

Sevilleta LTER 1996 Annual Report

Bruce T. Milne, Principal Investigator

Sevilleta LTER II: Biome-level constraints on population, community, and ecosystem responses to climate fluctuation.

(DEB 9411976)

1. On-going LTER Research.

The Sevilleta Long-Term Ecological Research Program (LTER) was initiated in October, 1988, and has focused on a suite of ecological hypotheses concerning climate dynamics and the responses of organisms in a biome transition zone in central New Mexico. The Sevilleta LTER research region straddles several major biomes of the Southwest, and the large geographic scale of the Sevilleta region is important for studies that range from genetics and physiology at the organismal level, to the dynamics of biome transition zones. The region is strongly influenced by the El Niño Southern Oscillation (ENSO), with major fluctuations in precipitation on semi-decadal time scales. To date, 83 LTER research papers have been published or are in press.

A. Weather Measurements. All weather stations on the Sevilleta NWR, Bosque del Apache NWR, and the Magdalena Mountains, are still operating. TDR instruments and probes have been installed at several of the major stations to provide detailed, continuous measurements of soil moisture. Precipitation samples continue to be collected for chemical analyses.

B. Vegetation/Ecotone Studies. All permanent plant transects have been sampled this spring, and data are being analyzed. Vegetation mapping of the Sevilleta will be completed in 1996, and field work on this project is scheduled to commence in mid-July. The vegetation transects will be re-sampled at peak production time in mid-September.

C. Primary Production. A project has begun in 1995 which measures primary production in the grassland areas of the Sevilleta. Dr. James Gosz has established replicated 25 x 25 m plots in mixed-grass prairie, and has used a large mower to harvest the above-ground standing biomass. Harvested grass amounts were sieved to remove accumulated dust particles, and then weighed. These plots were allowed to regrow during 1995, and were harvested by mowing last September. Additional paired plots also have been harvested to compare the amount of standing crop on mowed and unmowed plots. By repeating this procedure year after year, inter-annual differences in above-ground biomass can be detected, with minimal sampling variance due to the larger plot sizes. Biomass fluctuations will be correlated to precipitation and other biotic/abiotic variables.

D. Decomposition and Nutrient Cycling. Litterbag studies are being continued at all the major Sevilleta research sites. New sets of litterbags, containing a range of common Sevilleta plant species, were placed in the field in January, while older bags were harvested according to the pre-arranged schedule. Analyses of the recently harvested bags are in progress.

E. Trophic Interactions/Animal Population Studies. Vertebrates and invertebrates continue to be sampled as in past years. Pitfall traps and sweep samples of vegetation collect arthropods, while systematic trapping of small mammals provide samples for rodent populations and parasitology studies. Population studies of rabbits, coyotes, and pronghorn antelope are continuing.

F. GIS/Remote Sensing. This work continues to support various LTER projects, including the efforts in vegetation mapping on the Sevilleta, and estimation of primary production patterns and dynamics.

G. REU/UMEB Program. The Sevilleta Site REU Program was renewed for 3 years in 1995. The UMEB Program continues to operate in collaboration with the Sevilleta LTER. As in prior years, the goals of these programs are to (1) instruct undergraduates in the principles of scientific research, (2) expose the students to a wide variety of ecological research techniques and career opportunities, (3) facilitate individual student research projects, and (4) encourage students to continue their scientific education in upper-division courses and graduate school. To accomplish these goals, the programs include (1) orientation meetings and a seminar series devoted to the variety of scientific opportunities in ecological research at the Sevilleta, (2) faculty-student one-on-one instruction of hypothesis development and research protocols in ongoing Sevilleta LTER projects, (3) field and laboratory experiences in sampling and data collection, (4) implementation of individual student research projects, carried out under the guidance of student-selected faculty members, (5) a Sevilleta REU Symposium for project presentations by the students, (6) attendance at scientific meetings (12 REU and UMEB students presented posters at the 1995 ESA meeting in Snowbird, Utah, in August 1995), and (7) preparation and submission of project manuscripts to scientific journals. These activities integrate all theoretical and technical aspects of the LTER and promote a holistic approach to large-scale ecological studies.

2. New 1995-96 LTER Research.

A. Sevilleta Water Balance Studies. The mission of water balance studies is to “assess, predict, and extrapolate soil water availability for the Sevilleta LTER as it affects biodiversity, ecosystem function, and resource availability”. We have enlisted the collaboration of arid lands hydrologists, plant physiological and population ecologists, remote sensing specialists, and energy balance modelers at New Mexico Tech, the Department of Earth and Planetary Sciences (UNM), the New Mexico Heritage Office, NREL at CSU, Los Alamos National Laboratory, and the University of Kansas. Progress includes: (1) hiring of a post doc (Dr. Yeulong Yang) to coordinate the technical details, (2) installation of automated TDR systems, (3) detailed monitoring of plant phenology

throughout the year, (4) literature review to guide the selection of models, (5) professional recoding of the Jornada LTER site's Soil Water Balance model (SWB) into a maintainable, general purpose C program made available on the web (<http://algodones.unm.edu/waterbal/models/sevswb/sevswb.html#Downloads>), (6) creation of data base routines to utilize Sevilleta LTER archived weather data in the model, (7) production of a preliminary vegetation map of the Sevilleta from 12 TM scenes collected over a 4 yr period (<http://algodones.unm.edu/~bmilne/vegmap/veg.maps.html>), (8) associated maps of LAI, plant height, total cover, and topographically adjusted solar radiation used to estimate potential evapotranspiration, and (9) a recent supplement to implement National Weather Service doppler radar imaging of precipitation for the Sevilleta.

B. Grassland Modelling Project. Dynamics and Spatial Patterns of Dominant Plant Species, Communities, and Ecosystems in Grassland-Shrubland Ecotones at the Sevilleta LTER. The overall objective of this study, conducted by Dr. Debra Coffin, is to evaluate the environmental constraints and biotic processes important in determining temporal dynamics and spatial patterns in vegetation structure and ecosystem processes for grassland-shrubland ecotones at the Sevilleta. The focus is on three biomes that meet at this site: Great Plains grasslands dominated by *Bouteloua gracilis*, Chihuahuan desert grasslands dominated by *Bouteloua eriopoda*, and Chihuahuan desert shrublands dominated by *Larrea tridentata*. These communities were selected to allow cross-site comparisons with two other LTER sites: the SGS in northern Colorado where shortgrass communities are dominated by *B. gracilis*, and the Jornada in southern New Mexico where Chihuahuan desert grasslands and shrublands are dominated by *B. eriopoda* and *L. tridentata*. The approach is to use a combination of short- and long-term experimental studies and simulation modeling to evaluate these dynamics through time and space.

3. Status of Synthesis Activities.

The Sevilleta LTER synthesis activities revolve around the production of a synthesis volume. We held a Sevilleta LTER Symposium in January 1996 to review progress to date. At the meeting, we discussed the theme and organization of a synthesis volume that will be edited by Bruce Milne and Jim Gosz. The theme will address the role of biotic transition zones and ecotones as active sites for ecological responses to climate fluctuation. Milne is preparing an overview chapter to set the theme. The draft chapter will be circulated to stimulate contributions from other authors. Although an official submission date has not been set, we intend to have authors submit first drafts by March 1997.

In addition, three faculty from the Sevilleta LTER (Bruce T. Milne, James H. Brown, and Diane L. Marshall) will participate in the November symposium at the National Center for Ecological Analysis and Synthesis.

4. Cross-site Activities.

Small mammal enclosure study with Jornada LTER and Mapimi, Mexico. The LTER cross-site small mammal enclosure study that was begun in 1995 is completely underway at Sevilleta. One year of pre-fencing vegetation and soils data were collected from the Sevilleta and Jornada grassland and creosotebush sites in 1995. Rodent and rabbit enclosure fences were installed during the winter of 1995 at the Sevilleta and Jornada LTER sites. Ariel photos were taken of all Sevilleta and Jornada study plots, and soil samples were collected from all study plots to provide baseline information on whole-plot vegetation and soil patterns, and information on soil chemistry spatial patterns. Post-fencing vegetation and soils data were collected on all of the study plots in April 1996. Study sites were located, and study plots installed at the Mapimi Biosphere Reserve, Mexico, during the winter of 1995/1996. One year of pre-fencing vegetation and soil data will be collected at Mapimi prior to fence installation during the winter of 1996/1997. Vegetation, soil, rodent, and rabbit data were collected for the first time at Mapimi this past March.

5. Network-level Activities.

A. NASA/MODIS MODLERS Project. Bruce Milne has a subaward from Oregon State University to participate in the NASA/MODIS MODLERS Project. This project brings together 14 Long-Term Ecological Research (LTER) Network sites and NASA's MODIS Land (MODLAND) Science Team for the purpose of locally validating Earth Observation System-era global data sets.
(<http://atlantic.evsc.virginia.edu/~jhp7e/modlers/>).

B. LIDET Experiment. Sevilleta hosted the 1996 LIDET workshop for the LTER Network, and included the Sevilleta data in the project analyses.

C. LTER Network Soils Workshop. Sevilleta also hosted the Soils Workshop for the LTER soils research group.

6. LTER Data Set Status.

The Sevilleta LTER Information Management System (SIMS) is meeting the needs of its collaborating scientists through extensive development of WWW based information services. Through a contract from Sandia National Laboratory, SIMS Researchers have employed an html designer and programmer for the purpose of developing data and information access. All Sevilleta LTER core datasets either are, or are being prepared for, access via the WWW at URL <http://sevilleta.unm.edu/sims/sims-home.html> (This reference can also be reached via the home page at <http://sevilleta.unm.edu>). The publication of Sevilleta LTER datasets is not considered to be a trivial or routine process. Only datasets that have

met documentation standards for ecological data (Michener et al. 1996), have passed extensive quality assurance checks, and have been thoroughly reviewed are considered for publication on the WWW. Incomplete datasets are made available via the Internet to collaborating researchers with a SIMS account. A listing of SIMS data sets is provided in Table 1.

7. Additional Grant Support.

Sevilleta LTER 1996 Supplement Proposal: Near Real-Time Imaging of Precipitation in the Sevilleta LTER, NSF, \$48,461. PI: Bruce T. Milne.

Sevilleta LTER 1996 Supplement Proposal: REU students with the Sevilleta LTER. NSF, \$10,000. PIs: Bruce T. Milne, Robert R. Parmenter, and James W. Brunt.

Estimation of Ecosystem Attributes at the Landscape Scale in a Semi-arid Grassland, Subaward from Oregon State University. 1996. NASA, \$39,962. PI: Bruce T. Milne.

Hantavirus Infections: Ecology, Community, and Treatment. National Institutes of Health, \$1,500,000. PIs: Terry L. Yates and Fred Koster. This grant will use the Sevilleta LTER Program and field research sites as the basis for a new Center for Emerging Diseases in the southwestern United States; includes extensive collaboration between the Sevilleta LTER and the UNM Medical School, the New Mexico State Health Department, and the Federal Centers for Disease Control and Prevention.

Ecosystem and Soil Studies of Native American Runoff Agriculture. NSF, \$476,713. P.I.: Jonathan A Sandor, Iowa State University (ISU); Co-P.I.s: Mark Ankeny, Daniel Stephens, Carleton S. White, Stephen E. Williams, and Deborah A. Muenchrath.

Water Quality Study in the Santa Fe Watershed. USDA Forest Service. \$20,000. PI: Carleton S. White.

Ecology of Fire in Semi-arid Grasslands. USDA Forest Service, \$24,876. P.I. Carleton S. White.

8. 1995-1996 Sevilleta LTER Publications.

Brown, J.H., D.W. Mehlman, and G.C. Stevens. 1995. Spatial variation and abundance. *Ecology*. 76:2028-2043.

Evans, A. S., Robert J. Cabin. 1995. Can dormancy affect the evolutionn of post-germinationn traits? The case of *Lesquerella fendleri*. *Ecology*. 76:344-356.

Gosz, James R. 1995. Edges and natural resource management: future directions. *Ecology International*. 22:17-34.

- Gosz, James R., Douglas I. Moore, Gregory A. Shore, Herbert D. Grover, William Rison, Carol Rison. 1995. Lightning estimates of precipitation location and quantity the Sevilleta LTER, New Mexico. *Ecological Applications*. 5(4):1141-1150.
- Gosz, Rusty J., James R. Gosz. 1996. Species interactions on the biome transition zone in New Mexico: Response of blue grama (*Bouteloua gracilis*) and black grama (*Bouteloua eripoda*) to fire and herbivory. *Journal of Arid Environments*, in press.
- Hawkins, Lauraine K. 1996. Burrows of kangaroo rats are hotspots for desert soil fungi. *Journal of Arid Environments*. 32:239-249.
- Hill, Reginald, James J. Wilson, Achanta D. Sarma, Edgar L. Andreas, James R. Gosz, Douglas I. Moore. 1996. Data sets of the scintillation experiment at Sevilleta. In: NOAA Technical Memorandum ERL ETL. U.S. Department of Commerce. In press.
- Hill, Reginald, William D. Otto, James J. Wilson, Achanta D. Sarma, Edgar L. Andreas, James R. Gosz, Douglas I. Moore. 1996. Fluxes of momentum and heat measured at Sevilleta, New Mexico. In: NOAA Technical Memorandum ERL ETL. U.S. Department of Commerce. In press.
- Johnson, Alan R., Colleen A. Hatfield, Bruce T. Milne. 1996. Simulated diffusion dynamics in river networks. *Ecological Modelling*. In press.
- Loftin, Samuel R., and Carl S. White. 1996. Potential Nitrogen Contribution of Soil Cryptograms to Post-Disturbance Forest Ecosystems in Bandelier National Monument, NM. In: C. D. Allen (ed.). *Proceedings of the 1994 Symposium on the La Mesa Fire, March 29-31, 1994*. USDI National Park Service Technical Report. Denver, CO.
- Mehlman, David W. 1996. Change in avian abundance across the geographic range in response to environmental change. *Ecological Applications*. In press.
- Michener, W.K., J.W. Brunt, J. Helly, T.B. Kirchner, S.G. Stafford. 1996. Non-Geospatial Metadata for the Ecological Sciences. *Ecological Applications*. In press.
- Michener, William K., James W. Brunt, and William H. Jefferson. 1995. New techniques for monitoring *Crassostrea virginica* (American Oyster) recruitment in the intertidal zone. *ICES Mar. Sci. Symp.* 199:267-273.
- Mills, James N., Terry L. Yates, James E. Childs, Robert R. Parmenter, Thomas G. Ksiazek, Pierre E. Rollin, C. J. Peters. 1995. Guidelines for working with rodents potentially infected with Hantavirus. *Journal of Mammalogy*. 76:716-722.
- Milne, Bruce T., Alan R. Johnson, Timothy H. Keitt, Colleen A. Hatfield, John David, and Peter Hraber. 1996. Detection of critical densities associated with piñon-juniper woodland ecotones. *Ecology*. 77:805-821.
- Otto, William D., Reginald J. Hill, Archanta D. Sarma, James D. Wilson, Edgar L. Andreas, James R. Gosz, Douglas I. Moore. 1996. Results of the Millimeter-Wave Instrument Operated at Sevilleta, New Mexico. In: NOAA Technical Memorandum. National Oceanic and Atmospheric Administration. In press.

- Otto, William D., Reginald J. Hill, James J. Wilson, James R. Gosz, Douglas I. Moore. 1996. Results from optical scintillometers operated at Sevilleta, New Mexico. In: U.S. Department of Commerce, NOAA Technical Report. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Research Laboratories. In press.
- Parmenter, R. R., S. L. Brantley, J. H. Brown, C. S. Crawford, D. C. Lightfoot, and T. L. Yates. 1995. Diversity of animal communities on southwestern rangelands: Species patterns, habitat relationships, and land management. In: West, N. E. (ed.). Natural Resource and Environmental Issues: Biodiversity of Rangelands. College of Natural Resources, Utah State University, Logan. Pp. 50-70.
- Parmenter, Robert R. 1995. Pecos National Historical Park survey data help solve Hantavirus mystery. *Park Science*, 1995:12-13.
- Risser, Paul G. 1995. The status of the science examining ecotones. *BioScience*. 45:318-325.
- Sarma, Achanta D., Reginald J. Hill. 1996. A millimeter-wave scintillometer for flux measurements. In: NOAA Technical Memorandum ERL ETL. U.S. Department of Commerce.
- Schlesinger, William H., Jane A. Raikes, Anne E. Hartley, and Anne F. Cross. 1996. On the spatial pattern of soil nutrients in desert ecosystems. *Ecology*. 77(2):364-374.
- White, Carleton S. 1996. The effects of fire on nitrogen cycling processes within Bandelier National Monument, NM. In: Allen, Craig D. (ed.). Proceedings of the 1994 Symposium on the La Mesa Fire, March 29-31, 1994. USDI National Park Service Technical Report. Denver, CO.
- White, Carleton S., Yorgos D. Marinakis. 1996. Relationship between the Southern Oscillation and dry deposition of sulfur and soil elements at the Chiricahua National Monument, southeastern Arizona. *Biogeochemistry*. In press.
- Wilber, Patricia G., and Michael J. Patrick. 1996. Mark-recapture vs. simulated removal trapping for assessing temporal patterns in ecological communities: An example using coccidian parasites of two species of rodent. *American Midland Naturalist*. In press.
- Yates, Terry L. 1995. Assessing and monitoring biological diversity at the genetic level. Pages 41-49, In: M.M. Watanabe and M. Yasuno (eds.). Proceedings of the international workshop on biodiversity - Japan. National Institute for Environmental Studies, Tsukuba, Japan.