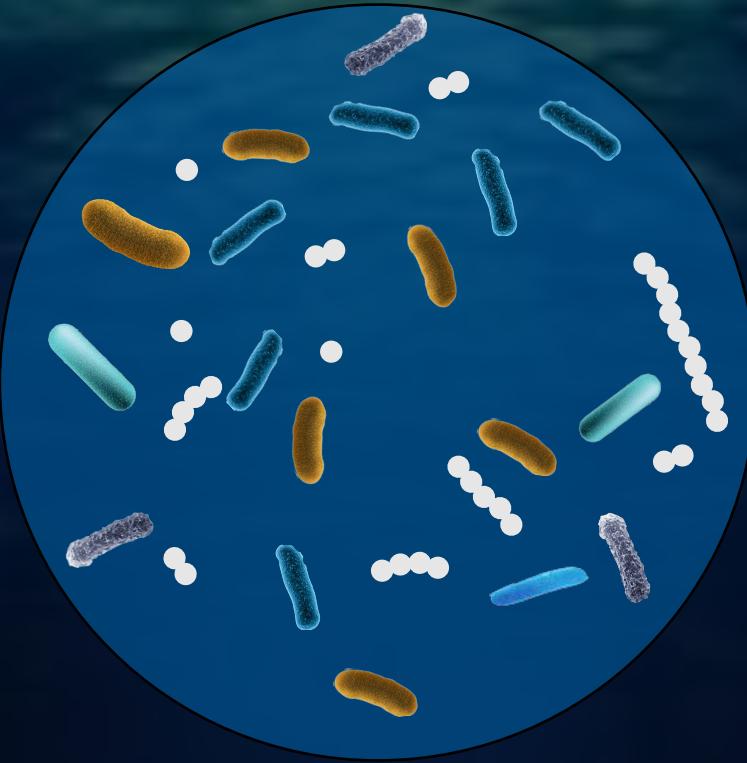
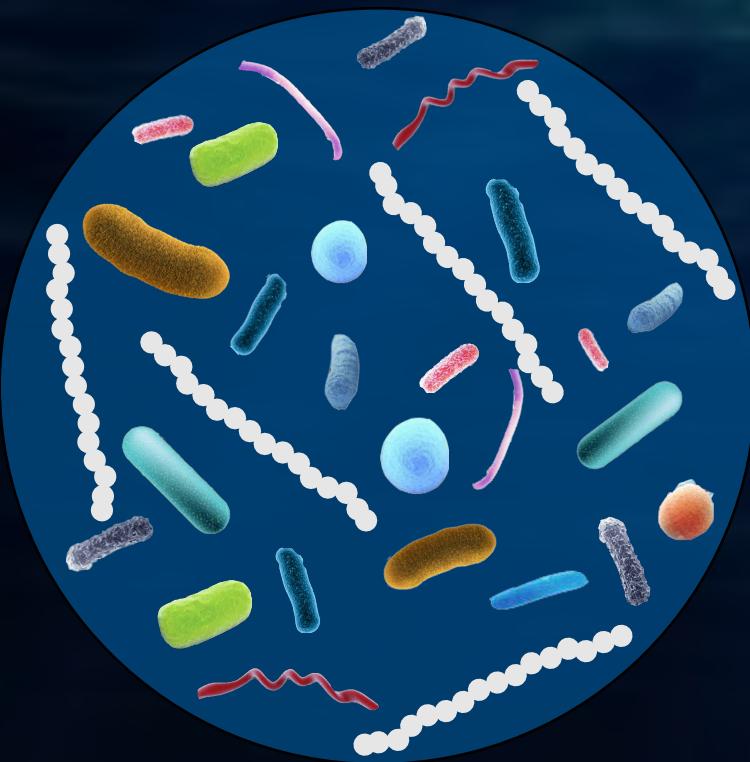


Enrichment of members that can
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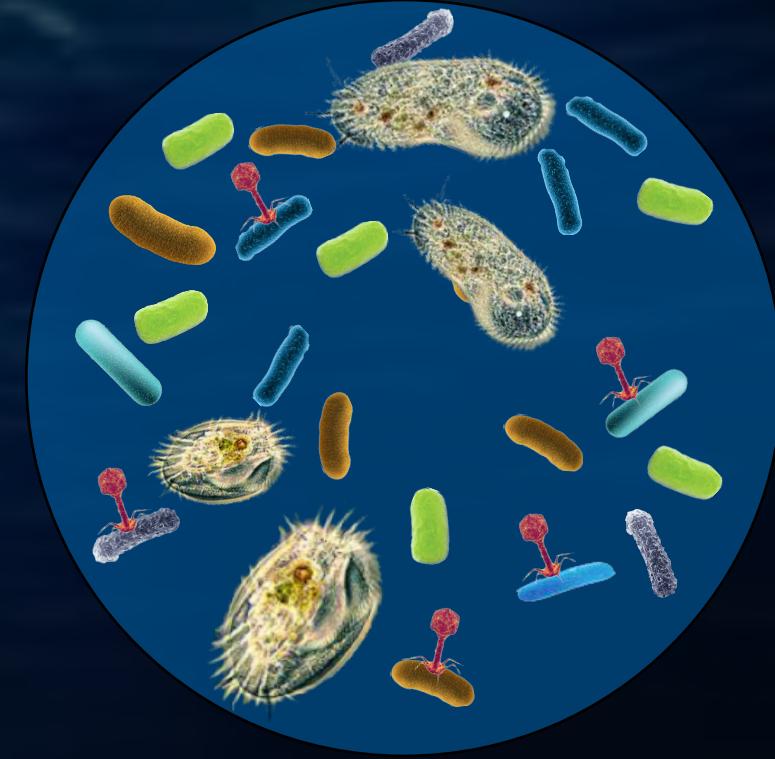


Community succeeded by:
• Cheaters
• Grazers

COMMUNITY

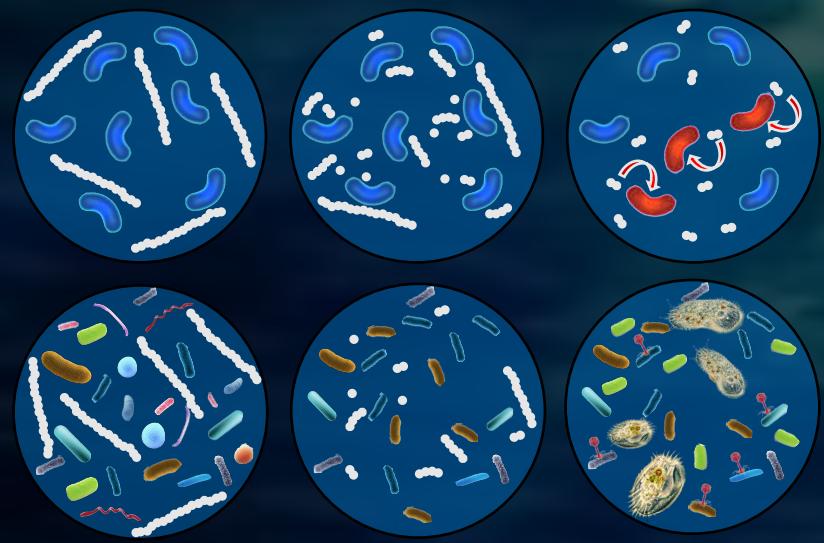
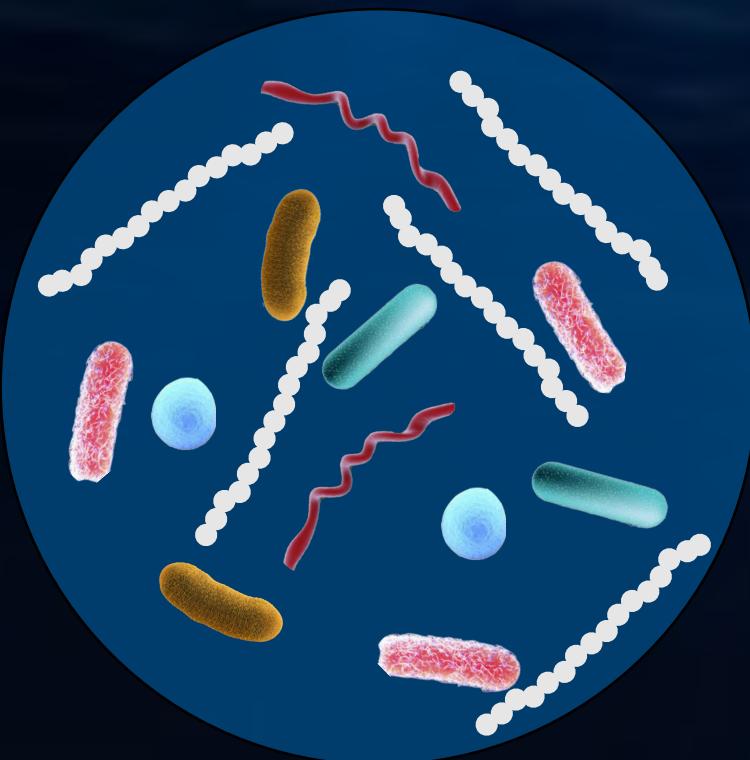


Enrichment of members that can
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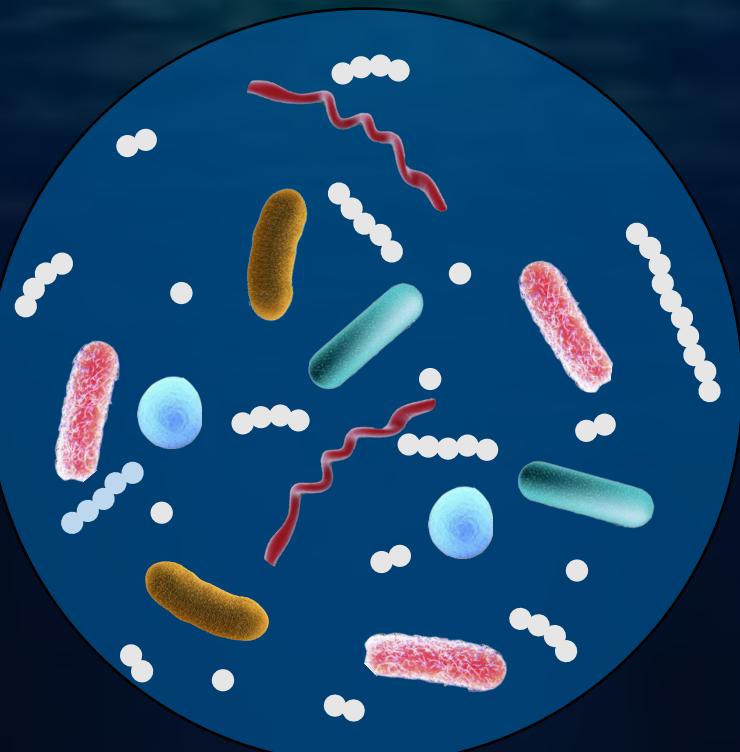
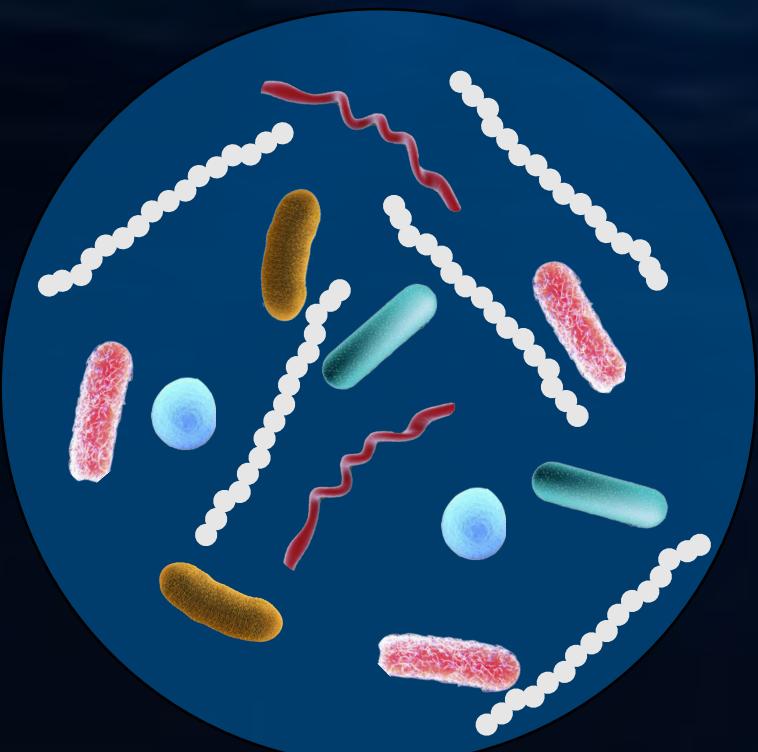


Community succeeded by:
• Cheaters
• Grazers
• Viruses

SYNTHETIC COMMUNITY



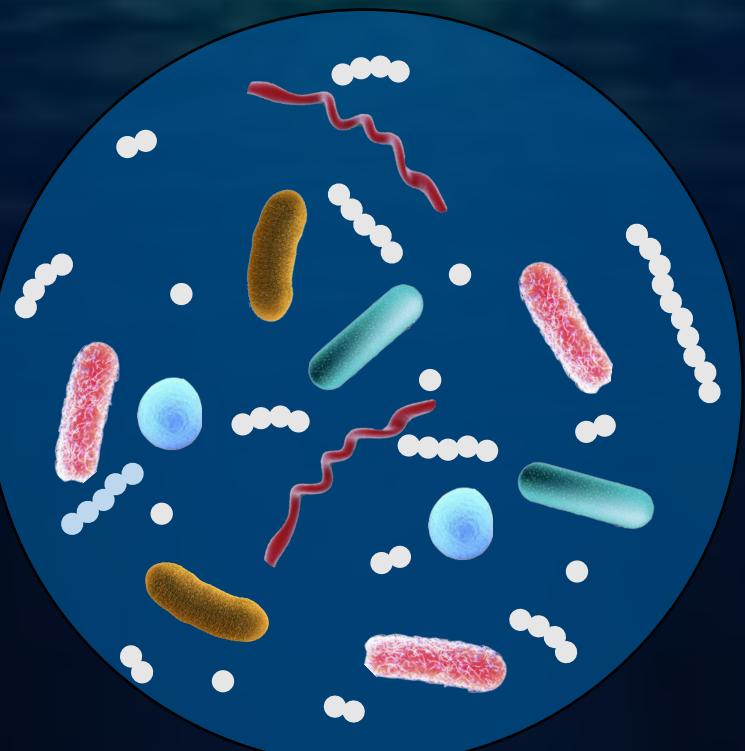
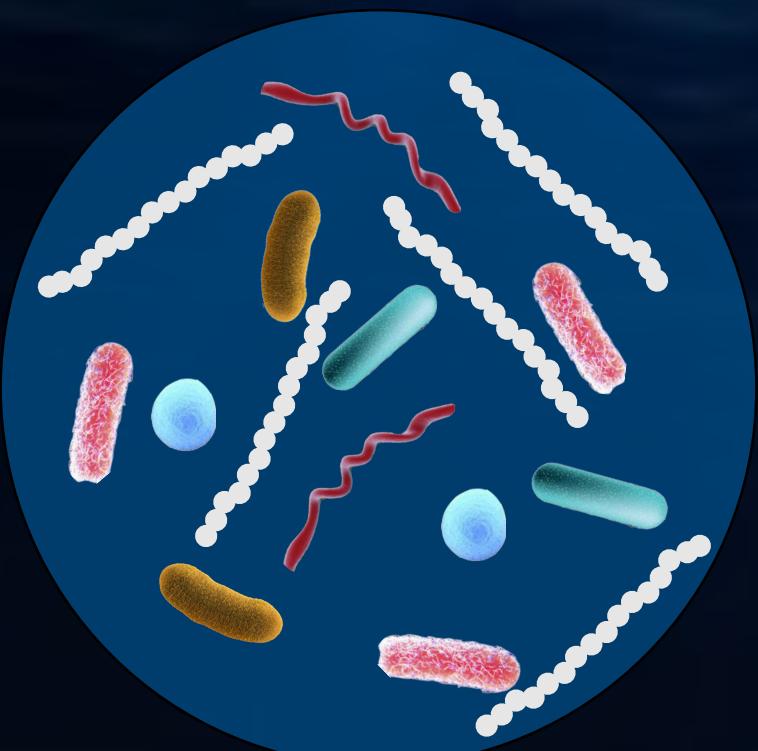
SYNTHETIC COMMUNITY



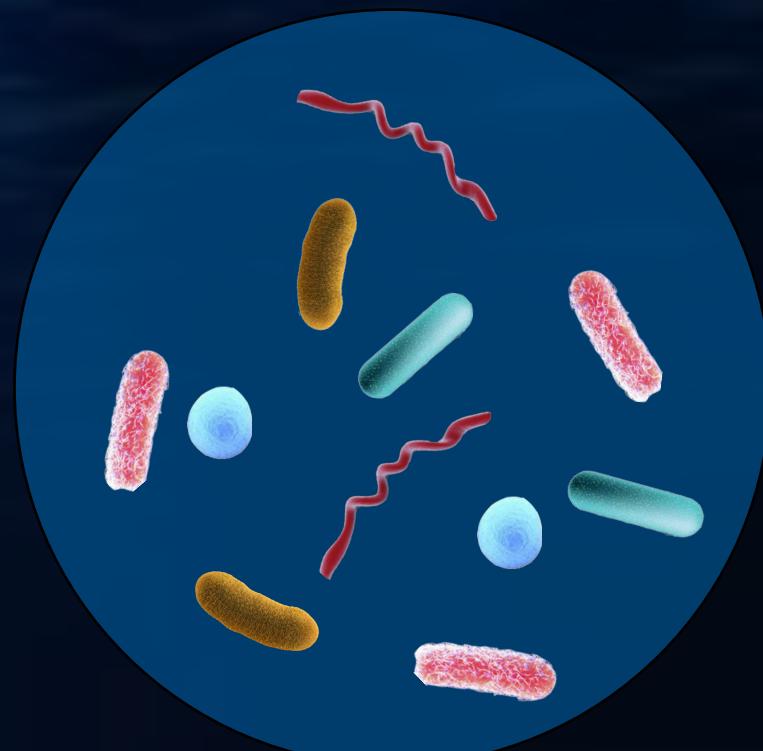
Degradation of PET



SYNTHETIC COMMUNITY



Degradation of PET



No community succession



Take home messages

- Community better than isolate at degradation
- Need low crystallinity PET to be able to see growth
- Or longer time period for degradation
- We do see community succession
- Need to do more work to characterise this further

Acknowledgements

- Supervisors: Joseph Christie-Oleza
Matthew Gibson
- Christie-Oleza group:



Thanks for listening!

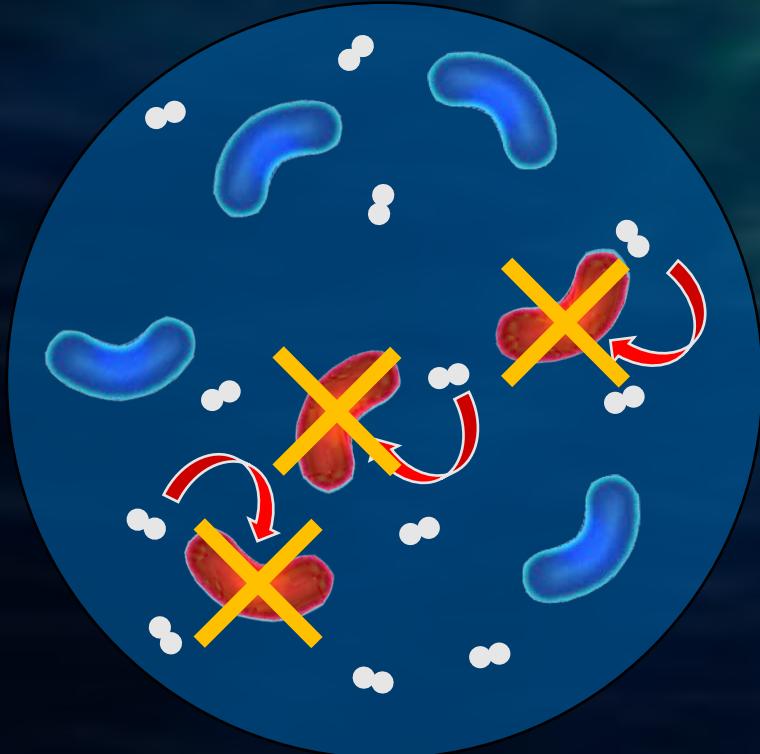


Thanks for listening!



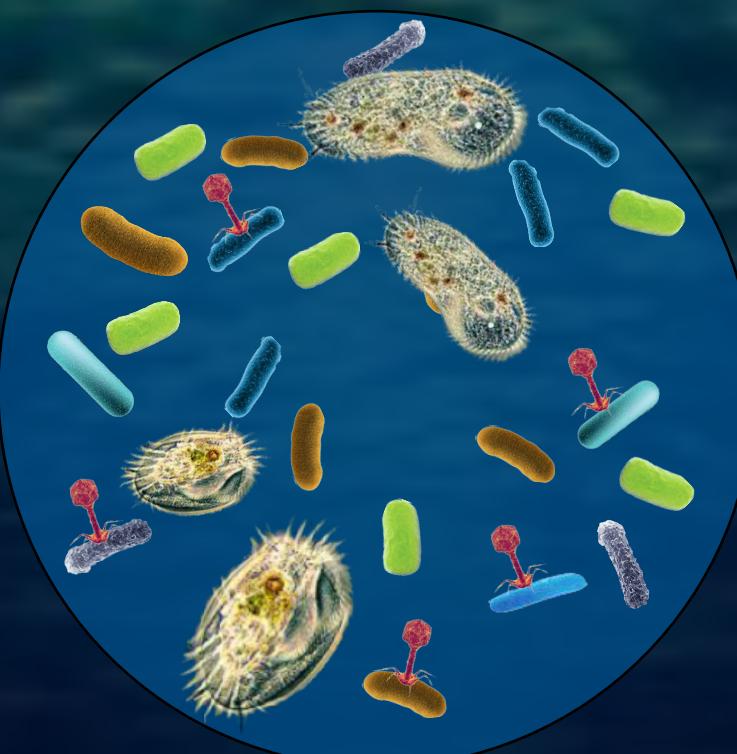
Questions?

ISOLATE



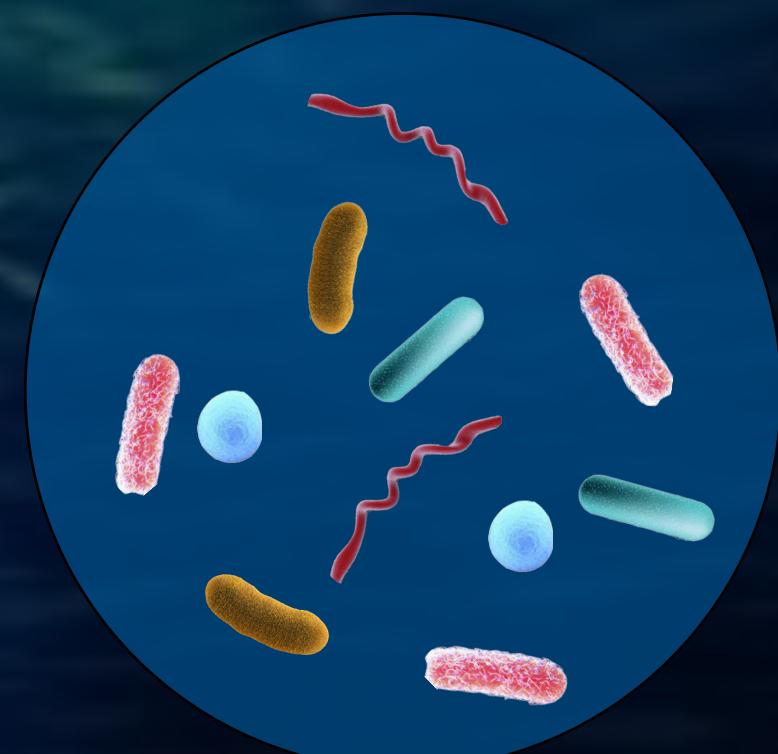
Build up of potentially toxic
intermediates

COMMUNITY



Overrun by cheaters, grazers and
viruses

SYNTHETIC COMMUNITY



Complete degradation



@RobynJWright

<https://www.christieoleza-lab.com>