By Mort Kothmann

SRM 2004 in Review

Let me give a big THANK YOU to all of the members of SRM who contributed to the successes and progress of SRM during 2004. It has been a great experience to serve as your president for a year. The view from this position makes it abundantly clear how many SRM members demonstrate their commitment to the vision and mission of SRM by giving untold hours of volunteer service. We have a talented and committed staff in the Denver office, but it is the volunteers on the committees and in leadership positions who do the work of SRM that accomplishes the objectives of the Society. Thank you! In this review, I will report on Annual Meetings, Membership, Programs, Partners & Affiliates, Administration, SRM Name, and Looking Forward.

Annual Meetings

Looking back, we began 2004 in Salt Lake City, Utah, with a record annual meeting. The vitality and enthusiasm of our members at this meeting took the momentum from prior meetings and built on it. We closed the year with another tremendous annual meeting in Fort Worth, Texas. The opportunities for professional development and networking at our annual meetings continue to expand. The diversity of the programs and the enthusiasm of the meeting participants are strong leading indicators that SRM is advancing. Future annual meeting sites that have been approved are Vancouver, British Columbia (2006), Reno, Nevada (2007), and Louisville, Kentucky (2008). Looking to the future, our expectation of continued growth of SRM and our annual meetings programs make it important that we provide meeting facilities that can support this growth. This is creating a "problem" because several sections do not have meeting facilities within their boundaries that can host a meeting of our current size. The Board is concerned and is committed to modifying our annual meeting model in a way that will allow all sections to have an opportunity to host an annual meeting and reap the associated benefits. The 2005 Board will be addressing this issue and will consult with the sections to develop a model that will serve SRM well in future years.

Membership

Membership provides another positive indicator of SRM health. Although we made necessary increases in membership dues in 2003 and 2004, membership increased during both of these years. This has never happened in the history of SRM. Leslie Radtke is doing an excellent job of managing the membership database and providing service to members. Now we SRM members need to continue recruiting new members and involving them in strong professional programs at the section level to complement our annual meetings. Membership is the responsibility of every member, not just a membership person or committee. Let's keep SRM expanding.

Programs

SRM maintains a broad range of programs for professional support and development. Certainly our annual meeting is one of the outstanding programs. Publications saw changes during 2004 with the culmination of a 3-year effort to enhance the effectiveness and impact of the *Journal of Range Management*. Keith Owens, Editor-in-Chief, produced the first issue of *Rangeland Ecology & Management* (REM), which appeared in January 2005. Our new publisher, Alliance Communications Group (ACG), is working on worldwide marketing and distribution. They publish about 40 other professional journals, and SRM is benefiting from their marketing expertise. The January issue is available online and will be open for anyone to read. Check it out at www.srmjournals.org. Subsequent issues will be available only to paid subscribers. REM also moved to electronic submission and review of manuscripts. Gary Frasier, Editor-in-Chief of *Rangelands*, is working with ACG and the *Rangelands* Editorial Board to give our membership publication a new look and content that will be more broadly appealing. Plans are being made for marketing of *Rangelands* to groups such as schools and FFA programs.

The number of universities with accredited range management programs reached a peak of 10 under the current program and has begun to decline, indicating a need to reexamine the program. I appointed a Task Group (TG) with Tom Thurow as chair to review the SRM University Accreditation Program. The Board received the TG report in October 2004. In January, I appointed an Accreditation Revision TG with Tom Thurow as chair. Their charge is to consider the recommendations of the Review TG and develop a proposal for consideration by the Advisory Council and Board during 2005. Texas A&M University and Colorado State University are scheduled for review for reaccreditation during 2005. The SRM Accreditation Committee will be conducting these reviews and making their recommendations to the 2005 SRM Board.

SRM committees are continuing to perform their many activities and important functions. In our new procedures, SRM members are invited to join and participate in the committees that interest them. If you want to work, don't wait to be asked. New Science and Ecology committees may be formed if there is a need and a critical mass of interested members. In January, I was approached by Mike Dechtner about the need for a standing SRM committee on Grassbanking. I told Mike to develop committee guidelines, recruit members, select leadership, and plan an agenda for the Fort Worth 2005 Annual Meeting. He did and they met and are now launched as the newest SRM committee. It really is that simple. The goal of the Board is to empower the SRM membership and support them. Communications between the Board and the Committees during 2004 was a weak point identified at the meeting of the Committee Chairs and Board in Fort Worth. The 2005 Committee Chairs and the Board reps will need to work to improve these important communications in 2005.

Partners & Affiliates

SRM has two types of Partners, professional societies and government agencies. We work with each of these in different ways. The P&A Committee made a recommendation to the Board at the 2004 Annual Meeting that we identify a set of key societies and develop a closer working relationship with them. This is being implemented. In October 2003, the entire Board met in Washington, DC. During the time we were there, we met with representatives from 10 other professional societies, including The Wildlife Society (TWS), Society of American Foresters (SAF), American Fisheries Society (AFS), Ecological Society, Agronomy, Soil Science & Crop Science, Weed Science, Soil & Water Conservation Society, and American Forage and Grassland Council. We discussed options for partnering and agreed to continue to explore opportunities. The Executive Committee returned to Washington, DC, in October 2004 and met with society representatives again. Let me give two examples of actions resulting from this increased communication. SAF called SRM, AFS, and TWS and invited us to share their exhibit space at the Forest Service Centennial Congress in January 2005. Deen Boe brought our display and shared time in the booth with the other society reps. We had many favorable comments from participants at the Congress about the apparent cooperation that this represented. AFS has invited SRM and 6 other societies from this group to join them in a congressional staff briefing in March 2005 on the topic of Invasive Plants, which the group agreed was a common high-priority issue. Three expert speakers were selected from the 8 societies, and all societies will share equally in the travel costs for the speakers. John Brock, Chair of the SRM Invasive Species Committee, was selected as one of the speakers. The SRM Executive Committee will return to Washington, DC, in March to meet with our agency and society partners. John Tanaka has established a listserve with all of the partner societies to facilitate communications.

Our primary agency partners have traditionally been NRCS, FS, and BLM. During our visit last fall, we also met with the National Park Service and the US Fish and Wildlife Service and explained the broad scope of SRM expertise and programs. They were pleasantly surprised at what we could offer them in the way of professional development and personnel training. Our annual meetings make an excellent venue for agencies to hold specialized training programs for their employees. This activity has occurred at the 2003, 2004, and 2005 annual meetings, and we expect it to continue to expand.

Another area of partnership with agencies has been the liaison and professional development positions that Leonard Jolley (NRCS) and Doug Powell (BLM) have filled during 2004. The agencies place these individuals with SRM for professional development and to strengthen our working partnerships. They have played key roles in programs such as CPRM and Technical Service Provider training, providing technical responses to issues such as Sage Grouse and others.

We have been discussing the possibility for the Forest Service to also participate in 2005.

Administration

Since we sold the office building we owned on York Street in 1999, we have been leasing office facilities in Lakewood on the west side of Denver. In 2003, the Board affirmed that it was the intention to maintain an office in Denver, and the search began for a suitable facility. In May of 2004, I appointed Jeff Burwell to chair a Facilities Search Task Group. Their charge was to find something suitable that we can afford with the money from the sale of the York Street building. In December 2004, the SRM Board decided it was in the best interest of the Society to make a change in the Executive Vice President (EVP) position in the Denver Office. Craig Whittekiend was hired as interim EVP on a part-time basis. I appointed an Executive Vice President Search Committee with Kris Havstad as Chair. Our goal is to hire a new EVP by summer 2005. This goal, coupled with the expected departure of Leonard Jolley (March 2005) and Doug Powell (June 2005), the planned retirement of Deen Boe (December 2005) as our Washington, DC, rep, and an office lease that expires in July 2005, left us in a position to reevaluate our operation. In January 2005, I appointed John Tanaka as Chair of an Operations Review Task Group with a charge to review our administrative procedures. This TG will report recommendations to the Board by March 1, 2005.

SRM Name

At the Membership Meeting in Salt Lake City, I promised the membership that the 2004 Board would not raise the issue of the name of our Society. During the year, several members of SRM acting on their own again raised the issue of changing the name of SRM with articles published in Member Resource News. At the 2005 meeting in Fort Worth, the Advisory Council passed a recommendation that the Board place the name of the Society on a ballot to allow the membership to vote and settle the issue. As its last official action, the 2004 SRM Board accepted the Advisory Council's recommendation and passed the issue to the 2005 Board. It is my fervent hope and request that the membership of SRM handle the discussion and decision process during 2005 in a professional manner. This is a very emotional issue for some of our members but not for others. Let's all try to be respectful and discuss the issue on its merits and then put this to rest and get on with the important task of furthering the vision and mission of SRM. People don't want to join or be a member of a family where the members are always fussing with each other.

Looking Forward

At a time when many of our partner societies are planning their budgets based on annual declines in membership of 2%–3%, we are well positioned to move counter to this trend, but it will take a major effort on the part of our whole membership. The aging of the federal workforce includes many of our longtime members. Young college graduates are not inclined to join professional societies like many of us did in the 1950–1970 era. Tight federal and state budgets make travel to meetings more difficult. We need a strong recruiting and retention program in each of the sections to make new members and to get them involved and keep them. Your Board has worked with the Denver staff to improve our membership service, and we pledge to continue this effort. However, the final result will depend on how each of you, the members of SRM, accepts responsibility for being an active contributing member. If we all make the commitment, SRM can grow and achieve the vision of well-trained professionals working for healthy rangelands around the world.

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By Gary Frasier

Frasier's Philosophy

Water—the essence of life. Without it, we cannot survive. The experts tell us that in much of the West, we have gone through a drought period of 3–5 years and maybe even longer in some areas. Will it continue? This, we do not know. Even in periods of drought, there can be too much water. In many instances, the water that we do get as precipitation is not distributed uniformly over the land, or else, it comes all at one time. As I write, I am listening to the news of massive amounts of rain and snow in California and Nevada.

Another problem is that we sometimes have a short memory. All too frequently, we forget during the periods of adequate water how to cope with limited water supplies in other times. Some of our readers can probably remember the drought of the 1930s, the "Dust Bowl" years. That is before my time. I do remember the dry years of the 1950s. As a rancher or resource manager, it is very disheartening to look out across the land and see very little evidence of growing plants and to look at the sky and see no signs of moisture. If this continues over a large area for several years, we call it a drought. It makes the national news. Legislators spend time and money to "solve" the problem. As soon as it starts raining, the problem vanishes from the public's eye. That does not mean that we have solved the problem. History tells us that it will happen again.

What does all this mean? To ensure that our rangeland resources are viable over a long term, we must always keep in mind that there will be periods of drought that reduce the plant resources. We must try to anticipate what the next year will bring. Many range plants have developed over a long period of time, which means that they have experienced droughts. Yet they have survived. This means that, even in good years, we must manage the rangelands resources on a conservative basis. Instead of saving for a "rainy" day, manage the resources so you can withstand a "dry" day.

I have spent a career studying rangeland water management in semiarid and arid regions. One thing that I have learned is that there have been periods in the past when drought was much more severe than anything we have experienced in recent times. Viable civilizations have vanished when extended droughts occurred. Could these civilizations have survived if there had been a better understanding of how to manage the natural resources in times of limited water resources? I would like to think so.

One thing I am sure of, droughts will occur in the future. Even in good years, there are usually areas where the rains are scarce.

This issue of *Rangelands* has "Water and Drought" as its theme. There are several articles that show the impact of drought on rangeland management and also how to efficiently use water when it is limited.

Let us not forget… ◆

Rangeland Water Matters to Everyone!

By Mike Mecke

I am going to pose some questions about your water source for your thought and actions. Our Earth is known as the Blue Planet because of the blue color we see from space, caused by the large amounts of water present on its surface. But most of the earth's water is undrinkable, salty ocean water or sometimes brackish groundwater. At least undrinkable without facing often high costs for treatment, disposal of the toxic salt waste products, and cost of transporting.

A website known as the Water Page states it this way.

> If a large bucket of water were to represent the sea water on the planet, an egg cup full would represent the amount of water locked in ice caps and glaciers and a teaspoonful would be all that was available as drinking water.

Water-harvesting facility for wildlife drinking water in western Arizona. Photo courtesy of Gary Frasier.

Years ago, due to a family emergency, I left the Bureau of Indian Affairs in Wyoming and moved home to San Antonio to enter the water-resources profession. As all good range folks are trained to think and act, as watershed managers, I was selected to work in water-resources planning and later in Ag conservation. The lone Ag graduate in a department of urban planners and engineers! But, we learned a lot from each other I believe. I had long been concerned with water, watersheds, and soil conservation from my Texas A&M classes and into my early Range Conservationist years with the former Soil Conservation Service.

Many decades ago, a profound statement by Dr Thad Box, former Dean at Utah State University, made a lasting impression on me. In a *JRM* article, Dr Box said something like "someday, the most important product from rangelands will be pure water!" That has always stuck with me and I am a firm believer in the wisdom of that statement. Rangelands do make up a high majority of the watersheds in the western half of the United States, which is the area I am mostly writing of today. The truth of the statement is now more apparent than ever. It has become a proven fact even to many non-range people.

Our use of freshwater resources such as rivers and lakes has steadily increased over the centuries. Human population has exploded across much of the world and many of our nations now use many times the amount of water actually needed for life. Quite often, we have too many people living and working in dry areas that cannot support them in a sustainable manner. Many of our large, growing cities across the Sunbelt are now experiencing water shortages or have projected shortages in coming decades.

Chisos Mountains, courtesy Big Bend National Park.

In Texas and elsewhere in the West, we range conservationists are very familiar with the ranching term "carrying capacity." This refers to keeping your forage (and water) supplies on a ranch in balance with the livestock herd, including the wildlife populations present. Well, I believe that our world has human carrying capacities also, especially water supplies. Are we always in balance with our carrying capacity in the arid and semiarid areas of the American Southwest and West? Or even some Southeastern areas? Florida has huge water problems. Are we leaving enough clean water in our creeks, rivers, aquifers, wetlands, and bays to keep them healthy and functional? Or, have we paved, channeled, developed, drained, or otherwise improved those water bodies and their watersheds? Do we treat all lands as a watershed? All lands are watersheds, as you know. I don't believe in many cases we are. We often get by in taking from Peter to pay Paul. Or have we left the problems for the next generation to fix?

With rapid population growth and increasing domestic, industry, and recreational water use, water is becoming an incredibly valuable resource but is still largely undervalued at our water meters and irrigation district offices. Price usually influences people's perceptions of an object's value. Many water experts feel that much of our extra water needs will come from irrigated agriculture in the future. Certainly, in many cases, irrigation can be done much more efficiently than it is now. Or does this mean that we will return these profitable, valuable irrigated fields to less productive native grasslands or desert? I have seen many hundreds of formerly irrigated fields in Arizona, New Mexico, and Texas abandoned to become weed-infested dust bowls causing other problems. Will we someday fairly soon buy much of the food and fiber needs of our states and nation from other countries? Becoming a Third World country in agriculture? What happens to the families, communities, and regions depending on irrigated agriculture's income and jobs? Or of the ranches depending on irrigated pastures for winter or summer forage? There could be a ripple effect economically that can reach far away, maybe even into the cities purchasing this water.

This rapid population growth and increased human water use has caused an explosion of water marketing/selling, trading, and leasing. Sound familiar? It does in Texas or in the Colorado River basin. These have become target areas, both for selling and buying of water and water rights, as have regions in other states. In Texas, we now have regular seminars on water marketing, something unheard of 10 years ago. Not only are US entrepreneurs involved, but foreign-owned water companies are also now investing in ownership and operation of water rights and utilities across the nation. Do Americans want and need that? Or should we own and manage our own water resources?

It is not only the scarcity of water that is becoming an issue, but also water quality. We know that properly managed rangelands, riparian areas, and wetlands not only produce water for our needs, but purify that water too. Auto/jet fuels, mineral fertilizers, home and agricultural pesticides, pathogens, and industrial by-products have seeped into aquifers and surface waters, contaminating them beyond human consumption and disrupting delicate ecosystems. We are now seeing some of our rivers polluted with pharmaceutical products that may affect not only those ecosystems but human water users downstream. Who would have ever dreamed that? Our towns and cities have sometimes indiscriminately dumped sewage, industrial wastes, and toxic pollutants into rivers and lakes, threatening the world's most important resource, fresh water. Ultimately, our bays and oceans are paying the price for our carelessness and negligence in protecting water resources.

Some US rivers and bays have become unfit for swimming or fishing, let alone for livestock or our own drinking. Unfortunately, Texas is in that group of states with many water-quality concerns. We need look no further than our beloved and historic Rio Grande/Rio Bravo or Pecos Rivers for examples. The ongoing 7–10-year drought across New Mexico, western Texas, and eastern Mexico has only made the current situation worse. This drought has spread north to Montana and west to the Pacific, further stressing our rangeland watersheds and riparian systems. Even Las Vegas is now conserving water. What next?

Will there be enough drinkable water to accommodate the needs of future generations of Americans and others worldwide? Will irrigated agriculture survive and prosper? Will it be affordable to all? There will be, if we properly manage all of our watersheds, water supplies, and plan our growth with this irreplaceable resource at the top of our lists. A planning method termed Smart Growth is not just a method of saving agricultural lands, reducing congestion, improving air quality, and saving wildlife habitat. Smart Growth can also be a method of properly planning water-resources development and management.

Water availability is the question that many of us in the water arena now wrestle with and try to address daily. It is also the issue that our children and grandchildren will face due to exploding human populations and the same amount of water. So, do your share NOW to conserve water and to keep our water supplies pure! Lead by example. Be a good—no, a great—steward of your land, whether 100 sections of rangeland or a home lot or a business site. Properly manage those watersheds and riparian areas so that they not only produce the forage and wildlife habitat needed but produce the clean water that we all require.

Conservation must always be No. 1 on our water resources planning list, as the water we save is always our cheapest water! Did you know that most home landscapes use from 40% to 60% of the family's total water use? We are doing better in urban conservation, especially in Tucson, San Antonio, El Paso, Albuquerque, and some other cities, but we are far from doing our best. We Americans love to be No. 1; it's in our genes; so why not try to be No. 1 in lowest water use per person? This should also be done in our farm and ranch homes. That achievement will do wonders for our water resources and for the future of our economy. When I was a Range Section Chief on the Papago Reservation in southern Arizona, I saw entire herds watered on rainwater catchments and then saw this again in Wyoming. Also, high evaporation rates of tank water had led to experimental floating covers. This is becoming a growth business now in arid west Texas. Your rangelands can do the same!

If we do our best at achieving sustainable rangelands and water resources, then the future will be brighter. Working closely with our neighbors in Mexico and Canada is part of the answer that we range and water professionals must address. We share not only water but watersheds. We must aim for sustainability, but achieving it will take all of us working together.

Water is not a commodity like oil. There are many substitutes for oil. But for water, none! Truly, water is life—or, as we say in the Southwest, agua es vida!

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Historical Weather Patterns: A Guide for Drought Planning

By Alexander J. Smart, Barry Dunn, and Roger Gates

How do we know when drought will occur? In 2002, the Great Plains suffered through a widespread drought that seemed to catch many ranchers off guard. In South Dakota, there was a flurry of extension activity generated to deal with drought issues. Why were so many ranchers caught off guard? One answer may reside in the patterns of past weather data. Being able to anticipate low rainfall and having the flexibility to handle it has been the common advice by extension personnel and ranchers that have successfully weathered the years. To do this, one has to develop the ability to evaluate historical data in regard to making decisions that have long-term implications for successfully navigating through ranching challenges. Our objective is to present historical precipitation data from western South Dakota and derive certain expectations of drought occurrence to show how this can be used in drought planning.

Annual Precipitation Patterns

It is well understood that the amount of precipitation in semiarid environments is the main factor that determines forage production. The Cottonwood Range and Livestock Station in western South Dakota has been recording weather data since 1909. The power of such information is that patterns emerge that can provide insight into the future, allowing preparation. It is not a crystal ball but at least an informed guide.

Drought is generally defined as 75% of average annual precipitation. At the research station, annual drought occurred 14 times out of 95 years of weather-data collection

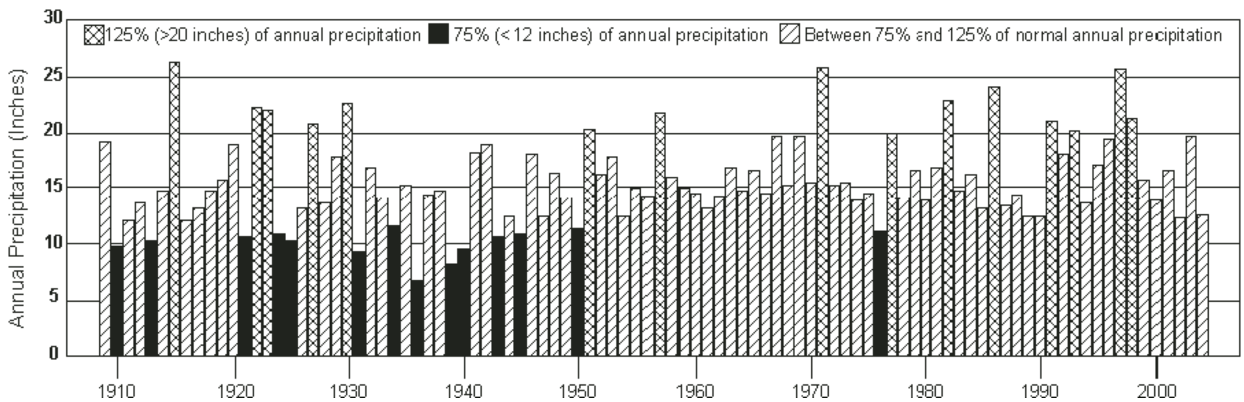

Figure 1. Annual precipitation from 1909 to 2004 for the Cottonwood Range and Livestock Station located 75 miles east of Rapid City, South Dakota, in the mixed-grass prairie. Mean annual precipitation is 16.04 inches (USDC 2004[1]).

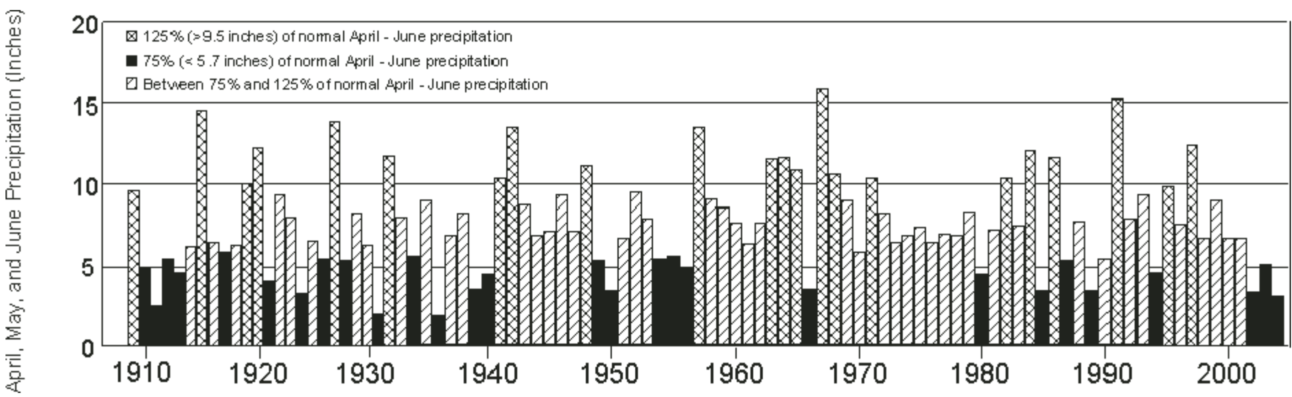

Figure 2. Cumulative precipitation for April, May, and June from 1909 to 2004 for the Cottonwood Range and Livestock Station, located 75 miles east of Rapid City, South Dakota, in the mixed-grass prairie. Mean precipitation for April, May, and June is 7.6 inches (USDC 2004[1]).

(Fig. 1). The last 50 years at the research station have been wetter. However, this might not reflect the true impact on forage-growing conditions because the timing of precipitation in a temperate climate is as important as annual precipitation.

Spring Precipitation Patterns

In the northern mixed-grass prairie of the Great Plains, the amounts of spring precipitation for the months of April, May, and June are particularly important as indicators of the current year's forage production. In a South Dakota agricultural experiment station bulletin published in 1951,[2] the authors recognized this phenomenon and also noticed that summer precipitation was 75% of normal 6 out of 7 years. Because the warm-season grasses consist mainly of shortgrasses, such as blue grama (*Bouteloua gracilis* [H.B.K.] Lag. Ex Griffiths) and buffalograss (*Buchloe dactyloides* [Nutt.] Engelm.), late-summer rainfall did little to increase the season's total forage production because the cool-season forages had already produced the majority of their biomass for that year. In 2004, Heitschmidt[3] confirmed this by examining 15 experiments in the northern Great Plains and found that 91% of the annual forage was produced by July 1.

Cumulative spring precipitation data for the months of April, May, and June from 1909 to 2004 are presented in Figure 2. As one would expect, spring precipitation was highly variable over the 95 years. Above normal (> 125% of the 95-year average), normal, and below normal (< 75% of the 95-year average) occurred 23%, 48%, and 29% of the time, respectively. Looking at the decades of the 1910s through the 1950s, below-normal spring precipitation occurred nearly 40% of the time while only occurring 15% of the time from the 1960s to the 1990s (Fig. 2).

Knowing What to Expect

While it's uncertain what the future will look like, looking at the occurrence of past events gives us an idea about what kind of spring rainfall could be expected given the current rainfall pattern. For example, in 2001, the research station had received 7 consecutive years of above-normal or normal spring rainfall since 1994 (Fig. 2). Given this pattern, the frequency of occurrence of 8 consecutive years of above-normal or normal spring rainfall was very low. In fact, such a pattern only occurred 1 time out of 27 periods, or 4%, between years with below-normal spring rainfall during the last 95 years (Table 1). It shouldn't have been a surprise when drought came in 2002; actually, it might have been anticipated because long periods (> 4) of normal or above-normal spring-rainfall years between spring-drought years are quite low (Table 1).

Back-to-back below-normal spring rainfall occurrence was 33% (Table 1). So when a spring drought does occur, it is not unreasonable to anticipate that another year of below-normal spring rainfall could follow. The good news is that consecutive years of spring droughts don't last as long as the number of years with above-normal or normal spring rainfall (Fig. 2). Most dry periods came in 1-year intervals with below-normal spring rainfall occurring 19 times during the 95 years (Fig. 2). The longest drought lasted 4 consecutive years but only occurred 1 time (Fig. 2).

Conclusion

Understanding historical patterns can lead to effective planning for successfully managing ranch resources. Historic weather records are available and readily accessible for most of the United States. In addition, keeping track of precipitation is probably standard practice on most ranches. In the northern Great Plains, spring rainfall is a better indicator of forage production because this rainfall overlaps the growing conditions for most cool-season forages. Ranchers should expect below-normal spring rainfall to occur about 30% of the time and should plan accordingly. Learning to be sensitive to recent weather patterns and assessing risk will help alleviate the financial struggles and degradation in rangeland resources caused by droughts. In western South Dakota, if

Table 1. Number and frequency of normal or above-normal spring (cumulative April, May, and June) rainfall years between years having below-normal spring rainfall at South Dakota State University's Cottonwood Range and Livestock Station from 1909 to 2004

Normal or above-normal spring rainfall years between years having below-normal spring rainfall	Times occurred	
Event	No.	%
0	9	33
1	5	18
2	3	11
3	4	15
4	2	7
5	0	-
6	0	-
7	1	4
8	1	4
9	1	4
10	0	-
11	0	-
12	0	-
13	1	4
Total	27	100

several favorable spring-rainfall years have occurred in a row, ranchers can probably anticipate a spring drought to occur within the next year or two. If a spring drought does occur, history suggests that the next year's spring could be dry because back-to-back spring droughts occurred 33% of the time. We believe that being able to anticipate low rainfall and stock at conservative rates or have flexible stocking alternatives is still the best advice from extension personnel and ranchers that have successfully weathered the years.

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Barriers to Successful Drought Management: Why Do Some Ranchers Fail to Take Action?

By Barry Dunn, Alexander Smart, and Roger Gates

Why does drought impact ranchers and their operations differently? Are there factors affecting the severity of the impact of drought other than precipitation and temperature? The drought of 2002 in the northern Great Plains provided the opportunity to observe ranchers' responses to drought. In South Dakota, the authors observed a wide range of responses, from no modification of management to implementation of a deliberate and appropriate drought-response plan. Anticipating low rainfall and having the flexibility to handle it has been the common advice from rangeland-management professionals and ranchers that have successfully weathered previous droughts. Yet there are barriers that hinder ranchers from responding effectively to drought. Our objective is to suggest reasons that ranchers may be unresponsive to drought. Our hope is that a deeper understanding of ranchers' responses to drought will lead to improved response in the future. The beneficiaries of an improved response to drought will be rangeland resources, ranchers and their families, and society in general.

Learning, Paradigms, and Mental Models

Ranchers may not be aware of the historic weather patterns and the expectations of drought in the northern Great Plains (see article by Smart et al[1]). Prior to 2002, favorable spring growing conditions had occurred 7 years in a row in western South Dakota. Given this pattern, the frequency of occurrence of 8 consecutive years of above-normal or normal spring rainfall was very low. In fact, such a pattern only occurred 1 time out of 27 periods, or 4%, between years with below-normal spring rainfall during the last 95 years. Ranchers and rangeland resource professionals should have been expecting a drought. Also, the occurrence of back-to-back spring droughts was 33%. Potential risk of reduced forage production was great. Knowing and understanding historic precipitation patterns is a critical first step to a well thought out and planned response.

Sensitivity to drought is influenced by experience. For example, ranchers who grew up during the 1960s in western South Dakota would have only experienced 6 spring droughts during the next 40 years (see article by Smart et al[1]). However, if they had grown up ranching in the 1920s, they would have experienced 10 spring droughts, 3 of them lasting for 2 or more years. A majority of ranchers operating in 2002 grew up during the 1950s and 1960s.

One's capacity to recall the impact of previous below-normal precipitation is difficult because we are heavily influenced by our most recent memories. For example, prior to the drought of 2002, at South Dakota State University's Cottonwood Range and Livestock Station in western South Dakota, the last dry spring had been in 1994. Forage yield from pastures on the Cottonwood Station averaged 1500 pounds/acre from 1997 to 2001. In 2002, the forage yield from these same pastures was reduced by 50%. When ranchers and rangeland professionals observe forage production during good years, especially for extended periods, it is easy to forget conditions during bad years.

Senge's work "The fifth discipline: the art and practice of the learning organization," published in 1990, defines a mental model as a deeply held assumption, or generalization, that influences one's views and interactions with the world. Do ranchers view their grasslands or their cows as their basic ranch factory? What is their mental model of a ranch production system? Is it based on cattle or grass? The

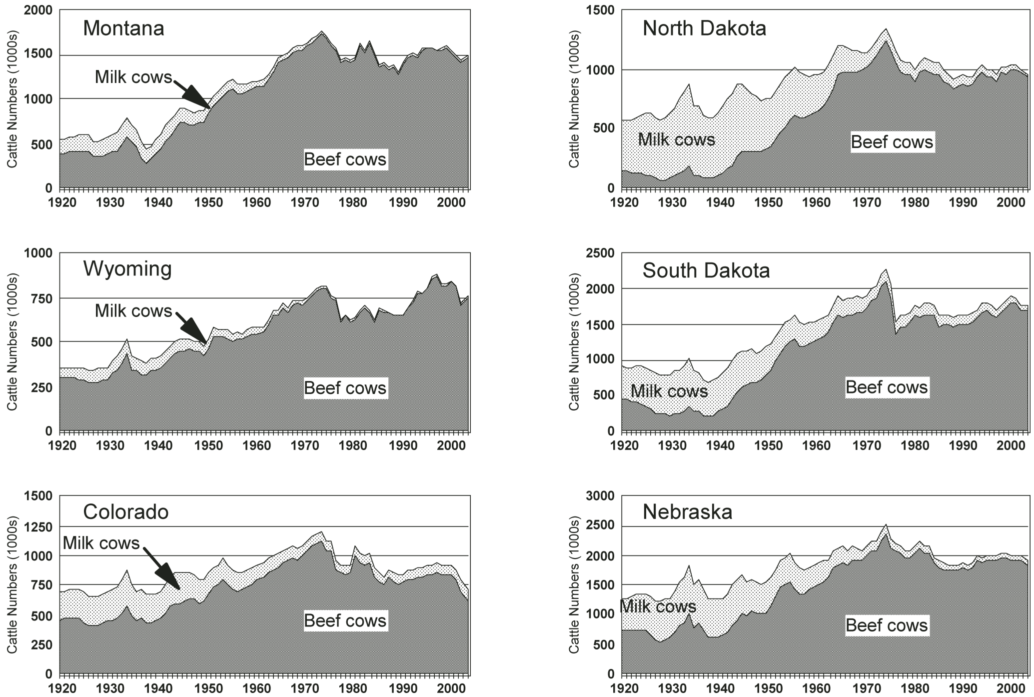

Figure 1. January 1 livestock inventories of beef and milk cows for states in the northern Great Plains from 1920 to 2004.[11]

6% decline in cow numbers from January 2002 to January 2003 in South Dakota (Fig. 1), while forage production in many areas dropped 50%, is evidence that ranchers view their cows, rather than their grasslands, as their factory. Understanding this mental model is critical in understanding rancher response to drought. From a rancher's perspective, investments in livestock genetics, market considerations, public policy, and an inherent positive attitude that negative short-term conditions will be buffered by long-term trends are strong incentives not to liquidate livestock. Evidence of this behavior is provided by the increasing cow-inventory trend from the northern Great Plains states (Fig. 1). How tightly this belief system is held has powerful implications for the health of both the rangeland and financial resources of ranchers.

Financial

In eco-regions like the northern Great Plains that experience periodic droughts, minimizing risk exposure is a key to sustainable long-term ranching success. Conservative stocking rates or flexible stocking alternatives have long been recognized as key strategies. One problem is that flexibility provided by maintaining different age classes of livestock is not in widespread practice, as it once was. The once common practice of grazing yearling cattle to harvest excess forage in years when it is abundant has been replaced by maintenance of larger cow herds. Inventories for yearling cattle on grazing lands are not available, but beef-cow numbers from 1920 to 2004 in the Great Plains states (Fig. 1) has risen dramatically. Grazing acres in this region have stayed fundamentally the same, indicating that this shift in inventory from yearlings to cows has probably occurred. There are many potential reasons explaining the phenomenon. Cattle genetics have changed dramatically during this period of time, responding to market signals demanding fast-growing animals. So the potential supply of desirable yearling cattle for grazing is smaller than it once was. In addition, surveys published in 1982 by Dooley et al[3] and in 2003 by Dunn et al[4] demonstrate that, in South Dakota, average calving dates are now approximately 60 days earlier in the year. Earlier calving decreases available supplies of desirable yearling cattle for grazing by increasing average ages and weights. The typical November-weaned calf produced by current management systems may be too heavy to be desirable to go to grass in May.

Stored feed is a strategy for reducing risk. Fifty years ago, ranchers commonly had one-half to a full year's feed needs on hand at all times. As haying systems, transportation systems, and crop yields have changed, ranchers are less reliant on feed stocks stored for emergencies, such as drought. This trend is validated with the understanding that hay harvested with modern technology can suffer dramatic loss of dry matter due to weathering during wet years. Round bales have a greater surface per ton of hay stored vs the large hay stacks of yesteryear. Improved transportation systems in South Dakota and the region facilitate the movement of harvested

Antelope Research Station in June 2002, located approximately 15 miles east of Buffalo, SD. Note the lack of green grass in this spring drought.

feed across long distances as well as the movement of livestock to feed supplies in regions unaffected by drought.

Reluctance to destock during drought can be associated with a rancher's valid concerns for the unpredictable impact that decisions may have on a ranching operation's financial situation. Sale of a large portion of a ranch's cow inventory will increase income for the fiscal year affected by the drought. However, it can have dramatic negative impacts on income in future years and unpredictable impacts on expenses. Ranch net income can actually increase during a drought, generating a tax liability, while decreasing net income in future years that may be needed for debt service or family needs like education. Cattle sold during the drought are often discounted in the marketplace due to increased supply, decreased demand, poor livestock condition, and untimeliness. Market value of livestock may be depressed below book value or balance-sheet values, which causes problems with net-worth statements and potentially with lenders.

Policy

Federal and state policy beginning in the 1930s, but even more so over the last 40 years, has generally been to provide aid to ranchers faced with the consequences of drought. This has taken many forms, including cash subsidies, low-interest-rate loans, various types of feed, use of Conservation Reserve Program land, tax-law changes, transportation subsidies, water development, cost-share programs for resource development, information networking, and counseling services. As described in a review article of federal disaster policy including drought, Barry Barnett[5] outlines how billions of dollars have been paid to farmers and ranchers in drought aid over the last 25 years. One unintended consequence to these policies is to encourage overuse of already stressed pastures and rangeland resources by encouraging livestock owners to hold livestock during drought rather than sell them. This encouragement has come in the form of cash subsidies, direct feed assistance, and transportation assistance. A second unintended consequence is that appropriate drought responses by ranch managers are delayed as policy alternatives are discussed, debated, and implemented. An example of the political climate during the drought of 2002 can be found in the November 20, 2002, article in the *Sioux Falls Argus Leader* by Peter Harriman[6] entitled, "Senate buries drought-relief bill." The long-term result is to encourage managers to maintain relatively high stocking rates and a reluctance to plan for and respond to periodic drought. Politics can exacerbate the impacts of policy as individuals leverage assistance for political gain. For example, "Lawmakers vow drought-aid fight" and "Budget bickering blocks drought aid" were actual newspaper headlines in the *Sioux Falls Argus Leader*[7,8] in the fall and winter of 2002 and 2003. Government response to drought was an important part of the political discussion and debate in both of South Dakota's senatorial campaigns in 2002 and 2004. This is summarized in the March 5, 2003, *Argus Leader* story by David Kranz[9] entitled, "Drought hurt his chances, Thune says" and the October 6, 2004, story by Mike Madden, "Drought aid tangled in political stalemate."[10] All major farm organizations have an expectation of government drought relief as part of their political platforms. As an alternative to counter-productive assistance tied to livestock numbers, rewarding farmers and ranchers for timely implementation of comprehensive drought-response strategies would have positive benefits to ranchers, rangeland and pasture resources, and society in general.

Scale

The management response to drought is impacted by the duration, severity, extent, and seasonal pattern. Spring droughts in the northern Great Plains can last 1–4 years (see article by Smart et al[1]). Actual precipitation during the drought can range from 25% to 75% of normal. The region affected can be many counties within a state or many states within a region. The financial impact of drought can vary depending on when it occurs in relationship to the cattle inventory and price cycle and other commodity markets. The scale of drought may affect the decision to destock, which ultimately determines the impact on the health and recovery of the rangeland resources. For example, if drought is perceived to be limited in scale, the inclination to retain livestock might be great. This behavior could actually exacerbate damage to rangeland resources. However, if the drought is large in scale, a rancher's sensitivity to the lack of feed may be enough to initiate destocking, reducing pressure on rangeland resources.

Conclusion

We suggest that there were four main areas that inhibit ranchers from responding to drought. These include: learning and mental models, financial considerations, government policy, and scale. Ranchers, rangeland professionals, and policy makers' sensitivity to and understanding of weather pat-

Antelope Research Station in June 2004, located approximately 15 miles east of Buffalo, SD. Note the green grass in this normal spring precipitation year.

terns, their impact on forage production, and their ability to make timely and appropriate risk assessments will help minimize and alleviate the negative financial impacts and the degradation of rangeland resources that droughts can cause. Well-thought-out and comprehensive drought-response strategies and plans are a critical part of successful ranch management. Government policies that reward the implementation of such comprehensive drought-management strategies and plans are also an important step for policy makers and advocacy groups to promote.

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Drought Effects on the Ranching Industry in Southeastern Colorado

By Mary M. Miller

In 2002, Colorado was in the grip of a multiyear drought—the worst and most widespread on record, according to Nolan Doesken, Colorado Assistant State Climatologist. It had severe effects on agriculture, tourism, recreation, commerce, water supplies, and wildlife.

Approximately 60%, or 14.5 million, of Colorado's 24 million acres of privately owned rangeland were severely impacted. Recovery has been slow.

In 2002, Colorado ranchers either sold or moved record livestock numbers to other states for grazing. Colorado saw a 60% decrease in the mother cow herd that year. The drought jeopardized the integrity of rangeland resources besides having negative economic impacts on Colorado ranches and rural communities.

Looking back, the drought forced changes in most ranching operations in southeastern Colorado. The types of changes varied from altering rangeland-management practices to one or both spouses taking jobs off the ranch to supplement the ranch income to selling one's entire mother cow herd and getting out of ranching.

Bill Hancock, Colorado State University Cooperative Extension (CSU CE) agent in Crowley and Otero counties, and Roy Roath, CSU CE Rangeland Management Specialist, both agreed that good times don't create teachable moments, the bad times do. Both worked with the US Department of Agriculture Natural Resources Conservation Service (NRCS) offices and local conservation districts plus other conservation groups in southeastern Colorado in sponsoring workshops designed to provide ranchers with information on how to recover from the drought. Topics covered the natural resources, financial resources, and animal resources on a ranch.

Cattle on drought-stricken rangeland in Otero County, Colorado. USDA-NRCS photograph by Mary Miller.

In the end, ranchers made decisions depending on their own personal situation. Bill Gray, president-elect of the Colorado Cattlemen's Association, has rangeland near Ordway, Colorado, and near Arlington, Colorado. The cow herd on his ranches has been in his family for more than 100 years. From the spring of 2002 to that fall, he destocked half the herd due to the drought. "When I had to sell those cows, I could hardly sit there," said Gray. "It's hard to even talk about it now."

Gray said that, due to the changes he made plus some good moisture this past year, his rangeland is beginning to recover. "You have to take care of the grass first," he said. "In the end, you can always buy genetics; you can't buy grass."

Another rancher in Bent County agrees with Gray about taking care of the grass. Preston Grover said, "We are grass


Drought-stricken rangeland in southeastern Colorado. USDA-NRCS photograph by Mary Miller.


May 2002 windstorm in southeastern Colorado. USDA-NRCS photograph by Mary Miller.

farmers." Besides knowing what the rangeland can handle as far as a stocking rate, Grover also believes that ranchers need to practice a deferred rotational grazing system. He feels that, by having a planned grazing system, he gives his rangeland the rest periods it needs to recover. Even though he also was hard hit by the drought, he sees improvement in his rangeland due to his management practices.

Roy Armstrong and Dave Kitch own Great Western Grazing Association near Fowler, Colorado, and United Feeders near Rocky Ford, Colorado. Having a feedlot and a ranch provided them some flexibility to make it through the drought. "One of the benefits of having a feedlot in conjunction with the ranch is we have flexibility—we can go back and forth," said Armstrong.

Armstrong feels the 2002 drought was devastating to the ranching industry in the southeastern corner of Colorado. He said that, in the spring of that year, they stocked their ranch at 50% capacity, but by July 1, they started moving cattle to the feedlot due to the lack of moisture on the rangeland. Many of their past feedlot clients also put their cattle into the feedlot much earlier in the year.

Prior to the drought, Armstrong and Kitch had worked with the local NRCS office through the old Great Plains Conservation Program to install watering facilities and cross-fencing for their rotational grazing system.

"We were probably better off than other ranchers who practiced season-long grazing going into the drought," said Kitch. "Roy is the main manager of the ranch. We are very conservative in our stocking rates." Even with a rotational system, Armstrong and Kitch only stocked their rangeland at 40% in 2003 and 50%–70% in 2004.

Grover, Armstrong, and Kitch differ from Gray in that they buy and sell either cows or yearlings, so they do not have the time and money spent on genetics and a main mother cow herd that Gray and other ranchers had.

Hancock and Roath, in cooperation with the NRCS, continue their work to help ranchers improve their grazing management and understanding of what the rangeland needs to recover from the 2002 drought. Roath says that some ranchers had more grass than they did water, so they are replanning their watering facilities so that, the next time it gets droughty, they are better prepared for a rotational grazing system. "They need to plan for the worst-case scenario and appreciate it when they ever get anything better than that," said Hancock.

The various agency grazing specialists believe that those ranchers with an established rotational grazing system in place minimized the drought's effects, were better prepared to weather the drought, and came out of the drought in better shape to restock the rangeland resource.

Armstrong believes that, in order to be prepared for tough years, ranchers need to be proactive in lowering stocking rates even in the early stages of a drought and need to be flexible within their grazing management system. "Have a Plan A and Plan B in your grazing system," said Armstrong.

To be ready for the next drought, Gray will improve his rotational grazing system, monitor his rangeland more, and just understand that this part of the country is always on the verge of a drought.

"In general, I do not think we were prepared for this drought," said Grover. "Hopefully, more of us will be better prepared for the next one."

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Water Management in Northwestern Egypt

By Gary Frasier

Visualize an area of 50 km by 400 km (30 × 120 miles) supporting an agricultural community of 40,000 people. Farmers raise sheep and goats, and better soil areas are planted to trees (figs and olive; Photo 1).

Now, impose a climate of a desert regime with 100–200 mm (4–8 inches) of precipitation a year, mostly arriving during the winter months (November–March). This is the area along the Mediterranean coast of northwestern Egypt, from west of Alexandria to the Libyan border and extending inland for 50–70 km (30–40 miles).

Photo 1. Wadi in northwestern Egypt with fig and olive trees.

Photo 2. Native vegetation on upland areas.

Historically, the land was pastoral desert rangelands, grazed by nomadic Bedouins moving their animals in an ever-changing pattern. Since World War II, the Bedouins have been furnished houses and now reside in one place. The animals graze the same general areas around the settlements yearlong. This has resulted in severe overgrazing of the limited native forage resource. Many areas have been disturbed by rock-mining activities. The ground is ripped by bulldozers to dislodge rocks that are hand picked and used for various construction projects: crushed for gravel, rock fences, and houses (Photo 2).

Photo 3. Dryland barley.

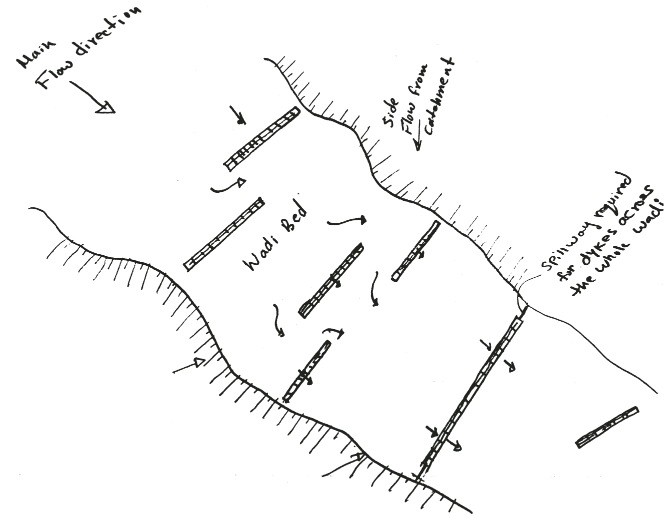

Figure 1a. Schematic of stone dykes to maximize infiltration of water into wadi channels.

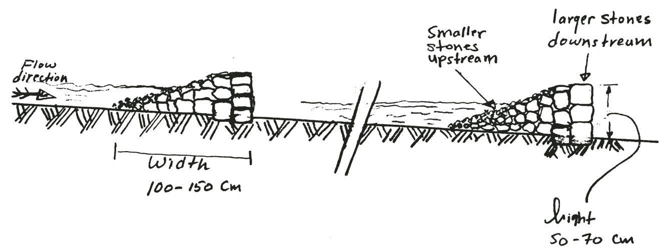

Figure 1b. Insert shows the recommended shape of the dykes.

A considerable amount of the land (traditional rangeland) is planted each year to a dryland barley. The precipitation patterns and quantity are marginal for the barley to produce a grain crop (about 2 years in 10). In about 6 years in 10, there is sufficient rain to produce barley fodder (Photo 3).

There is essentially no water in the area except for what falls as precipitation. Drinking and household water for most of the Bedouin homes is obtained by a process called water harvesting. Water harvesting is simply the process of collecting precipitation runoff water from an area and storing it until needed. A typical system for 2–4 families would have a small area (4–6 acres) for water collecting. The collected water is stored in underground cisterns. Other types of water harvesting and runoff farming installations (ie, microcatchments and strip-runoff farming) are used to maximize the limited water falling as rain.

In March 1997, I visited a site along the northwest coast under the sponsorship of the International Center for Agriculture Research in the Dry Areas (ICARDA) headquartered in Aleppo, Syria. The project involved the integrated management of agriculture, including water harvesting, as a means of improving production of range vegetation, grain crops, and fruit trees.

Major Systems of Water Harvesting and Water Management

The Wadi-Bed System

These systems may be more appropriately termed as floodwater management systems. They consist of a series of dykes constructed across the wadi (ephemeral channel) to retard (pond) the runoff water coming down channel. It is believed the ponded water would drop any sediment and provide a more fertile seedbed. As the ponded water fills the dyke, excess water flows around the end or over the spillway to the next area (Fig. 1). The area between dykes is usually 1–5 ha (2.5–12 acres) in size (estimate) usually planted to trees (figs, olive). At the upper end of the wadi (headwater), the areas are frequently planted to barley. The vast rangelands upstream and along the edges of the wadi provide the water collection area (Photo 4).

Dykes are frequently constructed of hand-laid rock walls approximately 1 m (3 feet) wide and 1 m (3 feet) high (estimate). In some dykes the rocks are cemented in place. Most dykes do not fully cross the wadi (Photo 5). Larger dykes frequently have a constructed spillway to pass major flows, sometimes in the middle and other times at one end. The spillways are usually and estimated 0.5 m (1.5 feet) lower than the top of the dyke (Photo 6). In many wadi systems, only 2–3 flows per year pass through the systems. The stone with mortar walls (called mabani) stop both water and sediments totally. With time, the mabani will be filled with eroded soil, and the wadi bed-slope will eventually be modified. In the meantime, lots of deep percolation of the ponded water occurs.

Cisterns

The cistern systems consist of a water collection area 1–2 ha (2.5 acres) in size (estimated), which has, at the lower corner, an excavated below-ground water storage chamber (Photo 7). A continuous layer of rock prevails in the region at a depth of 50 to 100 cm below the ground surface, which forms the ceil-

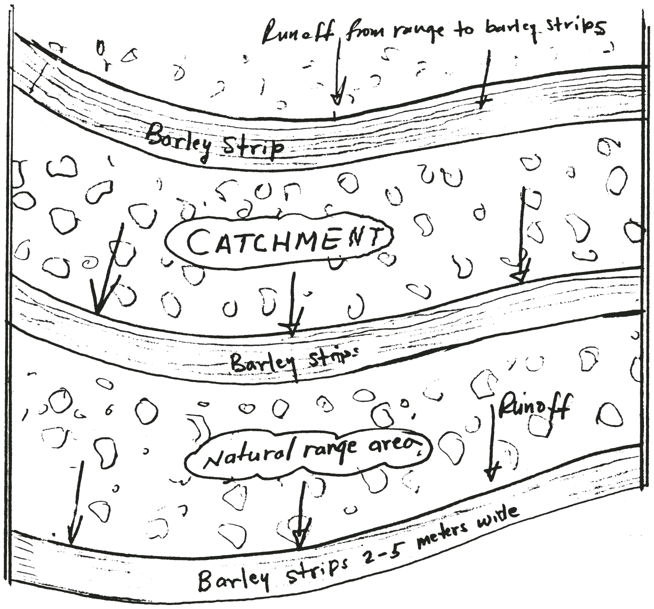

Figure 2. Schematic of barley grown in strips using runoff from undisturbed range areas.

ing of the chamber. This chamber is lined with plaster to prevent seepage of the collected water. There are usually small earthen berms at the lower edge of the catchment area to direct the water into the storage cistern. Cistern sizes range between 200 and 300 m^3 (5,000–8,000 gallons). In many areas, cisterns are the primary water source for domestic (drinking, washing, cooking, etc) and animal use. Water may also be applied by hand to plants (gardens, trees, etc).

Depression Systems—Strip Farming

These systems are usually on the upland sites, out of the major wadi drainages. Areas are selected that have some natural water runoff from higher slopes that pass over the area. They frequently have a small rock or earthen ridge around the lower sides. The planting area is chiseled and seeded to barley (Fig. 2). There is very little seedbed preparation and

Photo 4. Drainage area to a typical wadi.

Photo 5. Stone dyke across the middle of a wadi.

no collection area surface modification. Signs of severe water stress were observed in several areas. Soils are only 1-meter (3-feet) deep, and there has been a drought for 2 consecutive years. Range shrubs are being removed to plant barley and watermelon. Wind erosion is obvious, and sand dunes are being formed.

The Earth Bund Systems

Earth bunds are formed on lands above and within the wadi bed to collect water from local, usually small, catchments. The bunds are similar to the so-called tabia in Tunisia. Several basins are sometimes connected to each other and to the catchment in a system similar to the saylada system in Baluchistan. Improper spillways and drop structures are common and can cause the collapse of the system.

Microcatchments

The microcatchment water-harvesting basins are being evaluated at a research site of ICARDA. They consist of small water-collection areas that drain into a central area in a corner where a single tree is planted. The areas are enclosed with small earthen berms to direct the runoff water to the planted area. The collected water infiltrates into the soil around the tree. Each tree has its own runoff-water contributing area (Fig. 3). Studies are also evaluating the potential of using several small trees or shrubs at the lower side of the water collection area (Photo 8). Recent rains caused substantial runoff from the basins to the trees, which greatly increased the farmers' confidence in the system.

General Observations

1. The area is crowded with both reports and activities on water harvesting. This has been going on for a long time. Several projects are concentrating on the wadi-bed floodwater and the cistern systems. Most of these projects are concerned with development. Farmers generally are happy with the water-harvesting developments. Several successful intervention projects are present in several areas with

Photo 6. Stone dyke with a spillway across the entire wadi.

obvious heavy investment for small acreages. Many projects do not look economical nor something that can be adopted by farmers. Most of the costs are covered by the project, but the farmers primarily contribute the labor.

2. It is obvious that farmers are mismanaging many range areas by cultivating for barley and watermelon, which involves removing the shrubs that are stabilizing the soils. This is resulting in severe wind erosion with sand dunes forming in several areas.
3. Although major development work is going on, there was no evidence of measuring or estimating the quantity of runoff water in the wadi or outside. No estimate can be made about the water balance, the flow of the water, the deep percolation, the moisture use throughout the growing season, rainfall intensity, or rainfall runoff coefficients, all of which are important factors in designing these structures and ensuring fair distribution of water throughout the area.
4. Work in the wadi beds upstream and downstream does not seem to be coordinated. Many activities upstream are negatively affecting old water beneficiaries downstream. In some areas, fruit trees near the coast at the outlet of a long wadi are showing signs of stress from inadequate water. A farmer indicated his anger at the use of solid walls across the wadi (mabani) because the walls stop water from continuing downstream, and none is now available. It is obvious that much of the water in the wadi bed system is being collected upstream. This will be a greater factor when the ongoing works are completed. The system is unbalanced for effective and equitable water use among upstream and downstream landowners.
5. Systems are being developed without looking into what happens to other functions in the area. For example, improving rangelands by water harvesting is an objective of the project. However, any improvement in retaining the water on the rangeland will reduce the runoff to the wadies. At the same time, wadies are being developed to receive more water. These two concepts are incompatible, and a compromise has to be achieved somewhere. Because the existing upland rangeland catchments now supplying water for the wadi bed system are more fully developed for retaining water on-site, the wadi systems will become ineffective and/or disappear. As a catchment is developed for barley or for rangeland, it becomes a user for water rather than a water catchment for downstream areas. An overall strategy based on the whole system (rangeland and cultivated areas) is required if the system (the entire watershed) is to function properly in the future.

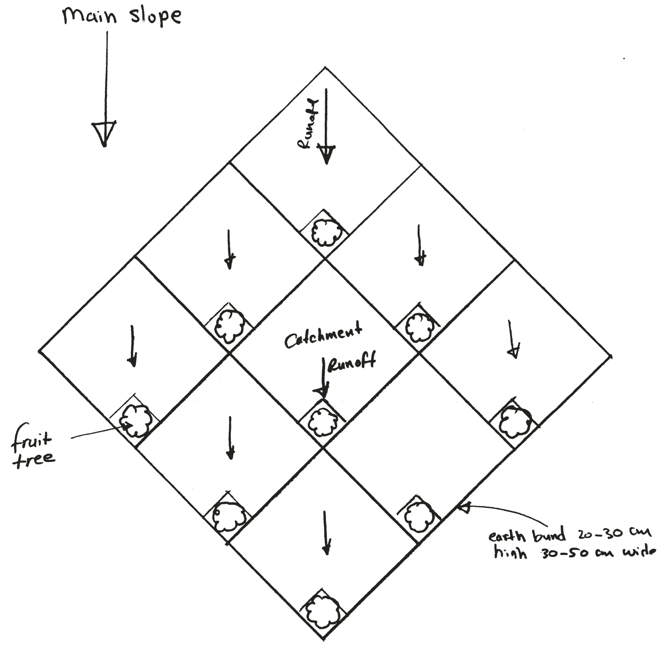

Figure 3. Layout of a typical group of microcatchments for growing trees.

6. Water is lost from the wadi bed system as deep percolation occurs behind the solid stone–mortar walls (mabani). This is due to the total blockage of the flow when the spillway is high.

Recommendations

1. The stone dykes being built in wadi beds are rectangular and sometimes very high, so they close the entire wadi bed. Collapse of these dykes can happen easily, and their function may not be accomplished. An alternative to the rectangular stone dykes is the triangular shape (Fig. 1b). If the dykes were built to heights not exceeding 60–70 cm, the stability of the dykes would improve and would trap sediments. The dykes could also be designed to be located only in the lower point of the bed, not continuously across the wadi (Fig. 1). Also, on the solid dykes (mabani) across the wadies, the spillways are usually very high, and the dams hold lots of water for a long time, which can be lost in deep percolation, depriving downstream farmers of the water. Low spillways could be constructed initially to allow most of the water to pass. Later, when the basin is filled with sediments, the spillway crest could be heightened to

Photo 7. Top of a cistern for storing water from the water-collection area in background.

Photo 8. Microcatchment for growing trees.

store only that water needed by the farmer. This could be continued until the entire slope behind the wall is filled with sediments.

2. It would be worthwhile to test the runoff-strip method for growing barley alternatively with rangeland (Fig. 2). The rangeland areas provide the needed water to improve the success of the barley crop. At the same time, the farmers have critical rangeland for their animals. In addition, this method protects the soil from potential wind erosion and helps satisfy the farmers' requirements for barley, fodder, and rangeland for the animals.
3. There is a critical need to reintroduce rangeland forages in many areas. These would ideally be forage grasses but may realistically be forage shrubs. Suitable trials need to be initiated to determine which plant species are suitable for reintroduction in the areas and the techniques required to establish the plants. Farmers need to be encouraged to protect the rangelands in dry years, whenever possible, which would include removing the animals from the areas. This will become increasingly important when new plants are being established on the land.
4. The efficiency of the cistern systems could be improved with little extra effort. Smoothing the soil in the catchment area would improve both the runoff efficiency and reduce the quantity of rain necessary to initiate runoff (threshold rainfall). These techniques may make it possible to reduce the size of the catchment areas, which would reduce the potential for sediment to be transported into the storage system. Also, the management of the stored water in the cistern could be improved by using the runoff from the early storms of winter for irrigating the trees, then refilling the storages for the summer from the late storms. Limited research on this issue showed that the probability of having a major storm in March is very high. Analysis of rainfall and runoff would give clues as to how this system could be managed for higher efficiency.
5. Currently, there are many interventions for trees in shallow soil. There is a high probability that the trees will die as they get older because they require deeper soil for root development. The entire water-harvesting system must operate as a matched system with sufficient area to collect the required quantity of water, proper management of the collected water (preventing soil erosion), proper storage of the collected water, and in cropping systems, adequate soil depth for plant growth.
6. A long-term maintenance plan needs to be developed for all constructed water-harvesting systems. Farmers must be a key element in this provision. The families should be encouraged to develop ideas for how the systems could be improved.
7. Microcatchments should be used as an alternative for supporting the trees (Fig. 3). Many areas have potential for this technique.
8. Systems should be made as small scale as possible. Small-scale projects are easier to maintain, and the farmers will be more likely to perform the required maintenance.

Author is Editor of Rangelands at the Society for Range Management, Loveland, CO 80538. *The author wishes to thank the International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria, for the financial support for the trip. Many thanks are extended to the personnel of the Matruh Resource Management Project for their time and effort in providing the guides and vehicles that allowed us to travel and see the various activities. A special thanks goes to Dr Theib Oweis, Irrigation and Water Management Specialist, ICARDA, Aleppo, Syria, and ICARDA's expert consultant to the project, who made the necessary arrangements and provided the excellent interface with the field personnel. This article is based on the trip report prepared by Dr Oweis and myself following the excursion into the project area.*

Can Shade Structures Help Riparian Areas?

A look at using constructed shades to pull cattle off riparian areas in northeastern Nevada.

By J. C. Davison and J. D. Neufeld

Management Techniques and Riparian Grazing

The damage caused by unmanaged cattle grazing on riparian habitats is well documented.[1] At the same time, ample evidence exists that well-managed cattle grazing is compatible with maintaining, and even improving, riparian habitats.[2] The key to creating stream-friendly grazing systems is to reduce the amount of time cattle spend in these sensitive riparian habitats.[3] We faced this challenge when we began our study on Antelope Creek during the spring of 1996. Antelope Creek is located on private land approximately 40 miles north and east of Battle Mountain, Nevada. The active stream channel had dropped to approximately 10–15 feet below the surrounding valley bottom, and bank erosion still occurs during high spring runoff events. Although many positive improvements had already been begun, we were interested in methods to foster continued improvements along this stream. Antelope Creek has already formed a small floodplain, and herbaceous, riparian plant communities are reestablishing along most of the banks. Intermittent willow clumps are also growing along the length of the stream. Established methods to exclude cattle from riparian areas along sensitive stream banks include fencing and the development of off-site water and mineral sources. Some researchers have even tried genetic selection of cattle herds and negative conditioning with electrical shock.[4,5]

In the spring of 1996, we began a project to determine whether constructed shade structures could reduce the amount of time cattle spend in the Antelope Creek riparian areas and, in turn, the impacts on riparian plant communities from grazing. The shades were intended to provide a more desirable location for cattle to loaf and ruminate than the adjacent riparian habitats that had little or no shade. Previous research that showed benefits in cattle production were primarily confined to feedlots and dairies,[6,7] and studies that concerned themselves with shade in range and pastures systems had conflicting results.[8–11] Our main goals were to determine whether 1) artificially constructed, shaded areas would be used preferentially by significant numbers of cattle in place of adjacent riparian bottoms; and 2) riparian-vegetation use classes, as estimated by stubble height and current-year shrub use, were lower adjacent to the shade structures when compared with the nonshaded areas, and if so, how far out from the structures.

Our project was conducted for 3 years, and changes in water quality (chemical analysis), riparian vegetation, and the size and shape of the stream bank were also investigated. We will not report these results here. We are focusing on the effects of constructed shade areas on Antelope Creek because of the recent interest and recommendations for use of shade to control cattle movements.

Shade-Structure or Loafing-Area Location and Construction

The project began with the clearing of 8 separate shade or loafing areas spread out over approximately 3.5 miles of

Antelope Creek (Fig. 1). At each location, we removed all sagebrush and other shrubs from an area that was approximately 25 feet wide and 75 feet long to provide a desirable location for the cattle to loiter and ruminate.

After the sites were cleared, we built a shade structure over each loafing site. The shade structures were constructed of 2 parallel rows of six, 6-inch × 6-inch, pressure-treated posts, set 3.5 feet into the soil. The rows were 16.5 feet apart.

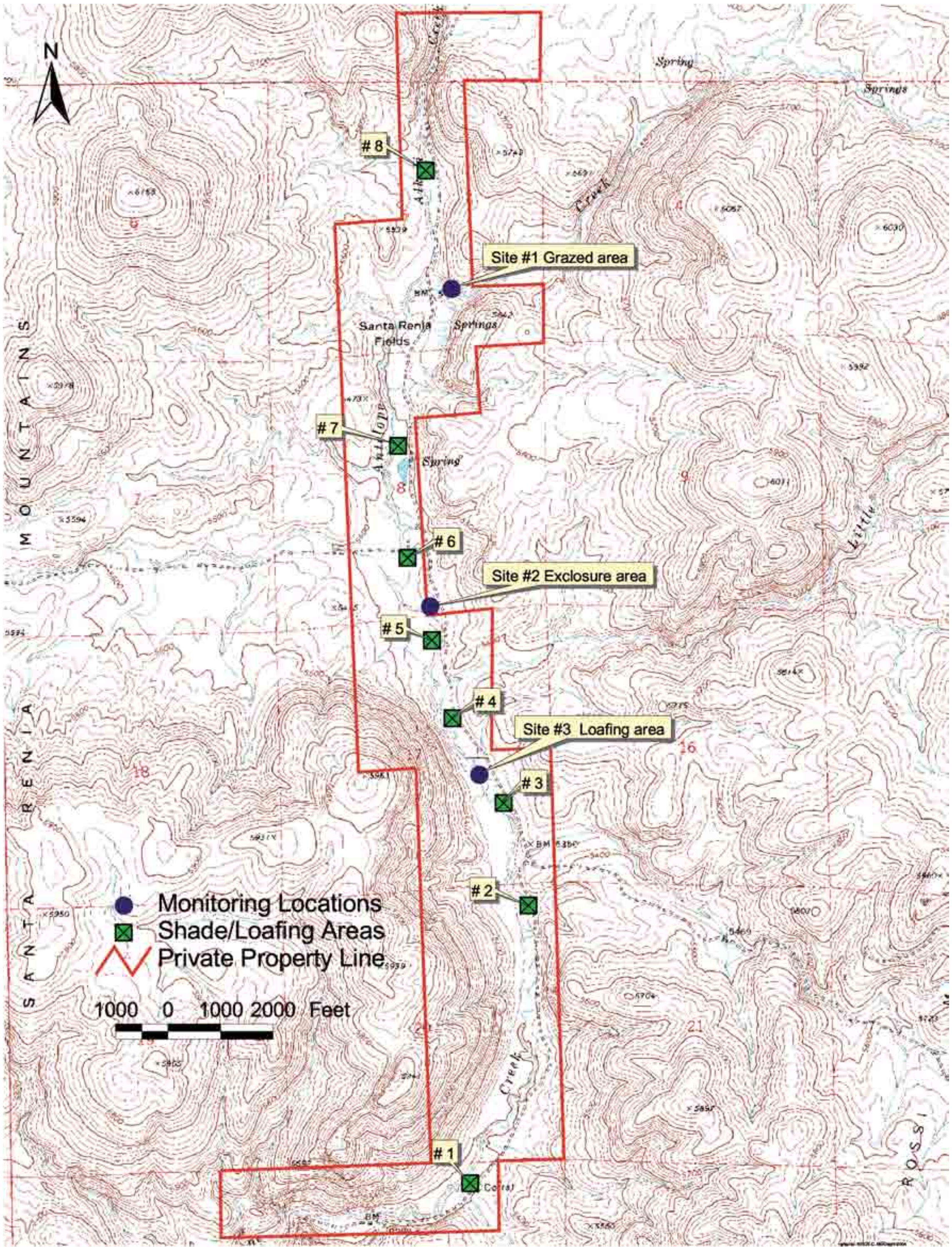

Figure 1. Map of project showing shade/loafing areas and permanent monitoring sites.

Figure 2. Cattle using shade structure adjacent to Antelope Creek.

Each post within the rows extended approximately 12.5 feet above the soil surface and was positioned every 10 feet. They were oriented in a north–south direction. A black, horticultural-grade shade cloth was fabricated and suspended between the posts with one-eighth inch wire rope and cable clamps. The shade cloth was rated as 95% shade and was porous to allow for drainage of water and to reduce wind resistance. The shade cloths were placed on the posts each spring and removed after the cattle left in the fall. Each shade structure cost approximately $1,150 to build (Fig. 2).

The ranch manager and authors selected the shade and loafing sites based on certain criteria. We selected sites that 1) provided easy access for the livestock to and from Antelope Creek, and 2) were a reasonable distance to the creek. We also selected sites on both sides of the creek. We spaced sites No. 2–7 about 1,500 feet apart to form a core loafing area. We sited locations No. 1 and 8 approximately 1 mile above and below the core area. The core area was established to determine if 6 closely grouped shade structures would result in lower overall livestock use levels within the core area when compared with creek areas without constructed shade and loafing areas. The purpose of shade/loafing areas No. 1 and 8 was to determine, if successful, the different use levels radiating from a shade structure and thus approximate the spacing necessary to protect a riparian area.

Monitoring and Cattle Use

We built an exclosure on the creek in the middle of the core loafing area to act as a nongrazed control. The exclosure was approximately 700 feet long and encompassed the entire width of the creek bottom. It consisted of a 2-wire electric fence that was set up each spring and removed each fall. It was generally effective in excluding cattle for all 3 years of the project.

We established permanent monitoring sites within the exclosure and at 2 other locations on the creek. A permanent monitoring site was established within the core shade/loafing area (downstream from the exclosure) and another was established between the core shade/loafing area and site No. 8. We labeled the monitoring sites as the exclosure, loafing, and grazed site, respectively (Fig. 1).

We established permanent photo points at each monitoring site and along the creek adjacent to each shade and loafing area. Pictures and use levels were obtained each fall at the 3 permanent monitoring points and at the photo points located near each shade/loafing area.

The results we discuss in this article include only the use and monthly counts of livestock within the project area during the midafternoon. We counted and classified cattle as 1) under, or immediately adjacent to, the shaded area, 2) in the riparian area, or 3) in the upland area within the project. We tallied the total sightings and expressed the location of the sightings as a percentage of the total count each year of the study.

Our definition of use was "The proportion of the current year's forage production that was consumed or destroyed by grazing animals." Use levels were estimated by comparing ungrazed forage with that remaining after the plant growth had ceased in the fall and cattle had been removed from the allotment (November). Use levels were estimated using the key forage-plant use method. Use levels were classified as none (0% use), slight (1%–20% use), light (21%–40% use), moderate (41%–60% use), heavy (61%–80% use), or severe (81%–100% use). We estimated use for the herbaceous (grass) communities as a whole because species were intermingled with no easily discernible borders. Wiregrass (*Juncus balticus*) communities were sampled because they are not normally consumed until other forage sources are exhausted. The proportion of current year's growth that had been removed from the woody species present was also estimated at the same time. Use estimates were obtained on the floodplain adjacent to the creek at each shade/loafing site and within the 3 permanent sampling locations (loafing, grazed, and exclosure). We also measured the stubble heights of herbaceous plants when we obtained the use estimates. Stubble heights were obtained separately for wiregrass communities and the more desirable grass communities at each permanent monitoring location and adjacent to the shade sites.

What We Found

1996

During the 1996 season, cattle did not enter the allotment until the 3rd week of September. They left the allotment in November when they were returned to the ranch. Precipitation amounts were normal to dry during the 1996 season. The creek began to dry up in midsummer with water flows very low after July. Pools were present at most locations except during late summer, when no water was available near shade/loafing area No. 1. The most used areas were those closest to water that had large trails down the entrenched sides of Antelope Creek. Another factor that was preferred by the cattle was the presence of large flat areas on the floodplain adjacent to the creek. The most used shade/loafing area had both factors present. Shade/loafing area No. 5 was the furthest from water, had relatively poor access to the creek, and the trail ended in a relatively narrow reach of the stream. It was the least used loafing area during all 3 years of the project. Shade/loafing area No. 2 was close to the creek, had several trails to the creek, and had a large, flat area. It was used the most frequently.

Riparian areas were the most preferred location for cattle to be found, when counts were made, regardless of the location of the shade and loafing area. During 1996, 70% of the cattle sightings were in riparian areas. We classified cattle as using the loafing areas 27% of the time, and only 3% of the cattle we counted were on the uplands in the project area.

Table 1. Use levels and stubble height measurements following the 1996 grazing season

Location	Herbaceous use rating	Grass stubble heights (inch)	Wiregrass stubble heights (inch)	Woody plant use rating
Shade 1	Severe	<1	1–2	Heavy
Shade 2	Severe	<1	2–3	Moderate–heavy
Shade 3	Heavy	1–2	4–6	Light
Shade 4	Severe	<1	3–4	Moderate–heavy
Shade 5	Heavy	1–2	5–6	Light–moderate
Shade 6	Heavy	1–2	6–8	Moderate–heavy
Shade 7	Moderate	2–3	6–8	Moderate–heavy
Shade 8	Light	3–5	No use	Slight
Loafing area	Heavy	1–2	3–4	Heavy
Grazed area	None	No use	No use	Moderate*
Enclosure	None	No use	No use	No use

*Used by deer as indicated by tracks and droppings.

Table 2. Use levels and stubble height measurements following the 1997 grazing season

Location	Herbaceous use rating	Grass stubble heights (inch)	Wiregrass stubble heights (inch)	Woody plant use rating
Shade 1	Severe	<1	<1	Heavy
Shade 2	Heavy	<1	3–5	Moderate–heavy
Shade 3	Light	2–4	6–8	Light
Shade 4	Severe	1	3–6	Moderate–heavy
Shade 5	Heavy	1–2	5–6	Light–moderate
Shade 6	Heavy	1–2	5–6	Moderate–heavy
Shade 7	Moderate	2–3	6–8	Moderate–heavy
Shade 8	Light	3–4	6–8	Slight
Loafing area	Moderate	2–3	6–8	Heavy
Grazed area	Light–moderate	2–4	5–7	Slight
Enclosure	None	No use	No use	No use

1997

The 1997 season was very different because the weather was much cooler and wetter during the spring and early summer. Spring runoff flows were very high, and cutting of some vertical banks was obvious. Soil deposits were evident at several locations following the spring high water. Rains were frequent throughout the season. The creek held water longer than during the 1996 season, and some water was always available near each shade/loafing area. The cattle entered the project area in mid-May and made very little use of any riparian areas or the shade/loafing areas until midsummer. The cattle were removed in November.

Cattle use patterns were different during 1997 than the previous grazing season. We found that riparian areas were still the most preferred by cattle, with 50% of the total number of sightings occurring in them. Upland use increased to 32% of the sightings because of the cool, wet spring, whereas use of the shade/loafing structure accounted for 18% of the sightings.

1998

The 1998 season was again cooler and wetter than normal. High spring flows occurred, resulting in obvious cutting and deposition of soil throughout the project area. Grass production was exceptional at all locations within the project, and adequate water was available at all locations throughout the season.

When cattle entered the allotment in mid-June they initially used the upland areas in preference to the riparian or loafing areas. We found that cattle use began to shift to the riparian areas in July and it was the preferred location until late fall, when it again shifted to the uplands.

During the 1998 season, we classified cattle use of riparian areas at 61%. Use of the loafing areas was 21%, whereas upland use was 18% of the cattle counted. We believe upland use fell from that classified during the previous season because the late arrival of cattle on the allotment.

Observations on Shade Structure Use by Cattle

High temperatures were common during all the summer months that cattle were in the allotment. We commonly measured temperatures in the shade as high as 105°F during late July and early August. Temperatures in the direct sunlight exceeded 120°F. In spite of that, we often observed cattle laying in full sunlight immediately adjacent to an unoccupied shade structure during the hottest part of the day. We also recorded them lying next to the creek in full sunlight although the nearby shade structure was unoccupied. At other times, cattle were crowded under the shade structure, whereas other cattle were lying near the creek or adjacent to the shade. The use of the shade structures by cattle appeared, to us, to be random. The majority of cattle on the allotment were black or black baldies. The remainder were Hereford or Hereford-cross cattle that were predominately red in color. An occasional light-colored animal was observed. Our cattle counts and observations did not determine that shade use was dependent on the color of the animals present. The age of the animals present did not appear to be a factor in use of the loafing areas because use of the loafing areas was not different between cows and calves.

In all 3 years of our study, cattle preferred the riparian areas to upland areas or the constructed-shade loafing areas. Cattle used the riparian areas in approximately 60% of the counts. Uplands were used the most during the cool, wet springtime months. The 3-year average use was about 18%. Once the forage began to dry the cattle began using the riparian and shade/loafing areas. Cattle used the shade/loafing areas moderately with the average, 3-year use count being 22%.

Plant Use by Cattle

The use monitoring we completed during the project supported the visual observations of cattle use. One objective of the study was to determine if use levels of riparian vegetation were measurably lower adjacent to the shade/loafing areas when compared with "open areas" without shade/loafing areas. If so, how far from the loafing area were use levels lowered? We selected use levels because they provide a rapid indication of cattle use levels and patterns. The results of the streamside use monitoring are displayed in Tables 1–3.

We found that average use levels varied only slightly during the 3 years that data was collected. The variations were thought to be related to the climatic conditions each year, the time cattle entered the grazing allotment, and accessibility of the riparian area adjacent to the shade structures. Normal livestock distribution patterns also played a role in use levels. The northern portion of the study area generally received less use during the project than the middle-to-southern portion regardless of climate or the factors we previously mentioned. The "grazed" transect area received less use than anticipated because of the presence of a large meadow area and spring near the site. Cattle used the meadow area extensively while generally avoiding the "grazed area" monitoring site.

Figure 3. Typical use levels in loafing area the following grazing season during the study.

Our most important finding during the course of the project was that there was no practical difference in use levels or stubble heights because of the presence of the loafing area and shade structures (Fig. 3). The estimates of average use levels that we observed when walking the length of the project reinforced the conclusion that the shade structures did not result in any less use of riparian plants than that

Table 3. Use levels and stubble height measurements following the 1998 grazing season

Location	Herbaceous use rating	Grass stubble heights (inch)	Wiregrass stubble heights (inch)	Woody plant use rating
Shade 1	Severe	<1	1	Heavy
Shade 2	Severe	<1	2–3	Heavy
Shade 3	Moderate	2–3	4–6	Heavy
Shade 4	Heavy	<1	3–4	Heavy
Shade 5	Heavy	1–2	5–6	Heavy
Shade 6	Heavy	1–2	6–8	Heavy
Shade 7	Heavy	2–3	6–8	Heavy
Shade 8	*	*	*	*
Loafing area	Heavy	1–2	3–4	Heavy
Grazed area	Moderate	2–3	4–5	Heavy
Enclosure	None	No use	No use	No use

*No Information gathered as structure was inaccessible during spring, and shade was not erected.

found on areas away from the structures. In fact, we observed that use levels on woody species may have been slightly higher adjacent to the shade/loafing structures. Because the number of willow colonies were limited, use levels were almost uniformly high throughout the project area every year. We concluded that the loafing areas did not meet our objective of reducing use levels on the adjacent riparian areas.

Recommendations

Our evaluation of the results of this project indicated that little or no positive changes occurred on the riparian areas on Antelope Creek as a result of increased cattle use of the shade/loafing areas. That finding is expected as the cattle use of the shade/loafing areas was random and sporadic throughout the life of the project.

Use levels on herbaceous plants were not reduced by the presence of the loafing areas. Use levels were normally heavy at most locations, and we found no measurable difference in use or stubble heights remaining at the end of the growing season. Use levels of woody species were no lower, and may have been slightly higher, adjacent to the loafing areas. Although we did not quantify the differences, our visual observations were that willow plants adjacent to the most used shade/loafing areas sustained more use overall than those located away from the areas.

We concluded that although cattle will use shade/loafing areas, the use is not consistent enough to result in significantly lower use of the adjacent riparian vegetation. Our results mirror those experienced in riparian grazing programs that fail to remove all cattle when a move becomes necessary. Even if small numbers of cattle remain in the riparian pasture, damage to the riparian community can occur.

Existing literature indicates that cattle will sometimes use shade structures enough to change pasture use levels. Our work did not support that finding. Although cattle did use the structures, the use was not high enough to reduce riparian vegetation use levels.

We assume that the Antelope Creek area does not get hot enough for a long enough time period to force cattle into using the shades for long periods. The majority of cattle used the shades during the hottest portion of the afternoon, which lasted only 2–3 hours. They were also observed lying in the direct sunlight adjacent to the shade structures, while the structures sat empty.

Considering the cost of construction ($1,158.27/structure), the maintenance required, and the lack of direct benefit, we cannot recommend the use of shade/loafing structures at this time for the northern portions of Nevada. Further studies may be useful in the southern portion of the West to determine their effectiveness in warmer climates.

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Big Bluestem Pasture in the Great Plains: An Alternative for Dryland Corn

Big bluestem pasture can earn more than twice as much per acre as dryland corn.

By Rob Mitchell, Ken Vogel, Gary Varvel, Terry Klopfenstein, Dick Clark, and Bruce Anderson

Corn production and perennial grass pastures provide the foundation for the agricultural industry in the central and eastern Great Plains. Typically, many producers grow both corn and perennial grass pastures to meet livestock feed demands and to diversify the operation. For example, corn was produced on more than 37% of the total cropland, and perennial pasture comprised 49% of the land in farms in Nebraska.[1] Corn was produced on an average of 7.8 million acres in Nebraska from 2000 to 2002, with 40% being dryland (nonirrigated) corn.[2]

Producers seek the best long-term economic and sustainable use of cropland. The need for flexibility in the agricultural operation, long-term familiarity with a specific crop rotation, expenses associated with equipment alteration, and the uncertainty of alternative markets make it difficult for producers to implement new management practices. Perennial grasses, such as big bluestem, provide an alternative use for nonirrigated cropland in the Great Plains. Producers have little economic information available, however, to decide whether or not to convert cropland to perennial pasture. Producers need information on the economic opportunities for alternative, sustainable uses of nonirrigated cropland in diversified agricultural operations. The economic returns of dryland corn and beef production on big bluestem pastures in the eastern Great Plains are compared using production information from field trials.

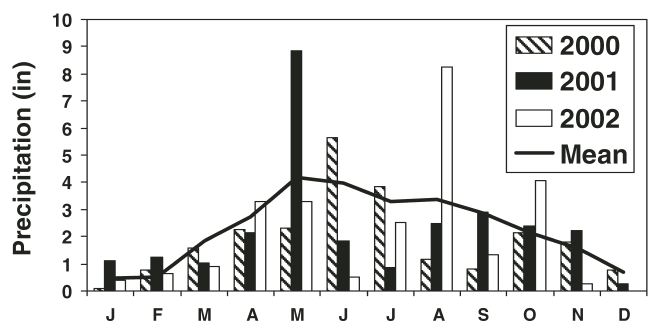

Figure 1. Monthly precipitation in 2000, 2001, 2002, and the long-term mean at Mead, NE. Annual precipitation was 23.1, 27.4, and 25.4 inches in 2000, 2001, and 2002, respectively (3). The long-term average annual precipitation is 27.7 inches.

Discussion

Annual precipitation at Mead was 23 inches in 2000, 27 inches in 2001, and 25 inches in 2002— all below the long-term average of 28 inches[3] (Fig. 1). However, corn yield and beef production per acre were greatest in 2000, followed by 2001, and 2002 (Table 1), demonstrating the importance of precipitation timing and distribution. In 2000, the year with the least annual precipitation of the 3 years, 4.6 inches of precipitation were received in April and May and 9.5 inches in June and July. In 2001, 11 inches of precipitation were received in April and May and 2.7 inches in June and July. In 2002, 6.6 inches of precipitation were received in April and

Table 1. Corn production (in bushels per acre) and beef cattle production (in pounds per acre) for no-till, dryland corn and fertilized, big bluestem pastures, respectively, grown near Mead, Nebraska, in 2000, 2001, and 2002

Production year	Corn (bu·acre^{-1})	November corn price[1] (\$·bu^{-1})	Beef (lb·acre^{-1})	June steer price[2] (\$·cwt^{-1})	August steer price[2] (\$·cwt^{-1})
2000	98	1.86	510	85	78
2001	80	1.85	363	91	87
2002	78	2.37	342	79	73
Mean	85	2.03	405	85	79

[1]Average November corn price for Nebraska each year.[5,6]
[2]Average steer prices for each weight class in Nebraska provided by Livestock Marketing Information Center, Lakewood, CO.

May and 3 inches in June and July. Big bluestem emerges in April, and the period of rapid growth begins in late May; however a majority of big bluestem standing crop accumulates in June and July. Consequently, precipitation in April and May is important for early big bluestem growth, but precipitation in June and July dictates how much forage will be available for grazing.

Corn

Corn production averaged 85 bushels per acre, and corn prices averaged \$2.03 bushels per acre (Table 1). Corn production inputs averaged \$127 per acre (Table 2). The cost of seed and custom planting accounted for 33% of the average inputs, whereas weed control accounted for 28% of the average inputs. The reduced need for weed control in 2001 kept production costs low. Although no drying costs were included, custom grain drying costs \$0.07 per point of moisture removed per bushel and would significantly increase production costs.[4]

Big Bluestem Pasture

Beef production averaged 405 pounds of beef per acre (Table 1). The continuous grazing period was 62 days in 2000, 43 days in 2001, and 38 days in 2002. Average daily gain (ADG) for the 3 years was 2.8 pounds per head per day. Precipitation in late July and August 2001 and 2002 promoted enough grass production to provide more than 3 animal unit months (AUMs) per acre of regrowth grazing in late August, but we collected no animal production data.

Pasture establishment costs were \$268 per acre, and were amortized for 15 years at 5% interest, resulting in a \$25 per acre amortization, based on an 80-acre pasture (Table 2). Seeding costs accounted for 17% of the pasture establishment costs, whereas fence and water development accounted for 34% and 40% of the pasture establishment costs, respectively (Table 2). Weed control costs accounted for only 5% of the pasture establishment costs, which reinforces the value of a good weed management program in the row crop before

This big bluestem pasture was intentionally over-utilized during September to evaluate winter persistence and spring regrowth, which were both excellent.

Dryland corn was harvested after extended field drying to reduce input costs.

Table 2. Production inputs (in dollars per acre) for no-till, dryland corn and big bluestem pasture near Mead, Nebraska, in 2000, 2001, and 2002					
Corn					
Inputs ($·acre⁻¹)		**2000**	**2001**	**2002**	**Mean**
Seed cost[1]		31.76	31.76	31.76	31.76
Custom plant[2]		10.00	10.00	10.00	10.00
Herbicide[3]		32.14	19.70	39.97	30.60
Custom spray[2]		5.00	5.00	5.00	5.00
Fertilizer[4]		23.54	23.54	23.54	23.54
Custom spread[2]		4.50	4.50	4.50	4.50
Harvest and haul[5]		22.00	22.00	22.00	22.00
Total inputs		128.94	116.50	136.77	127.40
Big bluestem pasture		**Management**			
Inputs ($·acre⁻¹)[6]	**Establishment**	**2000**	**2001**	**2002**	**Mean**
Seed cost[7]	46.00	-	-	-	-
Custom plant[2]	10.00	-	-	-	-
Fence[8]	92.06	-	-	-	-
Water[9]	106.65	-	-	-	-
Fertilize[10]	0	22.00	22.00	22.00	22.00
Custom spread[2]	0	4.50	4.50	4.50	4.50
Herbicide[11]	8.75	8.75	0	8.75	5.83
Custom spray[2]	5.00	5.00	0	5.00	3.33
Burn[12]	0	3.00	3.00	0	2.00
Annual inputs	-	43.25	29.50	40.25	37.67
Amortization[13]		24.60	24.60	24.60	24.60
Total inputs	268.46	67.85	54.10	64.85	62.26

[1]Actual seed cost for planting 18,150 seeds per acre.
[2]Cost for custom service in Nebraska.[4]
[3]Actual herbicide cost for each year.
[4]Actual cost for 107 pounds per acre of ammonium nitrate.
[5]Cost to harvest ($20 per acre) and haul ($2 per acre) corn in eastern Nebraska.[7]
[6]All input costs assume the establishment of an 80-acre pasture.
[7]Actual seed cost for 8 pounds of pure live seed (PLS) per acre at $5.75 per PLS pound.
[8]Cost for custom service assuming $4,910 per mile on 80 acres.[8]
[9]Cost for 120-foot well, tank, and solar pump ($8,532) on 80 acres.[9]
[10]Actual cost for 100 pounds per acre of ammonium nitrate.
[11]Actual cost of 4 ounces per acre of Plateau herbicide (BASF Corp, Research Triangle Park, NC).
[12]Cost to custom-burn small pastures.
[13]Establishment cost amortized for 15 years at 5% interest on 80 acres.

grass establishment. Annual pasture inputs ranged from $30 per acre to $43 per acre and averaged $38 per acre across years. The cost of fertilization accounted for at least 61% of the annual inputs (Table 2). Total pasture inputs ranged from $54 per acre to $68 per acre and averaged $62 per acre. The amortized costs of pasture establishment were less than the annual inputs required for pasture management.

Net Returns

The difference in net return between 2000 and 2002 reinforces

Table 3. Net return (in dollars per acre) for no-till, dryland corn and big bluestem pasture near Mead, Nebraska, in 2000, 2001, and 2002

Corn	2000	2001	2002	Mean
Yield (bu·acre^{-1})	98	80	78	85.9
Market price ($·bu^{-1})[1]	1.86	1.85	2.37	2.03
Gross return ($·acre^{-1})	182	147	184	171
Stalks ($·acre^{-1})[2]	5	5	5	5
Total gross return ($·acre^{-1})	187	152	189	176
Inputs ($·acre^{-1})[3]	129	117	137	127
Net return ($·acre^{-1})	58	36	52	49
Big bluestem pasture				
Animal weight on (lb·acre^{-1})	2,358	2,472	2,544	
Market price on ($·cwt^{-1})[4]	85.33	90.50	78.52	84.78
Animal value on ($·acre^{-1})	2,012.08	2,237.16	1,997.55	
Animal weight off (lb·acre^{-1})	2,868	2,835	2,886	
Market price off ($·cwt^{-1})[5]	77.99	86.59	72.70	79.09
Animal value off ($·acre^{-1})	2,236.75	2,454.83	2,098.12	
Gross return ($·acre^{-1})	224.67	217.67	100.57	
Inputs ($·acre^{-1})	67.85	54.10	64.85	62.26
Net return ($·acre^{-1})	156.82	163.57	35.72	118.70
Beef gain (lb·acre^{-1})	510	363	342	405
Net return lb^{-1} of gain ($)	0.31	0.48	0.10	0.30

bu indicates bushels; $, US dollars; lb, pounds; cwt, hundredweight.

[1]Average November corn price for Nebraska each year.[6]

[2]Value (in dollars per acre) of corn stalks for winter grazing.

[3]Assumes crop is field-dried and marketed at harvest so no drying or storage costs are included.

[4]Average June (on) steer prices for each weight class in Nebraska each year provided by Livestock Marketing Information Center, Lakewood, CO.

[5]Average August (off) steer prices for each weight class in Nebraska each year provided by Livestock Marketing Information Center, Lakewood, CO.

the importance of a relatively high market price to profitability ratio in corn production (Table 3). In 2000, corn yield was 20 bushels per acre more than in 2002. However, the 2002 market price for corn was $0.51 per bushel more than the 2000 market price and resulted in less than $6 per acre more net return in 2000 than in 2002, despite the 20 bushels per acre yield difference (Table 3). The value of corn stalks for winter grazing accounted for as much as 14% of the net return and may have a higher value during dry years if livestock water is readily available and in competitive locations.

Steers going to grass were nearly $6 per 100 pounds more expensive than beef cattle coming off grass (Table 3) because of the lower value per pound of the heavier steers (Table 1). The variability in the price differential between steers going to grass and steers coming off grass affected net return. The low price differential allowed 2001 to be nearly $7 per acre more profitable than 2000, despite the 147 fewer pounds of beef produced per acre in 2001. Additionally, the low market price in August 2002 ($73 per 100 pounds) reduced the value of cattle coming off grass.

We did not address government price supports, government cost-share programs, or the implications to taxes, soil erosion, wildlife habitat, or carbon sequestration. Although these items are important, they are difficult to quantify broadly and must be addressed for specific situations. Additionally, we did not include the cost to purchase land or interest costs on the loans required to fund the farming operation or purchase livestock.

Implications

Perennial grass pastures can be profitable in the eastern Great Plains. Big bluestem returned about 2.5 times more dollars per acre than dryland no-till corn grown in eastern Nebraska. These cattle gains are conservative and represent grazing on

Corn vs Big Bluestem Near Mead, Nebraska

A glyphosate-tolerant corn hybrid (DK 589 RR) was seeded no-till and grown in 0.4 acre dryland plots in 2000, 2001, and 2002 at the University of Nebraska Agricultural Research and Development Center (ARDC) near Mead, Nebraska. Ammonium nitrate fertilizer was applied at 107 pounds of nitrogen per acre. Weeds were controlled with glyphosate. The corn was grown on the same plots each year to represent a continuous corn production system with no crop rotation. "Bonanza" big bluestem was seeded in May 1998 at the ARDC in three 1-acre pastures. The pastures were uniformly cropped in soybeans for 2 years, then seeded no-till (8 pounds of pure live seed per acre) into the soybean stubble. Weeds were managed with herbicides in 1998. Pastures were burned in the spring of 2000 and 2001. No fertilizer was applied in 1998 or 1999, and no herbicides were applied in 2001. Fertilizer was applied as ammonium nitrate at 100 pounds of nitrogen per acre in 2000, 2001, and 2002. Each 1-acre pasture was stocked with 3 crossbred-yearling steers (650–960 pounds) in mid-June 2000, 2001, and 2002. Pastures were grazed continuously until forage use reached about 60%. Soils for the corn and pastures were primarily Sharpsburg silty clay loam.

Corn production, beef production, and market prices were different for each year (Table 1). Costs of production represent actual costs and published custom rates for seeding, fertilizer and herbicide application, and grain harvesting and hauling. All production inputs are presented in dollars per acre (Table 2). No cost was included for drying and storing because many dryland corn producers in eastern Nebraska delay harvest to allow the crop to dry in the field to reduce inputs on less-productive sites. Pasture establishment costs were amortized for 15 years at 5% interest, and are presented per acre based on an 80-acre pasture. No costs were included in 1998 and 1999 before grazing initiation (because hay could have been harvested) for lost production, livestock transportation costs, or livestock sales commissions. Cattle prices are based on information provided by the Livestock Marketing Information Center (LMIC), Lakewood, CO, and reflect an average of Nebraska markets for June and August in 2000, 2001, and 2002.

only the first growth of big bluestem. The inclusion of late-summer grazing on regrowth could increase the profitability of these perennial pastures. Additionally, the dry June and July in 2001 and 2002 represent the extreme in summer-moisture stress for eastern Nebraska, limiting the corn and pasture production. Big bluestem pastures require sound and moderately intensive management to maintain productivity. Improper management will promote weeds and increase costs. We do not promote planting big bluestem on all cropland in the eastern Great Plains. Dryland corn production is, and will continue to be, an important aspect of diverse agricultural operations in the Great Plains. However, perennial big bluestem pastures provide an excellent alternative to dryland corn on marginal cropland in the eastern Great Plains and provide ancillary benefits, such as reduced soil erosion, increased wildlife habitat, and potential carbon credits from the additional carbon sequestered. Bonanza big bluestem is adapted to Plant Hardiness Zones 4 and 5 in the Tallgrass Prairie region.

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Additional Reading

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VIEW Points

Range Readiness Is an Obsolete Management Tool

Range readiness is an outdated practice forcing rangeland managers into management situations that are detrimental to the natural resource base.

By B. L. Perryman, W. A. Laycock, L. B. Bruce, K. K. Crane, and J. W. Burkhardt

Introduction

The art and science of range management has benefited greatly from keen observations and thoughtful management guidelines by many rangeland management predecessors. However, as our knowledge and experience advances, it is prudent to revisit even the most well-established and accepted principles of range management. These periodic reevaluations serve to ensure that our rules of thumb remain scientifically sound and applicable within contemporary, ecological knowledge and rangeland management strategies. The following discussion provides a critical evaluation of range readiness, including the evolution, scientific basis, and usefulness of the idea in contemporary rangeland management.

The theory of range readiness evolved early in the 20th century during development of the art and science of range management on western rangelands. Both early and more recent research, along with the invention of specialized grazing systems, have made the application of range readiness not only obsolete but also potentially detrimental to the resource base.

The Society for Range Management defines range readiness as "the defined stage of plant growth at which grazing may begin under a specific management plan without permanent damage to vegetation or soil." The definition also explicitly suggests that range readiness is "usually applied to seasonal range." Using this definition, contemporary usage of range readiness would be to identify the precise moment in spring when plant development has progressed beyond the grazing animals' ability to detrimentally affect the plant. That would be under moderate grazing intensities, and when soil conditions are dry enough to prevent mechanical damage or compaction. Even though the ecological and management conditions under which range readiness evolved are seldom encountered today, the application is still frequently practiced. In fact, we often encounter rangeland managers relying on this rule of thumb to ensure seasonal grazing does not damage the vegetation and soil resource. For example, use of range readiness occurs at a number of planning levels including Forest Management Plans,[1] Allotment Management Plan Environmental Assessments,[2] Scoping Reports,[3] Area Activity Plans,[4] and Allotment Evaluation Recommendations.[5] Our investigation of the evolution and scientific basis for range readiness shows that the theory was conceived before the presence of widespread, seasonal grazing strategies. Also, indicators were never developed to determine impacts on soil resources.

Figure 1. Northern Nevada sagebrush steppe

Development of Range Readiness

Sampson[6] may have been the first rangeland ecologist to record development of the range readiness tool. He offered the following observation, "Removal of the herbage year after year during the early part of the growing season weakens the plant, delays the resumption of growth, advances the time of maturity, and decreases the seed production and fertility of the seed." He recommended deferring grazing of a portion of the range each year, initiating grazing after seed

Figure 2. Central Nevada basin and range topography

ripe to "…insure the planting of the seed crop and the permanent establishment of seedling plants without sacrificing the season's forage or establishing a fire hazard."

In a widely used grazing management guide, developed in 1919 for national forestlands, Jardine and Anderson[7] stated:

> *Premature grazing was undoubtedly one of the foremost causes of the deterioration of range lands prior to regulated grazing. The damage to forage plants from premature grazing is greatest immediately after growth begins and decreases as the growing season advances…In a broad sense, therefore, grazing at any time before seed maturity of the forage plants may be considered premature.*

Jardine and Anderson also recognized that delaying grazing on all rangelands until after seed maturity was not practical and recommended grazing initiation be timed so grazing damage would not be irreparable or out of proportion to the value of the forage. In other words, they recommended grazing be delayed until range readiness was reached, although they did not use the term. Neither Sampson nor Jardine and Anderson discussed or referred to soil conditions and range readiness. Early references to range readiness dealt only with plant growth characteristics and not with soil. Later on, Sampson and Malmsten[8] defined the time of range readiness as:

> *the date in any one year when the range first reaches the condition in which there is sufficient feed to keep livestock in thrifty condition and when the stock may be admitted without serious impairment of the growth and reproductive processes of the more important forage plants.*

This definition referred only to plant growth stage. Later in the publication, however, Sampson and Malmsten addressed soil conditions, "The opening date of the grazing season for a given range should be based upon the condition of the soil and the development of all of the important forage species present," and added, "The earliest plants on the range mature early and . . . when they are in full bloom, the main forage species are seldom sufficiently developed for grazing and the soil is soft and often boggy."

Range readiness was a useful and effective management tool when it was developed because, at that time, public rangelands (and many private lands as well) were greatly overstocked, and continuous, season-long grazing was the universal strategy. During that era, most rangelands were heavily grazed throughout winter, or winter feeding occurred on or in close proximity to native rangelands. Consequently, livestock had unrestricted access to rangelands, and grazing occurred immediately upon the emergence of new vegetation, with no rest during any time of the year. Depending on the particular area, that grazing strategy may have been practiced for 4 or 5 decades before Sampson's initial publication in 1914. As an example, at the time of the establishment of the Santa Rosa National Forest in 1911 in north-central Nevada, the small mountain range supported approximately 16,000 cattle, 1,500 horses, and 150,000 sheep, grazing all year long, for at least 20 years or more.[9] Under that scenario, range readiness provided a useful mechanism to delay initiation of intensive, season-long livestock grazing, essentially providing a rudimentary type of rest from intense, heavy grazing.

The emphasis on plant criteria in range readiness led to the development of growth guidelines for different plant species by federal agencies. In 1943, Stoddart and Smith's first range management textbook[10] published a long list of height or growth stages for a large number of grass, forb, and shrub species to mark when grazing should be initiated. Those guidelines were widely used by the Forest Service in California to determine range readiness. In 1994, Heady and Child[11] published a later version of range readiness criteria, taken from a California Forest Service District range analysis field guide, which listed growth characteristics of 13 species of grasses, forbs, and shrubs.

All of the early efforts to develop a quantitative way to determine range readiness focused on describing plant growth stages. For example, in 1939 Costello and Price[12] developed a way to predict range readiness based on the growth stages of major forage species and snowmelt dates. On the sagebrush–grass rangelands of the Snake River Plains of southeastern Idaho, Pechanec and Stewart[13] stated that after bluebunch wheatgrass leaves reached 2.5 inches, plant growth was sufficient to begin grazing and soil was generally firm enough to prevent compaction or other damage. In the same area, Blaisdell[14] found that the 2.5-inch leaf stage was highly correlated with the snowmelt date and the mean daily March temperatures, and so developed a way to predict the date of range readiness from the mean daily March temperatures.

The earliest publications clearly indicate that development of range readiness as a management tool was based on plant-growth stage and not soil characteristics. The contemporary definition and use of range readiness includes both vegetation and soil conditions. In practice, this seems logical but was not evident in the earliest literature addressing the range readiness idea. The later works of Costello and Price,[12] Pechanec and Stewart,[13] and Blaisdell[15] represent the first research efforts to develop practical management guidelines based on range readiness. By including references to soil conditions, their works also mark the initial divergence from the original concept that suggested range readiness be based solely on the growth stage of major forage plants and their ability to recover from grazing.

Seasonal Grazing Effects

In the 1930s, widespread conventional wisdom suggested that early grazing prevented adequate renewal of stored carbohydrates and weakened grass plants.[15–17] This point was emphasized in Stoddart and Smith's 2nd edition range management text[18], which stated, "Rapid growth of plants in the spring may temporarily deplete food reserves . . . . Deferring grazing until the plant has had opportunity to restore these food supplies is advisable." More recent research and reviews[19–21] suggest that the relationship between carbohydrate storage and grazing is questionable and that widely held theories of food reserves are in need of revision. The contribution of carbohydrate reserves to the leaf regrowth of perennial grasses may be much smaller than previously assumed. Briske[20] pointed out the difficulty of determining the amount and location of carbohydrate pools in plants, let alone their effects on plant growth. The use of range readiness cannot be based on food-reserve theories.

Sampson and McCarty[15] conducted some of the earliest research on the link between plant-growth stage and grazing effects on subsequent growth. They found that grazing or clipping once or twice, early in the growth cycle, had little influence on total annual herbage yield of purple needlegrass in California. They also found that removal of herbage between the time of flower-stalk production and seed maturity inhibited growth. McCarty[16] concluded that continuous, heavy grazing during flower-stalk formation reduced regrowth more than early, intense use of mountain brome in Utah.

Early research indicated that delaying grazing until forage plants reach early reproductive stages may not be the optimal strategy. McCarty and Price[17] demonstrated that early season grazing may be more appropriate for total annual forage production. In fact, common control methods such as grazing and burning to reduce or damage perennating buds and reproductive tillers of smooth bromegrass work best if applied at the time of initial tiller elongation. Smooth bromegrass is most vulnerable at this stage.[22] When grazing initiation (range readiness) dates and sufficiently high grazing intensities coincide with reproductive tiller elongation through the boot stage, productivity of native cool-season grasses can be significantly reduced.

In 1942, McCarty and Price[17] recommended that grazing be rotated so that no particular portion of the range was grazed at the same time each year to allow for seed production. That strategy was also recommended to reduce grazing intensities during critical periods of plant growth (ie, during the flowering period). A similar strategy was earlier proposed by Sampson in 1914.[6] Hormay and Evanko[23] developed rest–rotation grazing in 1958 "…to provide the amount of rest needed to satisfy the growth requirements of desirable range plants." Since then, rest–rotation grazing has been widely implemented on public and private rangelands, primarily as a strategy to reduce the impacts of grazing during critical periods of plant growth. Rest and rotation ensures that an area will be grazed when grass plants are producing reproductive tillers in only 1 out of 4 years.

Research has shown that early grazing at moderate intensities followed by grazing removal to allow for regrowth provides more benefit than grazing when grass plants are in the reproductive stage. In a 1989 review, Bawtree[24] concluded that grazing bunchgrasses during the boot stage (the appropriate stage of range readiness) is more damaging than at any other stage of growth. On Forest Service allotments in Montana, in 1994, Lacey and others[25] found an upward ecological trend in pastures grazed in early spring before tiller elongation. They also found that vegetation changes in early spring pastures were similar to or better than changes in summer pastures. In a 1994 study in the Blue Mountains of Oregon, bluebunch wheatgrass plants, clipped to simulate early spring grazing, developed similarly to unclipped plants because they had sufficient soil moisture and growing season left after clipping.[26]

Bawtree's review[24] presented a comprehensive discussion about the range readiness concept. One of the major points was that range plants are not damaged by early grazing but rather by grazing intensity. The key was to keep the grazing period short, removing grazing while there was still enough soil moisture left for grass plants to complete the reproduction cycle. Burkhardt[27] described a naturally occurring system of "functional herbivory" during the Pleistocene and early Holocene periods, before the introduction of domestic livestock. In this system, forage quality and opportunity for forage plants to recover from defoliation were simultaneously optimized through early season grazing. Burkhardt stated, "There does not appear to have been anything in the Pleistocene herbivory that was analogous to our concept of range readiness. Range readiness in the shrub steppe postpones grazing until the critical reproductive period of native bunchgrasses." Burkhardt went on to explain that the natural grazing pattern of native grazers in the western United States was to "follow the green." As soon as snow melts and plant growth was initiated on winter range, animals immediately began to graze new green forage. As the snow melt progressed to higher elevations, herds of native animals moved to obtain newly emerged green forage. Vallentine[28] described similar situations in the Intermountain West where free-roaming elk generally follow the receding snowline up the mountain in the spring, but livestock are permitted to graze only after range readiness. Burkhardt[27] also pointed out that the vegetation of the Intermountain West evolved with the seasonal migration by now-extinct Pleistocene megafauna as well as surviving species. The vegetation composition of the Intermountain West is essentially the same now as it was when it was grazed by Pleistocene species,[29,30] and logic dictates that plant communities are adapted to this seasonal migration pattern.

On western public lands, many areas are grazed based only on a system of deferment coincident with range readiness. This includes specific turnout and exit dates with no rotation system. Often, turnout dates correspond to plant-growth stages that are most detrimental to key grass species. Earlier turnout dates combined with exit dates before soil-moisture depletion and hot temperatures would be more appropriate for plant health and vigor. Earlier turnout and exit dates would also improve animal distribution, reducing riparian impacts that generally occur during the hot season.[31] This approach would also provide the potential to return for a late-season grazing period after seed set.

Application of range readiness also fails to recognize differential responses to grazing by different forage species. For example, Caldwell and Richards[32] demonstrated that crested wheatgrass is much less sensitive to early grazing than bluebunch wheatgrass, and they also provide physiological reasons for this difference. In 1967, Hedrick[33] reported that heavy grazing in April and May of crested wheatgrass in southeastern Oregon resulted in considerable more green regrowth and better seed production, which meant a potential early turnout the subsequent year. Yet where range readiness grazing turnout is practiced, agency field guidelines often make no distinctions, applying the same range readiness criteria across all species.

Potential Soil Impacts

In the 1980s, rangeland ecologists and management agencies began to recognize the potential for livestock grazing to negatively impact certain soil characteristics. The body of research addressing soil impacts and livestock grazing is substantial.[34–37] General conclusions across all grazing systems indicate that heavy stocking rates negatively affect infiltration rates and soil structure while increasing bulk densities. Often, these are only growing season effects that are alleviated by freeze–thaw processes the following winter. Effects are also variable with respect to soil type and precipitation patterns. However, with respect to range readiness, no specific quantitative soil moisture guidelines have been developed.

The greatest potential for negative soil impacts occurs when soil moisture levels are just below the saturation point. Even at the time of snowmelt, many western rangeland areas never approach this level of soil moisture content. Many ecological sites are also characterized by soils with coarse-fragment inclusions. On these sites, snowmelt rates seldom exceed infiltration rates,[38] limiting the time soils would be susceptible to negative impacts from large grazing animals. Concerns about soil damage from early grazing may not be warranted in many situations, particularly if animal distribution is good, indicating that the soil condition part of the range readiness concept may be overemphasized in many management scenarios.

Figure 3. University of Nevada-Reno Gund Ranch near Austin, NV

Management Implications

Over time, as rotation systems (deferred rotation, rest rotation, etc) have been implemented, we have gained a better understanding of the interrelationships between grazing and plant-growth stage. Because of this, the range readiness idea has become less important as a management tool. On any rangeland, with rotational deferment built into the grazing system, use of range readiness to determine initiation of grazing in the first pasture may actually be detrimental to plant health. Initiating grazing much earlier in the first pasture, followed by earlier livestock removal, and rotating the use of the first pasture each year may be a better strategy for plant and ecosystem health.

On western ranges where areas are grazed based only on a system of deferment coincident with range readiness and no rotation, turnout dates should be arranged for earlier use to avoid use during the reproductive tiller development stages. Early use should be followed by early removal. By the time of range readiness, upland plants are beginning to mature, and grazing animals switch their preference to riparian areas. Earlier turnout dates combined with exit dates before soil moisture depletion and hot temperatures would be more appropriate for plant health and vigor and would also improve animal distribution, reducing riparian impacts that generally occur during the hot season. This approach would also provide the potential to return for a late-season grazing period after seed set. Managers may also need to adjust animal numbers up or down to achieve distribution and use goals because earlier turnouts will probably have an effect on foraging behavior.

One additional aspect of range readiness—making sure that there is enough forage to sustain livestock once they are turned out—is still valid in view of animal performance.[39]

Early cattle and sheep foraging will include both new growth and residual growth from the previous year. Early research from the 1920s and 1930s demonstrated that the combination provides an adequate nutritional base.[15,17] Ensuring adequate residue to support early grazing usually is not a problem on rangelands that have been moderately or lightly grazed the previous year. Earlier turnout and removal dates may also necessitate changes in calving dates and location of calving operations. These are questions and scenarios that need to be discussed with grazing permittees on an individual basis. Some operations may be better suited to season-of-use changes than others. Bawtree[24] suggested that economic, animal nutrition, and rangeland ecology research all support the concept that grazing and removing animals early helps ensure resource health.

The range readiness tool is widely used on western rangelands today, even though research has demonstrated potential negative effects on forage grass species. Research has not effectively addressed potential soil impacts when range readiness is practiced. In general, rotational-grazing strategies effectively address the concern of severe, repeated defoliation of forage plants during critical growth stages. However, rangeland managers continue to use the range readiness tool to manage grazing at an individual plant scale across large spatial areas. Tools like range readiness were developed at a time when rangeland managers did not have the authority, experience, or scientific research on which to base grazing management. Today, we have the authority, knowledge, and experience to effectively manage livestock grazing at a landscape scale. Yet, even in the presence of proven, successful grazing management strategies, best management practices continue to be plagued by rule-of-thumb measures, applied too broadly, with little relationship to management objectives.

Range readiness was a useful and practical management guideline for the era in which it was developed. The original objective of range readiness—"avoiding permanent damage to vegetation or soil"—remains integral to meeting natural resource objectives through sound grazing management strategies. However, it is apparent that range readiness may no longer be an appropriate tool to meet this objective. We suggest that the range may always be "ready" provided that sufficient forage is present to sustain grazing animals and that it can be demonstrated that the existing grazing management strategy results in progress toward long-term plant community objectives.

Planning documents should provide rangeland managers with the flexibility to tailor turnout and exit dates to specific areas and permittee operations rather than focusing on regulating allotment or district-wide specifications and standards. Where range readiness is an appropriate tool, it should be employed; where it is detrimental, it should be rejected; and a discussion of the idea should be revisited by land managers and scientists alike. The appropriate question may not be "is the range ready?" but rather "is the rangeland manager ready?" Are we ready, when appropriate, to abandon cookbook approaches in exchange for on-the-ground applications of up-to-date ecological knowledge and experience? It is our assertion that rangeland managers are indeed ready and, in fact, have repeatedly demonstrated successful grazing management through communication, innovation, and sound application of ecological principles. Hopefully, this will be the approach embraced by authors of planning documents and rangeland managers in the future. Managers need the flexibility to reject inappropriate or outdated tools and concepts, leaving them in the past where they belong instead of attempting to apply them to situations where they no longer have relevance.

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Thad Box

Drought and Sustainability

> *Men stood by their fences and looked at the ruined corn, drying fast now, only a little green through the film of dust. The men were silent and did not move often. And the women came out of the houses to stand beside their men—to feel whether this time the men would break. The women studied the men's faces secretly, for the corn could go as long as something else remained. The children stood near by, drawing figures in the dust with their bare toes, and the children sent exploring senses out to see whether men and women would break…Horses came to the watering troughs and nuzzled the water to clear the surface dust. After a while the faces of the watching men lost their bemused perplexity and became hard and resistant. Then the women knew they were safe and there was no break.* (John Steinbeck, Grapes of Wrath).

The die-ups of livestock in the late 19th century are part of our range management lore. Dorothea Lange's haunting photographs of the Great Depression give us a hint of human suffering during drought. And John Steinbeck, in his great American novel, spells out what happens when we exceed the basic carrying capacity of land—when sustainability is ignored for corporate gain.

To me, "the drought" is that of the 1950s. I take that one personally. It is not so much that it turned me from a rancher to a school teacher. I can't forget the image of Dad sitting in that hot auction barn at Lampasas, Texas, watching his brood cows sell. And the tear that ran down his sunburned, dusty cheek.

The profession I chose exists because of drought. Or maybe, more accurately, because the first European pioneers misjudged what a land with so little rainfall could support. We continue to approach each new drought as if it is a disaster rather than the norm, ignoring the past, and paying only lip service to sustainable uses of naturally dry rangelands.

We study in detail the droughts of the last 150 years. But tree ring studies and archeological evidence show there have been 2 or 3 droughts per century greater than the one that caused Dad's tear trail to be etched so vividly in my brain. If America's western rangelands are to be sustainable, we must reassess the water that falls on them and the lifestyle uses we demand from them.

We know a lot about rainfall for the past 100 years. But from Elephant Butte, New Mexico, to Lake Mead, Nevada, to Jackson Lake, Wyoming, reservoirs are near empty. White sediments on sandstone ledges mark where water once stood at Lake Powell, Arizona. Acres of sand surround Bear Lake, Utah. In a few years, drought depleted the water storage behind dams old enough to have historical status.

News media decry economic loss to farmers, applaud ideas for xeriscaping yards, and list ways to save water. Some suggest importing water from Canada. Cities, states, and countries litigate compacts that allocate more water than streams flow.

Dry reservoirs are metaphors for our propensity to live beyond our means, our tendency to use temporary surpluses as if the bounty of good years and windfall profits are normal. Once addicted to living beyond our means, we borrow against an imagined prosperous future that history tells us has never happened—and the probability of it ever occurring is low.

Credit card debt and personal bankruptcies are at all-time highs. Local and state governments, required by law to balance the budget, search for ways to put current expenditures into the future. Federal budgets run deficits in the trillions—debts built up by a president and a party that claim to be conservative. Politicians dare not demand we live within our means lest they lose the next election.

Our water shortage should surprise no one. Scientists published volumes showing we use more water than falls in the West. Archeologists speculate that whole cultures of people—large cities and many villages—became extinct in the western states because of drought.

These facts inspired leaders of yesteryear to build storage facilities to capture the excesses of high rainfall years and make them available during bad years. As water stacked up behind dams, we did not accept stored water as a bank account to get through bad times. It became venture capital to make development bloom in the desert. Las Vegas is our fastest growing city because the most reckless gamblers are not in casinos, but in development offices.

"It will rain, and reservoirs will fill" is a hopeful prayer, not fact backed by history or science. No one knows what happened in the Range Creek, Utah, villages where Fremont people disappeared in a dry period some 1,300 years ago. No one knows what will happen in the American West if drought continues another 5 to 20 years.

What we do know is that our current level of development and our lifestyle are not sustainable. We used up half a century of surplus water in one historically short drought. If drought continues, or weather patterns change because of global warming—both predicted—the economy and culture of the West must change significantly.

The first attempt to maintain our overindulgent appetite is conservation. Water-saving toilets and gravel lawns are like smiley-face–decorated bandages on our ruptured jugular vein. Attempts to "produce" water through drilling into non-rechargeable aquifers and using technology to make brackish water fresh may slow the hemorrhage. But ultimately the economy must readjust to a level that can be supported by the annual amount of water available. The West is not sustainable if we use more water than falls from the sky.

Readjustment to live with our water supply will be difficult: First, we Americans are addicted to living beyond our means—credit cards maxed. We do not set aside surpluses for bad times or provide stability for the next generation. Second, leaders promise that growth will bail us out and pay off our debts. Third, growth means getting bigger. Getting bigger increases consumption and exacerbates the problem through more demand for limited water. Until we redefine growth as increasing quality rather than getting bigger, the West—and perhaps our country as well—is on a downhill slide. No one knows when we will hit bottom.

So what does this have to do with us range folk? Rangelands evolved in this dry, drought-prone environment. Organisms developed ways to conserve moisture, stay dormant during drought, and survive. Not only did plants and animals survive, they built amazing, productive, and beautiful communities.

Range managers are trained in understanding the carrying capacity of dry environments. We know the inevitable disasters that occur when carrying capacity is exceeded. We understand the modifications nature made for plants and animals to live through drought. We know intellectually, and personally, the joys and sorrows of surviving in dry areas.

There is no other group that has both the scientific training and personal attachment to drought-prone areas. But to accept this broad role, we must master complex problems of the interconnectedness of modern people and an overused land—from geology to ecology to sociology to economics to philosophy to politics. And we tackle these messy problems without fear.

> *The women watched the men, watched to see whether the break had come at last. The women stood silently and watched. And where a number of men gathered together, the fear went from their faces, and anger took its place. And the women sighed with relief, for they knew it was all right—the break had not come; and the break would never come as long as fear could turn to wrath.* (John Steinbeck, Grapes of Wrath).

Where is our outrage? Where is our anger? ◆

Colorado Section Society for Range Management: 2004 Annual Meeting

By Wayne Leininger

The annual meeting of the Colorado Section of the Society for Range Management was held in Longmont, Colorado, on December 1–2, 2004. It was well attended with nearly 100 registering for the meeting. Interestingly, one-third of the registrants were non-SRM members. Their attendance at the meeting is a testimony to the quality of the program and the high interest in rangeland issues.

The theme for the meeting was "The Health of Colorado's Rangelands." The meeting started with an overview by Renee Rondeau from the Colorado Natural Heritage Program on Colorado's grasslands. Ms Rondeau pointed out that prior to settlement, Colorado was 35%–40% grassland. Because of farming and other land use changes, Colorado presently has about 20% grassland.

David Bradford from the US Forest Service highlighted the history of the use and management of Colorado's rangelands. An interesting statistic that Bradford pointed out was that Native Americans first acquired horses in Colorado in the late 1600s. By the 1800s, Native Americans in Colorado had 6–12 horses for every man, woman, and child. One would have to wonder what their impact on the rangelands was.

After the introductory talks, the program focused on issues involving rangeland health. John Mitchel (US Forest Service) presented an overview of rangeland assessments in the United States. He pointed out that "…the more we know, the harder it is to monitor." How true that statement is.

Josh Saunders and Ben Berlinger, Range Management Specialists with the Natural Resources Conservation Service, talked about indicators of healthy rangelands. They reviewed the 3 attributes and 17 indicators used to evaluate rangeland health. Berlinger pointed out that there isn't just one health rating, but evaluations look at 3 separate attributes.

After lunch, Roy Roath, from Colorado State University, led a discussion on monitoring and assessing the health of grassland ecosystems. He stressed that rangeland health can't be given just one number and that rangeland management specialists need to be detectives. I guess we have a reason to watch CSI Miami (or your favorite version of the show).

Another professor from Colorado State, Bill Lauenroth, gave a presentation on the importance of ecological disturbance on rangelands. He pointed out that every grassland has disturbances, and many of these disturbances kill plants. However, only a few of disturbances, such as grazing and fire, can actually be manipulated. Lauenroth also pointed out that on the Northern Great Plains, where grasslands evolved with bison grazing, no grazing is a disturbance, and yet, "no grazing" is the control in many experiments on grazing.

Photo 1. Colorado Section Awards Committee Cochair Scott Woodall presents the Colorado Section Trail Boss Award to Don Hijar.

Sharon Collinge, Associate Professor at the University of Colorado, started the second day of the meeting off with a presentation on the biodiversity of Colorado's grasslands. She pointed out the importance of contiguous areas of grasslands to maintain the biodiversity of small mammals and birds. Collinge also highlighted the problem we're having on the Front Range of Colorado with the habitat loss and fragmentation due to urban development.

The next speaker at the meeting was Bill Travis, also from the University of Colorado. He addressed the human dimensions of rangeland health. He questioned, as many in the Society have, whether "health" is the right word.

The last talk of the meeting was given by George Beck, Colorado's Weed Extension Specialist, who spoke on threats to rangeland health from invasive weeds. He pointed out how extremely complex this topic is. For example, some invasive species, like Tamarisk, are excessive consumers of resources (eg, water). In contrast, other species, like sweetclover, enrich the soil with nitrogen. Further, some invasive species help to stabilize soils (eg, smooth bromegrass), whereas other species, like spotted knapweed, have been shown to increase sediment production from rangelands.

Two awards were presented at the Section's banquet on Wednesday evening. The Trail Boss Award, which is pre-

Photo 2. Colorado Section Awards Committee Cochair Tim Steffin presents the Colorado Section Excellence in Rangeland Conservation Award to Don and John Palmer of the Palmer Ranch, Boyero, Colorado.

sented to the individual who has made outstanding accomplishments to the profession of range management and provided outstanding service to SRM, was presented to Don Hijar. In addition to having served on numerous committees at both the Section and National levels, Hijar has been recognized as a leader in the seed industry where he has promoted the wise use of introduced and native species in the restoration and reclamation of rangelands.

The Excellence in Rangeland Conservation Award was presented to the Palmer Ranch from Boyero, Colorado. This ranch is intensively managed and the improved range condition and livestock distribution on the ranch has resulted in improved forage quality and habitat for wildlife. The ranch has also taken a lead in helping other ranches in the region become more profitable and better stewards of the rangeland resource by participating in field days and extension programs and through numerous personal contacts.

One of the keys to the success of this meeting was the diversity of backgrounds of the speakers. Many of them challenged the traditional views of range management. They stimulated much discussion among those who attended the meeting and pointed out the importance of proper stewardship of rangelands for its various users.

Author is Past President of the Colorado Section of SRM.

Sixth in a Series: Insight From SRM's Charter Members

The Society for Range Management (SRM) History Committee has conducted interviews with many of the Society's Charter Members to capture their perspective of events leading to, and subsequent to, the formation of the American Society of Range Management in 1947–1948. Interviews from several of these individuals will be shared for today's SRM members to enjoy and learn from.

SRM Charter Member – Charles Graham

Editor's Note: A videotape and audiotape were made in July 2003 at Charles Graham's home by Sheila Barry of the California Section. The information was transcribed by Tom Bedell. Charles Graham lives at 390 N Winchester, Apt 13B, Santa Clara, CA 95050. Charles was known as "Charlie" and will be referred to that way here.

When the American Society of Range Management (ASRM) was being organized in 1947–1948, Charlie was going to school on the GI Bill at University of California, Berkeley (UCB). He had been out of high school for 12 years at that time. In the 1930s, after high school, Charlie was in a Civilian Conservation Corps (CCC) camp. He took a civil service exam and was able to get into the US Forest Service doing vegetation mapping. He served in the US Army during the war, and when he got out, at Christmastime 1945, he decided to take advantage of the GI Bill and go to college. Because he had been working for the Forest Service before the war, forestry and range management were familiar, so he chose forestry school.

Charlie received both a BS and an MS from UCB. Before the war, he worked at the San Joaquin Experimental Range north of Fresno, California. Dr Harold H. Biswell was a Range Ecologist at the station at that time, and Charlie worked for him about 1.5 years. Dr Biswell had moved from Forest Service research to the faculty of the School of Forestry at UCB in about 1947, and because Charlie had worked for and knew him at the San Joaquin Experimental Range, he became Charlie's advisor. Charlie took the range option as the degrees were in Forestry. Charlie remembers Dr A. W. Sampson, Dr Harold Heady, and Professor Kittredge on the faculty.

Dr Biswell was one of the organizers of the ASRM and a strong promoter of the Society. Charlie was encouraged to join and did so. Charlie does not recall that there were any Sections organized that early on, but when the California Section was organized, Charlie became active in it. Charlie did not attend the first ASRM annual meeting in Salt Lake City, Utah. He does recall going to Albuquerque, New Mexico, in 1953, for an annual meeting and to several California Section meetings.

Charlie stated that because he was working in research, the development of the *Journal of Range Management* aided greatly in publishing research results for a range-oriented audience. He felt it was one of the greatest values of the Society.

After he finished graduate school, he continued at the Forest and Range Experiment Station on a seeding project near Susanville, California, and worked with Dr Don Cornelius for several seasons. In 1953, Charlie became the Superintendent of the San Joaquin Experimental Range and remained there until 1965. At least two Section field days were held at that site during that time. He recalls going to the Rapid City, South Dakota, meeting and flying his plane there. Al Murphy was President of the California Section, and could not go; Charlie was asked to go to represent the Section.

In 1965, Charlie took a foreign assignment in Iran for 2 years. This didn't work out because he got bleeding ulcers, so he returned to the California Station. The war in Vietnam was in full swing, and research was needed evaluating chemical treatments on several species of woody plants, especially tropical ones. Charlie worked with Jay Bentley on this research. The research work was being conducted in Hawaii, Puerto Rico, Georgia, and Thailand. Charlie made several trips to all the locations except Thailand. The group also did some research on brush management near Glendora in southern California and Mt Shasta in northern California. Their primary research tool was a rotary sprayer mounted on a tall tripod. Vegetation was 15 or more feet tall. They set out over 700 plots testing various levels and formulations of picloram, 2,4-Dichlorophenoxyacetic acid (2,4-D), and 2,4,5-Trichlorophenoxyacetic acid (2,4,5-T).

As mentioned earlier, Charlie was in the California Section. He was on the Board of Directors for 1 term and then ran for Section President. He and Dr Harold Biswell were tied in the race, so a recount was made, and a ballot or two were found to be ineligible. Dr Biswell had won by 1 vote! Charlie says he never got active in the parent society.

Regarding his observations about the Society now and its direction, Charlie chuckled and wondered just how much progress is being made. It looks to him as if research is being published on the same subjects as it was years ago. This suggests to him that the same problems exist. Of course, Charlie says, he has been retired for 30 years and doesn't keep up as he used to. However, he does wonder just how much progress is being made, citing as one example, the continued focus on *Bromus tectorum* invasions.

Charlie says young people should join SRM because the relationships they will find with other professionals will be important and valuable. Their thinking will be stimulated. They will develop positions on subjects in which they are interested. Even though there will be disagreements, the experience will be very worthwhile.

SRM Charter Member – W. A. "Bill" Hubbard

Editor's Note: This interview was conducted by Don Blumenaur, British Columbia Chapter, Pacific Northwest Section in 2002. Bill Hubbard lives at 2381 Tranquille Road, Kamloops, Canada BC V2B 3N6.

In 1947–1948, I was working at the Dominion Research Experimental Station in Manyberries, Alberta, Canada. My line of work was in the short grass prairie, deciding how many cattle we could run on the range. Basically, it was range management concerning livestock, with the stock being Hereford cattle. My work involved finding out the carrying capacity of the range and what we could do to improve range conditions by rotational or continuous grazing, that type of thing.

We were approached—the superintendent, myself, and others—and asked how we would like to be members of a special society on range management. Before this time, all the publications on range management had gone through forestry and forestry journals. There was no separate journal of range management at that time. And so I, along with others, decided to join and become a charter member.

The Section was the Great Plains Section because we were in Alberta and worked on the short grass prairie. I was not able to attend the first annual meeting in Salt Lake City, Utah, because of fiscal restraints and reluctance on the part of the Director General of Agriculture Canada at that time. I suppose I can say that my expectations in 1948 have been fulfilled. Sections have grown. Besides the 17 western states, there are 4 or 5 Canadian provinces that have become involved in the Society. At least we had a common place to meet and discuss the range across a wide variation in ecological types, all the way from Northwest Territories to Mexico.

In 1948, I attended university but was also employed, as I said, at Manyberries. I went to school for a couple of years, and then came back to work at Manyberries for a couple of years. I had received a BSA degree at the University of Saskatchewan in Forage Crops. I decided I needed more than that if I was going to stay with range management. I talked with Larry Stoddart, primary author of the range management text by Stoddart and Smith (STODDART, L. A., AND A. D. SMITH. Range management. New York, NY: McGraw-Hill Book Co.; 1943). He suggested that I go to Utah State for a Master's degree, and I did, graduating in 1948. I came back to work for a while but received an opportunity to go to a museum in Victoria, BC, as a botanist. While there, I wrote *Grasses of British Columbia* (HUBBARD, W. A. The grasses of British Columbia. Victoria, Canada: A. Sutton; 1969).

After some time, I thought I would like to get back into range management again. I had an opportunity at the research station at Kamloops, so in 1953 I came back. Tom Willis encouraged participation in the Society because he was a member, and he certainly gave me all the necessary encouragement.

I haven't held any offices in the Section or the parent society but have attended some of the annual meetings. In 1975, I took early retirement. I did go to the 50th anniversary meeting in South Dakota to see some of the old-timers and get reacquainted with people I had known for some years.

I think the SRM is on the right track, and I think anybody who is involved with livestock and rangelands can benefit from joining. I think we have had trouble over the years with the range and controlling grazing and controlling fires and one thing and another. I know you can talk with people who feel that cattle are part of the problem. I think, however, that the range management people and range ecologists are doing a great job in preserving the range, which is maybe not in its original condition but as close as possible to it, and keeping it in perpetuity for those coming up.

SRM Charter Member – Glenn Mueller

Editor's Note: On June 5, 2002, Chuck Jarecki interviewed Glenn Mueller. Glenn is an alert, 84-year-old, retired Forest Service employee, who keeps active and is up-to-speed on current land management issues. The interview was not tape-recorded. Glenn Mueller can be reached at PO Box 334, Libby, MT 59923-0334.

In 1947–1955, Glenn was employed by the Soil Conservation Service (SCS) at Malta, Montana, under the Land Utilization Program as the land manager of 10 grazing districts encompassing 1 million acres. A vast range-reseeding project was completed on the large acreages of abandoned croplands, mostly crested wheatgrass, that had been bought by the federal government. Efforts were being made to work out management systems for the lessees. At that time, there were no competing uses for the rangeland, and the grazing districts were the primary focus of attention.

Glenn recalls that he probably heard of the effort to form the American Society of Range Management through an SCS news publication and was an immediate supporter of the idea. At the time he joined, he does not recall that there were any Sections until several years later.

Glenn's first Section membership was in the Northern Great Plains when the Forest Service later employed him an assistant ranger at White Sulphur Springs, Montana. Later, he belonged to the International Mountain Section.

Glenn did not participate in the first meeting in Salt Lake City, Utah. However, he did attend the annual meeting in Great Falls, Montana.

Expectations in 1948 were to have an organization that would be of assistance in helping to keep current in the developing science and practice of sound range management. Those expectations have been met over the years. Although no longer taking the *Journal*, that publication was a major aid in keeping Glenn up-to-speed during his professional career. Glenn comments that he will continue to belong to SRM until he takes his last breath. Glenn also makes modest contributions to the SRM Endowment Fund.

Glenn emphasized that the SRM should never back down from supporting land management decisions that are based on sound science, even if that stance is not popular with certain segments of the population. Too often today, in this litigious society, land management policies are driven by public opinion that is too often influenced by "junk" science and not even by common sense.

Glenn was raised in the Lewistown, Montana, area. In his youth, he spent a lot of time hiking and camping in the surrounding mountains. During his years at the University of Montana, he was employed during the summers by the Lewis and Clark National Forest. In 1940, Glenn graduated from the University of Montana School of Forestry with a minor in Range Management. Mel Morris was his principle range professor. His first permanent job was with the SCS in west Texas as a range conservationist. He then transferred to Montana at Malta. Transfer to the Forest Service was made in 1956.

Following the job at White Sulphur Springs, Montana, Glenn became the Beartooth District Ranger on the Custer National Forest in 1957.

In 1962, Glenn was transferred to the Kootenai National Forest at Libby, Montana, where he served first as the Recreation and Lands Officer, and then on the Planning staff until retirement in 1978.

Glenn recalls that he was neither encouraged nor discouraged from belonging to SRM.

Following retirement from the Forest Service, Glenn served 2 terms in the Montana House of Representatives.

Glenn believes that the SRM would strengthen its position if the word "science" were to be incorporated into its name. The future of scientific land management is in question. Everyone today is an authority, and so much of this authority is based on emotion, not on hard facts and science. "It would be very difficult for me to work for the Forest Service today due to politics and failure to accomplish anything on the land."

SRM is on the right track. The organization needs to stand up and be counted as the voice of sound range management and policies. SRM needs to be managed as a business to be maintained on solid financial footing. Ranchers especially need to be made to feel welcome and be encouraged to participate in SRM activities.

A career in range management can be very rewarding for any young person to consider. As the number of competing uses for the range increases beyond the traditional use of mostly grazing, the challenges will become ever greater in balancing the needs of the different users while still maintaining the management of the land on the basis of science and common sense.

Tom Bedell is a member and former chairman of the SRM History Committee and a member of the Pacific Northwest Section living in Philomath, Oregon.

Ask The Expert

Editor's Note: How often have you been faced with reading or hearing a topic that sounds interesting, but you do not quite understand some of the detail? We have selected such a question and have had an expert on the topic provide an answer.

QUESTION:

"Warm-season and cool-season plants are frequently called C4 and C3 plants. What does this terminology represent and how do the plants differ?"

Carly Dorman, Fort Collins, Colorado

RESPONSE:

We usually think of warm-season plants as those that grow more during the warmer part of the year: mid-summer to early fall. Cool-season plants usually grow better in the spring and fall when temperatures are cooler. The terminology of warm- and cool-season plants indicates their most active growth periods as related to air temperatures. The other terms (C4 and C3) for these plants come from plant physiology and indicate the photosynthetic pathway type that each of these plants use in fixing carbon dioxide in the air into carbohydrates in the plant through photosynthesis. Warm-season plants use the C4 cycle in the fixation of carbon dioxide. This pathway type was discovered in tropical grasses in the 1960s by researchers Hatch and Slack and is sometimes referred to as the Hatch and Slack pathway. Until then, we assumed that all plants followed the "normal" C3 pathway (also known as the Calvin and Benson cycle) in carbon dioxide fixation. The names C4 and C3 arise from the number of carbon atoms that are in the first stable product that is produced in carbon dioxide fixation; in C4 plants, it is malic or aspartic acid (which contain 4 carbons in the initial product) as compared with phosphoglyceric acid (PGA) that has only 3 carbon atoms in the product.

So, why are the differences between these two pathways important to a range manager? Each of these pathways involve different enzymes, chloroplasts, and cellular locations, which results in different responses to a number of environmental variables. These differences make C3 plants better adapted to certain conditions, whereas C4 plants respond differently to these same conditions. The table below shows some ecophysiological differences between C4 and C3 plants.

The characteristics in the table indicate that in warmer climates, with drier conditions and less soil nitrogen available for growth, C4 plants should perform better than C3 plants. In cooler locations, with more soil water and nitrogen available, C3 plants should do well. In some areas, there can be mixtures of both C4 and C3 species, which can help extend the green foliage period through the growing season and allow grazing animals to use the C3 species early in the growing season, then use the C4 species during

Table 1. C3 and C4 plant responses to various conditions

Characteristics	C3 Plants	C4 Plants
Optimum light	Low intensity	High intensity
Optimum temperature	Low (20°–35°C, 68°–95°F)	High (30°–45°C, 86°–113°F)
Water use efficiency	Low	High
Nitrogen use efficiency	Low	High
Nutritional Value	Good (higher protein)	Fair (lower protein)

the middle of the growing season, and then, possibly, use the C3 species again in the fall if there is a "green up" of these plants. These mixtures of C4 and C3 plants can occur together or each may be in separate pastures. The mixtures may also include grasses, forbs, and shrubs because all 3 of these life forms have both C3 and C4 species representatives. Obviously, we may wish to consider which of these pathway types (or both) fit the environment better when we are reclaiming or restoring an area and are selecting plant species to use.

Dr M. J. Trlica, Professor, Department of Forest, Rangeland, and Watershed Stewardship, Colorado State University, Fort Collins, CO 80523.

If you have a question on a topic, please send a short note to: Gary Frasier, Rangelands *Editor-in-Chief, 7820 Stag Hollow Rd., Loveland, CO 80538 or email: gfrasier@aol.com. If selected, we will attempt to locate an expert for an answer and publish it in a future issue of* Rangelands.

CALL FOR PAPERS AND POSTERS ABSTRACTS AND SYPMPOSIA PROPOSALS

The deadline to submit abstracts and proposals is approaching for the **59th Annual Meeting of the Society for Range Management**, 11-17 February, 2006 in Vancouver, British Columbia. The theme of the meeting is "Rangelands to Rain Forests". We welcome submission of symposia and papers that are applicable to rangeland resource sciences and issues at national or international levels. The following deadlines apply:

▪ Symposia Proposals – 30 May 2005 ▪

▪ Workshop & Specific Program Proposals – 30 June 2005 ▪

▪ Oral and Poster Presentations – 31 July 2005 ▪

For more information or to submit abstracts for technical sessions and symposia, go to

http://www.rangelands.org

or

http://abstracts.co.allenpress.com/rama/index.html

For questions please contact Bill Krueger (541-737-1615 William.C.Krueger@oregonstate.edu) or Rick Miller (541-737-1622 Richard.Miller@oregonstate.edu), program co-chairs.

Poetry

By Dick Hart

The Battle of Shiloh in the Civil War was fought by 2 amateur armies: North and South. Thousands in both armies turned and ran: Union soldiers huddled under the banks of the Tennessee River; Confederate soldiers disappeared into the woods. My great-grandfather James Hart fought there, in the 46th Illinois Volunteer Infantry Regiment. In the summer of 1998, we visited the battlefield and found the regimental monument. It lists, out of an initial strength of about 600, 33 killed and 135 wounded, but just a single man missing. In other words,

Nobody Ran

In the 46th Illinois, we had fun
With the boys who skedaddled at Bull Run;
Told 'em it shoulda been called "Who run?"
"In the 46th," we bragged, "nobody ran."

At Shiloh, on a bloody April day,
We thought, as we faced the men in gray,
"When this fight's over, can we still say
In the 46th, nobody ran?"

I ain't the man with words to tell
What it was like in that thunderin' hell
Of screamin' shot and burstin' shell;
But in the 46th, nobody ran.

We heard the stories, of rank on rank
Of terrified men 'neath the river bank
Tryin' to sneak up a boat's gangplank;
Yet in the 46th, nobody ran.

No, the 46th Illinois stood to their work;
Carpenter, farm boy, dry goods clerk,
Couldn't let comrades see us shirk;
So in the 46th, nobody ran.

You can see at Shiloh, on our granite stone,
How many were wounded or left their bones,
But among the missing, just one alone;
'Cause in the 46th, nobody ran.

No commendations bear my name,
Just fought my fight and gained no fame,
But still I'm proud to state my claim;
"I fought in the 46th, and nobody ran."

Cowboy Rap

When ya throw yer loop on a ringy ol' steer,
Take a dally 'round the horn, keep yer fingers clear.
Wrap a bight, pull it tight, don't let it flap;
An' that's a rap, a cowboy rap.

On the hurricane deck of an ol' cayuse,
Screw yerself down tight an' don't come loose.
Take a twist 'round yer wrist with the halter strap;
An' that's a rap, a cowboy rap.

Now, it may do in the city, but 'way out West
To call a gal a "ho" just ain't the best.
That's apt to earn a slap in yer 'tater trap;
An' that's a rap, a cowgirl rap.

So rap is sumthin' diff'rent, out on the range,
Though a city dude might find it strange.
The definition's in position on the map;
An' that's what makes this a cowboy rap.

Now ya c'n clap.

The Recipe Corner

Editor's Note: *There are many "family" recipes that are passed from generation to generation that are never seen by outsiders. Many of these recipes would be enjoyed by others. This column is being established to present some of these recipes so others can enjoy them. The following recipe was submitted by Wayne Leininger, Fort Collins, Colorado.*

Chicken-Fried Elk Steak

When we go out to supper, my wife, Dana, will often order chicken-fried steak. She prefers this over poultry, fish, or Mexican food. Because I like to hunt and sometimes I am lucky and actually harvest an elk, I have come up with my version of chicken-fried steak using elk meat. The preferred steak is loin, but round steak also works well. The recipe I use is:

- ~ 1½ pounds elk loin or round steak
- 1 cup flour
- salt
- pepper
- garlic salt
- 2 eggs
- 30 saltine crackers
- shortening

Remove all the fat from the steak, and then coat the steak with a mixture of flour, salt and pepper, and a dash of garlic salt. Dip the coated steak in eggs that have been beaten, and coat this with finely ground crackers. I fry the steak in shortening that has been heated on medium high. Be careful not to overcook the elk because it will become tough. The final touch is to serve the meat with potatoes and a good white gravy. If done right, this will rival chicken-fried steak served in the finest restaurant. ◆

HIGHLIGHTS

Rangeland Ecology & Management, March 2005

Understanding Landscape Use Patterns of Livestock as a Consequence of Foraging Behavior

Karen L. Launchbaugh and Larry D. Howery

Many grazing management challenges stem from poor livestock distribution, resulting in overuse of some areas and low utilization of others. Herbivores are born with a set of behavioral and physical attributes that set a foundation for foraging. As herbivores grow and mature, they learn about their foraging environment through their own experiences and from other members of their herd or flock. In this paper, we describe the basic principles that underlie how animals make decisions about where to forage and how long to stay in a particular habitat. We also suggest management practices designed to modify animal behavior and alter habitat use patterns.

Identification and Creation of Optimum Habitat Conditions for Livestock

Derek W. Bailey

Habitat attributes can affect livestock performance as well as the uniformity and, correspondingly, the sustainability of grazing. Land managers can manipulate the habitat to improve conditions for livestock so that they perform better and avoid concentrating their grazing to limited areas of available rangeland. Livestock behavior can also be managed so that animals are more adapted to their habitat and use variable rangelands more efficiently and uniformly. Numerous opportunities exist to improve the ecologic and economic sustainability of livestock grazing, but continued research is needed to verify the effectiveness of management practices on a site-by-site basis.

Management Strategies for Sustainable Beef Cattle Grazing on Forested Rangelands in the Pacific Northwest

Timothy DelCurto, Marni Porath, Cory T. Parsons, and Julie A. Morrison

Nonuniform distribution and use of forage resources are a challenge for livestock managers on western rangelands. We have synthesized a number of research projects that have evaluated specific management strategies that may mitigate distributional problems. Our research suggests that several tools are available to manage livestock distribution and resource selection. These tools, in turn, when incorporated into a managed grazing system can provide for sustainable beef cattle production systems for western rangelands.

Livestock Grazing and Wildlife: Developing Compatibilities

Martin Vavra

Livestock grazing systems can be developed that have the potential to benefit wildlife. Specific systems can lead to changes in plant community composition, increased productivity, improved nutritional quality, or modified habitat diversity. Development of such systems requires an intimate knowledge of the landscape and plant communities to be treated, habitat requirements of targeted wildlife species, impact on livestock, and consideration of other management manipulations that may be required. The idea of using livestock as a tool for improving wildlife habitat is not new; however, knowledge related to its implementation is meager, and implementation into management practices is rare.

Diet Composition, Forage Selection, and Potential for Forage Competition Among Elk, Deer, and Livestock on Aspen–Sagebrush Summer Range

Jeffrey L. Beck and James M. Peek

Little information is available on potential for forage competition among ungulates sharing aspen–sagebrush summer range. We evaluated elk, mule deer, cattle, and domestic sheep diet composition, diet overlap, and forage selection on aspen–sagebrush summer range in northeastern Nevada over 3 years to understand potential for forage competition to provide better information for managing these communities. Our results suggest potential for forage competition is highest for forbs in aspen communities. Monitoring productivity and use of key forages, particularly forbs in aspen communities, should complement management objectives on shared aspen–sagebrush summer range.

Grazing History Affects Willow Communities in a Montane Riparian Ecosystem

Kathryn A. Holland, Wayne C. Leininger, and M.J. Trlica

There are few long-term studies that have examined effects of livestock use on willow community structure. We collected data on willow canopy cover, species diversity, height, and stem density in a montane riparian ecosystem between 1988 and 1999 from 4 grazing treatments: long-term grazing (since the early 1900s), long-term grazing exclosures built in the 1950s, recent grazing, and recent grazing exclosures. Results suggest that continued long-term grazing exclusion may lead to a closed canopy, lower willow species diversity, reduction in height growth, and reduced recruitment. This information should help resource managers to determine appropriate livestock utilization levels and to develop management plans for similar riparian ecosystems.

Predicting Nitrogen Content in the Northern Mixed-Grass Prairie

M.R. Haferkamp, M.D. MacNeil, and E.E. Grings

A technique to provide rapid estimation of forage quality would offer a tool for assisting in range livestock management decisions. An equation to predict percent forage N from proportion of dead plant tissue and accumulated growing degree days was developed from forage quality data collected in eastern Montana using multiple linear regression. The equation accounted for 76% of the variation in percent N with a prediction error variance of 0.26. The resulting correlation between predicted and actual N in a validation dataset was 0.79. This equation may prove useful for predicting forage quality in similar environments.

Brome Control and Microbial Inoculation Effects in Reclaimed Cool-Season Grasslands

M. Dean Stacy, Barry L. Perryman, Peter D. Stahl, and Michael A. Smith

Invasion of smooth brome into native cool- and warm-season grassland communities has become problematic where presence of native species is important, necessary, or mandated. This study examined the efficacy of burning, grazing, herbicide, and microbial inoculation to reduce smooth brome while minimizing coincident detrimental effects on cool-season grasses in a reclaimed surface coal mine site. Grazing and burning were most effective after 2 consecutive years of treatment. Inoculation had little effect on soil microbial biomass content and mycorrhizal infection. Smooth brome can be controlled in the short term, shifting the balance of community composition toward native grass species.

Topsoil Depth Effects on Reclaimed Coal Mine and Native Area Vegetation in Northeastern Wyoming

Brenda K. Schladweiler, George F. Vance, David E. Legg, Larry C. Munn, and Rose Haroian

Uniform topsoil replacement may hinder compliance with reclamation bond release standards involving canopy cover, aboveground production, shrub density, and plant diversity. We evaluated variable topsoil replacement depths of 15, 30, and 56 cm and short-term revegetation success. Total vegetation and number of species from canopy cover and aboveground production sampling were greatest in the 30-cm reclaimed treatment and included desirable seeded and volunteer perennial grasses and forbs. When we compared this site to a 1991 reclaimed site, we noted a consistent general pattern of species establishment. Our research suggests that a mosaic of different topsoil depths creates a broad range of vegetation responses with standard revegetation practices. The ability to use different thicknesses of topsoil should be a reclamation practice available to mine operators.

Evaluation of Native and Introduced Grasses for Reclamation and Production

Walter D. Willms, Ben H. Ellert, H. Henry Janzen, and Harriet Douwes

Crested wheatgrass and Russian wildrye are commonly used for reseeding in the Mixed Prairie but have been implicated in soil deterioration. We compared their net primary production and soil organic C between monocultures of 4 native grass species and between native monocultures and their mixtures. Monocultures of the introduced grasses were less productive than 2 native species, and monocultures of native species were equally productive as their mixtures, whereas soil organic C was not affected by the treatments. The relative merits of a species cannot be defined by its origin, and mixtures must be qualified according to their composition.

A Process for Assessing Wooded Plant Cover by Remote Sensing

Jason D. Afinowicz, Clyde L. Munster, Bradford P. Wilcox, and Ronald E. Lacey

The ability to measure the extent of woody plant cover in the rangeland environment is essential for the scientific study of rangelands and of growing importance from a management perspective. This paper documents a process using readily available data sources to quantify the amount of brush cover as well as other significant land cover types in the Guadalupe River watershed, Texas. A validation of the method showed a reasonably high success for measurement of some land cover parameters such as the density of wooded cover, and less success at distinguishing broad types of land cover classes. The results of the study demonstrate an opportunity for further refinement of the process into a powerful tool for characterizing rangelands.

Ranchland Ownership Dynamics in the Rocky Mountain West

Hannah Gosnell and William R. Travis

Anecdotal and demographic data suggest that an ownership transition is under way on western rangelands, but few data exist on rates of ownership change or the nature of new owners. Ranch sales data for 3 counties in the Rocky Mountain West (1990–2001) were collected and analyzed, and a typology of owners was used to classify buyers. Rates of ownership change ranged from 14% to 45%, and the majority of acres sold (54%) went to "amenity buyers." The study concludes that a significant ranchland ownership transition to a new type of owner is ongoing in the Rockies.

Technical Note: Development of Agitators for Seeding Forages Using Air Delivery Systems

Duane McCartney, Gord Hultgreen, Allan Boyden, and Craig Stevenson

Air seeders or air drills traditionally have been used for minimum till and direct seeding of cereal, oilseed, and pulse crops. These units have not been used extensively for forage seeding because of seed bridging problems with some types of grass seed over the metering system entry points in the seed tank. This study designed and evaluated modifications to the agitation and metering systems for seeding forages using 3 different types of Canadian-built air seeders. Field-scale testing indicated that grass forages could be successfully seeded using a full-size air seeder using these modifications.

Technical Note: Evaluation of Openers for Seeding Meadow Brome Grass (*Bromus riparius*) Using Air Delivery Seeding Systems

Duane McCartney, Gord Hultgreen, Allan Boyden, and Craig Stevenson

There is interest in Canada in seeding grass seed using air seeders and air drills that were originally designed for seeding cereals and oilseeds. Various types of furrow openers (ie, spoons or knives) were evaluated for their effectiveness in seeding meadow brome grass seed (*Bromus riparius*). Knife openers provided the best seed emergence results. Seed brakes and variable air velocities were also evaluated as a means of preventing the seed from blowing out of the seed row when using high air velocities. Acceptable seeding results were achieved without seed brakes when used at low air velocities; however, at these lower air velocities seed distribution may be less accurate.

Technical Note: Microhistological Estimation of Grass Leaf Blade Percentages in Pastures and Diets

Paola V. Sierra, M. Silvia Cid, Miguel A. Brizuela, and Carlos M. Ferri

Available procedures to quantify the relative consumption of leaf blades require the use of animals fistulated esophageally or expensive equipment. We propose an innovative, inexpensive procedure to quantify the percentages of blade in vegetation samples by the microhistological technique. To assess whether the procedure could be used to evaluate the blade percentages in herbivore diets, we evaluated its accuracy and precision in the estimation of the percentages of blade of 4 species before and after digestion. Although the procedure was tested with 4 species, it could also be used to estimate the percentage of blade of the dominant species in diets of herbivores grazing complex systems.

Technical Note: Using Geographic Information Systems to Present Nongeographical Data: An Example Using 2-Way Thermogradient Plate Data

Catherine S. Tarasoff, Mounir Louhaichi, Carol Mallory-Smith, and Daniel A. Ball

"A picture is worth a thousand words" is a familiar truism that is aptly suited to the dilemma of presenting complex research results involving multiple explanatory variables. Current methods such as tables and 3-dimensional graphs quickly become cumbersome when trying to present complex research results. Using techniques developed in the geosciences, researchers can explore alternative data presentation methods. Although somewhat unorthodox, Geographic Information Systems (GIS)–based techniques provide a powerful tool that provides a clear and visually apparent presentation of nongeographical data. ◆

Jeff Mosley

Browsing the Literature

This section reviews new publications available about the art and science of rangeland management. Personal copies of these publications can be obtained by contacting the respective publishers or senior authors (addresses shown in parentheses). Suggestions are welcomed and encouraged for items to include in future issues of *Browsing the Literature*.

Animal Ecology

Changes in rodent community structure in the Chihuahuan Desert, Mexico: Comparisons between two habitats. L. Hernandez, A. G. Romero, J. W. Laundre, D. Lightfoot, E. Aragon, and J. L. Portillo. 2005. *Journal of Arid Environments* 60:239–257. (Institute de Ecologia, Centro Regional Chihuahua, Km 33-3 carr Chihuahua-ojinaga, 32900 Aldama, Chihuahua, Mexico). Rodent diversity was equal between a tobosagrass site and a mesquite–creosote bush–prickly pear site, but rodent density was greater in the shrub site.

Differences in social behaviour between late pregnant, postpartum and barren mares in a herd of Icelandic horses. M. C. van Dierendonck, H. Sigurjonsdottir, B. Colenbrander, and A. G. Thorhallsdottir. 2004. *Applied Animal Behaviour Science* 89:283–297. (Dept. of Animal Science and Society, Utrecht Univ., Postbox 80168, 3508 TD Utrecht, The Netherlands). Social rank was correlated strongly with age. The dominant horses were older mares that had not yet lost physical condition due to old age. Also, horses selected grooming partners based on familiarity more so than kinship, and without influence from social rank.

Grassland vegetation and bird communities in the Southern Great Plains of North America. R. N. Chapman, D. M. Engle, R. E. Masters, and D. M. Leslie. 2004. *Agriculture Ecosystems and Environment* 104:577–585. (D. Engle, Dept. of Plant and Soil Sci., Oklahoma State Univ., Stillwater, OK 74078). Although grassland seeded to Old World bluestem had less plant species diversity than native mixed-grass prairie, breeding grassland birds did not preferentially select native prairie over the seeded grasslands.

Nesting biology of three grassland passerines in the northern tallgrass prairie. M. Winter, D. H. Johnson, J. A. Shaffer, and W. D. Svedarsky. 2004. *Wilson Bulletin* 116:211–223. (SUNY College of Environmental Sci. and Forestry, 1 Forestry Dr., Syracuse, NY 13210). The main cause of nest failure was nest predation, with nest predation averaging 48% for clay-colored sparrows, 42% for bobolinks, and 34% for Savannah sparrows.

Tree and shrub invasion in northern mixed-grass prairie: Implications for breeding grassland birds. T. A. Grant, E. Madden, and G. B. Berkey. 2004. *Wildlife Society Bulletin* 32:807–818. (US Fish and Wildlife Service, 681 Salyer Rd., Upham, ND 58789). As tree or shrub cover increased on grasslands in north-central North Dakota, fewer birds were present. Bird use declined more and more as the height of woody plants increased from low brush to tall shrubs to trees.

Variation in grasshopper (Acrididae) densities in response to fire frequency and bison grazing in tallgrass prairie. A. Joern. 2004. *Environmental Entomology* 33:1617–1625. (School of Biological Sci., Univ. of Nebraska, Lincoln, NE 68588). Individual grasshopper species had varied responses to fire frequency and bison grazing in the Flint Hills of Kansas. Bison grazing increased the density of 7 species, fire frequency affected 2 species, and 1 species was unaffected by either fire or grazing.

Grazing Management

Designing better water troughs: Dairy cows prefer and drink more from larger troughs. L. C. P. Machado, D. L. Teixeira, D. M. Weary, M. A. G. von Keyserlingk, and M. J. Hotzel. 2004. *Applied Animal Behaviour Science* 89:185–193. (Depto. de Zootecnia e Des Rural, Universidade Federal de Santa Catarina, Rod. Admar Gonzaga 1346, Florianopolis, SC 88.034-001, Brazil). Cows preferred a taller water trough (24 inches vs 12 inches) and they preferred a water trough that was larger in size (55 × 37 inches vs 50 × 27 inches).

Hydrology/Riparian

Livestock exclusion and belowground ecosystem responses in riparian meadows of eastern Oregon. J. B. Kauffman, A. S. Thorpe, and E. N. J. Brookshire. 2004. *Ecological Applications* 14:1671–1679. (Institute of Pacific Island Forestry, 1151 Punchbowl St., Room 323, Honolulu, HI 96813). Livestock exclusion for 9–18 years increased belowground plant biomass, lowered soil bulk density, and increased infiltration rates in riparian meadows.

Plant Ecology

Influence of habitat fragmentation and crop system on Columbia Basin shrubsteppe communities. M. A. Quinn. 2004. *Ecological Applications* 14:1634–1655. (Dept. of Crop & Soil Sci., Washington State Univ., Pullman, WA 99164). Shrub steppe sites located near annual croplands supported fewer grasshoppers, beetles, and butterflies than shrub steppe communities that were near fields of perennial crops.

Slow recovery in desert perennial vegetation following prolonged human disturbance. Q. F. Guo. 2004. *Journal of Vegetation Science* 15:757–762. (Desert Lab, Univ. of Arizona, Tucson, AZ 85721). Following several decades of excessive livestock grazing, about 50 years of livestock exclusion were required before plant diversity, density, and cover stabilized in the Sonoran Desert of southern Arizona.

Variable effects of feral pig disturbances on native and exotic plants in a California grassland. J. H. Cushman, T. A. Tierney, and J. M. Hinds. 2004. *Ecological Applications* 14:1746–1756. (Dept. of Biology, Sonoma State Univ., Rohnert Park, CA 94928). Soil disturbances by feral pigs "generally promoted the continued invasion of this coastal grassland by exotic plant taxa."

Reclamation/Restoration

Community- and ecosystem-level changes in a species-rich tallgrass prairie restoration. P. Camill, M. J. McKone, S. T. Sturges, W. J. Severud, E. Ellis, J. Limmer, C. B. Martin, R. T. Navratil, A. J. Purdie, B. S. Sandel, S. Talukder, and A. Trout. 2004. *Ecological Applications* 14:1680–1694. (Dept. of Biology, Carleton College, 1 North College St., Northfield, MN 55057). Only 3 years were required before warm-season perennial grasses became dominant within restored tallgrass prairie in southern Minnesota.

Effects of soil carbon amendment on nitrogen availability and plant growth in an experimental tallgrass prairie restoration. J. M. Averett, R. A. Klips, L. E. Nave, S. D. Frey, and P. S. Curtis. 2004. *Restoration Ecology* 12:568–574. (R. Klips, Dept. of Ecology, Evolutionary and Organismal Biology, Ohio State University, Columbus, OH 43210). Application of a soil carbon amendment (hardwood sawdust) provides several immediate benefits for tallgrass prairie restoration by decreasing the competitiveness of exotic plants.

Endangered cactus restoration: Mitigating the non-target effects of a biological control agent (*Cactoblastis cactorum*) in Florida. P. Stiling, D. Moon, and D. Gordon. 2004. *Restoration Ecology* 12:605–610. (Dept. of Biology, Univ. of South Florida, Tampa, FL 33620). The moth *Cactoblastis cactorum* is a biological weed control insect from Australia that has recently invaded the United States and threatens native cacti. Authors predict that many cactus species in the US South, Southwest, and Mexico are threatened by this moth.

Living with fire: Homeowner assessment of landscape values and defensible space in Minnesota and Florida, USA. K. C. Nelson, M. C. Monroe, J. F. Johnson, and A. Bowers. 2004. *International Journal of Wildland Fire* 13:413–425. (Dept. of Forest Resources, Univ. of Minnesota, 115 Green Hall, 1530 Cleveland Ave. North, St. Paul, MN 55108). Most homeowners in wildfire-prone areas supported the use of prescribed burns to reduce wildfire risks, especially if the prescribed burns were conducted by fire experts who understand the local ecology and fire behavior.

Restoration efforts for plant and bird communities in tallgrass prairies using prescribed burning and mowing. F. Van Dyke, S. E. Van Kley, C. E. Page, and J. G. Van Beek. 2004. *Restoration Ecology* 12:575–585. (Dept. of Biology, Wheaton College, 501 College Ave., Wheaton, IL 60187). Plant species diversity was unaffected by mowing or burning tallgrass prairie in Iowa, but mowing and burning did retard shrub encroachment.

Switchgrass and big bluestem hay, biomass, and seed yield response to fire and glyphosate treatment. M. A.

Sanderson, R. R. Schnabel, W. S. Curran, W. L. Stout, D. Genito, and B. F. Tracy. 2004. *Agronomy Journal* 96:1688–1692. (USDA-ARS, Bldg. 3802, Curtin Road, University Park, PA 16802). In central Pennsylvania, plant yield of switchgrass or big bluestem will be unaffected if burned before plants exceed 4 to 6 inches of new growth. In most cases, glyphosate herbicide should be applied just before green-up in spring.

Using ecological restoration to constrain biological invasion. J. D. Bakker and S. D. Wilson. 2004. *Journal of Applied Ecology* 41:1058–1064. (Ecological Restoration Institute, Northern Arizona Univ., PO Box 15017, Flagstaff, AZ 86011). Results suggest that a plant community's resistance to invasive plants depends on which species are present in the plant community. Therefore, potential exists for restoration seed mixes to be tailored to constrain selected invaders.

White-tailed deer forage production in managed and unmanaged pine stands and summer food plots in Mississippi. S. L. Edwards, S. Demarais, B. Watkins, and B. K. Strickland. 2004. *Wildlife Society Bulletin* 32:739–745. (Dept. of Wildlife and Fisheries, Mississippi State Univ., Box 9690, Mississippi State, MS 39762). In loblolly pine forests of north-central Mississippi, herbicide, prescribed fire, and fertilizer treatments were more cost-effective ways to improve forage production for whitetails than planting food plots of cowpeas.

Socioeconomics

Current issues in rangeland resource economics—2004. L. A. Torell, N. R. Rimbey, and L. Harris. 2004. Utah Agricultural Experiment Station Report 190. (available at http://www.agx.usu.edu/reports/2004/SRM). This report is the proceedings of a symposium held at the 2004 annual meeting of SRM in Salt Lake City, Utah. Papers discuss some of the socioeconomic impacts resulting from ongoing changes in rangeland ownership patterns and population demographics of the western United States.

Flying blind: The rise, fall, and possible resurrection of science policy advice in the United States. H. Kelly, I. Oelrich, S. Aftergood, and B. H. Tannenbaum. 2004. Federation of American Scientists Occasional Paper No. 2. 107 p. ($15; Federation of American Scientists, 1717 K St. Northwest, Suite 209, Washington, DC 20036). Authors contend that the infrastructure for providing science advice to Congress and the Executive Branch is in a state of crisis. In response, the authors provide Congress and the Executive Branch with detailed recommendations for ways that scientists can provide expert advice when policy decisions hinge on complex technical issues.

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BOOK REVIEW

Organ Pipe: Life on the Edge. By Carol Ann Bassett. Photographs by Michael Hyatt. 2004. The University of Arizona Press, Tucson. 89 p. US$13.95 paper. ISBN 0-8165-2384-3.

All life is on the edge of something. In *Organ Pipe*, a recent book by Carol Ann Bassett, the most obvious *edge* is the border between Arizona and Mexico that is such an integral part of the identity, history, and future of the Organ Pipe National Monument. The short book is one in a series of similar books being published by the University of Arizona Press on notable western locales. The author of *Organ Pipe* lived in the area for nearly 30 years and over that time acquired knowledge of its history, some familiarity with its flora and fauna, an awareness of the pulse of the landscape, and a sense of how the place has changed. The latter sense, in particular, gives the author the edge over any newcomer in interpreting the state and dynamics of the national monument.

In the first 3 of the book's 9 chapters, Ms. Bassett briefly surveys the history of the region and the national monument. The national monument is home to several conspicuous species of cacti, including the one for which it is named. The area's history and prehistory are interesting, and the author breezes through them in a smooth essay lacking any of the bibliographic citation you might have historically expected in a book published by a university press. Today, most university presses operate with business models that move their products inexorably toward those of commercial, popular presses. In any case, for the reader who is interested in the area, and who is unconcerned with historical documentation, *Organ Pipe* offers a pleasant little history.

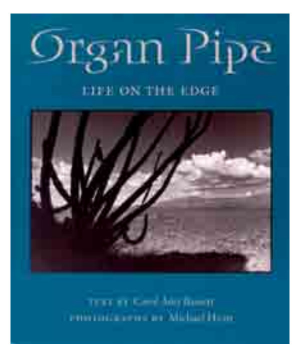
The middle chapters of *Organ Pipe* mainly explore the author's familiarity and experiences with the plants and animals of the national monument. Many notable species of the flora and fauna, including such locals as the saguaro, creosote bush, tarantula, and roadrunner, are encountered in these reflections. Here, too, the literary tone of the text is unfettered by scientific citations.

A later chapter entitled "Life on the Edge" briefly explores some aspects of the relationship between the US–Mexico border, and the environmental and biotic gradients in the Southwest. The penultimate chapter includes strikingly incongruous descriptions of the paramilitary activities associated with problems of illegal migration through the national monument from Mexico, how these long-standing problems have festered, and how much the countermeasures have intensified in the past several years. The author doesn't disrupt the tone of her essay by passing judgment, but her matter-of-fact descriptions are poignant evidence (as if such evidence were in short supply) of how effectively economically driven humanity can screw up something beautiful.

The book's 10 black-and-white photographs by Michael Hyatt are well-chosen, attractive compositions that match the text and support it effectively. The 5-×-6-inch book isn't large enough to ever be mistaken for a coffee-table book, so inclusion of a few more photographs would not have engendered any artistic risk on the part of the author, photographer, or publisher. Also, a simple map or two of the area would have helped the reader, and would not either have offended the readers' aesthetic sensibilities or damaged the author's subtly poetic tone. I sensed that the principals were unwilling to risk disrupting the poetic image of the landscape with any unpoetic maps.

Carol Ann Bassett's writing in *Organ Pipe* shows technical skill and good judgment. She shows some sense of when to back away from the edge, and the sentimentality that she feels for her subject is never allowed to completely overwhelm her literary detachment. Her credibility is maintained, and her text is more palatable than most of the plants she describes.

Organ Pipe's target audience is anyone sensitive to the natural history, human history, and aesthetics of remarkable areas such as the desert Southwest. Insensitive types will likely not fully appreciate its thoughtful tone as Ms. Bassett light-foots it through the desert.



David L. Scarnecchia, Washington State University, Pullman, WA. ◆