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Rethinking the predator-prey relationship

Abstract

Thanks to mathematical models, it is well-understood that the interaction between predator and prey populations can lead to periodic multi-annual oscillations in both populations. Predator-prey models generally consist of one predator and one prey, with the growth rate of the prey controlled by the functional response of the predator, that is, the per prey kill rate of the predator. Two fundamental types of functional response have been identified: (1) the specialist functional response is characteristic of predators who require the focal prey to survive, and (2) the generalist functional response is characteristic of predators who can switch to alternative prey when the focal prey becomes scarce. Traditionally, it has been assumed that the functional response is a fixed characteristic of the interaction between a given predator and prey pair. So, for example, the Canada lynx is described as being a specialist predator on the snowshoe hare, while the bobcat is described as a generalist. In this talk, I will look at what we can learn from models where the classical approach is relaxed in two different ways. First, I will investigate how our understanding of predator-prey cycles is extended when we examine a model with multiple predators. Second, I will allow the predator-prey relationship to vary structurally between seasons. That is, I will consider a predator with a functional response that is of one type in the summer, and a different type altogether in the winter. The predator-prey interaction is a fundamental and ubiquitous component of dynamical systems in ecology, but also appears in many other contexts including epidemiology (where the disease is the predator and the host is the prey), finance (where the losses of one sector are the gains of another), and social dynamics (where gains in one voter group co-respond to losses in another). Thus, the shifts in perspective that I offer in this talk, can also help us rethink the functional relationships between variables in other models.