

Featured Investigator - Laurie Abbott

Laurie Abbott, Range Ecologist in the Department of Animal and Range Sciences at NMSU, joined the Jornada Basin LTER in summer 2003 as co-principal investigator. Laurie earned a BS in Botany from the University of Michigan, a MS in Ecology and Evolutionary Biology, and a PhD in Range Management from the University of Arizona. Since arriving at NMSU in 2000, Laurie has worked to build a research program founded on the premise that sound management practices are fundamentally based on ecological principles, and that understanding processes can inform management issues related to loss of critical species, impacts and management of invasive species, and

New Staff

Louis (Jamie) Lamit joined the Jornada Basin LTER support staff on January 20, 2004. Jamie arrives with his undergraduate work completed at the University of Montana as well as study abroad at the Naropa Institute in Kathmandu, Nepal,

impacts of vegetation manipulation on ecosystem processes. Her research program focuses on vegetation, soil, and disturbance dynamics and their role in rehabilitation and restoration of degraded rangelands. Laurie has initiated several research projects that address questions in a variety of communities and at a variety of scales. In 2003, she initiated field experiments at the Chihuahuan Desert Rangeland Research Center (CDRRC) to investigate the efficacy of various treatments on restoration of mesquite-invaded former grasslands. Teaching is also a high priority and a major source of motivation. In addition to directing graduate and undergraduate students in research, she teaches graduate courses in rangeland

and field studies at Lake Itasca Biological Field Station. He was introduced to the LTER program as a Cedar Creek LTER intern and continues that association with us. Though Jamie soon will become a Jack-of-all-trades in support of the day-

ecology and quantitative ecology and undergraduate courses in rangeland restoration and rangeland analysis. She recently developed a new course in which incoming freshmen and transfer students learn about career opportunities in range science by talking to professionals who work in range-related positions. We welcome Laurie to the LTER and look forward to increased collaborations with her.

to-day duties of our field technicians, he will also be the "go to" person for questions related to plant taxonomy. He's hit the ground running since his arrival and is looking forward to the desert greening up this spring.



JORNADA TRAILS

Jornada Basin Long-Term Ecological Research Program

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Desert Carbon by Curtis Monger

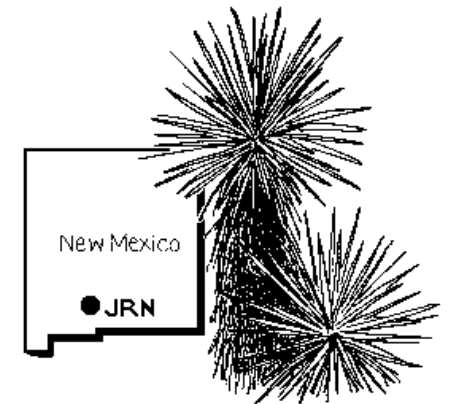
A patrician crossing southern New Mexico by stagecoach in the late-1800s is attributed to have said "I've never traveled so far and seen so little." But ecologists and others who work in the Chihuahuan Desert know that there is a lot more than meets the eye. This is true of carbon also.

In contrast to many forested systems, most carbon at the Jornada Basin LTER is below ground and out of sight. However, the belowground carbon is not out of mind because of the current scientific interest in carbon sequestration and greenhouse gases. Whereas trees in the forests of Tennessee for example, have an average 6.5 kilograms of carbon/m², the belowground carbon in soils at the Jornada can have 230 kg of carbon/m².

Similar to humid forests, belowground organic C at the Jornada exists as roots and soil organic matter. Yet unlike humid forests, a greater proportion of plant biomass at the Jornada is in deep tap roots and far-reaching lateral roots. Also, most of the belowground C exists as inorganic carbon, CaCO₃, which is

12% carbon by weight. As a general rule, the older the soil, the more CaCO₃ it contains (organic carbon reaches a steady-state quantity with time). Many soils at the Jornada have had a long time to accumulate CaCO₃; soil at the Stressor Site (Fig. 1) is ca. 1,600,000 years old based on radiometrically dated pumice in its profile.

Carbon flows into and out of Jornada ecosystems by the same processes as in humid forests: photosynthesis and respiration (including microbial decomposition of organic matter). But, carbon gets into CaCO₃ through the dissolution of a small fraction of respired CO₂ by soil water, its dissociation to bicarbonate, and reaction with calcium (supplied by weathering, dust, and rainwater) to form CaCO₃ crystals. These crystals, which are typically 5µm in diameter, form on the surfaces of gravel, sand, and silt, and progressively fill pore spaces until the soil becomes plugged with CaCO₃. At this state, it is known as indurated caliche, petrocalcic horizons, or calcrete (Fig. 1). (Continued on page 2)



The Jornada Basin LTER Program is an NSF funded project.



Fig. 1. Soil at the Stressor Site. Leland Gile and John Hawley, scientists with the USDA Desert Soil-Geomorphology Project, describe a petrocalcic horizon to visiting scientists.

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New Technology: Virtual Fences by Dean M. Anderson

Joseph Glidden changed the face of range animal management in 1874 with his barbed wire patent; however satellite signals may soon become the method of choice for controlling and distributing animals across rangeland landscapes in the 21st century.

At the Jornada, we are at the forefront of this technology with our research on Directional Virtual Fencing (DVF™). This innovative, patented methodology is the most recent tool to allow real-time management of animal control and distribution with flexibility equaled only by herding. DVF™ is a methodology that uses animal behavior and electro-mechanically produced cues to control an animal's location and subsequently its

movement. DVF™ relies on a constellation of ca. 24 Global Positioning System (GPS) satellites that provide continuous information on animal location. Together with GPS, the solar powered animal-mounted device uses cues activated by algorithms in a central processing unit. A Geographic Information System (GIS) allows pre-programmed longitude-latitude pairs to define a Virtual Center Line (VCL™) located at the center of the Virtual Boundary (VB™). A Virtual Paddock (VP™) created from several VB's™ can either hold animals stationary or move animal groups at variable rates across a landscape.

Our preliminary research suggests that

VP's™ can assume any size and shape, can be moved across the landscape, and that groups of cattle can be controlled by the instrumentation of a few animals. Our future research includes wireless technology to download data without the need to restrain the animal and using satellite imagery of vegetation to determine where to construct the VP™. DVF™ relies on altering animal behavior to control animals, therefore, it must not be used if absolute animal control is required. Thus, Glidden's barbed wire will never be completely eliminated from rangeland landscapes.

For additional information contact Dean Anderson (deanders@nmsu.edu, phone 505-646-5190).

NSF Site Review Report

In September 2003, the Jornada LTER was very favorably reviewed by a panel of scientific experts as part of our review process with NSF. Site reviews occur at the mid-point of each six year funding cycle and are a great way to gauge progress on the current grant as well as to develop ideas for the next proposal (due in 2006). A few quotes from the accompanying letter from NSF reflect the positive tone of the review: "The review team was clearly impressed with the new orientation around the broader scientific focus for JRN... It was also highly impressed by the effective and largely seamless partnership forged between NMSU and the ARS ... this truly represents an example of how interagency collaborations should work!" "Clearly, the IM/T program at JRN is second to none, as is the K-12 Education and Outreach program." We thank the reviewers for their time and energy during the review and for their comprehensive report. Based on their comments, we are developing integrated experiments on the spatial and temporal complexity in desert landscapes with a focus on cross scale interactions. Copies of the review document are available from <http://jornada-www.nmsu.edu/Site/Pubs/repro.htm>.

LTER Supplement Submitted to NSF

The Jornada Basin LTER recently submitted a supplement to the National Science Foundation totaling \$132,725. If funded, the supplement would support two undergraduate students to work with Vince Gutschick and Brandon Bestelmeyer. The Schoolyard LTER program directed by Stephanie Bestelmeyer would also be supported. We also requested support to increase collaborations among LTER scientists (Jeff Herrick and Brandon Bestelmeyer) with ecologists working in Mexico (led by Tulio Arrendondo). Support for enhanced research collaborations with two social scientists at NMSU (Rhonda Skaggs and Allen Torell) along with the purchase of wireless technology for two hydrology sites and sub-meter GPS receivers were also requested.

NSF Planning Grant Received

Investigators at NMSU (Milt Thomas) in collaboration with the USDA-ARS-Jornada Experimental Range (Debra Peters and Kris Havstad), recently received a planning grant from the National Science Foundation to develop a program to outline and prioritize steps to upgrade facilities at the Chihuahuan Desert Rangeland Research Center (CDRRC) located ca. 45 km northeast of Las Cruces, NM. The \$25,000 grant will coordinate management structure, assess user needs, compare operations at other field sites, create a business plan, conduct an archeological survey of potential building sites, and identify priorities for infrastructure investment. Representatives from the Colleges of Agriculture and Arts and Sciences serve on a committee to address these issues. Our goal is to use information from this planning grant when developing a full proposal to NSF for a field station. We're excited about the possibility of adding much-needed facilities to the CDRRC.

Synthesis Volume Completion

The Jornada Basin synthesis volume entitled "Structure and Function of a Chihuahuan Desert Ecosystem" is in the final stages of editing before submittal to Oxford University Press in April 2004, for publication in early 2005. The Oxford Editor, Peter Prescott, will receive an 18 chapter book with over 180 figures developed by over 30 contributors. Edited by K. Havstad, W. Schlesinger, and L. Huenneke, the chapter titles with lead

authors are: Introduction/W. Schlesinger, Regional Setting/C. Monger, Climate and Climatological Variations/J. Wainwright, Soil Development/C. Monger, Soil Water/K. Snyder, Nutrient Cycling/W. Schlesinger, Biogeochemical Fluxes/A. Abrahams, Energy and Water Balances/V. Gutschick, Eolian Processes/D. Gillette, Plant Communities/D. Peters, Patterns of Net Primary Production/L. Huenneke, Animals/W. Whitford, Livestock/K.

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Jornada Trails is a biannual publication of the Jornada Basin Long-Term Ecological Research (LTER) Program, sponsored by the National Science Foundation. Stories and story ideas are welcome. Send them to:

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Jornada Trails also appears on the World Wide Web at <http://jornada.nmsu.edu>

Newsletter by Kris M. Havstad and Valerie K. LaPlante

Desert Carbon (Continued)

Globally, it is estimated that there are about 800 x 10¹⁵ g of soil inorganic carbon, a quantity only exceeded by the amount in oceans (38,000 x 10¹⁵ g) and soil organic matter (1550 x 10¹⁵ g). In the U.S. there are ca. 50 x 10¹⁵ g of inorganic carbon; a larger amount than the ca. 14 x 10¹⁵ g of carbon in U.S. forests. Soil CaCO₃, combined with the extraordinarily deep roots of mesquite, makes the Jornada a unique system for carbon storage. And with respect to the extensive rooting systems, one could have said to the patrician that the desert of southern New Mexico has forests, but they are belowground.

For more information, contact Curtis Monger (cmonger@nmsu.edu).

Havstad, Remediation/J. Herrick, Remote Sensing/A. Rango, Modeling Potentials and Limitations/J. Reynolds, Summary and Reflections/K. Havstad, Future Directions/D. Peters.

This book is a contribution to the Long-Term Ecological Research Network Series of the LTER Publications Committee and Oxford University Press that currently consists of four published volumes.

Selected 2003 Publications from the Jornada Basin (from 60 Publications)

Abrahams AD, Parsons AJ, Wainwright J. 2003. Disposition of rainwater under creosotebush. *Hydrological Processes* 17:2555-2566.

Bestelmeyer BT, Brown JR, Havstad KM, Alexander R, Chavez G, Herrick JE. 2003. Development and use of state-and-transition models for rangelands. *Journal of Range Management* 56(2):114-126.

Bestelmeyer BT, Miller JR, Wiens JA. 2003. Applying species diversity theory to land management. *Ecological Applications* 13(6):1750-1761.

Brown MF, Whitford WG. 2003. The effects of termites and straw mulch on soil nitrogen in a creosotebush (*Larrea tridentata*)-dominated Chihuahuan Desert ecosystem. *Journal of Arid Environments* 53(1):15-20.

Goslee SC, Havstad KM, Peters DC, Rango A, Schlesinger W. 2003. High-resolution images reveal rate and pattern of shrub encroachment over six decades in New Mexico, USA. *Journal of Arid Environments* 54(4):755-767.

Grant DW, Peters DC, Beck KG, Fraleigh HD. 2003. Influence of an exotic species, *acrotilon repens* (L.) DC. on the initial survival and growth

of native grasses. *Plant Ecology* 166:157-166.

Gutschick VP, BassiriRad H. 2003. Extreme events as shaping physiology, ecology, and evolution of plants: toward a unified definition and evaluation of their consequences. *New Phytologist* 160:21-42.

Howes, DA, Abrahams, AD. 2003. Modeling runoff and runoff in a desert shrubland ecosystem, Jornada Basin, New Mexico. *Geomorphology* 53:45-73.

Kemp PR, Reynolds JF, Virginia RA, Whitford WG. 2003. Decomposition of leaf and root litter of Chihuahuan Desert shrubs: Effects of three years of summer drought. *Journal of Arid Environments* 53(1):21-39.

McGlone CM, Huenneke LF. 2003. The impact of a prescribed burn on introduced Lehmann lovegrass versus native vegetation in the northern Chihuahuan Desert. *Journal of Arid Environments*.

Monger, HC. 2003. Millennial-scale climate variability and ecosystem response at the Jornada LTER site. In: *Climate Variability and Ecosystem Response at Long-term Ecological Research Sites*. D Greenland, DG Goodin, RC Smith (eds.), 341-

369. Oxford University Press.

Parsons AJ, Wainwright J, Schlesinger WH, Abrahams AD. 2003. The role of overland flow in sediment and nitrogen budgets of mesquite dune-fields, southern New Mexico. *Journal of Arid Environments* 53:61-71.

Pyke DA, Herrick JE, Shaver PL, Pellant M. 2003. What is the standard for rangeland health assessments? 764-766. VIIth International Rangelands Congress.

Rango A, Foster J, Josberger EG, Erbe EF, Pooley CD, Wergin WP. 2003. Rime and graupel: Description and characterization as revealed by low temperature scanning electron microscopy. *Scanning* 25(3):121-131.

Rasetter EB, Aber JD, Peters DPC, Ojima DS, Burke IC. 2003. Using mechanistic models to scale ecological processes across space and time. *BioScience* 1-19.

Rastetter EB, Aber JD, Peters DC, Ojima DS, Burke I. 2003. Using mechanistic models to scale ecological processes across space and time. *BioScience* 53(1):68-76.

Jornada Basin Schoolyard LTER Expands To Northern New Mexico

The Jornada Basin Schoolyard LTER Program (Schoolyard Desert Discovery) began in 1998 with the goal of introducing students to long-term ecological research by allowing them to participate in it themselves. This successful program of schoolyard activities, field trips, and teacher workshops now serves more than 6,500 K-12 students each year.

The centerpiece of the project is a series of 28 activities grouped into six modules: weather, microclimates, soil, vegetation, arthropods, and birds. All activities include teacher pages, sample graphs, bilingual student pages, and correlations with education standards.

Changes at the Jornada Basin LTER

Laura Huenneke, Lead Principal Investigator of the LTER since 1998, recently accepted the position of Dean of the College of Arts and Sciences at Northern Arizona University. Laura has been an investigator with the Jornada Basin LTER for over 17 years, including serving as Lead PI from 1998-2003. She completed her PhD at Cornell in 1983 and held a postdoctoral post at Stanford before joining the faculty in the Biology Department at New Mexico State University in 1987. During her time in Las Cruces she was an active and highly regarded colleague serving as Chair of the Biology program before leaving for

Each module includes a Science Investigation Kit containing all of the equipment needed.

Since its inception, the Schoolyard Desert Discovery Project has received considerable praise. For example, the recent review of the Jornada Basin LTER called the schoolyard project "creative, effective, and well integrated with national and local curriculum standards."

Recently, the project took another leap forward with an expansion to northern New Mexico. A teacher from Hermosa Middle School in Farmington attended a workshop on the project. She was so excited that she quickly recruited a social



studies teacher to work with her. They then got the support of the school's principal and joined the project in January 2004.

For more information on this exciting project, please call the Chihuahuan Desert Nature Park office at 505-524-3334 or check the Nature Park's web site at www.cdn.org.

NAU. Her research interests include conservation biology (especially the biology of invasive species) and arid land community dynamics. During her NMSU tenure she was well regarded as an excellent teacher and received NMSU's Donald C. Roush Award for Excellence in Teaching in 1994. Laura served a two-year term as an elected Member-at-Large of the Governing Board of the Ecological Society of America. In 1999 she was selected to the Aldo Leopold Leadership Fellows, a program designed to provide academic ecologists with skills for communicating with a broader range of audience. During

her leadership of the Jornada Basin LTER the program saw growth in participation, collaborations, research productivity, and regard within the LTER network and the science community in general. These characteristics were evident by the highly positive mid-grant review the site received by the review team in September 2003. We are pleased Laura is maintaining participation in our LTER site even with her new duties as Dean at NAU.

Debra Peters (debpeter@nmsu.edu) is the new Lead Principal Investigator of the Jornada Basin LTER.