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Stability of ecosystem: global properties of a general predator-prey model.
(English summary)

Summary: “Establishing the conditions for the stability of ecosystems and for stable co-existence of interacting populations is a problem of the highest priority in mathematical biology. This problem is usually considered under specific assumptions made regarding the functional forms of non-linear feedbacks. However, there is growing understanding that this approach has a number of major deficiencies. The most important of these is that the precise forms of the functional responses involved in the model are unknown in detail, and we can hardly expect that these will be known in the feasible future. In this paper, we consider the dynamics of two species with interaction of consumer-supplier (prey-predator) type. This model generalizes a variety of models of population dynamics, including a range of prey-predator models, SIR and SIRS epidemic models, chemostat models, etc. We assume that the functional responses that are usually included in such models are given by unspecified functions. Using the direct Lyapunov method, we derive the conditions which ensure global asymptotic stability of this general model. It is remarkable that these conditions impose much weaker constraints on the system properties than are usually assumed. We also identify the parameter that allows us to distinguish between existence and non-existence of the coexisting steady state.”

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