Impacts of Invasive Species on Rangelands

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Introduction

I will discuss the impacts of invasive species as they affect rangeland managers and especially beef producers. The discussion will be limited to the California annual vegetation type excluding the northern coastal prairie where annual precipitation is greater than 50".

The forage plants in the annual rangeland discussed in the scope of this paper are mostly exotics which could be considered invasive species. They provide us with a rangeland that has higher herbaceous production than any natural vegetation type west of the Rockies (Menke, 1989). Its annual forage production is greater than much of the short grass prairie of the mid west. At Sierra Foothill Research and Extension Center (SFREC) annual herbaceous production has averaged 2900 pounds of dry matter over 19 years. This vegetation type produces forage that is nutritious with protein levels of 6-22% (Hart et al., 1932) and digestible organic matter of 50-80% (Morris, 1985). The forage produces good livestock gains: stocker calves at SFREC averaged 285 pounds gain in 190 days over four separate grazing seasons (Raguse et al., 1988).

The forage system is durable under moderate to heavy utilization by livestock. Management guidelines recommend leaving 500-800 pounds per acre of residual dry matter after grazing (Bartolome et al., 2002). This allows for about 75% utilization of forage plants by grazing animals, considerably more than the 45-55% usually recommended for perennial species.

Grazing annual plants does offer short-comings: there is a relatively short green growing season – 2-4.5 months at San Joaquin Experiment Range vs. 5-6 months for many perennial pastures. Forage productivity from annual species is also highly variable from year to year. At SFREC annual yield ranged from 1100-4700 pounds over 19 years. Range cattle managers mostly respond by using one of three production systems (or combinations of the three): stocker calves brought in as weanling calves in the fall and kept until forage matures in the spring; a cow-calf system with calves born in the fall and weaned and sold in the spring; and a cow-calf system of fall calving with the cows and calves moved to irrigated pastures or mountain meadows in the spring.

Troublesome Invasive Plants

Poisonous Plants

Poisonous plants are not a major problem on annual ranges. Yellow starthistle (*Centaurea solstitialis)* is poisonous to horses. Horses will not usually become poisoned unless other forage is short. Klamathweed *(Hypericum perforatum)* is no longer an issue because of the success of the biological control program. The biggest cause of poisonous plant livestock fatalities in California is a planted ornamental, oleander.

Injurious plants

Economic losses result from physical injury caused by annual grasses with long, rigid, barbed awns. Problem plants are mostly limited to the following: *Bromus diandrus* *Hordeum murinum* ssp. *leporinum, Hordeum* spp., *Taeniatherum caput-medusae, and Aegilops triuncialis*. Losses are due to eye injuries and lump jaw because of harsh awns that work their way into the soft tissue of the eye and mouth.

Plants That Replace Desirable Forage Plants

The most serious impacts of invasive plants on annual rangeland are a result of those plants that out-compete the more desirable forage plants for moisture and space, thereby reducing forage yield and/or quality. Such plants also affect grazing distribution because livestock tend to ignore areas with a high concentration of unpalatable plants even though desirable forage species are present. As a result, carrying capacity may be substantially diminished.

I will discuss three weedy species that I feel are the worst threat to California annual range: yellow starthistle, medusahead, and barbed goatgrass.

Yellow starthistle (*Centaurea solstitialis)* now infests 15 million acres in California, including cropland, roadsides and recreation lands as well as rangelands. It provides nutritional, palatable forage for livestock in winter and spring, with protein content up to 14%, but digestible protein and total digestible nutrients are reduced in the fall in yellow starthistle infested fields (http://wric.ucdavis.edu/yst/impacts/impacts.html). Ranchers need dry forage of at least moderate quality and palatability to support their animals in late and fall until adequate green feed is present. Yellow starthistle does not provide that quality of forage in summer and fall.

In spite of its widespread nature, there are no studies documenting the impact of yellow starthistle on the state's rangeland. At SFREC we established permanent line transects in eight moderately infested pastures ranging in size from 20-200 acres. The pastures are grazed by cattle. Yellow starthistle makes up 20-31% of the plant composition. It is difficult to estimate the impact on carrying capacity because of yearly variations in weather, but at this time, four years after establishment of the transects, it appears that carrying capacity has been reduced by at least 10-15%.

In another pasture, 50% composition of yellow starthistle was estimated along line transects. Vegetative material was dried and weighed with the following results:

Yield of Vegetation Components

Component	lbs./ac.
YST	2994
Grasses	1315
Other Forage Species	1584

Impacts on carrying capacity will vary with the degree of infestation and perhaps with the desired season of use. Very heavy infestations can probably result in loss of over 50% of a pasture's original carrying capacity.

Medusahead ***(Taeniatherum caput-medusae)*** has been in the state since 1900 and is now widespread. It is palatable while green, and in early growth stages its nutrient content is comparable to that of other annual grasses. It loses palatability as it matures, and it is poorly digested when mature and dry. In addition, its harsh awns at maturity discourage grazing, resulting in dense, ungrazed patches. The dry matter is slow to break down, and germination of other species is reduced. Thus, the patches tend to grow in size, effectively reducing the amount of area available for grazing.

Barbed goatgrass ***(Aegilops triuncialis)*** was first seen in California in the early 1900's. It was confined to two counties for about 70 years, but recently it has been expanding rapidly. It is a successful invader irrespective of soil, terrain or canopy cover. Early research stated that barbed goatgrass was unused by livestock, and in thick stands it may reduce carrying capacity by 50-75% (Jacobsen, 1929). Recent work and personal experience suggest that cattle do graze the plant when it is young, however its vegetative component is relatively small at early stages of growth.

Control Methods

Yellow starthistle

Biocontrol agents are widespread, and they reduce seed production, but enough seeds remain to maintain and expand yellow starthistle populations.

Intensive grazing is a useful tool in yellow starthistle control. In one study, high intensity, repeated cattle grazing reduced flowering heads by 78-91% (Thomsen et al., 1993). This practice is difficult to use on a large scale because of the high number of grazing animals needed at specific times. For example, to treat 1000 acres at the intensities used in the above study would require 1900 cows. In addition, for effective control grazing should be continued beyond the time when yellow starthistle is most palatable, so livestock production is diminished.

Chemical control. The selective herbicide clopyralid offers very effective yellow starthtistle control at label rates (DiTomaso et al., 1999b). We achieved at least 99% control at the field scale by applying clopyralid at the low label rate. (Connor et al., 2002). Multiple years of chemical treatment are required, with follow-up spot spraying in succeeding years.

Prescribed burning is an effective control method if applied at the early flower stage (DiTomaso et al. 1999a). Again, multiple years of treatment are required.

A combination of prescribed burning and clopyralid application in alternate years also provides successful control. We found that substituting fire for clopyralid application during either of the first two years of a three year treatment program resulted in yellow starthistle control equal to that achieved from three years of clopyralid use (Connor et al., 2002). Follow-

up spot spraying will need to continue for several years. Joe DiTomaso gained good control with a two year program of burning the first year and clopyralid spray the second year.

Medusahead

Prescribed fire can substantially reduce medusahead populations if the fire occurs as soon as desirable annual plants have matured and dried enough to carry a hot fire. At SFREC we reduced medusahead significantly from 25% composition to 6% or less in burns targeting yellow starthistle and consequently timed later than optimal for medusa head control. While burning will reduce medusahead, it will not eradicate it.

Intensive grazing is a usual tool for medusahead management. Timing controlled grazing reduced medusahead from 45% cover to 10% (George et al., 1989).

Barbed goatgrass

Glyphosate at one pound per acre followed by reseeding with a perennial grass-clover mix has been effective in controlling barbed goatgrass (Peters et al., 1996). At SFREC we have had success seeding with annual ryegrass plus nitrogen fertilization. Such treatments may be too expensive for wide scale use.

Prescribed fire appears to be the best barbed goatgrass control method available. It should be applied after desirable annuals mature and before goatgrass seed matures and drops. The fire must be hot enough to achieve a complete burn, and two successive years of burning are required (DiTomaso et al., 2001).

Constraints to Treatment

Costs vs. returns for chemical control

The following costs were incurred at SFREC annually during three years of chemical application for yellow starthistle control:

Clopyralid 4 oz./ac.	$12.00
Aerial application	14.50
Total cost per acre	$26.50
Follow up spot spray	$2.50

At least two to three years of clopyralid application are required. These costs are for helicopter application on about 300 acres per year. They may be reduced if flatter terrain and a nearby airstrip will allow use of fixed wing aircraft or if larger acreages are treated. Conversely, smaller treatment areas may result in much higher application costs. Follow-up spray costs are calculated based on our experience of searching about 10 acres for every acre that is actually sprayed. That is, if 100 acres are checked and 10 acres actually sprayed, the cost covers the labor, equipment and chemical to check 100 acres and spray 10 acres, divided by the 100 acres checked. Spot spraying will be necessary for several years following initial treatment.

An important point to make is that these costs must be applied to land from which the total annual rent received is typically only $10-$12 per acre.

Challenges to prescribed burning

Cost. At SFREC, over three years of prescribed burning for yellow starthistle control, the costs were not substantially less than that for applying herbicide. Out-of-pocket costs for labor, fuel, minor equipment repairs, permits, and seed and fertilizer for firebreaks was $23.00 per acre burned. We burned 200-400 acres per year, and we enjoyed the assistance at no cost of California Department of Forestry and Fire Protection (CDF) crews for fire ignition and control. This assistance is available to private land owners, but there are many more requests annually than there is available assistance.

Financial liability for escapes is the responsibility of the land owner unless he or she can get into one of the limited number of CDF programs available.

Other constraints include air quality requirements, variable weather during desired burn periods and the difficulties of burning within the time period required for weed control while also fitting agency requirements into periods of proper wind, humidity and temperature parameters.

Summary

Impacts of invasive weeds on annual rangelands are mostly due to those plants that out compete and therefore replace more desirable forage species. There are valuable tools that are used for control or management of these weedy plants. The rangeland manager faces constraints that explain why the tools are not more widely used on large acreages. The manager may want to focus weed control on the most productive or most easily managed areas. And we must emphasize the importance of catching weed invasions in there early stages, when there is less area that must be treated.

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