Arrhenotokous parthenogenesis & mate-finding Allee effect in parasitoids

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Abstract

Mating failures at low density – a common type of Allee effect – can reduce the *per capita* reproductive rate and, if severe enough, doom small populations to extinction. Parasitoids frequently undergo low densities triggered by their typically cyclic dynamic and/or the bottlenecks they experience when introduced for the biological control of agricultural pests. However, most parasitoid species belong to the order Hymenoptera and reproduce via arrhenotokous parthenogenesis: unfertilized eggs develop into males. A common belief is therefore that parasitoids are immune to the mate-finding Allee effect because mating failures yields more males, which should in turn restore mating success. Yet, meta-analyses of biological control introductions suggest that hymenopteran parasitoids are as extinction-prone as non-parthenogenetic species. Here we developed a population dynamic model to investigate the advantage of arrhenotokous parthenogenesis for parasitoid species that experience a mate-finding Allee effect. We show that: i) the conditions for which mating failures drive parasitoids to extinction are marginally more restricted for parthenogenetic species than for non-parthenogenetic ones; ii) parthenogenesis increases the resistance of parasitoids to accidental decrease in density and to invasions by a competing species whether or not parthenogenetic; and iii) parthenogenesis favors population establishment in new environments, whether or not already occupied. Hence even if arrhenotokous parthenogenesis is not as effective as expected to limit parasitoid extinctions caused by mating failures, it provides a significant advantage for population establishment and persistence.

Keywords: Allee effect, parasitoids, parthenogenesis, population dynamics, modeling, extinctions, mating failures

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