

## **ARS Long-Term Agro-Ecosystem Research Network**

### **Response to Request for Information**

**Candidate Site: Jornada Experimental Range, Dona Ana County, New Mexico**

**Submitter: Kris M. Havstad, Supervisory Scientist, Rangeland Management Research Unit based at the Jornada Experimental Range**

**Date: November 14, 2011**

### **INTRODUCTION**

The Jornada Experimental Range (Jornada) in southern New Mexico serves as a field station in support of the scientific mission of the Agricultural Research Service's (ARS) land management research unit based in Las Cruces, NM, on the campus of New Mexico State University (NMSU). The mission of this unit is to conduct science that addresses problems confronting the conservation and management of arid lands in the US, North America, and around the world. The Jornada is an historic research station that continues to operate as a scientifically active and networked field facility. The contributions of scientists working at this station for nearly a century have resulted in a lengthy record of diverse, accessible, and well-documented data sets. The Jornada is, at its core, a long term agricultural research field station. However, in recent decades this long term research nature has been leveraged beyond simple categorization as an agricultural research facility. The involvement of this facility in a broad array of important national science programs and research networks has positioned the Jornada as a multi-dimensional scientific facility of relevance for arid lands, their conservation, and their management. Of particular note is the Jornada's direct involvement since 1982 as one of the original cohorts of Long Term Ecological Research (LTER) sites, and its inclusion in 2012 as a relocatable site within the new National Ecological Observation Network (NEON).

The Jornada was established from withdrawn public domain by Presidential Executive Order #1526 signed by President William H Taft 5 months after New Mexico was granted statehood in early 1912. Originally named the Jornada Range Reserve, this 192,434 ac facility was established within the Bureau of Plant Industry of the USDA, but transferred to the US Forest Service (USFS) in 1915. The USFS quickly established a research program to address the principle objectives cited in the 1912 Executive Order including: 1) quantifying carrying capacity of native rangeland for livestock use, 2) establish a system of forage utilization consistent with growth requirements of desert forage plants, and 3) examine the possibility of rangeland improvements by introduction of new plants, seed planting, and conservation of runoff. These objectives were seen as critical to addressing the wide spread problems of rangeland degradation that had been documented across the American southwest at the end of the 19<sup>th</sup> Century. These objectives have been addressed.

In 1952 the Jornada was transferred to the then newly-created ARS. The ARS has been able to expand the research program from its more narrow beginnings to one with national and international significance for land and its conservation and management. The history of research during the past century is effectively categorized into 6 principal themes: plant and landscape ecology, ecosystem sciences, rangeland management, land monitoring and assessment strategies, rangeland improvements, and rangeland livestock production and husbandry (Havstad and Schlesinger 1996). The resulting productivity of over 2700 papers published in the peer-reviewed literature has been a significant contribution to a global understanding of arid ecosystems, their key ecological processes and properties, predictions for future dynamics, and important principles for livestock grazing and arid land management (see searchable bibliography at: <http://jornada.nmsu.edu/biblio>).

## PRODUCTIVITY

**Research Program:** Two main components of the research program at the Jornada are 1) the ARS based project “Management Technologies for Arid Rangelands” (2008-2012, USDA ARS Program # 6235-11210-006-00D), and 2) the NSF LTER-based project “Landscape Linkages in Arid and Semi-Arid Ecosystems” (2007-2012; DEB # 0618210). The ARS project contributes directly to the USDA ARS National Research Program in Pasture, Forage, and Rangeland Systems. The Jornada’s base ARS project has four research objectives of 1) developing assessment and monitoring approaches for multi-scale resource evaluations, 2) identifying key ecological processes that influence potential for restoring degraded landscapes, 3) developing adaptive management strategies with application for desert livestock production systems, and 4) predict system responses to both management dependent and independent drivers. The LTER project is conceptually linked to the ARS project in that key hypotheses have application to the ARS research objectives. The LTER program addresses identification of key processes which redistribute soil resources across spatial scales. Expanding our understanding of these processes will have direct application to both the management and restoration of arid rangeland systems in the US, throughout North America, and around the world. Both ARS and LTER projects build intensively and extensively upon the lengthy research history at the Jornada.

Our overall focus is on driver–pattern–process relationships interacting across spatial and temporal scales that lead to alternative states in linked natural and human-dominated systems. These interactions have consequences on present and future states, and the goods and services provided by these states (Peters et al. 2006, Fig. 1). Important modifiers of these relationships are historical legacies and geomorphic templates across these landscapes. We work at fine to landscape spatial scales so our results have eventual application to the needs of land managers.

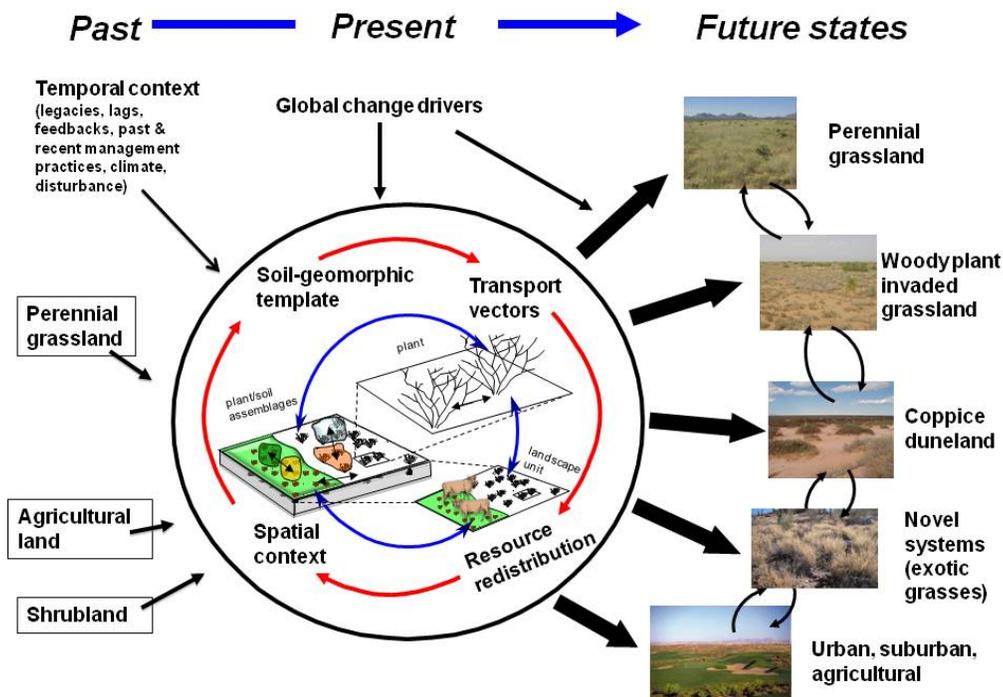


Fig. 1. Landscape linkages conceptual framework containing five key elements (legacies, drivers, soil-geomorphic template, transport vectors, resource redistribution) that interact to lead to cascading events and nonlinear dynamics in future states (Peters et al. 2006).

**Scientific Productivity:** Recent productivity of the Jornada scientific staff as of November, 2011, is illustrated in Fig. 2. Jornada scientific staff average ~3 peer-reviewed journal articles and ~3 other articles (books and book chapters, proceedings papers, and government documents), excluding abstracts, per scientist per year. All published manuscripts are posted on line at the Jornada web site within a searchable bibliography that provides direct public access to PDFs of published materials (see: <http://jornada.nmsu.edu/biblio>). Publications span from basic ecological studies targeting a scientific peer audience to field guides addressing applied management technologies with a land management practitioner audience. Periodically, Jornada staff publish syntheses of our scientific work, including special issues of journals (e.g., Estell et al. 2006) or text books summarizing research findings based on our long-term data sets (e.g., Havstad et al. 2006). Productivity has been enhanced over the past decade by maintaining 4-7 post-doctoral research associate positions within the unit, funded either through ARS or extramural funds, that both support permanent scientific FTE and provide the unit with a dynamic capacity to address emerging issues with needed expertise.

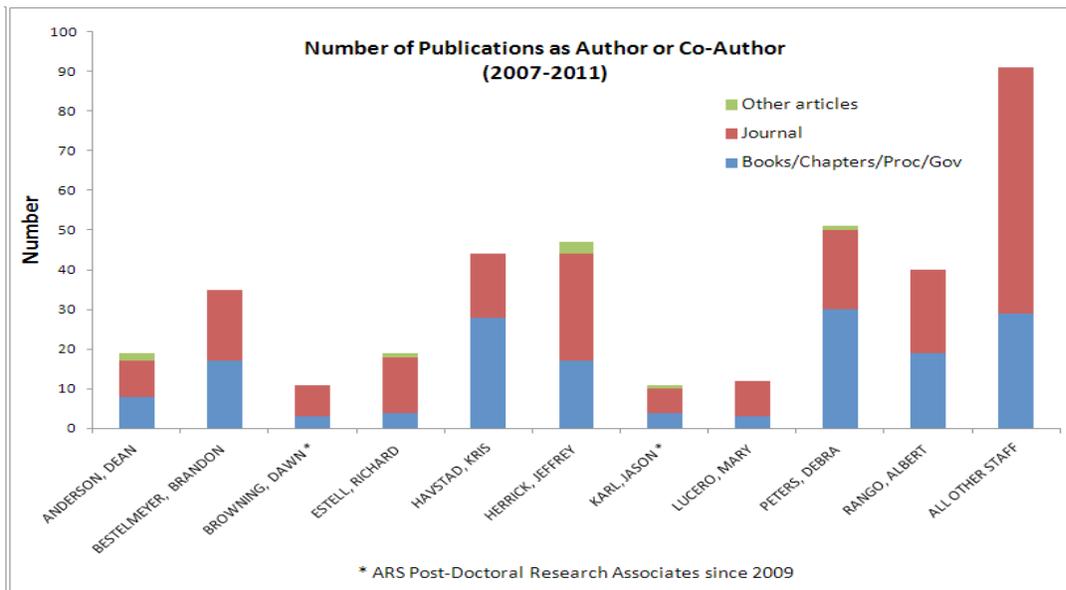


Fig. 2. Number of journal articles (red), books/book chapters/proceedings papers/government publications (blue), and other articles excluding abstracts (green) contributed by Jornada Unit scientists and staff as senior or co-authors from 2007 – 2011. All articles are accessible as pdfs on line at: <http://jornada.nmsu.edu>. The full searchable bibliography of published research from the Jornada’s history contains over 2700 articles.

Increasingly, our scientific productivity has incorporated perspectives built upon our long term data, and analyzed within scientific collaborations in relationship to other long term data. A recent example is illustrated in Fig 3 taken from Bestelmeyer et al. (in press in *Ecosphere*). This figure illustrates threshold dynamics in penguin populations in Western Antarctic in response to diminishing annual days of sea ice since the early 1970s and a threshold dynamic in perennial grass production in the Chihuahuan Desert (Jornada) in response to the severe drought of the 1950s. These diverse systems are exhibiting similar transitional dynamics in response to drivers critical within those systems. The Jornada grassland threshold is the first quantitative, published documentation of a transitional vegetative state change in a terrestrial system.

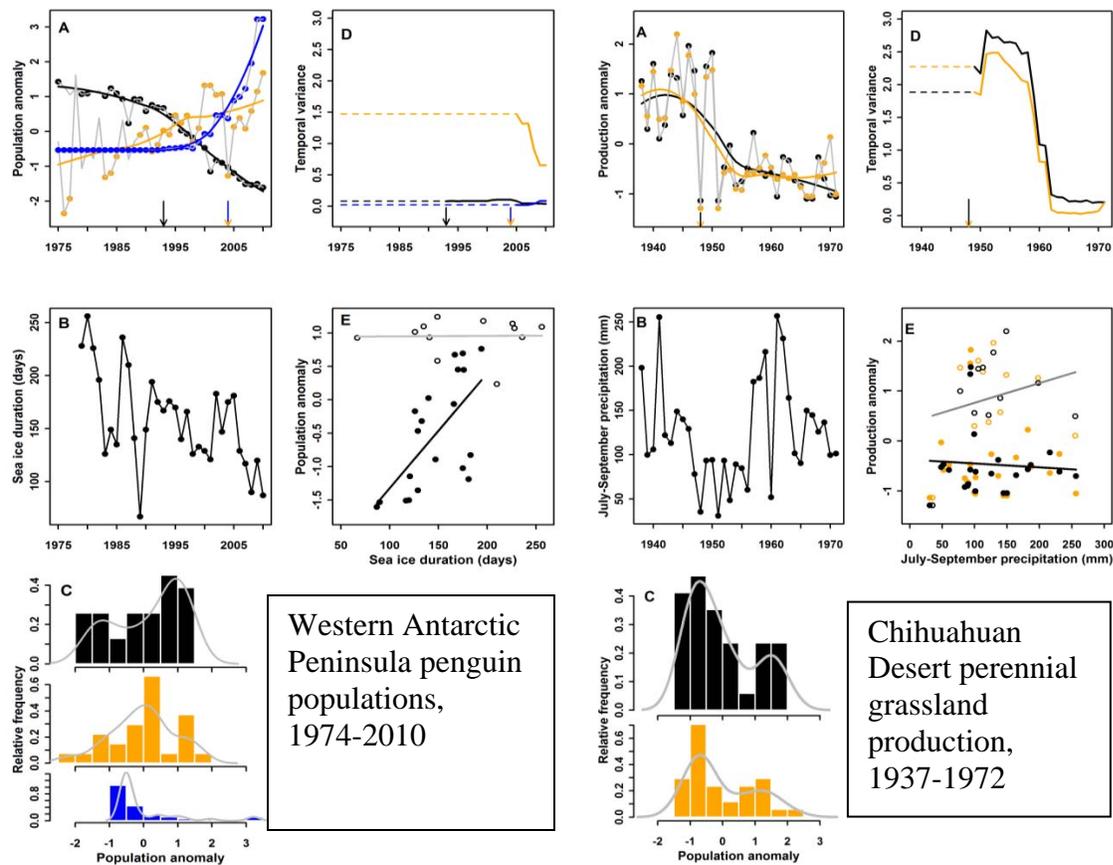


Fig. 3. Results of different sets of time series analyses (A-E) for three species of penguins over 37 years within the Western Antarctic Peninsula (left side) and perennial grass production over 36 years within Jornada pastureland of the northern Chihuahuan Desert (right side). The penguins are illustrated in three colors (Adélie penguins in black, chinstrap penguins in orange, gentoo penguins in blue), and 2 large desert pastures are illustrated in black and orange. These scenes illustrate the following time series analyses: (A) the observed data (either penguin populations or grass production) are shown as points scaled in standard deviation units; (B) the observed driver data (either sea ice duration or amounts of precipitation) are shown as points and the time series as grey lines connecting the points; (C) frequency distributions of penguin populations or grass production; (D) the time series of variance that demonstrate actual thresholds (changes in penguin populations or loss of grass production); (E) the relationship between the driver and response are illustrated for the initial state (solid symbols, black lines) and post-transition state (open symbols, grey lines); the Antarctic relationship between the driver and response is shown only for Adélies because there are too few data for the other species (adapted from Bestelmeyer et al. in press).

**Selected Bibliography:** The following 10 selected recent papers or journal issues originating from our Unit scientists reflect a record of scientific activities of a cross-site and/or networked nature.

Bestelmeyer, B.T., Ellison, A.M., Fraser, W.R., Gorman, K.B., Holbrook, S.J., Laney, C.M., Ohman, M.D., Peters, D.P.C., Pillsbury, F.C., Rassweiler, A., Schmitt, R.J., Sharma, S. 2011. Analysis of abrupt transitions in ecological systems. *Ecosphere* (In Press).

Peters, D.P.C., Lugo, A.W., Chapin III, F.S., Pickett, S.T.A., Duniway, M., Rocha, A.V., Swanson, F.J., Laney, C., Jones, J. 2011. Cross-system comparisons elucidate disturbance complexities and generalities. *Ecosphere* 2:art81. doi:10.1890/ES11-00115.1

- Herrick, J.E., Lessard, V.C., Spaeth, K.E., Shaver, P.L., Dayton, R.S., Pyke, D.A., Jolley, L., Goebel, J.J. 2010. National ecosystem assessment supported by science and local knowledge. *Frontiers in Ecology and the Environment* 8:403-408.
- Peters, D.P.C., Groffman, P.M., Nadelhoffer, K.J., Grimm, N.B., Collins, S.L., Michener, W.K., Huston, M.A. 2008. Living in an Increasingly Connected World: A Framework for Continental-Scale Environmental Science. *Frontiers in Ecology and the Environment* 6:229-237.
- Rango, A., Martinec, J. Roberts, R.T. Relative importance of glacier contributions to water supply in a changing climate. *World Resource Review*. 20:487-503. 2008.
- Havstad, K.M., Peters, D.P.C., Skaggs, R., Brown, J., Bestelmeyer, B., Fredrickson, E., Herrick, J., Wright, J. 2007. Ecological services to and from rangelands of the United States. *Ecological Economics*. 64:261-268. 2007.
- Peters, D.P.C., Bestelmeyer, B.T., Turner, M.G. 2007. Cross-scale interactions and changing pattern-process relationships: consequences for system dynamics. *Ecosystems*. 10:790-796.
- Peters, D.P.C., Bestelmeyer, B. T., Herrick, J. E., Monger, H.C., Fredrickson, E., Havstad, K. M. 2006. Disentangling complex landscapes: new insights into arid and semiarid system dynamics. *BioScience*. 56:491-501.
- Havstad, K.M., Huenneke, L.F., Schlesinger, W.H., editors. 2006. Structure and Function of a Chihuahuan Desert Ecosystem. The Jornada Basin Long-Term Ecological Research Site. Oxford, NY: Oxford University Press. 492 p.
- Estell, R.E., Fredrickson, E.L., Peters, D.P.C., editors. 2006. Special Issue - Landscape linkages and cross-scale interactions in arid and semi-arid ecosystems. *Journal of Arid Environments*. 65:193-335.

## **INFRASTRUCTURE**

**Staffing:** There are 10 permanent full-time category I ARS scientists, 7 full-time post doctoral research positions (either ARS associates or NMSU equivalent as of November, 2011), and 1 collaborating permanent full-time USDA Natural Resource Conservation Service (NRCS) scientist housed within this facility for a total of 18 scientists on site. These scientists are supported by 15 ARS FTE technical and administrative staff, and 20-25 state technical FTE supported by extramural grants and contracts. The Jornada research program staff of ~60 FTE are housed in Wooton Hall, a modern 29,000 sq. ft. USDA facility constructed in 2002 based on the campus of NMSU. This building contains modern laboratory, office and conference facilities that support both ARS and LTER programs based at the Jornada.

In addition, 5 ARS FTE technical staff are assigned to the Jornada field station in support of all maintenance, repair, and research assistance activities. These staff are housed at the Jornada field station headquarters on a daily basis and they provide all needed technical and logistic support for field station activities. In total, the Jornada has a staff of 70-75 scientists, technicians, office and administrative professionals, graduate and undergraduate students working within the Unit.

**Facility Administration:** An ARS senior scientist serves as location coordinator responsible for all overall administrative and scientific functions and operations of the Jornada research unit and its cooperative research activities (Fig. 4). Lead Scientists serves as Principle Investigators for either the ARS or the LTER research programs based at the Jornada. A Station Superintendent is assigned to the Jornada field station facility and directs staff, repair and maintenance (R&M) activities and field support functions on site. A research support scientist directs all livestock related activities at the Jornada. Individual technical staff handle specific research projects and field campaigns.

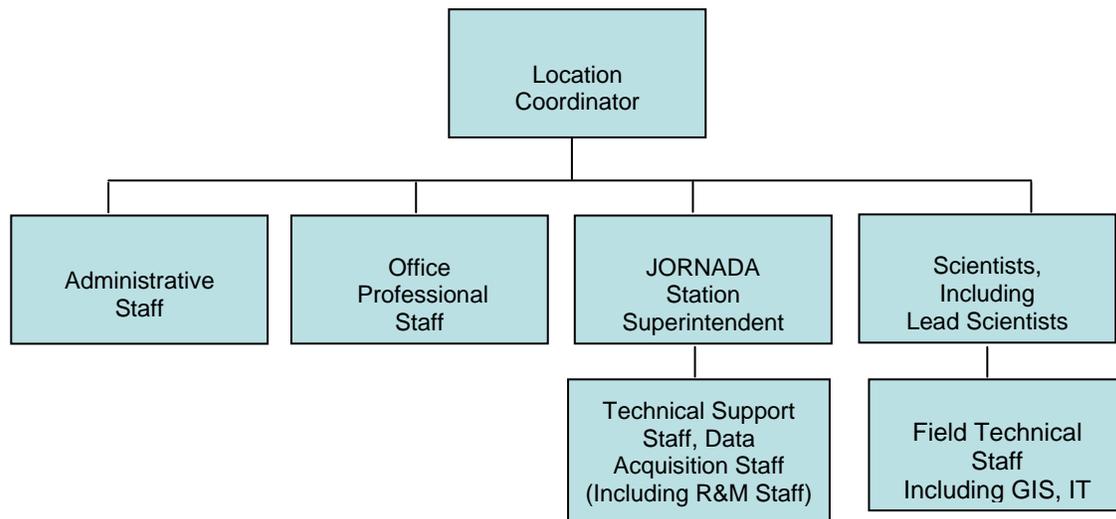


Fig. 4. Staffing chart.

**Headquarters Site:** The Jornada Experimental Range headquarters (HQ) is located in the geographic center of the field station and is approximately 30 mi from the campus of NMSU in Las Cruces. This location provides direct access to hundreds of field sites currently in operation across the Jornada. A single wide mobile trailer provides temporary housing for a resident on-site manager and family. Additional on-site housing (mobile homes) provides accommodations for up to 20 visiting scientists, students and field staff. A motor pool is based and maintained at the HQ to provide staff and visitor transportation needs. A fully equipped 4000 ft<sup>2</sup> shop area provides space for all basic equipment fabrication, repair and maintenance needs. Four additional shop areas of 500-750 ft<sup>2</sup> each provide specific space for wood, metal, mechanical and miscellaneous construction projects.

With the construction of Wooton Hall on the campus of NMSU in 2002 we completed the first phase of our facility development plan for the overall Jornada program. With modern laboratories and adequate office space on campus, our most pressing need for the improvement of the Jornada was development of field facilities at the Jornada field station. A NSF Division of Biological Infrastructure (DBI) planning grant (NSF DBI Award # 0330667) that was awarded in 2003 allowed us to develop the next phase of this facility improvement. During the course of identifying the priorities for needed new facility construction, we were able to use LTER, ARS, NMSU and NSF DBI funding support to dramatically improve the infrastructure at the Jornada HQ. Currently, at the Jornada HQ the existing infrastructure includes:

- resident housing for an on-site station manager,
- housing for ~20 visitors,
- modern shop, dry lab areas, and storage facilities/buildings,
- modern telecommunications services,
- modern electrical systems and distribution lines,
- an integrated network of 3 domestic water wells providing 50,000g of water storage and a modernized delivery system,
- offices for resident staff and visitors,
- a fire abatement system with appropriately distributed hydrants,
- a T1 fiber optics system providing high speed data communications and wireless internet access service to the HQ and subsequent wireless nodes across the field station,
- a new 2000 ft<sup>2</sup> multi-user facility.

**Proposed Improvements:** The NSF DBI planning grant award provided support to identify priorities for infrastructure investment. From that award ARS scientists, working with the Administration of NMSU, developed a master plan for research facilities within the Jornada basin. Part of this plan included

development objectives for the Jornada HQ. The master plan identified needed facilities to complete the field station in order to fully support existing, projected and proposed activities (Fig. 5). These three priority facilities are currently being provided through temporary structures. Subsequent proposals to NSF DBI are planned to provide needed construction funds. Our prior DBI awards for the planning grant and the multi-user facility increase the likelihood that these future proposals will be successful. In the interim, we have structures in place that provide the needed services and support.

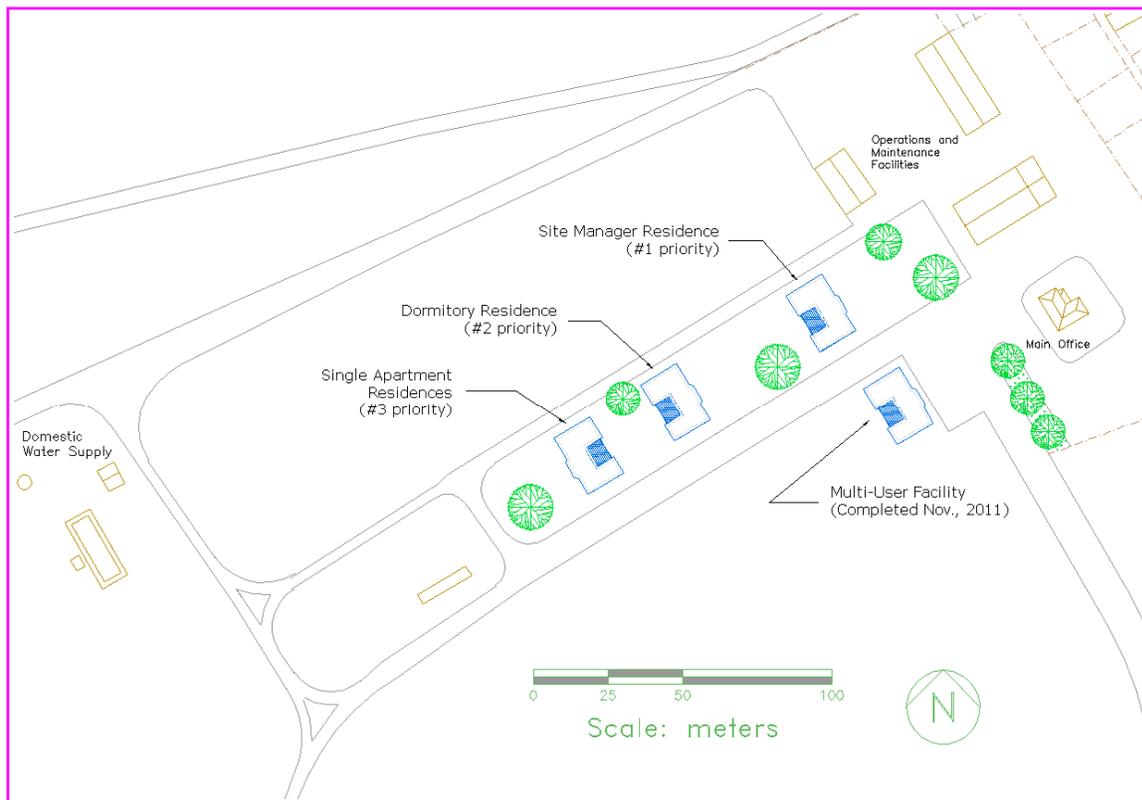


Fig. 5. Jornada Experimental Range (JER) Headquarter Site Master Plan.

The proposed facilities are, in order of priority:

1. A 2000 sq. ft. on-site manager residence. This facility will replace a 35-year old mobile home currently on site and used as this residence.
2. A 2000 sq. ft. dormitory for student guests with 2 large sleeping areas, a commons area, and restrooms and shower/bath areas.
3. A 2000 sq. ft. facility with 8 bedrooms for visiting scientists, a commons area, and restroom facilities.

**Jornada Field Station Research Sites:** Research sites across the Jornada can be characterized within one of two general categories; 1) long term, manipulative field studies, and 2) sensor networks (Fig. 6). Metadata are associated with both categories, and both documentation and data sets can be accessed on line (see Data Accessibility section for further descriptions). All investigators are required to complete a research authorization request to ensure both metadata requirements are met, and to protect all existing research sites and locations (see: <http://jornada.nmsu.edu/data-catalogs/documentation> for instructions on site access and data documentation requirements). The sensor networks include both local (for example, a dust collector network) and national (for example, climate reference network, U/V network) networks.

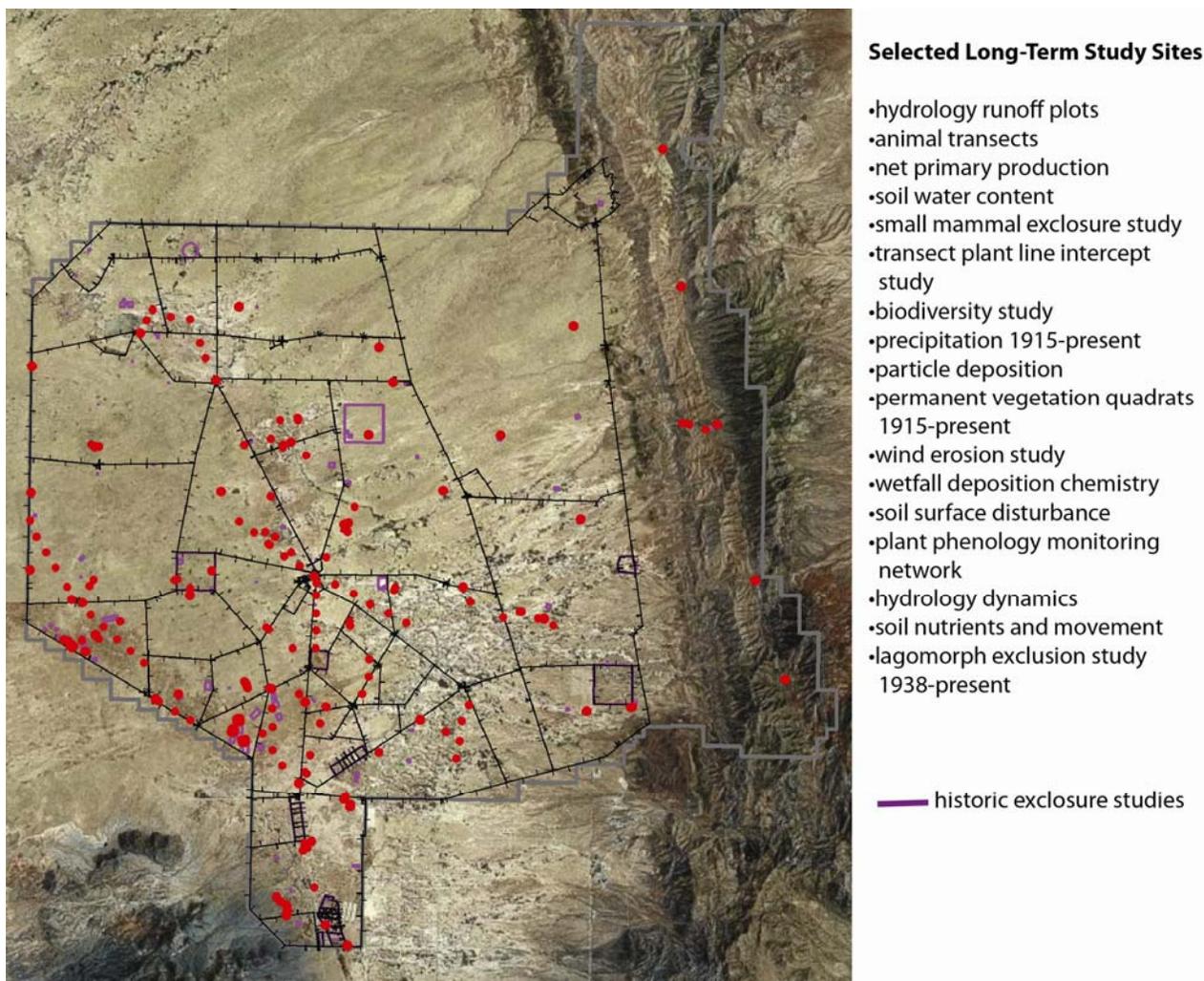


Fig. 6. Locations of selected long-term study sites across the Jornada.

**Facility Use and Maintenance Plan:** Our facilities on campus are maintained through a Research Support Agreement (RSA) with NMSU, and annual costs for routine use, maintenance, repairs, landscaping, fire protection, security and communications are less than \$10/sq. ft. Unit base funds are adequate for this RSA.

Our Jornada HQ facilities are maintained by ARS R&M staff positions based at the Jornada and supervised by the Station Superintendent. At least 4% of the Jornada annual operating budget (~\$176,100) is allocated to R&M activities directed towards station facilities. This budget allocation includes both force account labor and funds for supplies, materials, and needed capital equipment. The staff and base funding resources are adequate to address all facilities R&M needs.

**Research and Training Use of the Jornada Facilities:** Over the last 5 years, on average, approximately 140 scientific personnel from various institutions use the field station in a variety of regular, scheduled capacities each year. This use includes approximately 40 scientists accessing field sites and/or long term data sets originating from Jornada research, 10 post-doctoral research associates conducting research activities in support of either ARS or LTER programs, 25 technical staff directing field research activities, 30 graduate students from several institutions (including NMSU, Arizona State University, University of Arizona, Brown, UCLA, and several foreign Universities), 30 undergraduates providing support to field

campaigns, and 5 undergraduates involved in Research Experience for Undergraduate programs. Establishment of any new research site on the Jornada requires authorization by the Supervisory Scientist. All needed forms and the submittal process are completed online via the Jornada website.

In addition, there are numerous uses of the field station on a less routine or less scheduled basis each year. For example, in the past 2 years dozens of university students from several institutions, including West Texas State, NMSU, the University of Chihuahua, the University of California, and the Ecological Society of America's SEEDs program accessed the field station for several days or several weeks at a time in support of field courses or field experiments that took advantage of the Jornada research history, associated research programs, and its accommodations. Each year approximately 30-100 students and faculty access the Jornada in this manner.

As a land base withdrawn from the public domain and devoted to long term research, the Jornada is closed to unescorted public access according to federal policies. However, Jornada staff routinely escort public groups requesting access in support of specific interests. Each year the Jornada is a site for numerous local field trips organized by various civic groups, including local chapters of the Sierra Club, the Audubon Society, Soil and Water Conservation Districts, and the Native Plant Society. The Jornada staff also conducts 2-6 workshops each year for land management agency personnel, including the Bureau of Land Management and the Natural Resource Conservation Service. These workshops are typically 3-4 days each with a mixture of field and meeting room activities. These civic and agency groups are able to access Jornada facilities to support their local meetings and workshops, and associated on-site field activities.

**K-12 Schoolyard Program:** For over a decade, the Jornada program has provided quality, inquiry-based science education opportunities to K-12 students and teachers throughout southern New Mexico and west Texas. Over this time period, program staff have directly worked with >500 teachers who have participated in one-day, five-day and two-week teacher professional development workshops. These workshops are specifically directed towards development of science based curriculum that can be used by these teachers in their classroom programs. These curricula have been developed through a Cooperative Agreement with the Asombro Institute for Science Education (see: <http://www.asombro.org>), and specifically address state board of education outcomes for science education in New Mexico. The key to this volume of outreach continues to be this partnership that was established in 1998 among the LTER, the ARS, and the Asombro Institute for Science Education (formerly the Chihuahuan Desert Nature Park), a nonprofit science education organization. Using the combined expertise of these partners, we deliver a multifaceted K-12 education program which includes schoolyard studies, science investigation kits, teacher workshops, field trips, and classroom programs. Over the past 5 years, over 50,000 students have been involved in the Asombro Institute's programs. Approximately 20% of these students participate in field activities conducted on-site at the Jornada as part of their education activities. Annually, Jornada staff devote over 300 hours of time in support of these field programs at the Jornada. Our on-site resident manager provides logistical support for many of these activities.

## **DATA RICHNESS**

**Jornada Datasets:** The Jornada maintains a data catalog comprised of over 150 separate, documented data sets linked to specific field studies or monitoring networks collected for different lengths of time over the course of its research history. Most completed or active data sets, and their metadata, are accessible for open public use (see Data Availability section). We are actively working towards having all data sets completely available in 2012. These data sets are organized into one of the following seven categories that generally describe their nature or intent: animal, climatic, decomposition, hydrology, intersite, plant, or soil-related. Lengths of record vary with each specific data set.

Of these, 18 data sets are separated out as truly of a long term nature. These are data sets with a minimum of 15 years of record, and are data sets that are active, on-going measurements. Many of our other data sets are also on-going, active records, but are not yet a minimum of 15 years of continuous

collection. Several of these 18 long-term data sets trace back to the USFS and were initiated in 1915 and approaching a nearly 100 year record of recorded observations. These data sets (see: <http://jornada.nmsu.edu/data-catalogs/long-term>) include classic climatic records, including daily precipitation and maximum and minimum daily air temperatures, and records of vegetation and soil surface dynamics. Of particular note are the long-term records of vegetation cover dynamics from permanent quadrats established across the Jornada in 1915 (<http://jornada.nmsu.edu/jornadalter/studies/usda/projects/PermQuad.prj>), records of vegetation response to disturbances within plots established in 1938 (<http://jornada.nmsu.edu/jornadalter/studies/usda/projects/vclsusda.prj>), and spatial patterns of net primary productivity established in 1989 (<http://jornada.nmsu.edu/data-catalogs/data#LtNpp>). These records are still generating insights into long term dynamics within this desert, and are published in the peer-reviewed literature (e.g., Havstad et al. 1999, Yao et al. 2005, Gibbens et al. 2005, Peters et al. 2011). In addition, all of these data are open for public use.

The Jornada also maintains an extensive catalog of spatial data. These data include GIS layers detailing boundaries, climatic networks, geographic reference points (e.g., land surveys), cultural features (e.g., roads, livestock watering points, and fences), and land coverage maps. We also provide access to satellite imagery (landsat scenes starting in 1993) as both bit map images and downloadable shape files. The Jornada also has an extensive collection of aerial photographs providing complete coverage of the Range beginning in 1935. These images have been a recent and rich source of information that have contributed to our scientific efforts (e.g., see Browning et al. 2011). Our spatial data sets are an active area of effort to provide complete and open access via web-based interactive portals, but we have not yet completed this effort. All of these spatial data sets (maps, shape files, GIS coverages) will be available in 2012.

The Jornada also has an extensive collection of historical photographs mostly collected by USDA personnel beginning in the 1920s. All of our original prints and negatives have been archived within the historical special collections within the library system at NMSU to protect the original photographs. All images can be accessed through a searchable data base through the NMSU library system (see: <http://jornada.nmsu.edu/data-catalogs/photos>).

**Selected Bibliography:** The following 10 selected papers from this Unit reflect a record of scientific activities that utilize our long-term data sets.

- Peters D.P.C., Yao, J., Sala, O.E., Anderson, J. 2011. Directional climate change and potential reversal of desertification in arid and semiarid ecosystems. *Global Change Biology* (in press) [doi: 10.1111/j.1365-2486.2011.02498.x].
- Rango, A., Havstad K.M., Estell R.E. 2011. The utilization of historical data and geospatial technology advances at the Jornada Experimental Range to support western America ranching culture. *Remote Sensing*. 3:2089-2109.
- Browning, D.M., Laliberte A.S., Rango A. 2011. Temporal dynamics of shrub proliferation: Linking patches to landscapes. *International Journal of Geographical Information Science*. 25:913-930.
- Yao, J., Peters D.P.C., Havstad K.M., Gibbens R.P., Herrick J.E. 2006. Multi-scale factors and long-term responses of Chihuahuan Desert grasses to drought. *Landscape Ecology*. 21:1217-1231.
- Peters, D.C., Mariotto I., Havstad K.M., Murray L.M. 2006. Spatial variation in remnant grasses after a grassland-to-shrubland state change: Implications for restoration. *Rangeland Ecology and Management*. 59:343-350.
- Gibbens, R.P., McNeely R.P., Havstad K.M., Beck R.F., Nolen B. 2005. Vegetation changes in the Jornada Basin from 1858 to 1998. *Journal of Arid Environments*. 61:651-668.
- Goslee, S.C., Havstad K.M., Peters D.C., 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*. 54:755-767.

- Havstad, K.M., Gibbens R.P., Knorr C.A., Murray L.W. 1999. Long-term influences of shrub removal and lagomorph exclusion on Chihuahuan Desert vegetation dynamics. *Journal of Arid Environments*. 42:155-166.
- Gibbens, R.P., Beck R.F. 1988. Changes in grass basal area and forb densities over a 64-year period on grassland types of the Jornada Experimental Range. *Journal of Range Management*. 41:186-192.
- Gibbens, R.P., Tromble J., Hennessy J.T., Cardenas M. 1983. Soil movement in mesquite dunelands and former grasslands of southern New Mexico from 1933 to 1980. *Journal of Range Management*. 36:145-148.

**Global Datasets:** For the past several years the Jornada has led an effort to collect datasets from 50 participating research sites and field stations mostly across North America. The effort, termed the EcoTrends Project, was designed to promote and enable the use and synthesis of long-term data to examine trends in the Earth's ecosystems. The EcoTrends project is a collaborative effort among state and federal agencies and institutions to make long-term ecological data easy to access, analyze, and compare within and across sites. The EcoTrends website is a portal to:

- a large and diverse collection of standardized long-term ecological datasets and their metadata (> 1200 datasets)
- unique data exploration, downloading, graphing and synthesis tools
- information about participating research sites and their parent agencies

These datasets, tools, and information are available to anyone who would like to view trends in ecological variables for one or multiple sites or pursue additional statistical analyses of within-site and cross-site comparisons. A synthesis text on this project and detected trends from these data is in press:

Peters, DPC, Laney CM, Lugo AE, Collins SL, Driscoll CT, Groffman PM, Grove JM, Knapp AK, Kratz TK, Ohman MD, Waide RB and Yao J.2011. Long-term trends in ecological systems: a basis for understanding responses to global change. USDA Agriculture Research Service Publication No. XX. Washington, D.C.

## **DATA AVAILABILITY**

**Data Management:** The conceptual framework for providing access to our varied and numerous data sets is presented in Fig. 7. The Jornada has adopted the on-site data management policies established by NSF for the LTER network. The Jornada Basin Information Management System provides protocol and services for data collection, verification, organization archives and distribution in accordance with LTER guidelines, (see: <http://jornada.nmsu.edu/jrndmpol.php?withJS=true>). All data collected within the Jornada, either LTER, USDA, or other funding sources, complies with these data management policies.

Associated with data management policies is a data access policy that all data are made publicly available no later than 2 years after submission of the original data, unless a specific extension to this time limit is granted to a PI for a specific reason. Initial documentation for any data set is required of all scientists, collaborators, and their students and field personnel within 90 days of initiation of data collection. All data forms, access requests, and documentation forms are available on-line from <http://jornada.nmsu.edu>.

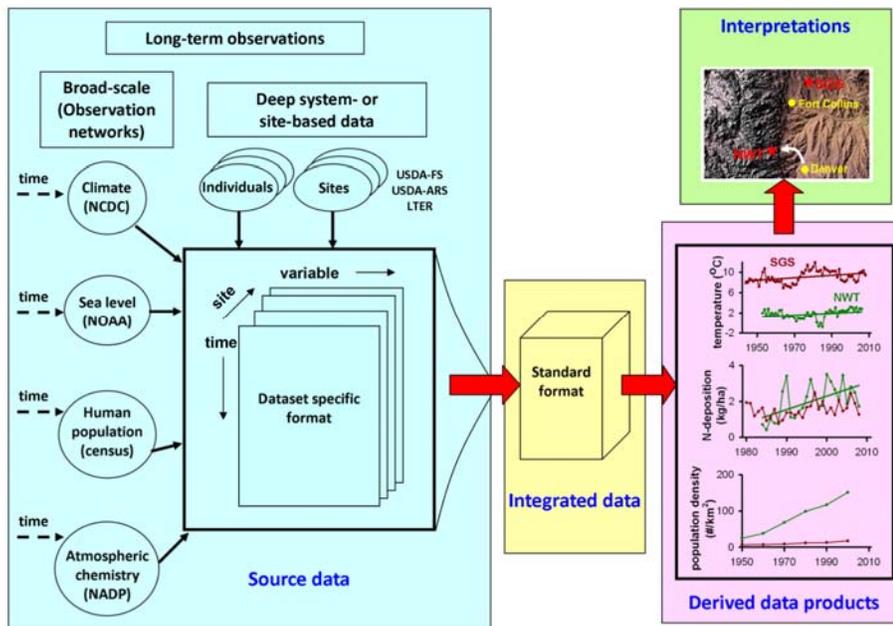


Fig. 7. The Jornada data availability strategy is built around the concepts of providing access to source data, integrated data, and derived data products, in order to create increased opportunities for interpretations of these data (From Peters 2010).

**Information Technology/Data Acquisition System:** The Jornada Information Management System includes acquisitions and management of spatial data and provision of network and computing systems (see Fig. 8). This system is staffed by 6 full-time personnel funded by both USDA and NSF LTER

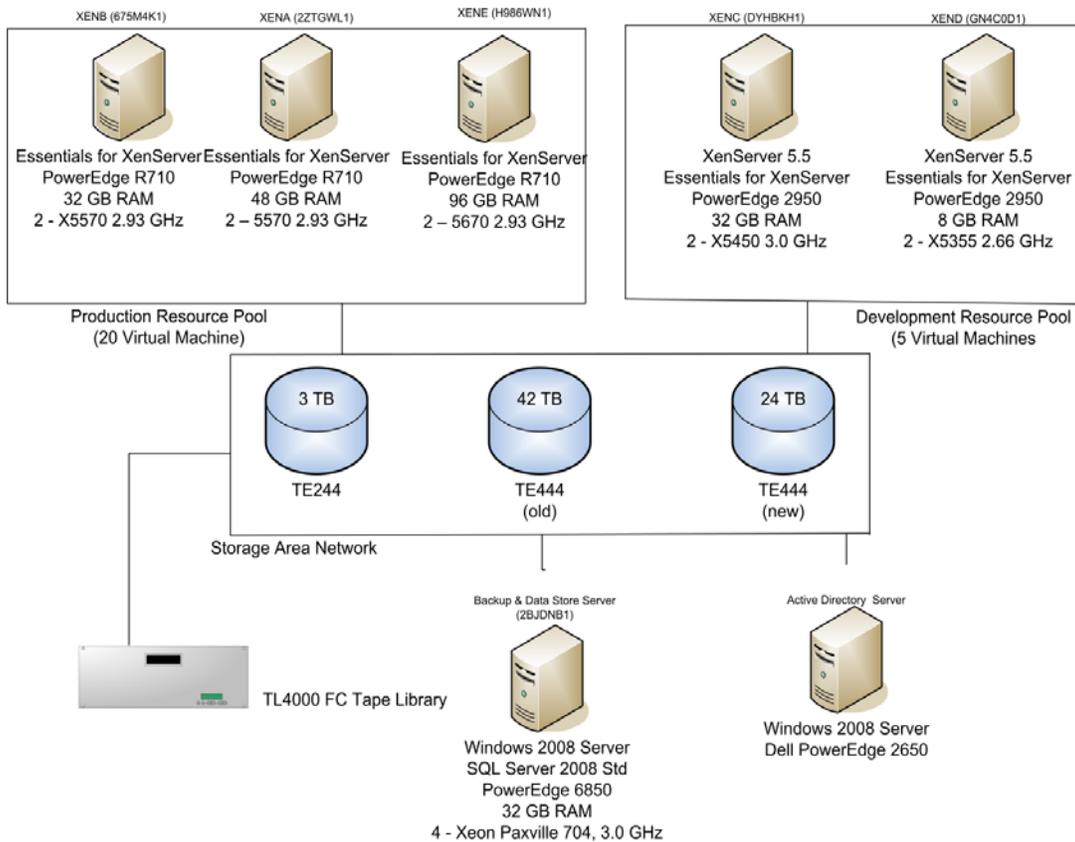


Fig. 8. Jornada network server system, including virtual servers established for both data development and data production activities.

programs. These positions include an overall systems manager, 2 GIS specialists, a computer systems manager and 2 network and data system support personnel. The Information Management system (IMS) is integrated with a Geographic Information System and is composed of a relational database management system and metadata repository.

All metadata can be searched and accessed through the Jornada data web access points. The sensor networks include both local (for example, dust collector network) and national (for example, climate reference network, U/V network) networks. National network sensor data are available on-line through respective network web sites. Data acquisitions within the Jornada are facilitated by a T1 fiber optic system based at the Jornada headquarters (HQ) and associated wireless network data access modes across the range, and a radio based data transmission system for transfer of data from remote instruments to Jornada HQ and subsequent relay to other hosts.

## **GEOGRAPHIC COVERAGE**

**Unique Elements:** Approximately 1/3<sup>rd</sup> of the world's ice-free land surface is arid and nearly 1/6<sup>th</sup> of the world's population of 7 billion live within or on the margins of arid lands. In this sense, the Jornada, as an arid land based research facility, is not unique. However, the Jornada is uniquely located within the Chihuahuan Desert, the largest desert in North America. The region covers nearly 650,000 sq. kilometers and is one of the most biologically diverse arid landscapes in the world. The Chihuahuan Desert includes nearly 1/3 of the world's cacti species, over 180 species of reptiles, and more than 3,000 species of plants. The only North American desert east of the Continental Divide, the region is a mosaic of enclosed basins and isolated mountain ranges that creates an extremely heterogeneous landscape that has both terrestrial and freshwater environments (Wauer and Riskind 1977). The Jornada basin is within the northern portion of the Chihuahuan desert and includes a unique subset of the biological diversity that characterizes this region. There are over 500 plant species, and particularly rich biota of animals. For example, approximately one-tenth of North American ant species are found within the Jornada Basin (Whitford and Bestelmeyer 2006). Fortunately, many of the floral and fauna are well documented due to the history of long-term research within this basin (Havstad et al., 2006).

**Coverage at Various Scales:** The Jornada is unique in that it is the only ARS long term research site to be within the following combination of geographic regions within the US (Fig. 9):

- the Mountain agroecosystem,
- the Southwest Neon Domain (#14), and
- the Rio Grande Region Watershed Unit Level 1 (region 13).

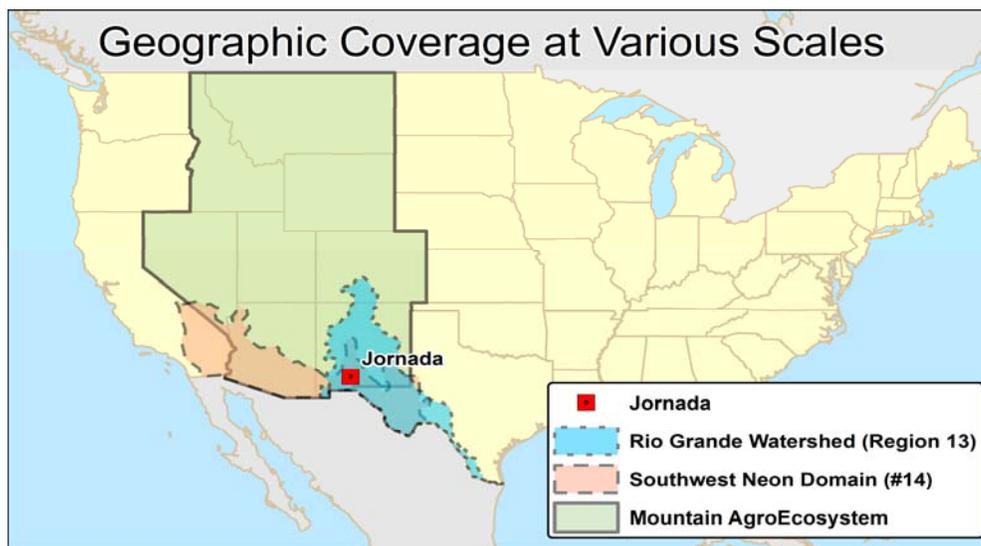


Fig. 9. Jornada location relative to important geographic regions within the US.

## PARTNERSHIPS

The overall program at the Jornada is based on integration of our research objectives into a broad set of collaborative research agreements with numerous institutions, agencies and non-profit organizations devoted to application of information and technologies resulting from our research to natural resource management. These partnerships include US government agencies with responsibilities for managing over 400 m ac (160 million ha) of public rangelands (both the Bureau of Land Management and the National Park Service), or providing technical support for hundreds of millions of ac of private rangelands across the US (the Natural Resource Conservation Service). These cooperative agreements also include groups interested in conservation of biodiversity (the Nature Conservancy and the Malpai Borderlands Group) and proper land management practices for degraded regions on other continents (the Agricultural University of Inner Mongolia and the National Institute of Agricultural Technology of Argentina). The Jornada has over 20 active agreements with many different organizations that result in research positively affecting both national policies and management of landscapes throughout the western US and on other continents.

New Mexico State University is the main cooperating institution with the Jornada. NMSU is one of the nation's largest Hispanic serving institutions, and the Jornada typically supports 12-20 NMSU students either through undergraduate research experience programs or graduate research assistantships. Of additional importance are the numerous, long-term collaborations with research faculty at NMSU that provide synergistic and complimentary expertise to our collective scientific efforts.

The national partnership most central to our program has been as a site within the NSF LTER Network. As one of the original cohort of 6 sites within this network, the Jornada has participated in the LTER since 1982. A proposal to NSF for a 6-year renewal for our participation in this program will be submitted in February 2012. The PI for this program is Dr. Deb Peters, an ARS scientist within our Unit.

The Jornada is a member institution and relocatable site within the Southwest Domain of the newly-formed NEON (NEON; <http://www.neoninc.org/neon-membership/neon-member-institutions.html>). The 3 NEON sites within this Domain are slated for construction in 2012.

The Jornada is also a member/participant in the following national/global networks:

- one of the original Man and Biosphere Reserves (established in 1976) ([www.unesco.org/mabdb/br/brdir/directory/biores.asp?mode=all&code=USA+14](http://www.unesco.org/mabdb/br/brdir/directory/biores.asp?mode=all&code=USA+14)),
- USDA UV-B Network (since 1994): [http://uvb.nrel.colostate.edu/UVB/uvb\\_network.jsf](http://uvb.nrel.colostate.edu/UVB/uvb_network.jsf)
- an institutional member site of the Association of Ecosystem Research Centers (since 2004): (<http://www.ecosystemresearch.org/>)
- NOAA Climate Reference Network (since 2007): <http://www.ncdc.noaa.gov/isis/station.htm;jsessionid=465FBDDC51504971D9B1A57C68D03874.lwf3?stationid=1307>
- NRCS Soil Climate Analysis Network (since 2009): <http://www.wcc.nrcs.usda.gov/nwcc/site?sitenum=2168&state=nm>.

**INSTITUTIONAL COMMITMENT**



**United States Department of Agriculture**

Research, Education, and Economics  
Agricultural Research Service

November 15, 2011

SUBJECT: Letter of Support  
TO: Long-Term Agro-Ecosystem Research Network, Steering Committee  
FROM: Dan R. Upchurch   
Director

I fully support the inclusion of the Jornada Experimental Range and its Research Unit as a site for inclusion within the ARS's Long-Term Agro-Ecosystem Research (LTAR) Network.

The vision for this network centers on sites that have a capacity to conduct transdisciplinary science over decades. The Jornada has repeatedly demonstrated this capacity over the course of its nearly 100-year history.

A goal for this network is to sustain our scientific infrastructure for research, management testing and education that addresses U.S. needs for providing diverse ecological goods and services from our nation's land resources. The Jornada's mission and its numerous accomplishments have repeatedly demonstrated its alignment with this goal.

A desired outcome of this network is the creation of a capacity to conduct shared research across multiple sites as a functioning scientific network. Over many years, through its participation in other national networks, the Jornada has demonstrated a capacity for cross-site research, and published results from those networked research activities.

Key components of this LTAR are both a richness and availability of long-term data sets that can contribute to the scientific vitality of this network. The Jornada already has over 150 active and accessible data sets that are being shared within the scientific community, and would certainly be of value to an ARS-based LTAR.

Within the constraints of the annual appropriation process I would expect that this location would continue in operation for an extended time period, thereby meeting the requirements for the LTAR Network.



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