Using Beneficial Insects to Control Diffuse Knapweed (*Centaurea diffusa*)

Abstract

By nature, invasive exotic plant species are difficult to control. The more management tools that are available to weed managers, the greater the chance that a particular noxious weed will successfully be controlled. Arapahoe County has made the decision to explore the use of beneficial insects to complement herbicide applications and mechanical controls in the fight against invasive plant species. Previously it has been understood that insects for diffuse knapweed were not effective. However, *Larinus minutus, Sphenoptera jugoslavica, and Cyphocleonus achates* have been released together and have effectively reduced the density of diffuse knapweed in the release area.

Introduction

For the past five years, Arapahoe County has been implementing biological controls on both public and private lands as a means of noxious weed control, specifically diffuse knapweed (*Centaurea diffusa*). In general, biological controls or beneficial insects, have proven to be successful. They have effectively controlled diffuse knapweed on the release site and have allowed native vegetation to re-establish. However, two species of insects have shown very little results, and have failed to establish at the site. Even with these failures, what is learned provides important knowledge for the future of the project.

Overview

Diffuse knapweed, in all likelihood, poses the biggest threat to Arapahoe County rangeland over any of the other noxious weed species. It is well adapted to semi-arid conditions and can easily crowd out our short to medium-grass prairie vegetation. It currently infests about 2500 acres east of Gun Club Rd. with the biggest pockets centered around Strasburg and the southern portion of County Road 129. To make matters worse, diffuse knapweed is able to secrete a substance around itself that kills off surrounding vegetation, freeing up valuable water and nutrients to ensure its survival. It spreads in many different ways, including wildlife or other animals, cars, and wind (mature plants break off at the base and then tumble in the wind). Each plant can produce around 20,000 seeds, which can stay viable in the soil up to 10 years. This characteristic makes the prospects for short-term control look rather grim and for the most part, diffuse knapweed infestations require long-term management using all available weed management tools.

Above: A typical white diffuse knapweed flower but they can also be purple or lavender in color. (Photo by R. Johnson)

Biological Control Overview

Biological controls for diffuse knapweed have been around since the early 1970's. During the time that they have been in use, it has been found that a single insect species used against knapweed will not control the plant (Powell 1989). It is only when a combination of insects are used that control can be achieved. Arapahoe County is working with five insects at the moment. 1) Sphenoptera *jugoslavica* is a root-boring beetle where the larvae do the most damage to the plant by mining out the taproot of knapweed. 2) *Agapeta zoegana* is a brightly colored yellow moth that works in the same way as *S. jugoslavica*. 3) *Larinus minutus* is a seed head weevil that feed on the leaves, stems, florets, and flower heads while the larvae feed on the seed head contents. 4) *Metzneria paucipunctella* is a species of moth where its larvae feed exclusively on the seed head. 5) *Cyphocleonus achates* is a large root-boring weevil that feeds on the taproot and leaves of knapweed rosettes. There are many theories as to why a single species of insect is not effective but the common explanation is that diffuse knapweed grows too rapidly for just one to keep up (Powell 1989). To significantly

Above: *Cyphocleonus achates*, a root-boring weevil. (Photo by R. Houtzel)

reduce populations, insects need to be able to successfully attack the larger, faster growing plants. This can only happen when insect populations are high enough to force beneficial insects onto these types of plants. This is typically not the case with most species of insects that feed on diffuse knapweed. This is why a combination of species is released so that the plant is attacked through several different vectors.

County Road 129 Release site:

Above: An adult *Larinus minutus* seed head weevil. (Photo by R. Richard)

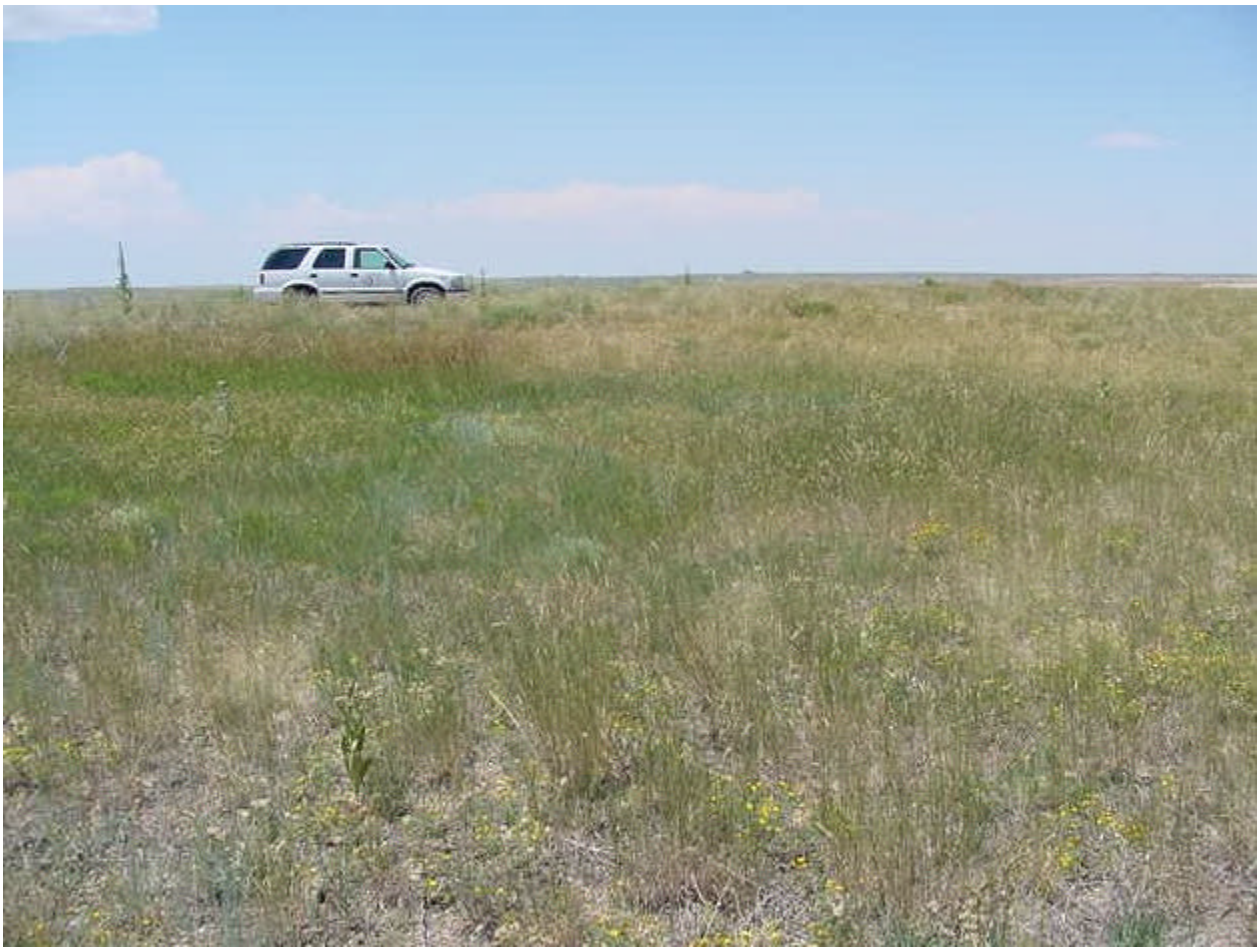
This is the site of Arapahoe County's only biological control project for diffuse knapweed. It was at one point in time an active minuteman nuclear missile site but was abandoned some time ago. It is believed that the gravel and fill dirt used by the military for roads and bunkers was contaminated with diffuse knapweed seed. Since the site was abandoned, the knapweed has been allowed to grow out of control, infesting nearly all 320 acres of the site as well as some private land that surrounds it. Given the magnitude of the situation, biological controls were chosen to help suppress the spread of this weed. This site is a particular problem to Arapahoe County because of the volume and density of diffuse knapweed. The possibility that it will continue to spread to surrounding areas is very real, so something must be done. To complicate matters further the federal government owns this site and has not been willing to deal with the problem. On the flip side, it is the only site of its kind in the County that provides an ideal setting for the use of biological controls.

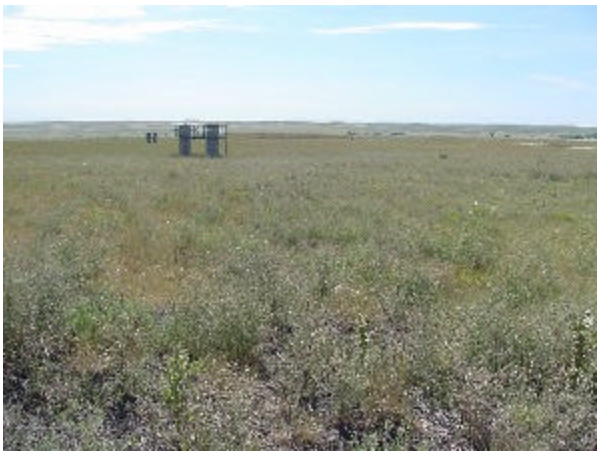
In July 1998, a release of 100 *Sphenoptera jugoslavica*, a root-boring beetle, was made. Early results were encouraging after their first year of release. However, there was no improvement in the site following the second year inspection. In addition, only in the immediate release area, had knapweed been suppressed and native vegetation begun to re-establish itself. In July of 1999 a release of 1000 *Larinus minutus*, a seed head weevil, 1000 *Metzneria paucipunctella*, a seed head moth, and 1000 *Agapeta zoegana*, root-boring moth, were released. Since their release, the *L. minutus* has become well established throughout the site and can be found throughout the 320 acres. However *A. zoegana and M. paucipunctella* have not been found on the site and there is no evidence of their existence, meaning that they did not establish. In August 2001, approximately 40 *Cyphocleonus achates* were released and although that initial release number is low, these insects have become established. In addition to the three introduced species that established, there are two flies that have been introduced naturally, *Urophora affinis* and *Urophora quadrifasciata.* Neither is known to effect diffuse knapweed drastically, however, both are helping to provide control.

It has now been five years since the initial releases were made and as the photos on the next pages show, there has been a drastic reduction in the amount of diffuse knapweed present on the site. Native vegetation is beginning to re-establish itself and besides a handful of plants, the areas along the remaining asphalt roads are the only areas still infested. Even in these areas the diffuse knapweed has begun to thin out, allowing more of the native vegetation to come back.

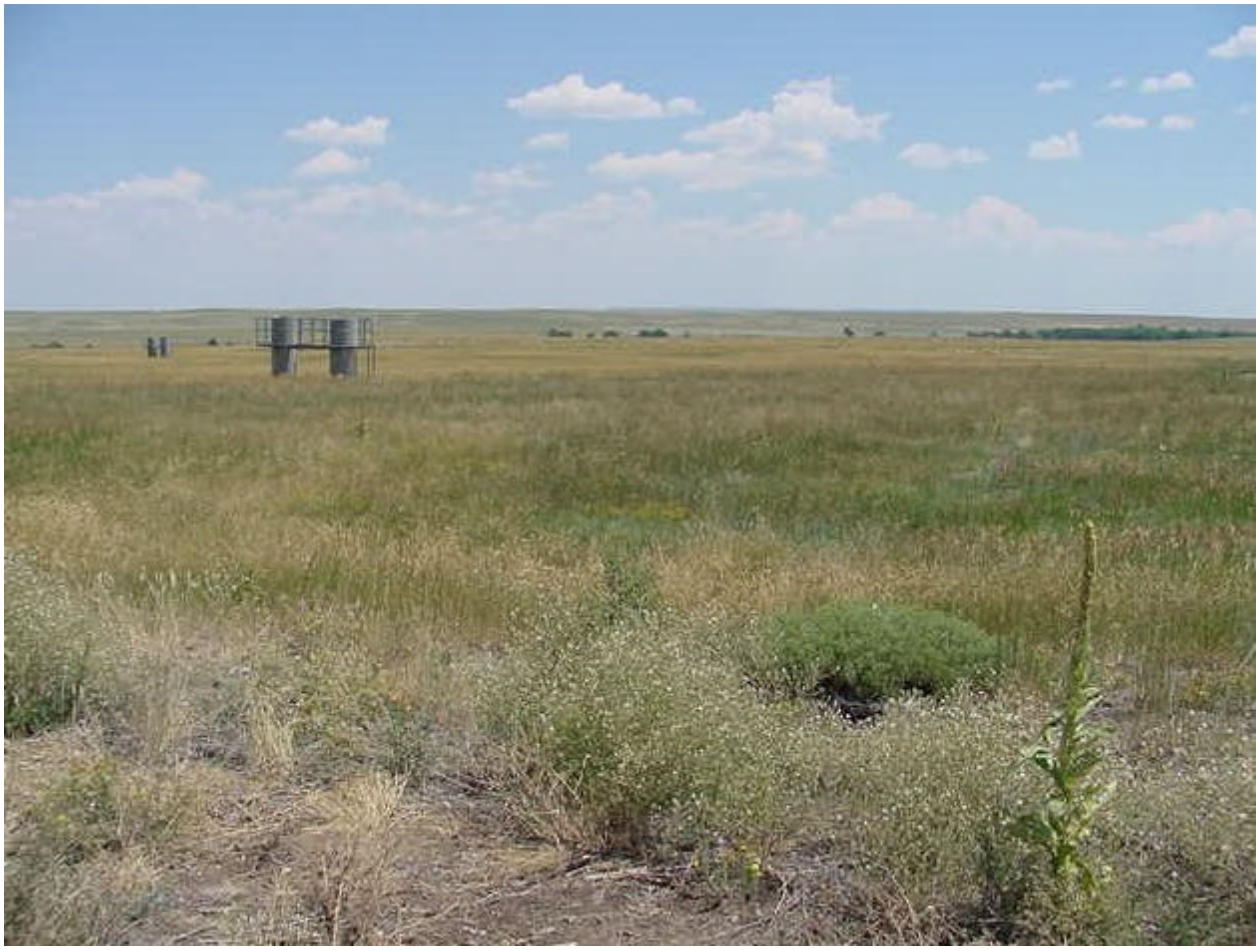
Above and Right: These pictures illustrate the density of the diffuse knapweed infestation at the release site. These pictures were taken in July of 1998, prior to the release of a bronze root-boring beetle.

Below: This picture illustrates the condition of the site as of July 2003. Diffuse knapweed has been almost eliminated from the site and native vegetation has begun to re-establish. (Photos by R. Johnson)





Clockwise from top left: This chronology of pictures is of the same view of the release site from 2001, 2002 and 2003. Even starting in 2001 it is obvious that the density of diffuse knapweed is considerably less than when the first releases were made in 1998. Note that the only visible plants in the 2003 photo are along the road edge surrounding the site. There are still a few plants mixed in with the native vegetation that re-established but those were all showing signs of insect damage and most likely will not produce viable seed. Next year we will be monitoring how many plants continue to grow along the roadside. (Photos by R. Johnson)



Summary

Above: One of the many antelope that utilize open rangeland within Arapahoe County. Diffuse knapweed threatens to destroy this habitat, forcing these animals to graze elsewhere. (Photo by R. Johnson)

Even though Arapahoe County's biological control program is still in its infancy, results have been promising and their future use is expected to aid weed control efforts on both public and private lands. Beneficial insects for diffuse knapweed have been very successful to date and their use is expected to increase as insectary numbers continue to increase during the next few growing seasons. Programs are already in place for their dispersal to private lands as well as neighboring jurisdictions. One important conclusion to make after seeing biological controls in action is that they are by no means a cure all solution to the problem of noxious weeds. Their use can be effective as a weed management tool in a more comprehensive weed management plan. What that means is the possible use of fewer herbicides, less fuel for tractors and mowers, less disturbance of native lands and the eventual return to native or desirable habitat. All of these are important to consider since Arapahoe County is home to several threatened and endangered species of plants and wildlife. Arapahoe County will continue the responsible use of beneficial insects in the future as well as explore the use of insects for the other noxious weed species that have found their way into the County.

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