

Project Title: Rearing and evaluating *Rhinusa linariae* and *Mecinus janthinus*, biological control agents of yellow toadflax.

Agreement #16-091

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Project Goals and Supporting Objectives

Linaria vulgaris, or yellow toadflax is an invasive weed, now found in 49 US States and 9 Canadian provinces. The species is on the noxious weed lists for at least 8 Western states. Like its congener Dalmatian toadflax, yellow toadflax was originally introduced as an ornamental plant. It now invades range, forest and park areas where it displaces native vegetation. The plant's chemical defenses (iridoid glycosides and alkaloids) are distasteful and toxic to livestock and other animals (Polunin 1969).

Toadflax species (*Linaria dalmatica* and *L. vulgaris*) have been the targets of classical biological control programs since the 1960's. Classical biological control has successfully been implemented to control Dalmatian toadflax in many areas. To date, several insect species have been introduced for toadflax control, including two seed-feeding beetles (which were also introduced adventively), the defoliating moth *Calophasia lunula* and the stem-boring weevil *Mecinus janthiniformis*. *Mecinus janthiniformis* has become the most effective weed biological control agent for Dalmatian toadflax in North America. Research into the genetics of these weevils (Tosevski et al. 2011) and the locations of their initial collection in Europe has now revealed that two sibling biotypes (cryptic species) were included in the original importation and release of stem borers: *Mecinus janthinus* and *M. janthiniformis*. *Mecinus janthiniformis* is the species/biotype that has proven successful for control of Dalmatian toadflax (*Linaria dalmatica*), while *M. janthinus* is the species currently found on *L. vulgaris* in Montana. The yellow toadflax weevil has subsequently been collected, reared in captivity, and redistributed at various sites in Colorado. We have evidence of establishment, but populations have grown slowly, perhaps the result of several dry years following the releases or some other, unknown, factor. *Mecinus janthinus* populations grow more slowly than *M. janthiniformis* (pers. obs. Dan Bean, pers. communication, Sharlene Sing, pers. communication).

Rhinusa linariae (previously named *Gymnetron linariae*) (Curculionidae) is a univoltine root-galling weevil specializing on yellow toadflax. Adults begin feeding on toadflax in early May, and after mating females descend to the roots and lay eggs. Larvae develop in

galls on the root system. Field studies have found up to 20 galls per plant, and in caged test studies plants with more than 100 galls were recorded (Jordan, 1994). Work at the CABI biological control center in Switzerland resulted in its permitting for release into the United States and Canada in 1994.

Progress

- Obtain plant materials for mass rearing: We have established approximately 150 clones of yellow toadflax from 3 populations in Colorado and have seed collections from another 4 populations. Plants and or seed were collected from populations in Boulder, Douglass and Jefferson Counties. Rooted plants were transplanted to 1 gallon pots and are being maintained in a shade house on the CSU campus. Seeds are being saved for studies on *M. janthiniformis* and *R. linariae* impact on yellow toadflax biotypes.
- Field Collection of *Mecinus janthinus*: In October, 2016 we collected approximately 300 *Mecinus janthinus* from a field release located in Douglass County, CO. These weevils are being overwintered in a growth chamber at CSU and will be used to start mass rearing colonies next spring. These weevils are the progeny of lab reared *M. janthinus* released into a field population in Spring 2015 - this population has made it through two winters in Colorado.
- Field collection of *Rhinusa linariae*: This year's field collections of *R. linariae* in British Columbia were lower than expected, and our cooperators elected to use all of the weevils for projects within Canada. We will work with cooperators to collect weevils again this summer. If the Canadian populations do not yield sufficient weevils we will collect from population that we recently established in southern Colorado. These weevils were field released in 2015, and as of October 2016 we were able to find plants with galls containing *Rhinusa*. Exploiting this field population is a second choice, as I am not sure how many weevils the population contains and we only have destructive sampling methods for *Rhinusa*.
- Project funding came to late in the year for me to recruit a graduate student to work on the project in 2016. I have several excellent students under consideration and will have a student in place to work on the project starting in early June 2017.