

We'd Eat It!

Evaluating the Potential
for Teaching Cattle to
Graze Weeds as Part of
an Integrated Weed
Management Program

Final Report
2008

Boulder County Parks and
Open Space Small Grants
Program

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Cow learning to eat diffuse knapweed



Trial Pasture Before



Trial Pasture After

Summary

Since 2004, I have been developing techniques for training cows to include weeds in their diets. The benefits of using cattle grazing as part of an integrated weed management program include:

- 1) reductions in herbicide use and cost;
- 2) a more effective IPM program when used in combination with herbicide application, biological controls, mechanical control efforts, etc, and
- 3) an additional tool for areas that are difficult to reach with herbicide application or mowing equipment, or where densities of target weeds are not great enough to warrant using other methods of control.

This project follows up on a 2007 project in which 50 heifers were trained to eat late season diffuse knapweed. The purpose of this year's project was to:

- determine if heifers trained the previous year continued to eat late-season diffuse knapweed in pasture and if their calves learned from them;
- train cows and calves to eat a new weed: dalmation toadflax.

Cows continued to eat late-season diffuse knapweed in pasture, calves did learn from the cows, as did the bulls, and they all learned to eat dalmation toadflax and grazed it in pasture. All animals also grazed musk and Canada thistle, and there was some evidence that they were adding horehound and wormwood sage to their diets as well. This tendency to add additional weeds without additional training has been observed in other trained herds since 2004. An unintended consequence of increasing their experience with foods appears to be that animals become more willing to explore and try other forages in their environment.

Project Schedule

This project ran from July 14 – July 29, 2008. We worked with the same animals trained to eat diffuse knapweed in 2007: 44 cows, their 44 calves and 2 bulls owned by Babe and Leo Hogan of Boulder, Colorado. Initially we had hoped to add another group of untrained heifers to the project to observe how rapidly they learned from the trained animals. However, this would have interfered with the breeding schedule our cooperating ranchers had set up so we were not able to include this portion of the project.

Our initial plan was:

1. Observe the herd in a trial pasture setting to see if the trained animals were eating late season diffuse knapweed and to observe calves learning to eat it.
2. Train the animals to eat dalmation toadflax and put them in another trial pasture targeting that weed.

The addition of the two bulls to the herd changed this schedule because of difficulties moving the animals and keeping them in the electric fenced trial pasture. We built fence for the trial pasture on day two, moved the herd into the pasture on day three and returned the next morning to find that the herd had broken the fence and returned to their normal pasture. So, on day four of the project we revised the schedule, training for dalmation toadflax first, followed by grazing in two separate trial pastures.

Training Process

The basic training process involves three, relatively simple steps:

Step 1) Know the target plant. What is its nutritional value? Does it contain any hazardous secondary compounds (toxins)? Will supplements aid animals in eating the plant?

Research demonstrates that animals choose what to eat based on the feedback they get from nutrients and toxins in the plant (Thorhallsdottir 1987, Mirza). Nutrients tend to increase intake and toxins tend to decrease it (Provenza 1995). All plants contain toxins, but very few are so toxic that they cause death. Knowing this, researchers have been interested in how animals manage them in their diets. Their studies show that animals learn to eat mixtures of nutrients and toxins in ways that mitigate the effects of toxins (Villalba et al 2003). Therefore, if plants are nutritious, animals are more likely to eat them, and if they are provided with a variety of different forages, they can safely eat forages that they might otherwise consume in only small quantities. Finally researchers have found that supplements (additional protein/energy or food additives such as Polyethylene glycol) can mitigate toxins or bind to them to eliminate their effect (Villalba 2002, Banner, Provenza 2000).

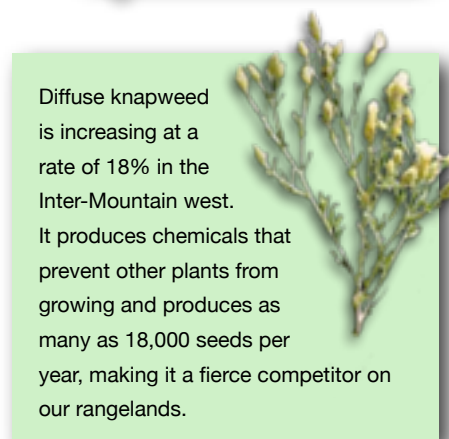
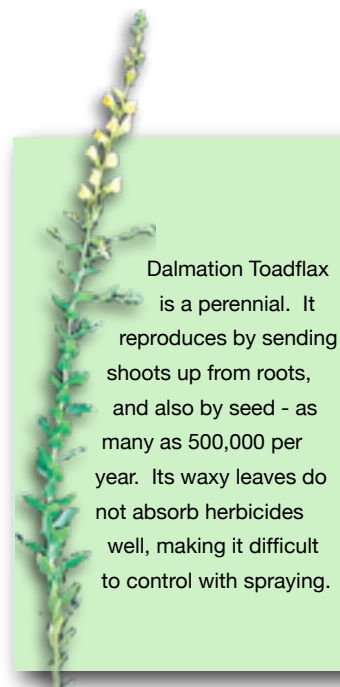
A review of the literature for diffuse knapweed indicates that there are no toxins of concern. Its nutritional value changes through the season, with crude protein dropping from a high of 18% in the rosette stage to 8% during the bud and flowering stage (Roche). In 2007, this low nutritional value was of potential concern to the project's success. Yet, in spite of its poor quality, animals ate it with gusto in pasture after becoming familiar with it.

Dalmation toadflax is similar to diffuse knapweed in the lack of toxins of concern as well as changes in nutritional value. An unpublished paper (Frost) indicates that protein values drop from 12-18% in rosette stage to 9-12% in bolt and 5-7% in flower and seedset. Based on my previous year's experience with late-season diffuse knapweed, it seemed likely that animals would add late-season dalmation toadflax to their diets as well.

Step 2) Choose the right animals.

Research shows that younger animals learn more quickly than older animals and that mothers pass diet selection knowledge on to their young (Burritt 2000). Therefore by working with young females, we can eventually have a whole herd of weed eaters for a very small investment.

The two-year-old, angus/limousin cross cows had experience with the training process from the year before and so we believed they would be good targets for training to a new weed. Their 44 calves would learn from them. We were not really concerned with training the 2 bulls of unknown age, but were interested to see what they would do. We trained in a large pasture on the Cohig property where the animals had free choice forage and water.



Step 3) Build on how animals choose foods by creating positive experiences with new foods, and making the unfamiliar seem familiar.

Basic behavioral research shows that when an animal has positive experiences with new things it is more willing it is to try other new things (Villalba 2004, Thorhallsdottir 1987, Burritt 1990, duToit). I build on this basic behavior by giving cows a series of good, unfamiliar food experiences morning and afternoon for 3 to 4 days. Foods consist of bagged grains (rolled, cracked and ground), grain mixtures, and pelleted feeds. Familiar tubs, people and flavors were incorporated in the feeding, because research indicates that animals are more likely to try something if it is associated with familiar forms and flavors (Launchbaugh 1997, Provenza 1995). In this case the tubs used for training were the same tubs used for protein supplement through the winter, so the cows and bulls were already familiar with them. The 44 cows were also already familiar with the training process from the year before, making it easier to get the herd to come to the tubs and try the foods in them. In previous projects I used molasses as a flavor additive, diluted 25% molasses 75% water. For this year's project we used no molasses except what was included in the feed mixes.

Training Days

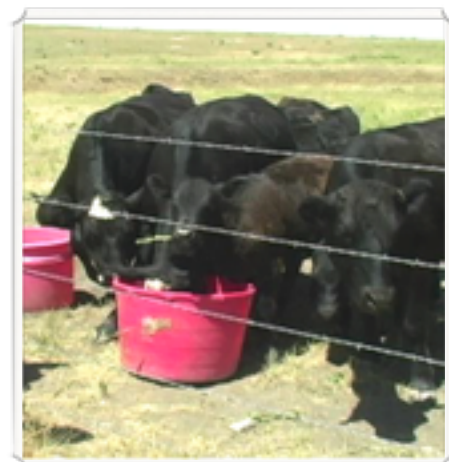
We used the dalmation toadflax training period to also cue the herd to the tubs, and the pickup truck and it's horn so that we could move them more easily. Beginning on the afternoon of July 17 we drove into the pasture near where the herd was grazing, honking the horn and setting out tubs containing two fifty-pound bags of rolled alfalfa pellets. By providing positive feedback (good food) in combination with a sound to call the animals (the truck horn) and two visual cues (the tubs and the truck), and repeating this at similar times each day, we were able to train the cows in just two days to come whenever they heard the horn and to follow the truck.



Cows training to truck and tubs

For each subsequent feeding on the morning and afternoon of the 18th and 19th we moved our feedings further from the area where the animals tended to graze in the pasture, with a goal of being able to call them with the horn to a feeding site set up near the road and closer to the trial pasture. The animals came running when they heard the horn even when they couldn't see the truck. Babysitter cows and the largest portion of the calf herd always arrived last.

We began feeding dalmation toadflax on Sunday, July 20th. We gathered one tub-full of the weed and divided it among 18 other tubs, adding wheat bran as a familiar flavor to encourage the animals to put their heads into the tubs and try the new food. Cows and calves ate some, but not all, of the weed. We reduced the amount of wheat bran added to the mixture on the 21st.



Calf and cows eat dalmation toadflax from tubs

When we arrived at the feeding site on the 22nd, the cows were waiting for us. Most of the toadflax had been eaten and we observed a calf and it's mother eating the remains from one tub. We fed weeds plain on the 22nd with good results.

On July 23rd we moved the herd to the late-season diffuse knapweed pasture. We built a small stretch of corridor fencing and used the truck to lead them to the trial pasture. Because the babysitter cows with calves were slower moving we had to move the herd in two groups. All cows were in the pasture by 6:00 p.m.

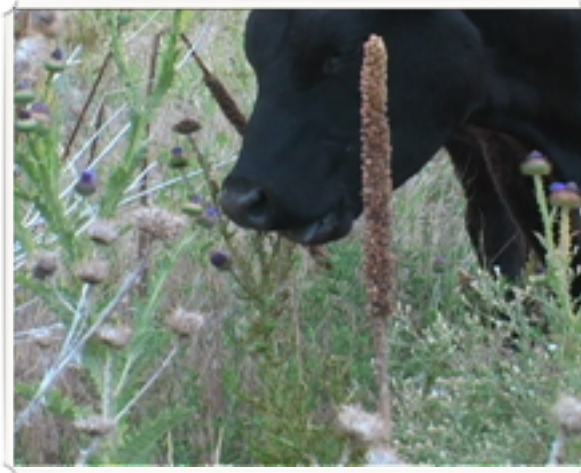


Calf eats diffuse knapweed in pasture

Results in Pasture

We had already seen evidence of grazed diffuse knapweed, and musk and Canada thistle in the larger pasture where the cows were grazing. Once in the trial pasture we were able to confirm that the cows, calves and bulls all ate diffuse knapweed. We also found evidence of them eating horehound and wormwood sage in pasture.

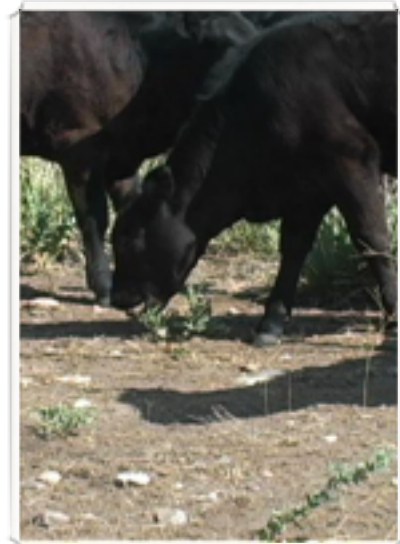
Animals were in the pasture from 6:00 p.m. on Wednesday, July 23rd through 2:00 p.m. on Saturday, July 26th. They made good progress on the diffuse knapweed patch, and all musk and Canada thistle in the pasture was grazed. Before and after pictures are attached as Appendix A.



Cow eats musk thistle in pasture

On Monday, July 28th Babe Hogan moved the cows for us to a 40-acre pasture with a small patch of dalmation toadflax. Dalmation toadflax was not abundant this year, and this was one of very few patches we were able to find where we could also provide water to the animals. We placed several empty tubs and a salt block in the area of the dalmation toadflax patch to encourage them to visit the area.

Both cows and calves ate dalmation toadflax in pasture as soon as they arrived. By the following day all the toadflax had been grazed down and the herd had also eaten some diffuse knapweed and musk and Canada thistle. Babe Hogan moved the cows back to their original pasture the next morning, completing the project for the year.



Calf eats dalmation toadflax in pasture

Observations, Lessons Learned and Questions Remaining

This is only the second time that I have trained cow-calf pairs. What I've learned is that calves hang back while mothers aggressively eat from the tubs. Once the adults are finished, calves come in to eat what ever is left over. As a result, calves ate much more dalmation toadflax than their mothers because that was what they found in the tubs once the cows had stopped eating. They carried this behavior on to the dalmation toadflax trial pasture. While adult animals checked the tubs and the salt block, calves found and ate a good deal of dalmation toadflax. Based on this behavior I will further explore cow-calf training opportunities as a quick and efficient way of increasing the number of weed eaters in a herd.

Bulls definitely change herd dynamics and manageability. Until we cued the herd to the truck and tubs, it was almost impossible to herd the animals on foot. Bulls consistently turned them back every time. In cases where ranchers or trainers are working with herds with bulls, additional time needs to be set aside for moving animals. Since the bulls were not trained to electric fence this also caused some problems initially in keeping the herd in their trial pasture. It appears that the cueing training and their experience with the electric fence during their first escape solved that problem.



One of the bulls in the diffuse knapweed pasture eating a musk thistle

The pasture where we worked with the cows was the same one used the year before. I visited the original diffuse knapweed trial pasture to see if there was a difference in the amount of knapweed. I was surprised to find almost no diffuse knapweed in the 2007 trial pasture and none at all where there had once been large patches. This contrasted sharply with the 40-acre pasture just across the road, where diffuse knapweed was thriving. I was not expecting this kind of result and have not yet found an explanation for it. One possibility is that a combination of cows and bugs dealt a powerful blow to the knapweed in the 2007 trial pasture. Kelly Uhing of the Colorado Department of Agriculture mentioned during the field tour that researchers had noticed that grazing animals tended to transport bugs and improve their success rate. Of course, further research will have to be done.

Research tells us that animals learn what to eat from each other, however there is no work on-the-ground to help us understand how we can best use trained animals to teach untrained ones. In the future I would like to use the trained animals from this project to answer questions like:

- What is the best ratio of trained to untrained animals to transfer knowledge most rapidly and efficiently?
- What training pasture size helps speed knowledge transfer between trained and untrained animals?
- How quickly does the transfer occur?

By answering these questions we can reduce cost and time involved in training and create larger herds of weed managers with minimal investment.

Project Outreach

This project was very visible in the local media this year. Coverage included the following:

- Channel 2 News, 7/20/08
- Boulder Daily Camera, 7/21/08 front page article, "Cow school teaches bovines to munch weeds" by Laura Snider, <http://www.dailycamera.com/news/2008/jul/21/cow-school-teaches-bovines-munch-weeds/>
- Channel 4 News, 7/22/08, <http://cbs4denver.com/green/weeds.cows.eat.2.777442.html>
- Channel 9 News, 7/24/08, <http://www.9news.com/rss/article.aspx?storyid=96399>
- Fort Collins Coloradoan, 7/26/08
- The Loveland Connection, 7/26/08
- KUNC Public Radio, 7/28/08

Copies of written articles are included as Appendix B.

We also held a field tour for local NRCS, Cooperative Extension and County weed management staff. Fifteen people attended the July 24th tour to see the cows in their diffuse knapweed trial pasture. A mailing list of 18 people received before and after pictures of the pasture they visited. (Tour participants and mailing list attached as Appendix C.)



Talking to the media doesn't always go smoothly. Here I talks to Channel 4 News. Their report got my name wrong (I was the electrifying "Kathy Volt") and the training time wrong (5 weeks instead of 5 days). We'll be prepared next time with handouts to help with names, information on the training process and why training cows like this is useful.

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Acknowledgements

Thanks to:

Rob Alexander, Agriculture Resources Manager, Boulder County Parks and Open Space for coordinating with our cooperating ranchers and the ditch people to make sure we had cows and water, for working with us on fencing, for setting up the field tour, and sharing “We’d Eat It!” information with colleagues.

Meaghan Huffman, Boulder County Parks and Open Space, for site exploration, fencing assistance, coordinating materials and supplies, and providing moral support the day our truck died in the field.

Larissa Read, for coordinating the field tour, fencing assistance, and sharing information on the “We’d Eat It!” project with friends and colleagues.

Babe and Leo Hogan, our cooperating ranchers, for allowing us to work with their animals and for moving them from pasture to pasture for the dalmation toadflax trials. You make our lives so easy!

Orie and Donna Voth, my Mom and Dad, for support and assistance through this and all my projects. We might still be sitting in the middle of the field if Dad hadn’t driven over to take us to a store to get a new battery for our dead truck.

Thanks to Peter Williams, my husband for encouraging me in the face of long, hot days and lots of time away from home. I could never do what I do without your care and feeding, and your love and support.

Appendix A: Before and After Pictures

Diffuse Knapweed Pasture Before



Diffuse Knapweed Pasture After



Diffuse Knapweed Pasture Before



Diffuse Knapweed Pasture After



Diffuse Knapweed Pasture Before



Diffuse Knapweed Pasture After



Diffuse Knapweed Pasture Before



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Diffuse Knapweed Pasture After



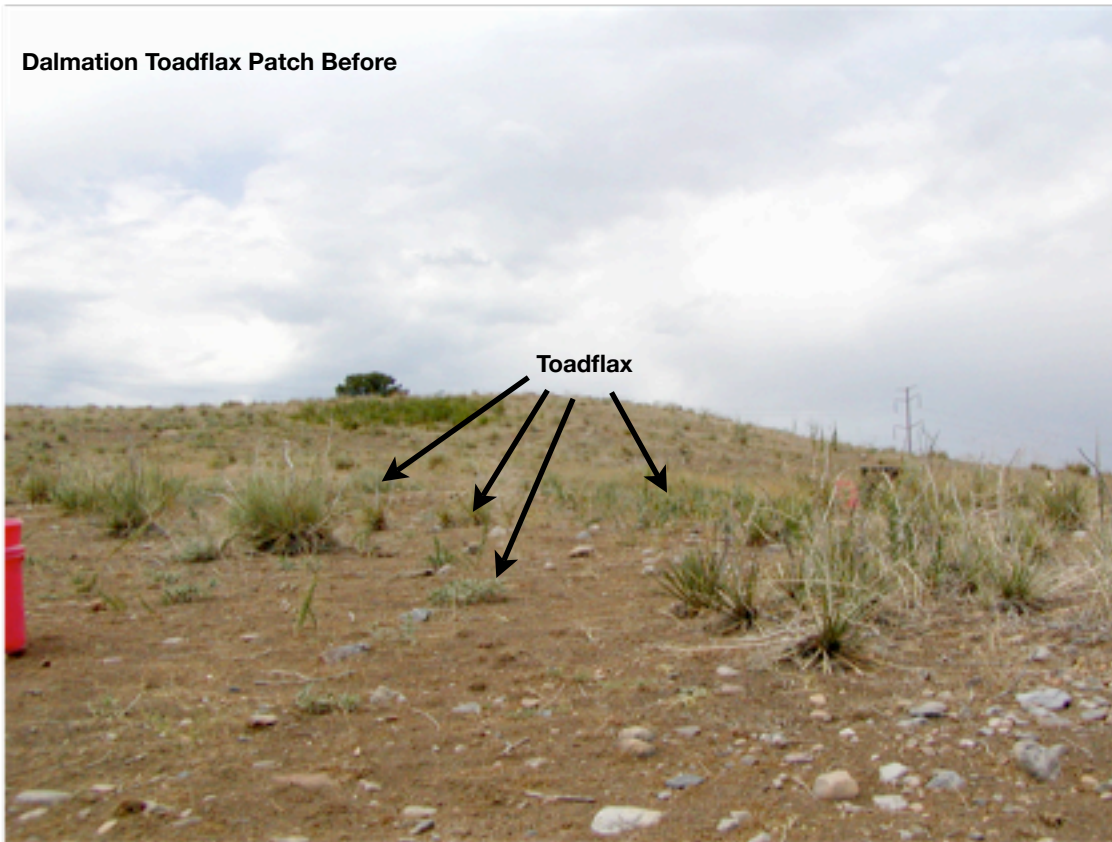
Dalmation Toadflax Patch Before



Dalmation Toadflax Patch After



Dalmation Toadflax Patch Before



Dalmation Toadflax Patch After





**Cows eat wormwood sage (above)
and horehound (below).**



Appendix B: Newspaper Articles

A novel approach to eradicating weeds



Photos by Marty Calvano | Camera

Leah Ashley prepares to slip a piece of Dalmatian toadflax, a noxious weed, in with a mouthful of wheat bran as she hand-feeds a cow named Sunshine near Superior. Ashley is working with Kathy Voth, of Livestock for Landscapes, to teach cattle to eat invasive plants, which threaten to out-compete native grasses.

**Boulder Daily
Camera, Front
Page Article,
7/22/2008**

Cow school in session

Grazing cattle help to rid open space of invasive plants

By **Laura Snider**
Camera Staff Writer

When Kathy Voth hooks her horn, the cows come running — all 90 of them, including 44 calves and two bulls — with saliva slinging off their wide lips as they lope toward her white pickup truck.

This week, Voth is training the herd of cows grazing just west of Superior to widen its culinary horizons beyond the typical diet of native grasses to include invasive species, essentially creating weed-munching machines. The hope is that the cows, which are already grazing on county open space land, can eat the undesirable plants and fatten themselves up in the process.

"We want strong, healthy animals who eat the things we want them to eat," Voth said.

This is the second year of Voth's cow school, which is being



Kathy Voth, of Livestock for Landscapes, watches from the back of her truck as cattle follow it to a location for "weed training." Voth tempts the cows with buckets of wheat bran, in which she slips species of noxious weed that she is training the cows to eat. Her current project, run with Boulder County Parks and Open Space, is to teach the animals to eat Dalmatian toadflax.

funded by a small research grant from Boulder County Parks and Open Space. Last year at about this same time, Voth taught a group of heifers to eat diffuse knapweed, which the city of

Boulder's Web site calls the "King of Noxiousness."

"I was a little skeptical to begin with," said Steve Sauer, weed

See **COWS, 7A**

Continued on next page

Cows tapped as weed eaters

Continued from 1A

coordinator for Boulder County Parks and Open Space.

"This time of the year (diffuse knapweed) is pretty nasty, real dry. It's real rough and if I was a cow, I don't think I'd want to eat it."

But with a little creative behavior-reinforcement training, Voth got the cows eating the knapweed — a lot of it — and now the cows, all new moms, are teaching their calves to chew on knapweed as well.

This year, the target weed is Dalmation toadflax, a waxy-leaved plant with yellow flowers that can produce half a million seeds over its three-year lifespan.

"Oh, that guy's eating a big bite," Voth said Monday as she leaned against her truck, pointing her video camera at an Angus who was chewing with a toadflax hanging from

his mouth. "Good job."

The cows clustered around Voth's truck were shoving their heads into buckets filled with a mix of rolled oats laced with molasses, wheat bran and Dalmation toadflax.

Since late last week, Voth and her assistant, Leah Ashley, have been feeding the cows tasty foods they don't recognize. The idea is to use positive feedback to get the cows used to eating the unusual. Starting Sunday, Voth pulled the switch, mixing the weeds in with the good stuff. The hope is that the cows recognize the weed and begin to graze on them out in the pasture.

Voth's idea of training cows was born during her tenure with the Bureau of Land Management in Utah. There she worked in conjunction with scientists on a seven-year project using goats to eat invasive

plants. The problem, she found, was not with the goats (they'll eat anything), it was with the ranchers, who weren't too keen to mix goats in with their livestock.

"It's easier to teach cows to eat weeds than it is to teach ranchers to include goats," she said.

Since then, Voth has started her own company, Livestock for Landscapes, and has taught cows how to eat non-toxic weeds from California to Wyoming. The newly trained Boulder County cows will head to a test pasture next week to see whether toadflax has caught on as a favored treat.

The prognosis is good, according to Voth, who has so far never met a cow she couldn't train to eat a weed.

Contact Camera Staff Writer Laura Snider at 303-473-1327 or sniderl@dailycamera.com.



Loveland CONNECTION

Saturday, July 26, 2008

Connect with us daily at LovelandConnection.com

LIVESTOCK WORKING TO MAKE BETTER LANDSCAPES PAGES 3-4

Weeding out new theories

Loveland woman using livestock to improve landscapes

BY DOUGLAS CROWL
Loveland Connection

Cows don't eat weeds, according to conventional thinking.

That's one dilemma behind a noxious weed problem in the United States, where millions of acres are being overrun by nonedible, exotic plants that kill native grasses.

Government agencies and private ranches throughout the nation implement extensive weed management programs to improve grazing areas and wildlife habitat, which usually require expensive herbicide sprays.

But one Loveland woman is turning the conventional thinking in this field upside down.

Kathy Voth is teaching cattle to eat weeds.

She has traveled across the country demonstrating how it works for her company, Livestock for Landscape LLC.

"I'm the only one of my kind so far," said Voth, who has worked on 12 projects throughout the United States teaching cattle — and in one case a small herd of buffalo on a Ted Turner-owned ranch — to eat weeds the animals usually avoid.

Voth has taught cattle to eat nine varieties of weeds so far, including Canadian thistle, several varieties of knapweed and black mustard, she said.

Before teaching the cows to eat the weed, she tests to ensure the plant isn't harmful.

Then, in about a week,



Bradley Wakoff Loveland Connection

Kathy Voth laughs as a herd of cattle noisily approaches while she describes her behavior training program. Voth has trained the cattle to eat weeds, such as thistle and knapweed. As a consequence of their training, the animals have learned that Voth usually brings tasty foods.

Voth introduces the cattle to the new foods, first something more conventional, like alfalfa pellets, and then slowly integrates the weed into their diets.

Once grazing freely, the animals choose to eat whatever weed she has introduced along with their regular forage.

In the broad field of range management, Voth's service may appear like pure fantasy to some people.

She admitted it can be

difficult to convince people that cattle can actually eat nuisance plants.

Rob Alexander, agricultural land manager for Boulder County, admitted he was a skeptical when Voth trained 50 cows to eat late-season diffuse knapweed and then turned them loose in a large pasture.

She received a Boulder County grant last year to apply her work on some of the county-owned open space leased for grazing.

Alexander said, sure,

cattle might eat the weed while enclosed in a small area, but would they choose such a meal when given the opportunity to gorge on native grasses?

"They ate the knapweed pretty heavily and that was a surprise," Alexander said.

He said the grazing knocked back the weed substantially and won Voth a second grant to teach the same cattle to eat Dalmatian toadflax this year, as well as to see if the animals pass the

learned behavior on to their calves.

"There are some weeds, like diffuse knapweed or Dalmatian toadflax, you just look at them and they are not nutritious and you think that no livestock is going to eat them," Alexander said. "It turns out we are wrong about that."

Voth began using livestock as a management tool with the Bureau of Land Management.

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Weeds

Continued from Page 3

She first worked on projects using goats to eat fire breaks to help control wildfires.

Then, she began pursuing the practice to stop weeds using cattle, because, largely, many ranchers don't want to keep goats.

"It was easier to teach cows to eat weeds than to teach ranchers to like goats," Voth said.

Though Voth likely is the only person doing such work with cattle, she's applying theories by one of her former colleagues and professors, **Fred Provenza**, at Utah State University, who focuses on animal behavior.

The idea is to train animals to forage in a way that better benefits the landscape, such as reducing weeds, supporting biodiversity, and improving habitat for certain species, such as grouse, Voth said.

It also could save ranchers money on weed control.

"I'd really like people to better understand how easy it is to use animal behavior to help us," she said.

Voth began her private company in 2004 when she moved to Loveland.

This year, she began gaining more attention for her work.

She's also planning a way for ranchers and land managers to train cattle using her techniques, so the practice can be more widely available — and so she doesn't have to travel



Bradley Wakoff Loveland Connection

Attendees stand Thursday in a plot of knapweed on an open space near Louisville. **Kathy Voth**, center, has trained cattle to eat the weeds.

as much.

"I could help them put together their own plan using the computer and phones," Voth said.

Alexander hopes to use Voth's work in a similar

way for Boulder County ranchers.

"I think she is going to get real busy, but I hope we are going to do more work with her in the future," he said.

Appendix C: Field tour participants and mailing list

Name	Organization	E-mail
Ember Brignull	City of Louisville	brignue@ci.louisville.co.us
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Names in red are mailing list only