

Rumen colonization and succession of microbial guilds during lamb development is affected by the presence of the dam

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TAKE-HOME MESSAGE

Rumen bacteria assemble through a clear succession of ecological guilds. Their trajectories depend on age and rearing system, indicating an association between contact with the dam and early microbial establishment.

WHY IT MATTERS

Rumen functions emerge from interacting microbial communities rather than from individual taxa acting in isolation. Understanding how microbial guilds assemble and replace one another during early life is therefore key to explaining the functional maturation and stability of the rumen ecosystem. Maternal contact provides both microbial sources and a shared environment, making artificial rearing a contrasting colonization context in which to reveal these ecological assembly processes.

RESEARCH QUESTION

How does maternal presence shape the assembly and temporal succession of rumen microbial guilds during early life?

LONGITUDINAL DESIGN

NEW BORN LAMBS

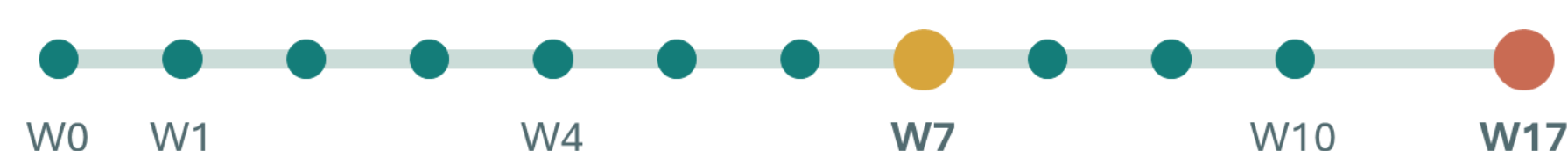
n = 19

Maternal-reared
Dam contact

n = 13

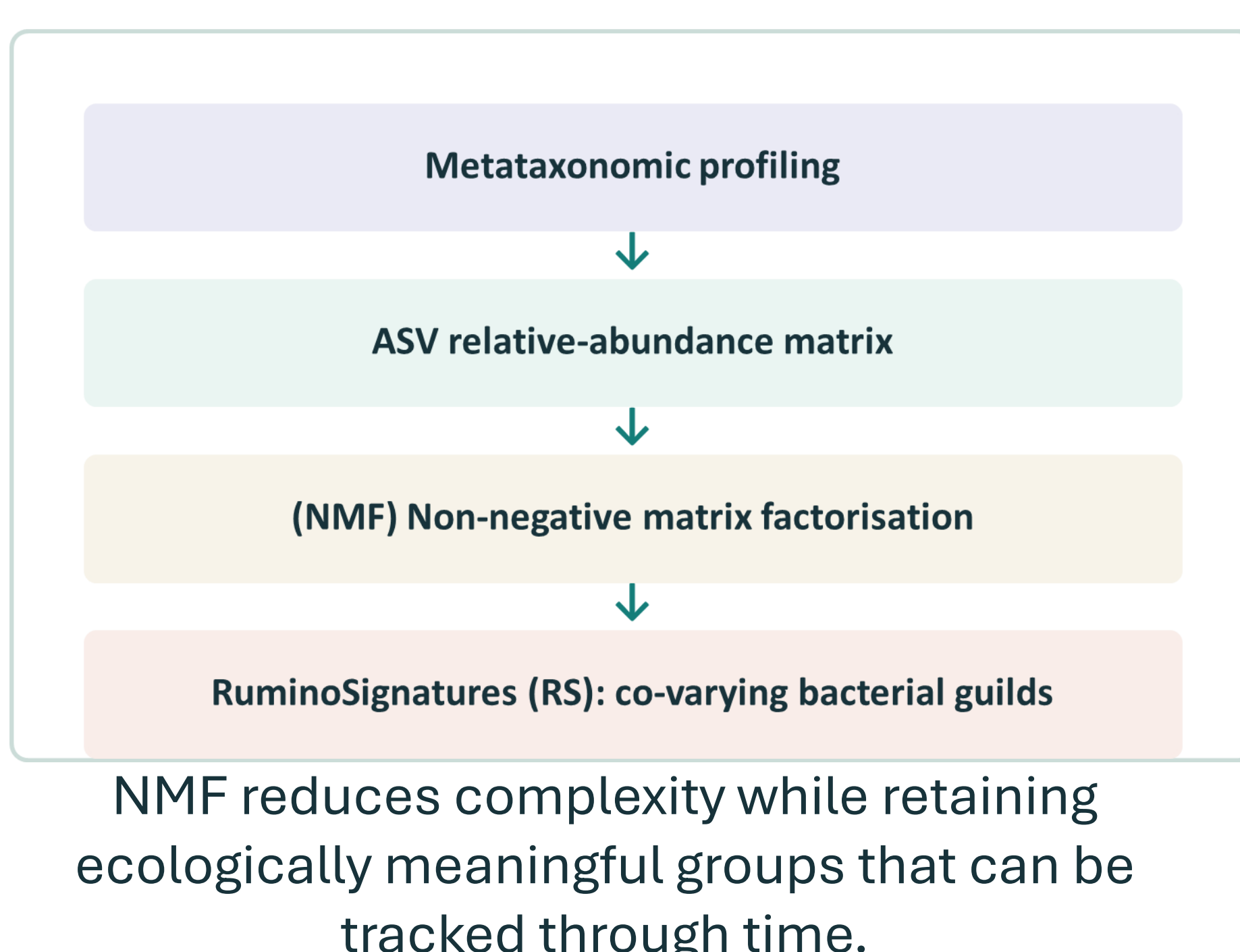
Artificially reared
No adult contact

RUMEN SAMPLING



Samples were taken weekly from birth to week 10, and then once at slaughter (week 17). Weaning occurred in week 7.

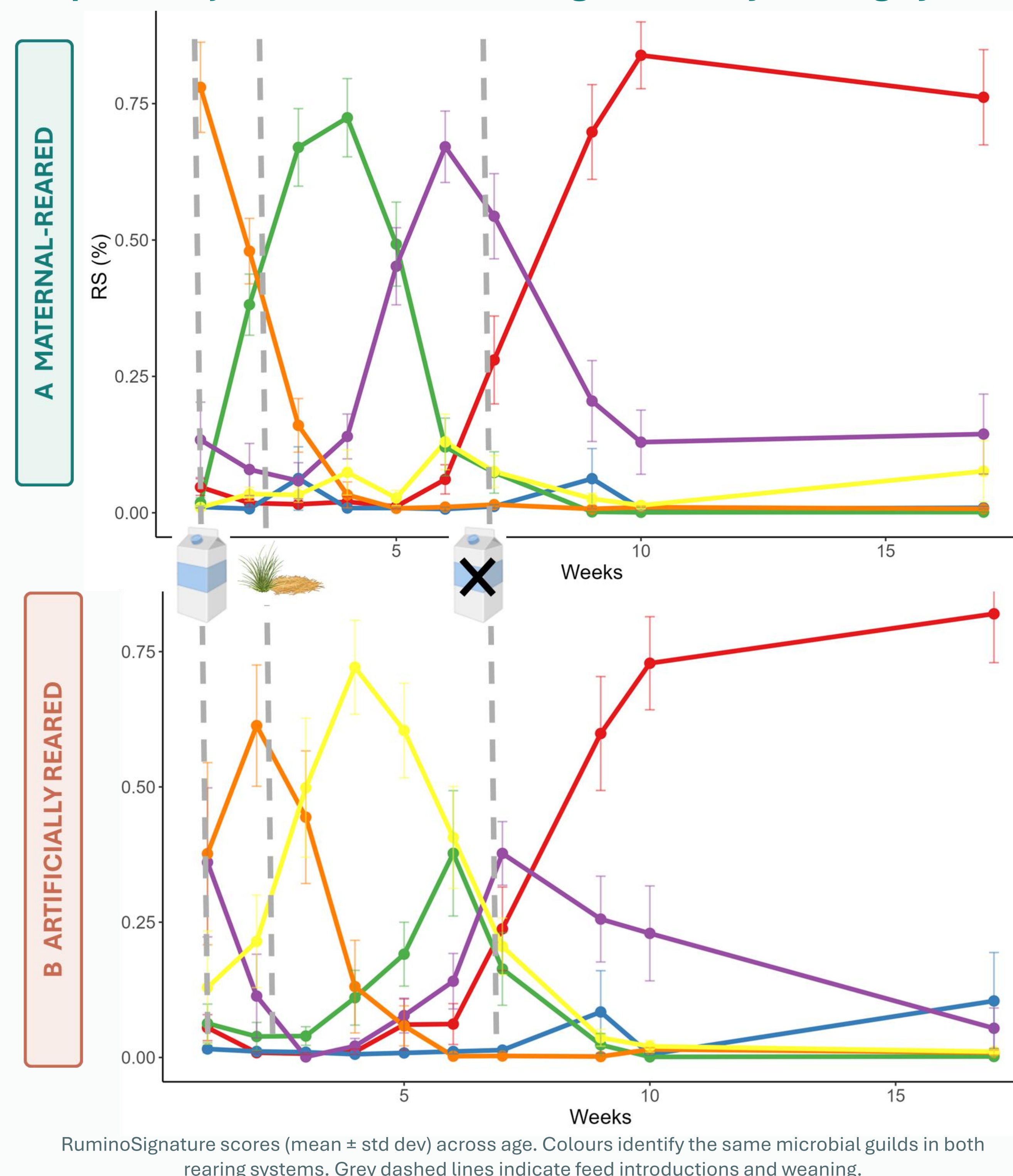
ANALYSIS STRATEGY



MICROBIAL SUCCESSION ACROSS EARLY LIFE

Distinct RuminoSignatures dominated at different developmental stages, revealing an ordered succession of bacterial guilds during rumen establishment.

Temporal trajectories of RuminoSignatures by rearing system



Each RuminoSignature combined several co-varying taxa, and some taxa occurred in multiple RS with different microbial partners.

Main microbial contributors to each RuminoSignature

RS1	Succinivibrionaceae UCG-001 Prevotella Erysipelotrichaceae UCG-002
RS3	F082 Prevotella-associated ASVs
RS4	Muribaculaceae Succinivibrionaceae UCG-002 Succinitticlasticum
RS5	Bacteroides Alloprevotella Neisseriaceae
RS6	Sharpea Rikenellaceae RC9 gut group Prevotella

Guild turnover reveals ecological succession

RuminoSignatures replaced one another in an ordered sequence rather than increasing independently. This turnover is consistent with changing ecological filters as milk-associated niches give way to solid-feed fermentation. The coordinated trajectories may reflect responses to shared niches and interactions among colonizers during rumen ecosystem maturation.

Maternal influence on the assembly pathway

Maternal-reared lambs showed an early RS3-dominated phase, whereas artificial rearing was characterized by a prominent RS6 phase and a delayed RS3 peak. Both groups subsequently converged towards RS1 dominance, consistent with early dispersal and priority effects followed by stronger dietary filtering after weaning.

Guilds reorganize, not just taxa

Early rumen development therefore appears to involve the reorganization of microbial associations rather than the simple replacement of individual taxa. These associations define candidate ecological units, although co-variation alone does not demonstrate direct microbial interactions.