

# **How are microbiomes transmitted across animals? An integrative approach to quantify the ecological factors driving microbiome transfer using guppies.**

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Microorganisms play an essential role in animal health, yet the mechanisms governing their colonization and transmission are poorly understood. Here, we investigated microbiome transmission using guppies (*Poecilia reticulata*), a established model in animal behavioral ecology. The aquatic environment offers the advantage to disentangle the environment from the host-driven processes of microbiome dispersal. We generated two cohorts of guppies with distinct microbial profiles and placed them in cohabitation with and without contact. Using an integrative framework combining genomics (16S rRNA, metagenomics), behavioral tracking, fluorescence microscopy, and ecological modelling we characterized microbiome dynamics across four host compartments (skin gills, gut, gonads). Our results reveal distinct transmission pathways for external versus internal microbiomes, along with pronounced sex- and microbial-specific differences. Understanding how microbiomes move between hosts, and how these processes differ across organs, is essential for elucidating microbiome function and holds great potential for optimizing microbiome-based interventions across diverse animal taxa, including humans.