

*Linaria dalmatica*  
Dalmatian Toadflax  
*Linaria vulgaris*  
Yellow Toadflax

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### History

*Linaria dalmatica*, Dalmatian toadflax, and *Linaria vulgaris*, yellow toadflax, are both short-lived perennial herbs. Dalmatian toadflax is native to the Mediterranean coastal regions of Europe and western Asia and the yellow toadflax is native to the steppe regions of southeastern Europe and southwestern Asia. These species were intentionally introduced in North America for various purposes as ornamental plants, fabric dye, and medical herbs. Yellow toadflax was introduced to New England by the late 1600s both for ornamental planting and as a source of fabric dye. Dalmatian toadflax was initially carried to the west coast of North America as an ornamental around 1874. Both have broken free from cultivation and have become pervasive exotic species across North America. Eight western states have legally designated yellow toadflax as a noxious weed and nine have legally designated Dalmatian toadflax as a noxious weed. These designations make it illegal to sell and cultivate these plants privately, however, in states that have no such designation, yellow toadflax is still sold as “butter and eggs,” “wild snapdragon,” or “Jacob’s ladder.”

In Rocky Mountain National Park (ROMO), Dalmatian and yellow toadflax have been recorded in the park at least since 1987. By 2006 both toadflax species had been identified as within the top four problem species in the park and in 2007 both were labeled as “prevalent.” Dalmatian and yellow toadflax are on the Colorado List B of noxious weeds.<sup>1</sup>

### Biological Concerns

There are certain characteristics of these species that enhance their competitive nature and limit the capacity of management efforts. Dalmatian toadflax occurs most frequently in coarse-textured soils that drain well, predisposing it to presence in disturbed or degraded areas such as roadsides, fields, waste areas, clearings, and degraded rangelands. Yellow toadflax on the other hand, requires more water and nutrients than Dalmatian toadflax, but has the capacity to invade at higher elevations. It appears to have already begun to invade higher elevations, as it has been observed above 11,500 feet since 2003.<sup>2</sup>

These two species have the ability to reproduce both through seed production and vegetative root shoots. The reproductive variability of these species makes management very difficult as it renders typical approaches, like mowing and burning, utterly ineffective. With these methods only the seedbank is being hindered. Moreover both mowing and burning, but especially burning, create disturbance patterns that facilitate the re-sprouting of new shoots from vegetative roots. Chemical control of these species is difficult due to a waxy coating on the leaves that helps the plant prevent absorption of herbicide. However, this type of control can be effective if a selective herbicide is used with a non-ionic surfactant, as the surfactant allows the herbicide to penetrate the waxy leaf surface.<sup>3</sup>

These species contain a poisonous glucoside that may be toxic to some grazing animals if largely consumed, namely horses and cattle. However, sheep and goats do not appear to be affected by these



Figure 1. Yellow toadflax (left) and Dalmatian toadflax (right). Source: Minnesota Department of Agriculture, Available from Minnesota Department of Agriculture, <http://www.mda.state.mn.us/plants/badplants/toadflax.aspx> (accessed July 2014).

elements. As a result, grazing at certain times of the year with certain animals could be an effective means for management of these species. A main caveat with grazing as a method of control is that livestock are thought to be a significant means of transport for exotic species so extreme care is needed.<sup>4</sup>

### **Management Strategies**

Sherry Lajeunesse offers key insight into the formation of management programs for both species stating, “management programs for Dalmatian toadflax should emphasize equally the prevention of seed formation and vegetative spread, while programs for yellow toadflax can emphasize control of vegetative spread with secondary emphasis on prevention of seed formation.” She also suggests incorporating as many strategies as possible because these species have ample genetic diversity, resulting in localized populations that respond differently to various treatment methods.<sup>5</sup>

Since at least 1987 these species have been treated in Rocky Mountain National Park. Dalmatian and yellow toadflax were managed mechanically up until 2003 when the Exotic Invasive Plant Management Plan was put in place and herbicide use began. In 2003 infestations were relatively limited to less than 30 acres but were well over 600 acres by 2013. Early on, Burnout was used as the herbicide for treatments but by 2013 management switched to Telar XP. Yellow toadflax was not sprayed in 2006, 2010, or 2013 due to issues with contractors, a momentary “shift in application operations,” and due to past herbicide treatments being ineffective in completely controlling the species. Tordon 22K and Plateau are also recommended for use on Dalmatian toadflax and Tordon 22K on yellow toadflax by Colorado State University Extension. The recommended time of application for each differs, with Dalmatian toadflax being primarily in the fall and yellow toadflax from flowering to the fall. Chemical control with these species is also difficult as chemical control is most effective at specific life stages of each plant, but it is likely that different individuals of a single population may be at different life stages, requiring selective herbicide application and multiple visits to a single site.<sup>6</sup>

Typical treatment methods remain relatively ineffective for these toadflax species, so management may consider the option of biological controls. Eight different species of insects including a defoliating moth (*Calophasia lunula*), an ovary-feeding beetle (*Brachypterolus pulicarius*), two-seed capsule-feeding weevils (*Gymnaetron antirrhini* and *G.netum*), a stem-boring weevil (*Mecinus janthinus*) and a root-boring moth (*Eteobalea intermediella*) have been intentionally or accidentally introduced in North America. These insects include four types of weevils, two moths, and one beetle. However, biological controls receive mixed reviews. Egan et al states, “damage by *B. pulicarius* alone...will not be effective in managing established *L. vulgaris* populations.” Additionally, there are very few studies on any of these controls, meaning that the potential secondary impacts of these species are unknown.<sup>7</sup>

### **Recommendations**

Control of Dalmatian and yellow toadflax is exceedingly challenging due to their lack of successful response to herbicide treatments and ability to respond quickly to disturbance from mechanical or manual treatments. Most sources recommend using a variety of treatment methods, however, only herbicide application has been seen to produce any level of effectiveness. The author recommends employing as many treatment methods as possible, especially as new studies on treatment methods are published. As of 2014, herbicide spraying of Telar XP and a surfactant is the recommended method, as Telar XP is already being utilized in ROMO to some success. The herbicide should be administered at the appropriate time of year and the site revisited given the multiple life stage characteristics of toadflax. Any individuals remaining toward the end of the field season should be removed through manual removal. As more studies are conducted on various biological methods, the author recommends the consideration of an experimental release of an insect given toadflax’s lack of significant success with any other method. Through a variety of management approaches, it should be possible to combat each of the species’ biological concerns in a way that is effective in drastically reducing the coverage of Dalmatian and yellow toadflax.

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## Endnotes

- <sup>1</sup>Jim Jacobs, "Ecology and Management of Dalmatian toadflax (*Linaria dalmatica* (L.) Mill.)," *Invasive Species Technical Note* (2006): 1; Sherry Lajeunesse, "Dalmation and Yellow Toadflax," *Montana Weed Control Association* (1999): 202; Linda M. Wilson, "Biology and Biological Control of Dalmation and Yellow Toadflax," (2005): 2; 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; Rocky Mountain National Park: Division of Resource Stewardship, 2000-2013; Rocky Mountain National Park, "27 Years of Exotic Plant Control in Rocky Mountain National Park: Summary and Recommendations," 1987.
- <sup>2</sup>Wilson, "Biology and Biological Control," (2005): 2; Rocky Mountain National Park, "27 Years of Exotic Plant Control in Rocky Mountain National Park: Summary and Recommendations," 1987.
- <sup>3</sup>Wilson, "Biology and Biological Control," (2005): 3.
- <sup>4</sup>Jennifer A. Erskine Ogden, "Dalmatian Toadflax (*Linaria Genistifolia* Ssp. *Dalmatica*)," (2005): 1.
- <sup>5</sup>Lajeunesse, "Dalmation and Yellow Toadflax," (1999): 206.
- <sup>6</sup>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>7</sup>Wilson, "Biology and Biological Control," (2005): 21-24; J. Franklin Egan, "Evaluation of the Field Impact of an Adventitious Herbivore on an Invasive Plant, Yellow Toadflax, in Colorado, USA," (2008): 110; K.G. Beck, "Biology and Management of the Toadflaxes," Colorado State University Extension, Fort Collins, CO, last modified October 2009.