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A complex regulating pattern induced by the effects of predation and parasites on root vole (*Microtus oeconomus*) populations during the breeding season

Guozhen Shang, Yuangang Yang, Yahui Zhu, Xueqing Wu, Yifan Cao, Yan Wu, Jianghui Bian ✉

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Abstract

Predators and parasites have synergistic effects on the phenotype of the species they share as prey and host. Experimental studies that incorporate the interactions between predation and parasitism are, however, scarce in small-mammal populations. Our previous work has shown that the combined effects of predation and coccidian infection reduce overwinter survival and population density in root voles (*Microtus oeconomus*). Here, we examined the separate and combined effects of these two drivers on the population growth of root voles during the breeding season. We carried out a two-level factorial experiment, in which we manipulated predator exclusion and the removal of parasites in enclosures and measured survival, fecal corticosterone metabolite (FCM) concentration, recruitment, and population density. An expected synergistic effect of predators and parasites on vole population was not found, due to no effect of parasites on FCM level and recruitment rate during the period of the experiment. Instead, we found phase-related effects of predation on demography. Predation reduced the survival rate of voles in spring, which was intensified by parasite infection. Predation risk reduced recruitment rate in early summer by elevating FCM levels. Consequently, both direct and indirect effects of