

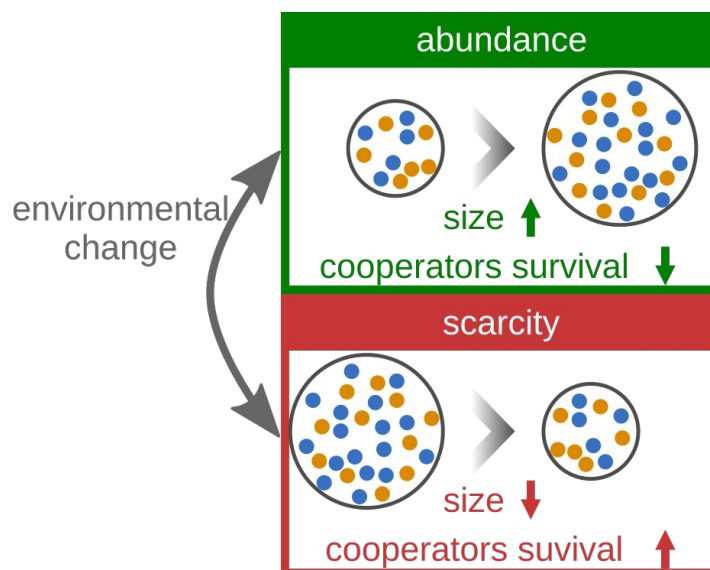
How environmental variability can help cooperators to survive

Environmental conditions lay the groundwork for species competition, but they change frequently. Our research shows that this helps bacteria cooperate.

Cooperation between individuals is beneficial for the population as a whole, but not for those who sacrifice their resources and energy to the common good. Why don't cooperators go extinct if others can freeload on their labor? This long-standing biological question is especially tricky in bacteria, which have neither brains nor social conventions to enforce cooperation.

A variable environment can help level the playing field. The amount of available resources (food, space, etc), in fact, limits the population size, and in small populations, freeloaders could die out by chance, despite their competitive advantage. What happens outside a population, thus, intertwines with what happens inside it.

When resources fluctuate, the population grows or shrinks accordingly, if it can keep up with the pace, offering cooperators more chances to compete in smaller arenas. Our theoretical model, see Refs.[1,2], demonstrates that, when the amount of resources continually switches between abundance and scarcity, the environment boosts the cooperators' survival chances, compared to a fixed environment with average resources (see Cartoon).



Cartoon of the model of Ref.[1]: Intertwined evolution of the population size and its composition.

Bacteria often face changing environments. Our bodies, for example, with their ever-changing conditions (hormones, nutrients, etc) provide a highly variable environment to a number of microorganisms. These theoretical findings highlight how such environmental variability can transform the interactions between bacteria, driving their evolution.

Ref. [1]: K. Wienand, E. Frey, and M. Mobilia, “*Evolution of a Fluctuating Population in a Randomly Switching Environment*”. E-print: <https://arxiv.org/abs/1708.08841>; to appear in Physical Review Letters.

Ref. [2]: Supporting videos are available here: <https://doi.org/10.6084/m9.figshare.5082712>