Mathematical Biology Seminar

Monday, October 16, 2023

3 pm MDT - 457 CAB (in person)

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Stoichiometric microplastics models in natural and laboratory environments

Microplastics pose a severe threat to marine ecosystems; however, relevant mathematical modeling and analysis are lacking. This paper formulates two stoichiometric producer-grazer models to investigate the interactive effects of microplastics, nutrients, and light on population dynamics under different settings. One model incorporates optimal microplastic uptake and foraging behavior based on nutrient availability for natural settings, while the other model does not include foraging for laboratory settings. We establish the well-posedness of the models and examine their long-term behaviors. Our results reveal that in natural environments, producers and grazers exhibit higher sensitivity to microplastics, and the system may demonstrate bistability or tristability. Moreover, the influences of microplastics, nutrients, and light intensity are highly intertwined. The presence of microplastics amplifies the constraints on grazer growth related to food quality and quantity imposed by extreme light intensities, while elevated phosphorus input enhances the system's resistance to intense light conditions. Furthermore, higher environmental microplastic levels do not always imply elevated microplastic body burdens in organisms, as organisms are also influenced by nutrients and light. We also find that grazers are more vulnerable to microplastics, compared to producers. If producers can utilize microplastics for growth, the system displays significantly greater resilience to microplastics.