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# Effects of higher-order interactions and finite number of species on replicator equations

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What we are concerned about is how complex ecosystems are maintained stably. We investigate factors contributing to the mechanism. Especially interactions with each species is examined. In this study we focus on replicator equations, known as dynamics of ecological populations, game theoretical strategies, etc. Commonly pair-wise (2-body) interactions are assumed in the conventional studies of the replicator equations. Such higher-order interactions are occured in general chemical reaction networks, indirect effects of ecological species more than two, Mendelian inheritance, etc. Recently a study on replicator equations with higher-order interactions were done by using the replica method [1]. As the study solved a replica symmetric solution, now we calculate one-step replica symmetry breaking solution of the equations. Second, we analyze dependency of a number of species on ecosystems by numerical simulations. This clarify how a finite system size limit. Because a ecosytem's typical system size is actually finite and cover a widespread range, to associate theoretical results as real ecosystems it is important to know finite system size. We will discuss effects of higher-order interactions and finite number of species on a stability of ecosystems.

## References

[1] V. M. de Oliveira and J. F. Fontanari. Random replicators with high-order interactions. Phys. Rev. Lett., 85:49844987, 2000.