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Sociobiology of *Bacillus subtilis* biofilms: competition assays and experimental evolution

The evolution of cooperation is one of the long-standing puzzles in evolutionary biology. Why would an individual contribute to the group at the expense of its own fitness? Individual bacterial cells cooperate by secreting products that are beneficial for the community, but costly to produce. It has been shown that cooperation is critical for microbial communities, most notably in biofilms; however the degree of cooperation strongly depends on the culturing conditions. The cells in a biofilm are enclosed in an extracellular matrix that mediates the attachment of the cells to each other or to surfaces, holding the biofilm together. We have recently showed that spatial community structure provides a solution how cooperation might develop and remain stable [1,2]. Using the Gram-positive bacterium, *Bacillus subtilis* as a model, we can examine the dynamics of cooperator and non-producer populations in various settings. Biofilms at the air-medium interface, the so called pellicles are used to reveal the importance of certain traits to the fitness of a bacterium. While flagellum-based motility, chemotaxis, and oxygen sensing are not absolutely essential for biofilm development in single strain cultures, these traits are important for successful competition during pellicle formation [3]. Moreover, we employ pellicle biofilms as a model to examine the dynamics of cooperator and non-producer bacterial populations, and their laboratory adaptation to understand the evolutionary trajectories in complex microbial systems. In sum, laboratory experiments help us to identify the importance of certain phenotypic traits, but also allow studying the evolutionary adaptation of bacteria to certain conditions.

[1] van Gestel J, Weissing F, Kuipers OP, Kovacs AT (2014) *ISME J* 8: 2069–2079

[2] Kovacs AT (2014) *Front Microbiol* 5: 649

[3] Hölscher T, Bartels B, Lin Y-C, Gallegos-Monterrosa R, Price-Whelan A, Kolter R, Dietrich LEP, Kovacs AT (2015) *J Mol Biol* doi:10.1016/j.jmb.2015.06.014