Bottom-Up Effects on Top-Down Regulation of a Floating Aquatic Plant by Two Weevil Species: The Context-Specific Nature of Biological Control

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Abstract

Predicting the efficacy of prospective biological control agents, the holy grail of weed biological control, while often advocated, is rarely implemented. We examined, *a posteriori*, whether it would have been possible to predict which of two introduced weevil species, *Neochetina eichhorniae* Warner or *N. bruchi* Hustciche, would have been the superior choice for controlling *Eichhornia crassipes* (Mart.) Solms-Laubach. Plant nutrition and competition can alter a plant's ability to sustain or compensate for herbivory and affect a phytophagous insect's ability to reproduce. These factors could also influence efficacy predictions. We therefore conducted three outdoor mesocosm experiments to compare the performance of these two weevils, independently and together, among five fertilizer treatments. A low initial plant density experiment examined their ability to reduce growth and flowering but allowed for density to increase. A high plant density experiment evaluated their ability to lessen biomass and reduce surface coverage. The third experiment began with low plant density but plants were maintained at low density by harvesting a portion whenever coverage exceeded 50% of the water surface. This was intended to minimize intraspecific competition. The effects varied between weevil species, among fertilizer treatments, and among experiments. Interactions between herbivory and fertilizer treatments were apparent and the nature of these interactions varied among experiments. Efficacy therefore seemed nuanced and context specific, requiring extensive assessments of multiple evaluation criteria across a wide range of environmental and ecological conditions. Overly simplistic evaluations risk rejection of effective agents capable of mediating adverse impacts from invasive plant populations. These results also argue against the concept that a single best agent can be identified to control a weed that inhabits a broad range of habitats and conditions.