New study refines biological evolution model

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Models for the evolution of life are now being developed to try and clarify the long term dynamics of an evolving system of species. Specifically, a recent model proposed by Petri Kärenlampi from the University of Eastern Finland in Joensuu accounts for species interactions with various degrees of symmetry, connectivity, and species abundance. This is an improvement on previous, simpler models, which apply random fitness levels to species. The findings published in the *European Physical Journal E* demonstrate that the resulting replicator ecosystems do not appear to be a self-organised critical model, unlike the so-called Bak Sneppen model, a reference in the field. The reasons for this discrepancy are not yet known.

The author studied so-called 'replicator networks' to incorporate the notion of species interaction. These account for the level of fitness for any species—whether or not they interact with others—and for the

consequences for regulating the abundance of the species.

Kärenlampi specifically focused on replicator systems that were incompletely connected. In addition, the species were endowed with different degrees of symmetry of interactions—be it symmetric interactions such as those found in competing or symbiotic species, or anti-symmetric interactions in the case of pray-predator relations, or possibly producer-consumer relations.

Replicator equations have previously been applied in the study of evolution. However, completely connected systems tend to yield small ecosystems. In reality, not all species interact with all other species—referred to as incompletely connected species—and they become large and complex. In particular, the author found that anti-symmetric interactions resulted in large, stable ecosystems, whereas symmetric systems remained small.

The properties of new species have been introduced through random numbers. In reality, species evolve from previous species through some kind of transformation or mutation. Thus, future models should reflect the fact that any new species should partially inherit the properties of a preceding species.

More information: Kärenlampi, P. P. (2014) Symmetry of interactions rules in incompletely connected random replicator ecosystems. *European Physical Journal E.* DOI: 10.1140/epje/i2014-14056-7

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