

Labile substrate availability shapes interactions in a synthetic chitin-degrading soil bacterial community

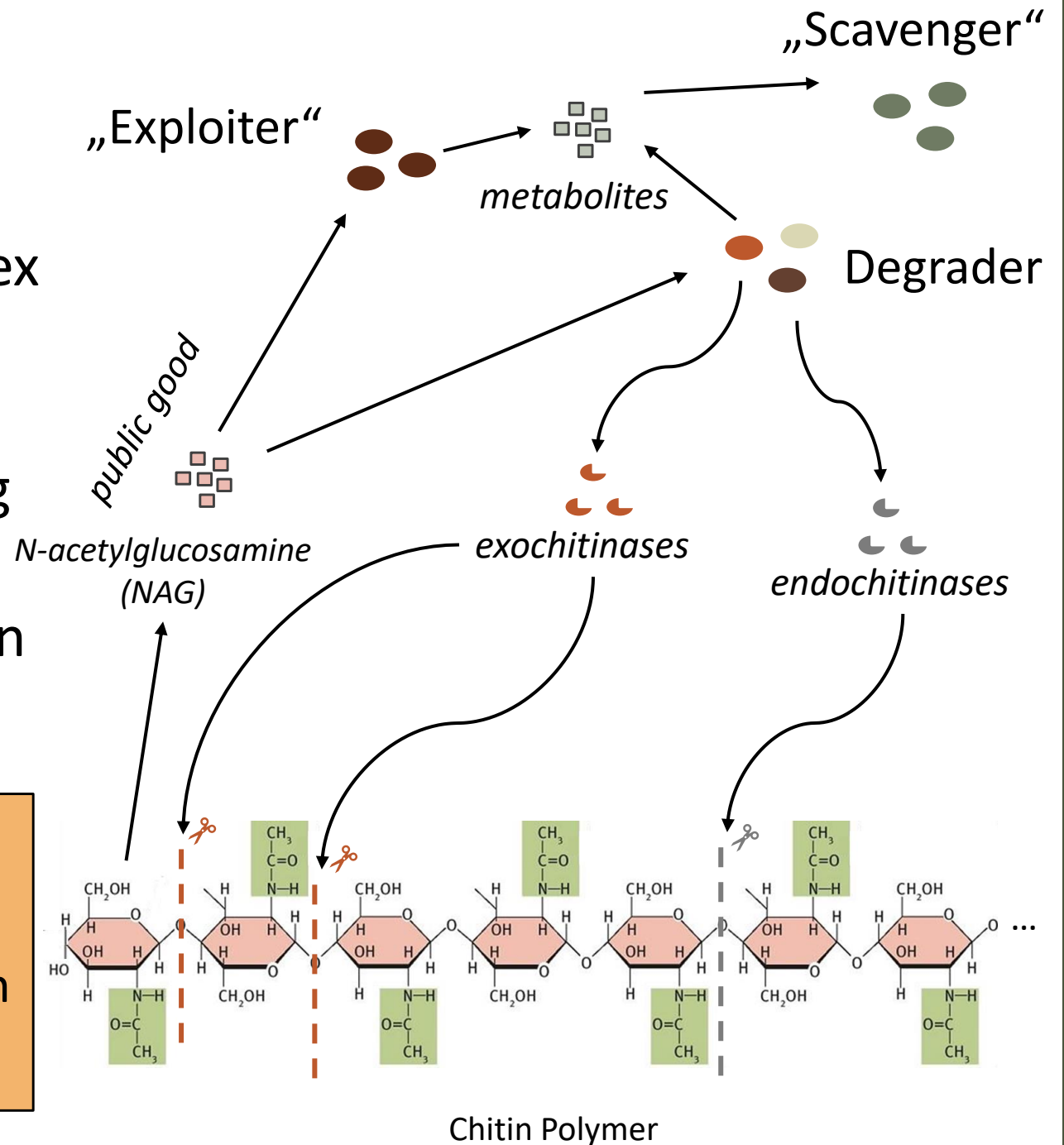
Moritz Mohrlok, Lauren Alteio, Ksenia Guseva, Julia Mor Galvez, Erika Salas Hernández and Christina Kaiser

SSS 4.7 - Microbial growth, turnover and functioning in soils: modelling and experimental advances

Chitin Degradation

- Chitin decomposition is a complex process
- “Social” interactions are often observed within chitin-degrading communities
- Interactions affect decomposition efficiency

Model system to study how bacterial interactions and self-organisation can affect complex substrate degradation in soil

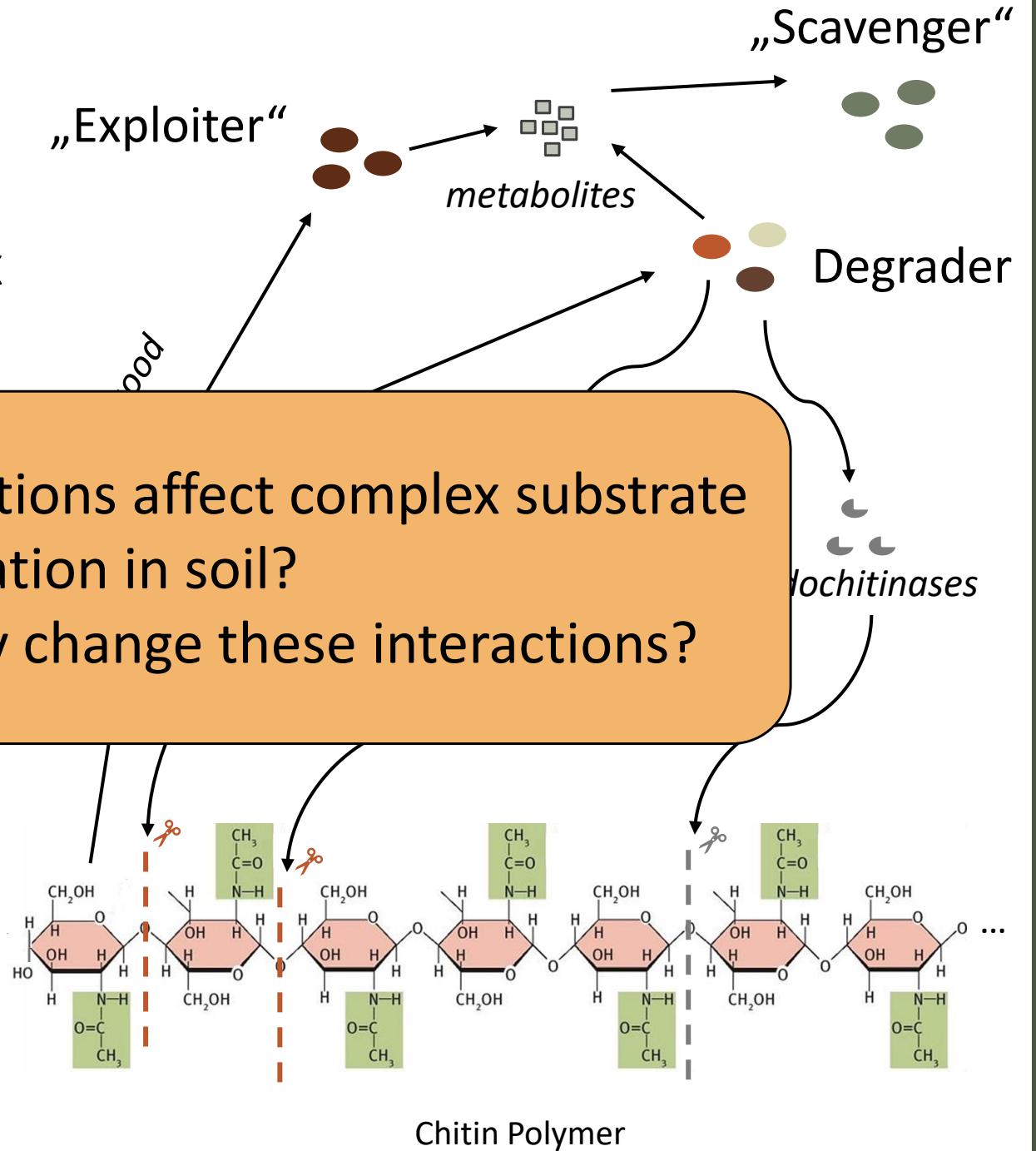


Chitin Degradation

- Chitin decomposition is a complex process
- “Social” observations in natural communities
- Interactions affect chitin degradation efficiency

How can bacterial interactions affect complex substrate degradation in soil?
Does labile C availability change these interactions?

Model system to study how bacterial interactions and self-organisation can affect complex substrate degradation in soil

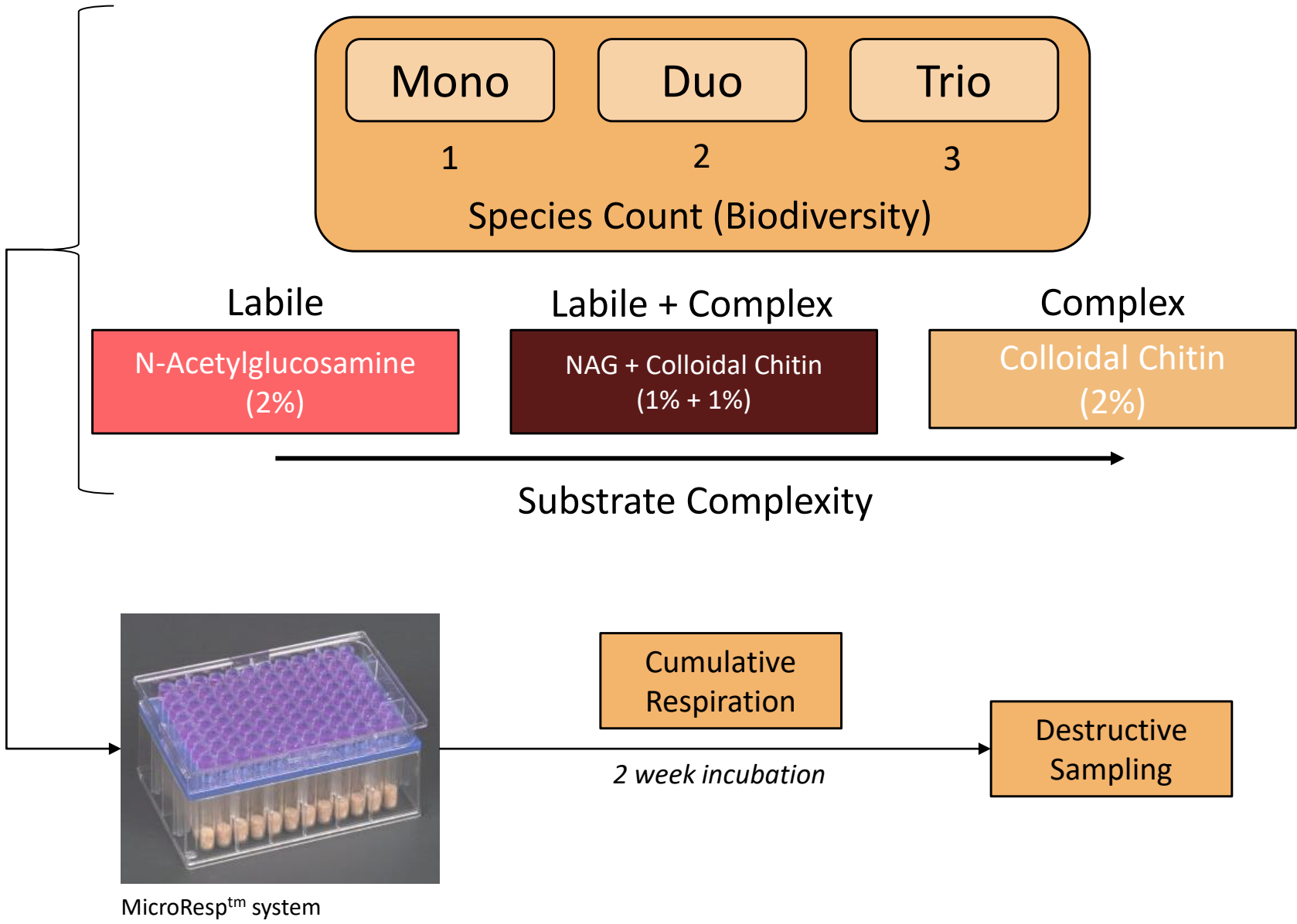


Model Consortium

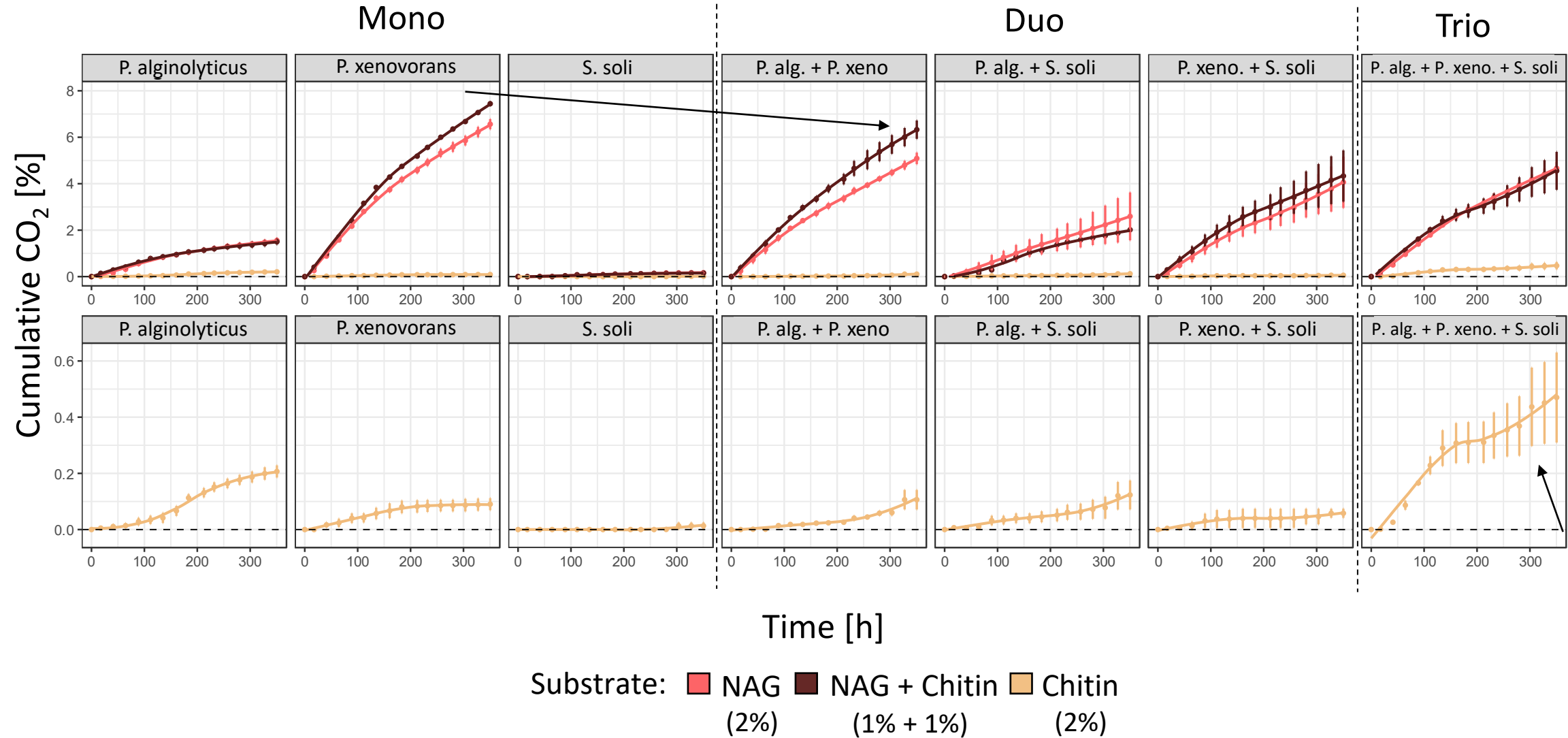
- Three isolated, culturable soil bacteria from different phyla
- Genomic potential to produce different chitinases (MetaCyc)

Phylum	Species
Firmicutes	<i>Paenibacillus alginolyticus</i>
β -Proteobacteria	<i>Paraburkholderia xenovorans</i>
Actinobacteria	<i>Solirubrobacter soli</i>

Experimental Setup

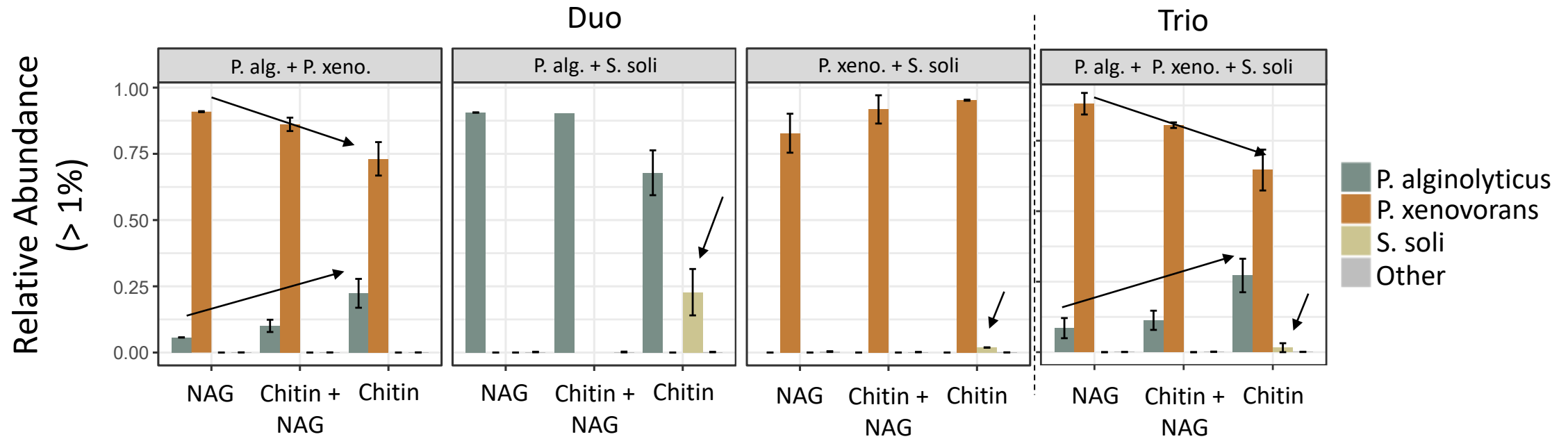


Respiration Data



Final Community Composition

16s Amplicon Sequencing



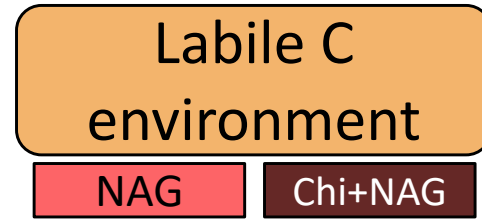
Main Findings

NAG availability affected respiration and final community composition

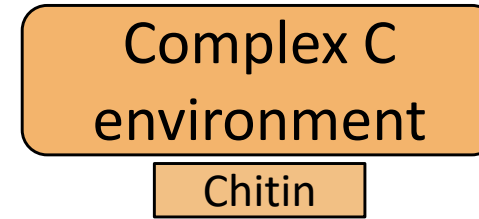
Signs of both competition and cooperation, depending on substrate conditions

Increased survival of less competitive strains with more complex substrate

Summary & Conclusion



- Strong competitor grows fast on labile substrate and outcompetes the other strains
- No positive interactions possible as weaker competitors are too low in abundance or completely removed



- Weaker competitors (slower growers) are not immediately overpowered
- Stable multispecies community
 - Stabilized by metabolic crossfeeding (data not shown)
- More efficient chitin decomposition
 - Production of different chitinases?

Low availability of labile substrate increased survival of less competitive strains, allowing positive interactions and affecting the decomposition of complex SOM

Thank you!



Margarete
Watzka



Ludwig Seidl



Julia
Wiesenbauer



Erika Salas
Hernández



Julia Horak



Hannes
Schmidt

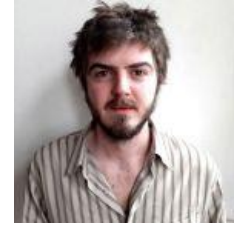
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Ksenia Guseva



Eva Simon



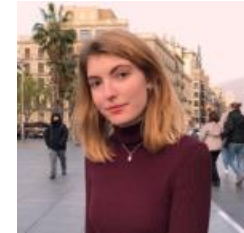
Sean Darcy



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Christina Kaiser



Julia Mor Galvez



Lauren Alteio

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Joana Séneca



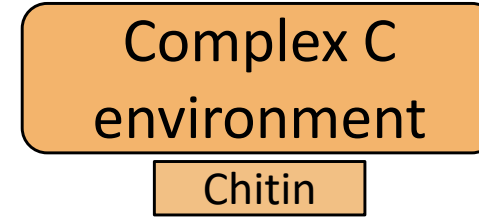
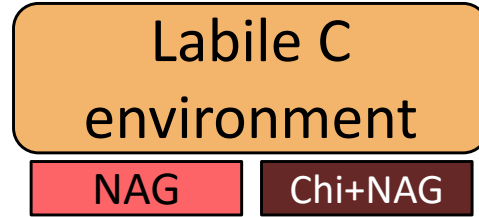
Petra Pjevac



Márton
Palatinszky

DOME/JMF

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Contact me!

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References

Images:

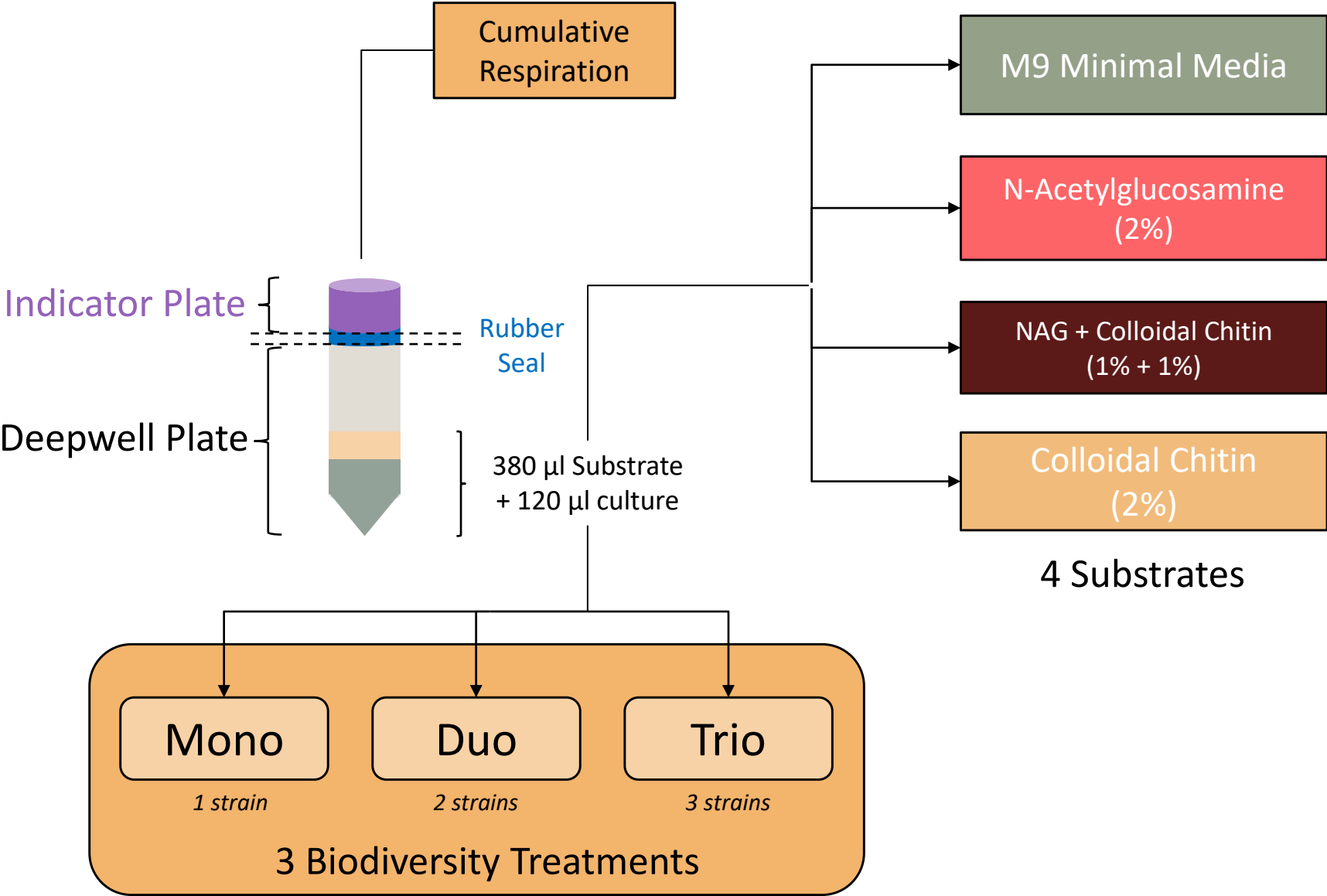
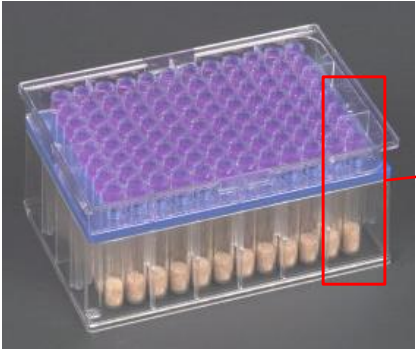
- Chitin structure: Modified from Berezina, N. (2016). Production and application of chitin. In *Physical Sciences Reviews* (Vol. 1, Issue 9). De Gruyter. <https://doi.org/10.1515/psr-2016-0048>
- MicroResp setup: <https://www.microresp.com/>, last accessed on 06.04.23

Literature:

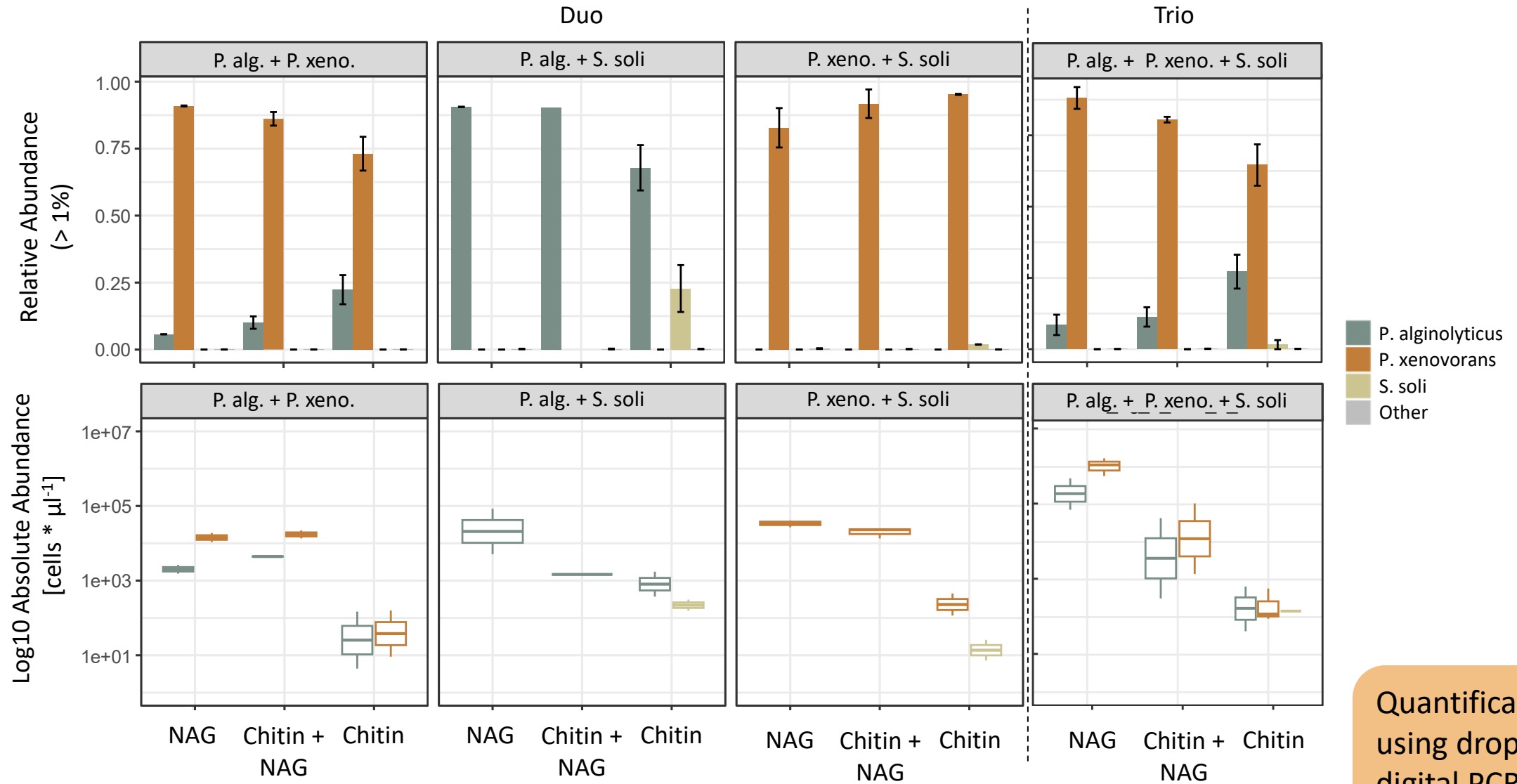
- Beier, S., & Bertilsson, S. (2013). Bacterial chitin degradation-mechanisms and ecophysiological strategies. *Frontiers in Microbiology*, 4(JUN), 1–12. <https://doi.org/10.3389/fmicb.2013.00149>
- Campbell, C. D., Chapman, S. J., Cameron, C. M., Davidson, M. S., & Potts, J. M. (2003). A rapid microtiter plate method to measure carbon dioxide evolved from carbon substrate amendments so as to determine the physiological profiles of soil microbial communities by using whole soil. *Applied and Environmental Microbiology*, 69(6), 3593–3599. <https://doi.org/10.1128/AEM.69.6.3593-3599.2003>
- Evans, R., Alessi, A. M., Bird, S., McQueen-Mason, S. J., Bruce, N. C., & Brockhurst, M. A. (2017). Defining the functional traits that drive bacterial decomposer community productivity. *ISME Journal*, 11(7), 1680–1687. <https://doi.org/10.1038/ismej.2017.22>
- Pollak, S., Gralka, M., Sato, Y., Schwartzman, J., Lu, L., & Cordero, O. X. (2021). Public good exploitation in natural bacterioplankton communities. In *Sci. Adv* (Vol. 7).

Supplementary Slides

Experimental Setup - MicroResp



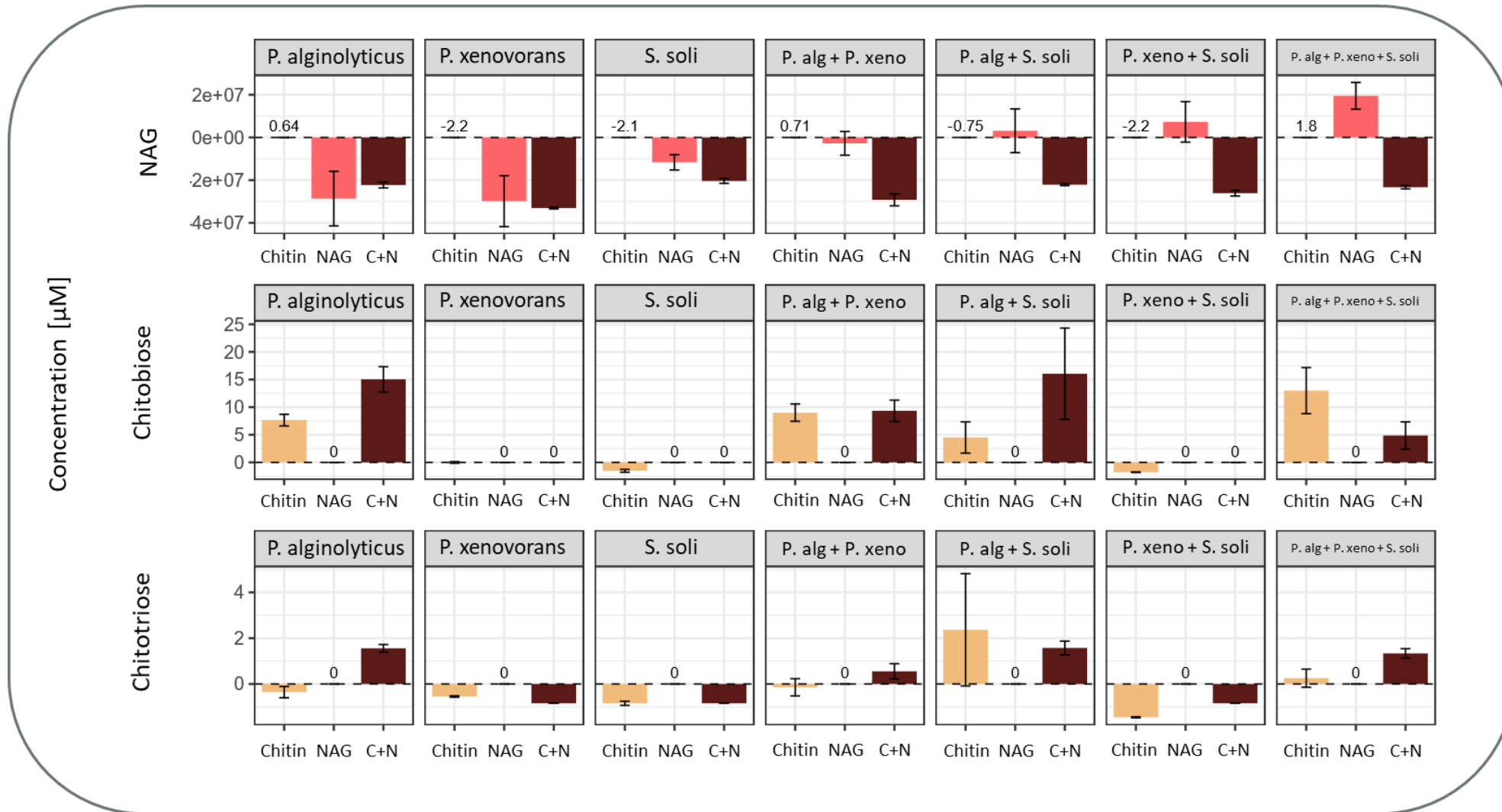
Final Community Composition



Absolute abundance followed similar patterns as respiration

Quantification using droplet digital PCR of the 16s region

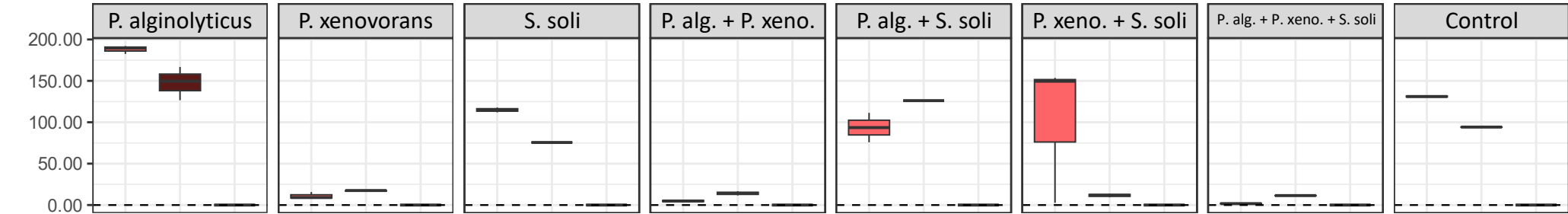
Chitin Oligomers (UPLC-MS)



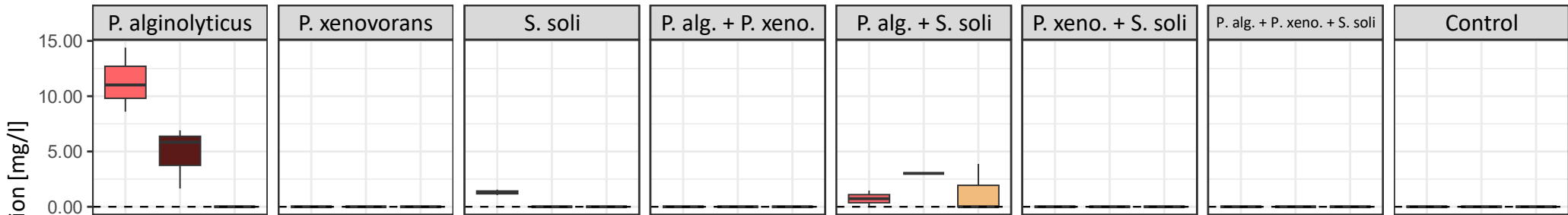
Highest Chitobiose concentration in Trio-treatment

Metabolites (HPLC)

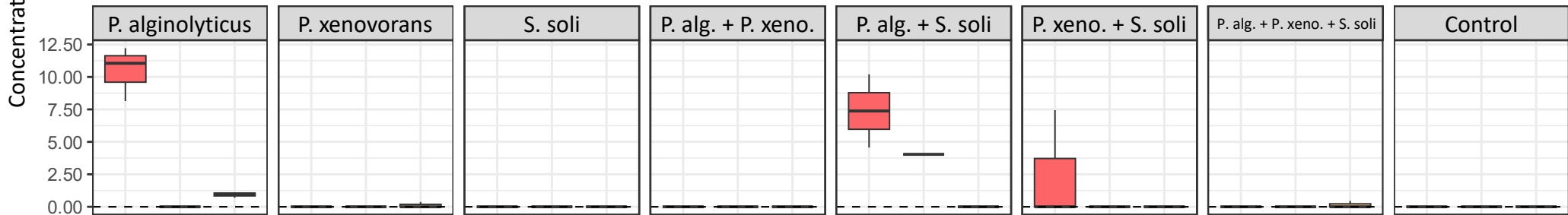
Acetate



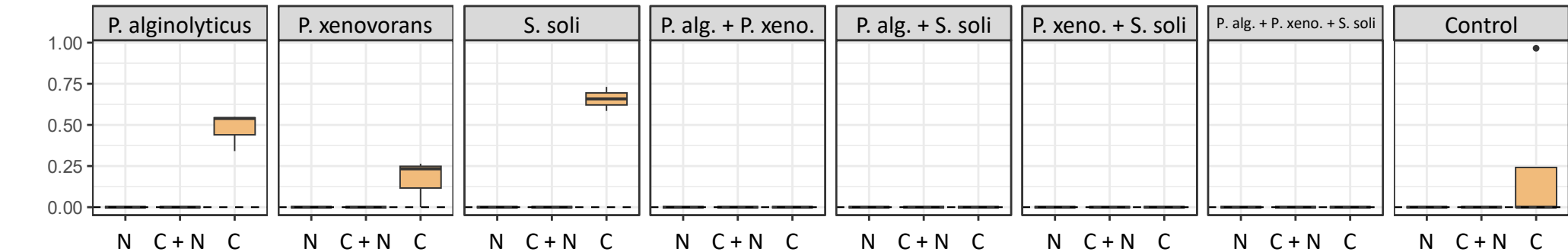
Succinate



Butyrate



Formate



Produced metabolites not accumulating in Trio-treatment