The Jornada Experimental Range Biosphere Reserve[1]

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Abstract.--The 78,106 ha Jornada Experimental Range is a research facility and operational cattle ranch in the northern Chihuahuan Desert. Continuous research programs since 1915 have provided much information on how to manage arid rangelands best. Current research, building on the past, is aimed at increasing products of direct benefit to man while preserving the integrity of basic ecosystems.

ADMINISTRATION

In 1912, lands designated as the Jornada Range Reserve were withdrawn from the Public Domain and placed under the jurisdiction of the U.S. Department of Agriculture. Originally administered by the Bureau of Plant Industry, the Range Reserve was transferred to the U.S. Forest Service in 1915. The Forest Service changed the name to the Jornada Experimental Range and carried out an active research program until 1954. At that time administration was transferred to the Agricultural Research Service which is now known as the Science and Education Administration-Agricultural Research (SEA-AR). The Experimental Range was designated a Biosphere Reserve under UNESCO's Man and the Biosphere Program in 1976.

Approximately one third of the experimental Range serves as a buffer zone for the U.S. Army's White Sands Missile Range. Public access to this portion of the Experimental Range is restricted but all research activities are permitted. Part of the mountainous portion of the Experimental Range is included in the San Andres Wildlife Refuge which is administered by the U.S. Fish and Wildlife Service.

Since its founding, the Experimental Range has functioned as an operating cattle ranch as well as a research facility. Grazing rights are leased to a private individual. Under present lease arrangements SEA-AR has complete control of livestock placed on the range and hires the personnel required for ranch operations.

DESCRIPTION

Located 37 km northeast of Las Cruces in south-central New Mexico, the Experimental Range includes 78,106 ha of basin range topography representative of the northern Chihuahuan Desert. The major portion of the Experimental Range occurs on the Jornada de Muerte Plain where the relief is level to gently undulating. The plain is a closed basin with no eternal drainage, and water occasionally collects in scattered playas. From the plain, at an elevation of 1,260 m, the Experimental Range extends to the crest of the San Andres Mountains at an elevation of 2,833 m. Rocks in the mountains are derived from marine sediments deposited in the Paleozoic. A mosaic of soil types occurs, but in general coarse-textured soils are found near the foothills and silts and clays are concentrated in the lowest areas. Sandy soils predominate and both water and wind erosional processes contribute to continuous changes in micro-relief.

The climate is arid, with an average annual precipitation of 230 mm. Precipitation is concentrated in the months of July, August and September when 52% of the annual total occurs. Summer rainfall usually occurs as intense, convective thunderstorms which are of short duration and highly localized. In winter, low-intensity precipitation originates from frontal storms which cover wide areas. The average maximum temperature is highest in June (36 °C) and lowest in January (13 °C). The frost-free period averages 200 days but vegetation growth is usually limited to a shorter period when soil water is available. Relative humidities are usually low and evaporation from a free water surface averages 235 cm per year.

Early collections identified 524 species of higher plants. These are assembled into a wide variety of vegetation types. Shrub types are most abundant within the mountains and are dominated by honey mesquite (Prosopis glandulosa), creosote bush (Larrea tridentata), sotol (Dasylirion

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[1]Paper presented at the workshop on Wildlife and Range Research Needs in Northern Mexico and Southwestern United States. [Rio Rico, Ariz., April 20-24, 1981].

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wheeleri, ocotillo (Fouquieria splendens), and mescat acacia (Acacia constricta). On the plains are found remnants of grasslands dominated by black grama (Bouteloua eriopoda), tobosa (Hilaria mutica), burrograss (Scleropogon brevifolius) and mesa dropseed (Sporobolus flexuosus).

Extensive vegetation changes have occurred since the turn of the century. The earliest vegetation records were made during a land survey conducted in 1858. These records, plus vegetation surveys made on the Jornada plain in 1915, 1928, and 1963 show that good grass cover had decreased from 90% of the area in 1858 to only 25% in 1963 (Buffington and Herbel 1965). Honey mesquite, creosote bush and tarbush (Flourensia cernua) have all encroached upon former grassland areas to the extent that no part of the plain is free of shrubs.

The wide diversity of habitats support about 400 species of mammals, birds, reptiles, and amphibians, plus numerous species of invertebrates. The actual number of animal species and specific or preferred habitats have not been well documented for some groups. All of the large native ungulates, pronghorn antelope (Antilocapra americana) mule deer (Odocoileus hemionus), and desert bighorn sheep (Ovis canadensis mexicanus), survive as viable populations although the bighorn population has been recently reduced by an outbreak of scabies. One introduced herbivore, the African gemsbok (Oryx gazella), is present in small numbers.

RESEARCH ACTIVITIES - PAST AND PRESENT

Much of the early research on the Experimental Range was concerned with livestock management, grazing effects, and the determination of utilization standards. Through the use of defoliation studies, permanent quadrat records, and permanent exclosures, a great deal of information was assembled on the autecology and synecology of the important plants and communities. From these studies evolved specific management strategies for the indigenous forage species (Paulsen and Ares 1962). The native fauna received less attention than vegetation although rodents and lagomorphs, which compete with livestock for forage, were the object of both life history studies and control efforts.

The ubiquitous increase in brush cover, which occurred in spite of good grazing management, led to intensive research on brush control methods (Herbel and Gould 1970) and on methods of seeding arid ranges after brush eradication (Abernathy and Herbel 1973). Diets and activities of different breeds of livestock were examined to determine their adaptability to arid rangelands (Herbel and Nelson 1966). The limiting role of soil water was recognized and examined in relation to different soil types and plant responses (Herbel and Gile 1973).

Both the grassland and desert biomes of the International Biological Program conducted research on the Experimental Range. Under these programs primary productivity and the interrelationships of consumers and decomposers were investigated. Much information was acquired on the structure and function of the black grama grassland ecosystem (Pieper et al. 1972).

The current basic and applied research on the Experimental Range are aimed at fulfilling two broad objectives: (1) The development of range improvement practices for increasing productivity of rangelands and (2) The development of grazing management systems which convert range forage more efficiently to animal products and are consistent with improvement, conservation, and multiple use of range ecosystems. A wide variety of projects, many in cooperation with scientists from New Mexico State University and other government agencies, are being conducted by the resident research staff.[3]

Studies are being conducted to find means of better utilizing the limited supplies of water. Rainfall inputs, interception of rainfall by plant cover, infiltration rates and soil water levels are being studied following brush control by chemical and mechanical methods. Runoff and sediment yield from a watershed dominated by creosote bush are being measured so that the effect of future brush control efforts can be determined. The effects of water ponding on barren rangeland sites and on sites with native vegetation are being determined. Retention dams and waterspreading systems are being examined as a means of controlling and utilizing wild water runoffs resulting from intense thunderstorms.

The photosynthetic efficiency of major forage species, both native and introduced, relative to soil water, irradiation and temperature are being determined. The development of a technique for *in situ* measurement of root respiration has allowed the evaluation of physiological-based plant adaptations to arid environments in terms of whole-plant carbon uptake (photosynthesis) and carbon loss (respiration). Predictive models of plant responses are the objective of phenological measurements of grass, forb and shrub species accompanied by continuous monitoring of precipitation, soil and air temperatures, wind velocities, total and net radiation and soil water.

Since many productive range sites are now dominated by brush species, methods of brush control and subsequent land management have a high priority. The future use of 2,4,5-T, long employed in mesquite control, is in doubt and the effectiveness of alternative herbicides is being

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investigated. Tebuthiuron shows promise of being able to control most brush species with minimum deleterious effects if applied at proper rates. Nursery and field-scale plantings to evaluate introduced and improved forage species are being made so that the forage base may be improved following brush control.

A major study now nearing conclusion has involved the investigation of the effects of brush control on a large area of mesquite dunelands. A 3,630 ha study site was treated with 2,4,5-T and a similar-sized area reserved as a control. Studies have been conducted on the sprayed and control areas to determine grass and forb productivity; populations of birds, rodents, insects, and soil microorganisms; time span of herbicide degradation; cattle diets and activities. The information collected will be useful in assessing the impact of large-scale range improvement programs.

Livestock and their management are objects of study in several current projects. The Experimental Range is one of a nation-wide network of sites where the performance of Angus-Hereford and Brahma-Hereford crosses will be evaluated under different climatic regimes. The use of sewage sludge as a supplemental feed is under investigation. Heat syncronization and artificial insemination are being employed to improve the timing of calving. Early weaning and drylot confinement are being evaluated as possible means of improving conception rates. Also, the Jornada herds are being used to determine the effectiveness of insecticide-impregnated ear tags for horn fly control.

Short duration grazing is being compared to continuous grazing on tobosa grassland, including the influence of the systems upon cattle performance, diets, and activities. Field tests of a transponder implanted under the skin of livestock and containing an identification number and a temperature sensor are being conductd. The transponder, used in conjunction with an interrogation unit, an electronic scale, and a recording unit, permits the acquisition of unrestrained cattle weights. Continuous automatic weighing of livestock may have potential in determining herd health and evaluating performance.

The Experimental Range has been selected by the National Aeronautics and Space Administration as a primary study site for the evaluation of remote sensing in desertification monitoring. This program is being carried out in close cooperation with Mexico where additional test sites are being studied.

Past and present research programs have maintained continuous records of precipitation, vegetation and stocking rates. The infrequency of occurrence of extreme wet and extreme dry periods in an arid environment make long-term records and studies a necessity. Life history strategies of plants and animals must be examined over the full spectrum of climatic oscillations if the available resources are to be wisely exploited for man's use. Since the current research program is mission oriented and has a finite budget it is somewhat restricted in scope. This does not detract from the fact that, with a long-term data base upon which to build, the Jornada Experimental Range offers unparalled opportunity to study man's interactions with grazing lands in an arid environment.

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