

Shape of Ecosystems -Universal hierarchy and regime change

Taksu Cheon

Kochi University of Technology, Tosa Yamada, Kochi 782-8502, Japan

Abstract

ゲーム理論にもとずいた「係数進化型ロトカ＝ヴォルテラ方程式系」の定式化がおこなわれ、生態系に一般的な形態特性の問題に適用された。例として、普遍的ピラミッド階層構造、階層社会における富の偏在の推移と体制変革のダイナミクス、競合二者系の支配者の登場による安定化の3つがある。

A theory of Lotka-Volterra system with evolutionarily variable parameters is formulated. It is derived from a game-theoretic two-timescale replicator dynamics. In the model, certain parameters in multi-dimensional Lotka-Volterra nonlinear differential equation system are treated as quenched (or adiabatic) variables, whose motion is determined by the potential surface constructed from the stable fixed point solution of the Lotka-Volterra equation itself. The model is successfully applied to several problems of understanding generic features of ecosystems. They include universal pyramidal hierarchy in ecology [1], social dynamics of class disparity and regime change [2], and the “vindication of bosses” -- the role of apex predator for warring species [3]. Up-to-date reference materials can be found in [4].

References

- [1] T. Cheon, “Evolutionary stability of ecological hierarchy”
Phys. Rev. Lett. **90** (2003) 258105(4).
- [2] T. Cheon, “Altruistic duality in evolutionary game theory”
arXiv.org preprint, cond-mat/0305351 (2003).
- [3] T. Cheon and S. Ohta, in preparation.
- [4] <http://www.mech.kochi-tech.ac.jp/cheon/>