

Climate change allows invasive weed to outcompete local species

May 31 2011, by Brian Wallheimer

Yellow starthistle already causes millions of dollars in damage to pastures in western states each year, and as climate changes, land managers can expect the problem with that weed and others to escalate.

When exposed to increased carbon dioxide, precipitation, nitrogen and temperature — all expected results of [climate change](#) — yellow starthistle in some cases grew to six times its normal size while the other grassland [species](#) remained relatively unchanged, according to a Purdue University study published in the early online edition of the journal *Ecological Applications*. The plants were compared with those grown under ambient conditions.

"The rest of the grassland didn't respond much to changes in conditions except nitrogen," said Jeff Dukes, a Purdue associate professor of forestry and natural resources and the study's lead author. "We're likely to see these carbon dioxide concentrations in the second half of this century. Our results suggest that yellow starthistle will be a very happy camper in the coming decades."

The study is one of the first comparing the growth of invasive species versus their local competitors under future climate scenarios. Dukes believes the results indicate problems [land managers](#) and crop growers could see in the coming decades, and not just with yellow starthistle.

"Plants are going to respond in a number of ways to [climate change](#). Sometimes, the species we depend on will benefit, but other times, it will

be the weedy, problematic species that benefit most, and there can be economic and ecological damages associated that people should be aware of," Dukes said. "These problems with yellow starthistle aren't going to go away on their own. If anything it's going to become more of a problem than it is now."

Yellow starthistle is a significant [weed](#) in the West, especially in California, where it has a longer growing season than native plants and depletes ground moisture, affecting water supplies.

"It reduces the quality of the area for animal forage, is toxic to horses and when it forms spines, cattle don't want to eat it," Dukes said. "Many consider yellow starthistle to be the worst grassland weed in the West."

The decreased pasture production, lost water, and control costs associated with yellow starthistle cause economic impacts in many western states. Experts suggest that in Idaho alone, the weed may cause more than \$12 million a year in economic damage and that yellow starthistle reduces pasture values by 6 percent to 7 percent across the state of California.

Dukes said all plants increased in size as expected when exposed to more [nitrogen](#). But yellow starthistle was especially responsive to increased carbon dioxide.

That might be in part because the weed can gain access to more soil resources, Dukes said. Grassland plants' stomata, small porelike openings on the leaves, don't have to be open as wide to take in carbon dioxide when there is a larger concentration in the air. Those smaller stomata allow less water to escape, and the extra water in the soil could favor yellow starthistle. The added carbon dioxide also changed the mix of species competing with the weed and may have allowed it to grow a more effective root system.

"It was an impressive increase in growth," Dukes said. "It was one of the largest responses to elevated [carbon dioxide](#) ever observed."

Biological control species introduced to control yellow starthistle have not been effective enough, and Dukes said it is becoming urgent that better controls be developed to address invasive species that could cause significant damage to pasture, cropland and wildlands.

More information: Strong Response of an Invasive Plant Species (*Centaurea solstitialis* L.) to Global Environmental Changes, *Ecological Applications* (2011)

Abstract

Global environmental changes are altering interactions among plant species, sometimes favoring invasive species. Here, we examine how a suite of five environmental factors, singly and in combination, can affect the success of a highly invasive plant. We introduced *Centaurea solstitialis* L. (yellow starthistle), which is considered by many to be California's most troublesome wildland weed, to grassland plots in the San Francisco Bay Area. These plots experienced ambient or elevated levels of warming, atmospheric CO₂, precipitation, and nitrate deposition, and an accidental fire in the previous year created an additional treatment. *Centaurea* grew more than six times larger in response to elevated CO₂, and, outside of the burned area, grew more than three times larger in response to nitrate deposition. In contrast, resident plants in the community responded less strongly (or did not respond) to these treatments. Interactive effects among treatments were rarely significant. Results from a parallel mesocosm experiment, while less dramatic, supported the pattern of results observed in the field. Taken together, our results suggest that ongoing environmental changes may dramatically increase *Centaurea*'s prevalence in western North America.

Provided by Purdue University

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