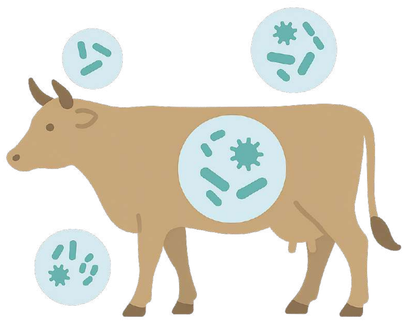
Microbiomes and Holobionts as Genetic Resources for Agroecology

Gwendal Restoux[1], Jordi Estellé[2], Catherine Larzul[3], Paul Cotter[4], Nichole Ginnan[5], Kellye Eversole[6], Claire Rogel-Gaillard[7]

(1) Gwendal.Restoux@inrae.fr – Université Paris-Saclay, INRAE, AgroParisTech, GABI, Jouy-en-Josas, France
(2) jordi.estelle@inrae.fr – Université Paris-Saclay, INRAE, AgroParisTech, GABI, Jouy-en-Josas, France
(3) catherine.larzul@inrae.fr – Université de Toulouse, INRAE, ENVT, GenPhySE, Castanet-Tolosan, France
(4) Paul.Cotter@teagasc.ie – Teagasc Food Research Centre, Moorepark, Cork; APC Microbiome Ireland, Ireland; VistaMilk, Ireland
(5) nichole.ginnan@email.ucr.edu – College of Natural & Agricultural Sciences, University of California, Riverside, CA, USA
(6) eversole@eversoleassociates.com – Animal Microbiomes Working Group, International Alliance for Phytobiomes Research, Eau Claire, WI, USA
(7) claire.rogel-gaillard@inrae.fr – Université Paris-Saclay, INRAE, AgroParisTech, GABI, Jouy-en-Josas, France; Animal Microbiomes Working Group, International Alliance for Phytobiomes Research, Eau Claire, WI, USA

The Holobiont – Host and Microbiome as One

Considering the host and its associated microbiome as a single biological unit – **the holobiont** – reveals the full scope of genetic and functional diversity of a herd member.



Microbiomes provide a wide range of essential functions to their hosts, shaping health, metabolism, and resilience.

Holobionts interact in shared environments, with the dispersal of microbes and their genetic potential occurring through **feed, air, water, soil**, and across **species** and **individuals**.

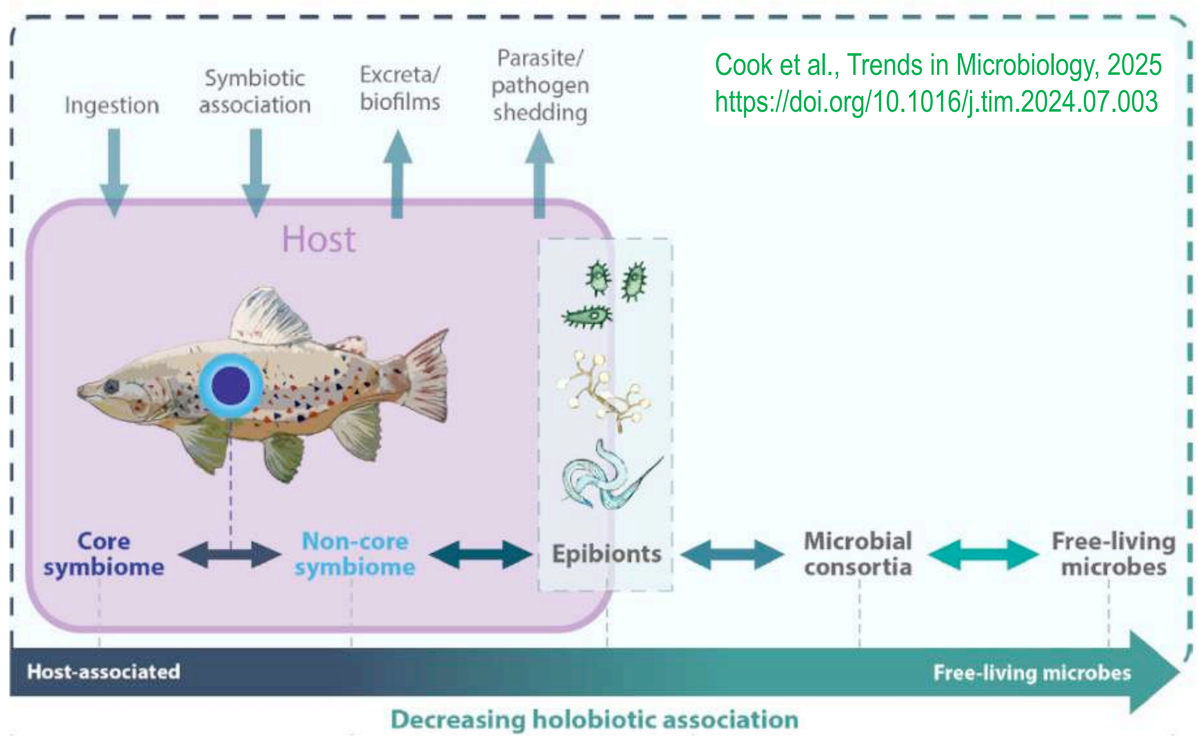
Holobiont Diversity – A New Paradigm for Genetic Resources

The microbiome of the digestive tract contains up to **100 times more genes than the host genome**. It provides a flexible, dynamic reservoir of genetic diversity throughout the animal's lifetime.

Studies suggest that host and microbiome genomes are non-randomly paired, highlighting the need to study them as a single unit.

The Holobiotic Continuum

Microbes, from pathogenic to beneficial, are key connectors across systems. Associations between host organisms and their microbiomes exist along a continuum, ranging from core symbionts (e.g., gut microbiota, obligate parasites) to free-living microbes that associate only incidentally.



Cook et al., Trends in Microbiology, 2025
https://doi.org/10.1016/j.tim.2024.07.003

ISAG is a key arena to explore how to define genetic diversity at the holobiont level, and to assess and prioritize its potential to address the challenges currently facing agriculture.

Research Questions

- How can we define genetic resources at the holobiont level?
- How do plant and environmental microbiomes affect animals?
- How do we define and assess holobiont genetic diversity?
- How can we assess, secure and store livestock holobiont diversity?
- How can this knowledge transform farming?

Managing Holobiont Diversity Is Key: Importance of Resources Centers

Genetic diversity in livestock herds can boost the population's disease resistance, adaptability, and long-term productivity.

A knowledge-based strategy for characterizing, preserving and controlling holobiont diversity is critical for developing **sustainable agricultural management strategies**.

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Animal Microbiomes Working Group of the Phytobiomes Alliance

Focus areas:

- Characterize the **biodiversity** and understand the **interconnectedness** of plants, animals, soil, microbiomes and their environment from a One Health perspective
- Harness microbiomes to optimize the **sustainability** of livestock systems
- Determine the impact of microbiomes on **animal resilience** and **health**

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