Jornada Basin LTER

The goal of the Jornada Basin (JRN) LTER program is to understand and quantify the key factors and processes controlling ecosystem dynamics and state changes in Chihuahuan Desert landscapes. Studies beginning in 1915 have been incorporated into the JRN LTER in collaboration with the Jornada Experimental Range (USDA Agricultural Research Service, Las Cruces, NM). Short and long term field studies, multi-scale pattern analyses, simulations, and experimental manipulations are used to challenge the typical assumption that shifts from grassland to shrubland in desert landscapes is always inevitable and irreversible.

Instead, trigger events, such as grazing or precipitation, interact with wind, water, and other resources to affect ecosystem dynamics at multiple spatial and temporal scales. Work from JRN LTER is informing a comprehensive framework that can be applied to other drylands around the world.

Between 2008-2018:

14 investigators

10 institutions represented

72 graduate students

Grassland

Principal Investigator:

Debra Peters

New Mexico State University

Est. 1982

Funding Cycle:

LTER VII

NSF Program:

Biological Sciences / Division of Environmental Biology

Key Findings

Insights into vegetation change. The shift from grassland to shrubland is not the only alternative state for desert vegetation. Jornada Basin LTER research has documented shifts from desertified shrublands back towards native grassland, and shifts from grass or shrublands to novel ecosystems dominated by non-native annual or perennial grasses. State changes depend on wind and water movement patterns, spatial variation in soil and vegetation type, and triggers such as multiple years of precipitation and livestock grazing at levels above or below average precipitation. [Products 1-4]

Connectivity plays a key role in vegetation dynamics. Locations that are functionally connected in the landscape experience greater materials and energy transfer, which ultimately influences spatial and temporal vegetation dynamics in desert landscapes. In pilot studies, small connectivity modifying structures (ConMods) increased grasses and forbs relative to areas without ConMods [5].

Sources of groundwater recharge. Using long term observations and a water balance approach, JRN LTER researchers determined that small watersheds on piedmont slopes are large contributors to groundwater recharge on the Jornada Basin. This was one of the first studies to quantify groundwater recharge in arid region first-order watersheds [6].

Rodent biomass linked to precipitation. Desert rodent biomass depends on an interaction between shrub cover and precipitation – more rodent biomass is associated with grasslands following droughts and with shrublands following wet years. This pattern can be largely explained by the irruption of folivores (which prefer shrubbier vegetation) during wet years and suggests that rodent population dynamics are likely to change following climatic shifts [7].

The power of "Big Data." Researchers at JRN LTER are incorporating machine learning into complex dataset exploration. The data exploration interface is capable of suggesting potential analytical approaches to new users based on interactions with previous users [8].

Photo credit: John Kuehner (top)

Synthesis

Co-founder of the EcoTrends Project. Jornada Basin LTER researchers developed and maintain a long term archive of data and products from many long term monitoring sites on the EcoTrends website. EcoTrends is particularly valuable for increasing data accessibility to high school students, journalists, and citizen scientists.

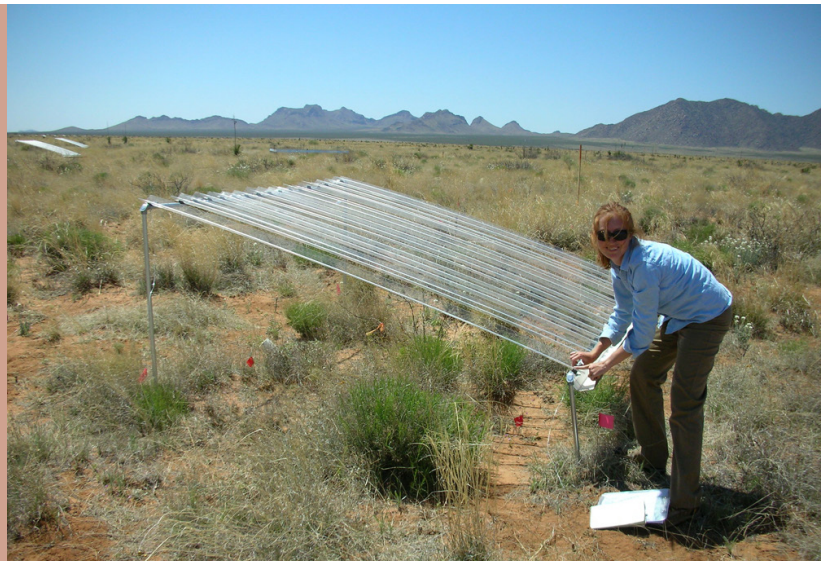
Leading desert research. Jornada Basin LTER funded and contributed to several special issues: Frontiers in Ecology and the Environment ("Emerging perspectives and shifting paradigms in water-limited systems", 2015), BioScience ("Connectivity and scale in dryland ecosystems", 2018), and Ecosphere (Dynamic Deserts, to be published 2019).

Partnerships

USDA Agricultural Research Service
Jornada Experimental Range program |
New Mexico State University

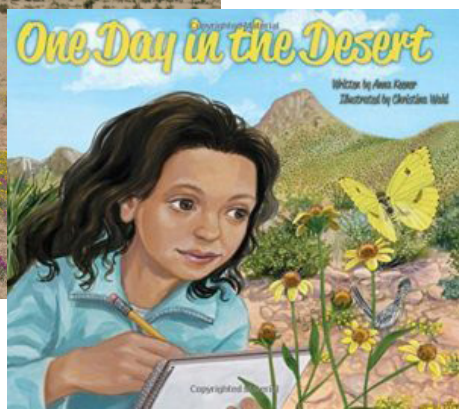
Data Accessibility

The Jornada Basin LTER data collected over the last 30+ years is stored in a data archive and posted to the Environmental Data Initiative Repository (EDI). Researchers at JRN LTER are currently developing tools that will enhance collaboration, including sharing data in real-time from meteorological stations and using RStudio to visualize and present key datasets.



Broader Impacts

Supporting diverse participation. Jornada Basin LTER supports graduate and undergraduate students from a diverse set of institutions and disciplines, and attracts postdocs and visiting scientists from around the world. New Mexico State University, University of Texas, El Paso, Arizona State University, and University of Arizona are frequent collaborators that are also minority, Hispanic serving institutions. The Jornada Basin LTER K-12 education program primarily engages underserved students – 84% of participants are economically disadvantaged and 82% are Hispanic.



Developing innovative K-12 education. In collaboration with Asombro Institute for Science Education, the Jornada Basin Schoolyard LTER program includes field trips, classroom/schoolyard lessons, and teacher workshops to improve K-12 science literacy for more than 15,000 students each year. In addition, the JRN Schoolyard LTER program develops and broadly disseminates models of K-12 science education. The Jornada middle school Data Jam competition engages up to 500 students per year and is now being replicated at other LTER sites [9].

Informing land management. Jornada LTER scientists spearheaded the development of rangeland monitoring protocols that have been adopted by the Natural Resources Conservation Service and the Bureau of Land Management. The LandPKS app estimates soil and vegetation properties in the field [10].

Top Products

1. Peters, DPC, et al. 2014. Mechanisms of grass response in grasslands and shrublands during dry or wet periods. **Oecologia.** doi: 10.1007/s00442-013-2837-y
2. Peters, DPC, et al. 2015. Beyond desertification: new paradigms for dryland landscapes. **Frontiers in Ecology and the Environment.** doi: 10.1890/140276
3. Bestelmeyer, BT, et al. 2013. A test of critical thresholds and their indicators in a desertification-prone ecosystem: more resilience than we thought. **Ecology Letters.** doi: 10.1111/ele.12045
4. Sala, OE, et al. 2012. Legacies of precipitation fluctuations on primary production: theory and data synthesis. **Philosophical Transactions of the Royal Society B.** doi: 10.1098/rstb.2011.0347
5. Okin, GS, et al. 2015. Connectivity in dryland landscapes: shifting concepts of spatial interactions. **Frontiers in Ecology and the Environment.** doi: 10.1890/140163
6. Schreiner-McGraw, AP and Vivoni ER. 2017. Percolation observations in an arid piedmont watershed and linkages to historical conditions in the Chihuahuan Desert. **Ecosphere.** doi: 10.1002/ecs2.2000
7. Schooley, RL, et al. 2018. Shrub encroachment, productivity pulses, and core-transient dynamics of Chihuahuan Desert rodents. **Ecosphere.** doi: 10.1002/ecs2.2330
8. Peters, DPC, et al. 2014. Harnessing the power of big data: infusing the scientific method with machine learning to transform ecology. **Ecosphere.** doi: 10.1890/ES13-00359.1
9. Bestelmeyer, SV, et al. 2015. Collaboration, interdisciplinary thinking, and communication: new approaches to K–12 ecology education. **Frontiers in Ecology and the Environment.** doi: 10.1890/140130
10. Herrick, JE, et al. 2013. The global land-potential knowledge system (LandPKS): Supporting evidence-based, site-specific land use and management through cloud computing, mobile applications, and crowdsourcing. **Journal of Soil and Water Conservation.** doi: 10.1002/ehs2.1209

Photo credits: JRN LTER & U.S. LTER