Nonlinear Age-Structured Models of Polycyclic Population Dynamics with Density Dependent Death Rates

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In this work the explicit recurrent algorithms are developed for solving two different age-structured nonlinear models of polycyclic population dynamics with density-dependent death rates. This work continues the study in paper [1] for polycyclic population including the effect of nonlinear mortality (population growth feedback) and proliferation. In the first model the nonlinear death rates is considered as a power function of number of individuals in population with arbitrary exponent n. In the second one death rate is described by a power function of population density with arbitrary exponent n. The temporal and age dynamics of population density in each model is governed by semi-linear transport equations with non-local integral boundary condition.

The explicit recurrent formulae of travelling wave solution are derived with the compatibility conditions for the coefficients of system and initial values. We obtain and study the discontinuous, continuous and smooth travelling wave solutions for the different types of initial values of population densities. The asymptotically stable travelling wave solutions are obtained and studied for autonomous systems with different values of exponent in power functions of nonlinear death rates. We observe also the population outbreaks in the form of quasi-periodical travelling wave solutions for the oscillating death rate and birth modulus for both models of death rate. Theoretical and applied results obtained in this work can be effectively used in the practical researches of biological population dynamics.

References

[1] V.V. Akimenko, Yu.V. Zahorodnii, *Analytical and numerical solutions for the age-structured cell aggregation dynamics model*, Cybern. Syst. Anal. **50** (4) (2014) 578-593.