Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Theoretical ecology without species MIKHAIL TIKHONOV[1], Harvard University — The sequencing-driven revolution in microbial ecology demonstrated that discrete "species" are an inadequate description of the vast majority of life on our planet. Developing a novel theoretical language that, unlike classical ecology, would not require postulating the existence of species, is a challenge of tremendous medical and environmental significance, and an exciting direction for theoretical physics. Here, it is proposed that community dynamics can be described in a naturally hierarchical way in terms of population fluctuation eigenmodes. The approach is applied to a simple model of division of labor in a multi-species community. In one regime, effective species with a core and accessory genome are shown to naturally appear as emergent concepts. However, the same model allows a transition into a regime where the species formalism becomes inadequate, but the eigenmode description remains well-defined. Treating a community as a black box that expresses enzymes in response to resources reveals mathematically exact parallels between a community and a single coherent organism with its own fitness function. This coherence is a generic consequence of division of labor, requires no cooperative interactions, and can be expected to be widespread in microbial ecosystems.

[1]Harvard Center of Mathematical Sciences and Applications;
John A. Paulson School of Engineering and Applied Sciences

Mikhail Tikhonov
Harvard University

Date submitted: 06 Nov 2015 Electronic form version 1.4