

“Commensal Mediation” in Resource-Consumer Interactions

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Abstract

Foraging habits and behaviors of a consumer population are relatively plastic adaptive traits that can be easily adjusted into a changed environment. It is highly possible that a consumer may facilitate others, those usually do not affect them directly, to feed on the same resource and then to reproduce successfully. Such commensal consumers (facilitated population) can heavily influence the rate of resource exploitation and thereby affect the usual resource – consumer cycles. While involving such commensal consumer- induced effects, called here commensal mediation, into the Lotka– Volterra type models, it shows that the commensal mediation can have stabilizing or destabilizing effects on resource dynamics depending on the strength of interactions and the conditions in which the interactions occur. In the natural ecosystems where the growth rate of resource population depends on its own density even in absence of consumers, the commensal mediation provides a destabilizing effect on resource dynamics; increasing commensal population density increases the amplitude of resource fluctuations and the time lags from one peak to the next. On the other hand, in the managed ecosystems where the growth rate of resource population is expected to be maintained at a constant level in absence of consumers, the commensal mediation provides stabilizing effect at a certain condition; with a given restriction on the consumer population, decreasing mortality of the commensal population can stabilize the resource population dynamics at a stable, steady-state. Moreover, while the resource population experiences saturation effect, resource–consumer interactions with the commensal mediation exhibit a range of dynamical behaviours starting from stable equilibrium, then damped oscillation, to limit cycles as the resource carrying capacity increases from a critical level. In addition, commensal mediations with both controlling facilitator consumer population and resource harvesting are analyzed separately and the results are discussed for some exemplified managed and natural ecosystems.

Key words: Managed ecosystem; Natural ecosystem; Density-dependent effects; Mediator species; Commensal population; Lotka–Volterra model.