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Center for Grassland Studies

Fall 1997 Newsletter

Volume 3, No. 4
Fall 1997



From the Director

There has always been a need for cooperation among scientists and educators, but for a number of reasons, not the least of which is constrained resources, there has never been a time when the need is greater than at present. Likewise, as we look at societal problems, most of them do not lend themselves to being solved by any one discipline. Therefore, more faculty members at our universities are looking at both interdisciplinary and multi-state cooperation with their colleagues.

In that context, the Center for Grassland Studies recently hosted a meeting of plant and animal scientists and agricultural economists from the four-state area of Missouri, Iowa, Nebraska, and Kansas. These were scientists and educators who were interested in one or more areas of the grazing-livestock system. The purpose of the meeting was to review the research and education programs currently in progress in the four states, assess the areas of common interest, and determine if there are opportunities for faculty from two or more states to work together for the mutual benefit of all.

We were pleased that 29 people from the four states indicated a strong desire to explore potential group activity, and 21 were able to attend the first meeting in August. Several topics were discussed that had interest from multiple states, and the group was enthusiastic about continuing our efforts. Dates for the next meeting have already been set for January 6 and 7, 1998.

Although there are many variations in environmental factors among the four states, there are equally as many or more similarities. Therefore, much of the research data and education programs can be used across state lines. Also, working cooperatively can avoid duplication and permit the states to specialize more in certain areas or phases of the program. Problems are likely to be solved quicker because more resources can be brought to research the problem. Work conducted at numerous locations is also beneficial.

We are fortunate to have outstanding people in this four-state region who are interested in grazing-livestock systems and in working cooperatively to better and more efficiently serve the residents of this region. I believe this new interest in cooperative effort will bring enhanced service to our citizens and more efficient utilization of our scarce resources. I am delighted about the potential and applaud these individuals for their unselfishness and the new excitement they bring to this area of work.

The Nebraska Gap Analysis Project: Geographic Information for Land Resource Managers

by Marlen Eve and James Merchant,

Conservation and Survey Division, UNL

Access to accurate information in a timely manner . . . that is the need of land managers across Nebraska, the Great Plains, and around the world. The goal of the Nebraska Gap Analysis Project is to provide information and tools to assist land stewards in making wise decisions about management of natural resources. The project is generating information on the state's land use and land cover, as well as the distribution and richness of vertebrate species. The effort seeks to identify the degree to which all native plant and animal species and natural communities are or are not represented in our present-day mix of conservation lands. Species-rich areas that are not adequately managed for the long-term maintenance of native species and natural ecosystems constitute conservation "gaps."

Gap Analysis is a U.S. Geological Survey/Biological Resources Division program being implemented across the U.S. with the help of over 400 cooperating organizations including private business corporations, non-profit groups, universities and other government agencies. It is designed as a pro-active effort to enhance conservation in such a way as to ensure that species and communities that are common today remain common in the future. The Nebraska Gap Analysis Project is being carried out by the UNL Center for Advanced Land Management Information Technologies (CALMIT) in cooperation with the Nebraska State Museum, the Nebraska Game and Parks Commission, The Nature Conservancy, and many other agencies and organizations.

Implementation of the Gap Project involves mapping the distribution of Nebraska's vegetation using satellite imagery and other records, and mapping the distributions of native animal species using museum and agency records in conjunction with known or projected habitat preferences. These data are manipulated and displayed with a computerized geographic information system (GIS). Maps of species-rich areas, individual species of concern, and vegetation types are overlaid on maps of public land ownership and management to determine where conservation efforts need to be focused in order to achieve optimal conservation of overall biodiversity. Because the Gap Program is based on a standardized method and format, as state projects are completed the data are edge-matched with adjacent states to reveal, for the first time, actual patterns of biodiversity at scales relevant to both the magnitude of present-day changes and the multiple levels of biological organization. Statewide and regional Gap data will be useful to many agencies, non-profit organizations and others involved in land management, public policy development, planning and teaching.

Current information on land cover and land use are critical to the success of the Gap Project. Because existing land use/land cover data for Nebraska are nearly two decades old and not very detailed, CALMIT staff are currently working to develop a new land cover database from Landsat Thematic Mapper (TM) satellite imagery acquired in the early 1990s. The resulting map will display about 35 land cover types across the state, with a minimum mapping unit less than 5 acres and an overall accuracy of approximately 85%. Currently, a first-draft land cover map of the western half of Nebraska has been completed. Last summer, vegetation surveys were conducted to assist in identifying land cover classes on the satellite imagery. Where field data and class delineation allowed, classes are labeled to roughly the "alliance" level as set forth in the Federal Geographic Data Committee's Vegetation Classification System. In other areas, the map is labeled at a more general level. A first-draft map for the rest of the state will be completed by the end of 1997. During 1998 additional field work will be conducted to enable refinement of this preliminary product. It is anticipated that the final land cover map should be completed by December 1998.

An initial step in mapping Nebraska's land cover was to construct an image that covers the entire state. This required constructing a mosaic of 18 individual Landsat scenes that span the 1991 through 1993 growing seasons. The statewide mosaic has been produced as a poster titled "Satellite View of Nebraska," which is available at two different scales: 1 inch = 8 miles and 1 inch = 16 miles. The image on the poster is displayed in "false colors." The TM sensor is sensitive to energy, such as "near-infrared," beyond that visible to the

human eye. Actively growing plant leaves strongly reflect near-infrared and absorb visible (especially red light) energy. In TM images, near infrared reflectance is commonly displayed as the color red, while areas having high visible red and green light reflectance are portrayed as green and blue respectively. Portions of the landscape with a lot of growing vegetation, therefore, appear more red, while less vegetated areas, or where vegetation is dormant at the time of imaging, have a more blueish appearance.

To order posters, contact the Conservation and Survey Division Publications office at 402-472-7523. The large size is \$15, the smaller is \$10, plus shipping and tax. For updated details or additional information on the Nebraska Gap Project see our web page at <http://www.calmit.unl.edu/gap>, or contact: Dr. Marlen Eve, Project Coordinator, Telephone: 402-472-9984; Fax: 402-472-2410; E-mail: meve@tan.unl.edu; or Dr. James Merchant, Principal Investigator, Telephone: 402-472-7531; Fax: 402-472-2410 ; E-mail: jm1000@tan.unl.edu

Mailing address: Nebraska Gap Project, Conservation & Survey Division, University of Nebraska-Lincoln, 113 Nebraska Hall, Lincoln, NE 68588-0517.

Nebraska Gap Analysis Land Cover Mapping: Frequently Asked Questions

What is land cover? Is land cover the same as land use?

Land cover is defined as the type of material that covers the earth's surface at a specific location at a specific time. Land use is the manner in which human beings utilize a specific tract of the earth's surface. As an example, the land use in an area might be cropland, but the land cover at a specific location within this area of cropland might be wheat, corn, soy-beans, bare soil, grass, or even trees (as in a windbreak). In an area of single-family residential land use, the land cover at a specific location might be asphalt, concrete, grass, or trees. Note that land cover may change dramatically over short periods of time. For example, a field that had a land cover of wheat in June might be bare soil in August.

What data sources are being used to map Nebraska's land cover?

The Nebraska land cover database is being developed principally through computer-assisted analysis of satellite imagery. Landsat Thematic Mapper (TM) satellite data acquired between 1991 and 1993 comprise the basic dataset. It takes portions of 18 TM scenes to cover the state. The Center for Advanced Land Management Information Technologies (CALMIT) currently has TM scenes on hand to provide at least two images, taken at opposite ends of the growing season (e.g., April-June and July-September), for every area of the state. Research has shown that satellite-based land cover mapping is substantially improved when data from more than one observation date are used in concert. Images being used for Nebraska land cover mapping have been geometrically and radiometrically corrected. The satellite data are augmented with aerial photography and field data. Other ancillary data (e.g., STATSGO soils data, digital elevation data, National Wetlands Inventory data) are also used to support the satellite image analysis.

Will the land cover database be developed from Landsat data obtained in a single year?

The Landsat satellite is in an orbit that brings it over a given location every 16 days. Thus, during a typical annual growing season (May-September) there may be eight or nine opportunities to capture an image. Note, however, that some images will be cloud covered, and others will be degraded by satellite, sensor or data transmission problems. It usually takes two to three years of data to provide one cloud-free, high-quality dataset for an area as large as Nebraska. The Multi-Resolution Land Characteristics Consortium TM dataset is comprised of images taken in 1991-1993. In some areas of the state these will be augmented with additional

data from later years.

Are you mapping at the full spatial resolution of the TM?

Landsat Thematic Mapper data have a spatial resolution of 30 x 30 meters (about .25 acre). Our land cover mapping is being carried out at the full 30-meter resolution of the data. We will, however, be providing products aggregated to several other spatial resolutions for meeting specific user requests. For example, we are providing data aggregated to 2 hectare (~5 acre) resolution to develop a regional land cover dataset for EPA Region 7 (Nebraska, Kansas, Iowa, Missouri). Custom aggregations can be developed to meet any user need.

To what level of categorical detail are you mapping?

We are attempting to build a land cover database that has maximum utility within Nebraska, but that also addresses interests of our funding agencies in having a database that is regionally consistent. Our objective is to map to the level of the vegetation alliance as specified in the Federal Geographic Data Committee (FGDC) Vegetation Classification system. However, because this classification system was not specifically developed to be used with satellite data, we will be making some alterations. We are working with our neighboring states to develop methods and procedures for extracting the maximum amount of detail within the FGDC framework. At this stage, we expect to map about 35-40 land cover classes across the state of Nebraska.

Are you mapping crop types?

For the Gap Project we do not plan to map specific crop types on a statewide basis. Instead, we will be mapping cropland. Our goal is to provide a map that will provide a perspective on Nebraska's land cover and land use that will stand up for at least several years. Because crops change annually, and we are working (statewide) with data acquired over several calendar years, we do not think it useful to map crop types. CALMIT has, however, been contacted by other agencies about preparing crop type maps for specific regions of the state on a case-by-case basis.

Are you mapping towns and urban areas?

Landsat data are not particularly well-suited for providing detailed information on urban land use and land cover. Such information is generally better acquired through air photo interpretation or analysis of satellite data having higher spatial resolution. In our project we will provide selected information on generalized patterns of urban development in larger communities. This information will be obtained from a combination of Landsat data and ancillary data sources.

Will the database be 100% accurate? How will accuracy be assessed?

No database, however it may be developed, is 100% accurate. Experience has shown that land cover maps developed through computer-assisted analysis of TM data typically exhibit average accuracies of approximately 80-85%. Our goal is to do at least that well. Note that this goal has been established regionally (in concert with EPA and our neighboring states) and nationally (by USGS and EPA) to conform to national map accuracy standards.

Accuracy will be assessed using a variety of methods. The basic approach will involve comparison of data collected for hundreds of field sites with their equivalent locations in the classified imagery. Field data will be obtained using air photos augmented with site visits by CALMIT staff and cooperators, including staff from the Nebraska Game and Parks Commission, Nebraska Natural Heritage Program, the Nature Conservancy, the U.S. Forest Service, the Nebraska State Museum, USDA/Natural Resources Conservation Service, and Natural Resources Districts. We will also use forest census data from the U.S. Forest Service and National Resources Inventory (NRI) data from USDA/NRCS.

When will land cover data become available?

First Draft land cover data for the entire state will be available by late 1997. Most of western and central Nebraska have been completed in draft form. As data are completed, they will be released in draft form to cooperators willing to provide expert review. Inquiries about availability of data for specific locations should be directed to CALMIT. Note that draft products are intended for evaluation and will be subject to revision. Final products will become available in late 1998.

How can the Nebraska land cover database be used?

Data derived from Landsat are intended to be used for re-gional environmental analyses, planning, and wildlife habitat assessment. The maps will also serve as a base-line from which to measure land cover change in subsequent years. The maps, of course, reflect the 30m spatial resolution of the sensor, the timing of Landsat data used for land cover analysis, and the methods used in image interpretation.

Are there plans for periodically updating the database?

The Nebraska land cover database will be established in such a way that it can be updated by CALMIT or other agencies as more current or more detailed information becomes available. CALMIT is involved in preliminary planning for a statewide update of the land cover map in GAP II about the year 2000.

What other databases are being prepared for Gap Analysis?

The Nebraska Gap Analysis Program will entail development or enhancement of many other spatial databases. For example, faunal collection records from the Nebraska State Museum and other museums are being geocoded and digitized. These data are being used with wildlife habitat models to develop digital maps portraying potential ranges of dozens of species.

1998 Nebraska Range Shortcourse

by Lowell Moser, Department of Agronomy, UNL

More than 23 million acres, or nearly half of the total land area of Nebraska, is in rangeland. Although there are only sparse amounts of the Tallgrass Prairie that remain in the eastern part of the state, the Nebraska Sandhills, Loess Hills, and High Plains contain the largest expanse of rangeland in the state. Since rangeland occupies such a high percentage of the land area of the state, management of these lands touches Nebraskans from many walks of life: ranchers, government and higher education workers, environmentalists, animal and plant biologists, ecologists, and agribusiness to name a few.

With this background, the Nebraska Section of the Society for Range Management established an adult education program in range management. The shortcourse offers Nebraskans the opportunity to update their education on this topic. It can also provide those with little range knowledge a solid base in the structure and management of range ecosystems.

The first range shortcourse was in 1978 and has been offered every even-numbered year since. It is a joint venture involving the University of Nebraska-Lincoln, Chadron State College, the USDA Natural Resources Conservation Service, the U.S. Forest Service, and ranchers who provide instruction and field experiences for the participants. Since 1980 UNL has provided leadership and coordination of the shortcourse, using northwest Nebraska as an outdoor laboratory.

The shortcourse starts on Sunday evening and ends at noon on Friday. In this retreat setting the participants

are able to immerse themselves in range management for a week, allowing them to gain considerable depth in the subject. The main areas of emphasis are:

- **Rangeland resources** plant function and identification, and range soils and geology;
- **Ecology** ecological principles for grasslands, monitoring range ecosystems, and determination of range condition;
- **Management of public and private lands** emphasizes fire, revegetation, and multiple use of rangelands for livestock, wildlife, or environmental protection;
- **Grazing and livestock production** determining stocking rates and establishing grazing systems;
- **Fitting livestock to the production system.**

Since Nebraska is a private land state, nearly all of the range is grazed. The final section of the course offers an integrated summary of profitable livestock production and range sustainability. In each section fundamental principles are taught in a classroom setting in the mornings, and the concepts are applied and integrated with field trips in the afternoons.

The course has been successful in attracting those who are involved directly with management of range, such as ranchers and other range managers, as well as persons who serve in advisory roles through agencies and educational institutions. It also attracts persons with little or no range training or background. These persons are interested in a concentrated educational experience so that they have a base for appreciating range and interacting with those associated with Nebraska rangelands through businesses or personal contact. One of the greatest strengths in the course is the opportunity for this diverse group of participants to interact with each other informally in field exercises and socially in the evenings and at meal times. The shortcourse consistently receives high ratings from participants.

The course will be offered for the 11th time from June 14-19, 1998, at Chadron State College. If desired, academic credit can be obtained from the University of Nebraska or Chadron State College. The registration fee is reasonable (about \$125) and covers all materials and transportation for field trips (additional tuition fees apply if taking the course for credit). The course is limited to the first 45 applicants, so you will want to register early.

Brochures will be available about February 1, 1998. If interested, contact the shortcourse coordinator, Lowell Moser (402-472-1558, agro043@unlvm.unl.edu) or the CGS office to be placed on the mailing list.

The Konza Prairie: Our Tallgrass Neighbors

by Rob Peters, formerly with The Land Institute, Salina, Kansas

[The following article is reprinted with permission from *The Land Report*, Summer 1997, published by The Land Institute.]

The Konza Prairie Research Natural Area is located in the Flint Hills of Kansas. Konza's tallgrass, steep slopes and gullies are more reminiscent of the Old West than the flat wheat fields most people associate with Kansas. Much of the soil covering the flint-bearing limestone and shales is too shallow or rocky to plow, so the Flint Hills have been cattle country since bison were displaced in the 1850s.

Konza vegetation is a patchwork, with tallgrass growing more than eight feet in good soils and short and midgrasses where the soil is dry, shallow or rocky. The grasses support rare prairie chickens, collared lizards and skinks, a host of grasshoppers in summer, and a large bison herd. During a field trip in May, interns from The Land Institute saw the bones of a cow bison that had died three years before while calving. An oval of taller, greener grass showed where her decomposing body had released fertilizing nitrogen.

Bison disappeared from Konza in the last century as European settlers arrived, but returned in 1987 when 30 animals were donated by Fort Riley army base. The herd now numbers approximately 250 head on some 2,400 acres. Between 50 and 60 calves are born each spring, but excess animals are sold so herd size remains the same.

A bison eats 900 pounds of forage monthly, grazing at "bison lawns," where the grass is cropped frequently and grows back tender and green. At present stocking levels, bison consume 25 to 30% of the annual above-ground plant growth, about the same consumed by Flint Hills cattle stocked at moderate densities.

"Grasshoppers are the other big natural herbivore," said Valerie Wright, Konza's environmental educator. "Most people who aren't farmers don't realize it, but some years we've got so many grass-hoppers they eat more than bison."

As one of the nation's largest tracts of native tallgrass prairie, the Konza Prairie is primarily a research station, with ongoing studies by Konza staff, Kansas State University (KSU) scientists, the Long Term Ecological Research program, and numerous other visiting scientists from around the U.S. Researchers collect detailed information on weather, soils, vegetation, and animal populations. A key question is how bison and cattle affect the composition and health of the prairie. From May to October, KSU researchers keep cattle in four pastures and bison in another four, observing which plants they eat. Both cattle and bison increase plant diversity by eating dominant grasses, like big bluestem and Indian grass, that otherwise would choke out less competitive forbs. "Bison increase diversity somewhat more than cattle," said David Hartnett, Konza's director, "because they eat proportionately more of the dominant grasses. The bison's wallowing behavior also increases diversity by creating bare depressions that favor certain plants."

Under historic conditions, fire swept frequently across the prairie, burning old grass stems and allowing light to penetrate to ground level, benefitting new growth. Fires also killed the shrubs and trees that otherwise would invade the grasslands. At Konza, researchers study the effects of fire frequency by burning different watersheds at 1-, 2-, 4-, 10-, and 20-year intervals. "Natural fires have threatened to burn our experimental sites off schedule," said Wright, "but so far, we've been lucky. In February 1996, a wildfire burned 3,300 acres, but 3,200 of those were scheduled to be burned."

If the time between fires is too long, then shrubs and trees invade. If fires are too frequent, plant diversity drops. "This is an example of how our research benefits ranchers," said Hartnett. "We found that burning every year, which some ranchers do, decreases plant diversity compared to burning every three years. And the areas that are burned too often don't produce as much forage for cattle during dry years. Our results suggest that ranchers who manage for botanical diversity may add long-term stability to their pastures."

The Nature Conservancy (TNC) and KSU own different parts of the Konza Prairie Research Natural Area, but the whole area is managed by KSU. The largest section is the 7,220-acre Dewey Ranch, an active cattle ranch since the late 1800s, purchased by TNC in 1975. The ranch's original limestone barn and house, built between 1915 and 1920, serve as Konza Prairie headquarters. The old bunkhouse was renovated in 1997 as an educational center to hold botanical and zoological collections, where students may observe eating habits of small reptiles, mount collected insects, and examine fossils.

Students and other visitors can hike three public trails, open from dawn to dusk, located near the main entrance. Although casual visitors are not allowed in the bison research areas, visitors can arrange in advance for tours led by staff or docents, trained by Konza's new environmental education program. Docents are recruited from the general public and are "people who love the prairie and enjoy teaching others about it," says docent Nancy McClanathan, social studies teacher at Eisenhower Middle School. "I'm learning, too," she says. "My favorite time is out among the bison, listening to their sounds and watching calves, and I even catch grasshoppers to feed the skinks and glass lizards."

Editor's Note: For more information about the Konza, call the Konza Prairie office at 913-587-0441. For more information about The

Land Institute, which owns nearly 100 acres of never-plowed native prairie, contact that office at 785-823-5376. Both of these programs offer fine research and educational opportunities.

Festival of Color Draws 9,000 This Year

More than 9,000 people came to the fifth Festival of Color to learn about landscape design and maintenance. The event is held every September at the John Seaton Anderson Turfgrass and Ornamental Research Area at the University of Nebraska Agricultural Research and Development Center near Mead, Nebraska. Horticulture extension assistant Amy Greving, who has coordinated Festival of Color with horticulture professor and CGS Associate Don Steinegger since the first year, notes a trend toward the demand for information on landscape techniques that require less maintenance and conserve water.

"Another trend is a more relaxed landscape, especially for acreages," said Greving. "We're seeing more interest in use of native grasses and plants to help create a more casual look."

An important part of Festival of Color are the permanent and "inprogress" demonstration sites that are perfect for addressing landscaping practices homeowners face in their own yards. Demonstrations included best lawn management practices and turf selection and renovation. Guided tours on tree and shrub selection, perennials, ornamental grasses, and turfgrass are also very popular.

"The need for this type of information is evident by the crowds this event attracts. In spite of all-day rain and temperatures in the 40s, the first Festival of Color in 1993 drew about 800 people, and crowd size has increased substantially each year," Greving said.

For more information on the 1997 event, see the Web page: <http://hort.unl.edu/fallfest/>

To be added to the mailing list for future Festival of Color announcements, contact the Center for Grassland Studies.

CGS Associate News

Dick Clark was recently named for two awards for his work on a publication, *Managing for Today's Cattle Market and Beyond*. The booklet received the American Agricultural Economics Association Distinguished Extension Program Award and the Outstanding Extension Project Group Award.

Jim Merchant received the John Wesley Powell Award, the U.S. Geological Survey's top award for nongovernmental employees, for "significant contributions to the advancement of the USGS mission to the development of a global land cover database.

Jim Power is the recipient of the 1997 Hugh Hammond Bennett Award, the highest award given by the Soil and Water Conservation Society.

Richard Sutton was given a Merit Research Award by the Great Plains chapter of the American Society of Landscape Architects for research as part of his dissertation titled, "Scale In the Aesthetic Assessment."

Don Wilhite was among the scientists tutoring President Clinton in early October on the effects of global warming in preparation for Clinton's trip to Japan for the December international conference on climate change.

RESOURCES

The Manhattan Plant Materials Center has lists of vendors in Oklahoma, Kansas and Nebraska who supply grasses, legumes, native forbs, and wetland species for use in CRP plantings. Call 785-823-4541 to request copies.

The National Forage Testing Association has a new Web site: http://www.dfrc.wisc.edu/foragetesting_nfta.html

Info Tufts



As Yellowstone National Park celebrates its 125th anniversary, officials are fearing a repeat of last winter's heavy snows that caused some American Buffalo to roam onto private lands in search of food where they were slaughtered to prevent infection of cattle with the deadly disease brucellosis. According to park officials, the buffalo population dropped from 3,500 in 1996 to 2,169 at the most recent counting. (9/22/97 news item)



In the U.S. our public natural areas are being lost at an estimated rate of 4,600 acres per day to invasive species. Purple loosestrife in the Midwest is an example of the hundreds of invasive plants of foreign origin that have been introduced in this country, accidentally or intentionally, and have since raged out of control.



Illinois, the "prairie state," has only 1% of its original tallgrass prairie.



The Kansas Flint Hills is the largest area of tallgrass prairie in the U.S. because the steep slopes and rocky soils made the area unsuitable for plowing.



There are more than 15,000 existing golf courses in the U.S.

In Sympathy

Our condolences to the family of Bob LeDioyt who died in August. Bob was a member of the CGS Citizens Advisory Council.

Calendar

Contact CGS for more information on these upcoming events:

1997

Dec. 4: 12th Annual Grazing Lands Forum, Washington, DC

Dec. 7-10: 59th Midwest Fish and Wildlife Conference, *Managing Natural Resources: Integrating Ecology and Society*, Milwaukee, WI

<http://www.dnr.state.wi.us/fh/fish/mwfwc.htm>

1998

Jan. 12-14: Nebraska Turfgrass Conference, Omaha, NE

Feb. 3-4: Mid-America Alfalfa Expo, Hastings, NE

Feb. 8-12: Society for Range Management Annual Meeting, Guadalajara, Mexico

Feb. 26-27: 28th National Alfalfa Symposium, Bowling Green, KY

Mar. 7-11: American Forage and Grassland Conference, Indianapolis, IN

July 5-9: Soil and Water Conservation annual conference, *Balancing Resource Issues: Land, Water, People*, San Diego, CA

Sep. 28- Monocots II and 3rd International Symposium

Oct. 2: on Grass Systematics and Evolution, Sydney, Australia

(e-mail: karen@rbgsyd.gov.au)

1999

Feb. 21-26: Society for Range Management Annual Meeting, combined with the American Forage and Grassland Council Meeting, Omaha, NE

Jul. 19-23: VI International Rangeland Congress, *People & Rangelands: Building the Future*, Townsville, Australia

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