

On dynamics of predator-(Allee type) prey communities mediated by prey dispersal

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We explore the population dynamics of two-patch communities, prey – predator-prey and two predator-prey systems. The system interactions are mediated by Allee-type prey populations and differences in prey abundance in habitats are the drivers of prey dispersal. The considering models are 3D- and 4D- ODE cubic systems which depend on some parameters. The main mathematic goal consists of the description and interpretations of the bifurcation diagrams of the models. In fact, we showed that considering communities can coexist with such parameter values for which a separate system get extinction and had analyzed the modes of coexistence.

The 3D-model shows that as dispersal between the prey-refuge and the predator-prey habitats increase, the community experiences transitions from predator-prey extinction (for all initial conditions), to predator-prey oscillatory stable co-existence, to predator-prey stable non-oscillatory co-existence with the outcomes depending on initial conditions. The possibility of bi-stability and tri-stability all leading to distinct outcomes is discussed. The 4D-model demonstrate two types of 4D- stable oscillations with the same parameter values belonging to wide range parameter domains. For changing of parameters oscillations of the first type disappear in heteroclinics (e.a., by an unlimited growth of period) whereas oscillations of the second type disappear chaotically. Notice, that 4D-model demonstrates all stable regimes of the 3D- model at some initial values (for example, zero initial value of the fourth variable). Informally it means that the “two predator-prey” community is more resistant with respect to possible catastrophic impacts than “prey—predator-prey” community.