Proceedings and Abstracts

The 2008 Jemez Mountains Science Symposium

Santa Fe Community College, Room 216 (Lecture Hall)
6401 Richards Ave., Santa Fe, NM 87508
Friday, March 28th, 2008

The 2008 Jemez Mountains Science Symposium was held on Friday, March 28th, 2008, at the Santa Fe Community College in Santa Fe, New Mexico. A total of 36 speakers presented the results of their research projects, and the agenda is included below. This proceedings document provides expanded abstracts from the authors that include not only text descriptions of the study and salient results, but also summary tables and/or graphics of their results. A DVD of the presentations (in pdf file format) is available to view the actual presentation materials. This DVD can be requested by contacting the Valles Caldera Trust at 505-661-3333, or via email to bparmenter@vallescaldera.gov.

Abstracts for the presentations listed in the agenda follow, and are alphabetically arranged by the lead author of the presentations.

Agenda

8:00 AM Welcome -- Bob Parmenter, *Valles Caldera Trust*

8:05 Revised geologic map of the Valles Caldera, New Mexico.
Fraser Goff, Jamie N. Gardner, Steve Reneau, Shari Kelly, Kirt Kempter and Rick Lawrence
Dept Earth & Planetary Sciences, UNM, Los Alamos National Laboratory, NM Bureau of Geology and Minerals, NM Tech, and Lawrence GeoServices Ltd. Co.

8:17 Geologic Overview of the Northern Jemez Mountains.
Kirt A. Kempter, Shari A. Kelley, R. Lawrence, and Fraser Goff
NM Bureau of Geology and Minerals, NM Tech, Lawrence GeoServices Ltd. Co., and Dept Earth & Planetary Sciences, UNM

8:29 Soils of the Valles Caldera National Preserve: Development of a high-resolution soils map.
Charles Hibner, *Natural Resources Conservation Service*

8:41 El Niño - Southern Oscillation (ENSO) impacts on Jemez Mountains precipitation.
Douglas I. Moore, *Department of Biology, University of New Mexico*

8:53 A lacustrine sedimentary record of two mid-Pleistocene glacial cycles (MIS 14 to 10) from the Valles Caldera National Preserve, New Mexico
Linda Hurley, Peter J. Fawcett, Jeff Heikoop, R. Scott Anderson, Fraser Goff , John W. Geissman, Catrina Johnson, Giday WoldeGabriel, Craig D. Allen, Julianna Fessenden-Rahn, *Dept. Earth & Planetary Sciences, UNM, Los Alamos National Laboratory, Los Alamos, Northern Arizona University, U.S.G.S. Jemez Mountains Field Station*

9:05 Water quality dynamics on the Valles Caldera.
Julie Tsatsaros, Karen Browne, Becca Pava, Bob Parmenter, *Tetra Tech, Valles Caldera Trust*

9:17 Changes in stream functioning condition on the Valles Caldera National Preserve, 2001-2006.
Steve McWilliams, *retired, US Forest Service*

9:29 Atmospheric deposition of radioactive particles in the Valles Caldera National Preserve.
Greg Kaufmann, *Pueblo of Jemez*

9:41 The Jemez Mountains Obsidian Database Project: Compiling Obsidian Artifact Provenance ("Sourcing") Data to Inform on Prehistoric Movement, Trade, and Interaction.
Anastasia Steffen, Philippe D. LeTourneau, and William Barfuss, *Valles Caldera Trust and UNM*

9:53 State of New Mexico Recovery Efforts for the Meadow Jumping Mouse (*Zapus hudsonius*).
Leland J. S. Pierce, *Conservation Services Division, NM Department of Game and Fish*

10:05-10:20 BREAK

10:20 Valle Toledo Fire Experiment: Introduction and Overview.
Bob Parmenter, *Valles Caldera Trust*

10:32 Valle Toledo Fire Experiment: Plant responses to fire and grazing.
Will Barnes, Bob Parmenter, Molly Padgett, *GrassWorks, Inc., and Valles Caldera Trust*

10:44 Valle Toledo Fire Experiment: Ground-dwelling arthropod responses to fire and grazing.
Zoe Anna Duran, Bob Parmenter, *Valles Caldera Trust*

10:56 Valle Toledo Fire Experiment: Fish population responses.
Mike Anderson, Colleen Caldwell, Bob Dubey, *USGS Coop Fish & Wildlife Research Unit*

11:08 Valle Toledo Fire Experiment: Aquatic invertebrate responses.
Jerry Jacobi, *Jacobi and Associates*

11:20 Valle Toledo Fire Experiment: Interactive effects of fire with grazing and vegetation on the dynamics in soil nutrients.
Carl White, *Department of Biology, University of New Mexico*

11:32 Valle Toledo Fire Experiment: Obsidian responses to fire.
Jamie Civitello, *Valles Caldera Trust*

11:44 BREAK FOR LUNCH (On your own in the SFCC CAFETERIA)

1:00 PM Overview of the SAHRA Hydrology Research Program.
Paul Brooks, *University of Arizona*

1:12 Status of the Jemez Mountains elk herd.
Stewart Liley, *Elk Program Coordinator, New Mexico Department of Game and Fish*

1:24 Elk foraging and abundance in the Cerro Grande Fire burn area: Are linkages with plant patch characteristics evident?
James Biggs, *Los Alamos National Laboratory, NM State Univ.*

1:36 Relative use of mountain meadows and deciduous browse communities by elk and cattle: lessons from the Lincoln National Forest. Lou Bender, Heather Halbritter, *Dept. Extension Animal and Natural Resources, NMSU, and USGS Coop Fish & Wildlife Research Unit, NMSU*

1:48 Modeling elk response to post-fire successional dynamics in northern New Mexico.
Susan Rupp, *Dept. Wildlife & Fisheries Sciences, South Dakota State University*

2:00 The ecology and natural history of the coyote on the Valles Caldera National Preserve.
Suzanne Gifford, Eric Gese, Marc Chipault and Bob Parmenter, *Utah State University, and Valles Caldera Trust*

2:12 Large predator population trends in the Jemez Mountains.
Frederic Winslow, *New Mexico Department of Game and Fish*

JEMEZ MOUNTAINS SCIENCE SYMPOSIUM -- AFTERNOON SESSION (CONTINUED).

2:24 The natural history and ecology of Merriam's turkey in the Valles Caldera National Preserve.
Marc Chipault, Bob Parmenter, *Valles Caldera Trust*

2:36 *Sorex* of the Jemez Mountains: recognition of a new shrew.
Andrew Hope, James Findley, Tommie Findley, Joseph Cook, *University of New Mexico*

2:48 The ecology of rodent-borne diseases in the Valles Caldera National Preserve.
Megan Friggens, Bob Parmenter, Gabor Racz, Jessica Jakubanis, *Northern Arizona University, Valles Caldera Trust, and University of New Mexico*

3:00-3:15 BREAK

3:15 Growth rates and movements of trout in the Valles Caldera National Preserve.
Mike Anderson, Colleen Caldwell, *USGS Coop Fish & Wildlife Research Unit, NMSU*

3:27 Bald eagle use of the Valles Caldera National Preserve.
Terry Johnson

3:39 Fire history from charcoal and tree-ring records at Alamo Bog, Valles Caldera National Preserve.
Craig Allen, R. Scott Anderson, Renata B. Jass, Jaime L. Toney, Christopher H. Baisan, *USGS Jemez Mountains Field Station, Northern Arizona University, Brown University, University of Arizona*

3:51 Post-Dome Fire Seeding Effects on Native Vegetation.
Rebecca W. Oertel and Craig D. Allen, *USGS Jemez Mountains Field Station*

4:03 Frost and fire: forest-grassland dynamics in the Valles Caldera National Preserve.
Jonathan Coop, *Mountain Studies Institute & Rocky Mountain Research Station*

4:15 Mapping four centuries of tree demography at the ponderosa/pinon-juniper ecotone.
Andrew Goumas, Craig D. Allen, Kay Beeley, Rebecca Ortel, Peter M. Brown
Ecology Group Bandelier, USGS Jemez Mountains Field Station, Rocky Mt. Tree-ring Research

4:27 Overview of stable isotope studies in the Jemez Mountains.
Julianna Fessenden, *Los Alamos National Laboratory*

4:39 Adaptive Management on the Valles Caldera National Preserve.
Marie Rodriguez, *Valles Caldera Trust*

4:51 Forest mastication project on Banco Bonito, Valles Caldera National Preserve.
Helen Smith, *US Forest Service, Rocky Mountain Research Station, Missoula, MT*

5:03 Wrap-up and adjourn – Bob Parmenter, *Valles Caldera Trust*

Contact for information:

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Fire History from Charcoal and Tree-Ring Records at Alamo Bog, Valles Caldera National Preserve

Craig D. Allen[1,6], R. Scott Anderson[2], Renata B. Jass[3], Jaime L. Toney[4] and Christopher H. Baisan[5]

[1]U.S. Geological Survey, Jemez Mountains Field Station, Los Alamos, NM 87544, USA
[2]Center for Environmental Sciences & Education, & Quaternary Sciences Program, Northern Arizona University, Flagstaff, AZ 86011, USA
[3]4014A Lewis Lane, Austin, TX 78730, USA
[4]Brown University, Geological Sciences, Providence, RI 02912, USA
[5]Laboratory of Tree-Ring Research, University of Arizona, Tucson, AZ 85721 USA
[6]Corresponding author, Email: craig_allen@usgs.gov

Abstract

Two primary methods for reconstructing paleofire occurrence include dendrochronological dating of fire scars and stand ages from live or dead trees (extending back centuries in the past) and sedimentary records of charcoal particles from lakes and bogs, providing perspectives on fire history which can extend back for many thousands of years. Studies using both proxies have become more common in regions where lakes are present and fire frequencies are low, but are rare where high-frequency surface fires dominate, and sedimentary deposits are primarily bogs and wetlands. Here we investigate sedimentary and fire-scar records of fire in two small watersheds in northern New Mexico, in settings recently characterized by relatively high-frequency fire where bogs and wetlands (Chihuahueños Bog and Alamo Bog) are more common than lakes. Our research demonstrates that (1) essential features of the sedimentary charcoal record can be reproduced between multiple cores within a deposit; (2) comparison of tree-ring fire scar and charcoal proxies both document the anomalous (compared to the remainder of the Holocene) lack of fire during the 20th century; (3) sedimentary charcoal records probably underestimate the frequency of fire in high-frequency, mixed conifer stands; and (4) the sedimentary records from these sites are complicated by factors such as burning and oxidation of these organic deposits, diversity of vegetation patterns within watersheds, and potential bioturbation by ungulates. Thus we consider a suite of particular challenges in developing and interpreting fire histories from bog and wetland settings in the Southwest. The identification of these issues and constraints with interpretation of sedimentary charcoal fire records does not diminish their essential utility in assessing millennial scale patterns of fire activity in this dry part of North America.

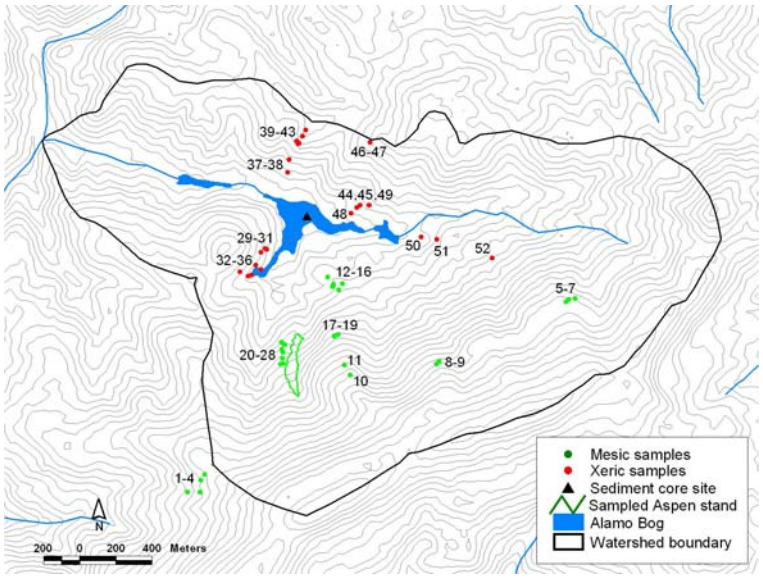

Figure 1. Topographic map view of Alamo Bog in the Alamo Canyon watershed, with locations of the sediment core site, fire-scarred tree samples at red (xeric sites) and green (mesic sites) dots with tree sample numbers, and outline of the dated aspen stand that regenerated in 1879. Contour interval = 40 feet. Inset photograph showing Alamo Bog and mixed conifer forest on north aspect slope; arrow indicates the sampled aspen stand.

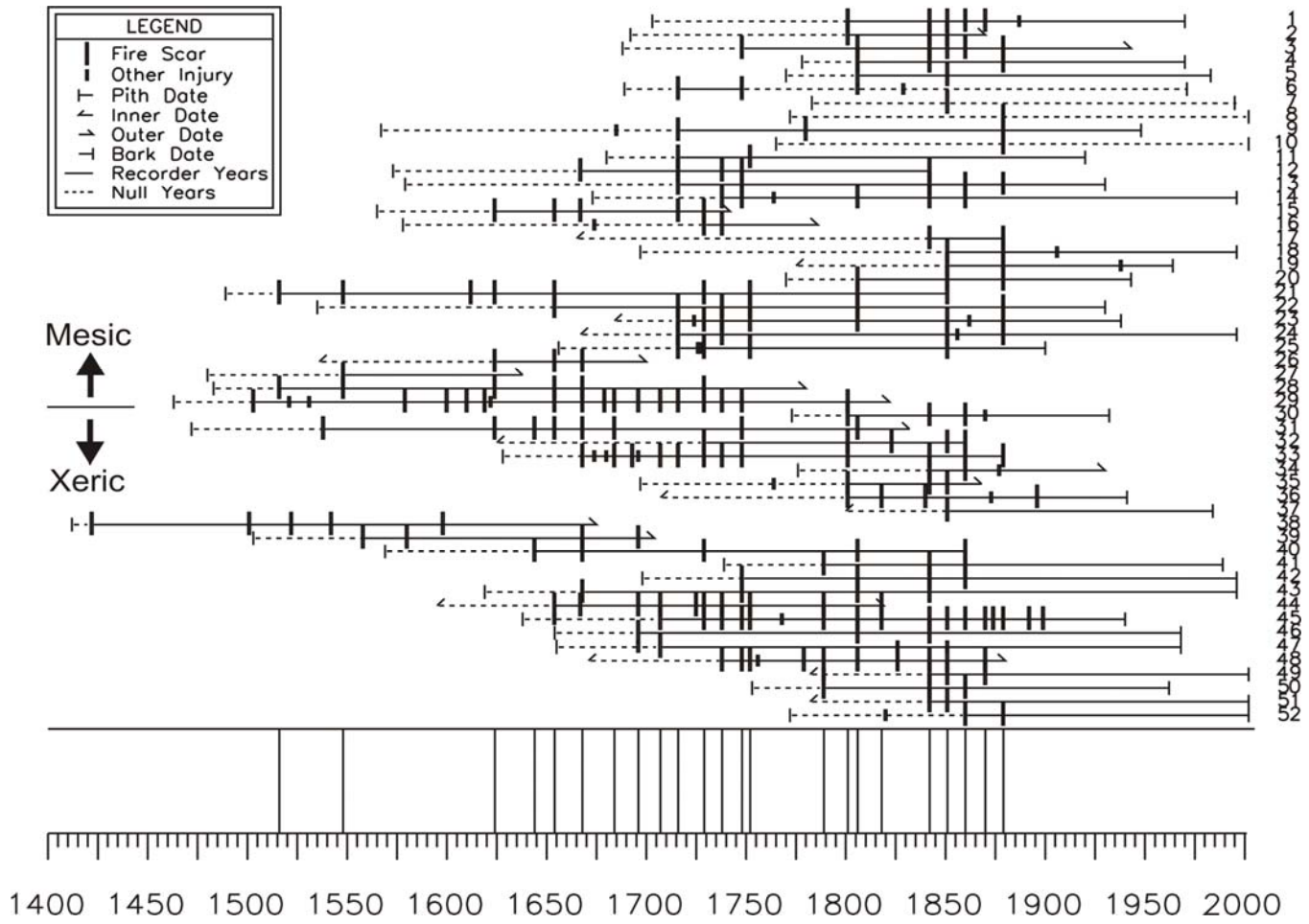

Figure 2. Composite fire scar chronology from the Alamo Bog watershed. Horizontal lines show the calendar-year life spans of individual trees (labeled with sample numbers), and the short vertical lines are fire scar dates. The longer vertical lines at the bottom of the chronology indicate years with spreading fires, in which fire scarred at least 10% of previously scarred trees and a minimum of two samples. Xeric and mesic site trees are plotted in separate groups, with sampled trees arrayed within each site group from lowest elevation (bottom) to highest. Note the high frequency of fire activity prior to AD 1880, the synchronism of fire years across samples, and the cessation of spreading fires after AD 1879.

Effects of Riparian Grazing on Growth Rate and Movement of Brown Trout in the Valles Caldera National Preserve, New Mexico

Mike Anderson and Colleen Caldwell.

New Mexico Cooperative Fish and Wildlife Research Unit, Box 30003 MSC 4901, New Mexico State University, Las Cruces, NM 88003

The objective of this research was to characterize the effects of riparian grazing on growth rate and movement of brown trout (*Salmo trutta*) within Valles Caldera National Preserve, New Mexico. Three sites were established at upper, middle, and lower reaches along Rio San Antonio (San Antonio). Each site consisted of three grazing treatments: (1) closed to elk and cattle grazing (ELK), (2) open to only elk grazing (CATTLE), and (3) open to both elk and cattle grazing (OPEN). Salmonid abundance was estimated twice yearly in each treatment during spring and fall using backpack electrofishing depletion sampling. Within each treatment, 30 fish were implanted with PIT tags during fall 2006 and spring 2007. Recapture electrofishing was conducted on 6 to 8 intervals between April and November. Growth rate was calculated for each age class using instantaneous growth equations to determine seasonal growth cycles and identify periods critical to salmonid productivity. Movement was calculated as displacement distance between successive recapture occasions. Movement observed within treatment areas was calculated by measuring the distance between the center stream reaches of successive relocations. GPS locations were taken for brown trout moving outside treatment and input into GIS stream layers to measure the distance between successive relocations.

Brown trout population densities showed little treatment effect between 2004 and 2007 (Figure 1), however, within the San Antonio brown trout density increased progressively in the upper portions of the watershed (Figure 2). To date, growth rate (grams/day) among age-2 brown trout was 0.24 (± 0.142; mean ± 1 SD) in treatments closed to grazing, 0.09 (± 0.03) in treatments with only elk grazing, and 0.09 (± 0.09) in treatments open to elk and cattle grazing (Figure 3). Resident and mobile life individuals are present within San Antonio Creek, with 80% of the total recaptures being within 50 m of the previous relocation (Figure 4). Fish tagged within closed treatments moved 162 m (± 1761) while fish tagged within exclosures open to only elk moved 360 m (± 2506). Fish tagged within treatments open to both elk and cattle moved 286 m (± 1969). There was no detectable effect of treatment on fish movement. Movement appears to be correlated with population density as individuals tagged in the lower site (4.5 fish/100m^2±2.9) exhibited mean displacement of 1446 m (± 4639). Brown trout tagged in the middle site (33.9 fish/100m^2±14.26) exhibited mean displacement of 74 m (± 627), and brown trout tagged in the upper site (61.6 fish/100m^2±33.7) exhibited mean displacement of 42 m (± 547) (Figure 5).

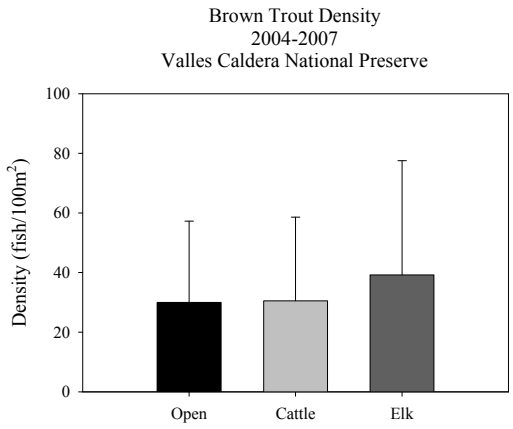

Figure 1: Average density (fish/100 m^2) and standard deviation (error bars) of brown trout estimated in Rio San Antonio grazing treatments from 2004-2007. Density estimates from upper, middle, and lower sites were combined to evaluate treatment effects on fish density.

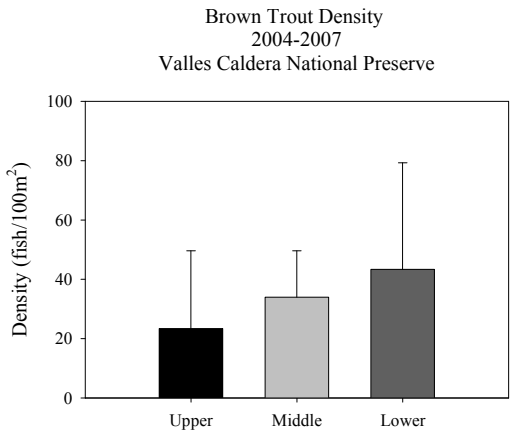

Figure 2: Average density (fish/100 m^2) and standard deviation (error bars) of brown trout estimated in Rio San Antonio grazing site from 2004-2007. Density estimates from open, cattle, and elk treatments were combined to evaluate watershed characteristics within Rio San Antonio.

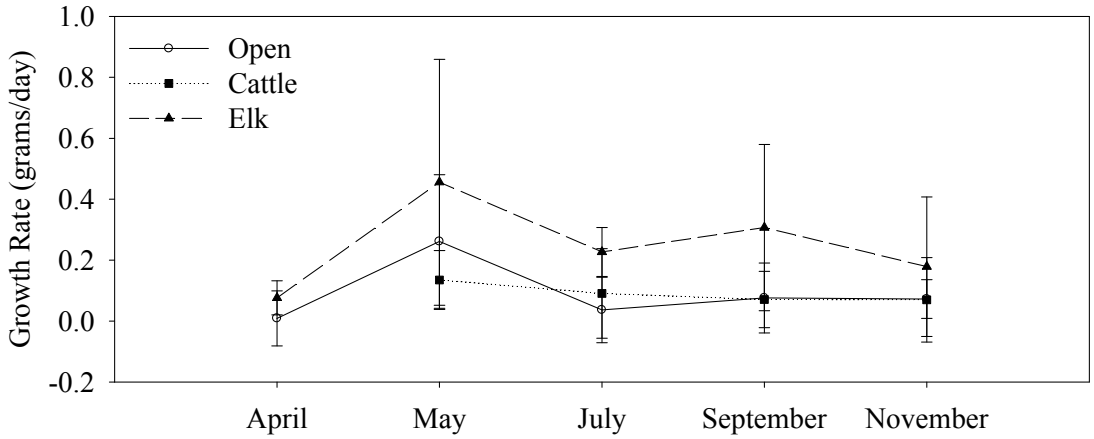

Figure 3: Average seasonal growth cycles (grams/day) and standard deviation (error bars) of Age-II brown trout in San Antonio Creek between April and November 2007. Mean growth rates were combined across upper, middle, and lower San Antonio Creek grazing sites to evaluate grazing treatment effect on growth cycles.

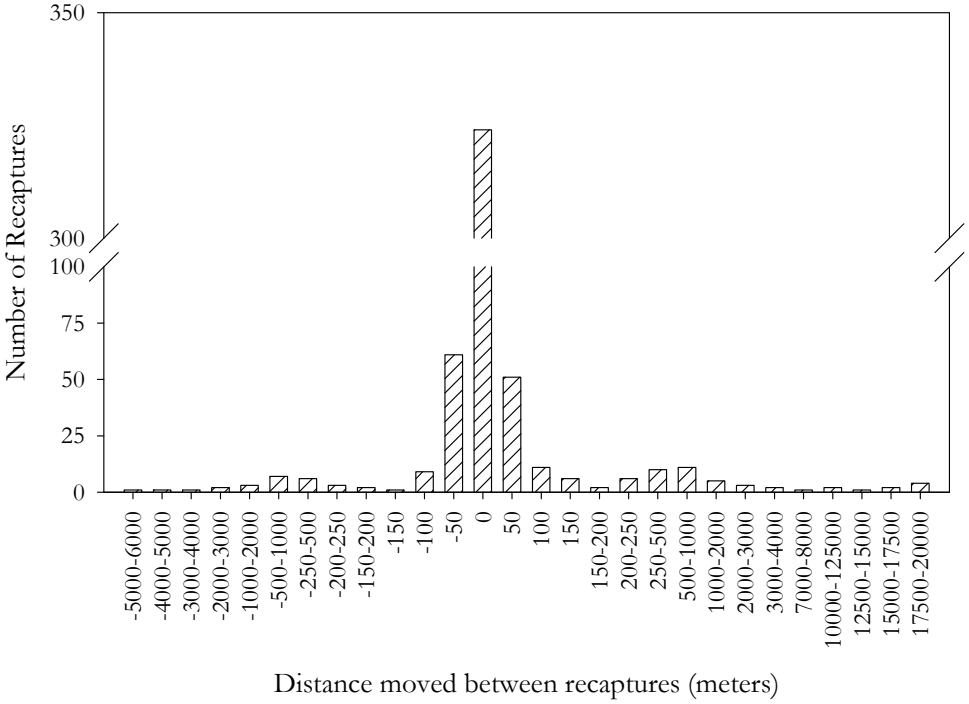

Figure 4: Observed displacement for all brown trout recaptures within San Antonio Creek between April and November 2007. Observations were combined across all age classes to determine resident or mobile characteristics within the salmonid population. Negative values signify downstream movements.

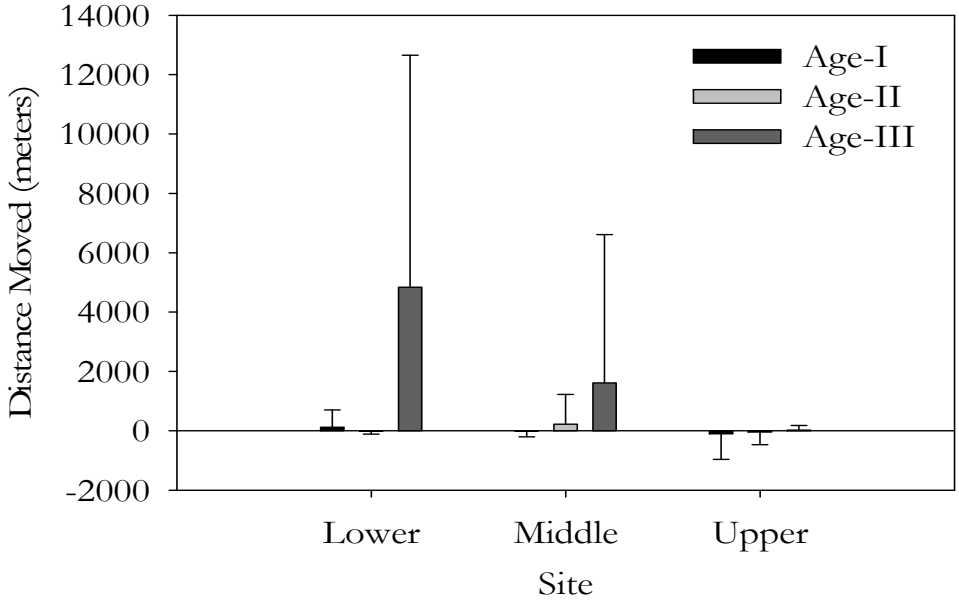

Figure 5: Mean displacement (meters between successive relocations) and standard deviation (error bars) of Age-I, Age-II, and Age-III brown trout in San Antonio Creek. Displacement distances were combined across open, cattle, and elk grazing treatments to evaluate effects of salmonid population density on brown trout movement.

Stream Fish Response and Water Quality Characteristics Following Prescribed Fire, Valles Caldera National Preserve, NM

Mike Anderson, Colleen Caldwell, Robert DuBey and Robert Parmenter.

U.S.G.S., New Mexico Cooperative Fish and Wildlife Research Unit, Box 30003 MSC 4901, New Mexico State University, Las Cruces, NM 88003 575-646-6259; and Valles Caldera National Trust

Understanding the effects of prescribed fire on fish populations and water quality is essential to forest and fisheries management decision making. Numerous studies have shown detrimental effects of uncontrolled wildfire on aquatic systems, however, little is known regarding the effects of low intensity controlled fire on aquatic systems. Prior to the prescribed fire on the Valle Toledo within Valles Caldera National Preserve in 2005, study sites were selected on the Rito de los Indios (Indios) as a reference site. Within the watershed of the prescribed fire, a southern portion of the Rio San Antonio (San Antonio) was selected as the treatment site. Prior to the prescribed fire, three reaches (50 m each along the stream thalweg) were established within each stream. At each of these stream reaches, fish populations (species composition, density, relative weight, recruitment) were assessed spring and fall pre-treatment (2005) and spring and fall post-treatment (2006-2007). Species composition and fish density were estimated using backpack electrofishing at each site. All brown trout (*Salmo trutta*) were measured for total length (mm) and weight (g) to calculate relative weight (Wr) and brown trout recruitment was monitored by estimating abundance of Age-0 fish (young-of-the-year fish hatched within the calendar year) from each fall sample collection. Water quality (temperature, dissolved oxygen, conductivity, pH, turbidity) was monitored using in-stream datasondes placed within both reference and treatment streams from April through November. A mean was computed from temperature (^{o}C) and turbidity (NTU) collected at 15 minute intervals within a 24 h period to obtain the daily average. From these daily averages, a mean was computed for temperature and turbidity between 1 June and 31 August.

The prescribed fire may have had very little effect on fish density estimates as reflected by the decline in fish density in both the Indios and the San Antonio from 2005 through 2007 (see Figure 1). In addition, there were no effects of prescribed fire in 2006 and 2007 on salmonid recruitment as reflected by little change in Age-0 fish density estimates in the San Antonio (see Figure 2). Relative weight indices (i.e., health condition) showed little change from 2005 through 2007 for Age-II, -II, or -IV brown trout in the San Antonio (Figure 3). Of note, Wr decreased as age increased with Wr below 100 (optimum score for fish in "good" condition) in the Age-IV fish.

While turbidity in the San Antonio was elevated in 2006 (max 331 NTU) and 2007 (max 467 NTU) compared to 2005 (max 8.6 NTU), the prescribed fire had no effect on stream temperature in either 2006 or 2007. The mean daily temperatures for the summer months in the San Antonio were 15.2 ^{o}C in 2005, 15.1 ^{o}C in 2006 and 15.0 ^{o}C in 2007. The highest average temperature recorded in one day was greater in 2005 (17.9 ^{o}C) than in 2006 (16.4 ^{o}C) or 2007 (16.4 ^{o}C). In summary, the trends observed in this study suggest that the prescribed fire had no impact on the fish populations of the Rio San Antonio.

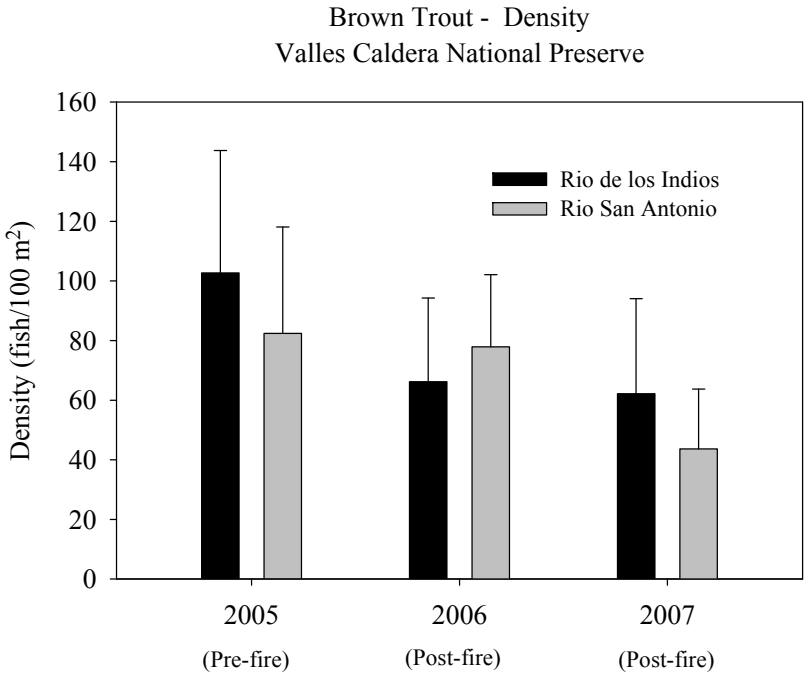

Figure 1. Average density (fish/100 m^2) and standard deviation (error bars) of brown trout estimated in the Rito de los Indios (reference stream) and the Rio San Antonio (treatment stream) from 2005 (Pre-fire) through 2007 (Post-fire) on the Valles Caldera National Preserve, New Mexico.

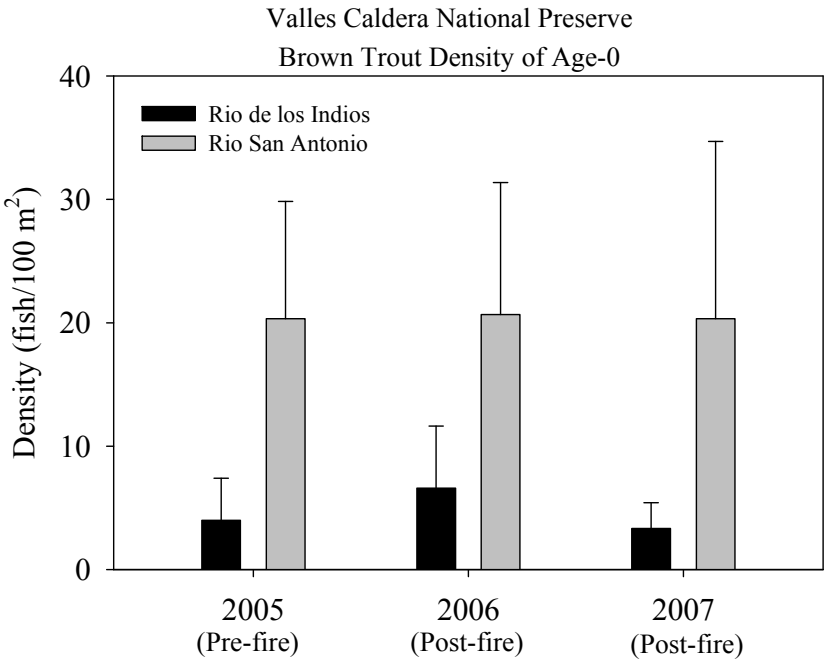

Figure 2. Average density (fish/100 m^2) and standard deviation (error bars) of Age-0 brown trout estimated in the Rito de los Indios (reference stream) and the Rio San Antonio (treatment stream) from 2005 (Pre-fire) through 2007 (Post-fire) on the Valles Caldera National Preserve, New Mexico.

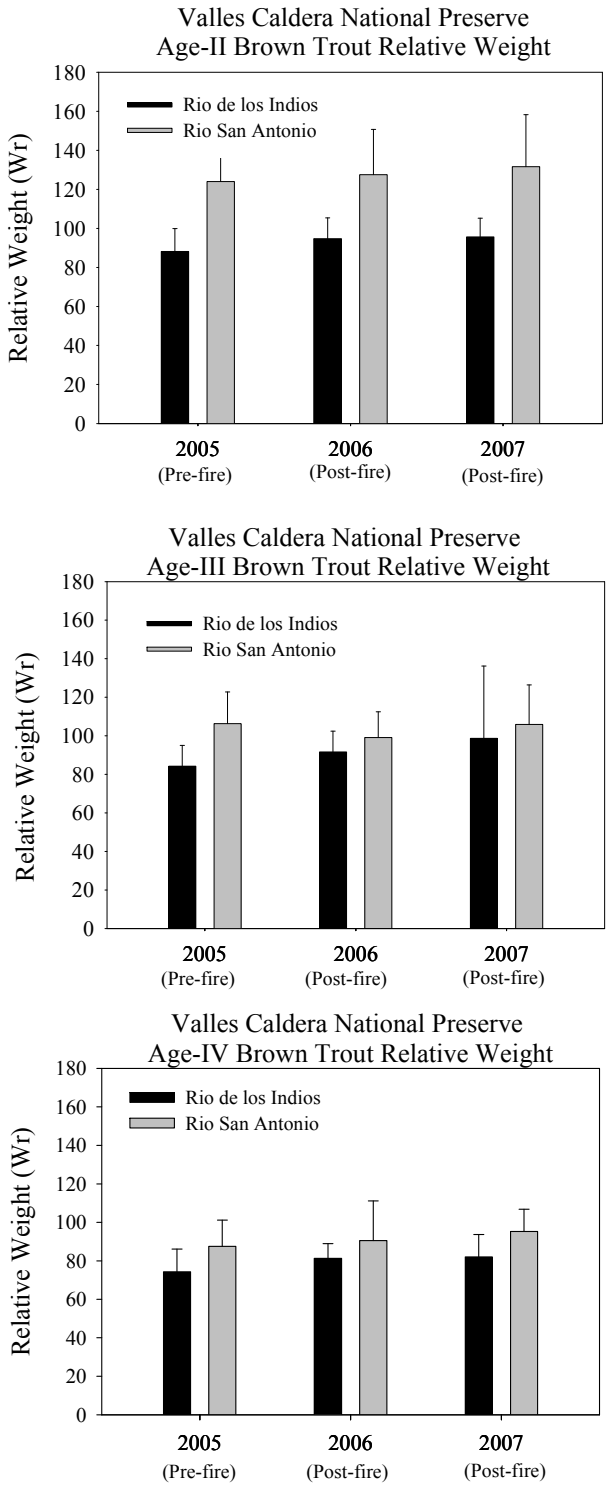

Figure 3. Average relative weight (Wr) and standard deviation (error bars) of Age II, III, and IV brown trout sampled from the Rio de los Indios (reference stream) and the Rio San Antonio (treatment stream) from 2005 (Pre-fire) through 2007 (Post-fire) on the Valles Caldera National Preserve, New Mexico.

Relative use, foraging impacts, and diet quality of sympatric elk and cattle: lessons from Lincoln National Forest, southcentral New Mexico

Louis C. Bender and Heather Halbritter,

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Research Unit, PO Box 30003 MSC 4901, Las Cruces, New Mexico 88003, USA
Department of Fisheries and Wildlife, New Mexico State University,
Las Cruces, New Mexico, USA.

Concurrent herbivory by elk and cattle is a contentious management issue on Lincoln National Forest (LNF), southcentral New Mexico. We documented plant community composition, structure, and grazing and browsing utilization for 4 key vegetation cover and structure types, including mountain meadows, aspen, thinned conifer, and large burns. Concurrently, we documented relative use of these types by elk, mule deer, and cattle, and modeled factors related to residual biomass of mountain meadow communities and browse utilization of forested types. Last, we determined quality of elk and cattle diets in LNF and those factors affecting it. Elk used thinned conifer and mountain meadows more than aspen; cattle used mountain meadows more than thinned conifer or aspen; and mule deer used thinned conifer more than aspen or mountain meadows. Each herbivore used large burns comparably or greater than other cover-types. Palatable browse was limited in key vegetation cover/structure types (< 107 stems/ha), and use was moderate–heavy in both thinned conifer (20–73%) and aspen (45–88%), likely due to limited availability. Combined elk, cattle, and deer use accounted for 61% and 17% of the variance in browse utilization in burns and aspen conifer types, respectively, with elk responsible for the majority of browsing (45% and 12%, respectively). Use of grasses in mountain meadows was generally less than management recommendations in both 2005 and 2006. Modeled alone, combined elk, cattle, and deer use accounted for only 33% of the variance in RSHs of Kentucky bluegrass in 2005, with the majority of use (15%) attributable to cattle. When site-specific environmental covariates were included in models, elevation and aspect contributed 25% and 7% of the variation in RSH of Kentucky bluegrass, respectively, while herbivore contributions declined to < 14%. In 2006, combined ungulate herbivory accounted for only 8% of the variation in RSH of Kentucky bluegrass, with no species being significant in models. Including environmental covariates, factors other than large herbivore use again contributed the majority of the variation in residual biomass of Kentucky bluegrass; these included grass species (36%) and area/perimeter factor (11%) of mountain meadows. Diet quality data indicated that digestibility of elk diets ranged from 56–63% and cattle diets ranged from 67–69%; crude protein levels in cattle diets were 13.2–14.7%, indicating high quality diets for cattle and marginal to low-good quality diets for elk. At current stocking levels and densities co-utilization is not affecting diet quality of either elk or cattle, nor are key habitat types on LNF being used beyond sustainable levels. The low level of browse availability indicates that substantial opportunity exists to increase forage availability for elk, deer, and cattle on LNF, and thus increase populations without increasing impacts to plant communities.

Valle Toledo Fire Experiment: Plant responses to fire and grazing.

Will Barnes, Bob Parmenter, Molly Padgett

GrassWorks, Inc., and Valles Caldera Trust, Jemez Springs, NM 87025

Plant populations were sampled for population demographics, nutritional content and plant litter decomposition rates before and after the prescribed fire and closure of grazing exclosure plots in both grassland and subcanopy forest habitats. Results for the two years following the treatments indicated that (1) the major grass species suffered no mortality from the fire, (2) plant size (canopy diameter and height) were sometimes reduced by fire and grazing somewhat (<20%, and dependent on species), but this variability was small compared to annual effects of different rainfall levels, and (3) the nutritional content of the regrowing plant leaf blades were significantly higher in protein. Litter decomposition rates of plant materials grown after the fire showed variable results, with Parry oat grass showing no significant difference in mass loss rates, while Arizona fescue and Kentucky bluegrass showing opposite results: post-fire regrowth leaf blades of Arizona fescue decomposed more slowly than those of unburned plants, whereas post-fire litter of Kentucky bluegrass decomposed more quickly. Differences in total nitrogen content appear to be related to these results. Taken altogether, the fire and grazing impacts on the grasses of the Valle Toledo appear to be minimal, and recovery is very rapid.

Elk foraging and abundance in the Cerro Grande Fire burn area: Are linkages with plant patch characteristics evident?

James Biggs
Los Alamos National Laboratory, Guest Scientist
Dept. of Animal and Range Sciences, New Mexico State University

The Cerro Grande Fire (CGF) of May 2000 burned 17,400 ha of occupied and potential elk habitat in the Jemez Mountains, New Mexico. A question of primary interest is whether the burned area can sustain current distribution, seasonal use patterns, and abundance of elk without adversely affecting regenerating plant communities. I assessed relationships among plant characteristics and elk foraging and abundance using belt transects, exclosures, and pellet analysis within the CGF burned area. I also assessed whether herbaceous cover created by the fire will result in lower impacts to woody species (swamp theory). Although localized browsing effects were observed, patch size and height of regenerating plants did not appear to be affected by current ungulate use and abundance patterns. If use increases during summer or if elk numbers increase in the burned area during winter without expanding their range of use, woody plant communities may be negatively impacted. The "swamp effect" could not be verified. The percent of twigs browsed increased with increasing cover of graminoids but few significant effects of herbivory and abundance on regenerating plant communities were observed. In most cases, patch size and height were smaller for > 35% twigs browsed compared to ≤ 35% twigs browsed and for pellet-group densities > 7 per 100 sq m compared to ≤ 7. The mean pellet-group density per 100 sq m (2.77) was similar to previously described thresholds for determining impacts to aspen. Based on results of this study, habitat improvements in transitional use ranges in this region could consider a carrying capacity of 4 ha per elk as a starting point. Guidelines for managing aspen related to elk herbivory and abundance are also provided (see table below).

Grazing intensity guidelines for regenerating aspen stands, Jemez Mountains, New Mexico.

[1]Qualitative Grazing Category	[2]LBPP (%)	[2]MPGD (#/100 sq m)	Mean Old Growth Stubble Heights (cm)			[4]Mean Emerging Growth Stubble Heights (cm)		
			Slender wheat-grass	Brome grass	[3]Sedge	Slender wheat-grass	Brome grass	Sedge
Light to non-use Conserv.	≤35	≤2.77 (≈3)	43.4+ (≈43)	47.28+ (≈47)	11.65+ (≈12)	7.42+ (≈7)	8.1+ (≈8)	4.56+ (≈5)
Moderate Heavy Severe	>35	>3	≤34	≤28	≤9	≤4.8 (≈5)	≤4.3 (≈4)	≤4

[1] Holechek and Galt (2000).
[2] LBPP-leaders browsed per plant, MPGD-mean pellet-group density (#/100 sq m).
[3] Estimate for moderate category based on guidelines provided by Holechek and Galt (2000).
[4] Emerging growth should be used with old growth and at least one other indicator.

An Ecohydrological Observatory in the Jemez Mountains of New Mexico

*Paul D. Brooks, E. Vivoni, M. Litvak, N. McDowell, P. Troch. N. P. Molotch, J. Kostzrewski, S. Lyon, W. Veatch, J. Gustafson, F. Liu, K. Musselman, J. McConnell, R. Bales, A Rinehardt, E. Small, B. Parmenter

*Hydrology and Water Resources, University of Arizona, Tucson, Arizona 85721

The NSF-funded Science and Technology Center SAHRA is leading a major, interdisciplinary effort to design, implement, and operate a long-term environmental observatory to quantify the affects of vegetation change on basin-scale water balance in semi-arid environments. Our research is focused on high elevation catchments in Jemez Mountains of New Mexico where precipitation, especially snow and snowmelt, provide a major source of water for lower elevations, but where climate and vegetation are rapidly changing. Our primary interests are in quantifying how these changes in system structure and boundary condition will impact hydrological and ecological processes.

The coupling of hydrological, biogeochemical, and ecological processes at catchment to landscape scale results in observable patterns in ecosystem structure, the amount and chemistry of stream discharge, and landsurface-atmosphere exchanges of energy and biogeochemicals. All of these patterns result from the close coupling of water, energy, carbon, and nutrient cycling, yet rarely are both the vertical (landsurface - atmosphere) and lateral (hydrological residence time and streamflow) exchanges associated with a particular ecosystem structure studied in concert. Our research attempts to bridge this gap by focusing on how ecosystem structure, specifically vegetation, mediates four-dimensional (X,Y,Z, and time) fluxes of water, carbon, and nutrients in semi-arid environments of the southwestern United States. Our generalized approach involves an iterative combination of measurement, modeling, and experimentation where process-level inferences drawn from one research activity are used to develop testable hypothesis for related efforts. Preliminary results have linked spatial variability in hydrologic residence time to seasonal variability in nutrient limitation; spatial and interannual variability in water source with carbon uptake and isotopic signature; vegetation controls on both snow water input and soil moisture; and the importance of alluvial aquifers in stream and river biogeochemistry.

The Natural History and Ecology of Merriam's Turkey in the Valles Caldera National Preserve, New Mexico

Marc Chipault and Robert Parmenter

Valles Caldera Trust, Jemez Springs, NM 87025

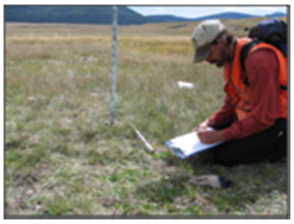
In 2007 the Valles Caldera Trust undertook a study of the ecology of the Merriam's Turkey in the Valles Caldera National Preserve, New Mexico (VCNP). The goals of this study are to map movements and home ranges on multiple time scales; identify preferred habitat for roosting, nesting, brooding and feeding; determine rates of mortality and natality; and to determine how these factors relate to fire history on the landscape and silviculture treatments. Six walk-in traps were deployed across the preserve in the fall of 2007. Traps were baited with cracked corn distributed from an automatic feeder twice per day. Automatic cameras recorded visitation at the trap sites. Use of the trap sites by turkeys increased dramatically following the development of snowpack; however, snowpack also hampered trapping efforts. On February 12, 2008 researchers successfully captured and marked two adult male turkeys in Redondo Meadow, in the southwest corner of the VCNP. The turkeys were fitted with radio-transmitters and marked with colored metal leg bands. During subsequent locations of the turkeys made using radio telemetry they were found to be in the Redondo Meadow area for approximately the next month. On March 25, 2008 they were located by telemetry on the northwest side of the Valle Grande. This represents a straight-line distance from the capture site of approximately 9 km; 13 km by the most likely path of travel. Researchers will continue efforts to capture and mark turkeys on the VCNP through 2008. Different capture techniques may be tested and unproductive traps will be relocated.

Valle Toledo Prescribed Burn: Obsidian Responses to Fire

Jamie A. Civitello

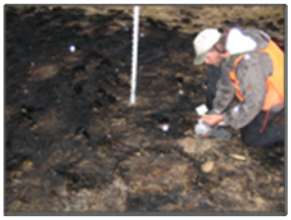
Valles Caldera Trust, Jemez Springs, NM 87025

The Valles Caldera National Preserve recently conducted a prescribed burn in the Valle Toledo, one of the large, high-elevation grassland valleys that characterize the caldera. Extensive archaeological obsidian surface deposits occur within the 1900-acre burn area, providing an opportunity to examine fire effects to obsidian. Fire can physically alter obsidian and affect the obsidian hydration dating potential of artifacts. The effects of low-intensity grassland fire, however, are not well known. Fire effects to obsidian were documented within four artifact monitoring plots, with obsidian samples exposed to fire under varying biomass loads and effective temperatures. Artifacts from a large quarry on the Preserve were collected, cataloged, and sawed in half. 10 artifacts were placed at each plot; one sawed half of each artifact remained as a control sample. The artifacts in the plots were placed intentionally within fuel, etched for identification, and mapped. Fuel type and height was recorded. A HOBO thermocouple was placed at each plot and recorded temperatures during the fire every 15 seconds. After the fire, the artifacts were re-mapped and collected. Both the control and burned sample were assessed for macroscopic fire effects and submitted for obsidian hydration analysis. All plots burned with the exception of Plot B in the low biomass condition of the lower montane grassland. Temperatures at Plots A and C reached over 800°F for a maximum of 15 seconds. Plot D reached 1218°F for a maximum of 15 seconds. In total, 10% of artifacts exposed to fire showed altered obsidian hydration bands. Broken down by plot, 1 of 10 artifacts in Plot A and Plot C each showed altered hydration bands, while 1 artifact of 9 in Plot D was altered. No artifacts showed surface crazing, a diagnostic fire effect observed after high intensity forest fires. 62% of all artifacts showed sooting or plant residue buildup, with the greatest percentage of effected artifacts in Plots A and D. Previous studies have indicated that fire effects are primarily influenced by the variables of temperature and duration of fire exposure. Most studies have documented altered hydration bands where temperatures reached at least 300°F. Although temperatures at our plots reached up to 1218°F, exposure to temperatures above 200°F only ranged from 30 seconds to 1 minute, 45 seconds. Short duration of exposure may account for the relatively low occurrence of altered bands, even in the two plots with the highest biomass and highest experienced temperatures (Plots A and D). The most widespread fire effect was the buildup of soot and plant residue on artifact surfaces, particularly on the artifacts in Plot A under the pine and grass litter. Even though more artifacts in Plot A experienced macroscopic effects than artifacts in other plots, there is no greater proportion of altered hydration bands on those artifacts. This experiment contributes to the ongoing evaluation of obsidian hydration dating as a tool for understanding the prehistory and historical ecology of the Preserve.

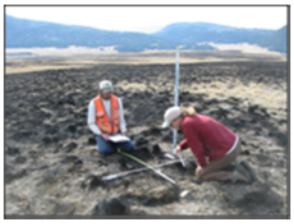


Assessing plot conditions

Fire moves through Plot D



Retrieving thermocouple



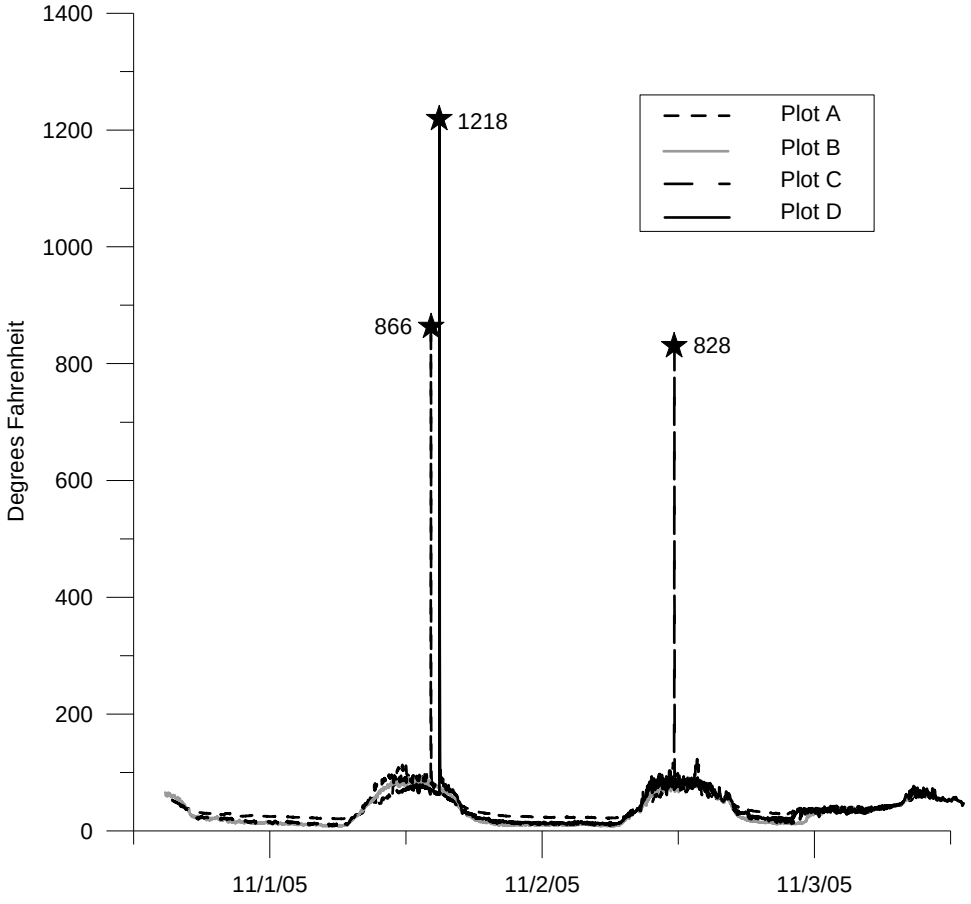
Retrieving artifacts

Plant residue on artifact from Plot A. Portion on left is control sample.

Results – Alteration of the Obsidian Hydration Band

Plot, Artifact Count	**Vegetation Type**	**Ground Fuel Conditions**	**Relative Biomass Level**	**Maximum Experienced Temp. Degrees F**	**Percentage of Artifacts with Hydration Band Alteration**
Plot A n=10	Ponderosa pine overstory with Parry's oatgrass and Thurber's fescue understory	Thick pine needle and grass litter and duff	high	866	10%
Plot B n=10	Lower Montane Grassland	Sparse pine dropseed and blue grama clumps. High % bare ground	low	unburned	unburned
Plot C n=10	Upper Montane Grassland	Parry's oatgrass and Arizona fescue bunches. Low % of bare ground.	moderate	828	10%
Plot D n=9	Upper Montane Grassland	Vigorous oatgrass and fescue. Zero % bare ground	high	1218	11%

Temperatures at each Plot during the Burn



Frost and fire: forest /grassland dynamics in the Valles Caldera

Jonathan Coop

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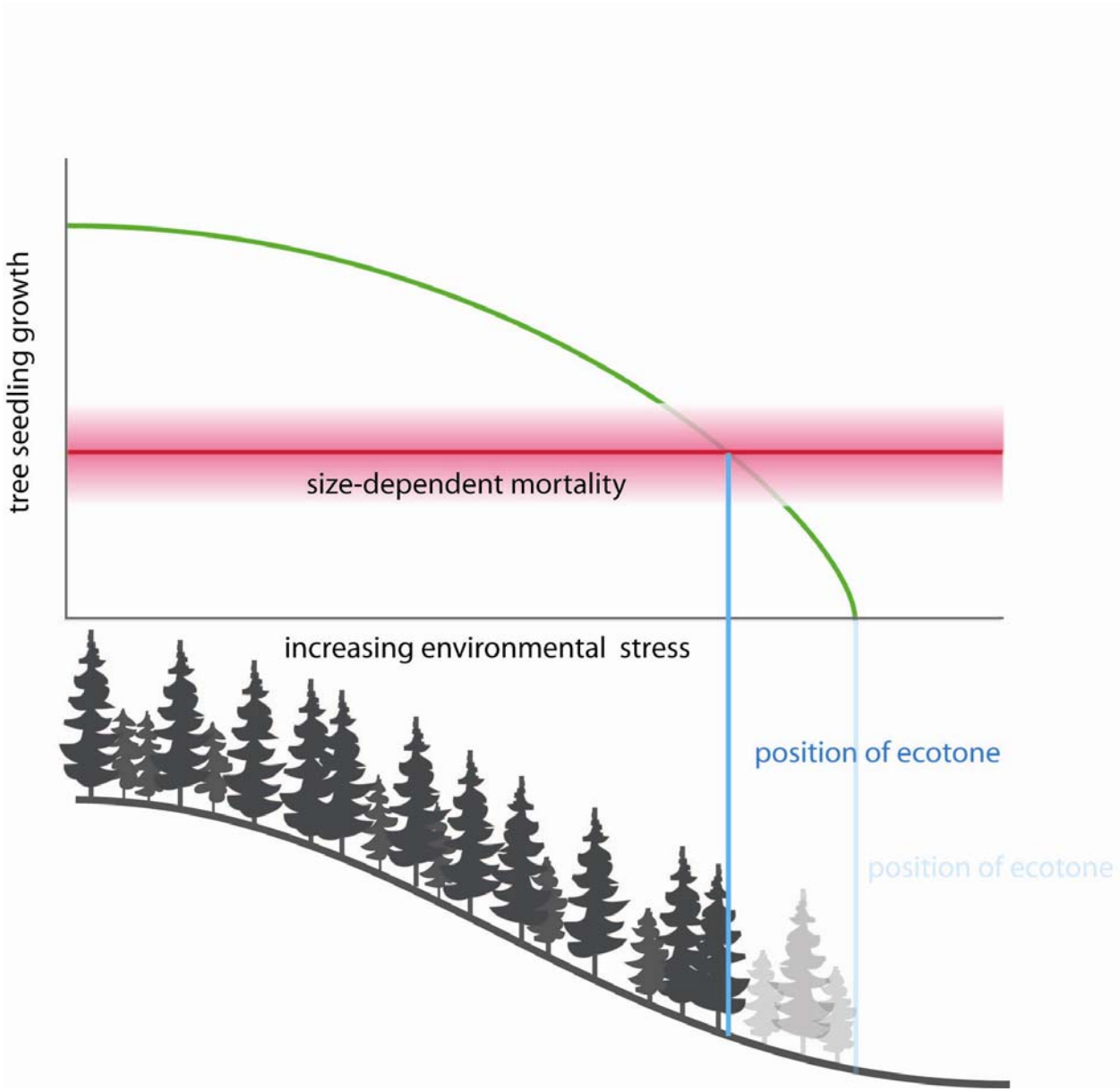
Abstract: Montane and subalpine grasslands frequently occur in broad valley bottoms known as *valles* in northern New Mexico. Why are there no trees in the *valles*, and what factors determine the location of the forest/grassland boundary in the Valles Caldera National Preserve (VCNP)? Cold air accumulation subjects valley bottoms to frequent summer frosts, and drops minimum temperatures 5-7° C below those of adjacent slopes. Soils of valley bottoms are also of finer texture and more nutrient rich than those of mountain slopes, promoting a dense growth by graminoids and forbs. Fine soil texture, low soil moisture, herb competition, and low minimum temperatures all contributed to photosynthetic stress of experimentally transplanted seedlings of ponderosa pine (*Pinus ponderosa* var. *scopulorum*). However, only minimum temperatures exerted strong effects on seedling growth. Seedlings in frosty valley-bottom sites were unable to effectively produce needles or add height, and poor growth in turn served as the best single predictor of mortality over the next year.

The spatial position of the forest/grassland ecotone in the large valles of the VCNP may be determined by frost alone, but poor tree seedling growth at frosty sites also increases exposure to sources of size-dependent mortality. Historically, slowly growing, frost-damaged seedlings would have been extremely vulnerable to the low-severity fires that frequently burned valley margins until the late 19th C. Recent forest encroachment (resulting in a nearly 18% decline in the area of VCNP grasslands since 1935) may thus be driven by both rising minimum temperatures and cessation of frequent fire. These processes—frost and fire—can be brought together in a more general model in which treeline location is set by the interaction between spatially-structured gradients that influence tree seedling establishment and growth, and a disturbance regime that imposes high mortality for seedlings that do not achieve threshold growth rates (Figure 1). A prediction of this model is that treelines in the VCNP would have been pushed farthest upslope in landscape locations where 1) historic fires were most frequent, or 2) where fires achieved longer flame lengths and killed taller seedlings; following the breakdown of the historic fire regime, tree encroachment would be expected to proceed most rapidly in these areas. This model also suggests that environmental changes (e.g., increasing minimum temperatures) that promote tree seedling establishment and growth beyond the current treeline could be offset by more frequent or more lethal burns.

Figure 1. The landscape location of the treeline ecotone may occur at the point of zero seedling growth imposed by environmental conditions such as frost. However, under a disturbance regime that exerts size-dependent mortality (such as frequent, low-severity fire) the treeline location will sit at the minimum growth threshold required to survive disturbance.



Valle Toledo Fire Experiment: Ground-dwelling arthropod responses to fire and grazing.

Zoe Anna Duran, Robert R. Parmenter

Valles Caldera Trust, Jemez Springs, New Mexico 87025

The experimental burn and grazing exclosure results for ground-dwelling arthropods collected in pitfall traps indicated that significant treatment effects existed for various taxa. Of the total 209 invertebrate taxa examined, the 11 most abundant species were analyzed for changes in abundances following the fire and the closure of the fences in the non-grazing plots. Species of herbivores, particularly grasshoppers and crickets, showed significant effects to fire and grazing. For example, Mormon crickets showed no response to fire in the first post-fire year (2006), but then exhibited dramatic increases on the burned area in the second year (2007). Other grasshoppers showed decreases in population following both fire and grazing. Predators showed varying responses: ground spiders (Gnaphosidae) and wolf spiders (Lycosidae) exhibited no significant response to fire or grazing, whereas centipedes showed a large increase in trap captures 2 years following the fire. These results are indicative of the complex interactions of fire and grazing with habitat structure and the nutritional quality of plant resources, and illustrate the time lags of population changes in post-fire environments. Future sampling will indicate the total time period required for a return to pre-fire conditions for each taxa.

Overview of stable isotope studies in the Jemez Mountains

Julianna Fessenden and Heather Kelly

Los Alamos National Laboratory, and Junieta College

In the summer of 2006, we conducted a research program to determine the magnitude of carbon movement and the vegetative response to the changes of the local meteorology. We monitored the light stable isotopes of carbon to measure the vegetation stress and productivity shifts within the grasses in the Valle Grande, specifically targeting the non-disturbed grasses found in the Elk Exclosure close to the horse paddock. We monitored the fluxes of carbon using closed chambers, we monitored the isotopes of carbon found in the soils, dominant plants, and the CO_2 in air (from chambers and from an eddy covariance tower), and we compared these isotopes found in the grassland to the Ponderosa stand to look at seasonal changes in vegetative stress. We monitored these fluxes and isotope ratios at 6 times during the growing season (June to September) of 2006. We found shifts in C3 to C4 productivity, changes in vegetative stress in the grasses (but not the trees), and increases in carbon flux as the monsoon precipitation fell. These results, show clear vegetative impacts due to the precipitation changes in the Valles Caldera which provide insights into carbon storage in a high Montagne grassland.

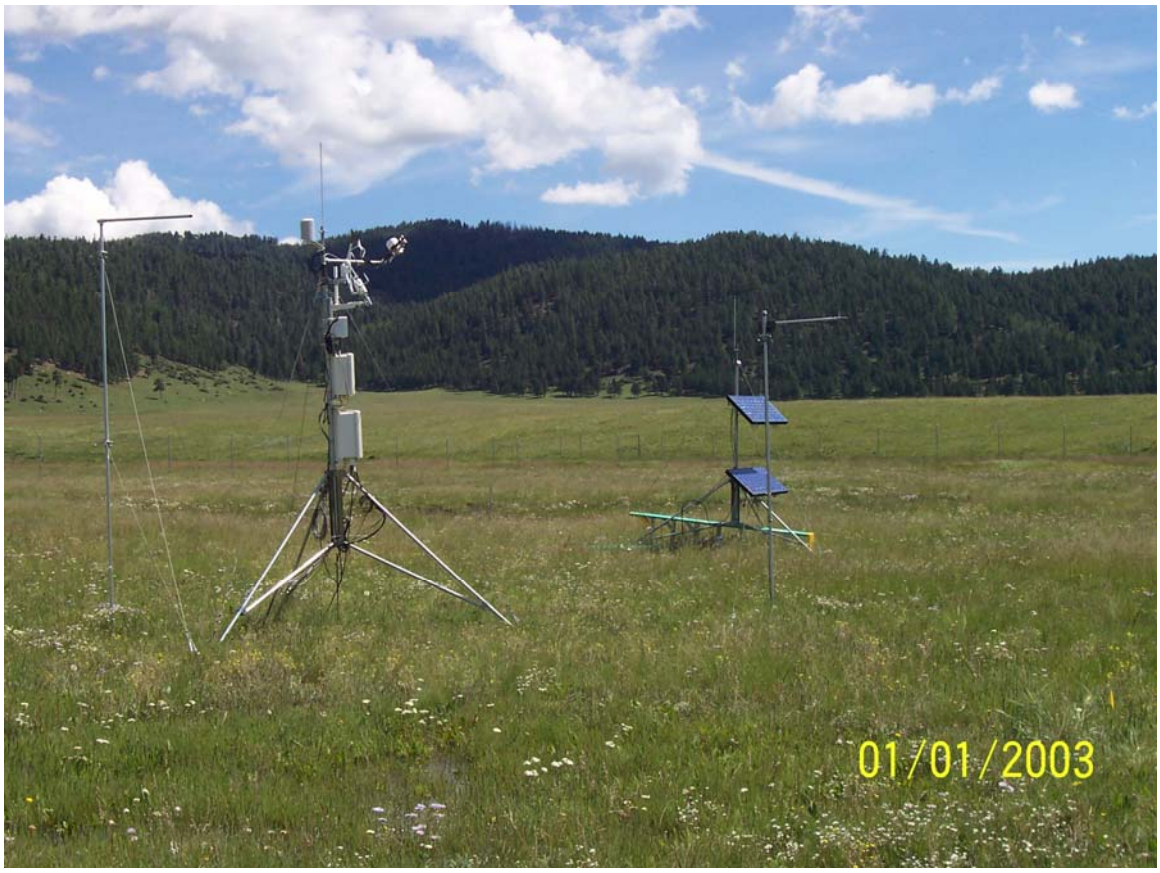


Figure 1. *Eddy covariance tower located in the Elk Exclosure of the Valle Grande*

The Ecology of Rodent-borne disease in the Valles Caldera National Preserve.

Megan Friggens, Robert Parmenter, Gabor Racz, and Jessica Jakubinas

Northern Arizona University, Flagstaff, AZ; Valles Caldera Trust, Jemez Springs, NM; and University of New Mexico, Albuquerque, NM.

Hanta (Sin nombre) virus and plague (*Yersinia pestis*) are important zoonotic diseases with recurring outbreaks in human populations of the SW United States. A number of studies have linked outbreaks of these rodent borne diseases to years of high precipitation. It is hypothesized that precipitation, through its influence on primary productivity and cascading effects on rodent populations, can initiate rodent borne disease outbreaks by driving rodent populations to high densities. In addition, it is predicted that rodent population increase leads to rodent dispersal from high elevation "refugia", where rodent populations are stable from year to year, into low lying areas, thereby increasing rodent-human contact and spread of rodent borne disease. As part of cross site project designed to test these hypotheses, the rodent and flea fauna of the VCNP were surveyed from 2004 through 2007 and tested for the presence of three diseases, Hantavirus, plague, and *Bartonella*. We found all three pathogens and the primary rodent hosts of these diseases in the Valles Caldera National Preserve (Table 1). Hanta (Sin nombre) virus, which causes human pulmonary syndrome, is directly transmitted between individuals of its rodent host, *Peromyscus maniculatus*. Hantavirus was common in VCNP rodents and we were able to track the movement of uninfected and infected *P. maniculus* populations along elevational gradients in a manner predicted by the refugia concept. Plague, most famous as the agent of black death (bubonic plague) in the European middle ages, is a flea transmitted bacterial pathogen. Introduced into the United States in the 1900s, plague quickly became established in the western US creating problems for both human and wildlife populations. It remains unclear how plague is maintained within natural habitats though *Peromyscus* and *Neotoma* species are commonly implicated as reservoir hosts. Despite an apparent plague related die off in prairie dog populations within the VCNP, plague was found in only a few rodent and flea individuals over the course of this survey. Among the plague positive fleas, 2 species (*Aetheca w. ophidius* and *Stenopia americana*) were recovered from *P. maniculatus*, 1 species (*Orchopeas s. neotomae*) was recovered from *N. mexica*, and 1 species (*Oropsylla hirsuta*) was recovered from *Cynomys gunnisoni* (prairie dogs) and their burrows. *Bartonella*, though less pathogenic in humans, is also a blood borne bacterial pathogen of rodents transmitted by fleas. *Bartonella* is particularly useful for analysis of disease exchange between host species because it contains host specific species. By identifying the *Bartonella* species carried by various rodent species, we have been able to verify disease exchange among major rodent groups in the VCNP. Ultimately, these patterns of *Bartonella* exchange may help us identify the important transmission components of the plague lifecycle that lead to outbreaks in vulnerable wildlife populations like prairie dogs. In summary, the rodent fauna, presence of zoonotic pathogens, and topographical features of the VCNP have allowed us to explore several important themes in disease ecology including disease movement through host populations and habitats and disease and flea exchange between host species.

Table 1. Rodent and flea communities and disease incidence in the Valles Caldera National Preserve, NM, 2004-2007.

Number of rodent individuals	2444
Number of rodent spp.	11
Number of Flea spp.	28
Overall Prevalence: Hanta virus	6-38%
Overall prevalence: *Yersinia pestis*	<1%
Overall prevalence: *Bartonella*	64%

Ecology and Natural History of the Coyote (*Canis latrans*) on the Valles Caldera National Preserve

Suzanne Gifford, Eric Gese, Bob Parmenter, Marc Chipault

Utah State University, Logan, UT, and Valles Caldera Trust, Jemez Springs, NM 87025

We are conducting a study to describe the ecology and natural history of the coyote (*Canis latrans*) on the Valles Caldera National Preserve (VCNP), in partial response to low elk calf : cow ratios (NMDGF 2003) coinciding with the cessation of persecution and increased visibility of coyotes on the VCNP (anecdotal accounts). Data collection is ongoing; the bulk of data analyses will be conducted over the next several months. To date, we have performed 43 captures (35 individuals), with GPS data from 14 coyotes in hand and 10 GPS collars currently in the field, and VHF telemetry data on 10 individuals. Preliminary diet assessment based on scat analysis suggests that coyote diet during summer 2006 consisted primarily of rodents (41% volume, 61% frequency), followed by insects (25, 49) and then elk (16, 28). Preliminary habitat use analysis suggests a late summer avoidance of forest and preference for wet meadows compared with habitat type availability within home ranges. Five sub-sampling schemes of 5-minute interval locations generated statistically indistinguishable habitat use results ($p < 0.001$), suggesting that temporal autocorrelation is not impacting habitat use estimates. 2006 serology indicates 30% exposure to canine distemper virus, 100% exposure to canine parvovirus, and 100% exposure to plague. Future analyses will compare seasonal, annual and territorial differences in scat composition; describe space use, habitat use, and movement patterns of collared coyotes; describe population characteristics including population density, social organization, age structure, disease prevalence, and causes of mortality; and finally, assess whether a relationship exists between social cohesion and body size of diet components.

Revised Geologic Map of the Valles Caldera, New Mexico

Fraser Goff[1], Jamie N. Gardner[2], Steven L. Reneau[2], Shari Kelley[3], Kirt Kempter[3], and John R. Lawrence[4]

[1]Earth and Planetary Sciences Dept., University of New Mexico, Albuquerque, NM 87131
[2]Earth and Environmental Sciences Division, Los Alamos National Laboratory, NM 87545
[3]State Map Program, New Mexico Bureau of Geology & Mineral Resources, Socorro, NM 87801
[4]Lawrence Geo Services Ltd. Co., Albuquerque, NM 87112

A revised geologic map of the Valles caldera (c.a. 1.25 Ma to present) is in preparation that has been compiled from portions of nine recently completed, but preliminary 1:24,000 quadrangle maps within the center of the Jemez Mountains volcanic field, New Mexico. Geologic mapping was conducted from about 2000 to present and sponsors include the Valles Caldera National Preserve, the United States Forest Service, the United States Park Service, the Los Alamos National Laboratory, the U.S. Geological Survey, and the New Mexico Bureau of Geology and Mineral Resources. Maps from which the Valles Caldera geology has been compiled are Bland, Cerro del Grant, Jarosa, Jemez Springs, Polvadera Peak, Seven Springs, Redondo Peak, Valle San Antonio, and Valle Toledo (available at:

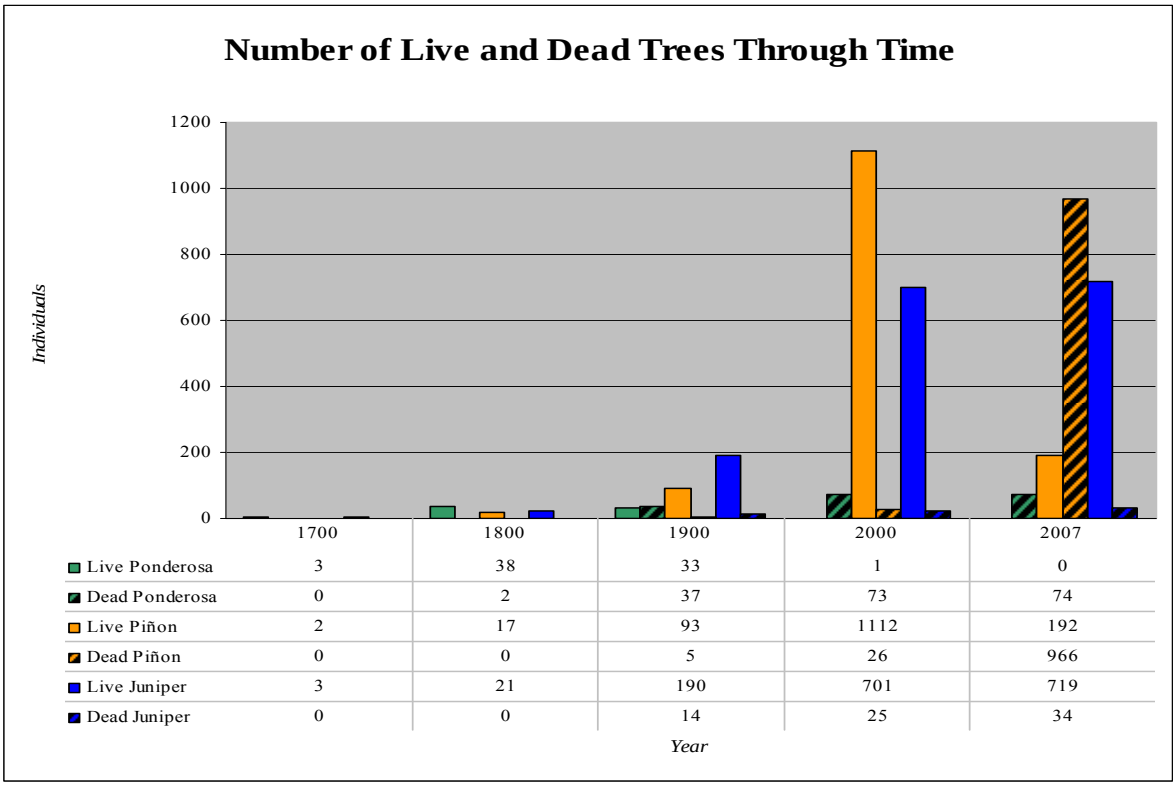
http://geoinfo.nmt.edu/publications/maps/geologic/ofgm/home.html).

The new compilation will provide much more detail on the geology of 1) pre-caldera volcanic and sedimentary rocks flanking the topographic rim of the caldera, 2) uplifted caldera floor rocks comprising Redondo Peak and Redondo Border (the resurgent dome), 3) the ring of post-caldera rhyolite dome, flow and pyroclastic rocks (moat rhyolites), 4) post-caldera lake deposits, and 5) post-caldera alluvium, colluvium, terraces, fans, and landslides. Although the final product has not been designed, it is anticipated that it will be presented on a shaded relief topographic base. An example map will be brought to the meeting for display.

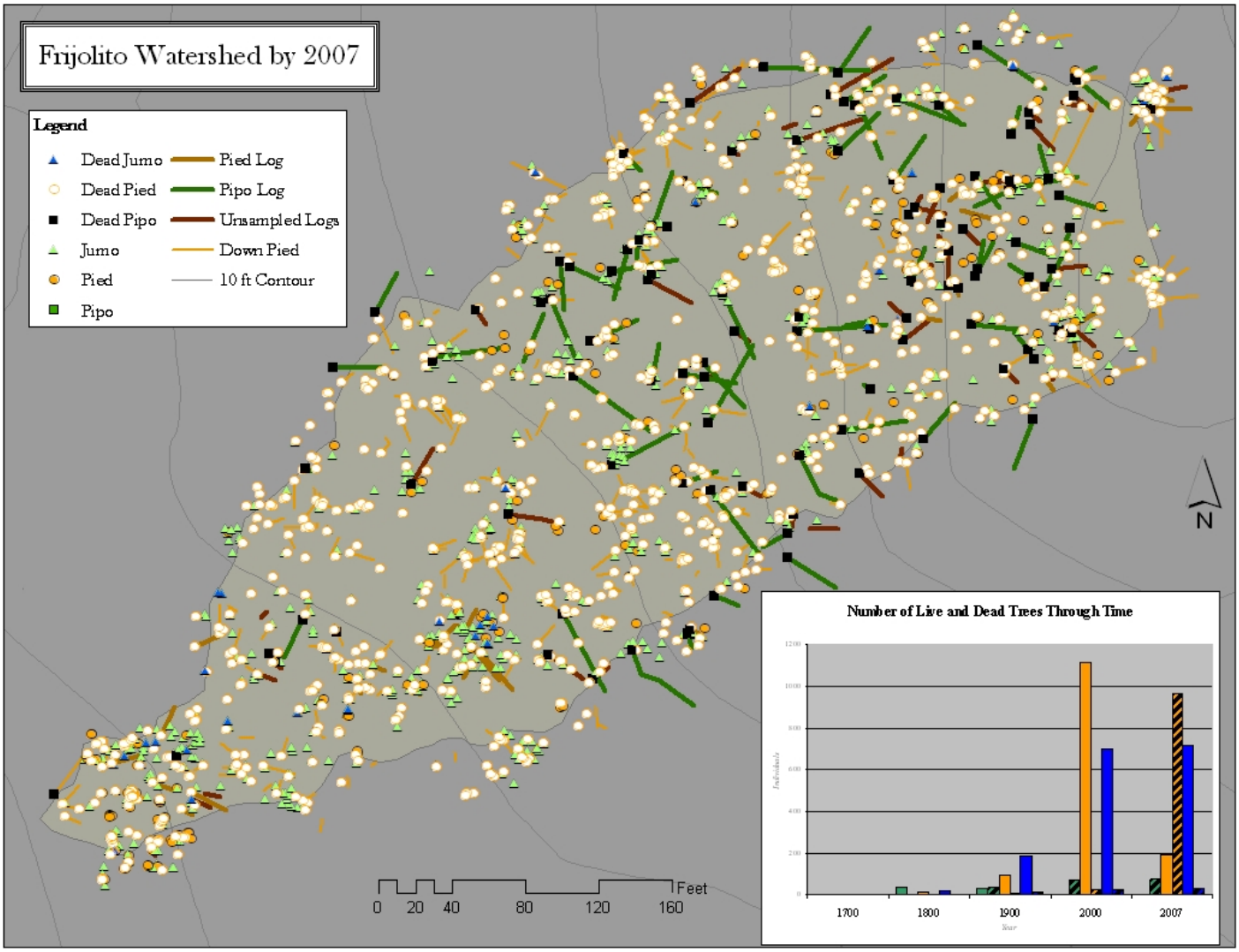
Mapping Four Centuries of Tree Demography at the Ponderosa/Piñon-Juniper Ecotone

Andrew M. Goumas, Craig D. Allen, Kay Beeley, Rebecca Ortel and Peter M. Brown
Ecology Group Bandelier, USGS Jemez Mountain Field Station, Rocky Mountain Tree-Ring Institute

Woody vegetation in semiarid regions is highly responsive to climate variability, with wet and dry periods driving pulses of tree establishment and mortality. We document detailed patterns of tree establishment and death through time across topographic gradients within the Frijolito watershed at Bandelier National Monument. This small (1 ha) semiarid watershed has been at the ecotone between lowermost ponderosa pine forests and upper piñon-juniper woodlands. We used existing data sets describing size-class of the piñon (*Pinus edulis)* and juniper (*Juniperus monosperma)* and applied a series of size-age regressions to determine the age structure of the woodland. Dendrochronological reconstruction of birth and death dates of 98 old remnant logs of ponderosa (*Pinus ponderosa)* and piñon samples added depth to the age structure as well as a dendrochronological record of fire history for the hillslope. We spatially related all the age structure data and created intensive and detailed maps of the Frijolito watershed. This has allowed detailed reconstruction of spatial and temporal patterns of tree establishment and mortality from the early 1600s to present. The early record shows ponderosa pine dominant across most of this hill slope, with surface fire activity present until fire exclusion in ca. 1870, with some piñon and juniper on fire-safe rocky spots and in the lower portions of the watershed. With fire exclusion, establishment of larger numbers (446) of piñon and junipers is evident from the 1870's through ca. 1950, often sprouting under existing ponderosa canopies. The severe drought of the 1950s resulted in complete mortality of the remaining ponderosa (20) here, and some mortality of old piñon (at least 8). Substantial piñon and juniper regeneration (347, piñon and 79, juniper) occurred during the warm wet period of 1978-1995, but ponderosa regeneration has not recurred. Most recently, the 2000's drought caused nearly all piñon > 2 cm drc to die on this site, (936), although many (192) smaller piñon survive currently. Since 1800 the Frijolito watershed has transitioned from open ponderosa forest/savanna with enough grass to sustain surface fires, to ponderosa with piñon and juniper understory and less grass by 1880, to dead ponderosa and surviving piñon and juniper as dominant by 1960, to now juniper (and shrub) dominance of this hill slope. These major shifts in vegetation cover almost certainly have affected runoff and erosion processes on this hillslope, which we have monitored since 1993.



	1700	1800	1900	2000	2007
Live Ponderosa	3	38	33	1	0
Dead Ponderosa	0	2	37	73	74
Live Piñon	2	17	93	1112	192
Dead Piñon	0	0	5	26	966
Live Juniper	3	21	190	701	719
Dead Juniper	0	0	14	25	34


Frijolito Watershed by 2007
Legend
Dead Jumo
Dead Pied
Dead Pipo
Jumo
Pied
Pipo
Pied Log
Pipo Log
Unsampled Logs
Down Pied
10 ft Contour
N
0 20 40 80 120 160
Feet
Number of Live and Dead Trees Through Time
1700
1800
1900
2000
2007

Soils of the Valles Caldera National Preserve: Development of a high-resolution soils map.

Charles Hibner, Natural Resources Conservation Service, Santa Fe, NM

The existing National Cooperative Soil Survey (NCSS) product for the Jemez Mtns. was completed in the late 1980's. In 2001, preliminary soil survey work was initiated in the newly established Valles Caldera National Preserve (VCNP) to provide a map of higher resolution delineations with detailed soil and vegetation information. During the course of the survey, we utilized national technical assistance through a geomorphic tour, laboratory sampling tour, and several annual reviews and field assists to better understand the various landscapes, and soil physical and chemical characteristics. Combining knowledge of climate-vegetation relationships and detailed studies into the geomorphology, stratigraphy, hydrology, and pedology, we classified the soil-landscapes of the VCNP into map units based on their ecological function and management regime. These map units represent one or more soil components usually based on difference in landform position so that the user can identify which soil is present in their specific area of interest. The entire set of collected field data has been entered into the National Soil Information System (NASIS) database, where eventual publication to an online forum that can derive interpretative tables and raw data can be obtained by the public. Geospatial components will be incorporated into the final product whereby preserve managers can utilize both spatial and tabular soils data in wise decision making in future resource management.

Sorex of the Jemez Mountains: recognition of a new shrew

Andrew Hope, James Findley, Tommie Findley, and Joseph Cook
Museum of Southwestern Biology, and Department of Biology, University of New Mexico, Albuquerque

Until recently there were eight species of shrews recognized from New Mexico and four species from the Jemez Mountains. In particular, the masked shrew (*Sorex cinereus*) was considered to occur in the north of New Mexico both within the Jemez and San Juan Mtns. and also the Sangre de Cristos. Preliminary genetic data now indicates that specimens of tentative *S. cinereus* from the Jemez are actually Hayden's shrew (*S. haydeni*) and represent a disjunct population isolated from the rest of *S. haydeni* occurring in the northern Great Plains. This represents a new species of mammal recognized within New Mexico and has implications for the biogeographic history of the Jemez Mountains. In addition, recognition of novel pathogens from these shrews has implications for emerging infectious disease in light of comtemporary climate change.

A lacustrine sedimentary record of two mid-Pleistocene glacial cycles (MIS 14 to 10) from the Valles Caldera, New Mexico

Linda Hurley[1], Peter J. Fawcett[1], Jeff Heikoop[2], R. Scott Anderson[3], Fraser Goff [1], John W. Geissman[1], Catrina Johnson[1], Giday WoldeGabriel[2], Craig D. Allen[4], Julianna Fessenden-Rahn[2]

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A long-lived middle Pleistocene lake formed in the Valle Grande, a large moat valley of the Valles Caldera in northern New Mexico, when a post-caldera eruption (South Mountain rhyolite) dammed the drainage out of the caldera. The deposits of this lake were cored in May 2004 (GLAD5 project, hole VC-3) and 81 m of mostly lacustrine silty mud was recovered. A tentative chronology has been established for VC-3 with a basal tephra Ar-Ar date of 552 +/- 3 kyr, a correlation of major climatic changes in the core with other long Pleistocene records (SPECMAP and long Antarctic ice core records) and the recognition of three geomagnetic field polarity events in the core correlative to events recorded by lava flows in Idaho, and sediments from the western Atlantic and Mediterranean oceans. This record spans a critical interval of the middle Pleistocene from MIS 14 (552 kyr B.P.) to MIS 10 (~350 kyr B.P.), at which time the lacustrine sediments filled the available accommodation space in the caldera moat.

Multiple analyses including core sedimentology and stratigraphy, sediment density and rock magnetic properties, organic carbon content and carbon isotopic ratios, C/N ratios, and pollen content reveal two glacial/interglacial cycles in the core (MIS 14 to MIS 10). Glacial terminations V and VI and complete sections spanning interglacials MIS 13 and MIS 11 are captured at a high resolution. The interglacial stages preserve a complex mixture of iron, iron-titanuim, and iron-sulfide bearing phases, and the largest most variable rock magnetic intensity values. In the VC-3 record, both of these interglacials are relatively long compared with the intervening glacials (MIS 14 and MIS 12), and interglacial MIS 13 is significantly muted in amplitude compared with MIS 11. These features are similar to several other mid-Pleistocene records. Of particular interest is relatively large amplitude millennial-scale variability evident in several proxies through the interglacial MIS 11 section. The glacial terminations are quite abrupt in this record with notable changes in sedimentation, organic carbon content, C/N ratios and watershed vegetation type. Termination V is the largest climate change evident in this part of the middle Pleistocene. The glacial inceptions tend to be more gradual, on the order of a few thousand years.

BALD EAGLE USE OF THE VALLES CALDERA

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ABSTRACT Bald eagles have congregated in the Valles Caldera National Preserve every fall, with peak numbers of up to 20 eagles in November 2002. A few bald eagles have remained through the winter. Inventory of bald eagles in the Preserve began in 2001, and monitoring began in 2002, spanning a range of natural conditions and management actions. Bald eagles foraged primarily for fish in the creeks, favoring locations where trees overlook San Antonio Creek, especially the Puerto de Trasquilar (between the Valle Toledo and Valle San Antonio), and meadow stream banks near the headwaters of the East Fork of the Jemez River. They also ate elk remains, small mammals, and waterfowl. Bald eagles were frequently disturbed by human activity, flushing from perches at distances up to 500 meters (one-third mile) from pedestrians or vehicles. Bald eagle use of San Antonio fishing perches was inversely related to observed flushing rates ($R^2 = 0.49$, $P = 0.0006$), and flushing rates as low as 10% affected use. Flushing rates averaged 16% overall, and ranged from 33% to 52% in 4 of the 6 San Antonio stream reaches. Proximity of roads to perches and traffic levels together determined flushing rates. Bald eagle use of fishing perches in the Puerto decreased with increasing road use there, from an average of 7.5 eagles when roads were closed in 2002, to 3.9 when roads were open to occasional administrative use during 2003-2005, and 1.9 eagles when roads were opened to hunters in 2006. Total use of San Antonio fishing perches decreased somewhat less, from an average of 11.9 in 2002 to 8.9 during 2003-2005, and 7.9 in 2006. Decreases in foraging and roosting counts were similar; so most bald eagles that were displaced from the Puerto by vehicle traffic evidently left the Preserve. Details are available in the 2007 Valles Caldera Trust contract report, 2006 Bald Eagle Monitoring in the Valles Caldera National Preserve.

Atmospheric Deposition of Radioactive Particles in the Valles Caldera National Preserve

Greg Kaufman, Pueblo of Jemez, Department of Resource Protection

This study measured Gross Alpha and Beta radioactivity as well as the activity of individual radioisotopes found in air samples obtained in the Valles Caldera National Preserve during 2007.

The Preserve is the ancestral domain of the Jemez Pueblo Indians and is the location of countless Jemez cultural artifacts, shrines and holy places. The Caldera is also a sensitive and unique ecosystem that supplies the Jemez people with traditional plants and minerals as well as game for food. The headwaters of the Jemez River form in the expansive Valles Grande within the Preserve and eventually flow through the Pueblo itself, 40 miles to the south, providing irrigation and drinking water to the 2,500 inhabitants of the Pueblo.

Pajarito Ridge separates the Caldera from the Pajarito Plateau to the east where the Los Alamos National Laboratory (LANL) is situated. LANL has several air emission sources that exhaust a wide variety of radionuclides. LANL has also been an emission source for fission materials as a result of nuclear weapons development during World War II and the Cold War.

This study considers the hypothesis that radioisotopes emitted from LANL migrate to the west and are deposited on soils and water bodies in the Caldera impacting culturally significant natural resources. To investigate this hypothesis, the Pueblo obtained a Radiological Air Sampling Network (AIRNET) sampling unit identical to those used by LANL to measure radioisotope concentrations around the LANL facility.

With the assistance of LANL's Air Quality Group (ESH-17), and the Caldera staff, this unit was installed near the center of the Caldera. Samples were obtained throughout 2007 and were analyzed using the same sampling and analytical protocols employed by LANL in their AIRNET program. The results indicate:

1. The concentration of Gross Alpha emitting radioisotopes is elevated compared to the mean regional concentrations measured by LANL. Some measurements exceed three times the mean regional concentrations. Most of the Gross Alpha measurements also exceed the national Gross Alpha average concentration in air calculated by the National Council on Radiation Protection and Measurements (NCRP) on which EPA regulatory standards for individual exposure are based.

2. The concentration of Gross Beta emitting radioisotopes is below the mean regional concentrations measured by LANL as well as the national average calculated by the NCRP.

3. Of the individual radioisotope analytes, Pu-238/239 and U-235/236, all alpha emitters, returned values exceeding their respective mean regional concentrations as measured by LANL.

GEOLOGIC OVERVIEW OF THE NORTHERN JEMEZ MOUNTAINS, NORTH-CENTRAL NEW MEXICO

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Abstract:- Recent geologic mapping of four contiguous 7.5-minute quadrangles along the northern rim of the Valles Caldera has yielded numerous insights into the late Oligocene to Pleistocene sedimentary and volcanic history of the region. This mapping, funded by the STATEMAP program at New Mexico Bureau of Geology and Mineral Resources, is part of a compilation geologic map project for the entire Jemez Mountains. Some important geologic observations from our work in the northern Jemez Mountains include: (1) a better understanding of the timing and location of volcanic activity in the past 12 million years; (2) recognition of Bearhead rhyolite volcanism at approximately 7 million years ago just north of the Valles Caldera rim; (3) mapping of several sedimentary deposits that preceded, interceded, and postdated the Toledo and Valles caldera eruptions; and (4) paleotopographic interpretations for the northern Jemez Mountains prior to the eruptions of the Otowi and Tshirige Members of the Bandelier Tuff.

Several new Ar^{40}/Ar^{39} ages for northern Jemez volcanic units suggest that Lobato volcanic activity in the northeastern Jemez occurred primarily between 9 to 10.5 Ma, and was particularly intense between 9.5 to 10 Ma. The next major phase of volcanic activity occurred between ~7 to 8.5 Ma along the La Grulla Plateau, where andesitic and dacitic lavas cap a more mafic sequence of basaltic andesites to andesites. A relatively small volume of rhyolite was emplaced just northeast of the Valles caldera rim at ~7.1 Ma that we correlate to the Bearhead Rhyolite of the southern Jemez Mountains. This was followed by major Tschicoma Formation volcanism in the northeastern Jemez Mountains that was mostly emplaced between ~5.3 to 3 Ma. Along the western margin of Mesa El Alto, the El Alto basalt eruption occurred at ~2.9 Ma, followed by three El Rechuelos Rhyolite domes emplaced west of Polvadera Peak at ~2.1 Ma. Lastly, the Toledo and Valles caldera eruptions at ~1.61 Ma and ~1.25 Ma, respectively, deposited the Bandelier Tuff along two lowland corridors in the northern and northwestern Jemez Mountains.

Status of the Jemez Mountains Elk Herd

Stewart Liley, New Mexico Department of Game and Fish, Santa Fe, NM

The New Mexico Department of Game and Fish has recently shifted its methodology for surveying elk populations statewide. Previously the Department surveyed elk populations post-hunt using sightability index survey methods and models developed by personnel at Idaho Department of Fish and Game and the University of Idaho. One of the main reasons for the shift in survey methodology was the inherent problems with sexual segregation of elk post-rut and the difficulties of differentiating between young of the year and yearlings in mid to late winter. In the fall of 2006 the Department started surveying elk during the peak of the breading season when the greatest intermixing of sex and age classes occur. The Department then uses these data and the previous years harvest data to reconstruct population sizes. Population sizes are also evaluated using population models (POP-II) developed for wildlife managers. Elk were surveyed in late September of 2007 throughout the Jemez Mountains, with the majority of the animals being observed on VCNP. A total of 716 animals were observed with ratios being 45 bulls per 100 cows and 27 calves per 100 cows. The bull to cow ratio was comparable to other herds surveyed throughout the state whereas the calf to cow ratio was below most herds in the state. The Department plans on surveying the Jemez elk herd again in the fall of 2008 to give a better understanding of population size and composition.

Table 1. Fall composition data from the Jemez Mountains. The bull mortality rate is the annual adult (>1.5 years) male mortality rate, it is percentage of yearling males in male segment (>1.5 years) of the population. All ratios are the number of bulls, calves, or spikes to 100 cows.

Location	Bull Mortality Rate	Calf:Cow	Bull:Cow	Spike:Cow	# of Animals Observed
Jemez	**0.204**	**27** +/- 3.8	**45** +/- 5.7	**9** +/- 1.9	**716**

Changes in stream functioning condition on the Valles Caldera National Preserve, 2001-2006

Steve McWilliams (retired Forest Service watershed program manager SFNF)

A rapid assessment of watershed conditions on the 89,000 acre Valles Caldera National Preserve (VCNP) was conducted in July and August of 2000 at the time of transfer from private to public ownership. This assessment covered roughly 52 miles of perennial stream and provided resource concerns to the Santa Fe National Forest as the interim caretaker and to the Board when it accepted management responsibilities in 2002. The Forest Service conducted the assessment with an interdisciplinary team covering hydrology, soil science, vegetation, and fisheries biology.

Riparian/wetland areas along major perennial systems were selected to reflect conditions over the larger upland areas of the VCNP in general and the riparian/wetland areas in particular. The assessment used a coarse filter qualitative assessment method Proper Functioning Condition (PFC) to cover the area rapidly, locate problem segments, and reference reaches for later fine filter quantitative assessments using Thalwag Watershed Area Link (T-WALK) and benthic sampling (Dr. Jacobi). This assessment provided a picture in time of current and past effects of use on the VCNP, segments of impairment to the structures and function of riparian/wetland systems, stream health, reference reaches, and water quality inferred by using a biotic sampling in the riparian wetland areas. These observed conditions offer a decision space for management between existing and potential/desired conditions.

To prepare for the 2008 VCNP Report to Congress, the New Mexico cadre of the Creeks and Community Strategy (PFC) was asked to conduct a reassessment of the VCNP in 2006. The assessment was conducted in July and August of 2006 following a PFC training sponsored by the NM Riparian Council at the VCNP. The effort involved a diverse group of 18 students and 8 cadre the first week and the cadre the next. The PFC assessment found differences from 2000.

El Niño-Southern Oscillation (ENSO) impacts on Jemez Mountains precipitation

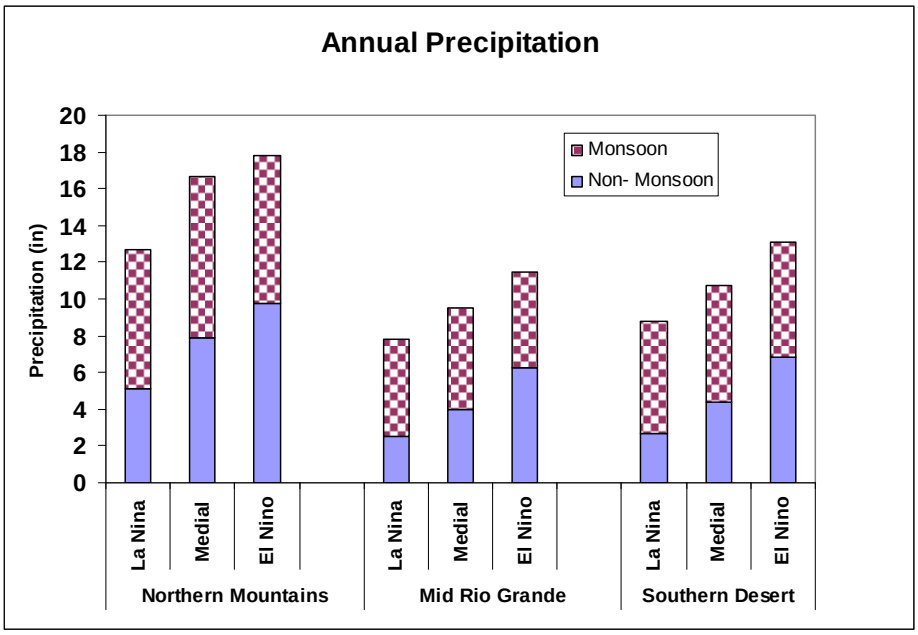
Douglas Moore, University of New Mexico

New Mexico is divided into 8 climate divisions by the National Climate Diagnostic Center (NCDC). The climate regime of the Jemez Mountains of NM can generally be derived from the long-term meteorological records from weather stations in division 2, the Northern Mountains. This presentation will use these long-term records to show the importance of the El Niño-Southern Oscillation (ENSO) on annual precipitation in the Jemez Mountain area and compare this with its impact on some other areas of NM

Precipitation in central New Mexico can be considered to have two phases. During the winter NM precipitation arrives via storms originating in the Pacific and riding the Jet Stream across NM. These storms can have varying trajectories with colder and drier storms coming out of the NW and wetter and warmer storms tracking out of the west or southwest. These storms are important for soil moisture recharge and snow pack development. This moisture from October through May can be considered non-monsoon in nature. In central NM June is typically dry until the onset of the North American Monsoon (NAM). From mid June through mid September monsoon moisture flows north out of Mexico and up through the southwest. Daily heating lifts this moisture within convective systems which results in intense thunderstorms that can be very heterogeneous in both time and space. Orographic effects mean that higher elevations receive more of this monsoon moisture. This 4-month monsoon precipitation phase usually contributes about half the annual precipitation in NM.

The relatively recent discovery of the influence of the El Niño-Southern Oscillation (ENSO) on climates around the globe has raised much interest in the quantification of this influence as well the ability to predict it. The 100+ record of temperature and precipitation from climate division 2 shows that, as with most of NM, the ENSO cycle has a considerable influence on the non-monsoon moisture but almost no effect on monsoon moisture during the summer. The El Niño phase of the cycle is seen to increase mean Oct. – May precipitation by about 23% while the La Niña phase reduces precipitation by an average of almost 35%. Figure 1 shows how this compares with some other NM climate divisions. The biggest reduction in precipitation is seen during the spring months. Temperature is less variable on a monthly basis than precipitation but there is a significant increase in average daily temperature during all of the non-monsoon months while this difference disappears during the monsoon months. There is a smaller and less predictable decrease in temperature during El Niño years. These increases and decreases in precipitation and temperature are extremely important for the Jemez Mountains as much of the moisture for this period comes as snow. The amount of snow, combined with temperatures plays a vital role in the supply of moisture in the soil in spring available for vegetative growth and/or runoff.

Figure 1.



Post-Dome Fire Seeding Effects on Native Vegetation

Rebecca W. Oertel and Craig D. Allen

USGS Jemez Mountains Field Station Bandelier National Monument

The effects of post-fire seeding on the long-term recovery of native vegetation are not well understood yet land managers faced with potential runoff and erosion damage to natural resources have been utilizing reseeding as a post-fire mitigation for many years. After the Dome Fire of 1996, the Forest Service seeded their burned lands with a ryegrass-based seed mix, while Bandelier lands and one control area within Forest Service land were not seeded. In an effort to examine the effects of burn intensity and seeding on the recovery of vegetation following the Dome fire, AD Barclay et. al. (International Journal of Wildland Fire, 2004) established 49 permanent vegetation transects (50 m long each) in 1997. The two-year study (data from 1997 and 1998) found that the seeding may have caused decreased native forb species richness and diversity. The study also found that the seeded areas had an increased ryegrass cover that may have negatively affected conifer regeneration and survivorship. The primary exotic was *Conyza canadensis,* which had greater cover in areas with higher burn severity. The unseeded transects had the highest cover values for *Conyza*, possibly due to the lack of competition with seeded species.

In 2002, ten unseeded transects in Bandelier were revisited. For that study, ponderosa pine tree canopy cover in the moderate burn intensity area increased by nearly 10% since 1997. The percent grass cover increased by a few percent in all burn intensities and the species diversities remained constant. The percent forb canopy cover decreased significantly, perhaps due to low precipitation in the severe drought of 2002 and/or an increased competition with the grasses. The primary exotics in 2002 were *Conyza canadensis* and *Verbascum thapsis*. We intend to revisit, recollect, and analyze vegetation data from the original Barclay transects in the fall of 2008 to study native species recovery trends in relation to climate variability, burn severity, and seeding treatments in the Dome Fire area.

Valle Toledo Fire Experiment: Introduction and Overview.

Robert R. Parmenter
Valles Caldera Trust, Jemez Springs, NM 87025

A multidisciplinary research team in New Mexico is examining the ecological responses of a montane grassland/forest ecosystem to an experimental prescribed fire. This project was designed to test a series of hypotheses concerning the effects of grazing activities and prescribed fires on ecosystem structure and functioning in the grasslands and forest ecotones of the Valle Toledo of the Valles Caldera National Preserve in northern New Mexico. The project consists of 12 research tasks, based on a series of ungulate (elk/cattle) exclosures and open study plots within burned and unburned areas of both grassland and Ponderosa pine forest. The project was initiated in spring, 2005, with a pre-fire sampling schedule, followed by a projected minimum of 2-years of post-fire studies.

All field study plots were established in early summer, 2005, and sampled at scheduled times prior to the prescribed fire in the autumn. The prescribed fire was undertaken on November 1-2, 2005, by fire teams from the US Forest Service and Bandelier National Monument (Fig. 1). Initial estimates of fire coverage indicated that approximately 70% of the surface area of the designated fire acreage was burned; as expected, areas that did not burn either had insufficient fuel loads or (in the case of some riparian areas) were too moist and replete with green vegetation. Special attention for ignition was directed to the research study plots, and all of these areas were burned successfully and completely.

Follow-up field sampling was conducted in 2006 and 2007. Results indicate that the prescribed fire did not cause any measurable negative impacts on either the grassland or forest ecosystem. Plant productivity on burned study plots equals or exceeds that of unburned sites; mortality of grasses and forbs was negligible. Elk use of the burned areas increased dramatically compared to the summer before the fire. Soil erosion was insignificant, although this may be due to the extreme drought conditions and lack of snowpack during the winter of 2005-2006. Fire impacts on stream water quality, fish populations and aquatic macroinvertebrate communities also appear to be minimal, a result likely due to the lack of fire in the adjacent streamside sedges and grasses.

In total, the use of prescribed fire in the montane grasslands and adjacent forests of the Valles Caldera National Preserve appears to have no measurable negative ecological impacts. If future measurements on the study plots bear out this conclusion, prescribed fire will continue to be an important management tool for the Valles Caldera Trust.

Fig. 1. Aerial view of Valle Toledo prescribed fire area following burn on Nov. 2, 2005.

State of New Mexico Recovery Efforts for the Meadow Jumping Mouse (*Zapus hudsonius*).

Leland J. S. Pierce

Conservation Services Division, NM Department of Game and Fish

The State of New Mexico is in the final stages of producing a Recovery Plan for two species of rodents found in riparian habitat in the State, the meadow jumping mouse, *Zapus hudsonius*, and the Arizona montane vole, *Microtus montanus arizonensis*. The meadow jumping mouse is a federal candidate for listing and is listed as endangered in New Mexico. The Arizona montane vole is listed as endangered in New Mexico. The meadow jumping mouse has very large hindlegs and hindfeet, and a tail accounting for at least sixty percent of its total length. The mouse is orangish and slightly darker on the back than the sides. In New Mexico, the meadow jumping mouse is found in the San Juan, Sangre de Cristo, Jemez, and Sacramento Mountains, as well as potentially in Catron County adjacent to the White Mountains in Arizona, and along the Rio Grande and Rio Chama drainages. The meadow jumping mouse may climb through the upper portions of its native vegetation. The meadow jumping mouse requires riparian areas with tall, dense vegetation, particularly sedges, with damp to wet soils. The presence of beavers is useful in maintaining habitat. The meadow jumping mouse eats primarily seeds and insects. The meadow jumping mouse may produce two litters per year in lower elevations but only one in montane populations, given that mouse hibernates up to nine months a year in montane populations. Habitat alteration, such as removal of vegetation from ungulate grazing, loss of beaver, water diversion leading to drying out of habitat, and various recreational activities within the habitat are the chief threats to the species. The meadow jumping mouse has shown a sharp decline in recent years, up to 91 % in the Sacramento Mountain populations, and 67% in the Jemez Mountains. The species remains extant in the Rio Cebolla, Seven Springs, and Fenton Lake areas in the Jemez Mountains. An Advisory Committee was formed to develop the Recovery Plan, and met on January 15, 2008, at the Bosque del Apache National Wildlife Refuge, Socorro County, New Mexico, to formulate the management section. To recover the species, threats to the meadow jumping mouse, such as improper grazing and water use practices, will be managed to minimize negative impacts to habitat and environmental conditions necessary for population viability in both species. Habitat improvement by land managers and owners will be encouraged, with guidelines developed and funding for such work sought out. More knowledge of the biology and natural history is needed to aid in the preservation of this species, in particular, improved knowledge of population structure and regulation, habitat structure, hibernation biology, interaction with grazing, metapopulation modeling, relatedness of populations, and dispersal.

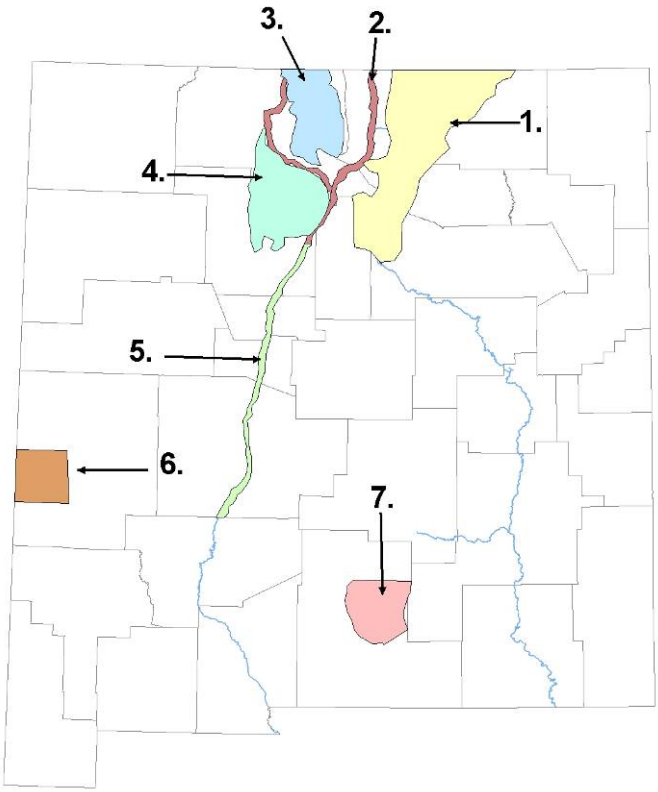


Figure 1. Riparian Rodent Recovery Plan Management Units:

1. **Sangre de Cristo**
2. **Upper Rio Grande-Chama**
3. **San Juan**
4. **Jemez**
5. **Middle Rio Grande**
6. **San Francisco**
7. **Sacramento**

Applying Adaptive Management on the Valles Caldera National Preserve

Marie Rodriguez, Valles Caldera Trust, Jemez Springs, NM 87025

While adaptive management is generally accepted as the best method for dealing with the uncertainties of managing complex natural systems, its application is not commonplace in public land management. The NEPA procedures developed for the Valles Caldera National Preserve define adaptive management and require its application.

Challenges in applying adaptive management include:

- Upfront investments in time and resources – Decision making needs to occur at a scale that permits adjustments in actions. Planning, analysis, and decision making at a landscape level require greater upfront investments than planning and decision making at a project level.
- Management concerns - The perception that adaptive management may expand the public's scrutiny of management beyond decision making, through implementation, monitoring and evaluation.
- Stakeholder concerns – The perception that adaptive management is used to avoid careful consideration of the direct, indirect and cumulative effects of our actions. Stakeholders are also skeptical of agencies' commitment to follow through on monitoring, evaluation and adjustments to management actions.

The Valles Caldera Trust is addressing these challenges in implementing an adaptive management strategy for the management and restoration of the Preserve's forests and grasslands.
The Trust has invested in key data sets for determining the reference condition for the Preserve's ecosystems as well as measuring the departure of the current ecological condition from that reference condition. Investments in data will allow the Trust to establish goals, objectives and outcomes that can be meaningfully evaluated in time and space.

This upfront investment in quantifying the Preserve's resources and establishing monitoring protocols will reduce future costs in time and money associated with resource management. Early investments in monitoring will also help assure stakeholders that there is a system in place to implement adaptive management and that the Trust is clearly invested in monitoring and evaluation.
The Trust intends to use existing tool such as the publication of an annual Report to Congress and the publication every five years of the State of the Preserve to keep stakeholders informed. Volunteer opportunities in annual rangeland monitoring have provided an outlet for groups and individuals who wish to have a more active role in adaptive management. The Trust foresees expanding this program as the management of forests and grasslands increases.

Collaboration between management and stakeholders in the implementation of adaptive management can effectively alleviate the concerns of both parties.

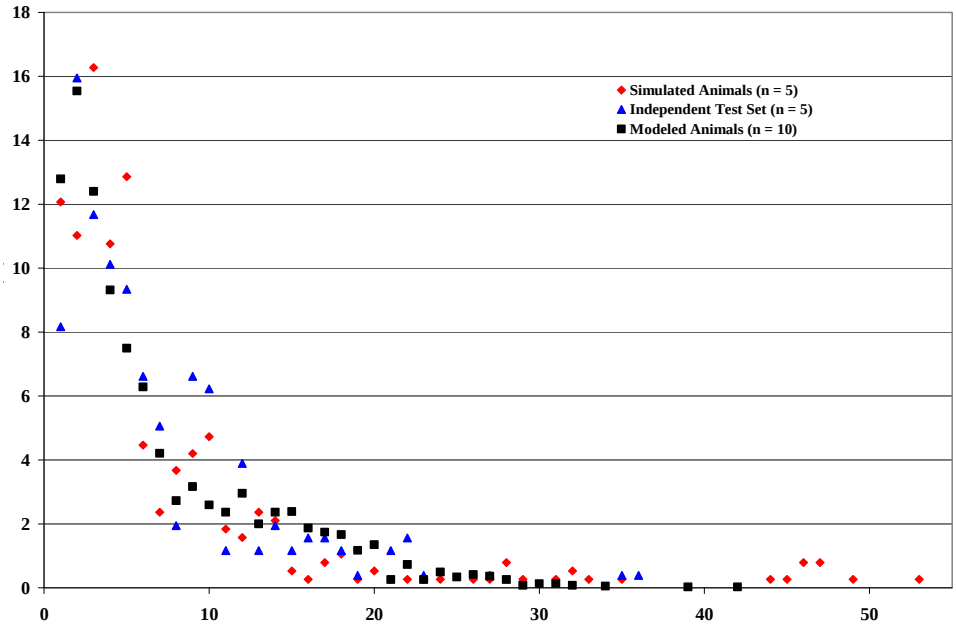
Modeling elk response to post-fire successional dynamics in northern New Mexico.

Susan Rupp

Dept. Wildlife & Fisheries Sciences, South Dakota State University

In May 2000, the Cerro Grande Fire burned approximately 17,200 ha in northcentral New Mexico as the result of an escaped prescribed burn initiated by Bandelier National Monument. The interaction of large-scale fires, vegetation, and elk is an important management issue, but few studies have addressed the ecological implications of vegetative succession and landscape heterogeneity on ungulate populations following large-scale disturbance events. Primary objectives of this research were to identify elk movement pathways on local and landscape scales, to determine environmental factors that influence elk movement, and to evaluate movement and distribution patterns in relation to spatial and temporal aspects of the Cerro Grande Fire. Data collection and assimilation reflect the collaborative efforts of National Park Service, U.S. Forest Service, and Department of Energy (Los Alamos National Laboratory) personnel. Geographic positioning system (GPS) collars were used to track 54 elk over a period of 3+ years and locational data were incorporated into a multi-layered geographic information system (GIS) for analysis. SAVANNA, a spatially explicit, process-oriented ecosystem model, was used to simulate successional dynamics. Inputs to the SAVANNA included a land cover map, long-term weather data, soil maps, and a digital elevation model. Parameterization and calibration were conducted using field plots. Model predictions of herbaceous biomass production and weather were consistent with available data and spatial interpolations of snow were considered reasonable for this study. Dynamic outputs generated by SAVANNA were integrated with static variables, movement rules, and parameters developed for the individual-based model through the application of a habitat suitability index. Model validation indicated reasonable model fit when compared to an independent test set. The finished model was applied to 2 realistic management scenarios for the Jemez Mountains and management implications were discussed. The final model provides an adaptive management tool that integrates interdisciplinary experience and scientific information, allowing users to make predictions about the impact of alternative management policies.

Percent of elk locations for snow depths ≥ 1 cm for simulated animals compared to an independent test set as well as animals used in model development. Though the real animals used as an independent test set significantly differed from real animals used in model development, the simulated animals did not significantly differ from either indicating the model performed as intended.



Overview of an integrated study investigating masticated fuel: Forest mastication project on Banco Bonito, Valles Caldera National Preserve.

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Many low elevation coniferous forests in the western US once supported frequent, low intensity fires, but due to a century of fire exclusion and other factors, severe wildfires have now become common. With the goal of lowering fire intensities and severities, one possible fuel treatment that is currently gaining favor with many land managers is mastication. Fuel mastication is a mechanical treatment that breaks, shreds, or grinds canopy (seedlings, saplings and pole trees) and surface fuel (fine and coarse woody material) into smaller sizes and deposits the treated fuel on the ground. Although mastication is somewhat expensive, it may be a useful tool for reducing canopy fuels and restoring historical stand structures. Mastication poses little risk to the fire manager when compared with prescribed burning and it gives immediate results in mitigating potential high intensity fire behavior and restoring historical stand structures. However, very little is known concerning the effects of this treatment on the resulting fire behavior, vegetation community, and ecosystem responses. Little is known 1) of the characteristics and properties of masticated fuel beds such as bulk density, particle size class distribution, and mineral content; 2) of standardized methods to estimate fuel loading of the masticated fuelbeds; and 3) of resultant fire behavior and effects as masticated burn under various moisture scenarios and weather conditions. Managers need to be aware of the beneficial and adverse effects of mastication to more effectively manage ecosystems. To this end, the overarching goal of this study is to investigate the effects of masticated fuels on various ecosystem processes and characteristics. More specifically, this study uses a set of integrated secondary objectives to accomplish the primary objective. These secondary objectives are:

- *Describe the characteristics and properties of masticated fuelbeds*
- *Develop a sampling protocol to estimate the loading of masticated fuelbed*
- *Describe fire behavior in burning masticated fuelbeds*
- *Evaluate the effects of masticated fuelbed on the ecosystem*

We have established study sites on the Valles Caldera National Preserve, New Mexico; San Juan National Forest, Colorado; and Kootenai National Forest, Montana. Each site contains control, masticate, masticate and burn, and burn only units. Results will be forthcoming. In the future, we hope to add additional sites as funding and opportunities arise.

The Jemez Mountains Obsidian Database Project: Compiling Obsidian Artifact Provenance ("Sourcing") Data to Inform on Prehistoric Movement, Trade, and Interaction

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[2] University of New Mexico, Department of Anthropology, Albuquerque

Several high-quality obsidian source areas in the Jemez Mountains were used throughout prehistory in the southwestern United States and across North America. The Valles Caldera National Preserve and University of New Mexico are collaborating to develop a database that compiles known occurrences of archaeological artifacts sourced to Jemez Mountains obsidian deposits. The goal of the project is to create a research database in support of continental and regional studies of obsidian resource use and transport. The database is a compilation of existing data, most of it reported in published articles, research reports, theses and dissertations, and in the grey-literature of CRM reports. We have included only those artifacts with geochemical analyses of provenance (e.g., XRF, NAA, or ICP-MS). The database is designed to capture three kinds of information: who conducted the archaeological study, where the artifact assemblage is located, and information on each obsidian specimen analyzed and the technical analysis.

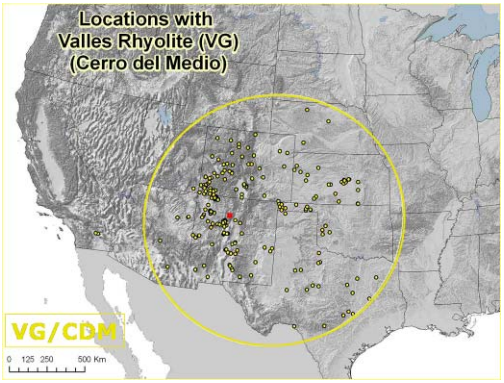
The Jemez Mountains obsidian sources are identified by a number of different names. The three that have been best investigated and that are most familiar (the "Big Three") occur in primary deposits at Cerro del Medio, in the center of the Valles caldera, at Obsidian Ridge and Rabbit Mountain, on the south side of the caldera, and near Polvadera Peak, north of the caldera

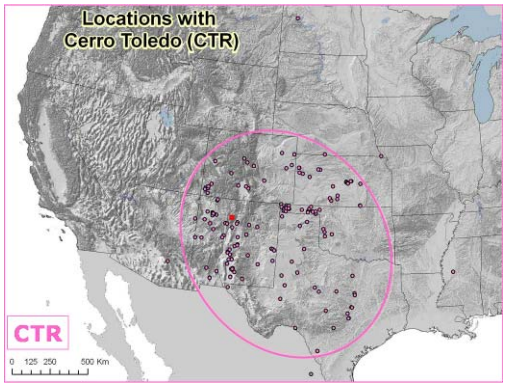
Geological Units for Primary Deposits of Jemez Mountains Obsidian

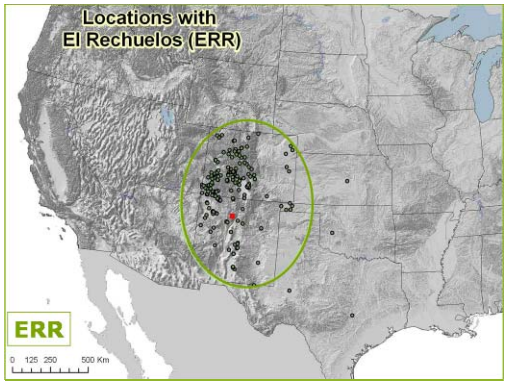
			Common Alternate Source Names/Loci	
Quaternary	Tewa Group	Valles Rhyolite (VG/CDM)	Cerro del Medio Valle Grande	Los Posos
		Cerro Toledo Rhyolite (CTR)	Obsidian Ridge Rabbit Mountain Cerro Toledo	Sierra de Toledo Bland Canyon*
Tertiary	Polvadera Group	El Rechuelos Rhyolite (ERR)	Polvadera Peak	
	Keres Group	Paliza Canyon Formation (PC)	Paliza Canyon	
		Canovas Canyon Rhyolite (CCR)	Bear Springs Peak Borrego Canyon	Bland Canyon**
		Bearhead Rhyolite (BR)	Bearhead Peak	

Results: To date, the database includes 2,105 artifacts from 565 sites in 12 states. Jemez obsidian artifacts are found at sites in: AZ, CA, CO, KS, MS, NE, ND, NM, OK, TX, UT, and Nuevo Leon (Mexico). NM and CO account for 82% of the artifacts and 70% of the sites. Data for CO are the most complete; CO likely serves as the most representative sample for all the data compiled thus far. Many NM assemblages have not yet been entered in the database. The Big Three sources (VG/CDM, CTR, ERR) account for 92% of all artifacts. There are only a handful of Bland Canyon, Canovas Canyon, and Paliza Canyon artifacts; so far, artifacts from these minor obsidian sources are known from locations in New Mexico only.

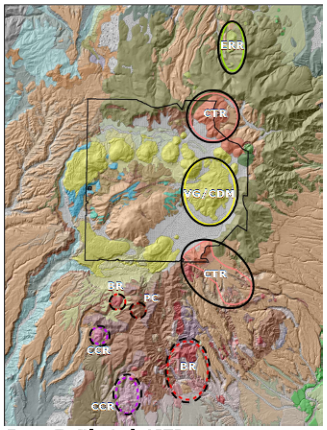
Comparing among the distributions of artifacts sourced to the Big Three, El Rechuelos (ERR) dominates in Colorado and there is very little ERR except in Colorado, and secondarily New Mexico. Cerro del Medio dominates in New Mexico and Cerro Toledo & Cerro del Medio have a similar distribution in other states. CTR obsidian is found in the most distant locations in this database. Only half of the sourced artifacts include information on the type of artifact (n=1,153). 72% are non-tool debitage, cores, and worked flakes, 28% are shaped tools of some kind, such as bifaces, points, and drills. Comparing among the sources, there is little difference in % artifact type;



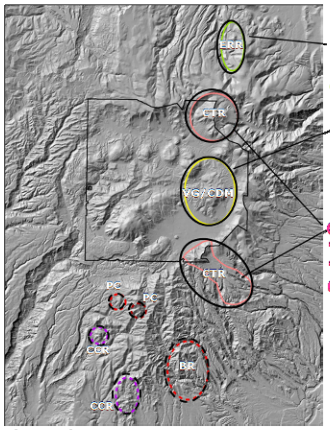




Jemez Sources: Primary Deposits



From: Smith et al. 1970
(This image depends on color to provide additional information)



"Big Three" Sources:

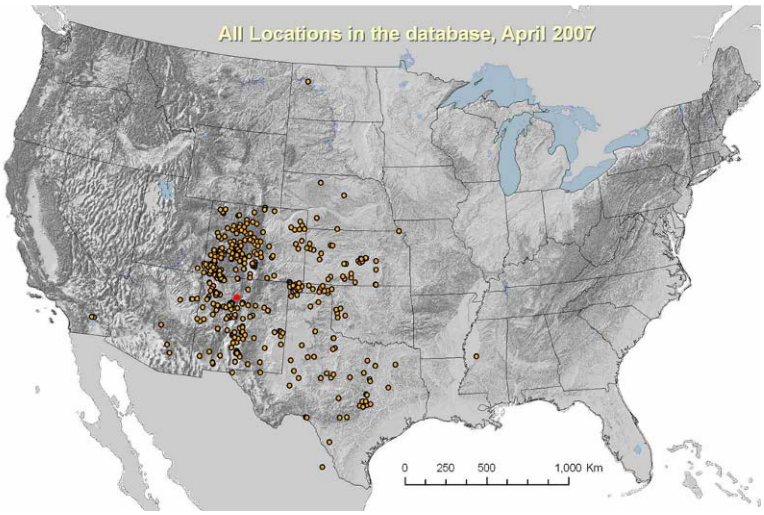
El Rechuelos Rhyolite
"Polvadera Peak"
ERR

Valles Rhyolite
"Cerro del Medio"
"Valle Grande"
VG/CDM

Cerro Toledo Rhyolite
"Obsidian Ridge"
"Rabbit Mountain"
CTR

Lesser known sources:
Paliza Canyon Formation (PC)
Canovas Canyon Rhyolite (CCR)
Bearhead Rhyolite (BR)

Results: Geographic Distribution of All Locations



Water Quality Dynamics on the Valles Caldera National Preserve

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In 2005, the Valles Caldera Trust (VCT) established five water quality sampling stations on the Valles Caldera National Preserve (Valles Caldera). These water quality stations included the East Fork Jemez River, San Antonio Creek West, San Antonio-Toldeo Creek, Rio de los Indios Creek, and Redondo Creek. The State of New Mexico, Surface Water Quality Bureau (SWQB) also established water quality sampling stations on the Valles Caldera in 2001-2002. Figure 1 shows the VCT and SWQB sample locations on the Valles Caldera.

VCT instituted a sampling program consistent with the SWQB program to facilitate data sharing and collaborations. Utilizing multiparameter sondes for unattended sampling, these stations record pH, dissolved oxygen, temperature, turbidity, and specific conductance. Grab samples are collected for nutrients and water chemistry at each of these stations as well.

The SWQB conducted field assessment surveys on the Valles Caldera in 2001-2002 and in 2005. In 2006, the SWQB issued total maximum daily loads (TMDLs) for the East Fork Jemez River (from the Caldera boundary to its headwaters) for temperature. Additionally, TMDLs were written for Jaramillo Creek (from the confluence with the East Fork Jemez River to its headwaters) for temperature and turbidity. Potential sources of impacts are attributed to past land management practices (e.g., logging, grazing and ranching operations).

Data evaluated for this analysis included: SWQB data from 2001-2002 and 2005, and VCT data from 2005, 2006, and 2007. Water quality data indicates that mean stream temperatures have decreased in all streams since 2001. In four of the five water quality stations, maximum stream temperatures have been decreasing since 2001. Refer to Table 1 below.

Mean turbidity values remain below 50 NTU at three water quality stations from 2001 and 2005-2007. However, East Fork Jemez River and Redondo Creek indicate mean turbidity values above 50 NTU in 2006 and 2007. At all five stations, maximum turbidity values recorded spikes above 900 NTU mainly during the monsoon seasons.

Mean dissolved oxygen values from all stations ranged from 6.0-8.8 mg/L from 2001 and 2005-2007. Some minimum dissolved oxygen values below 3 mg/L were recorded in 2005-2007. There were also maximum dissolved oxygen values that ranged from 9-14 mg/L in 2001 and 2005-2007. Dissolved oxygen data indicate large fluctuations in dissolved oxygen levels mainly during the summer months, which could indicate high plant productivity rates in some Valles Caldera streams.

Changes in land management practices may be contributing to current water quality conditions in Valles Caldera streams. For example, reduced logging, grazing and ranching operations have resulted in increased vegetation on the Valles Caldera, which may contribute to lower stream temperatures.

Future water resources work on the Valles Caldera includes: (1) continued monitoring of physical and chemical parameters of water quality; (2) the installation of flow meters and pressure transducers to accurately assess the contribution of flows from streams originating on the Valles Caldera, and the development of regional curves; and (3) reintroduction of beavers into Santa Clara Creek in cooperation with Santa Clara Pueblo.

Figure 1. Water Quality Stations on the Valles Caldera.

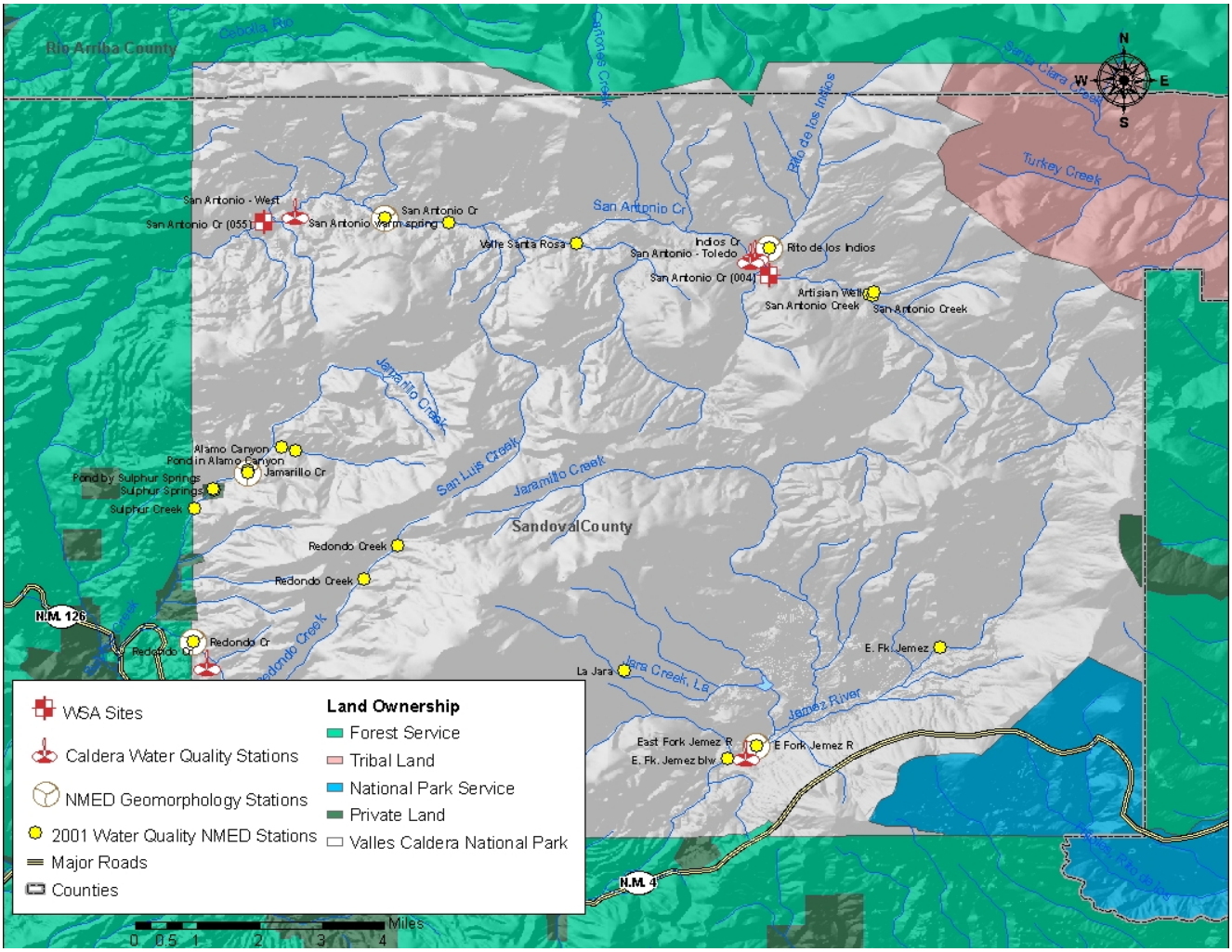

Table 1. An Overview of Stream Temperature Data (ºC) on the Valles Caldera.

STREAM	YEAR	MIN	MEAN	MAX
East Fork Jemez River (Preserve boundary to headwaters)	2001	3.58	16.17	28.27
	2005	4.56	15.62	25.96
	2006	2.92	15.33	28.81
	2007	3.50	15.95	26.01
Rio de los Indios (above San Antonio)	2001	2.79	11.49	22.0
	2005	3.52	12.26	23.4
	2006	1.85	11.2	21.98
	2007	1.20	10.99	19.79
Rio San Antonio (below warm springs)	2001	5.12	16.53	29.09
	2005	5.75	16.67	26.58
	2006	2.97	15.69	26.51
	2007	5.05	14.17	21.05

STREAM	YEAR	MIN	MEAN	MAX
Rio San Antonio-Toledo Creek	2001	N/A	N/A	N/A
	2005	8.89	15.21	21.02
	2006	8.52	14.25	21.34
	2007	5.05	14.21	21.10
Redondo Creek	2001	4.05	13.36	23.01
	2005	3.28	12.71	22.38
	2006	N/A	N/A	N/A
	2007	1.85	12.73	25.4

Valle Toledo Prescribed Fire: Interactive effects of fire with grazing and vegetation on soil nutrient dynamics.

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Use of prescribed fire was recognized in legislation creating the Valles Caldera National Preserve. To assure that programs are based upon sound science, a prescribed fire conducted in early November 2005 within the Valle Toledo. As part of a multi-disciplinary study of this management fire, collection of soils for nutrient analyses began six months before the fire and has continued for two years after. The study involves three treatment factors with two treatment options within each factor. Factors are: (1) burning treatment (options are burned, **B**; and unburned, **U**; see Figure 1); (2) vegetation (grassland, **G**; and forest-invaded grassland, **F**); and (3) grazing (open to grazing, **O**; and exclosures after fire, **E**), which yields 8 treatment-type combinations that are replicated 5 times within the study area. Soil analyses include measurement of and field-available moisture (Field Water), water-holding capacity (WHC), total organic matter (OM), total carbon (C) and total nitrogen (N), potentially mineralizable N (PMN, a measure of potential for plant production), and field available ammonium-N (NH4), nitrate-N (NO3), and their sum. As expected, vegetation type has had a significant effect on soil nutrients. The light-intensity fire had no immediate effect on soil nutrients but increased field available ammonium and PMN 7 months after the fire. Significant effects of grazing and/or its interaction with other factors appear 1 year after the fire and concurrent exclosure from grazing. After 2 years the fire had significant effects on soil organic matter, water-holding capacity, total C, and total N, indicating that the pulse of inorganic nitrogen seen 7 months after the fire may have stimulated production of soil organic matter below ground. Thus, the fire may have longer-term effects on soil organic matter and its quality, which are resources that are closely related to longer-term soil fertility. Grazing and its interaction with other factors were significant for multiple soil characteristics. Contrary to predictions, PMN did not increase in the grassland relative to the forest-invaded plots. In fact, the difference in PMN between the forest-invaded plots, which had higher PMN than the grasslands in the initial collection, and the grasslands tended to be greater than in the initial collection. In the future, unforeseen factors may start exerting influence on soil characteristics, such as a possible increase in pocket gopher activity within the exclosures. It is the interaction of multiple factors that determines the sustainability of management practices, and this research shows that significant interactions may become evident only with longer-term monitoring.

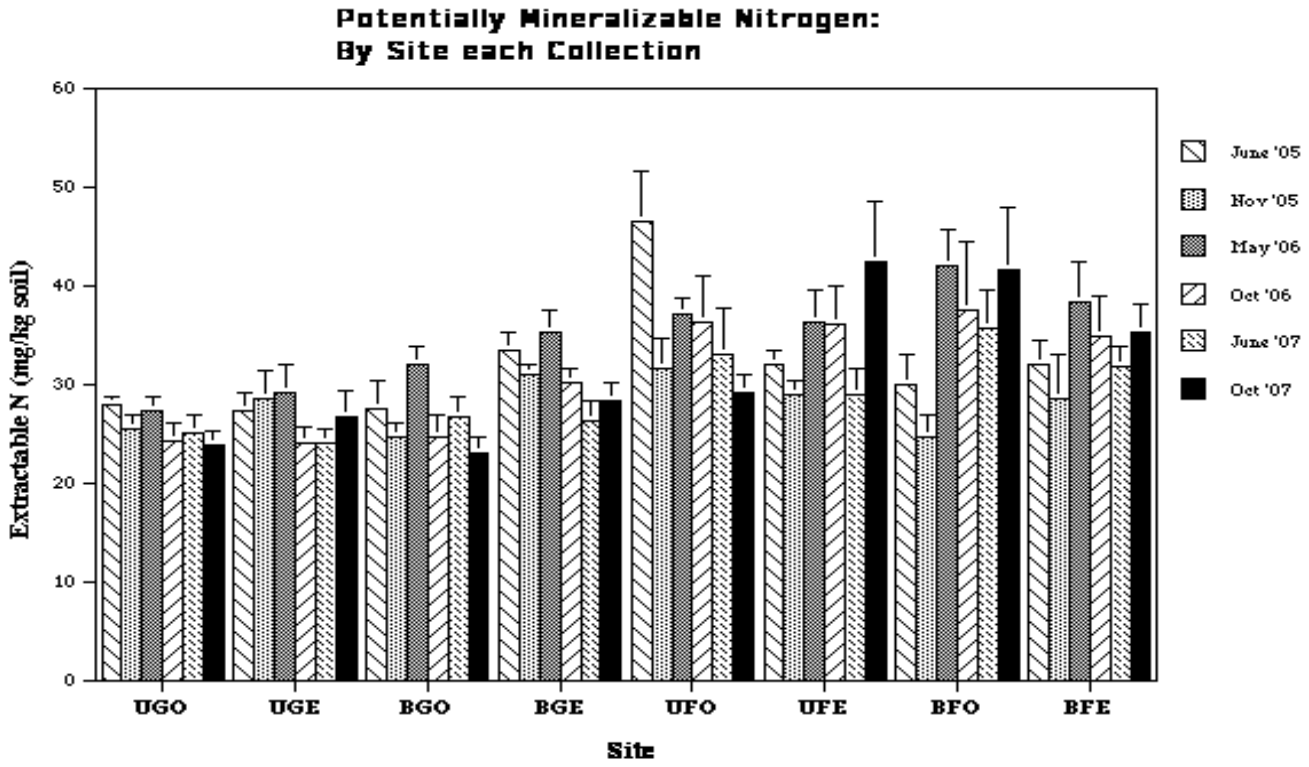

Figure 1. Potentially mineralizable nitrogen, or total nutrient supply over a growing season, by site for the six collections for unburned (U) and burned (B) sites within the grassland (G) or forest (F) area with open grazing (O) or within exclosures (E). The fire occurred before the November 2005 collection. After a slight but general increase in the burned plots relative to unburned in the May 2006 collection, the next three collections for the grasslands had the lowest levels of any other collections while the forest had only slightly lower levels in the next two collections and higher levels in the last collection.

[redacted]

Large Predator Population Trends in the Jemez Mountains

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The Jemez Mountains are comprised of Game Management Units (GMUs) 6A, 6B and 6C. GMU 6B is the Valles Caldera National preserve. Large predators that occur in the Jemez Mountains include black bear and cougar, both species are hunted in GMUs 6A and 6C but not in 6B. Because of high road densities in the Jemez Mountains and a high occurrence of outfitters nearby, hunting pressure on the black bear and cougar populations is high. Despite heavy hunting pressure large predator populations are healthy according to model projections, harvest and general indicators. GMU 6B, Bandolier National Monument, Los Alamos National Laboratories properties and the San Pedro Parks Wilderness serve as *de facto* refugia in the greater GMU 6 allowing hunted predators areas of escape and relatively light disturbance. Black bear and cougar harvest could be sustainable in GMU 6B at a very light level. Black bears reproduce at a very slow rate and therefore should be harvested very lightly, cougar populations tend to replace losses rapidly, particularly from surrounding areas that are harvested lightly, and can be harvested fairly aggressively.

2007 Black Bear Harvest for GMU 6	**2007 Cougar Harvest for GMU 6**
6 females	3 females
13 males	9 males
All sport harvest	All sport harvest
18-22 total and 5-7 females is sustainable	13-17 total is sustainable
33-66 is approx. Valles Caldera Pop.	5-8 is approx. Valles Caldera Pop.
Harvest of 2-3 w/1 fem. sustainable	Harvest of 2 is sustainable