

A Model of Ecoevolution

Nobuyasu Ito, Yohsuke Murase, and Takashi Shimada

Department of Applied Physics, Graduate School of Engineering, The University of Tokyo

Abstract

A population dynamics model of ecological system is proposed. Instead of a popular quadratic form for prey-predator interaction, x_i, x_j , a fractional term $x_i^a, x_j^{(1-a)}$ is considered in this model, where x_i denotes a population of species i . This term represents a nonlinear interaction between species i and j , but this term itself is linearly scaled when populations of all species are scaled with a constant factor. Therefore this model is called the "scale-free" or "size-free" model. Together with random mutation, this inter-species coupling model reproduces qualitative and quantitative feature of real ecosystems: ecosystems with many species appears, food-web structures explain observed ones in the real ecosystems, and a distribution function of species life-time reproduces one from fossil data which is shown to be a q -exponential function. It is shown that there are two phases in ecoevolution. The number of species is finite in one phase and grows infinitely in the other phase. The transition between these two phases are continuous. This scale-free model will be the simplest model not only of ecosystems but also of self-organizing systems with diversity. Applications of economical systems like free markets are to be discussed.[1–3]

-
- [1] T. Shimada, Satoshi Yukawa and N. Ito, *Artif. Life Robotics* vol.6 (2002) p.78, "Selforganization in an ecosystem."
- [2] T. Shimada, Satoshi Yukawa and N. Ito, *Intern. J. Mod. Phys. C* vol.14 No.9 (2003) p.1267, "Life-Span Families in Fossil Data Forms q-Exponential."
- [3] Y. Murase, T. Shimada and N. Ito, in preparation, "Phase transition from simple to diverse ecosystems."

