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On the relationship between competition and adaptation in changing environments

**Abstract**

When competitive exclusion between lineages and genetic adaptation within lineages occur on the same timescale, the two processes may interact. Here, I use experimental microbial evolution different lineages of a photosynthetic microbe are grown either alone or in communities for hundreds of generations under CO<sub>2</sub> enrichment. After about 300 generations of growth, multilineage communities are both less productive and less fit than single lineage communities. In addition, there is a negative relationship between the ability of a lineage to exclude competitors and the ability of that lineage to adapt in response to abiotic change alone. I use the Price equation to partition the differences in community productivity between single lineage and multilineage communities into components that can be attributed to either sustained physiological acclimation, shifts in community composition, or evolutionary change within lineages. I find that the contribution of shifts in community composition to productivity is always negative in this system. I suggest that one parsimonious explanation for the negative relationship between competition and adaptive evolution is that when a population is successfully adapting to an abiotic challenge, the presence of competitors adds complexity to the adaptive landscape, thus slowing adaptation to both the environment and to the competitor for that lineage. Conversely, lineages that adapt less in response to the abiotic challenge alone are then able to improve their ability to compete while paying a lower cost of complexity.