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By Peter Morrison, Executive Director, Pacific Biodiversity Institute

## **Dalmatian toadflax - *Linaria dalmatica ssp. dalmatica***

### **Species Description and Current Range**

Dalmatian toadflax is a member of the snapdragon family, the Scrophulariaceae. It is an aggressive and highly competitive weed that is native to central Europe east into central Asia. This herbaceous, short-lived (3-5 y) perennial plant grows up to 1.5m tall with creeping roots, broad to lanceolate clasping leaves (2-5 cm long) and showy, irregular, yellow flowers. Both the stem and leaves are green and waxy with a bluish or whitish cast. The flowers are bright yellow with orange markings and elongated spurs born on simple, elongate, terminal racemes. This species was first introduced into eastern North America in the late 1800s as an ornamental plant. It is currently found in 22 US states and 7 Canadian provinces. It can be found in all US states and Canadian provinces of the PNW and has occurrences in nearly 75% of the counties and districts of the region.

There are two close relatives of *Linaria dalmatica ssp. dalmatica* that also occur in North America and have a more limited distribution in the PNW. Yellow toadflax (*Linaria vulgaris*) is common in the eastern US and Canada with very limited distribution in the PNW. Broomleaf toadflax (*Linaria genistifolia*) is similar in appearance, but has narrower leaves and smaller flowers. It also has a limited distribution in the PNW. All three toadflax species are invasive exotics that pose similar management challenges.

### **Impacts to Communities and Native Species**

Dalmatian toadflax is a highly aggressive exotic that invades both disturbed areas and intact native habitats. It displaces existing native plants and can dramatically alter the composition and structure of native plant communities. Dalmatian toadflax will rapidly colonize disturbed sites and is a strong competitor with native plants, spreading through native grasslands, shrub-steppe and dry coniferous forests. It will also colonize aspen, oak and riparian forests as well as other shrub and herb dominated communities.

The alteration or displacement of native habitats can cause a loss of forage to native ungulates. Deer have been observed to browse Dalmatian toadflax, but heavy use has not been recorded. Some bird and rodent species consume small amounts of toadflax seed, but the minute seed size limits its use by most animals. Competition with native plant species may result in the elimination of the food source for some animals with diets restricted to a few native species. Insects and birds that are obligate feeders on the native plants displaced by toadflax are the most susceptible. On sites where toadflax replaces sod-forming native grasses, surface runoff and soil erosion may increase.

### **Control Methods and Management**

Dalmatian toadflax has high genetic variability and successful control and management requires the integration of multiple strategies that exploit the vulnerabilities of individual strains. The goal is to eliminate seed production and vegetative spread. Prevention of infestation is the highest priority due to the difficulty of control of established populations. Hand pulling can be effective with small populations. Removal of roots is important. Mowing can be an effective method of eliminating seed production, but timing is key and must be repeated frequently until the population dies out. Tilling is an effective control where feasible, but must be repeated 4-5 times each summer for at least 2 y for effective control. It has sufficient palatability that grazing by sheep and goats can effectively suppress stands of toadflax and reduce seed production. But grazing by cattle is counterproductive, as they preferentially select native grasses and herbs, leaving the toadflax behind. Burning is also counterproductive. Four beetles (*Brachypterolus pulicarius*, *Gymnaetron antirrhini*, *Gymnaetron netum* and *Mecinus janthinus*) and two moths (*Eteobalea intermedia*, *Calophasia lunula*) have been used as biological controls. These insects attack the roots, stems, leaves and reproductive organs. Use of multiple organisms will be most effective. Effectiveness of herbicides is highly variable. The waxy leaf surface forms a barrier to uptake. Repeated applications (for 3-4 y) of picloram or combinations with 2,4-D, 2,4-DB, MCPA, MCPB, or mecoprop have been effective. Surfactants may be necessary to increase uptake. Herbicide levels that are effective in toadflax control will also kill most native vegetation (including trees), therefore chemical control measures may have undesirable effects if applied in native plant communities. Effectiveness of any

of the above control measures depends on rapid, subsequent establishment of competitive desirable vegetation cover.



Release of *Mecinus janthinus* beetles on Dalmatian toadflax population in north central Washington.

### **Life History and Species Overview**

Flowering occurs from May to October and seeds mature from July to November. A mature Dalmatian toadflax can produce up to 500,000 seeds annually. Seedlings emerge in early March to May on most sites. During the first few weeks after emergence they are exceptionally vulnerable to dehydration and competition. Some seed production can occur the first year. Dalmatian toadflax plants usually produce a mat-like rosette in the early autumn and then regenerate in early spring from vegetative buds on the rootstock. The roots of a mature plant often reach depths of 1-2 m (3 m on occasion) and lateral roots can extend 3 m or more. This extensive root system makes Dalmatian toadflax an extremely effective competitor with most native plants. It is particularly competitive at this time and rapidly forms floral stems. Dalmatian toadflax is self-incompatible, and relies upon insects for pollination. Once established, high seed production and the ability for vegetative reproduction allow for rapid spread and high persistence. Toadflax plants live three to five years. This relatively short lifespan facilitates control measures that target elimination of seed production.

### **History of Invasiveness**

Dalmatian toadflax has been cultivated as an ornamental for at least 400 years and was introduced into North America in the late 1800's. By the 1920's, it had escaped cultivation. It spread rapidly to infest pastures, farmland, roadsides, rangeland, forests and riparian zones throughout much of the USA and Canada