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Cooperation, cheating, and collapse in microbial populations

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Natural populations can suffer catastrophic collapse in response to small changes in environmental conditions, and recovery after such a collapse can be exceedingly difficult. We have used laboratory yeast populations to study proposed early warning signals of impending extinction. Yeast cooperatively breakdown the sugar sucrose, meaning that there is a minimum number of cells required to sustain the population. We have demonstrated experimentally that the fluctuations in the population size increase in magnitude and become slower as the population approaches collapse. The cooperative nature of yeast growth on sucrose suggests that the population may be susceptible to cheater cells, which do not contribute to the public good and instead merely take advantage of the cooperative cells. We have confirmed this possibility experimentally by using a cheater yeast strain that lacks the gene encoding the cooperative behavior [1]. However, recent results in the lab demonstrate that the presence of a bacterial competitor may drive cooperation within the yeast population.

[1] Gore et al, *Nature* **459**, 253 – 256 (2009)