Annual Report for Period: 11/2003 - 11/2004
Submitted on: 09/02/2004
Principal Investigator: Collins, Scott L.
Award ID: 0217774
Organization: University of New Mexico
Title:
Sevilleta LTER: Long Term Ecological Research in a Biome Transition Zone

Project Participants

Senior Personnel

Name: Collins, Scott
Worked for more than 160 Hours: Yes
Contribution to Project:
Principal Investigator for the Sevilleta LTER Program

Name: Gosz, James
Worked for more than 160 Hours: Yes
Contribution to Project:
Former PI, now Co-PI involved in research on biogeochemistry and plant community dynamics

Name: Yates, Terry
Worked for more than 160 Hours: Yes
Contribution to Project:
Project Leader for research on Hantavirus ecology

Name: Parmenter, Robert
Worked for more than 160 Hours: Yes
Contribution to Project:
Former Project Manager. Continues research program in consumer population dynamics

Name: Wolf, Blair
Worked for more than 160 Hours: Yes
Contribution to Project:
Project Co-PI and leader of the Consumers Research Group

Name: Pockman, William
Worked for more than 160 Hours: Yes
Contribution to Project:
Co-PI and Project leader of the Water in the Environment research group.

Name: Vanderbilt, Kristin
Worked for more than 160 Hours: Yes
Contribution to Project:
Information manager

Name: Dahm, Cliff
Worked for more than 160 Hours: Yes
Contribution to Project:
Formerly interim PI, now leader of the Climate research group.

Name: Muldavin, Esteban
Worked for more than 160 Hours: Yes
Contribution to Project:
Este is a vegetation ecologist

Name: Lightfoot, David
Worked for more than 160 Hours: Yes

Contribution to Project:
David Lightfoot is the lead scientist on the small mammal exclosure study. His specialty is arthropod dynamics, particularly grasshoppers

Name: Allen, Michael
Worked for more than 160 Hours: Yes
Contribution to Project:
Conducts work on mycorrhizae and belowground production in pinyon-juniper woodlands and grassland areas on the Sevilleta

Name: Li, Haiban
Worked for more than 160 Hours: Yes
Contribution to Project:
Larry Li is a theoretical ecologist analyzing spatial patterns and patch dynamics in Sevilleta grasslands

Name: Westman, Carol
Worked for more than 160 Hours: Yes
Contribution to Project:
Carol has students working on soil biogeochemistry and vegetation mapping projects using remotely sensed data.

Name: Small, Eric
Worked for more than 160 Hours: Yes
Contribution to Project:
Eric is one of the lead investigators on the rainout shelter experiments along with Will Pockman. Eric is a hydrologist looking at fine scale moisture fluxes in Sevilleta grasslands and shrublands.

Name: Pennington, Deana
Worked for more than 160 Hours: Yes
Contribution to Project:
Deana was a postdoc investigating the spatial and temporal dynamics of drought at the Sevilleta. She now works for the SEEK project and is supported by the SEV LTER for 1 month each year.

Name: Sinsabaugh, Robert
Worked for more than 160 Hours: Yes
Contribution to Project:
Dr Sinsabaugh is an Associate Professor at UNM whose research examines the role of decomposition in nutrient cycling.

Post-doc

Graduate Student

Name: Garcia-Bustamante, Joslyn
Worked for more than 160 Hours: Yes
Contribution to Project:
Joslyn is a PhD student in the Department of Biology at UNM working on thermophilic fungi in the soils of the Sevilleta. She is also our full-time administrative assistant. She maintains project budget spreadsheets and schedules rooms and vehicles for the SEV Field Station

Name: Koontz, Terry
Worked for more than 160 Hours: Yes
Contribution to Project:
Terry is a former member of the field crew specialzing in Botany. She is now a graduate student in Biology at UNM and works on Sevilleta LTER study sites for her thesis concearning seed banks in grasslands. Terri recieved summer graduate support from this grant.

Name: Davidson, Ana
Worked for more than 160 Hours: Yes

Contribution to Project:
Ana Davidson is working on her dissertation research investigating how the presense of prairie dogs and kangaroo rats together and separately affect biodiversity of plants, arthropods, and small mammals and lizards in desert grasslands

Name: Medeiros, Juliana

Worked for more than 160 Hours: Yes

Contribution to Project:
Juliana is completing her Master's Degree research on water relation in different size classes of Creosote bush at the Sevilleta. She will enter a PhD program in Biology at UNM next Fall.

Name: Kurc, Shirley

Worked for more than 160 Hours: Yes

Contribution to Project:
Shrley Kurc is a graduate student at University of Colorado who is supported by the SEV LTER during the summer to support research activies on the Bigfoot project and in the rainout shelter experiment. Her research involves understanding soil moisture dynamics and plant responses in Sevilleta grasslands.

Name: Brandel, Brian

Worked for more than 160 Hours: Yes

Contribution to Project:
Brian Brandel is a PhD candidate from CSU whose research considers remote sensing of vegetation on the Sevilleta.

Name: Zeglin, Lydia

Worked for more than 160 Hours: Yes

Contribution to Project:
Lydia is a PhD candidate at UNM whose dissertation research is entitled 'Linking structure and function of microbial communities to functionality in the N Cycle'. She receives summer support from this project.

Name: Lauber, Chis

Worked for more than 160 Hours: Yes

Contribution to Project:
Chris is a UNM PhD candidate who received summer support for preliminary PhD research o¡n the Sevilleta NWR which will examine the role of microorganisms as facilitators of nutrient transformation in arid soils.

Name: Gallo, Marcy

Worked for more than 160 Hours: Yes

Contribution to Project:
Marcy is UNM PhD candidate who received summer support for her project entitled 'Microbial diversity in arid ecosystems: connecting function and structure.'

Name: Crenshaw, Chelsea

Worked for more than 160 Hours: Yes

Contribution to Project:
Chelsea is the SevLTER Graduate Student Rep, as well as the LTER Graduate Student Committee Co-Chair. She is a PhD candidate at UNM and received summer support for her research examining rates of NO3 uptake, transformation and denitrification in hyporheic sediments in streams that carry elevated NO3 as a result of agriculture and urbanization

Name: Meehan, Tim

Worked for more than 160 Hours: Yes

Contribution to Project:
Tim is a PhD candidate at UNM. He received summer support for research examining resource use and radio isotopes in a lizard community

Name: McLin, Ryan

Worked for more than 160 Hours: Yes

Contribution to Project:
Ryan is a PhD candidate at NMT. He recisved summer support for research evaluating the relationship between depth of

Name: Moses, Melanie

Worked for more than 160 Hours: Yes

Contribution to Project:

Melanie is a PhD candidate at UNM. She received summer support for her research o¡n allometric ant foraging o¡n the Sevilleta NWR

Undergraduate Student

Technician, Programmer

Name: Moore, Doug

Worked for more than 160 Hours: Yes

Contribution to Project:

Manages met stations, climate research, NPP datasets, as well as the wireless radio system recently established on the Sevilleta NWR.

Name: Friggens, Mike

Worked for more than 160 Hours: Yes

Contribution to Project:

Mike is our GIS Services and Project Manager.

Name: Wetherill, Karen

Worked for more than 160 Hours: Yes

Contribution to Project:

Karen is head of the field crew. She schedules field crew activities and coordinates data entry and QA/QC by the field crew

Name: Munson, Seth

Worked for more than 160 Hours: Yes

Contribution to Project:

Seth was a member of the field crew during 2002-2004, specializing in plant ecology. He has recently moved on to a PhD program at CSU.

Name: Hickman, Caleb

Worked for more than 160 Hours: Yes

Contribution to Project:

Caleb is a member of the field crew specializing in animal ecology

Name: Craig, John

Worked for more than 160 Hours: Yes

Contribution to Project:

John is a chemist in charge of the SevLTER wetlab and instrumentation. He also manages SevLTER decomp data.

Name: Belludi, Harsha

Worked for more than 160 Hours: Yes

Contribution to Project:

Programmer

Name: Brown, Renee

Worked for more than 160 Hours: Yes

Contribution to Project:

Renee is our systems administrator. She maintains all the SEV computers on campus and at the Field Station. She is also co-managing our wireless network at the Field Site as that is developed.

Name: Zimmerman, Ben

Worked for more than 160 Hours: Yes

Contribution to Project:

Ben worked as a summer intern assisting John Craig.

Name: Dauble, Alison
Worked for more than 160 Hours: Yes
Contribution to Project:
Summer Research Intern

Name: Sweet, Jesse
Worked for more than 160 Hours: Yes
Contribution to Project:
Summer Research Intern

Name: Tovey, M. Garret
Worked for more than 160 Hours: Yes
Contribution to Project:
Summer Research Intern

Name: Nelson, Traci
Worked for more than 160 Hours: Yes
Contribution to Project:
Traci worked as a summer intern in 2003.

Other Participant

Research Experience for Undergraduates

Name: Gilman, Casey
Worked for more than 160 Hours: Yes
Contribution to Project:
Casey worked last year with Professors Blair Wolf and Eric Toolson studying the ecophysiology of grasshoppers in blue grama dominated grassland at the Sevilleta. This year she has continued to work with Blair Wolf as an REU student investigating physiological constraints on population biology of a lizard community on the Sevilleta NWR.

Years of schooling completed: Junior
Home Institution: Same as Research Site
Home Institution if Other:
Home Institution Highest Degree Granted(in fields supported by NSF): Doctoral Degree
Fiscal year(s) REU Participant supported: 2004 2003
REU Funding: REU supplement

Name: Zieman, Renee
Worked for more than 160 Hours: Yes
Contribution to Project:
Renee comes from Seattle Pacific University, and her REU research examinined invasive plant species on the Sevilleta NWR.

Years of schooling completed: Junior
Home Institution: Other than Research Site
Home Institution if Other: Seattle Pacific University
Home Institution Highest Degree Granted(in fields supported by NSF): Doctoral Degree
Fiscal year(s) REU Participant supported: 2004
REU Funding: REU supplement

Name: Robinson, Eva
Worked for more than 160 Hours: Yes
Contribution to Project:
Eva came from Colgate University and worked on population dynamics of Ocotillo on the Sevilleta as part of her REU experience.

Years of schooling completed: Junior
Home Institution: Other than Research Site
Home Institution if Other: Collgate College
Home Institution Highest Degree Granted(in fields supported by NSF): Doctoral Degree
Fiscal year(s) REU Participant supported: 2003
REU Funding: REU supplement

Organizational Partners

University of Colorado at Boulder

University of California-Riverside

University of Nebraska-Lincoln

Fish and Wildlife Service

New Mexico Tech

USDA Forest Service
USFS Staff are collaborating with Sevilleta PI's and staff to study fire effects on grassland composition, shrub species dynamics and pollination ecology and genetic diversity of creosote bush. Also, USFS regional office has provided partial support for a graduate RA working at the Sevilleta.

Other Collaborators or Contacts

See Activities Section of the report

Activities and Findings

Research and Education Activities: (See PDF version submitted by PI at the end of the report)

Findings: (See PDF version submitted by PI at the end of the report)

Training and Development:
The Sevilleta Schoolyard LTER is the Program Bosque Ecosystem Monitoriing Program (BEMP). This program now connects 16 school systems along the middle Rio Grande through a standard monitoring protocol. The students and teachers collect data in the field on a monthly basis and are also provided with a resource book for classroom activities. Members of the BEMP team as well as undergraduate interns participate and facilitate classroom and field activities.
Members of the Sevilleta LTER Program frequently participate in a variety of outreach activities, especially tours of the Sevilleta to a variety of groups (K-12 school groups, university classes, conference attendees, etc.), the annual Sevilleta National Wildlife Refuge Open House, the State Fair of New Mexico, and other types of groups. A group from Belen High School helps Sevilleta scientists with data collection, and in turn these scientists help the students develop classroom-oriented research projects.

Outreach Activities:
see educational activities

Journal Publications

Dahm, C.N., M.A. Baker, D.I. Moore and J.R Thibault, "Biogeochemistry of surface waters and alluvial ground waters in steams and rivers during drought.", Freshwater Biology, p. 1219, vol. 48, (2003). Published

Michener, W.K., J.B. Brunt, M. Hori and K.L. Vanderbilt., "Ecological Informatics: A Long-Term Ecological Research Perspective", Japanese Journal of Ecology, p. , vol. , ( ). Accepted

Parmenter, R.R., T.L. Yates, D.R. Anderson, K.P. Burnham, J.L. Dunnum, A.B. Franklin, M.T. Friggens, et al., "Small mammal density estimation: a field comparison of grid-based versus web-based density estimators.", Ecological Monographs, p. 1, vol. 73, (2003). Published

Allen, M.F., J. Lansing and E.B. Allen., "Fine root length, diameter, specific root length and nitrogen concetrations of nine tree species across four North American biomes", Ecology, p. , vol. 84, (2003). Accepted

Bess, E.C., R.R. Parmenter, S. McCoy and M.C. Molles, Jr., "Responses of a riparian forest-floor arthropod community to wildfire in the Middle Rio Grande Valley, New Mexico", Environmental Entomology, p. 774, vol. 31, (2002). Published

Martinez-Vilalta, J. and W.T Pockman., "The vulnerability to freezing-induced xylem cavitation of Larrea tridentata (Zygophyllaceae) in the Chihuahuan Desert", American Journal of Botany, p. 1916, vol. 89, (2002). Published

Yates, T.L., J.N. Mills, C.A. Parmenter, T.G. Ksiazek, R.R. Parmenter, et al., "The ecology and evolutionary history of an emergent disease: Hantavirus pulmonary syndrome.", BioScience, p. 989, vol. 52, (2002). Published

Weiss, J.L., D.S. Gutzler, J.E.A. Coonrod and C.N. Dahm., "Long-term vegetation monitoring with NDVI in a diverse semiarid setting, Central New Mexico, U.S.A.", Journal of Arid Environments, p. 248, vol. 58, (2004). Published

Weiss, J.L., D.S. Gutzler, J.E.A. Coonrod and C.N. Dahm, "Seasonal and interannual relationships between vegetation and climate in Central New Mexico, USA", Journal of Arid Environments, p. 507, vol. 57, (2004). Published

Bhark, E.W. and E.E. Small., "The relationship between plant canopies and the spatial variability of infiltration in grassland and shrubland of the northern Chihuahuan Desert", Ecosystems, p. 185, vol. 6, (2003). Published

Small, E.E. and S. Kurc., "Tight coupling between soil moisture and the surface radiation budget in semiarid environments: Implications for land-atmosphere interactions.", Water Resources Research, p. 1278, vol. 39, (2003). Published

Rastetter, E.B., J.D. Aber, D.P.C. Peters, D.S. Ojima and I.C. Burke., "Using mechanistic models to scale ecological processes across space and time", BioScience, p. 68, vol. 53, (2003). Published

Symstad, A.J., F.S. Chapin, D.H. Wall, K.L. Gross, L.F. Huenneke, G.G. Mittelbach, D.P.C. Peters, and D. Tilman., "Long-term and large-scale perspectives on the relationship between biodiversity and ecosystem functioning", BioScience, p. 89, vol. 53, (2003). Published

Hobbie, J.E., S.R. Carpenter, N.B. Grimm, J.R. Gosz and T.R. Seastedt., "The US Long Term Ecological Research Program", BioScience, p. 21, vol. 53, (2003). Published

Turner, M.G., S.L. Collins, A.E. Lugo, J.J. Magnuson, T.S. Rupp and F.J. Swanson., "Disturbance dynamics and ecological response: the contributions of Long-term Ecological Research", BioScience, p. 46, vol. 53, (2003). Published

Abramson, G., V.M. Kenkre, T.L. Yates, and R.R. Parmenter, "Traveling waves of infection in the Hantavirus epidemics.", Bulletin of Mathematical Biology, p. , vol. , ( ). Accepted

Petrovskii, S., B.-L. Li, and H. Malchow., "Quantification of the spatial aspect of chaotic dynamics in biological and chemical systems.", Bulletin of Mathematical Biology, p. 425, vol. 65, (2003). Published

Corkidi, L., D.L. Rowland, N.C. Johnson and E.B. Allen., "Nitrogen fertilization alters the functioning of arbuscular mycorrhizas at two semiarid grasslands", Plant and Soil, p. 299, vol. 240, (2002). Published

Johnson, N.C., D.L. Rowland, L. Corkidi, L.M. Egerton-Warburton and E.B. Allen., "Nitrogen enrichment alters mycorrhizal allocation at five mesic to semiarid grasslands", Ecology, p. 1895, vol. 84, (2003). Published

Dahm, C.N., J.R. Cleverly, J.E.A. Coonrod, J.R. Thibault, D.E. McDonnell, and D.J. Golroy., "Evapotranspiration at the land/water interface in a semi-arid drainage basin", Freshwater Biology, p. 831, vol. 47, (2002). Published

Peters, D.P.C., "Recruitment potential of two perennial grasses with different growth forms at a semiarid-arid transition zone.", American Journal of Botany, p. 1616, vol. 89, (2002). Published

Weltzin, JF, ME Loik, S Schwinning, DG Williams, P Fay, B Haddad, J Harte, TE Huxman, AK Knapp, G Lin, WT Pockman, MR Shaw, EE Small, MD Smith, SD Smith, DT Tissue and JC Zak., "Assessing the response of terrestrial ecosystems to potential changes in precipitation.", BioScience, p. 941, vol. 53, (2003). Published

Huxman TE, M.D. Smith, PA. Fay, A.K. Knapp, M.R. Shaw, M.E. Loik,
S.D. Smith, D.T. Tissue, J.C. Zak, J.F. Weltzin, W.T. Pockman,
O.E. Sala, B. Haddad, J. Harte, G.W. Koch,
S. Schwinning, E.E. Small, and D.G. Williams., "Convergence across biomes to a common rain-use efficiency.", Nature, p. 18, vol. 429, (2004). Published

Pringle, C.M., S. Collins., "Needed: a unified structure to support long-term scientific research on public lands.", Ecological Applications, p. 18, vol. 14, (2004). Published

Allen, M.F., W. Swenson, J.I. Querejeta, L.M. Egerton-Warburton, and K.K. Treseder., "Ecology of mycorrhizae: A conceptual framework for complex interactions among plants and fungi.", Annual Review of Phytopathology, p. 271, vol. 41, (2003). Published

Treseder, K.K., C.A. Masiello, J.L. Lansing, M.F. Allen, "Species-specific measurements of ectomycorrhizal turnover under N-fertilization: combining isotopic and genetic approaches.", Oecologia, p. 419, vol. 138, (2004). Published

White, Carleton S., Douglas I. Moore, John A. Craig., "Regional-scale drought increases potential soil fertility in semiarid grasslands.", Biology and Fertility of Soils., p. 73, vol. 40, (2004). Published

Makarieva, A.M., V.G. Gorshkov, B.-L. Li., "A note on metabolic rate dependence on body size in plants and animals.", Journal of Theoretical Biology., p. 301, vol. 221, (2003). Published

Hochstrasser, T., and D. P. C. Peters, "Subdominant species distribution in microsites around two lifeforms at a desert grassland-shrubland transition zone.", Journal of Vegetation Science., p. , vol. , ( ). Accepted

Kroel-Dulay, Gy., P. Odor, D. P. C. Peters, and T. Hochstrasser., "Distribution of plant species at a transition zone between the shortgrass steppe and the Chihuahuan desert grassland.", Journal of Vegetation Science., p. 531, vol. 15, (2004). Published

Peters, D. P. C., D. L. Urban, R. H. Gardner, D. D. Breshears, and J. E. Herrick., "Strategies for ecological extrapolation.", Oikos, p. 627, vol. 106, (2004). Published

Peters, Debra P. C., "Selection of models of invasive
species dynamics.
", Weed Technology., p. , vol. , ( ). Accepted

Kerkhoff, A.J., S. N. Martens, G.A. Shore and B.T. Milne, "Contingent
effects of water balance variation on tree cover density in semiarid
woodlands.
", Global Ecology and Biogeography, p. 237, vol. 3, (2004). Published

Kerkhoff, A.J., S. N. Martens, and B.T. Milne., "An ecological
analysis of Eagleson's optimality hypotheses.
", Functional Ecology., p. 404, vol. 18, (2004). Published

McClellan. Y, R. August, J. Gosz, S. Gann, R. Parmenter, M. Nelson, and M. Harper., "Plant and Environment Interactions: Uptake Rates of

Thorium Progeny in
a Semiarid Environment.
", J. Environ. Qual., p. 1759, vol. 32, (2003). Published

Huxman, TE, D Tissue, K Snyder, J Leffler, K Ogle, WT Pockman, DR Sandquist, and DG Williams., "Precipitation pulses and carbon dynamics in semi-arid and arid ecosystems.", Oecologia, p. , vol. , ( ). Accepted

McCulley RL, EG Jobbagy, WT Pockman, and RB Jackson., "Nutrient uptake as a contributing explanation for deep rooting in arid and semi-arid ecosystems.", Oecologia, p. , vol. , ( ). Accepted

Huxman, TE, BP Wilcox, R Scott, K Snyder, D Breshears, EE Small, KH Hultine, WT Pockman, and RB Jackson., "Woody plant encroachment and the water cycle: an ecohydrological framework.", Ecology, p. , vol. , ( ). Accepted

Seyfried, M.S., S. Schwinning, M.A. Walvoord, W.T. Pockman, B.D. Newman, R.B. Jackson and F.M. Phillips., "Ecohydrological Control of Deep Drainage in Semiarid Regions.", Ecology, p. , vol. , ( ). Accepted

A.K. Knapp, M.D. Smith, S.L. Collins, N. Zambatis, M. Peel, S. Emery, J. Wojdak, M.C. Horner-Devine, H. Biggs, J. Kruger and S.J. Andelman, "Generality in Ecology: Testing North American Grassland Rules in South African Savannas", Frontiers in Ecology and the Environment, p. , vol. , ( ). Accepted

Books or Other One-time Publications

Allen, M.F., D.A. Jasper and J.C. Zak., "Micro-organisms", (2002). Chapter, Accepted
Editor(s): A.J. Davy and M. Perrow
Collection: Handbook of ecological restoration Volume 1. Principles of restoration part 4. Manipulation of the biota
Bibliography: Island Press

Milne, B.T., D.I. Moore, J.L. Betancourt, J.A. Parks, T.W. Swetnam, R.R. Parmenter and W.T Pockman., "Multidecadal drought cycles in south-central New Mexico: patterns and consequences.", (2003). Chapter, Published
Editor(s): D. Greenland, D. Goodin and R. Smith
Collection: Climate variability and ecosystem response at Long Term Ecological Research (LTER) Sites
Bibliography: Oxford University Press.

Pregenzer, A., R.R. Parmenter, H. Passell, J. Vander Castle, T. Budge and G. Bonito., "Sustainability of arid grasslands: New technology applications for management", ( ). Chapter, Accepted
Editor(s): M. Shachak and J.R. Gosz.
Collection: Biodiversity in drylands: Toward a unified framework.
Bibliography: Oxford University Press

Friggens, M.T., "Relating small mammal dynamics to precipitation and vegetation on the Sevilleta National Wildlife Refuge, New Mexico.", (2003). Thesis, Published
Bibliography: Department of Biology, University of New Mexico

Buxbaum, C.A.Z., "Landscape heterogeneity, soil development, precipitation regime, and growth and distribution of vegetation in a desert-grassland ecotone.", (2003). Thesis, Published
Bibliography: Department of Biology, University of New Mexico

Pennington, D., Jasso, H., Shin, P., and Fountain, T., "The effect of landscape heterogeneity on classification accuracy: a comparison of classifier prediction in sub-optimal sampling conditions.", (2004). Proceedings, Published
Editor(s): N/A
Collection: Seventh Workshop on Mining Scientific and Engineering Datasets, 2004 SIAM International Conference on Data Mining (SDM 2004), April 24, 2004, Orlando, Florida.
Bibliography: N/A

Shachak, M., J. Gosz, and S.T.A. Pickett., "Species diversity and ecosystem processes in water limited systems.", (2004). Book, Accepted
Editor(s): Shachak, M., J. Gosz, S.T.A. Pickett and A. Perevolotsky (
Collection: Biodiversity in Drylands: Towards a Unified Framework.
Bibliography: Oxford University Press

Shachak, M., S.T.A. Picket, and J. Gosz. 2004, "Introduction. A framework for Biodiversity Studies.", (2004). Book, Accepted
Editor(s): Shachak, M., J. Gosz, S.T.A. Pickett and A. Perevolotsky
Collection: Biodiversity in Drylands: Towards a Unified Framework.
Bibliography: Oxford University Press

Web/Internet Site

URL(s):
http://sev.lternet.edu
Description:
This is the Sevilleta LTER website.

Other Specific Products

Contributions

Contributions within Discipline:
The Sevilleta LTER has contributed to several important questions within the discipline. In particular, we have shown that aridland vegetation is resilient to haevy grazing by cattle. Results from our long-term studies show that many of the grasslands on the Sevilleta are once again dominated by long-lived perennial C4 grasses and native forbs.

We have concluded that ENSO events are not significant drivers of long-term vegetaiton change, but they do have short term impacts on netprimary production and consumer dynamics, particularly small mammal populations.

Detailed analyses of soil moisture fluxes show the ability of these systems to respond to precipitation pulses, and that these responses differ somewhat in grassland and shrubland primarily as a function of differences in total vegetation cover, but not in water use, per se.

Past work has shown that these arid grasslands can recover rapidly from fire given sufficient summer precipitation in the year of the fire. Indeed, 2004 was a year of average precipitation that yielded significant aboveground growth by domiant and subordinate species following the 2003 fire. Surveys of shrub responses to fire suggest that nearly all monitored invdividuals have sprouted this year.

Sevilleta personnel continue to play a role nationally in the development and implimentation of EML.

We are just beginning to investagate the causes and consequences of low soil fertility (N and C pools) on ecosystem processes. We hypothesize that low fertility may be a consequence of past grazing coupled with relatively young and active surface soils. This might imply that C and N cycles are mostly decoupled from each other, and from production/decomposition dynamics. This will be a major line of exploration for future biogeochemical research.

In 2004 we will complete the addition of irrigation systems to increase annual precipitation inputs by 50% and we will begin the intallation of a new set irrigation plots that will allow us to control precipitation amount and interval between precipitation events.

Contributions to Other Disciplines:
There are strong linkages between ecosystem research at the SEV and geoscience research, especially hydrology and climatology. The Sevilleta will serve as a site for the development of models to better predict the North American Monsoon. Current work reflects a collaboration between soil scientists and hydrologists on soil moisture fluxes and how this affects soil development in aridlands.

New work in 2004 is designed to investigate how evaporation and transpiration are partitioned in aridland ecosystems. This is a challenging general research question. Sev PI's are working with scientists at Penn State and New Mexico Tech to address this issue.

Contributions to Human Resource Development:
The Sevilleta Schoolyard LTER program connects K-12 kids to ecosystem monitoring and research through field and classroom activities.

The Sevilleta also serves as a testbed for the development and implimentation of wireless sensor webs and sensor technology. These projects are scalable, and can be translated to other ecosystems. The SEV provides a technological challenge to the engineers and computer scientists who are developing this technology because of its abundant sunlight and high temperatures.

We have installed a wireless backbone on the Sevilleta which can serve as a prototype for wireless systems at other relatively remote LTER sites.

We continue to involve undergraduate students in all phases of our project through hiring of summer interns and through the annual REU supplements.

The Sevilleta will host a SEEDS workshop in 2005 as a first step in broadening participant diversity within the Sevilleta LTER and across the LTER Network.

Contributions to Resources for Research and Education:

See about about BEMP.

We submitted a GK-12 Track 1 proposal this year in hopes of partnering the Sevilleta with middle school systems in Socorro and Belen, NM, and the education programs at the Sevilleta National Wildlife Refuge.

Contributions Beyond Science and Engineering:

Our research provides key information and understanding about aridland ecosystems that is used by the Fish and Wildlife Service in making management decisions.

Work by Sevilleta scientists on ecosystem processes and restoration in the bosque is contributing directly to the development of a state water plan, and water management through ecological restoration. Plans for extensive restoration continue in 2004 and Sevilleta scientists are actively involved in planning, designing and monitoring these riparian restoration efforts.

Special Requirements

Special reporting requirements: None

Change in Objectives or Scope: None

Unobligated funds: $ 0.00

Animal, Human Subjects, Biohazards: None

Categories for which nothing is reported:

Any Product

INTRODUCTION

The Sevilleta LTER Program joined the LTER Network in 1988. Formerly, the overarching goal of the Sevilleta LTER was to understand the causes of biotic transitions at multiple spatial and temporal scales, and the consequences of those transitions for ecosystem structure and function. Although this was a broader framework than that used to organize the original Sevilleta research program, the focus on biotic transition zones did not fully incorporate the breadth of research activities now being conducted by the Sevilleta LTER, not did it accommodate needed changes in research foci of general relevance to aridland ecosystems and ecological theory. Based on the recommendations of the 2003 site visit team, we have continued to modify our overarching conceptual framework and our LTER research organization so that we can more fully integrate the components of our research program as well as test important hypotheses of general ecological interest. Therefore, our current overarching framework is now: **Abiotic pulses and constraints: effects on dynamics and stability in aridland ecosystems.** Although it has long been recognized that aridland ecosystems are subjected to the vagaries of precipitation events (Noy-Meir 1973), the role of pulse events in arid environments is now receiving considerable research attention (Huxman et al. 2004). Our new framework will allow us to better integrate our activities within three distinct ecosystems (piÒon-juniper woodlands, desert grassland to shrubland transition, and the Rio Grande riparian zone) at the Sevilleta where several key abiotic drivers (drought, fire, flooding) affect ecosystem dynamics at multiple spatial and temporal scales. Our earlier conceptual approaches (e.g., patch dynamics) have not been abandoned; rather they are now embedded within our newer, more inclusive framework. Indeed, our plant community research is still strongly tied to the theme of patch dynamics (e.g., Peters et al. submitted). Thus, our new framework allows us to continue well-established long-term experiments and measurements as well as add new manipulative experiments and long-term measurements to address additional questions of general ecological interest. New research will be centered on, for example, understanding how the size and frequency of precipitation events drive ecosystem dynamics and how predicted changes in climate variability will affect the future of aridland ecosystems.

To facilitate implementation of this framework, we have organized our research activities into five inter-related research working groups (group leaders in

parenthesis): (1) climate variability (Cliff Dahm), (2) water in the environment (Will Pockman), (3) biogeochemistry (Bob Sinsabaugh), (4) producers (Esteban Muldavin and Deb Peters), and (5) consumers (Blair Wolf). These group leaders plus IM Kristin Vanderbilt, Field Crew Leader Karen Wetherill and PI Collins make up the Sevilleta LTER Executive Committee. In addition, May 2004 we hired Mike Friggens to replace Bob Parmenter as SEV LTER Project Manager who resigned in May 2003 to take a job as Director of Science at the Valles Caldera National Preserve. Mike has greatly improved our project organization and our communication with staff at the Sevilleta National Wildlife Refuge.

In this report, we will focus on a subset of our activities and findings in 2004. Many of these studies are on-going because our field season does not end until well after our annual report is due.

ACTIVITIES

Continued activities: In 2004 we continued our long-term data collection activities at our main upland and riparian sites on and around the Sevilleta. These activities include comprehensive meteorological measurements at seven locations, as well as sampling of small mammal populations, ground-dwelling arthropods, grasshoppers, bees, net primary production and plant phenology at three core sites on the Sevilleta. In addition, we continue to maintain CO_2 and ET flux towers as follows: two CO_2 towers in grassland, one in creosote shrubland and one in a Russian olive stand in the Rio Grande bosque. Three of these towers (shrubland, bosque and one grassland tower) also include Bowen ratio measurements of ET. 2004 will be the tenth year of data collection on our long-term small mammal exclosure experiment established through an LTER cross-site award to Dave Lightfoot in 1995 with data collection and management provided continuously since 1995 by the Sevilleta LTER. In addition, we continued to collect data from two sets of long-term permanently located grassland vegetation transects. These sets include two 400-m line-intercept transects in unburned grassland and four 100-m transects across a boundary between twice burned (1995, 2003) and once-burned (2001) areas.

In addition to these long-term studies, we are now into the fourth year of our long-term rainfall manipulation experiment in grassland, grass-shrub transition and shrubland areas at the Sevilleta. In these experiments, we are using water addition plots, rainout shelters and untreated control plots to determine the

effects of extended drought and extended mesic periods on grass and shrub productivity and species interactions. After imposing rainfall manipulation treatments, we measure seasonal growth and physiological responses of grasses and shrubs in drought and water-addition plots relative to untreated controls to assess the effect of extended climate extremes on ecosystem productivity and encroachment of woody shrubs into semiarid grassland. These experiments are also designed to determine whether ecosystem response is determined by immediate differences in grass and shrub structural and functional characteristics or whether the response develops over time as ecosystem modifications accumulate.

In 2003-2004, we focused on completing the sampling of the vegetation patterns at the SEV. We stratified our sampling by boundaries or ecotones between two major grass species, blue grama and black grama. We selected five ecotones between blue grama and black grama dominated communities for intensive study. Four 150 m long transects were located that traversed each ecotone. The following data were collected every 5 m along each transect (n=1440/data type): elevation (mm) using a Total Position Station, vegetation cover by species in 0.5 m^2 quadrats, and the spatial coordinates using a Geo Positioning System (GPS). For two transects, we collected soil samples every 5-10 m from three depths (0-1, 1-5, 5-20cm). We also geo-referenced the location of each ecotone and surrounding community. We are continuing to conduct particle size distribution analysis on the soil samples, and are working with a GIS technician to overlay our data layers with existing GIS layers from the Sevilleta LTER.

New research activities: This year, we began a set of intensive measurements of species composition, microbial diversity and dynamics, N_2O flux, and NPP on a set of long-term fertilizer addition plots in desert grassland. Like the small mammal exclosure study, these plots were established in 1995 through an LTER cross-site grant to Edie and Mike Allen (UCR) and Nancy Johnson (NAU) study the effects of N dynamics and climate variability on mycorrhizal colonization, composition and dynamics (see Johnson et al. 2003). Twelve of the 20 plots also have minirhizotrons that have been read three times each year since 1995. The additional measurements we are gathering starting in 2004 will help us better understand biogeochemical processes and nutrient limitation in these grasslands, and how these processes affect NPP and plant community composition and dynamics. These data will then be added to a large on-going cross-site research activity on productivity-diversity-plant traits which, thus far, is using data from fertilization experiments at 9 LTER sites and one non-LTER site.

This year, the Sevilleta LTER program established seven new sites for annual measurement of net primary production bringing the total number of upland ANPP sites to 10. Two of these sites are located in burned and unburned grassland, two (burned, unburned) in the grass-shrub transition zone, one new site in burned creosote shrubland to compliment measurements at our existing core shrub site, one site in the piÒon-juniper woodlands, and one in the long-term N fertilization experiment in grassland. NPP is measured using the non-destructive allometric approach developed at the Jornada LTER (Huenneke, et al. 2001). This method allows us to make non-destructive, long-term NPP measurements within our manipulative experiments as well as at our core sampling sites.

In addition to our new efforts at the N-fertilization site, we have established new long-term measurements of plant species composition and soil N dynamics in two large mammal grazing exclosure experiments. The first experiment includes three 300x300 m^2 replicates of the following treatments: (1) grazed by cattle, (2) recently ungrazed (fenced in 1993) and (3) long-term ungrazed (fenced in 1973). The purpose of this experiment is to estimate rate of ecosystem recovery following removal of cattle in desert grassland. The second grazing experiment includes four 300x300 m^2 replicates of the following treatments: (1) unburned, ungrazed, (2) unburned, grazed by native ungulates (antelope), (3) burned, ungrazed, and (4) burned and grazed. Measurements in each replicate include plant species composition, soil nitrogen (resin bags, lab incubations) and peak standing crop biomass.

Information Management: The Sevilleta unveiled a new website in January 2004 (http://sev.lternet.edu). Sevilleta IM personnel Kristin Vanderbilt (Information Manager), Mike Friggens (Program Manager), and Harsha Belludi (student programmer) collaborated with Marshall White from LNO to design and implement this new site in the PostNuke content management system. In addition to a fresh look and feel, the new web site is more intuitive to use and has much more dynamically generated content. Several of Sevilletaís new datasets are now being managed in MySQL and are queryable from the new website. Renee Brown, Sevilleta system administrator, has also established an intranet, which is a new feature of the Sevilleta website. Web-based data entry programs being developed by Harsha will be accessible from the intranet, as will WebMail, a new email client made available to Sevilleta associates in July 2004.

EML implementation at the Sevilleta has been a struggle. LNO personnel determined in late 2003 that extant Sevilleta metadata are unstructured enough so as to be impossible to parse into EML. Janine McGann of LNO therefore cut and pasted metadata from a few Sevilleta datasets into EML to serve as examples for converting the rest of the legacy metadata. A few legacy datasets at the Sevilleta have since been agonizingly converted into attribute-level EML using Morpho. The rest of the legacy data will be converted into discovery-level EML during the next year as time permits.

To capture new metadata as EML, Kristin Vanderbilt cooperated with Linda Powell at FCE and programmer Gaurav Gupta at LNO to devise an Excel template for metadata input and a Java application that would translate it into EML. This project was abandoned by LNO after months of work following the departure of Gaurav Gupta in favor of creating a new, web-based data entry application. The capabilities needed from this tool were discussed by James Brunt, Mark Servilla, Linda Powell and Kristin Vanderbilt in early June 2004. Development of this application was placed fourth on the list of priorities for the NIS development team by NISAC. Sevilleta therefore expects to await the completion of the Excel to EML tool that is now being developed by FCE personnel. The tool was demonstrated by Linda Powell at the 2004 LTER Information Managersí meeting in Portland, OR. It will not be completed until the EML Best Practices Committee releases its report.

Information gathering: With funding from a Biological Field Stations and Marine Lab award and UNM cost-share, the Sevilleta LTER has installed Phase I of a wireless backbone that will cover the east side of the Sevilleta National Wildlife Refuge. The purpose of this backbone is to allow us to collect, transmit and store data from research projects in real time via wireless technology. The system we constructed begins with a wireless backbone obtained with paired Trangolink10 master and remote units operating at 5.8 ghz. The master unit is on the roof of our main Field Station building. The remote unit is on top of a peak in the Los Pinos. The remote Trango unit in the Los Pinos connects to a D-Link hub. From that hub the system becomes a standard 2.4 ghz 802.11b network. This network includes two access point radios (Smartbridge Airpoint Prototals) that connect to the same D-Link hub. One of these is set on channel 1 and is pointed at the middle to northern portion of Mckenzie flats. The other is set to channel 11 and is pointed to the southern part of Mckenzie flats including Palo Duro canyon.

The Annual Sevilleta Research Symposium and Workshop: The Annual Sevilleta Research Symposium was held on the UNM campus in January 2004 followed by a poster session and all day workshop at the Sevilleta Field Station. The meeting was attended by approximately 60 LTER researchers (senior personnel, UNM faculty, FWS staff, students, research staff), and included both oral presentations and posters. The workshop is used to determine the schedule of our upcoming research activities and to discuss new research projects.

Educational Activities. We have greatly increased our graduate student training activities over the past two years. During 2004, we provided summer stipends and/or other support (computer, laboratory, field vehicles, etc.) for >12 graduate students and one postdoc from UNM, University of Colorado, UC Riverside and the University of Nebraska. The Sevilleta LTER program also offers research experiences for several undergraduate students. In 2004, we supported two REU students with an LTER REU supplement. One student, Casey Gilman, a UNM undergraduate, worked with PIs Blair Wolf and Eric Toolson on ecophysiology, fecundity, and population dynamics of collard lizards in and around the Sevilleta. A second student, Renee Ziemann from Seattle Pacific University, worked with PI Collins and SEV staffer Jennifer Johnson to assess the ability of roads and property boundaries to serve as conduits for invasive species into the Sevilleta National Wildlife Refuge. The Sevilleta Schoolyard LTER program continues its active research and education program both in the classroom and at a variety of field sites along the Middle Rio Grande Valley in collaboration with 16 school systems in New Mexico including the Albuquerque Public Schools, private schools, a home school, rural schools and two Pueblo schools north of Albuquerque. In 2004, the Sevilleta LTER received an additional education supplement to host a SEEDS workshop at the Sevilleta Field Station in partnership with ESA. Because of scheduling conflicts, this workshop must be postponed until November 2005, but we have already begun planning for this workshop as well as creating a plan to convene SEEDS workshops at other LTER sites. Finally, Sevilleta scientists continue to participate in a variety of formal and informal public outreach activities, including research tours, classroom visits, working with High School sciences classes at the Sevilleta and organizing information booths at public events (e.g., the New Mexico State Fair).

Cross-Site and LTER Network-Level Activities. Sevilleta LTER scientists continue to participate in numerous cross-site research projects (with both LTER and non-LTER sites) and LTER Network-level activities. For example, Sevilleta LTER scientists Collins and Peters participated in a recent cross-site synthesis on climate change and disturbance held in June 2004 at the University of Wisconsin (NTL) and at the 2004 CC meeting hosted by the Bonanza Creek LTER. PI Collins is a participant in an intersite initiative to use common stream invertebrate datasets to assess core-satellite species distribution and meta-community structure in space and time. The core-satellite and metacommunity working group presented papers at the 2004 NABS and ESA annual meetings, including an undergraduate as the lead author on the ESA presentation. SEV PI Collins is

the lead PI, along with Katie Suding (NWT) on an RCN proposal to support further synthesis by the productivity-diversity-plant traits network group which was established through LTER Network Office support. This collaboration has already generated two recently submitted manuscripts.

The Sevilleta continues to serve as a desirable site for externally funded ecological research. For example, David Hartnett at Kansas State University and his students are using the Sevilleta in their new cross-site study of belowground plant meristematic bud banks. Nathanial and Peggy Ostrom, Michigan State University, are using the N addition plots at the Sevilleta in their cross-site research on isotopomers and N_2O flux, bacterial composition and denitrification from terrestrial soils. Bruce Hayden and Jose Fuentes from the University of Virginia recently installed towers and monitoring equipment at the Sevilleta to determine the kinds of volatile compounds being emitted from creosote and weather or not these compounds can modulate winter low temperatures above creosote bush stands. Chris Duffy from Penn State University is working with PI Dahm at a site in the Rio Salado on the Sevilleta to assess the relative roles of evaporation and transpiration in riparian zones. Several streams within central New Mexico, including streams on the Sevilleta, are part of a multisite NSF-funded project on nitrate uptake and retention in streams. Participants include UNM PI Dahm and LTER Graduate students Chelsea Crenshaw and Lydia Zeglin. The NM portion of this project is part of a regional collaboration between SEV and CAP LTER scientists.

Sevilleta scientists continue to make significant contributions to LTER Network-level activities. Sevilleta PIís Gosz and Collins are the lead PIís on the recently funded LTER Planning grant whose goal is to take LTER science to a new level of regional science, collaboration and synthesis, one that fully integrates research and education. Jim Gosz was recently re-elected as Chair of the LTER Coordinating Committee and Collins was elected to serve on the LTER Executive Committee. IM Kristin Vanderbilt continues to serve on the US ILTER committee and on the IM Exec Committee. She also collaborated with Longjiang Ding and Peter Arzberger at the San Diego Supercomputer Center to organize the January 2004 web services training workshop for LTER information managers and international IT personnel. She contributes to the NSF ITR SEEK (Science Environment for Ecological Knowledge) project by co-teaching workshops for post-docs in ecology, and also co-teaches information management workshops for personnel from the Organization of Biological Field Stations (OBFS) in support of an RCN proposal with LNO. Project Manager Friggens also leads GPS training activities organized by SEEK.

International Activities. International activities by Sevilleta LTER scientists include participation by Information Manager Kristin Vanderbilt in an ILTER-sponsored meeting of the Environmental Long-Term Observatories Network of Southern Africa (ELTOSA) in Botswana (October 2003). In May 2003 and again in June 2004, PI Collins participated in an NCEAS-sponsored Knowledge Network for Biocomplexity workshop that focused on ecological comparisons of North American and South African grasslands (Knapp et al. 2004). In 2004, in collaboration with KNZ (Blair) and SGS (Knapp), the Sevilleta LTER received an ILTER supplement to establish additional collaborative research with colleagues in South Africa. Using start-up funds, Collins will be going to Kruger National Park in October 2004 for a preliminary visit and plans are developing for the three site collaborators (Blair, Collins, Knapp) along with a graduate student from each site to begin data collection in collaboration with South African scientists using the ILTER supplement funding.

SEVILLETA RELATED ACTIVE EXTRAMURAL GRANTS - 2003-2004.

The Sevilleta LTER program continues to work hard to leverage our LTER core funding. Below we list non-LTER grants that were active during the 2003-2004 reporting period. These grants include funding for Sevilleta research activities, graduate training, research infrastructure and network-level collaborations.

Pockman, W.T. and E.E. Small. Impact of climate variability and woody encroachment on productivity in a semiarid grassland in New Mexico. DOE National Institute for Global Environmental Change, 9/1/03 ñ 8/31/06, $287,880.

Yates, T. and R.R. Parmenter. EID: Ecological Drivers of Rodent-borne Disease Outbreaks: Trophic Cascades and Dispersal Waves. NSF-NIH Special Competition: Ecology of Infectious Disease Program, 9/1/03 ñ 8/31/07, $1,700,000.

Wolf, B. SGER: Using Portable Ultrasonography to Quantify Life History Traits and Energetic Status of Small Animals in the Field. NSF Ecological and Evolutionary Physiology Program, 06/01/04 ñ 11/01/05, $50,492.

Milne, B.T., D. Bader, W.T. Pockman and C. Restrepo. Self-organization of semi-arid landscapes: Tests of optimality principles NSF Ecosystem Studies Program, 1/1/00 ñ 2/28/04, $674,911.

Dahm, C.D. Nitrate uptake and retention in streams: mechanisms and effects of human disturbances from stream reaches to landscapes. NSF IRCEB Program, 8/1/01 - 7/31/06, $$ (UNM subcontract on award to ORNL).

Ward, A.K., A.C. Benke, C.N. Dahm, W.B. Lyons, and R.G. Wetzel. IGERT: Freshwater graduate studies link fundamental science with applications through

integration of ecology, hydrology, and geochemistry in regions with contrasting climates. NSF-IGERT Program. 1/1/99 ñ 12/31/05, $2,699,289.

Pockman, WT, D.O. Natvig, S.L. Collins, C.D. Dahm, R.R. Parmenter. The Sevilleta Research Field Station: infrastructure enhancements for high-quality water resources and wireless data transmission. NSF Biological Field Stations and Marine Labs, 12/1/03 ñ 11/30/06, $76,270.

Gosz, J.R., S.L. Collins, B. Benson, D.L. Childers, A.C. Whitmer ñ Preparing the LTER Network for collaborative science, education and synthesis: a planning grant. $985,462, 9/1/04 ñ 8/31/06.

FINDINGS

Here we present a subset of results from Sevilleta research in 2004.

Climate change and climate variability at the Sevilleta (PIís Cliff Dahm, Will Pockman, Scott Collins, LTER Staff Doug Moore, PostDoc Joe Fargione): In preparation for establishing new climate manipulation experiments including infrastructure that will allow us to (1) control the size and frequency of rainfall events as well as event size, and (2) create warmer winter days and nights, we analyzed climate variability from the main meteorological station on the Sevilleta at Deep Well. Results show that daily highs during January, the coldest month have increased nearly 2oC from 1989 to the present, whereas nighttime lows have only increased marginally if at all. Summer high temperatures during the warmest months are also increasing, and the seasonal variation in the size of rainfall events at the Sevilleta is increasing (Fig. 1). These results are in keeping with global change models that predict warmer temperatures and more variable precipitation events in the future. We are using this information to help us design experiments that will use a new irrigation system, located in conjunction with the rainfall manipulation plots to test hypotheses concerning how the size and frequency of rainfall events affects soil nutrient availability, ANPP, decomposition, and population and community dynamics. In addition, this winter we will be prototyping open-topped chambers to allow us to passively warm small experimental plots either in winter daytimes, nighttimes or both.

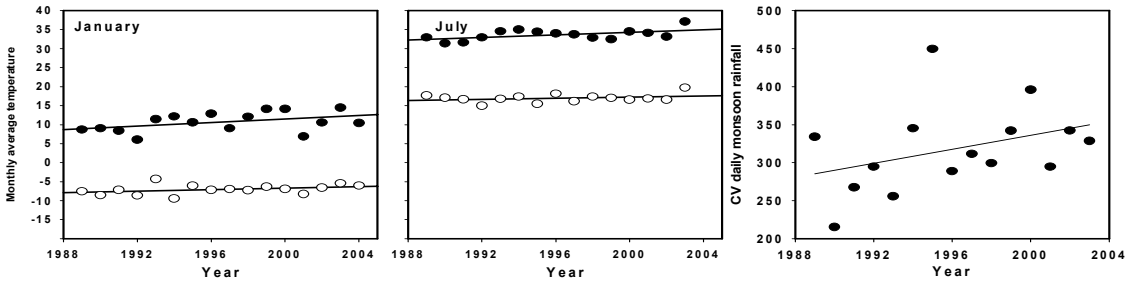


Figure 1. Change in average monthly high and low temperatures in January and July at the Deep Well site. In both months, the average high temperate has increased nearly 2oC over the past 15 years. In addition, the coefficient of variation of the size of daily monsoon rainfall events has increased. Thus, the climate is getting warmer and precipitatin is becoming more variable over time.

Sevilleta Groundwater and ET in the riparian zone (PI Cliff Dahm, Research Scientists James Cleverly and Jim Thibault): Groundwater elevations and rates of evapotranspiration (ET) have been measured in the riparian zone along the Rio Grande at the Sevilleta LTER since 1999. The site is an area dominated by the non-native salt cedar (*Tamarix chinensis*) and native salt grasses. The area rarely sees flooding and stand density is at the lower end of riparian habitats along the Rio Grande in central New Mexico. Figure 2 shows ET for the growing season of 2003. Background ET rates of generally less that 1 mm/day occur until

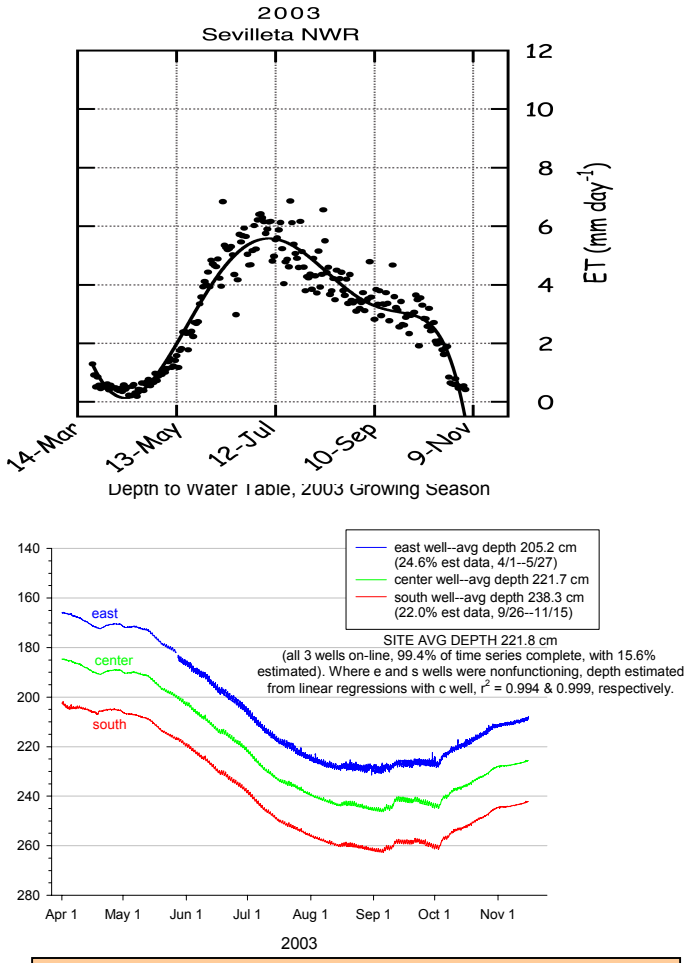


Figure 2. Top panel: annual track of evapotranspiration at the La Hoya site on the Sevilleta. Bottom panel: ground water levels in the riparian zone at La Hoya, NM.

leaf out in late April to early May. ET rates increase rapidly to maximum values above 6 mm/day in late June and July with decreased rates in August and September. Senescence in October is followed by a return to baseline ET rates after the first hard freeze in early November. The average annual growing season ET for the site in 2003 is estimated at 68 cm. Interactions between ET and ground water elevation are apparent in Figure 2. Water tables are highest at the beginning of the growing season and drop progressively throughout the growing season. The downturn in ET late July, August, and September correlates well with the greatest depth to ground water at three wells within the Sevilleta study site. Groundwater elevations rebound at the end of the growing season and after the first strong freeze of early November. These data were recorded during the fourth year of a long-term and strong hydrological drought in the region. The response of native and non-native vegetation of riparian zone plant communities along the Rio Grande to this intense drought is an ongoing long-term research interest of the Sevilleta LTER. In addition, understanding the role of riparian vegetation for the regional water budget of the Rio Grande is a focus for this long-term research project.

Effects of wildfire on plant and soil chemistry in a Rio Grande riparian forest (Graduate students: Mary Harner, Jennifer Follstad Shah, Teresa Tibbets, Chelsea Crenshaw, and Jennifer Schuetz): Riparian forests of the southwestern

United States have evolved under the influence of flooding disturbances. Increasingly, these forests are experiencing more disturbances by fire than by floods. A fire in April 2003 burned a long-term research site along the Rio Grande, New Mexico, which provided an opportunity to study the influence of fire on this ecosystem. Soil inorganic N; leaf chemistry of cottonwood, salt cedar, and Russian olive plants (mature leaves pre-fire; re-growth post-fire); soil moisture; and soil temperatures were monitored before and after the fire. Mean soil temperature was 5.6 °C higher at the burn site compared to three other unburned riparian sites. Inorganic N in soils was 16.4 mg N/kg dry soil in June 2003 following the fire compared to 4.7 mg N/kg dry soil in June 2002. Soil inorganic N exhibited a strong, positive linear correlation with subsurface soil temperature after the fire. Leaf C:N ratios were low (molar C:N < 20) from all three plant species, and cottonwood leaves sampled post-fire contained more nitrogen than leaves sampled pre-fire (Fig. 3). Fire, in combination with hot, dry conditions, increased the availability of soil inorganic nitrogen, which was reflected in an altered chemistry of plant leaves.

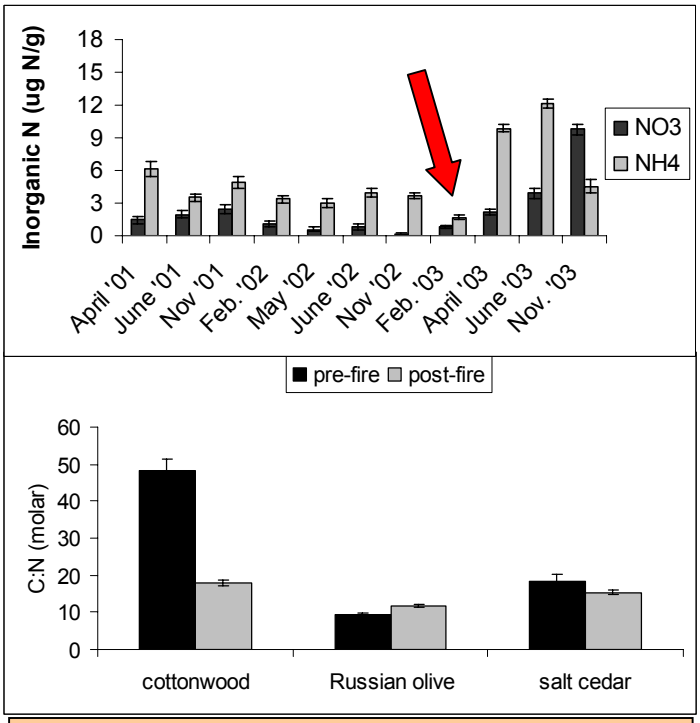


Figure 3. Top panel: Available ammonium and nitrate at 10 cm depth before and after wildfire at Bernardo, NM. Arrow denotes date of wildfire in early April 2003. Bottom panel: Comparison of leaf chemistry (ratio of molar carbon to nitrogen) of leaves from cottonwood, Russian olive, and salt cedar before and after Bernardo wildfire. Leaves were sampled in August or October.

Productivity and species composition in the rainfall manipulation plots (PIís Will Pockman, Eric Small; Grad student Shirley Kurc; Sev LTER staff Jennifer Johnson, Jim Elliott): Aboveground net primary productivity (ANPP) is measured annually for grasses and 3 ñ 5 times per year for shrubs (March, late June, and October). Shrub ANPP is measured using allometric methods based on the change in size of first order twigs. Grass ANPP is measured with destructive sub-sampling of 5, 10 x 10 cm areas per plot. Samples are sorted to separate green biomass before drying and weighing. These samples also allow calculation of LAI for grasses by separating leaf tissue and using a regression between leaf area and mass.

Over the first two years of treatment, shrubs have not exhibited significant

differences in twig growth between control and rainout plots (Fig. 4). In contrast, we have observed a significant decrease in ANPP between control and rainout plots at the grassland site. This trend has also been observed at the ecotone plots (data not shown) but has not been significant.

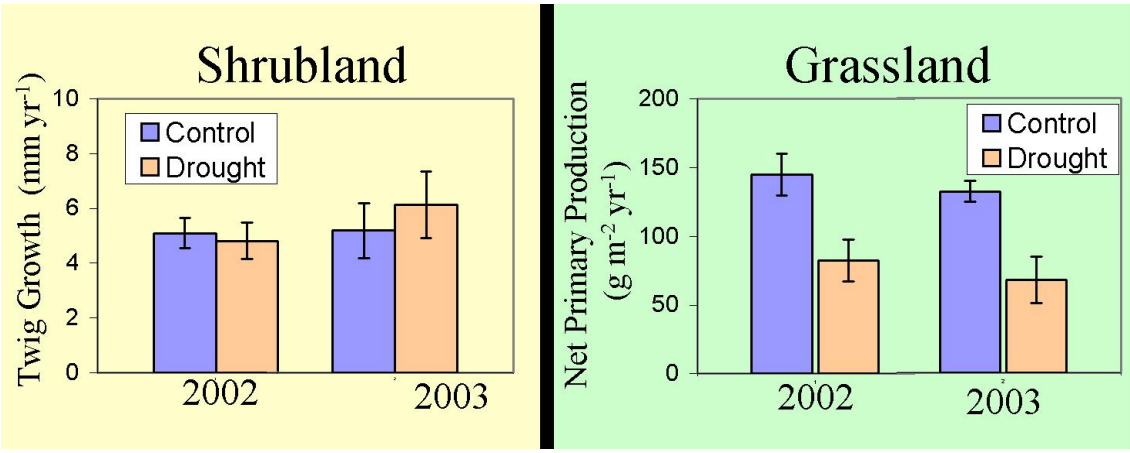


Figure 4. Effect of experimental drought on creosote bush twig growth at the shrub-dominated site and ANPP at the grassland site in 2002 and 2003, a year of low exceptionally low summer rainfall.

For comparison with species productivity data, plot scale plant cover and bare soil are assessed with overhead photos collected using a digital camera and analyzed using ArcGIS software. Three cover types have been identified: (1) shrub canopy; (2) grass canopy and surrounding litter; and (3) interspace. The amount and spatial distribution of different cover types are measured using digital photos (3.34 megapixel) of each plot, collected at peak biomass to capture species dynamics and changes in the drainage network. A Nikon CoolPix 990 camera mounted on a specially designed boom achieves sufficient elevation (7 m) to cover an entire plot with a set of 6 photos. After rectification and assembly, ArcGIS software is used to measure total grass and shrub cover. These mosaics allow detailed, field checked, measurements of changes in grass and shrub size, stone cover, and interspace connectivity. Mosaics are being assembled for each plot on a yearly basis.

Comparisons of overhead photos from Fall of 2002 and 2003 in the control and drought plots indicates that one year of drought treatment has led to a significant decrease in grass cover in the drought treatment of grassland plots (Fig. 5). These cover changes are consistent with the decreased productivity observed in the grass drought plots in both 2002 and 2003 (Fig. 4). Although the decrease in cover may have been exacerbated by low precipitation and late and below-average summer monsoon, no such differences were detected in the control plots over the same period. Overhead photos and productivity measurements from 2004, with a strong ongoing summer monsoon, will help reveal whether this result is indicative of a long-term trend in the drought treatment. If this pattern of decreasing cover continues, we expect to have an opportunity to observe how

the drainage network and redistribution of precipitation are affected by long-term drought.

Data from the Sevilleta, including insights from these rainfall manipulation plots, contributed to a cross-site analysis of productivity and ecosystem-scale rain use efficiency published recently in *Nature* (Huxman et al., 2004a).

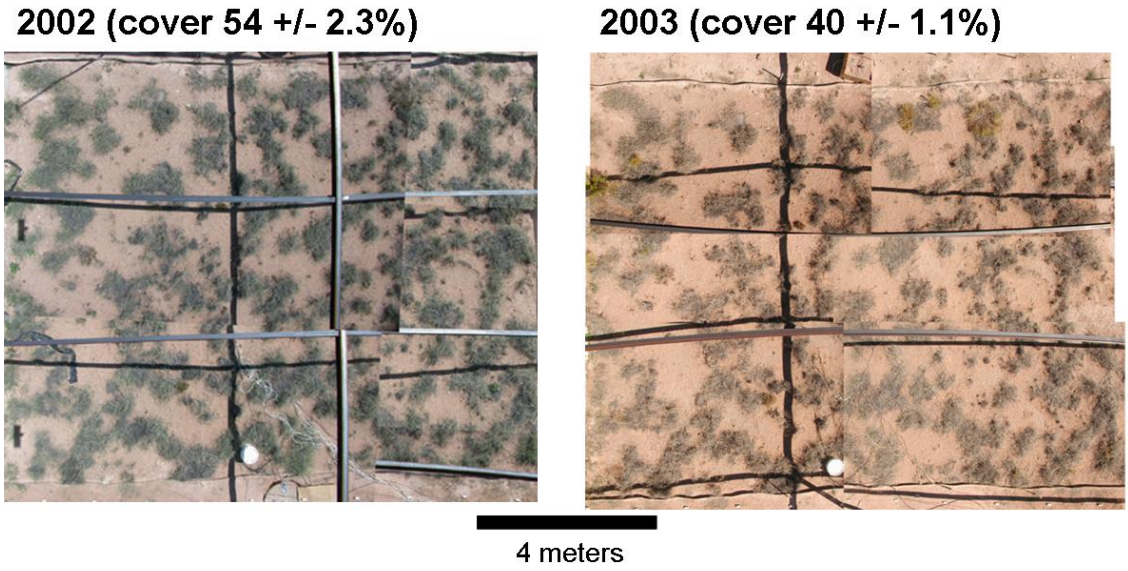


Figure 5. Aerial photo of grassland plots. 2003 was a year of severe drought and the reduction in canopy cover can be easily seen relative to the plots in 2002.

N-fertilization plots (PIís Bob Sinsabaugh, Scott Collins; Grad students Chelsea Crenshaw, Marcy Gallo, Chris Lauber, Lydia Zeglin): Most of what we report here is from a collaboration between graduate students Gallo, Lauber and Zieglin under the guidance of Sinsabaugh and supported by the SEV LTER. In the summer of 2004 soils were collected from beneath the grass canopy and in bare areas within our long-term N fertilized and control plot experiment (N=10). Subsamples of these soils were analyzed as follows. Crenshaw Collins conducted lab incubations of soil samples to determine if carbon and or nitrogen limited denitrification in these soils. Gas samples have been collected and further analysis awaits the arrival of a new ECD for the GC in the LTER analytical lab. This instrument was purchased with a combination of startup, IGERT and LTER funds. Preliminary results from work in Sinsabaughís lab shows that these aridland soils serve as a dramatic contrast to more heavily studied mesic systems. Thus far, we have found that there is a 10X difference between the N addition plots and controls in exchangeable ammonium and and 2-3X difference in exchangeable nitrate (Fig. 6). There is not much difference in SOC with N addition but the C:N ratio in N addition plots is half that of control plots. An extensive survey of soil enzymatic activity is ongoing with plans to assaying 25 enzymes. Results thus far show that glycosidase activities are higher in soil beneath the grass canopy than in the gaps between tussocks (Fig. 7). The addition of N accentuates this pattern; activities increase by 50-100% in canopy

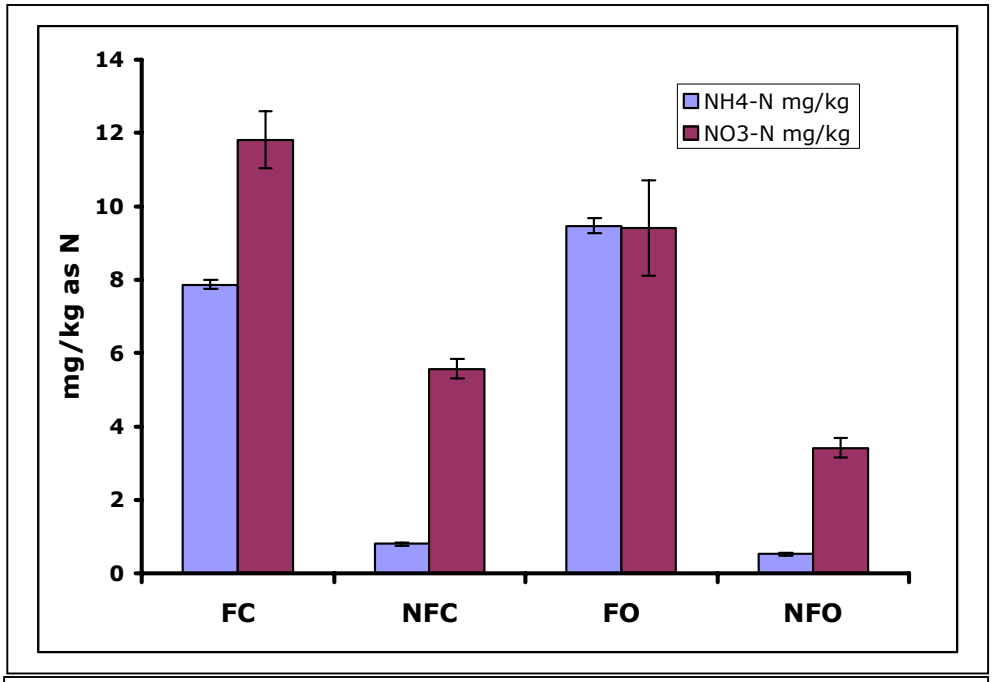


Figure 6. Ammonium and nitrate levels beneath grass canopy (C), and open areas (O) in fertilized (F) and control (NF) plots at the Sevilleta. Results show that NO3-N is generally higher in fertilized plots and under the grass canopy relative to controls.

soils but only ca. 20% in gap soils. Peptidase activities show the opposite pattern, activities are higher in the gaps than under canopy. N addition represses activity by 50% or so with the biggest effect in the gaps. Aminohydrolase activities follow a similar trend. Laccase and peroxidase activities are flat with respect to location and N treatment. The same is true for fatty acid esterase, which can be considered a general measure of microbial activity. It is clear that these arid soils are very responsive to N addition, at least as responsive as temperate forest soils. The "anomaly" is the lack of repression of oxidative activity. Because of soil pH and other conditions, fungi are likely to be nearly absent from the microbial community which may be the reason we do not observe oxidation repression. We are still probing for laccase genes and getting phylotypic data to eventually address this hypothesis.

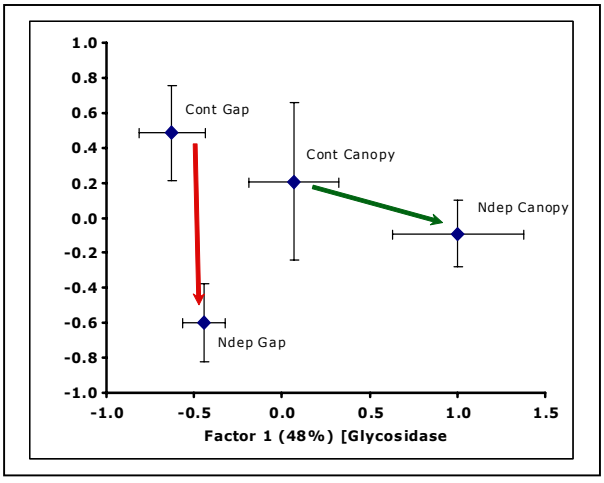


Figure 7. Glycosidase activity beneath grass canopies and open areas in control and fertilized plots (10g-N m^2 yr^2) at the Sevilleta.

Invasibility of the Sevilleta National Wildlife Refuge (PI Scott Collins and REU Renee Ziemann): This summer we tested the hypothesis that a pasture grazed by cattle outside the northern boundary of the Sevilleta could serve as a source area for invasive plant species onto the Refuge. We also tested the hypothesis that roads running from the grazed area onto the Refuge would serve as invasion corridors. To test these hypotheses we established approximately 50 sampling transects perpendicular to the northern boundary and perpendicular to the two main dirt roads entering the Sevilleta from the north. The good news is that there are very few invasive plant species in the grazed area and in the Refuge. Common invasives were Russian thistle and tumbleweed. However, if we consider native weeds (rapidly growing annuals typical of disturbed areas) as surrogates for invasibility, the Refuge is highly prone to invasion. There were few, if any, significant differences in abundance of weedy species in the grazed pasture compared to adjacent grasslands on the Refuge. Also, there were few significant distance effects away from roads or from the fence line. If anything, there is a general increase in weediness away from the roads and fence lines. This results from low plant cover and abundance near roads and a general increase in cover of all species away from roads. Thus, weediness is highly correlated with regional species richness as has been found in many other studies.

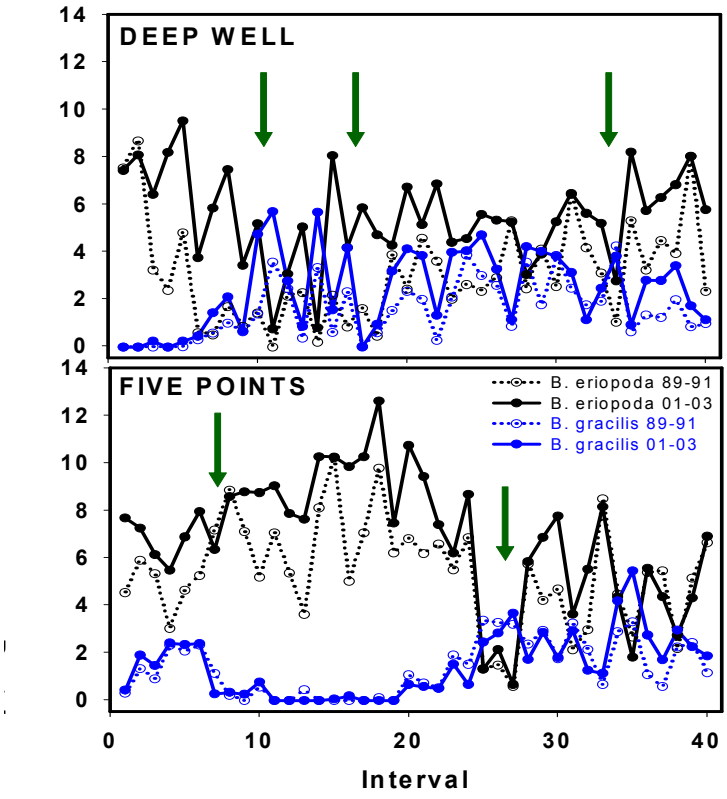
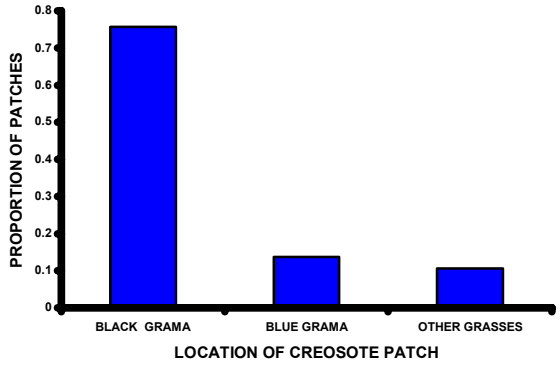


Figure 8. Change in cover of blue and black grama from 1989 through 2003 within 10m intervals along two 400 m line intercept transects (Deep Well and Five Points). Each transect was divided into either three or four larger segments based on compositional variability. Different sections of each transect changed at different rates over the 15 year interval. In some cases the rate of change in one segment was double that of other segments.

Long-term vegetation transects (PIís Scott Collins and Este Muldavin; Sev LTE R Staff Doug Moore and Seth Munson): In 1989, a series of permanently located line intercept transects was established at several locations within the Sevilleta National Wildlife Refuge. Given the significant time commitment needed to sample all transects, only a 400 meter subsection

has been sampled annually on two transects since 1989. Along each transect, plant species cover is recorded at 1 cm resolution two times (spring, late summer) each year. This dataset provides a highly detailed documentation of plant species composition and dynamics over the past 15 years. The data have been used for detailed spatial analyses of species distributions and patch structure (Anand and Li 2002, Li et al. 2004). To assess compositional change, transects were divided into 10 m subunits to study the spatial and temporal dynamics of desert grassland at the Sevilleta. Results demonstrate that across the transect as a whole there is a weak positive correlation between summer rainfall and summer forb cover and summer grass species richness. Abundance of the two dominant grasses, blue and black grama, was positively correlated over time. At Deep Well, there is a significant positive correlation between grass and forb cover. The same trend occurred at Five Points, where abundance of black grama is higher, but it was not significant. By aggregating segments based on boundary structure, we found that temporal patch dynamics are occurring at different rates across these grasslands. In some cases one patch type is changing at a rate more than double that of adjacent patches. These different rates occur in response to the interactions among different combinations of dominant species played out across a variable soil texture and nutrient template.

Patch structure and vegetation transitions (Deb Peters): We collected patch size distribution data from the Sevilleta to test hypotheses about ecotone structural and functional properties. Twenty blue grama patches and twenty black grama patches were selected along each transect for a total of 800 blue grama and 400 black grama patches. We also selected all creosote patches (> 300) along 5 50-200m long transects that traversed communities dominated by either blue grama or black grama. Each patch was measured either for two diameters to calculate basal area or for basal area directly. A subset of grass patches was collected for biomass determination. Vegetation cover inside and outside creosote patches was estimated using quadrats. Our results for creosote show that most creosote patches are located within communities dominated by black grama; the few number of creosote patches located within blue grama communities suggests that this grass species is less resistant to invasion by this shrub. We are currently writing a manuscript for publication that describes these results.



Grazing Exclosures (PI Scott Collins, Grad Student Lydia Zeglin, SEV LTER Staff Mike Friggens): In 1993, Three 300x300 m^2 cattle exclosures were established in a grazed pasture on the north border of the Sevilleta National Wildlife Refuge.

Three nearby 300x300 m^2 open control areas and three comparably sized areas were also established in the grazed pasture and on the Sevilleta. The purpose of this experiment was to determine how quickly desert grasslands recovered from moderate grazing. Cattle were removed from the Sevilleta in 1973 when the Refuge was established, thus this experiment has three treatments, currently grazed, recently ungrazed, and long-term ungrazed. A Single small mammal trapping web was located within each exclosure and open area. These webs have 144 sample points marked with rebar located along 12 transects radiating from a central point (Parmenter et al. 2003). In 2004 we selected four trapping points along the outer arm of each web as the location for a single permanent 50x50 cm^2 vegetation quadrat. Therefore, each exclosure and open area now has 48 permanently located vegetation quadrats that will be sampled annually. We sampled vegetation this spring and will complete the fall sampling in September. Other measurements include soil N (N_{min} and resin bags), microbial diversity, and leaf C,N, and P for stoichiometric analyses of the dominant grasses. Results to date indicate that grass C:N is higher in the spring than the fall (plenty of new growth on the grasses in May 2004) due to lower %N and slightly higher %C (%N 1.68 in fall, 1.20 in spring; %C 44.88 in fall, 45.37 in spring). There were no significant differences among grazed areas, exclosures, and plots on the Sevilleta; although the exclosure grass stoichiometry is still

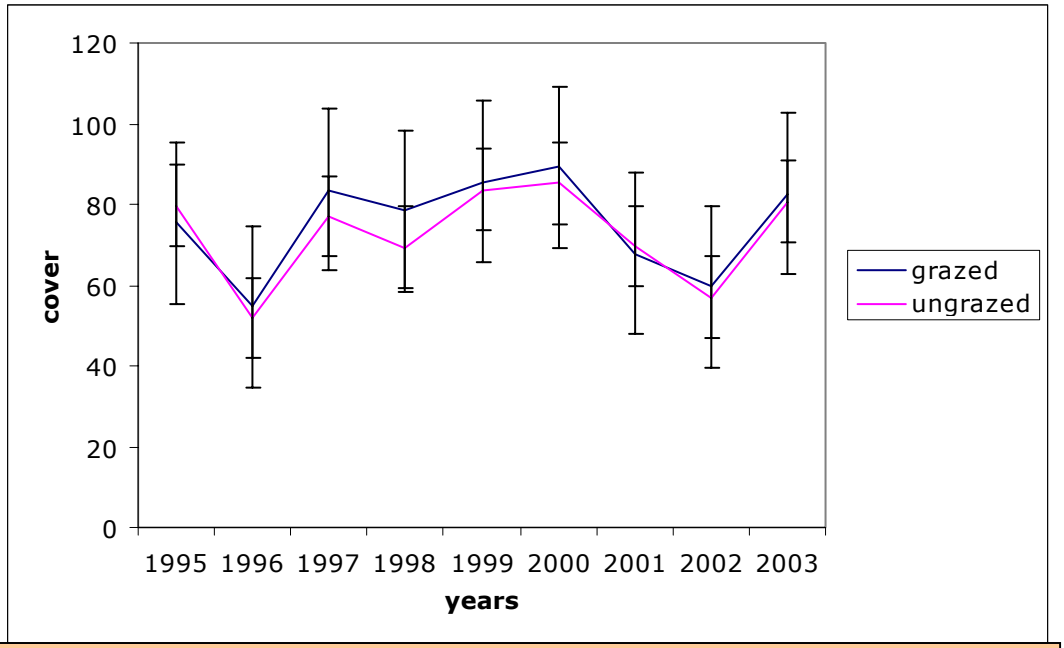


Figure 9. Changes in cover of black grama (*Bouteloua eriopoda*), an abundant C_4 grass in Sevilleta grasslands, from 1995 to 2003 in plots that are open to rodent herbivores (grazed) and plots where rodents have been excluded.

closer to that of the grazed plots than the Sevilleta plots). Grass P data and soil CNP data are still being analyzed.

Small mammal exclosure study (Plís David Lightfoot and Scott Collins, Grad students Selene Baez, Terri Koontz). In the summer of 2004, we began to

analyze data from this long-term exclosure experiment. The overarching goal of the small mammal exclosure study (SMES) is to determine the relative impact of small mammals on plant community dynamics in grassland and shrubland vegetation at three study sites: the Sevilleta, the Jornada LTER and Mapimi in northern Mexico. The study is based on the pioneering work of Brown and colleagues (e.g., Brown and Heske 1990) in grasslands at Portal, AZ. Our initial analyses focus on responses in the grass and shrub plots at the Sevilleta. The underlying conceptual framework is based on bottom up controls driven by abiotic factors versus top down controls through herbivory and granivory by small mammals. After nine years of rodent exclosure, there are few overall changes in plant community structure in either the grassland or shrub-dominated areas. In general, total cover, cover of dominant species (Figure 9), and plant species diversity are driven more by year to year fluctuations in climate than they are by the activities of granivores. There is some evidence that community heterogeneity is decreasing in the rodent exclosures. The general lack of response occurs, we suspect, because these systems are dominated by long-lived perennial plants and reproduction by seed is rare. We are still investigating the impacts of granivory on the abundances of annuals and forbs in these plots.

Stoichiometry, energetics and thermal biology of desert herbivores (PIs: Blair Wolf and Eric Toolson, REU Students Casey Gilman, Donna Pham and Josh Nuygen): Grasshoppers are dominant herbivores in desert grasslands yet the role they play in ecosystem structure and function at the Sevilleta is poorly known. In particular, use of resources by grasshoppers is dependant on species abundance, individual species energy requirements and their dependence on element stoichiometry mediated through the plants they eat (Fig. 10). This on-going project takes a mechanistic approach to examining the impact of this key group of herbivores on productivity and nutrient cycling. This is an ongoing project where undergraduate students are developing a data set that will help us better understand the dynamics between consumers and producers in arid environments.

T. pallidipennis Thermal Physiological Ecology

Red font: data required to quantify parameters and/or define mapping functions will be obtained from appropriate lab/field studies currently underway or planned for the near future..