

Achievements in management and utilization of privately-owned rangelands

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Abstract

Historically, there have been several seminal achievements in management and utilization of privately-owned rangelands. The most important of the early achievements were domestication of livestock, fencing, haying, and the transfer of federal lands to private ownership. Later, federal programs to stimulate range research and extension were the springboard for the modern range research complex. The Morrill Acts established the land-grant institutions with agricultural research as one of the founding principles. The Hatch Act later provided funding for agricultural research, and the Smith-Lever Act funding for the extension of that research to the agricultural industry. Recent trends have been away from funding applied research and towards funding for basic research defined by the political scientific bureaucracy. Those achievements that I consider of major influence in management and utilization of rangelands include: defining stocking rate-animal performance relationships, refining prescribed burning techniques, formulation of selective-translocated herbicides, developing plant varieties and seeding methods for reseeding, matching forage quality with nutritional requirements of livestock, basic research on morphologic and physiologic characteristics of range plants, and information dispersal through extension and federal agencies for better management of rangelands. The future is uncertain, and unless we can reverse the trend away from applied to wholly basic research funding, we will have fewer achievements in managements of privately-owned rangeland.

Key Words: range management, range utilization, Hatch Act, Smith-Lever Act, university research, ARS research

On 27 January 1955, Arthur Sampson, called by many the Father of Range Management, delivered an address at the 8th Annual Meeting of the American Society for Range Management in San Jose, California (Sampson 1955). That address dealt with 2 aspects of range management: 1) an appraisal of the influence of research in formulating range management practices at that time, and 2) the future research needs of the field of range management. This paper is retrospective, evaluating the impact of past research efforts and other events that may have shaped the management and utilization of rangelands. In 1989, Dr. Sampson's widow and her sister bequeathed almost 3,000 acres of excellent bluestem range to the range research program at

Kansas State University. Not only did Dr. Sampson contribute greatly to the range profession, but through his wife's gift, that contribution continues. In his talk, Dr. Sampson stated, "In future years, progress in range rehabilitation will depend upon the effectiveness of the research program and the extent to which the findings have been applied". This talk will, in part, deal with whether we have been effective in research and whether we have applied those research findings extensively.

Achievements are relative. Obviously, the first step by a child is monumental in the eyes of proud parents, but hardly earthshaking to others. However, that first step may be the first for an Olympic champion. So, my initial task will be to put achievements in management and utilization of privately-owned ranches into a framework that highlights the simple, but monumental, first steps towards better use of rangelands.

The initial achievement that started all management of rangelands was the domestication of ungulate herbivores. The hunter/gatherer society merely existed within the framework of natural ecosystems and did not alter resource allocation or control population dynamics. Once animals were domesticated and controlled, mankind became a harvester/manipulator (Van Dyne 1966) with the power to alter temporal and spatial utilization of rangelands. His wealth was determined largely by the numbers of animals and range resources that he controlled. With only the range resource with which to work, movement away from the hunter/gatherer system was minimal. Agrarian pursuits allowed for greater control over livestock numbers. One single achievement in range and forage science, haying, had profound historical consequences. Dyson (1988), a theoretical physicist, summarized that monumental achievement in management and utilization of forages as follows:

"The technologies which have had the most profound effects on human life are usually simple. A good example of a simple technology with profound historical consequences is hay. Nobody knows who invented hay, the idea of cutting grass in the autumn and storing it in large enough quantities to keep horses and cows alive through the winter. All we know is that the technology of hay was unknown to the Roman Empire but was known to every village of medieval Europe. Like many other crucially important technologies, hay emerged anonymously during the so-called Dark Ages. According to the Hay Theory of History, the invention of hay was the decisive event which moved the center of gravity of urban civilization from the Mediterranean basin to Northern and Western Europe. The Roman Empire did not need hay because in a Mediterranean climate the grass grows well enough in winter for animals to graze. North of the Alps, great cities dependent on horses and oxen for motive power could not exist without hay. So it was hay that allowed populations to grow and civilizations to flourish among the forests of Northern Europe. Hay moved the greatness of Rome to Paris and London, and later to Berlin and Moscow and New York."

Certainly, there are few in the forage and range professions who can lay claim to such an achievement as that provided by an anonymous visionary centuries ago. Therefore, park your egos at the door, while many recent achievements have been noteworthy, they pale in comparison to those simple yet essential achievements of yesteryear.

Fast forward to the late 19th and early 20th centuries. A general statement that rangelands had been abusively grazed during the latter half of the 19th century is largely accepted. Certainly, those areas that remained in federal ownership and were grazed as open range were subject to overgrazing. Cotton (1904) reported on range conditions of Central Washington and stated that "the deterioration of the range is due to overgrazing, and so long as it remains public domain little can be done to improve its condition. In most cases, the stockman using the range is trying to get all out of it that he can without reference to the future. He is not to be blamed for using it in this manner, for he knows that if he does not, some one else will." One could conclude from that statement that a singularly great achievement in rangeland use would be the transfer of that land to private ownership. While that conclusion may be valid, it would be an egregious error to lay range deterioration due to overgrazing entirely at the foot of ownership. It is likely a misconception that free grazing leads to overstocking. Certainly, private rangelands have been rated as having a higher range condition by the various schemes for determining that elusive somewhat arbitrary value judgment. Land ownership lies in the private sector in the Great Plains and eastern forest ranges, while over half the western range area is federally owned. Ownership has had an impact on the condition of rangelands. Estimates of range condition for North and South Dakota, Nebraska, and Kansas indicated 66% of the private rangeland in those states was in good to excellent condition, while western rangelands had 72% of their area in poor to fair condition. Private ownership apparently was incentive to maintain quality rangeland (USDA 1974). Unfortunately, conclusions have been drawn with that limited scope. Perhaps, the most convincing evidence that rangelands in the Public Domain were in the poorest condition lies in the land alienation scheme. Those lands with deeper soils and with water were taken under the various land alienation acts, leaving extremely low-productivity areas as public rangeland (Kollmorgen 1969). During the

late 19th century throughout the Great Plains region, even privately-owned range areas were considered severely deteriorated. Ownership issues did not entirely explain the apparent abusive grazing behavior.

Economic incentive on privately-owned rangelands is almost always the reason for change (Conner 1991). Possibly, the salvation of privately-owned rangelands in this country can be attributed to the a single mechanical device, the livestock scale. Until such time as there was an economic penalty for reduced individual animal performance due to overgrazing, the economic advantage was for maximum numbers with reasonable weight and health considered. As long as livestock were sold on a per head basis with little economic penalty for differences in weight, most livestock producers grazed at rates which supported the greatest numbers of livestock, not the fattest. With the advent of marketing of livestock on a per pound basis, the first true impact of range research programs could be realized. Stocking rate studies sprouted in almost every state to quantify stocking rate/animal gain relationships. While these studies were not revolutionary in their design or outcome (they were designed such that a rate that had been shown to be sustainable and with the greatest number of animals would be the most desirable, i.e., moderate stocking), they allowed range management specialists to show economic benefit from stocking rates that were less than could be sustained with reduced individual performance but highest gain per unit area (heavy grazing).

Certainly, domestication of ungulates, planting and harvesting of crops, hay making, and changes in marketing were the prominent features that set range management and utilization on its present course. Before enumerating the modern-day achievements, it is necessary to detail the research setting that produced those achievements.

Range Research

Certainly, one of the major achievements in utilization and management of rangelands was the development of the research and extension infrastructure. That infrastructure has its roots in several acts of Congress that centered the range research capacity in the states. By providing land grants, the First Morrill Act (1862) was intended to provide colleges for the benefit of agriculture and mechani-

cal arts. Those lands were to be used to provide funding for establishment and operation of the land-grant institutions. To further stimulate agricultural research, the Hatch Act (1887) provided funding to establish agricultural experiment stations in connection with the colleges previously established by the Morrill Act. Other subsequent acts including the Adams Act - 1906, the Purnell Act - 1925, and the Bankhead-Jones Act -1925 and 1946 reaffirmed the policy of the Congress to continue support of the state agricultural experiment stations. In 1890, Congress passed the Second Morrill Act which provided direct appropriations to states that showed race or color was not an admissions criterion. In the segregated south, separate institutions were allowed under this bill, thereby creating the so-called 1890's institutions. The American Indian Higher Education Council (AIHEC) successfully lobbied Congress in 1994 to attain land-grant status for 29 tribal colleges. The other piece of the research puzzle was the Agricultural Research Service (ARS) which was established on 2 November 1953, which merely renamed the research by USDA personnel. Congress first authorized federally supported agricultural research in the Organic Act of 1862, which established what is now USDA.

Since knowledge, not communicated, is not knowledge, the establishment in 1914 of a partnership between the USDA and the land-grant universities, as the Cooperative Extension Service under the Smith-Lever Act, was seminal in the goal of improved management and utilization of rangelands. Further dispersal of range research findings was precipitated by the passage of the Soil Conservation Act in April of 1935 in response to soil erosion, primarily associated with recurring droughts. Without a doubt, the Information Age has dawned, and with the almost instantaneous electronic dissemination of information will accelerate the changes wrought by current and future research.

Our current research is only as good as the foundation that was laid earlier. That foundation was based on a different research philosophy than currently exists. Imagine getting extramural funding to do a stocking rate study or a life history study today. Originally, research on rangelands was largely funded by agricultural experiment stations with formula funding from federal and state sources and the ARS. Recently, there has been great concern over funding sources for applied and basic research (Engle and Waller 1993). Derner

(1994) provided support for that contention. He concluded that the decline in federal and state funding for applied research has led to an increased emphasis on extramural funding that is largely in the basic research area. With only 5% of all grant proposals funded, a premium is being placed on recruits to the range research system with the ability to attract extramural funding. That funding is inherently inefficient with typical projects lasting only 2–3 years, with a startup time of several months to a year and a phase out time of several months as well, research topics are severely limited and are in no way conducive to long-term answers to complex issues. Research topics are selected at a national level to ostensibly reduce the chance of failure and to spend research dollars wisely. To insure that the research will be successful, 3 or more peer reviews are conducted to further reduce the risk of failure. **The magnitude of the risk taken is likely the magnitude of the discovery.** Our research infrastructure is designed to minimize risk, thereby minimizing the magnitude of our discovery. While more emphasis should likely be placed on applied research, basic research must be funded as well, but not at the expense of the applied area.

What does the privately-owned ranching community want from research? There is certainly an indication from my years in the Kansas Flint Hills that changing management strategies is relatively rare. Woodrow Wilson said, "If you want to make enemies, try to change something". Change has occurred and some of that change has been good and some bad. In general, the research that the rancher wants on privately-held rangelands leads to a greater profit while maintaining a diverse healthy resource (Conner 1991). He wants that knowledge provided to him in clear, concise language easily applied to his operation. That requires a strong link between those who communicate with the rancher and the researcher. In general, the rancher wants to be respected for his conservation of the resource as well. While it is certainly to his benefit to maintain a healthy resource, there are management strategies that may significantly alter the resource and still maintain a profit. The rancher typically shuns those.

What has the research community provided to the ranching industry? Those major achievements in the management of privately-owned rangeland are enumerated below. Certainly, there will be those I miss, but quoting Desai, "An expert gives an objective view. He gives his own

view." Larry Newell, a former grass breeder at the University of Nebraska-Lincoln, rose at the Western Grass Breeders Conference in Manhattan, Kans. in 1965 and opined, "I am particularly impressed with my views on this matter and they are....". I don't profess to be as confident as Dr. Newell was at that time, but here are my candidates for significant achievements in utilization and management of privately-owned rangelands.

- **Documentation of the relationship between stocking rate and animal performance.**

Undoubtedly, the major modern achievement was characterizing and quantifying the relationships among stocking rate and per animal and per head gains on rangelands. Undoubtedly, economic forces would have defined stocking rate in a similar manner, but the huge database that was created by stocking rate studies throughout the country offered experimental results that could be used in convincing ranchers that proper stocking rates were the most advantageous. Because economic health required good rangeland health, rangelands generally have improved during this century. Misconceptions still abound within this basic relationship. One common problem arises when range specialists advise that increased range condition will ultimately lead to a greater total amount of livestock product to sell. Improved range condition, any way you wish to define it, relies on reduction in stocking rate which improves per head production but reduces production per unit area. Ranchers know that! Apparently, we as range researchers do not. The illusion that the improvement in range condition will increase livestock production per unit area seems like common sense. Common sense is what tells you the world is flat. To this day, there is a perception in the minds of many that the reason for reductions in livestock gains or reproductive performance is due to a lack of forage quantity, when in reality, for almost all situations, it is the quantity of quality forage that determines livestock productivity.

- **Formulation of selective, translocated herbicides.**

The secret discovery of 2,4-dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic (2,4,5-T) during World War II was not one of those contributions of war. In reality, the work had begun much before and only because of the potential of many compounds in bio-

logical warfare was there any restriction on the publication or use of the phenoxy herbicides for agricultural purposes (Peterson 1967). Phenoxy herbicides have their origin in the 1930's with work by familiar faces such as F.W. Went, A.E. Hitchcock, P.W. Zimmerman who were working with growth regulators. By late 1944, the first publication concerning herbicidal activity of 2,4-D was reported in by Hamner and Tukey (1944). Because phenoxy herbicides selected mostly dicot plants, they were ideal in control of broadleaf plants in grassland range. While this important achievement was important to improving rangelands that had changed from grass dominance to weedy forb and woody species, it provided an escape from the ultimate question, why did the change occur. The popular whipping boy was of course overgrazing. It is likely that overgrazing was only one cause. Many changes from natural controls likely could be identified as culprits in weed and brush invasions in rangelands. Reductions in fire frequency and change from multifaunal to monofaunal grazing were likely as important or more important than overgrazing. As herbicides have been banned from use on rangeland, i.e. 2,4,5-T, new research has and will continue to focus on the natural controls of many weed species, including prescribed fire and grazing with more than one species of livestock.

- **Implementation of prescribed burning.**

The reintroduction of fire into range plant communities has promoted changes in plant populations that may more nearly represent stable natural ecosystems. Timing, frequency and fire intensity have been the primary areas of research and fire prescriptions can attain many and varied range management objectives. Included in those objectives are weed and brush control, improved grazing distribution, increasing forage quality, wildlife habitat manipulation, removal of excessive litter accumulations, and seedbed preparation.

- **Reseeding and genotypic identity of range plant materials.**

Because large areas of rangeland which were plowed could not sustain tillage agriculture, there was a need to return them to self-sustaining ecosystems. Also there were areas where mechanical brush control left rangelands devoid of grazeable vegetation. Secondary successions on these sites were slow to extremely slow, so reseeding was introduced to speed the

transition of formerly-tilled areas to ecosystems that approximated the former natural rangeland. Research has addressed time and depth of planting, seedbed preparation, rangeland drill design and function, and plant materials. One important achievement was the development of so-called "named varieties", cultivars that had known genetic origin and adaptation. The range seed production industry has provided those cultivars for revegetation during the past 50 years or so. Soil Bank and Conservation Reserve Programs have benefited greatly from the ability to supply adapted seed to diverse ecologic zones throughout the privately-owned range areas.

• Matching forage quality with forage requirement.

Over many decades, there has been a concerted, mostly successful effort to describe quality of numerous forages using various quality tests. Concurrently, range animal nutrition groups have defined the nutritional requirements of range livestock. The admirable achievement of these groups has been to provide, through supplementation or complementary forages, diets which match requirement and availability for growth and reproductive livestock enterprises. While use of complementary forages and supplements has been a part of range use a century or more, the refinement provided by recent research has improved livestock production efficiency greatly.

• Basic research on the physiology and morphology of range plants.

Management strategies have been tailored to accomplish certain management objectives using information on food reserve cycles, meristem placements, nutrient status, propagation strategies, and water relations. Examples of improved utilization of rangelands include proper timing of herbicide application, haying, mechanical brush control, and prescribed fire based on translocation of storage carbohydrates to reserve storage organs. Knowledge of translocation of nutrients from senescing leaves is important in forage quality decisions. Grazing system design relies heavily on source/sink relationships of carbon and other nutrients. The use of mechanisms elucidated through basic research has fueled the modeling effort in range ecosystems. Indeed, the why of plant physiology and morphology is critical in development of the management practices applied to rangelands.

• Implementation of grazing systems that improve both plant and animal components.

Research on grazing systems was likely fueled most by the desire to improve range areas that had suffered from overgrazing. Indeed, a critical look at the results from most grazing studies shows that in almost all cases plant productivity improved, but in almost all cases individual animal productivity declined. The greatest achievements in grazing system research and application comes from those systems that have fostered improvement of range health without reduced or with improved individual animal productivity (Launchbaugh et al. 1978). Research in the grazing systems area has been difficult because of the tremendous capitol required for experimental designs to test those systems. Research on grazing systems requires that each treatment be compared using equal stocking rates and equal pasture size and uniformity. When those design criteria have been met, it is difficult to justify use of most grazing systems if both animal and plant health is considered. Recent work has explained much of the perceived greater plant production on many specialized grazing systems. If there is reduced animal performance, then there is reduced forage quality, and if there is reduced forage quality then there is reduced intake. That translates into a greater amount of herbage remaining at the close of the grazing season. Increasing stocking rates to take advantage of the increased forage remaining further reduces individual animal performance. One could conclude that after almost a century of grazing systems research that few systems address the needs of both the plant and the animal.

• Information dispersal.

The development of the state and local extension systems has given the range research community an opportunity disperse discovery to the entire ranching community. Combined with the Natural Resource Conservation Service conservation districts, we have been fortunate to be able to reach the individual rancher with relative ease, provided that rancher wished to be reached and the message was legitimate. The owner/operator on privately owned rangelands has no obligation to seek or take advice from those dispensing it. There must be a 2-way street in ranchers relations. Much of the research that has proved successful in the past has originated in communication between the ranching community and the research/extension

groups. The future promises an even greater opportunity. Through electronic access, information will become available more quickly and extensively. All extension and research publications within a state will be available and direct access to the researcher through e-mail will aid in greater achievements in management and utilization of privately-owned rangelands.

What other clientele groups exist for the range research community? Privately-owned rangelands, while an economic enterprise, may and likely should serve others groups as well. Quality water resources, wildlife, and aesthetic values are derived from those areas. These resources offer another potential income source, but the ranching community in many areas has not exploited that area. Hunting leases are common in certain range areas, almost nonexistent in others. Scenic easements have been purchased in some areas for their aesthetic value. Because these resources reside in private hands, both government and the individual must interact with the ranching community to serve the needs of the broader population. There must be a cooperative spirit with little confrontation and a great deal of understanding on both sides, private and public.

Where have we failed? Failure in the research area is not defined as research which was not useful in improving rangelands. We have spent huge amounts on range fertilization, grazing systems, plant introductions, and trying to predict herbage production with little success, but the information we received has been useful in selecting profitable practices. Alternatively, failure should be defined as not addressing problems which were known. Probably the greatest deficiency in the range research effort has been the lack of resources devoted to the economic area. If one enumerates the number of research publications devoted to different research areas, they will find that there are relatively few published studies in the range economics area. In fact, the number of research programs that regularly include an economic component is minuscule. We have generally failed to provide cost/benefit information for most of our recommendations. It seems the rancher must be the researcher when it comes to risk of capitol and labor.

Conclusions

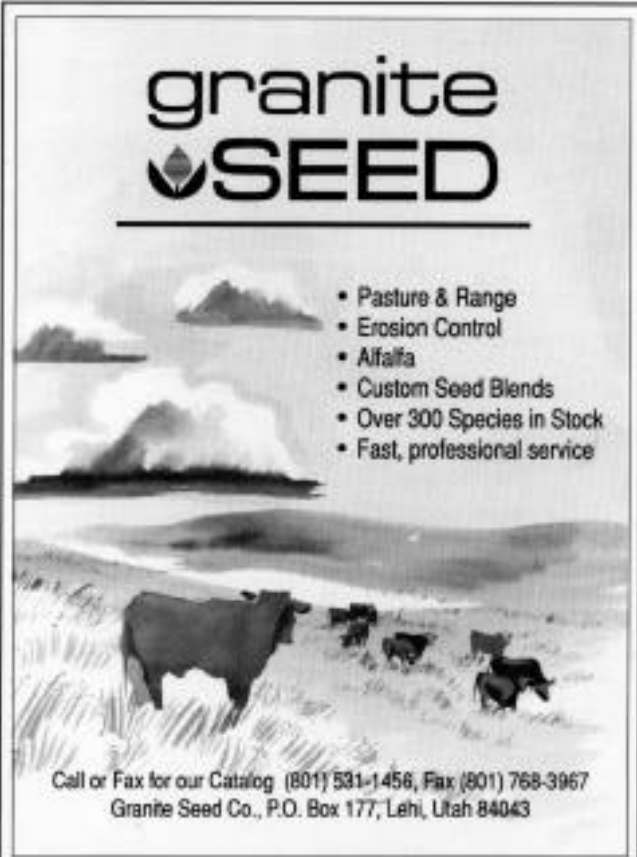
In most ways, the management and utilization of private rangelands has changed little since Dr. Sampson's address, and

that is likely the course that should have been followed. With natural ecosystems constrained by numerous resource deficiencies, management strategies must conform to those natural mechanisms that define rangeland productivity and response to perturbations. Because of the low economic output from the range enterprise, costly inputs must be justified economically. Rarely have we found management inputs that significantly improved the profitability of the ranching enterprise. Indeed, the most significant research findings and their application have been the reimposition of some natural ecosystem process, such as fire, that had been eliminated from the ecosystem previously. Research that improves the efficiencies of resource allocation and utilization will offer opportunity to improve management and utilization of privately-owned rangelands. Examples of research that has and will improve the economic status of the rancher include those that improve the conversion of ingested forages to the maximum amount of salable product, and

research that improves the conversion efficiency of scarce ecosystem resources to forage for wildlife and livestock. I tell my class at the beginning of each semester that they can have the short version of the course or the semester-long version. The short version is "to put the proper number of livestock on the range at the proper time of year and for the proper duration". Our job in research is to define the proper livestock number, the proper time of the year, and the proper duration. The semester-long version merely justifies my existence.

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