



The arthropod holobiont: a model for transformation of soil organic matter?



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The Holobiont concept

A conceptual revolution

- Ubiquitous nature of host-associated microbes
- Central role in host,
 - Biology
 - Ecology
 - Evolution

Margulis L (1991). Symbiogenesis and symbiogenesis, in *Symbiosis as a Source of Evolutionary Innovation*. Eds L. Margulis and R. Fester (MIT Press). 1-14.

- Unit of selection?
 - The *Hologenome* concept

Rosenberg E. et al. (2007) *Nat Rev Microbiol*
[10.1038/nrmicro1635-c2](https://doi.org/10.1038/nrmicro1635-c2)

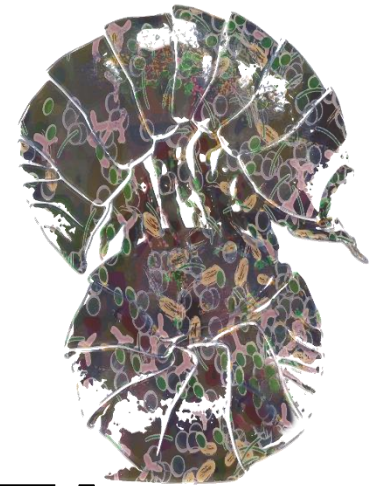
Host as an ecosystem



Bea Roggero Fossati

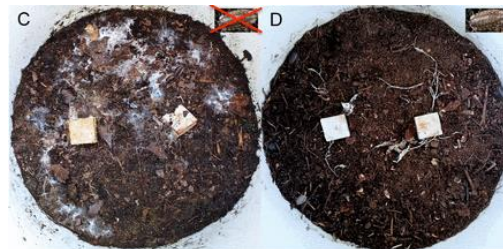
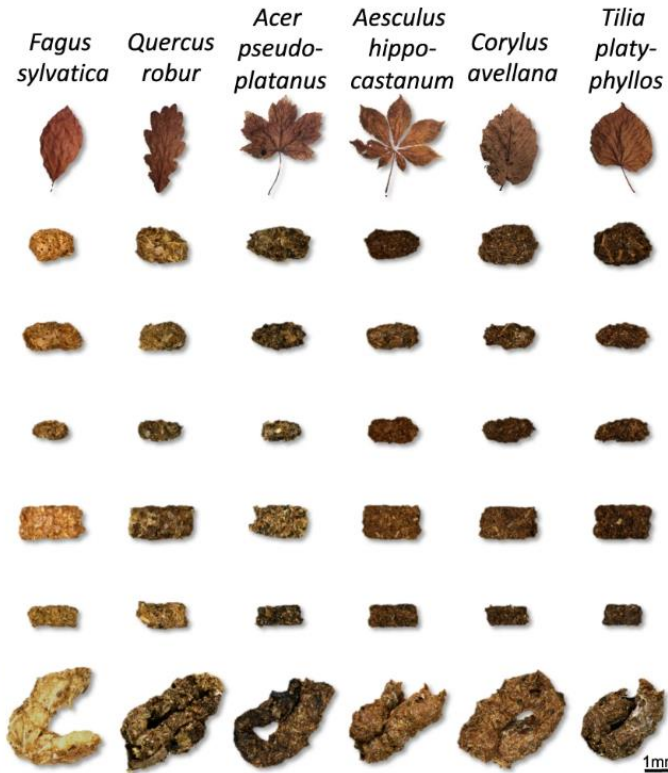
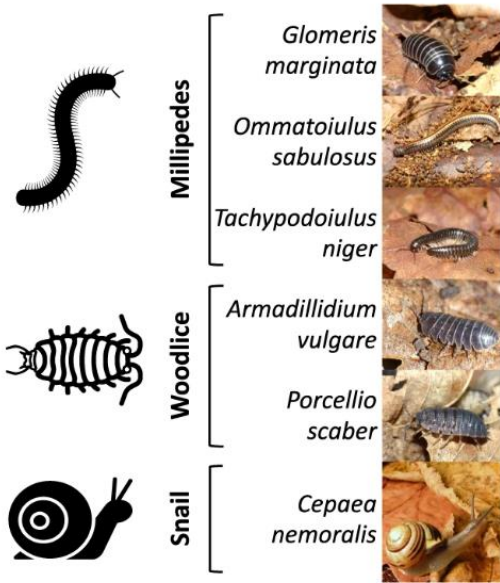
A model system?

ARTHROPOD-MICROBIOTA INTERACTIONS

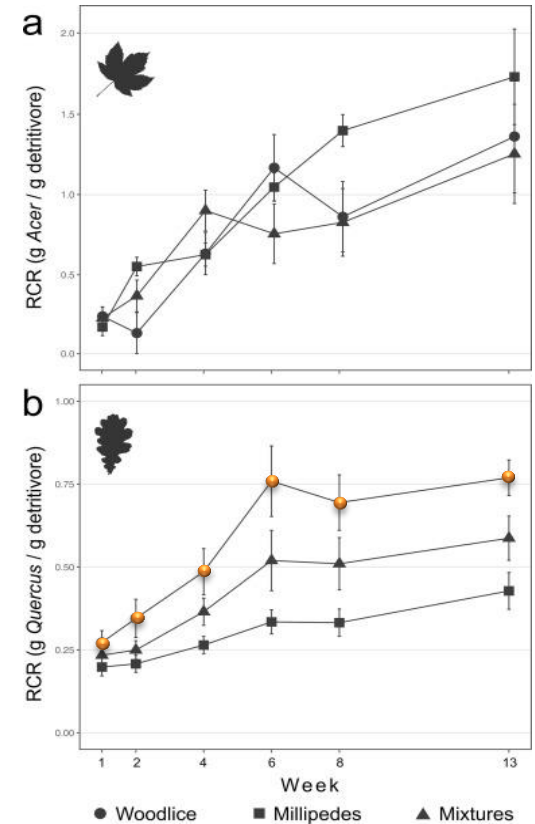


Ecological relevance: Dominant litter dwelling macro-detritivores

Joly et al. 2020 Com. Biol.
[10.1038/s42003-020-01392-4](https://doi.org/10.1038/s42003-020-01392-4)



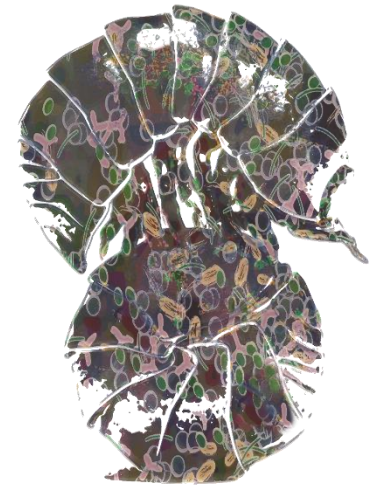
Crowther et al. 2015 PNAS
[10.1073/pnas.1502956112](https://doi.org/10.1073/pnas.1502956112)



De Smedt et al. 2018 Appl. Soil Ecol.
[10.1016/j.apsoil.2018.07.010](https://doi.org/10.1016/j.apsoil.2018.07.010)

Metagenomics: from taxonomic to functional analysis

A MODEL SYSTEM FOR LIGNOCELLULOSE DIGESTION?

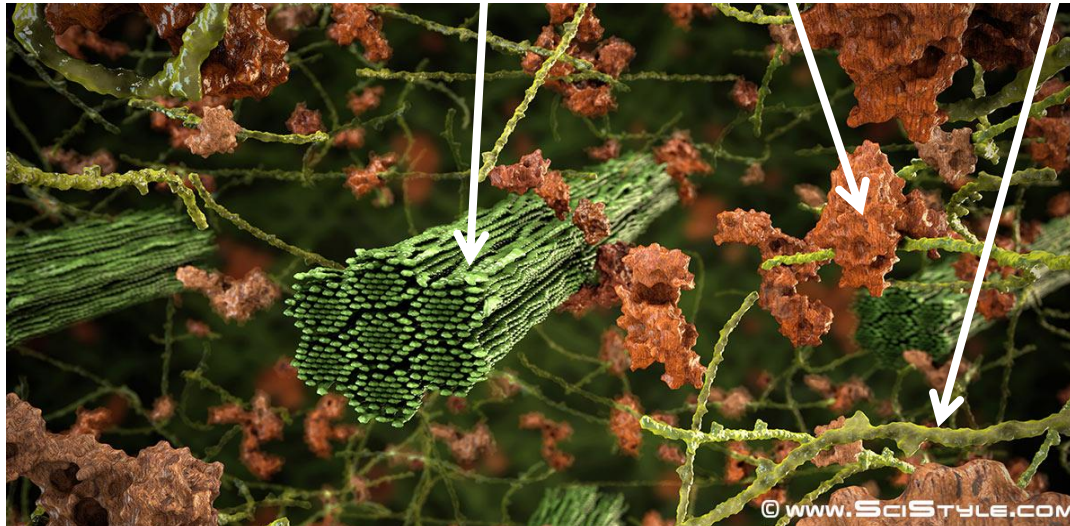


Lignocellulose

The major component of plants

The most abundant biomass on the earth

Lignocellulose = Cellulose + Hemicellulose + Lignin



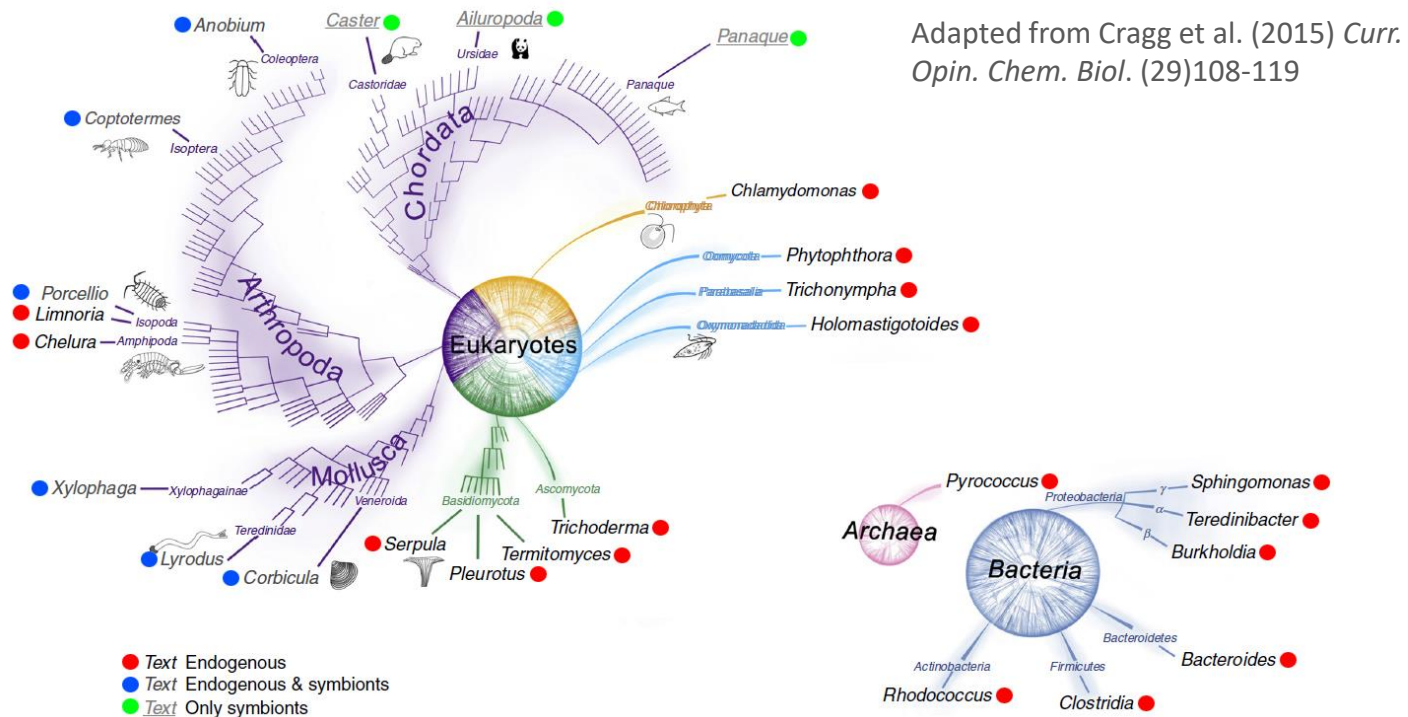
Needs specific Carbohydrate-Active enZymes (**CAZymes**) to be degraded

Lignocellulose degradation across the Tree of Life

Some organisms, but not all, express lignocellulose-degrading CAZymes

Solution ?

Interactions between the host and its microbiota



Adaptation to terrestrial life?

ARTHROPOD METAGENOMICS & TRANSCRIPTOMICS

The Triumvirate of litter decomposers



Termite
Coptotermes gestroi

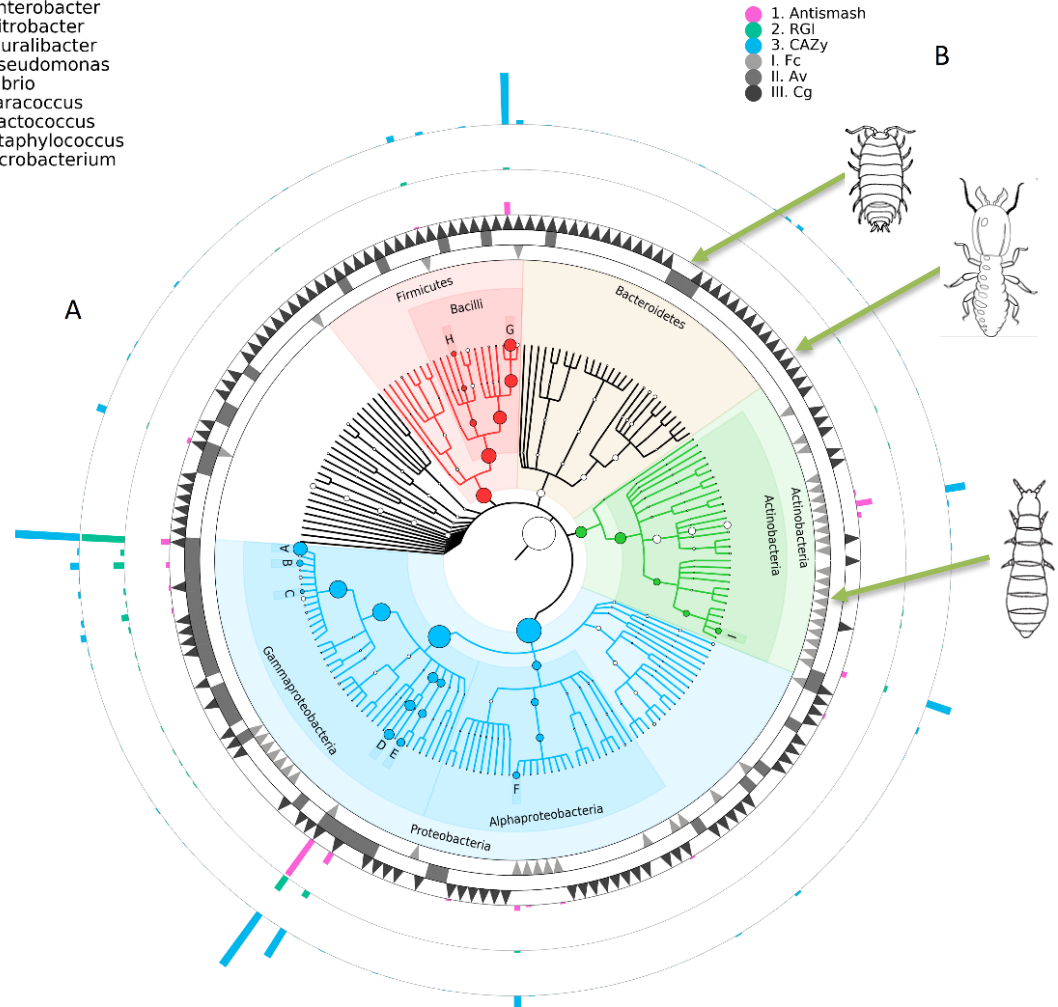


Pill bug
Armadillidium vulgare



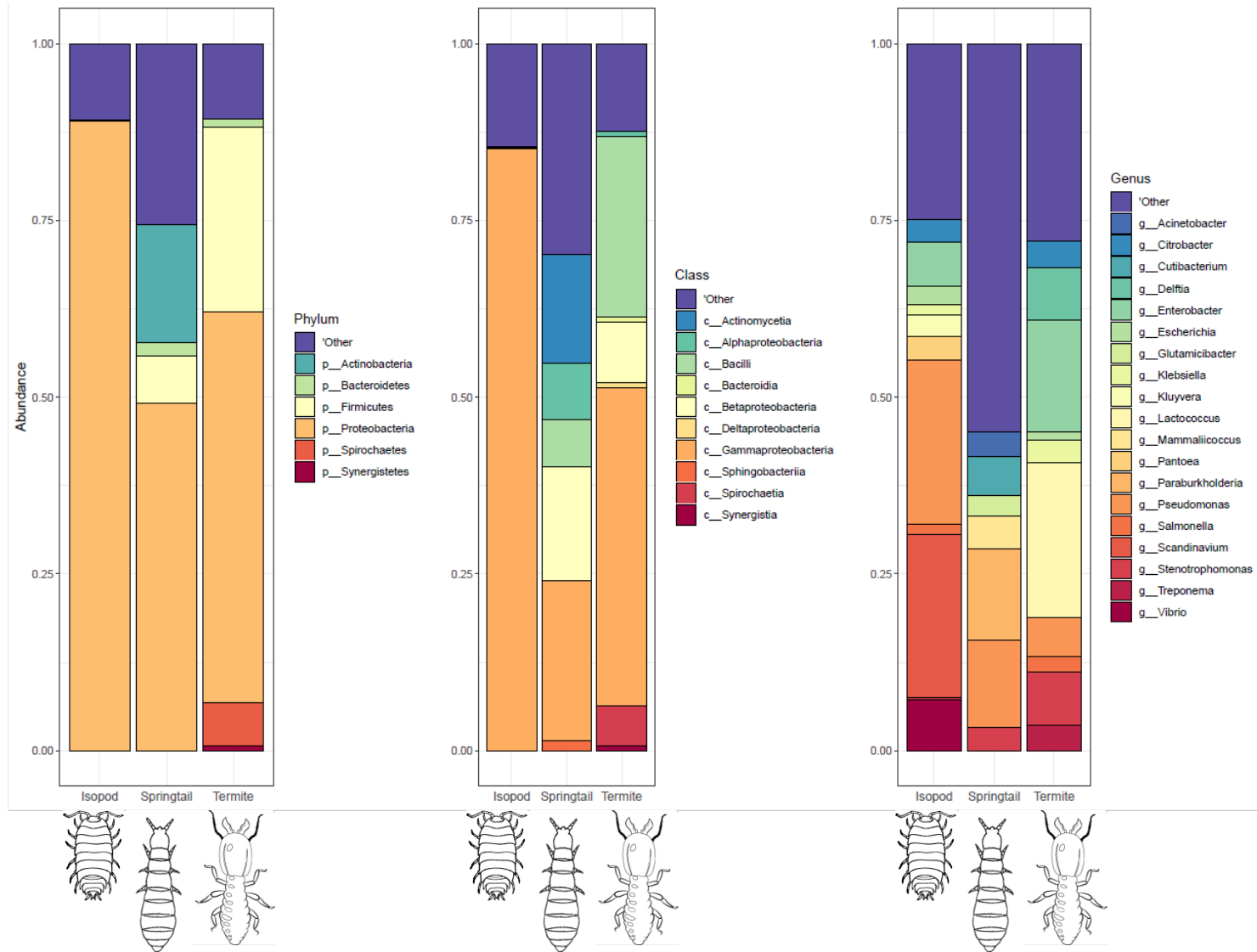
Springtail
Folsomia candida

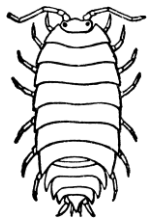
- A: Enterobacter
- B: Citrobacter
- C: Pluralibacter
- D: Pseudomonas
- E: Vibrio
- F: Paracoccus
- G: Lactococcus
- H: Staphylococcus
- I: Microbacterium



Le et al. *Microorganisms* submitted

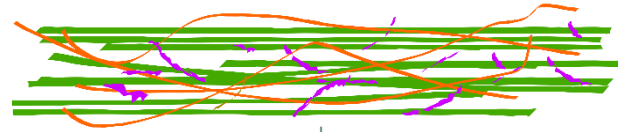
Microbiota: specific diversity but functional redundancy





Interactions in the *A. vulgare* holobiont

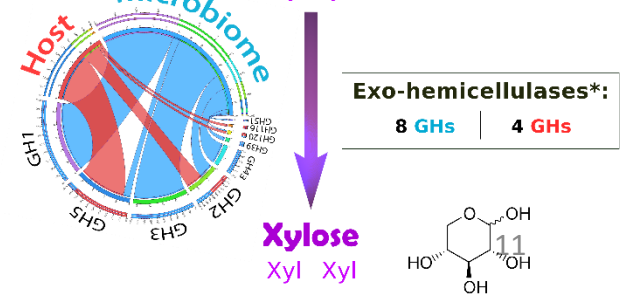
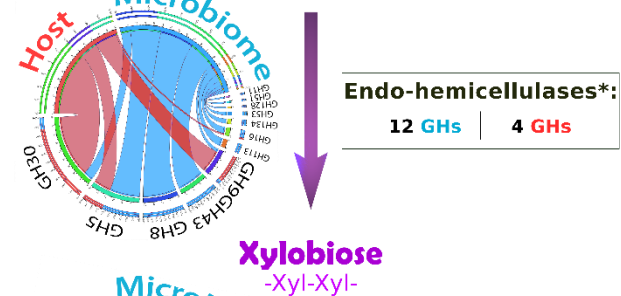
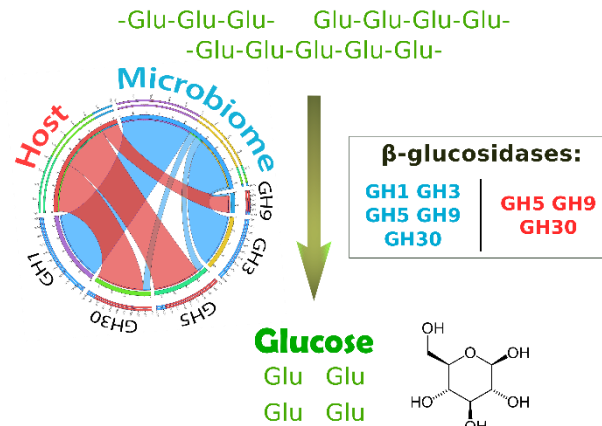
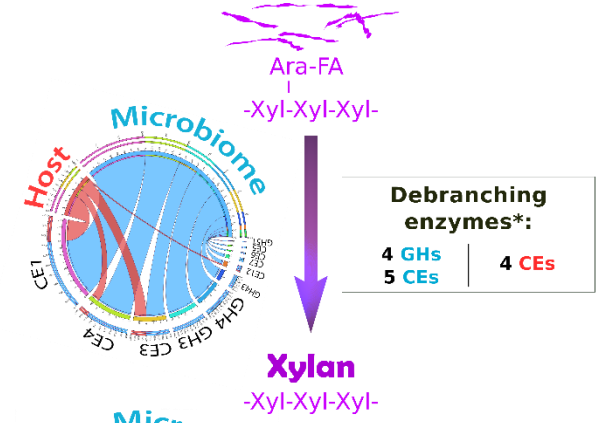
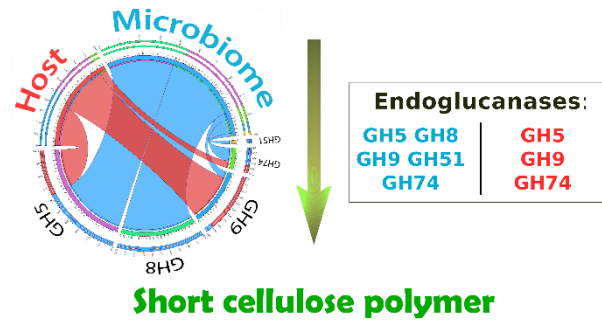
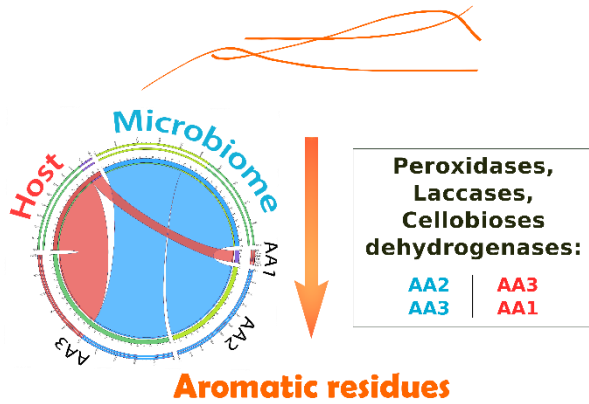
Lignocellulose



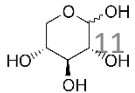
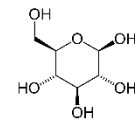
Lignin

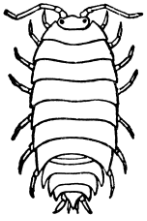
Cellulose

Hemicellulose



■ *A. vulgare*
■ Microbiome
 Ara = Arabinose
 FA = Ferulic Acid
 Xyl = Xylose
 Glu = Glucose





CAZymes of isopod holobionts

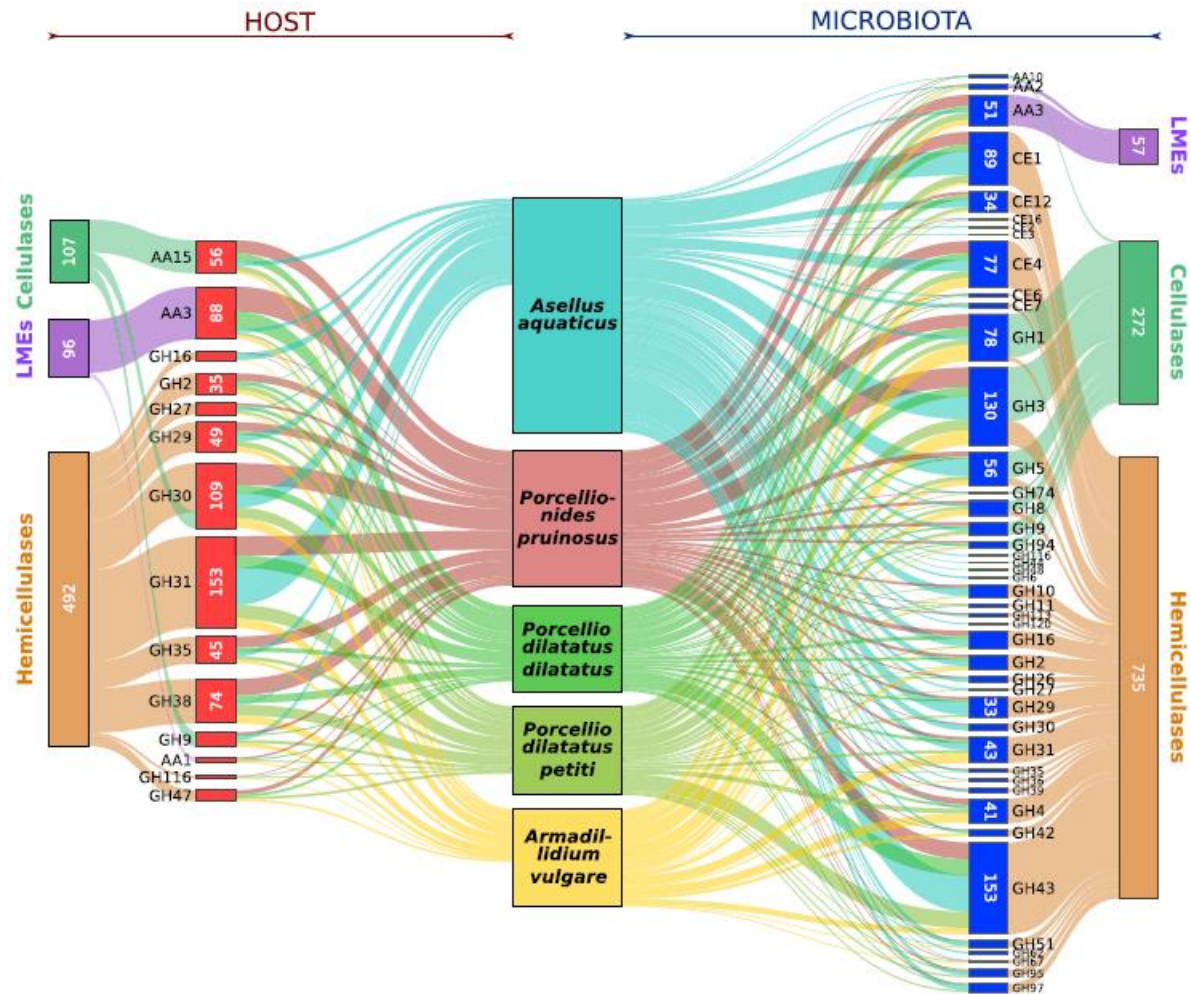


Fig. 1 Lignocellulose-degrading CAZymes of isopod holobionts. Numbers represent normalized CAZyme counts identified in the host (red) on the left and microbiota (blue) on the right. The thickness of the connector is proportional with the number of normalized CAZyme counts identified in a given family

Bredon *et al.* 2019 *BMC Genomics*

Take-home message



Arthropod Holobiont

~~The Terrestrial Isopod Microbiome:~~ An All-in-One Toolbox for Animal–Microbe Interactions of Ecological Relevance

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To be continued...



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Bredon et al. *Microbiome* (2018) 6:162
<https://doi.org/10.1186/s40168-018-0536-y>

Microbiome

RESEARCH **Open Access**

Lignocellulose degradation at the holobiont level: teamwork in a keystone soil invertebrate

Marius Bredon¹, Jessica Dittmer^{1,2}, Cyril Noël¹, Bouziane Moumen¹ and Didier Bouchon^{1*}



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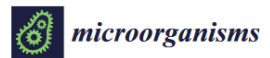
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Article

Effects of Dysbiosis and Dietary Manipulation on the Digestive Microbiota of a Detritivorous Arthropod

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