Cattlemen’s Update 2008

(Cattlemen’s Update is an annual educational program offered by the University of Nevada Reno for beef cattle producers. Program topics speak to current beef cattle production management issues in the Great Basin region affecting profitability and product quality. Subject matter selection is based on a needs assessment of Nevada beef cattle producers and on concerns and trends expressed by the leaders of the beef cattle industry in the United States.)

Welcome to the 2008 edition of the Cattlemen's Update Proceedings. This year finds us in times with good cattle prices and an increasing demand for beef products; among many other things. The cattle business is changing forever. With things like BSE and other food safety issues, National Livestock Identification, marker assisted DNA selection, alliances, other marketing schemes, international import and export markets, soaring energy costs coupled with global warming and the push for renewable energy, and the continuing advances of technology; the business is different and will be different forever. The industry is becoming more complicated, and our competition now comes from not only down the road, but also around the world. The cattle business is no longer just weaning a calf and selling in the fall, but a business of providing a specific product that performs in a certain way to create something to sell to the population that they want. It is through forums like this, as well as the new forms of education (the Internet, email, etc.) that provides the ability to stay on top and survive to make a profit in the business.

Livestock producers with a computer and e-mail can participate at anytime in an educational forum by using Extension Coffee Shop (a subscribed e-mail list). Coffee Shop is designed to help solve problems and face issues in the livestock industry. Call Ron Torell (775-738-1 721), Dr. David Thain (775-784-1 377), or Dr. Ben Bruce (775-784-1624) to participate if you are not a member or have any other questions.

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PROGRAM SPEAKERS

Ethanol Industry's Impact on the Beef Industry--Ron Torell
UNCE Area Livestock Specialist

Feeding Ethanol Co-products from Corn to Beef Cattle----------------------Dr. Dave Bohnert
Oregon State University Livestock Specialist

Cattle Disease Risk Management--Dr. David Thain
D.V.M, State Extension Veterinarian

Analyzing Production Goals without Individual Animal Id------------------------Dr. Ben Bruce
UNCE State Livestock Specialist

Ranch Bio-Security as a Weed Control Measure--------------------------------------Earl Creech
UNCE Area Weed Specialist

Issue of Local Concern---Local Veterinarian

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May 2007 **Animal Sciences Department** ANS B07-01

Feeding Ethanol Co-products from Corn to Beef Cattle

David Bohnert[1], Ron Torell[2], and Randy Mills[1]
[1]Oregon State University Extension Service
[2]University of Nevada Cooperative Extension Service

I think that most of us have heard the phrase "When you are handed lemons, make lemonade". Such is the case with the wake-up call for cattle producers when the rapidly growing ethanol industry revealed its hunger for corn. So, how can we make lemonade out of this? The answer is by using the co-products of ethanol production, such as distiller's dried grains, which are becoming increasingly available and can be a cost effective feed ingredient. We will be discussing how ethanol is made from corn, the nutritional value of ethanol co-products, and storage concerns of the co-products.

Ethanol Production

The ethanol industry in the U.S. is expanding rapidly because the production of ethanol from corn has become a strategy to reduce our reliance on foreign oil. There are currently two types of milling processes used to produce ethanol. They are wet and dry milling, with the vast majority of ethanol in the United States coming from dry milling.

Wet milling is the more complex of the two processes because the corn kernel is partitioned into several components to facilitate high value marketing. During this process, corn is "steeped" and the kernel's components are separated into bran, starch, gluten meal, germ, and soluble components. This process requires high quality corn because it typically results in numerous products, primarily for human use, such as corn oil and corn sweeteners like high fructose corn syrup and dextrose. Co-products of this process that can be used as livestock feed are corn gluten feed and corn gluten meal (Figure 1).

The dry milling process is relatively simple (Figure 2). Corn is ground, fermented, and the starch converted to ethanol and carbon dioxide, with about 1/3 of the dry matter (DM) remaining as co-product (this is because corn is approximately 2/3 starch). Quantitatively, dry milling 100 pounds of corn will result in approximately 4.8 gallons of ethanol, 32 pounds of distillers dried grains, and 32 pounds of carbon dioxide. The distillers dried grain is a good supplemental feed for cattle. With approximately 1/3 of the dry matter of corn remaining following fermentation, all of the remaining nutrients (primarily protein and fat) are concentrated approximately 3-fold. For example, whole corn grain contains about 4% oil and 9% crude protein. Following dry milling, dried distillers grain contains approximately 12% oil and 30% crude protein.

Ethanol Co-Products

The main co-products of ethanol production used as livestock feed are listed in Table 1.

Wet Milling

Wet corn gluten feed (CGF) is a popular protein and energy source for feedlot cattle because it is rich in highly-digestible fiber and moderate in crude protein. It is the highest volume co-product of the wet milling process. Contrary to its name, CGF does not contain gluten, but rather a mixture of corn bran and condensed "steep" solubles. Most CGF is fed within 100 miles of a processing plant as a wet product; however, dry CGF is also available and is often marketed as a pelleted product. Research with feedlot cattle has suggested that the energy value of wet CGF is approximately 92 to 100% of the energy value of whole shelled corn. Another positive aspect of wet CGF is that it can be fed to cattle in very large amounts (up to 50% of the diet) and still maintain acceptable performance. It should be noted that CGF can be variable in nutrient composition both within and between processing plants. This is because the ratio of corn bran to corn steep liquor will vary depending on the markets available.

Corn gluten meal (CGM) is golden-yellow and is mainly gluten, the protein part of the corn kernel. As a result, it is used primarily in the swine and poultry industries as a protein supplement. However, it is a good source of undegradable intake, or "escape", protein that is sometimes used in the diets of rapidly growing calves or high producing dairy cows.

Dry Milling

Distillers grains are the primary co-product of the dry milling process. It can be sold as a wet (approximately 35% DM), modified (approximately 50% DM), or dry product (approximately 90% DM). However, due to the large quantity of distillers grains being produced and limited livestock availability near ethanol plants, the dried product is the most commonly available to cattle producers in the Western US. Another product of the dry milling process is condensed distillers solubles (CDS). This is a result of removing the distillers grains from the liquid fraction, frequently called thin stillage, remaining after ethanol production. Thin stillage is further evaporated, or condensed, to produce CDS which is also referred to as "syrup". Many ethanol production facilities will either market the CDS or combine it with various forms of distillers grains. As a result, types of distillers co-products available to beef producers from dry milling are:

1) Wet distillers grains (WDG)
2) WDG plus solubles (WDGS)
3) Modified distillers grains (MDG)
4) MDG plus solubles (MDGS)
5) Dried distillers grains (DDG)
6) DDG plus solubles (DDGS)

Dried distillers grains plus solubles is the co-product most available to cattle producers in the Western US.

Distillers grains can be fed to cattle with little, if any, of the negative effects on forage digestion normally seen with feeding high levels of starch containing grains (e.g. corn, wheat, barley, etc.). This is because the starch has been fermented to produce ethanol, leaving little to interfere with fiber digestion. Also, on a DM basis, wet, modified and dry distillers grains are relatively similar in nutritional composition, containing from 30 to 35% crude protein and 8 to 12% fat (Table 1). Research has shown that WDG and WDGS may contain from 5 to 15% more available energy then dry-rolled corn (based on feedlot performance) with DDG and DDGS being equal to dry-rolled corn.

Mineral concerns. Distillers grains can have high levels of phosphorus and sulfur. The increased phosphorus is normally a benefit to cow/calf producers because most pasture- or hay-fed cattle are at least marginally deficient in phosphorus. In contrast, the potentially high sulfur content can affect copper status and cause sulfur-induced polio if proper nutritional management is not followed. The sulfur content of distillers grains can vary dramatically (Table 1), however, most will average between 0.6% and 0.8% sulfur. Therefore, when considering use of ethanol co-products, it is essential to analyze the sulfur content of water sources and factor that into the nutritional program. According to Mineral Tolerances of Animals, cattle consuming 85% to 100% concentrate diets can tolerate 0.3% total dietary sulfur, whereas cattle consuming 40% to 100% forage diets can tolerate 0.5% total dietary sulfur. A management option to consider that may reduce the potential for sulfur-induced polio is to provide 150 to 200 mg per head per day of thiamine when the dietary sulfur concentration is greater than 0.35% of diet DM with concentrate diets or when distillers grains make up more than 40% of the diet DM in forage fed cattle. If cattle showing signs of polio are given a 2000 mg intravenous dose of thiamine early (before cattle go down) they will often recover. In addition, a dietary sulfur concentration greater than 0.3% can reduce copper availability, requiring additional dietary copper to maintain adequate copper status.

Research has shown that beef cattle can be successfully fed as much as 40% of their diet as distillers grains (DM basis); however, current recommendations for forage-based diets are to not feed over 10 pounds of distillers grains (DM basis) per day to mature beef cows, primarily because of the high fat content and potential sulfur concerns. For backgrounding or growing diets, calves can be safely fed up to 30% of their diet, or roughly 3 to 6 pounds of DM, as distillers grains. Distillers grains can be an economical, and effective, protein and energy supplement for cattle producers.

Storage Concerns of Ethanol Co-Products

An important consideration in using co-products of ethanol production is how they will be stored and fed. Dried products can be stored for extended periods of time, can be shipped greater distances more economically and conveniently than wet products, and be easily blended or mixed with other dietary ingredients. However, it should be noted that DDGS and CGM will "bridge" in mixers and storage bins. If DDGS are to be stored for more than 1 week, use of a commodity bin or concrete pad should be considered. It is also recommended to let any dried product cool prior to storage to help reduce bridging. Dried distillers grains are also susceptible to wind. It is important to keep them protected from strong winds during storage. Unfortunately, functional pellets or range cubes made entirely from DDGS are not commercially available at this time.

Wet distillers grains will normally remain fresh and palatable for only 5 to 7 days. However, this length of time is dependent on environmental temperature, with spoilage and reduced palatability occurring more rapidly in hot weather. In contrast, WDG has been kept in acceptable condition for up to 3 weeks during cool/cold temperatures. In some cases, WDG can be treated at the ethanol plant with a preservative or mold inhibitor that can effectively increase “shelf life” by 2 weeks or more depending on the amount of preservative added.

There have been some reports of WDG being preserved for more than a year in silo bags, without preservatives, but filling the bags can be difficult because WDG settles easily and can result in split bags. Caution should be exercised when filling bags to not overstretch the bags, particularly on the sides. Also, there have been reports that WDG can be successfully mixed with a forage source to make very palatable and nutritious silage.

Condensed distillers solubles (CDS), like all liquid feeds, requires special handling and feeding equipment. Storage tanks should be maintained indoors or underground to prevent freezing in cold temperatures. Also, CDS will need to be routinely mixed using a recirculation or agitation pump to minimize settling if stored for extended period of time and/or before adding it to the feed ration or mixer.

Summary

Distillers grains normally contain from 30 to 35% crude protein and 10 to 12% fat. Current recommendations for forage-based diets are to limit the amount of distillers grains to about 10 pounds DM per day to mature beef cows. For backgrounding or growing diets, calves can be fed up to 30% of the diet as distillers grains. Distillers grains can be an economical, and effective, protein and energy supplement for cattle producers. It is an excellent source of protein, energy, and phosphorus for cows and growing calves. Hopefully you have found a little “lemonade” in this information.

References used in preparation of this fact sheet:

Kononoff, P. J., and G. E. Erickson. 2006. Feeding corn milling co-products to dairy and beef cattle. Proceedings of the 21st Annual Southwest Nutrition and Management Conference, February 23-24, 2006, Tempe, AZ. pp. 155-163.

Lardy, G. 2003. Feeding coproducts of the ethanol industry to beef cattle. North Dakota Extension Service, North Dakota State University. AS-1242:1-4.

Schingoethe, D. J. 2006. Feeding ethanol byproducts to dairy and beef cattle. Proceedings of the California Animal Nutrition Conference, May 10-11, 2006, Fresno, CA. pp. 49-63.

Select on-line information concerning co-products of ethanol production:

http://beef.unl.edu/byprodfeeds/manual_02_05.shtml

http://www.ddgs.umn.edu/

http://www.distillersgrains.com/

http://www.iowarfa.org/index.php

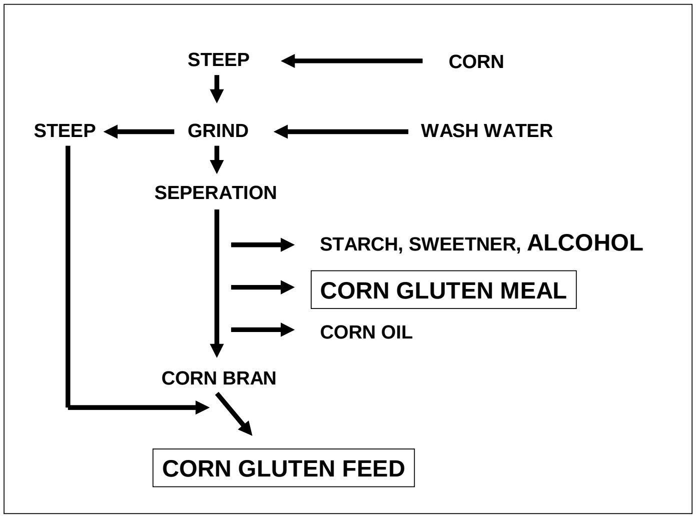


Figure 1. Flowchart of the corn wet milling industry.

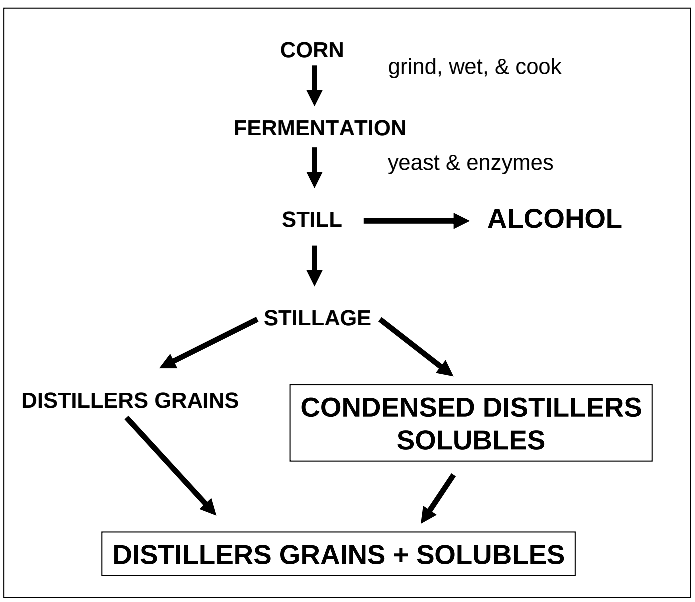


Figure 2. Flowchart of the corn dry milling industry.

Table 1. Nutrient content (%; DM basis) of Ethanol Co-Products

	Ethanol Co-Product[a]					
Item	**WDG**	**CDS**	**DDG**	**DDGS**	**CGF**	**CGM**
DM	25-35	23-45	88-90	88-90	90	90
CP	30-35	20-30	25-35	25-32	20	65
TDN	70-110	75-120	77-88	85-90	80	86
Fat	8-12	9-15	8-10	8-10	2.8	2.2
Calcium	0.02-0.03	0.03-0.17	0.11-0.20	0.10-0.20	0.07	0.08
Phosphorus	0.50-0.80	1.30-1.45	0.40-0.80	0.40-0.80	1.1	0.53
Sulfur	0.4-1.2	0.3-1.4	0.4-1.2	0.4-1.2	0.33	0.72

[a] WDG = wet distillers grains; CDS = condensed distillers solubles; DDG = dried distillers grains; DDGS = dried distillers grains with solubles; CGF = corn gluten feed; CGM = corn gluten meal

Impact of Ethanol Production on the Livestock Industry

Ron Torell, UNCE
Livestock Specialist

Why is corn redirecting?

^Reduced dependency on foreign oil
^$0.51/gallon tax incentive subsidy
^Renewable natural resource
^Good for American farmers & rural America
^Politically correct
^Environmentally sound
^Fuel has become more important than food?

Current incentives

$0.54/gallon import tariff on ethanol expires 2009

$0.51/gallon tax credit expires in 2010

Federal Policy = 7.5 billion gallons produced by 2012

Develop more efficient extraction process

Other forages used as sources for ethanol production (sugar cane, switch grass, etc.)?

Corn's Redirection?

Ethanol production will utilize over three billion bushels in 2007 and over six billion over each of the next three years. In comparison, the livestock feeding industry is consuming approximately seven billion bushels annually.

One Bushel of Corn= 56 pounds

2.8 gallons ethanol

17 pounds dried distillers grain

36.2 pounds carbon dioxide

Corn Supply & Demand Economic Signals

- **More acres planted to corn**
- **Less acres other feed grains & hay**
- **Efficient plants & extraction processes developed**
- **New varieties of ethanol corn developed**
- **Other crops developed and used for ethanol production**

Breakeven Purchase Price/cwt. 550 lb. Steer

Fed Price	**Corn Price $/Bushel**		
	$ 2.50	**$ 3.00**	**$ 3.50**
$80.00	**$125.00**	**$112.50**	**$100.00**
$82.00	**$128.75**	**$116.25**	**$103.75**
$84.00	**$132.50**	**$120.00**	**$107.50**
$86.00	**$136.25**	**$123.75**	**$111.25**
$88.00	**$140.00**	**$127.50**	**$115.00**
$90.00	**$143.75**	**$131.25**	**$118.75**

*relationship modified with availability of grass
source=CattleFax $0.10 move in bu. corn = $2.5/cwt move in calves

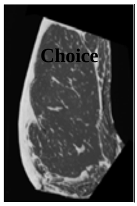
Breakeven Purchase Price/cwt. 750 lb. Steer

Fed Price	Corn Price $/Bushel		
	$ 2.50	$ 3.00	$ 3.50
$80.00	$110.00	$103.00	$ 96.00
$82.00	$112.95	$105.95	$98.95
$84.00	$115.90	$108.90	$101.90
$86.00	$118.85	$111.85	$104.85
$88.00	$121.80	$114.80	$107.80
$90.00	$124.75	$117.75	$110.75

*relationship modified with availability of grass
source=Cattle Fax $0.10 move in bu. corn = $1.40/cwt move in yearlings

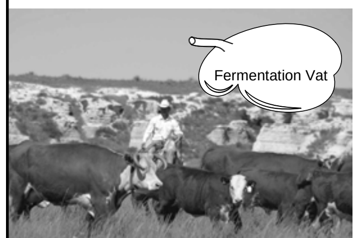
Corn is no Longer King of the Livestock Industry

Feedlot older and heavier	Reduce % choice and prime
Fewer days on feed	Widen choice/select spread
Increased carcass weight	Improved yield grades
Reduced fat	Cattle older at harvest Health Issue



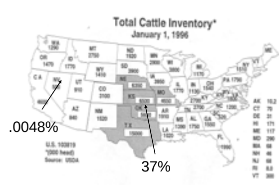
$10 to $20/cwt choice-select spread

Beef's Advantage



Marketing of Cattle?
Calving dates relative to new marketing climate

- **Four weights double seasoned on grass**
- **Five & six wt. calves have no home**
- **Yearlings vs. calves?**



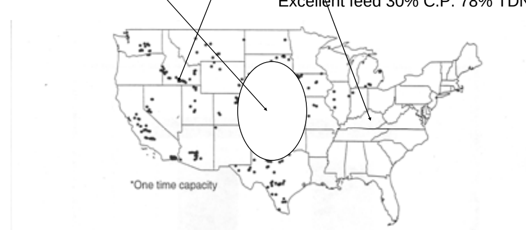
Feed yards > 4000 Head

Packers > 200 Head

Source Cattle Fax

The Lemonade

WDG Wet Distillers Grain	**DDGS** Dry Distillers Grain With Solubles
• Cheap	Expensive to dry
• Poor move ability	Good move ability
• High transportation cost	Reasonable transportation cost
• Short shelf life	Good storage & shelf life
• Plentiful	Excellent feed 30% C.P. 78% TDN



Impact of DG on Feedlot Sectors ?

- Higher feedlot COG
- Shift feedlot locations near Ethanol plants
- Reduce percent choice grade cattle
- By-product feeds have new life

What is more important to U.S. consumers, food or energy

?

Questions ?

Simple Cow Records

Dr. L. Ben Bruce, University of Nevada Reno
Cooperative Extension
College of Agriculture Biotechnology and Natural Resources

Individual cow identification is sometimes a luxury that cannot be afforded in extended range operations. However, that doesn't preclude record keeping that can assist in making a more profitable, efficient operation.

Profit is an interaction between cost and production. Costs include everything that goes into the cowherd to keep it viable on a yearly basis. Production is the amount of pounds of animals sold, including calves and culls. Production is the bottom line of total herd performance. For operations that can individually identify animals, total herd performance is the average of individual animal performance. When individual records are not kept, estimates of total herd performance can still be made.

Total herd performance is a combination of several factors. Growth of all calves to weaning is one of the most important. Embedded in this number is gain of the calves as well as the survivability, which is percent calf crop. The number of open cows and the length of calving season are two more factors. These have important relationships to cull cow numbers. The last major factor is death loss.

When these factors are studied, it is obvious that many are manifestations of overall reproductive efficiency. Reproductive performance is the most important single block of beef cow efficiency. Even with no individual identification system, certain records can be kept that monitor reproductive efficiency. The number of cows exposed to bulls and the number of calves resulting from this exposure is a percentage of breeding efficiency. Along with that, count the number of open cows.

The weight of the calves sold is also important. This is a function of genetics, nutrition available, and once again, reproductive efficiency. Calf weights are related to reproductive efficiency particularly through length of the calving season. A long calving season produces calves that can vary by months in age, and consequently in weight. This should be recorded by counting the cows that calve in the first 21 days of the calving season, and the number in the second 21 days, etc. Protracted calving seasons hurt in both reproductive efficiency and calf weights.

Also important to record, but a recording that can be difficult, is how many cows are rebreeding in the first 21 days post partum, second 21 days, etc. A rough record of how many calves are born each day through out the calving season can give similar information. Also, as implied before, record the number of weaned calves.

This information, even though cows are not individually identified, can tell you a lot. Some of the numbers that have meaning include total income minus total costs of production. That is the "bottom line" for any operation, and should be positive. The next most important number is total cost minus income form culls divided by the total weight of calves sold. This is cost of production and is the only highly correlated number to success. It is more important than caving percent or weaning weight.

The above numbers relate to the overall health of the operation, but numbers from simple records can also tell about the herd's performance. Reproductive performance is the most important to measure, and several numbers tell about that. First is how far apart the calves are from year to year in birth. There should be a calf every 365 days. The first number is average rebreeding interval, as noted by counting cows in 21-day intervals after calving as to when they are breeding. If that number cannot be counted, then a note of how may calves are born each day (or by 21 day intervals) during the entire calving season can give the same number. The next important number in breeding efficiency is the number of calves weaned per cow exposed to bull. These two numbers are a guide to overall reproductive performance and can indicate areas of management to work on.

Other numbers from herds without individual identification can help in management. The average calf selling weight is a good indication of nutritional and breeds selection performance. The total number of pounds of caves sold divided by total number of cows exposed (a number always less than average selling weight) indicates total producing performance by the herd. The numbers of cull cows sold and a reason for their selling is another performance indicator. Bull replacement rates and the cost associated is also important. Replacement heifer rates, retained or bought, are important to overall herd productivity.

Many things can be learned from simple records without having to identify each individual cow. This is any introductory and I hope to cover each item in more detail over the next few months.

Ranch Bio-Security as a Weed Control Measure

Earl Creech
State Weed Specialist
University of Nevada Cooperative Extension

Outline

- Why prevention?
- The basics of weed reproduction and spread
- Protecting your ranch from weed invasion

Impacts of Weeds

- Lower plant and animal yields
  - Crop yields reduced $32 billion, annually
- Less efficient land use
- Higher costs of insect and disease control
- Poorer quality products
- More water management problems
- Lower human efficiency

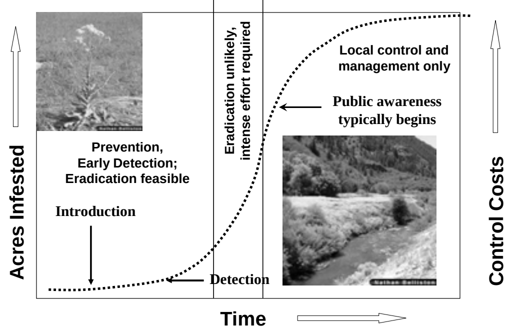
Some interesting figures…

- U.S. farmers and ranchers spend $12 billion for weed control each year
- Invasive weeds are spreading at average rates of 11-18% per year

Where do new weeds come from?

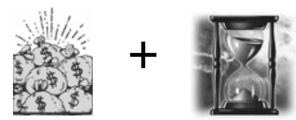
Where do new weeds come from?

Weed Increase and Control Potential Over Time



What can we do?

1. Reactive weed management
   – Wait until a weed invades, spreads across many acres, and impacts ranch profitability before doing something about it



What can we do?

2. Proactive weed management
   – Take steps to prevention weed invasion
   – Always the best strategy!
   – "An ounce of prevention is worth a pound of cure"

Number of Seeds Produced per Plant

	# of seeds (per plant)
Canada thistle	680
Sandbur	1,100
Leafy spurge	82,100
Mullein	**223,200**

From Stevens (1932)

Photo: California Weeds

How long can weed seed last in soil?

- 1879 – Beal buried seed of 21 weeds in 20 glass bottles.

Results

- 1920 - 8 species germinated
- 1940 - 3 species germinated
- 1980 - 2 species germinated
- 2000 - 2 species germinated

The Weed Seed Bank

One years seeding
Is seven years' weeding

- Old gardening proverb

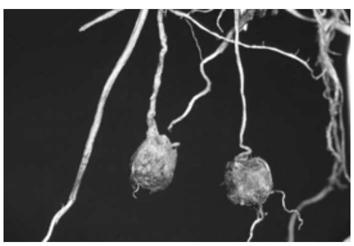
How many weed seeds are in the soil?

- Forcella et al. (1992) sampled fields in 7 states (IA, MI, MN, NE, WI, IL, and OH)
  - No. of seeds = 56 – 14,864 sq ft
- Equivalent to 2.5 - 650 million seeds per acre!

Vegetative reproduction - Rhizomes


J. DiTomaso, UC-Davis

Vegetative Reproduction - Bulbs, Bulblets, Tubers, Nutlets

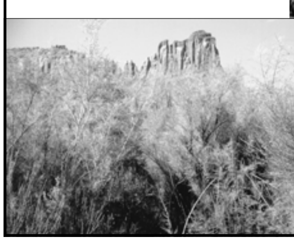



J. DiTomaso, UC-Davis

Vegetative Reproduction - Stolons

J. DiTomaso, UC-Davis

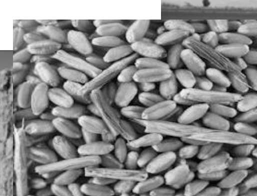
Vegetative Reproduction – Cut material

J. DiTomaso, UC-Davis

Weed Seed Movement

1. Crop seed, grain feed, hay, and straw


Dodder contaminated alfalfa seed
(planted at 20 lb per acre)

Dodder seed by wt (%)	No. of dodder seeds sown per acre
0.001	160
0.01	1,600
0.1	16,000
0.25	40,000

J. DiTomaso, UC-Davis

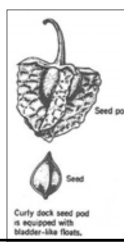
Weed Seed Movement

1. Crop seed, grain, hay, straw, and soil
2. Wind

J. DiTomaso, UC-Davis

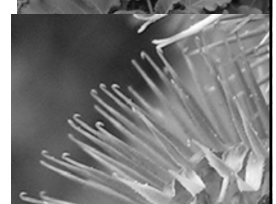
Weed Seed Movement

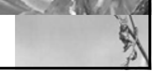
1. Crop seed, grain, hay, straw, and soil
2. Wind
3. Water



Weed Seed Movement

1. Crop seed, grain, hay, straw, and soil
2. Wind
3. Water
4. Animals and humans





What about seeds that are passed through an animal?

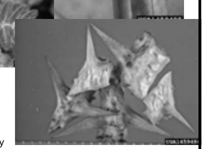
Type of seed	Calves	Horses	Sheep	Chickens
	-------- % viable seed -------			
Field bindweed	22	6	9	0
Sweetclover	14	15	5	0
Velvetleaf	11	5	6	1
Smooth dock	4	7	7	0

Harmon and Keim (1934)

Photo: www.nrcs.usda.gov

Weed Seed Movement

1. Crop seed, grain, hay, straw, and soil
2. Wind
3. Water
4. Animals and humans
5. Machinery



Source: Steve Dewey

Weed Seed Movement

1. Crop seed, grain, hay, straw, and soil
2. Wind
3. Water
4. Animals and humans
5. Machinery

Protecting your ranch from weed invasion

- Prevention is the ALWAYS the best strategy!
  - Use weed free products
  - Clean contaminated machinery and clothing
  - Quarantine animals
- Early detection is the second best strategy
  - Monitor high risk areas
    - Roadways, waterways, areas frequented by visitors
    - Look for any unfamiliar plants
  - Control new infestations
    - Contain: Prevent seed production and spread
    - Eradicate:

Questions?

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Nutritional properties of stock piled and standing basin wildrye over time

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Abstract

Basin wildrye (*Elymus cinereus* Scribn. & Merr.) is common in the west and produces a large amount of forage. Because of the elevated growing points, it is not recommended for spring or early summer grazing but when mechanical harvesters are adjusted such that the cutting bars are mostly above the growing points this problem can be avoided. This project tested windrowed wildrye for nutritional value it had over the season. Great Basin wildrye on the UNR Gund Ranch was sampled for nutritional analysis on the first of June, and then a portion of the basin wildrye was windrowed with a swather having its cutter bar raised until it was estimated to be above most growing points. Then the first of each succeeding month, July through October the standing basin wildrye was sampled for nutritional analysis as well as the windrow. Dry matter, differed widely between the windrows and standing, with windrows being much dryer, until October when they were the same. Crude protein remained higher in the windrow throughout the test period, but decreased steadily from 12 percent in June to 4.6 percent in October in the standing crop. The ADF content was consistently lower in the windrow, in the standing crop ADF increased from June to October, representing declining energy values. Phosphorus was lower in the windrow in July, but it maintained that level and was higher in the subsequent months than the standing crop, in which phosphorus steadily decreased from July to October. Both hemicellulose and NDF/ADF remained higher in the windrow, at a consistent content, than in the standing crop, which decreased over time. NDF, nitrate-N, manganese, and sodium showed no difference between standing crop and the windrowed. Magnesium, boron and clacium decreased in the windrow as compared to the standing crop. The remaining minerals were generally higher in the windrow, including potassium, sulfur, zinc, iron and copper. Ash was about the same in the free standing as the windrow, until September and October when the ash content was lower than in the windrow. The quality of the windrowed forage was well above the standing basin wildrye, providing improved quality forage in fall and perhaps winter.

Introduction

Basin wildrye (*Elymus cinereus* Scribn. & Merr.) is common in many western states and on many ranches. It produces a large amount of forage and will grow in an 8 to 20 inch precipitation zone (USDA NRCS, 2007). Because of the elevated growing points, it is not recommended for spring or early summer grazing (USDA NRCS, 2007), but as winter or fall forage it has a greatly decreased nutrient value (Ganskopp and Bohnert, 2001). Grazing animals, unless stocking rate is light, will damage these growing points as well as traditional methods of mechanical harvest. When mechanical harvesters are adjusted such that the cutting bars are mostly above the growing points this problem can be avoided, however the high remaining stubble makes bailing and removal a problem. The forage should still have value if left in the windrow as stockpiled forage and then grazed later in the season. This project was designed to test if the stockpiled forage maintains the nutritional value it had when cut and would be a more valuable forage resource than standing basin wildrye would be later in the season.

Materials and Methods

The study area was a Great Basin wildrye stand on the Gund Ranch, operated by the University of Nevada Reno, about 65 km north of Austin, NV, near the geographic center of the state. The ranch is located in Grass Valley and the basin wildrye is located in or adjacent to several sub irrigated hay meadows.

After an appropriate basin wildrye stand was identified, treatments were applied. On the first of June, the stand basin wildrye was sampled for nutritional analysis (S06), and sample frozen until they could be delivered to the laboratory. Then a portion of the basin wildrye was windrowed with a swather having its cutter bar raised until it was estimated to be above most growing points. Then the first of each succeeding month, July (S07), August (S08), September (S09) and the last month, October (S10) the standing basin wildrye was sampled for nutritional analysis. At the same times, from the June windrow samples were taken for nutritional analysis (WS07 is July sample, WS08 is August sample, WS09 is September sample, and WS10 is October sample).

The samples were sent to Stukenholtz Laboratory, Inc (2924 Addison E, POB 353, Twin Falls, Id, 83303) for nutritional analysis including crude protein, acid detergent fiber (ADF), neutral detergent fiber (NDF), ash, dry matter, nitrate-N, phosphorus, potassium, calci8m, magnesium, sulfur, zinc, iron, copper, manganese, boron, and sodium. Hemicellulose was then calculated form ADF and NDF.

Each nutrient from all treatment groups were tested with single factor ANOVA (Microsoft Excel statistical analysis pack) for significance in difference between the treatments. When these were identified as being different between treatments, they were further studied using paired t tests (Microsoft Excel statistical analysis pack). For example, crude protein was tested in the following pairs: S07 with WS07, S08 with WS08, S09 with WS09, and S10 with WS10. This was then done for each nutrient (paired by month with windrow and standing crop).

Results and Discussion

Table 1 presents the results for some of the major nutrients. Dry matter, as expected differed widely between the windrows and standing, with windrows being much dryer, until October when they were the same. Most of the nutrients were better in the windrow all the way through October, although several were unchanged and a few lower in the windrow than in the standing biomass.

Crude protein remained higher in the windrow throughout the test period. The CP level remained consistent (but slightly higher) in the windrow with the CP content at cutting time (Table 1, Figure 2). The apparent rise in CP in the windrow over the time it was cut is most likely due other nutrients decreasing, CP in harvested forages generally decrease very slowly compared to other nutrients (Buckmaster, et al, 1989), artificially increasing the percentage. Crude protein in the standing crop decreased steadily from 12 percent in June to 4.6 percent in October. Sometime in August the CP content drops to levels that are poor for livestock.

The ADF content (Figure 3, Table 1) was consistently lower in the windrow, but since ADF is negatively correlated with energy content, this is beneficial to the stockpiled forage. In the standing crop ADF increased from June to October, representing declining energy values. Acid detergent fiber was consistent in the windrow from July to September, and then increased in October. The ADF content in the windrow is consistently lower than the ADF content of standing plants at harvest. What caused this to happen is unknown, but there could have been further respiration in the cut plants, and the changing relative values of other nutrients in the windrow.

Phosphorus (Table1) was lower in the windrow in July, but it maintained that level and was higher in the subsequent months than the standing crop. Phosphorus in the standing crop steadily decreased from July to October. It was similar in content at June and July.

Hemicellulose was calculated by subtracting ADF from NDF, and the NDF/ADF ratio by division (Table 1). Both hemicellulose and NDF/ADF remained higher in the windrow, at a consistent content, than in the standing crop, which decreased over time. Since hemicellulose is digestible for ruminants, this is an advantage for the stockpiled rye grass.

The ones that showed no difference between standing crop and the stockpiled (windrowed) were: NDF, nitrate-N, manganese, and sodium. NDF did change over time, but it changed at the same rate in both the windrow and standing crop ($P < 0.01$, Fig. 1, Table 2). Much of this change is likely due to the fluctuations of other nutrients, rather than real differences in content. Nitrate-N, manganese, and sodium showed no change either over time, or with being windrowed or stockpiled (Table 2).

Three elements decreased in the windrow as compared to the standing crop (Table 2). Magnesium was lower in the windrow until October when the standing crop dropped to the same level. Magnesium remained at a consistent level in the windrow, while the standing crop decreased steadily over time. Boron was lower in the windrow compared to standing crop as well. Only in July and October were the differences significant. In both the windrow and standing crop boron dropped over time. Calcium was lower in the windrow than the standing crop and changed little over time until October. The calcium in the standing crop decreased steadily over time, but still remained higher than the windrow even through October.

The remaining minerals were generally higher in the windrow. Ash (Table 3) was about the same in the free standing as the windrow, until September and October when the ash content was lower than in the windrow. This probably due to the free standing plants leeching more nutrients than the windrow, changing relative percentages because of fewer nutrients in the free standing crop. Potassium (Table 3) was always lower in the free standing crop than in the windrow. Potassium in the free standing plants decreased over time, whereas it held steady in the windrow until October when it dropped, but still remained higher than in free standing plants. Sulfur (Table 3) remained nearly the same in both the windrow and free standing plants, with the exception of September when the windrow had a higher content. Zinc, iron and copper (Table 3) were all higher in the windrow than in the standing plants. All of these minerals decreased with time in the standing wildrye, and remained consistent in the windrowed crop.

Implications

The quality of the forage was well above the standing basin wildrye. Windrowing provides an opportunity for improved access to quality forage in fall and perhaps winter. Work still remains to determine cost effectiveness and if repeated mowing will cause any stress to the basin wildrye.

References

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USDA NRCS. 2007. Plant Guide: Basin Wildrye. http://plant-materials.nrcs.usda.gov.

Buckmaster, D. R., C. A. Rotz, and D. R. Mertens. 1989. A model of alfalfa hay storage. Trans. of the ASE. 32(1)30-36.

Table 1. Principle nutrients and their change over time for freestanding and windrowed basin wildrye.

	Nutrient[1]					
Sample[2]	DM	CP	ADF	Hemicellulose	P	NDF/ADF ratio
S06	52.9±9.1	12.0±1.5	41.7±2.3	28.3±0.34	0.31±0.04	1.7±0.1
S07	32.9±3.7[a]	11.3±1.8	43.8±1.4[a]	20.9±1.4	0.30±0.02[a]	1.5±0.0[a]
WS07	90.0±1.3[b]	12.4±1.7	36.4±2.6[b]	26.9±3.7	0.24±0.02[b]	1.7±0.2[b]
S08	36.2±2.0[a]	9.8±1.7[a]	43.1±2.2[a]	19.0±1.9	0.20±0.03[a]	1.4±0.0[a]
WS08	68.3±15.0[b]	14.3±1.6[b]	37.4±4.4[b]	26.7±4.3	0.29±0.06[b]	1.7±0.0[b]
S09	44.8±1.7[a]	6.2±0.7[a]	47.9±3.2[a]	16.4±4.2[a]	0.16±0.05[a]	1.3±0.1[a]
WS09	90.2±1.6[b]	15.2±1.4[b]	35.9±2.5[b]	27.6±2.9[b]	0.26±0.05[b]	1.8±0.1[b]
S10	89.6±0.9	4.6±0.8[a]	52.5±2.8[a]	18.2±3.9[a]	0.10±0.02[a]	1.4±0.1[a]
WS10	89.4±0.6	13.4±2.1[b]	44.1±1.8[b]	27.7±2.5[b]	0.17±0.02[b]	1.6±0.1[b]

[1]DM is dry matter, %; CP is crude protein, % dry matter basis (dmb); ADF is acid detergent fiber, % dmb; Hemicellulose (calculated as neutral detergent fiber-ADF) in % dmb; P is phosphorus, % dmb and NDF (neutral detergent fiber)/ADF ratio is NDF divided by ADF. Means in paired rows by column are different at $P<0.01$ if superscript letters are not the same.
[2]S06 is sampled growing first of June; S07 is sampled growing first of July; S08 is sampled growing first of August; S09 is sampled growing first of September; S10 is sampled growing first of October; WS07 is sampled in July from a June windrow; WS08 is sampled in August from a June windrow; WS09 is sampled in September from a June windrow; and WS10 is sampled in October from a June windrow.

Table 2. Nutrients that did not change over time for freestanding and windrowed basin wildrye or that decreased in the windrow over time.

Sample[2]	Nutrient[1]						
	NDF	Nitrate-N	Manganese	Sodium	Magnesium	Boron	Calcium
S06	70.1±3.4	231±173	125±146	0.060±0.029	0.10±0.09	16±7	0.28±0.03
S07	64.8±1.3	75±53	50±12	0.031±0.004	0.17±0.13[a]	31±15[a]	0.37±0.09[a]
WS07	63.3±1.8	135±62	43±4	0.040±0.004	0.07±0.08[b]	13±3[b]	0.25±0.01[b]
S08	62.1±3.1	53±28	39±8	0.095±0.126	0.12±0.11[a]	23±6	0.36±0.04[a]
WS08	64.0±7.8	274±330	51±9	0.074±0.030	0.07±0.08[b]	18±8	0.29±0.06[b]
S09	64.4±6.7	81±59	52±10	0.071±0.015	0.10±0.12[a]	27±15	0.43±0.08[a]
WS09	63.4±2.8	84±56	51±15	0.088±0.049	0.07±0.07[b]	19±5	0.25±0.02[b]
S10	70.7±1.5	93±60	33±6	0.025±0.005	0.06±0.06	15±5[a]	0.31±0.01[a]
WS10	71.7±2.0	84±24	36±9	0.031±0.011	0.06±0.06	9±2[b]	0.26±0.03[b]

[1]NDF is neutral detergent fiber, %; Nitrate-N is in ppm; Manganese is in ppm; Sodium is in %; Magnesium is in %; Boron is in ppm; and Calcium is in percent. Means in paired rows by column are different at $P<0.01$ if superscript letters are not the same.
[2]S06 is sampled growing first of June; S07 is sampled growing first of July; S08 is sampled growing first of August; S09 is sampled growing first of September; S10 is sampled growing first of October; WS07 is sampled in July from a June windrow; WS08 is sampled in August from a June windrow; WS09 is sampled in September from a June windrow; and WS10 is sampled in October from a June windrow.

Table 3. Some mineral nutrients and their change over time for freestanding and windrowed basin wildrye.

Sample[2]	Nutrient[1]					
	Ash	Potassium	Sulfur	Zinc	Iron	Copper
S06	9.8±0.03	4.02±0.46	0.12±0.02	23±6	106±7	6±1
S07	11.1±1.2	2.61±0.57[a]	0.10±0.01	16±4	92±24	4±0
WS07	9.8±0.8	3.42±0.20[b]	0.9±0.02	14±2	85±12	5±1
S08	12.7±0.9	2.62±0.21[a]	0.07±0.03	6±3[a]	82±5[a]	3±1[a]
WS08	11.4±3.5	4.11±0.78[b]	0.10±0.03	17±3[b]	108±10[b]	5±0[b]
S09	14.7±2.4[a]	2.83±0.30[a]	0.05±0.01[a]	6±2[a]	88±5[a]	4±1[a]
WS09	8.7±0.8[b]	3.21±0.47[b]	0.10±0.02[b]	20±5[b]	119±8[b]	5±1[b]
S10	10.5±1.4[a]	0.49±0.12[a]	0.08±0.01	6±1[a]	86±8[a]	3±1 [a]
WS10	6.0±1.4[b]	1.39±0.58[b]	0.04±0.01	14±3[b]	109±11[b]	4±1[b]

[1]Ash is in % dry matter basis (dmb); Potassium is in % dmb; Sulfur is in % dmb; Zinc is in ppm; Iron is in ppm, and Copper is in ppm. Means in paired rows by column are different at $P<0.01$ if superscript letters are not the same.
[2]S06 is sampled growing first of June; S07 is sampled growing first of July; S08 is sampled growing first of August; S09 is sampled growing first of September; S10 is sampled growing first of October; WS07 is sampled in July from a June windrow; WS08 is sampled in August from a June windrow; WS09 is sampled in September from a June windrow; and WS10 is sampled in October from a June windrow.

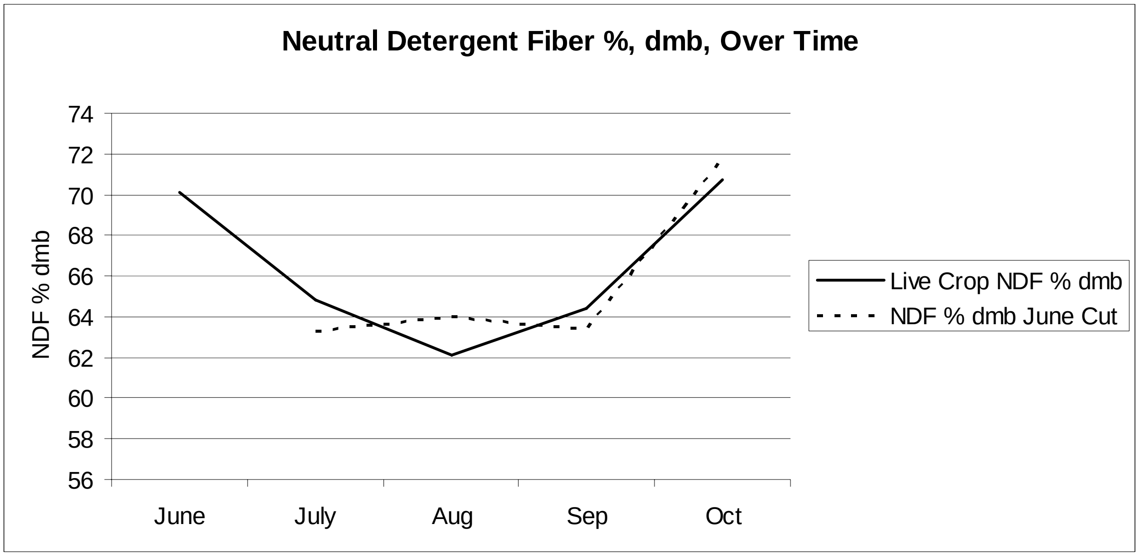

Figure 1. The change in NDF (neutral detergent fiber) content for basin wildrye over time.

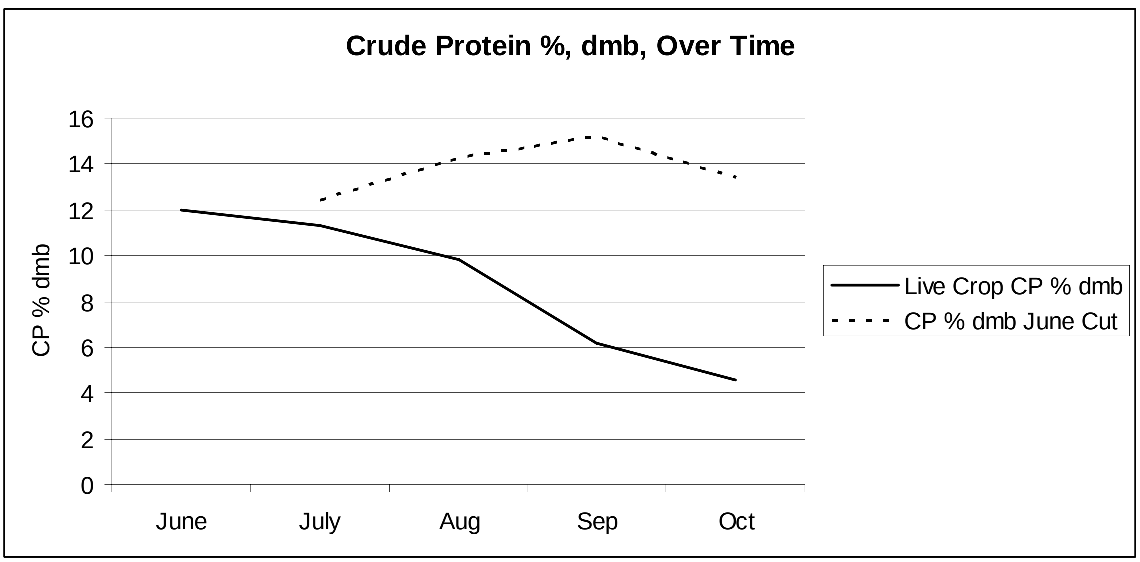

Figure 2. The change in crude protein content for basin wildrye over time.

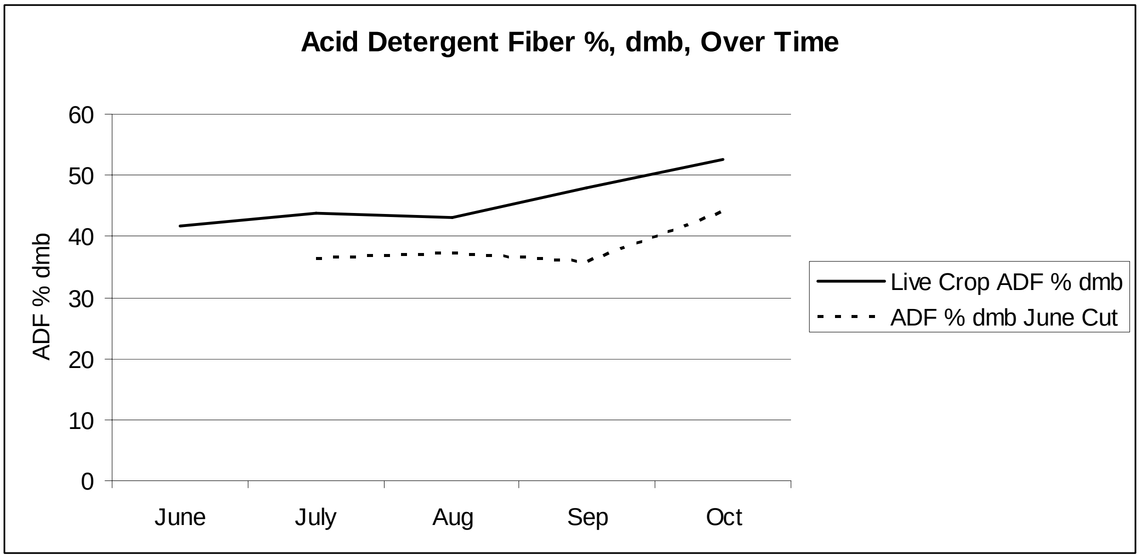

Figure 3. The change in acid detergent fiber content for basin wildrye over time.

DNA Paternity Identification and Intra-herd EPDs in Free Range Beef Cattle

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Introduction

DNA-technologies allow for paternity testing. A DNA marker is a sequence of DNA (containing hereditary information) that tested in parents and offspring can be used to trace inheritance. Cattle, as humans, have two sets of homologous chromosomes. In each set, and for each marker there are two variants or alleles of the genes at a DNA marker. Paternity is rejected if the offspring did not have at least one of the two genes of the bull. Therefore, a bull can be rejected for paternity of a given calf with 100% confidence. However, paternity identification can not be 100% accepted unless we rule out other bulls in the herd. We normally say that genotypes of a given bull match the genotype of a calf. The more markers we use and match bull and calf genotypes, the closer we are to identify the bull as the sire of the calf.

Free range commercial beef cattle operations normally have no control of paternity of their calves. DNA paternity identification in free range beef cattle allows:

1) Identification of bulls producing very little or no progeny.
2) Estimation of Expected Progeny Differences (EPD) intra-herd for weaning weights.
3) Evaluation of performance of different bull sire breeds for crosses in commercial conditions

Objectives

The objective of this study was to test DNA paternity identification in a free range beef cattle herd. A second objective was to estimate EPDs for weaning weights in this herd.

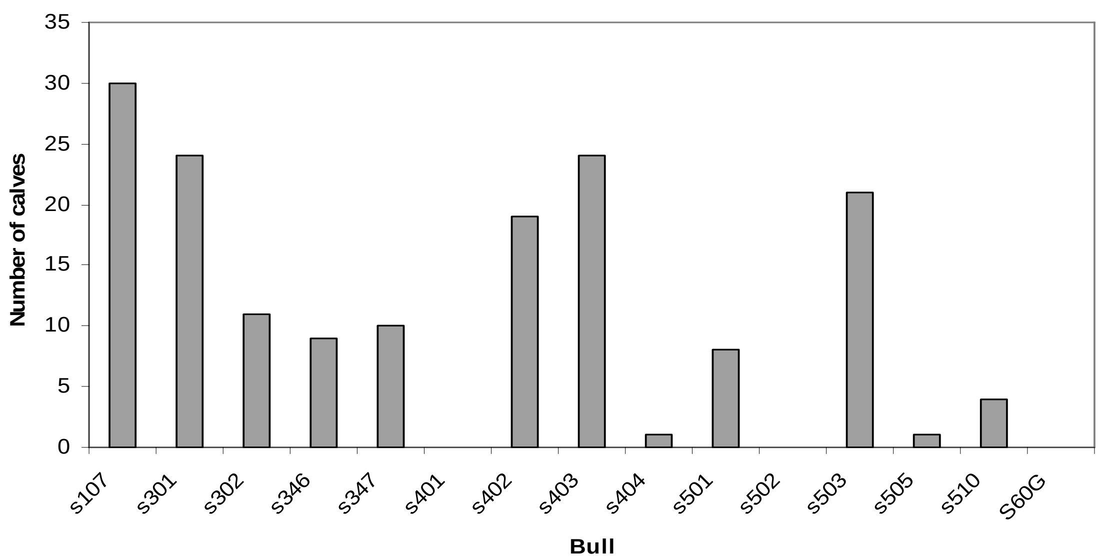

Figure 1. Number of progeny per each of the 15 bulls at a beef cattle ranch.

Markers. The following DNA markers (microsatellites) were used to estimate calves' paternity: BMS1244, BMS20055, BMS410, LSTS081, TGLA227, BMS1634, BMS1789, BMS2573, BMS499, BMS601, BMS1226, BMS1315, BMS650, and ILSTS058.

Animals. Ear notches samples where taken at the ranch from 15 bulls and 292 calves.

Results and Discussion: The distribution of the calves for each of the 15 bulls is given in Figure 1. We were able to identify paternity of 162 calves but for 8 of them, we could not discriminate between two bulls. There were a few bulls with no offspring in the herd. Possible explanations are that bulls are not fertile, homosexual or more likely that there are dominant relationship among bulls. There were a relative large number of calves, (~130) whose paternity was rejected with the 15 bulls at the free range ranch. The most likely reason is that they are calves from four bulls that were culled before sample collection was taken.

The next step was to estimate EPDs for weaning weights for the bulls in the herd (Figure 2). Calves whose paternity was not identified were pooled as a progeny from bull "Phantom". There are differences in the average performance of progeny from different bulls at the ranch.

DNA paternity identification can be used to improve breeding and production of free range beef cattle ranches.

Conclusions

1) DNA Paternity identification is possible in free range beef cattle.
2) We identified bulls with no progeny in the herd (costing to keep them but with no production).
3) There were up to 22 pounds difference in EPDs at weaning for progeny from two different bulls.

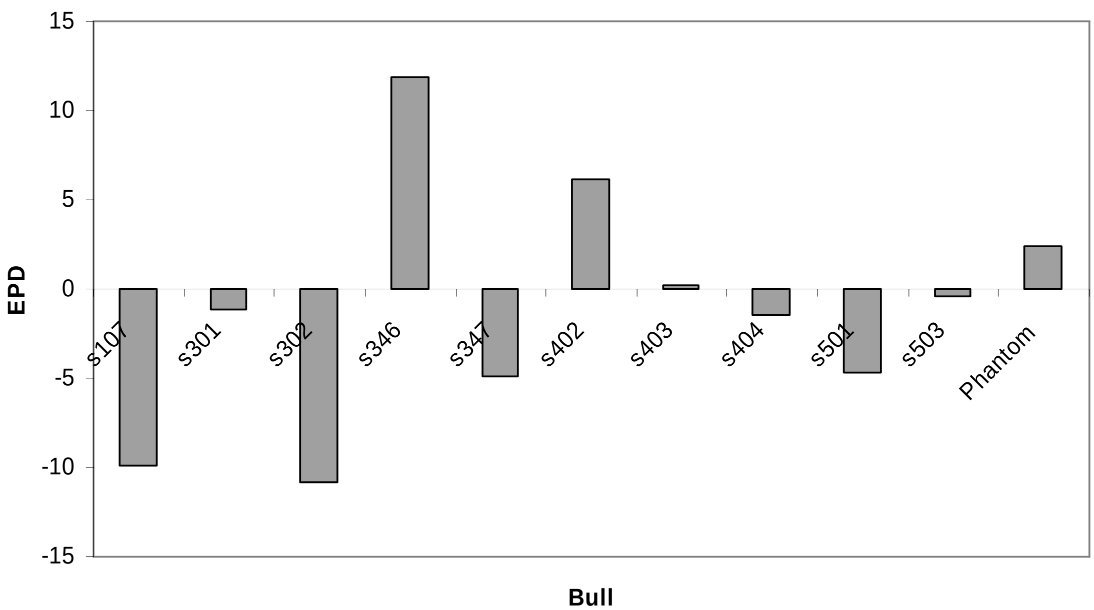

Figure 2. EPDs (in pounds) for weaning weights for bulls at the ranch.

Drought, Plant Growth and Grazing

Brad Schultz, University of Nevada Cooperative Extension, Extension Educator
Kent McAdoo, University of Nevada Cooperative Extension, Natural Resources Specialist
Ron Torell, University of Nevada Cooperative Extension, Livestock Specialist

A quick look at accumulated precipitation from October 1, 2006 through May 16, 2007 shows most river basins with below to well below average precipitation. Decades of research reveals that drought means less forage. Less total forage production, however, is only a part of the plant-animal relationship producers must understand to have productive rangelands when precipitation returns. Successful grazing management requires understanding relationships among precipitation, soil-water availability, plant growth and energy storage, and grazing.
The arid Intermountain West largely receives its precipitation during the winter. Cold temperatures and dormant plants allow much of the precipitation to infiltrate deep into the soil profile, where it becomes available for plant growth later in the growing season after shallow soil moisture is depleted. Deep soil moisture provides for longer growing periods, but winter drought usually means little if any deep soil moisture is present. Less water stored in the winter equals less forage production, regardless of spring precipitation. Spring precipitation benefits plant growth, but seldom (if ever) is sufficient to fully recharge the soil profile. Unless abundant spring rains continue through May and June, when plants typically use the deep soil moisture, the growing season will be shorter than usual and plant size smaller.

Established perennial grass plants are composed of individual growth units called tillers. Each tiller typically has three to seven leaves. It can but does not always become reproductive and produce a seed head. Reduced forage biomass during drought typically results from the production of fewer and/or smaller leaves. Long, intense drought may result in the die-back of individual tillers and eventually entire plants. How plants are grazed during drought influences tiller survival, and therefore, the amount of forage production after the drought breaks. Managing grazing during drought requires an understanding about how grasses grow, the location and role of stored energy for future growth, and how grazing can influence plant growth and energy storage.

Plant growth is the interaction of producing new cells and increasing their size. Less soil moisture typically shortens the period for growth; thus, fewer and smaller cells are produced. All cells for grass growth come from four microscopic locations on the plant. These are: the base of the leaf blade, where it bends away from the central stem (culm); the base of the leaf sheath at the culms node; the tillers terminal growth point (it becomes the seed head); and axillary buds on the tiller where the leaf sheath attaches to the culm. When growth begins in the early spring, all of these growing points are at ground level. This largely prevents grazers from removing them. Some perennial grasses elevate their growing points several inches or more above ground level early in their vegetative growth period, while others elevate them only when seed heads are produced, which typically is late in the growth period. Elevation of the growing points several inches or more leaves them susceptible to removal by grazing. Both immediate forage production and long-term tiller survival (future forage production) are affected by a complex interaction between the specific growing points that grazing removes, the phase of the plant's growth cycle when it is grazed, and its ability to regrow after grazing.

Grazing that removes leaf blades above their growing point allows the leaf and plant (remember the roots) to continue growth. But removing the leaf blade's growing point stops all of its growth. Additional forage production only occurs if the tiller produces a new leaf from its terminal growing point. Regrowth from the terminal growing point takes much longer than regrowth from the base of leaf blade and it can consume stored energy the plant needs to initiate growth after dormancy the following year. When grazing removes the entire leaf blade and the terminal growing point, that tiller can no longer produce any leaves. Additional forage production only occurs if an axillary bud at the base of the tiller grows into a new tiller. Regrowth from basal buds takes the longest and uses the most stored energy. During dry years, if grazing removes all growing points but the basal bud, the subsequent long regrowth period combined with a shorter growing season results in little if any chance for an entirely new tiller to grow, Stored energy for future use is likely to decline and potentially affect long-term plant health. Obviously, managing grazing to maintain growing points at the base of the leaf blade benefits the plant and long-term forage production.

Grass plants are similar to cows. Both require stored energy reserves to be productive the following spring. For the cow, stored energy is essential for lactation and rebreeding. For a perennial grass plant, stored energy ensures its very survival. The grass plant's leaves photosynthesize and produce carbohydrates. Most of the carbohydrates are used to produce leaves, stems and roots; but a small amount becomes stored energy, called non-structural carbohydrates. Non-structural carbohydrates are stored in the plants axillary buds, root crowns and roots, and they perform two important roles critical to a plant's survival (i.e., sustained forage production). First, perennial grasses typically are dormant for 6 to 9 months. Buds on dormant plants develop into the new leaves and roots the following spring. These buds must respire throughout dormancy, and their respiration uses energy. The energy for respiration comes from soluble carbohydrates stored the previous year. Second, if the bud survives the winter it must use additional stored energy to produce the first 2 or 3 green leaves on a tiller. Inadequate stored energy for either process results in death of the bud and tiller and less forage. Only after the tiller produces 2 to 3 leaves is leaf area sufficient for photosynthesis to produce enough carbohydrates to meet the plants needs for both growth (leaves for forage) and stored energy, for the coming dormant period.

During drought, plant leaves are typically shorter than during wet years, and/or the growing season ends earlier. Stocking rates set to achieve 50% utilization during average to wet years are going to have a much higher utilization level during drought. Also, the shorter growing season provides less time for grazed plants to regrow their leaf area and store energy for the coming dormant period. Finally, the dormant period is likely to be longer than usual, particularly if fall green-up does not occur or is too short to store many carbohydrates. Buds without adequate energy reserves to meet respiration and initial growth needs will die, decreasing the number of tillers present and ultimately forage production. Significantly less forage eventually equals fewer livestock.

Plants that have been well managed typically can withstand initial drought conditions relatively well. Grazing an allotment or pasture the same way during a drought year as during non-drought years puts additional stress on the plants. This stress is additive on top of the effect of poor growing conditions. When drought is short the plants are likely to recover relatively well the following growing season. Problems occur when grazing management early in a drought decreases the plants ability to withstand the stress created by a prolonged drought. Grazing management should be adjusted annually not only to address the conditions of the current year, but to prevent plants from having to enter a second year of drought in a dramatically weaker condition (e.g, less stored energy, smaller roots and tiller die-back). How we graze this year affects the plant's ability to cope with growing conditions and grazing next year. Long-term successful grazing management cannot occur if our approach focuses only on today and ignores tomorrow; grazing the same place the same way every year creates problems. Our forage plants will treat us well if we fully consider their needs and adapt our management to meet those needs. Obviously, the interaction of plant growth and grazing is much more complex than can be presented in one short article. Numerous universities and their Cooperative Extension programs conduct Range Management Schools that address this issue in more detail. The authors strongly recommend that you attend one of these education programs if they occur in your area.

Paper in Progressive Rancher, Nevada Rancher, Farm Bureau Journal and similar Trade Journals, Early Summer 2007

Back to Basics:

Drought Induced Early Weaning?

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As range or pasture plants mature their nutritive quality declines, eventually resulting in less than optimum livestock production. Research at the Squaw Butte Experiment Station in Oregon indicates vegetation on northern Great Basin desert ranges, in a normal precipitation year, typically reaches maturity in mid-July. During drought the period of active plant growth usually is shortened and the quantity of vegetation produced is reduced. An individual plant's maturation date will vary with the year, temperature, rainfall, soil, elevation, aspect, etc.; however, it is well established that with maturation both the digestibility and protein content decline. Regardless of the calendar date, the decline in forage quality begins at the boot stage for grass plants and the bud stage for broad leaved forbs. Vegetation on more arid sites will mature earlier. On high elevation, wetter sites, maturity comes later. After the boot and bud growth stages are reached, which usually is earlier in drought years, it is difficult for a lactating cow to consume sufficient nutrients to maintain her calf, herself, and her own body condition.

The current drought condition on western rangelands requires active monitoring of both land and cattle and using that data to adjust management options to sustain and/or enhance both the land and livestock. Time of weaning can be altered to improve the cow's body condition to maintain high reproductive rates and reduce winter feed requirements. When cows nurse their calves for either a longer or shorter period than is traditional, there is a corresponding decrease or increase in their body condition. Lactating cows that are declining in body condition often have calves that grow at a reduced level or not at all. Changing either the calving date and/or the weaning date can benefit the cow's condition. Any change in time of weaning must balance the potential positive impacts on the cows with potential negative impacts on the calves or calf market weights.

A Nevada study (Conley et al., 1995) showed time of weaning dramatically influences heifer body condition. One hundred first calf heifers were weaned at either 150 days (EW: July 1) or 205 days (LW). When the LW group was weaned (September 2), 77% of heifers from the EW group had BCS of 4+ to 5, compared to 29% of heifers from the LW group Little change in BCS was seen 1 month later (October 8) 1992, at gathering. After feeding on alfalfa aftermath for almost 2 months (November 23), heifers from the EW group still had better body condition. This clearly demonstrates the advantage of maintaining the body condition of heifers, compared with trying to improve body condition once it has been lost.

After adjusting to a 205-day weaning date, the average weight of calves from the EW group was 401 lb. compared with 421 lb. for LW calves. Feed and forage costs were calculated for the period from October 1 to September 1 for both the EW and LW groups. Early weaned claves cost an additional $15.50 per head due to pasture and supplemented feed costs from July 1 to September 1. The 20-lb. weight disadvantage for EW calves cost an additional $20 (20 lb. @ $1.00/lb.); thus, the total cost for EW calves over LW calves was $35.50. The complete picture, however, requires understanding the cost to bring heifers from the LW group up to a body condition comparable to the EW heifers. This cost is $100/head due to increased supplemental feed (one ton of alfalfa hay/head @ $100). Increased costs associated with early weaning can easily be offset by substantially higher costs to improve the body condition of heifers.

The specific result of an early weaning program will depend upon quality and quantity of available forage and body condition of the cows. In drought years, weaning calves during or soon after the breeding is an accepted practice for stretching a limited forage supply. Research in Ohio (Peterson et al., 1987) found dams from early weaned fall-born calves (110 vs. 222 days of age) had hay consumption 45.3 percent less than cows with normal weaned calves. When TDN consumption for both the cow and the calf was compared, early weaned cow/calf pairs consumed 20.4 percent less TDN than normal weaned cow/calf pairs. Work in Oklahoma (Purvis et al., 1995) indicates that cows consume about 1 percent less of their body weight after early weaning.

Precipitation, market and management circumstances often change from year to year. Implementation of a variable weaning system may confer multiple benefits to a rancher. These include: 1) better herd and land management when drought occurs, 2) a better match between cow condition and the quality of the available feed supply, 3) minimizing the purchase of “off ranch” inputs, and 4) meet certain markets for the calves.

There are, however, limitations and challenges to adopting a variable weaning approach. Time of weaning may vary considerably from one year to the next. It is important to plan well. Factors such as marketing at different times each year, adjusting stocking rates to utilize grazing after calves are weaned, or stretching grazing if calves remain with cows beyond typical weaning time must be addressed.

Several options are available to cattle producers to use time of weaning as a management tool to manipulate cow body condition. Advantages of early weaning are greater in young cows, especially first-calf heifers, than in mature cows. To maintain any advantages to early weaning, the calf must receive adequate post weaning nutrition and care.

Forage quantity and quality on western US rangelands and pastures vary tremendously, both within and between years. When forage quantity and quality are favorable, cows may gain weight late in lactation. Also, in some cases, calves may continue growing. The relative performance of the animals, however, depends upon lactation demands, forage conditions, and forage management. If a herd analysis shows low reproductive rates and low condition scores at weaning, altering the weaning date is one option for cows that are too thin going into the winter. The cost of maintaining the cow and calf, however, needs to be part of the equation. In some cases changes in forage management to improve forage quality may be the appropriate option. Every operation is different and a one-size-all approach will not be successful at every place. The best solution must consider the strengths (opportunities), weaknesses, and constraints specific to each operation.

The ecology of a western bovine disease: Epizootic Bovine Abortion (EBA), current findings on the distribution of "Foothill Abortion"

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Since its identification over 50 years ago, epizootic bovine abortion (EBA) has been identified as a cause of late term abortions in beef cattle herds in Nevada, Oregon, southern Idaho and in many regions of California. In Nevada, abortions due to EBA have been diagnosed in beef cattle herds in the northern half of the state and along its western border with California. The disease is transmitted through the bite of an infected soft tick *Ornithodoros coriaceus*, commonly referred to as the pajahuello tick. The presence of pajahuello ticks in an area cattle are grazing is a necessary component for transmission of EBA and the disease is known to cause of large-scale abortions in beef cattle herds grazed in tick endemic region with losses of 50 to 60% of a calf crop in a susceptible herd commonly reported.

Epizootic bovine abortion is often referred to as "Foothill Abortion", the name reflecting the disease's original description as a problem in beef cattle grazed in the foothills of the Sierra Nevada and coastal mountain ranges surrounding the Central Valley of California. Since abortions due to this disease were first observed, EBA has been diagnosed in beef cattle herds throughout the mountainous regions of northern California. In the decades that followed its original description, the distribution of EBA cases has seemed to expand beyond the borders of California into southern Oregon, southern Idaho and regions of Nevada where it had not been recognized previously. Possible explanations for the apparent spread of this disease include: the introduction of EBA into new regions where the pajahuello ticks are already present through the movement of infected animals or introduction of EBA infected ticks into habitats where they were not previously found.

An important consideration to bear in mind is that awareness of this disease and our ability to diagnose it has improved significantly since it was originally recognized as a cause of reduced productivity in western beef cattle herds. This said, the distribution of the disease has seemed to expand in the affected states and after conversations with experienced cattlemen and veterinarians we have begun to become increasing convinced that this is not solely a result of increased detection efforts.

Current research efforts at the University of Nevada, Reno are aimed at measuring the distribution of the soft tick vector, a key determinate for the presence of EBA. By extension we can assess the degree of movement of the pathogen the tick carries. Knowledge of the life cycle of the pajahuello tick is important in understanding how these parasites play a role in the dissemination of EBA. Unlike the familiar ticks people see attached to their pets or livestock, soft ticks such as *O. coriaceus* feed rapidly and usually engorge themselves completely within an hour and leave the host. Therefore, these ticks are not commonly seen attached to the animals they prefer to feed upon. This is true for all life stages of the pajahuello tick except its larval form. These tiny ticks, which have just emerged from their eggs, will feed and remain attached for up to two weeks. Because the larvae can stay attached for a lengthy period, tick movement through an animal host may play an important role in its distribution, especially if the ticks are attached to a large animal host such as cattle or deer. Tick movement on the host may have an even more significant effect on its distribution when the ability to move tick infested cattle quickly across long distances by trucking is taken into consideration.

To measure tick movement over a large geographic area we are using molecular techniques in order to identify whether genetic material is being exchanged between tick populations. This technique is very similar to methods of DNA “fingerprinting” used to determine relatedness in human beings and is known as microsatellite analysis. Microsatellites are repeating sequences of DNA unique to individuals or populations. We have identified microsatellites unique to given populations of ticks in California and Nevada and have begun to look for similarities between the populations that indicate ticks are being moved from one geographic area to another. Pajahuello ticks were collected at sites along the eastern slope of the Sierra Nevada Mountains from southern Nevada to the northern California border. The collection sites where separated by large geographic distances, an average of 60 miles between sites, making movement of ticks by themselves or on small animals highly unlikely. Our preliminary findings indicate that ticks from sites in California are exchanging genetic material with ticks in Nevada revealing movement of the ticks over large areas.

Our efforts are now aimed at expanding the number of collection sites to include other areas of California, northern Nevada and southern Oregon to determine the scale of genetic exchange and the manner by which this may be occurring between tick populations. We plan to compare sites where the genetic exchange between ticks is high with wildlife movement patterns, distance to roads, land use patterns and the prevalence of EBA infected ticks. If cattle do appear to play a role in the introduction of ticks into new geographic areas it is most likely as a host for the larval stage of the tick, the stage that remains attached long enough to be carried into new habitats. The use of long lasting anti-parasitic medications, such as Doramectin, prior to shipment of animals may help reduce the potential to spread the tick vector (and the EBA pathogen) by killing the larval stages of the parasite. Current research at UNR’s Agricultural Research Station is aimed at the development of an effective vaccine to protect cattle against EBA but in its absence, today’s ranchers have few options for controlling EBA outbreaks in their herds. Current management strategies available to ranchers include:

- Exposing heifers who have reached puberty to EBA endemic areas prior to the breeding season to develop immunity.
- Turn out heifers and cows to EBA endemic areas AFTER calving.
- Retain heifers or cows that have had an EBA abortion as they are more likely to have some immunity.
- Buy replacement heifers from known EBA endemic areas as this increases the possibility that they have been previously exposed and may still retain a degree of immunity.

Please feel free to contact us if you have questions regarding EBA in Nevada or our research program at: Mike Teglas, mteglas@cabnr.unr.edu 775-784-1002

Body weight loss and estimated grazing intake in free range sheep and cattle

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Introduction

The efficiency of animals transforming food into meat or product is a key element in the economic return of farm operations. In extensive production systems, (seasonally) animals are raised out on the rangelands and feed is gathered by grazing. This is a practice in many parts of the world for sheep, goats, beef cattle and occasionally pigs. Livestock grazing reduces production costs because animals do not need to be fed. However, grazing animals may mobilize large amounts of body tissue in periods of undernutrition during droughts or in the winter.

Sheep have a greater ability to graze selectively than do cattle or horses. Also within species there is variation in the ability to graze selectively. Selection for within-species variation in grazing ability may offer the opportunity to breed for range animals with an increased grazing intake and better adaptation to poor quality rangelands, resulting in healthier animals and improved production. However, feed intake is difficult to record in animals under free range conditions without the use of sophisticated methods. Some researchers investigated grazing behavior as a way of understanding grazing patterns. Others investigated pasture intake by means of fecal markers. These methods are time consuming and expensive and therefore unlikely to be used as a selection criterion in practical breeding. An alternative method is to evaluate changes in body weight of animals after a period of grazing on the rangelands, as those animals that are able to eat more will gain more or loose less body weight.

An example in Rafter 7 range sheep

Animals A Rafter 7 Merino flock was initiated in Nevada (USA) in 1990. Rambouillet ewes were artificially mated with imported semen from Australian Merino rams. The breeding objective was to develop a purebred Merino flock with Australian genetics that would be adapted to the rangeland environment of the western United States. A grade-up program ($\frac{1}{2}$, $\frac{3}{4}$, $\frac{7}{8}$, $\frac{15}{16}$ and higher Merino breeding) was implemented utilizing semen and imported rams. Early in the breeding program, the Rafter 7 Merino line was developed, which is approximately $\frac{5}{8}$ Merino and $\frac{3}{8}$ Rambouillet and has been a closed line for almost 10 years. The ranch includes approximately 3400 acres of private property plus grazing permits on approximately 89,500 acres of land. Management procedures are extensively described by Rauw et al. (2007). Data were available on 455 Rafter 7 Merino ewes, 163 $\frac{7}{8}$ Merino × $\frac{1}{8}$ Rambouillet ewes, and 297 fullblood Merino ewes from 50 sires. About 150 animals were artificially inseminated and all others were flock mated in groups of about 50 to 75 ewes per ram. Animals were weighed in 2005 before going to the rangeland at the beginning of January (BW_{Jan05}) and right after returning from the rangelands in the middle of March ($BW_{March05}$). Lambs were born between 28 and 71 days after the second weighing. A total of 471 ewes gave birth to a single lamb, 246 ewes to a twin and 10 ewes to a triplet; 188 ewes did not give birth.

Factors affecting body weight changes during grazing Body weight changed from 139.2 lbs before their release to the rangeland to 125.0 lbs when they returned. Of all animals, 93.6% lost body weight during the grazing period, 5.4% gained body weight, and 1.0% neither gained nor lost body weight. Two and three year old ewes lost less body weight than older ewes (Figure 1), and non-pregnant ewes lost considerable more body weight during the grazing period than pregnant ewes. Also, the closer the animals were to lambing at the second weighing, and thus the longer time pregnant during the grazing period, the less body weight they lost (about 0.17 lbs per day). These results suggest that younger ewes over older ewes, pregnant ewes over non-pregnant ewes, and ewes pregnant for a longer time than ewes pregnant for a shorter time ingested more food by grazing.

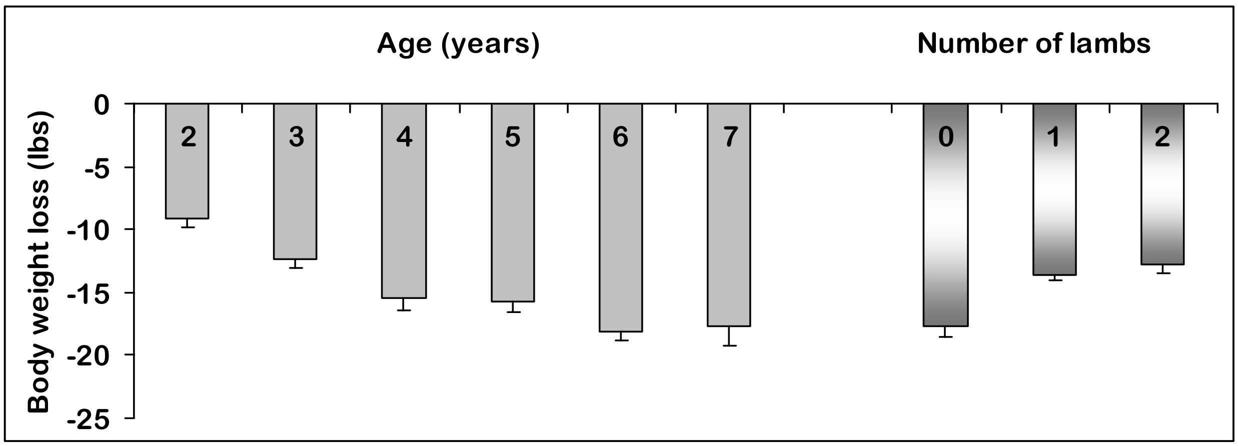

Figure 1. The effect of age and number of lambs on body weight loss in the Rafter 7 flock during the grazing period between January and March 2005

Estimated grazing intake Grazing intake can be estimated from changes in body weight with the following model: $EGI = (b_1 \times BW^{0.75}) + (b_2 \times BWG) + (b_3 \times PROD)$, were EGI is the estimated grazing intake, $BW^{0.75}$ is the average metabolic body weight, BWG is body weight gain, PROD is the average production of the individual (milk, wool, pregnancy, etc), and $b_{1,}$ b_2 and b_3 is the metabolizable energy needed for one unit of metabolic body weight, BWG and product, respectively. Thus, EGI is a calculation of the amount of resources the individual animal acquires from grazing based on the amount of energy that the animal needs for maintenance of its body size (weight), growth (or body weight loss) and production/reproduction. Since the b-values cannot be estimated in the field, estimates from literature can be used, or better, estimates from controlled experiments on a sub-group originating from the animal population of interest. This work is currently in progress. EGI presents an estimate of the individual ability to graze at resource limiting rangelands. Recording of body weight once before and once after a period of grazing is little time consuming and of low cost.

Discussion

Although the importance of grazing efficiency has been recognized, no practical method is available to record feed intake in grazing animals today, and therefore, grazing efficiency is not considered a trait that can be selected for. However, animals that are better grazers, will loose less body weight under suboptimal resource conditions and with an appropriate model the amount of food ingested during the grazing period by an individual can be estimated from body weight and body weight change. Preliminary results indicate that both traits are heritable and can thus be used in a selection program. Both traits are closely related and are both an estimate of the individual ability to graze at resource limiting rangelands. However, as estimated grazing intake is expressed in metabolizable energy consumed units, estimated grazing intake can be compared not only between animals sharing a given environment but also between animals living in different environments or even between different species living in the same environment. Selection for estimated grazing intake would foremost result in healthier animals that can produce offspring without compromising welfare of their own and that of their offspring. Secondly, improved estimated grazing intake may aid in rangeland management and is a tool that can be used in determining the grazing load or potential of different ruminant species in different ecosystems. Further research will be devoted to optimize the estimated grazing intake model, implement estimated grazing intake in a breeding goal and estimate the phenotypic and genetic relationships between estimated grazing intake and other production traits.

Rauw, W.M., Glimp, H.A., Jesko, W., Gomez-Raya, L., 2007. Weaning weights in a range purebred Merino and crossbred Merino × Rambouillet flock. Sheep and Goat Research Journal 22:1-6.

Food Safety: Prevalence and Pre-Harvest Control of Shiga Toxin-Producing *Escherichia coli* in Range Cattle

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Introduction

The safety concerns with beef began with the first two reported outbreaks of human illnesses in 1982 (Riley et al., 1983). Worldwide, the number of outbreaks and sporadic cases of Shiga toxin-producing *Escherichia coli* (**STEC**) infections due to consumption of contaminated beef (CDC, 2003) has been on the rise. The human illnesses (Griffin and Tauxe, 1991; Paton and Paton, 2000) range from mild or bloody diarrhea to the life-threatening hemolytic uremic syndrome (**HUS**) and in some cases to death of individuals with compromised immune functions. The increased number of outbreaks and the severity of human illnesses continue to emphasize the role of beef as an important vehicle of STEC transmission.

Because beef cattle harbor a wide range of STEC serotypes at high rates, they are considered reservoirs of these foodborne pathogens (Hussein and Bollinger, 2005). Under the range conditions (Hussein and Bollinger, 2005), prevalence of *E. coli* O157 ranged from 0.9 to 6.9% whereas prevalence of non-O157 STEC ranged from 4.7 to 44.8%. Of the large number of STEC serotypes isolated from grazing beef cattle (Hussein and Bollinger, 2005), 22 serotypes are known to cause HUS and an additional 25 serotypes are known to cause other human illnesses such as abdominal pain, diarrhea, hemorrhagic colitis, and strokes (WHO, 1998; Anonymous, 2001; Blanco et al., 2003). With a few exceptions (Thran et al., 2001; Barkocy-Gallagher et al., 2003; Hussein et al., 2003), data on STEC prevalence in beef cattle in the U.S. have been limited to *E. coli* O157 (Hancock et al., 1994; 1997). Because of this limitation and the health risks associated with non-O157 STEC, this study was designed to examine prevalence of STEC in range cattle. Another objective was to determine the effects of pre-harvest control factors on STEC prevalence.

Materials and Methods

Cattle Population. Owners of cow-calf operations were solicited for participation in this study using lists of producers compiled by Veterinary Medical Officers of the USDA and Farm Advisors employed by the University of California Cooperative Extension. Six cow-calf operations (ranging from 65 to 225 cows; located from Northern to Southern California) were enrolled. Fecal samples were collected from 463 cows, 40 heifers, and 271 calves (16 to 121-day-old) over one year.

Fecal Sampling and Analyses. Four cow-calf operation were sampled once in each of the four seasons. For unexpected reasons, the fifth and sixth operations were only sampled during two (summer and fall) and three (summer, winter, and spring) seasons, respectively. From each operation, approximately 32 fecal samples were collected in each season with the samples being divided between cows and calves (16 each). When calves were not available, all 32 samples were collected from cows. When collection of 16 fecal samples from calves was not possible, efforts were made to collect as many calf samples as possible and the remaining samples were collected from cows. Calves are considered a critical component of the dynamics of STEC infection because they are more likely to be infected and to shed STEC in their feces at higher rates than adult cattle (Pearce et al., 2004). A minimum of 5 g fresh feces were collected from each animal, placed in sterile Whirl-pak bags, and shipped on ice to our laboratory for analysis at ≤ 24 h after collection. The methods of testing the fecal samples for STEC were reported previously (Bollinger et al., 2005).

Management and Herd Composition. Immediately after collection of the fecal samples, a standardized questionnaire was administered to each operation owner or manager to collect data related to the cattle and their feeding and management practices.

Statistical Analysis. A significant difference ($P < 0.05$) in the prevalence of STEC between or among the levels or categories tested was determined by using an exact conditional scores test (Mehta and Patel, 2000).

Results and Discussion

Prevalence of STEC in the cattle tested (across operations, types [cows, heifers, and calves], and seasons) are presented in Table 1. STEC were prevalent in all the cow/calf operations at rates ranging from 0.7 to 18.6%. Across operations, STEC prevalence was higher ($P < 0.05$) for calves and heifers (8.1 and 15.0%, respectively) than for cows (3.7%) and also higher ($P <$ 0.05) in winter than in the other seasons (13.6 vs an average of 3.0%).

The STEC isolates (Table 2) belonged to 34 serotypes that included *E. coli* O1:H2, O5:H⁻ (a nonmotile isolate), O26:H11, O39:H⁻, O84:H2, O84:H⁻, O96:H19, O111:H16, O111:H⁻, O116:H2, O116:H36, O125:H2, O125:H16, O125:H19, O125:H27, O125:H28, O125:H⁻, O127:H2, O127:H19, O127:H28, O128:H2, O128:H16, O128:H20, O146:H21, O157:H7, O158:H16, O158:H19, O158:H28, O166:H2, O166:H6, O166:H20, OUT (an untypeable O antigen):H2, OUT:H19, and OUT:H⁻. Of these, ten (O5:H⁻, O26:H11, O84:H⁻, O111:H⁻, O125:H⁻, O128:H2, O146:H21, O157:H7, OUT:H2, and OUT:H⁻) are known to cause HUS and three (O1:H2, O84:H2, and OUT:H19) are known to cause other human illnesses (WHO, 1998; Anonymous, 2001; Blanco et al., 2003). A total of 19 serotypes (O1:H2, O86:H2, O116:H2, O116:H36, O125:H2, O125:H16, O125:H19, O125:H27, O125:H28, O127:H2, O127:H19, O127:H28, O128:H16, O128:H20, O158:H19, O158:H28, O166:H2, O166:H6, and O166:H20) have not been reported previously in cattle.

Various on-ranch factors with potential effects on STEC prevalence were examined (data not shown). Several animal factors (e.g., herd size, length of breeding season, length of calving season, and number of unweaned calves in the herd) appeared not to influence ($P > 0.05$) STEC prevalence. However, lower ($P < 0.05$) STEC prevalence was associated with decreasing stock density (from 15.3 to 2.8% when density is ≤ 1.0 cow/acre), early separation of calves from dams (from 6.1 to 0.7 when calves' age is ≤ 6 mo), increasing the size of calving pasture (from 12.7 to 1.7% when the pasture is > 120 acres), and absence of diarrheic calves 2 to 4 mo prior to fecal sampling (from 9.6 to 1.6%). Of the dietary factors tested (e.g., supplementation of pregnant cows with alfalfa, molasses, or selenium), only molasses supplementation decreased ($P < 0.05$) STEC prevalence (from 6.7 to 0%). Thus, decreasing STEC prevalence in range cattle appears possible by altering management practices and/or dietary manipulation.

Conclusions

A large-scale assessment of STEC presence in California range cattle revealed prevalence of isolates belonging to O157:H7 and 33 non-O157 serotypes. Additionally, STEC isolates were prevalent in all the ranches tested at variable rates. Interestingly, 38% of the STEC serotypes detected in this study are known to cause various illnesses, including HUS. Based on our results, decreasing STEC prevalence in range cattle appears possible by altering management practices and/or dietary manipulation.

Acknowledgment

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Table 1. Prevalence of STEC in range cattle

Item	Number of cattle		Prevalence, %
	Tested	STEC positive[a]	
Cow/calf operation[b]			
1	148	1	0.7
2	159	4	2.5
3	142	6	4.2
4	143	12	8.4
5	80	3	3.8
6	102	19	18.6
Cattle			
Cows	463	17	3.7
Heifers	40	6	15.0
Calves[c]	271	22	8.1
Season[d]			
Summer	219	8	3.7
Fall	190	9	4.7
Winter	198	27	13.6
Spring	167	1	0.6

[a]An animal is considered STEC positive based on an initial fecal testing with the verotoxin-producing *E. coli* (**VTEC**)-screen kit (Denka Seiken Co., Ltd., Tokyo, Japan) and a follow-up confirmation by testing the potential isolates by the same kit.

[b]The cow/calf operations ranged in size from 65 to 225 beef cows.

[c]The calves ranged from 16 to 121 days of age at the time of sampling.

[d]The seasons were summer (June and July), fall (September and October), winter (December and January), and spring (March and April).

Table 2. STEC serotypes isolated from range cattle

Item	Serotypes[a]
Cow/calf operation	
1	O125:H2, O125:H19, and O158:H19
2	**O84:H^{-}**[b], O125:H19, O128:H20, **O157:H7**, and O166:H20
3	O96:H19, **O111:H^{-}**, O125:H28, **O146:H21**, **O157:H7**, O158:H16, and **OUT**[c]**:H^{-}**
4	**O5:H^{-}**, O84:H2, **O84:H^{-}**, O111:H16, O116:H2, O125:H2, O125:H16, O125:H19, O125:H28, O127:H2, O127:H28, **O128:H2**, O128:H16, and **OUT:H^{-}**
5	**O157:H7**, **OUT:H2**, and OUT:H19
6	O1:H2, **O26:H11**, O39:H^{-}, **O84:H^{-}**, O116:H36, O125:H19, O125:H27, O125:H28, **O125:H^{-}**, O127:H2, O127:H19, O127:H28, **O157:H7**, O158:H28, O166:H2, and O166:H6

[a]The serotypes in bold and those underlined are known to cause HUS and other human illnesses, respectively (WHO, 1998; Anonymous, 2001, Blanco et al., 2003).

[b]H^{-} indicates a nonmotile isolate.

[c]OUT indicates an untypeable O antigen.

Food Safety: Prevalence and Pre-Harvest Control of Shiga Toxin-Producing *Escherichia coli* in Cattle on Irrigated Pastures

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Introduction

Since the first reported *E. coli* O157:H7 outbreaks in 1982 (Riley et al., 1983), the associations between beef cattle, their products, and human infections with Shiga toxin-producing *Escherichia coli* (**STEC**) have been established. Worldwide, the number of STEC outbreaks traced to consumption of contaminated ground (CDC, 2003), roast (CDC, 2003), or smoked (Germani et al., 1997) beef has been on the rise in the past two decades. Other STEC-contaminated beef products such as sausage (Henning et al., 1998; Ammon et al., 1999), steak (CDC, 2003), tri-tip (CDC, 2003), and veal (CDC, 2003) also caused outbreaks of human illnesses. Thus, the safety concerns of beef, especially in the ground form, have gained attention at many levels, including the producers, consumers, and governmental agencies. The STEC-related illnesses (Griffin and Tauxe, 1991; Paton and Paton, 2000) include mild diarrhea, bloody diarrhea, hemorrhagic colitis, hemolytic uremic syndrome (**HUS**), stroke, and a neurological impairment known as thrombotic thrombocytopenic purpura. In many cases, the infection caused death of individuals such as children, the elderly, and others with compromised immune functions.

Because beef cattle were found to harbor a wide range of STEC serotypes at high rates (Hussein and Bollinger, 2005), they are considered reservoirs of these foodborne pathogens. The STEC isolates of beef cattle origin belonged to O157:H7 and over 250 non-O157:H7 serotypes (Hussein and Bollinger, 2005). As a result, STEC-infected cattle entering the food chain can impose significant health risks to humans through contamination of various beef products during processing. Due to their age and the resulting low beef quality, most beef cows enter the food chain as ground beef which has been implicated in a very large number of human illness outbreaks worldwide.

Evaluation of published reports in the past 25 years revealed prevalence of *E. coli* O157 in grazing beef cattle at rates ranging from 0.7 to 27.3% (Hussein and Bollinger, 2005). Higher prevalence rates (ranging from 4.7 to 44.8%) were reported for non-O157 STEC (Hussein and Bollinger, 2005). With regard to STEC from grazing beef cattle, a large number of isolates (belonging to 22 serotypes) were found to cause HUS and additional isolates (belonging to 25 different serotypes) were found to cause other human illnesses (WHO, 1998; Anonymous, 2001; Blanco et al., 2003). With a few exceptions (Thran et al., 2001; Hussein et al., 2003), data on STEC prevalence in U.S. grazing beef cattle have been limited to *E. coli* O157 (Hancock et al., 1994; Laegreid et al., 1999; Renter et al., 2003). Because of this limitation and the human health risks associated with many STEC serotypes, this study was designed to assess STEC prevalence in beef cattle grazing irrigated pastures and to identify pre-harvest control factors with the potential to decrease prevalence of these foodborne pathogens.

Materials and Methods

Cattle Population. Owners of cow-calf operations were solicited for participation in this study using lists of producers compiled by Veterinary Medical Officers of the USDA and Farm Advisors employed by the University of California Cooperative Extension. Four cow-calf operations (ranging from 38 to 1,300 cows; located from Northern to Southern California) were enrolled. Fecal samples were collected from 437 cows and 201 calves (28 to 92-day-old) over one year.

Fecal Sampling and Analyses. Each cow-calf operation was sampled once in each of the four seasons. From each operation, approximately 40 fecal samples were collected in each season with the samples being divided between cows and calves (20 each). When calves were not available, all 40 samples were collected from cows. On a few occasions, it was not possible to collect all 20 samples from calves due to calf age, pasture size, or difficulties in bringing cattle to the working facility. Under these circumstances, efforts were made to collect as many calf fecal samples as possible and the remaining samples were collected from cows. Calves are considered a critical component of the dynamics of STEC infection because they are more likely to be infected and to shed STEC in their feces at higher rates than adult cattle (Pearce et al., 2004). A minimum of 5 g fresh feces were collected from each animal, placed in sterile Whirl-pak bags, and shipped on ice to our laboratory for analysis at ≤ 24 h after collection. The methods of testing the fecal samples for STEC were reported previously (Bollinger et al., 2005).

Management and Herd Composition. Immediately after collection of the fecal samples, a standardized questionnaire was administered to each operation owner or manager to collect data related to the cattle and their feeding and management practices.

Statistical Analysis. A significant difference ($P < 0.05$) in the prevalence of STEC between or among the levels or categories tested was determined by using an exact conditional scores test (Mehta and Patel, 2000).

Results and Discussion

Prevalence of STEC in the cattle tested (across operations, types [cows and calves], and seasons) are presented in Table 1. STEC isolates were recovered in all the operations tested at rates ranging from 1.9 to 5.0%. Across operations, STEC prevalence was higher ($P < 0.05$) for calves than for cows (7.5 vs 1.6%) and also higher ($P < 0.05$) in the spring than in the remaining seasons (6.3 vs an average of 2.5%).

The STEC isolates (Table 2) belonged to 13 serotypes that included O1:H2, O5:H16, O5:H^- (a nonmotile isolate), O26:H8, O26:H11, O84:H^-, O103:HUT (an untypeable H antigen), O111:H8, O125:H2, O125:H19, O137:H16, O157:H7, and O169:H19). Of these, six (O5:H^-, O26:H11, O84:H^-, O103:HUT, O111:H8, and O157:H7) are known to cause HUS and three (O1:H2, O5:H16, and O26:H8) are known to cause other human illnesses (WHO, 1998; Anonymous, 2001; Blanco et al., 2003). Four of the serotypes detected (O125:H2, O125:H19, O137:H16, and O169:H19) have not been reported previously in cattle.

Various on-farm factors with potential effects on STEC prevalence were examined (data not shown). Several animal factors (e.g., herd size, length of breeding season, number of replacement heifers, number of calves with diarrhea prior to or at sampling time, stock density, cows to bull ratio, and number of weaned calves) appeared not to influence ($P > 0.05$) STEC prevalence. However, lower ($P < 0.05$) STEC prevalence was associated with decreasing the length of calving seasons to less than 2 months (from 6.3 to 1.6%). Lower ($P < 0.05$) STEC prevalence was also associated with offering running drinking water (streams or springs vs ponds or ditches) to cattle (0 vs 7.7%). Dietary supplementation of cows during pregnancy did not appear to influence ($P > 0.05$) STEC prevalence.

Conclusions

Fecal testing of a large number of grazing cattle in California revealed prevalence of STEC in all the cow/calf operations tested. To emphasize the potential health risks to humans, nine of the thirteen STEC serotypes detected in this study are known to cause various illnesses, including the life-threatening HUS. Based on our results, decreasing STEC prevalence in cattle grazing irrigated pastures appears possible by altering some animal-related factors and/or management practices.

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Table 1. Prevalence of STEC in cattle grazing irrigated pastures

Item	Number of cattle		
	Tested	STEC positive[a]	Prevalence, %
Cow/calf operation[b]			
1	158	4	2.5
2	160	3	1.9
3	160	8	5.0
4	160	7	4.4
Cattle			
Cows	437	7	1.6
Calves[c]	201	15	7.5
Season[d]			
Summer	160	4	2.5
Fall	159	4	2.5
Winter	159	4	2.5
Spring	160	10	6.3

[a]An animal is considered STEC positive based on an initial fecal testing with the verotoxin-producing *E. coli* (**VTEC**)-screen kit (Denka Seiken Co., Ltd., Tokyo, Japan) and a follow-up confirmation by testing the potential isolates by the same kit.

[b]The cow/calf operations ranged in size from 38 to 1,300 beef cows.

[c]The calves ranged from 28 to 92 days of age at the time of sampling.

[d]The seasons were summer (June and July), fall (September and October), winter (December and January), and spring (March and April).

Table 2. STEC serotypes isolated from cattle grazing irrigated pastures

Item	Serotypes[a]
Cow/calf operation	
1	**O26:H11**, **O84:H^{-}**[b], and O125:H19
2	O26:H8, **O103:HUT**[c], and **O157:H7**
3	O1:H2, O5:H16, **O5:H^{-}**, **O26:H11**, O125:H2, O125:H19, and **O157:H7**
4	**O111:H8**, O137:H16, **O157:H7**, and O169:H19

[a]The serotypes in bold and those underlined are known to cause HUS and other human illnesses, respectively (WHO, 1998; Anonymous, 2001, Blanco et al., 2003).

[b]H^{-} indicates a nonmotile isolate.

[c]HUT indicates an untypeable H antigen.

Food Safety: Prevalence and Pre-Harvest Control of Shiga Toxin-Producing *Escherichia coli* in Feedlot Cattle

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Introduction

The safety concerns with Shiga toxin-producing *Escherichia coli* (**STEC**)-contaminated beef have been on the rise since 1982 (Riley et al., 1983). At that time, ground beef containing *E. coli* O157:H7 caused gastrointestinal symptoms (e.g., severe abdominal cramps, grossly bloody diarrhea, and a low-grade fever) in 47 people in Michigan and Oregon. In the following 25 years, a large number of *E. coli* O157:H7 outbreaks continued to be traced to consumption of undercooked beef in the U.S. (CDC, 2003). This is why most U.S. studies have focused on prevalence of this foodborne pathogen in beef cattle (Hancock et al., 1994; Barkocy-Gallagher et al., 2003). In other countries, different STEC isolates (e.g., members of the O26, O91, O103, O111, O118, and O145 serogroups) have been isolated from beef cattle (WHO, 1998) and caused similar human illnesses (Paton and Paton, 2000).

Although other infection routes (e.g., vegetables [Cieslak et al., 1993], raw milk [Lahti et al., 2002], dairy products [Reid, 2001], and drinking water [Yatsuyanagi et al., 2002]) exist for STEC, beef remains a major vehicle of transmission (CDC, 2003). Of the various beef products investigated, undercooked ground beef still remains the main cause of human illnesses. These include mild or bloody diarrhea, hemorrhagic colitis, hemolytic uremic syndrome (**HUS**), strokes, and thrombotic thrombocytopenic purpura (Paton and Paton, 2000).

Because beef cattle are reservoirs of O157 and non-O157 STEC (Hussein and Bollinger, 2005), the safety concerns with their products have gained significant attention. For decades, the epidemiology of STEC in the U.S. has addressed only *E. coli* O157:H7 and ignored the continuously evolving role of non-O157:H7 STEC strains. Thus, the objectives of this study were to assess prevalence of O157:H7 and non-O157:H7 STEC in California feedlot cattle and to identify potential pre-harvest control measures that support beef safety.

Materials and Methods

Cattle Population. Owners of feedlots were solicited for participation in this study using lists of producers compiled by Veterinary Medical Officers of the USDA and Farm Advisors employed by the University of California Cooperative Extension. Four feedlots (ranging from 13,000 to 46,000 Holstein steers) located from Northern to Southern California were enrolled. Fecal samples were collected over one year from 318 and 322 steers that had been on feed for the shortest (ranging from 11 to 186 d) or longest (ranging from 190 to 346 d) period of time, respectively.

Fecal Sampling and Analyses. The feedlots were visited once in each of the four seasons for fecal sampling. From each feedlot, approximately 40 fecal samples were collected once in each season. This was accomplished by random selection of a pen of cattle in early feeding and another in late feeding and by collection of 20 fecal samples from each pen per season. The early pen that was sampled in one season was then used as the late pen in the following season. A new early pen was selected at random at that time for fecal sampling. A minimum of

5 g fresh feces were collected from each animal, placed in sterile Whirl-pak bags, and shipped on ice to our laboratory for analysis at ≤ 24 h after collection. The methods of testing the fecal samples for STEC were reported previously (Bollinger et al., 2005).

Management and Herd Composition. Immediately after collection of the fecal samples, a standardized questionnaire was administered to each feedlot owner or manager to collect data related to the cattle and their feeding and management practices.

Statistical Analysis. A significant difference ($P < 0.05$) in the prevalence of STEC between or among the levels or categories tested was determined by using an exact conditional scores test (Mehta and Patel, 2000).

Results and Discussion

Prevalence of STEC in the cattle tested (across feedlots, days on feed, and seasons) are presented in Table 1. STEC were prevalent in three of the four feedlots at rates ranging from 1.9 to 4.3%. Across feedlots, STEC prevalence was not altered ($P > 0.05$) by season (averaging 2.5%), but tended to decrease ($P = 0.13$) during finishing than during growing (3.1 vs 1.9%).

The STEC isolates (Table 2) belonged to 14 STEC serotypes that included O86:H19, O114:H2, O125:H19, O127:H19, O136:H12, O136:H^{-} (a nonmotile isolate), O153:H^{-}, O157:H7, O165:H7, OUT (an untypeable O antigen):H5, OUT:H12, OUT:H20, OUT:H^{-}, and OUT:HUT (an untypeable H antigen). Of these, two (O157:H7 and OUT:H^{-}) are known to cause HUS (WHO, 1998; Anonymous, 2001; Blanco et al., 2003), two (OUT:H12 and OUT:HUT) are known to cause other human illnesses such as abdominal pain, diarrhea, hemorrhagic colitis, and strokes (WHO, 1998; Anonymous, 2001; Blanco et al., 2003), and six (O86:H19, O114:H2, O125:H19, O127:H19, O165:H7, and OUT:H20) have not been reported previously in cattle.

Various possible factors affecting STEC prevalence in feedlot cattle were examined (data not shown). Several animal and/or management factors (animal age, feedlot size, pen size and/or density, water source, location of water troughs, frequency and/or method of cleaning water troughs, method of cleaning feedbunks, presence of a mound, and manure handling) appeared not to influence ($P > 0.05$) STEC prevalence. Lower ($P < 0.05$) STEC prevalence (1.6 vs 3.8%) was associated with heavier cattle (> 273 kg). Of the dietary factors tested, type of concentrate or feeding additives, including ionophores, had no effect ($P > 0.05$) on STEC prevalence. However, increasing the forage level in the diet from 10 to 15% decreased ($P < 0.05$) STEC prevalence from 4.0 to 0%. Increasing frequency of cleaning the feedbunk (from once to twice a month) decreased ($P < 0.05$) STEC prevalence from 5.1 to 0.9%.

Conclusions

A large-scale assessment of STEC presence in California feedlot cattle revealed prevalence of isolates belonging to O157:H7 and 13 non-O157 serotypes. Additionally, STEC isolates were prevalent in three of the four feedlots tested at variable rates. Interestingly, 29% of the STEC serotypes detected in this study are known to cause various illnesses, including HUS. Based on our results, decreasing STEC prevalence in feedlot cattle appears possible by altering management practices and/or dietary manipulation.

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This research was funded by the Integrated Research, Education, and Extension Competitive Grants Program - National Integrated Food Safety Initiative (grant No. 2001- 51110-11463) of the USDA Cooperative State Research Education, and Extension Service.

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Table 1. Prevalence of STEC in feedlot cattle

Item	Number of cattle		Prevalence, %
	Tested	STEC positive[a]	
Feedlot[b]			
A	162	7	4.3
B	161	0	0
C	158	3	1.9
D	159	6	3.8
Days on feed[c]			
Shortest	318	6	1.9
Longest	322	10	3.1
Season[d]			
Summer	161	5	3.1
Fall	158	5	3.2
Winter	160	2	1.3
Spring	161	4	2.5

[a]An animal is considered STEC positive based on an initial fecal testing with the verotoxin-producing *E. coli* (**VTEC**)-screen kit (Denka Seiken Co., Ltd., Tokyo, Japan) and a follow-up confirmation by testing potential isolates by the same kit.

[b]The feedlots ranged in size from 13,000 to 46,000 cattle.

[c]The number of days ranged from 11 to 186 for the shortest and from 190 to 346 for the longest periods on feed.

[d]The seasons were summer (June and July), fall (September and October), winter (December and January), and spring (March and April).

Table 2. STEC serotypes isolated in feedlot cattle

Item	Serotypes[a]
Feedlot	
A	O136:H12, **O157:H7**, O165:H7, OUT[b]:H5, <u>OUT:H12</u>, and **OUT:H^{-}**[c]
B	
C	O114:H2, O127:H19, and <u>OUT:HUT</u>[d]
D	O86:H19, O125:H19, O136:H^{-}, O153:H^{-}, **O157:H7**, and OUT:H20

[a]The serotypes in bold and those underlined are known to cause HUS and other human illnesses, respectively (WHO, 1998; Anonymous, 2001, Blanco et al., 2003).

[b]OUT indicates an untypeable O antigen.

[c]H^{-} indicates a nonmotile form.

[d]HUT indicates an untypeable H antigen.

Food Safety: Prevalence and Pre-Harvest Control of Shiga Toxin-Producing *Escherichia coli* in Dairy Cattle

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Introduction

Recently, consumer's concerns with safety of beef and dairy products have increased due to the large number of human illness outbreaks caused by Shiga toxin-producing *Escherichia coli* (**STEC**). These illnesses (Griffin and Tauxe, 1991) range from mild diarrhea to the life-threatening hemolytic uremic syndrome (**HUS**). Other symptoms include bloody diarrhea, severe hemorrhagic colitis, and thrombotic thrombocytopenic purpura that is characterized by central nervous system abnormalities (Paton and Paton, 2000). These illnesses were caused by more than 100 STEC serotypes (WHO, 1998). These include *E. coli* O26:H11, O26:H$^-$ (a nonmotile isolate), O91:H10, O91:H21, O103:H2, O103:H$^-$, O111:H2, O111:H8, O111:H$^-$, and O157:H7. Pathogenic *E. coli* strains not only produce toxins but can have other virulence factors that increase the severity of human illnesses (Paton and Paton, 2000).

Dairy cattle are considered reservoirs of O157:H7 and non-O157:H7 (Hussein and Sakuma, 2005) STEC. Several STEC isolates were detected in raw milk (Chiueh et al., 2002), cheeses (Pradel et al., 2001), and ground beef from dairy cattle (Doyle, 1991). Also, STEC outbreaks were traced to consumption of raw milk (Lahti et al., 2002), cheeses (Deschênes et al., 1996), yogurt (Morgan et al., 1993), and dairy beef (Ostroff et al., 1990). Due to the rising concerns with safety of foods of dairy origin, more efforts have been devoted to develop and implement pre-harvest (on-farm management practices) and post-harvest (milk processing and meat packing) control measures to decrease the risk of STEC contamination of dairy products. This study was designed to examine prevalence of STEC in California dairy cattle and to identify pre-harvest control factors that support safety of dairy products.

Materials and Methods

Cattle Population. Owners of dairy farms were solicited for participation in this study using lists of producers compiled by Veterinary Medical Officers of the USDA and Farm Advisors employed by the University of California Cooperative Extension. Four dairy farms (averaging 712 Holstein cows) located in the southern San Joaquin Valley in California were enrolled. Fecal samples were collected from 1,007 cows and 261 heifers over one year.

Fecal Sampling and Analyses. Each dairy farm was visited once in each of the four seasons for fecal sampling. From each farm, approximately 80 fecal samples were collected from heifers and cows at different stages of lactation. A minimum of 5 g fresh feces were collected from each animal, placed in sterile snap-seal plastic cups, and shipped on ice to our laboratory for analysis ≤ 24 h after collection. The methods of testing fecal samples for STEC were reported previously (Bollinger et al., 2005).

Management and Herd Composition. Immediately after collection of the fecal samples, a standardized questionnaire was administered to each operation owner or manager to collect data related to the cattle and their feeding and management practices.

Statistical Analysis. A significant difference ($P < 0.05$) in the prevalence of STEC between or among the levels or categories tested was determined by using an exact conditional scores test (Mehta and Patel, 2000).

Results and Discussion

Prevalence of STEC in the cattle tested (across farms, types [heifers and cows], lactation, days in milk [1 to 60, 61 to 150, ≥ 151], and seasons) are presented in Table 1. STEC were prevalent in all the dairy farms at rates ranging from 0.8 to 3.2%. Across farms, STEC prevalence were not different ($P > 0.05$) for cows or heifers (averaging 2.0%), for lactation (averaging 1.6%), for days in milk (averaging 1.6%), and for season (averaging 1.7%).

The STEC isolates (Table 2) belonged to 16 serotypes that included O15:H^-, O116:H^-, O125:H20, O127:H19, O128:H20, O136:H2, O136:H10, O136:H12, O136:H19, O136:HUT (an untypeable H antigen), O157:H7, O166:H6, OX13 (a new O serogroup):H19, OX13:H20, OUT (an untypeable O antigen):H7, and OUT:H^-. Of these, two (O157:H7 and OUT:H^-) are known to cause HUS (WHO, 1998; Anonymous, 2001; Blanco et al., 2003), two (O15:H^- and OUT:H7) are known to cause other human illnesses (WHO, 1998; Anonymous, 2001; Blanco et al., 2003), and eight (O125:H20, O127:H19, O128:H20, O136:H10, O136:H19, O166:H6, OX13:H19, and OX13:H20) have not been reported previously in cattle.

Various on-farm factors with potential effects on STEC prevalence were examined (data not shown). Several animal factors (e.g., herd size, parity, number of lactating cows, and number of dry cows) appeared not to influence ($P > 0.05$) STEC prevalence. Of the dietary factors tested, higher ($P < 0.05$) STEC prevalence was associated with feeding yeast cultures (2.0 vs 0.6%) and also with total or partial replacement of soybean meal with cottonseed meal in the protein supplement (3.8 vs 0.7%). Thus, decreasing fecal shedding of STEC by dairy cattle appears possible by dietary manipulation.

Conclusions

Fecal testing of a very large number of dairy cattle in California revealed prevalence of STEC in all the farms tested. To emphasize the potential health risks to humans, four of the sixteen STEC serotypes detected in this study are known to cause various illnesses, including the life-threatening HUS. Based on our results, decreasing STEC prevalence in dairy cattle appears possible by dietary manipulation.

Acknowledgment

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Table 1. Prevalence of STEC in dairy cattle

Item	Number of cattle		
	Tested	STEC positive[a]	Prevalence, %
Farm			
A	390	3	0.8
B	328	5	1.5
C	311	10	3.2
D	239	4	1.7
Cattle			
Heifers	261	6	2.3
Cows			
First lactation	424	6	1.4
Second lactation	298	7	2.3
Multiparous[b]	285	3	1.1
Days in milk			
1 to 60	229	3	1.3
61 to 150	373	7	1.9
≥ 151	405	6	1.5
Season[c]			
Summer	323	3	0.9
Fall	337	7	2.1
Winter	306	4	1.3
Spring	302	8	2.6

[a]An animal is considered STEC positive based on an initial fecal testing with the verotoxin-producing *E. coli* (**VTEC**)-screen kit (Denka Seiken Co., Ltd., Tokyo, Japan) and a follow-up testing potential isolates by the same kit.

[b]Cows in their third to eight lactation.

[c]The seasons were summer (June and July), fall (September and October), winter (December and January), and spring (March and April).

Table 2. STEC serotypes isolated from dairy cattle

Item	Serotypes[a]
Farm	
A	O15:H^{-}[b], O136:H2, and O166:H6
B	O125:H20, O128:H20, O136:H2, O136:H12, O136:H19, O136:HUT[c], **O157:H7**, and **OUT**[d]**:H^{-}**
C	O116:H^{-}, O136:H10, O136:H12, **O157:H7**, and OUT:H7
D	O127:H19, O128:H20, **O157:H7**, OX13[e]:H19, and OX13:H20

[a]The serotypes in bold and those underlined are known to cause HUS and other human illnesses, respectively (WHO, 1998; Anonymous, 2001; Blanco et al., 2003).

[b]H^{-} indicates a nonmotile form.

[c]HUT indicates an untypeable H antigen.

[d]OUT indicates an untypeable O antigen.

[e]OX13 is a provisional designation for a new O serogroup.

The Detergent Method for Forage Fiber Evaluation

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The Proximate Analysis System has served for many years in predicting the nutrient value of feeds. However, recognition of limitations in this system as related to crude fiber (CF) and nitrogen-free-extract (NFE) fractions, has resulted in the development of the Detergent Method to measure forage quality. Currently, universal acceptance and use of the Detergent Method of forage fiber analysis continues to evolve because of its ability to more accurately define the carbohydrate components of forage feeds.

The Detergent Method separates fibrous feeds (forages) into two fractions: A neutral-detergent fiber (NDF) fraction that is used to predict voluntary feed intake, and an acid-detergent fiber (ADF) fraction used as an indicator of forage digestibility. The neutral-detergent fiber fraction consists of hemicellulose, cellulose, lignin, silica and protein; cell wall components of low digestibility. Consequently, digestion is dependent upon bacteria, fungi, and protozoa of the digestive tract, with efficiency of the microbial digestion influenced by plant species and stage of maturity. The lower the NDF %, the more the animal can consume. It is inversely related to voluntary consumption. Therefore, a low NDF % is desirable. The acid-detergent fiber (ADF) fraction is primarily cellulose, lignin and varying amounts of silica. Lignin and silica in forage plants are associated with low digestibility. The lower the ADF %, the more feed the animal is able to digest. Therefore, a low ADF % is desirable. As lower NDF % is related to higher consumption and lower ADF % is related to higher digestibility, the Detergent System is becoming more valuable as a tool in the evaluation of fibrous feeds.

Uses For The Detergent System of Forage Analysis

1. NDF % and ADF % can be used to predict feed consumption and digestibility

2. NDF % can be used to predict Net Energy values of legume and grass forages

3. The system can be used to determine Relative Feed Value of forages (DM Basis)

Legumes: NEm (mcal/lb) = 1.1698 – 0.0111 x NDF

Grasses: NEm (mcal/lb) = 1.3875 – 0.0125 x NDF

Relative Feed Value

Relative feed value is a computation developed to determine the relative value of forages. It is now a standard for buying and selling hays in various areas. Relative feed value considers the differences in consumption and digestibility as affected by forage maturity. A high relative feed value indicates high quality forage. Relative feed value provides a means to compare various types of forage feeds.

Equation To Calculate RFV

$$RFV = \frac{\%DDM \times \%DMI}{1.29}$$

Where

$$\%\,DDM = 88.9 - (ADF\,\% \times 0.779) \qquad \%DMI = \frac{120}{\%NDF}$$

Summary

Limitations of the Proximate Analysis System provided for the development of the Detergent System as a method to evaluate the energy content of forages. This method separates fibrous feeds into Neutral and Acid Detergent fractions. The lower the NDF % the higher the consumption. The lower the ADF % the higher the digestibility. High RFV values are associated with low fiber content of a feed. Using NDF % and ADF %, RFV can be determined to make a comparison of one forage to another relative to feed quality and value.

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Table 1. NDF % ADF % and RFV of Hays (1)(2)(3)

Forage	Growth –Stage	CP%	NDF%	ADF%	RFV (Index)
Alfalfa					
	Early – Bloom	20.5	36.3	28.6	170
	Mid - Bloom	20.8	42.9	33.4	136
	Full - Bloom	17.8	50.9	39.5	106
Cool Season Grass					
	Immature	18.0	49.6	31.4	120
	Mid-Mature	13.3	57.7	36.9	97
	Mature	10.8	69.1	41.6	76
Mix Grass/Legume					
	Immature	19.7	45.4	30.8	133
	Mid-Mature	18.4	50.8	35.8	111
	Mature	18.2	56.0	50.1	108
Oats					
	Headed	9.1	58.0	36.4	97
Wheat					
	Headed	9.4	61.1	38.1	90

(1) National Research Council (2007) Nutrient Requirements of Horses 6[Th] Ed.
National Academy Press, Washington, D.C.
(2) 100 % Dry Matter Basis
(3) RFV (Relative Feed Value) Calculated

Use of the RFV (Index)

1. RFV can be ranked from highest to lowest. High RFV values are associated with lower fiber content of a feed.

2. Value comparison of feeds: Mid – Bloom Alfalfa hay would be worth a least 1.4 times the cost of Oat Hay (136 / 97 = 1.4)

Agricultural Land-Owner Willingness to Participate in Water Markets and Adopt Water Conserving Strategies in the Walker River Basin

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Introduction

Bordering the eastern side of the Sierra Nevada mountain range lays a vast space of open dry land that is interspersed with sections that mirror an oasis. It is this desired lifestyle within these desert mountains, in one of the driest states in the nation, where cattlemen are determined to survive an ever-changing world focused on the use of water. Competing demands from urban, rural and recreational users requires that sustainable and integrated water management policies be established to avoid crisis and to maintain food security (Wolfe, 2003).

It is the governing use of water resources, entwined in a legal framework, which is among the most complex and intriguing of renewable resources. This framework derives from the mixture of common-law heritage, constitutional and statutory law (federal, state, and local), local custom, judicial decisions and international convention (Adams, 1993). The Walker River faces the same fate of other rivers in the Western United States. The demand for water is unbounded creating conflict. For whom and for what use should have the highest priority?

The challenge is to find potential solutions that can sustain the agricultural economy of the Walker River Basin, while maintaining a healthy ecosystem. Production systems have changed little over time in the Walker River Basin due to market demands and competitive prices of traditional agriculture crops and cattle. Diversification while maintaining agriculture land use and maximizing financial benefits to producers who are conserving water, can offer new opportunities and strengthen the communities within the basin.

Statement of the Problem

The Walker River Basin water system, running from the eastern slopes of the Sierras in California to Walker Lake in Nevada, has been the focus of controversy for farmers, ranchers, environmentalists, Indian Tribes and federal/state agencies for decades. Arguments over water rights in the Walker River Basin began after the settlement of homesteaders and have continued into the 21st century. To the casual observer who travels to Walker Lake at the terminus of the Walker River, the problem is obvious. However, to upstream water users, their lifestyle and livelihoods are at stake. The water issues are much more complicated than the simple issue of declining lake levels.

Purpose of Study

Potential solutions in the Walker River Basin require a clear understanding of the economics, lifestyles, customs, and cultures of every community, individual and species affected by water use in the basin. Therefore, it is the objective of this research study to describe perceptions and attitudes regarding water markets and water conservation strategies among Walker Basin agricultural land-owners based on surveys conducted in 2003 and 2007.

Methodology

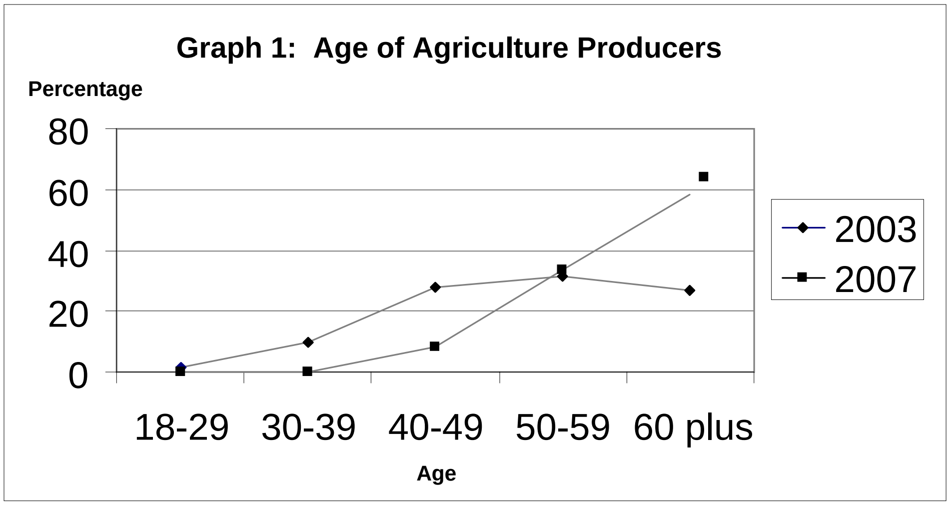
The 2003 in-person survey was conducted during the summer and 520 water-right owners were identified through a number of sources including the United States Department of Agriculture's State Statistician. There were 116 water-right owners representing the three geographical areas that participated in the survey out of 139 water right-owners contacted. These 116 respondents included 49 from the Walker River Irrigation District, 38 from Walker River Indian Reservation, and 29 from the Headwaters (primarily Coleville, CA). The questionnaire was developed in cooperation with local area conservation districts. The instrument was field tested to ensure clarity and face validity.

The second survey, a mail survey, was conducted during the summer of 2007. Three-hundred-twenty Walker Basin land-owners were identified through the United States Department of Agriculture's State Statistician. Of the 320 land-owners surveyed, 70 agriculture producers, representing all areas of the basin, participated in the survey, for a response rate of 22%. The questionnaire was developed using several sections of the 2003 survey, as well as questions regarding respondent willingness to adopt water conserving irrigation or cropping strategies. Additionally, respondents were asked about their current cropping strategies and costs associated with those strategies.

Results and Findings

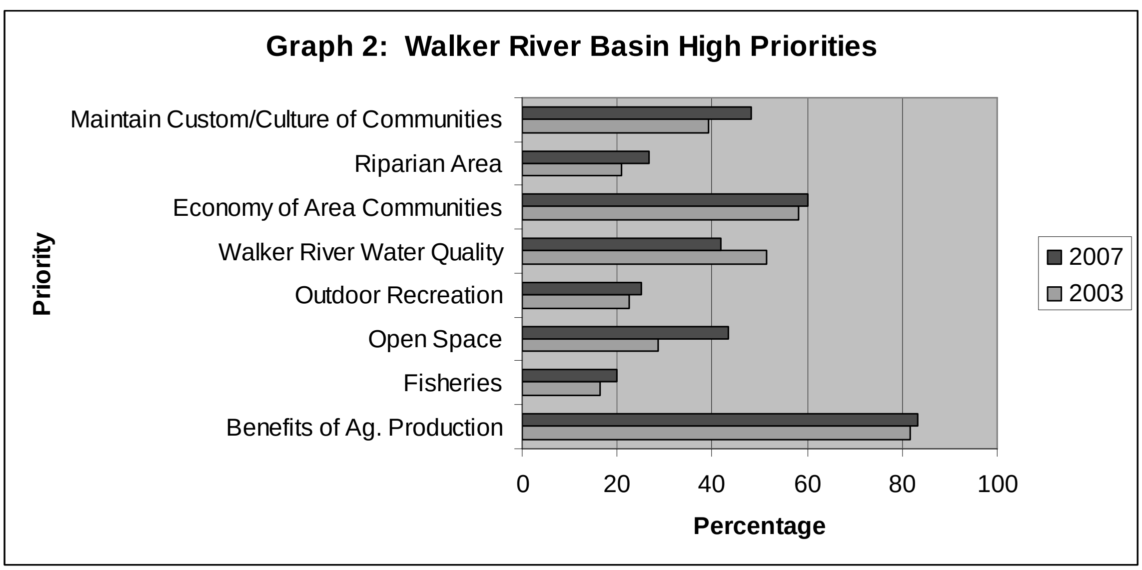
Demographics

The demographic questions included in both the 2003 and the 2007 surveys included the number of years the agriculture producer lived in the basin, the number of years they had been involved in agricultural production and their current age. Almost 43% of producers in the 2003 survey lived in the basin 36 years or more (generations) with 41% involved in agriculture for generations. Compared to 2007, there were 55% of producers that had lived in the basin 36 years or more with 56% reporting they had been involved in agriculture production for generations. The age of respondents in 2003 and 2007 is shown in Graph 1 below.



Walker River Basin Priorities

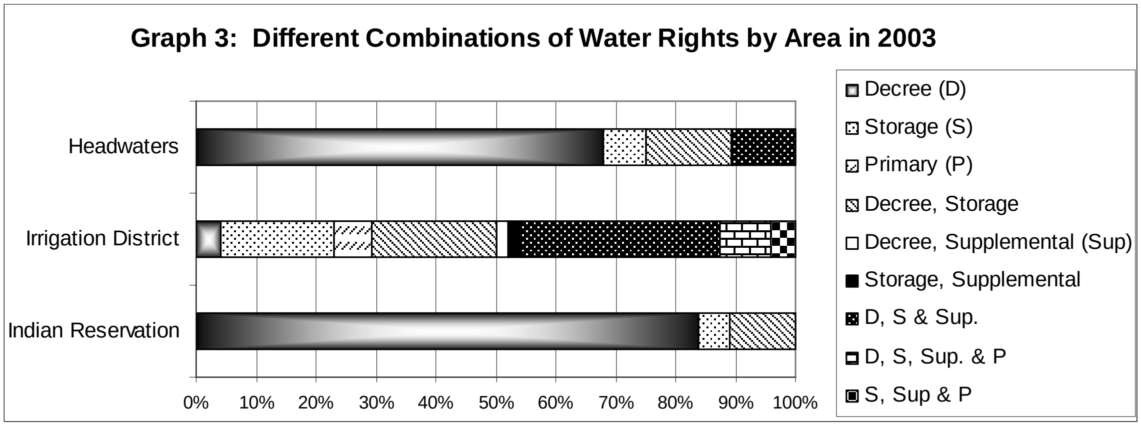
The 2003 and 2007 survey instrument asked respondents to rate eight separate priorities within the Walker River Basin on a scale of 1-5, with 5 representing *high priority*. The highest priority to both the 2003 and 2007 respondents included the benefits of agriculture to the local communities, followed by the economy of area communities. The biggest differences between responses in 2003 and 2007 included the increase in priority of open space in the Walker River Basin in the 2007 survey and the decrease in priority of water quality in 2007. Water quality was a topic of significant difference between areas in the Walker River Basin in 2003, especially between Walker River Indian reservation respondents and upstream water users. The comparison between the high priorities is given in Graph 2 below.



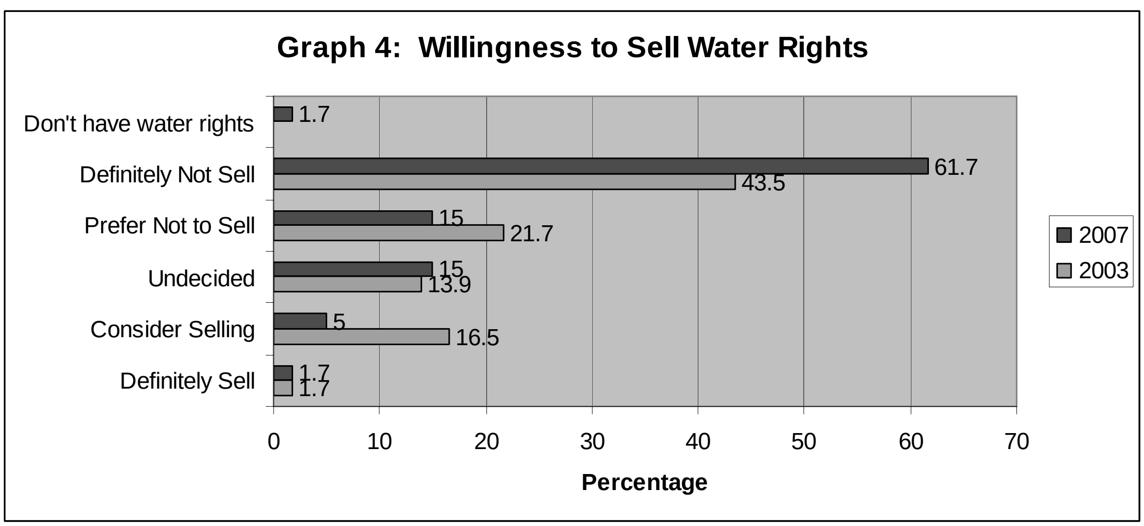
Water Rights in the Walker River Basin

The 2003 survey requested information on what types of water rights in the Walker River Basin that agriculture producers were using. There are four types of water rights in the basin, which include Decree (surface water), Storage (surface water in reservoirs), Primary (groundwater) and

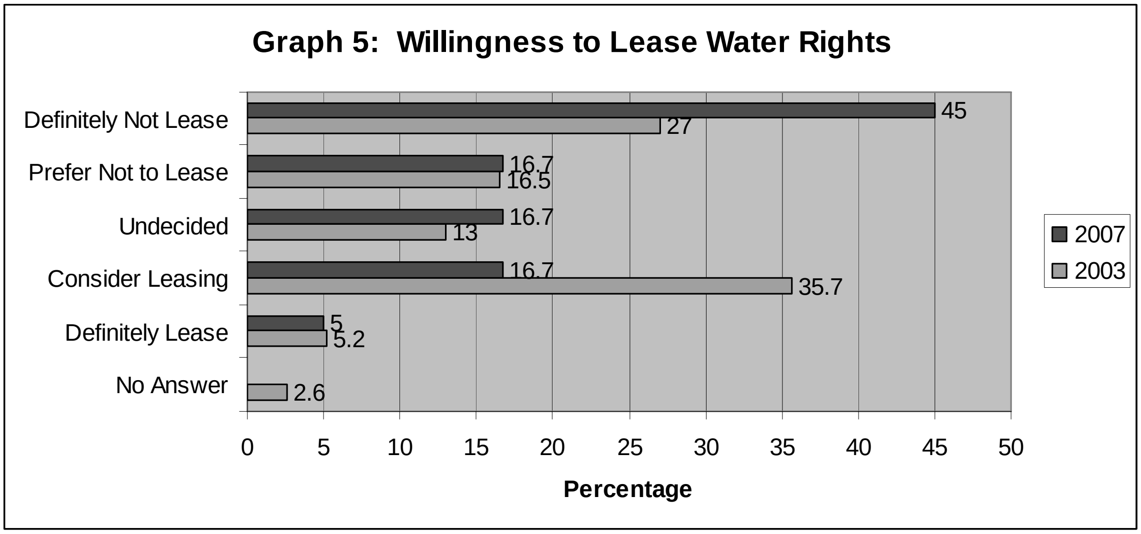
Supplemental (groundwater). Over the decades the four types of water rights have been combined to give the agriculture producer more opportunity to raise economically feasible agricultural products. The different combinations reported in the 2003 study are reported below in Graph 3. The Headwaters is the Colville, CA, Bridgeport, CA and those producers that own ranches in California and Nevada in the Walker River Basin. The Irrigation District is Walker River Irrigation District and the Indian Reservation is the Walker River Paiute Indian Reservation.



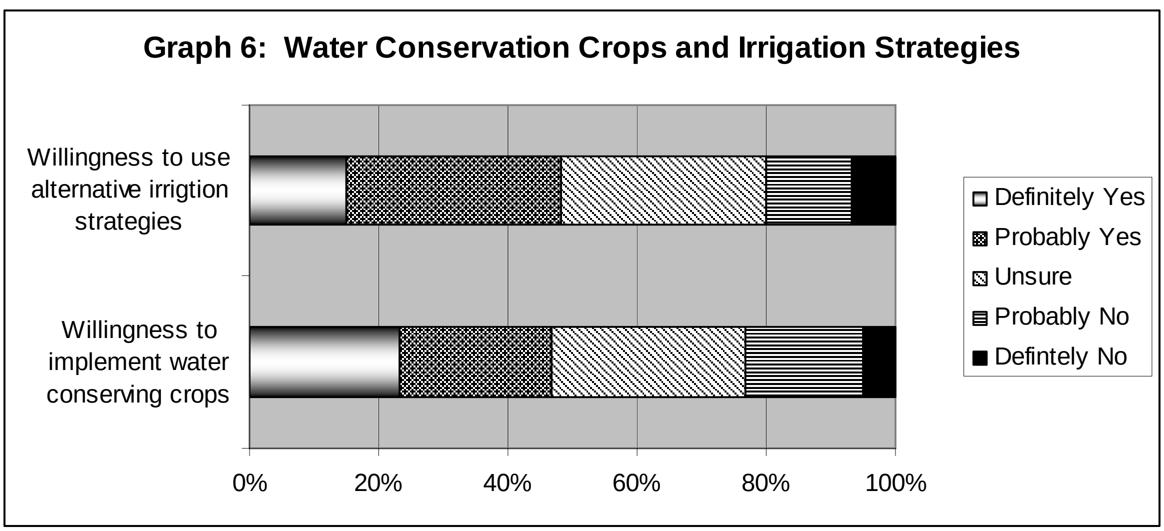
The 2003 and 2007 surveys asked agriculture producers their willingness to sell and lease water rights in the basin. The comparison shows differences between the two surveys regarding the willingness of producers to sell their water rights. Interestingly, the percentage of producers who would consider selling water rights decreased from 16.5% to 5%. The respondent attitudes regarding their willingness to sell water rights in the 2003 and 2007 surveys are provided in Graph 4.



The two surveys also asked producers if they would consider leasing water rights in the basin. The 2007 survey shows that 45% of producers would definitely not lease compared to 27% in the 2003 survey. In addition, there are only 16.7% in the 2007 survey that would consider leasing while 35.7% would consider leasing in 2003. An overview of these results is provided in Graph 5.



<u>Water Conservation and Alternative Irrigation Strategies</u>
The 2007 study asked producers if they were willing to implement water conserving crops or use alternative irrigation strategies. While there were 5% that would definitely not implement water conserving crops and 6.7% that would definitely not use alternative irrigation strategies, there were 23.3% that definitely would implement water conserving crops and 15% that would definitely use alternative irrigation strategies. There were 23.3% that probably would implement water conserving crops while 30% were unsure. There were 33.3% that would use alternative irrigation strategies while 31.7% were unsure. The data reported shows potential for both water conserving crops and alternative irrigation strategies in the basin. Refer to Graph 6 an overview of survey results.



Implications for Walker River Basin Cattlemen

The majority of agricultural operations in the Walker River Basin produce livestock with the highest percent producing both crops and livestock. Many producers have been involved in agriculture for generations and have lived in the basin for many years. National statistics show that agriculture producers are getting older in age and the younger generation is not as interested or is unable economically to sustain agricultural operations. This is evidenced by the decreasing amount of land in farms in Nevada, as well as the ever widening span of urbanization (NASS, 2005).

Nevada's population is projected to increase by 4.4 million over the next 20 years. While the majority of growth is projected in southern Nevada, Lyon County, the center of the Walker River Basin, is one of the fastest growing rural counties in the nation. Lyon County is projected to double in size over the next 20 years according to State Demographer. This expanded growth presents an ever increasing demand for municipal water or residential water use. This increasing demand for water along side generational turnover and reduction in farming, present a difficult decision for retiring agricultural producers. Ranchers and farmers would typically prefer to see their land remain in agriculture, but are aware of the financial gains to selling water rights for other uses. These decisions are common as any organization or business needs to continually assess its strengths and challenges to meet the changing needs of society (Seevers et al., 1997).

The most pressing issue facing the Walker River Basin is the acquisition of water rights from willing sellers for use in Walker Lake, a desert terminal lake at the end of the watershed. Study results in 2003 and 2007 show that while the majority of producers prefer not to sell water rights, there were 19.1% in the 2003 survey and 6.7% in the 2007 survey that would consider selling water rights. There are four types of water rights in the Walker River Basin. However, it is the ownership of the combination of the four different water rights and how the water rights are delivered to the producer in the irrigation system that creates complexity and risk to the producer once water rights are sold. A major issue centers around how the water delivery system will be affected as the water rights are sold and land is removed from production.

The 2007 survey shows that the producers (46.6% alternative crops, 48.3% irrigation strategies) are interested in alternative water saving crops and/or alternative irrigation strategies. The survival and success of ranching and farming operations will depend on innovative and insightful producers that will adapt production techniques and diversify products based on the resources available to the operation and profitability (Bazen et al., 2006). Therefore, the second step in this Walker River Basin task is to look at how diversification of alternative crops can spread economic risk for the operation and what profitable markets are available.

Conclusions

The 2003 and the 2007 surveys provide a snap-shot of producer attitudes in the Walker River Basin. A statewide agriculture needs assessment conducted in 2006 also shows that agriculture producers would like more assistance in dealing with water related issues facing the agriculture economy of Nevada (Singletary & Smith, 2006). The Walker River Basin task is to find potential solutions that can sustain the agriculture economics of geographical areas in the Walker River Basin.

Diversification while maintaining agriculture land use and maximizing financial benefits to producers has the potential to strengthen ranching and farming within the basin. While water acquisition poses risk to the economics of farming and cattle ranching in the basin, alternative crops and production strategies can lessen the impact and maintain economic profitability only with the cooperation and input of Walker River Basin producers.

The result of this study gives insight into the progression of perceptions/attitudes over the last few years. However, additional producer input and involvement is needed. The goal will be to provide an array of producer option diversification strategies involving water conservation and alternative crops. This comparison of survey research was compiled to identify attitudes of producers over time. In no way was this research study created to favor one side or the other. Further, this research study is being used as part of a second phase to provide a valuable tool in reaching potential solutions through diversification, water conservation and alternative crops.

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We Influence Great Basin Changes

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The wildfires that spread across Nevada and the rest of the West were devastating in their scale—multiple deaths, thousands of homes destroyed and many more threatened, hundreds of thousands of acres burned. For natural resource based industries, one of the significant impacts is the frequency of where basic ecological function was compromised as thresholds were crossed.

What had gone wrong – if anything? Are these large fires outside of historical parameters? And why, after years of few large fires, are some of America's most spectacular conflagrations arising now?

Our European background frame of reference is that fires are always bad – because when fires are out of control they destroy homes, crops and livelihoods. As a society then, it is difficult to recognize that the large fires of the past 10 years are a result of our political actions and social perceptions which result in inappropriate land management. It may be time to consider analysis and maybe reform of our culture and the craft by which we approach the phenomenon of wildfire on the rangelands of the intermountain west. The fire problem is largely the outcome of what we have done, and not done. Our society operates not according to strict evolutionary selection but in the realm of culture, which is to say, of choice and confusion.

Yet, one can also argue that the trend toward larger and more extreme fires is a manifestation of the crucial role fire has surely played in forming and maintaining our intermountain ecosystems, muscling back onto the landscape in this extreme form after too long an absence. As such, the "modification" of the fuel for easier and more frequent burning can be seen as our opportunity, we resource managers, stockmen and women, sportsmen, and environmentalists, to change our relationship to fire. The mandate of sustainability demands that it must be seen thus.

Fire isn't a being. It isn't listening. It doesn't feel our pain. It doesn't care—really, really doesn't care. It understands a language of wind, drought, woods, grass, brush, and terrain, and it will ignore anything stated otherwise.

Fire ecology and fire fighting technology have changed. Reduced resource use (timber harvesting and livestock grazing) over the past 15 years contribute to fuels. Together these are the two most obvious examples of why we have the fuels buildup that are fueling unprecedented massive fire acres. In the Great Basin the insidious spread of fine-fuel annual grasses provides the tinder to make the conflagration problematic. A less recognized factor appears to be the uniformity of vegetation across the landscape. Fire behavior is fuel dependent. And when that fuel is uniform over a large area the fire is able to generate sufficient microclimatic wind and temperatures to burn until conditions change significantly – which now means large fires because of the homogeneity of the plant community.

But there may be more to the picture than that.

Anthropological data from historical times confirms Native Americans used fire constantly, a consciously applied technology for maintaining the landscape upon which they relied exclusively for their living. Ecological data about "pre-settlement" conditions in the west indicates periodic fires recurring at such frequencies as would imply the burning of vast acreages every year. We know too that early European settlers adopted these practices as well, until the emergence of economic disincentives, such as expensive fences built with wooden posts, began to curtail the practice.

During the post-1850 settlement period livestock numbers neared, or exceeded, the long-term carrying capacity of western rangelands. Fires were naturally suppressed over large areas because of the decrease in fine fuels necessary for fire ignition. This grazing practice might well have started a process of making plants more uniform in age and composition. That high level of grazing pressure was greatly reduced starting about 1900 because of factors such as the severe winter of 1888-89, high transportation costs and low livestock prices, and changing public perceptions. Reducing livestock numbers to correct overgrazing continues today. The cultural mindset is that if grazing caused the problem, taking away grazing will correct it – an ecological concept never demonstrated and not supported by science.

Land ownership patterns may be one of the often overlooked major factors having an impact on fires. Fundamental to the discussion, land ownership is divided systematically and artificially into square particles, rather than partitions that follow watersheds or land contours. Development of private lands of all sizes follows that square pattern. Then, in response to conflicts over grazing use, the U.S. Forest Service was organized and given control of most of the higher elevation timber, rangelands, and watersheds. This established an agency with a specific set of goals and objectives. Later the Taylor Grazing Act and other congressional actions led to other agency goals which occasionally are in conflict with neighboring landowners. For example, allotment boundaries were often established for control of land management practices. The historic movement of animals "following the green" in the annual spring and fall migrations became nearly impossible. "Rest and rotation" of rangelands is today the most acceptable management practice – in spite of evidence that other livestock/wildlife use patterns may be more compatible with plant growth and ecological functionality.

Another compounding factor occurred with settlement. With the movement of people, materials, and animals from other continents came the introduction of plants from those areas. Some of these plant species originated in areas of the world very similar to the Western U.S., but in very different ecological environments. A small number of these species were well adapted to Great Basin rangelands, but at the same time have the ability to capitalize upon scarce moisture and nutrition resources at times when native vegetation cannot use them effectively. This gives these plant species a competitive advantage and enhances their ability to become well established, which results at times in monocultures of introduced "invasive" plant species. That well documented situation nearly eliminated the potential for a return to "pre-settlement" ecological conditions. Annual grasses are included in this category simply because the Great Basin had few annual grasses that survived the evolutionary drying that occurred with the Sierra Nevada geological upthrust. The newly introduced annual grasses provide a previously missing fine fire fuel on a scale that was unprecedented. Other species are poised to dominate if the homogeneity of landscapes continues to expand.

Another factor, but by not means the final one, is the efforts by some with political agendas, to force public land managers to a position where only passive management can occur. These actions increase costs and decrease land managers ability to react proactively for maintenance of the ecological mosaic so essential for properly functioning natural resources. While their oversight is valuable, congressional action is necessary to limit their ability to intervene so that proactive management activities are still encouraged.

Following the devastating 1910 timbers fires in Montana and Northern Idaho, a national policy developed, which coincided with our heritage, to stop all fires before they could cause "damage."

Rangeland livestock operators and resource managers are still learning how to manage ecological functionality. Decades of fire suppression have culminated in vast expanses of dense and decadent sagebrush, fuel for extreme fire events. Fire recovery and restoration policies centered on "rest" from grazing have only resulted in the build-up of fuel for rapidly repeated burning, and the continued spread of vast areas of introduced annual grassland monocultures. Greatly decreased livestock numbers on our rangelands and reduced forest management activities reveal an accumulation of decadent, volatile fuels.

Technology improvements since 1910 have allowed land managers to become much more efficient in putting out fires. A "war" mentality with regards to wildfire gives the firefighting industry ever increasing legal authority, social significance, and regional economic clout. While the long term costs of scorched ecosystems and habitats are very real, yet nearly impossible to calculate, the infusion of firefighting dollars into local communities during fire season is immediate and measurable. But, as a result of changing ecological conditions described, the expense of fighting/suppressing wildfires continues to escalate. In addition, as we have experienced in recent years, a point is reached where fire behavior is sufficiently extreme that no amount of fire suppression can achieve control. The result is the conflagrations that we are currently experiencing.

Something we often forget, political actions have consequences.

One might argue that wildfire has become, though through no one's conscious decision and at the expense of our ecological stability, the "cash crop" of the western rangelands, replacing livestock. In an expression of self-governing economic market phenomenon worthy of our amazement, the fuel for that "crop" is being modified, from brush to grasses to annual grasses, to provide for easier, more frequent "harvest."

We must return to a culture which uses and manages range fire, rather than one which merely "fights" it, waiting uncertainly for some breakout, some "insurgency."

Investigation of cell counting method, sampling day and mastitis status on somatic cell count (SCC) and milk constituents in sheep milk, and the efficacy of the PortaSCC® milk test to determine SCC and detect subclinical mastitis in sheep.

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Introduction

Mastitis is defined as an inflammation of the udder caused by infection or undue stress on the mammary tissue. Mastitis can be classified into two categories, clinical or subclinical infection. The producer can often visually diagnose clinical mastitis, whereas subclinical mastitis can only be detected by methods of milk testing. A testing method commonly used to determine subclinical mastitis is analysis of somatic cell count (SCC) which is the number of white blood cells found in milk. Somatic cell count increases when an infection is present, and can be an indicator of subclinical mastitis.

Mastitis can result in many losses for the sheep industry including premature culling, a decrease in milk quality and quantity, poor lamb growth resulting in low weaning weights, and in severe cases, death. Watson and Buswell (1984) reported that 46% of the culled ewes were culled because of mastitis. Producers may prevent premature culling of ewes by developing management practices that will decrease the amount of subclinical mastitis in their flock. An on-farm test that detects subclinical mastitis would be beneficial for the producer to reduce or treat mastitis in their flock.

The PortaSCC® milk test (PortaScience Inc., Moorestown, NJ) is an easy to use, relatively inexpensive ($0.90/ udder side or $ 1.80/ ewe) on-farm test now used in the dairy industry. The test consists of a disposable test strip that requires a small drop of milk and produces a color change proportional to the somatic cell count (SCC) in the milk. The color changes produced by the test strip can be read visually by comparison to a color chart or quantitatively with a small hand-held device called a reflectometer. The reflectometer measures the reflectance of the test strip. Two reflectometers were used in this study, one calibrated for cow's milk and an uncalibrated reflectometer. The four color changes produced by the PortaSCC® milk test strip are no color change, light blue, blue and dark blue, and represent SCC ranges for cow's milk of < 200, 200 to 750, 750 to 2,000 and > 2,000 x 10^3 cells/mL, respectively. The SCC range for no color change (< 200 x 10^3 cells/mL) on the test strip indicates the normal limit for a healthy udder half, and the SCC range for light blue (200 to 750 x 10^3 cells/mL) indicates a range of healthy to inflamed/infected udder halves. The blue color represents a SCC range of 750 to 2,000 x 10^3 cells/mL and indicates infection/subclinical mastitis. The dark blue color represents a SCC range of > 2,000 x 10^3 cells/mL and indicates chronic/clinical mastitis. Therefore, the color changes on the test strip of no color, light blue, blue and dark blue will be represented on the following tables as udder health categories of healthy, healthy to inflammation, infection/subclinical mastitis, and chronic/clinical mastitis, respectively. The color change on the strip can be read 45 minutes to 2 hours after the milk sample has been applied, thereby allowing the producer a rapid on-farm tool for detecting subclinical mastitis. The objective of this study was to determine the efficacy and accuracy of the PortaSCC® milk test in determining SCC and subclinical mastitis in sheep.

Materials and Methods

Animal Management. Ninety-two Rambouillet-cross multiparous and primiparous lactating ewes (2-6 years of age) were used in this study. Following weaning the ewes were maintained as two separate flocks on pasture through the breeding season and until shearing. After shearing the ewes were moved to a covered barn and placed in pens (16 ft x 32 ft) and pen-fed alfalfa pellets a week prior to parturition, during the lambing weeks and for the first 60 days following parturition. Ewes were group-fed 4 lbs alfalfa pellets/head/day before parturition. Following parturition, the ewes were pen-fed 6 lbs alfalfa and .5 lb of corn/head/day. All ewes were allowed free access to water and mineralized salt blocks. Ewes lambed within about a 5-wk period. Each ewe's age and lambing status (triplet, twin or single births) was recorded at parturition as well as any changes in suckling status during the lactation period. Animals were milked at weaning (89 ± 16 days; mean ± standard deviaiton) and 24 hours post-weaning.

Milk Sampling. Before sampling, udders were disinfected with isopropyl alcohol and the first ~3 mL of milk from each teat was stripped and discarded. A 40 mL sample was collected from each udder half for analysis of SCC. Milk samples were kept cool until delivery to the laboratory. Upon arrival at the laboratory the milk samples were gently shaken and one drop of milk was pipetted from each sample onto the sample window of the PortaSCC® milk test strips. Three drops of activator solution was added to each strip. The strips were allowed to develop for 1 hour during which time a color reaction took place depending on the SCC level in the milk. The blue color generated by the color reaction was read visually by comparison to the Quick Check Color Chart and quantitatively by two palm-sized reflectometers produced by PortaSCC®. One of four colors (No Color, Light Blue, Blue or Dark Blue) was recorded for each test strip. Two reflectometers were used in this study, one calibrated for cow's milk and an uncalibrated reflectometer. The four color changes produced by the PortaSCC® milk test strip are no color change, light blue, blue and dark blue, and represent SCC ranges for cow's milk of < 200, 200 to 750, 750 to 2,000 and > 2,000 x 10^3 cells/mL, respectively. The SCC range for no color change (< 200 x 10^3 cells/mL) on the test strip indicates the normal limit for a healthy udder half, and the SCC range for light blue (200 to 750 x 10^3 cells/mL) indicates a range of healthy to inflamed/infected udder halves. The blue color represents a SCC range of 750 to 2,000 x 10^3 cells/mL and indicates infection/subclinical mastitis. The dark blue color represents a SCC range of > 2,000 x 10^3 cells/mL and indicates chronic/clinical mastitis. Therefore, the color changes on the test strip that were no color, light blue, blue and dark blue will be represented on the following tables as udder health categories of healthy, healthy to inflammation, infection/subclinical mastitis, and chronic/clinical mastitis, respectively.

Somatic cell count was measured by flow cytometry (FC) and by the Dairy Herd Improvement Association (DHIA) laboratory located in Fresno, CA. The results from the PortaSCC® test strips were compared with actual SCC values determined by FC and the DHIA.

Results

An analysis of the number and percent of udder sides that fell below, within and above the projected SCC range for each udder health category is represented in Table 1. Overall, greater percentages of udder sides remained within the projected SCC range for the healthy and chronic/clinical mastitis categories, and SCC values for udder sides that tested in the healthy/inflammation and infection/subclinical mastitis categories were more varied and did not remain within the projected SCC ranges for those categories.

The data from the test strip reading and SCC results were compiled to find the SCC ranges represented by each udder health category (Table 2). No difference in actual SCC was detected between testing methods for samples associated with the healthy, healthy/inflammation, and infection/subclinical mastitis test strip categories. Values for the chronic/clinical mastitis category were greater ($P < .0001$) for DHIA than for FC. Actual SCC values measured by FC did not differ ($P > .5$) among the healthy, healthy/inflammation, and infection/subclinical mastitis categories, but were lower ($P < .0001$) than those for chronic/clinical mastitis. For DHIA, values for the healthy category did not differ ($P > .64$) from healthy/inflammation but were lower ($P \leq .05$) than those for infection/subclinical mastitis and chronic/clinical mastitis. Values for infection/subclinical mastitis did not differ ($P > .8$) from those for healthy/inflammation but were lower ($P < .0001$) than those for chronic/clinical mastitis, and values within the chronic/clinical mastitis range were greater ($P < .0001$) than those for any other udder health category.

Somatic cell count was measured quantitatively by FC, TM and two PortaSCC® hand-held digital reflectometers. The calibrated digital reflectometer displays projected SCC based on the reflectance reading from the test strip. The calibration curve was derived from reflectance and SCC readings from bovine milk samples.

The calibrated reflectometer has minimum and maximum detectable SCC thresholds of 5,000 cells/mL and 4 million cells/mL, respectively. However, as the upper and lower SCC thresholds were derived form the calibration curve for cow's milk, the actual threshold for sheep milk that can be detected by the reflectometer is unknown. An interaction between SCC values detectable by the reflectometer and test strip category was detected ($P < .0001$) and is shown in Table 3. Milk samples with SCC below the minimum or above the maximum threshold were excluded from this analysis. When measured by the calibrated reflectometer, SCC for udder sides that tested in the healthy range did not differ ($P = .68$) from those for healthy/inflammation, but were lower ($P < .02$) than those for infection/subclinical and chronic/clinical. Values for infection/subclinical did not differ ($P > .15$) from those for healthy/inflammation but were lower ($P > .0001$) than those for chronic/clinical, and values within the chronic/clinical range were greater ($P < .0001$) than those for any other category. Due to the low end detectable SCC threshold of the calibrated reflectometer, average SCC values for each category were lower than those measured by FC and DHIA.

An udder health category by sampling day interaction was detected ($P < .0001$) for SCC. Across testing methods, the mean SCC for samples that tested in the chronic/clinical mastitis range was greater ($P < .0001$) at 24 hours post-weaning than at weaning (Table 4). An udder health category by sampling day interaction was also detected for reflectance data measured by the uncalibrated reflectometer. The uncalibrated digital reflectometer measures raw reflectance data from the PortaSCC© test strips in mmol/L and mg/dL. No day effect was detected ($P \geq .59$) on samples that tested in the healthy or chronic/clinical mastitis categories, but samples in the healthy/inflammation and infection/subclinical mastitis categories were greater ($P < .03$) at weaning than at 24 hours post-weaning (Table 5).

Implications

Our results indicate that the PortaSCC® milk test could be used as an on-farm tool for determining udder health status in sheep as either healthy or within the chronic/clinical mastitis range. However, this test has not shown to be able to differentiate between udder sides between the healthy and infection/subclinical mastitis ranges. The PortaSCC® milk test can differentiate between healthy and chronic/clinical mastitis udder sides but does not differentiate between "doubtful" sides with SCC between 200,000 to 1,000,000 cells/mL. The projected SCC readings by the PortaSCC® calibrated reflectometer did not appear to add any accuracy to the test strip readings. Thus, the raw reflectance readings from the uncalibrated reflectometer may be a more accurate indication of SCC in sheep milk than the calibrated reflectometer.

Sampling day affected both SCC and reflectance data, indicating that testing at 24 hours post-weaning would be optimal for detecting all ewes with udder health problems.

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Table 1. Analysis of number and percent of udder sides below, within and above the projected somatic cell count (SCC x 10^3 cells/mL) range for the four test strip categories as measured by flow cytometry (FC), the traditional method (TM), and the PortaSCC® calibrated digital reflectometer.

Udder Health Category (SCC range)	FC			TM			Calibrated Reflectometer		
	Below	Within	Above	Below	Within	Above	Below	Within	Above
Healthy (< 200)	0	172 (58%)	127	0	237 (79%)	62	268[a]	25 (1%)	6
Healthy/ Inflammation (200 – 750)	3	13 (72%)	2	8	7 (39%)	3	14	4 (22%)	0
Infection/ Subclinical Mastitis (750 – 2,000)	20	2 (1%)	0	16	3 (14%)	3	20	2 (1%)	0
Chronic/ Clinical mastitis (> 2,000)	2	12 (100%)	0	0	14 (100%)	0	1	13 (93%)	0

[a] Values were below the detectable SCC threshold of the calibrated digital reflectometer.

Table 2. Effect of flow cytometry (FC) and the traditional method (TM) on somatic cell counts (SCC x 10^3 cells/mL) within each PortaSCC® test strip category.

Strip Category	Cell Counting Method			Color Chart
	FC	TM	SE	
Healthy	207[c]	130[d]	113	< 200
Healthy/ Inflammation	364[c]	351[c,d]	461	200
Infection/ Subclinical Mastitis	509[c]	1,008[c]	433	750
Chronic/ Clinical Mastitis[a]	7,296[b]	11,296[b]	535	2,000

[a] Row values differ (P < .0001).
[b,c,d] Column values with different superscripts differ (P < .05)

Table 3. Comparison of PortaSCC® test strip category to projected somatic cell count (SCC x 10^3 cells/mL) values from the calibrated PortaSCC® digital reflectometer.

Strip Category	SCC	SE	Color Chart
Healthy (n = 31)	132[c]	57	< 200
Healthy/Inflammation (n = 9)	183[b,c]	106	200
Infection/Subclinical Mastitis (n = 15)	374[b]	82	750
Chronic/ Clinical Mastitis (n = 4)	3,525[a]	159	2,000

[a,b,c] Column values with different superscripts differ (P < .02).

Table 4. Effect of sampling day on somatic cell count (SCC x 10^3 cells/mL) within PortaSCC® test strip category.[a]

Strip Category	Day 1	Day 2	SE	Color Chart
Healthy	119[d] (n = 148)	219[d] (n = 151)	114	< 200
Healthy/ Inflammation	178[d] (n = 9)	536[d] (n = 9)	461	200
Infection/ Subclinical Mastitis	720[d] (n = 15)	798[d] (n = 7)	523	750
Chronic/ Clinical Mastitis[b]	4,270[c] (n = 5)	14,321[c] (n = 9)	619	2,000

[a] Day 1 = weaning; Day 2 = 24 h post-weaning.
[b] Row values differ (P < .0001).
[c,d] Column values with different superscripts differ (P < .0001).

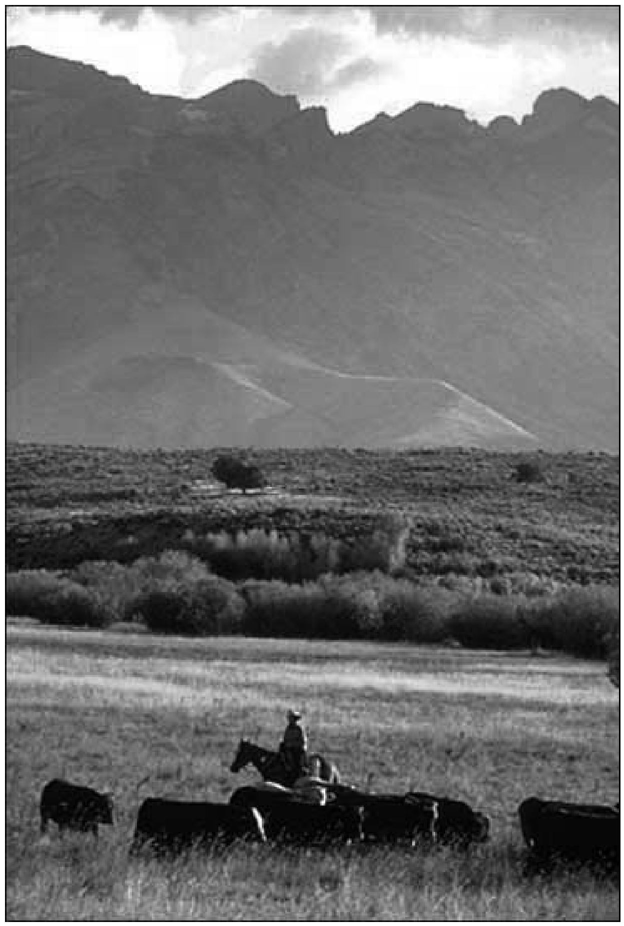
Table 5. Effect of sampling day on reflectance data from the uncalibrated PortaSCC® digital reflectometer measured in mmol/L and mg/dL (mean ± SE) in comparison to PortaSCC® test strip category and somatic cell count (SCC x 10^3 cells/mL) measured by flow cytometry (FC).[a]

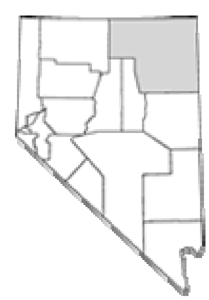
	Reflectance						
	mmol/L		mg/dL		FC SCC		
Strip Category	Day 1	Day 2	Day 1	Day 2	Day 1	Day 2	SE
Healthy	87 ± 0.6	87 ± 0.6	88 ± 0.6	88 ± 0.6	119	217	114
Healthy/ Inflammation	86 ± 1.4[b]	77 ± 2.5[c]	85 ± 1.5[b]	78 ± 2.6[c]	178	536	461
Infection/ Subclinical Mastitis	78 ± 1.3[b]	70 ± 1.9[c]	77 ± 1.9[b]	70 ± 2.1[c]	720	798	523
Chronic/ Clinical Mastitis	48 ± 2.6	46 ± 2.2	46 ± 2.2	45 ± 2.3	4,270[b]	14,321[c]	619

[a] Day 1 = weaning; Day 2 = 24 h post-weaning.
[b,c] Row values with different superscripts differ ($P < .03$).

TECHNICAL REPORT
UCED 2006/07-03

ANALYSIS OF IMPACTS OF PUBLIC LAND GRAZING ON THE ELKO COUNTY ECONOMY AND MOUNTAIN CITY MANAGEMENT AREA: ECONOMIC IMPACTS OF FEDERAL GRAZING IN ELKO COUNTY





UNIVERSITY OF NEVADA, RENO

ANALYSIS OF IMPACTS OF PUBLIC LAND GRAZING ON THE ELKO COUNTY ECONOMY AND MOUNTAIN CITY MANAGEMENT AREA: ECONOMIC IMPACTS OF FEDERAL GRAZING IN ELKO COUNTY

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PHOTO IS OF THE RUBY MOUNTAINS IN ELKO COUNTY NEVADA: NEVADA COMMISSION ON TOURISM

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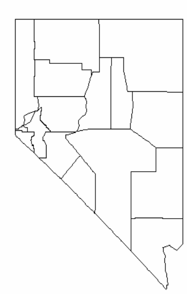

UCED
University of Nevada, Reno
University Center for Economic Development
Department of Resource Economics

Analysis of Impacts of Public Land Grazing on the Elko County Economy and Mountain City Management Area: Economic Impacts of Federal Grazing in Elko County

Executive Summary

The University Center for Economic Development completed an analysis of the economic impacts to Elko County of federal grazing permits as an input to cattle ranching. The results of this study can be used as background material for public lands management policies.

Historic Trends in Livestock Production in Elko County

- Beef cattle inventory for Elko County in 2006 was estimated to be 152,000 head.
- Beef cattle inventories have fluctuated over the past 30 years but have displayed an overall downward trend.
- Sheep and lamb inventory for Elko County in 2006 was estimated to be 19,700 head.
- Sheep and lamb inventories have displayed an even stronger downward trend than cattle inventories over the past 30 years and in 2006 were only 36% of 1975 levels.
- Sales of cattle made up more than 95% of livestock receipts to Elko County according to 2002 Census of Agriculture data.
- Elko County real net farm proprietor's income totaled $11.5 million and incorporated farm income was $18.3 million in 2004.
- Average operator age is increasing in Elko County and in the U.S. as a whole.
- Elko County average ranch size has decreased from 8,745 acres in 1987 to 6,227 in 2002.
- Operator characteristics data may indicate an increase in so-called lifestyle ranches, whether by choice or by default, and potential issues regarding a lack of younger operators for ranch succession plans.

Livestock Economics

- A linear programming model that simulates a representative Elko County ranch operation was used to examine potential impacts to Elko County ranches due to changes in federal grazing land availability.

- Average annual net cash income for the representative ranch under current conditions was $53,442. With a 25%, 50%, 75% and 100% reduction in federal AUM availability, average annual net cash income decreased to $46,134, $35,560, $8,703 and $-80,757 respectively.

- The probability of bankruptcy for the Elko County representative ranch was less than 1% if federal AUM reductions were less than 50%. Likelihood of bankruptcy increased to 12% at a 75% reduction and 96% in the case that no federal grazing is available.

- The variability of ranch profits increased as reductions in federal AUM availability increased.

- There were an estimated 847,000 permitted AUMs in Elko County in 2006. Approximately 85% of these were BLM allotments with the remaining allotments on the Humboldt-Toiyabe National Forest.

- There were an estimated 73,000 permitted AUMs in the Mountain City Ranger District and nearly 28,000 in the Jarbidge Ranger District.

- In 1997 in Elko County, 177 ranches or 68% of operations with beef cow inventories held federal grazing permits.

- The value of production associated with one AUM for beef cattle in Elko County was estimated to be $38. Total economic impact in Elko County from production value of one AUM was estimated to be $68.

- For every 1,530 AUMs available for cattle production in Elko County, one job was generated. Earnings per job generated by cattle production were estimated to be an average of $20,700 per year.

- Using the information above about one AUM, the 847,000 Federal grazing permits in Elko County could generate $32.6 million in cattle production, $57.3 million in total economic activity, $11.4 million in labor earnings and 553 jobs.

- For the Mountain City Ranger District, 73,100 AUMs can generate $2.8 million in cattle production output, $4.9 million in total economic activity in Elko County, $987 thousand in labor earnings and 48 jobs.

- For the Jarbidge Ranger District, 27,600 AUMs can generate $1.1 million in cattle production output, $1.9 million in total economic activity in Elko County, $373 thousand in labor earnings and 18 jobs.

- In certain circumstances, one AUM of federal grazing land may be more valuable than an average AUM in production of cattle. This depends on factors such as seasonal dependency, the extent of a given ranch's dependence on federal grazing, availability of substitutes and ranch viability issues. From a ranch production perspective, one AUM of federal grazing land in Elko County could be associated with as much as $84 in value of cattle production.

- From the ranch production perspective total economic impacts from one AUM of federal grazing are associated with as much as $148 of total economic activity, $30 of labor earnings and 0.0014 jobs. This implies one job per 714 AUMs of federal grazing.

- Using the ranch production perspective, total labor income associated with all permitted federal AUMs in Elko County would be $25.0 million representing 1,212 jobs.

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I. Introduction

Leased Bureau of Land Management (BLM) and United States Forest Service (USFS) land are an integral part of ranch production in Elko County, Nevada. The area of Elko County is approximately 11,000,000 acres of which over 70 % or nearly 8,000,000 acres are federal lands (Zimmerman and Harris 2000). A previous survey of ranches in northeastern Nevada found only 4 out of 56 ranches that did not use federal land for grazing. On average the ranches used federal rangeland to provide 49% of the feed requirements for their animals (Torell et al. 1981).

Because of the multiple use character of Federal BLM and USFS lands, reduction of availability of federal grazing is often under consideration. For example, recently changes in federal grazing land management have been under consideration in Elko County because of concerns over wildlife habitat for Lahontan cutthroat trout, sage grouse and other species (Bureau of Land Management 2006; Harding 2006). It is clear that reducing access to available animal unit months (AUMs) of grazing will increase costs and reduce profits for ranchers in Elko County. This report quantifies these losses to ranchers. In addition, economic losses to ranchers have an effect on the local economy. Cattle sector exports bring money into the Elko County economy which then cycles through the economy, helping to support other sectors such as local wholesalers and retailers, and providing wages to employees. These economic impacts related to federal grazing in Elko County are also quantified in this report.

The focus of this report is economic impacts related to ranch production. Ranch production of cattle in Elko County is a basic industry. In 2003, the Cattle Ranching and Farming Sector in Elko County recorded a value of output of $53.8 million which was 2.95% of total county value of output. This ranks the Cattle Ranching and Farming Sector eighth in value of output of Elko County's 142 economic sectors. The sector had export sales of $43.5 million which was 5.77% of total Elko County exports, which ranks the Cattle Ranching and Farming Sector fourth highest in export sales of Elko County's 142 economic sectors. The Cattle Ranching and Farming Sector is of significant economic importance to Elko County (Fadali and Harris 2006).

This report does not attempt to quantify existence or use benefits from any potential increases or decreases in wildlife, tourism or lifestyle use of the grazing lands, although these values may also be important. Any potential costs associated with overgrazing or changes to long-term productivity of the land are also not considered here. The assumption is made that

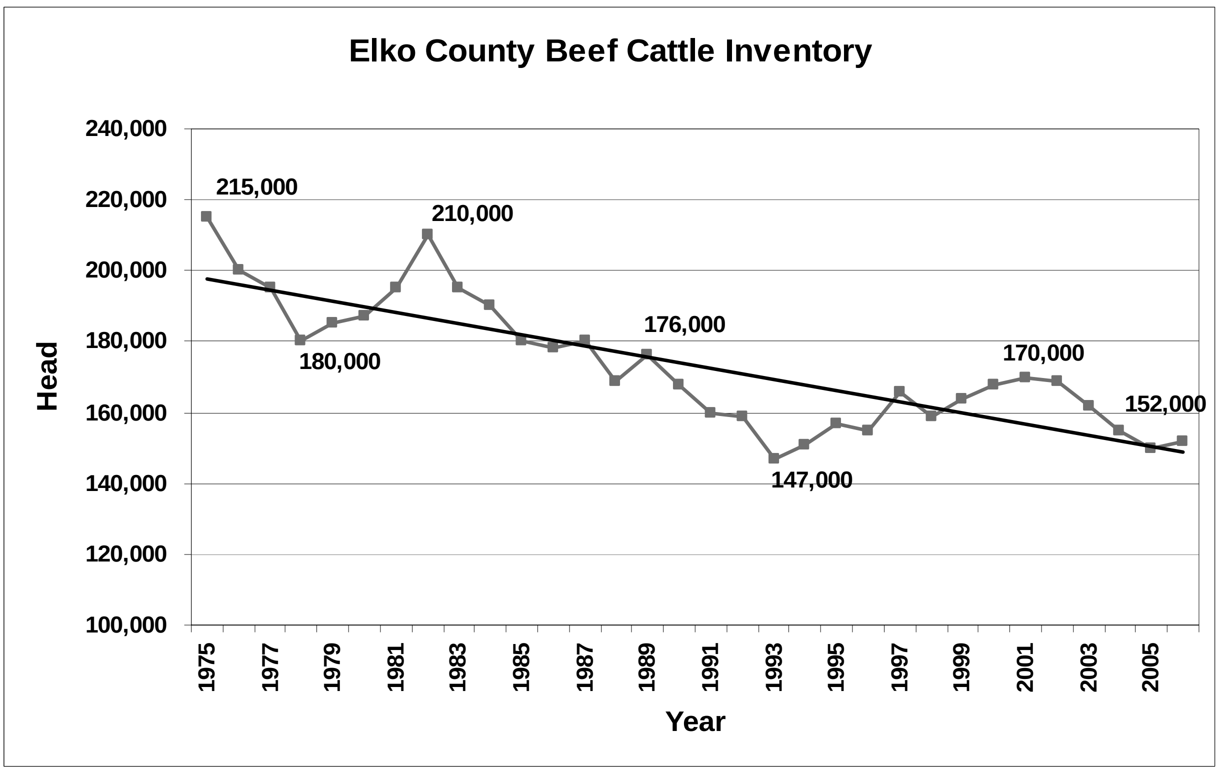
AUM availability reported by federal agencies is sustainable usage. In addition, other possible benefits or costs of ranchland such as provision of open spaces, barriers to residential development, or interactions with the fire cycle are not considered.

II. Historic Trends in Elko County Livestock Production[1]

Cattle Production

Beef cattle inventory for Elko County in 2006 was estimated to be 152,000 head. Inventory over the period from 1975 to 2006 ranged from a high of 215,000 head of beef cattle in 1975 to a low of 147,000 head in 1993. Although there was some fluctuation due to cyclical movements in the cattle industry and other factors, there was an overall decline in beef cattle inventory over the period from 1975 to 2006 as is illustrated by the trend line (in black). Tables 8 and 9 in Appendix A contain the complete data series used in Figures 1, 2, 3 and 4.

Figure 1. Elko County Beef Cattle Inventory with Trend Line, 1975-2006



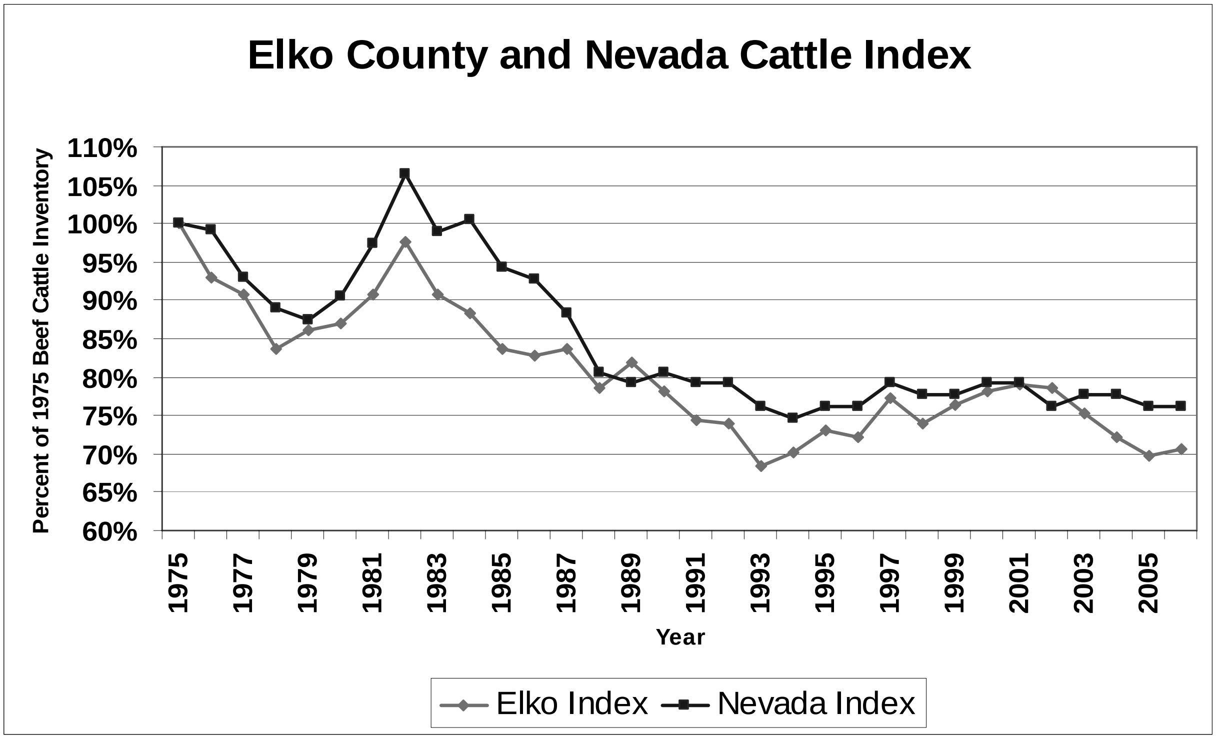
Data source: Quick Stats, U.S. & All States County Data - Livestock, United States Department of Agriculture. National Agricultural Statistics Service 2006

In Figure 2, beef cattle inventory over the period 1975 to 2006 for the state of Nevada and for Elko County is graphed as a percentage of 1975 inventory. Again, there are fluctuations but the downward trend in both indices is clear. Both state and county inventories do not reach

[1] This report follows portions of Foulke, T., R. H. Coupal and D. T. Taylor (2006). Implications for the Regional Economy from Changes in Federal Grazing: Park County, Wyoming. Western Regional Science Association, 45th Annual Meeting, Santa Fe, NM, University of Wyoming Department of Agricultural and Applied Economics.

above 80% of 1975 levels from 1991 onwards. In 2006, beef cattle inventories for Elko County and the state of Nevada were 71% and 76% of 1975 levels, respectively.

Figure 2. Elko County and Nevada Beef Cattle Index, 1975-2006.

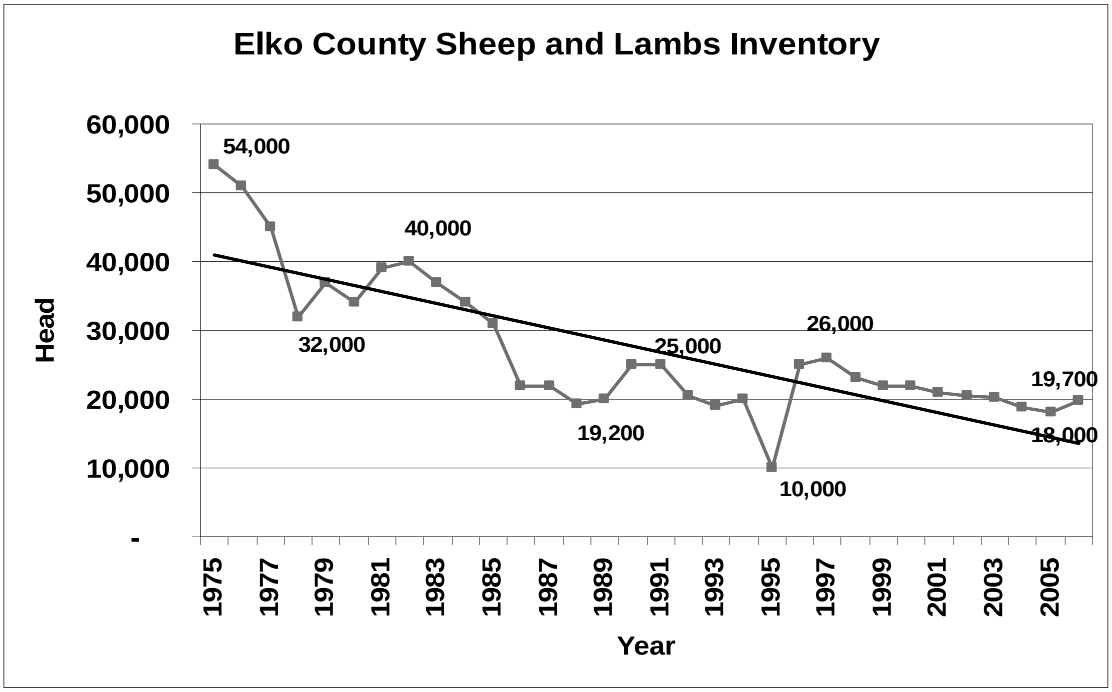


Data source: Quick Stats, U.S. & All States County Data - Livestock, United States Department of Agriculture. National Agricultural Statistics Service 2006, UCED analysis.

Sheep Production

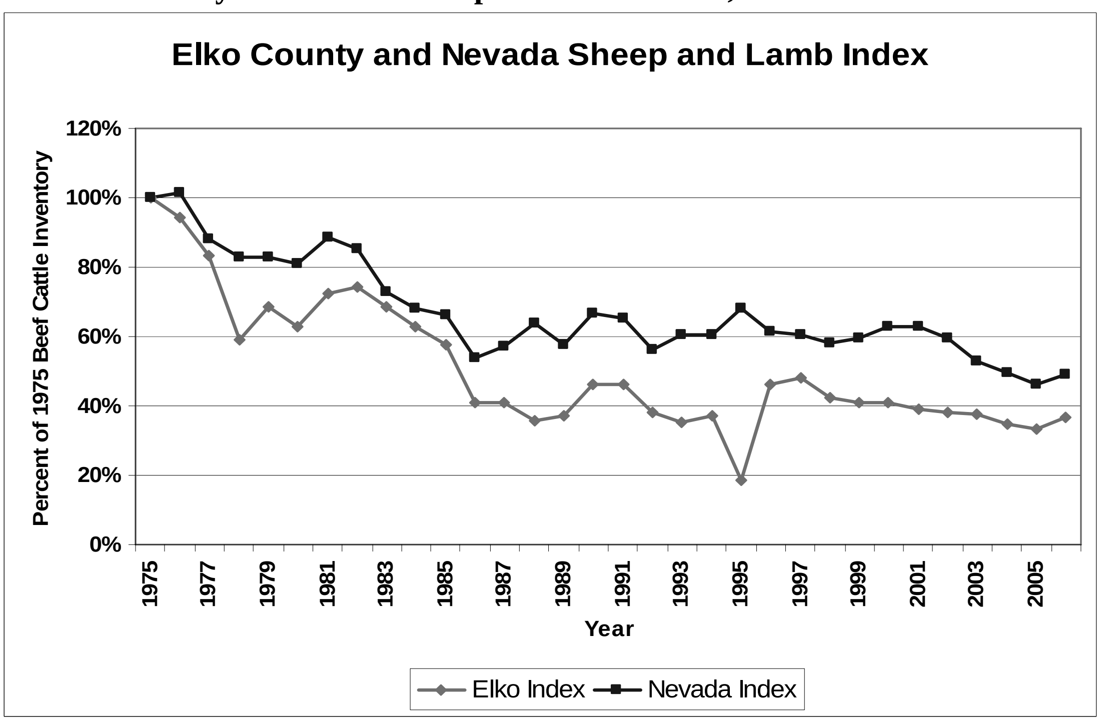
Sheep production makes up a small portion of total livestock sector activity in Elko County. Beef cattle production dominates, making up 95% of livestock sector receipts in 2002 (NASS 2004). Never-the-less, in 2006, sheep and lamb inventory in Elko County was estimated to be 19,700 head. As shown in Figure 3, there has been an even steeper decline in Elko County sheep and lamb inventories over the period from 1975 to 2006 than in beef cattle inventories. The high over the period occurred in 1975 at 54,000 head, while the low occurred in 1995 at 10,000 head. Figure 4 shows how Elko County declines in sheep and lamb inventory have been similar to but greater than declines in the state of Nevada inventory. Elko County inventories in 2006 were 36% of 1975 levels while Nevada inventories were 49% of 1975 levels. A nationwide decline in sheep and lamb inventories occurred over the same period. Inventories in the U.S. in 2006 were only 43% of 1975 levels. Many reasons have been posited for this decline such as labor costs and availability, synthetic fiber, imports, food preferences, predator control, lack of innovation in the industry, and competition from other meat sources.

Figure 3. Elko County Sheep and Lambs Inventory with Trend Line



Data source: Quick Stats, U.S. & All States County Data - Livestock, United States Department of Agriculture. National Agricultural Statistics Service 2006

Figure 4. Elko County and Nevada Sheep and Lamb Index, 1975- 2006.

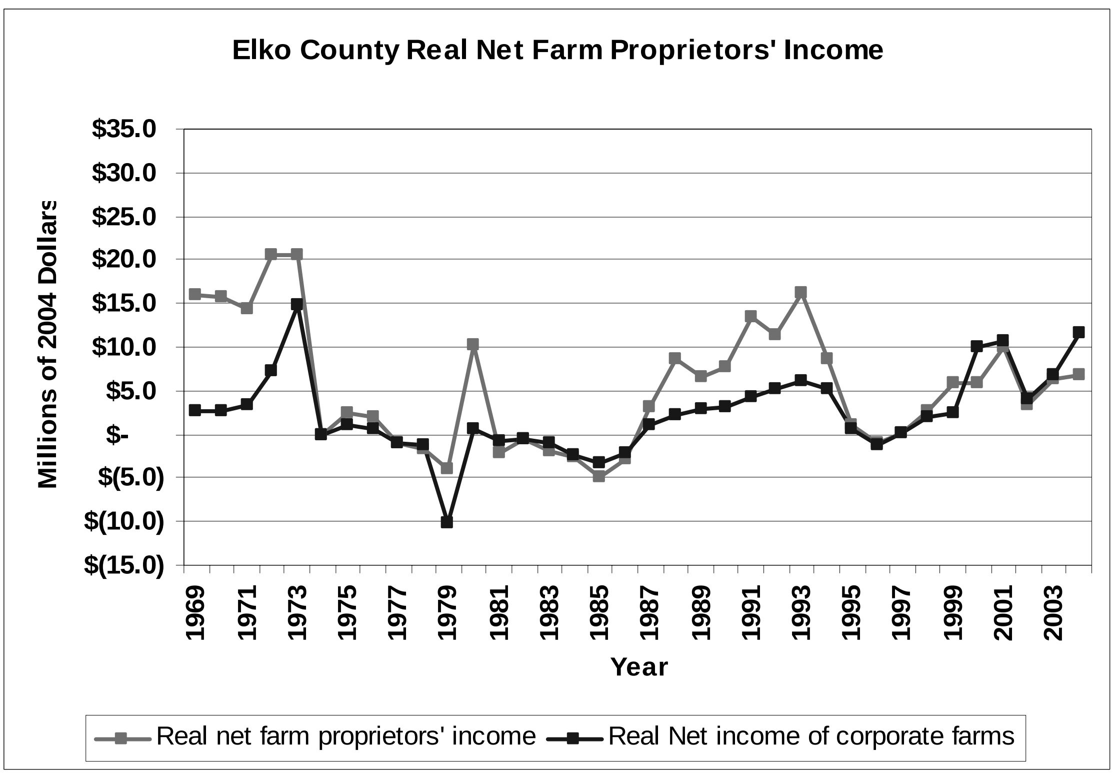


Data source: Quick Stats, U.S. & All States County Data - Livestock, United States Department of Agriculture. National Agricultural Statistics Service 2006, UCED analysis

Operator Demographics and Operation Size Trends

As shown in Figure 5, real net farm proprietors' income has been volatile over the period from 1969 to 2004, the period of record for Regional Economic Information Systems data. Real net income for incorporated farms has been somewhat less volatile over the period. Both series have been adjusted for inflation to 2004 dollars. For proprietors in Elko County, the highest net income was in 1973 at $20.6 million (2004 dollars) and the lowest was in 1985 when farm proprietor's lost $5 million (2004 dollars). For corporate farms the highest income also occurred in 1973 at $14.9 million (2004 dollars). The second highest corporate farm income in Elko County was in 2004 ($11.5 million). The lowest corporate farm income year was 1979, when farm corporations in Elko County lost $10.2 million (2004 dollars). Negative incomes for both corporate farms and farm proprietors in Elko County occurred from 1977 to 1979, 1981 to 1986 and in 1996. The 1980s marked a particularly difficult period for the U.S. cattle industry as a whole. The cattle cycle that occurred from 1979 to 1990 marked the first time that a cattle inventory cycle peak did not break a new record. In addition, the liquidation phase of this cycle

Figure 5. Net Farm Proprietor's Income and Net Income of Corporate Farms, Elko County, Nevada, 1969 to 2004, Millions of 2004 $



Data source: Regional Economic Information Systems (Bureau of Economic Analysis 2006), UCED analysis.

lasted eight years instead of the average of four years. Cheaper competing meats and changes in consumer preferences are thought to have been the causes of the 1980s prolonged cattle cycle and the failure to set new record highs in the cycle peak (Anderson et al. 1997).

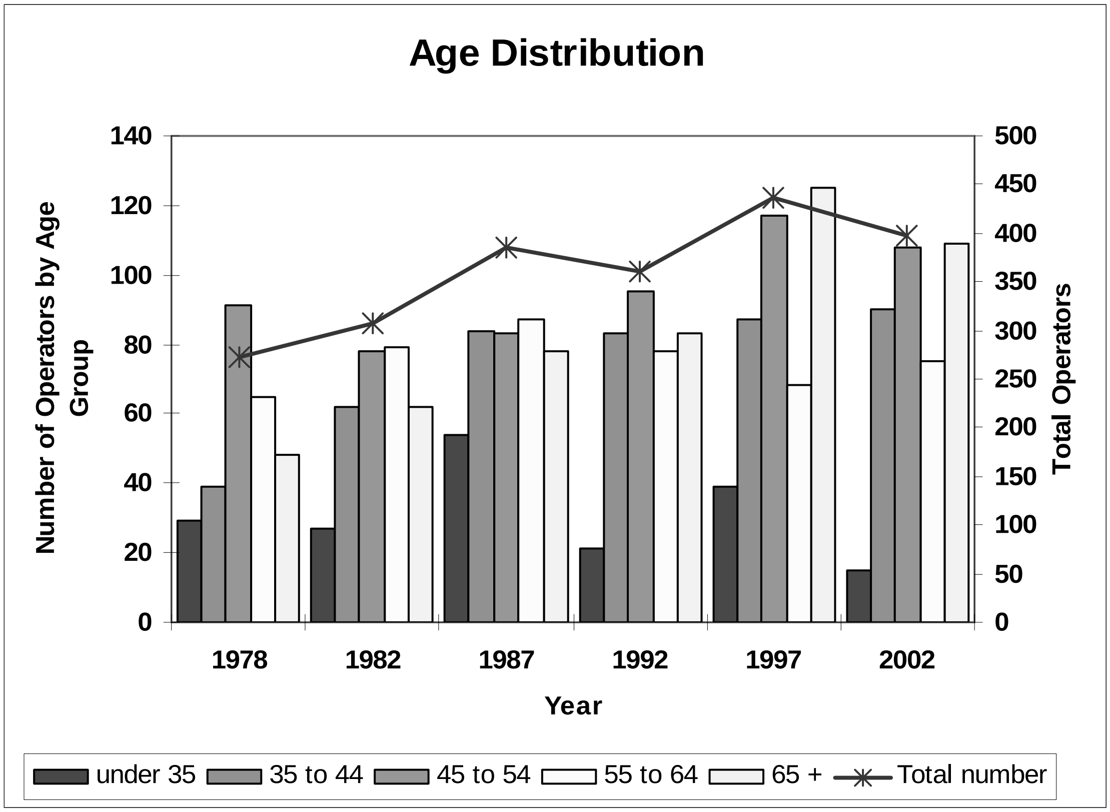
Figure 6 shows the total estimated number of Elko County ranch operators for each of the years that the Census of Agriculture has been taken from 1978 to 2002. Except for a decline from 1997 (436 operators) to 2002 (397 operators), there has been an upward trend in number of operators from 272 in 1978 to 397 in 2002[2]. Figure 6 also shows the number of ranch operators by age group over the period. There is an increase in the numbers of operators who are 65 and over from 48 in 1978 to 109 in 2002. The number of operators in the youngest age group under 35 years fluctuated, and ultimately failed to replace itself, while the 35 to 44 year old operators increased from a low of 39 in 1978 to a high of 90 in 2002. The 45 to 64 year old age group increased over the period also, but more modestly from 156 to 183 operators. The shift toward an older population of operators may reflect national trends in aging. The growth in the 35 to 44 year age group and the shrinking of the youngest age group of under 35 year olds may also reflect national demographic trends of the baby boom and baby bust generations. Elko County, however, experienced a growth rate of 4.3% in the number of people in the 20 to 34 year old age group over the years 1990 to 2000 while the United States as a whole experienced a loss in the number of people in this age group of 5.4%. Average age in Elko County (31.2) has been far younger than average age statewide (35.0) or nationally (35.3), (Census Bureau 2001). Taken together, these demographics may raise some eventual concerns about ranch succession plans as the large number of ranch operators 65 and older retire and the large baby boom generation also reaches retirement age.

Figure 7 shows the changing distribution of ranch size in Elko County from 1982 to 2002. From Figure 7, a general trend towards smaller ranch size can be observed. While the number of ranches with less than 9 acres actually decreased from 59 to 50 ranches over the period, there was nearly a doubling of the number of ranches with 9 to 49 acres from 39 ranches to 75 ranches. For the largest ranches with 2000 or more acres there was a decrease of 20 ranches from 127 to 107. Overall, the number of ranches with less than 260 acres increased by approximately 30% while the number of ranches with more than 260 acres decreased by

[2] 1997 and 2002 estimates from the Census of Agriculture are not entirely comparable with earlier years because of a change in weighting procedures, so the amount of the increase is not precise (Harris, 2006).

approximately 17% over the period from 1982 to 2002. Figure 8 shows how average ranch size has changed from 1987 to 2002 for ranches greater than 260 acres in size and for ranches less than 260 acres in size. Ranch size for larger ranches decreased from an average of approximately 15,000 acres to 13,100 acres, while average size for smaller ranches increased from 62 acres to 72 acres. This may indicate some increase in so-called lifestyle ranches and a corresponding decrease in the larger more commercially oriented livestock operations in Elko County.

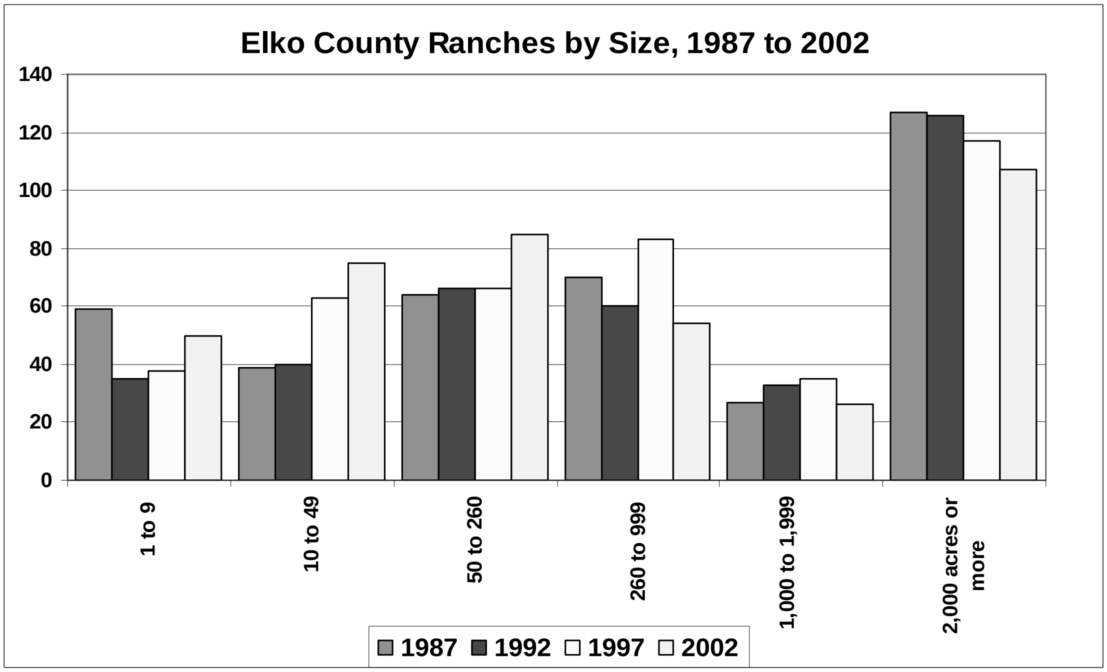
Figure 6. Age Distribution of Ranch or Farm Operators, Elko County, 1978-2002.



Data source: National Agricultural Statistics Service 2004. E-mail from Amanda Pomicter, Caudill Library, Marketing and Information Services Office, NASS.

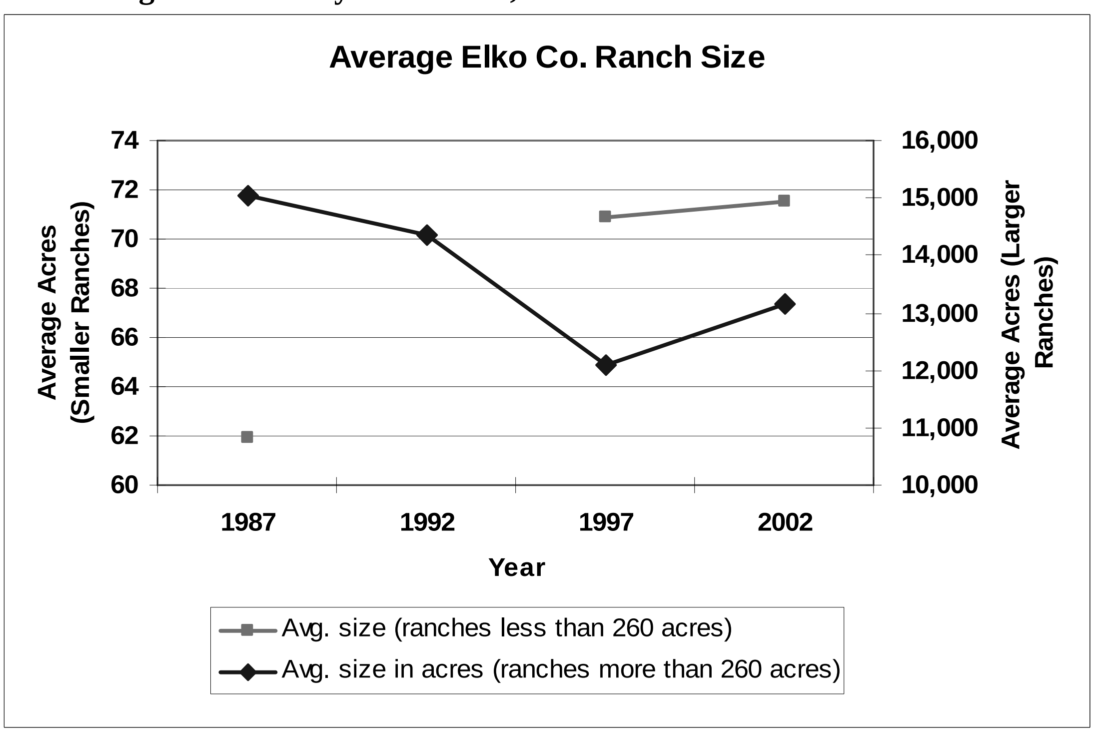
Figure 9 shows Elko County ranches by value of sales for Census of Agriculture years from 1987 to 2002. The number of ranches with $2,500 or less in sales increased from 81 in 1997 to 141 in 2002. The value of sales for ranches may differ dramatically from year to year depending on cattle prices and other cyclical factors. The large increase in number of ranches with sales less than $2,500 in 2002, however, occurred despite an improved real net farm income in 2002 when compared with 1997. This may indicate both a consolidation of profits amongst larger outfits and an increase in "hobby" ranching, whether due to the difficulty of turning a profit or to preference.

Figure 7. Number of Elko County Ranches by Size in Acres, 1987 to 2002.



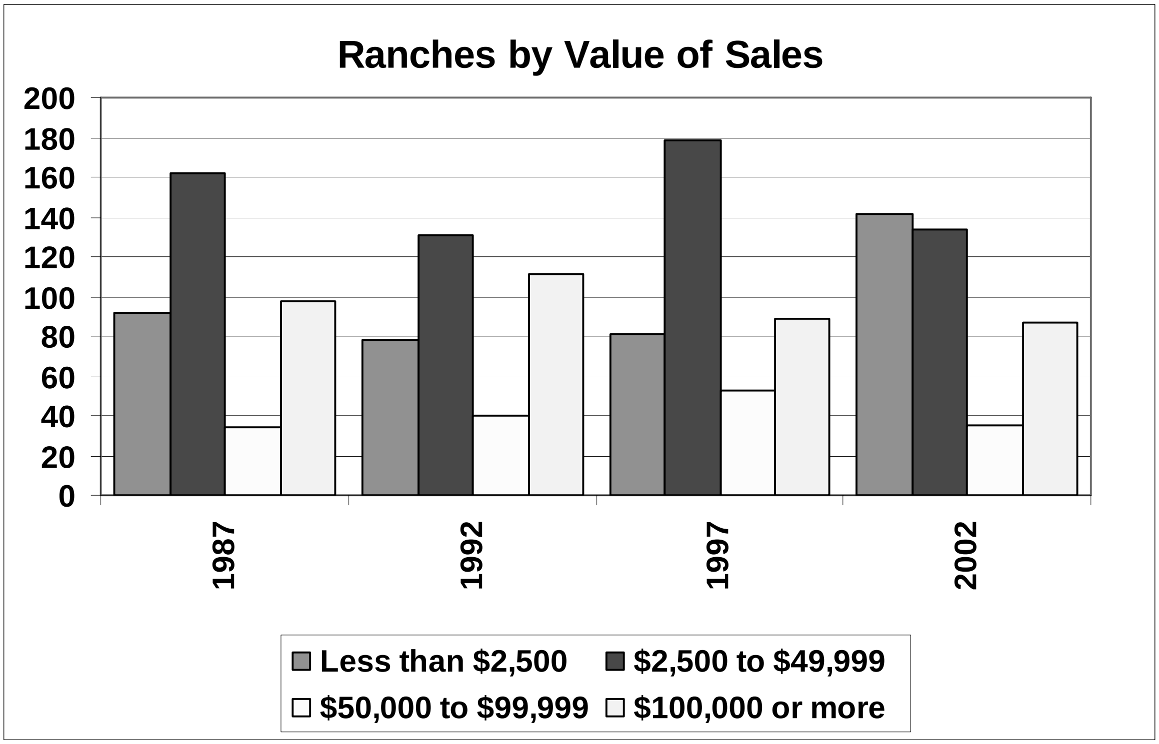
Data source: National Agricultural Statistics Service 2004, UCED analysis

Figure 8. Average Elko County Ranch Size, 1987-2002



Data source: National Agricultural Statistics Service 2004, UCED analysis

Figure 9. Elko County Ranches by Value of Sales, 1987-2002.



Data source: National Agricultural Statistics Service 2004, UCED analysis

III. Livestock Economics

GAMS Model Description

In order to estimate the economic impacts of changes in federal grazing rights an economic model of a representative 700 head ranch in Elko County was constructed. The study made use of a linear programming model developed in GAMS (General Algebraic Modeling System) that was originally developed by Alan Torrell and Larry Van Tassell. The program was modified to reflect current practices in ranching operations in Elko County using data collected by Curtis et al. (2005) from a panel of Elko County producers.

The linear program maximizes net returns of the representative ranch over a 40 year period, subject to constraints on land, forage and cash availability. The program allows for borrowing and saving by the proprietor as well as substitution across alternative input and output mixes in response to price and/or policy changes.[3] Policy questions associated with federal grazing reductions are addressed by first running a baseline model in which the current level of federal AUMs is available. Six alternatives that include federal AUM reductions of 10%, 25%, 50%, 75%, 84%, and 100% are also analyzed. The 84% reduction is included since it represents an approximate break-even point for ranch profits across all years and iterations. Table 1 presents the available AUMs for the representative ranch in the baseline case.

Table 1: Land Base for the Elko County Representative Ranch.

Type	Amount	Productivity
Federal	4148 AUM	
Private Lease	500 AUM	
Deeded Rangeland	115 AUM	
Forage	4826 AUM	
Hay	800 acres	1.5 tons/ acre

Table 2 details the key findings from the simulation runs. In the baseline, with the full federal allotment available, an average of 3,683 AUMs or 89% of those available are used. The share increases as AUMs are restricted so that with a 50% or greater reduction nearly the entire

[3] 100 iterations of the 40 year period were run with each using a price series that reflects a 12 year cycle of cattle prices. The starting point of the cycle was selected at random for each iteration in order to minimize the effect of price variability on policy impacts (Torrell et al. 2002). Prices were deflated using the most recent USDA Summary of Agricultural Prices (2006).

allotment is used under all price scenarios. Herd size (AUYs) and net cash income both fall as the AUM restriction becomes more stringent. The declines are not as severe as the AUM reductions, however, since increased use of alternative AUM sources mitigates their effects. As a result the share of federal AUMs in the total used falls from 44% in the baseline to 35% when federal AUMs are reduced by 50%. Less than proportional reductions in grazed hay and purchased alfalfa as well as small increases in purchased hay account for the greater shares of AUMs from non-federal sources.

For both the AUY and the net cash income, the severity of the negative impact increases dramatically when the restrictions grow larger than 50%. Initially, the decline in herd size occurs more rapidly than the economic returns so the net cash income per AUY is actually increasing from $148 at the baseline and peaking at $163 at the 50% level of reduction before falling sharply with further reductions.

In general it is true that, while the economic consequences of a loss of grazing rights are always negative, they become much more severe when the reductions exceed 50%. For example, the simulations reveal that bankruptcy is unlikely with reductions up to and including 50% percent where it reaches only a 1% probability. The probability increases dramatically however climbing to 12% and 43% with reductions of 75% and 84%, respectively. The complete elimination of federal AUMs makes bankruptcy a near certainty with a 96% probability of failure. The high level of ranch failures are associated with debt loads that increase from negligible amounts of less than $100 for reductions less than 50% up to $15,000 and $65,000 for the 84% and 100% reductions.

Similarly, the probability of a loss in any year is fairly constant, between 19 to 22%, for the baseline case and reductions up to and including 50% but increases dramatically with additional AUM cuts, reaching a high of 64% for the 100% reduction in AUMs. When the probability of a loss is less than the probability of bankruptcy (64% versus 96%) the implication is that the average loss is much larger than the average gain. Thus for the 100% reduction in AUMs, we find that the average loss is -$158,274 and the average gain $51,446 a ratio of -3.1 to 1. The economic consequences of this result are significant for the scenarios with large AUM reductions. It implies that large fluctuations in output and profitability may precede a ranch failure, with potentially destabilizing effects on the economy in the surrounding community.

Table 3 reports additional information on gross revenues and returns as well as on sources of revenue under the different scenarios. In addition to the figures reported in Table 3, the model assumes that the ranch generates an additional $10,000 in off-ranch income. In the baseline, gross revenues reach $294,000 and total costs of $240,731 yield the ranch profits of $53,442. Revenues are associated with the sale of 220 steer calves and 120 heifer calves as well as the sale of 263 tons of hay. Hay sales decline little with the reduction in AUMs, however revenues associated with livestock sales decline more rapidly than costs leading to 3.5%, 13.7% and 33.5% reductions for the 10%, 25%, and 50% reductions, and ultimately to the large losses associated with complete elimination of the federal AUMs.

Table 2: Summary of Ranch Level Results for Federal AUM Reductions.

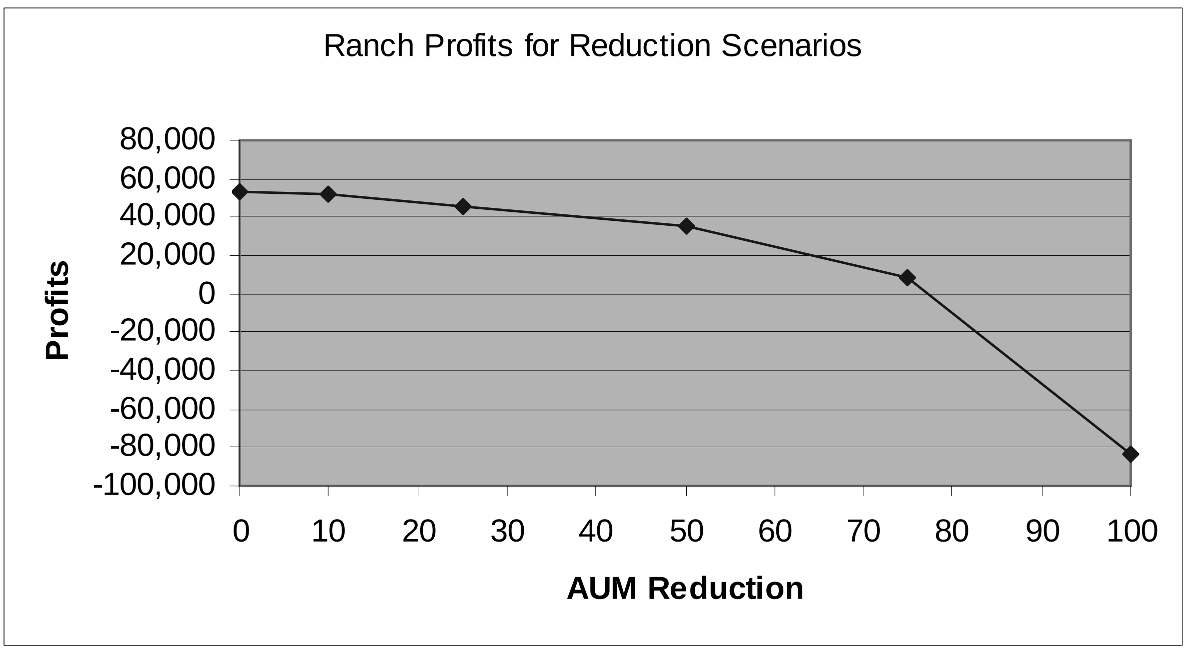
AUM Reduction (%)	**0**	**10**	**25**	**50**	**75**	**84**	**100**
Federal AUMs Available	4,148	3,733	3,111	2,074	1,037	664	0
Mean AUMs Used	3,683	3,508	3,067	2,072	1,033	662	0
SD AUMs used	*268*	*207*	*87*	*37*	*53*	*33*	*0*
Percent of AUMs from Federal Land	44%	43%	41%	35%	24%	25%	----
Average broodcows (head)	417	402	367	311	252	237	196
SD Broodcow	*28*	*25*	*26*	*28*	*38*	*35*	*62*
Average number of AUYs	700	676	619	526	429	405	336
SD AUY	*45*	*38*	*38*	*42*	*62*	*57*	*113*
Average annual variable costs ($)	190,915	185,913	172,611	145,027	132,031	127,861	185,086
SD varcost	*12,424*	*11,516*	*9,725*	*12,376*	*114,458*	*60,611*	*230,179*
Average annual variable costs per AUY ($/AUY)	273	275	279	276	308	315	553
*Average annual net cash income ($)	103,259	101,395	95,950	85,376	58,518	49,864	-33,115
SD Net	*58,216*	*56,158*	*51,331*	*44,259*	*120,896*	*67,423*	*293,246*
Average annual net cash income per AUY($/AUY)	148	150	155	162	137	122	-98
Change in net cash income from initial fed. AUM level (%)	-----	-1.80%	-7.08%	-17.32%	-43.33%	-51.71%	-132.07%
Deeded rangeland (AUMS)	115	115	115	115	115	115	115
SD Deed	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Priv Lease (AUMs)	0	0	0	0	3	3	2
SD Priv Lease	*0*	*0*	*0*	*0*	*35*	*35*	*31*
Meadow hayland in pasture (acres)	17	13	36	137	240	290	345
SD meadow hayland pasture	*33*	*41*	*65*	*88*	*95*	*101*	*148*
Meadow hay fed/grazed (acres)	783	787	764	663	560	510	455
SD hay fed	*33*	*41*	*65*	*88*	*95*	*101*	*148*
Purchased Alf	153	148	136	115	93	88	72
SD purchalf	*27*	*25*	*23*	*20*	*20*	*20*	*46*
Purchased Hay	2	2	6	14	19	19	5
SD Purchased Hay	*16*	*21*	*44*	*97*	*119*	*122*	*393*
Average borrowings ($)	55	58	88	358	10,322	14,593	65,490
Probability of bankruptcy (%)	0	0	0	1	12	43	96
Probability of negative profits in a single year (%)	20%	19%	19%	22%	30%	40%	64%

Prices adjusted using the most recent USDA Summary of Agricultural Prices (2006). Numbers in *italics* are standard deviations.

Table 3. Summary of Revenues and Returns for AUM Reduction Scenarios, Elko County

AUM reduction	0	10	25	50	75	100
			$ (dollars)			
Gross	294,174	287,309	268,561	230,403	190,550	154,144
Total Cost	240,731	235,729	222,426	194,843	181,847	234,901
Ranch Profits	53,442	51,579	46,134	35,560	8,703	-80,757
Profit decline (%)	----	3.5	13.67	33.46	83.72	251.11
Revenue sources						
Steers	220	212	194	164	134	104
Heifers	122	117	107	91	75	59
Hay (tons)	263	301	345	323	297	256

Figure 10. Mean Ranch Profits at Different AUM Reduction Levels.



Economic Importance of Public Grazing in Elko County

Federal grazing plays a large role in Elko County agricultural production. According to the 1997 Census of Agriculture, 177 ranches held grazing permits or approximately 41% of total agricultural operations in Elko County (436) in 1997 and 68% of operations with a beef cow inventory (262) in 1997. Of these ranches, 144 held grazing permits with the BLM, 61 held grazing permits with the USFS and 16 held permits with other types of land owners. Note that some owners had grazing permits with more than one type of agency.

Current data on the number of available animal unit months (AUMs) was collected from Elko County regional offices of the BLM, USFS and U.S. Fish and Wildlife Service. The data are displayed in Table 4. Total permitted AUMs in Elko County in 2006 were estimated to be approximately 847,058 with 85% of the total permitted AUMs on BLM lands and the remaining 15% on USFS land. A small amount of grazing was permitted on the Ruby Lake National Wildlife Refuge. Actual AUMs used were less than the permitted amount and vary from year to year. Another study of Elko County grazing estimated that as much as 49% of total AUMs used by the cattle industry were provided by federal grazing land (Torell et al. 1981). In addition to being a large portion of total AUMs, often the timing of forage availability on federal lands increases their importance to the ranch operation. Because of the seasonal factors, several studies have found that the value of an AUM from federal lands is greater than the value of AUMs from other sources (Torell et al. 1981; Torell et al. 2002).

Table 4. Permitted Animal Unit Months in Elko County, 2006

	Permitted AUMs
Elko and Wells District, BLM	719,680
Mountain City RD, USFS	73,101
Jarbidge RD, USFS	27,627
Ruby RD, USFS	25,937
Ruby Lake National Wildlife Refuge	713*
Total	**847,058**

Sources: Nevada Department of Agriculture 2003; Bureau of Land Management 2006; Prall 2006; Stefani 2006
*AUM availability varies by year from 433 to 1004. Approximately one-third of the possible grazing acreage is in White Pine County, Mackay 2006.

The results from the ranch level analysis in the previous section help to quantify the economic impacts that would result from restrictions on AUM availability on federal lands in Elko County. Because ranching operations have economic linkages with other sectors of the county's economy, changes in federal grazing also have implications for the overall economy of Elko County. Results of the ranch level analysis suggest that there are at least two possible approaches to evaluating economic importance of federal grazing to local communities. These three approaches are 1) evaluating federal AUMs only; and 2) evaluating federal AUMs and the total effects on total production. Each of the two approaches may be appropriate in different situations depending on the individual or collective circumstances of a ranch or ranches. Factors such as dependency on federal land grazing, the magnitude of changes in grazing availability under consideration and the availability of substitutes for AUMs lost will effect which of the two approaches best reflects actual impacts on the Elko County economy.

Impact of Federal AUMs Only

UNR cooperative extension cow-calf budgets for Elko County were employed to derive a per AUM value of production of $38 (Curtis et al. 2005). Using a modified 2003 input-output IMPLAN model for Elko County, the total economic impact of an AUM of production was estimated to be $68 per AUM (Minnesota IMPLAN Group 2004). This represents the total economic activity that occurs within the Elko County economy as a result of an AUM of livestock production. The total economic activity generated by cattle production is greater than the direct economic activity because of the multiplier effect. A dollar earned from exports of cattle provides an injection of funds into the Elko economy. Each dollar of expenditure in the local economy creates multiple impacts as it circulates around the local economy. When a rancher buys supplies from a local feed store, a portion of that dollar is then spent to hire local employees or buy local supplies, while some of the dollar leaks outside the county. Local employees spend a portion of their salary to at local retailers and so forth. The input-output methodology estimates this multiplier effect by estimating transactions between the various sectors of the local economy and its households. The multiplier effect means that each AUM of production value generates an estimated $13 in labor earnings and 0.00065 jobs. This represents one job for approximately 1,530 AUMs. Average earnings per job was estimated to be $20,700 per year.

From the Federal Grazing Only Perspective, the 847,000 Elko County AUMs of federal grazing result in $32.6 million of production, $57.3 million in total economic activity, $11.4 million in labor earnings, and 553 jobs in Elko County. (Table 5).

Impact of Federal Grazing on Ranch Production

Estimating the economic impact of federal grazing based solely on federal AUMs in many cases underestimates the actual importance of federal grazing. The results from the Northeastern Nevada ranch model indicate that, in terms of ranch production, one AUM of federal grazing can potentially generate as much as $84 of livestock production. This assumes that since federal AUMs are part of an overall grazing system, a change in federal grazing affects the optimal use of the rest of the forage resources.

From the Ranch Production Perspective, the 847,000 AUMs of federal grazing could result in $71.3 million in production, $125.4 million in total economic activity, $25.0 million in labor earnings, and 1,212 jobs in Elko County.

Previous research and results from the Northeastern Nevada ranch model indicate that the availability of federal land grazing is critical to the economic viability of many federal grazing dependent ranches. The ranch level analysis shows that net profits for federal grazing dependent ranches are negative without some level of federal grazing rights. This finding is consistent with other research done in the Mountain West (Torell et al., 2002, Myer et al.).

Table 5. Economic Impact of Federal Livestock Grazing in Elko County.

Per AUM	Federal Grazing Only	Ranch Production Perspective
Value of Production	$38	$84
Total Impact	$68	$148
Labor Earnings	$13	$30
Employment	0.00065	0.0014
Avg. Earnings/Job	$20,659	$20,659
Total AUMs	847,058	847,058
Value of Production	$32,552,054	$71,288,998
Total Impact	$57,267,859	$125,416,611
Labor Earnings	$11,434,320	$25,041,162
Employment	553	1,212

Economic Impact from Federal Grazing in Jarbidge and Mountain City Ranger Districts

Using the same methodology outlined above, total Elko County economic impacts associated with the USFS AUMs available in Jarbidge and the Mountain City Ranger Districts were estimated. The results are displayed in Table 6 and 7.

From Federal Grazing Only Perspective, the 27,600 Jarbidge AUMs result in $1.1 million of production, $1.9 million in total economic activity, $373 thousand in labor earnings, and 18 jobs in Elko County. (Table 6). Using the ranch production perspective, total economic activity associated with cattle production using the 27,600 AUMs in Jarbidge Ranger District is $4.1 million and results in 40 jobs.

For the Mountain City Ranger District for the federal grazing only perspective, the estimated 73,100 AUMs available on Forest Service land are associated with $2.8 million of production, $4.9 million in total economic activity, $987 thousand in labor earnings, and 48 jobs in Elko County (Table 7). The ranch production perspective would imply $10.8 million in total economic impacts and 105 jobs associated with the 73,100 AUMs.

Table 6. Economic Impact of Federal Livestock Grazing in Elko County for Jarbidge Ranger District AUMs.

	Federal Grazing Only	Ranch Production Perspective
Total AUMs	27,627	27,627
Value of Production	$1,061,693	$2,325,108
Total Impact	$1,867,805	$4,090,493
Labor Earnings	$372,933	$816,724
Employment	18	40
Avg. Earnings/Job	$20,659	$20,659

Table 7. Economic Impact of Federal Livestock Grazing in Elko County for Mountain City Ranger District AUMs.

	Federal Grazing Only	Ranch Production Perspective
Total AUMs	73,101	73,101
Value of Production	$2,809,238	$6,152,232
Total Impact	$4,942,209	$10,823,438
Labor Earnings	$986,780	$2,161,049
Employment	48	105
Avg. Earnings/Job	$20,659	$20,659

Summary

Federal livestock grazing is integral to cattle ranching operations in Elko County. The availability of federal lands for grazing livestock is important for individual ranches but also has an effect on the Elko County economy as a whole. Total economic impacts associated with federal land grazing in Elko County range from $11.4 million to $25.0 million in labor income and from 553 jobs to 1,212 jobs.

Appendix A: Elko County Beef Cattle and Sheep and Lamb Inventory Tables, 1975 to 2006

Table 8. Elko County Beef Cattle Inventory, 1975 to 2006

Year	Beef Cattle Inventory (head)		Year	Beef Cattle Inventory (head)	
	Elko Co.	Nevada		Elko Co.	Nevada
1975	215,000	657,000	1991	160,000	520,000
1976	200,000	651,000	1992	159,000	520,000
1977	195,000	611,000	1993	147,000	500,000
1978	180,000	585,000	1994	151,000	490,000
1979	185,000	575,000	1995	157,000	500,000
1980	187,000	595,000	1996	155,000	500,000
1981	195,000	640,000	1997	166,000	520,000
1982	210,000	700,000	1998	159,000	510,000
1983	195,000	650,000	1999	164,000	510,000
1984	190,000	660,000	2000	168,000	520,000
1985	180,000	620,000	2001	170,000	520,000
1986	178,000	610,000	2002	169,000	500,000
1987	180,000	580,000	2003	162,000	510,000
1988	169,000	530,000	2004	155,000	510,000
1989	176,000	520,000	2005	150,000	500,000
1990	168,000	530,000	2006	152,000	500,000

Source: Quick Stats, U.S. & All States County Data - Livestock, United States Department of Agriculture. National Agricultural Statistics Service 2006

Table 9. Elko County Sheep and Lambs Inventory, 1975 to 2006

Year	Sheep and Lambs Inventory (head)		Year	Sheep and Lambs Inventory (head)	
	Elko Co.	Nevada		Elko Co.	Nevada
1975	54,000	151,000	1991	25,000	98,500
1976	51,000	153,000	1992	20,500	85,000
1977	45,000	133,000	1993	19,000	91,000
1978	32,000	125,000	1994	20,000	91,000
1979	37,000	125,000	1995	10,000	103,000
1980	34,000	122,000	1996	25,000	93,000
1981	39,000	134,000	1997	26,000	91,000
1982	40,000	129,000	1998	23,000	88,000
1983	37,000	110,000	1999	22,000	90,000
1984	34,000	103,000	2000	22,000	95,000
1985	31,000	100,000	2001	21,000	95,000
1986	22,000	81,000	2002	20,500	90,000
1987	22,000	86,000	2003	20,200	80,000
1988	19,200	96,000	2004	18,700	75,000
1989	20,000	87,000	2005	18,000	70,000
1990	25,000	101,000	2006	19,700	74,000

Source: Quick Stats, U.S. & All States County Data - Livestock, United States Department of Agriculture. National Agricultural Statistics Service 2006

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January, 2008 Cattlemen's Update

The office of the State Veterinarian for Nevada is once again pleased to take part in the 2008 Cattlemen's Update. As State Coordinator of the Animal Identification Program, I appreciate the ability to participate and take advantage of the opportunity for public outreach and education.

Through the office of the State Veterinarian, the Nevada Department of Agriculture (NDOA) will continue the contract with the United States Department of Agriculture (USDA) for the National Animal Identification System (NAIS). The first step continues to be premises registration.

By registering your premises, state animal health officials have the ability to trace to the source a potential or real disease threat. This ability is necessary for the health and economic well-being of the commercial food producing industries – livestock, poultry and aqua culture. Accurate and complete information to respond effectively to a disease event or conduct disease surveillance programs will minimize potential spread, lessen the impact and provide a "return to normal" in an expeditious manner.

The desired time frame for traceability is 48-hours. Within this time frame, animal health officials and local veterinary practitioners through data retrieval will be able to identify the source and limit potential harm to animal agriculture. We look forward to continue working with industry partners to achieve this goal to maintain consumer confidence and the confidence of trade partners.

Animal disease is costly to producers. For example, costs recently released by USDA identify $130M in indemnity and control for Bovine Tuberculosis; $5M investigation and $189 M enhanced surveillance program for Bovine spongiform encephalopathy (BSE) and $160M for eradication cost for Exotic Newcastle disease. A standardized information system with official identification provides an opportunity for producers to participate in safeguarding animal health before a disease outbreak occurs.

The premises registration program remains voluntary and confidential. In Nevada, confidentiality is protected by NRS 561.285 which defines confidential and proprietary information. Premises registration is by physical location, i.e. address. There is no fee to register and we do not collect number information of any species.

I have attached a direction sheet and Premises Registration Form. I hope you will take a moment to review this information; complete the form and return it to me at your earliest opportunity. My complete contact information is also provided. I am looking forward to seeing you at the update.

Sincerely,
Holly Pecetti

Holly Pecetti, Program Officer 1
Animal Identification Coordinator

National Animal Identification System/Premises Registration Form

This form has been developed by the office of the Division of Animal Health, Nevada State Veterinarian's Office. The goal of premises registration is to achieve a rapid trace back should the need arise to respond to disease outbreak or bioterrorism/agro-terrorism attack which may pose a threat to the nation's food supply.

Please read the following points before completion of the attached form:

- Premises registration applies to a physical address and the name (s) of the legal property owner (s). Should property ownership change, the registered number stays with the address. Notification of the change should be promptly made to the State Animal ID Coordinator at the State Veterinarian's office of NDOA.
- Premises registration is not related to brand(s) registration. A brand number may be used as a State ID number to cross-refer contact information.
- This is **not** a program of numbers. We do not collect the number(s) of species, only the primary three (3) species on the premises.
- Age and source verification is becoming increasingly critical to feedlot managers, processors and international trade. The unique 7-digit number is included on the individual animal identification tags and group lot tags for sheep, swine, and poultry. This system allows producers who are registered and their animals identified to obtain the highest market value for their livestock.
- Once a premise has been registered, a card is mailed providing the producer the information necessary to start the animal identification process to coincide with current business practices.
- Website information: www.agri.nv.gov.
- Return completed form information:

Nevada Department of Agriculture
Holly Pecetti, Program Officer 1
Animal Identification Coordinator
350 Capitol Hill Ave
Reno, Nevada 89502

email at hpecetti@agri.state.nv.us

Fax: 775/688-1733

Questions: 775/688-1180 ext. 236

- Please do not hesitate to contact me if there are any questions related to form completion or if you need further information.

NEVADA PREMISES REGISTRATION FORM

Premises Name

Premises Owner- First:

Premises Owner-Last

Physical Address for UPS delivery or Emergency Services Response

City

State

NV

ZipCode

County:

US Postal Service Mailing Address :

Mailing City:

Mailing State:

Mailing Zipcode:

Contact Information First Name

Contact Information Last Name

NV Brand Registration Number

Other State Brand Registration Number

Phone Number

Cell Phone Number

Fax Number

E-mail

OTHER LOCATION INFORMATION

Latitude

Longitude

Checkoff Species: Beef __ Dairy __ Sheep __Goats __Horses __ Swine __ Poultry __

Comments and other information

Please fill out and fax to: 775-688-1733 or Mail To:
NDOA
Att. Holly Pecetti
350 Capitol Hill Ave
Reno, NV 89502

For Questions Please Call Holly Pecetti at 775-688-1180 ext. 236

NEVADA PREMISES REGISTRATION FORM