Seasonal Variation of Nutrient Loading in a Stoichiometric Producer–Consumer System

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Recent discoveries in ecological stoichiometry have indicated that food quality in terms of the phosphorus:carbon (P:C) ratio affects consumers whether the imbalance involves insufficient or excess nutrients. This phenomenon is called the "stoichiometric P:C knife-edge." In this study, we develop and analyze a producer–consumer model which captures this phenomenon. It assesses the effects of (external) nutrient (P) loading on consumer dynamics in an aquatic environment by mechanistically deriving and accounting for seasonal variation in nutrient loading. In the absence of seasonal effects, previous models suggest that the dynamics are Hopf bifurcation, saddle-node bifurcations, and limit cycles. However, seasonal effects can have major implications on the predicted solutions. Bifurcation analysis demonstrates that seasonal forcing can lead to rich population dynamics, including periodic and quasi-periodic solutions.