

Grazing Systems Research in the Nebraska Sandhills

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Grazing systems define the arrangement of grazing and non-grazing periods within a grazing season and/or year. A grazing system should be looked at as a tool used to achieve enterprise goals and objectives within a set of environmental, economic, resource, and management factors. There is an endless number of potential grazing systems because a grazing system should be custom-made for each situation. Conceptually, there are three categories of grazing systems used in the Nebraska Sandhills: season-long continuous grazing, deferred-rotation grazing, and short duration or management intensive grazing. This review of grazing systems will be based largely on a 10-year research project conducted at the University of Nebraska's Barta Brothers Ranch (BBR) located about 30 km south of Long Pine, Nebraska.



Figure 1. Cow/calf pairs on upland range at the Barta Brothers Ranch.

BBR Research Design and Results

The project was initiated in 1999 on upland range at BBR to compare deferred rotation (DR) grazing and short duration grazing (SDG) in terms of botanical composition and production of vegetation cover and diet quality and weight gains of grazing cattle (Figure 1). Twenty-four pastures (50 to 70 ha each) on upland ecological sites (sands, sandy, and choppy sands) were allocated to two, 4-pasture DR grazing systems and to two, 8-pasture SDG systems. Rangeland vegetation was dominated by a mixture of warm-season tallgrasses (e.g., prairie sandreed and switchgrass), but also included significant components of cool-season grasses (e.g., porcupinegrass and prairie junegrass),

forbs (e.g., western ragweed and stiff sunflower), and shrubs (e.g., leadplant and rose). The pastures were grazed each year (from 1999 through 2008) from about May 15 to October 15 by cow/calf pairs at 0.75 AUM/acre. Each pasture in the two DR systems was occupied once during the grazing season for 30 to 45 days;

whereas, each pasture in the two SDG systems was occupied three times during the growing season for 2 days (early season), 6 or 7 days (mid season), and 10 to 12 days (late season), respectively (Figure 2). Measurements were taken during the course of the study to quantify plant and animal responses to the grazing systems, including: standing crop in grazing exclosures clipped in mid-June and mid-August of each year; botanical composition based on frequency of occurrence in 1998 (pre-treatment), 2003, and 2008; quality of diet samples

collected by esophageally fistulated cows in 2005 and 2006; and average daily gains of spayed heifers grazing with the cow/calf pairs in 2006, 2007, and 2008.

Grazing system had very little effect on botanical composition changes over the 10 years of the study, although the warm-season grasses sand bluestem and little bluestem showed a greater increase in frequency of occurrence on DR pastures than on SDG pastures. Overall, botanical composition changes were much more responsive to trends in rainfall and topography (e.g., dune tops vs. interdune areas) than to grazing system. Herbage production generally did not differ between the two grazing systems over the study period (Figure 3). The only differences occurred in

(continued on page 4)

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Note: Opinions expressed in this newsletter are those of the authors and do not necessarily represent the policy of the Center for Grassland Studies, the Institute of Agriculture and Natural Resources or the University of Nebraska.

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FROM THE DIRECTOR

“Grass is that indispensable form of plant life without which civilization, as we know it, would not exist on the earth today.” (Archer, Sellars G. and Clarence B. Bauch. 1953. *The American Grass Book*. University of Oklahoma Press. Norman).

The above statement was used by the authors to introduce the first chapter of their book (cited above) on the subject of the importance of grass. Even though this statement was written 57 years ago, it is still true today. Just how important are grasses to society’s health and economic well being? If we did not have corn, wheat, rice, millets and other cereal grains, we would not have the basic foods of nearly all of the people on the earth. Without these crops, you would have largely fruits, nuts and vegetables, which are grown on relatively small areas of good land, but not producing nearly enough food to feed today’s population. Few of these latter crops are adapted to dry upland or wet marshy conditions. The fruits from plants like corn, rice, wheat and millets are used to produce a wide array of products for human consumption. Try to think of a time recently when you have had a meal that did not contain a product from one of these grasses.

Next, if you eliminate those animals that sustain themselves largely on grass, you have lost most of those, except for swine, that produce our milk and meat plus any draft animals and pleasure horses. Also, one is reminded that a number of birds that depend on grass or grass seeds also add to our food supply.

During most of our history, grasses have been an important source of energy. First, through the use of draft animals that depended largely on grasses for their energy, and more recently as feedstock for renewable liquid energy. Both corn and sugarcane have been primary sources of feedstock for today’s ethanol production, whereas cellulosic biomass produced largely from grasses is expected to be a primary source of feedstock for renewable liquid fuels in the future.

In addition to the primary uses of grasses for food, feed and renewable fuels, they are also used as sources of fibers, pulp and paper, and specialty chemicals. Imagine what our environment would be like if we had no grasses to cover our lawns and home landscapes, golf courses, parks and other recreational areas. Grasses are further used to control soil erosion by wind and water, and for water purification and soil remediation.

Grasslands maintain a tremendously wide diversity of life forms from the smallest bacteria to large animals such as bison and elephants, while providing many other environmental benefits. Grasses have one of the widest ranges of adaptability of any group of higher plants ranging from high altitudes in the polar regions to the tropical areas, and from dry desert regions to those areas where the roots are continuously covered with water. Grasses grow and reproduce under essentially all environments on the surface of the earth. All of us need to work on increasing the awareness of the importance of grasses and grasslands in underpinning our modern society while ensuring a viable and sustainable future.

I hope you enjoy reading in this issue of our newsletter John James Ingalls’ ode to blue grass as printed in the USDA 1948 yearbook of agriculture.

M. A. Massengale

Ingalls' Ode to Blue Grass

[Editor's note: The following was written by John James Ingalls (1833-1900) and appeared in *Grass: The 1948 Yearbook of Agriculture*. That yearbook served as inspiration for *Grassland: Quietness and Strength for a New American Agriculture*, which was published in 2009. See the Resources section of this newsletter for information on these two publications. Below is exactly how the Ingalls' speech excerpt appeared in the 1948 yearbook.]

IN PRAISE OF BLUE GRASS John James Ingalls (1833-1900)

John James Ingalls was Senator from Kansas from 1873 to 1891. An address of his, printed in the *Kansas Magazine* in 1872 and here reprinted in part because copies of it are hard to get, contains a passage that is quoted often. He was an eloquent man but not a scientist.

ATTRACTED by the bland softness of an afternoon in my primeval winter in Kansas, I rode southward through the dense forest that then covered the bluffs of the North Fork of Wildcat. The ground was sodden with the ooze of melting snow. The dripping trees were as motionless as granite. The last year's leaves, tenacious lingerers, loath to leave the scene of their brief bravery, adhered to the gray boughs like fragile bronze. There were no visible indications of life, but the broad, wintry landscape was flooded with that indescribable splendor that never was on sea or shore – a purple and silken softness, that half veiled, half disclosed the alien horizon, the vast curves of the remote river, the transient architecture of the clouds, and filled the responsive soul with a vague tumult of emotions, pensive and pathetic, in which regret and hope contended for the mastery. The dead and silent globe, with all its hidden kingdoms, seemed swimming like a bubble, suspended in an ethereal solution of amethyst and silver, compounded of the exhaling whiteness of the snow, the descending glory of the sky. A tropical atmosphere brooded upon an arctic scene, creating the strange spectacle of summer in winter, June in January, peculiar to Kansas, which unseen cannot be imagined, but once seen can never be forgotten. A sudden descent into the sheltered valley revealed an unexpected crescent of dazzling verdure, glittering like a meadow in early spring, unreal as an incantation, surprising as the sea to the soldiers of Xenophon as they stood upon the shore and shouted "Thalatta!" It was Blue Grass, unknown in Eden, the final triumph of nature, reserved to compensate her favorite offspring in the new Paradise of Kansas for the loss of the old upon the banks of the Tigris and Euphrates.

Next in importance to the divine profusion of water, light, and air, those three great physical facts which render existence possible, may be reckoned the universal beneficence of grass. Exaggerated by tropical heats and vapors to the gigantic can congested with its saccharine secretion, or dwarfed by polar rigors to the fibrous hair of northern solitudes, embracing between these extremes the maize with its resolute pennons, the rice plant of southern swamps, the wheat, rye, barley, oats, and other cereals, no less than the humbler verdure of hill-side, pasture, and prairie in the temperate zone, grass is the most widely distributed of all vegetable beings, and is at once the type of our life and the

emblem of our mortality. Lying in the sunshine among the buttercups and dandelions of May, scarcely higher in intelligence than the minute tenants of that mimic wilderness, our earliest recollections are of grass; and when the fitful fever is ended, and the foolish wrangle of the market and forum is closed, grass heals over the scar which our descent into the bosom of the earth has made, and the carpet of the infant becomes the blanket of the dead.

As he reflected upon the brevity of human life, grass has been the favorite symbol of the moralist, the chosen theme of the philosopher. "All flesh is grass," said the prophet; "My days are as the grass," sighed the troubled patriarch; and the pensive Nebuchadnezzar, in his penitential mood, exceeded even these, and, as the sacred historian informs us, did eat grass like an ox.

Grass is the forgiveness of nature – her constant benediction. Fields trampled with battle, saturated with blood, torn with the ruts of cannon, grow green again with grass, and carnage is forgotten. Streets abandoned by traffic become grass-grown like rural lanes, and are obliterated. Forests decay, harvests perish, flowers vanish, but grass is immortal. Beleaguered by the sullen hosts of winter, it withdraws into the impregnable fortress of its subterranean vitality, and emerges upon the first solicitation of spring. Sown by the winds, by wandering birds, propagated by the subtle horticulture of the elements which are its ministers and servants, it softens the rude outline of the world. Its tenacious fibres hold the earth in its place, and prevent its soluble components from washing into the wasting sea. It invades the solitude of deserts, climbs the inaccessible slopes and forbidding pinnacles of mountains, modifies climates, and determines the history, character, and destiny of nations. Unobtrusive and patient, it has immortal vigor and aggression. Banished from the thoroughfare and the field, it bides its time to return, and when vigilance is relaxed, or the dynasty has perished, it silently resumes the throne from which it has been expelled, but which it never abdicates. It bears no blazonry or bloom to charm the senses with fragrance or splendor, but its homely hue is more enchanting than the lily or the rose. It yields no fruit in earth or air, and yet should its harvest fail for a single year, famine would depopulate the world.

One grass differs from another grass in glory. One is vulgar and another patrician. There are grades in its vegetable nobility. Some varieties are useful. Some are beautiful. Others combine utility and ornament. The sour, reedy herbage of swamps is baseborn. Timothy is a valuable servant. Redtop and clover are a degree higher in the social scale. But the king of them all, with genuine blood royal, is Blue Grass. why it is called blue, save that it is most vividly and intensely green, is inexplicable, but had its unknown priest baptized it with all the hues of the prism, he would not have changed its hereditary title to imperial superiority over all its humbler kin.

Taine, in his incomparable *History of English Literature*, has well said that the body of man in every country is deeply rooted in the soil of nature. He might properly have declared that men were wholly rooted in the soil, and that the character of nations, like that of forests, tubers, and grains, is entirely determined by

(continued on next page)

the climate and soil in which they germinate. Dogmas grow like potatoes. Creeds and carrots, catechisms and cabbages, tenets and turnips, religions and rutabagas, governments and grasses, all depend upon the dew point and the thermal range. Give the philosopher a handful of soil, the mean annual temperature and rainfall, and his analysis would enable him to predict with absolute certainty the characteristics of the nation.

Calvinism transplanted to the plains of the Ganges would perish of inanition. Webster is as much an indigenous product of New England as its granite and its pines. Napoleon was possible only in France; Cromwell in England; Christ, and the splendid invention of immortality, alone in Palestine. Moral causes and qualities exert influences far beyond their nativity, and ideas are transplanted and exported to meet the temporary requirements of the tastes or necessities of man; as we see exotic palms in the conservatories of Chatsworth, russet apples at Surinam, and oranges in Atchison. But there is no growth: nothing but change

of location. The phenomena of politics exhibit the operations of the same law....

The direct agency upon which all these conditions depend, and through which these forces operate, is food. Temperature, humidity, soil, sunlight, electricity, vital force, express themselves primarily in vegetable existence that furnishes the basis of that animal life which yields sustenance to the human race. What a man, a community, a nation can do, think, suffer, imagine or achieve depends upon what it eats.

* * *

The primary form of food is grass. Grass feeds the ox: the ox nourishes man: man dies and goes to grass again; and so the tide of life, with everlasting repetition, in continuous circles, moves endlessly on and upward, and in more senses than one, all flesh is grass. But all flesh is not bluegrass. If it were, the devil's occupation would be gone.

Grazing Systems Research in the Nebraska Sandhills (continued from page 1)

mid-August of 2001 and 2007 when standing crop was 33% and 17% greater, respectively, on DR pastures than on SDG pastures. Overall, vegetation responses to grazing system were negligible.

A) Short duration grazing.

Pasture	May	June	July	August	September	October
1						
2						
3						
4						
5						
6						
7						
8						

B) Deferred rotation grazing.

Pasture	May	June	July	August	September	October
1						
2						
3						
4						

Figure 2. Grazing periods for (A) an 8-pasture short duration grazing system and (B) a 4-pasture deferred rotation grazing system at the Barta Brothers Ranch in the eastern Nebraska Sandhills.

Crude protein content and digestibility of diets of grazing cattle did not differ between the two grazing systems in 2005 and 2006. Crude protein content of diets declined from as much as 15% in May to 7 or 8% in October in the two years. In vitro dry matter digestibility of the diets decreased from 65 to 70% in May to less than 45% in October of the two years. Heifer daily gain averaged 0.84 kg/head/day and was not different between grazing systems or years. With similar diet quality and stocking rates between the two grazing systems, weight gains of heifers would not be expected to differ between the grazing systems.

Management Implications

Multiple grazing periods (two or more) and relatively large numbers of pastures (seven or more) are key components of SDG and are reported to optimize overall grazing efficiency of SDG systems. High grazing efficiency is commonly associated with SDG because of improved grazing distribution and control of frequency

of grazing. An assumption commonly made when expecting high grazing efficiency from SDG is that grazed forage plants will grow following a defoliation event. There are three primary reasons why growth following grazing is essential to the premises of SDG, including increased grazing efficiency. 1. New growth of a previously grazed plant should not be grazed within the same grazing period, so grazing periods should be relatively short to avoid a second grazing of a plant in the same grazing period. 2. Forage grasses can be "maintained" in a vegetative stage of growth because grazed vegetative tillers will continue to grow and stimulate growth of new vegetative tillers, thus minimizing the number of low-quality and non-palatable reproductive tillers. 3. Defoliated grass plants will produce more aboveground biomass than a non-defoliated plant (a.k.a., compensatory growth). Conceptually, the multiple grazing periods of SDG are designed to take advantage or manage the rapid growth of forage plants following defoliation. Properly planned grazing and recovery periods are used to manage for intensity and frequency of grazing. The multiple grazing periods are designed to keep the forage plants largely in a vegetative stage of growth and to manage for compensatory growth.

In semi-arid regions such as the uplands of the Nebraska Sandhills, soil moisture is relatively low by mid to late growing

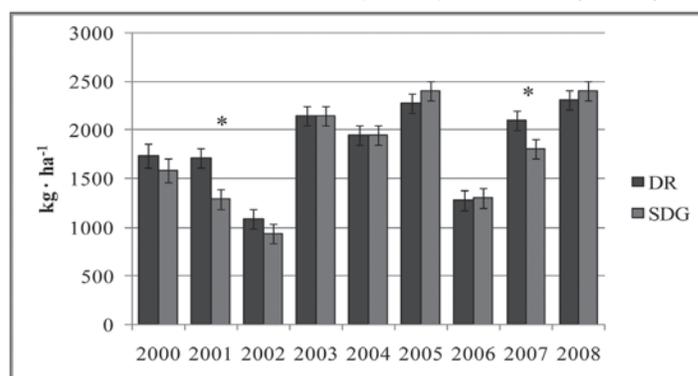


Figure 3. Mid-August standing crop (kg/ha) from 2000 through 2008 for deferred rotation grazing and short duration grazing at the Barta Brothers Ranch.

season in most years. The relatively high grazing pressure in the early growing season required of SDG (to attain spatial uniformity of defoliation) is risky when adequate soil moisture for new growth following defoliation is uncertain. And with low soil moisture, compensatory growth cannot occur. Moreover, native perennial grasses in the Sandhills reproduce vegetatively and most grass tillers remain vegetative throughout the growing season. Even in pasture that is not grazed until late growing season, a majority of the grass tillers are vegetative. Briefly, multiple grazing periods of SDG do not appear to provide the reported benefits on upland Sandhills range. Deferred rotation grazing does not depend on new growth from defoliated plants as a forage source. In fact, with two pastures of a 4-pasture DR grazing system held back for grazing until the last half of the grazing season (August, September, and October), DR grazing is based on stock piling forage produced early in the season for grazing later in the growing season, which is a good match for the Sandhills. Our research has shown that 60 to 75% of annual forage production on Sandhills rangeland occurs by June 15, which is only one-fifth of the way into the growing season. Therefore, for a management unit (set of pastures), much of the forage biomass to be grazed in the last half of the growing season is produced early in the season.

Finally, much of the reported improvement in vegetation cover and grazing distribution seen in moving from extensively-managed grazing with large pastures to SDG systems likely is a result of decreasing pasture size and distance to water and improved pasture design (e.g., fencing along ecological/range site boundaries). Based on the results of our study, there are no

vegetation productivity and animal performance improvements with SDG when compared to properly-designed DR grazing on upland Sandhills rangeland; therefore, the added infrastructural and management-related expenses associated with SDG cannot be justified. When planning for DR grazing on upland Sandhills sites, properly designed systems should include the following:

- Each pasture should be of similar ecological/range site.
- Distance to water in each pasture should not be greater than ¼ to ½ mile.
- Timing of grazing is a critical consideration.
 - For rangeland dominated by warm-season grasses, avoid grazing a pasture in July/August in consecutive years.
 - Generally graze the most vigorous pasture in the July/August period.
 - Grazing in the deferment period (September and October) generally is detrimental to the cool-season grasses, especially in years with good precipitation in the late summer and/or early fall.
 - Delaying grazing until the deferment period or dormant season generally is beneficial to the warm-season grasses.
 - Consider stocking the first pasture in the grazing sequence again in the dormant season in years with good soil moisture and herbage production during the growing season.
- And of course, consider other grazing management practices, such as appropriate stocking rates and grazing dates for the site.

2010 CGS Fall Seminar Series

This August marks the 16th year of the Center's Fall Seminar Series. While students can take the seminar class for undergraduate or graduate credit, the seminars are also open to the public. They are held most Mondays during the fall semester, 3 to 4 p.m., at the University of Nebraska-Lincoln's East Campus Union. Refreshments will be available prior to each seminar, compliments of the Frank and Margaret Leu Foundation Fund, which also supports the Leu Distinguished Lectureship each year.

The entire schedule, which appears below, is subject to change; any revisions will be posted on the Center's Web site. Video of these seminars and selected seminars from past series will be available for checkout from the Center for Grassland Studies, 203 Keim Hall.

- Aug. 30** – Zac Reicher, Professor, Dept. of Agronomy and Horticulture, UNL, "Some Challenges Facing the Future of Turfgrass"
- Sept. 6** – No seminar (holiday)
- Sept. 13** – Larkin Powell, Associate Professor, School of Natural Resources, UNL, "Bush Control and Fight for Grasslands in Namibia"
- Sept. 20** – Gerry Steinauer, Botanist, Nebraska Game and Parks Commission, "Grassland Management Plans for the Nebraska Game and Parks Commission Wildlife Management Area"
- Sept. 27** – Bill Whitney, Executive Director, Prairie Plains Resource Institute, "Native Grass Seeding and Other Observations at the Prairie Plains Resource Institute"

- Oct. 4** – Matt Stockton, Assistant Professor, West Central Research and Extension Center, UNL, "How Different Calving Times and Rangeland Productivity Are Affected by Drought"
- Oct. 11** – Doug Whisenhunt, State Prescribed Burn/Grazing Specialist, Nebraska Natural Resources Conservation Service, "Working with Fire and Private Landowner Groups to Reclaim Rangelands"
- Oct. 18** – No seminar (semester break)
- Oct. 25** – Al Steuter, Private Landowner and Rancher, Johnstown, Nebraska, "The Value of Rangeland Heterogeneity in a High Cost Future: A Producer's Perspective"
- Nov. 1** – No seminar (professional meetings)
- Nov. 8** – Swapna Purandare, Graduate Student, School of Biological Sciences, UNL, "Role of Aphid Honeydew in Foraging Behavior of Ladybird Beetle Larvae"
- Nov. 15*** – Trey Patterson, Chief Operating Officer, Paddock Ranches, Ranchester, Wyoming, "A Systems Approach to Grassland Management"
- Nov. 22** – Karla Jenkins, Assistant Professor, Panhandle Research and Extension Center, UNL, "Utilization of Western Rangelands by Livestock"
- Nov. 29** – TJ Fontaine, Assistant Unit Leader, USGS Nebraska Cooperative Fish and Wildlife Research Unit, "Avian Conservation in the Prairie Pothole Region"
- Dec. 5** – TBA

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SPECIAL ISSUE: SAVING THE WORLD'S GRASSLANDS

In April 2010, GREAT PLAINS RESEARCH published a special issue focusing on "Saving the World's Grasslands." This volume contains nine original papers by researchers working in Africa, Asia, South America, and North America, and includes ten color images.

- The volume has three goals: to assess the status of grasslands worldwide, to report on new, innovative, and mostly non-governmental approaches to grassland conservation, and to draw implications and lessons for the Great Plains region.
- A major theme is how conservationists and entrepreneurs are developing private methods—sometimes for-profit, sometimes non-profit—to save and nurture the world's grasslands and the amazing biodiversity that they support.
- This volume has been widely distributed, not only within the Great Plains but also nationally and internationally.

GUEST EDITORS: Dr. Richard Edwards of UNL's Center for Great Plains Studies and Dr. Richard Reading, Director of Conservation Programs at the Denver Zoo.

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August 1 Is Pre-registration Deadline for Nebraska Grazing Conference



The previous issue of this newsletter provided detailed information about this year's Nebraska Grazing Conference at the Kearney Holiday Inn on August 10 and 11 (see the CGS Web site, www.grassland.unl.edu, for conference details). While walk-in registrations are accepted, you'll want to take advantage of the pre-registration prices.

The two-day pre-registration fee is \$80. One-day registrations are also available. Registration form and check (made out to 2010 Nebraska Grazing Conference) should be sent to the Center for Grassland Studies. Late fees apply to all registrations postmarked after August 1 and to walk-ins.

Registration fee will be waived for students who will be in high school next year and who pre-register by August 1, compliments of the UNL College of Agricultural Sciences and Natural Resources. Reduced registration fees apply for other full-time students.

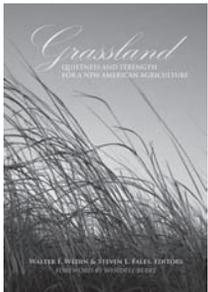
Participants of any of the previous Nebraska Grazing Conferences as well as all Nebraska extension educators should have received a brochure in the mail in June. The brochure is also downloadable from the Web site.

The Center for Grassland Studies is one of the underwriting sponsors and provides overall coordination of this conference, which draws around 250 people annually. Contact the Center with any questions.

CGS Associates

Sidney District Conservationist **Kristin Miller** received this year's NRCS State Quality Assurance Award.

Resources



Grassland: Quietness and Strength for a New American Agriculture, by Walter F. Wedin and Steven L. Fales, ed. What follows is the description on the ASA-CSSA-SSSA online store Web site. "Geared toward agriculturists, students, the public, and policy makers, *Grassland* takes on the task of increasing our awareness of the vital role grass and grassland plants have in ensuring a sustainable future for

America. Aiming to inspire and educate, the book's three main sections highlight the voices of grassland advocates through history, examine the many functions of grassland today, and look at the benefits grass-based agriculture can provide when grass is treated as an essential resource. Includes a foreword by Wendell Berry. Walter F. Wedin and Steven L. Fales, ed. Hardcover, 256 pages, with companion CD. 2009. ASA, CSSA, SSSA. ISBN: 978-0-89118-171-2. Item number: B40722." The book can be purchased online through ASA-CSSA-SSSA for \$80 at www.societystore.org, or by phone at 608-268-4960.

The U.S. Department of Agriculture's *Grass: The 1948 Yearbook of Agriculture* is available online through the USDA National Agricultural Library Digital Repository. Go to <http://naldr.nal.usda.gov/NALWeb/Publications.aspx>, check the box for Yearbook

United States Department Agriculture, and type in the years 1948 to 1948. You can then arrange the output of the sections by author or title. For example, to get to the essay by John James Ingalls, click to arrange by author and then go to the page containing Ingalls.

A Targeted Grazing Workshop was held at the annual meeting of the Society for Range Management in February, 2010 in Denver. The SRM Web site now contains the following PowerPoint presentations from that workshop that anyone can download and use: Healing Hooves, LLC – Using goats as a tool to help clients achieve landscape objectives; Prescriptive Livestock Services – Vegetation management on public and private lands; More is Better – A Montana rancher employs over 3000 sheep to combat leafy spurge and spotted knapweed; Jay Springs Lamb – Using targeted grazing to produce more grass, more trees, and more lamb; Heifer Targeted Grazing – Potential impacts on Japanese brome in Nebraska Loess Canyons; Targeted Grazing of Plants with Toxic Properties; Opportunities for Grazing as an Ecological Tool on National Forests; NRCS Programs that Encourage Targeted Grazing; Targeted Grazing on Public Lands for Hazardous Fuels and Weed Reduction; Livestock Biological Control of Weeds. Access these files at www.rangelands.org/targetedgrazing.



Dig It! Smithsonian Exhibit Omaha

“There are more living creatures in a shovel-full of soil than human beings on the planet, yet more is known about the dark side of the moon than about soil.” That is the first sentence on the Durham Museum Web site promoting the “Dig it! The Secrets of Soil” exhibit that is scheduled to appear October 2 through December 26, 2010. The 5,000 sq ft traveling version of the Smithsonian exhibit includes interactive displays, hands-on models, videos, and 54 soil profile samples from each U.S. state, territory and the District of Columbia. It will be a wonderful educational tool for children and adults alike. Learn more at the following sites:

- <http://durhammuseum.org/experience/exhibits/temporary/exhibit-details.aspx?ID=185>
- <http://forces.si.edu/soils/>

Info Tufts



The Audubon Cooperative Sanctuary Program for Golf Courses is an award winning education and certification program that helps golf courses protect our environment and preserve the natural heritage of the game of golf. By helping people enhance the valuable natural areas and wildlife habitats that golf courses provide, improve efficiency, and minimize potentially harmful impacts of golf course operations, the program serves as a vital resource for golf courses. There are several hundred Certified Audubon Cooperative Sanctuary Golf Courses around the world, most of which are in North America, and only one of which is in Nebraska: Beatrice Country Club. For more information, see <http://acspgolf.auduboninternational.org>.