

# Jornada Basín

## LongTerm Ecological Research

Over the past 150 years, large areas of black grama grassland have been invaded by desert shrubs in the Chihuahuan Desert, primarily mesquite and creosotebush. This type of conversion of grassland to shrubland has occurred in many areas around the world. This change in vegetation has far-reaching consequences for ecosystem function, the preservation of biodiversity, and sustainable development in these areas. The basic goal of the Long Term Ecological Research (LTER) program in the Jornada Basin is to understand the causes and consequences of desertification in the lower Rio Grande valley of New Mexico. This understanding is used to develop effective strategies for managing arid and semiarid landscapes in the U.S. and beyond. Researchers at the Jornada Basin use historical records of vegetation, climate, soils, and land use, in some cases dating to the 1800s. Research began in the Jornada Basin with the USDA Agricultural Research Service (ARS) in 1912. The Jornada was part of the International Biological Program (IBP) in the 1970s. The Long Term Ecological Research program at the Jornada formally began in 1981, with funding from the National Science Foundation. The LTER program is based at New Mexico State University in Las Cruces, NM. Investigations in the Jornada Basin are conducted by scientists from a consortium of universities throughout the U.S. and by researchers from the ARS. Some 104,000 hectares of land, which comprise the Chihuahuan Desert Rangeland Research center of New Mexico

Further information about the Jornada and the LTER program is available via the World Wide Web:



State University and the Jornada Experimental Range of the USDA, are available for LTER studies. The Jornada LTER program welcomes visitors and researchers who may wish to develop independent or collaborative work at the field site, located about 30 km northeast of Las Cruces, New Mexico (32.5 N 106.8 W).

Through its close collaboration with the Chihuahuan Desert Nature Park, our schoolyard LTER program brings environmental science education to thousands of K-12 students, teachers, and the public annually. Field trips, classroom, and schoolyard programs provide year-round opportunities for the development of scientific inquiry skills while learning about their desert environment.



Students and teachers learn about the Chihuahuan Desert through on-site discovery activities at the Jornada. Photo: S. Bestelmeyer.

<http://jornada-www.nmsu.edu>

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The Jornada Basin LTER project is part of a diverse network of research sites. For more information, see:

<http://www.lternet.edu>

Cover: main photo, black grama grassland, Jornada Basin, New Mexico; top inset, invading honey mesquite community; bottom, invading creosotebush community.



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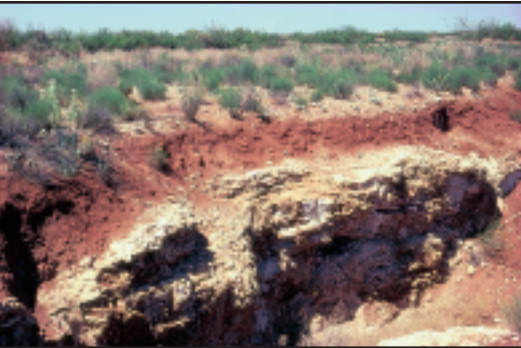
Long Term Ecological Research



We use a combination of experiments, long-term observations, simulation modeling, and remote sensing technologies to develop and test our hypotheses. Our research has resulted in knowledge and technologies that support conservation and management of hundreds of millions of acres of land in North America and around the world. Key examples of our research are described below.

Basic Resources

A long-term 15-site study has shown that high spatial and temporal variability in annual plant production cannot be explained by low (23 cm/year) or variable precipitation. We are applying our framework to better understand this variability in five major habitats of the Jornada Basin: black grama grassland,



Soil profile, Jornada Basin.

creosotebush shrubland, mesquite shrubland, tarbush shrubland, and playas or dry lakes. Our improved understanding of the factors

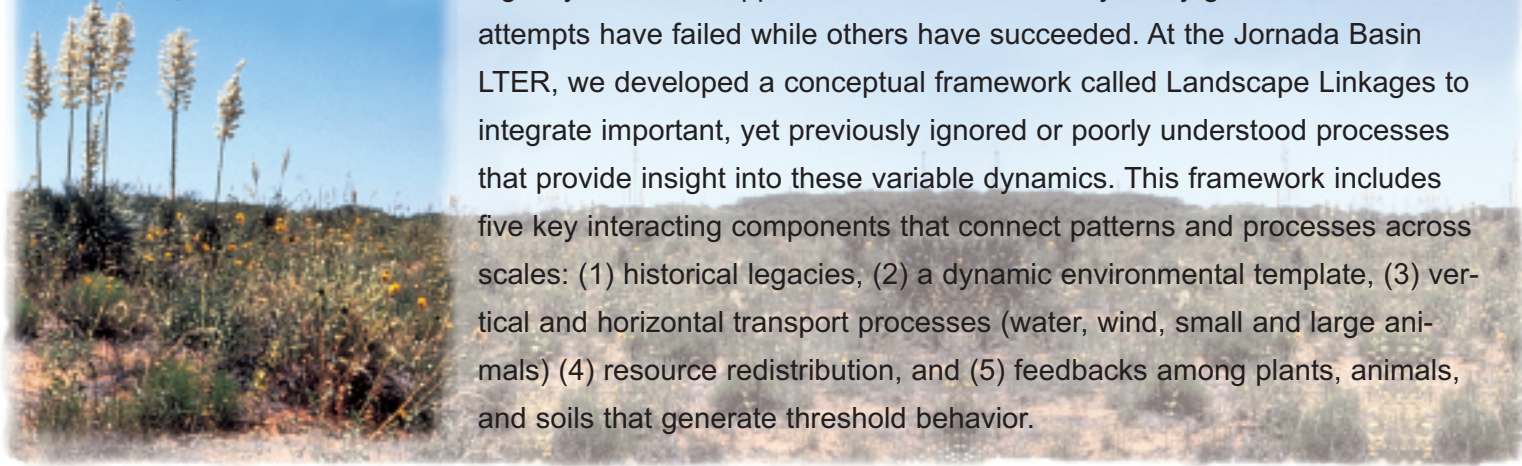
controlling plant community productivity in deserts is being used to develop more sustainable livestock production systems and more successful restoration strategies.

Soils in the Jornada Basin are diverse and dynamic, providing an ideal template for testing hypotheses about the relative importance of resource redistribution and plant-soil feedbacks at multiple scales to desert ecosystems. The Jornada and the adjacent Rio Grande valley have attracted international researchers seeking to understand the development of desert soils, most notably through the “Desert Soils Project”. The mosaic of alluvial and eolian soils provides clues to reconstructing past environments, understanding present patterns, and predicting potential future landscape dynamics.



Bannertail kangaroo rat.Photo: D. Lightfoot.

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Biodiversity

As shrubs have invaded grasslands, some grasses have become marginalized on the Jornada Basin, while other plants, primarily shrubs, have become more abundant. Long-term observations and experimental manipulations help us understand how changes in the structure and composition of the vegetation affect the functioning of Chihuahuan Desert ecosystems. These studies have contributed to the development of internationally adopted land assessment and monitoring protocols.

The Chihuahuan Desert is among the most biologically diverse systems in the world. In the Jornada Basin alone, we have documented more than 500 plant species, 140 birds, 30 mammals, and 20 snake species. A long-term species removal experiment is being used to better understand the importance of biodiversity in desert environments, while new studies are designed to examine the importance of biodiversity at patch to landscape scales.

Desertification is commonly defined as the transformation of arable or habitable land to desert. Resource degradation as a result of desertification is a major problem facing human populations living in arid regions around the world. While well studied, there is no general consensus regarding why or how it happens. It is also unclear why many grassland restoration attempts have failed while others have succeeded. At the Jornada Basin LTER, we developed a conceptual framework called Landscape Linkages to integrate important, yet previously ignored or poorly understood processes that provide insight into these variable dynamics. This framework includes five key interacting components that connect patterns and processes across scales: (1) historical legacies, (2) a dynamic environmental template, (3) vertical and horizontal transport processes (water, wind, small and large animals) (4) resource redistribution, and (5) feedbacks among plants, animals, and soils that generate threshold behavior.

Land Use

In the early 1900s, stocking rates of cattle were significantly greater (top panel) than currently (bottom panel). We are studying



Cattle densities at the Jornada in early 1900s (top) and in 2000.

the importance of this land use legacy as well as the current role of cattle on ecosystem properties using long term observations and replicated experiments. In addition to direct grazing impacts, cattle are effective in redistributing seeds and resources across the Jornada landscape. Our results have direct applications to public lands throughout the western U.S.

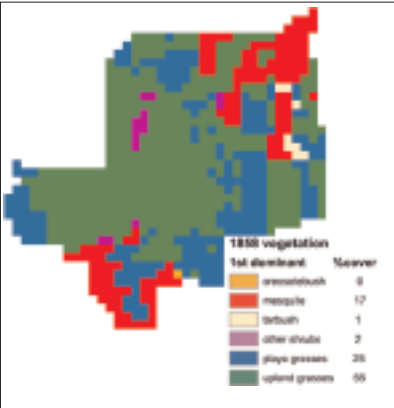
Hydrologic Studies

Flash floods and overland flow from large, summer thunder-showers are important vectors for the landscape-scale movement of seeds, soils, and soil nutrients, while smaller rain events contribute to redistribution at plant to patch scales. Our investigations attempt to understand how vegetation cover, soil surface conditions, and rainfall intensity control the pattern and amount of soil erosion.

Predicting Future Landscapes

The American Southwest is growing in human population density as exemplified by the Tucson and Phoenix areas of Arizona. New studies at the Jornada are examining socioeconomic drivers and consequences of human activities to landscape change in areas that represent the early stages of urban transformation. Through collaborations with international scientists, we are improving our understanding of how socioeconomic and biophysical factors and processes interact to modify landscapes at regional, continental, and global scales.

Simulation models combined with spatial data layers and remotely sensed images are key synthetic tools for Jornada researchers. Spatial simulation models of vegetation and water dynamics (ECOTONE) are being linked with wind models to understand current ecosystems and to predict future behavior. An extensive library of vegetation, soils, and land use maps and remotely sensed images, some dating to the 1850s, provide information about historical context, spatial relationships, and connectivity across scales. These comparisons are being used to develop extrapolation techniques as well as to provide indicators of changes in vegetation and soils through time.



Vegetation change over time, Jornada Basin. Image: modified from Gibbens et al. (2005). JAE 61:651-668

