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COMPLEX DYNAMICS OF DISCRETE-TIME PREDATORPREY SYSTEM WITH STAGE-STRUCTURED PREY

Oksana Revutskaya*,
Matvey Kulakov and Efim Frisman

Institute for Complex Analysis of Regional Problems
Far Eastern Branch Russian Academy of Sciences,
Birobidzhan, Russia

oksana-rev@mail.ru (*corresponding author),
k_matvey@mail.ru, frisman@mail.ru

The study of biological communities, such as predator-prey or host-parasite systems, is one of the most important environmental problems. Predator-prey interactions are crucial to formation of the species composition in a community and their dynamics. In particular, predator-prey interactions can cause fluctuations in the numbers of both interacting species and can amplify such fluctuations if they exist due to other causes. In this work, we present a new look at the problem of complex dynamics that can arise between a prey and a predator.

The paper investigates dynamic modes of the predator-prey model with age structure for prey. We use a slight modification of the Nicholson-Bailey model to describe the interaction between predator and prey. We assume the population size is regulated by decreasing juvenile survival rate with growth of age class sizes. Conditions for sustainable coexistence of interacting species are described. It is shown that the coexistence of species becomes possible if there are a transcritical or saddle-node (tangential) bifurcations. Due to the saddle-node bifurcation there is bistability in the system of interacting species: predator either coexists with prey or dies depending on the initial conditions. It is shown, with changing parameters values and transition through the stability domain boundary the stability loss of the model fixed point may occur according to both scenarios: the period doubling and the Neimark-Sacker bifurcation. In the first case period doubling bifurcation leads to occurrence of stable fluctuations of sizes. In the second case the dynamics of population sizes begins to demonstrate quasiperiodic dynamics.

We studied the oscillation scenarios of interacting population, influences of reproduction, survival and self-regulation rates of population prey and age-dependent predation as well as variations in the current number on transitions between different dynamic modes. It is shown that an increase in the birth rate of the prey under intraspecific competition can lead to a dynamics destabilization and to complex oscillations appearance in numbers. Besides, age-dependent predation has a stabilizing influence. The anthropogenic impact on the community and its components, including deratization and harvesting, has been studied. It was found that in the model parametric space there arise the areas of multistability, which are not related to bistability of semi-trivial and non-trivial fixed point. Consequently, even a small variation of the current

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population size leads to more complex behavior of the interacting species, and can give a significant change in both the observed dynamic mode and the coexistence scenario of the species.

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