

Spotted knapweed: Effects of climate change on invasiveness and biological control

By: Yvette Ortega (yortega@fs.fed.us), Ecologist, and Dean Pearson, Research Ecologist, RMRS Wildlife and Terrestrial Ecosystems Program, Missoula, MT | Nancy Sturdevant, Entomologist, USDA Forest Service, Forest Health and Protection, Missoula, MT

Exotic weeds have invaded vast stretches of forest and rangeland, yet as highlighted by the previous review by Runyon and others in this issue, little is known about the factors driving the success of these invaders or how factors such as climate change may alter outcomes. Spotted knapweed (*Centaurea stoebe*) is one of the worst weeds in the Western U.S., infesting over seven million acres. Even so, knapweed populations declined in Western Montana in the early 2000s, coincident with severe drought. Furthermore, the biocontrol agent, the knapweed root weevil (*Cyphocleonus achates*), was established at some of the sites where strong declines in knapweed occurred, suggesting that this weevil could have a role in suppressing the notorious invader under conditions of drought stress.

Researchers are conducting a long-term experiment in Missoula, Montana, to examine the effects of drought and biological control, both alone and in combination with each other, on the invasiveness of spotted knapweed. They found that both spring drought and the biocontrol agent killed adult knapweed plants. However, adult knapweed mortality induced by both drought and the biocontrol agent was completely compensated for by increased recruitment of new knapweed plants. Therefore, neither spring drought nor biocontrol truly suppressed overall knapweed populations or allowed recovery of native grasses (see Ortega and others 2011 Recent Publications for the complete citation).

In the next phase of the experiment, researchers are extending the drought treatment to extend throughout summer, thereby more closely matching the conditions seen at the turn of the century as

well as the scenario predicted by climate change. Again, they are seeing that both the drought treatment and the biocontrol readily kill adult knapweed plants. Preliminary results further indicate that intensive drought may also shut down the recruitment of new knapweed plants such that populations are no longer able to compensate for adult mortality. Therefore, drought alone and the double whammy of drought and the biocontrol may limit the invasiveness of knapweed. The researchers plan to run the experiment for one more season to confirm these trends. Their work will advance understanding of the factors

influencing weed invasiveness and also provide direction for improved management of forests and rangelands over the large range of spotted knapweed invasion by developing guidelines for distribution of a promising biocontrol agent based on current and future climate conditions.



(Left) The knapweed root weevil (*Cyphocleonus achates*) is a biological control agent for spotted knapweed (*Centaurea stoebe*). Larvae of this weevil develop within knapweed roots of adult plants, sometimes killing the host plant. **(Right)** An experimental garden in Missoula, Montana, showing drought structures (in open position) used to manipulate precipitation levels, and flashing used to control access of biocontrol agents. Photo by Michael Gallagher, Missoulian.

