

**Barbed goatgrass (*Aegilops triuncialis*) at Coyote Ridge
Management Report June 2008**



Spring wildflower display on UTC property, Coyote Ridge

Christal Niederer
Biologist
Creekside Center for Earth Observation
www.creeksidescience.com
christal@creeksidescience.com

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Introduction

This report details the treatment and monitoring activities for barbed goatgrass (*Aegilops triuncialis*) on Coyote Ridge in south San Jose, California. Barbed goatgrass is an invasive annual grass that threatens serpentine grassland habitat that supports federally threatened Bay checkerspot butterflies (*Euphydryas editha bayensis*) and rare plants such as the federally endangered Santa Clara Valley dudleya (*Dudleya setchellii*), and CNPS List 1B.2 most beautiful jewelflower (*Streptanthus albidus peramoenus*). This unpalatable grass is not controlled by grazing, the traditional management tool on Coyote Ridge. The main infestation is on United Technologies Corporation (UTC) property, which hosts an infestation on the order of hundreds of acres.

A variety of control options have been used since 2005 on Coyote Ridge, including spraying with a grass-specific herbicide (Envoy), string cutting, burning, and handpulling. Different treatments were chosen for different areas based on location and size of infestation. Envoy has been shown to be the most effective treatment, but the other techniques show promise as well. Future treatments may include hydromechanical obliteration, tarping, and flaming. Effects on Coyote Ridge's many rare species are considered with any treatment, including an open dialog between Creekside Center for Earth Observation and the U.S. Fish and Wildlife Service.

Management and control of invasive plants such as goatgrass is most effectively done in the context of ecosystem management. There are thousands of acres of serpentine grassland on Coyote Ridge, and localized impacts from control efforts and other management can be minimized. The large dynamic checkerspot butterfly populations can rapidly respond to increased habitat quality as invasive species are controlled, and similar responses are likely by the protected plants. For example, most beautiful jewelflower can increase dramatically after disturbance along roadsides and within grasslands.

The initial strategy has been to focus efforts on the smaller, outlying infestations to prevent them from enlarging. This strategy has paid off, and these outliers have significantly decreased in density along the southern ridgetop road.

However, an additional colony more than 1.5 miles south of previously mapped colonies was found along the ridgetop road by Santa Clara County Open Space Authority staff in May 2008. This small colony appears to have been spread by vehicles or grading equipment.

The ability of this grass to spread creates an urgent need to begin more treatments in the densely infested UTC property, especially along the roadside where seeds are more easily spread by vehicle tires and grading equipment.

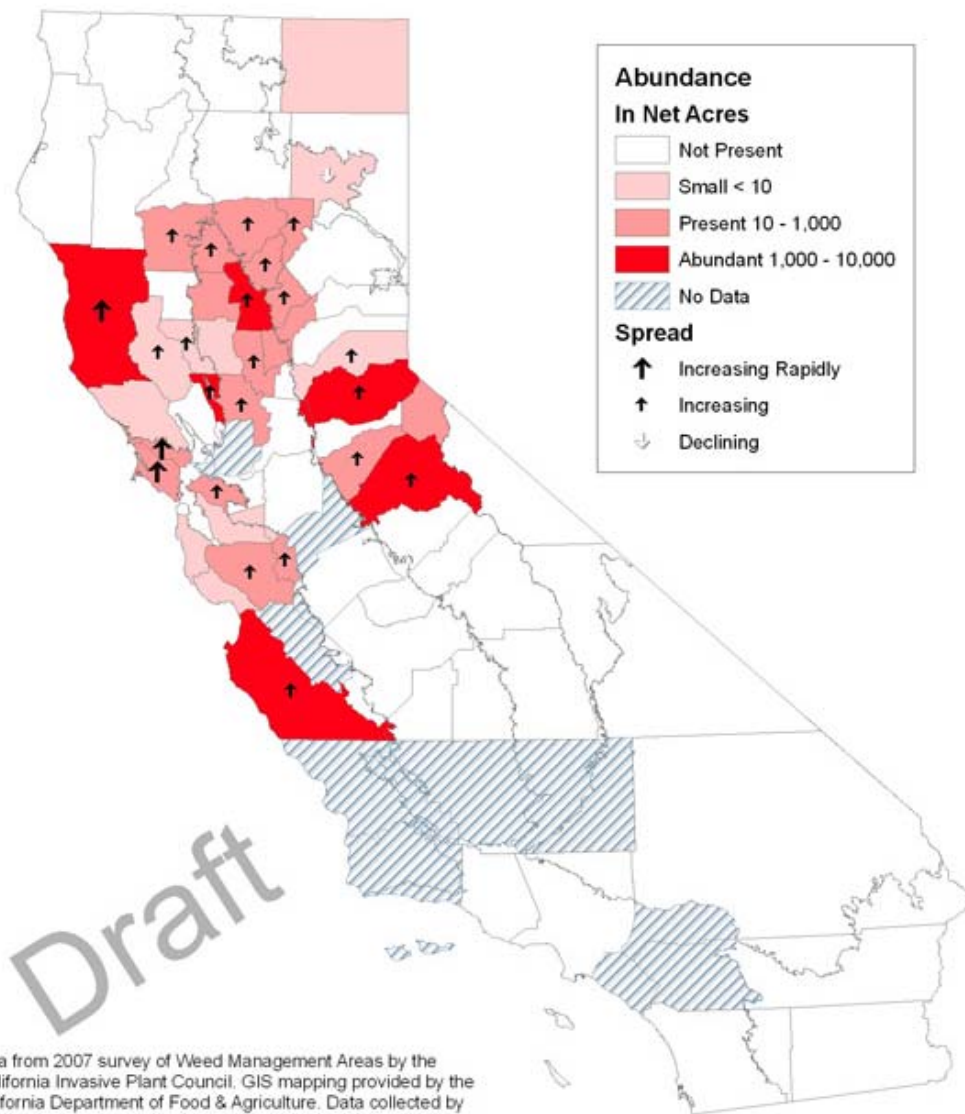
Continuing to work on previously treated areas is the first priority. Spraying the entire infestation along the ridgetop road bed plus a 3-meter buffer on each side is the next priority. Coordinated treatment has taken place on parcels owned by UTC, Kirby Canyon Butterfly Preserve, Valley Transportation Authority (VTA), and Silicon Valley Land

Conservancy (SVLC). This campaign must continue in order to prevent further spread of this grass, and to protect the fragile serpentine grasslands and the biodiversity they contain.

Status, Biology, and Impacts

The California Department of Food and Agriculture lists barbed goatgrass a B-rated noxious weed. This calls for eradication, containment, control or other holding action at the discretion of the commissioner. The California Invasive Plant Council gives it a pest rating of high. Its distribution in California is shown in Figure 1.

Figure 1. Statewide distribution of *Aegilops triuncialis*



Data from 2007 survey of Weed Management Areas by the California Invasive Plant Council. GIS mapping provided by the California Department of Food & Agriculture. Data collected by county and Jepson vegetation region. Values for small polygons assigned from adjacent polygon in same Jepson region. All values are best estimates of approximate scale of abundance and spread.

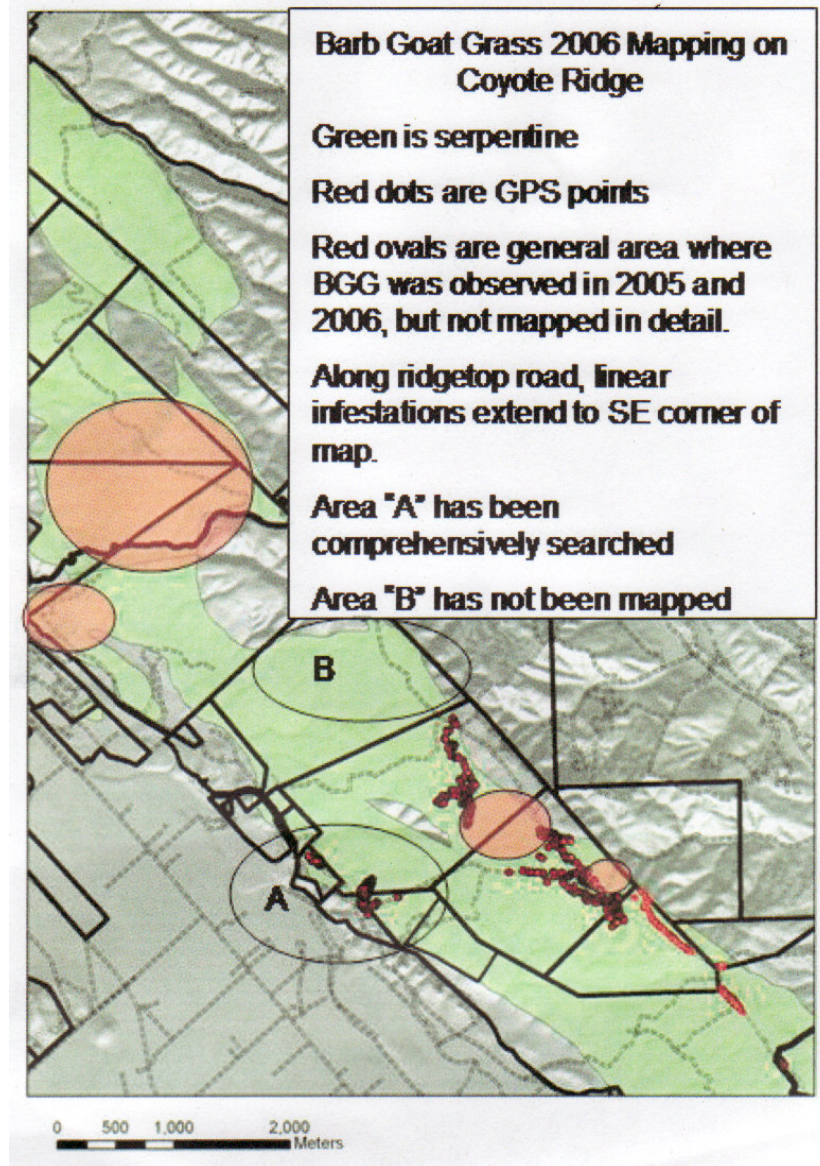
Barbed goatgrass is regarded among the wildland weed community as particularly invasive and difficult to control. It sets seed later than most annual grasses, remaining green into May or June in most years. The seeds remain viable in the soil for 2 or more years (DiTomaso and Healy 2007). Its roots reach deeper than many other annual grasses, allowing it to use high amounts of soil moisture and further enhancing its competitive ability. *Aegilops* can decrease forage production in rangelands from 50 to more than 75%, especially after it flowers and develops its sharp, long, barbed awns. Heavy grazing, either throughout the season or in short durations, appears to increase density (DiTomaso and Healy 2007). It can be dispersed by livestock, wild animals, people, and vehicles (Peters et al. 1996). Roads provide primary invasion routes at Coyote Ridge.

Rice's (2007) research suggests that *Aegilops triuncialis* is evolving a tolerance to serpentine. Native European strains survive but do not thrive on serpentine. Some California ecotypes perform similarly to the native strains, while others can thrive on serpentine.

Known Distribution on Coyote Ridge

The infestation is estimated to be on the order of hundreds of acres, although the entire ridge has not been mapped (Figure 2). Many of the PG&E towers along the lower ridge have populations of *Aegilops* near them (Heath Bartosh, pers. comm., 2007). Mapping will continue in 2009.

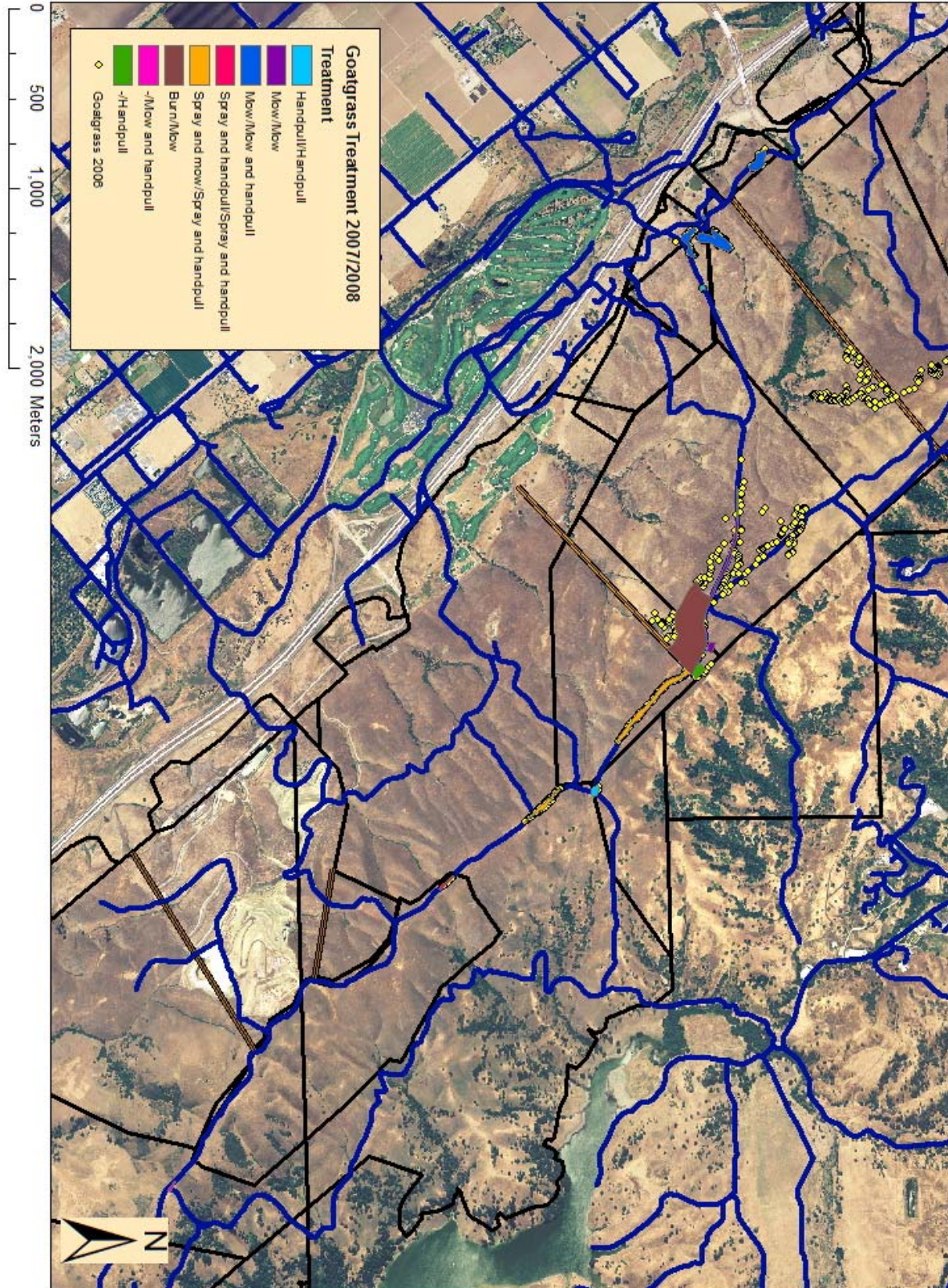
Figure 2. Known goatgrass distribution on Coyote Ridge



Control Options

Several control options are appropriate for this species. Bay checkerspot larvae are in diapause during the appropriate window for mowing, burning, and much of the handpulling. Figure 3 shows how populations were treated in 2007 and 2008.

Figure 3. Barbed goatgrass treatments on Coyote Ridge



Handpulling

This technique is time- and labor-intensive, although the plants are easy to pull. It is effective in small areas where roots can be removed and airdried (CDFA). Treated areas must be revisited as the individuals mature at different rates. It is difficult to spot seedheads that have already fallen on the ground, so handpulling is normally done before the plants shatter. If plants are pulled early enough (soft dough stage or before), they will not continue developing viable seed and can be left onsite. It is preferable to bag pulled plants, however, as next year's dormant seeds may be viable at the base of the plant.

Results

Handpulling appears to be effective in small areas of low density. About a dozen plants were found this year in an area on the VTA/UTC border that has been handpulled for four years. The infestation is so low that it is difficult to find plants. They are present, however, so the site must be checked carefully several times while goatgrass is flowering. No other treatments seem appropriate in an area with so few individuals.

Handpulling has also been used effectively as follow up to mowing and spraying. It is also useful on leading edges of dense infestations or for treating small outliers. Large crews or volunteer groups are especially useful in spotting these sometimes cryptic plants.

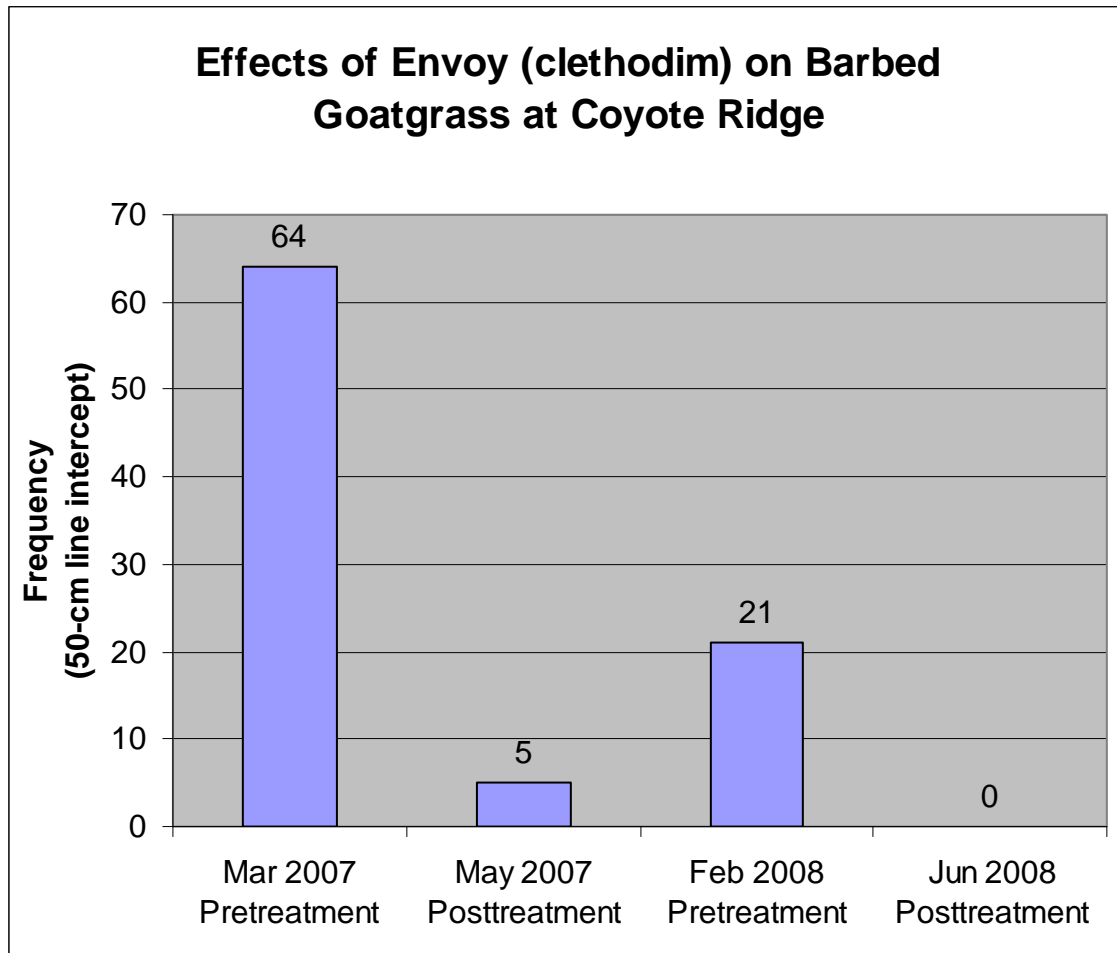
Chemical

Envoy (clethodim) has been selected for use because it is grass specific and approved for wildland and rangeland use. It does not impact native forbs, including Coyote Ridge's rare plants and Bay checkerspot host plants and nectar sources. It is effective against all grasses, and the only restriction on grazing is that the application must dry before livestock are returned. Envoy has been recommended by Scott Johnson, Vegetation Management Specialist, Wilbur-Ellis Company, as well as by staff of the Santa Clara County Agriculture Department (Eric Wylde and Keith Meyer, pers. comm., 2006). Applications should be made to nonstressed plants in spring after germination and before seedheads emerge (DiTomaso, pers. comm. 2007).

Results

Properly timed applications of Envoy show excellent results (Figure 4). After two years of treatment, no goatgrass plants were found along the monitoring transect. The goatgrass is still present in the treated area, but at very low densities. This area was sprayed in March 2007, mowed and handpulled in May 2007, and sprayed in February 2008. Follow up mowing scheduled for May 2008 was cancelled on the three areas that were treated with two years of spraying. The low densities of goatgrass were treated instead with handpulling only in May/June 2008.

Figure 4



A line of death was clearly visible after a few weeks of the 2007 spraying (Figure 5). This line illustrated how remarkably different our pre-invasion grasslands must have looked, with lots of native forbs such as tarweeds, soap plant, and purple sanicle. The rare most beautiful jewelflower appears unaffected by the spraying, with robust populations in both 2007 and 2008. Some of the native perennial bunchgrasses survived the spraying. The 2008 wildflower display in the sprayed areas was spectacular.

Figure 5. The Envoy “line of death” shown twelve days after spraying in 2007. The sprayed area along the road is filled with native forbs, while the unsprayed area to the right is dominated by nonnative grasses.



Roundup (glyphosate) is a nonspecific herbicide that is effective against barbed goat grass, but will also kill desirable forbs. This chemical has not been tried on goatgrass at Coyote Ridge, but may be considered in the future for spot-spraying. No grazing restrictions beyond the drying period are required. Sources are variable on timing. The California Department of Food and Agriculture’s Encyclopedea recommends applications be made to nonstressed plants in spring after tillering but before flowering (CDFA). A December 2001 University of California newsletter states glyphosate can be used in winter or spring (University of California 2001). Spot spraying should be tried at different times to see how late Roundup will control this plant (i.e., after flowering when it can be easily identified).

Mowing

Carefully timed mowing can be effective in controlling annual grasses. Mowing should be done after flowering, but before the seeds reach the soft dough stage. Mowing too early promotes tillering, and mowing too late spreads seeds (CDFA). Mowing is most likely to be effective when combined with other treatments (Peters et al. 1996). Mowing is best conducted in well-defined, densely infested areas. String cutters are used to prevent fires and to work in the steep and rocky terrain on the ridge.

Results

Our two groups of mowing transects showed different results (Figures 6 and 7). Mow area one, near the burned area, showed a decrease in both reproductive output and frequency after one year of treatment. Mow area 2, along the old roadbed west of the ridgetop road, showed an increase in reproductive output, with stable frequency. Mowing alone is not sufficient for treating goatgrass. Mowing with thorough handpulling as followup is suggested.

Figure 6

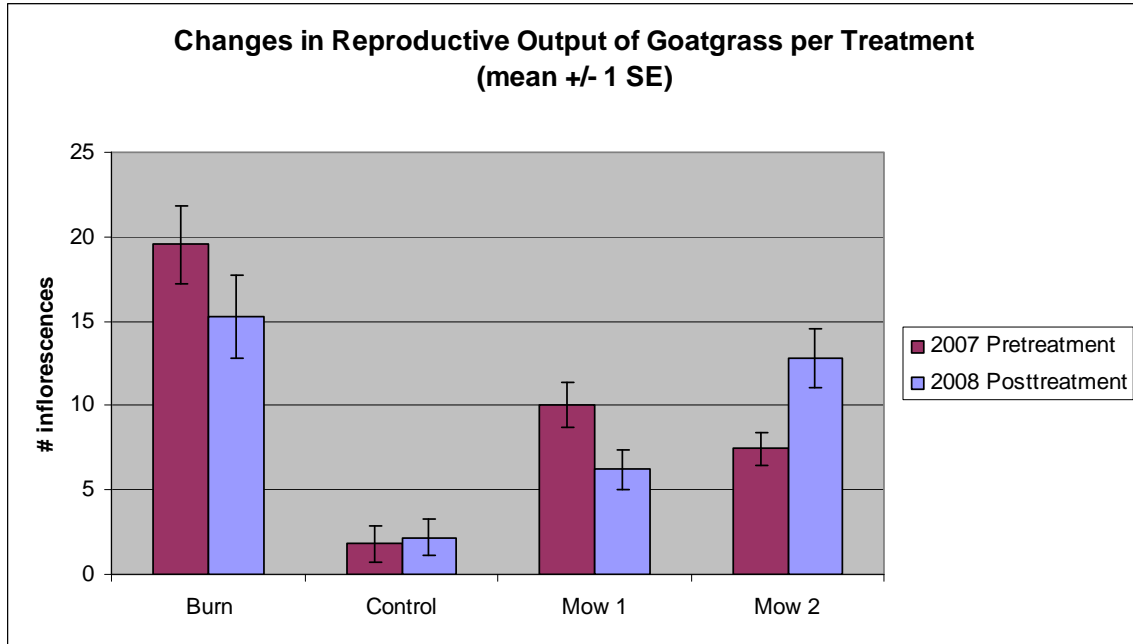
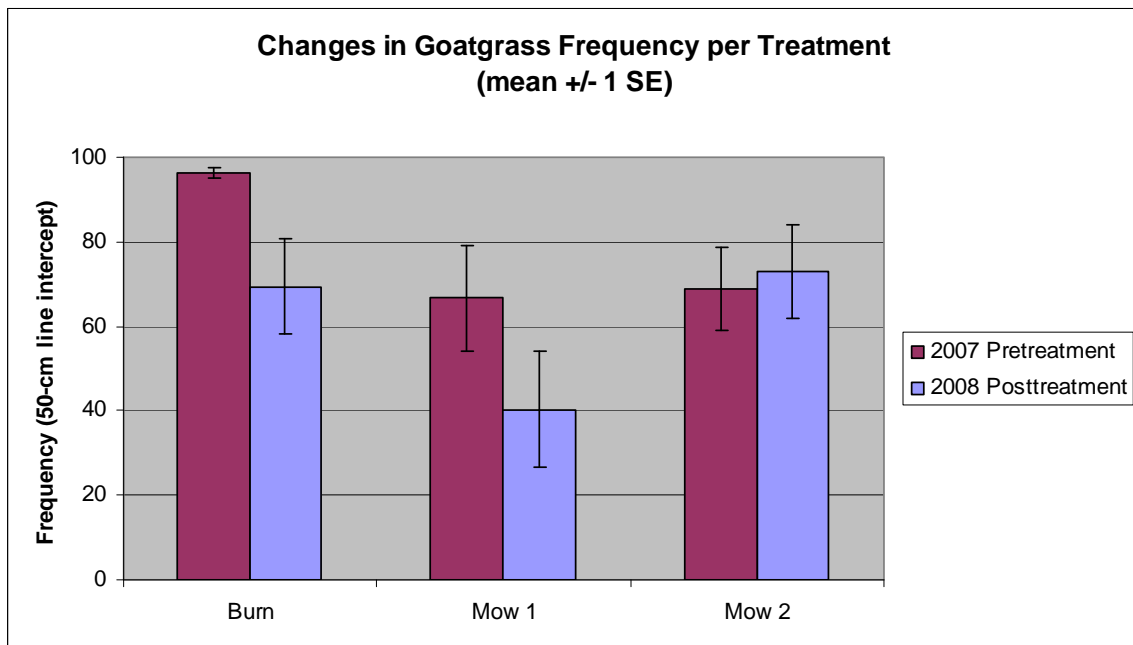


Figure 7



Burning

Two consecutive late spring burns can provide >95% control of barbed goatgrass (DiTomaso *et al.* 2001). Again, timing is critical. Burn temperatures at the soil surface (150-350°C) are considerably lower than in the grass canopy (500-900°C). Therefore, the strategy is to burn after other grasses and forbs have cured enough to carry a fire, but before the goatgrass seeds have matured and dropped to the soil.

It is critical to get a hot enough fire to destroy the seeds. Grazing animals should be removed from the area one year prior to burn to allow buildup of fuel. Other methods to increase a fire's heat include burning on windier or drier days and attempting to back the fire down hill or into a breeze to increase the time it is over a given spot (DiTomaso and Johnson 2006).

It may be difficult in serpentine soil to achieve a hot enough fire the second year due to lack of fuel (DiTomaso, pers. comm., 2006, Martin pers. comm. 2007). A secondary control option such as mowing or spraying may be needed the second year.

Results

Burns were conducted in June 2006 and 2007 on a 10- and 17-acre parcel on UTC property. The 2006 event was conducted as a training burn led by Pat Congdon, General Manager of the Santa Clara County Open Space Authority (SCCOSA). In 2007, SCCOSA and the UTC fire department worked together to conduct the burn, while CDF personnel monitored the activities. Both burns were conducted safely, with weather within prescription.

In both years, this grazed, serpentine area did not have sufficient fuel to carry a hot fire throughout the burn unit. After the first burn, it was recommended that temporary fencing be used to keep cows off the unit completely to allow fuel buildup. Unfortunately, our otherwise cooperative rancher lost access to additional pastures, leaving him unwilling to give up additional acreage in the burn unit.

The burn was very spotty, and the burn unit as a whole is still very densely infested. A set of the transects did have a light to hot burn, however, and did show a frequency decrease from the treatment (Figures 6 and 7).

Burning was not conducted in 2008, due to liability concerns. If burning is conducted in the future, it is recommended that temporary fencing be used to exclude cattle and allow fuel to build up. Alternatively, areas that already have more fuel could be sought as burn unit. Grazing pressure is much lower on steeper slopes where cattle do not congregate.

It should be noted that UTC conducted a prescribed burn in June 2007 and plans another in June 2008. It is unknown what kind of monitoring, if any, was conducted on this burn, but it would be interesting to follow up on results.

Grazing

Due to its high silica content and sharp, barbed awns, this species is both unpalatable and potentially injurious to livestock. Heavy grazing promotes spread of this species (DiTomaso and Healy 2007), perhaps because livestock is forced to eat everything else.

Hydromechanical Obliteration

This new technique was demonstrated on UTC property in June 2008. Plants are removed using pure water shot through a high pressure nozzle. The water vaporizes almost immediately on contact, leaving the ground barely damp and with little to no soil disturbance. Thatch is broken up. This technique can be used such that native perennials incur slight damage, but annuals are completely removed. This technique can be used selectively on a plant-by-plant basis, or on a larger scale. Work must be conducted within 300 feet of the water truck. Trying this technique in 2009 is recommended.

Operator Cameron Colson currently has a video of the demonstration online at <http://www.youtube.com/watch?v=cDBFtkeVp4g>

Conclusion

Progress is being made in controlling barbed goatgrass on Coyote Ridge. The small, high priority infestations along the ridgetop road that were sprayed with Envoy are now down to very low densities. Spraying Envoy is the most effective treatment. The persistent seedbank and the cryptic nature of this plant means years of followup, possibly with hand pulling, are required for full eradication.

Because the goatgrass continues to spread, clearing the ridgetop road through the main infestation on UTC property is critical to protect this sensitive habitat. Continued treatment with Envoy, mowing, hand pulling, and possibly hydromechanical obliteration is strongly recommended.

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