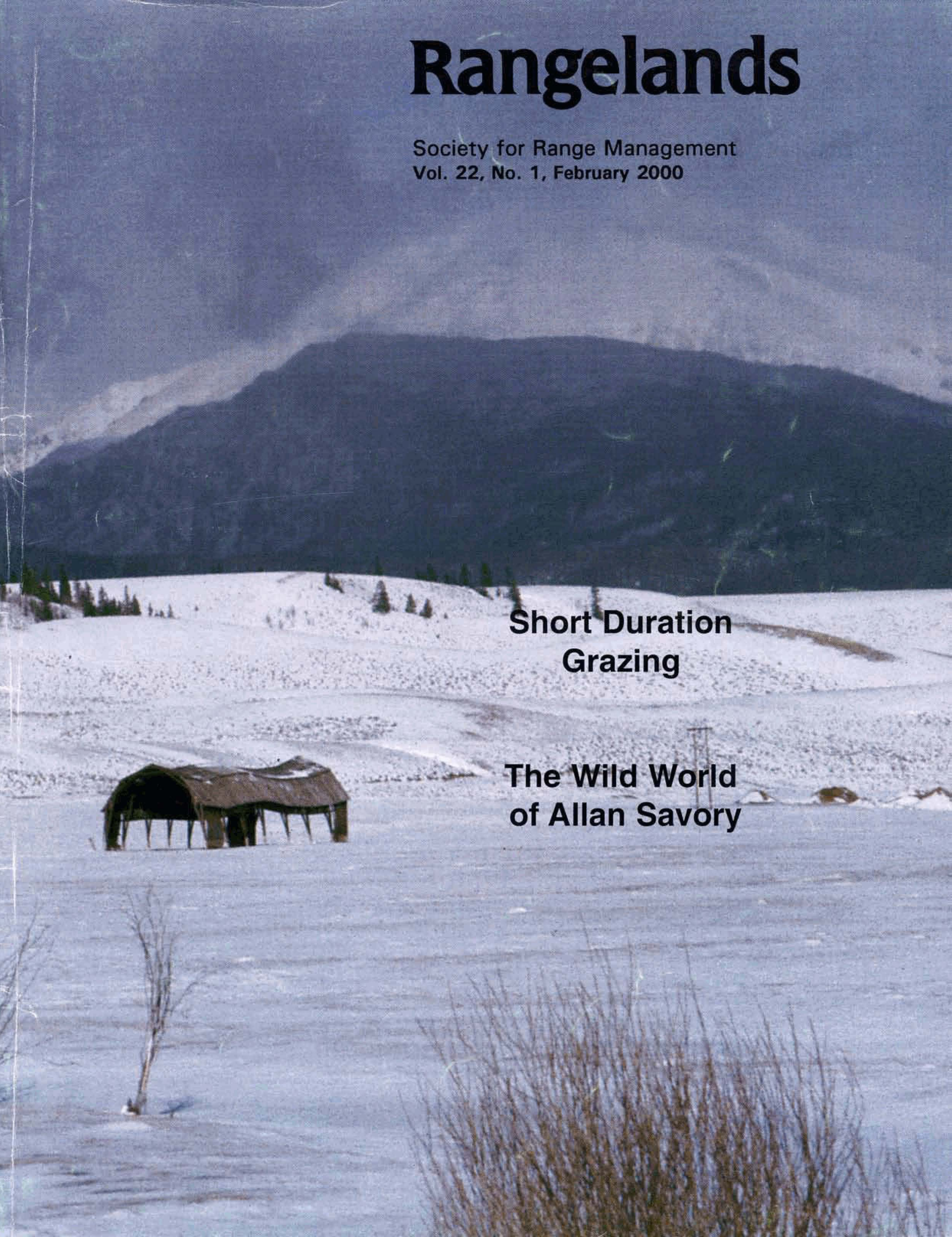
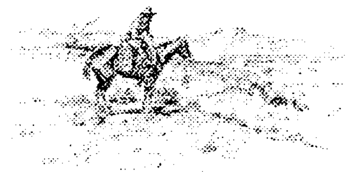

Rangelands
Society for Range Management
Vol. 22, No. 1, February 2000
Short Duration
Grazing
The Wild World
of Allan Savory



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Rangelands

FEATURE ARTICLES

DEPARTMENTS

COVER

FRONT COVER: The cover is a picture of Mt. Massive in Colorado and a barn .

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Society for Range Management

The Society for Range Management

The Society for Range Management founded in 1948 as the *American Society of Range Management*, is a nonprofit association incorporated under the laws of the State of Wyoming. It is recognized exempt from Federal income tax, as a scientific and educational organization, under the provisions of Section 501(c) (3) of the Internal Revenue Code, and also is classed as a public foundation as described in Section 509 (a) (2) of the Code. The name of the Society was changed in 1971 by amendment of the Articles of Incorporation.

The objectives for which the corporation is established are:

—to properly take care of the basic rangeland resources of soil, plants and water;

—to develop an understanding of range ecosystems and of the principles applicable to the management of range resources;

—to assist all who work with range resources to keep abreast of new findings and techniques in the science and art of range management;

—to improve the effectiveness of range management or obtain from range resources the products and values necessary for man's welfare;

—to create a public appreciation of the economic and social benefits to be obtained from the range environment;

—to promote professional development of its members.

Membership in the Society for Range Management is open to anyone engaged in or interested in any aspect of the study, management, or use of rangelands. Please contact the Executive Vice-President for details.

Rangelands

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Executive Vice-President's Comments

As is customary in the February issue each year, I would like to summarize some of the SRM activities in 1999. This serves as a form of "annual report" for those members unable to participate in the Annual Meeting.

It was a significant year for the Denver staff in terms of personnel activity. I use the term significant because of the importance of some of the actions we took. Our first move was to hire Deen Boe as our Washington D. C. Representative. The position had been vacant for almost a year. Deen has been working to catch up on our contact activities in that area. Having Deen on the job has made a big difference in our participation in national activities. Our next action was to hire Helen Hall to cover office services and production assistant duties. For almost two months we were up to full staffing but as usual it never seems to last. Matt Wirt resigned to relocate to Alabama, leaving our membership position vacant. Helen Hall was promoted into this position and the job was somewhat redesigned to include membership recruitment and retention duties, along with managing the membership database. Svetlana Orekhov was hired in the office service/production assistant position. Most recently, Jeff Burwell has come to our staff filling a newly created position covering public affairs and professional certification. Jeff is on loan from the Natural Resource Conservation Service and will work with SRM for the next three years. For the present, we have a very capable staff in place to carry out the Denver office programs.

Membership continues to be a topic that occupies the energy of the organization, and I'm pleased to report that it feels as if the tide is turning. While there is a slight decrease in membership through December 31, January memberships will more than make that up. Also there are indications that things are becoming more stable. Members are paying renewals more timely than in the past, we had a high number of new members in 1999, over 500, and the innovative ideas of our membership committee and Helen Hall, our membership manager, seem to be having an effect. I would say that communications between the members, Denver staff, membership committee, and Board of Directors is as good as it's been in a long time, and is having positive results. I'm optimistic that we will continue to improve in 2000.

Dues for the regular member category have been changed for 2000. The Board of Directors did this after careful consideration of the results of the three level structures, compared to the concerns expressed by both members and potential members with the income level system. Dues will be $50.00 plus $5.00 section dues. I appreciate the simplified structure. I am however, concerned that the income will not be adequate for our needs. It is obvious that more will need to be done on this question in the coming year.

A huge undertaking this year for the Denver staff and myself was the sale of the building and relocation of our office. As I reported previously, the Board of Directors made a decision to list the property for sale in the fall of 1998. The building was listed in early 1999, and an offer was accepted in August. Closing was September 3, and relocation to leased office space was completed shortly after. Sale price was $535.000.00. Proceeds at closing were 489,495.37. At that time outstanding notes with 1999 interest, totaled $47080.00. These notes and interest were paid off in December. The remaining balance has been invested in a building trust account, and is providing income to partially offset the cost of our current space. We are now located in a suite of offices in a professional office building. The space is proving to be very efficient and adequate for our needs. The appearance of the office is good and provides a very professional presence for SRM. The location is somewhat strategic in that many members work nearby, and visits have increased noticeably.

A certification program for rangeland professionals was initiated in 1999. This is a concept that has been discussed and debated for a long time. In fact I have seen file information going back almost 30 years on this issue. This is a culmination of several years' work by the professional affairs committee, which presented their final recommendations to the Board of Directors at the Annual Meeting in Omaha. The recommendations were accepted and a task group appointed to work on implementation. The entire program was published in the November 1999 *Trail Boss News*. Interest is building and applications for certification are coming in. Jeff Burwell can provide you additional information on this program.

If there were one theme that describes our activities in 1999, it would be our Journey to Change. Many of the issues and problems that have occupied our time and energy for quite some time have been the result of the changing world around us. It is becoming increasingly clear that a vast majority of people in this country have little exposure to the production of raw products from rangelands, and the importance of the rangeland resource to economies and cultures. Instead, there is a rather obvious trend toward the value of the many amenities available from this land. This trend has caused great discomfort and debate within our profession, and up to this point we have had little opportunity to effectively deal with it as an organization. Beginning in 1999, this is changing. Under the leadership of our President, Kendall Johnson, SRM took the first steps to deal with the complex subject of change in our profession, and especially in our professional society. The first step occurred in August prior to our summer Board meeting in Ft. Collins, Colorado. A two-day workshop was facilitated by Work-Span, a consulting firm specializing in assisting professional societies deal with change. A group representing a cross-section of our membership and officers participated in this first effort. Information developed by this first group of participants has been evaluated by the Board, and will figure prominently in future planning and actions. The next step will be taking place about the time this edition reaches you, during our annual meeting in Boise. Two more groups will be exposed to the concept of dialog, a concept important to formulating our future. This next exercise will allow the discussion to be moved to the sections, which is where the real actions on change will take place.

In considering the year ahead, I remain optimistic that we will stabilize our numbers, and bring valuable information and educational opportunities to our membership.—**Craig Whittekiend**, EVP

WAS THE HIGH PLAINS A PINE-SPRUCE FOREST?

Stephen A. Hall

Introduction

Twenty thousand years ago a sheet of ice more than a mile thick mantled the Northern Plains, the Midwest, and most of Canada. The ice sheet, called the Laurentide, was the last of several Ice Age glaciers that plowed through the north (Fig. 1). The cold climate that spawned the ice sheet also changed the distribution of plants and animals everywhere in the world. Ecologists speculated that the Great Plains prairies may have disappeared entirely, replaced by forests.

Far from the ice sheet, the Llano Estacado or High Plains of Texas and eastern New Mexico was home to a dozen species of giant horses and bison, all extinct today and known only from their fossilized bones. Looking at their teeth, which are little different from the teeth of their modern descendants, we know that these extinct animals were grazers. It almost goes without saying that grazers and grasslands go together, yet for many years, despite the evidence from fossil Ice Age horses and bison, ecologists have believed that the High Plains was not rangeland but instead was a forest composed of pine and spruce trees.

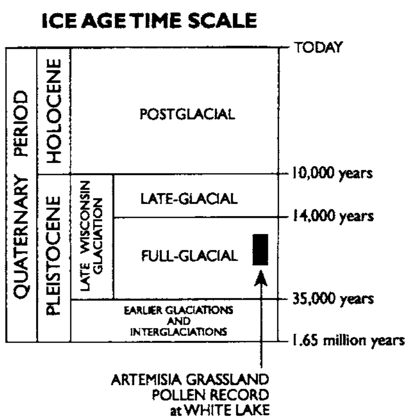

Fig. 1. *Time scale of the Quaternary Period or Ice Age extending back 1.65 million years; the Laurentide ice sheet reached its maximum about 18,000 to 20,000 years ago.*

In the 1950s and 1960s, the Ice Age history of North America was of special interest to ecologists because of the dramatic changes that had taken place. During the period of cooler glacial climate that prevailed over the continent, plant and animal communities in the north were displaced hundreds of miles by the Laurentide ice sheet (Fig. 2). While early ideas suggested wholesale southward movement of more-or-less intact forests, it was soon realized that Ice Age plant communities were very different from those that we see today. Now it is also recognized that, during periods of environmental change and stress, plant and animal species alike migrate independently of each other, not in groups or associations. As a consequence, the make-up of today's modern plant communities and biomes may have come about only recently.

Most of our information on Ice Age plant biogeography comes from studying fossil pollen grains in peat bogs and lakes. Plants produce tremendous amounts of pollen. In the High Plains grasslands, range plants produce more than 120 billion pollen grains per acre every year (Hall 1990). Some pollen grains fall in playa lakes where they are entombed in mud. By recovering fossil pollen that was deposited thousands of years ago, it is possible to tell what plants were growing in the vicinity and what range conditions were like.

Between 1957 and 1959, an innovative project was sponsored by the Museum of New Mexico, Santa Fe, to determine the environmental history of the southern High Plains. Geologists examined sand dunes and playa lakes, and paleontologists studied fossil bones and snails and even fossilized remains of algae from the lake muds left behind in the Ice Age playas. During the project, studies of fossil pollen from the ancient and now-dry playas turned out to be of unexpected importance, destined to be cited for decades to come.

"Pine-Spruce Forest"

The lake muds contained high percentages of pine and spruce pollen. The ecologist who studied the pollen stated, "the most probable interpretation of the high pine pollen values...is that the pine formed *an open forest with a very scanty field vegetation*" (Hafsten 1961, p. 84, his emphasis). In a later paper, he interpreted it as "a cold and wet period with open boreal woodlands of pine and spruce..." (Hafsten 1964, p. 414).

Although the interpretation of a "pine-spruce forest" on the High Plains had been accepted by scientists and range specialists, the original work left two unanswered questions.

1. The high percentages of pine pollen in the lake muds were too high; some of the mud contained 85 to 100% pine. Modern pine forests generally produce only 60% pine pollen, the remaining 40% represented by other trees, understory shrubs, and ground plants. The ecologist was aware of this, and worried about the lack of pollen from herbs, stating simply that there was "...a very poor field vegetation covering the Southern High Plains" (Hafsten 1961, p. 85).

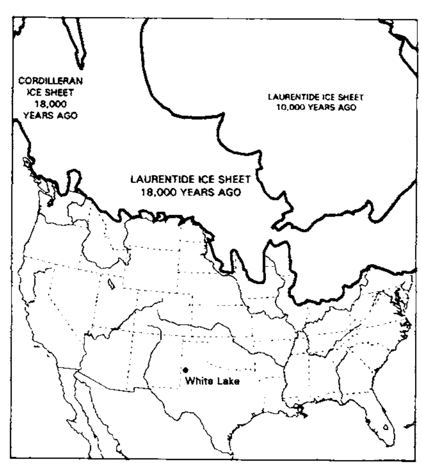

Fig. 2. *Location of Ice Age playa deposits at White Lake, Texas, in relation to the Laurentide ice sheet.*

Fig. 3. *Ice Age lake muds, White Lake, Muleshoe National Wildlife Refuge, Bailey Co., Texas; the top of the ridge is the crest of a lee dune (photo, S. A. Hall).*

2. The project ecologist also worried about the effects of a conifer forest on soil development on the Llano Estacado. Pine forests produce podzolic soils, very different from prairie soils, and none of the forest soils were present on the High Plains. Citing studies from temperate Europe, he stated that dry-climate adapted pines may thrive on very weak soils along with low pollen-producing forms, such as lichen and ericaceous shrubs in pine-barrens. If the weak soils were eroded by winds, he states, it would account for the absence of a conifer-forest soil. He also states that "It may be that the buried soil beds discovered in a few places represents the only remains of former soil profiles, for instance, the buried soil of the Judkins red sand" [near Monahans, Texas] (Hafsten 1961, p. 84). More recently, the absence of podzol soils has been reiterated as evidence that there was no conifer forest on the Llano Estacado (Holliday 1987).

Ice Age Sagebrush Grasslands

A new pollen study has produced a novel twist to the old data and calls for a revision of the status of the "pine-spruce forest." Reinvestigation of pollen from White Lake at Muleshoe National Wildlife Refuge, Bailey Co., Texas (Fig. 3), has revealed that the upper part of the glacial-age playa clays is dominated by very high percentages of pine pollen, just as were accurately reported earlier. However, not realized by earlier workers, the high percentages of pine pollen are a product of differential pollen preservation and are useless for interpreting vegetation.

The cause of differential preservation can be explained by pollen-grain chemistry. The wax-like pollen walls have a composition that varies from one plant species to another. Because of the differences in pollen chemistry, pollen grains from some plants are more susceptible to deterioration than are others. During weathering of pollen-bearing sediments, some pollen types are lost first while other types "survive" and are the last to go. Pine and spruce pollen fall into the latter category. When non-pine pollen is destroyed, the percentages of pine pollen go up. So, when the glacial-age playa lakes on the Llano Estacado dried up 14,000 years ago, the lake muds weathered and the pollen became partly destroyed, leaving behind a zone of high percentages of pine and spruce in the upper part of the old lake deposits.

Fortunately, the lower part of the lake muds were not weathered and contain lots of well-preserved pollen. Pollen from unweathered mud indicates that the glacial-age vegetation of the High Plains was a sagebrush grassland and not a pine-spruce forest after all (Hall and Valastro 1995).

Now that it is apparent that a sagebrush grassland was present on the High Plains during the Ice Age, other ecological records begin to fall into place, showing that a grassland vegetation once dominated the southern Great Plains and throughout much of the now-arid southwest, from Kansas to Arizona (Fredlund 1995; Hall 1985, 1997).

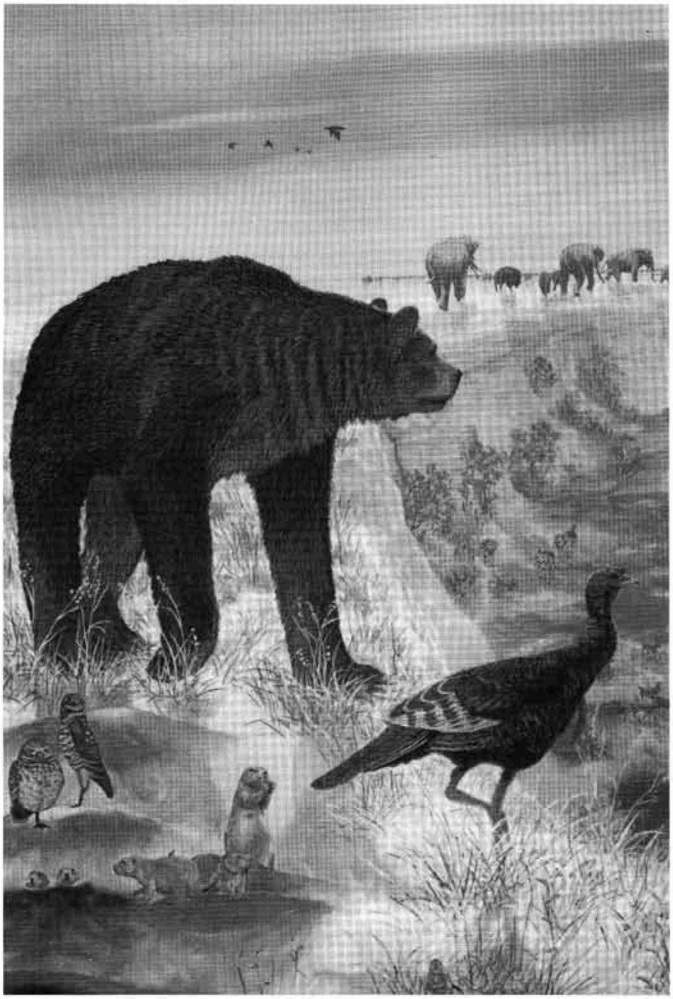

Fig. 4. ***Painting of the Texas High Plains during late-glacial time about 12,000 years ago; although sagebrush is not shown in the painting, it was a major component of the vegetation 18,000 years ago (painting by Nola Davis, courtesy of Texas Parks and Wildlife, Interpretation and Exhibits Branch).***

Conclusion

The southern High Plains was a sagebrush grassland during the last glaciation 16,000 to 20,000 years ago, and, even though the climate was cooler than today, there was no pine-spruce forest. The sagebrush grassland was part of a larger Ice Age biome that extended throughout the south-central region of the continent and included mammoths, bison, horses, camels, and other extinct mammals (Fig. 4). The Ice Age grasslands may have been very different in species composition and abundance from that seen in modern prairies. The vertebrate fauna and climate were clearly different from those of today. Nevertheless, the extensive Ice Age sagebrush grassland was the predecessor from which the modern prairies and desert grasslands have been derived.

Supporting Literature

Fredlund, G. G. 1995. Late Quaternary pollen record from Cheyenne Bottoms, Kansas. Quaternary Research 43:67–79.

Hafsten, U. 1961. Pleistocene development of vegetation and climate in the southern High Plains as evidenced by pollen analysis. In Paleoecology of the Llano Estacado, F. Wendorf, ed., 59–91. Fort Burgwin Research Center, Publ. No. 1, Santa Fe, N.M.: Museum of New Mexico Press.

Hafsten, U. 1964. A standard pollen diagram for the southern High Plains, USA, covering the period back to the early Wisconsin glaciation. International Quaternary Congress, VI, Report 2, 407–420, Warsaw.

Hall, S. A. 1985. Quaternary pollen analysis and vegetational history of the Southwest. In Pollen Records of Late-Quaternary North American Sediments, V. M. Bryant, Jr. and R. G. Holloway, eds., 95–123, Dallas: American Association of Stratigraphic Palynologists Foundation.

Hall, S. A. 1990. Pollen deposition and vegetation in the southern Rocky Mountains and southwest Plains, USA. Grana 29:47–61.

Hall, S. A. 1997. Pollen analysis and woodrat middens: Re-evaluation of Quaternary vegetational history in the American Southwest. Southwestern Geographer 1:25–43.

Hall, S. A., and S. Valastro, Jr. 1995. Grassland vegetation in the southern Great Plains during the last glacial maximum. Quaternary Research 44:237–245.

Holliday, V. T. 1987. A reexamination of Late-Pleistocene boreal forest reconstructions for the southern High Plains. Quaternary Research 28:238–244.

Acknowledgment

The writer thanks Don Clapp (Muleshoe National Wildlife Refuge) for permission to work on the refuge, and Cathryn A. Hoyt (Texas A & M University) for editorial comments. The Late Pleistocene painting by Nola Davis (courtesy of Texas Parks and Wildlife, Interpretation and Exhibits Branch) was created for the Lubbock Lake Landmark State Historical Site, Lubbock, Texas; their permission to use the painting is greatly appreciated.

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The Wild Life of Allan Savory

C.J. Hadley

Reprinted from the Fall issue of Range Magazine, *1999.*

This Rhodesian biologist has been spreading the gospel of holistic management to the masses on several continents. Some respond to his message. Others deny his successes and ridicule his changes of mind. Is this extraordinary man a genius or simply a contradiction? Is he saving the world or frightening scientists?

Allan Savory is a botanist and zoologist with a history as varied as the flora and fauna of the country in which he was born. Rhodesia was a white ruled British territory and when he was a member of the Rhodesia Party Savory broke ranks, crossed the aisle and worked for the black vote. Soon after, he had to flee the country in fear of his life.

He landed in Texas in the early '70s, now lives in New Mexico, but for most of his 63 years, this maverick has been wandering wild places trying to stop desertification, which is a symptom of a worldwide and deadly serious loss of biodiversity.

"As a youngster, my only aim was to live in the African bush forever." He had that opportunity but ended up "forsaking it in order to work toward saving the wildlife that was my reason for being in the bush. Even in the wildest areas, the land was deteriorating, in fact turning to desert, rendering it ever less able to support life of any kind. I was determined to find a way to reverse this process."

He worked as a biologist, soldier, public servant, member of parliament, president of a political party, farmer, rancher, consultant. "Throughout that," says Savory, "there was constantly just one theme—poor land means poor people, social upheaval, political unrest. We farmers and ranchers have destroyed more civilizations than armies have done. Armies change civilizations. We farmers and ranchers destroy them, they never rise again. And I've been obsessed with this problem of why this is happening, why it's happened for 10–15,000 years, and why we've never been able to stop it.

Biodiversity loss, caused by humans, is taking place at a faster rate than any time in history. "Desertification is a symptom of the loss of biodiversity caused by overloading the air through the burning of fossil fuels, biomass burning, chemicals, fertilizer, agriculture, pollution, burning of national parks and forests," says Savory. "Scientists only have three tools—rest, technology and fire, so they try to justify fire when technology fails, but no fire lit by a human being is natural. Put those three together and those are now threatening not just trees and birds and fish, these are now threatening human survival."

Savory's quest took him a surprising route. He was compelled to work with farmers and ranchers, whose management he believed was responsible for initiating the deterioration. He's on public record in Rhodesia (now Zimbabwe) as saying, "Let's shoot every damn cow and any bloody rancher that stands in the way" because he could see no point of being in the army, and defending his nation, when ranchers were raping it behind him. "My feelings are very, very deep as an environmentalist and I don't particularly like cattle, but I ended running them on my own ranches, which used to be just elephants and lions and buffalo." He did change his mind and has said many times, "The number one public enemy is the cow. But the number one tool that can save mankind is the cow. We need every cow we can get back out on the range. It is almost criminal to have them in feedlots which are inhumane, antisocial, and environmentally and economically unsound."

Constantly searching for new ideas that worked, he thought all that had to be done was to get ecologists into parliament to produce change. "Well, I couldn't produce a scrap of change even when I was president of a political party."

He discovered remorseless spread of deserts and the human impoverishment that always resulted was related to management, but more fundamentally to the way people were making management decisions, whether or not those people lived or worked on the land. "Though our fate as a civilization is tied to the land and its health, and though millions of ordinary people in making their living from the land control that fate to a large degree, unless these people have the support of the hundreds of millions of others who depend on their efforts, they cannot succeed."

He read voraciously. He admires Thomas Samuel Kuhn, who wrote "The Structure of Scientific Revolutions." In it Kuhn talks about science advancing through shifting paradigms. "What he discovered of our scientists, and I know its true of me, is that we have these effects that flow from our deep beliefs and our training. The information which fits our beliefs we see very quickly and easily. The data which does not fit our beliefs is almost invisible to us. We just cannot see it."

It's a deeply held belief that removing cattle from the public lands will heal it. No proof is necessary because it fits the paradigm. It is a deeply held belief that trampling by cattle is destructive to plants and soils; cattle have been blamed for destruction of water points and rivers for thousands of years—because it fits the paradigm.

"General Jan Christiaan Smuts, a botanist by love, a lawyer by training, a soldier and statesman by force of circumstance, a brilliant man, fought through the Boer War and two world wars. Although not an Englishman, he served in the British cabinet. When he was out of office as prime minister of South Africa, he wrote a book called 'Holism and Evolution.' He studied the development of the human personality. It was an obsession and he studied how it developed from solid matter through life, mind, to human personality. He pointed out that in this entire development from solid matter there were no parts. He warned us that we would never understand the world until we studied wholes. The concept of a part is totally alien to the world. "Now when you think of it that was staring us in the face." Eroding soil is the biggest single export from the U.S., billions of tons outweighing all grain, timber, military hardware, and commercial products—even with the greatest know-how in the world. Where there used to be soil cover there is none and all soil cover comes from life. Once there are exposed soils there is erosion, non-effective water cycles, mud slides off California, ever increasing floods in Texas and along the Mississippi. "These floods and this flood damage will just get worse and worse and worse and the deserts will just keep advancing, advancing, advancing until somebody, someday finally understands what I'm saying."

Savory is handsome, serious, jaunty, often sporting khakis, a tweed cap and an impish smile. He can charm easily, but his barbed tongue is just as likely to devastate. He's been called "an abrasive personality," "brilliantly original," "an offshoot of the loony left." He is truly unique. But his tone does not denote his real personality, which is gentle, intellectual and kind. But after more than four decades of research and work, his deep frustrations show because he sees history repeating itself, again, and again.

Savory says he hates cows and yet he admits to damaging an African wildlife preserve irreparably because he insisted on removing domestic livestock.

"We used to burn people at the stake for coming up with truly original work and, tragically, one way or another throughout my life, I've tended to think ahead and come up with stuff that to me seems common sense but to other people seems way out and threatening." When his book, "Holistic Resource Management," was first published, he couldn't even get it reviewed. But it's been selling slowly and consistently and now 17 universities are using the textbook.

Savory's first job in the U.S. was to convince government and academia that desertification was not due to overgrazing or overstocking, as was commonly thought, but due to bad decision-making. "That was a red rag to the bull, to all academics, to all universities." His thought processes were contrary to the deeply held beliefs of ranchers, academics, scientists. "It's the opposite of what people believed so I was roundly condemned." The dean of agriculture at Montana State University once told Savory. "We have no argument with you. We've got to heed the new way, holistic thinking and what you're saying, but our problem is what do we teach? All the textbooks are written the old way."

During a big conference in Rhodesia years ago, someone asked Savory, "Why is there such an intense, almost violent opposition to your thinking? Is it vested interest?" Savory had no answer but someone else said, "Allan, you are up against the biggest vested interest in the world—professional people's egos."

For years there have been anti-desertification conferences around the world, some sponsored by the United Nations. "The developed countries are spending billions to cut the effects of greenhouse gasses," said the Executive Secretary to the UN at the biggest environmental meeting ever held in Africa. "We must show them that desertification is a global environmental problem and if they don't do something they'll feel the consequences themselves...." He also said, desertification" arises from placing too much pressure on the land, often because of overgrazing."

Savory has heard all this before. "That's just like the Royal Navy," he says with a sigh. "Captain James Lancaster sold four ships to India in 1601. He gave the crew on one ship limes and they got no scurvy. The other three ships got no limes and 50 percent of the crew died. That was pretty convincing evidence but because the Royal Navy is a bureaucracy, led by brilliant officers, they discussed and argued about that for approximately 150 years at which point James Lind, a surgeon in the Navy repeated it, and got patients to recover. Then the Royal Navy argued another 49 years before they accepted it." It took the Merchant Marine 70 more years to follow suit.

Nothing has changed. "You are dealing with humans and bureaucracies. Every environmental organization is a bureaucracy. Every university is a bureaucracy. Every one of these international agencies is a bureaucracy. We've gone for nearly 50 years already since we knew that overgrazing was not due to too many animals, since that was first known to science, and we've probably got another 100 years to go before they will accept new scientific thinking."

Savory likes the saying: The whole is greater than the sum of its parts, "but," he says, "when you put brilliant individuals in a bureaucracy it's one of the few exceptions where the whole is less than the sum of the parts."

There is some light. Hundreds of ranchers are working with the Center for Holistic Management (recently renamed the Allan Savory Center for Holistic Management in honor of the man behind the cause). Unfortunately, people in power are still not listening.

This is the age of specialists and one problem is scientists who study a single topic all have very dogmatic opinions. "All of them are probably right, from their point of view, but none of them are seeing the whole. Now when you see the whole, you might get a totally different opinion, but the universities haven't trained scientists to look at the whole. With our scientific ways, if we had a Ph.D. in hydrogen and a Ph.D. in oxygen, we could bring them together to manage water but how much would they know about water? Nothing. They wouldn't even know it existed. It's only now that a theory of chaos is coming in to being—people are beginning to take the word 'holistic' seriously."

Savory asks if I like watching the sun rise. When assured that I do he says, "Well it doesn't rise and it doesn't set, it stays absolutely still and we've known that for 300 years but you've not been able to change. Now that shift in paradigm from a mechanical linear mechanistic world of today's science, to a mind-boggling complex holistic world that only functions in wholes and patterns and energy—for that shift to take place is going to be an even bigger shift than the sun staying still. And we've got to make that shift if we're going to survive as a species."

His teachings are, indeed, a major shift. "Holistic management is a unique, goal-drivien, decision-making process that integrates human values with economic and environmental concerns, resulting in management that is proactive and sound—socially, ecologically and economically. Practitioners have learned how to restore the land profitably through practices that mimic nature. Many others have merely sought a more rewarding personal or family life. It has worked in communities—with a common vision that reflects what the people there value and hope to accomplish."

Savory has worked for governments on several continents, including the World Bank in North Yemen. "They believe, as everybody does, that deserts have too much livestock and too many nomads abusing them. I showed them evidence that desertification was human, man-made through *inadequate* use. The man who headed the team, Wade Gregory, was intrigued because it made sense to him. Rain fell while we were there, an inch of rain, and I was able to take a picture of the flood and the next day was able to take a picture of bone dry ground. Not a meter of that rain was effective and I explained how it was due to rest and not due to overgrazing and there's a consequence of that."

Because they couldn't understand his report, they asked if he would show them examples so he chartered three planes and flew a dozen people around some projects he was doing in the U.S. "I showed them good and bad. Ones that were going well. We went to a Texas ranch in the middle of a drought. We had doubled the livestock, increased by another 209 pairs, cut the supplementary feed in half. It was the only ranch to do it in the whole of Texas that I'm aware of and I showed them grass right up to the water points. They looked at it all and it absolutely blew up in my face. They wrote letters denouncing me and sent them all over the place."

A Frenchman who was there told him years later, "Allan, how naive you were. We had just spent $20 billion on anti-desertification work around the world. That group you brought together were our specialists and you took us in the middle of a drought and showed us that! You showed them how clever you were and how stupid they were. Do you expect us to applaud you?"

There have been so many similar ego-deflating success stories that the Center now, as a matter of policy, refuses to do any demonstrations. "We just won't do them because they are counterproductive. The more successful the demonstration, the anger and hatred became worse. And it's heart-breaking if you're trying to move humans into a more constructive course. Humans find it very hard to accept new thinking."

Holistic management decision-making, among other things, has helped increase beef production; in four years grass types jumped from six to 23 on a single range in northeastern New Mexico markedly improving biodiversity; riparian areas have improved along with the watersheds; and ground cover has increased. In Namibia, Savory was given some of the worst farms available, "so I couldn't wreck it. They were very frank about it. They said it was beyond reclamation." He took 4,000 acres and pushed his ideas to the breaking point. He tried to make it fail. "And in 5 years, we couldn't. It just got better and better, and we were producing five times as much meat per acre from what was bare ground where I would have given you $100 if you could find a single perennial grass plant. We produced solid perennial grassland with no reseeding, no capital, no anything, just changing the animal behavior and planning the grazing."

When he was exiled, he couldn't return to the test farm for four years and it collapsed. No animals left. Back to bare ground. "That was a very big lesson to me and the mistake was mine. All the years we ran it I flew in frequently and told the managers what to do. Guided them...thought I was teaching them, but I wasn't.

He admits they had become consultant-dependent. They didn't understand why they were doing things. "They said the collapse was due to drought. I told them drought didn't overgraze plants. What did you do when I left? They said, 'Breathed a sigh of relief.' I asked Why? And they said, 'Well, we didn't have to do all that paperwork and planning.' What else? 'We just kept on with the short duration grazing rotation and moved the cattle every one to two days, watching the grass and the cattle.' Well that's enough to wreck anything. You can't do that."

If you've read Savory's books, if you've listened to every talk he's ever given in the U.S., he's always insisted, "Don't do that." But his teaching is complex, and, once again, it's new. And, he says for the zillionth time, "Holistic management is not a grazing system; it's a decision-making process. I have tried to show ranchers it was about decision-making on whether to build fence, how to graze the animals, should you do management intensive grazing, should you do planned grazing? There are a lot of decisions that have to be made. They just couldn't get it. They liked management intensive grazing and did that. Fine. Someday you'll come unstuck. And if you are in a non-brittle environment it will be very forgiving, you'll get away with it probably for your life. You can rotate stock for years and years and not see a problem, but if you're in a brittle environment you'll come unstuck rather quickly." He adds, "We spend too much time on grazing and fencing. We've got to start thinking in different terms. Something beyond production. It has to be about caring.

Savory is asked about collaboration and Coordinated Resource Management Plans. "It's nice to get together but the land isn't deteriorating because we weren't collaborating. And you can't manage holistically without collaborating so it is a first step, but planting willows and doing those things is fiddling while Rome burns. The land was deteriorating because of conventional decision-making. Even after they plant willows, please believe me that the land will continue to deteriorate until they've removed the cause of the deterioration."

He insists that cattle are not the cause. "I am an environmentalist and I'm trained conventionally as a scientist so I grew up hating cows, believing all the conventional myths. But then, from my own work and the work of others, I found that we were wrong. So I changed. Now, until more people change, the land will keep deteriorating. They will publish photographs of improved riparian areas, claim successes, get awards, but let time pass and you will find that I am right."

In major cities in the West, Las Vegas, Nev., and Albuquerque, N.M., and many others, flood control has cost millions of dollars even though there's hardly any rainfall. Albuquerque has nine inches of rain annually but its flood control ditches are enormous. Children have drowned in them. "The reason for the floods around here is because of rest, because the land isn't used. If the land wasn't deteriorating nobody would be getting violent, and the ranchers are causing that deterioration because they insist on continuing to over-rest the land."

He went back to basics. He asked himself what did the forefathers of modern science try to do? They were trying to understand the world. Nature. He was trying to get people to think holistically and it caused anger, especially with government and university people. He separated scientific specialties in terms of color. When red and blue and yellow and green were mixed together they became gray. What did any scientist know of gray? The answer was nothing.

Highly trained scientists tried to manage world desertification. How much did they know about the whole? Nothing.

He figured it was an organizational problem. They didn't even understand each other's jargon. Scientists pulled together, each with their own strength. They formed collaborating terms, all focusing on the natural world. When he wanted to know how much scientists knew about gray, the whole, the answer was nothing. It was a revelation. Integrated resource management started to cross train different disciplines. Highly trained scientists tried to manage world desertification. How much did they know about the whole? Nothing.

"What did we do? We reversed the process. We started from the point of view of gray, that's the whole, your whole resource space, your company, your business. We formed a holistic goal meeting your deepest values to the land, to your resource, to your life. We looked at the experts' opinions, read papers, scientific journals, went back to old knowledge, went to new knowledge, asked the right questions and tested that knowledge to see if it fit the whole. We asked, "Is this the correct way to this? That's what holistic management is about. That's what gave us the breakthrough and it's almost the opposite of all the conventional management in some ways and the beauty of it is that everything good in conventional management is embraced by holistic management. You don't reject anything."

He talks about resting land and non-brittle environments where there's high humidity and high rainfall. "Rest is the most powerful tool known to science to restore biodiversity, so if you rested major fields in England or on the East Coast or West Coast, it would come back to high biodiversity. Now, if you go to the other extreme, the very brittle environments, particularly the low rainfall ones, rest is probably the most destructive tool known to science. Now the Forest Service and The Nature Conservancy and these people are coming in and saying 'Let's leave that to nature' and that, by definition, means resting it, well that's very destructive because it's no longer natural. They don't get it because they don't understand the role of animals in nature."

Rancher George Work attended his first classes in holistic management in 1986 and says now, "After 13 years, I can say it is still the hardest simple thing I have ever tried to do. The lack of success we have had in some areas has not been because holistic management doesn't work; it is because we haven't practiced it properly."

There are many symptoms of biodiversity loss handled as problems. That is wrong. "Noxious plant invasions—if you treat these as a problem you will fail. Leaders in Montana spent over $50 million trying to kill knapweed. They may as well proclaim it the state flower because there are now more than ever. That's because it never as a problem; it's only a symptom of the loss of biodiversity. Texans have spent over $200 million chaining, poisoning, rooting up mesquite, and there's now more than ever. It never was a problem; it is a symptom of the loss of biodiversity. Small insect, animal outbreaks, locusts, etc.; another symptom. Underground water dries up. Another symptom. A beautiful example of this is the southern part of Africa. Three hundred years ago there were millions and millions of springbok and wildebeest and buffalo and giraffe and all the big game of Africa. Nine inch rainfall. Today, you can travel hundreds of miles and see maybe 50 sheep, 10 head of cattle and it's overstocked, all dried up.

"Next is dying villages and towns. People settle with their families in an area with high biodiversity and they are prosperous in farming and ranching. They form towns, villages, businesses, churches, schools. Then biodiversity starts to go. A butterfly has gone. A bird has gone that used to be there. Old ladies in tennis shoes draw attention to it and we deride them; we are worried about jobs and our cattle and farms. As the biodiversity continues to be lost, so we start to lose farmers and ranchers and the people are not sympathetic. 'Joe was stupid, he was greedy, he overstocked.' As the biodiversity loss continues, the population isn't big enough to support the schools and churches. The villages and towns fold up. The people in cities are not sympathetic. It's more workers for the factory. And as the biodiversity loss continues, finally, the cities fall. Throughout history, that has always happened."

Public enemy number one in the West is cattle. They're blamed for the bulk of these ailments, for causing deserts. The environmental movement has been trying for years to get cattle off the public lands. "You can find this in ancient Hebrew texts 2,000 years ago, blaming the nomads and their animals for causing deserts. It's a human belief of a long period. They are putting methane into the air, which is changing global weather patterns now. The public perception is that they are dripping with fat and oozing chemicals. Even people I respect deeply say you only have to control the three C's—carbon, chainsaws, and cattle. Now it's very serious when you are handling the number one public enemy with the greatest problem that humanity faces threatening our very survival and you are condemned by the top ecologists and scientists in the world."

Savory has taken photographs all around the arid West and the results are not detrimental to cattle. What he has found is a horrible and frightening similarity on ranches, on Indian land and on public land. "On one side of the fence we have community property. Nobody loves it, nobody cares for it. There is overstocking, overgrazing, ignorance, greed. Everything that is bad. On the other side of the fence we have the best management that the U.S. can provide. It's the National Park Service. There is no overstocking, there are no cattle, no sheep—haven't been for 50 years. There is no stupidity, no ignorance, no greed, no communal ownership and there is all the know-how of every university in the world. Vast sums of money have been spent on range management and land management. Now after 50 years of totally different treatments—one totally condemned by every ecologist environmentalist and rancher, and the other praised by scientists—unfortunately, you can't tell which is which on a photo of a fenceline between these properties. The results are the same!"

There are hundreds of sites around the West showing similar lack of success with the greatest minds working on the problem. People are in court suing each other over it, lobbyists are fighting each other in the halls of Congress, "and nobody knows what the hell they are talking about. It's time to stop that and start pulling together. It's time to start collaborating and healing and overcoming this terrible worldwide ignorance of this problem. As soon as we can get cattle back on the land where they belong and where we desperately need them, the sooner we can start to heal the land, cultures, societies, villages, etcetera."

The cycles of life are birth, growth, death, and decay, commonly known as a carbon cycle. When biodiversity is lost the cycle is broken. Overgrazing is due to the time of exposure of the plant to the animal and re-exposure of the plant to the animal. When a plant is grazed it is given a few more years of life. "Severe grazing," says Savory, "is absolutely essential to maintain biodiversity."

When scientists stopped the overgrazing of plants by fencing exclosures, the plants all grew, reports were produced, and government regulations and laws were written. Then the scientists went home. "Thank God the plots remained. If you study them today you will find enormous evidence that rest *doesn't* work in brittle environments. There is biodiversity loss, soil erosion. Births have stopped, the carbon cycle stopped, everything is going to hell. We've removed pack hunter and we've removed herding prey and the whole breaks up. It's a disaster."

Using cattle as a tool, Savory has produced solid perennial grassland on what had become bare ground without any reseeding. "We simulated the predator with livestock and the perennial grassland returned. Just put the whole back, and there it was. You'll find the scientific method never discovers anything. Observant, creative people make discoveries. But the scientific method protects us from cranks like me."

The Center has shared tremendous success with abject failures. "We had success for 15 years then total collapse. Something was still missing. What was missing was the concept of Smuts' 'whole'. We weren't looking at the family. We weren't looking at the community. We weren't looking at people. We were looking at economics and land and cattle and wildlife and it wasn't working."

What he found in hindsight was that all humans use a decision-making model. You use a model but do it subconsciously so you're not even aware of it. You want to go to town? You can go on horse, foot, bicycle, car, or you can hitchhike. There's a whole lot of ways you can go. That's decision-making. What'll it cost, how cold is the weather, how far is it, how long will it take, what about prestige? What'll my neighbors think if I arrive on a bike and I'm a cowboy? So you use a decision-making model. All civilizations have used that. And what we've found is that the decision-making model that we use is where our fault lay. It took us a long time. If you use the holistic management model, you have goals—production, preservation, rare and endangered species, reduction of knapweed or mesquite or sagebrush, eradication of diseases, problem solving, soil erosion; you have the resources—energy, minerals, water, etc.; and you have tools—technology, fire and rest. Scientists and enviros use the same three tools. It's trained in every university in the world, they are the only three tools acceptable to main line science, and you use your brain, your money and labor. Then you go through decision-making. Is it profitable? Does the cash flow? How quick is it? What are the research findings? What do my peers think? What are the laws and regulations? What's expert opinion?

Holistic management works with the whole—the people, the family, the community, the water base, the wealth. "We have to form a goal, the values of the family, their culture, language, religion. What forms of production will sustain that family or community? Visualizing the future landscape that will sustain those forms of production becomes the goal against which we make decisions. We add two more tools, animal impact and grazing, without which you cannot reverse desertification. That's why cattle are so vital to our futures now."

Long ago, Savory struck incredible opposition when he came to America. "I was one lonely insignificant little scientist with some new thinking and just got this bombardment of antagonism and resistance and hammering and hatred. And you realize you have got to keep your sense of humor, not take yourself too seriously, have good innings, and only look for recognition in your own eyes because you are not going to get it from the outside. Just do the best you can and don't worry about the rest."

The Allan Savory Center for Holistic Management is a non-profit organization devoted to practicing and disseminating information about concerned use of natural resources. The Center provides training for Holistic Management practioners and educators and includes community learning sites in the U.S., Australia, and Zimbabwe. It conducts research such as the use of livestock and wild grazers as an alternative to biomass burning, and manages farms, ranches, and public lands. The Center provides educational materials including a video, textbook, workbook, planning aids and charts, and fincial planning software. They also publish an informative newsletter, "In Practice." Contact Shannon Horst, Exec. Dir., Allan Savory Center for Holistic Management, 1010 Tijeras NW, Albuquerque, NM 87102. 505-842-5252.
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Tamarisk...Maybe Not Invincible

Lee E. Hughes

Tamarisk (*Tamarix ramosissima* Ledeb.) is one cussed bush. Cussed because it's a heavy water user, not great wildlife habitat, hard to hike through, and an exotic.

Much effort is taking place to find final solutions to its dominance in the Virgin and Colorado River Basins (Arizona, Nevada, and Utah). There are planning efforts to develop basin wide thinning or eradication of tamarisk (Virgin River Basin Tamarisk Work Group Draft Mission Statement). Biological controls are being developed to thin out the tamarisk population (Deloach 1997). Department of the Interior agencies have had some success in eradicating it in small areas, such as springs by using mechanical and chemical methods. The National Park Service((NPS) has put forth a year-to-year effort in some springs and other small water sources to eradicate tamarisk in the Glen Canyon and Lake Mead National Recreation Areas(Nancy Brian, National Park Service, Personal Communication).

Like a lot of efforts, different strategies emerge depending on the individuals and the areas involved. There are the head-on-frontal-attack-of-the-species strategies to the minimalist strategies. Both have their places depending on the money available and time tables of those involved.

In the early 1990s, the Arizona Strip Field Office of the Bureau of Land Management began inventorying its riparian resources. Another and more extensive inventory on the Virgin River took place in Utah, Arizona and Nevada in the mid-1990s. During these efforts monitoring sites were established on the Virgin and Paria Rivers and Kanab Creek, to determine the trends of the various woody species growing on the regeneration zone along these rivers. As

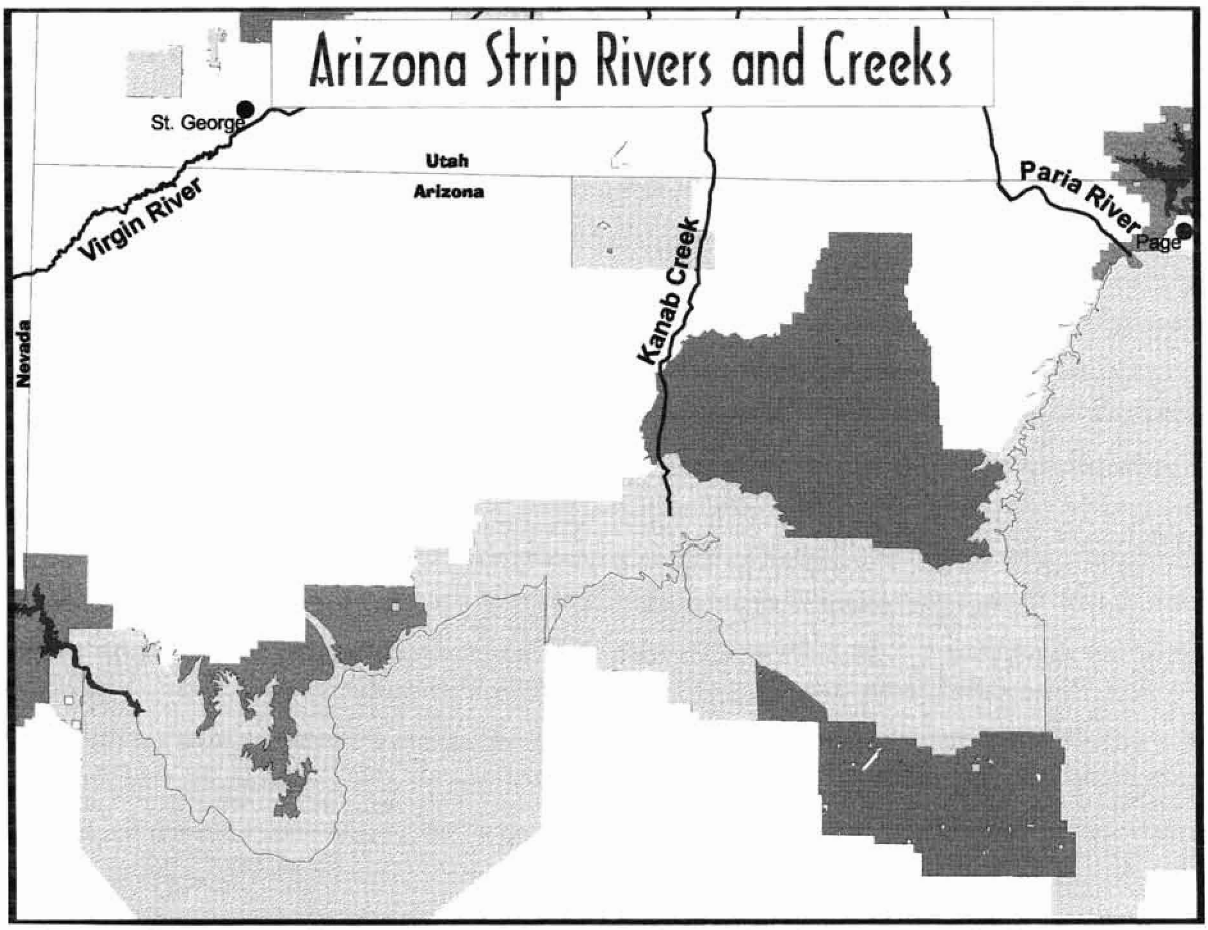

TABLE 1

SIZE STRUCTURE TRANSECTS

Virgin River								
			Segment One					
		1995				**1998**		
SPECIES	**0-3'**	**3-6**	**6-10**	**10+**	**0-3'**	**3-6**	**6-10'**	**10'+**
Willow	**3**	**18**	**7**	**0**	**40**	**47**	**96**	**0**
Tamarisk	**5**	**10**	**5**	**0**	**5**	**20**	**50**	**1**
Seep Willow	**0**	**2**	**0**	**0**	**4**	**0**	**0**	**0**
			Segment Seven					
Willow	**15**	**48**	**39**	**0**	**139**	**196**	**279**	**0**
Tamarisk	**7**	**6**	**9**	**0**	**19**	**45**	**51**	**0**
Seep Willow	**0**	**7**	**1**	**0**	**10**	**4**	**11**	**0**
			Segment Nine					
Willow	**7**	**36**	**15**	**0**	**10**	**9**	**14**	**0**
Tamarisk	**23**	**24**	**18**	**0**	**3**	**2**	**15**	**0**
Seep Willow	**6**	**8**	**0**	**0**	**0**	**1**	**1**	**0**
Arrowweed	**3**	**9**	**0**	**0**	**19**	**103**	**0**	**0**
Kanab Creek Segment 3								
			1995				**1997**	
Willow	**7**	**9**	**16**	**14**	**13**	**60**	**202**	**9**
Gooding Willow	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**
Tamarisk	**2**	**2**	**1**	**9**	**0**	**1**	**0**	**0**
Seepwillow	**1**	**6**	**2**	**0**	**2**	**4**	**0**	**0**
Paria River								
			1994				**1998**	
Arrowweed	**89**	**0**	**0**	**0**	**51**	**1**	**0**	**0**
Rabbitbrush	**7**	**0**	**0**	**0**	**28**	**3**	**0**	**0**
Cottonwood	**2**	**0**	**1**	**1**	**5**	**2**	**0**	**4**
Russian Olive	**4**	**3**	**4**	**3**	**5**	**3**	**13**	**5**
Seep Willow	**62**	**0**	**0**	**0**	**0**	**1**	**10**	**0**
Tamarisk	**0**	**1**	**0**	**0**	**0**	**2**	**0**	**0**
Willow	**0**	**0**	**0**	**0**	**0**	**14**	**0**	**0**

reported by Hughes, the exotic, tamarisk, was a major species on two of these drainages. The mid-1990's inventory showed the same results.

The Vegetation Monitoring Methods

The regeneration zone is that belt of young woody vegetation parallel to both river banks. The quantity and height class of each woody species was measured in three by six foot plots. A three hundred foot transect was designated in the regeneration zone. Plots were located at 10 foot intervals and each woody species was counted and placed in a height class. Height classes were 0–3 feet, 3–6 feet, 6–10 feet, and 10+feet. Usually one transect was placed on each side of the creek or river at the monitoring site). This was the Greenline Method as described in Cagney.

Typical weight based data were obtained from segment five of Kanab Creek. The 9.6 square foot circular plot was placed along a line ten times. At each plot vegetation was clipped and weighed. This data had three readings at different years (Interagency Technical Reference).

The monitoring was done on the Arizona segments on the above sites. Monitoring as described above began in 1991. Some monitoring sites have been read twice and others three times.

Trend of the Regeneration Zones (See Figures 1-3)

Virgin River

Segment one, which is in the Gorge of the Virgin River in Arizona, showed an increase in willow from 1995 to 1998. Tamarisk also showed an increase of equal robustness. The cattle management of this segment permits grazing from January to May. Each pasture receives winter rest and spring rest every other year. Grazing does occur every other year in the spring when the willows are greening up. However, spring rest and light (20–40%) to moderate(41–60%) utilization levels on forage species during spring use years allows willows to be as aggressive as tamarisk and other woody shrubs.

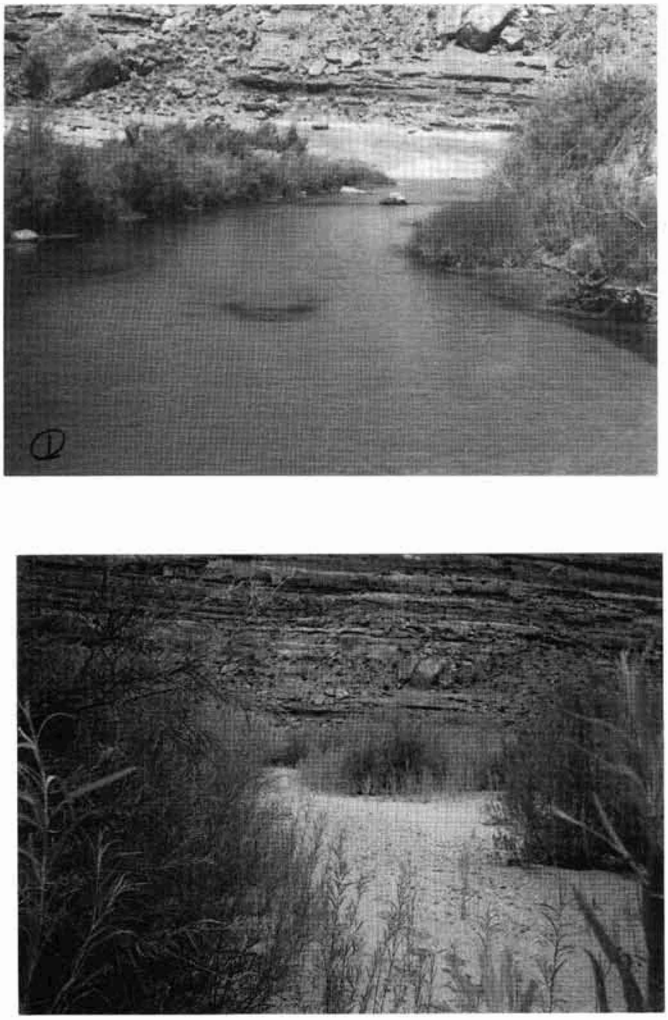

Fig. 1. *Segment 1 transect area on the Virgin River. The top picture is from 1991 and the bottom picture is from 1998. Willow is a strong presence.*

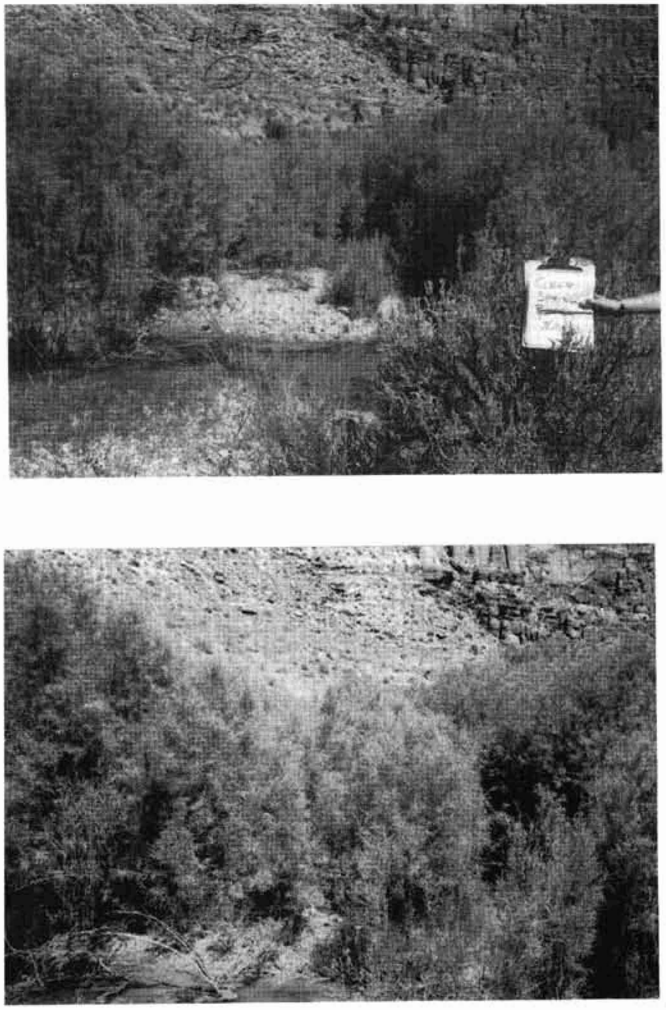

Fig. 2. *Segment 3 on Kanab Creek transect area. Willows are on the increase. Top photo is from 1993 and bottom photo is from 1997.*

Segment seven of the Virgin River had a significant increase in the willow population over a two year period from 1996 to 1998. This segment is affected by a Category 1 habitat designation for desert tortoise, a threatened species. Cattle can graze the allotment in the winter; no livestock use had occurred in this segment from 1995 to 1998.

Segment nine is affected by Category 2 desert tortoise habitat designation (tortoise habitat and population are to be main-

TABLE 2

Kanab Creek
Weight Data
Segment Five

	1991	1993	1997
Tamarisk	9%	13%	10%
Rabbitbrush	0	5	1
Willow	11	28	40
Seep willow	31	6	10
Russian Olive	0	11	1
Salt Grass	38	34	12
Sedge	8	Tr	6
Other	3	3	20

Structure trend is not shown as there is only one reading and that was in 1997.

Fig. 3. ***Virgin River between Springdale and Rockville in Utah. Top photo from 1936 and bottom photo from 1996. Show narrowing of the river.***

tained in stability) which, up to now has allowed for livestock use. Cattle grazing had occurred every winter and spring, but changed in 1999, when spring grazing ends. The trend of the willows and the tamarisk was down and the arrowweed increased almost ten fold from 1995 to 1998. The location of the regeneration zone transect is now an upland site, as the river has moved 100+ feet southward away from the transected zone, which is of higher elevation than the river. The transect was relocated in 1998 after the final trend reading.

Kanab Creek

Segment three of Kanab Creek showed a notable increase in the willow population in the regeneration zone. Little else exists in the zone. Willows in segment five of Kanab Creek showed a steady increase, the tamarisk had a static level, russian olive and seep willow went down in numbers, while rabbitrush maintained its presence. Thirty six head of cattle graze in the canyon from October through May each year.

Paria River

The trend transect in the lower segment of the Paria River showed small changes. Arrowweed and seep willow showed decreases, while cottonwood, russian olive, and willow showed increases. Tamarisk remained static. A week prior to monitoring the Paria site, a severe, high flood occurred, so the regeneration zones were mud caked at monitoring time. Normally, cattle grazing in the lower Paria occurs in the winter and spring with one year out of three as a rest-from-grazing year. However, no livestock grazing occurred in 1997 and 1998.

Conclusion

Tamarisk is an aggressive species but near the water zone in a riparian area several native species like willow, seep willow, and cottonwood can compete and increase their presence. Granted, observations of uplands above riparian zones show tamarisk can out compete plants (such as willow) when water is more distant. In the case of segment nine of the Virgin River the arrowweed, a native, increased in the drier floodplain rather than the tamarisk and willow, which were left high and dry by the river's relocation.

On the Arizona Strip when livestock are restricted to winter use and kept out of riparian areas during the growing seasons on a systematic basis, willows and other palatable woody species can grow and increase to their potential.

Supporting Literature

Cagney, Jim. 1993. Greenline Riparian-Wetland Monitoring Riparian Area Management TR 1737-8 1993. USDI-Bureau of Land Management, Denver, Colo.

DeLoach, C.J. 1997. Saltcedar and Biological Controls. The Arizona Riparian Council Newsletter 10(1):pp. 1&3.

Hughes, Lee E. 1993. Tamarisk-The Devil's Own. Rangelands 15(4):151–155.

Interagency Technical Reference, 1996. Sampling Vegetation Attributes. BLM/RS/St-96/002+1730:pg 102–108.

Virgin River Basin Tamarisk Work Group Mission Statement. 1997.

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Antelope Bitterbrush Seedling Transplant Survival

Charlie D. Clements and James A. Young

Antelope bitterbrush is one of the most studied western range shrubs. The browse of this species is a highly preferred and highly nutritional forage for native ungulates and domestic livestock. Antelope bitterbrush occurs from British Columbia to Montana, and south to New Mexico, and California. Using records from the U. S. Forest Service, August Hormay estimated that antelope bitterbrush occurred on over 340 million acres of rangeland in 11 states. It is found on 7.5 million acres in California alone.

Arthur W. Sampson, one of the fathers of range management, reported in 1924 that antelope bitterbrush is a strong feed that produced a solid fat on lambs. This is the first report describing antelope bitterbrush as an important browse species, and as an important shrub on winter ranges for mule deer, elk and antelope. In the late 1930s and early 1940s studies of key browse species began as it was recognized that browse species contributed to the forage base of rangelands, and were essential in the diet of mule deer. Joseph Dixon studied the food habits of California deer in different regions of the state and reported that antelope bitterbrush was very important to mule deer in northeastern California; thus the management of antelope bitterbrush was deemed critical for mule deer habitat.

This site was recruiting 0.7 bitterbrush seedlings per acre per year, but to maintain this population a recruitment of 6.7 plants per acre per year was needed.

Many antelope bitterbrush ranges have been in decline because of inadequate seedling recruitment. For example, Adams (1975) reported that at a site in southern Oregon there was an average of 473 antelope bitterbrush plants per acre. This site was recruiting 0.7 bitterbrush seedlings per acre per year, but to maintain this population a recruitment of 6.7 plants per acre per year was needed. The concern over the lack of antelope bitterbrush seedling recruitment into the natural population has been an ongoing and growing concern ever since the recognition of the shrub as a *key* browse species.

Once it was realized that antelope bitterbrush stands were declining in vigor and density, a number of treatments were devised to enhance the communities. These treatments have included direct seeding, fertilization to increase seed production, and pruning of existing plants to increase vigor. Direct seedings of antelope bitterbrush has always been a high risk undertaking. **Failure to establish stands has been attributed to poor seed quality, predation of seeds and seedlings, and competition for moisture from weeds such as cheatgrass.** The problems associated with direct seeding were so chancy that it led to the transplanting of nursery grown seedlings onto rangelands. This practice grew in popularity, especially in California, because of a large pool of labor available from prison inmate crews assigned to conservation activities.

The California Department of Fish and Game (CF&G) became very active in the collection of antelope bitterbrush seeds, nursery rearing of antelope bitterbrush seedlings, and transplanting of the seedlings to critical mule deer habitat. They were not satisfied with their seedling establishment success rate and asked our research project back in the fall of 1996 to investigate factors that contributed to successful antelope bitterbrush seedling establishment.

Field studies were located on the historic Evans Ranch located in Long Valley, Sierra County, California, about 20 miles north of Reno, Nevada. The ranch was purchased by the California Department of Fish and Game through mountain lion initiative funds. The purpose was to enhance critical habitat for wintering mule deer and inturn enhance the prey base for mountain lions. Before wildfires swept through the area in 1984 and 1985, mountain big sagebrush and antelope bitterbrush were the dominant plant species. The wildfires released herbaceous species such as Sandbergs bluegrass, western needlegrass and mules ear. Cheatgrass also invaded the area increasing the chance of wildfires and further loss of sagebrush/antelope bitterbrush communities. Because of past unsuccessful attempts at restoring antelope bitterbrush through direct seeding, the CF&G, in cooperation with The Mule Deer Foundation, transplanted 79,000 antelope bitterbrush seedlings between 1993 and 1995. To increase establishment success, antelope bitterbrush seedlings were protected by placing a sleeve-like fine netting over the seedlings to reduce browsing by mule deer and black-tailed jackrabbits. Domestic livestock had been removed following the purchase of the land. Less than 1% seedling success was reported.

Antelope bitterbrush (*Purshia tridentata*)
Mule deer (*Odocoileus hemionus*)
Elk (*Cervus elaphus*)
Antelope (*Antilocapra americana*)
Cheatgrass (*Bromus tectorum*)
Mountain lion (*Felis concolor*)
Big sagebrush (*Artemisia tridentata*)
Sandbergs bluegrass (*Poa secunda* ssp.sanbergii)
Western needlegrass (*Hesperostipa comata* ssp. comata)
Mules ear (*Wyethia helenioides*)
Black-tailed jackrabbit (*Lepus californica*)
Ponderosa pine (*Pinus ponderosa*)

The CF&G supplied us at the Exotic and Invasive Weeds Unit, Agricultural Research Service, USDA, with 600 of their nursery grown, bare root seedlings. These seedlings were 2-0 stock (two year old seedlings) grown in sterilized beds from seed collected in the general area where the transplanting was to occur. The seedlings were root pruned at 12 inches for lifting from the nursery beds. As soon as the antelope bitterbrush seedlings were examined limited chances for successful establishment of seedlings was suspected. The seedlings had made excellent top growth with shoots 14-20 inches long. Unfortunately, there were virtually no fine roots above where the tap root was cut for lifting.

Treatments were repeated inside and outside an existing big game exclosure, totalling 600 antelope bitterbrush seedlings transplanted. Treatments: 1) control, 2) tillage (roto-tilled with tractor mounted roto-tiller), 3) application of 0.25 lb/ac of the herbicide sethoxydim for selective grass control, and 4) inoculating the transplants with one cup of soil dug from the fine roots of established antelope bitterbrush plants growing in un-burned islands adjacent to the site.

When transplanting of antelope bitterbrush seedlings was first tried, it was popular to use container grown stock. Everett found through experimentation, that two-year-old stock started in the fall, held over summer in shade-houses, and transplanted very early the next spring and grown in containers of at least one quart in volume gave excellent results. These are rather expensive seedlings because of the care required and the cost of transporting the containers. Antelope bitterbrush was then grown by forest nurseries as bare root seedlings as a less expensive alternative. It is unknown if the 600 seedlings we received were a representative sample of the 79,000 planted by CF&G.

Antelope bitterbrush seedlings were transplanted in mid April of 1996. The experimental site was located at 5,500 feet elevation on a broad northeasterly facing slope at a site that had burned 11 years before. The soils are a well drained stony sandy loam. A randomized design with four replications was used, except for the control blocks in which there were three replications, with 20 seedlings in each block. The seedlings were transplanted on three foot centers. Treatments were repeated inside and outside an existing big game exclosure, totalling 600 antelope bitterbrush seedlings transplanted. Treatments: 1) control, 2) tillage (roto-tilled with tractor mounted roto-tiller), 3) application of 0.25 lb/ac of the herbicide sethoxydim for selective grass control, and 4) inoculating the transplants with one cup of soil dug from the fine roots of established antelope bitterbrush plants growing in un-burned islands adjacent to the site. When we received the seedlings there was no evidence of root nodules. This is important because antelope bitterbrush plants are known to fix nitrogen through a symbiotic relation with a microorganism in root nodules. Transferring soil from an established antelope bitterbrush shrub is a method to inoculate the seedlings with *Frankia*, the microorganism that forms nodules on the roots of antelope bitterbrush plants. The numbers of surviving seedlings were recorded monthly for the next 2 years.

Results

After two years, there were significant differences in antelope bitterbrush seedling survival among treatments (Table 1). Those seedlings protected by the big game exclosure yielded better survival than those unprotected. Outside the big game exclosure no antelope bitterbrush seedlings in the control plots survived, compared to 6% survival inside the exclosure. Inoculating, tilling and herbicide spraying all increased seedling survival significantly. Mortality of transplanted antelope bitterbrush seedlings occurred largely within the first six months.

The two year old nursery reared antelope bitterbrush seedlings cost about $1.10 each. The lower the success the more each surviving seedling ends up costing. Our initial transplant of 600 seedlings cost $1.10 each, labor not included. **After two years, the surviving antelope bitterbrush seedlings averaged $8.15 each.** If a resource managers goal was to establish 200 antelope bitterbrush seedlings per acre, at an estimated 25% success rate, the high end of success we experienced, this would cost more than $1,000/acre, labor included. The traditional method of using conservation crews, volunteers, and simply planting the seedlings in the ground, could cost as much as $7,000 at an estimated 5% success. With many acres of bitterbrush communities in need of recruitment, the present methods of transplanting seedlings are too expensive.

The results we experienced suggest that competition with other plants, and browsing by deer and jackrabbits are inhibiting the success of transplanted antelope bitterbrush seedlings. We did not measure for soil microorganisms, but our method of inoculating the seedlings suggests that the lack of the soil microorganisms (*Frankia*) may also be an inhibiting factor. Our transplanting efforts took place during a wet snow storm. Both 1996 and 1997 were above average for precipitation, 18.9 inches in 1996, and 20.4 inches in 1997. The average is 14-16 inches. The quality of the bare root antelope bitterbrush seedlings when they arrive from the nursery is the crucial unknown factor in applying the results of this study. If our 600 seedling sample reflects the typical seedlings produced, successful establishment will always be limited.

Transplanting antelope bitterbrush seedlings in ponderosa pine woodlands has been more successful, but wildlife managers are more concerned with the lower sagebrush/antelope bitterbrush communities. These are the essential antelope bitterbrush communities for mule deer that are available for use during severe winters.

Table 1. Two year survival of antelope bitterbrush seedlings transplanted into control, tilled, selective herbicide treated, or soil inoculated treatments in or outside a mule deer exclosure.[1]

Treatment	Surviving seedlings: Inside exclosure	Surviving seedlings: Outside exclosure
	%	
Control	6c	0c
Tillage	25a	15b
Herbicide	25a	8ab
Inoculation	27a	15b

[1]Means followed by the same letter are not significantly different at the 0.05 level of probability as determined by Duncan's Multiple Range Test.

Further research into the condition of the root system and/or nursery practices may reveal useful information into this subject matter. Also, the question arises as to the benefits, if at all, that may occur from transplanting or direct seeding of antelope bitterbrush immediately following wildfires, before the competition with exotic weeds increases. We are not advocating that transplanting antelope bitterbrush seedlings not be considered by resource managers in their management decisions, but rather that this approach be carefully thought out. Perhaps more intense labor efforts, such as applying weed control or inoculation practices would yield more favorable results and therefore be more cost effective over time.

Suggested Reading

Adams, A. W. 1975. A brief history of juniper and shrub populations in southern Oregon. Oregon State Wildl. Comm. Wildl. Res. Rep. 6. Corvallis, Oregon. 33p.

Anon. 1937. Range Plant Handbook, USDA, Forest Service, GPO Washington, D.C.

Dixon, J. S. 1934. A study of the life history and food habits of mule deer in California. Calif. Fish and Game 20:315-354.

Everett, R. L. 1980. Use of containerized shrubs for revegetating arid road cuts. Reclamation Review 3:33–44.

Hormay, A. L. 1943. Bitterbrush in California. Res. Note 34, USDA, Forest Service, Berkeley, California.

Nord, E. C. 1965. Autecology of bitterbrush in California. Ecol. Monogr. 35:307-334.

Sampson, A. W. 1924. Native American Forage Plants. John Wiley and Sons, Inc. New York, N.Y.

Webster, S. R., C. T. Youngberg, and A. G. Wollum II. 1967. Fixation of nitrogen by bitterbrush (*Purshia tridentata* [Pursh] D.C.) Nature 216:392–393.

Young, V. A. and G. F. Payne. 1948. Utilization of "key" browse species in relation to proper grazing practices in cut-over white pine lands in northern Idaho. J. Forestry 46:35–40.

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Short-Duration Grazing: The Facts in 1999

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Short-duration grazing (also called rapid-rotation, time-controlled, Savory grazing, holistic resource management) was conceived in Zimbabwe by Allan Savory in the 1960's and later introduced into the United States by Goodloe (1969). When Savory came to the United States in the late 1970's, he made further refinements discussed by Savory (1978), Savory and Parsons (1980), Savory (1983), and Savory (1988). During the 1980's short-duration grazing attracted much attention based on the claims it would accelerate range improvement while at the same time accommodating higher stocking rates. On many ranches it was contended that stocking rates could be doubled or even tripled while at the same time improving both range and livestock productivity.

Common conception of Savory grazing typically involves a wagon-wheel arrangement of fences with water and livestock handling facilities located in the center of the grazing area. However, it can be applied without the wagon-wheel design. A key feature is that a single herd of livestock is rotated through no fewer than 8 pastures (paddocks). Typically, the grazing period during active forage growth should be 5 days or less followed by 4 or more weeks of nonuse. It is recommended that livestock be moved more quickly during periods of active forage growth than in dormancy.

According to Savory and Parsons (1980), Savory (1983), and Savory (1988), short-duration or time-controlled grazing can do the following if properly implemented:

1. Improve water infiltration into the soil as a result of hoof action.
2. Increase mineral cycling.
3. Reduce the percentage of ungrazed plants.
4. Improve livestock distribution (more uniform use of range).
5. Increase the period when actively growing forage is available to livestock.
6. Accelerate plant succession.

Savory's ideas generated much controversy among the range science academic community. Later Savory (1983) emphasized that holistic resource management (his grazing management approach) is not the same as short-duration grazing. He expressed doubt that holistic resource management could be validated experimentally because of its flexibility in animal numbers, length of grazing periods, number and arrangement of pastures, and various other management factors. Nevertheless, researchers at 13 locations in North America have attempted to evaluate the validity of Savory's ideas. They have generally been careful to use the term short-duration grazing rather than Savory grazing method or holistic resource management in describing the particular rotation scheme they evaluated. Still, they generally have related their findings to Savory's ideas and theories.

We will summarize present knowledge on short-duration grazing, focusing on a few recent studies that are fairly complete in terms of evaluating soil, vegetation, livestock, and financial responses over time and space. The managerial implications of these studies and their relevance to Savory's ideas will be given particular emphasis. Reviews of various grazing studies from Africa will be included in our discussion.

Research Descriptions

Most of the scientific information available on short-duration grazing is from prairie rangelands in the Great Plains or seeded dryland pastures (Table 1). Considerable information is available on short term impacts (1–4 years) of short-duration grazing on soils, vegetation, and livestock. However, there are only 4 studies in North America that have evaluated longer term vegetation, livestock, and financial outcomes under short-duration grazing (Heitschmidt et al. 1990, Taylor

Table 1. Primary studies evaluating short-duration grazing in North America.

Rangeland Type	Location	Livestock Type Studies	Duration of study (years)	Primary References
Crested wheatgrass	Oregon	Yearling cattle	2	Daugherty et. al 1982
Smooth bronze grass	Nebraska	Yearling cattle	2	Jung et al. 1985
Northern mixed prairie	North Dakota	Cow-Calf	2	Kirby et al. 1986
Crested wheatgrass	Utah	Yearling cattle	3	Olson and Malechek 1988
Chihuahuan desert	New Mexico	Cow-yearling	2	Anderson 1988
Southern mixed prairie	Texas	Yearling Cattle	4	Bryant et al. 1989
Northern mixed prairie	Alberta	Cow-cal	5	Willms et al. 1990
Southern mixed prairie	Texas	Cow-calf	6	Heitschmidt et al. 1990
Shortgrass	New Mexico	Cow-calf	5	White et al. 1991
Southern mixed prairie	Texas	Cattle-Sheep	8	Taylor et al. 1993
Crested wheatgrass	Oregon	Yearling cattle	4	Angell 1997
Shortgrass	Wyoming	Yearling cattle	13	Manley et al. 1997
Tallgrass prairie	Oklahoma	Yearling cattle	6	McCollum et al. 1999

et al. 1993, Manley et al. 1997, McCollum et al. 1999). Generally, we consider these long term studies to be well designed and implemented.

Hoof Action and Soils

The best researched of Savory's claims is that short-duration grazing will increase water infiltration into the soil compared to continuous grazing. Several studies at different locations have been quite consistent in showing that hoof action from having a large number of animals on a small area for short time periods reduced rather than increased infiltration (McCalla et al. 1984, Thurow et al. 1986, Weltz and Wood 1986, Warren et al. 1986, Pluhar et al. 1987). These same studies have also been consistent in showing short-duration grazing increased erosion compared to continuous or season-long grazing. In the Warren et al. (1986) study, simulated short-duration grazing applied at progressively increased stocking rates progressively reduced infiltration and increased erosion compared to an ungrazed control (Table 2).

Table 2. Infiltration rate and sediment production in relation to stocking rate and soil water content at the time of trampling on the Edwards Plateau, Texas.

Stocking Rate	Trampled Dry	Trampled Moist
Infiltration Rate (mm hr^{-1})		
0	166	160
1x	140	133
2x	121	99
3x	117	96
Sediment production (Kg ha^{-1})		
0	976	2,007
1x	2,827	2,875
2x	3,438	4,274
3x	4,788	5,861

Source: Warren et al. 1986.
1x = moderate stocking rate, 2x = twice moderate stocking rate, 3x = triple moderate stocking rate.

In our search of the literature we could find no studies that substantiate Savory's claims on the benefits of hoof action on range soils. One of the most intensive studies of short-duration grazing impacts on range soils was conducted in Alberta, Canada over a 5 year period (Dormaar et al. 1989). In this study, short-duration grazing at twice or triple the recommended rate reduced soil moisture, increased soil bulk density, and reduced fungus biomass compared to an ungrazed exclosure. Hoof action did not significantly increase incorporation of litter into the soil. The hypothesis that controlled animal impact as recommended by Savory would improve soil health was rejected. Another study, conducted at 3 sites in Alberta, showed time controlled (short-duration) grazing reduced soil organic matter and nitrogen but increased phosphorus over ungrazed controls (Willms et al. 1990). It was concluded that using high animal density and stocking rates with time-controlled grazing would result in range deterioration.

Forage Production

Several studies now show that there is little difference in forage production between short-duration and continuous grazing systems if stocking rates are the same (Jung et al. 1985, Pitts and Bryant 1987, Anderson 1988, Thurow et al. 1988, White et al. 1991, Manley et al. 1997). In a 6 year study on blue grama rangeland in south-central New Mexico, total grass production averaged 828 lbs $acre^{-1}$ under continuous grazing compared to 724 lbs $acre^{-1}$ under short-duration grazing. In north-central Texas, Heitschmidt et al. (1990) reported forage production averaged 2,300 lbs $acre^{-1}$ for heavy continuous, 2,500 lbs $acre^{-1}$ for moderate continuous, 2,700 lbs $acre^{-1}$ for Merrill 3 herd/4 pasture, and 2,600 lbs $acre^{-1}$ for short-duration grazing. Only the heavy continuously grazed treatment differed significantly from the others. In the tall grass prairie of Oklahoma, standing crop of forage averaged 16% higher under short-duration compared to continuous grazing (3,200 vs. 2,760 lbs $acre^{-1}$) (Cassels et al. 1995). However, it was later reported that this was not due to greater plant vigor under short-duration grazing but rather higher forage intake by steers under continuous grazing (McCollum et al. 1999). In north-central Texas herbage growth dynamics did not differ between short-duration and continuous grazing (Heitschmidt et al. 1987b) or between 14 versus 42 paddock short-duration grazing (Heitschmidt et al. 1987a).

Plant Succession and Range Condition

Several studies have shown short-duration grazing to be similar to continuous grazing in effects on plant succession and range condition if stocking rates were the same (Pitts and Bryant 1987, White et al. 1991, Manley et al. 1997, Gillen et al. 1998). In a south Texas study, it was found that progressively increasing the stocking rate under short-duration grazing up 2.5 times the rate recommended by Merrill (1954) caused the frequency and composition of mid-grasses to decline but shortgrasses were not affected (Ralphs et al. 1990). Standing crop of all major forage classes declined as stocking rate increased under short-duration grazing. Another study at the same location (Sonora Research Station) showed short-duration grazing did not promote secondary succession from shortgrasses to mid-grasses as effectively as high intensity-low frequency grazing (Taylor et al. 1993).

The most complete study in North America on short-duration grazing in terms of replication in time and space was conducted on shortgrass prairie in southeastern Wyoming (Manley et al. 1997). They compared season-long, deferred rotation and short-duration grazing at 3 stocking rates. Over a 13 year period changes in bare ground and vegetation composition were primarily a function of stocking rate rather than grazing system. There were trends towards more bare ground and less western wheatgrass as stocking rate increased. During this study, deferred rotation, time-controlled (short-duration), and season-long grazing did not differ in their effects on either forage production or plant succession. In a 5 year New Mexico study, blue grama cover was slightly higher but other grasses (primarily mid-grasses) were lower under short-duration compared to continuous grazing (White et al. 1991). It was concluded any differences in short-duration compared to continuous grazing in terms of plant productivity or succession were doubtful. In Alberta, Canada Willms et al. (1990) compared plant succession on time-controlled grazing and protected areas over a 6 year period. They used high stocking rates and high livestock densities. Utilization averaged about 80% of available forage over the study period. In this study time-controlled grazing caused a definite decline in range ecological condition on mixed prairie and rough fescue prairie sites. The hypothesis that time-controlled grazing with high stocking rates and high stock densities will improve rangeland condition was strongly rejected by the authors.

Harvest Efficiency and Livestock Distribution

Research does not support the Savory and Parsons (1980) contention that short-duration grazing will improve forage harvest efficiency (Kirby et al. 1986, Heitschmidt et al. 1987a, 1987b, Hart et al. 1989, Bryant et al. 1989, Walker et al. 1989). In North Dakota, Kirby et al. (1986) found that increased stocking rate and stock densities under short-duration grazing did not improve grazing distribution over season-long grazing. In Wyoming, Hart et al. (1989) found pasture subdivisions of equal sizes under short-duration and continuous grazing had the same utilization patterns. However, a large continuously grazed pasture was less uniformly used than small continuous and short-duration grazed pastures. It was concluded the benefit of short-duration grazing in terms of increasing grazing capacity was entirely from pasture subdivision rather than rotation of livestock.

Livestock Productivity

Findings on how short-duration grazing impacts livestock productivity show some inconsistency. Four studies have shown short-duration grazing has lowered individual livestock productivity compared to continuous or season-long grazing (Parker et al. 1987, Anderson 1988, Heitschmidt et al. 1990, McCollum et al. 1999). Another 5 studies showed no difference between short-duration and continuous grazing (Jung et al. 1985, Pitts and Bryant 1987, Olson and Malechek 1988, Taylor et al. 1993, Manley et al. 1997) while 1 study showed short-duration grazing increased livestock productivity (Daugherty et al. 1982). A careful analysis of these 10 studies indicates small or no difference in livestock productivity between short-duration and continuous grazing if stocking rates are equal with one exception. McCollum et al. (1999) found live weight gains of yearling cattle were 11 to 20% lower under short-duration than season long grazing when averaged across six levels of stocking. This was caused by lower forage intake of cattle under short-duration grazing (McCollum and Gillen 1998).

Forage and diet quality under short-duration and continuous/season-long grazing have generally shown little difference if stocking rates were comparable (Jung et al. 1985, Anderson 1988,Olson and Malechek 1988, Heitschmidt et al. 1987b). One exception is Hirschfield et al. (1996) who found both cattle diet crude protein content and forage intake to be increased by short-duration grazing on mixed prairie rangeland in North Dakota. They attributed this to more growth opportunity through periodic rest under short-duration grazing. In contrast, McCollum and Gillen (1998) found diet quality and forage intake of steers were lower under short-duration than continuous grazing on tall grass prairie in Oklahoma.

Financial Returns

Limited research indicates that short-duration grazing has no financial advantage over continuous/season long grazing (Table 3). Lower individual animal productivity under short-duration grazing is the primary explanation why it gave inferior net returns compared to season-long grazing in south-central Oklahoma (McCollum et al. 1999).

Holechek (1992) discussed potential financial returns from a medium sized (250 animal unit) cow-calf operation under short-duration grazing in the Chihuahuan Desert of New Mexico. He modeled a best case scenario that assumed stocking rate could be increased 50% over recommended rates with no adverse impact on forage production, no decline in cattle productivity, no increase in fixed costs, and no interest rate cost would be incurred for capital investment. He used average cattle price and ranching costs for the 1986–1991 period. Total cost for the short-duration grazing program was $190,400. He found best case return on investment from short-duration grazing was 8.1%, which was nearly the same as 30 year U.S. treasury bonds and below the historic return of the U.S. stock market (10%). Extended drought and lower cattle prices have occurred in the Chihuahuan Desert since 1992. The hypothetical short-duration operation Holechek (1992) discussed could easily have lost $48,000 or 25% of its investment due to forced cattle liquidation at prices well below those in the 1986–1991 period. Further reductions in returns from the above short-duration grazing scenario are probable. Parker et al. (1987), in south-central New Mexico, found short-duration grazing at a stocking rate 25% above that for

Table 3. Financial returns from studies comparing short-duration and continuous grazing systems.

Study	Location	Type of Livestock	Net Returns: Short-Duration grazing	Net Returns: Continuous grazing
			($/acre)	
Heitschmidt et al. 1990	North-central Texas	Cow-calf	6.36	5.25
Taylor et al. 1993	South-central Texas	Cattle-sheep	7.39	7.20
Manley et al. 1997	South-eastern Wyoming	Yearling cattle	12.07	15.20
McCollum et al. 1999	North-central Oklahoma	Yearling cattle	2.83	8.50
Average across studies			7.16	9.04

moderate continuous grazing lowered calf crops about 14% compared to moderate continuous grazing. Calf weaning weights were also depressed under short-duration grazing.

Studies from Africa

Two comprehensive reviews are available that consider African experiences with short-duration grazing (Skovlin 1987, O'Reagain and Turner 1992). Over 50 grazing experiments are evaluated by these reviews. Authors of both reviews drew essentially the same conclusions that are as follows:

1. Stocking rate has a major impact on range condition and animal production.
2. Continuous and short-duration grazing systems differ little in their effects upon range condition and livestock production.
3. Multi-camp (8 or more paddocks) rotation systems have no advantage over 4 paddock systems in either vegetation or livestock productivity.
4. Continuous grazing at moderate stocking rates does not cause rangeland degradation.
5. Herd effects from grouping large numbers of animals together lower water infiltration and increase erosion.
6. Grazing intensity rather than rotation system is the primary factor determining long term grazing outcomes on vegetation, livestock, and financial returns.

North American grazing studies strongly support these conclusions (Holechek et al. 1999).

Some Analysis and Conclusions

We find it interesting that government agencies so readily accepted Savory's theories and aggressively encouraged use of short-duration grazing. Grazing research that was available by the late 1970's already refuted much of what Savory contended but it received little consideration by many ranchers and government employed range managers. History shows that it's human nature to believe a good story rather than pursue the truth. Many ranchers undoubtedly found the prospect of much higher profits through use of Savory grazing methods most appealing. However, scientific investigation has disproven many of the early claims for short-duration grazing. This is particularly true regarding hoof action and accelerated range improvement from increased stocking rates and densities.

What led to such a widespread acceptance of the high intensity grazing concept without scientific proof? Initial programs in the early 1980's came at the end of a period of low cattle prices and low precipitation. From the middle 1980's through the early 1990's both cattle prices and rainfall drastically increased. Precipitation for the 1984–1993 period was 27% above the long term average across New Mexico (Holechek 1996). This more than doubled forage production. Wondrous tales were told regarding the effects of short-duration grazing on vegetation and livestock productivity. However, nature also taketh away. From 1993 to the present drought has prevailed across northern Mexico, Texas, and New Mexico. The hard lessons learned in Africa about short-duration grazing and drought in the early 1980's (Gammon 1984) are now being learned by many southwestern USA/Mexican ranchers (Holechek 1996, Molinar et al. 1998). No grazing approach, including that of Savory, will overcome the adverse effects of drought and/or chronic heavy stocking on forage production (Pieper and Heitschmidt 1988). Conservative stocking has been scientifically proven to be the surest grazing approach to maximizing plant productivity under drought, and improving rangeland condition (Klipple and Costello 1960, Paulsen and Ares 1962, Martin and Cable 1974, Holechek et al. 1994).

It is our view that the U.S. and Mexican governments should never have aggressively spent money on training range personnel on unproven theories or provided cost sharing for implementation of short-duration grazing until it had been fully evaluated. We can only wonder what the outcome might have been if government agencies had spent this money on educating their personnel and ranchers on scientifically proven range management practices and principles. We agree with O'Reagain and Turner (1992) who stated range managers should adopt a more critical attitude so as to prevent the assimilation of untested hypotheses into accepted management practices.

Ranchers across the southwestern USA and Mexico have suffered severe financial losses since 1994 (Holechek 1996, Molinar et al. 1998, Torell et al. 1998). Part of their problem centers around using high risk management strategies involving heavy stocking rates (Molinar et al. 1998, Ward 1998, Ward 1999). This may also have intensified rancher/environmentalist conflicts as rangeland ecosystem sustainability depends heavily on maintaining adequate levels of standing vegetation biomass (Heitschmidt and Walker 1996).

Short-duration grazing can facilitate improved management of livestock, and it gives ranchers more control over how specific parts of their ranch are grazed than continuous grazing. We believe it can be a useful grazing system for some ranchers if applied at conservative to moderate stocking rates. In closing, we hope the scientific information we have identified in this article will be more widely read and lead to better informed decisions on the use of short-duration grazing. Controversy generated by Allan Savory has, without doubt, led to more thorough investigation of various grazing processes. This research should now be put into practical application.

Supporting Literature

Anderson, D. M. 1988. Seasonal stocking of tobosa managed under continuous and rotation grazing. J. Range Mange. 41:78–83.

Angell, R. F. 1997. Crested wheatgrass or shrub response to continuous or rotational grazing. J. Range Manage. 50:160–164.

Bryant, F. C., B. E. Dahl, R. D. Pettit, and C. M. Britton. 1989. Does short-duration grazing work in arid and semi-arid regions? J. Soil and Water Cons. 44:290–296.

Cassels, D. M., R. L. Gillen, F. Ted McCollum, Kenneth W. Tate, and Mark E. Hodges. 1995. Effects of grazing management on standing crop dynamics in tallgrass prairie. J. Range Manage. 48:81–84.

Daugherty, D. A., C. M. Britton, and H. A. Turner. 1982. Grazing management of crested wheatgrass for yearling steers. J. Range Manage. 35:347–350.

Dormaar, J. F., S. Smoliak, and W. D. Willms. 1989. Vegetation and soil responses to short-duration grazing on fescue grasslands. J. Range Manage. 42:252–256.

Gammon, D. M. 1984. An appraisal of short duration grazing as a method of veld management. Zimbabwe J. Agric. Res. 84:59–64.

Gillen, R. L., F. T. McCollum III, K. W. Tate, and M. E. Hodges.

1998. Plant community response to grazing system and stocking rate in tallgrass prairie. J. Range Manage. 51:139–146.

Goodloe, S. 1969. Short-duration grazing in Rhodesia. J. Range Manage. 22:369–373.

Hart, R. H., M. J. Samuel, J. W. Waggoner, Jr., and M. A. Smith. 1989. Comparisons of grazing systems in Wyoming. J. Soil and Water Cons. 44:344–347.

Heitschmidt, R. F. and J. W. Walker. 1996. Grazing management: technology for sustaining rangeland ecosystems. Rangelands. 18:194–215.

Heitschmidt, R. K., S. L. Dowhower, and J. W. Walker. 1987a. 14- vs 42-paddock rotational grazing: Aboveground biomass dynamics, forage production and harvest efficiency. J. Range Manage. 40:216–244.

Heitschmidt, R. K., S. L. Dowhoer, and J. W. Walker. 1987b. Some effects of a rotational grazing treatment on quantity and quality of available forage and amount of ground litter. J. Range Manage. 20:318–321.

Heitschmidt, R. K., J. R. Conner, S. K. Canon, W. E. Pinchak, J. W. Walker, and S. L. Dowhower. 1990. Cow/calf production and economic returns from year-long continuous deferred rotation and rotational grazing treatments. J. Prod. Agr. 3:92–99.

Hirschfield, D. J., D. R. Kirby, J. S. Caton, S. S. Silcox, and K. C. Olson. 1996. Influence of grazing management on intake and composition of cattle diets. J. Range Manage. 49:257–263.

Holechek, J. L. 1992. Financial benefits of range management practices in the Chihuahuan Desert. Rangelands 14:279–282.

Holechek J. L. 1996. Drought and low cattle prices: hardship for New Mexico ranchers. Rangelands 18:11–13.

Holechek, J. L., H. Gomez, F. Molinar, and D. Galt. 1999. Grazing studies: What we've learned. Rangelands 21(2):12–16.

Holechek, J. L., A. Tembo, A. Daniel, M. Fusco, and M. Cardenas. 1994. Long term grazing influences on Chihuahuan Desert Rangeland. Southern Nat. 39:342–349.

Jung, H. G., R. W. Rice, and L. J. Koong. 1985. Comparison of heifer weight gains and forage quality for continuous and short-duration grazing systems. J. Range Manage. 38:144-149.

Kirby, D. R., M. F. Pessin, and G. K. Clambrey. 1986. Disappearance of forage under short-duration and season-long grazing. J. Range Manage. 39:496-499.

Klipple, G. E. and D. F. Costello. 1960. Vegetation and cattle responses to different intensities of grazing on shortgrass ranges of the central Great Plains. U.S. Dept. Agr. Tech. Bull. 1216.

Manley, W. A., R. H. Hart, M. J. Samuel, M. A. Smith, J. W. Waggoner, Jr., and J. T. Manley. 1997. Vegetation, cattle and economic responses to grazing strategies and pressures. J. Range Manage. 50:638–646.

Martin, S. C. and D. R. Cable. 1974. Managing semidesert grass-shrub ranges: Vegetation responses to precipitation, grazing, soil texture, and mesquite control. U.S. Dept. Agr. Tech. Bull. 1480.

McCalla, G. R. II, W. H. Blackburn, and L. B. Merrill. 1984. Effects of livestock grazing on infiltration rates, Edwards Plateau of Texas. J. Range Manage. 37:265–269.

McCollum, F. T. III and R. L. Gillen. 1998. Grazing management affects nutrient intake by steers grazing tallgrass prairie. J. Range Manage. 51:69–72.

McCollum, F. T. III, R. L. Gillen, B. R. Karges, and M. E. Hodges. 1999. Stocker cattle response to grazing management in tallgrass prairie. J. Range Manage. 52:120–126.

Merrill, L. B. 1954. A variation of deferred rotation grazing for use under southwest range conditions. J. Range Manage. 7:152–154.

Molinar, F., H. de Souza Gomes, J. L. Holechek, and R. Valdez. 1998. Mexico, macro-economics, and range management. Rangelands 20:16–24.

Olson, K. C. and J. C. Malechek. 1988. Heifer nutrition and growth on short-duration grazed crested wheatgrass. J. Range Manage. 41:259–263.

O'Reagain, P. J. and J. R. Turner. 1992. A evaluation of the empirical basis for grazing management recommendations for rangeland in southern Africa. J. Grassl. Soc. Southern Africa 9:1–52.

Parker, E. E., G. B. Donart, R. D. Pieper, J. D. Wallace, and J. D. Wright. 1987. Response of range beef cattle to different grazing management systems. New Mexico Agr. Expt. Sta. Bul. 732.

Paulsen, H. A. and F. N. Ares. 1962. Grazing values and management of black grama and tobosa grasslands and associated shrub ranges of the southwest. U.S. Dept. Agr. Tech. Bull. 1270.

Pieper, R. D. and R. K. Heitschmidt. 1988. Is short-duration grazing the answer. J. Soil and Water Cons. 43:133–137.

Pitts, J. S. and F. C. Bryant. 1987. Steer and vegetation response to short-duration and continuous grazing. J. Range. Manage. 40:386-389.

Pluhar, J. J., R. W. Knight, and R. K. Heitschmidt. 1987. Infiltration rates and sediment productions as influenced by grazing systems in the Texas Rolling plains. J. Range Manage. 40:240–244.

Ralphs, M. H., M. M. Kothmann, and C. A. Taylor, Jr. 1990. Vegetation response to increased stocking rates in short-duration grazing. J. Range Manage. 43:104–108.

Savory, A. 1978. A holistic approach to range management using short-duration grazing. Proc. Intn'l. Rangel. Congr. 1:555–557.

Savory, A. 1983. The Savory grazing method or holistic resource management. Rangelands 5:155- 159.

Savory, A. 1988. Holistic resource management. Island Press, Washington, DC.

Savory, A. and S. D. Parsons. 1980. The Savory grazing method. Rangelands 2:234–237.

Skovlin, J. M. 1987. Southern Africa's experience with intensive short-duration grazing. Rangelands 9:162–168.

Taylor, C. A. Jr., N. E. Garza Jr., and T. D. Brooks. 1993. Grazing systems on the Edwards Plateau of Texas: Are they worth the trouble? II. Rangelands 15:57–61.

Thurow, T. L., W. H. Blackburn, and C. A. Taylor Jr. 1986. Hydrologic characteristics of vegetation types as affected by livestock grazing systems, Edwards Plateau, Texas. J. Range Manage. 39:505–509.

Thurow, T. L., W. A. Blackburn, and C. A. Taylor, Jr. 1988. Some vegetation responses to selected livestock grazing strategies, Edwards Plateau, Texas. J. Range Manage. 41:108–114.

Torell, L. A., J. M. Hawkes, and T. D. Stromei. 1998. Range livestock cost and return estimates for New Mexico, 1996. New Mexico State Univ. Agr. Exp. Sta. Rep. 726.

Walker, J. W., R. K. Heitschmidt, and S. L. Dowhower. 1989. Some effects of a rotational grazing treatment on cattle preference for plant communities. J. Range Manage. 42:143–148.

Ward, N. 1998. Sustainable ranching: A ranchers perspective. Rangelands 20(3):33–37.

Ward, N. 1999. Ranchers need support for sustainable ranching: What government can do: A ranchers perspective. Rangelands 21(3): 13-17.

Warren, S. D., W. H. Blackburn, and C. A. Taylor, Jr. 1986. The influence of livestock trampling under intensive rotation grazing on soil hydrological condition. J. Range Manage. 39:491–496.

Weltz, M. and M. K. Wood. 1986. Short-duration grazing in central New Mexico: Effects on infiltration rates. J. Range Manage. 39:365–368.

White, M. R., R. D. Pieper, G. B. Donart, and L. White-Trifaro. 1991. Vegetation response to short-duration and continuous grazing in southcentral New Mexico. J. Range Manage. 44:399–404.

Willms, W. D., S. Smoliak, and J. F. Dormaar. 1990. Vegetation response to time-controlled grazing on mixed and fescue prairie. J. Range Manage. 43:513–518.

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A RANGE CONDITION DILEMMA

Michael G. Willoughby and Michael J. Alexander

In the late 1800's livestock grazing was unregulated along the eastern slopes of the Rocky Mountains in Alberta. To protect the Saskatchewan River basin watershed the Rocky Mountains Forest Reserve (RMFR) was established in 1910. Grazing by domestic animals was prohibited. However, by 1913 grazing by livestock was recognized as a useful tool to limit forage accumulation and assist in reducing a potential fire hazard. Inadequate management policies and funding, caused water quality to continue to deteriorate because of fire and localized overgrazing. To examine the overgrazing concerns in the Rocky Mountains Forest Reserve, Land and Forest Service established the Rangeland Reference Area Program in 1949. The objectives were to assess range condition and monitor range trend on grasslands within the boundaries of the RMFR (Hanson 1975).

To date forty-five fenced exclosures have been established in the RMFR, some dating back to 1953. These exclosures include permanently marked grazed and ungrazed transects. Species composition data has been recorded since their establishment. Recent analysis indicates that the vegetation moves through a number of vegetation states and the process closely follows the "state and threshold" model of succession (Laycock 1991). This created a dilemma on how the condition of these rangelands should be assessed because condition ratings for Alberta rangelands have used the old " linear range condition" model (Wroe et al. 1988).

To examine the vegetation changes at the various reference areas over-time a combination of both ordination (DECORANA) (Gauch 1982) and cluster analysis (SAS) were used to group the inside and outside transects of different years. The groupings from cluster analysis were overlain on the site ordination and years with similar species composition were grouped into community types.

Mean grazing pressure for each year was assessed by comparing annual utilization to the rated carrying capacity of the allotment. Total yearly AUM (Animal Unit Months) usage from the inception of the allotment was divided by the calculated carrying capacity (AUM) and multiplied by 100. For example a number of 100 would indicate proper utilization.

Historic grazing pressure

Range use has averaged over 154% of calculated carrying capacity since 1947 when records were first kept at the Castle River site. Range use around the reference area has averaged 175% of calculated carrying capacity from 1940 through the 1970's. Use declined somewhat during the 1980's averaging 127% of calculated carrying capacity. Since 1990 use has declined to 67% of calculated carrying capacity.

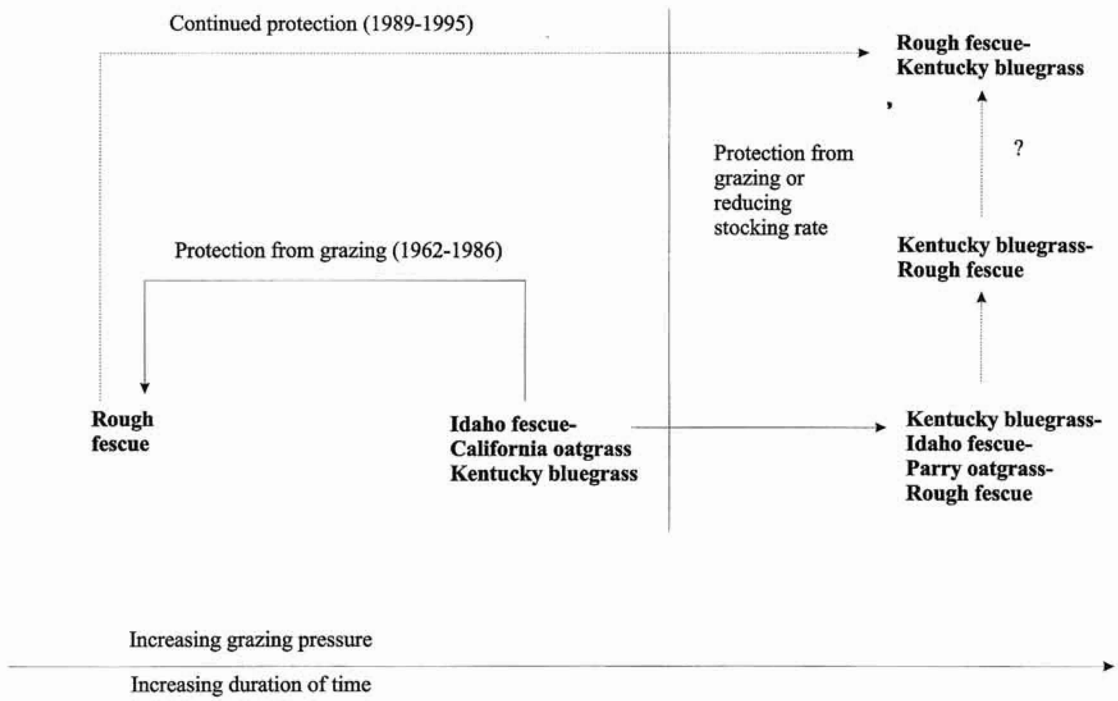


Fig. 1. Successional changes in the presence and absence of grazing disturbance at the Castle River Rangeland Reference Area.

Plant community ecology

The rangeland reference area has been represented by 3 community types since it was established in 1953 (Figure 1). When the site was first established the inside and outside transects were represented by the Idaho fescue-California oatgrass community type. When the site was protected from grazing for 24 years it succeeded to a rough fescue dominated community type. Moss and Campbell, and Willoughby found that rough fescue grows almost to the exclusion of other plants in the absence of disturbance. Moss and Campbell also found that rough fescue declined and Parry oatgrass and Idaho fescue increased with increased grazing pressure indicating that the Idaho fescue-California oatgrass dominated community type which dominated the site in 1962, to be a grazing disclimax community. Since 1989, the undisturbed inside transect at the site has been invaded by Kentucky bluegrass from outside the exclosure and the transect appears to be undergoing succession to a Rough fescue-Kentucky bluegrass dominated community type.

The continued heavy grazing pressure at the reference area from 1953 to 1990, has allowed Kentucky bluegrass to become dominant on the outside grazed transect to form a Kentucky bluegrass-Idaho fescue-Rough fescue community. Moss and Campbell, Looman and Willms et al., all found that long-term heavy grazing pressure leads to a decline in rough fescue and an increase in Kentucky bluegrass. Since 1990 the grazing pressure has declined to about two thirds of the calculated carrying capacity. During this time rough fescue has increased in cover and the transect appears to be succeeding to a Kentucky bluegrass-Rough fescue dominated community type.

The successional sequences for the Castle River Rangeland Reference Area are outlined in Figure 1. Protection from grazing on the Idaho fescue-California oatgrass community type in 1962 allowed rough fescue to increase, to form the rough fescue dominated community type in 1986. Invasion by Kentucky bluegrass since 1989 appears to be causing the inside transects to succeed to a Rough fescue-Kentucky bluegrass dominated community type. Continued grazing pressure on the outside transect has allowed Kentucky bluegrass to dominate the site and the reduction in grazing pressure in the 1990's appears to be allowing rough fescue to increase. The outside transect now appears to be succeeding to a Kentucky bluegrass-Rough fescue dominated community type.

The grazed transect at the Castle River Rangeland Reference Area was established in 1953 and the ungrazed transect was established in 1962. This reference area has been subjected to intense grazing pressure since 1947 when records were first kept.

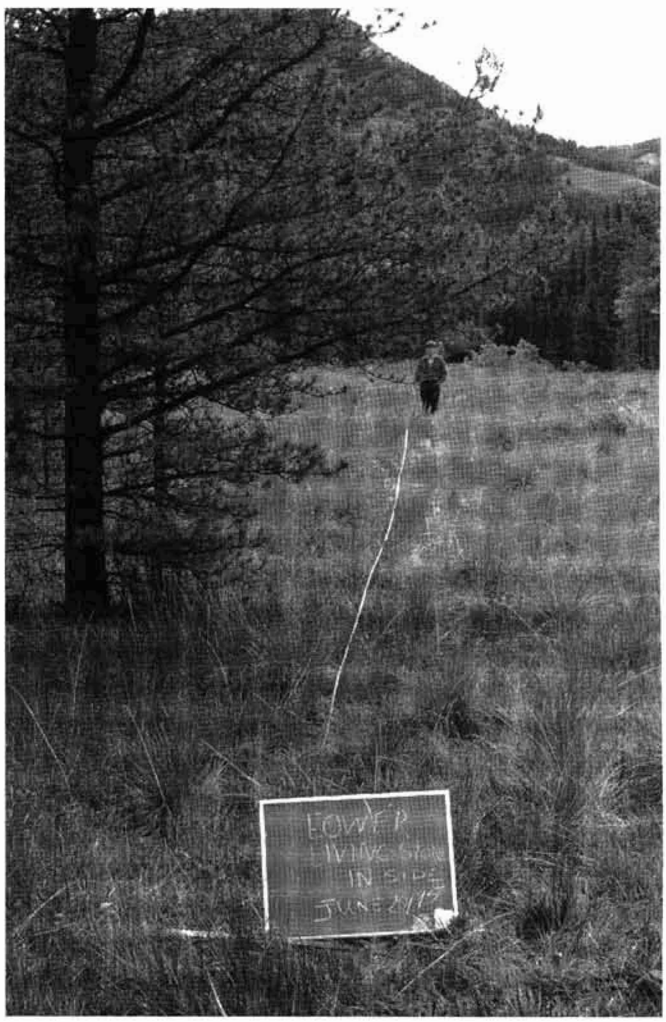
This model implies that the grassland species composition moves to the point of stabilization with plant species that have invaded rather than succeed back to the original vegetation.

Range condition

Traditionally, range condition in Alberta, has been defined by comparing species present with species of the climax community (Dyksterhuis 1949). This climax range condition model suggests that vegetation will be directional, predictable and revert back to the original rough fescue dominated predisturbance plant community in time. This concept appears to be applicable to this reference area up to the point in time before Kentucky bluegrass becomes a significant component of the community. When a Idaho fescue-California oatgrass community type is protected from grazing it appears to succeed back to a rough fescue dominated grassland. Consequently, the inside grazed transect would have been in good to excellent condition in 1986. However, once Kentucky bluegrass invades the community the traditional range condition model does not apply and the vegetation dynamics closely follow the state and threshold model. This model implies that the grassland species composition moves to the point of stabilization with plant species that have invaded rather than succeed back to the original vegetation. It appears once Kentucky bluegrass becomes established it continues to remain co-dominant with rough fescue in the absence of disturbance. It seems that both models apply to the vegetation dynamics of this site.

1953 ↑

1995 →



In 1953 when this reference area was protected from grazing it was dominated by rough fescue. Forty years later the understory vegetation continues to be dominated by rough fescue. These rough fescue dominated grasslands represent the edaphic climax plant community in the absence of disturbance on river terraces and meadows with deep black soils in the Foothills of Southern Alberta. The lack of fire allows trees to encroach, but the time frame for complete tree invasion is unclear.

The current dilemma on which system best describes range condition has led the Task Group on Unity in Concepts and Terminology (1995) to propose that ecological site and desired plant community concepts be used to assess the status of rangelands. Ecological site is defined as "a kind of land with specific physical characteristics which differs from other kinds of land in its ability to produce distinctive kinds and amounts of vegetation and in its response to management". The undisturbed transect at the Castle reference area has succeeded to a community that is dominated by rough fescue and Kentucky bluegrass. This community type has been quite stable for the last 6 years and it seems unlikely the site will return to a community that is dominated solely by native plant species.

The desired plant community is defined as "of the several plant communities that may occupy a site, the one that has been identified through a management plan to best meet the plan's objectives for the site". Historically, the desired plant community of these rangelands was one that maximized beef production. Invaders such as timothy and Kentucky bluegrass were desirable. Today society desires the conservation of native grasslands and the desired plant community is native rough fescue. Plants considered non-native (Kentucky bluegrass, timothy and dandelion) are no longer desirable. It appears that the past management practices have altered the community structure so that the plant community desired by today's society is unlikely. This has created a dilemma on how range condition of these rangelands should be assessed.

New rangeland health protocols developed by the USDA are trying to address this dilemma. The USDA has created 17 rangeland health indicators to assess Soil/Site stability, Hydrologic Function and Integrity of the Biotic Community and determine if the community is stable, at risk or non-functioning and not intact (Pellant 1999). Clearly, the Castle River Rangeland Reference Area would have a stable rating for Site/Soil Stability and would be functioning hydrologically, but the Integrity of the Biotic community would not be intact. It is likely that range condition assessments will have to be done with non-native invaders as a component of the climax community, but ultimately this maybe a societal decision.

Supporting Literature

Dyksterhuis, E.J. 1949. Condition and management of rangeland based on quantitative ecology. J. Range Manage. 2:104-115.

Gauch, H.G. 1982. Multivariate analysis in community ecology. Cambridge University Press, Cambridge, 298pp.

Hanson, A.R. 1975. Current range management on forest lands in Alberta. Alberta Energy and Natural Resources, Forest Service. Unpublished report. 79pp.

Laycock, W.A. 1991. Stable states and thresholds of range condition on North American rangelands-a viewpoint. J. Range Manage. 45:427-433.

Looman, J. 1969. The fescue grasslands of Western Canada. Vegetatio, 19:28-145.

Moss, E.H. and J.A. Campbell. 1947. The fescue grassland of Alberta. Can. J. Res. 25:209-227.

Pellant, M. 1999. Presentation to RAM committee on Interagency Rangeland Health Evaluation. 1999 Society for Range Management Annual Meeting. Omaha, Nebraska. Feb 21-26.

Task Group on Unity in Concepts and Terminology. 1995. New concepts for assessment of rangeland condition. J. Range Manage. 48:271-283.

Willms, W.D., S. Smoliak and J.F. Dormaar. 1985. Effects of stocking rate on a rough fescue grassland vegetation. J. Range Manage. 38:220-225.

Willoughby, M.G. 1992. Rangeland Reference Areas: Plant communities , ecology and repsonse to grazing in Division 1. Forestry, Lands and Wildlife, Alberta Forest Service. Pub. no. T/266. 44pp.

Wroe, R.A., S. Smoliak, B.W. Adams, W.D. Willms and M.L. Anderson. 1988. Guide to Range Condition and Stocking Rates for Alberta Grasslands. Forestry, Lands and Wildlife. Edmonton. AB. 33 pp.

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Book Review

Starrs, Paul F. 1998. Let the Cowboy Ride: Cattle Ranching in the American West. Johns Hopkins University Press, Baltimore. 356 pp. $29.95 (hard).

Considering the dramatic changes in uses of both private and public lands across the American West, geographers seem particularly well disposed to capture the interplay of human communities and landscapes. Paul Starrs, editor of *Geographical Review* and geographer at the University of Nevada-Reno, has produced a book that provides provocative reading for those interested in ranching, still the principle land use west of the 100th meridian. Indeed, not since Terry Jordan's North American Cattle-Ranching Frontiers: Origins, Diffusion, and Differentiation has such an essential work appeared dealing with the culture and geography of western livestock operations. The book is divided into three sections: the legacy of ranching and range land; ranch country; and the future of ranching.

The opening section, "The Legacy of Ranching and Range Land," explores the inherent tension that exists between ranchers and government across the western landscape, blended half with private and half with public lands. In their attempts to settle the West the U.S. Congress, through their agent, the General Land Office, refused to let go of the Jeffersonian ideal of small family farms. Accordingly, Homestead acts never allowed tracts of land big enough for sustainable agriculture operations. This in spite of the fact the region was defined more by aridity than forests. Congress and the advancing pioneers were products of the forested and much wetter Atlantic seaboard. How could they have appreciated what John Wesley Powell tried to tell them in his *Report on the Lands of the Arid Region of the United States, With a More Detailed Report of the Lands of Utah,* that this region could only support small farms where water could be put on the soil. Wisdom almost prevailed. In 1876 the commissioner of the General Land Office, in his report to the Secretary of the Interior, urged that the public domain west of the 100thmerdian and east of the Sierra Nevada Mountains should not be surveyed in minute subdivisions "except only small portions which are susceptible of cultivation without artificial irrigation." He recommended that the "barren lands" be thrown open to purchasers in tracts of unlimited size, "as they are worthless without irrigation, which cannot profitably be undertaken for small areas of 160 acres each." This recommendation found favor in Washington, D.C. where President Hayes in his message to Congress on 3 December 1877 said, "I would also call the attention of Congress to a statement made by the Secretary of the Interior concerning the disposition that might be made of the desert lands not irrigated west of the 100th meridian. These lands are practically unsalable under existing laws, and the suggestion is worthy of consideration that a system of leasehold tenure would make them a source of profit to the United States, while at the same time legalizing the business of cattle raising which is at present carried on upon them." This was not to be and instead the distribution of the arid lands by the General Land Office bequeathed a Western geography where private-land ranchers and public land managers still struggle for coexistence. This tension is even more exacerbated by the emerging, and more lucrative, alternative uses for range lands, both private and public: subdivisions and outdoor recreation. Discussions about the continued viability of private-public lands grazing are an ongoing part of our nation's dialogue, argued across the fence, in federal and state courts, and dramatized in journalist's stories. Paul Starrs concludes that "Extensive livestock ranching may or may note be economically salvageable. It might, and probably should, however, be approached as a problem in conservation and cultural continuity."

A sub-theme Starrs explores in the first section are the roots of Western ranching, tracing them back to Spain and the Old World code of the Mesta-the rules of conduct of the 15th century Iberian sheep raisers' guild. Ranching in the New World can trace its origins back 500 years to the early occupation by Spain. Although some historians and geographers have credited ranching as an innovative response to aridity and a largely treeless landscape, and remarked on the inventions of windmills and barbed wire, the true roots of early and successful livestock operations in the West must be credited to Spanish explorers and settlers that were not initially shocked when they encountered a treeless Western region and its arid plains.

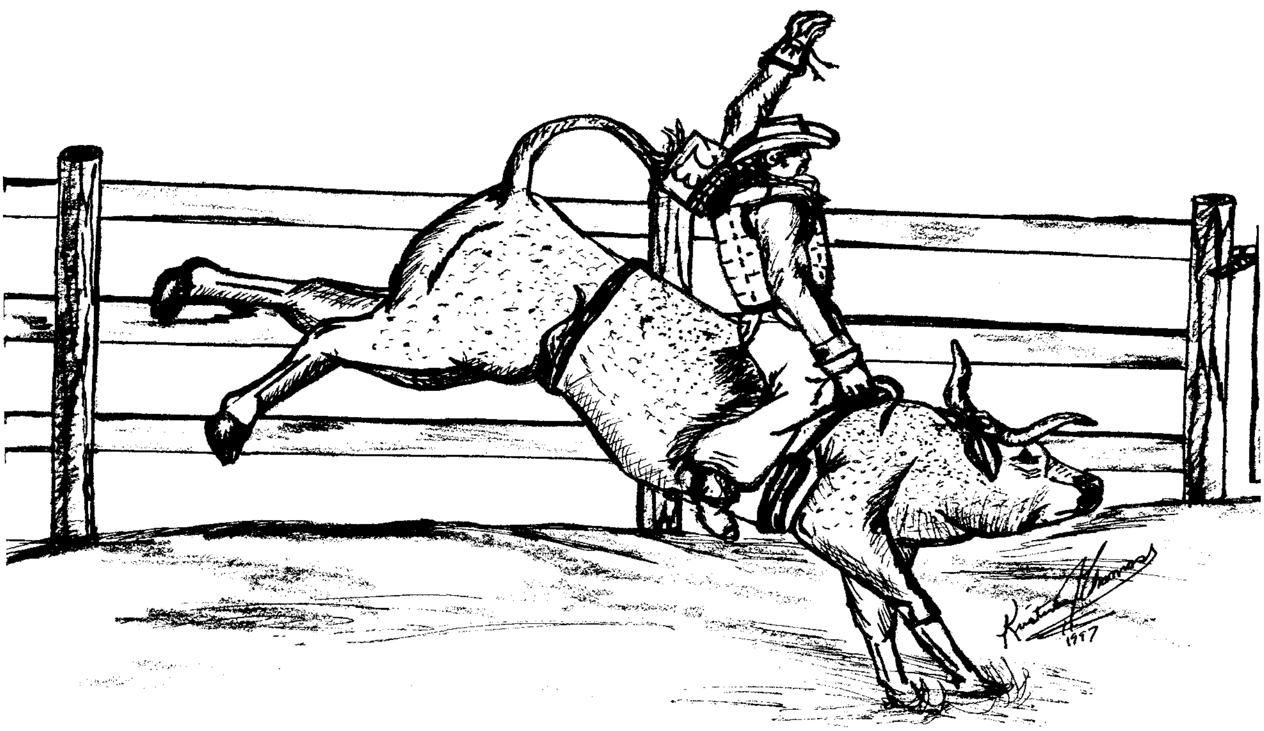
The book's second section is titled "Ranch Country," and provides a delightful twist to the examination of ranch culture. Here Starrs explores the demographics, economics and cultural adaptations of ranching in five different parts of the western United States: Rio Arriba County, New Mexico; Deaf Smith County, Texas; Cherry County, Nebraska; Sheridan County, Wyoming; and Elko County, Nevada. Such diversity is guaranteed to entertain and educate as Starrs uses such widely disparate locales to highlight the regional accommodations of ranching to land. Starrs also examines how history helped define ranching in each region. For example, ranches in Deaf Smith County, Texas consist of deeded property whereas ranches in Rio Arriba County, New Mexico depend on public land leases to sustain their operations. The difference lies in history. When Texas became a state in 1845 it did not cede unclaimed lands to the federal government. Instead it formed the Texas Land Office which, unlike the General Land Office, was remarkably efficient in parceling off nearly a quarter of a million acres to private ownership. The result is that ranches in Deaf Smith County consist almost exclusively of deeded land. History also was the determining factor that shaped ranch ownership in Rio Arriba County. Here ranches are small and dependent upon Forest Service lands for summer grass. Originally the Spanish law of the Mesta shaped ranching families in this northern New Mexico county. Productive land was irrigated while the rest was often collectively grazed in community-held land grants. Later-arriving Anglo settlers desired this land and by a variety of illicit means found backing from the U.S. Government to transfer these lands to federal ownership. There, either given away b the Land Office or placed in national forests, the Hispanic ranch families found their future radically altered. These five case studies illustrate the maxim that "the land determines," but only in the context of human histories.

The concluding section of the book is titled "The Future of Ranching" and here Starrs shows his wisdom and his respect for the continuity of ranching in a region marked by endless waves of change. Using the five case studies in the middle section of the book Starrs now comes to grips with the changing economic and social environment ranchers find today on the land. His case studies clearly illustrate the poverty of policy from a distant federal government while at the same time introducing the idea of "ranch fundamentalism," that is, ranching in the West makes sense only when it is approached as a way of life. How else can one understand the persistence of families to ranching when faced with falling commodity prices, increasing government oversight, and lucrative alternatives for ranch land. Importantly, Starrs presents this information in a non-judgmental fashion, avoiding the trend of many contemporary Western thinkers who cheer on the "sagebrush rebels" or damn the "welfare ranchers." Indeed, Starrs admits there are some lands too precious to graze and some ranchers to bad to be allowed to use public lands.

In the end, Starrs succeeds wonderfully in informing, posing vexing problems for land-use planners and scholars alike, and leaves the reader with troubling, unanswerable questions. Perhaps his finest thoughts are the closing words in his book. They, like Starrs and the topic he addresses *Let the Cowboy Ride*, reflect the real-world complexity of answering the question whether ranching will persist, or even if it should:

To know ranching's realm and ranchers themselves, to know cows and cowboys and their horses, to see the land and its people, watching the complicated interactions of grazers, their charges, and the terrain, is to absorb one of the astoundingly complex and rich stories of humanity. From the stories of children's books and National Research Council studies there are equivalent descriptions of the bonds of people to their domesticated animals, something dating to the Neolithic or before. In the modern world no one is so close to the land as working ranchers—women and men who gunnysack dry calves born at winter dawns, who laboriously move cattle up distant hillsides toward the salt blocks placed there to encourage the animals to spend time on heights, away from creek bottoms, or who simply devote days on horseback, at a walk or trot, looking over the status and prospect of land, plants, and animals. That is husbandry—nurturing—at its most basic. It is a very odd thing, perhaps unforgivable, that many ranchers in western North America do not own much of the land that provides for their livelihood, but that is a fact and part of the narrative of ranching in western North America. A disembodied land tenancy is no excuse for what has gone wrong in the past ecology and economy of ranching. But the abuses of policy on geography do explain a great deal, and understanding those abuses goes someway toward explaining why, wherever possible and plausible ranching in the West should be encouraged to continue.

Richard L. Knight is a professor of wildlife conservation at Colorado State University. With colleagues he is organizing a conference during 4–6 May 2000 called **"The Culture, Ecology, and Economics of Ranching West of the 100th Meridian,"** to be held at Colorado State University. For registration information please call 970-491-6222. Paul Starrs will be a featured speaker.



Sneek a Peek at the upcoming issue of Journal of Range Management

Carbon Exchange Rates in Grazed and Ungrazed Pastures of a Mixed Grass Prairie

Daniel R. LeCain, Jack A. Morgan, Gerald E. Schuman, Jean D. Reeder and Richard H. Hart

Little is currently known about how cattle grazing on rangelands impacts the photosynthetic response of native plant communities. We measured canopy photosynthesis rates, throughout 3 growing seasons, on heavily grazed, lightly grazed and ungrazed pastures in the mixed grass prairie of Wyoming. Results show higher photosynthesis rates in grazed pastures in the spring, due to earlier spring green-up under grazing, but lower photosynthesis later in the season, due to foliage removal by grazing. Overall, there was no annual difference in plant community photosynthesis rates in grazed vs. ungrazed pastures, suggesting that this ecosystem is very tolerant to grazing by cattle.

Broom Snakeweed Establishment Following Fire and Herbicide Treatments

K.C. McDaniel, D.B. Carroll, and C.R. Hart

Establishment of broom snakeweed seedlings following prescribed burning of New Mexico's blue grama grasslands can negate the expected benefits. A 9-year study evaluated broom snakeweed establishment after fire and herbicide control. The majority of broom snakeweed seedlings emerged within a year of summer burning when bare ground exposure was high. Seedlings on spring burned areas were equivalent to non-treated areas. Herbicide spraying was the only treatment which increased grass yield and cover after broom snakeweed control and was effective in reducing seedling establishment.

Grazing Effects on Spring Ecosystem Vegetation of California's Hardwood Rangelands

Barbara Allen-Diaz and Randall D. Jackson

Few studies have examined cattle grazing effects on cold-water spring composition or cover, yet managers generally assess range condition or health by comparing existing plant composition based on cover to a standard. The effects of different cattle grazing intensities on vegetation surrounding springs were evaluated over 6 years on California's oak-dominated hardwood rangeland. Stable plant communities persisted on sites regardless of grazing intensity or cover changes. Total herbaceous cover was sensitive to interannual fluctuations in rainfall making it a more useful gauge of ecosystem health than plant composition.

Are Namibia's Grasslands Desertifying?

David Ward and Ben T. Ngairorue

Absence of long-term data defining past grassland conditions are a major problem in assessing whether desertification has occurred. Data exist in Namibia that allow us to evaluate the relationship between herbage production and average annual rainfall from 58 years ago with the present day. Herbage production is currently half that recorded in 1939 with no evidence of a change in rainfall over this period, nor is there any evidence that either short-term or longer term stocking densities affect current herbage yield. It is concluded that grazing over the last decade has not been the cause of the observed desertification.

Spotted Knapweed and Grass Response to Herbicide Treatments

Roger L. Sheley, Celestine A. Duncan, Mary B. Halstvedt and James S. Jacobs

Information is lacking on the long-term effect of the optimum timing of herbicide application to maximize spotted knapweed control and subsequent forage production. A 4-year study was conducted at 2 sites to evaluate spotted knapweed control using 3 herbicide treatments at different growth stages to maximize weed control and grass production. Herbicide effects depended upon spotted knapweed growth stage at the time of application and the number of years after application. This study showed that clopyralid plus 2,4-D provide effective and longer-term spotted knapweed control without limiting land management options.

Ungulate Herbivory on Utah Aspen: Assessment of Long-term Exclosures

Charles E. Kay and Dale L. Bartos

Does livestock grazing and big-game browsing have an effect on the decline of aspen in the Intermountain West? Eight aspen exclosures on the Dixie and Fishlike National Forest in southcentral Utah were measured to determine aspen stem dynamics, successional status, and understory species composition. Aspen totally protected from large herbivores successfully regenerated and developed multiaged stems while those subjected to excessive ungulate herbivory did not. These findings will assist land managers plan for restoration of decadent aspen in the western U.S.

Seasonal Chemical Composition of Saltbush in Semiarid Grasslands of Jordan

Moh'd Khair J. EL-Shatnawi and Yaser M. Mohawesh

Native forages in Jordan are nutritionally deficient for much of the dry season, and other sources of feed are needed to assure adequate animal performance. Leaves and stem of saltbush (*Atriplex halimus* L.) were evaluated over a 2-year period. Saltbush is a good source for protein, Ca and energy for sheep during summer and autumn; although P content would not meet nutritional requirements for ewes. A mosaic of saltbush shrubs and grasses at the semiarid grassland of Jordan would elevate the nutritive plain of livestock and possibly minimize the need for grain supplements during summer and autumn.

Supplementation of Yearling Steers Grazing Northern Great Plains Rangelands

James F. Karn

Strategic supplementation of grazing steers could enhance weight gains and improve the viability of a ranching operation. Supplementation and intake trials were conducted from 1988-1992 with summer grazing yearling steers to evaluate weight gain responses from ground barley, phosphorus and crude protein. Weight gains were greater for steers supplemented with barley or barley and phosphorus compared to unsupplemented controls. Supplementation should be beneficial most years but results may vary with the quantity and quality of availability forage.

Residual Nitrogen Effects on Soil, Forage, and Steer Gain

William A. Berg and Phillip L. Sims

Nitrate movement into substrata following fertilization is a concern on introduced grass pastures in the Southern Great Plains. A 3-year study evaluated herbage mass, forage nutritive value, steer gain, and concentrations of nitrate, ammonium, total N and organic C in the soil after 5 years of pasture fertilization. There were no differences in nitrate concentrations to depths of 2.8 m among treatments with peak standing herbage yields and steer weight gains greater in fertilized paddocks and linearly related to total N applied. Substantial benefits can be expected for several years following N application to Old World bluestem pastures.

Estimating aboveground Plant Biomass Using a Photographic Technique

José M. Paruelo, William K. Lauenroth and Pablo A. Roset

Present techniques for estimating aboveground net primary production on grassland ecosystems are time consuming and expensive. A non-destructive, photographic technique was developed for estimating biomass in semiarid grasslands. The relationship between the percentage of green pixels and either green grass or total green biomass changed during the growing season. Despite the need of proper calibration, the results show that digital images and an algorithm based on color theory can provide good estimates of plant biomass in semiarid grasslands.

Effects of Nitrogen Fertilization in Leafy Spurge Root Architecture

Kirstin Ringwall, Mario E. Biondini, and Carolyn E. Grygiel

There is a dearth of information regarding the response of leafy spurge roots to patchy fertilization. The problem was addressed with 3 separate experiments conducted in large containers. Patchy fertilization did not alter the morphological characteristics of leafy spurge roots, but reduced root biomass, doubled the percentage of roots located in the top 10 cm of soil, and shifted roots toward the fertilized patches. These results indicate that N fertilization could potentially be used to alter the rooting strategy of leafy spurge, and thus make it more susceptible to chemical and biological controls.

Spatial Distribution of Economic Change from Idaho Ranches: Cattle Prices and Federal Land Grazing in Idaho

Aaron J. Harp, Robert R. Loucks and James N. Hawkins

The spatial distribution of economic impacts from reduced cattle prices and a reduction in federal grazing AUMs was examined for two-county area in central Idaho. A community level input/output model with a trade hierarchy was built using extensive interviews with individuals and businesses. The impacts of the two scenarios between the seven communities differ greatly and there is a great difference when compared to the area taken as a single economy. The results indicate that local economic structures differ significantly and this will determine how differentially they experience changes in the range cattle industry.

Alkaloid Levels of a Tall Larkspur Species in Southwestern Alberta

W. Majak, R. E. McDiarmid, J. W. Hall and W. Willms

Tall larkspurs are widely distributed in western North America and kill more cattle on rangelands than any other poisonous plant. A 2-year survey at 5 sites in southwestern Alberta evaluated the levels of the neurotoxic norditerpenoid alkaloid methyllycaconitine at different growth stages. The alkaloid levels during bud to pod development were not different but they exceeded the reported levels in low larkspur by 5 to 10 times. The vegetative stage of growth yielded the highest levels of the alkaloid and the decline and change in concentration during the interval could be predicted on the basis of the Julian date.

Herpetofaunal Responses to Brush Management with Herbicide and Fire

Bob Jones, Stanley F. Fox, David M. Leslie, Jr., D. M. Engle, and Robert L. Lochmiller

Little information is available on the effects of brush management on native herpetofauna. We evaluated effects of derived habitat types from brush management with herbicide and fire on populations of reptiles and amphibians in the Cross Timbers in Oklahoma. Amphibians were most abundant in untreated and tebuthiuron—only pastures, lizards were most abundant on untreated pastures, and snakes were most abundant on pastures treated with tebuthiuron plus fire. Maintenance of a mosaic of habitats may enhance herptile habitat under carefully controlled livestock grazing.

Rangeland Management Impacts on Soil Biological Indicators in Southern Alberta

Johan F. Dormaar and Walter D. Willms

Quantitative techniques are needed to determine the effects of cultivation and livestock grazing on biological indicators of soils. We evaluated the effect of selected management practices at 3 major grassland ecosystems in Canada on 3 biological indicators of soil quality. Mineralizable-N, and phosphatase and dehydrogenase activities were sensitive to time following 7 external management changes and seasonal fluctuations. Soil biological indicators can be used to quantify temporal and botanical changes in diverse ecotypes within the Northern Great Plains.

N-alkane as an Internal Marker for Predicting Digestibility of Forages

Russel E. Sandkey, Don C. Adams, Terry J. Klopfenstein and Richard J. Grant

Naturally occurring n-alkanes are probably more reliable than IADF for estimating DMD of immature forages. However, freeze drying should be used to dry fecal samples for analysis rather than oven drying. Generally, digestibility was underestimated by n-alkane analyses and marker recovery rate was not consistent among forages. Apparently, digestion affects recovery of the specific marker, hentriacontane.

Switchgrass Growth and Development: Water, Nitrogen, and Plant Density Effects

M.A. Sanderson and R.L. Reed

Interest in growing switchgrass for alternative uses has raised questions about resource use during production. The objective of our study was to examine how N and water affected interspecific plant competition in switchgrass. Soil moisture tensions below −45 kPa reduced switchgrass photosynthetic rates xylem pressure potential, and as plant spacing increased, tiller number, leaf area, plant dry weight, and morphological development stage increased. Our data indicate that competitive responses of switchgrass plants at high plant densities were controlled by competition for aboveground resources, as plant yield and morphology at high densities were not affected by water or N inputs.

A Comparison of Methods to Determine Plant Successional Stages

Susan R. Winslow and Bok. F. Sowell

Federal agencies are changing their methods of assessing rangeland health. Our study compared traditional NRCS range condition analysis to USFS Ecodata on 26 macroplots in southwest Montana. Range condition scores of NRCS methods were 15 % greater than Ecodata methods but condition classes were similar. Differences in scores between these methods might not be due to a reduction in rangeland condition.

Browsing the Literature

JEFF MOSLEY

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 publisher or senior author (addresses shown in parentheses). Suggestions are welcomed and encouraged for items to include in the future issues of *Rangelands.*

Animal Ecology

Effects of drought on desert tortoise movement and activity. J.J. Duda, A.J. Krzysik, and J.E. Freilich. 1999. Journal of Wildlife Management 63:1181-1192. (Dept. of Biological Science, Wayne State Univ., Detroit, MI 48202). Desert tortoises had smaller home ranges during drought years.

Effects of recreational trails on wintering diurnal raptors along riparian corridors in a Colorado grassland. R.J. Fletcher, S.T. McKinney, and C.E. Bock. 1999. Journal of Raptor Research 33:233-239. (Dept. of Animal Ecology, Iowa State Univ., Ames, IA 50011). Bald eagles avoided recreational trails, but red-tailed hawks were not affected.

Feed resources and feeding techniques of small ruminants under extensive management conditions. R.G. Ramirez. 1999. Small Ruminant Research 34:215-230. (Apartado Postal 142, Suc. F, San Nicolas De Los Garza 66451, NL, Mexico). Evaluated the botanical composition and nutritive quality of diets for Spanish goats, sheep, and white-tailed deer in northeastern Mexico.

Habitat characteristics of small mammals in southeastern Utah. M. Sureda and M.L. Morrison. 1999. Great Basin Naturalist 59:323-330. (Dept. of Biological Sci., California State Univ.- Sacramento, Sacramento, CA 95819). Describes habitat characteristics (i.e., grass, forb, shrub, and tree cover) of 8 small mammal species on rangeland in southeastern Utah.

High foal mortality limits growth of a desert feral horse population in Nevada. P.D. Greger and E.M. Romney. 1999. Great Basin Naturalist 59:374-379. (Bechtel Nevada, Box 98521, Las Vegas, NV 89193). Mountain lion predation was believed to be a major factor limiting growth of a feral horse population.

Grazing Management

Effects of grazing dates on forage and beef production of mixed prairie rangeland. M.P. Schellenberg, N.W. Holt, and J. Waddington. 1999. Canadian Journal of Animal Science 79:335-341. (Semiarid Prairie Agr. Research Centre, P.O. Box 1030, Swift Current, SK S9H 3X2, Canada). Cattle grazing of mixed-grass prairie in early spring did not affect forage yield the next year.

Hydrology

Effects of climate change on hydrology and water resources in the Columbia River Basin. A.F. Hamlet and D.P. Lettenmaier. 1999. Journal of the American Water Resources Association 35:1597-1623. (Dept. of Civil and Environmental Engineering, Univ. of Washington, Box 352700, Seattle, WA 98195). Less snowpack and earlier runoff are predicted to reduce summer runoff volume by 10–25%.

Potential climate change impacts on mountain watersheds in the Pacific Northwest. L.R. Leung and M.S. Wigmosta. 1999. Journal of the American Water Resources Association 35:1463-1471. (Pacific Northwest National Lab., P.O. Box 999, Richland, WA 99352). Impacts of climate change will vary widely among watersheds in the region, with some basins relatively unaffected.

Potential climate change impacts on water resources in the Great Plains. D. Ojima, L. Garcia, E. Elgaali, K. Miller, T.G.F. Kittel, and J. Lackett. 1999. Journal of the American Water Resources Association 35:1443-1454. (Natural Resource Ecology Lab., Colorado State Univ., Fort Collins, CO 80523-1499). Precipitation, air temperature, and cool season plants are predicted to increase.

The impacts of climatic changes for water resources of the Colorado and Sacramento-San Joaquin River Basins. P.H. Gleick and E.L. Chalecki. 1999. Journal of the American Water Resources Association 35:1429-1441. (Pacific Institute for Studies in Development, Environment, and Security, 654 13th St., Preservation Park, Oakland, CA 94612). Suggests that the ratio of rain to snow and the amount of winter runoff will increase, spring runoff will begin and end earlier, and summer water availability will decrease.

Improvements

Plant and soil responses to source, rate, and timing of applied N for plains bluestem production. S.B. Phillips, W.R. Raun, and G.V. Johnson. 1999. Journal of Production Agriculture 12:254-257. (Dept. of Plant and Soil Sci., Oklahoma State Univ., Stillwater, OK 74078). Forage yield and protein content increased when up to 200 lbs N/acre was applied in spring; yield increased more when N was applied in early May rather than late April.

The effect of fire, mowing and fertilizer amendment on arbuscular mycorrhizae in tallgrass prairie. A.H. Eom, D.C. Hartnett, G.W.T. Wilson, and D.A.H. Figge. 1999. American Midland Naturalist 142:55-70. (D.C. Hartnett, Division of Biology, Kansas State Univ., Manhattan, KS 66506). Burning and mowing did not affect arbuscular mycorrhizae.

Understory responses to fire and artificial seeding in an eastern Cascades Abies grandis forest, USA. T.L. Schoennagel and D.M. Waller. 1999. Canadian Journal of Forest Research 29:1393-1401. (Dept. of Botany, 132 Birge Hall, Univ. of Wisconsin, Madison, WI 53706). Native plant cover was reduced, and total plant cover was not increased, when non-native grasses were seeded to control erosion after wildfire.

Plant/Animal Interactions

Native and alien species diversity at the local and regional scales in a grazed California grassland. S. Harrison. 1999. Oecologia 121:99-106. (Dept. of Environmental Sci. and Policy, Univ. of California, 1 Shields Ave., Livermore, CA 95616). Cattle grazing did not affect plant species richness.

Livestock activity and Chihuahuan Desert annual-plant communities: Boundary analysis of disturbance gradients. M.S. Nash, W.G. Whitford, A.G. deSoyza, J.W. VanZee, and K.M. Havstad. 1999. Ecological Applications 9:814-823. (U.S. Environmental Protection Agency, P.O. Box 93478, Las Vegas, NV 89196). Livestock activity near water points created habitat for annual plant communities.

Plant Ecology

Facilitation of conspecific seedling recruitment and shifts in temperate savanna ecotones. J.F. Weltzin and G.R. McPherson. 1999. Ecological Monographs 69:513-534. (Dept. of Ecology and Evolutionary Biology, Univ. of Tennessee, Knoxville, TN 37996). The oak woodland-grassland ecotone in southeastern Arizona is very stable due to low rates of seed dispersal and the importance of overstory shade for oak seedling development.

Grassland plants of South Dakota and the northern Great Plains. J.R. Johnson and G.E. Larson. 1999. ($17.95 plus shipping; Ag Communications, South Dakota State Univ., Box 2230, Brookings, SD 57007). Portrait-quality photos and writeups on 289 plant species from the mixed-grass prairie, tallgrass prairie, and sandhills prairie.

Mycorrhizae indirectly enhance competitive effects of an invasive forb on a native bunchgrass. M.J. Marler, C.A. Zabinski, and R.M. Callaway. 1999. Ecology 80:1180-1186. (Division of Biological Sci., Univ. of Montana, Missoula, MT 59812). Results suggest that Idaho fescue plants are less competitive against spotted knapweed when mycorrhizae are present on Idaho fescue.

Plants of the Black Hills and Bear Lodge Mountains. G.E. Larson and J.R. Johnson. 1999. ($34.95 plus shipping; Ag Communications, South Dakota State Univ., Box 2230, Brookings, SD 57007). Excellent photos and descriptions of 600 plant species found in the mountains of western South Dakota and northeastern Wyoming.

Relationships between Pinus ponderosa forest structure, light characteristics, and understory graminoid species presence and abundance. E. Naumburg and L.E. DeWald. 1999. Forest Ecology and Management 124:205-215. (School of Forestry, Box 15018, Northern Arizona Univ., Flagstaff, AZ 86011). Tree density and tree diameter can be managed to manipulate the species composition of the grass understory.

Reclamation

Arbuscular mycorrhizal fungal isolate effectiveness on growth and root colonization of Panicum virgatum in acidic soil. R.B. Clark, S.K. Zeto, and R.W. Zobel. 1999. Soil Biology and Biochemistry 31:1757-1763. (USDA-ARS, 1224 Airport Rd., Beaver, WV 25813). Arbuscular mycorrhizal fungi enabled switchgrass plants to withstand acidic soil and dramatically increase forage production.

Socioeconomics

Economic and social appraisal of the feasibility of land restoration, rehabilitation, and reallocation in arid and semiarid zones: A holistic approach. J.P. Chassany. 1999. Arid Soil Research and Rehabilitation 13:383-395. (INRA, Pl. Viala, F-34060, Montpellier, France). Economic evaluations of alternatives for ecosystem restoration must consider the social acceptability of the alternatives.

Policy objectives and economic incentives for controlling agricultural sources of nonpoint pollution. R.D. Horan and M.O. Ribaudo. 1999. Journal of the American Water Resources Association 35:1023-1035. (Economic Research Service, Room 4015, 1800 M St. NW, Washington, DC 20036). Discusses possible economic incentives that government could provide to landowners for controlling nonpoint pollution.

Soils

Carbon storage after long-term grass establishment on degraded soils. K.N. Potter, H.A. Torbert, H.B. Johnson, and C.R. Tischler. 1999. Soil Science 164:718-725. (USDA-ARS, 808 E. Blackland Rd., Temple, TX 76502). After 100 years of continuous cropping, it will take 160 years for a restored grassland to sequester the same amount of carbon as native prairie.

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View from the Valley of Virginia

On this cold Virginia day in early 2000, it is time to warm up the Word program for the New Year and provide you a bit more evidence of gains in recognition of SRM.

Executive Vice President Craig Whittekiend discussed both the H. John Heinz Center for Science, Economics and Technology and the Invasive Species Advisory Committee in his December 1999, article in *Rangelands*. SRM recommendations have been seriously considered by both the Center and the Invasive Species Council in tapping expertise for efforts they have underway.

The H. John Heinz Center, a non-profit institution working to improve the scientific and economic foundaion for environmental policy, is identifying a suite of core measures of the use and condition of U.S. ecosystems. The project will also identify gaps where information on key ecosystem aspects is not presently collected in a comparable and consistent manner. The goal is to produce a full report by 2001, which will lay a foundation for comprehensive, credible, and regular reporting on the state of America's ecosystems. SRM members Hugh Barrett, Bob Budd, John Mitchell, and Greg Simonds have all be en named to the Rangelands Workgroup. Project Manager Robin O'Mally will speak at the Rangeland Assessment and Monitoring Sponosium on the afternoon of February 15th at the Annual Meeting in Boise.

The Invasive Species Advisory Committee, authorized by a U.S. Presidential Executive Order, functions to provide advice to a national Invasive Species Council. The Committee will provide expert advice on an array of issues related to minimizing economic, ecological and human health impacts that invasive species cause. The Council is co-chaired by the Secretaries of the Interior, Agriculture, and Commerce. Celestine Duncan, owner of Weed Management Services, in Helena, Montana and Steve Dewey, Extension Weed Specialist at Utah State University, have both been named to the committee. The success in getting both Celestine and Steve named to the committee was due largely to the high quality nomination proposals prepared by the SRM Invasive Species Committee under the leadership of Larry Howery.

A couple of other activities currently underway are setting up contacts in the Washington D.C. area for President Kendall Johnson's visit in early February and joining in an effort led by the Wildlife Management Institute to interact with U.S. Department of Agriculture leadership to express support for extension programs.

I hope to get the opportunity to visit with many of you at the Annual Meeting. I look forward to hearing your thoughts on the bases we should be covering and suggestions on how to get it done. See you in Boise!

Deen Boe

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