

On mathematical model of the bats population's development under the assumption of variable capacity of the habitats *

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Abstract

Bats are the only mammals capable to active flight, predominantly leading nocturnal lifestyle. These animals, regardless of their age, are looking for hiding places throughout their life. Constant migration is a hallmark of their life. Bats use echolocation for orientation in space, as well as for detecting, identifying and localizing food or roosts. We describe the bats behaviour and their searching strategy on the basis of cavity roosting bats (*Nyctalus noctula* and *Nyctalus leisleri*) living in Białowieża Forest located in Poland. These bat social groups are fission-fusion societies, which spread over multiple tree cavities, with the number of bats in each tree ranging from a few to several hundred individuals. We propose mathematical model describing development of bats colony and its division on subpopulations. In model we consider natural bats abilities: constant migration, limited detection range, settling tree cavities with a surplus of resources, dividing into subpopulations. Our model is based on the system of ordinary differential equations. Moreover, bats change habitats due to lack of space in the roost, lack of food in the nearby hunting area, to avoid parasites developing in tree cavities and reduce the risk of predation. At the same time, bats have memory skills about the distribution of habitats in the area and often return to roosts previously inhabited, and in which conditions may have improved. Therefore, we additionally introduce in the mathematical model biologically justified assumption of the variable capacity of the habitat. Theoretical results we illustrate by computer simulation and its comparison with biological remarks. According to our knowledge there are no others similar theoretical models describing the development of bats fission-fusion societies. We know only three papers [1], [2] and [3] concerning simulations of bats behaviour and its

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searching strategy. Paper [2] contains computer simulation based on C++ programming language describing cavity searching strategy for individual in areas with different topography. Mathematical model proposed in [1] and [3] is based on the system of difference equations.

Keywords: bats · population · differential equations · numerical simulations.

References

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