Central Plains Experimental Range: 50 Years of Research

Marvin Shoop, Susan Kanode, and Mary Calvert

The dust bowl days—just thinking about them brings up pictures of dust-filled skies, devastated farmland and bare rangeland.

The mid-1930s found most farmers and ranchers on the western Great Plains in bad to desperate economic straits. The Government homesteads were too small to be profitable. Plowing destroyed the shortgrass prairie and remaining rangelands were damaged by drought, overgrazing and soil blown from plowed fields.

The western shortgrass prairie was not suitable for dryland farming. There was a definite need to improve management practices of these fragile grasslands. The Central Plains Experimental Range was established to meet this need.

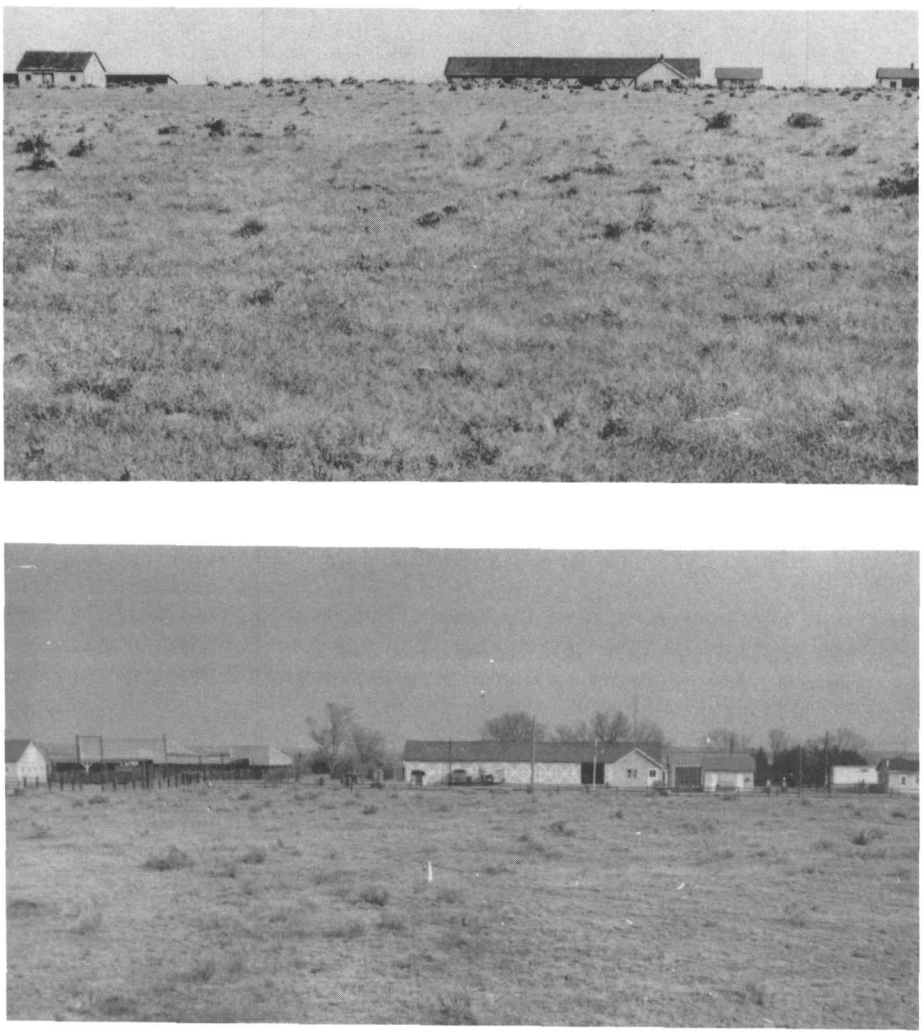
In 1933 the Federal Government passed the National Industrial Recovery Act followed by the Emergency Relief Appropriations Act in 1935, and the Bankhead-Jones Farm Tenant Act in 1937. The Resettlement Administration was created to manage these programs. One of the more devastated areas in northern Colorado was designated as the Weld County Land Utilization Project. Under this project, the government bought land and assisted property owners in relocating.

Administration of the Weld County Land Utilization Project passed from the Resettlement Administration to the Soil Conservation Service in 1938 then to the U.S. Forest Service in 1954. The project was renamed the Pawnee National Grassland on April 1, 1961.

In May 1937 the Agriculture Secretary approved a Forest Service request for an experimental range in Weld County. The northwestern corner of the Land Utilization project area was chosen for the Central Plains Experimental Range. The original project contained 8,440 acres of Federal land but was soon expanded to 9,440 acres. The Experimental Range's main mission was, and is, to solve range management problems of the shortgrass prairie.

From the Experimental Range's beginning the Crow Valley Livestock Cooperative, Inc. (Crow Valley) has supplied grazing study cattle under Forest Service and Agriculture Research Service agreements. Crow Valley, organized in 1936, holds grazing permits on the Pawnee National Grassland's western portion. They have been supporters of research programs throughout Central Plains Experimental Range's history.

Some natural events stand out in the Experimental Range's history. A flood on Little Owl Creek in June 1965 swept away 38 heifers belonging to Crow Valley ranchers. The flood deposited hail drifts taller than the horses



CPER headquarters in about 1939 (top) and in 1989 (bottom). The shrub is fourwing saltbush, common on sandy range and flood plain sites.

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Pricklypear harvesting in about 1939 (top) and in 1980's (bottom).

the staff rode to survey damage. The blizzard of 1949 practically buried the buildings and prevented all travel. Droughts in 1939 and 1954 were severe but the worst was in 1964 when essentially no forage was produced on upland sites.

Both visitors and inhabitants have been awed and inspired by the shortgrass prairie's beauty in early summer when grass is green and sprinkled with wildflowers. They also have been awed, but not inspired, by the prairie's starkness during cold winter months.

1937-53

Dr. David Costello, associate forest ecologist, directed the Experimental Range research from its start through 1953. Hubert D. Burke, junior range examiner, was the first scientist in charge and he selected the site and established the facilities.

Burke had a budget of only $1,400 to establish the facilities. The Resettlement Administration, Soil Conservation Service and other organizations provided assistance and some materials. Several National Forests provided 23 railroad carloads of posts and poles for fences and corrals. The Work Project Administration provided construction. Most of the barbed wire for 58 miles of fence was obtained from old homestead fences as far as 25 miles away. Workmen salvaged lumber from old homestead buildings for an office, warehouse-shop, barn, cattle shed, and scales. Eleven wells and windmills, two sets of corrals, a dipping vat, and a gasoline house were also built. Travel was difficult during this time and some staff hired a cook and lived on the Experimental Range. Burke was re-assigned to an Oklahoma project in July 1938.

The Forest Service initiated the first formal research, a grazing intensity study, in May 1939. The first year was basically devoted to developing research procedures. Other early studies included the effect of rabbits on vegetation, and the life histories of blue grama and plains prickly pear.

In April 1939, George Turner succeeded Burke as scientist in charge until he entered the military in July 1942. W.M. (Wally) Johnson was in charge of the Experimental Range during the remaining war years. G.E. (Zeke) Klipple started to work full time at the Experimental Range in 1945 and in September 1946 became scientist in charge.

Costello, Turner, Klipple and others wrote over 40 publications from Experimental Range research. Most publications during World War II were about increasing rangeland production to help the war effort.

Frank R. Williams, a cowboy for the Hardy Ranch before it became part of the Experimental Range, was the first person hired by the Forest Service to tend the Experimental Range's cattle.

1954-88

The Agricultural Act of 1953 brought about a major change. The Act reorganized the USDA and transferred Klipple and the Experimental Range's administration from the Forest Service to the Agricultural Research Service.

On Aug. 25, 1961, the Forest Service transferred 14,599 acres to the Agricultural Research Service. This included the previous lands of the Experimental Range and about 4,000 adjacent acres from the Pawnee National Grassland. Additional lands were added at other times.

Robert (Bob) Bement was scientist in charge from December 1955 until retirement in early 1973. He used Experimental Range grazing intensity data to develop curves relating quantity of ungrazed vegetation to individual animal gains and gain per acre. Proper stocking rates have been determined using this technique from Iceland to Africa.

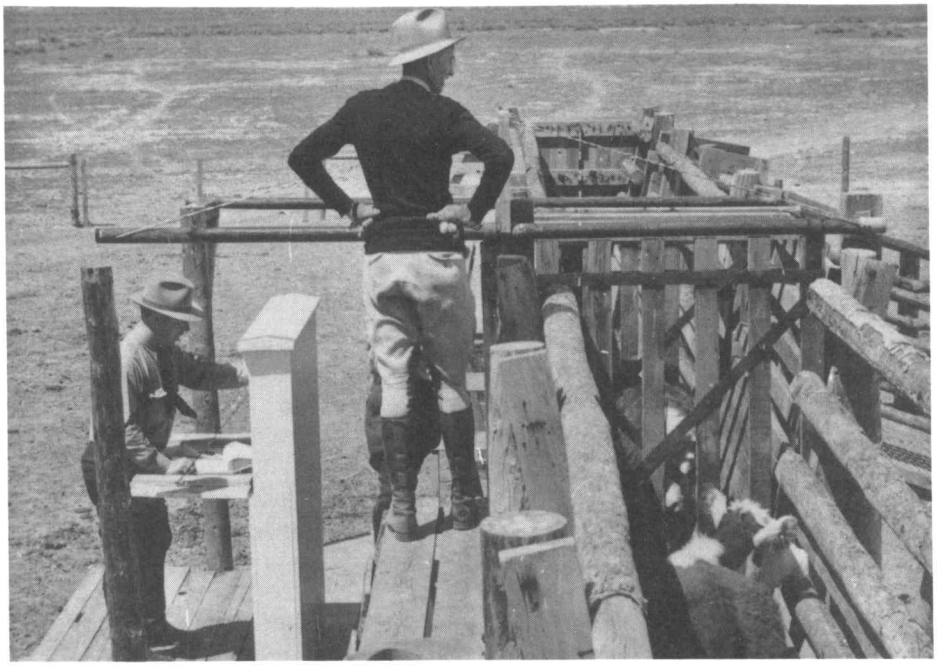
Other research scientists that have conducted extensive studies on the Experimental Range include: William J. (Bill) McGinnies, worked from 1956 to 1987 on reseeding and range improvements. Dr. D.N. (Don) Hyder transferred from Burns, Ore., in 1961. Hyder was Forage and Range Management Research Unit leader from its creation in 1973 until retirement in 1976. He was widely recognized for achievements in plant development and plant-grazing interaction. Dr. Walter Houston researched range improvements from 1968 until his retirement in 1977. Dr. Charley Townsend began research on selecting and breeding legumes for rangeland in 1969. He is still a dedicated member of the Unit.

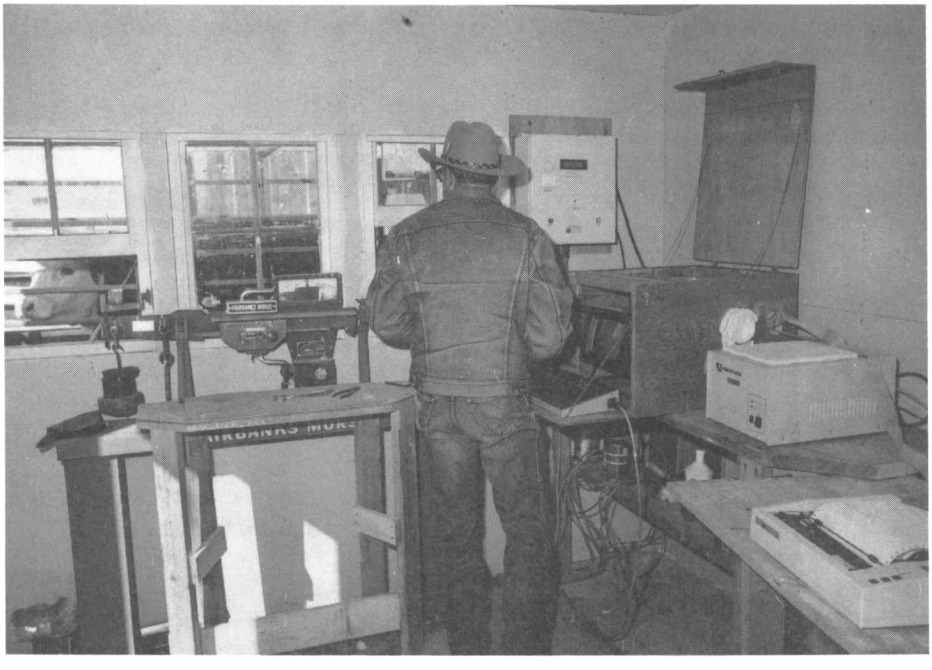
Forage and Range Unit achievements during 1961-77 showed that a group of scientists working together can accomplish more per scientist than one or two scientists working alone. Experimental Range funding had been meager. Indoor plumbing was not available there until 1963.

During 1954-72 cooperation with Colorado State University scientists increased. Some of those include Don Hervey, A.C. Everson, R.D. Barmington, E.E. Remmenga, Charles Terwilliger Jr., J.J. Norris, Terry Vaughn, and K.L. Knox. Later University cooperators included Gary Rupp, Robert Mortimer, Les Ball, Timm Stanton, Clint Wasser and Ken Doxtader.

Robert Bement recording forage inventory with paper and pencil during 1950's (top) and Robert Engel recording with hand-held computer and bar coding during 1989 (bottom).

In 1968, the Central Plains Experimental Range staff began working with Colorado State University's Natural Resource Ecology Laboratory on studies funded by the National Science Foundation. Programs include the Grassland Biome project of the International Biological Program (1968-1974) and the Long Term Ecological Research program (1982-present). Much Grassland Biome research conducted mainly on the Exper-





David Costello (left) and G.E. Klipple weighing cattle with mechanical scales and hand-recorded weights during 1940's (top) and Robert Engel weighing with electronic scale and computer during 1989 (bottom). Equipment at left of Engel is beam and self-stamping poise of standby mechanical scale.

imental Range was commonly referred to having been on the "Pawnee Site".

The Long Term Ecological Research project is one of 16 sites in 14 states and territories. Each site was established to study natural and agricultural systems processes on time scales from decades to centuries. At the Experimental Range, this research focuses on: (1) interrelations among geomorphology, landscapes, soils and vegetation structure; (2) weather and atmospheric deposition; (3) erosion and sedimentation; (4) soil water dynamics; (5) patterns and controls of primary production; (6) elemental cycling and organic matter; (7) secondary production and population dynamics of selected consumers; and (8) small and large-scale disturbance ecology. Simulation modeling is an important tool for each research topic common to all 16 sites.

The physiology and morphology of blue grama grass seedlings were investigated by Dr. A.M. (Al) Wilson from 1972 until his death in 1984. Wilson transferred from Pullman, Wash. Dr. Marvin Shoop came to Fort Collins from the Agriculture Research Service range program at Woodward, Okla., to become scientist in charge of the Experimental Range after Bement's retirement in 1973. Shoop's interests have been range improvements and grazing management. Dr. W.A. (Bill) Laycock replaced Dr. Hyder in 1976 as Forage and Range Unit leader until 1985. In 1980, Dr. R.A. (Rudy) Bowman converted from full-time research with the Soil, Plant, Water Research Unit to half-time work on range soils. Dr. Jon Hanson transferred from Cheyenne, Wyo., to Fort Collins in 1983 to work on computer simulation of range systems. Dr. Albert Grable was research leader of the Unit from 1985 to 1988. Under Grable, the Forage and Range and the Agri-Ecosystems Research Units were combined, forming the Great Plains Systems Research Unit.

Robert Engel, technician and foreman, has been associated with the Experimental Range longer than any other person. He started work there in 1953. His wife Atheline has worked at the Experimental Range part-time since 1960. Another long-term technician was F.E. (Spud) Horton. He worked at the Experimental Range from 1955-79.

Accomplishments

An early achievement was understanding plant life on native prairie and abandoned plowed lands. Knowledge of experimental techniques for measuring vegetational response to treatments was gained, including interpreting vegetational responses after excluding livestock grazing.

A 10-year comparison of an early- and late-season grazing system with summer-long grazing showed significant losses in herbage production from the early- and late- season pastures with short-term heavy stocking. Early-season grazing also caused mechanical damage to vegetation and soil. Summer-long pastures maintained production, had little plant damage, and were as profitable as early-grazed pastures.

Summer-long grazing on shortgrass range at a 60% forage use (heavy grazing) reduced herbage production by 35% compared with a utilization level of only 40% (moderate grazing). Heifers on heavily grazed pastures gained 19% (43 pounds) less than those on moderately grazed pastures. Moderate grazing was more proffitable than either heavy or light grazing (20% forage use). After 23 years of grazing, frequency percentage of species did not differ greatly among the three grazing intensities on shortgrass range.

A primary finding of long-term studies was that amounts of herbage available on a pasture can be used as a guide for managing shortgrass range. Maximum profits from yearling cattle and grass are obtained when 300 pounds of air-dry herbage per acre remain ungrazed. This nongrazed herbage level provided optimum livestock production and adequate foliage for rapid herbage growth with favorable conditions. Vegetation and soil were also conserved. Research showed the amount of available herbage can be easily estimated using visual indicators.

Studies determined combined and individual effects of time of rainfall, time of heavy grazing, and nitrogen fertilization on range plant species abundance and production, and beef production. With repeated heavy grazing, most species responded more to weather than grazing.

Researchers found that atrazine controls all annual species on the shortgrass prairie, reduces abundance of cool-season grasses when applied at medium rates, and increases protein content and drought resistance of warm-season grasses. Most significant, from 1979-88 atrazine applied at one pound per acre in alternate falls increased beef production 53% above no treatment and was highly profitable.

Grazing trials showed that fertilization of shortgrass range with 20 pounds of nitrogen per acre each fall increased beef production 66% from 1979-88, but reduced profits due to high cost. Nitrogen fertilization increased drought mortality of blue grama on fine sandy loam soil, and probably should not be applied to any soil unless atrazine is also applied to increase drought resistance.

Nitrogen fertilizer applied at 20 pounds per acre each fall for nine years controlled red threeawn, improved botanical composition, and increased herbage yield on sandy, abandoned cropland. However, costs were not recovered until six years after fertilization ceased.

Scientist determined requirements and equipment needed for frequency sampling to be a fast, reliable means of measuring abundance of plant species on shortgrass range.

Research showed that snowfences can be used to increase spring soil moisture and produce cool--season grass for earlier spring forage or a hay crop. Big sagebrush, spreading rabbitbrush, rubber rabbitbrush, and silver buffaloberry, have proven adapted to growing for living snowfences. Their snow harvesting efficiencies are being tested.

Contrary to the one-time common belief, heavy grazing of shortgrass prairie does not influence plains pricklypear cactus abundance. Early studies determined pricklypear ecology and developed mechanical control techniques. Digestibility of singed pricklypear was found to at least equal that of high-quality alfalfa. The pads produced good cattle gains when a protein supplement was fed. An efficient pricklypear harvester and a prototype of a despiner were also developed.

Spaying range heifers by the new K-R Technique proved highly satisfactory. Spayed heifers implanted with zeranol (Ralgro) gained 14% more than those without zeranol. Pasturing implanted spays and steers together did not reduce gain of either gender as compared with gains of those in pastures with only their own gender.

The most important accomplishment in reseeding of shortgrass range was finding why establishing blue grama seedlings is difficult. Morphological and physiological features prevent establishing crown (adventitious) roots in dry soil. Root elongation can be assured if surface soil is wet for two to four days when seedlings are two to six weeks old, a rare occurrence on the shortgrass prairie. Comparing blue grama seeding failures with crested wheatgrass seeding successes helped define objectives for breeding a superior blue grama.

Research to evaluate and improve legumes for shortgrass range showed that yellow-flowered alfalfa was most promising for areas with 12 inches or more of precipitation. Prairie milkvetch was the only native legume showing potential for rangeland improvement. It is extremely difficult to establish, especially on heavier soils because it has exceptionally small seeds and very poor seedling vigor.

Several studies have been conducted on replacing salt grass in saline-alkaline meadows with more productive and palatable grasses. Russian wildrye and crested wheatgrass were found better adapted than tall wheatgrass, smooth brome or other tested grasses. Research established that B horizon material on the soil surface was the primary obstacle to establishing new grass because it prevented soil water uptake. Chisel plowing followed by vertical-axis tilling did not increase surface salinity and alkalinity as much as moldboard plowing.

CPER Facts

**Administration-Owner:* U.S. Department of Agriculture, Agricultural Research Service. *Location:* Northwestern Weld County, Colorado, western edge of Central Great Plains;

13 miles northeast of Nunn, CO. *Address:* USDA-ARS GPSR, 1701 Center Ave., Fort Collins, CO 80526. *Phone:* (303) 484-8777. *Scientists:* 1 full time, 3 intermittent. *Support Staff:* Technicians: 5 full-time, several intermittent. Clerical: 2 full-time and 2 intermittent. *Acreage: 15,500 (800 provided by CVLCI); about 3,200 are revegetated cropland. Pastures:* 80. *Exclosures:* 31; mostly 2 acres each.

**Annual Precipitation:* 12.8", range 4" to 23", 81% April-Sept. *Mean Temperature:* 26 deg. F in Jan., 70 deg. F in July. *Frost-Free Period:* 133 days. *Wind Velocity:* 6.4 mph annually. *Elevation:* 5,250 to 5,550 feet ASL. *Topography:* Mostly rolling plains. *Soils:* Mostly sandy loam (Aridic Argiustolls and Ustollic Haplargids). *Range Sites:* Primarily loamy and sandy plains.

**Vegetation:* Blue Grama is dominant grass. Other important grasses and sedges are buffalo grass, red threeawn, western wheatgrass, inland saltgrass, needleandthread and needleleaf sedge. Important forbs are scarlet globemallow, slimflower scurfpea, and Russian thistle. Important shrubs are fourwing saltbush and woody buckwheat. Plains pricklypear is abundant. *Herbage Yields:* Average about 625 lbs. per acre, oven dried. *Carrying Capacity:* 4 acres per animal unit month.

**Cattle Data:* About 5,000 animal unit months of grazing. Cattle owned by Crow Valley members. Yearling heifers on moderately grazed native range gain about 240 lbs. per head May-Oct. and about 40 lbs. per head Nov.-Apr. On winter native range, long-yearling heifers need about 100 lbs. of 41% protein supplement and occasional storm hay.

**Regional Problems:* Low precipitation with 81% occurring in summer; frequent droughts; high evaporation and transpiration; short growing season; only well adapted grass is blue grama and it is poorly adapted for reseeding; many acres of abandoned cropland are thinly covered with low-quality forage plants; soils are highly erosive when not protected by vegetation; low soil fertility; lack of forage during early-growing-seasons and drought periods; and ranches are too small.

Future Research

Current research project priorities include: (1) using atrazine on rangeland to increase production and determining how atrazine works to increase grass growth; (2) establishing the effect of thinning blue grama stands on herbage and beef production, vegetational cover changes, and water and nutrients; (3) harvesting snow to produce hay and early spring pasture; (4) improving the germplasm of yellow-flowered alfalfa for the western shortgrass prairie; and (5) determining the ecology and physiology of various ecotypes of blue grama.

A study is planned to determine how soil depth and texture in the surface horizon, organic carbon, and enzyme activities affect blue grama growth. Scientists plan to develop a system to interface remotely collected data (e.g., by satellites) with mathematical models and decision-support systems (computerized models) to make remotely collected data more usable for managing natural resources.

Other research under consideration includes: (1) developing a system to reliably monitor the health of rangelands; and (2) developing basic knowledge and practices to more effectively utilize the limited precipitation of the shortgrass plains to improve herbage production.

The Central Plains Experimental Range was established because of need—to develop conservation and production practices. As times and technologies change, so do needs. Major accomplishments have been made to improve conservation and production. For rangelands to be managed as valuable and treasured resources with a benefit to land users, continued research is imperative. The knowledge base and tools of research have improved greatly in the last 50 years. This knowledge, continued public support, past experience, present programs and future goals could and should put the Central Plains Experimental Range in the forefront of developing new knowledge for shortgrass rangelands.

In observance of the Central Plains Experimental Range's 50 years of range research, two field days are being planned, July 14 and 15. Topics on the 14th will be oriented to ranchers, range managers and professional conservationists. The program July 15 is designed for the general public. Persons interested in attending should phone 1-800-669-3240 or write for further information.

Further Reading

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