Plankton growth dynamic driven by plankton body size in deterministic and stochastic environments

Tiancai Liao[1]

[1]China Jiliang University

December 24, 2021

Abstract

In this paper, we establish a new phytoplankton-zooplankton model by considering the effects of plankton body size and stochastic environmental fluctuations. Mathematical theory work mainly gives the existence of boundary and positive equilibria, and shows their local as well as global stability in the deterministic model. Additionally, we explore the dynamics of V-geometric ergodicity, stochastic ultimate boundedness, stochastic permanence, persistence in the mean, stochastic extinction and the existence of a unique ergodic stationary distribution in the corresponding stochastic version. Numerical simulation work mainly reveals that plankton body size can generate great influences on the interactions between phytoplankton and zooplankton, which in turn proves the effectiveness of mathematical theory analysis. It is worth emphasizing that for the small value of phytoplankton cell size, the increase of zooplankton body size can not change the phytoplankton density or zooplankton density; for the middle value of phytoplankton cell size, the increase of zooplankton body size can decrease zooplankton density or phytoplankton density; for the large value of phytoplankton body size, the increase of zooplankton body size can increase zooplankton density but decrease phytoplankton density. Besides, it should be noted that the increase of zooplankton body size can not affect the effect of random environmental disturbance, while the increase of phytoplankton cell size can weaken its effect. There results may enrich the dynamics of phytoplankton-zooplankton models.

Hosted file

`Plankton growth dynamic.pdf` available at https://authorea.com/users/452602/articles/550618-plankton-growth-dynamic-driven-by-plankton-body-size-in-deterministic-and-stochastic-environments