

Group selection in microbial communities

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Short project Description

A central question in the development of Darwinian evolutionary theory is what is the biological entity being selected, i.e. the object of selection. A question still open is if it makes sense to consider an object of selection above the organismic level.

For macroscopic organisms, altruistic behaviour has been traditionally considered a necessary condition for group selection to appear. Since altruism has a fitness cost, most of the work focuses on the evolution of social species, with concepts like kin selection and inclusive fitness leading to vigorous debates. Nevertheless, processes such as horizontal gene transfer or metabolic syntrophy (which do not necessarily imply a cost) may lead us to reconsider the notion of group selection in microbial communities, even at the multispecies level. In this work, we aim to clarify the epistemological assumptions underlying the notion of group selection, and to delineate suitable conceptual experiments via synthetic scenarios that may help us to elucidate if group selection is a reasonable hypothesis to consider in modern microbiology. A natural starting point to explore the notion of group selection is to consider as a null hypothesis that only organism-level selection occur in nature, and then look for experiments attempting to reject it. It is in this context where an alternative hypothesis stating that group selection explains the observation is plausible. We will follow a strategy in which we look for experiments that would favour species survival if they coexist as a group, and try to explain them with both organism-level and group-level selection. We will investigate these questions with the help of computational models describing the population dynamics of microbial species.

Scope: Master Project. Fair programming skills are required, and an inclination towards philosophical questions desirable.

[1] Pascual-García, A., Bonhoeffer, S. & Bell, T. (2020). Microbial metabolically cohesive consortia and ecosystem functioning . *Philos. Trans. Royal Soc. B*, 375: 20190245

[2] Okasha, S. (2001). Why won't the group selection controversy go away?. *British Journal for the Philosophy of Science*, 52(1).

[3] Mayr, E. (1997). The objects of selection. *Proceedings of the National Academy of Sciences*, 94(6), 2091-2094.