Cattlemen's Update 2009

(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 2009 edition of the Cattlemen's Update Proceedings. This year finds us in times with economic turmoil. This year's program will focus on international marketing, something that is going to become more and more important in the future. 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 (775-738-1721), Dr. David Thain (775-784-1377), 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

The Changing International Beef Market & Export
Marketing Opportunities Jim Robb Livestock Marketing Information Center Director
Age, Source, & Process Verification for International Export Dr. Ben Bruce UNCE State Livestock Specialist
Animal Welfare & Bio-SecurityDr. David Thain UNCE Veterinarian
National Market Cow & Bull Beef Quality Audit and
Regional BQA CertificationRon Torell UNCE Area Livestock Specialist
Nevada Beef Council Product Development and PromotionLucy Rechel & Bob Butler Nevada Beef Council
Update on the Cattlemen's AssociationMeghan Wereley & Rachel Aja Nevada and National Cattlemen's Beef Associations
Issue of Local ConcernLocal Veterinarian

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January, 2009 Cattlemen's Update

STATE OF NEVADA



DEPARTMENT OF AGRICULTURE

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Once again, it is a privilege to take part in this year's Cattlemen's Update. This occasion provides an opportunity for producers and members of the State Veterinarian's staff to discuss programs at work that can benefit Nevada producers and their various operations.

This year, premises registration continues to be a focal point. The Country Of Origin Label (COOL) took effect September 30, 2008. Beef, pork, lamb, chicken, goat meat as well as some perishable commodities are subject to COOL.

To be COOL compliant, producers who choose to participate in the official animal identification "840" tag program will be required to have a premises number. In the event of a potential or real animal health incident State officials will be able to locate where and what animals may be involved; establish appropriate response; halt the spread of disease; minimize industry losses and return to routine business.

The value of individual identification can be realized in marketing programs such as age/source verification; quality assurance and COOL. The "840" tags are to be used for animals born in the United States as of July 15, 2008. The use of 840 RFID tags may also lead to production as well as yield and grade information becoming available to livestock producers.

The USDA web site <u>www.usda/nais/840</u> will provide current information regarding tags and premises registration.

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, Program Officer 1
Animal Identification Coordinator

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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.

Premises Name NEVADA PRE	EMISES REGISTRATION FORM Update 2009 pg 3
Burning Come First	Describes Octobel and
Premises Owner- First:	Premises Owner-Last
Physical Address for UPS delivery or Emergency Servic	es Response
City	State ZipCode County:
	NV
S Postal Service Mailing Address :	
Mailing City:	Mailing State: Mailing Zipcode:
Contact Information First Name Cont	tact Information Last Name
V Brand Registration Number	Other State Brand Registration Number
none Number	Cell Phone Number
ax Number	
-mail	
OTHER LOCATION INFORMATION	
atitude	Longitude
Checkoff Species: Beef Dairy	SheepGoatsHorses Swine Poultry
comments and other information	
Please fill out and fax to: 775-688-1733 or	To addonore Floures can from Footh at
Mail To: NDOA	775-688-1180 ext. 236
Att. Holly Pecetti 350 Capitol Hill Ave	NEVADA PREMISES REGISTRATION FORM
Reno. NV 89502	

COOL, NAIS, QSA, PVP, BEV, and AMS and other Producer Hoops to Jump Through

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

These programs are all independent, but in many ways, intertwined. COOL is at the bottom level and PVP at the top. They are related in several fashions. If you have NAIS approved ID in your cattle, you have already covered COOL. If you are in a QSA, you have already covered COOL but maybe not NAIS. A PVP covers all of the COOL, QSA, and maybe NAIS requirements. The following may do a little bit to sort out the different programs.

What is COOL? COOL is country of origin labeling, a law becoming effective 30 September 2008. Packers will require certain information from producers to comply. Cattle are not included in COOL, but beef is, so that means cowherd owners have to prove where they were born for the packers. For beef cattle producers this means keeping some kind of a record system to prove the animal was born on your place. There has not been specified a certain record keeping system. Noting calving dates in the red book along with farm records of supplement purchases, brand inspection certificates, medical purchases, and other records will probably suffice, but the records must be available for audits. There is an affidavit that must be signed, and the suggested one is on the last page of this article. If you are using NAIS, a QSA or PVP you are already covered.

What is NAIS? NAIS is USDA's national animal identification system and is a voluntary program designed to track animals in cases of disease. This is primarily for disease tracking, food poisoning outbreaks and the like. NAIS has three distinct phases, the first premises identification. The goal is to list all locations where animals are produced. Producers apply for and get a premises identification number. The second step is animal identification. This can be by individual animal or by group lots. Individual identification is by RFID (the 840 tag) and contains a unique 15 digit number. Animals identified in a group get a 15 digit group animal identification number. The third component is animal tracing and requires producers to select an animal tracking data base. There are a number of these available. Movement within a production unit is not recorded, but other movements are. The information can be use to track animals in the case of disease outbreaks or other reasons. All three components of the NAIS are strictly voluntary.



What are BEV and AMS? BEV is Beef Export Verification and is a USDA program ran through the Agricultural Marketing Service (AMS, a USDA agency) to verify the ages and sources of animals. Many countries will only allow products from animals age 20 months or younger. To satisfy the needs of BEV, a producer needs to be in a QSA or a

PVP. QSA is quality system assessment. It is an audit and verification program, and is a private-industry program aimed at getting beef to meet USDA Beef Export Verification programs. PVP is process verified program (also private Industry), and is like the QSA only a little broader. Besides age and source verification, PVP will have feeding management and genetic records.

Both QSA and PVP are used to qualify animals for the USDA's Beef Export Verification program (BEV). Each country we do business with has differing requirements for export and it is the BEV that keeps track of that. The QSA and PVP are programs ran by packers and exporters to meet the requirements of BEV. Producers have to join with a company offering a QSA or PVP to take advantage of any price increase and follow their guidelines. A PVP program can use the label "USDA Process verified", but QSA can't. Considerable extra effort is involved, as well as some costs, so weigh the advantages carefully.

Quality Systems Assessment is essentially a subset of a PVP or Process Verified Program. The usually have fewer documented procedures and records than a PVP. It is difficult to exactly describe either a QSA or PVP as each company will have their own rules and guidelines. In general the basic recommendation to the producer for either would be to maintain the following records and procedures:

- 1. Tag all cows and calves with a unique number. Tagging calves at or near birth is best. Please note below that this is not strict. Identification of animals may be by either group or individual, and in some cases brands will work. If you keep different groups of cattle, keep record of the groups separately.
- 2. Keep detailed calving records. The red book can help greatly here. Records should include calf ID, dam ID, calving date and the sex of the calf. If you are group identifying the calves, record the date the first calf was born and the day the last calf was born. Be able to differentiate caving seasons if you have more than one. Also keep records of artificial insemination, including semen purchases and servicing dates. Keep these records in a safe and retrievable place.
- 3. Keep records of all cattle sales, method of marketing, and brand certificates.
- 4. Become a BQA certified producer.
- 5. Keep all BQA records up to date as required. Record all vaccinations, dewormings, implanting, and health treatments.
- 6. Keep all records in a safe, accessible location for a minimum of three years.

There are some general misconceptions on verification programs. You don't have to enroll in a company sponsored QSA or PVP. You can have your own. Estimates for the

expense of these vary, so do your homework. The paper work may not be as bad as feared. Depending on your operation, you may already have most of the records needed. The audits are not by the USDA, but by the company with the verification program. Onsite verifications are not necessarily required. You are not required to participate in the NAIS. Some programs will strongly suggest it, as does the AMS, but it is not a requirement for a QSA or PVP. Brands can be used as identification, but the ranch must have only one defined calving season and no outside calves may be purchased and brought onto the farm. The untagged animals, when marketed, must be moved to a USDA supplier directly, where they will be tagged. RFID tags are not required, ranch tags can work and in some cases brands.

Recommended Country of Origin Affidavit/Declaration Statements

Continuous Country of Origin Affiday operation in the livestock chain attesting producers.)	vit/Declaration to the Country	n: (This following affidavit could be used by any y of Origin of livestock but particularly for first-level
knowledge, normal business records, or p document or other communications spec	producer affic ific to the tran ould the origin	n of my livestock become other than that described
This affidavit/declaration shall remain in	ı effect until r	evoked in writing by the undersigned and is
delivered to	(agent/buye	er).
Signature	Date	Business/Farm/Ranch Names/Location
Declaration on Record or as a Stand-Alo as a supporting declaration of origin specifi	me Declaration fic to transaction it/declaration	s and Other Sales Documents with a Continuous n of Origin: (The following statement would be used ons involving livestock from persons with a continuous on specific transaction(s) on invoices, check-in sheets
origin.	tins documen	t and transferred are of
Signature		Date
may request that their immediate/direct sugaffidavit/declaration statements to affirm maintained by their immediate suppliers.	ppliers add the the period of This may be t d they must be country of orig (Inser	rt business name) has, and will maintain records of

I attest that these records reflecting specific transactions are available for inspection for the sole purpose of compliance with an audit as described by the country-of-origin labeling provisions contained in the Farm Security and Rural Investment Act of 2002 as amended. (P.L. 108-767, USCA section 1638a, 2003).

Timely Marketing of Cull Cows:

Every Cattleman's/Dairyman's Responsibility Ron Torell, University of Nevada Cooperative Extension Livestock Specialist

Short-term, gummer, and smooth-mouth are all terms cattlemen use to describe their older bovine employees. They have produced well for the past 10-12 years. These cows are the experienced veterans of the herd. However, due to age, lack of teeth, and an anticipated decline in production, they are forced to retire. Before issuing her "pink slip" many try to squeeze that last calf, or in the case of dairy cows, that last drop of milk out of her. Humane treatment of animals and timely marketing of these veteran employees as a means of eliminating non-ambulatory cows at sale barns and harvest facilities is every cattleman's responsibility. In this paper let's address and rethink that last calf and that last drop of milk.

Prices for cull cows are based on their expected USDA carcass grade. The most common grades, in order of the least amount of marbling and dressing percentage to the greatest, are: canner (very thin body condition scores of 2 and 3); cutter (thin body condition score of 4); utility (moderate body condition score of 5); and commercial (fleshy body condition score 6 and above). Both price per pound and dressing percentage significantly increases with the higher body condition score animals. This economically favors marketing these cows in a timely manner prior to them losing body condition and falling into a lower grade. Most non-ambulatory animals are emaciated and would be classified in the canner, very thin body condition score category.

According to Dr. Dan Drake, Yreka, California farm advisor, "A major reason these old cows decline in production and body condition is due to their reduced ability to breakdown feed stuffs. Of course this is primarily due to the loss of the mechanical tools, the teeth. The digestive system of the ruminant is dependent on small particle sizes for proper digestion. Because the particle size of the feed stuffs consumed by these old cows is increased, passage rate is slowed, thus consumption is reduced. Nutrient requirements of these old cows have not increased; rather her consumption and feed efficiency have both decreased. The combination of the two requires that these cows be placed on a more nutrient dense ration with smaller particle size and softer feed. We need to do more of the feed breakdown for the cow," concludes Drake.

Glenn Nader, Yuba County, California farm advisor, agrees with Drake. He also feels that many of these old cows have lost some of the villa in the lining of the digestive tract which adds to the lowered feed efficiency and digestion. Additionally, Nader feels functionality of some internal organs such as the liver and kidney is compromised in many of these old cows. Nader feels that these old cows need to be pampered if they are kept for the last calf. "They can no longer produce with the same feed and under the same conditions as the main cow herd. Rations such as chopped hay with a concentrate work well on these old smooth mouth cows. This is a nutrient dense ration which is high in protein and energy. More importantly, because it is chopped, the particle size of the feed is small. This compensates for the old cows lack of ability to break that feed stuff down herself."

"If you keep these old cows for one more year, you have to manage them differently than the main-cow herd," agrees Dan Gralian, manager of the TS Ranch of Battle Mountain, Nevada and current president of the Nevada Cattlemen's Association. "If you do not provide that extra feed and care, a dink calf and a shelly canner cow is the result. The shelly canner cow is what the industry is trying to avoid through timely and early marketing of these old cows. Shelly canners will dress less than 38 percent and pose a humane treatment issue to the industry. Prevention is always the best cure."

What once worked from a marketing standpoint for Rebel Creek Ranches of Orovada, Nevada may not work today with higher winter feed costs. Ron Cerri, owner/manager of Rebel Creek Ranch and President-elect of the Nevada Cattlemen's Association would calve these old cows in March and run the pairs inside on irrigated pasture in the spring and early summer. The calves would be weaned at about 170-days of age in mid to late summer with the cow being immediately sold while she still had good body condition. "By timing the marketing of these old cows for late summer the better cull-cow market was hit adding value. This added value offset the added cost of better winter feed for these short-term cows," states Cerri.

Henry Smith, of Brownsville, California makes a living from buying small bunches of bred, short-term cows. "You have to be careful which cows you buy," warns Smith. "Some cows are worn out. They will not produce under any circumstances. We tried the younger cull cows paying as much as \$75 per head premium over rail price. Only 50 percent of them worked out. We were always purchasing someone else's problem cows. We now buy old, sound cows and are able to purchase them just over rail price. We have access to by-product feeds here in central California. These old cows do well during the winter. We calve them out, place the pairs on grass until mid to late summer, wean the calf and sell the open cow. We do not run bulls with these old cows and we do not vaccinate for any of the reproductive diseases. We do vaccinate with 7-way and for the respiratory diseases. Our costs are reduced," concludes Smith.

A University of Nevada economic evaluation on heifer development shows that on average, most cows have paid for themselves by age six showing that the longer a cow stays in the herd, the more profitable she becomes. Her production may decline after eleven years of age, so we need to recognize the impact of longevity on the total cost of production. Anything beyond those six years certainly has economic significance. This supports keeping a cow in the herd as long as she is productive and breeds back provided the added cost of winter feed for these aged cows is reasonable, which is currently not the case.

Jon Griggs, manager of Maggie Creek Ranch of Elko, Nevada and Second Vice President of Nevada Cattlemen's Association also sees a need for timely marketing of other age and classes of cattle. "Lump jaw, permanent lameness, bad eyes, poor bags-catching these ailments early and marketing these cows in a timely manner before these conditions pose a health or humane treatment issue is paramount to our industry's survival," concludes Griggs.

Gralian, Cerri and Griggs, speaking on behalf of the Nevada Cattlemen's Association urge cattlemen and dairymen to practice timely marketing of cull cows. It is every cattleman's responsibility and it is the right thing to do. In light of all the publicity concerning weak and downer cows we need to be especially vigilant of the condition of the cull cows we send to the sale barn or packing plant. The cull cows we ship to market are a reflection on all of us in the industry.

If you are unwilling to harvest these cows for home consumption by family and friends; do not send them to market! The take home message of this article is timely and smart marketing of all cull cows. The days are over of hauling canner spent cows to the sale yard and hoping to retrieve enough cash for gas. Prevent the canner cow; it is the right thing to do.

Methods of Determining Age of Cattle

Ron Torell, Northeast Area Livestock Specialist

The beef cow has a relatively short life span. After their peak productive age, breeding market value usually declines as the animal gets older. Year branding or ear tag numbering are good methods of permanently identifying the age of cattle. These practices usually add value when selling bred cows. Buyers can bid with confidence on the age of cow they are purchasing. However, many cattle ranchers are unable to accurately identify the ages of their cattle.

The approximate age of cattle may be determined by examining the teeth as illustrated in Diagram 1. The tooth method of aging cattle involves noting the time of appearance and the degree of wear on the temporary and permanent teeth. The temporary or milk teeth, are easily distinguished from the permanent teeth by their smaller size and whiter color. At maturity cattle have 32 teeth, 8 of which are incisors in the lower jaw. The two central incisors are known as pinchers; the third pair are called second intermediates or laterals; and the outer pair are known as the corners. There are no upper incisor teeth; only the thick, hard dental pad.

The tooth method of aging cattle is more accurate when animals are grazed for their entire life on "soft feed" (irrigated pasture). Under rough feed conditions, such as desert rangelands, teeth are worn at a much faster rate. Under rough feed conditions, accuracy of aging cattle is reduced, particularly in animals over five

years of age where tooth wear is the only indicator. Adjusting the accompanying chart to match feed conditions is essential to accurately determine the age of cattle. The best way to adjust the accompanying age chart to an individual ranch is to examine teeth of individuals with known ages and adjust the scale depending on wear.

Becoming proficient at aging cattle by the tooth method requires practical experience and a lot of practice. It also requires theoretical knowledge of the information presented in Diagram 1.

A second method of aging cattle involves reading the brucellosis tattoo in the right ear of female cattle. The tattoo (if legible) will reveal the year that the cow was a weaned calf and brucellosis vaccinated. The first digit of the tattoo represents the quarter of the year that the animal was vaccinated. For example, a two would mean the animal was brucellosis vaccinated in April, May or June. The middle portion of the tattoo is a shield. The last number is the year the animal was vaccinated. For example, a 7 would mean the animal was vaccinated in 1997. as a calf. The calf could have been born in 1996 or during 1997. Brucellosis tags do not reveal the year of birth, only vaccination.

Diagram 1. Handy guide to determining the age of cattle by the teeth¹

	At birth to 1 month	Two or more of the temporary incisor teeth present. Within first month, entire 8 temporary incisors appear.
	2 years	As a long-yearling, the central pair of temporary incisor teeth or pinchers is replaced by the permanent pinchers. At 2 years, the central permanent incisors attain full development.
	2 ½ years	Permanent first intermediates, one on each side of the pinchers, are cut. Usually these are fully developed at 3 years.
	3 ½ years	The second intermediates or laterals are cut. They are on a level with the first intermediates and begin to wear at 4 years.
	4 ½ years	The corner teeth are replaced. At 5 years the animal usually has the full complement of incisors with the corners fully developed.
	5-6 years	The permanent pinchers are leveled, both pairs of intermediates are partially leveled, and the corner incisors show wear.
497 P	7-10 years	At 7 or 8 years the pinchers show noticeable wear; at 8 or 9 years the middle pairs show noticeable wear; and at 10 years, the corner teeth show noticeable wear.
	12 years	After the animal passed the 6 th year, the arch gradually loses its rounded contour and becomes nearly straight by the 12 th year. In the meantime, the teeth gradually become triangular in shape, distinctly separated, and show progressive wearing to stubs. These conditions become more marked with increasing age.

¹The illustrations for this table were prepared by R.F. Johnson and published in *The Stockman's Handbook* by Ensminger Second Edition page 539.



ASE STUDY: Grazing Management on Seeded and Unseeded Post-Fire Public Rangelands¹

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ABSTRACT

Public land management agency standard policy has been to delay grazing on burned areas for a minimum of 2 yr on both seeded and unseeded areas. This 2-yr grazing moratorium has not been specifically validated by research. Study objectives were to investigate seeding and not seeding as well as grazing and not grazing immediately after a fire. The study area was located on a fire-impacted Bureau of Land Management allotment in central Nevada that was divided into 4 large blocks. Treatments were imposed in a $2 \times 2 \times 2$ factorial arrangement. Factors were seeded or unseeded, grazed or ungrazed, and 2 growing seasons. Grazing treatments were implemented in 2000, without pastures being rested. Post-treatment data was collected in 2001 and 2002. Baseline data indicated no difference between the 4 treatment areas. Fifty-three species of plants occurred in the area after the burn and 40 species in 2002. For the 2001 and 2002 analyses, to-

tal grass and shrub cover and density were not different. Forb cover was not different. Forb density was lower in grazed areas (P = 0.04). Forb density tended to be lower in 2001 than 2002 (P = 0.09) and lower in unseeded treatments, although no forbs were included in the rehabilitation seed mix. Cheatgrass density was lower in 2001 than 2002 (P = 0.03). Mean species richness decreased from 2001 to 2002 and was greater in the unseeded treatment (P = 0.04). There were no differences in diversity index values or percentage of similarity. For this study, grazing and aerial seeding had no effect on plant community response after fire.

Key words: fire, grazing, seeding, cattle, public land

INTRODUCTION

Wildland fires have had major impacts on vegetation systems throughout Nevada and the Great Basin. On lands managed by the Bureau of Land Management (BLM), general policy is to defer grazing (where allowed or permitted) for 2 or more years after a fire (BLM, 1999). The scientific evidence for this policy is sporadic, and many range scientists and managers question scientific basis for the policy (Sanders, 2000). Evalua-

tions of expert opinions concerning range plants and their differential responses to fire and grazing show some disagreements (Rodriguez and Kaufmann, 1998). Rodriguez and Kaufman (1998) also cited a lack of knowledge as part of the problem, especially concerning fire. Sanders (2000) indicated that due to the great variety in plants, plant types, and ecological settings, as well as weather patterns, it is difficult to suggest one policy for an infinite variety of scenarios. Reports in mixed prairies show variable response to fire and grazing (Engle and Bidwell, 2001; Willms et al., 2002). In semidesert sagebrush areas, burned and unburned, and grazed and ungrazed, results were variable, and vegetation response often did not progress toward the preburn community composition or a new state (West and Yorks, 2002). These studies provide no indication that a 2-yr rest prior to grazing after a fire is ecologically necessary, but demonstrate that each area and fire circumstance is different and the timing of grazing after a fire is probably best determined site-specifically.

Burned areas with grazing potential include both rehabilitated (seeded) and nonrehabilitated areas. Identical grazing pressure on seeded and unseeded areas can re-

¹Research was funded by a grant from the Arid Rangelands Initiative program and Nevada Agricultural Experiment Station, University of Nevada, Reno.

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sult in differential plant community effects (Vallentine, 1971). Additionally, Lynch (2003) indicated that grazing rehabilitated areas during the first 2 yr after fire increased seeding success if the timing of grazing reduced cheatgrass (*Bromus tectorum* L.) competition.

The objectives of this study were to determine the effects of grazing and no grazing on 1) perennial plant cover and density in both fire-rehabilitated (seeded) and unseeded areas; 2) cheatgrass cover and density in both fire-rehabilitated (seeded) and unseeded areas; and 3) plant community diversity in grazed and ungrazed treatments.

MATERIALS AND METHODS

Study Area

The study area was a fire-impacted BLM allotment 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 specifically located in Grass Valley, and the allotment runs north to south extending west to east from the valley bench to the top of the Simpson Park Mountains, with a predominantly west aspect. Several streams emanate from the top of the range, creating drainage valleys with north- and southfacing side slopes.

Allotment terrain varies from playa to high mountains, with elevations ranging between 1,700 and 3,000 m. Climate is characterized by warm, dry summers and cool, wet winters. Precipitation ranges from 20 cm in the valley to 40 cm in the mountains (based on records of the Gund Ranch, 2002). Prior to the fire, lower elevations (1,700 to 2,100 m) were dominated by basin big sagebrush (Artemisia tridentata spp. tridentata Nutt.) and black sagebrush (Artemisia nova A. Nels.), with an understory of Sandberg bluegrass (Poa secunda Presl), bot-

tlebrush squirreltail (Sitanion hystrix [Nutt.] J. G. Smith), and Indian ricegrass (Achnatherum hymenoides [Roem. & Schutt.] Beckworth). At the mid elevations (2,100 to 2,500 m), vegetation composition was dominated by pinyon pine (Pinus monophylla Engelm), Utah juniper (Juniperus osteosperma Sarg.), and basin and black sagebrush, with an understory of bottlebrush squirreltail, Thurber needlegrass (Stipa thurberiana Piper), Indian ricegrass, Nevada bluegrass (Poa nevadensis Vasey ex Scribn.), and basin wildrye (Elymus cinereus Scribn. & Merr.). Vegetation in the upper elevations (2,500 to 3,000 m) was primarily low sagebrush (Artemisia arbuscula [Nutt.]), big sagebrush, Douglas rabbitbrush (Chrysothamnus viscidiflourus [Hook.] Nutt.), and serviceberry (Amelanchier alnifolia [Nutt.] Nutt. Ex. M. Roem.), with an understory of Idaho fescue (Festuca idahoensis Elmer), Sandberg bluegrass, Nevada bluegrass, and bottlebrush squirreltail. In 1999, a lightning-ignited fire burned nearly all of the allotment (approximately 50 km²). Included in the burn were all of the vegetation types and areas that were being heavily encroached by Utah juniper and single leaf pinyon pine.

Field Methods

This project was treated as a case study because of the impossibility of replication. The burn was an uncontrolled, natural fire in a unique ecological setting. There was no (nor has there been since) existing similar ecological situations. The experimental design is pseudo-replicated. Replication was impossible; however, this does not mean that important information cannot be gleaned from the study. An all pairwise students t-test could have been conducted, but the inflated probability of a Type I error precludes its usefulness here. Our analysis is only relevant to this case. The case study approach is the

most reasonable and useful for this situation.

The study area was divided into 4 large blocks (pastures) that had similar vegetation composition, soils, topography, riparian areas, fire intensity, precipitation zones, and historic wildlife and livestock use. The experiment was organized in a randomized complete block design with treatments arranged in a $2 \times 2 \times 2$ factorial with 3 replications. Factors were seeding (seeded or unseeded), grazing (grazed or ungrazed), and years (2001 and 2002). A misapplication of seed by aerial broadcast into one area not meant for seeding forced a design with unequal replications. Pastures were randomly assigned 1 of 4 treatment combinations: 1) seeded and rested for 2 yr (standard practice); 2) unseeded and rested for 2 yr (to examine potential for natural recovery); 3) seeded and grazed as in prefire operations; and 4) unseeded and grazed. The trial was conducted over 2 yr. Treatments were designed to examine impacts of grazing, seeding, or both, on vegetation recovery. The seed mixture (Table 1) was applied aerially at a rate of 13.8 kg pure live seed per ha (12.3 lbs/acre).

Transects were randomly located in each treatment combination, and location recorded by global positioning system. Basal cover of herbaceous species and canopy cover of shrubs were determined by species using the line intercept method (Canfield, 1949). Within each treatment combination area, three 50-m transects were randomly located away from fences and watering points to avoid above average grazing intensities and other associated animal impacts. Density measurements by species were performed using 1-m² quadrats located along each transect at 3-m intervals (Hyder and Sneva, 1960) and are reported as plants per 1 m². Sampling was performed at the time of peak production, June 2001 and 2002. Percentage of

Table 1. Seed mix species, application rate, and costs **Species** Seeding rate¹ Bluebunch wheatgrass (Festuca idahoensis Elmer) 0.9 Idaho fescue (Festuca idahoensis Elmer) 0.9 Basin wildrye (Elymus cinerus Scribn. & Merr.) 0.3 Thickspike wheatgrass [Agropyron dasystachym (Hook.) Scribn] 9.1 Western wheatgrass (Agropyron smithii Rydb.) 1.3 **Totals** 12.3

similarity (number of shared species/total species × 100) was determined for each treatment group by year. Diversity was investigated using cover data for the species occurring in the quadrats by pairing grazing treatment and seeding treatments by year. Grazing and seeding treatments were also paired by year and compared. A Shannon-Weiner index value (Shannon and Weaver, 1949) was calculated for each pairing and then analyzed

¹Pounds per acre pure live seed.

with a modified *t*-test (Zar, 1999). Sampling was also performed in June of 2000 prior to initiation of grazing treatments and seed germination to insure plant community composition was consistent across all treatment combinations as a quality control measure.

Each block (pasture) was bounded on the upper elevation side by the ridge top. Fences ran from the ridge top to the valley floor. Grazing treatments were im-

plemented in 2000 (after collection of baseline data), without the pastures being rested, at seed set (July), and continued in 2001 and 2002. The grazing period was 60 d, from July 1 through August 31. Stocking rates were designed to achieve 50% utilization. Fences and riders maintained separation of grazing areas, providing uniform utilization within each grazing treatment. Approximately 200 AUM [Au: write out AUM] were utilized for both grazing treatments, although this number was adjusted annually to match forage produced by variable growing season conditions. The grazing animals were not treated any differently than under standard Gund Ranch conditions, which operate under a standard operating procedure as outlined in FASS (1999).

VassarStats Internet statistical package (Lowry, 2003) was used in all data analysis except for diversity. Percentage of cover data was transformed using the arcsine procedure (Zar, 1999) for analysis, but results are reported as percent. Density and cover differences were de-

Table 2. Number of species, percentage of similarity, mean species richness (SEM), and density of plants per square meter (SEM) for forbs, grasses, shrubs, and cheatgrass in 2000 for all individual treatments and main treatment effects

Treatment	Species by treatment (no.)	Similarity (%)	Meanqcspecies richness	Forbs	Grasses	Shrubs	Cheatgrass
Individual treatments							
(53 total)							
Grazed							
Seeded	38	71.7	14.8 (2.6)	24.0 (12.1)	6.0 (2.2)	0.5 (0.3)	13.6 (8.6)
Unseeded	37	69.8	19.3 (2.8)	29.0 (4.0)	9.6 (1.0)	0.5 (0.5)	15.6 (14.9)
Ungrazed							
Seeded	36	67.9	18.7 (1.8)	34.0 (18.2)	8.0 (6.1)	0.2 (0.3)	13.7 (13.6)
Unseeded	26	49.1	17.5 (0.5)	25.1 (8.8)	10.0 (5.0)	0.3 (0.3)	10.5 (10.5)
Main treatments							
Grazing component							
Grazed	47	88.7	16.7 (2.0)	26.1 (6.7)	7.6 (1.4)	0.5 (0.3)	14.4 (7.2)
Ungrazed	43	81.1	18.2 (1.0)	30.4 (10.6)	8.8 (3.7)	0.3 (0.2)	12.4 (8.2)
Seeding component							
Seeded	48	90.5	16.4 (1.7)	28.3 (9.7)	6.9 (2.6)	0.4 (0.2)	13.6 (6.9)
Unseeded	41	77.4	18.6 (1.6)	27.4 (3.7)	9.8 (1.7)	0.5 (0.3)	13.6 (8.9)

Table 3. Density of plants per square meter (SEM) and percentage of cover (SEM) in the 4 treatment groups and main treatments by year and major plant groupings for 2001 and 2002

Individual	Density			Cover				
treatments	Forbs	Grasses	Shrubs	Cheatgrass	Forbs	Grasses	Shrubs	Cheatgras
Grazed								
Seeded								
2001	20.9 (6.7)	4.7 (1.8)	0.6 (0.4)	28.8 (9.9)	5.98(2.15)	5.30 (2.1)	1.48 (1.19)	1.93 (0.96
2002	20.7 (7.2)	4.9 (2.3)	0.5 (0.3)	180.8 (85.4)	5.79 (3.57)	1.44 (0.76)	2.00 (1.81)	2.92 (1.31
Unseeded	, ,			, ,				
2001	11.0 (3.5)	10.2 (2.7)	0.7 (0.6)	12.1 (8.8)	7.50 (5.12)	5.97 (0.96)	2.73 (1.37)	0.43 (0.30
2002	23.4 (6.3)	11.4 (2.5)	1.2 (0.7)	57.6 (30.6)	7.47 (3.27)	4.11 (1.03)	3.78 (2.12)	2.17 (1.92
Ungrazed	` ,	` ,	` ,	` ,	` ,	` ,	` ,	`
Seeded								
2001	29.5 (10.1)	6.2 (4.7)	0.3 (0.3)	14.1 (12.1)	5.03 (1.62)	3.00 (1.86)	1.27 (1.07)	0.77 (0.50
2002	49.5 (7.2)	6.4 (4.9)	0.2 (0.2)	42.4 (30.5)	8.53 (3.53)	1.81 (1.37)	2.39 (1.99)	1.22 (0.98
Unseeded		,	()	()	()	(1101)		(
2001	24.5 (6.1)	5.4 (0.8)	0.9 (0.7)	15.4 (15.4)	1.30 (0.74)	3.45 (0.05)	4.3 (3.50)	3.55 (3.55
2002	33.4 (7.3)	6.1 (1.9)	1.1 (0.6)	146.9(143.7)	9.29 (6.79)	1.63 (0.29)	4.79 (4.63)	2.33 (2.33
Main treatments	(,,,,	(,	(111)	, , , ,	(,	(1,27)	()	
Grazed								
2001	16.7 (4.3)	7.0 (1.8)	0.6 (0.3)	21.6 (7.1)	6.6 (2.3)	5.6 (1.2)	2.0 (0.9)	1.3 (0.6)
2002	21.8 (4.6)	7.7 (2.0)	0.8 (0.3)	128.0 (53.3)	7.0 (2.4)	2.6 (0.8)	2.8 (1.3)	2.6 (1.00
Ungrazed	(,	(=,,	()		(=, ,)			
2001	27.5 (6.4)	5.9 (2.6)	0.5 (0.3)	14.6 8.2)	8.2 (3.2)	3.2 (1.0)	2.5 (1.5)	1.9 (1.3)
2002	43.1 (6.0)	6. (2.8)	0.6 (0.3)	84.2 (54.8)	8.2 (2.8)	1.7 (0.8)	3.4 (1.9)	1.79 (1.0)
Seeded	13.1 (0.0)	0. (2.0)	0.0 (0.5)	0 1.12 (0 1.10)	0.2 (2.0)	(0.0)	3.1 (1.2)	1.77 (1.0)
2001	24.6 (5.8)	5.3 2.1)	0.5 (0.2)	22.5 (7.6)	5.6 (1.3)	4.3 (1.4)	1.4 (0.8)	1.4 (0.6)
2002	33.0 (7.5)	5.5 (2.3)	0.4 (0.2)	121. (54.8)	6.5 (2.3)	1.6 (0.7)	2.2 (1.2)	2.2 (0.9)
Unseeded	33.0 (7.3)	3.3 (2.3)	0.1 (0.2)	(3 1.0)	0.5 (2.5)	(0.7)	(1)	2.2 (0.7)
2001	16.4 (4.3)	8.2 (1.9)	0.8 (0.4)	13.4 (6.9)	9.7 (3.9)	5.0 (0.8)	3.4 1.4)	1.7 (1.4)
2002	27.4 (4.8)	9.3 (2.0)	1.2 (0.4)	93.3 (53.1)	8.8 (2.9)	3.1 0.8)	4.2 (1.9)	2.2 (1.3)

[Au: is the third column under density correct as edited (shrubs, not grasses)?]

termined at $P \le 0.05$, and diversity differences at $P \le 0.1$.

RESULTS AND DISCUSSION

For 2000 there were no differences among the 4 treatment groups for any parameter measured (Table 2); there were no interactions and no block effect, indicating a high degree of similarity between plots. For the 2001 to 2002 analyses, total grass and shrub cover and density were not different (Table 3). There was no difference in forb cover as well; however, grazed and ungrazed treatments differed in forb density (19.3 plants/m² vs. 35.3, respectively, P = 0.04, Table 3). The grazed treat-

ment had lower forb density; most individual forb species densities were similar among treatment groups. Greater forb density was due to several dense patches of lupine (Lupinus caudatus Kell.) and hawksbeard (Crepis acuminata Nutt.) in the ungrazed areas and other plot nuances. Forb density tended to be different between years with lower density in 2001 than 2002 (21.5 plants/m² vs. 31.8, respectively, P = 0.09). Forb density was also lower in unseeded treatments, although no forbs were included in the rehabilitation seed

Cheatgrass density was less in 2001 than 2002 (18.7 plants/m² and 109.7, respectively, P = 0.03,

Table 4). Cheatgrass increased with time, and both years were dryer than normal. Anecdotal observations indicated the burned area contained little cheatgrass prior to the fire, but gradually increased to 3-yr post-fire levels. There were no differences in main cover effects, nor were there any interactions.

Mean species richness decreased from 2001 to 2002 as annuals common after fire began to decline (Table 4), typical of plant composition response after fire (Parsons and Stohlgren, 1986). Species richness in the seeded and unseeded treatments was different and declined in both treatments between 2001 and 2002 (Table 4). The unseeded groups had a greater mean number

Table 4. Number of species, percentage of similarity, and mean species richness (SEM) in 2001 and 2002 for all treatments

Treatment	Total species	Species by treatment (no.)	Similarity (%)	Mean species richness ¹
2001	46	_	_	_
2002	40	_	_	_
Individual treatments				
Grazed				
Seeded				
2001		33	71.7	13.3 (2.2)
2002	_	26	65.0	10.5 (1.5)
Unseeded				, ,
2001	_	33	<i>7</i> 1. <i>7</i>	16.0 (2.3)
2002	_	26	70.0	15.3 (2.0)
Ungrazed				` ,
Seeded				
2001	_	28	60.9	12.3 (2.6)
2002	_	24	60.0	11.3 (2.4)
Unseeded				` ,
2001	_	27	58.7	16.5 (1.5)
2002	_	19	47.5	13.5 (3.5)
Main Treatments				` ,
Grazed				
2001	_	42	91.3	14.4 (1.6)
2002	_	36	90.0	12.6 (1.5)
Ungrazed				` ,
2001	_	36	78.2	14.0 (1.8)
2002	_	29	72.5	12.2 (1.8)
Seeded				` ,
2001	_	41	89.1	12.8 (1.5)
2002	_	32	80.0	10.9 (1.2)
Unseeded				` ,
2001	_	38	82.6	16.2 (1.4)
2002	_	31	77.5	14.6 (1.6)

¹Mean species richness are different between seeded [11.8 (1.0)] and unseeded [15.4 (1.0)] groups for 2001 and 2002, P = 0.04.

of species (seeded 11.8, unseeded 15.4, P = 0.04). There was no evidence that seeded species were displacing antecedent native and nonnative species. New seedling density was very low.

Diversity index value comparisons indicated no differences for any of the treatments. Both grazing and seeding treatments were not different within or between years. Percentage of similarity showed no differences (Table 4). Fifty-three species of plants occurred in the area 9 mo after the burn, and 40 species were recorded at the end of the study in 2002. Treatment areas were dominated by forbs, followed

by grass and a few shrubs for both years of the study. Forb dominance after a fire is common (Hargis and McCarthy, 1986; Parsons and Stohlgren, 1989).

Seeding of burned areas on BLM land where recovery of desirable vegetation is not expected is a commonly followed policy, and in steep or rocky terrain it is typically broadcast-seeded using aircraft, as in this study. A large body of research has shown that aerial seeding is often unreliable (Wagenbrenner et al., 2002) and this coupled with very dry years provided poor results in this study. From 1972 to 2002, average rainfall at the Gund

Ranch was approximately 25 cm. Rainfall in 2000 was 20.6 cm, but only 13.25 and 11.25 cm for 2001 and 2002, respectively. These were the 2 driest years of the previous 20. Lack of moisture undoubtedly had an effect on seeding response, and there was no masking of grazing effects due to average or above average soil moisture.

There was no measurable positive or negative effect from grazing, with few differences among treatment combinations. Differences that did occur were artifacts of plot location and inherent variability. There was no evidence detected that grazing enhanced seed-to-soil contact in the seeded areas, and there were no detectable detrimental grazing effects as well. Cheatgrass proliferation was occurring, but occurred equally across all treatment combinations. Grazing utilization was limited to 50% of annual production and was closely monitored. More intense or prolonged grazing may have provided different effects.

IMPLICATIONS

In this study, grazing neither inhibited post-fire recovery nor enhanced it, and aerial seeding was ineffective. The one difference in forb density was due to plot nuances and presence of isolated, but dense, lupine and hawksbeard colonies. Our results indicate that each allotment should be individually evaluated for appropriateness of grazing and seeding after fire, and that blanket recommendations are inappropriate. It is also important to emphasize that grazing protocols were strict and closely followed. Grazing on burned areas immediately after fire should be allowed only with carefully planned protocols and with specific land management objectives in place.

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Management of Native Hay Meadows After Herbicide Treatment for Noxious Weeds

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In a recent article in this magazine, Earl Creech and his co-authors highlighted the importance of controlling noxious weeds as soon as they appear. Early control saves a substantial amount of time, funds and forage resources, which provides producers operational flexibility. Operational flexibility is essential to maintaining the long-term viability and success of ranches in the Great Basin. Having a flexible operation is the only way producers can successfully cope with the variable climate and forage resources of the Great Basin.

Native grass-hay meadows and pastures are an essential component of most Great Basin ranches. These areas, however, frequently become infested with noxious weeds. The first few weeds have little effect on hay production or quality. Left uncontrolled, however, the rapid spread of these weeds can cause significant declines in forage quantity and/or quality in the future. A decrease in the forage resource eventually reduces operational flexibility and the long-term stability and viability of the ranch.

The most commonly used tool for weed control is herbicides. Modern herbicides are powerful and quick acting so treated weeds will often show symptoms within a week and die shortly thereafter. The following spring, weed populations are often 85 to 95 percent smaller and it appears that the weed has become a thing of the past. But, have we successfully controlled the weed? Unfortunately, the answer is no.

After herbicides are successfully applied several conditions exist. First, there are large areas of bare ground and/or a thin stand of desired forage species. Russian knapweed, perennial pepperweed and other deep-rooted perennial species often form large patches that crowd out other species. As a result, when the weed is removed substantial amounts of bare ground are left. It may take several growing seasons or more for the residual forage species to fully occupy the treated areas. The actual rate will depend upon the size of the bare areas, the availability of irrigation water and the vigor of the remaining forage species. Drill-seeding barren areas with desired forage species can often help to speed the recovery process.

Second, large mature stands of deep-rooted perennial weeds are seldom fully controlled with one herbicide application. Most deep rooted perennial weeds have roots with many buds and some of the buds will survive and produce new shoots. Surviving roots probably are those furthest from the leaves where herbicide uptake occurs, which suggests the deeper roots have the best chance of surviving. If you have noticed substantially more new shoots from weeds the second year after treatment, these shoots are probably from deep roots. It just took a full growing season for their regrowth to reach the surface of the soil.

Third, once a weed has gone to seed the weed will be present for many years. Seeds from weeds are viable anywhere from several years to decades, depending upon the species. This fact alone tells us why producers must kill weeds as soon as they occur. Once seed is produced and dispersed, the weed will likely be a problem on the ranch for decades.

Abundant bare ground and weak stands of forage species creates the ideal environment for weeds to grow. Neither the surviving roots nor germinating seedlings face competition from desired plants. The lack of competition is a weeds best friend. That alone, is why meadow and pasture management after weed control is important for the long-term success of both weed management and forage production.

All too often, producers think that once the drought breaks the forage plants will return and the weeds will die off. This seldom happens. After the initial weed control effort, the management of a meadow or pasture cannot be the same as before treatment occurred. Managers must ask the question, "why did the weed problem occur?" Yes, a drought can affect our vegetation, but management of the vegetation, typically when and how often its harvested, must be changed to accommodate the drought. Remember the flexibility concept: this is where it becomes critical. Producers cannot control the timing, duration, or intensity of a drought, but they can control how the vegetation is managed during and after a drought and/or other stress. If managers do not apply flexible management toward the desired forage species, so they can accommodate their natural stresses, the only outcome will be weak forage plants. Weak forage plants facilitate the establishment of weeds and continued improper management only facilitates more weeds.

Harvest of the forage species must be managed so these desirable species can increase their root biomass, tillers (stems) and leaf area. 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 forage plant, stored energy ensures the plant's 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. This energy is stored in plant buds, crowns and roots.

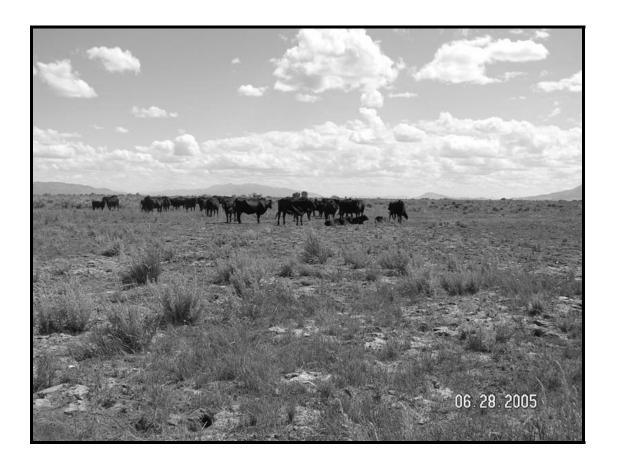
Stored energy has two important roles that are critical to a plant's survival (i.e., sustained forage production). First, pasture grasses typically are dormant for 6 to 9 months. Buds on dormant plants develop into the new leaves and roots the following spring. In order to survive dormancy, these buds use energy (a process called respiration). The energy for respiration comes from carbohydrates stored during 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. Plants that are repeatedly harvested have insufficient leaf area to produce enough carbohydrates to keep all buds on the root crown alive. The result is fewer roots, smaller plants, more bare ground and ultimately many weeds. If harvest management before weed control weakened the desired forage plants, continuing the same management strategy after weed control will only guarantee that weeds will return.

Successful weed control management only begins with herbicide treatments. Perennial weeds with large, deep root systems will require annual follow-up treatment for several to many years. Furthermore, harvest management of the desired forage species must be changed to ensure that their physiological needs for growth and energy storage are met. Only then will the establishment and spread of noxious weeds be slowed to a manageable level.

Photo 1. This area is infested with Russian knapweed and was treated in October 2004. The bare areas are where the knapweed formed dense patches and eliminated all desired forage species. Grazing this pasture throughout the growing season the first spring after it was treated will prevent the residual forage species from colonizing the bare spots and thickening the

weakly vegetated areas. Often, large barren areas like this one should be seeded to increase the rate of recovery of the desired vegetation. Without rapid re-establishment of desired forage species, the return of the Russian knapweed and/or other noxious weeds is inevitable.



Assessing the Potential Interest and Feasibility of Incorporating Agriculture Education that Meets Current Required Standards, into Washoe County Elementary School Curriculum

M. S. Burrows and D. W. Holcombe

Abstract

Agriculture is an integral part of society; however, many citizens lack the agricultural literacy that enables them to understand the connection between agriculture, the environment and people. In 1988 the National Research Council concluded that agriculture should be offered to all students, regardless of their career goals or whether they are urban, suburban, or rural. They recommended that all students should receive at least some systematic instruction about agriculture, beginning in kindergarten or first grade and continuing through twelfth grade. (NRC, p. 2) There are many resources available to teachers that will meet state education standards while incorporating agriculture into the curriculum. It is unclear whether teachers are either unaware of these resources or are unwilling to use them. Through the use of a teacher survey that will be distributed to each Washoe County elementary school teacher in grades 1st through 6th, this study will assess the potential interest of teachers, as well as the feasibility of incorporating agriculture education into Washoe County Elementary School Curriculum. Teachers will receive examples of agriculture related lesson plans, as well as, materials and activity ideas along with the survey. The surveys will be collected after two weeks and the data compiled and analyzed. Recommendations derived from the data will be provided to Washoe County Ag in the Classroom in order to improve their program and increase teacher awareness as well as participation in the Ag in the Classroom program.

Introduction

It is important for all citizens to have an understanding of where their food comes from, particularly, with the current increase in concerns about food safety and country of origin. Agriculture has been an integral part of America's development and expansion; however the vast numbers of individuals needed in production agriculture has considerably decreased. The reduced need for individuals related directly to production agriculture has created a society where more than 97% of all employed people do not produce their own food. They are available to manufacture other products and provide services which are needed by highly industrialized nations (Nipp, 1988). This often creates a disconnect between citizens and the food on their table. Incorporating education about agriculture into classroom lessons provides diversity and variety in the learning process as well as helps students make the necessary connections between agriculture, the environment and the human population.

Ag in the Classroom is a program that is coordinated by the USDA and is carried out in each of the 50 states. Each state operates its own program based on the state's individual needs. Their goal is to "help students gain a greater awareness of the role of agriculture in the economy and society, so that they may become citizens who support wise agricultural policies" (Ag in the Classroom). The degree of teacher participation in Ag in the Classroom varies from state to state, however in Nevada few teachers are taking advantage of this valuable resource. Nevada Ag in the Classroom has agriculture related curriculum available to teachers that can be

incorporated into classrooms while maintaining and meeting the required state and county educational standards. However, many educators are either reluctant to include agriculture in their curriculum or are unaware of the possibility to fulfill state educational standards.

It is important to understand why teachers are not taking advantage of this useful, often free, resource, determine why Ag in the Classroom curriculum is not being utilized by teachers, and what we can do to increase the use of the material.

The objectives of this project are:

- 1) Determine if elementary teachers in Washoe County are using agriculture in their current classroom curriculum.
- Determine the level of interest and willingness of Washoe County elementary school teachers to incorporate agriculture into their current classroom curriculum and aid in meeting current state standards.
- 3) Ascertain teacher awareness of the Ag in the Classroom program as well as interest in program participation.
- 4) Determine methods for improving teacher participation and the incorporation of Ag in the Classroom materials into elementary school classroom curriculum.

Materials and Methods

This project will essentially consist of two separate studies, a pilot study (Study 1) that used a short teacher survey given to teachers who attended the Washoe County Ag in the Classroom Farm City Festival with their classes and then a larger more in depth survey (Study 2) distributed to all teachers in Washoe County elementary grades one through six.

Study 1:

In March, 2008 the pilot survey was developed and distributed to all teachers who attended the Washoe County Farm City Festival with their classes. The survey contained questions regarding the importance of agriculture to all individuals as well as the specific use of agriculture as an educational tool. In addition we determined teacher interest in obtaining agriculture education information to be used in their curriculum.

We used the feedback from this pilot survey to develop the larger, more in depth survey that is currently being distributed to all Washoe County elementary school teachers in grades first through sixth.

Study 2:

In May, 2008 the second, more in depth survey began being distributed to the 67 elementary schools and approximately 1400 teachers in Washoe County. Included with each survey are two

lesson plans that come from the Food Land & People Curriculum provided to all teachers who attend an Ag in the Classroom teacher Workshop. Also included is an Ag Mag which is an agriculture magazine for kids. Along with questions regarding current educational curriculum, teachers are asked to evaluate the enclosed agriculture related lessons. Surveys are delivered to each school in person, with a brief explanation of the study. A sealed file box is placed at a location determined by the principal within the school. The box remains at the location for two weeks, allowing participants to complete the survey and turn it in at their convenience while maintaining their anonymity. At the end of the two week period, the survey return box is collected and the data is compiled. Upon collection of the surveys an agriculture commodity map is delivered for every teacher, regardless of their participation.

Results of Study 1:

For the pilot study (Study 1), we received 105 respondents and of these 71% were kindergarten teachers and 5% were $3^{rd} - 5^{th}$ grade.

The findings from the pilot survey indicated that 95.2% of respondents either agreed or strongly agreed that agriculture education is important to elementary aged students and; 87% either agreed or strongly agreed that they would use an agriculture education curriculum that met current standards. However, only 59% either agreed or strongly agreed they would attend an in-service or workshop to incorporate agriculture education. Data gathered from this pilot survey was used to make changes to the Washoe County Farm City Festival, more specifically to the structure of the event. We are offering the festival for two days, the first day is for K-2 and the second day is for 3rd & 4th grades only. On this day, the students are invited to come and take a "Journey Through Nevada Agriculture" where each station will represent a county in Nevada and an agriculture commodity from that county. We will align this day with the state education standards which will help teachers justify the field trip. We have already noticed a substantial increase in upper grade registration for this event, over last year.

Results of Study 2:

At this time, the survey is still being distributed to schools. Approximately one third of the schools have received the survey and it is anticipated that distribution should be complete by April, 2008. As soon as all the data has been received, it will be compiled and analyzed.

Outcome

It is anticipated that this project will provide valuable information that will enable Washoe County as well as Nevada State Ag in the Classroom to improve their programs. We hope to increase awareness among Washoe County elementary school teachers about the advantages and opportunities available through the use of agriculture within their classroom curriculum and improve teacher participation in the AITC program, which will in turn enhance student understanding about the connection between agriculture, the environment and the food on their table.

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Influence of percent intramuscular fat on individual fatty acids in the longissimus muscle from Wagyu crossbred beef.

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¹University of Nevada, Reno, NV, USA and ²Washington State University, Pullman, WA, USA. *Animal Biotechnology-202, University of Nevada, Reno, NV, 89775, USA, tringkob@unr.nevada.edu **Abstract**

Percent intramuscular fat and individual fatty acids were measured in the longissimus muscle from the 13th rib region. The steak and muscle samples were collected 2 days postmortem and vacuum packaged from 46 animals (34 sired by Wagyu and 12 by Angus). Fatty acid methyl esters (FAME) were synthesized by H₂SO₄ catalysis. The fatty acids are expressed as a percent of the total fatty acids measured. Percent intramuscular fat in the longissimus ranged from 2 to 18%. There was a curvilinear and significant relationship between the percent intramuscular fat and n-3, n-6, n-6:3 ratio and polyunsaturated fatty acids (PUFA). A ten member taste panel detected flavor differences in the omega-3 fatty acid levels but not the CLA. The panel also detected significant negative flavor differences with n-6:3 ratio and PUFA. The panel did not detect significant differences for off-flavor in the n-3, CLA and PUFA levels or n-6:3 ratio. There was a positive and significant relationship between percent intramuscular fat and initial and sustained tenderness as assessed by the taste panel.

Introduction

Animal fat's image has suffered because of its dense caloric content contribution to the human diet. However, beef fat may impact the diet in a positive way depending on the composition of the lipids. Because beef also contributes certain monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acids which may be beneficial to the human diet, there is a need to know how muscle composition affects the proportion of certain fatty acids such as omega-3 and CLA. The objective of this study was to ascertain the influence of the percent intramuscular fat in the longissimus on the fatty acid composition and taste panel response.

Materials and Methods

Fatty acid methyl esters (FAME) were synthesized by H₂SO₄ catalysis and measured by capillary GC to determine fatty acid composition (O'Fallon, Busboom, Nelson, & Gaskins, 2007). A ten member trained taste panel evaluated cooked longissimus and recorded their responses to initial tenderness, juiciness, flavor, off-flavor and sustained tenderness on a 10 centimeter scale (0-10 cm).

Results and Discussion

Percent intramuscular fat in the longissimus muscle ranged from 2 to 18%. Both panel sustained tenderness and flavor scores (Fig. 1 & 2) increased from 2 to 10% intramuscular fat in a curvilinear fashion. Omega-3, omega-6:3 ratios and PUFA (Fig. 3, 4 & 6) decreased with increasing levels of intramuscular fat. CLA (Fig.5) decreased with increasing percent intramuscular fat possibly due to the fact the animals were in a feedlot with no access to fresh green forage. Increasing levels of omega-3 and PUFA are associated with decreasing panel flavor scores. Omega-3 and PUFA (Fig. 7 & 10) are negatively associated with increasing intramuscular fat. However, increasing CLA and MUFA (Fig. 8 & 9) are positively associated with increasing intramuscular fat. No off-flavor problems Fig. 11 &12) with omega-3 and CLA were detected.

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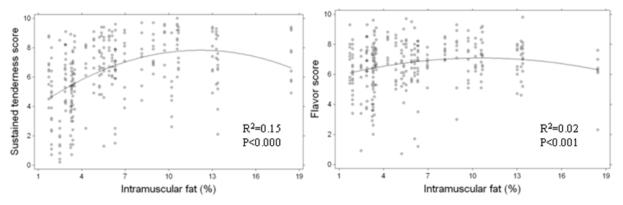


Figure 1. Sustained tenderness associated with increasing levels of intramuscular fat in the longissimus muscle.

Figure 2. Panel flavor score associated with increasing levels of intramuscular fat in the longissimus muscle.

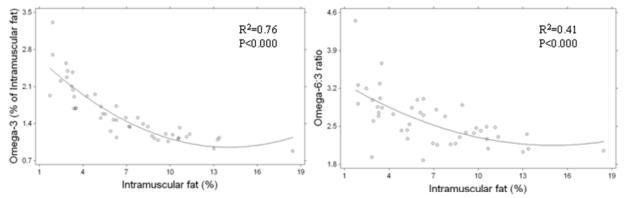


Figure 3. Omega-3 fatty acid associated with increasing levels of intramuscular fat in the longissimus muscle.

Figure 4. Omega-6:3 fatty acid ratio associated with increasing levels of intramuscular fat in the longissimus muscle.

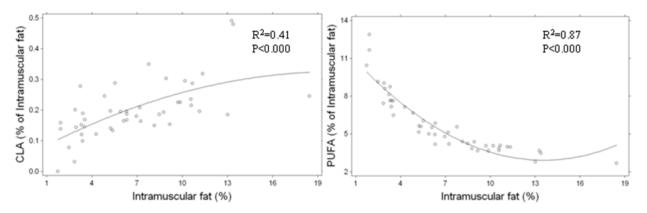


Figure 5. CLA fatty acid associated with increasing levels of intramuscular fat in the longissimus muscle.

Figure 6. PUFA associated with increasing levels of intramuscular fat in the longissimus muscle.

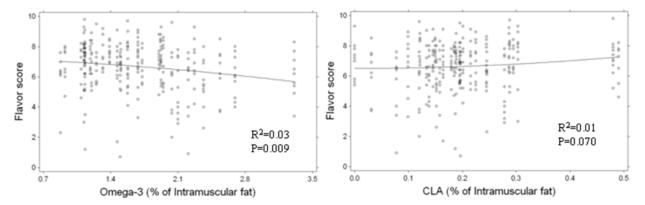


Figure 7. Panel flavor score associated with increasing levels of omega-3 measured in the intramuscular fat in the longissimus muscle.

Figur e 8. Panel flavor score associated with increasing levels of CLA measured in the intramuscular fat in the longissimus muscle.

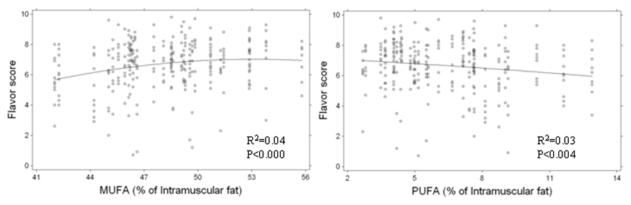


Figure 9. Panel flavor score associated with increasing levels of MUFA measured in the intramuscular fat in the longissimus muscle.

Figure 10. Panel flavor score associated with increasing levels of PUFA measured in the intramuscular fat in the longissimus muscle.

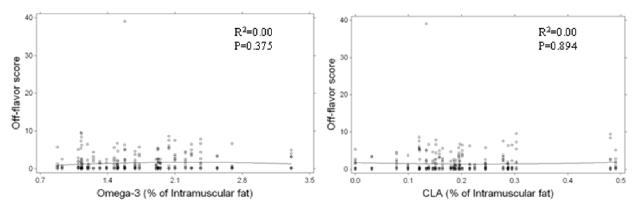


Figure 11. Panel off-flavor score associated with increasing levels of omega-3 measured in the intramuscular fat in the longissimus muscle.

Figure 12. Panel off-flavor score associated with increasing levels of CLA measured in the intramuscular fat in the longissimus muscle.

Utilizing Crop Residue As A Feed Source

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High hay and grain prices often force cow/calf producers to search for lower cost feed alternatives to stretch existing hay and forage supplies. Grazing crop residues such as grain fields that have been irrigated after harvest to sprout leftover kernels of grain or cornstalk residual is a frequent sight. Baling and feeding baled cornstalks is becoming more commonplace. Utilizing crop residues can reduce feed costs, however there are several factors that should be considered.

Feed Value

Perhaps the greatest challenge in utilizing any crop residue as a feed source is the wide variation in nutrient content and digestibility. Sprouted grains are high in nutrient value although straw residue and plant density can impact intake. On grazed cornstalks, nutrient content declines with each day the cattle are in the field. In a large field of cornstalks, cattle will seek out and consume any missed ears, spilled kernels, leaves and cornhusks first. They will then consume the more lignified stalks which are of much lower nutrient value. The nutrient value of baled cornstalks can vary greatly depending on field conditions and harvest methods. Some growers simply bale the windrow left from the combine. Others will swath all remaining cornstalks and then rake them into a larger windrow. Swathing and raking corn stalk residue will increase the tons per acre harvested but will also increase the amount of lignified stalks and dirt content of the bales. Table 1 shows the variation that existed in several different loads from Northeast Oregon in 2007. One load that was sampled in the Burns, Oregon area actually tested with 7.4% crude protein, which would be considered high.

Table 1. Baled Corn Stalks Analysis Results*

			%	NO3-N
	% DM	% CP	TDN	(ppm)
1	85.8	3.7	53.4	N/A
2	82.1	4.5	52.5	1270
3	84.6	5.1	54.3	1560
4	77.8	5.2	49.8	750
5	84.8	3.9	55.2	705
Average	83.02	4.48	53.04	1071

^{*}reported on a dry matter basis

Feed Comparisons

In order to place an appropriate value on crop residues, producers can make comparisons with something common such as alfalfa. Moisture should be the first comparison that is made. When adjusted for moisture to match alfalfa hay, the price for \$55/ton cornstalks becomes \$59.64/ton. Eighty-five dollar/ton baled cornstalks are now \$92.17/ton. One other moisture content consideration should be the potential for mold developing in the bale. Bales that are less than 85% dry matter can develop mold if stored for very long.

Nutritional content should be the next comparison. Protein, TDN, net energy for maintenance (NE_m), and metabolizable energy should be considered. How do those figures compare to each other and to the cow's actual nutrient needs? Table 2 shows those comparisons.

	CP	TDN	NE_m	ME	Ca	P
Corn Stalks	4.5%	53.0%	.49	.87	.39%	.17%
			Mcal/lb	MCal/lb		
Alfalfa Hay	17%	60%	.60	.99	1.39%	.24%
			Mcal/lb	Mcal/lb		
Requirements	7.32%	51.3%	7.57	14.5	.21%	.17%
1000 lb. cow			Mcal	Mcal		
Requirements	7.31%	51.4%	8.68	16.6	.22%	.17%
1200 lb. cow			Mcal	Mcal		

In order for a 1200 lb. cow to meet her needs for net energy, she must consume 21.3 lbs. of cornstalks daily on an as fed basis. To meet her needs for protein, she would have to consume over 31 lbs. of cornstalks. Rate of passage of baled cornstalks will be much slower than with higher quality feeds. This will reduce intake and make it impossible to meet a cow's nutrient requirements solely with baled cornstalks.

Other considerations should include feeding methods and dirt content. One producer this fall reported scattering bales around the pasture and cutting all but three strings on the bale. Cattle were then allowed unrestricted access. This resulted in waste loss of up to 40%. It was also reported that some bales were up to 8% dirt by weight. It appeared that the farmer doing the swathing and baling attempted to pick up every little bit of cornstalk. It is important to consider these and other additional factors when determining the true value of baled crop residue.

Grazing

Perhaps the most cost effective method of utilizing crop residue is by grazing. This eliminates the fuel and machinery cost associated with harvesting the residue. One common problem with grazing crop residues is a lack of fences around fields. This can be easily remedied by utilizing portable electric fencing. Portable electric fencing can also be used to strip-graze the field which greatly increases the utilization rate. Research shows that a 3 day strip-graze yields 40% more grazing days per acre as compared to a 14 day strip-graze.

Animal class

Dry, pregnant (mid gestation), mature cows are best suited to utilize crop residues. Their nutritional requirements are low as compared to lactating and late gestation animals. Growing calves, feeder cattle and replacement heifers are not suited for crop residues. In most instances, their nutrient requirements will not be met which will reduce their growth and performance.

Other considerations

When feeding crop residue it is important to consider any possible negative effects of the feed. For example, certain types of grass seed straw can have high levels of alkaloids that can potentially cause negative effects on the cows, such as fescue toxicosis. All cereal grain hays should be tested for nitrates, and corn stalks are no different. Table 1 shows the nitrate-nitrogen (NO3-N) levels of the tested corn stalk hay sampled in NE Oregon. While not alarmingly high, samples 2 and 3 should not be fed at a rate greater than 50% to pregnant cattle, as nitrate toxicity may occur and cows may abort fetuses or die.

Summary

Crop residue can be effectively utilized to reduce feed costs. It is important however to consider more than just price. Producers should consider the class of animals to be fed, harvesting method, and nutrient and moisture content of any baled residue and should be willing to test for quality as well as nitrate content.

The Impacts of Increasing Fuel Costs on Nevada's Agricultural Enterprises

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INTRODUCTION

As fuel costs continue to increase, many sectors of the marketplace may be negatively impacted with regard to profits including crop and livestock production. This publication examines the changes created by increased fuel costs on net returns of various agricultural enterprises throughout northern Nevada and is intended to reflect impacts on potential returns. Practices described are based on the production practices considered typical for these crops, livestock operations and region, but may not apply to every situation.

TRENDS IN DIESEL EXPENSES

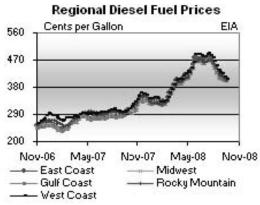
Although diesel fuel prices fluctuate cyclically, there has been a constant upward trend since the turn of the century, mimicking regular gas prices.



Source: GasBuddy.com - historical price chart for Nevada

In May of 2002, regular diesel retailed for \$1.31 per gallon (EIA, 2008). Thirty-six percent of that cost was taxes, creating a price of approximately \$0.82 per gallon for diesel for off-highway use. Since 2002, prices continued to escalate and the percentage allotted to taxes continually declined, narrowing the gap between conventional and agricultural diesel prices. Fuel expenditures for farms rose thirty-six percent just between 2004 and 2005 (Shoemaker et al., 2006). In August of 2006, regular diesel averaged \$3.05 per gallon; taxes accounted for 17.5 percent of that cost resulting in an off-highway diesel cost of \$2.52 per gallon (EIA, 2008). The current published data from the Energy Information Administration, who compiles the official energy

statistics for the U.S. government, reports a cost of \$4.30 for a gallon of regular diesel in August 2008 with the percentage of taxes on that gallon of fuel comprising 10.8 percent. Thus, the cost of a gallon of diesel is \$3.84 when taxes are excluded. The difference between the 2006 price of \$2.52 and the 2008 price of \$3.84 for a gallon of red dye diesel represents an increase of fifty-three percent.



Source: Energy Information Administration

It is widely recognized that this increasing trend in the expense of diesel for agricultural producers could have significant impacts on producer profits. Research has been conducted to determine the extent of these impacts, ranging from case studies to practical working papers that help producers estimate changes. Examples include the "Impact of Fuel and Nitrogen Prices on Profitability of Selected Crops: A Case Study" by Skalsky et al. in 2008 and "Estimating the Effect of Fuel Price Increases on Your Operation" by Dorn, also in 2008.

EFFECTS ON NEVADA ENTERPRISE BUDGETS

All changes to the enterprise budgets and the resulting differences in net returns were based on increasing the cost of machinery fuel and lubrication expenses by fifty-three percent, the difference between the 2006 and 2008 off-highway diesel per gallon costs (See Tables 1 & 2 for example). Additional impacts to producers resulting from higher fuel costs such as increased expenses of nitrogen based fertilizers or increased irrigation pumping expenses were not included in this analysis.

Farms and Ranches. Six differing representative farms and ranches were chosen for this analysis. These farms and ranches include alfalfa producers in Pershing County and Northwestern Nevada (Washoe, Storey, Douglas, Lyon, and Mineral Counties), onion producers in Northwestern Nevada, and cow-calf operations in Elko, Lyon and Pershing Counties. Acreage varied between 400 and 750 acres for crop production and herd size varied between 350 and 700 head for the cow-calf operations.

Fuels. For purposes of this analysis, the fuel under consideration was 'red dye' diesel. Red dye diesel is a tax-exempt diesel fuel that is created to be used for off-road agricultural production activities. This analysis only includes the increase in costs of operating the farm machinery and vehicles that utilize red dye diesel, not the increased costs of either electricity or other sources of fuel.

Alfalfa. Alfalfa is grown throughout the state on a total of 265,000 acres (NASS, 2008). Although it varies in the amount and quality of production, it is the leading cash crop in Nevada (NDA, 2008). Most alfalfa is grown for alfalfa hay and is exported to surrounding states as animal feed.

Pershing County. The Pershing County alfalfa enterprise budget is based on 750 acres of production. Prior to the increase, fuel and lubrication costs were \$38,080.00 annually. After the adjustments to the budget, total fuel and lubrication costs increased to \$58,262.40. Net returns dropped from \$36,555.12 to

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\$11,553.65 for the entire farm. On a per-acre basis, net returns dropped from \$48.74 to \$15.40 per acre of production.

Northwestern Nevada. The Northwestern Nevada alfalfa enterprise budget is based on 400 acres of production. Prior to the increase, fuel and lubrication costs were \$51,563.36 annually. After the adjustments to the budget, total fuel and lubrication costs increased to \$78,891.94. Net returns dropped from a profit of \$33,057.47 to a loss of (\$823.14) for the entire farm. On a per-acre basis, net returns dropped from \$82.64 to a loss of (\$2.06) per acre of production.

Onions. The Northwestern Nevada onion enterprise budget is based on 400 acres of production of a combination of red, white and yellow bulb onions. Prior to the increase, fuel and lubrication costs were \$118,587.12 annually. After the adjustments to the budget, total fuel and lubrication costs increased to \$181,438.29. Net returns dropped from a profit of \$16,063.39 to a loss of (\$48,421.91) for the entire farm. On a per-acre basis, net returns dropped from \$40.16 to a loss of (\$121.05) per acre of production.

Cow-Calf Operations. Cattle ranching occurs primarily in the northern part of Nevada and is the leading agricultural industry (NDA, 2008). Although Nevada has stocker operations and feedlots, cow-calf operations are the primary enterprise, averaging 500,000 total head in 2007 (NASS, 2008).

Pershing County. The Pershing County cow-calf enterprise budget is based on production of 500 head of cattle. Prior to the increase, fuel and lubrication costs were \$13,439.20 annually. After the adjustments to the budget, total fuel and lubrication costs increased to \$20,427.58. Net returns dropped from a profit of \$3,172.57 to a loss of (\$3,997.51) for the entire ranch. On a per-head basis, net returns dropped from \$6.35 profit per head to a loss of (\$8.00) per head of production.

Lyon County. The Lyon County cow-calf enterprise budget is based on production of 350 head of cattle. Prior to the increase, fuel and lubrication costs were \$5,810.67 annually. After the adjustments to the budget, total fuel and lubrication costs increased to \$8,890.33. Net returns dropped from a profit of \$534.04 to a loss of (\$2,705.76) for the entire ranch. On a per-head basis, net returns dropped from \$1.53 profit per head to a loss of (\$7.73) per head of production.

Elko County. The Elko County cow-calf enterprise budget is based on production of 700 head of cattle. Prior to the increase, fuel and lubrication costs were \$11,466.51 annually (See Table 1). After the adjustments to the budget, total fuel and lubrication costs increased to \$17,543.76. Net returns dropped from \$7,192.44 to \$940.17 for the entire ranch. On a per-head basis, net returns dropped from \$10.27 per head to \$1.34 per head of production (See Table 2).

SUMMARY

Although all of the budgets under consideration were negatively impacted by the increase in fuel prices, the impacts were largest on the smaller operations that are unable to distribute those costs across acres or number of cattle. Additionally, the impacts will vary depending on the amount of machinery utilized for crop or livestock production. Those enterprises utilizing the largest amount of machinery are the most affected by the increasing fuel costs. This is corroborated by a similar study in Wyoming that found differences in the impact of rising fuel prices on profit by crop (Skalsky et al., 2008). Nevada is additionally vulnerable to changes in fuel costs because of the arid climate; "variation in the regional distribution of energy input costs suggests that changes in energy prices would most affect producers in regions where irrigation is indispensable for crop production (Shoemaker et al., pg. 19, 2006)". Because Nevada ranches and farms encompass large areas and are often distant from brokers or buyers, rising fuel prices may also impact the cost of transporting goods to market. For Nevada producers to remain solvent when faced with continually rising fuel costs, both directly as

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increased diesel prices to operate equipment and machinery for tillage, harvest and irrigation, and indirectly as petroleum products prices such as nitrogen fertilizers increase, increasing the price received for their goods may be one of the few options available.

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Table 1. Elko County 700 Cow-Calf Production Costs and Returns, 2006

	Weight Per	Unit of		_	Price/Cost			Va	lue/Cost
Description	Animal	Measure	Total Units		Per Unit	200 - 200 -		Per Head	
Description	Allillai	Weasure	Total Office		Per Unit		i Otal Value	F.	ei neau
GROSS INCOME									
Cull Cows	1100.00	lbs	84.00	\$	0.44	\$	41,025.60	\$	488.40
Cull Bulls	1665.00	lbs	10.00	\$	0.55	\$	9,157.50	\$	915.75
Yearling Replacements	875.00	lbs	40.00		1.01	\$	35,350.00	\$	883.75
Heifer Calves	440.00	lbs	165.00		1.19	\$	86,394.00	\$	523.60
Steer Calves	570.00	lbs	306.00	\$	1.28	\$	223,257.60	\$	729.60
TOTAL INCOME			605.00				\$395,184.70		\$653.20
			100 (00 (00 (00 (00 (00 (00 (00 (00 (00				******		* = = = = =
OPERATING COSTS									
Leased land		AUM	100	- 25	14.00	\$	1,400.00	\$	2.00
Grass Hay (Meadow Hay)		Ton	2065.00		70.00	\$	144,550.00	\$	206.50
Grain		Ton	42.00	\$	115.00	\$	4,830.00	\$	6.90
Alfalfa Hay		Ton	100.00	0.00	100.00	\$	10,000.00	\$	14.29
Federal Grazing (BLM)		AUM	6000.00		1.56	\$	9,360.00	\$	13.37
Horse (Shoeing, Vet, Feed,	, etc.)	Head	12.00	\$	450.00	\$	5,400.00	\$	7.71
Veterinary/Medical		Head	700.00	\$	25.00	\$	17,500.00	\$	25.00
Marketing (Brand, Video, C	ommission)	Head	605.00	\$	13.06	\$	7,903.69	\$	11.29
Checkoff		Head	605.00	\$	1.00	\$	605.00	\$	0.86
Salt & Minerals		Head	700.00	\$	12.00	\$	8,400.00	\$	12.00
Hauling		\$	605.00	\$	2.50	\$	1,512.50	\$	2.16
Hired Labor		Annual	0.75	\$	20,000.00	\$	15,000.00	\$	21.43
Operator Labor		Monthly	12.00	\$	3,000.00	\$	36,000.00	\$	51.43
Accounting & Legal Fees		\$	1.00	\$	2,000.00	\$	2,000.00	\$	2.86
Maintenance (Buildings, Ve	ehicles, etc.)	\$	1.00	\$	17,028.20	\$	17,028.20	\$	24.33
Fuel & Lube		\$	1.00	\$	11,466.51	\$	11,466.51	\$	16.38
Utilities		\$	1.00	\$	5,600.00	\$	5,600.00	\$	8.00
Miscellaneous		Head	700.00	\$	5.00	\$	3,500.00	\$	5.00
Interest Operating Capital		\$	\$ 241,644.72		7.20%	\$	8,699.21	\$	12.43
TOTAL OPERATING COS	TC					\$	310,755.11	\$	443.94
TOTAL OF ENATING COS	10					Ψ	310,733.11	Ψ	440.34
INCOME ABOVE OPERAT	TING COSTS					\$	84,429.59	\$	120.61
OWNERSHIP COSTS									
Capital Recovery (Deprecia	ation).								
Buildings, Improvements		\$	1.00	\$	8,259.92	\$	8,259.92	\$	11.80
Machinery & Vehicles	-, - = q = p = 10 = 11	\$			14,876.11	\$	14,876.11	\$	21.25
Purchased Livestock (B	ulls & Horses)	\$	1.00			\$	15,000.00	2.0	21.43
Cash Overhead:	and a rivided)	Ψ	1.00	Ψ.	10,000.00	*	10,000.00	*	21.10
Liability Insurance		\$	1.00	\$	3,500.00	\$	3,500.00	\$	5.00
Office & Travel		\$	1.00		1.5	\$	3,000.00	\$	4.29
Interest on Retained Live	estock	\$	1.00			\$	5,277.89	=1000	7.54
Annual Investment Insur		\$	1.00			\$	2,927.53		4.18
Annual Investment Taxe		\$			24,395.70	\$	24,395.70	\$	34.85
TOTAL OWNERSHIP COS	ete					\$	77,237.14	\$	110.34
TOTAL OWNERSHIP COS	,13					Ψ	11,231.14	Ψ	1 10.34
TOTAL COSTS						\$	387,992.26	\$	554.27
NET PROJECTED RETUR	RNS					\$	7,192.44	\$	10.27
	700 C . C . 1						(A 1: .4. 1	9.50	

Table 2. Elko County 700 Cow-Calf Production Costs and Returns, 2006 Adjusted

Description	Weight Per Animal	Unit of Measure	Total Units		Price/Cost Per Unit	8	Total Value		lue/Cost er Head
ODOGO INCOME									
GROSS INCOME	1100.00	lho	94.00	¢	0.44	d.	44 005 60	¢.	100 10
Cull Cows	1100.00 1665.00	lbs	84.00 10.00		0.44	\$	41,025.60	\$	488.40
Cull Bulls		lbs			0.55	\$	9,157.50	\$	915.75
Yearling Replacements Heifer Calves	875.00 440.00	lbs lbs	40.00 165.00		1.01 1.19	\$ \$	35,350.00 86,394.00	\$	883.75 523.60
Steer Calves		lbs				\$			729.60
Steel Calves	570.00	IDS	306.00	Ф	1.28	Φ	223,257.60	\$	129.00
TOTAL INCOME			605.00				\$395,184.70		\$653.20
OPERATING COSTS									
Leased land		AUM	100	\$	14.00	\$	1,400.00	\$	2.00
Grass Hay (Meadow Hay)		Ton	2065.00		70.00	\$	144,550.00	\$	206.50
Grain		Ton	42.00	- 100	115.00	\$	4,830.00	\$	6.90
Alfalfa Hay		Ton	100.00		100.00	\$	10,000.00	\$	14.29
Federal Grazing (BLM)		AUM	6000.00		1.56	\$	9,360.00	\$	13.37
Horse (Shoeing, Vet, Feed	t etc)	Head	12.00		450.00	\$	5,400.00	\$	7.71
Veterinary/Medical	ı, e.c.)	Head	700.00		25.00	\$	17,500.00	\$	25.00
and the second of the second o	Commission)	Head	605.00		13.06	\$	7,903.69	\$	11.29
Marketing (Brand, Video, Charlett	201111111881011)		605.00		1.00	\$	605.00	\$	0.86
Checkoff Salt & Minerals		Head Head	700.00	35	12.00	\$	8,400.00	\$	12.00
		neau \$	605.00		2.50			\$	2.16
Hauling						\$	1,512.50		
Hired Labor		Annual	0.75		20,000.00	\$	15,000.00	\$	21.43 51.43
Operator Labor		Monthly	12.00		3,000.00	\$	36,000.00	\$	
Accounting & Legal Fees	-1-1-11- X	\$	1.00		2,000.00	\$	2,000.00	\$	2.86
Maintenance (Buildings, V	enicles, etc.)	\$	1.00		17,028.20	\$	17,028.20	\$	24.33
Fuel & Lube		\$	1.00		17,543.76	\$	17,543.76	\$	25.06
Utilities		\$	1.00		5,600.00	\$	5,600.00	\$	8.00
Miscellaneous		Head	700.00	\$	5.00	\$	3,500.00	\$	5.00
Interest Operating Capital		\$	\$ 246,506.52		7.20%	\$	8,874.23	\$	12.68
TOTAL OPERATING COS	STS					\$	317,007.39	\$	452.87
INCOME ABOVE OPERA	TING COSTS					\$	78,177.31	\$	111.68
BOLLOW AND							,	33-40	
OWNERSHIP COSTS	- 1:								
Capital Recovery (Depreci			v remen		00-0			^	, e e e
Buildings, Improvement	ts, & ⊨quipment	\$	1.00		8,259.92	\$	8,259.92		11.80
Machinery & Vehicles	Secure At Exposition action	\$			14,876.11	\$	14,876.11		21.25
Purchased Livestock (E	sulls & Horses)	\$	1.00	\$	15,000.00	\$	15,000.00	\$	21.43
Cash Overhead:		121	(2) (CHR022)	2	<u> </u>	20	<u> </u>	_31	
Liability Insurance		\$	1.00		3,500.00	\$	3,500.00		5.00
Office & Travel	w	\$	1.00			\$	3,000.00		4.29
Interest on Retained Liv		\$			5,277.89	\$	5,277.89		7.54
Annual Investment Insu		\$			2,927.53	\$	2,927.53		4.18
Annual Investment Taxe	es	\$	1.00	\$	24,395.70	\$	24,395.70	\$	34.85
TOTAL OWNERSHIP CO	STS					\$	77,237.14	\$	110.34
TOTAL COSTS						\$	394,244.53	\$	563.21
						195.6			
NET PROJECTED RETUI	RNS					\$	940.17	\$	1.34

Measuring the Economic Linkages of the Range Cattle Sector in Elko County: A Supply-Driven Social Accounting Matrix

Thomas R. Harris
Chair Professor and Director
University of Nevada, Reno
Department of Resource Economics
University Center for Economic Development

Elizabeth Fadali Research Analyst University of Nevada, Reno Department of Resource Economics University Center for Economic Development A supply-driven social accounting matrix (SDSAM) model was developed to examine backward and forward linkage impacts of the Range Cattle Sector on the Elko County economy. These are preliminary reported results and a final report will be developed by the University Center for Economic Development as well as a University of Nevada Cooperative Extension fact sheet. Below are enumerated highlights of the on-going research:

- A SDSAM model is used to derive both backward and forward linkages of the Range Cattle Sector on the Elko County economy. Also, impacts of reductions from public land grazing will be estimated using the SDSAM.
- A social accounting matrix (SAM) is a matrix of balanced expenditure and income accounts providing a tabular snapshot of an economy at a given point of time.
- Constructing a SAM begins with specifying the input-output accounts consisting of detailed industry, commodity, factor, and final demand transactions.
- A SAM also provides information on non-market financial flows by capturing payments of taxes by households and businesses, and fund transfers between households and institutions.
- A SDSAM can be used to derive backward and forward linkages and impacts of a given economic sector.
- A backward linkage can be defined as a sector's relationship with upstream sectors (suppliers) that sell goods and services to the sector that are used as intermediate inputs in the sector's production.
- A forward linkage can be defined as a sector's relationship with the downstream customers (demanders) that purchase goods and services from the sector that are used as inputs by downstream sectors.
- In the SDSAM model of the Range Livestock Sector, the backward linkage effects occur because a decrease in output of a sector (i.e., decrease Range Cattle Sector output) will reduce the sector's demand for intermediate inputs (such as alfalfa hay, fuel, etc.) purchased from other sectors, and for primary factors of production, such as labor and capital.
- Forward linkage effects occur because the reduction in output of a sector (i.e., decreased Range Livestock Sector output) may reduce the output of downstream sectors (i.e., livestock processors and restaurants) that purchase inputs from this sector for their own production process.
- The SDSAM model was derived from a model developed for Elko County using 2003 data. The modified model augmented the Elko County IMPLAN model by disaggregating the agricultural sector to derive an Alfalfa Hay Sector and a Range Cattle Sector.

- For this paper it is estimated that the Range Cattle Sector will have a ten percent (10%) reduction in output.
- A 10% reduction in output for the Range Cattle Sector in Elko County in 2003 would reduce output by \$5.378 million.
- Total backward linkage impacts in Elko County from a 10% decline in Range Cattle Sector production is estimated to be \$2.171 million.
- Total forward linkage impacts to Elko County from a 10% decline in Range Cattle Sector production is estimated to be \$1.771 million.
- Total backward and forward linkage effects of a 10% reduction in Range Cattle Sector production in Elko County, not including direct effects, are estimated to be \$3.942 million.
- Estimates for backward and forward employment, employer compensation, and other income impacts are to be estimated in a later publication.







Crop and Livestock Insurance Options for Nevada Producers

Organized by

Margaret Cowee, Research Analyst in the Department of Resource Economics in the College of Agriculture, Biotechnology and Natural Resources at the University of Nevada, Reno.
 Kynda Curtis, Assistant Professor in the Department of Resource Economics in the College of Agriculture, Biotechnology, and Natural Resources; and State Extension Specialist in the College of Cooperative Extension at the University of

What Types of Crop, Livestock, and Farm Insurance are Available in Nevada?

Four types of insurance are available in Nevada: Crop insurance (yield protection), Livestock Risk Protection (price protection), Livestock Gross Margin (gross margin protection), and AGR-Lite (whole-farm revenue protection).

Crop Insurance

Crop insurance in Nevada is offered on forage production, forage seeding, small grains (wheat, barley, and oats), onions, potatoes (Humboldt County only), and alfalfa seed (pilot program). Not all crops are covered in each county. A crop insurance agent should be contacted for more information as to availability by county. Below is a list of important dates to consider when purchasing crop insurance. Some of these dates are specified for the 2009 growing season in the following sections, while others will need to be discussed with a crop insurance agent.

- <u>Sales closing date</u> last day to apply for coverage.
- Final planting date last day to plant unless insured for late planting.
- <u>Acreage reporting date</u> last day to report the acreage planted. If not reported, insurance will not be in effect.
- <u>Date to file notice of crop damage</u> after damage; the date the producer decides to discontinue caring for the crop; prior to the beginning of harvest; immediately, if farmer determines that the crop is damaged after harvest begins; or the end of the insurance period, whichever is earlier.
- End of insurance period latest date of insurance coverage.
- Premium Billing date last day to pay the premium without being charged interest.
- Cancellation date last day to request cancellation of policy for the next year.
- <u>Production reporting date</u> last day to report production for Actual Production History (APH)
- <u>Debt termination date</u> date insurance company will terminate policy for nonpayment.

Forage Production

Crop insurance for forage production is available for the 2009 production year against adverse weather conditions, failure of irrigation water supply, fire, insects, plant disease, and wildlife. Producers can choose coverage levels from 50-75% of approved average yield or 55-100% of a price announced by USDA. Catastrophic risk protection (CAT) coverage is also available and guarantees 50% of approved average yield will be valued at 55% of the announced price.

- Sales closing date: Oct. 31
- Acreage reporting date: Nov. 15
- End of insurance period: Insurance ends the **earliest** of: (1) total destruction, (2) removal from the windrow or the field for each cutting, (3) final adjustment of a loss, (4)

date grazing commences on the forage crop, (5) abandonment of the forage crop or (6) October 15.

Forage Seeding

Crop insurance for forage seeding is available for the 2009 production year against adverse weather conditions, failure of irrigation water supply, fire, insects, plant disease, and wildlife. Producers can recover out-of-pocket cultural costs if more than 25% of the alfalfa seeding is damaged before the stand is established. The insured selects a percent coverage (27.5 -75%) of a dollar amount offered by USDA before the insurance period. Additionally, CAT coverage and higher coverage levels are available.

- Sales closing date: Jul. 31
- Final planting date: Sept. 15 for fall, Jun. 15 for spring
- Acreage reporting date: Nov. 15 for fall, Jun, 15 for spring
- End of insurance period: Insurance ends the **earliest** of: (1) total destruction, (2) the initial harvest of the unit, (3) final adjustment of a loss, (4) the date grazing commences on the forage crop, (5) abandonment of the forage crop, or (6) April 14 for all spring planted acreage and October 15 for fall planted acreage.

Small Grains

Crop insurance for small grains is available for 2009 for wheat, barley, and oats against adverse weather conditions, failure of irrigation water supply, fire, insects, plant disease, and wildlife. Producers can select a level of coverage ranging from 50-75% of approved average yield and 50-100% of a price announced by USDA, or CAT coverage based on 50% of approved yield and 55% of the price. Please note that wheat, barley, and oats are only insurable under this program when grown for grain. They are not insurance under this program when grown for hay.

Barley

- <u>Sales closing date</u>: Oct. 31 for Humboldt & Pershing Counties; Mar. 15 for all other counties
- <u>Acreage reporting date</u>: Nov. 15 for winter and Jun. 15 for spring for Humboldt & Pershing Counties; Jul. 15 for all other counties
- End of insurance period: No later than Oct. 31

Oats

- Sales closing date: Mar. 15
- Acreage reporting date: Jul. 15
- End of insurance period: No later than Oct. 31

Wheat

- Sales closing date: Oct. 31
- Acreage reporting date: Jun. 15 (winter coverage endorsement: Nov. 15)
- End of insurance period: No later than Oct. 31

Onions

Crop insurance for onions is available for 2009 against adverse weather conditions, failure of irrigation water supply, fire, insects, plant disease, and wildlife. Producers can select a coverage level ranging from 50-75% of individual approved yield and 55-100% of the price announced by

USDA. CAT coverage is also available and is equal to 50% of approved average yield and 55% of price. Please note that only fresh onions are insurable under this program.

- <u>Sales closing date</u>: Feb. 1Final planting date: Apr. 20
- Acreage reporting date: Jun. 30
- End of insurance period: The insurance period ends the **earliest** of: (1) removal of the onions from the field, (2) fourteen days after lifting or digging, (3) August 31 for all non-storage onions, or (4) October 15 for all storage onions.

Potatoes

Crop insurance for potatoes is available for 2009 (in Humboldt County exclusively) against adverse weather conditions, failure of irrigation water supply, fire, insects, plant disease, and wildlife. Producers can select a coverage level ranging from 50-75% of average yield. CAT coverage is also available and is fixed at 50% of average yield and 55% of the price election.

- Sales closing date: Nov. 30 for winter/summer; Mar. 15 for spring
- Acreage reporting date: Mar. 30 for winter; Oct. 1 for summer; Jun. 30 for spring
- End of insurance period: The insurance period ends the **earliest** of: (1) total destruction of the potato crop, (2) harvest of the crop, (3) final adjustment of a loss, (4) abandonment of the crop, or (5) the calendar date specified in the policy.

Alfalfa Seed Pilot

A crop insurance pilot for alfalfa seed is available for 2009 against adverse weather conditions, failure of irrigation water supply, fire, insects, plant disease, and wildlife. Producers can select coverage levels from 50-75% of approved average yield or 55-100% of a price announced by USDA. CAT coverage is also available and guarantees 50% of approved average yield will be valued at 55% of the announced price. Please note that only alfalfa seed that is certified or grown under a contract is insurable under this program.

- Sales closing date: Oct. 31
- Acreage reporting date: Apr. 15 for fall, Jun. 30 for spring
- End of insurance period: Insurance ends the **earliest** of: (1) total destruction of the crop, (2) final adjustment of a loss on a unit, (3) abandonment of the crop, (4) harvest (removal of the seed from the windrow or field), (5) the date grazing commences on the crop, or (6) October 31.

Nursery

Nursery crop insurance for wholesale nurseries is available in select counties in Nevada for 2009 against adverse weather conditions, failure of irrigation water supply, fire, and wildlife. Producers can select coverage levels from 50-75% of plant inventory value. CAT coverage is also available at a fixed rate of 27.5% of plant inventory value.

Livestock Insurance

Livestock insurance in Nevada is sold as livestock risk protection, or LRP. LRP is single-peril risk insurance that protects producers from adverse price changes in the livestock market. LRP does not cover any other peril, such as death or disease. Producers interested in obtaining LRP must submit an application to an authorized livestock insurance vendor, which can be done at any time during the year in Nevada. Once the application has been submitted, the producer

chooses a coverage price, which is a percentage of the expected ending value of the livestock, however, the price selection process is not complete until a specific coverage endorsement (SCE) has been completed. A lower coverage price relative to the estimated ending value corresponds to a lower premium. The producer must also choose an endorsement length, which is the length of the policy and can range from 13 to 52 weeks depending on the livestock type (see the individual policy descriptions below). The endorsement length should have an ending date that meets the producer's risk management objectives. For example, a producer selecting coverage for his or her feeder cattle may want the ending date to correspond with the expected date the cattle will be sold or moved to a feedlot. A producer choosing coverage for his or her fed cattle may want the ending date to match up with the expected date the cattle will be ready for slaughter.

LRP coverage will not begin until the SCE is selected by the producer and approved by RMA. The SCE specifies the elected coverage price, number of head covered, and length of coverage. The ending value of LRP is not the cash price received or the closing futures price on the end date of the policy, rather it is a weighted average price reported by USDA-AMS or the Chicago Mercantile Exchange, depending on livestock type.

LRP-Fed Cattle

- LRP-Fed Cattle can be purchased throughout the year
- SCE may be purchased for up to 2,000 head of heifers and steers
 - o Weight must be between 1,000 and 1,400 lbs
 - o Annual limit is 4,000 head per producer per crop year
- All insured cattle must be in a state approved for LRP-Fed Cattle at time of purchase
- SCE length: 13, 17, 21, 26, 30, 34, 39, 43, 47, or 52 weeks
- Coverage prices may range from 70-100% of expected ending value
- Application for LRP policy may be filled out at any time
 - o Coverage does not begin until an SCE is selected
 - o Multiple SCEs may be purchased with one application
- Actual ending values determined by weighted prices reported by USDA-AMS

LRP-Feeder Cattle

- LRP-Feeder Cattle can be purchased throughout the year
- SCE may be purchased for up to 1,000 head feeder cattle
 - o Expected to weigh up to 900 lbs at end of insurance period
 - Two weight ranges to choose from: under 600 lbs, and 600-900 lbs
 - o Annual limit is 2,000 head per producer per crop year
- All insured cattle must be in a state approved for LRP-Feeder Cattle at time of purchase
- SCE length: 13, 17, 21, 26, 30, 34, 39, 43, 47, or 52 weeks
- Coverage prices may range from 70-100% of expected ending value
- Application for LRP policy may be filled out at any time
 - o Coverage does not begin until an SCE is selected
 - o Multiple SCEs may be purchased with one application
- Actual ending values determined by weighted prices as reported in the Chicago Mercantile Exchange Feeder Cattle Index

LRP-Lamb

- LRP-Lamb can be purchased throughout the year
- SCE may be purchased for up to 7,000 head
 - o No weight requirement
 - o Annual limit is 28,000 head per producer per crop year
- All insured lambs must be in a state approved for LRP-Lamb at time of purchase
- SCE length: 13, 26, or 39 weeks
- Coverage prices may range from 80-95% of expected ending value
- Application for LRP policy may be filled out at any time
 - o Coverage does not begin until an SCE is selected
 - o Multiple SCEs may be purchased with one application
- Actual ending values determined by weekly average prices for "Formula Live Lambs" as reported by USDA-AMS

LRP-Swine

- LRP-Swine can be purchased throughout the year
- SCE may be purchased for up to 10,000 head
 - o Expected to reach market weight near the end of coverage period
 - o Annual limit is 32,000 head per producer per crop year
- All insured swine must be in a state approved for LRP-Swine at time of purchase
- SCE length: 13, 17, 21, or 26 weeks
- Coverage prices may range from 70-100% of expected ending value
- Application for LRP policy may be filled out at any time
 - o Coverage does not begin until an SCE is selected
 - o Multiple SCEs may be purchased with one application
- Actual ending values determined by weighted prices as reported by USDA-AMS

Livestock Gross Margin-Cattle

Livestock Gross Margin (LGM)-Cattle provides protection against the loss of gross margin, defined as the market value of livestock minus feeder cattle and feed costs. Only cattle sold for commercial or private slaughter primarily intended for human consumption are insurable under this program. LGM-Cattle is different from other livestock insurance programs in that it is a bundled option that covers both the cost of feeder cattle and the cost of feed, effectively insuring the producer's gross margin over the insurance period. Producers can sign up for LGM-Cattle 12 times per year and insure all cattle that are expected to market over a rolling 11-month insurance period. Producers do not have to decide on the mix of options to purchase, the strike price of the options, or the date of entry. Additionally, the policy can be tailored to fit any size operation.

Whole Farm Insurance: AGR-Lite

Adjusted Gross Revenue-Lite (AGR-Lite) is the only whole-farm revenue-protection insurance plan available in Nevada. AGR-Lite protects the farm from revenue losses due to natural disasters (including fire, insects, disease, wildlife, earthquakes, weather, and irrigation issues due to natural disaster) and market fluctuations. AGR-Lite can be used as a stand-alone plan or as an umbrella plan combined with other insurance, or to insure multiple commodities. AGR-Lite covers most crops and animals and animal products, including grain and non-grain crops, fruits and vegetables, nuts, nursery plants, floriculture, livestock, milk, eggs, and wool. AGR-Lite was

designed primarily for operations that are small to mid-size and are susceptible to market and/or production losses, and alternative enterprises, such as organic.

2009 Crop and Livestock Insurance Policy Providers for Nevada

Below is a current listing of insurance companies licensed to write insurance policies in Nevada. Please note that this list is current for the 2009 crop year as of October 1, 2008 and is subject to change. Insurance providers for each state can be found on RMA's website at http://www3.rma.usda.gov/tools/agents/companies/.

Ace Property & Casualty Insurance Company

(Rain and Hail Agricultural Insurance, LLC) Northwest Division Office

200 N. Mullen Road Suite 111 Spokane, WA 99206

Phone: (800) 967-8088 Fax: (509) 926-1843

E-mail: spokane@rainhail.com Website: www.rainhail.com

Products: Crop & livestock insurance, farm & ranch

policies

American Agri-Business Insurance Company

(Ag Risk Management Technologies Insurance

Services) 7101 82nd Street Lubbock, TX 79424 Phone: (800) 335-0120 Fax: (806) 473-0333

E-mail: armtech@armt.com Website: www.armt.com

Products: Crop & livestock insurance

Janet M. Blethen

Janet Blethen Insurance Agency 4185 Wilkinson Way Lovelock, NV 89419

Phone: (775) 273-1727 Fax: (775) 273-1727

E-mail: janet@janetblethen.com Website: www.janetblethen.com

Products: Crop & livestock insurance, farm & ranch

policies

Casualty Underwriters

Food and Fiber Risk Managers, LLC 3160 8th Street SW Suite F Altoona, IA 50237 Phone: (877) 957-9339

Fax: (515) 957-9091 E-mail: aglann@fafrm.com Website: www.fafrm.com Products: Livestock insurance

Rural Community Insurance Company

(Rural Community Insurance Services)

7040 N. Marks Suite 101 Fresno, CA 93711 Phone: (866) 646-7247 Website: www.rcis.com

Products: Crop & livestock insurance

Four-year contraception rates of mares treated with singleinjection porcine zona pellucida and GnRH vaccines and intrauterine devices

Gary Killian A,D, David Thain Nancy K. Diehl Jack Rhyan and Lowell Miller

Abstract. We evaluated the multiyear contraceptive efficacy of the gonadotrophin-releasing hormone (GnRH) vaccine GonaCon, the porcine zona pellucida (PZP) vaccine SpayVac and the human intrauterine device (IUD) 380 Copper 'T' in mustang mares provided by the State of Nevada. Eight untreated control mares were compared with 12 mares treated with SpayVac, 16 mares treated with GonaCon and 15 mares treated with the copper-containing IUD. Rates of contraception for Years 1, 2, 3 and 4 respectively for SpayVac were 100% (12 of 12), 83% (10 of 12), 83% (10 of 12) and 83% (10 of 12), rates for GonaCon were 94% (15 of 16), 60% (9 of 15), 60% (9 of 15) and 40% (6 of 15) and rates for IUD-treated mares were 80% (12 of 15), 29% (4 of 14), 14% (2 of 14) and 0% (0 of 14). Antibody titres against PZP and GnRH declined over the four-year study. For mares given SpayVac, uterine oedema was commonly observed. IUDs were visible by ultrasonography in non-pregnant mustang mares, suggesting that pregnant mares did not retain their IUD. IUD retention may be a function of uterine size: pony mares with IUDs had high retention and contraception rates for 4–5 years. We conclude that long-term contraception of mustang mares with a single shot of either the SpayVac or GonaCon vaccine is possible.

Introduction

Overpopulation of wild horses is a significant concern in the western United States (Fisher 1983). In Nevada, where most of the wild horses are located, populations grow at a rate of 15–20% a year on State lands, while their range continues to shrink. Current management strategies of removal and adoption are expensive, logistically challenging, and minimally (if at all) effective in reducing and maintaining wild horse populations at a desired level. Conflicting interests associated with increased movement of people into wild horse ranges, sympathy to maintain wild horse populations because of their historic and cultural importance, competition among horses and indigenous plant and wildlife species, as well as ranching interests, are issues impacted by wild horse overpopulation. Controlling the fertility of free-ranging horses is considered a viable option for population control. However, this approach has many challenges for which solutions have been elusive. Ideally, methods for contraception of wild horses should be safe and potentially reversible, effective for several years, practical to administer and of reasonable cost and have minimal effect on reproductive or harem behaviour. Immunocontraceptive vaccines have garnered considerable attention in recent years as a means to address problems of overabundant wildlife and feral species (Fagerstone et al. 2002; Delves and Roitt 2005; Naz et al. 2005). Two immunocontraceptive vaccines that have been used in a variety of species and for which data exist on their safety and efficacy are porcine zona pellucida (PZP) vaccine (Kirkpatrick et al. 1992, 1995; Miller et al. 1999, 2001; Kirkpatrick and Turner 2002; Turner and Kirkpatrick 2002, 2003; Curtis et al. 2007) and

gonadotrophin-releasing hormone (GnRH) vaccine (Miller et al. 2000, 2004; Killian et al. 2006a; Massei et al. 2008). Fertility control of mares using existing PZP vaccines has been shown to be safe and effective for up to 10 or more years. However, wild horses vaccinated with PZP preparations have required revaccination every year or two to maintain infertility (Turner et al. 2001, 2002). Limited data exist for the use of GnRH vaccines in mares to control fertility, ovarian function or behaviour (Dalin et al. 2002; Killian et al. 2004, 2006b; Imboden et al. 2006; Elhay et al. 2007). Information on multiyear efficacy and effects following a single injection of a GnRH vaccine in mares is lacking. Regardless of the contraceptive vaccine considered, most formulations that have been used do not appear to be effective for the long term without revaccination. Revaccination of mustangs involves considerable expense, manpower, and horse handling to maintain infertility. If a single-injection multiyear contraceptive were available it may be possible to achieve effective population reduction and reduce costs and risks associated with frequent horse handling.

We initiated a study in the autumn of 2002 and the spring of 2003 to compare the multiyear contraceptive efficacy of a single-shot contraceptive vaccine directed at GnRH with that of a single-shot vaccine directed at the zona pellucida of the ovum. We selected GonaCon to test as the GnRH vaccine on the basis of our positive experiences with it as a single-injection vaccine in deer and other species (Miller *et al.* 2000, 2004; Miller and Killian 2001; Killian *et al.* 2006*c*; Fagerstone *et al.* 2008). We selected SpayVac as the PZP vaccine to test in mares on the basis of our unpublished experiences with it as a single-injection vaccine in

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white-tailed deer and the reports of multiyear efficacy in harbor seals (Brown et al. 1997) and fallow deer (Fraker et al. 2002). Both vaccines were administered with AdjuVac, an adjuvant developed at the National Wildlife Research Center. In addition, on the basis of preliminary studies with pony mares, we evaluated the use of an intrauterine contraceptive device (IUD), the 380 copper 'T', which has been shown to be safe and efficacious in humans for multiple years (Fortney et al. 1999; Wu et al. 2000). Preliminary results of these studies with Nevada mustangs have been reported earlier (Killian et al. 2004, 2006b). This paper reports results for these contraceptive approaches after four years of study with Nevada mustangs and five years of observation on the use of IUDs in pony mares.

Materials and methods

Animals

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Horses for the study were provided by the State of Nevada and were maintained at the Nevada State Penitentiary, located at Carson City. The studies were approved by the Institutional Animal Care and Use Committee of the Pennsylvania State University. In total, 51 mares and three stallions were used. The mares weighed 225–360 kg and their ages were estimated to be between 18 months and 12 years of age at the time the treatments were given. All mares except the 18-month-old filly were observed in the wild to foal normal healthy foals.

For jugular blood sampling and vaccinations, the mares were run into a hydraulic chute and haltered. Vaccines were given intramuscularly in the left lateral neck. Mares were chemically restrained for IUD placement and for pregnancy evaluations by ultrasound or palpation. Chemical restraint was achieved with an initial intravenous injection of a mixture of 1 mL Dormosedan (detomidine hydrochloride) 10 mg, 2 mL xylazine 200 mg, and 2 mL acepromazine 20 mg to produce sedation, followed in 5 min with a second intravenous injection of one bottle of Telazol (250 mg Tiletamine base, 250 mg Zolazepam base) resuspended in 3 mL xylazine 300 mg for anaesthesia. This regimen typically gave 15–45 min of anaesthesia.

Ten pony mares and two pony stallions belonging to the Department of Dairy and Animal Science of the Pennsylvania State University were used to develop methods and evaluate the use of IUDs as a means to block fertility. The mares ranged in age from 18 months to 12 years when the treatments were administered. Seven of the mare ponies were pastured with a stallion during the entire five-year study, except when treatments were being administered or when data were collected. They weighed 204–306 kg, Three of the mares were on the study for only one year and were pastured with a stallion for two months during the breeding season. They weighed 281–391 kg.

Ponies were haltered and restrained in a chute for examination and data collection. If sedation was necessary, mares were given intravenous $0.5-1.5\,\mathrm{mL}$ xylazine $(50-150\,\mathrm{mg})$ and $0.2-0.5\,\mathrm{mL}$ butorphanol, or $0.1-0.25\,\mathrm{mL}$ Dormosedan $(10-25\,\mathrm{mg})$ and $0.2-0.5\,\mathrm{mL}$ butorphanol $(20-50\,\mathrm{mg})$.

Treatments

For the Nevada study vaccinations were given in March of 2003. Eleven mares were given a single-shot GnRH vaccine containing $1800\,\mu g$ of GonaCon and four mares were given a single-shot

GnRH vaccine containing 2800 µg GonaCon, 12 mares received a single-shot PZP vaccine containing 400 µg SpayVac and 8 mares were assigned to be untreated controls. Copper-containing 380 'T' IUDs were placed in the uterus of 15 mares transcervically in October of 2002. The SpayVac PZP vaccine was provided Dr Robert Brown (Brown et al. 1997), who developed the vaccine. The GonaCon vaccine was provided by the National Wildlife Research Center, USDA-APHIS-WS. Both SpayVac and GonaCon were made into an emulsion with AdjuVac adjuvant (Miller et al. 2004) and injected as a 1-mL dose. To evaluate reproductive capacity, treated and control mares were randomly assigned to two breeding groups. 'Band Stallions' that had been observed to sire multiple generations in the wild were selected to be pen stallions. Most mares were maintained in the same pen throughout the study, but if behavioural issues resulted in mares fighting, the less dominant mare was moved to the other pen. Mares were penned with a fertile stallion for a breeding trial typically lasting from June through September of each year. If mares failed to breed, or failed to become pregnant or foal during the breeding season, they were considered infertile.

Ponies were used to evaluate three different types of IUDs for ease of placement, retention and efficacy. The 380 Copper T and the GyneFix IUDs were purchased from Family Planning Sales Limited, Littlemore, Oxford, UK. The ring IUD was fabricated from Sialistic tubing (2.5 mm o.d.), which was used to create a ring size of ~2.5 cm. Prior to closing the ring with Silastic cement, five or six small copper cable clamps were threaded over the tubing for inclusion in the ring.

In preliminary studies we attempted direct finger insertion of the IUDs into the uterus of the mare after dilation of the cervix with two fingers. Because this approach was somewhat cumbersome, time consuming and did not easily ensure placement of the IUD deep within the uterine lumen we attempted to use the IUD insertion devices that were supplied with the IUDs that were intended for humans. However, both of these insertion devices were unsatisfactory for the mare uterus. The insertion device for the copper 'T' was too short to traverse the mare vagina and cervix. Likewise, the insertion device for the GyneFix IUD, which is intended to attach the IUD to the uterine endometrium with a monofilament, was also too small for the mare reproductive tract. Consequently, we modified disposable large animal uterine swabs to accommodate the IUDs. The modified swabs enable the successful deposit of the IUDs transcervically into the uterine lumen of sedated ponies or anesthetised Nevada mares. The insertion device containing the IUD was placed between the two fingers used to dilate the cervix and guided into the uterine lumen where the IUD was discharged. With minimal practice the time needed to clean the perineum, palpate the cervix by hand, and then insert the device was 2-5 min, with actual insertion of the rod and placement of the device requiring ~30-60 s.

For the research trial, all IUDs were placed into the uterus transcervically following dilation of the cervix with one or two fingers. As detailed in the Results, several animals received more than one type of IUD during the course of the study. If a mare became pregnant after receiving an IUD she was either allowed to go to term or, in the case of two mares in which the pregnancy was 60 days or less, the pregnancy was terminated with prostaglandin F2α. Within 2–3 weeks of termination of pregnancy or

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parturition, mares were treated with another IUD. As a result, the GyneFix IUD was evaluated in four mares, the copper ring in four mares and the 380 Copper 'T' in seven mares. Two untreated mares served as a control for each breeding season.

Observations

Blood samples were collected from treated Nevada mares once or twice a year. However, the only observations consistently made on the eight control mares were general health, body condition and foaling. In mid- to late-October of each year treated mares were examined by rectal ultrasonography for pregnancy, IUD retention and uterine inflammation. Pregnancy was established by ultrasonography by observance of an embryonic vesicle, a fetus or in the case of later gestation, rectal palpation of a fetus. These observations were later confirmed by birth of a foal. In a few cases where the behaviour of the mare prevented ultrasonography or rectal palpation, pregnancy was determined later by the birth of a foal. General health and body condition, and uterine oedema that may be associated with oestrous cycle changes or presence of an IUD were noted. Uterine oedema in healthy mares is an indication that she is in heat and that she is under the influence of oestrogen produced by ovarian follicles (Sample 1997). All blood samples were assayed for oestradiol, progesterone and antibody titres to the contraceptive vaccines (Miller et al. 2000, 2001). One mare receiving the GonaCon vaccine and one mare with an IUD died after the first breeding season of causes not related to the treatments.

From April through November of 2002-05 ponies were gathered and examined by ultrasonography every 4-6 weeks. During the 2004 breeding season, daily observations were also made from April through August on the breeding and harem behaviour of a group of ponies consisting of one stallion, two control mares, one mare with a GyneFix IUD, two mares with the ring IUD and four mares with the 'T' IUD. For 2006, ponies were pastured for the entire year and the only observations made were for general health status and foaling rates. In April of 2007, ultrasonography was performed to check for IUD placement, pregnancy and any contraindications.

Statistical evaluation

Data from hormone assays were subjected to one-way analysis of variance by treatment. Differences between means were detected by two-sided t-test. Mean values are reported plus or minus standard error. Regression analyses were used to evaluate changes in antibody titres during the study.

Results

Nevada mustangs

Foaling data for the eight control mares for Years 1–4 were 75% (6 of 8 mares), 75% (6 of 8 mares) 88% (7 of 8 mares) 100% (8 of 8 mares), respectively. Rates of contraception for SpayVac-treated mares for Years 1, 2, 3 and 4 were 100%, 83%, 83% and 83%, respectively (Fig. 1). Average anti-PZP titres for the autumn bleed for mares that were contracepted were sustained considerably above the titers of mares that became pregnant (Fig. 2). Although regression analysis indicated a significant decline of anti-PZP titres for the first three years of the study (P < 0.05), average titres tended to increase in the fourth year. Compared with titres in the

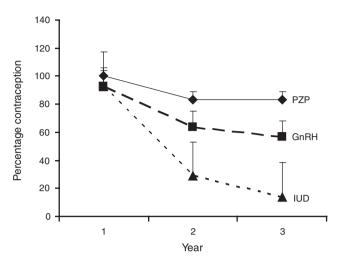


Fig. 1. Comparative rates of contraception for the three methods of contraception for each year of the four-year study. Rates of contraception for SpayVac-treated mares for Years 1, 2, 3 and 4 were 100% (12 of 12 mares), 83% (10 of 12), 83% (10 of 12) and 83% (10 of 12), respectively. Rates of contraception for GonaCon-treated mares were 93% (14 of 15 mares), 64% (9 of 14), 57% (8 of 14) and 43% (6 of 14) for Years 1-4, respectively. Contraception rates for intrauterine device (IUD)-treated mares were 80% (12 of 15 mares), 29% (4 of 14), 14% (2 of 14) and 0% (0 of 14), respectively in Years 1-4 of the study. In Year 2, one mare died in each of the GonaCon- and IUD-treatment groups of causes not related to the treatments.

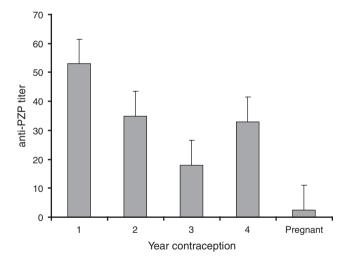


Fig. 2. Average anti-porcine zona pellucida (PZP) titres (\pm s.e.m.) for the autumn bleed for mares that were contracepted compared with titres of mares that became pregnant. The average titres for each of Years 1-4 were for the serum samples for the 10 mares that were infertile. The titre for the pregnant mares was the average for the 2 mares that became pregnant during the study.

third year, individual titres increased in 8 of the 10 contracepted mares, with the remaining 2 mares having titres similar to the titres they had in the third year. For all years, serum progesterone values $(ng \, mL^{-1})$ averaged 1.3 ± 0.40 for non-pregnant mares during the October bleed compared with 17.5, the average for two pregnant mares. We were unable to obtain serum oestradiol

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values for the two SpayVac-treated mares that became pregnant, but the average serum oestradiol concentrations (ng mL $^{-1}$) for the cycling females at the autumn bleed was 25.9 ± 2.9 .

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Rates of contraception for GonaCon-treated mares were 93%, 64%, 57% and 43% for Years 1–4 (Fig. 1). For contracepted mares, regression analyses indicated that there was significant decline of average antibody titres over the last three years (P < 0.01). Nevertheless, anti-GnRH titres of non-fertile mares were significantly greater (P < 0.01) than average titres for mares that became pregnant during the study (Fig. 3). Serum progesterone concentrations (ng mL⁻¹) for non-pregnant GonaCon-treated mares at the autumn bleed averaged 0.3 ± 0.1 , which was significantly lower (P<0.01) than progesterone concentrations of pregnant mares treated with GonaCon (7.7 \pm 1.5). Average serum oestradiol concentration (pg mL⁻¹) for the non-pregnant GonaCon-treated mares for all years was 32.6 ± 6.7 , which was significantly less (P<0.001) than concentrations detected in pregnant GonaContreated mares (1179 \pm 225).

Contraception rates for IUD-treated mares were 80%, 29%, 14% and 0%, respectively in Years 1–4 of the study (Fig. 1). Average serum progesterone for all years at the autumn bleed was significantly lower (P < 0.017) for non-pregnant IUD-treated mares ($4.3 \pm 1.4 \,\mathrm{ng}\,\mathrm{mL}^{-1}$) than for pregnant IUD-treated mares ($11.3 \pm 2.7 \,\mathrm{ng}\,\mathrm{mL}^{-1}$). The average serum oestradiol concentration of $62.5 \pm 34.2 \,\mathrm{pg}\,\mathrm{mL}^{-1}$ for all years for non-pregnant IUD-treated mares was significantly less (P < 0.001) than the oestradiol serum concentrations of IUD-treated mares that became pregnant (1907 ± 505).

Comparing autumn serum progesterone values among treatments for non-pregnant mares, differences between GonaCon- and SpayVac-treated mares were not significant. However, progesterone values in non-pregnant GonaContreated mares and SpayVac-treated mares were significantly lower (P < 0.02) than values in non-pregnant IUD-treated mares (Fig. 4). In contrast, serum progesterone values at the autumn bleed were lower in pregnant GonaCon-treated mares

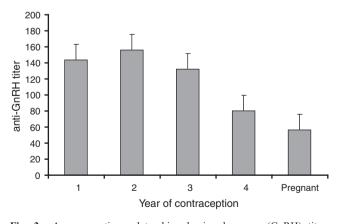


Fig. 3. Average anti-gonadotrophin-releasing hormone (GnRH) titres (\pm s.e.m.) for the autumn bleed for mares that were contracepted compared with titres of mares that became pregnant. The sample sizes for titres for Years 1, 2, 3 and 4 were 14, 9, 8 and 6 respectively. The average titre for the pregnant mares was for the 8 mares that became pregnant during the four-year study.

than in pregnant SpayVac- or IUD-treated mares (Fig. 5). These differences were significant between IUD- and GonaCon-treated mares (P < 0.025), but because only two SpayVac-treated mares became pregnant, statistical comparisons could not be made with the other treatments. There were no significant differences in serum oestradiol concentrations in non-pregnant mares among treatments (P = 0.13) and differences between serum oestradiol concentrations of pregnant IUD-treated and pregnant GonaContreated mares were not significant (P = 0.1).

Observations made by ultrasonagraphy usually enabled visualisation of IUD location and the presence of uterine oedema or luminal fluid. In most instances IUDs were not observed in mares that were pregnant. When uterine oedema was observed it was recorded by treatment that the mare received (Table 1). These values were compared with the expected incidence of uterine oedema during oestrus based on a normal mare oestrous cycle. We assumed that within a normal 21-day oestrous cycle, 5–7 days of the cycle would be in oestrus, and the remaining 14–16 days the mare would be in dioestrus (Crowell-Davis 2007). Therefore, in a random sample of mares taken from a normal population, ~25–30% would be expected to be in oestrus

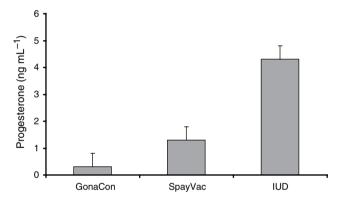


Fig. 4. Average progesterone values (ng mL⁻¹) (\pm s.e.m.) in non-pregnant GonaCon-treated mares (n=35) and SpayVac-treated mares (n=46) and non-pregnant intrauterine device (IUD)-treated mares (n=17) for the autumn bleed for all years of the study. Values for GonaCon- and SpayVac-treated mares were significantly lower (P<0.02) than values for IUD-treated mares.

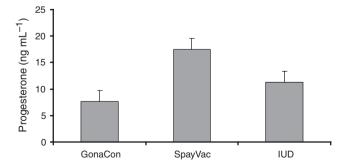


Fig. 5. Average serum progesterone (ng mL⁻¹) at the autumn bleed for pregnant GonaCon-treated-mares (n=8), pregnant SpayVac-treated mares (n=2) and pregnant intrauterine device (IUD)-treated mares (n=7). Values were significantly different between IUD- and GonaCon-treated mares (P<0.025); a comparison could not be run with the SpayVac-treated mares because of only two observations.

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Table 1. Percentage of reproductive tracts with oedema revealed by ultrasonography of mares for each of the treatments compared with the predicted number of mares expected to be in oestrus Numbers in parentheses indicate the number of mares showing uterine oedema out of the total number observed. Not all mares were observed at all time points. If a mare was found to be pregnant in a given year, she was dropped from the trial and not observed in subsequent years. Some mares on the trial could not be evaluated by ultrasonagraphy at a sampling date because their behaviour was unmanageable

Percentage	Year 1	Year 2	Year 3	Year 4
Predicted	25-30%	25-30%	25–30%	25–30%
IUD actual	20% (2 of 10)	0% (0 of 4)	0% (0 of 2)	_
GonCon actual	23% (3 of 13)	25% (2 of 8)	25% (2 of 8)	17% (1 of 6)
SpayVac actual	82% (9 of 11)	91% (10 of 11)	100% (10 of 10)	70% (7 of 10)

and to have oedematous uteri during the breeding season. Non-pregnant mares treated with GonaCon had rates of uterine oedema similar to the expected rate of 25–30% for normal non-pregnant cycling mares (Table 1). Likewise, IUD-treated mares in the first year had rates of uterine oedema similar to the expected rate, although in subsequent years too few non-pregnant mares remained in the IUD-treated group to obtain a reliable estimate. In contrast, SpayVac-treated mares had high rates of uterine oedema during all four years of the study (Table 1).

Ponies

A summary of the IUDs inserted into the pony mares is provided in Table 2. Only one of the four mares successfully retained the GyneFix IUD for a five-year period. Likewise, the coppercontaining Sialistic ring was retained in only one mare for at least a year before she was sold. The copper 'T' device provided the greatest rates of contraception and retention, with several mares having the device in place for 3–5 years. We were able to

Table 2. Summary of intrauterine device (IUD) types installed in pony mares, dates of installation, duration of contraception and reason for failure

n.a. = not applicable because the IUD is still intact

IUD type/ mare	Installation date	Date of last observation	Duration of contraception	Reason for failure	
GyneFix					
Maddie	24.v.2002	25.vi.2002	30 days	Pregnant	
Godiva	24.v.2002	23.vii.2002	60 days	Pregnant	
Sprite	24.v.2002	28.iv.2007	5 years	n.a.	
Libby (2)	23.ix.2005	23.iv.2006	7 months	Pregnant	
Ring					
Maddie	2.vii.2002	23.viii.2002	10 days	Pregnant	
Mandy	14.ix.2002	10.xii.2003	>1 year?	No data	
Libby	25.v.2004	1.vii.2004	36 days	Pregnant	
Libby	9.vii.2004	18.ix.2004	2 months	Pregnant	
'T'					
Dewdrop	24.v.2002	1.xi.2006	5 years	Pyometria	
Maddie	30.v.2003	28.iv.2007	4 years	n.a.	
Godiva	14.vii.2003	28.iv.2007	4 years	n.a.	
Libby	24.v.2002	15.v.2003	1 year	Pregnant	
Connie	25.v.2004	28.iv.2007	3 years	n.a.	
Wanda	4.ix.2002	30.v.2003	>1 year?	No data	
Remy	4.ix.2002	30.v.2003	>1 year?	No data	

observe only two of the mares (Table 2: Wanda, Remy) for one year before they were removed from the study.

Regardless of the type of IUD, the usual reason for failure was pregnancy. In most instances, we assumed that the pregnancy resulted from failed retention of the IUD, since we were unable to visualise the IUD by ultrasonography, or to identify it in the afterbirth when observed. In one case, we observed a 60-day pregnancy, but in a subsequent examination six weeks later the mare was not pregnant and the IUD was seen, suggesting that the pregnancy was aborted. In one case, a copper 'T' was removed because of pyometria. The recovery of that mare was unremarkable.

Two mares (Table 2: Libby, Maddie) were tested with all three IUD types. Both mares had the longest contraception rates with the copper 'T'. It is noteworthy that most mares given the copper 'T' IUD remained contracepted for multiple years. However, one mare (Libby) became pregnant within a year, regardless of the IUD type.

Observations made from April through August 2004 on the breeding behaviour of three non-pregnant mature mares equipped with a Copper 'T' IUD (Dewdrop, Maddie, Godiva) indicated that they had four or five oestrous cycles. The one mature mare equipped with a GyneFix IUD (Sprite) had six oestrous cycles and the one filly equipped with a 'T' IUD at 11 months of age had three oestrous cycles. These numbers were within the normal range of oestrous cycles for pony mares at the Penn State University facility.

Discussion

As with other species, population management of wild horses presents a specific set of challenges for a contraception method to meet in order for it to be of practical use. Assuming the contraception method does not pose serious problems to the health, behaviour or well being of the animal, two factors of considerable importance for contraceptive application in wild horses are long-term efficacy and whether the approach is easy to use. Wild horses need to be gathered from their range and managed under safe conditions for them to be hand injected with an immunocontraceptive vaccine. This approach has routinely been used for horses in the western United States. However, it is time consuming, expensive and, despite best efforts, not free of risk of injury to the horses or the human handlers. Although remotely darting individuals is possible (Kirkpatrick et al. 1990; Turner et al. 1996), it is not practical for vaccinating large numbers of horses in the western United States. For example, an internal cost-benefit analysis performed

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by the Nevada Department of Agriculture (D. Thain, unpublished) for the Nevada Virginia Range horsemanagement area, consisting of over 145 000 ha of mountainous arid rangeland, concluded that equine bands did not aggregate in any one area to enable cost-effective darting. Because the Nevada Virginia Range is typical of many horsemanagement areas in the western United States, we believe that having a single-application contraceptive approach that is effective for multiple years would minimise or remove the need for additional gathers in these areas for revaccination in subsequent years. To date, a single-injection vaccine with multiple years of efficacy has not been available for horses despite considerable efforts of investigators working on the problem (Turner et al. 2001, 2002; Liu et al. 2005). The present study provides evidence that multiple years of contraceptive efficacy can be achieved with a single-shot immunocontraceptive vaccine in the mustang mare. SpayVac was shown to have the greatest contraception rate. For the four years of study, only two of the 12 SpayVac-treated animals had foals. This rate for a single vaccination far exceeds what has been reported by others for wild horses, although SpayVac has been shown to have long-term efficacy in other species (Brown et al. 1997; Fraker et al. 2002). Mare contraception with SpayVac was associated with antibody titre, since the two mares that became pregnant had titres much below the average titre of contracepted mares. Although the average titre for the non-pregnant SpayVac-treated mares declined in Years 2 and 3 relative to Year 1, the titres actually increased in the fourth year in most of the contracepted mares. This suggests that self boosting of the immune response may occur (Perry et al. 2006), perhaps as a result of the seasonality of mare reproduction. It is thought that self boosting occurs in the draining lymph node (Burton et al. 1994) as antigen is released from the follicular dendritic cell when the antibody flowing through the draining lymph node drops to a certain level. The released antigen then provides restimulation of antibody production. It is also possible that as the mare returns to breeding condition from a period of anoestrus, new zona pellucida proteins are produced with the initiation of follicle development which restimulate an immune response. If the titre at which mares became pregnant is assumed to be the set point for pregnancy to occur, we would predict that the mares currently contracepted with SpayVac will remain infertile for several more years. It is also possible that some of the mares may remain infertile indefinitely.

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Compared with GonaCon and the IUD treatments, mares treated with SpayVac had a greater incidence of uterine oedema than would be predicted for normal cycling mares. Uterine oedema is associated with a predominance of oestradiol (Sample 1997), although there was no significant difference among treatments in oestradiol values for non-pregnant mares. However, expression of uterine oedema during the normal oestrous cycle is also influenced by the absence of serum progesterone (Crowell-Davis 2007). Relative to non-pregnant IUD-treated mares, which we found to have normal cycle lengths in the pony study, the serum progesterone values were significantly lower in SpayVac-treated mares than in IUD-treated mares. Although we were unable to make observations on the length of the oestrous cycle for the Nevada mares in this study, it has been reported that mares treated with PZP vaccine

tended to have normal cycle length (Kirkpatrick *et al.* 1997; Powell 1999) although urinary oestrogen has been reported to be lower (Kirkpatrick *et al.* 1992), along with a short-term high incidence of persistent corpora lutea (Liu *et al.* 2005).

Serum oestradiol concentrations determined for SpayVactreated mares suggest that some follicular development occurred. However, for SpayVac-treated mares showing some evidence of follicular development based on serum oestradiol, ovarian pathologies may be involved. Ovarian pathologies have been recorded for several species given PZP vaccines (Skinner et al. 1984; Mahi-Brown et al. 1988; Kirkpatrick et al. 1992; Lou et al. 1996; Stoops et al. 2006; Curtis et al. 2007), and are summarised as a disruption of folliculogenesis, depletion of primary oocytes and an infiltration of leucocytes. Given that serum progesterone was significantly lower in SpayVac-treated mares than in IUD-treated pony mares known to be having oestrous cycles of normal length, we suggest that SpayVac-treated mares may undergo some follicular development, but fail to ovulate and/or develop a normal corpus luteum.

Literature reports of circulating progesterone concentrations for untreated mares indicate considerable variation of values. Although concentrations of serum progesterone of $<1 \text{ ng mL}^{-1}$ are generally associated with oestrus, the concentrations progressively increase to high dioestrous values by Days 5-7 and are sustained there until Days 13-14. According to Ginther (1992, pp. 238-240), the range of means for 10 publications assaying serum progesterone during mare dioestrus was $4-22 \,\mathrm{ng}\,\mathrm{mL}^{-1}$. Clearly, an average exceeding $4 \,\mathrm{ng}\,\mathrm{mL}^{-1}$ for the IUD-treated mares suggests that most IUD-treated mares were in dioestrous when they were sampled. This is what would be expected when randomly sampling a population of mares. In contrast, an average of 1.3 ng mL⁻¹ for SpayVactreated mares suggests that most of those mares were not in dioestrus. Whether they were in oestrus or transitioning into or out of dioestrus cannot be determined with only one sampling point for each mare. Nevertheless, we believe that the published values for average progesterone values during dioestrus, plus the reports of ovarian pathologies associated with PZP vaccines supports the notion that the lower progesterone values in SpayVac-treated mares may be due to a failure to form or maintain a normal corpus luteum. It is possible that antibodies to the zona pellucida prevent follicles from developing to normal ovulatory size and formation of the corpus luteum. Aside from these characteristics, there was no other evidence of contraindications associated with the SpayVac treatment.

Mares receiving a single vaccination of GonaCon showed a high degree of contraception during the first year, but this rate gradually declined to less than half after four years. This decline was associated with a gradual decline in antibody titre to GnRH over the same period. Unlike what was seen with SpayVac titres, there was no evidence for a self-boosting effect that occurs when the native protein is produced. The reason for this difference in response to the two immunogens is unknown, but it may relate to the fact that the PZP immunogen is a large glycoprotein compared with the GnRH decapeptide. Nevertheless, while the contraceptive efficacy of GonaCon was not as impressive as that of SpayVac, the GonCon results exceed rates of contraception reported by others for mares using other single-injection contraceptive vaccines (Turner et al. 2001, 2002).

The incidence of uterine oedema for GonaCon-treated mares was similar to what would be predicted in a population of normal cycling mares. This suggests that these mares may have some degree of oestrous cycle activity, although it is difficult to make firm conclusions. Theoretically, we would predict minimal steroid hormone production in GonaCon-treated mares if we assume that GnRH were inactivated by antibody to the vaccine. However, plasma oestradiol and progesterone concentrations in GonaCon-treated mares were similar to those in the other treatment groups. Because we have no direct observations on the reproductive behaviour of the GonaContreated mares, we cannot say whether these females expressed oestrus or showed evidence of an oestrous cycle. However, our unpublished data from white-tailed deer treated with GonaCon suggests that GonaCon does inhibit expression of oestrus at least in the first year or two following vaccination.

The presence of serum oestradiol in GonCon-treated mares is contrary to the notion that the GnRH is the sole regulator of follicle-stimulating hormone (FSH) secretion by the pituitary gland leading to stimulation of follicle development and oestrogen secretion. The GonaCon used in this study is prepared with the luteinising hormone-releasing hormone (LHRH) peptide (Levy et al. 2004) which has been shown to stimulate both luteinising hormone (LH) and FSH secretion. However, there is also evidence in several species for a folliclestimulating hormone-releasing hormone (FSHRH) that specifically stimulates FSH secretion by the anterior pituitary gland (McCann et al. 1993, 1998; Yu et al. 1997; Padmanabhan and McNeilly 2001; McNeilly et al. 2003). If an FSHRH exists in the mare, it could explain the presence of serum oestradiol in infertile GonaCon-treated mares. Antibodies to LHRH in the serum would act to block some follicular development and the LH surge associated with ovulation, but some follicular development and oestrogen production would also occur in response to FSHRH and FSH secretion.

Contraception results for the Nevada mares treated with the IUD were encouraging in the first year of the study, but the performance was poor for the remainder of the study.

When IUDs were visualised, there was no evidence of uterine pathology as assessed by ultrasonography. It has been reported that mares implanted with a Sialistic ring IUDs were infertile for one year, but that device was associated with a uterine inflammatory response (Daels and Hughes 1995). In our study we did not see evidence of a uterine inflammatory response, and mares in the IUD-treatment group had the predicted number of occurrences of uterine oedema for the population size sampled. This, along with the serum progesterone and oestradiol data suggests that the IUD-treated mares were experiencing oestrous cycles.

Studies with ponies enabled more frequent observations of the IUDs and oestrous cycle events. From these observations we concluded that the 380 Copper 'T' IUD was superior to the other IUDs tested for long-term contraception. In addition, observations on oestrous cycle events for one breeding season led us to conclude that cycle length for mares with IUDs was within the normal range. The discrepancy in long-term rates of infertility between the mustang mares and pony mares equipped with a similar IUD is probably due to differences in uterine size. The retention of foreign objects in the mare uterus is related to the size of the object, relative to the size of the uterus. The ability of

glass balls to be retained in the mare uterus has been shown to be related to the size of the glass ball (Nie *et al.* 2001; Thomas 2002). Although we have not found IUDs expelled by the uterus of an IUD-treated mare that became pregnant, we suspect the reason for the decline in efficacy of the Nevada mares was that the IUD was not retained in the uterus. This suggests that if larger 'T' IUDs were used, better rates of retention and contraceptive efficacy may be possible. On the basis of the pony studies, there is also evidence to suggest that shape of the IUD may also be a factor affecting retention, since neither the string GyneFix nor the ring IUDs were retained and performed as well as the 'T'.

The mechanism preventing fertility in IUD-treated females has been argued to be either by interference with attachment of the early embryo to the uterus, or by induction of early abortion (Ortiz et al. 1996; Fortney et al. 1999). This mechanism may differ among species and no data have been published for the mechanism in the mare. Because the length of the oestrous cycle of pony mares in this study was within the normal range, we suggest that infertility in most instances was the result of the IUD interfering with events occurring between fertilisation and early embryo attachment. However, in one pony mare that was observed to be 50-60 days pregnant, in a subsequent examination she was not pregnant and the IUD was visualised. This indicated that abortion had occurred, but the IUD was retained. This observation raises the possibility that if pregnancy occurs followed by abortion, IUD expulsion may also occur. It is also possible that if pregnancy occurs but abortion does not, the IUD could be expelled with the placenta at parturition. This appears to have occurred with one Nevada mare that we observed to have the IUD when she was pregnant, and she went on to foal.

We believe that these studies provide evidence that long-term contraception of the mare is possible with the SpayVac PZP vaccine. Further improvements to the formulation of GonaCon that are now being tested in white-tailed deer suggest that rates of contraception similar to SpayVac are achievable with GonaCon. Development of larger IUDs that are better suited to the mustang mare may be possible. Regardless of the approach used, if a high rate of contraception is achievable for multiple years, population models suggest that contraception alone or used in conjunction with removal programs have the potential to stabilise and reduce population growth as well as reduce wild horse management costs (Garrott et al. 1992; Cameron et al. 2001; Bartholow 2004; Ballou et al. 2008; Kirkpatrick and Turner 2008). These observations lead us to conclude that population management of wild horses by single-application multiyear contraceptives will probably be possible in the near future for horse populations that can be gathered from their range for treatment and release.

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Animal Care & Biosecurity

David Thain, DVM Extension Veterinarian **UNR Cooperative Extension**

Animal Care Issues

- Jan 2008 undercover HSUS videos of Westland/Hallmark Beef HSUS.ORG
- April-May 2008 undercover HSUS videos of auction markets in New Mexico, Maryland, Texas, and Pennsylvania HSUS.ORG
- Summer 2008 Issues with down dairy cow at a Fallon area auction market
- The public perceives the industry based on the last bad news report!

NRS 574.130

■ NRS 574.130 Selling, offering to sell or exposing diseased animal. A person who willfully sells or offers to sell, uses, exposes, or causes or permits to be sold, offered for sale, used or exposed, any horse or other animal having the disease known as glanders or farcy, or other contagious or infectious disease dangerous to the life or health of human beings or animals, or which is diseased past recovery, or who refuses upon demand to deprive of life an animal affected with any such disease, is guilty of a misdemeanor.



Special thanks to Tom Fuhrmann, DVM

The Following slides were part of a presentation by Dr. Fuhrmann at the National Beef Quality Assurance State Coordinators Meeting June 2008

Today's DAIRYMAN.....

- Brings a product to the market place daily.....
 - Milk quality a constant goal and we understand quality
 - Beef.....a residual product that "leaves" dairies

Take Home Message: Dairymen think MILK rather than MEAT.

Today's DAIRYMAN.....

- Handle Cattle Continuously:
 - Milk 3x/day:
 - 1,000 cows X 4 teats x 3 times = 12,000 teats!!!
 - People walk cows to milking parlors 2 or 3 times daily
 - Reproductive Programs:
 - 4 12 injections to become pregnant (ovsynch programs)

 - Lock up cows daily:
 - Cattle are accustomed to restraint
 Lots of people/animal interaction

Take Home Message: Almost every dairy worker "connects" with cows daily.

Today's DAIRYMAN.....

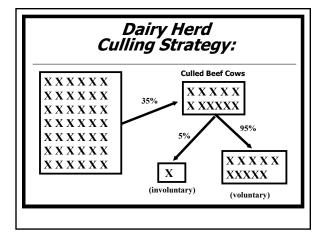
- Cows go through "stages" during lactation:
 - Calving (assistance, complications, processing)
 - Transition (uterine infection, indigestion)
 - Peak production (feeding, health issues, lameness)
 - Breeding (heat detection, breeding, injections)
 - Milking (3x/day, mastitis, health)
 - Dry Period (vaccinations, preventive foot trimming)

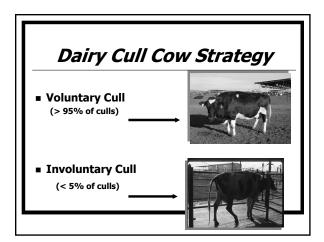
Take Home Message: Lot's of opportunity for both good and bad welfare activities!!!!

Today's DAIRYMAN.....

- Hispanic Workers are important cowside technicians on dairies:
 - Great workers
 - Good followers; more are becoming leaders
 - Cowside decision makers
 - English/Spanish training

Take Home Message: Include Spanish in training materials.





Today's DAIRYMAN.....

■ DEBILITATED ANIMALS:

- Very small group of animals from each dairy... the exception
- Biggest challenge for Dairymen
- Small %, but huge potential for consumer perception (CA incident)



Take Home Message: Need to address strategies to remove this animal from the food chain.

Economic Incentives to Change Culling Strategies

MILK REVENUE

- 1,000 cow dairy @ 70 lbs
- \$15.00 / hdwt
- \$10,500 per day

BEEF REVENUE

- 1,000 cow dairy @ 30% cull rate
- \$500 / cull animal
- \$12,500 per month
- > \$3,800,000 per year
- @ \$150,000 per year
- Take Home Message: 1) Revenue from beef is less
 - 1) Revenue from beef is less than 4% of total dairy revenue!!!
 - 2) Appeal to "future" of industry

Dairy Perspective: Animal Welfare Issues

- Debilitated Animals (small number of animals, but huge consumer reaction impact)
- Antibiotic Residues in Meat (are very familiar with this issue in milk)
- Injection Sites (administer many useful medications throughout the lactation of a cow)
- Lameness and Joints (smallest loss from dairy cull carcasses)

What About Beef Producers?

- Trying to catch that last year out of a cow
- "Shelly Cattle"



The changing times of information

- What happens now can be on YouTube™ later the same day
- www.youtube.com search for calf branding



Biosecurity

■ Biosecurity – the outcome of all actions used to prevent disease agent entry into a unit of interest ie. The Ranch!

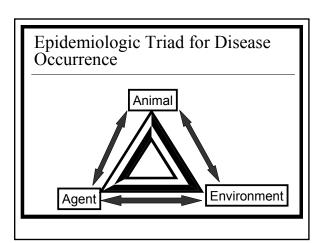
> **Protecting Your Animals and** Your Livelihood

> > Dargatz, Vet CI FoodAn 18 (2002) 1-5

Biosecurity Important on Multiple Levels

- Herd Level
 - Lost Productivity and
 - Profitability ■ Calf Scours
 - BVD-PI
 - Trichomoniasis (TRICH)
- State Level
 - **Restricted Animal** Movement
 - Bovine Tuberculosis
 - Brucellosis (BANG's)
- National/International Level
 - Trade Restrictions
 - BSE (Mad Cow)
 - Foreign Animal Diseases (FAD)

Foot and Mouth Disease



New Herd Introductions – Part of a Herd Biosecurity Plan

Calf Scours



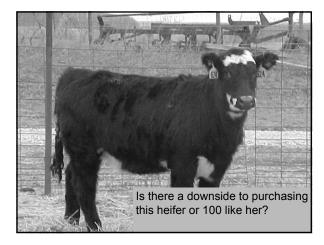
- Introducing cattle during calving increases risk for scours
- Most cattle carry 1 or more scours agents

New Herd Introductions Management Considerations

- Do not immediately commingle with resident herd.
 - About 3-4 weeks may be sufficient
 - Allows time for arrival tests
 - Allows recovery time if acute disease occurs
 - Treat sick animals if illness occurs, isolate longer if needed
 - Pursue confirmed diagnosis if illness occurs.

New Herd Introductions Management Considerations

- Do not commingle during calving season
- Use vaccination to reduce risk when commingling is done

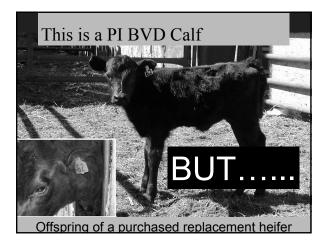


This cow is BVD-PI



- •Poor reproductive performance
- •Watery diarrhea •Contagious
- •Leads to Death
 •Other cattle in herd (including calves) are carriers





This Ranch.....

- Calved these replacement heifers <u>separate</u> from the resident herd.
- Tested calves and then dams of positive calves.
- Positives were culled before commingling with resident herd.
- Resident herd (as part of existing health program) and new arrivals were vaccinated.

This Ranch.....

- Bottom line....BVD was not introduced into the herd even though PI animals resulted fron the purchase.
- Spent about \$150 on tests that potentially saved thousands over the next years.

Controlling Trichomoniasis

- Trich is a venereal disease
- Transmitted through bulls breeding infected cows the breeding non-infected cows
 - Maintain a closed herd, if possible
 - Avoid exposure to neighbor's bulls?
 - Maintain fences in good repair?
 - Vaccination and annual bull testing
 - Pregnancy testing and culling open cows
 - Cooperate with state animal health officials during traceback investigations

Critical Biosecurity Concepts

- Do not immediately commingle new arrivals with resident herd.
- Only purchase replacements from "high health" sources or maintain a closed herd.
- Keep Fences in Good Repair
 - Keep cattle from co-mingling with neighbor's cattle
- Control vectors on your property
 - Wildlife can be vectors for certain diseases
- Register Your Premises

Premises Registration

■ Voluntary Program

- Strictly Confidential
- Easy
- Forms available from multiple sources
 - National Cattlemen's Beef Association
 - Breed Associations
 - State Departments of Agriculture
- Premises registration is simply your 911 address and the type of species you have on your operation

Premises Registration, COOL & NAIS

- Allows officials to notify producers in areas of infection
- Helps producers in areas close to infection keep outside cattle off premises and not move cattle to infected area
- Ensures a more timely response to an animal health challenge
- An essential component of a good biosecurity plan
- Facilitated by existing Beef Quality Assurance initiatives

Take Home Message

- Reacting to a challenge is always more costly than preventing a challenge.
- A proactive approach utilizing sound science and common sense will help prevent the introduction of disease
- Biosecurity is Every Producers Responsibility!
- Having a Premises ID # is part of a good biosecurity plan and easier COOL compliance

Questions

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