Environmental stress leads to the breakdown of mutualistic interactions a simplified bacterial community

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The Anthropocene era has been associated with consequential environmental changes and the deterioration of biodiversity. As a result, significant biodiversity loss has occurred, but species still successfully evolve and adapt to new environmental conditions, a phenomenon known as Evolutionary Rescue (ER). ER has been extensively investigated in single-genotype populations however its understanding remains limited in communities comprising interacting genotypes. In this study, we explored the dynamics of ER using a cross-feeding system involving genetically engineered auxotrophic *Escherichia coli* strains engaged in reciprocal exchange of essential amino acids. Following exposure to several stresses, obligate mutualistic populations exhibited diminished growth rates and underwent biomass reduction, approaching the extinction. Surprisingly, these populations recovered and avoid the extinction through th6e emergence of a singular prototrophic strain, thereby instigating the breakdown of the mutualistic interaction. Notably, the consistent compensation for auxotrophy within the same strain across all experimental replicates suggests that the ER potential of mutualistic populations may depend on their ability to revert to a prototrophic state, especially when auxotrophy is more susceptible to stress than prototrophy. Our findings underscore the heightened stress sensitivity resulting from obligate dependencies, which can result on the unraveling of mutualistic networks and contribute to the loss of biodiversity in the face of environmental deterioration.

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