Dynamical peculiarity and intricacy in ecological model equations

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Replicator equation is known as one of the most simplified models of ecological systems. Though the model equation is simplified — using only the population and its growth rate of each species —, it still preserves some basic features of the systems of self replicative elements. One of the specific features of this system is the existence of 'robust' invariant hyperplanes that correspond to set of zero population states of certain species. This feature is quite generic in the sense that it is irrelevant to the detail of model, and some interesting dynamical structures are induced by it.

Main subject of this talk would be phenomena related to one of such dynamical structures, "networks of heteroclinic orbits". While such a network consists of some unstable invariant sets (e.g. fixed point) and orbits connecting them, the network as a whole can be stable in various sense, and the network deeply affects the behavior of the system in typical cases.

The trajectories in the neighborhood of such network corresponds to a kind of oscillatory behavior with extremely large amplitude and long period: a certain set of species decrease until they are seemingly extinct, but they recover after a certain period and instead another set of species fade out. Such alternation of species continue forever.

Close analysis on such phenomena revealed a mechanism that a microscopic difference in the initial condition or system parameters makes qualitative changes in the behavior of the system such that whether a certain species would die out or not. I'd like to discuss the relation between the intricacy of the large scale ecological model system and some fundamental concepts used to extract relevant features of the behavior of the systems.