

*Centaurea maculosa*  
Spotted Knapweed  
*Centaurea diffusa*  
Diffuse Knapweed

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### History

Spotted knapweed, a perennial, and diffuse knapweed, a biennial, are taprooted species native to southeastern Europe and Asia Minor. Roger Sheley et al report that these species were initially introduced to the Pacific Northwest from their native ranges as contaminants in alfalfa shipments. Spotted knapweed appears also to have been introduced through soil transported in the ballast water of ships. Spotted knapweed's first record is from Victoria, British Columbia in 1893 and diffuse knapweed's first record is from Washington State in 1907. From their introduction onward, these species are thought to have spread through the transport and exchange of agricultural products such as alfalfa.<sup>1</sup>



Figure 1. Spotted knapweed (left), diffuse knapweed (right). Source: Colorado State University Extension, Fort Collins, CO. Available from: K. G. Beck, Colorado State University Extension, <http://www.ext.colostate.edu/pubs/natres/03110.html> (accessed on 14 July 2014).

By 1980 diffuse and spotted knapweed had been recorded in Larimer and Boulder County (Figures 2 and 3). Based on this information, these species may have made their way into Rocky Mountain National Park (ROMO) by this time, or at the very least, the park would have been at risk to introduction of these species by this time.<sup>2</sup>



Figures 2 and 3. The current distribution of diffuse knapweed determined from herbarium records and interviews with weed authorities from 15 states in the western United States. Shaded areas represent areas where diffuse knapweed (left figure) and spotted knapweed (right figure) are present and unshaded areas represent areas where diffuse knapweed (left figure) and spotted knapweed (right figure) have not been detected. Source: Roger L. Sheley et al "Distribution, Biology, and Management of Diffuse Knapweed (*Centaurea diffusa*) and Spotted Knapweed (*Centaurea maculosa*)." *Weed Technology* 12 (1998): 354-355.

Diffuse knapweed was observed along Highway 36 east in Boulder in 1990, one mile from the park in 1991 and then in ROMO along High Drive in 1993. Spotted knapweed was first documented in the park in 1992 in the Moraine Park campground and is suspected of being introduced by park visitors. By 2009 the infestation was believed to be "serious," due to the uncontrolled population in neighboring Estes Park. In Colorado, both diffuse and spotted knapweeds are List B noxious weeds.<sup>3</sup>

### Biological Concerns

Spotted and diffuse knapweeds are considered to be mildly allelopathic. They produce the compound cnicin, which has been shown to inhibit the germination of some wheatgrass and fescue species. However, the effects of soil nutrient competition on the local plant community appear to be more impactful than their allelopathy. Both species reproduce by seed but spotted knapweed is capable of

growing rosettes from lateral shoots in close proximity to the parent plant making it predisposed to developing a monoculture. These species thrive in areas with high and frequent soil disturbance, with density increasing as the intensity of soil disturbance increases. This correlation should induce caution with regard to management of spotted and diffuse knapweed because an unregulated or poorly monitored method may intensify their propagation. Knapweed dominated areas facilitate soil surface runoff thereby increasing sedimentation levels when compared to (typically native) bunchgrass dominated communities. The 2009 ROMO Year-End Report states that an increase in soil erosion has been observed as the result of knapweed presence and that “the possible loss of topsoil combined with the presence of allelopathic compounds in the remaining topsoil could prove to make future restoration attempts in these areas extremely difficult, if not impossible.”<sup>4</sup>

### **Management Strategies**

The earliest record showing treatment of spotted and diffuse knapweed in Rocky Mountain National Park is the Year-End Report from 2000, but it is likely that control began before this time. Manual control through digging and hand pulling was the primary treatment method from 2000 through 2009, and 2003 monitoring records report that spotted knapweed responded well to digging. In 2009 a biological control was introduced to the park of 400 adult *Larinus minutis* weevils at Beaver Point. These weevils consume the seed head and leaves of both spotted and diffuse knapweed. Beaver Point was chosen as the site to introduce this species because the knapweed species were thought to be abundant enough to permit the weevils to establish a population beneficial to both ROMO and Estes Park. Other biological controls for knapweeds exist, however the *Larinus minutis* weevil is considered one of the most aggressive options. This approach and its impact in the Estes Park Valley were not mentioned again in the Year-End Reports, so this effort may not have been monitored to determine its effects. As populations of spotted and diffuse knapweed increased throughout the park, management shifted to a combination of manual and chemical treatments with the herbicide Milestone from 2010 through 2013. Reports of the success of chemical treatments in the literature are mixed, but the need for cultural control is clear. Grasses that are resistant to herbicide are the most frequently suggested cultural course against knapweed reinvasion.<sup>5</sup>

According to the Weed Control Methods Handbook, prescribed burns, if repeated, can reduce the abundance of knapweed species. It is difficult to burn through dense patches, however, and burns are only effective where native species are able to swiftly revegetate the burned area. Grazing may help control spotted and diffuse knapweed, but grazing alone is not an effective treatment. Wallander et al reports that viable seeds from spotted knapweed were retrieved between two and ten days after passing through the manure of sheep and mule deer. The viability of seeds was reduced, however, not eliminated.<sup>6</sup>

### **Recommendations**

Knowing the inefficacy of grazing and the potential for negative impacts from biological controls and prescribed burning, the author’s recommendation is to continue typical manual approaches for small populations and to use a combination of manual and chemical approaches on large populations of spotted and diffuse knapweed. For dense cultures of knapweed species, using the safest and most effective chemical control agent followed by hand pulling has shown significant impacts in ROMO, whereas other control methods – while seemingly effective – bring more significant negative impacts than could be deemed worthwhile. Between chemical and manual methods that could be followed by revegetation efforts, management in ROMO has a chance to, at the very least; dampen the spread of these species.

## Endnotes

<sup>1</sup> Roger L. Sheley et. al. "Distribution, Biology, and Management of Diffuse Knapweed (*Centaurea Diffusa*) and Spotted Knapweed (*Centaurea Maculosa*)." *Weed Technology* 12 (1998): 353-354; Donald M. Maddox, "Biological Control of Diffuse Knapweed (*Centaurea Maculosa*) and Spotted Knapweed (*C. maculosa*)." (1982): 76.

<sup>2</sup> Sheley, "Distribution," (1998):357-358.

<sup>3</sup>Chris R. Rutledge and Terry McLendon, "An Assessment of Exotic Plant Species of Rocky Mountain National Park," Colorado State University Department of Rangeland Ecosystem Science (1996); Julie Knudson, Matt Ounsworth, Michael Prowatzke, Jamie Dahlkemper, Jim Bromberg, and Brian Kolokowsky, "Rocky Mountain National Park Exotics Year-End Reports," Rocky Mountain National Park: Division of Resource Stewardship, 2000-2013.

<sup>4</sup> Sheley, "Distribution," (1998): 355-358.

<sup>5</sup>Year-End Reports 2000, 2009- 2013; Beck, K.G, "Diffuse and spotted knapweed: Biology and management," Colorado State University Cooperative Extension (1994).

<sup>6</sup> Mandy Tu, et. al. "Weed Control Methods Handbook: Tools & Techniques for Use in Natural Areas," (2001): 3,6; Roseann T. Wallander, et. al. "Spotted Knapweed Seed Viability after Passing through Sheep and Mule Deer." (1995): 148.