Vegetation Restoration in the Chihuahuan and Sonoran Deserts of North America

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Efforts to improve the semidesert grasslands in southeastern Arizona, southern New Mexico, west Texas, and northern Mexico have been on-going for the past 90 years by various private and governmental agencies. We reviewed the popular and technical information and found that most restoration studies were not published. The objectives of this study are to (1) use historical records and photographs to document vegetation changes, (2) show the development of range reseeding research efforts, (3) summarize past reseeding work, and (4) identify research characteristics and direction needed to produce fundamental and widely applicable results.

Land Condition

Cattle and sheep were introduced into the northern Mexican frontier states by Father Kino, who explored, established missions, and distributed small herds throughout Chihuahua and Sonora, Mexico, southeastern Arizona, southern New Mexico, and west Texas between 1697 and 1740. Spanish cattlemen grazed the northern frontier between 1770 and 1827 and were frequently forced to retreat south by Indians, malaria, and drought.

Prior to the Civil War, American botanists, military personnel, and religious groups travelled through the semidesert grasslands. These travellers noted sacaton, alkali sacaton, and tobosa lowlands and grama grass uplands (Fig. 1, 2, 3 and 4). Brushy species such as mesquite, catclaw, whitethorn, creosotebush and tarbush were present, but their numbers were limited.

It has been estimated that range cattle in the desert southwest exceeded 500,000 head between 1830 and 1840. After the Civil War additional cattle were either driven or shipped from eastern Texas, central Mexico, and the Great Basin. Populations peaked at approximately 1.5 million head in the late 1880's.

Ranchers H.C. Hooker and C.H. Bayless described the events which took place between 1870 and 1901: "There were large beds of sacaton and grama grass and the beaver dams checked water flow . . . trappers exterminated the beaver, farmers plowed the sacaton bottoms, rivers were channeled to provide irrigation for crops, and ranchers overgrazed the grasslands." Most water sources dried up by 1893 and approximately 65% of the range cattle died (Fig. 5). The drought was over by 1895, but the combined effects of overgrazing, farming, drought, and flooding had resulted in accelerated sheet and gully erosion in flood plains.

The Development of Range Reseeding Research

Early Work (1890-1930). After documenting range deterioration the Division of Agrostology (USDA) and State Experiment Stations at Las Cruces, N. Mex., and Tucson, Ariz., began cooperative research in the 1890's. Their research was designed to determine the feasibility of reseeding native forage species to restore land productivity. Early reseeding efforts were failures because investigators were looking for a "miracle plant" that would produce an abundance of good quality forage under limited precipitation. Such a painless cure-all was impossible and future studies (after 1930) were designed to determine ecological and physiological plant requirements.

Although scientific range management in the desert southwest began in the 1930's, early agronomists and botanists such and J. Bently, A.E. Blount, R.H. Forbes, D. Griffiths, C.A. Keffer, P.S. Standley, J.J. Thornber, J.W. Toumey, C.P. Wilson, and E.D. Wooten contributed much to the art of range management. These individuals were keen observers and collectively identified problems associated with overgrazing.

Organized Research (1930-1945). Serious national and worldwide problems affected the United States in 1930. A major drought affected fiber and red meat production and a depression destabilized the economy. Congress enacted the National Industrial Recovery Act (NIRA), Work Progress Administration (WPA), and Civilian Conservation Corps (CCC) and made funds available to hire range scientists to conduct reseeding research. However, this opportunity was not realized because the majority of these funds were rechanneled into the military as the country entered the 1938-1940 prewar period.

Many scientists were drafted during World War II, which further disrupted range seeding studies. The remaining scientists were required to keep up with too many studies,

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Fig. 1. *The Santa Rita Experimental Range near Herfano Butte in 1902 (J.J. Thornber, U.S. Forest Service).*

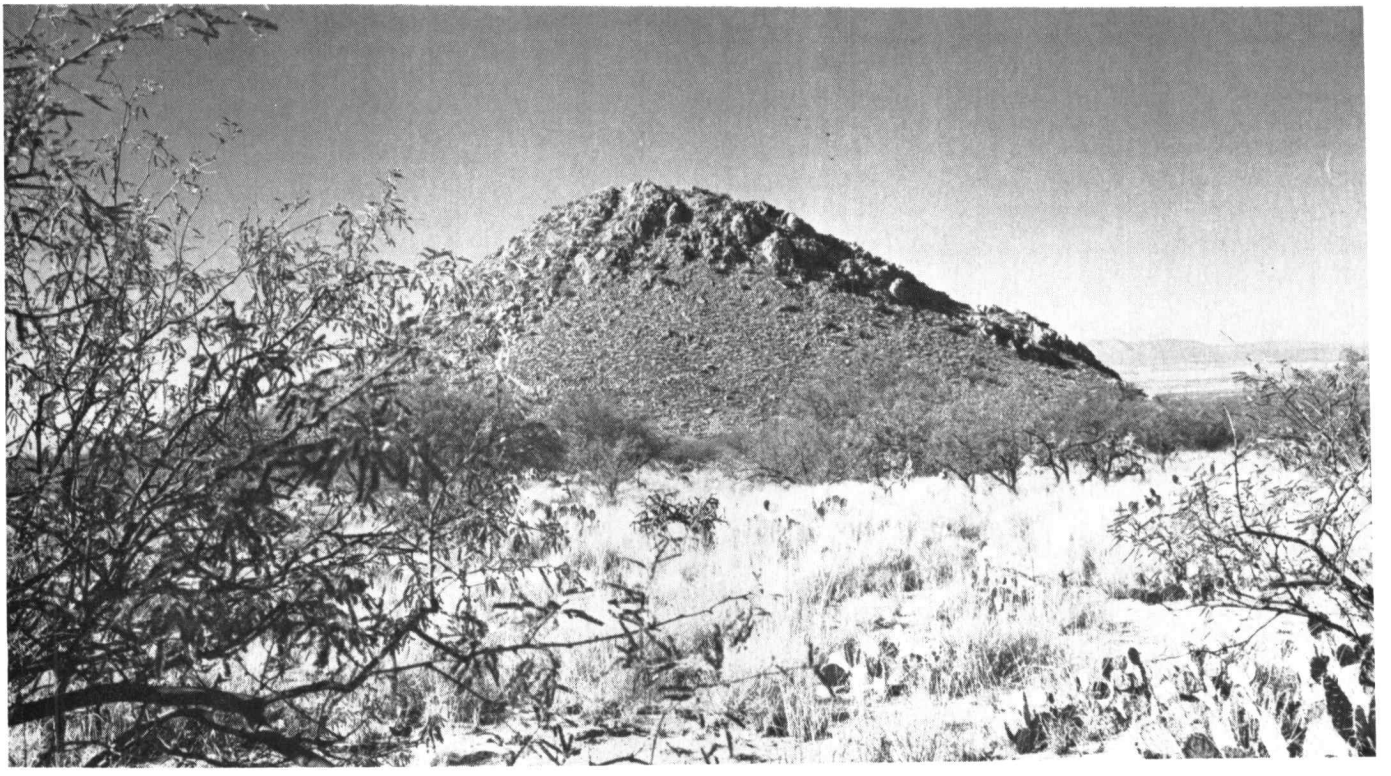

Fig. 2. *The Santa Rita Experimental Range near Herfano Butte retaken in 1980. The grasslands have been replaced by mesquite, burroweed, and cacti.*

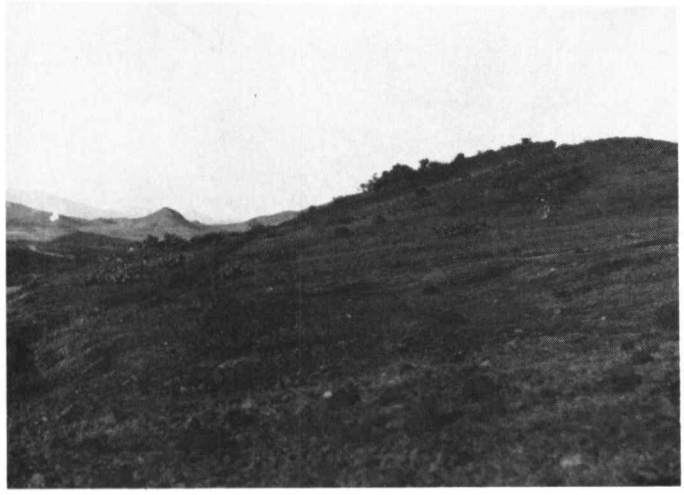

Fig. 3. *A rocky hillside northeast of Rosemont with a sparse covering of grass in 1933 (U.S. Forest Service).*

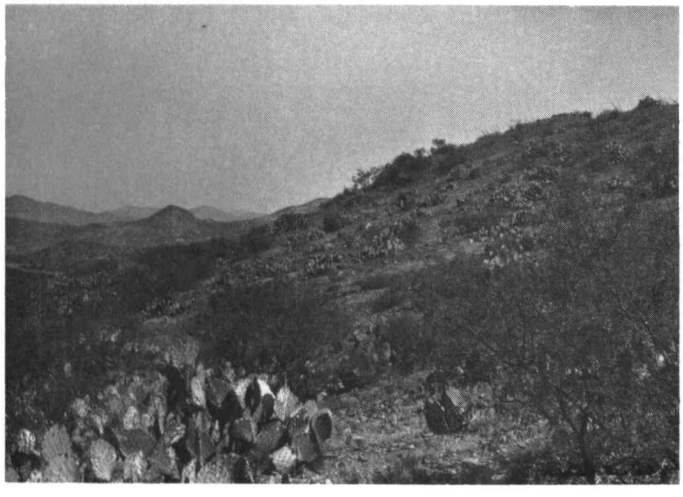

Fig. 4. *Retake in 1980. Note increase in cactus and mesquite.*

Fig. 5. *Cattle bones at Vail Station in 1902 (J. J. Thornber, U.S. Forest Service).*

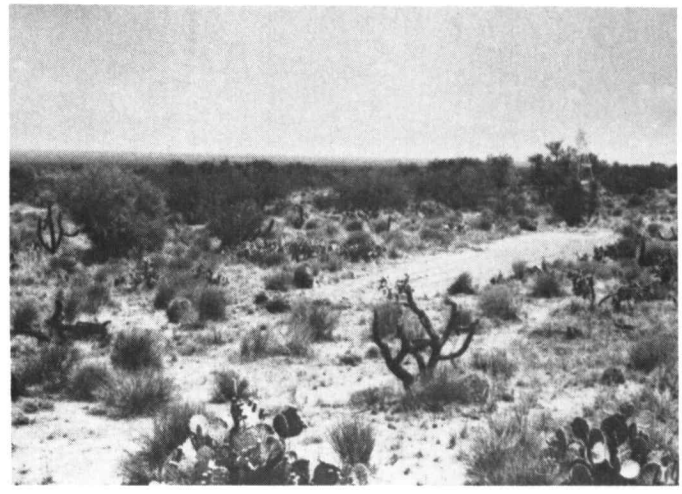

Fig. 6. *A typical mixed brush Sonoran Desert site in June 1979.*

Fig. 7. *The same site after brush control and fencing in September 1981. The dominant grass is Arizona cottontop.*

and time often limited field replication. The situation was further confounded by variations in data collection methods. Each individual or agency had different methods for acquiring data: some were quantitative, some were qualitative, and others were combinations. Thus, results were not comparable between seedbed treatments and study sites.

The situation was discontinuous, but there were some good seeding studies. However, the results often stressed failures, which were not published in scientific journals; thus, reseeding information was disseminated during field tours as typed or mimeographed handouts. Researchers and administrators recognized the problems and developed new agency and experiment station technical outlets, and new professional groups such as the Society for Range Management.

Current Reseeding Research (1945-1980). Method of seeding, and evaluating establishment, and persistence in combination with grazing began to evolve after 1945. Many of the technological advances for planting and distributing seed were spectacular. However, most seeded areas were unfenced within large pastures and were often overgrazed even

Table 1. Classification of adapted species based on areas of adaptation within the Chihuahuan and Sonoran deserts.

Common name	Genera	Origin	Area of adaptation	Adaptation site (slope)
Boer lovegrass	*Eragrostis*	Africa	North Central Mexico	Uplands
Cochise lovegrass**	*Eragrostis*	Africa	Southeastern Arizona	Uplands
Lehmann lovegrass	*Eragrostis*	Africa	Southeastern Arizona	Uplands
Wilman lovegrass	*Eragrostis*	Africa	North Central Mexico	Uplands
Buffelgrass	*Cenchrus*	Asia	Northwestern Mexico	Flood Plains
Johnsongrass	*Sorghum*	Asia	Southwestern United States	Flood Plains
Kleingrass	*Panicum*	Asia	Southeastern Arizona	Flood Plains
Blue panicgrass	*Panicum*	Asia	Southeastern Arizona	Flood Plains
Green sprangletop	*Leptochloa*	North America	North Central Mexico	Uplands
Fourwing saltbush	*Atriplex*	North America	Central Mexico	Flood Plains

*Has not been adequately tested to determine the area of adaptation.

under light to moderate stocking rates. Thus, successful seedings became failures because of management.

Problems associated with range seeding trials between 1900 and 1945 still exist today. Scientists still fail to: (1) replicate treatments in time and space, (2) collect on-site weather data, (3) compare new seedbed treatments with existing standards such as rootplowing or disk plowing, (4) use standard methods for collecting data, and (5) correctly identify seed sources; for example, Lehmann lovegrass Accessions 68, 14107, 14328, 317, 13317 are from a common seed source and are not individual accessions.

The situation becomes more confusing when positive seeding results, obtained at atypical sites or in atypical years, were extrapolated and recommended for use over large areas. For example, Lehmann lovegrass is recommended for use in southern New Mexico and Wilman lovegrass in southeastern Arizona. At upland sites, both species will germinate in wet summers and persist in mild, wet winters. However, neither species will survive in dry, cold winters or in more arid areas within the Chihuahuan and Sonoran Deserts.

A Summary of Range Reseeding. Artificial seeding has been going on for the past 92 years in the southwestern United States and northern Mexico. More than 300 forb, grass, and shrub species have been planted on 40 mechanically prepared seedbeds at more than 400 planting sites. Eighty-three species and 8 seedbed preparations have been or are currently recommended for rangeland use. Unfortunately, some recommendations are based on premature results, infrequent observations, poorly conducted experiments, and data collected at atypical sites in atypical years. We found that 10 species can be consistently established at specific locations within the Chihuahuan and Sonoran deserts (Table 1). Eight of these species are introduced perennial grasses, one is a native grass, and the other is a native shrub. The most widely adapted species are boer lovegrass (A-84 and Catalina), Cochise lovegrass (P-15068), and Lehmann lovegrass (A-68).

Seedbed preparation methods are difficult to compare among sites, and seeding success varies among treatments, sites, and years. Root plowing followed by pitting increases soil moisture, reduces runoff, and is most often recommended. However, no single seedbed treatment has been shown to be superior to any other over time.

Future Needs in Range Reseeding

The information obtained from past rangeland seedings provides a foundation upon which future studies can be based. Future seeding studies will be more meaningful if researcher will:

1. Describe vegetation and soils before and after planting.
2. Measure on-site daily precipitation, soil surface temperatures, and relative humidity.
3. Seed all species at known rates of pure live seed.
4. Compare new methods of seedbed preparation with a standard, such as root plowing or root plowing plus disking.
5. Gather field data on density and above-ground production through time without grazing and relate survival and production to concurrent climatic data.
6. Systematically identify plant introduction numbers and collection sites.

Rangeland plantings are typically above 3,000 ft and seeding trials are usually weighted with palatable grasses. Future research might be more useful if focused in the following areas:

1. Emphasize the seeding of coarse perennial bunchgrasses which accumulate litter. Fire might then be used to limit shrub growth.
2. There are approximately 2.5 million acres of abandoned irrigated farmland in the southwestern United States. A valuable forage base might be developed if such areas were seeded with adapted range grasses and shrubs following final crop harvest and irrigated for 1 growing season.

Frequent drought and continual abuse by man has caused the deterioration of the semidesert grasslands in North America. The result is accelerated erosion, brush invasion, and reduced forage production. Revegetation is difficult and costly, but not impossible (Fig. 6 and 7). ●