ISSN 2610-8708 (Print)
ISSN 2640-8740 (Online)

Multidisciplinary Research at the La Botica Site, Conejos County, Colorado

Edited by Mark D. Mitchell

Research Contribution 115

PCRG
PaleoCultural Research Group

Research Contribution 115

Multidisciplinary Research at the La Botica Site, Conjeos County, Colorado

Edited By

Mark D. Mitchell

With Contributions By

Gregory J. Bream
Christy F. Briles
Peter M. Brown
Matt Davis
Rosemary Downing
Kristy L. Duran
Camille A. Holmgren
Scott E. Ingram
Shawn Kelley
Kelly Kindscher
Shannon A. Mahan
Mark D. Mitchell
Sean O'Meara
James Rivers
Chester A. Ruleman
Charles N. Saenz
Kenzie J. Turner

2022

PCRG
Paleocultural Research Group

Major funding for this project was provided by a History Colorado – State Historical Fund grant. Additional funding was provided by the Colorado State Land Board, Colorado Parks and Wildlife, and the Sangre de Cristo National Heritage Area. The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the opinions and policies of History Colorado, the Colorado State Land Board, Colorado Parks and Wildlife, or the Sangre de Cristo National Heritage Area. Mention of trade names or commercial products does not constitute their endorsement.

Abstract

The La Botica site (5CN1061), located in Conejos County's spectacular La Jara Canyon, is a large and complex archaeological site that preserves a remarkable record of American Indian lifeways spanning at least 7,500 years. The site is also an important locality for the San Luis Valley's Hispano residents, who gathered medicinal plants there in the nineteenth and twentieth centuries. The demonstrated time depth of the site's occupation, combined with its unique and culturally significant botanical inventory, make it one of the most important archaeological sites in the region.

To better understand La Botica's place in the regional cultural landscape, as well as the natural and cultural factors that have shaped it, Paleocultural Research Group (PCRG), a nonprofit organization dedicated to archaeological and paleoecological research in the Southern Rocky Mountains and Great Plains, conducted a multi-disciplinary research project at the site. The PCRG research team included a diverse mix of contributors, including archaeologists, biogeographers, geologists, geomorphologists, anthropologists, botanists, dendrochronologists, and historians.

P.O. Box 745309, Arvada, Colorado 80006

Submitted To:

History Colorado – State Historical Fund
1200 Broadway
Denver, Colorado 80203

Colorado State Land Board
1127 Sherman Street, Suite 300
Denver, Colorado 80203

Colorado Parks and Wildlife
6060 Broadway
Denver, Colorado 80216

Sangre de Cristo National Heritage Area
P.O. Box 844
Alamosa, Colorado 81101

Prepared Under:
State Historical Fund Grant 2018-02-039
Colorado State Land Board Purchase Order 2018-11601
Colorado Parks and Wildlife Purchase Order 2019-2249
Sangre de Cristo National Heritage Area Grant Agreement

Principal Investigator: Dr. Mark D. Mitchell

Colorado State Archaeology Permit: 74151
Colorado Division of Wildlife Special Use Permit for La Jara Creek State Wildlife Area
Archaeological Resources Protection Act Permit: C-79004

SHF Grant Deliverable 10 (Final Report)

Mitchell, Mark D. (editor)
2022 *Multidisciplinary Research at the La Botica Site, Conejos County, Colorado*. Research Contribution 115. Paleocultural Research Group, Arvada, Colorado. Submitted to History Colorado-State Historical Fund, Denver; Colorado State Land Board, Denver; Colorado Parks and Wildlife, Denver; and the Sangre de Cristo National Heritage Area, Alamosa, Colorado.

ISSN 2640-8708 (Print)
ISSN 2640-8740 (Online)

DOI: https://doi.org/10.32946/PCRG.115

Mitchell ORCiD ID: https://orcid.org/0000-0003-4494-8840

Table of Contents

List of Tables

List of Figures

Acknowledgments

Multidisciplinary or interdisciplinary research has always been a hallmark of PCRG projects. PCRG's bylaws specifically extend the organization's research mandate beyond archaeology to "related sciences," and many PCRG projects feature important contributions by researchers who are not archaeologists by training.

But the La Botica project was different. PCRG's citizen scientists had a chance to work with, and learn from, botanists, climate scientists, ethnographers, geologists, soil scientists, dendrochronologists, historians, and anthropologists. Perhaps more importantly, La Botica was different because persuasive answers to the project's research questions depended on data and interpretations from many different fields of study, only one of which was archaeology. Prior PCRG projects commonly used data offered by researchers in "related sciences" to bolster archaeological interpretations. For the La Botica project, other disciplines contributed at least as much to the success of the work as archaeology did. Many of the project volunteers, as well as the researchers involved, found that emphasis on true multidisciplinary collaboration very rewarding.

Successful fieldwork depends on getting the right people to the right place at the right time with the right equipment. The logistics of the large La Botica project field camp proved to be especially complex and the fact that it functioned smoothly is a tribute to the hard work of numerous individuals and organizations. Bureau of Land Management archaeologist Marvin Goad assisted with initial scouting for the camp location and provided critical information about site access. PCRG is grateful to the State Land Board and Colorado Parks and Wildlife for permission to establish the camp on state land that ordinarily is closed to camping. PCRG member and Forest Service archaeologist Angie Krall and her husband (and recovering archaeologist) John Evaskovich assisted with pre-field coordination and delivered a 500-gallon water tank to the camp—under conditions that proved to be challenging. The tank was loaned to the project by the Rio Grande National Forest and the trailer on which it was mounted was loaned by project participant and Adams State University anthropology student Jordyn McMaster-Neely. PCRG is grateful to Brandt's Septic for going above and beyond in the service of science.

The crew enjoyed visits by various people interested in the work we were doing, including Julie Chacon and Nick Saenz (Sangre de Cristo National Heritage Area), Katie Arntzen (History Colorado), Meg Van Ness (U. S. Fish and Wildlife Service), and Mindy Gottsegen and Savanah Smith (Colorado State Land Board). Gottsegen and Smith also participated in the fieldwork. The crew especially enjoyed an evening lecture by historian and linguist Dennis Lopez; PCRG is grateful for his participation.

PCRG also is grateful for the *pro bono* participation of many professional scientists and scholars, including Kenzie Turner and Cal Ruleman (U. S. Geological Survey), Kristy Duran (Adams State University), and Kelly Kindscher (University of Kansas and Kansas Biological Survey). The U. S. Geological Survey also provided OSL dates on sediment samples. Particle size data on sediment samples taken from soil stratigraphic excavation units were provided by the Kansas Geological Survey, directed by Rolfe Mandel.

PCRG's citizen-science projects would not be possible without the dedication of the organization's many member volunteers. A total of 20 people, including both professional scientists and avocational volunteers, participated in the project. PCRG Research Director Mark Mitchell supervised the archaeological fieldwork. He was assisted by PCRG Research Affiliate Marilyn Martorano, PCRG Operations Director Chris Johnston, and PCRG crew chiefs Britni Rockwell and Talle Hogrefe. PCRG interns included Adams State University students Jordyn McMaster-Neely and Katie Peterson. PCRG volunteers included Kevin Black, Stephanie Boktor, Matthew Fischer, Ann Holloway, Bruce Holloway, Carol Kellison, James Kovats, Larry Scarbrough, Katy Waechter, and Greg Wolff. Many of these people also contributed to the environmental and paleoenvironmental field work in addition to the archaeological investigation.

Major funding for the project was provided by a History Colorado – State Historical Fund grant awarded to PCRG (No. 2018-02-039). Former SHF Director Cynthia Nieb helped the research team envision a more comprehensive approach to the La Botica project. SHF Archaeological Specialist Katie Arntzen and SHF Contracts Officer Breanne Nugent provided outstanding support throughout. Supplemental funding was provided by the Sangre de Cristo National Heritage Area, the Colorado State Land Board, and Colorado Parks and Wildlife. State

Land Board Conservation Services Manager Mindy Gottsegen was instrumental in obtaining Division of Natural Resources funding for the project. Julie Chacon, Sangre de Cristo National Heritage Area Financial Officer and Interim Director, has been and continues to be an enthusiastic supporter of archaeological and historical research in the San Luis Valley, including the La Botica project.

Additional acknowledgments specific to each aspect of the project are provided at the end of each of the report's chapters.

HISTORY Colorado
STATE HISTORICAL FUND

COLORADO PARKS • WILDLIFE

DNR CO COLORADO
State Land Board
Department of Natural Resources

SANGRE • DE • CRISTO
NATIONAL HERITAGE AREA

About the Contributors

Gregory J. Bream recently graduated from the University at Buffalo with an MS in Geography with a concentration in Earth Systems Science. His MS thesis reconstructed patterns of drought and explored disturbance history in the Genesee Valley of New York using tree-rings. His other research interests include paleoecology and climate change. He is currently part of a research team working on several dendroecology projects and plans on earning his PhD at the University at Buffalo.

Dr. Christy Briles is an Associate Professor at the University of Colorado – Denver in Geography and Environmental Sciences. She is a biogeographer and paleoecologist who studies how biologically diverse areas have developed and been maintained since the last ice age (~20 kyr). She uses pollen and charcoal preserved in lake sediments as the main proxies in reconstructing past environments. Besides Colorado (where she was born and raised), she also works in northern California, Australia, and Vietnam. Some of her more recent studies have focused on reconstructing resources for Indigenous peoples and the impact they and others have had on ecosystems. Her coauthors for chapter 3, Rosemary Downing, Matt Davis, and James Rivers, were students at CU Denver and contributed to the coring of Beaver Lake, data collection, and interpretation of the data.

Dr. Peter M. Brown is the Director of Rocky Mountain Tree-Ring Research (rmtrr.org), a nonprofit corporation he founded in 1997. His research involves use of tree-ring and other data to reconstruct fire, forest, and climate histories, and the application of such data to current issues in forest and fire management and restoration ecology. Current projects include dating of numerous cabins and Indigenous "peel trees" across Colorado and the Four Corners. He received BA and MS degrees from the University of Arizona and a PhD degree in Forest Sciences from Colorado State University, where he also serves as an Affiliate Faculty member in the Department of Forest and Rangeland Stewardship and teaches courses in forest and fire ecology and dendrochronology.

Dr. Kristy L. Duran grew up in the San Luis Valley and is currently the Faculty Director of Undergraduate Research, and a Professor of Biology at Metropolitan State University of Denver. Her research focuses on the effects of dwarf mistletoes on host physiology and ecology. She mainly works on dwarf mistletoes in the southwest, but has also worked on eastern dwarf mistletoe. In addition to her research on dwarf mistletoe, she is interested in ethnobotany. She developed and taught courses on ethnobotany at Mesa State College (now CMU) and Adams State University. She authored a chapter on the ethnobotany of the San Luis Valley in the recently published book *The Geology, Ecology, and Human History of the San Luis Valley.* Dr. Duran is passionate about undergraduate research. She engages students in her projects and encourages them to develop their unique research ideas.

Dr. Camille Holmgren is Professor and Chair of the Geography & Planning Department at SUNY Buffalo State. Her research explores changing environmental conditions in arid and semi-arid environments from the last ice age until present. She specializes in using plant fossils from rodent middens (their dens) to reconstruct vegetation patterns in western North and South America. Midden studies provide insight into plant species and community responses to changing climatic conditions over the past ~50,000 years and provide a baseline for assessing current and projected future changes. Dr. Holmgren is also active in developing innovative teaching materials, including an NSF-sponsored Integrate course module "Changing Biosphere" in which students evaluate recent human influences on the biosphere in the context of the geologic record and is a contributor to the Science Education Resource Center. Dr. Holmgren teaches courses in physical geography, biogeography, global change, past climates and environments, and research methods. Her research has appeared in the journals *Ecology*; *Global Ecology and Biogeography*; *Journal of Arid Environments*; *Journal of Biogeography*; *Journal of Quaternary Science*; *Palaeogeography, Palaeoclimatology, Palaeoecology*; and *Quaternary Research* among others.

Dr. Scott Ingram is an Associate Professor at Colorado College, Department of Anthropology. His research objectives are to: (1) contribute insights toward understanding contemporary problems such as human vulnerability to climate change and social and ecological sustainability by investigating long-term human and environmental interactions, (2) advance understanding of depopulations and migrations in the North American Southwest, especially during the dramatic population decline of the 1300 to 1500 CE period; and, (3) document, describe, and interpret Colorado's past in collaboration with students. Most aspects of his work involve applications of archaeology to contemporary socio-environmental problems.

Shawn Kelley is a cultural anthropologist and historian. Over the course of his career, Shawn has worked with over 50 Native American tribes in the western United States and Alaska developing wide-ranging partnerships with community members and multiple organizations to work on ethnographic studies, cultural resource preservation, and public outreach projects. Shawn is the former President of the High Plains Society for Applied Anthropology. He is the author of numerous technical reports and co-authored the award-winning books Ho! To the Land of Sunshine: A History of the Belen Cutoff and Route 66 and Native Americans in New Mexico.

Dr. Kelly Kindscher is a Professor in the Environmental Studies Program and Senior Scientist at the Kansas Biological Survey at the University of Kansas. He is best known as a passionate advocate for native plants, native landscapes, edible and medicinal plants, and wild places. His research and 130 publications have focused on ethnobotany, medicinal plants, prairies and prairie restoration, wetlands, and plant communities. He has extensive fieldwork experience, led many research projects, been involved in numerous plant and habitat inventories, and restoration projects with native plants. He is the author of the books: *Edible Wild Plants of the Prairie* (1987), *Medicinal Wild Plants of the Prairie* (1992), editor/author of *Echinacea—Herbal Medicine with a Wild History* (2016), and most recently is author of *Sahnish (Arikara) Ethnobotany* (2020). Dr. Kindscher is one of the founders and board member of the Kansas Land Trust, and is on the Advisory Board of the United Plant Savers, the organization focused on the conservation of medicinal plants in the U.S.

Shannon A. Mahan is the Director of the USGS Luminescence Geochronology Laboratory and a research geologist. She has worked for the USGS at the Denver Federal Center for 35 years and it has been the best job in the world. Besides enjoying field seasons that span all year from the Mojave Desert to the Boundary Waters of Minnesota, she appreciates the people she has been privileged to work with. She continues to work in geology, paleontology, and archeology aspects of luminescence for the foreseeable (and dateable!) future.

Dr. Mark D. Mitchell is the Research Director for Paleocultural Research Group. His research explores the archaeology of two different regions: the Northern Plains in western North Dakota, and the Southern Rocky Mountains in Colorado and New Mexico. Mitchell's Southern Rockies research focuses on American Indian mobility and land use in the San Luis Valley and adjacent mountains. He is particularly interested in how technological and environmental change affected native peoples' economic decisions. Mitchell's Northern Plains research focuses on the political and economic development of post-A.D. 1200 farming villages of the Missouri River valley. He also studies historic American Indian rock art and the history of archaeology. Mitchell's research has appeared in *Plains Anthropologist*, *Antiquity*, *American Antiquity*, *Southwestern Lore*, *Colorado Archaeology*, *Quaternary International*, and in a number of book chapters. He is the author of *Crafting History in the Northern Plains: A Political Economy of the Heart River Region, 1400-1750* (University of Arizona Press, 2013) and co-editor of *Across A Great Divide: Continuity and Change in Native North American Societies, 1400-1900* (University of Arizona Press, 2010).

Sean O'Meara is a research anthropologist based in Flagstaff, Arizona. His work primarily focuses on Native American ethnohistory, ethnography, and ethnobotany. He has authored and co-authored technical reports, and presentations regarding his work on ethnographic resource studies for tribes, including the Southern Ute Indian Tribe and the Jicarilla Apache Nation, as well as for state and federal agencies in Colorado, New Mexico, Nevada, and Arizona. He has a M.A. in American Indian Studies from the University of Arizona.

Chester (Cal) Ruleman studied geology at the University of Montana (Missoula) and Montana State University (Bozeman) and has been performing geological investigations for the last 25 years in various tectonic and geomorphic settings including Montana, Idaho, Wyoming, Nevada, Colorado, New Mexico, Alaska, Suriname, South America, Afghanistan, and Nepal. He and his wife served as U.S. Peace Corps Volunteers in Suriname, South America, from 2002-2004. After returning he worked as an independent consultant for seismic and landslide hazards and joined the U.S. Geological Survey in 2007. His work has ranged from Archean to Holocene, local to regional tectonics, and Plio-Pleistocene paleoclimate, with a focus on geomorphology and landscape evolution.

Dr. Charles N. Saenz is a professor of history at Adams State University. A former president of the Sangre de Cristo National Heritage Area, his recent work has focused on the history and culture of the San Luis Valley. He served as a consultant for History Colorado on the development of museum exhibits for the Borderlands of Southern Colorado program and co-edited *The Geology, Ecology, and Human History of the San Luis Valley* (University Press of Colorado, 2020).

Kenzie J. Turner is a research geologist with the Geosciences and Environmental Change Science Center of the U.S. Geological Survey in Denver, Colorado. Turner conducts geologic mapping while exploring the interconnections between tectonism and magmatism. Turner's recent geologic mapping and research focus has been on unraveling the volcanic history of the Taos Plateau volcanic field and the evolution of the San Luis Basin.

1

Introduction

Mark D. Mitchell

Roadside interpretive signs and exhibits in local history museums tell curious travelers tracing North America's scenic and historic byways that Indigenous Americans[1] first followed those routes thousands of years ago. Those signs and exhibits are not wrong, but they are incomplete. Indigenous oral traditions, as well as the results of archaeological research, tell us that by the Middle Holocene—at the latest—Native peoples had visited every part of the continent, every river valley and mountain range, every lakeshore, desert, and woodland. No part of North America lacks evidence of American Indian occupancy. But their occupancy was uneven: not every part of the continent was visited equally frequently or used equally intensively.

To be sure, changes in the North American landscape—cycles of sediment erosion and deposition—over the 15 or more millennia since Native people came to the continent have affected the preservation, as well as the visibility, of physical traces of their occupancy. Those processes have disproportionately destroyed or buried the oldest traces (Surovell *et al*. 2009), making valid models of American Indian land use difficult to construct. Nevertheless, archaeological data indicate that uneven occupation was an enduring feature of Indigenous land use: people in the past recognized especially productive or especially meaningful places and returned to them repeatedly. Some of those places were focal points of American Indian visitation or residence for centuries or millennia.

Archaeologists sometimes use the term "persistent place" to describe those special localities. Sarah Schlanger's (1992:97) early formulation of the concept

2022 *Multidisciplinary Research at the La Botica Site, Conejos County, Colorado*, edited by Mark D. Mitchell, pp. 1-7. Research Contribution 115. Paleocultural Research Group, Broomfield, Colorado.

defines them as "places that were repeatedly used during long-term occupations of regions." Under Schlanger's definition, some persistent places exhibit distinctive geographical or other characteristics that are especially well-suited to particular activities, such as well-watered bottomlands for farming or reliable but isolated water sources for hunting. Other places persist on the human landscape owing to the presence of a preexisting built environment: previously constructed trails, buildings, or fields provide a draw, as well as a context, for later uses of that area. Still other places persist when people reuse or re-purpose objects and materials left behind by earlier visitors.

Schlanger articulated the persistent places concept at a time when archaeologists were beginning to think in new ways about how their long-standing objects of study—sites and artifact collections—were connected to one another (Patterson 2008). To be sure, archaeologists for decades have been interested in settlement patterns (the relationships among sites of human habitation in terms of their functions, sizes, or locations) and in the distributions of critical materials (the spatial patterning of food, water, and mineral resources). But the persistent places concept was one of the tools archaeologists developed to focus attention on the landscape itself, not simply as the spatial dimension of settlement patterns and resource distributions but as a primary object of study.

The persistent places concept expanded archaeological research by highlighting the historicity of landscapes. The characteristics of human occupancy, including buildings, artifacts, and practices of natural resource extraction, structure how a landscape is later used. The concept also indirectly invoked the notion of social memory: landscape attributes are affective because people remember (or at least recognize based on their cultural knowledge) traces left by prior occupants, perhaps especially those left by their own ancestors.

However, the concept did not stray far from the functional and ecological approaches that dominated archaeological research throughout the 1970s and 1980s. The attributes of Schlanger's persistent places—key resources and traces of prior occupancy—can be regarded as material affordances, economic assets that people draw upon to make a living. Under her definition, the persistence of a place reflects the higher benefits and lower costs offered by previously occupied locations.

Archaeologists' understanding of cultural landscapes has evolved during the three decades since the persistent places concept was first applied. That evolution has been driven in part by increasing engagement with landscape studies carried out by anthropologists and human geographers. However, the most important driver has been Indigenous critiques of environmental and economic approaches to landscape analysis. Archaeologists, as David and Thomas (2008:35) observes, have come to recognize that their approach to landscape archaeology has failed to "accurately reflect Indigenous peoples' own notions of their landscapes or the reasons why they lived in certain ways."

Missing from the persistent places concept is a recognition of the intimate connections between landscape and identity, place and experience (*e.g.* Ashmore 2002, 2004; Ashmore and Knapp 1999; Basso 1996; Bender 1993; Eiselt 2012; Ingold 1993; Ucko and Layton 1999). Landscapes are more than just distributions of affordances. They also comprise the meaning-charged places that embody people's social and cultural identities. Landscapes are storehouses of the things people need to survive but simultaneously they are the "meaningful location[s] *in* which lives are lived" (David and Thomas 2008:38; emphasis original).

Affordance and meaning, activity and identity, are inseparably linked aspects of cultural landscapes. Archaeologists now recognize that resources cannot be understood independently from the ways that people conceptualize, experience, and use them (Lemaire 1997). The resources needed to sustain life are "brought into being by processes of extraction and manipulation carried out by individuals and groups that have defined relationships with one another and that hold particular beliefs about the world in which they live" (Mitchell 2008:46). Landscape, in short, is a material manifestation of the social and cultural practices of its inhabitants (Ingold 1993). And the relationships among materials, people, and the cosmos—each a fundamental component of social reproduction—are perhaps most powerfully expressed at those places that were persistently occupied.

A Persistent Place in Colorado's San Luis Valley

The research described in this book is an effort to document the attributes of one persistent node of human occupancy and to understand its relationships with the broader socionatural landscape. That node, known as the La Botica site—a Spanish term for "the pharmacy"—is located within south-central Colorado's San Luis Valley, an arid, high-elevation basin bounded on the east by the Sangre de Cristo Mountains and on the west by the San Juan Mountains (figure 1.1). Located just above the floor of the Valley in the spectacular La Jara Canyon, La Botica was recognized more than three decades ago as a gathering locality for wild medicinal plants (Bye and Linares 1986). More recently, archaeologists have shown that the site preserves a unique record of American Indian lifeways spanning more than 7,500 years (Crosser *et al*. 2009). Few other documented archaeological sites in the San Luis Valley preserve a record of consistent use spanning such a long period of time, making La Botica important for understanding stability and change in American Indian mobility and subsistence practices.

La Botica also is important for understanding San Luis Valley Hispano traditions. It is the only documented—although unquestionably not the

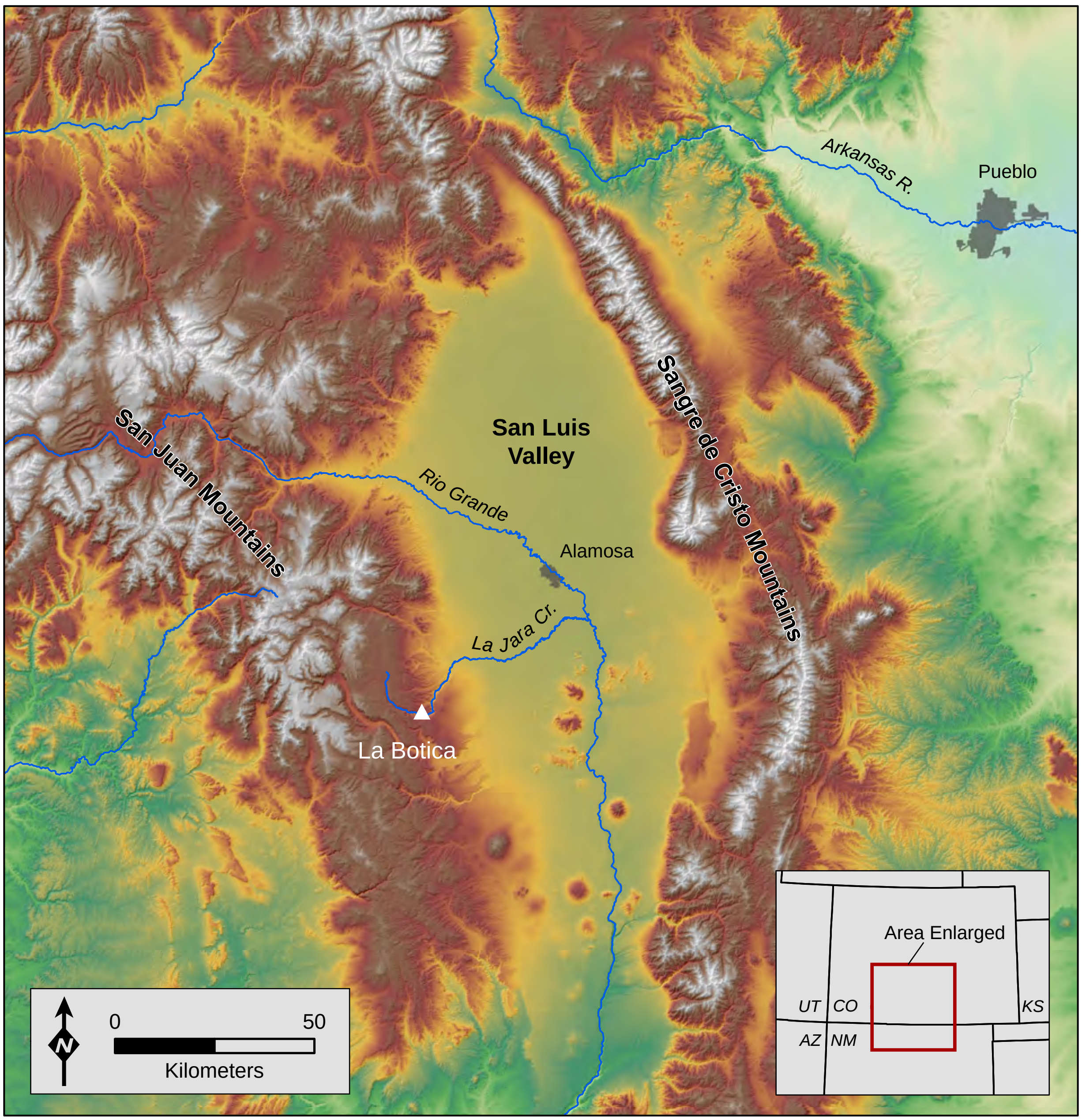


Figure 1.1. Terrain map of the San Luis Valley showing the approximate location of the La Botica site.

only—medicinal plant-gathering locality in the region and so data from La Botica can contribute to an understanding of local folk medicine practices. Although the origins of those practices are uncertain, the Valley's early Hispano residents may have learned about the region's medicinal and comestible wild plant resources from the Indigenous Americans with whom they interacted.

Botanical inventories and ethnobotanical studies conducted prior to and concurrent with the project described in this book demonstrate that an unusually diverse and culturally significant plant community occurs at the site today (English 2018; Kelly Kindscher, personal communication 2018). Prior archaeological research further suggests that plant gathering and processing occurred regularly at the site in the past (Crosser *et al*. 2009). In combination with the ethnobotanical data reported in Bye and Linares (1986), these data suggest that an intimate connection exists at La Botica between climate and topography on the one hand and a specific history of human use on the other. The study of the human use of the site is therefore closely intertwined with the study of the site's ecology both in the present and in the past: ecological factors may have promoted the growth of culturally valued plants, while harvesting by human groups attracted to those plants may have shaped the site's ecology. Regular use fused the site's botanical affordances with the identities of the people who came there to gather them. Thus, data on both ecological and human factors can provide a better picture of the site's role as a persistent place within the broader cultural landscape.

Experiencing La Botica

Untrained eyes might consider La Botica to be visually unremarkable (figure 1.2). Despite its dramatic setting within the La Jara Canyon, the site itself exhibits characteristics that are typical of the pinon-juniper woodland rimming the San Luis Valley: a sea of sagebrush thickets dotted with bunch grasses, flowing between archipelagos of squat juniper and pinon trees. Ponderosa pines—shoreline lighthouses—overlook the scene. Dense stands of conifers and aspens climb the canyon walls. In the right season, wildflowers flash from the shadows.

But the view from the canyon rim above the site reveals aspects of its distinctiveness (figure 1.3). La Botica is perched mid-slope, suspended between the riparian thickets lining La Jara Creek and the wind-blasted mesas bordering the canyon. In the winter, a river of cold air running down canyon toward the San Luis Valley often flows below the site. Winds rushing outward from the high San Juans skip from canyon rim to canyon rim, high above the site. No other similarly well protected landform occurs in the La Jara Canyon.

Accessing that protected location is challenging. A visitor can cautiously pick their way down the steep slope from the rim, avoiding talus fields and unseen drops. Alternatively, one can ford rushing water, force their way past creek-side undergrowth, and scramble up a steep slope. No one comes easily to La Botica.

Another distinctive aspect of the site visible from the canyon rim is its grass-covered central basin, seasonally a green or brown disc floating in the sage-gray sea. That basin announces the site's internal drainage: water from rain and snow that falls on the site, or that issues from toe-slope springs, flows inward toward the central basin, periodically ponding and creating an intermittent wetland in an otherwise dry landscape.

Close examination of the tangled thickets surrounding the site reveals still another aspect of its distinctiveness (figure 1.4). A profusion of plant species grow where the sagebrush meets the encircling talus slope and conifer forest, including woody perennials, vines, mosses, and herbaceous annuals. Many of those species occur more commonly at higher elevations in cooler, wetter locations. The confluence of higher- and lower-elevation species that occurs at La Botica makes its plant inventory notably large and diverse. To date, some 199 species have been documented at or immediately adjacent to the site (appendix A). Three species ranked as rare and imperiled within Colorado—Ripley's milkvetch, New Mexico cliff fern, and Lunell's heavy-fruited sedge—are present at La Botica (English 2018). Thus, despite the seeming dominance of a few common species, La Botica in fact harbors a tremendous storehouse of botanical resources.

Studying La Botica

This book considers La Botica from a variety of perspectives. Each perspective offers one view of the site's environment and ecology or of the ways human groups may have used—or conceived of—it in the past. These views are not mutually exclusive, and the project team recognizes that no single perspective—or even the sum of the perspectives presented—fully

Figure 1.2. Ground-level view of the La Botica site looking toward the rim of the La Jara Canyon.

Figure 1.3. View of the La Botica site from the canyon rim. Pinons mark the outer edge of La Botica's mid-slope landform. The brown disc marks the central basin. (Photo courtsey of Cal Ruleman.)

encompasses La Botica's significance for people in the past.

La Botica's seemingly unusual geography may have been one of the factors that drew people to the site. In chapter 2, Kenzie Turner, Cal Ruleman, and Shannon Mahan describe the geology and geomorphic history of the site. They also compare some of La Botica's key features to those of other potentially similar locations in the region to better understand the site's place in the wider landscape.

Modern plant inventories demonstrate La Botica's ecological diversity. Ethnobotanical research shows that the site and the adjacent La Jara Canyon were in the recent past and are today destinations for wild plant collection. Archaeological data indicate that La Botica was visited repeatedly for millennia, often for plant gathering. But can one therefore conclude that wild plant collection and processing was the primary activity that brought people to La Botica in the distant past? One way to approach that question is

Figure 1.4. View of the profusion of plants that grow along the site boundary, where the talus slope meets the sagebrush.

to learn more about what the local climate was like in the past and how long-term changes in temperature or precipitation regimes might have affected the distributions of valued plant species. Chapters 3, 4, and 5 undertake that task using a variety of proxy measures for past climate. In chapter 3, Christy Briles, Rosemary Downing, Matt Davis, and James Rivers take a wide-angle, long-term view of the region's climate using data stored in lake sediment. They track regional changes in climate during the past five millennia by examining changes in charcoal, pollen, and mineral fragments in sediment cores taken from the bottom of Beaver Lake, located roughly 16 km west of La Botica.

In chapter 4, Camille Holmgren, Gregory Bream, Kristy Duran, and Christy Briles unlock local paleoenvironmental data contained in ancient woodrat middens. The record they develop provides a detailed view of vegetation changes in the immediate vicinity of La Botica during the past 5,000 years. The record is especially robust for the past 3,000 years and includes evidence for long-term vegetation stability as well as changes that occurred following the entry of European Americans into the San Luis Valley.

In chapter 5, Peter Brown and Scott Ingram use data from tree rings to reconstruct aspects of climate variability that have local as well as regional dimensions. They consider possible changes in local and regional resource availability during the past half millennium using evidence of past forest fires preserved in living trees along with evidence of variations in precipitation recorded in differences in the growth rates of trees over time. They also examine relationships between human activity in the past and the record of ecological processes.

In chapter 6, Mark Mitchell describes the archaeology of La Botica. Using data on artifacts discarded at the site, as well as on constructed features preserved there, he examines how La Botica was used by human groups in the past and how those uses may have changed over time. He also considers evidence for the cultural identities of the site's ancient occupants.

Finally, in chapter 7, Sean O'Meara, Shawn Kelley, and Nick Saenz describe the connections between the plant resources that occur at La Botica and the identities and experiences of American Indian and local Hispano communities. Their account relies heavily—and fittingly—on the words of the cultural specialists and elders whose life experiences link the site and the broader landscape to cultural identities and cultural practices.

Endnote

[1] Descendants of the people who colonized the Americas in the late Pleistocene use a wide variety of terms to refer to themselves, including Indigenous Americans, American Indians, First Nations, and Native Americans. Many Native individuals prefer specific tribal, band, or community terms. A variety of terms are used in this book to acknowledge the diversity of Native perspectives and identities. All denote the original inhabitants of the Western Hemisphere and their descendants.

References Cited

Ashmore, Wendy
2002 "Decisions and Dispositions": Socializing Spatial Archaeology. *American Anthropologist* 104(4):1172-1183.
2004 Social Archaeologies of Landscape. In *A Companion to Social Archaeology*, edited by Lynn Meskell and Robert W. Preucel, pp. 255-271. Blackwell Publishing, Malden, Massachusetts.

Ashmore, Wendy, and A. Bernard Knapp (editors)
1999 *Archaeologies of Landscape*. Blackwell, Oxford.

Basso, Keith
1996 *Wisdom Sits in Places: Landscape and Language among the Western Apache*. University of New Mexico Press, Albuquerque.

Bender, Barbara
1993 Landscape—Meaning and Action. In *Landscape: Politics and Perspectives*, edited by Barbara Bender, pp. 1-17. Berg, Oxford.

Bye, Robert A., Jr., and Edelmira Linares
1986 Ethnobotanical Notes from the Valley of San Luis, Colorado. *Journal of Ethnobiology* 6(2):289-306.

Crosser, Ian, Mona Charles, J. Robbins, and Adrienne Anderson
2009 Colorado Cultural Resource Inventory forms for site 5CN1061. Prepared by Fort Lewis College, Durango, Colorado. Submitted to History Colorado – Office of Archaeology and Historic Preservation, Denver.

David, Bruno, and Julian Thomas
2008 Landscape Archaeology: Introduction. In *Handbook of Landscape Archaeology*, edited by Bruno David and Julian Thomas, pp. 27-43. Routledge, New York.

Eiselt, B. Sunday
2012 *Becoming White Clay: A History and Archaeology of Jicarilla Apache Enclavement*. University of Utah Press, Salt Lake City.

English, Carol
2018 Stewardship Trust Baseline Inventory for the La Botica Property. Department of Natural Resources, Colorado State Land Board, Denver.

Ingold, Tim
1993 The Temporality of Landscape. *World Archaeology* 25:152-174.

Lemaire, Ton
1997 Archaeology between the Invention and Destruction of the Landscape. *Archaeological Dialogues* 4:5-21.

Mitchell, Mark D.
2008 Making Places: Burned Rock Middens, Feasting, and Changing Land Use in the Upper Arkansas River Basin. In *Archaeological Landscapes on the High Plains*, edited by Laura L. Scheiber and Bonnie J. Clark, pp. 41-70. University of Colorado Press, Boulder.

Patterson, Thomas C.
2008 The History of Landscape Archaeology in the Americas. In *Handbook of Landscape Archaeology*, edited by Bruno David and Julian Thomas, pp. 77-84. Routledge, New York.

Schlanger, Sarah H.
1992 Recognizing Persistent Places in Anasazi Settlement Systems. In *Time, Space, and Archaeological Landscapes*, edited by Jacqueline Rossignol and LuAnn Wandsnider, pp. 91-112. Springer Science+Business Media, New York.

Surovell, Todd A., Judson Byrd Finley, Geoffrey M. Smith, P. Jeffrey Brantingham, and Robert Kelly
2009 Correcting Temporal Frequency Distributions for Taphonomic Bias. *Journal of Archaeological Science* 36(8):1715-1724.

Ucko, Peter J., and Robert Layton
1999 Introduction: Gazing on the Landscape and Encountering the Environment. In *The Archaeology and Anthropology of Landscape: Shaping Your Landscape*, edited by Peter J. Ucko and Robert Layton, pp. 1-20. Routledge, New York.

2

Geologic Setting and Geomorphic History of La Botica and Surrounding Area

Kenzie J. Turner, Chester A. Ruleman, and Shannon A. Mahan

La Botica is located on the gently east-dipping marginal area between the high San Juan Mountains to the west and the San Luis Basin to the east in south-central Colorado. The site is positioned on a topographic bench perched about 70 to 80 m above La Jara Creek (figure 2.1), a tributary to the Rio Grande. The unique floral assemblage at La Botica has resulted in intermittent occupation over the last several thousand years. The physical environment supporting this assemblage is a result of Quaternary surface processes that have modified the underlying Tertiary bedrock. Underlying bedrock at the site consists of Oligocene to Pliocene volcanic and sedimentary deposits related to the Rio Grande rift and the San Juan volcanic locus of the Southern Rocky Mountains volcanic field. Local bedrock is mildly deformed by normal faulting and eastward tilting due to the onset of Oligocene extensional deformation and initial formation of the San Luis Basin. The geomorphic evolution and incision history of La Jara Creek are directly linked to middle to late Pleistocene evolution of the Rio Grande and to regional alpine glacial cycles over the last 500 k.y. (thousand years). Subsequent degradation of surrounding bedrock and development of mass-wasting deposits, such as landslides and talus slopes, have strongly influenced the incision history of La Jara Creek and the local environment at La Botica. In addition, local talus slopes and blockfields can host processes that actively modify the local environment, and these processes may have contributed to establishment of the floral assemblage.

2022 *Multidisciplinary Research at the La Botica Site, Conejos County, Colorado*, edited by Mark D. Mitchell, pp. 9-27. Research Contribution 115. Paleocultural Research Group, Broomfield, Colorado.

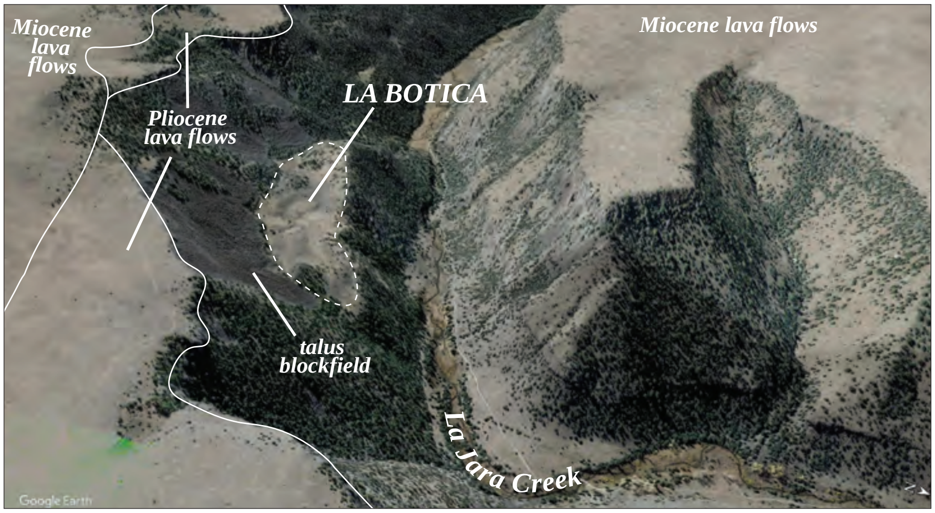


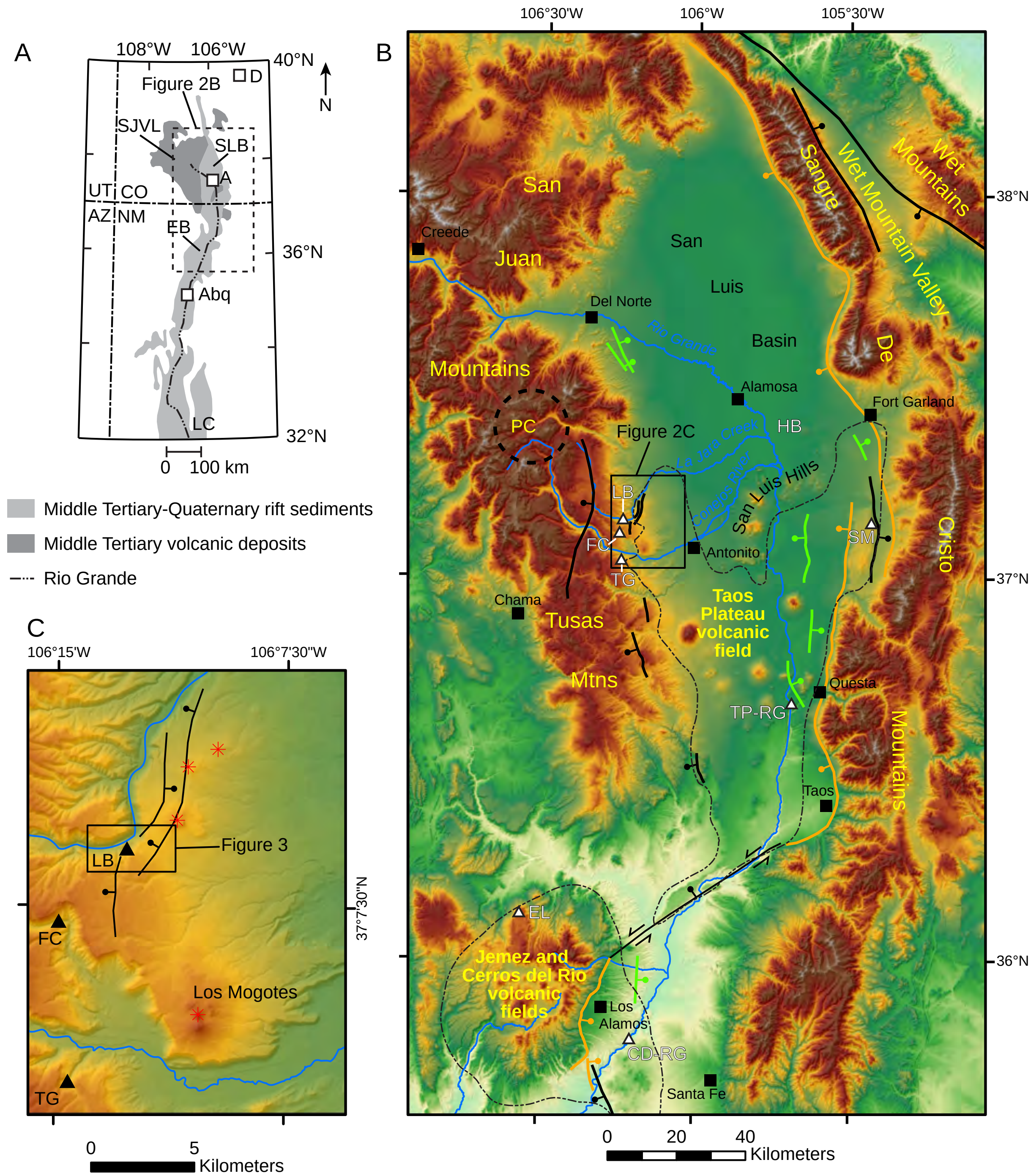
Figure 2.1. Oblique view looking west-southwest at La Botica and surrounding area (image from Google Earth, accessed September, 2020). White dashed line is approximate outline of La Botica site.

Regional Geologic History

Volcanic deposits of the middle Tertiary Southern Rocky Mountains volcanic field once blanketed the Southern Rocky Mountains in Colorado and northern New Mexico (Lipman 2007; Steven 1975). Between 38 and 23 Ma (million years ago), magmatism resulted in stratovolcanoes, large calderas, shallow intrusions and widespread volcaniclastic aprons (Lipman 2007; Lipman *et al.* 1970). Some of the earliest eruptions associated with the San Juan volcanic locus started at about 33 Ma west and northwest of La Botica in the southeastern San Juan Mountains (Colucci *et al.* 1991; Lipman 1975a; Steven and Lipman 1976). Volcanism included recurrent ignimbrite (ash- and pumice-dominated eruptions that flow across the ground) eruption and caldera collapse within the Platoro caldera complex between 30.5 and 29 Ma (figure 2.2[B]) (Lipman 1974, 1975a, 1975b; Lipman *et al.* 1996). Ignimbrites flowed in all directions from the caldera complex including significant distribution over the area of the modern San Luis Basin. Post-caldera volcanism continued in the southeastern San Juan Mountains until about 27 Ma, contemporaneous with volcanism in the San Luis Hills (Lipman 1975a; Lipman *et al.* 1970; Thompson and Machette 1989; Thompson *et al.* 2015) and the western and central San Juan Mountains (Lipman *et al.* 1970). Ignimbrite deposits from the southeastern and central San Juan Mountains and sedimentary deposits composed of volcanic debris underlie La Botica.

Superposed on deposits of the Southern Rocky Mountains volcanic field is the middle to late Cenozoic Rio Grande rift, which is recorded by basin

*Figure 2.2. **A**) Map showing the regional footprint of Rio Grande rift basin-fill deposits (light gray) and middle Tertiary deposits of the Southern Rocky Mountains volcanic field (dark gray). City abbreviations include: A, Alamosa, Colo.; Abq, Albuquerque, N. Mex.; D, Denver, Colo.; LC, Las Cruces, N. Mex. Other abbreviations: SLB, San Luis Basin; EB, Española Basin; SJVL, San Juan volcanic locus of Southern Rocky Mountains volcanic field. **B**) Regional shaded-relief map of the San Luis and Española Basins. Heavy dashed line designates approximate boundary for the Taos Plateau and combined Jemez and Cerros del Rio volcanic fields. Fault symbology indicating sense of fault movement: bar and ball on downthrown side of fault; arrows indicate lateral sense of slip. Fault colors indicate probable latest displacement age: black, Miocene to Pliocene; green, Pleistocene; and orange, Holocene (USGS-CGS-NMBGMR 2020). Locality abbreviations include: CD-RG, Rio Grande landslide locality in Cerros del Rio volcanic field; EL, Encino Lookout landslide locality; FC, Fox Creek talus slope; HB, Hansen Bluff; LB, La Botica; PC, Platoro caldera complex; SM, San Pedro Mesa landslide locality; TG, Trail Gulch talus slope; and TP-RG, Rio Grande landslide locality in Taos Plateau volcanic field. **C**) Shaded-relief map for the area surrounding La Botica. Box indicates area of geologic map in figure 2.3A. Red asterisks indicate locations of known Pliocene volcanic vents. Black triangles and abbreviations as in 2.2B. Shaded-relief map generated from U.S. Geological Survey 10-m digital elevation model (DEM) data from The National Map, accessed November 2019, at https://viewer.nationalmap.gov/basic/.*



filling deposits and extensional faulting (stretching of the lithosphere and crust). The rift is a series of generally north-south elongated basins extending from northern Mexico into northern Colorado that are filled by clastic sedimentary and subordinate volcanic deposits (figure 2.2[A]). From central New Mexico north to the upper Arkansas River valley in Colorado, the narrow physiographic outline of well-defined basins marks the axis of extension separating the Colorado Plateau to the west from the interior of the North American craton (a stable block of the Earth's crust forming the core of the continent) to the east. Interpretations for the onset of extensional tectonism throughout the extent of the Rio Grande rift vary from about 36 to 26 Ma depending on indicative criteria used and geographic location within the rift

(Aldrich *et al.* 1986; Cather 1990; Henry *et al.* 1991; Lipman and Mehnert 1975; Thompson *et al.* 1991). The current physiographic expression of northern Rio Grande rift axial basins, including the San Luis Basin, is a result of Miocene (about 20 Ma) and younger deformation (Chapin 1988; Chapin and Cather 1994; Ingersoll 2001; Ingersoll *et al.* 1990; Lindsey *et al.* 1986).

The San Luis Basin is the largest of the northern Rio Grande rift basins at over 200 km north to south and greater than 75 km east to west across the central part of the basin (figure 2.2[B]). Structurally, the San Luis Basin is characterized as an east-dipping half graben (down-dropped block between two faults where one side of the block demonstrates greater downward offset) with the deepest parts of the basin adjacent to the master basin-bounding, down-to-west Sangre de Cristo fault zone at the foot of the Sangre de Cristo Mountains (figure 2.2[B]). The west side of the San Luis Basin, near La Botica, is characterized by a gentle eastward slope reflecting the underlying eastward dip of bedrock deposits (Lipman, 1975a). Faults trend north-northeast to north-northwest and demonstrate both west and east dips. Tertiary deposits are displaced as much as 300 m along some fault segments in the Tusas Mountains and southeastern San Juan Mountains, although most fault segments near La Botica record substantially smaller displacement, reflecting a broadly distributed fault zone (Lipman 1975a 1975b; Manley 1982). An angular unconformity cut into 30 to 28 Ma ignimbrites may record the earliest development of the San Luis Basin prior to emplacement of 27 to 26 Ma lava flows (Lipman and Mehnert 1975). Continuation of tectonic activity until the recent past is indicated by fault scarps on the east side of the basin developed in Holocene deposits (figure 2.2[B]) (Colman 1985; Crone *et al.* 2006; McCalpin 1982; Ruleman and Machette 2007; Ruleman *et al.* 2013) and on the west side of the basin, south of the town of Del Norte, where faults displace Pleistocene deposits (figure 2.2[B]) (Lipman 1975b; USGS-CGS-NMBGMR 2020).

Formation of rift basins was accompanied by sedimentation and magmatism. Sedimentary deposits record fluvial, lacustrine, and eolian processes in both closed- and open-basin settings (Chapin and Cather 1988; Ruleman *et al.* 2013). Contemporaneous rift-related volcanism within the San Luis Basin includes Oligocene and Miocene lava flows (Lipman and Mehnert 1975; Thompson *et al.* 1991) and lava flows of the Pliocene to Pleistocene Taos Plateau volcanic field (Lipman and Mehnert 1979). The Taos Plateau volcanic field underlies much of the southern half of the San Luis Valley and extends north into Colorado near Fort Garland on the east and La Botica on the west (figure 2.2[B]).

Volcanic deposits of the Taos Plateau volcanic field accumulated in the southern part of the San Luis Basin while extensional faulting continued along the Sangre de Cristo fault system and within intrabasin faults during the Pliocene and Pleistocene. As a result, the San Luis Basin was subdivided into northern and southern closed basins. The previously south-flowing path of the Rio Grande terminated at a structural and topographic high in the San Luis Hills resulting in the formation of Lake Alamosa north of the San Luis Hills (Machette *et al.* 2013; Siebenthal 1910). South of the San Luis Hills, closed subbasins also developed where deposition of alluvial-playa deposits indicative of closed basins were juxtaposed against lava flows of the Taos Plateau volcanic field to the west and the Sangre de Cristo Mountain front to the east (Ruleman *et al.* 2013; Winograd 1959). The fact that Lava Creek B ash (about 631 ka [thousand years ago]) (Matthews *et al.* 2015), which erupted from the Yellowstone caldera, is present within the closed-basin deposits indicates the basins remained closed until sometime after 600 ka (Kirkham and Heimsoth 2003; Kirkham *et al.* 2003, 2004, 2005; Machette *et al.* 2008; Pazzaglia and Wells 1990; Rogers *et al.* 1992; Ruleman *et al.* 2013; Scott and Taylor 1975; Wells *et al.* 1987). The final closure of the San Luis Basin lasted from about 2 Ma to 400 ka (Machette *et al.* 2013; Rogers *et al.* 1985, 1992; Ruleman *et al.* 2013, 2016, 2019).

Paleoclimatic interpretations of early Pleistocene sediments exposed at Hansen Bluff (HB in figure 2.2[B]) in the central part of the San Luis Basin indicate summer precipitation was low, and pan evaporation and temperature were high between about 1.8 Ma and 800 ka (Rogers *et al.* 1985, 1992). This long, warm-dry interval induced mobilization of abundant loess and promoted oxidizing, semi-arid to arid pedogenic processes, indicated by the high silt content and red hue, respectively, of uppermost San Luis Basin closed basin deposits (Rogers and Larsen 1992; Rogers and Wang 2002; Rogers *et al.* 1985, 1992, 2000; Ruleman *et al.* 2013, 2019). During the early to middle Pleistocene transition (about 800 to 700 ka), the regional climate shifted from a warm, dry climate to a colder, wetter climate (Rogers *et al.* 1985, 1992, 2000) associated with the onset of intervals of larger-magnitude and higher-frequency glaciations recorded in the marine oxygen isotope record (oceanic oxygen isotope values correlate with temperature and global ice volume) (Lisiecki and Raymo 2005).

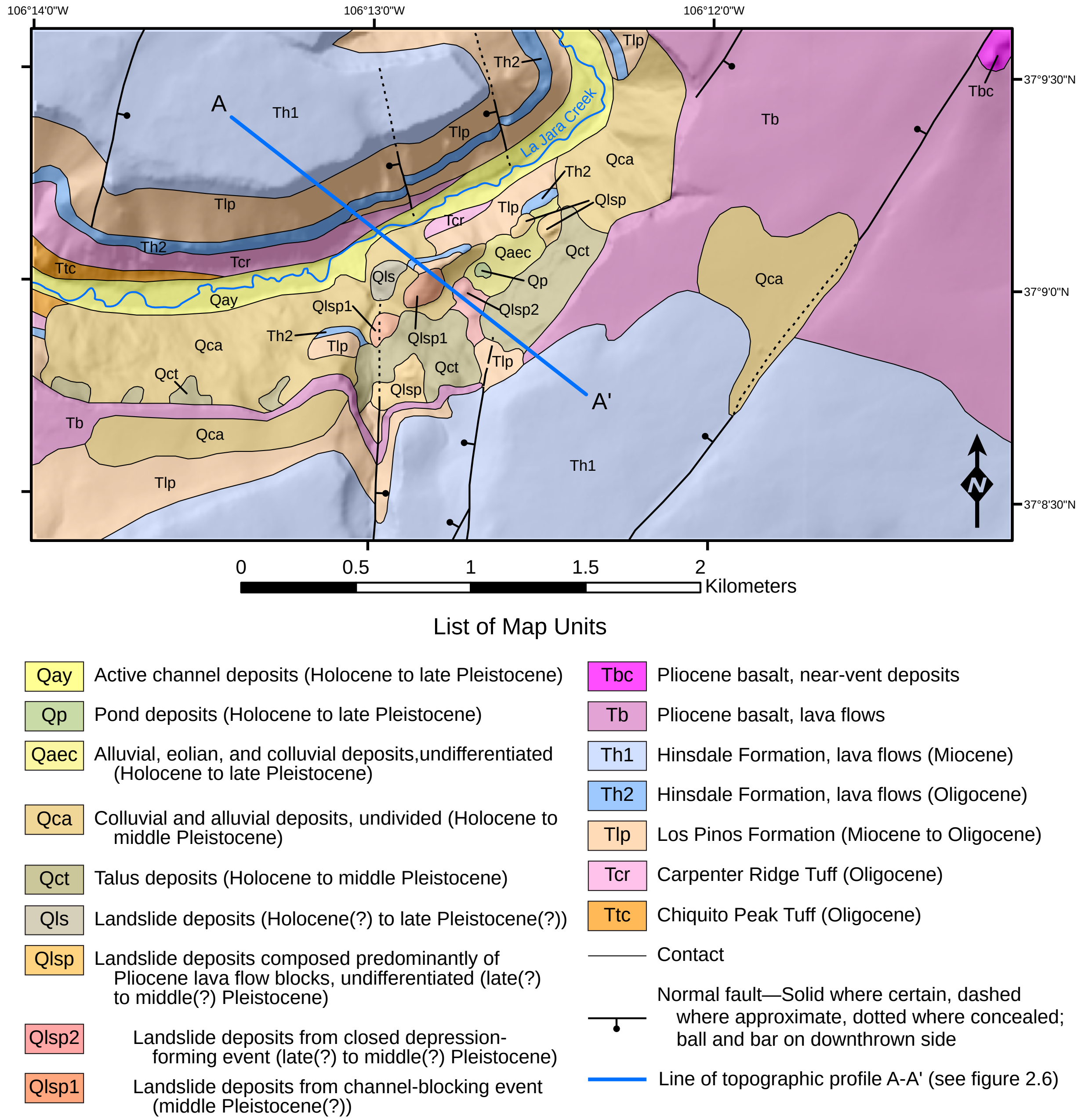
With major middle Pleistocene glaciations developing in the surrounding mountains, pluvial (higher precipitation) environments began to fully develop within the closed San Luis Basin. At about 430 ka Lake Alamosa reached its highstand (greatest water depth) (Machette *et al.* 2007, 2013). Sometime between 400 and 385 ka the topographic barrier in the San Luis Hills was breached and the lake highstand level was abandoned (Ruleman *et al.* 2016, 2019). Relict lacustrine landforms including spit, barrier bar, and lagoonal deposits observed in the San Luis Hills (Machette *et al.* 2007, 2013; Ruleman *et al.* 2016) are evidence for the existence of Lake Alamosa. Draining of Lake Alamosa across the previously closed southern San Luis Basin and Taos Plateau connected the San Luis Basin with the Española Basin, which was at much lower elevation. This induced headward incision and incipient formation of the Rio Grande gorge at about 400 to 385 ka (Ruleman *et al.* 2016, 2019). Outflow of Lake Alamosa was constricted to the main Rio Grande gorge corridor by about 250 to 200 ka, inducing a rapid drop in base level. Later, meltwater from middle to late Pleistocene glaciations provided the fluvial capacity to form the approximately 240-m-deep Rio Grande gorge. From the time of initial breach of the Lake Alamosa topographic barrier (about 400 to 385 ka) to present, the gorge has incised at a rate of about 0.6 mm/yr.

Local Bedrock Geology

The environment around La Botica is influenced by the physical properties, structural deformation, and erosion of Oligocene to Pleistocene sedimentary and volcanic deposits (figure 2.3). The oldest Tertiary deposits near La Botica are associated with the Southern Rocky Mountains volcanic field. The Chiquito Peak Tuff (unit Ttc; figure 2.3) is a crystal-rich ignimbrite that records the final caldera-forming eruption of the Platoro caldera complex at 28.77 Ma (Lipman and Zimmerer, 2019; Lipman *et al.* 1996). The tuff is a resistant cliff former as a result of its moderate to high welding. In some areas, the tuff readily fractures into irregular and platy blocks forming extensive talus slopes. Stratigraphically above the Chiquito Peak Tuff is the Carpenter Ridge Tuff (unit Tcr; figure 2.3), an ignimbrite erupted at 27.73 Ma (Lipman and McIntosh 2008; age adjusted to a Fish Canyon Tuff age at 28.2 Ma to be consistent with Chiquito Peak Tuff age) from the Bachelor caldera near Creede, Colorado, in the central San Juan Mountains (figure 2.2[B]) (Steven and Lipman 1976). The Carpenter Ridge Tuff is approximately 10 to 15 m thick along La Jara Creek and generally forms rounded cliff faces as a result of weak welding.

The earliest deposits associated with the Rio Grande rift are basin-filling sedimentary deposits of the Los Pinos Formation and basaltic lava flows of the Hinsdale Formation (Chapin and Cather 1994; Lipman and Mehnert 1975; Thompson *et al.* 1991). The Los Pinos Formation comprises sandstone, conglomerate and minor mudstone that are tuffaceous and incorporate clasts of volcanic rocks. Deposits are weakly indurated resulting in poor exposures and undercut ledges where overlain by competent layers. The fluvial dominated Los Pinos Formation is subjacent to Quaternary deposits that underlie La Botica based on the presence of rounded clasts in the slopes south of La Jara Creek (figure 2.3[A]). Interbedded within the Los Pinos Formation are lava flows of the Hinsdale Formation (figure 2.3[B]). The Hinsdale Formation records distinct Oligocene and Miocene episodes of basaltic volcanism that were contemporaneous with deposition of the Los Pinos Formation (figure 2.3[B]). The oldest Hinsdale flows erupted between about 27.5 and 25 Ma (Hon and Mehnert 1983; Lipman and Mehnert 1975; Thompson *et al.* 1991) from an inferred source in the San Luis Hills. The Oligocene flows are well exposed in the slopes north of La Jara Creek and are discontinuously exposed in the slopes south of La Jara Creek (figure 2.3[A]). Miocene lava flows, which erupted from an unknown source between about 20 and 18 Ma (Hon and Mehnert 1983; Lipman and Mehnert 1975), underlie the gently east-sloped mesa north of La Jara Creek and part of the escarpment south of La Botica.

Pliocene basaltic lava flows related to the Taos Plateau volcanic field erupted from multiple, roughly north-aligned vents east of La Botica (figure 2.2[C]) between 5.5 and 4.5 Ma (Hon and Mehnert 1983; Lipman and Mehnert 1975). The Pliocene lava flow holding up the escarpment south of La Botica (figure 2.1) is unconformably inset into Los Pinos Formation and Miocene lava flows of the Hinsdale Formation (figure 2.3[A]). As a consequence of pervasive penetrative cooling fractures and the presence of easily eroded Los Pinos deposits stratigraphically below, the Pliocene lava flow is prone to rock falls and slab failure. Secondary fracturing of the Pliocene



lava flow and other Tertiary deposits by intermittent extension-related deformation may have further enhanced the erodibility of bedrock deposits.

Mild structural deformation consists of normal faults and a gentle eastward tilt. The eastward tilt results, in part, from extensive down-to-west displacement along the Sangre de Cristo fault zone and subsidence of the San Luis Basin (Lipman and Mehnert 1975). East-dipping bedding orientations can be attributed, to a lesser degree, to local faulting. East- and west-dipping normal faults in the vicinity of La Botica trend northwest to northeast. Faults displace Oligocene-aged Hinsdale lava flows in the slopes north of La Jara Creek (unit Th2; figure 2.3[A]). South of La Botica, Miocene lava flows are displaced down-to-west by about 40 m. Northeast of La Botica, deposits as young as Pliocene lava flows are displaced by northeast-trending normal faults that demonstrate 3 to 10 m topographic scarps (figure 2.3[A]). Although deformation in the vicinity of La Botica is minor, faulting may have intensified fracturing in brittle units like the basaltic lava flows. In addition, the net

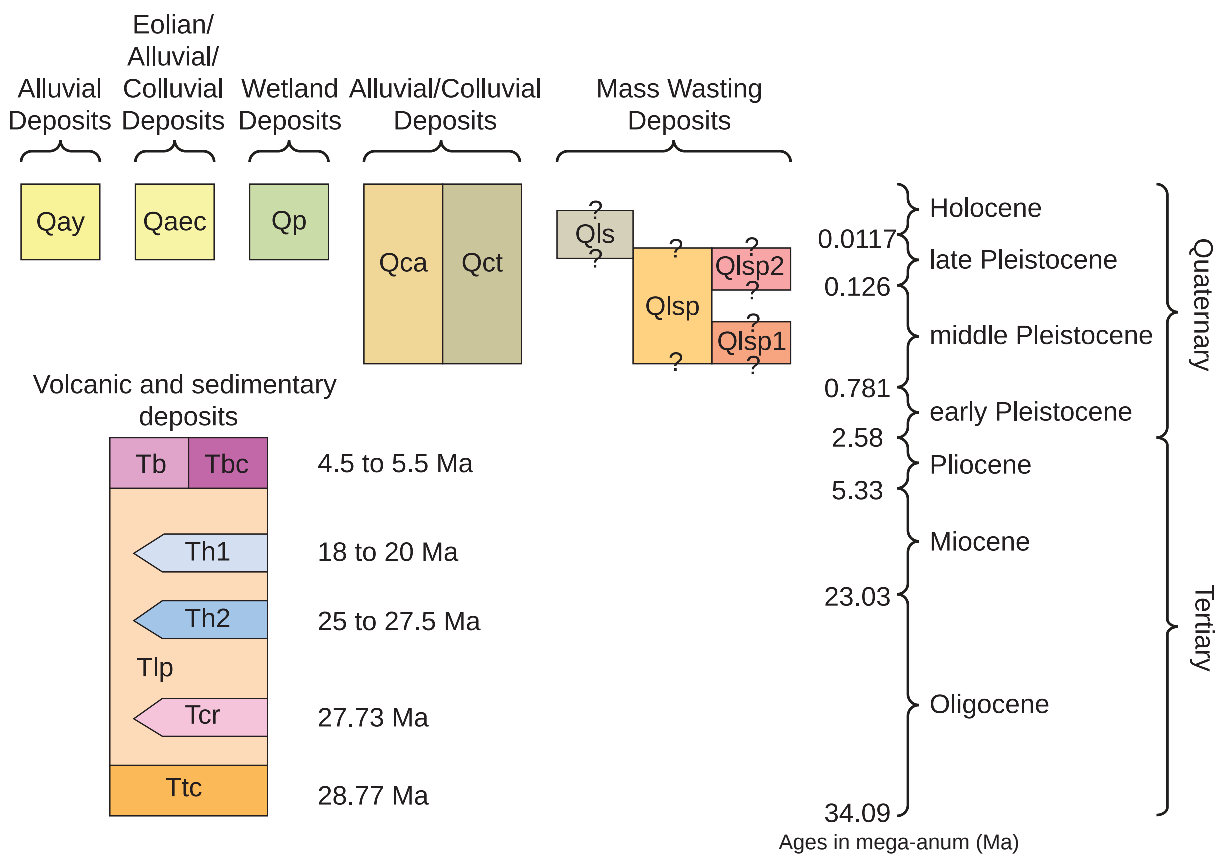
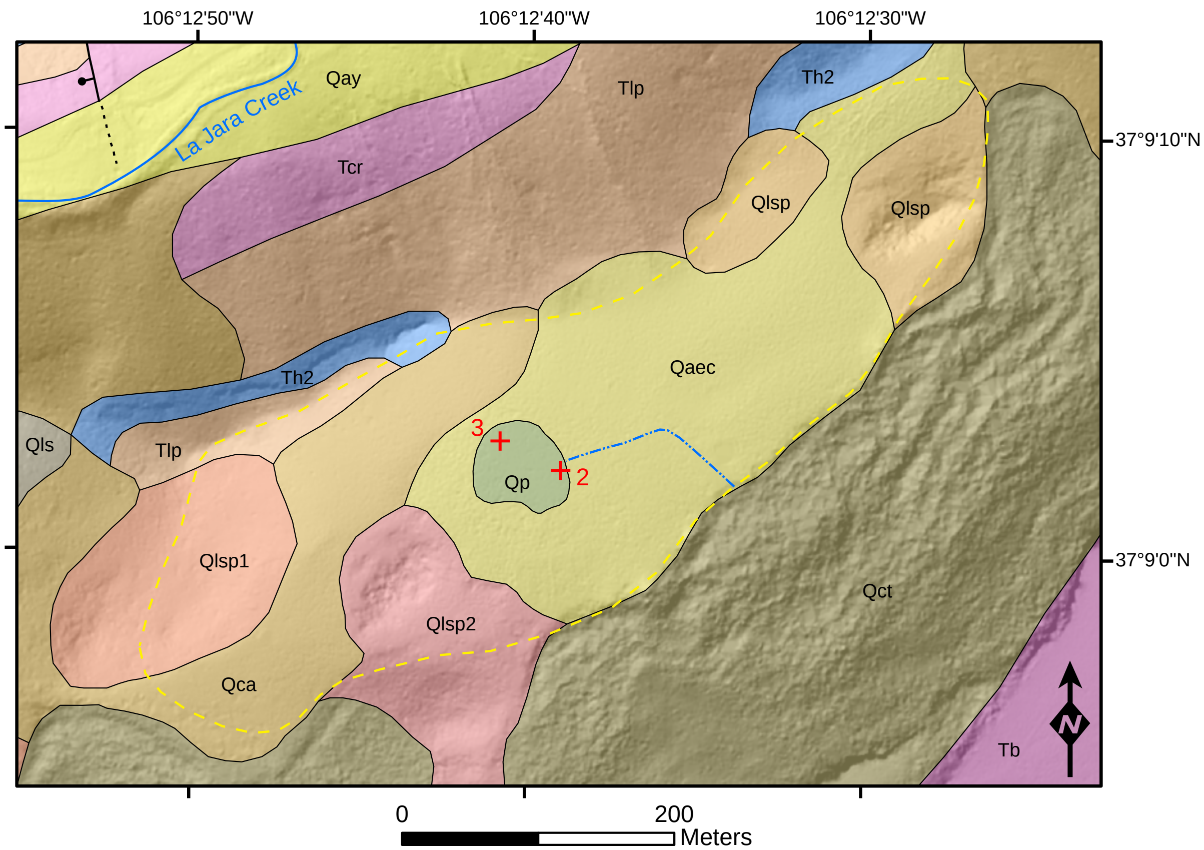


*Figure 2.3. Left: **A**) Geologic map of La Botica and surrounding area. Geology modified from Lipman (1975b). Shaded-relief base generated from 1/3 arc second lidar acquired in 2011. Dataset accessed November 2019 from The National Map (https://viewer.nationalmap.gov/basic/). Above: **B**) Correlation of map units showing stratigraphic relationships for units depicted in geologic map. Volcanic unit ages are from Hon and Mehnert (1983), Lipman and Mehnert (1975), Lipman and McIntosh (2008), Lipman and Zimmerer (2019), and Lipman and others (1996). Unit symbols as in figure 2.3A.*

result of basin subsidence left this marginal area of the basin elevated above the valley floor, which increased the erosion potential. Furthermore, the path of the La Jara Creek paleochannel was likely controlled by the intersection between east-dipping Miocene lava flows and Pliocene lava flows that formed a west-sloping surface from their topographically higher vent areas to the east (figure 2.2[C]).

Local Surficial Geology

Quaternary deposits surrounding and underlying La Botica record fluvial, mass-wasting, and eolian processes (figure 2.3). Fluvial deposits are associated with the active channel and narrow floodplain of La Jara Creek (unit Qay; figure 2.3). Older fluvial deposits that underlie La Botica likely consist of fine-grained overbank deposits and possibly lag gravels, but could not be distinguished as a separate mappable deposit from younger eolian, sheetwash, and colluvial deposits (unit Qaec; figure 2.4) or lag gravels and transient clasts of Los Pinos Formation. The location of La Botica in a leeward position relative to the uphill escarpment south of La Botica provides an environment favorable to settling of wind-transported material resulting in a mantle of loess around La Botica and sediment infiltration into the coarse talus blockfield deposits. Talus blockfield deposits result from disaggregation of slide blocks in addition to rock fall from the intact Pliocene lava flow ledge that holds up much of the uphill escarpment (figure 2.5). Landslide deposits consist dominantly of Pliocene lava flow debris that range from large (greater than 1 m) blocks to small (less than 0.05 m) platy debris.



List of Map Units

Qay	Active channel deposits (Holocene to late Pleistocene)
Qp	Pond deposits (Holocene to late Pleistocene)
Qaec	Alluvial, eolian, and colluvial deposits,undifferentiated (Holocene to late Pleistocene)
Qca	Colluvial and alluvial deposits, undivided (Holocene to middle Pleistocene)
Qct	Talus deposits (Holocene to middle Pleistocene)
Qls	Landslide deposits (Holocene(?) to late Pleistocene(?))
Qlsp	Landslide deposits composed predominantly of Pliocene lava flow blocks, undifferentiated (late(?) to middle(?) Pleistocene)
Qlsp2	Landslide deposits from closed depression-forming event (late(?) to middle(?) Pleistocene)
Qlsp1	Landslide deposits from channel-blocking event (middle Pleistocene(?))
Tb	Pliocene basalt, lava flows
Th2	Hinsdale Formation, lava flows (Oligocene)
Tlp	Los Pinos Formation (Miocene to Oligocene)
Tcr	Carpenter Ridge Tuff (Oligocene)
	Contact
	Normal fault—Solid where certain, dashed where approximate, dotted where concealed; ball and bar on downthrown side
	Intermittent or ephemeral stream
2	Soil pit indicating unit number (see chapter 6, this volume)
	Approximate site boundary

Figure 2.4. Geologic map of La Botica. Geology modified from Lipman (1975b). Shaded-relief base generated from 1/9 arc second lidar acquired in 2011. Dataset accessed November 2019 from The National Map (https://viewer.nationalmap.gov/basic/).

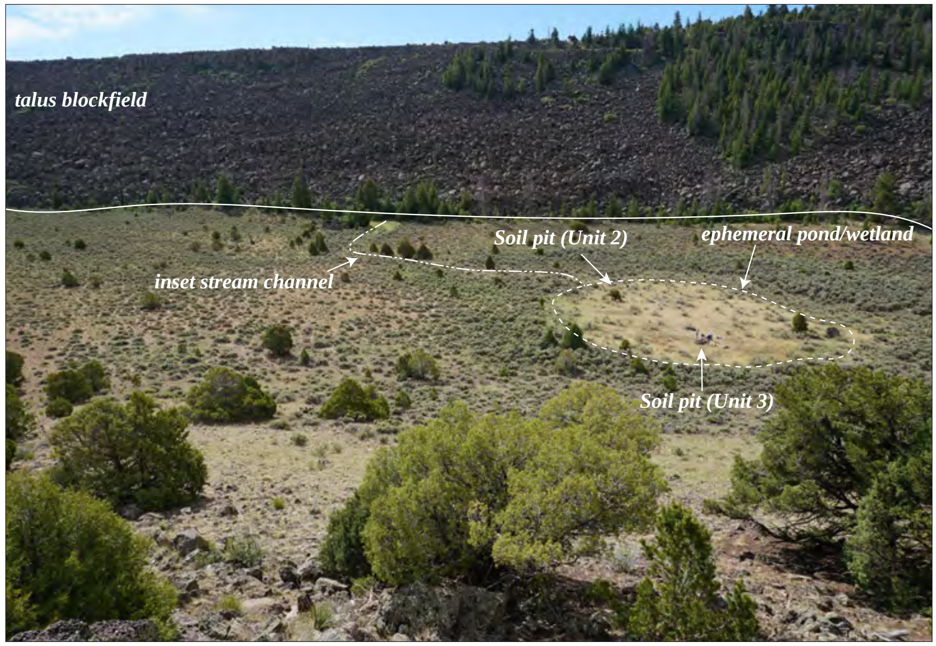


Figure 2.5. View to the southeast of La Botica showing inset stream channel, ephemeral wetland area, and soil pits (Units 2 and 3; see chapter 6) where OSL and radiocarbon ages were collected (Photograph by K. Turner, June 2018).

Landslide deposits grade down to La Botica (figure 2.5) suggesting these deposits may underlie unit Qaec in some areas. A central ephemeral ponded area (unit Qp; figure 2.4) is inferred based on a change from dominantly grass within the ponded area to shrubs in the surrounding area.

Moisture infiltration into the blockfield and intermittent accumulation of interstitial ice (see the "Local Influences on Environment" section later in the chapter) has permitted incipient rock glacier processes, indicated by the downslope flowlines observed in aerial photographs. A subtle inset channel emerges from the toe of the talus blockfield deposits and terminates at the central ponded area (figures 2.4 and 2.5). The channel suggests episodic melting of the intermittent blockfield ice core may supply surface flow from an outlet spring. The lack of distinguishing surface deposits between the inset channel and the surrounding surface may reflect dominantly sheetflow processes during more recent drier intervals, which has affected the entire La Botica surface (see chapter 6). Periodic moistening of the central depression from precipitation events and melting ice resulted in a favorable environment for wetland aggradation of eolian silts and clays and accumulation of sheetwash alluvium.

Five optically stimulated luminescence (OSL) ages on three samples (about 11.4 to 9.3 ka; table 2.1) and an uncalibrated radiocarbon age at 7686±44 ^{14}C yr B.P. (see table 6.8) from two soil pits within the ponded area (unit Qp; figure 2.4) indicate early Holocene deposition and pedogenesis.

At a few localities along the toe of the talus blockfield, a topographic depression is situated between a berm of silty eolian deposits and the coarse-grained blockfield deposit. The origin of these features is uncertain but could result from mobilization and infiltration of eolian deposits into pore spaces within the talus blockfield. The talus blockfield and an older landslide complex may extend beneath late Pleistocene to Holocene eolian and wetland deposits that form the surface at La Botica (see chapter 6).

Discussion

Geomorphic Evolution

Geologic relations indicate the topographic bench that underlies La Botica represents an abandoned paleofluve of La Jara Creek. Although the landform surrounding La Botica resembles the upper surface of landslide blocks observed along the Rio Grande, the stratigraphic relations of Tertiary deposits do not support this interpretation. The Oligocene Hinsdale basalt flow (unit Th2; figure 2.4) and Carpenter Ridge Tuff (unit Tcr; figure 2.4) are at a higher elevation—by as much as 40 m—in the slopes south of La Jara Creek than in the slopes north of the creek (figure 2.4) (Lipman, 1975b). Stratigraphy in a landslide block should be lower than correlative undisturbed deposits,

Table 2.1. Feldspar IRSL and quartz OSL data and dates for La Jara Creek/La Botica site, southern Colorado. (Data from Mahan and Krolczyk [2021]; sample coordinates withheld to preserve archaeological site.)

Sample ID	% Water Content[a]	K (%)[b]	U (ppm)[b]	Th (ppm)[b]	Total Dose (Gy/ka)[c]	Equivalent Dose (Gy)	n[d]	Scatter[e]	Age(yrs)[f]
CR-SLV-1	7 (31)	2.05 ± 0.06	2.27 ± 0.06	10.7 ± 0.54	3.51 ± 0.11	<34.4 ± 2.3	2 (2)	0%	<9,800 ± 730
CR-SLV-2	8 (36)	2.01 ± 0.06	2.34 ± 0.06	11.0 ± 0.55	3.47 ± 0.11	39.5 ± 1.8	21 (22)	20%	11,370 ± 630
					5.01 ± 0.16[g]	51.3 ± 2.0[g]	21 (22)	17%	10,240 ± 520[g]
CR-SLV-3	11 (34)	2.05 ± 0.06	2.52 ± 0.06	11.6 ± 0.58	3.61 ± 0.12	33.7 ± 2.6	18 (21)	32%	9,340 ± 780
					5.24 ± 0.17[g]	49.8 ± 4.0[g]	9 (10)	45%	9,500 ± 820[g]

[a] Field moisture, with figures in parentheses indicating the complete sample saturation percent. Ages calculated using 20 percent of the saturated moisture (i.e. 7 (31) = 31 *0.20 = 6).

[b] Analyses obtained using inductively coupled plasma mass spectrometry (ICP-MS). All errors were obtained with calibration standards and are generally around 3 percent.

[c] Includes cosmic doses and attenuation with depth calculated using the methods of Prescott and Hutton (1994). Cosmic doses were about 0.30 Gy/ka.

[d] Number of replicated equivalent dose (D_E) estimates used to calculate the total. Figures in parentheses indicate total number of measurements included in calculating D_E and age using the central age model (CAM); analyzed via single aliquot regeneration quartz/feldspar grains.

[e] Defined as "over-dispersion" of the D_E values. Obtained by the "R" factor program. Values >30 percent are considered to be poorly bleached or mixed sediments.

[f] Dose rate and age for fine-grained 250-90 μm-sized quartz. Exponential + linear fit used on D_E, errors to one sigma.

[g] Age for fine-grained 250-90 μm-sized K-feldspar, post IR230C; no anomalous fade. Exponential + linear fit used on D_E, errors to one sigma.

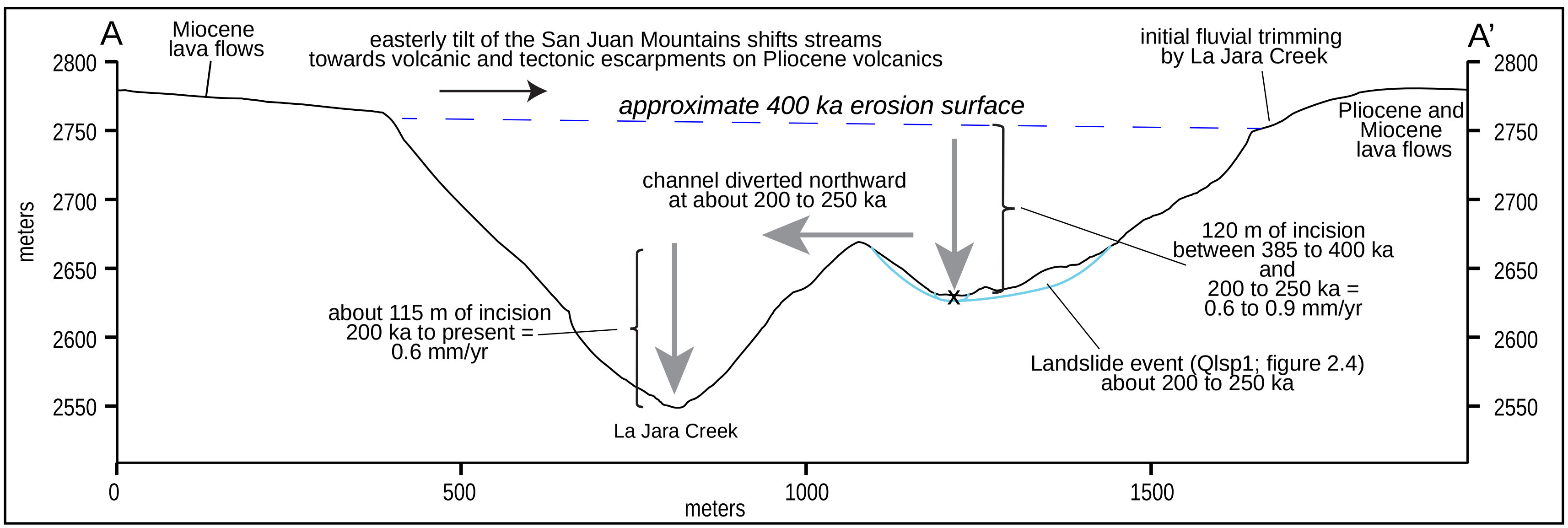


Figure 2.6. Topographic profile along A-A' (see fig. 3) showing geomorphic relationships related to the inferred incision history of La Jara Creek that is a tributary to the Rio Grande fluvial system. Small "x" marks center of La Botica site. Cyan blue lines represent inferred bottom of landslide deposits.

as is the case for debris from Pliocene lava flows observed on the bedrock ridge that separates La Botica from La Jara Creek (unit Qlsp1; figure 2.4). The ridge is much lower than the upper ledge of the escarpment south of the site. The debris is mixed with blocks of Hinsdale Formation lava flow (unit Th2; figure 2.4) indicating the Pliocene lava only mantles the surface of the bedrock ridge whereas the Oligocene flow is *in situ*. Fluvial deposits associated with incision of the paleofluve were difficult to differentiate from younger eolian, alluvial, and colluvial deposits; therefore, age constraints for the evolution of the surface are lacking. Nevertheless, the geomorphic evolution of the surface can be inferred based on better-constrained regional base-level changes (elevation changes in the lower limit for an erosion process often tied to a major river system) (Ruleman *et al.* 2019).

As a tributary to the Rio Grande, La Jara Creek and the topographic bench underlying La Botica have a geomorphic evolution that is directly related to base level constraints of middle Pleistocene Lake Alamosa and the evolution of the Rio Grande within the San Luis Basin (Machette *et al.* 2013; Ruleman *et al.* 2013, 2016, 2019). Based on this association, initial downcutting through the Miocene and Pliocene upper basalt-capped surface resulted from headward incision following the final breach of Lake Alamosa, abandonment of the lake highstand, and connectivity of the Rio Grande with basins south of the San Luis Basin at about 400 to 385 ka (figure 2.6). This age corresponds to deglaciation following a significant alpine glaciation that is reflected in the marine oxygen isotope record between isotope stage 12 (glacial, 478 to 424 ka) and stage 11 (interglacial, 424 to 374 ka) (Lisiecki and Raymo 2005), the strongest glacial-interglacial signature in the Pleistocene marine record. Vast alpine glaciation reaching down to elevations below 2400 m in some areas provided increased fluvial capacity and erosive capability of local drainages fed by the transient glaciers (Atwood and Mather 1912, 1932). Large boulders left as vestiges of glacial deposits associated with this glaciation exist upstream from La Botica on abandoned fluvial divides, indicating abandoned outwash sources that once aided the incision of La Jara Creek. Glacial meltwaters likely carved the broad valley down to the level of the bedrock ridge separating La Botica from the present position of La Jara Creek (figure 2.7[A]). This period of broad valley formation coincides with gradual base level changes along the Rio Grande following initial breach of Lake Alamosa (about 400 to 385 ka) but prior to consolidation of stream flow into the Rio Grande gorge (Ruleman *et al.* 2019). Localization of stream flow within the paleochannel that eroded down to La Botica (figure 2.7[B]) may reflect a change to more rapid incision in response to an increased rate of base level drop as flow was constricted within the main Rio Grande corridor at about 250 and 200 ka (Ruleman *et al.* 2019). Total incision depth to the surface at La Botica is about 120 m (figure 2.6), which based on average long-term incision rates associated with the Rio Grande (about 0.5 to 0.6 mm/year), suggests the paleochannel reached maximum depth by about 250 to 200 ka.

Channel incision and corresponding canyon broadening undercut banks in the Los Pinos Formation below the Miocene and Pliocene lava flows promoting gravitational collapse through landslide events. After eroding down to maximum channel depth at La Botica, stream flow was disrupted by a landslide event represented by unit Qlsp1 (figure 2.4). The deposit comprises Pliocene lava flow debris that covers most of the south-facing slope of the east-northeast-trending bedrock ridge that separates La Botica from the modern La Jara Creek channel, which suggests complete blockage of the paleochannel may have occurred. Blockage of the channel would have facilitated reestablishment of the main channel northward corresponding to the modern channel of La Jara Creek (figure 2.7[C]). Stream flow across the landslide deposit likely persisted, albeit to a lesser extent, until the northern La Jara Creek paleochannel eroded below the level of La Botica. The northern paleochannel of La Jara Creek incised 115 m between about 250 and 200 ka and the present (figure 2.6).

Following abandonment of the paleofluve that underlies La Botica, east-migrating headward erosion of the western end of the perched La Botica surface was likely governed by local base level drop along the north-south oriented tributary located southwest of the site (Tributary #1; figure 2.7[D]). As downcutting along the north-flowing tributary continued, southwest-directed surface flow and arroyo cutting across the abandoned paleofluve may have developed (figure 2.7[D]). A later landslide event recorded by unit Qlsp2 (figure 2.4) formed a barrier to southwestward flow of surface water and formed a closed depression east of the landslide deposit (figures 2.4 and 2.7[E]). The closed depression and intermittent ponded water created a favorable setting for accumulation of late Pleistocene to Holocene wetland- and eolian-derived sediment (see chapter 6).

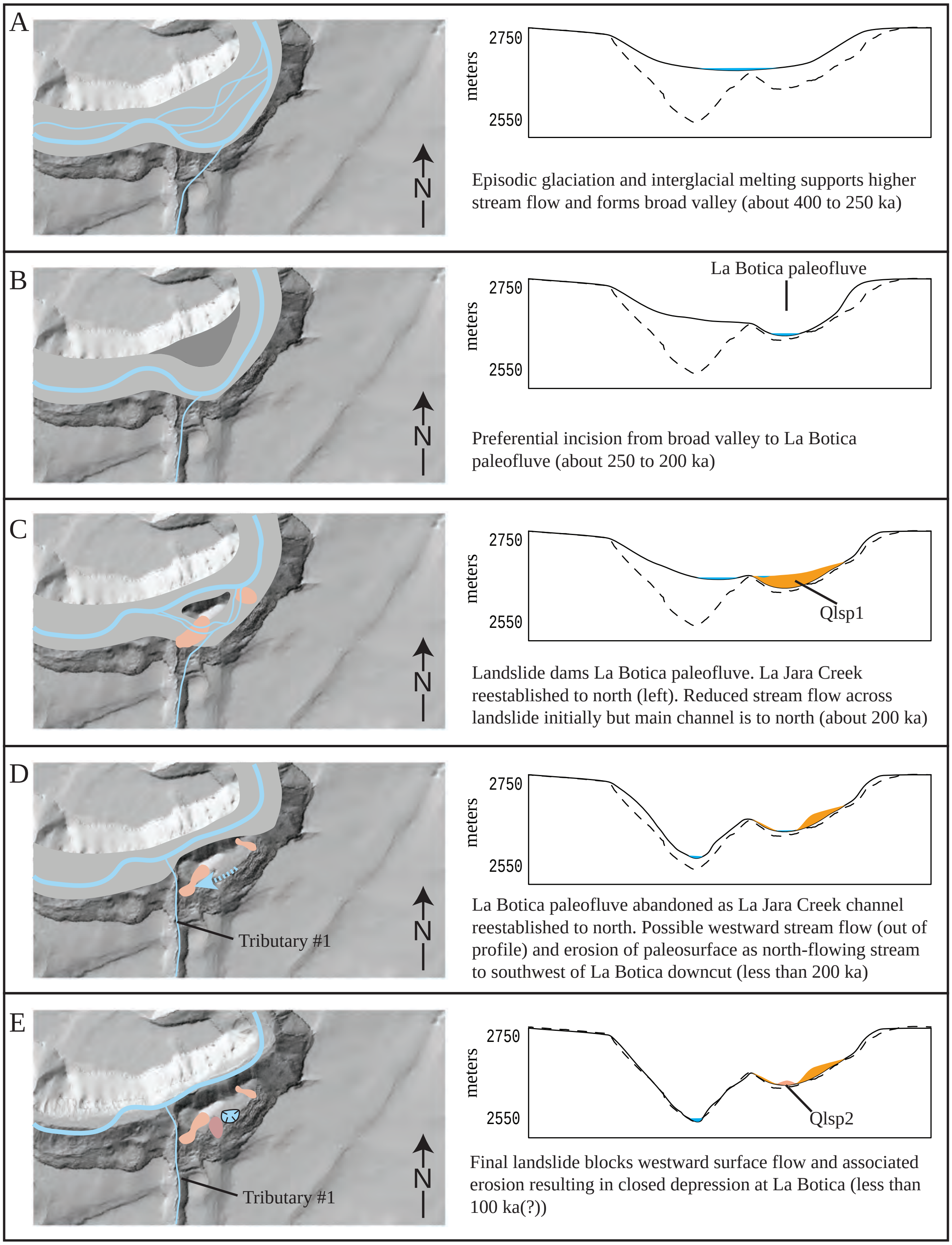


Figure 2.7. Inferred fluvial evolution of La Jara Creek and La Botica abandoned paleofluve. Panels listed oldest (A) to youngest (E). Line of profile is the same as indicated on Figure 2.3A. Cyan color is used to illustrate surface water flow. Solid line represents topographic profile at the time characterized. For reference, dashed line represents modern topographic profile as shown in figure 2.6.

Local Influences on Environment

Geography, geology, and climate are important and, in some ways, interrelated influences on the environment at La Botica. Geographic characteristics include elevation, landform, and slope aspect of the adjacent escarpment. Geologic factors include the distribution, composition, and physical properties of bedrock and surficial deposits. Undoubtedly, other factors play important roles in controlling the environment at La Botica, but this discussion is focused on characteristics with direct association to the geologic and geographic setting. Evaluation of the regional climate record is beyond the scope of this chapter (see chapters 3-5).

During field investigations in June 2018, ice was observed within the lower parts of the talus blockfield deposits and air temperatures around the toe of the talus slopes were noticeably cooler than ambient air temperature (see chapter 6). The talus blockfield was not examined repeatedly throughout the year, so the extent to which these conditions are maintained is unclear. However, the north-facing aspect of the talus deposits coupled with seasonally dependent, reversible air circulation through porous deposits like talus (e.g. central Asia: Gurbonov *et al.* 2004; Switzerland: Delaloye and Lambiel 2005) suggest the ice and cooler temperatures adjacent to the deposits can persist throughout the year. Delaloye and Lambiel (2005) document air circulation processes where during winter months relatively warm air vents from upper parts of the deposit, inducing intake of colder air from the base, and resulting in cooler ground temperatures below the deposits. Conversely, during warmer months, gravity-driven processes cause dense colder air to vent from the lower parts of the deposit. As a result of these processes, permafrost beneath the deposits is documented at elevations more than 1000 m below typical elevations of discontinuous permafrost formation (Gurbonov *et al.* 2004) and may facilitate growth of internal ice during wetter or cooler periods. Melting during warmer months can result in more sustained discharge from outlet springs that support wetlands (Millar *et al.* 2013). In close proximity to the coarse debris deposits, air temperatures can be lowered by 2.5 to 4 °C creating specific environmental conditions more typical of higher elevations or latitudes (Delaloye and Lambiel 2005; Gurbonov *et al.* 2004; Morard *et al.* 2008). With distance from the talus slope, air temperatures transition to that of ambient air, resulting in a gradient of specific environments that may support floral assemblages from otherwise disparate settings. Without the benefit of detailed site measurements through time, we can only speculate on the role of this process at La Botica, but we suspect it does contribute to the environment and therefore consider it in regional analogs. Regionally, well-developed talus slopes are observed at similar elevations, but rarely do these settings share all key aspects that characterize La Botica.

Comparison to Regional Analogs

Regional analogs are evaluated based on physical and geologic characteristics at La Botica. Topographically, La Botica resembles the upper surface of landslide blocks common along the Rio Grande gorge in the Taos Plateau (figure 2.8[A]) (Kelson *et al.* 2008) and Cerros del Rio volcanic fields (figure 2.8[B]) (Dethier and Koning 2007) in the San Luis Basin and Española Basin, respectively (figure 2.2). Landslide blocks are also present along the flanks of San Pedro Mesa on the east side of the San Luis Basin (Machette *et al.* 2008) and at Encino Lookout in the Española Basin (figures 2.2 and 2.8[C]) (Kelley *et al.* 2005). Elevations of upper landslide block surfaces surrounding San Pedro Mesa (2570 to 2620 m) are similar to La Botica (2640 m), whereas Encino Lookout is somewhat higher (2800 to 2930 m), and the Rio Grande gorge localities are lower (1700 m 2150 m). Upper landslide surfaces are also generally perched above active channels, have low to moderate tree growth, commonly have talus-covered slopes below basaltic lava flows, and occasionally display evidence of ephemeral ponds. Slope aspects of virtually all landslide block talus slopes are west-, east-, or south-facing unlike the north-facing talus slope at La Botica. Tree density at localities along the Rio Grande and San Pedro Mesa is like that of La Botica, whereas the Encino Lookout locality is densely forested.

Assuming the local effect from air circulation in the talus deposits is a relevant contributing factor to the environment at La Botica, other localities at the toe of large talus blockfield slopes may provide a similar environment. Localities with north-facing talus slopes and at similar elevation to La Botica (2640 m) are identified in the southeastern San Juan Mountains below cliffs of Chiquito Peak Tuff. Numerous examples exist although only two are considered here based on proximity to La Botica. Those localities are at Fox Creek (2670 to 2720 m) about 5 km southwest of La

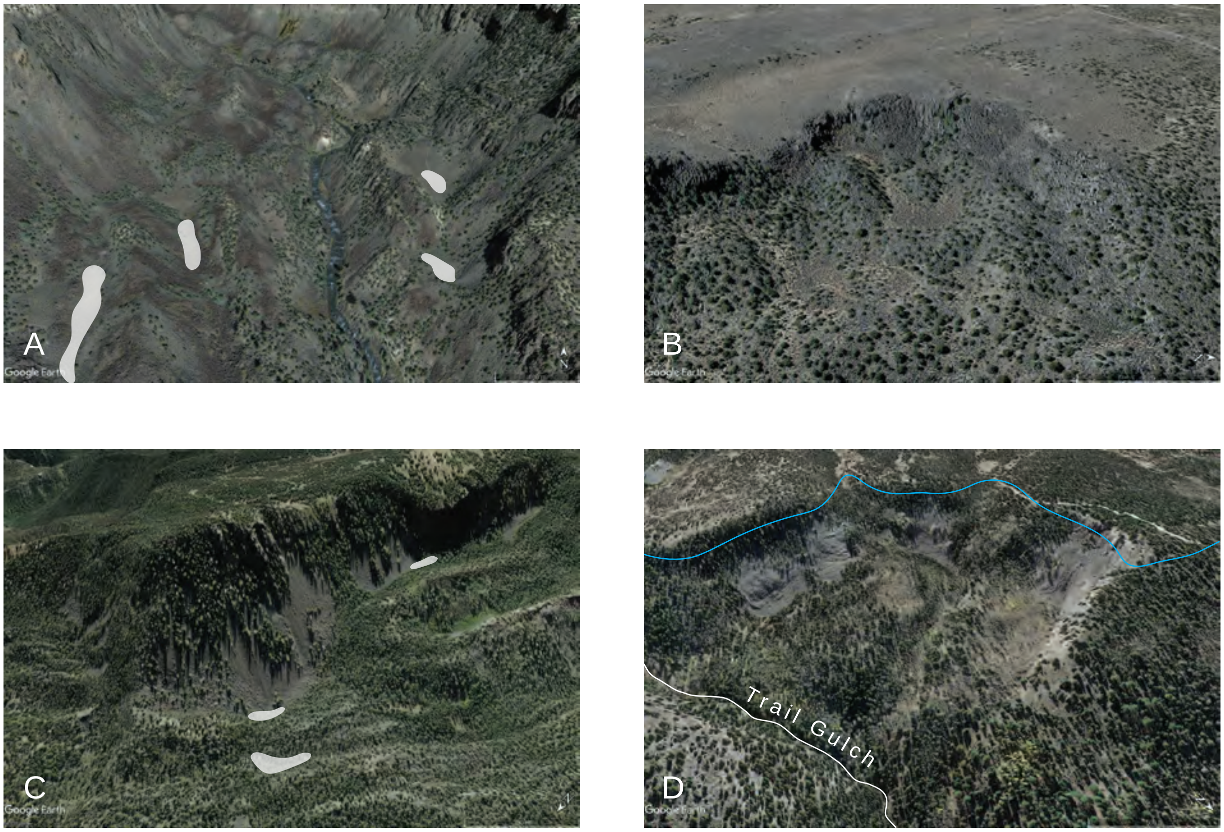


Figure 2.8. Oblique aerial views of select regional analogs discussed in text (images from Google Earth, accessed February 2020). See figure 2.2 for locations. ***A****) Upper landslide block surfaces along the Rio Grande near Questa, N. Mex.; white polygons indicate closed depressions.* ***B****) Upper landslide block surfaces at San Pedro Mesa.* ***C****) Upper landslide block surfaces at Encino Lookout in the Española Basin; white polygons indicate closed depressions.* ***D****) Talus blockfield slopes at base of Chiquito Peak Tuff; blue line drawn at base of Chiquito Peak Tuff.*

Botica and Trail Gulch (2780 to 2830 m) about 10 km south of La Botica (figures 2.2 and 2.8[d]) (Lipman 1975b). Talus deposits along Fox Creek terminate at the valley floor near the meandering channel of a perennial stream, which supports a more densely vegetated environment that includes abundant grasses and a riparian zone. North-facing talus slopes along the middle section of Trail Gulch display well-developed ridge and furrow structures typical of rock glaciers suggesting that an ice core may exist or have existed at one time. In contrast to La Botica, the Trail Gulch locality is densely forested and well drained at the terminus of the talus blockfield deposit.

The localities described above provide settings similar to La Botica but have notable differences impacting the environment in various ways that can be discussed qualitatively. Upper landslide surfaces in the San Luis Basin and Española Basin have a similar topographic form, have evidence of ephemeral ponds, and often have talus blockfield slopes. The San Pedro Mesa and Encino Lookout localities are at similar elevations. However, Rio Grande gorge localities are at lower elevations and latitudes; talus slopes at these localities generally have east, west, or south slope aspects. These environmental factors would result in higher air temperatures and increased solar input. These factors likely repress the accumulation of ice or permafrost, in turn decreasing or eliminating any sustained local air temperature cooling effects during the warmer summer months due to air circulation through the talus deposits. With respect to upper landslide surfaces, the Encino Lookout locality may be the closest analog due to north-facing talus blockfield slopes, similar elevation, and presence of topographic depressions supporting ephemeral ponds. However, in contrast to La Botica, Encino Lookout is densely forested around the base of the talus blockfield slopes resulting in a shadier environment. Talus slope localities below the Chiquito Peak Tuff have similar elevations and are in close proximity to La Botica suggesting climate differences would be minor. The Fox Creek talus blockfield slope terminates at the valley floor adjacent to the active stream channel providing perennial availability of water that supports a grassy and riparian environment substantially different from La Botica. The Trail Gulch locality, on the other hand, is north-facing and displays features consistent with a rock glacier, suggesting that if air circulation through the deposits is an active process, there could be some localized temperature gradient. However, the base of the talus blockfield slope is well drained, preventing ponding of water, and tree growth is denser resulting in a shadier environment.

Conclusions

La Botica was shaped through the modification of Tertiary volcanic and sedimentary deposits by geomorphic processes. The area had high erosion potential following Oligocene to Pleistocene development of the San Luis Basin that left the area around La Botica elevated above the valley floor. Incision by La Jara Creek and the geomorphic evolution of La Botica was related to the formation and demise of Lake Alamosa and the reintegration of the Rio Grande. The Lake Alamosa highstand occurred at about 430 ka and was abandoned as the topographic barrier was breached between about 400 and 385 ka, which allowed the Rio Grande to connect with lower elevations in the Española Basin and southerly basins downstream. Headward erosion along the Rio Grande and tributaries resulted in about 120 m of incision along La Jara Creek between about 400 and 200 ka. The paleofluve that underlies La Botica was abandoned around 200 ka as La Jara Creek reestablished a channel to the north where an additional 115 m of downcutting has occurred up to the present day. During the late Pleistocene to Holocene, talus blockfield deposits developed as earlier-formed landslides became dormant and stabilized, and ephemeral ponding facilitated aggradation of eolian clay and silt that are dominant components of the modern and ancient soils. Coarse debris deposits like the talus blockfield deposits can have a local influence on air temperatures as a result of air circulation processes, which may support a range of local microenvironments. The presence of ice in these deposits in June of 2018 suggests air circulation processes could have impacted the local environment at La Botica after development of the deposits. Although localities at Encino Lookout in the Española Basin and along Trail Gulch about 10 km south of La Botica likely exhibit similar environmental conditions, all compared localities have notable differences that imply La Botica provides a rare environment.

Acknowledgments. We thank Margaret Berry and Adam Hudson (U. S. Geological Survey, Denver, Colorado) for reviewing this document. Geologic mapping and acquisition of OSL ages were supported by the U. S. Geological Survey National Cooperative Geologic Mapping Program and Geosciences and Environmental Change Science Center. Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U. S. Government.

References Cited

Aldrich, M. J., Jr., C. E. Chapin, and A. W. Laughlin
1986 Stress History and Tectonic Development of the Rio Grande Rift, New Mexico. *Journal of Geophysical Research* 91(B6):6,199-6,211. DOI: https://doi.org/10.1029/JB091iB06p06199.

Atwood, Wallace W., and Kirtley F. Mather
1912 The Evidence of Three Distinct Glacial Epochs in the Pleistocene History of the San Juan Mountains, Colorado. *The Journal of Geology* 20:385-409. DOI: https://doi.org/10.1086/621985.

Atwood, Wallace W., and Kirtley F. Mather
1932 *Physiography and Quaternary Geology of the San Juan Mountains, Colorado*. U. S. Geological Survey Professional Paper 166. DOI: https://doi.org/10.3133/pp166.

Cather, Steven M.
1990 Stress and Volcanism in the Northern Mogollon-Datil Volcanic Field, New Mexico: Effects of Post-Laramide Tectonic Transition. *Geological Society of America Bulletin* 102:1,447-1,458. DOI: https://doi.org/10.1130/0016-7606(1990)102%3C1447:SAVITN%3E2.3.CO;2.

Chapin, Charles E.
1988 Axial Basins of the Northern and Central Rio Grande Rifts. In *Sedimentary Cover-North American Craton: U. S.*, edited by L. L. Sloss, pp-165-170. The Geology of North America Volume D-2. Geological Society of America, Boulder,

Colorado.
Chapin, Charles E., and Steven M. Cather
1994 Tectonic Setting of Axial Basins of the Northern and Central Rio Grande Rift. In *Basins of the Rio Grande Rift: Structure, Stratigraphy, and Tectonic Setting*, edited by G. R. Keller and S. M. Cather, pp. 5-26. Geological Society of America Special Paper 291. DOI: https://doi.org/10.1130/SPE291-p5.
Colman, Steven M.
1985 Map Showing Tectonic Features of Late Cenozoic Origin in Colorado. U.S. Geological Survey Miscellaneous Investigations Series Map I-1566 [Scale 1:1,000,000].
Colucci, M. T., M. A. Dungan, K. M. Ferguson, P.W. Lipman, and S. Moorbath
1991 Precaldera Lavas of the Southeast San Juan Volcanic Field: Parent Magmas and Crustal Interactions. *Journal of Geophysical Research* 96(B8):13,413-13,434. DOI: https://doi.org/10.1029/91JB00282.
Crone, Anthony J., Michael N. Machette, Lee-Ann Bradley, and Shannon A. Mahan
2006 Data Related to Late Quaternary Surface Faulting on the Sangre de Cristo Fault, Rito Seco Site, Costilla County, Colorado. U. S. Geological Survey Scientific Investigations Map 2955.
Delaloye, Raynald, and Christophe Lambiel
2005 Evidence of Winter Ascending Air Circulation Throughout Talus Slopes and Rock Glaciers Situated in the Lower Belt of Alpine Discontinuous Permafrost (Swiss Alps). *Norsk Geografisk Tidsskrift - Norwegian Journal of Geography* 59:194-203. DOI: https://doi.org/10.1080/00291950510020673.
Dethier, David P., and Daniel J. Koning
2007 Geologic Map of the White Rock 7.5-Minute Quadrangle, Santa Fe, Sandoval, and Los Alamos Counties, New Mexico. New Mexico Bureau of Geology and Mineral Resources Open-File Geologic Map 149 [Scale 1:24,000].
Gurbonov, Aldar P., Sergei S. Marchenko, and Eduard V. Seversky
2004 The Thermal Environment of Blocky Materials in the Mountains of Central Asia. *Permafrost and Periglacial Processes* 15:95-98. DOI: https://doi.org/10.1002/ppp.478.
Henry, Christopher D., Jonathan G. Price, and Eric W. James
1991 Mid-Cenozoic Stress Evolution and Magmatism in the Southern Cordillera, Texas and Mexico: Transition from Continental Arc to Intraplate Extension. *Journal of Geophysical Research* 96(B8):13,545-13,560. DOI: https://doi.org/10.1029/91JB00202.
Hon, Ken, and Harald H. Mehnert
1983 *Compilation of Revised Ages of Volcanic Units in the San Juan Mountains, Colorado: Recalculated K-Ar Age Determinations Using IUGS Constants*. U. S. Geological Survey Open File Report 88-668.
Ingersoll, Raymond V.
2001 Structural and Stratigraphic Evolution of the Rio Grande Rift, Northern New Mexico and Southern Colorado. *International Geology Review* 43:867-891. DOI: https://doi.org/10.1080/00206810109465053.
Ingersoll, Raymond V., William Cavazza, W. Scott Baldridge, and Muhammad Shafiqullah
1990 Cenozoic Sedimentation and Paleotectonics of North-Central New Mexico: Implications for Initiation and Evolution of the Rio Grande Rift. *Geological Society of America Bulletin* 102:1,280-1,296. DOI: https://doi.org/10.1130/0016-7606(1990)102<1280:CSAPON>2.3.CO;2.
Kelley, Shari A., John R. Lawrence, and G. Robert Osburn
2005 Geologic Map of the Youngsville 7.5-minute Quadrangle, Rio Arriba County, New Mexico. New Mexico Bureau of Geology and Mineral Resources Open-File Geologic Map 106 [Scale 1:24,000].
Kelson, Keith I., Paul W. Bauer, and Ren Thompson
2008 Geologic Map of the Guadalupe Mountain 7.5-Minute Quadrangle Map, Taos County, New Mexico. New Mexico Bureau of Geology and Mineral Resources Open-File Geologic Map 168 [Scale 1:24,000].
Kirkham, Robert M., Brian S. Brister, V. J. S. Grauch, and James R. Budahn
2005 Culebra Graben—A Major Intrarift Structure in the San Luis Basin, Rio Grande Rift. *Geological Society of America Abstracts with Programs* 37(6):14.
Kirkham, Robert M., and Cristine M. Heimsoth
2003 Geologic Map of the Fort Garland SW Quadrangle, Costilla County, Colorado. Colorado Geological Survey Open-File Reports OF-02-06 [Scale 1:24,000].
Kirkham, Robert M., John L. Lufkin, and Neil R. Lindsay
2004 Geologic Map of the La Valley Quadrangle, Costilla County, Colorado. Colorado Geological Survey Open-File Report OF-04-08 [Scale 1:24,000].
Kirkham, Robert M., Kenneth C. Shaver, Neil R. Lindsay, and Alan R. Wallace
2003 Geologic Map of the Taylor Ranch Quadrangle, Costilla County, Colorado. Colorado Geological Survey Open-File Report OF-03-15 [Scale 1:24,000].
Lindsey, David A., P. A. M. Andriessen, and Bruce R. Wardlaw
1986 Heating, Cooling, and Uplift During Tertiary Time, Northern Sangre de Cristo Range, Colorado. *Geological Society of America Bulletin* 97:1,133-1,143. DOI: https://doi.org/10.1130/0016-

7606(1986)97%3C1133:HCAUDT%3E2.0.CO;2.

Lipman, Peter W.
1974 Geologic Map of the Platoro Caldera Area, Southeastern San Juan Mountains, Southwestern Colorado. U. S. Geological Survey Miscellaneous Investigations Series Map I-828 [Scale 1:48,000].

Lipman, Peter W.
1975a *Evolution of the Platoro Caldera Complex and Related Volcanic Rocks, Southeastern San Juan Mountains, Colorado*. U.S. Geological Survey Professional Paper 852. DOI: https://doi.org/10.3133/pp852.

Lipman, Peter W.
1975b Geologic Map of the Lower Conejos River Canyon Area, Southeastern San Juan Mountains, Colorado. U.S. Geological Survey Miscellaneous Investigations Series Map I-901 [Scale 1:48,000].

Lipman, Peter W.
2007 Incremental Assembly and Prolonged Consolidation of Cordilleran Magma Chambers: Evidence from the Southern Rocky Mountain Volcanic Field. *Geosphere* 3:42-70. DOI: https://doi.org/10.1130/GES00061.1.

Lipman, Peter W., and William C. McIntosh
2008 Eruptive and Noneruptive Calderas, Northeastern San Juan Mountains, Colorado: Where Did The Ignimbrites Come From? *Geological Society of America Bulletin* 120: 771-795. DOI: https://doi.org/10.1130/B26330.1.

Lipman, Peter W., and Harald H. Mehnert
1975 Late Cenozoic Basaltic Volcanism and Development of the Rio Grande Depression in the Southern Rocky Mountains. In *Cenozoic History of Southern Rocky Mountains*, edited by Bruce F. Curtis, pp. 119-154. Geological Society of America Memoir 144. DOI: https://doi.org/10.1130/MEM144-p119.
1979 The Taos Plateau Volcanic Field, Northern Rio Grande Rift, New Mexico. In *Rio Grande Rift: Tectonics and Magmatism*, edited by R. E. Riecker, pp. 289-311. American Geophysical Union, Washington, D. C.

Lipman, Peter W., and Matthew J. Zimmerer
2019 Magmato-Tectonic Links: Ignimbrite Calderas, Regional Dike Swarms, and the Transition from Arc to Rift in the Southern Rocky Mountains. *Geosphere* 15:1893-1926. DOI: https://doi.org/10.1130/GES02068.1.

Lipman, Peter W., Dungan, Michael A., Brown, Laurie L., and Deino, Alan
1996 Recurrent Eruption and Subsidence at the Platoro Caldera Complex, Southeastern San Juan Volcanic Field, Colorado: New Tales from Old Tuffs. *Geological Society of America Bulletin* 108:1,039-1,055. DOI: https://doi.org/10.1130/0016-7606(1996)108<1039:REASAT>2.3.CO;2.

Lipman, Peter W., Thomas A. Steven, and Harold H. Mehnert
1970 Volcanic History of the San Juan Mountains, Colorado, as Indicated by Potassium-Ar Dating. *Geological Society of America Bulletin* 81:2,329-2,352. DOI: https://doi.org/10.1130/0016-7606(1970)81[2329:VHOTSJ]2.0.CO;2.

Lisiecki, Lorraine E., and Maureen E. Raymo
2005 A Pliocene-Pleistocene Stack of 57 Globally Distributed Benthic $\delta^{18}O$ Records. *Paleoceanography* 20:PA1003. DOI: https://doi.org/10.1029/2004PA001071.

Machette, Michael N., Ren A. Thompson, and Benjamin J. Drenth
2008 Geologic Map of the San Luis Quadrangle, Costilla County, Colorado. U.S. Geological Survey Scientific Investigations Map SIM-2008-2963 [Scale 1:24,000].

Machette, Michael, Ren Thompson, David Marchetti, and Robert Kirkham
2007 Chapter B-Field Trip Day 2 Quaternary Geology of Lake Alamosa and the Costilla Plain, Southern Colorado. In *2007 Rocky Mountain Section Friends of the Pleistocene Field Trip-Quaternary Geology of the San Luis Basin of Colorado and New Mexico, September 7-9, 2007*, edited by Michael N. Machette, M. M. Coates, and M. L. Johnson, pp. 187-197. U. S. Geological Survey Open-File Report 2007-1193.

Machette, Michael N., Ren A. Thompson, David W. Marchetti, and Roger S. U. Smith
2013 Evolution of ancient Lake Alamosa and Integration of the Rio Grande During the Pliocene and Pleistocene. In *New Perspectives on Rio Grande Rift Basins: From Tectonics to Groundwater*, edited by M. R. Hudson, and V. J. S. Grauch, pp. 1-20. Geological Society of America Special Paper 494. DOI: https://doi.org/10.1130/2013.2494(01).

Mahan, Shannon A., and Emma T. Krolczyk
2021 Data Release: Geologic Setting and Geomorphic History of the La Botica Area, South-Central Colorado. U. S. Geological Survey Data Release. DOI: https://doi.org/10.5066/P96V29EC.

Manley, Kim
1982 Geologic Map of the Bighorn Peak Quadrangle, Rio Arriba County, New Mexico and Conejos County, Colorado. U. S. Geological Survey Miscellaneous Field Studies Map MF-1451 [Scale 1:24,000].

Matthews, Naomi E., Vazquez, Jorge A., and Calvert, Andrew T.
2015 Age of the Lava Creek Supereruption and Magma Chamber Assembly at Yellowstone Based on 4-Ar/39Ar and U-Pb Dating of Sanidine and Zircon Crystals. *Geochemistry, Geophysics,*

Geosystems 16:2,508-2,528. DOI: https://doi.org/10.1002/2015GC005881.

McCalpin, James P.
1982 Quaternary Geology and Neotectonics of the West Flank of the Northern Sangre de Cristo Mountains, South-Central Colorado. *Colorado School of Mines Quarterly* 77.

Millar, Constance I., Robert D. Westfall, and Diane L. Delany
2013 Thermal and Hydrologic Attributes of Rock Glaciers and Periglacial Talus Landforms: Sierra Nevada, California, USA. *Quaternary International* 310: 169-180. DOI: https://doi.org/10.1016/j.quaint.2012.07.019.

Mitchell, Mark D.
2020 *Archaeological Research During 2018 at the La Botica Site, Conejos County, Colorado*. Research Contribution 114. Paleocultural Research Group, Broomfield, Colorado. Submitted to History Colorado, Denver, the Sangre de Cristo National Heritage Area, Alamosa, Colorado, and the Colorado State Land Board, Denver.

Morard, Sebastien, Reynald Delaloye, and Jonathan Dorthe
2008 Seasonal Thermal Regime of a Mid-Latitude Ventilated Debris Accumulation. *Proceedings of the 9th International Conference on Permafrost* 29:1,233-1238.

Pazzaglia, Frank J., and Stephen G. Wells
1990 Quaternary Stratigraphy, Soils and Geomorphology of the Northern Rio Grande Rift. In *Tectonic Development of the Southern Sangre de Cristo Mountains, New Mexico*, edited by P. W. Bauer, S. G. Lucas, C. K. Mawer, and W. C. McIntosh, pp. 423-430. New Mexico Geological Society Guidebook, 41st Annual Field Conference 41.

Prescott, J. R., and J. T. Hutton
1994 Cosmic Ray Contributions to Dose Rates for Luminescence and ESR Dating—Large Depths and Long-Term Time Variations. *Radiation Measurements* 23:497-500. DOI: https://doi.org/10.1016/1350-4487(94)90086-8.

Rogers, K. L., C. A. Repenning, R. M. Forester, E. E. Larson, S. A. Hall, G. R. Smith, E. Anderson, and T. J. Brown
1985 Middle Pleistocene (Late Irvingtonian: Nebraskan) Climatic Changes in South-Central Colorado. *National Geographic Research* 1:535-564.

Rogers, Karel L., and Edwin E. Larson
1992 Pliocene and Pleistocene Sedimentation in South-Central Colorado: Opportunity for Climate Studies. *Quaternary International* 13-14:15-18. DOI: https://doi.org/10.1016/1040-6182(92)90004-L.

Rogers, Karel L., Edwin E. Larson, G. Smith, D. Datzman, Gerald R. Smith, Thure Cerling, Yang Wang, Richard G. Baker, K. C. Lohmann, Charles A. Repenning, Penny Patterson, and Gerald Mackie
1992 Pliocene and Pleistocene Geologic and Climatic Evolution in the San Luis Valley of South-Central Colorado. *Palaeogeography, Palaeoclimatology, Palaeoecology* 94:55-86. DOI: https://doi.org/10.1016/0031-0182(92)90113-J.

Rogers, Karel L., Charles A. Repenning, Fred G. Luiszer, and Richard D. Benson
2000 Geologic History, Stratigraphy, and Paleontology of the SAM Cave, North-Central New Mexico. *New Mexico Geology* 22: 89-117.

Rogers, Karel L., and Yang Wang
2002 Stable Isotopes in Pocket Gopher Teeth as Evidence of a Late Matuyama Climate Shift in the Southern Rocky Mountains. *Quaternary Research* 57:200-207. DOI: https://doi.org/10.1006/qres.2001.2309.

Ruleman, Chester A., Adam M. Hudson, Ren A. Thompson, Daniel P. Miggins, James B. Paces, and Brent M. Goehring
2019 Middle Pleistocene Formation of the Rio Grande Gorge, San Luis Valley, South-Central Colorado and North-Central New Mexico, USA: Process, Timing, and Downstream Implications. *Quaternary Science Reviews* 223(105846):1-30. DOI: https://doi.org/10.1016/j.quascirev.2019.07.028.

Ruleman, Cal, and Michael Machette
2007 Chapter J: An Overview of the Sangre de Cristo Fault System and New Insights to Interactions Between Quaternary Faults in the Northern Rio Grande Rift. In *2007 Rocky Mountain Section Friends of the Pleistocene Field Trip-Quaternary Geology of the San Luis Basin of Colorado and New Mexico, September 7-9, 2007*, edited by Michael N. Machette, M. M. Coates, and M. L. Johnson, pp. 187-197. U.S. Geological Survey Open-File Report 2007-1193.

Ruleman, C. A., Machette, M. N., Thompson, R. A., Miggins, D. P., Goehring, B. M., and Paces, J. B.
2016 Geomorphic Evolution of the San Luis Basin and Rio Grande in Southern Colorado and Northern New Mexico. In *Unfolding the Geology of the West*, edited by S. M. Keller and M. L. Morgan, pp. 291-333. Geological Society of America Field Guide 44. DOI: https://doi.org/10.1130/2016.0044(13).

Ruleman, C. A., R. A. Thompson, R. R. Shroba, M. Anderson, B. J. Drenth, J. Rotzien, and J. Lyon
2013 Late Miocene-Pleistocene Evolution of a Rio Grande Rift Subbasin, Sunshine Valley-Costilla Plain, San Luis Basin, New Mexico and Colorado. In *New perspectives on Rio Grande Rift Basins: From*

Tectonics to Groundwater, edited by M. R. Hudson and V. J. S. Grauch, pp. 47-73. Geological Society of America Special Paper 494. DOI: https://doi.org/10.1130/2013.2494(03).

Scott, Glenn R., and Richard B. Taylor
1975 *Post-Paleocene TertiaryRrocks and Quaternary Volcanic Ash of the Wet Mountains Valley, Colorado*. U.S. Geological Survey Professional Paper 868. DOI: https://doi.org/10.3133/pp868.

Siebenthal, C. E.
1910 *Geology and Water Resources of the San Luis Valley, Colorado*. U.S. Geological Survey Water Supply Paper 240. DOI: https://doi.org/10.3133/wsp240.

Steven, Thomas A.
1975 Middle Tertiary Volcanic Field in the Southern Rocky Mountains. In *Cenozoic History of Southern Rocky Mountains*, edited by Bruce F. Curtis, pp. 75-94. Geological Society of America Memoir 144. DOI: https://doi.org/10.1130/MEM144-p75.

Steven, Thomas A., and Lipman, Peter W.
1976 *Calderas of the San Juan Volcanic Field, Southwestern Colorado*. U. S. Geological Survey Professional Paper 958. DOI: https://doi.org/10.3133/pp958.

Thompson, Ren A., Clark M. Johnson, and Harald H. Mehnert
1991 Oligocene Basaltic Volcanism of the Northern Rio Grande Rift: San Luis Hills, Colorado. *Journal of Geophysical Research* 96(B8):13,577-13,592. DOI: https://doi.org/10.1029/91JB00068.

Thompson, Ren A., and Michael N. Machette
1989 Geologic Map of the San Luis Hills area, Conejos and Costilla Counties, Colorado. U. S. Geological Survey Miscellaneous Investigations Series Map I-906 [Scale 1:50,000]. DOI https://doi.org/:10.3133/i1906.

Thompson, Ren A., Ralph R. Shroba, Michael N. Machette, Christopher J. Fridich, Theodore R. Brandt, and Michael A. Cosca
2015 Geologic Map of the Alamosa 30' x 60' Quadrangle, South-Central Colorado. U. S. Geological Survey Scientific Investigations Map 3342 [Scale 1:100,000]. DOI: https://doi.org/10.3133/sim3342.

U. S. Geological Survey, Colorado Geological Survey, and New Mexico Bureau of Geology and Mineral Resources [USGS-CGS-NMBGMR]
2020 Quaternary Fault and Fold Database for the United States. Electronic document, https://doi.org/10.5066/F7S75FJM, accessed November 20, 2020.

Wells, Stephen G., Keith I. Kelson, and Christopher M. Menges
1987 Quaternary Evolution of Fluvial Systems in the Northern Rio Grande Rift, New Mexico and Colorado: Implications for Entrenchment and Integration of Drainage Systems. In *Quaternary Tectonics, Landform Evolution and Soil Chronologies, and Glacial Deposits - Northern Rio Grande Rift of New Mexico: Field Trip Guidebook*, edited by Christopher M. Menges, Y. Enzel, and B. Harrison, pp. 55-69. Friends of the Pleistocene, Rocky Mountain Cell Guidebook, Albuquerque New Mexico.

Winograd, I. J.
1959 *Ground-Water Conditions and Geology of Sunshine Valley and Western Taos County, New Mexico*. New Mexico Office of the State Engineer Technical Report 12.

3

Paleoenvironment: The Lake Sediment Record

Christy E. Briles, Rosemary Downing,
Matt Davis, and James Rivers

Lakes are excellent archives of environmental change and are useful for assessing resource availability. Pollen, other botanicals, small charcoal particles, and mineral dust are lofted into the atmosphere during wind events and fall out on a lake's surface or the surrounding landscape. The particles also get washed into the lake during snowmelt events and rainstorms or are brought in by inflowing streams. Additionally, internal lake processes, such as algal and aquatic plant growth, produce organic material that decomposes when it dies. Year after year, the particles and decomposed organics slowly get incorporated in the bottom of the lake as layers of sediment, which preserve a constant snapshot of the landscape and lake environment.

We can collect sediment cores from these lakes using manual coring devises made of stainless steel or plastic tubes fitted with a piston to hold the mud in the barrel. Typically, cores are taken from an anchored floating platform and the coring device is pushed into the sediment by several people and then brought to the surface undisturbed. The sediment is extruded from the barrel of the corer for analysis at the laboratory. We can then analyze the sediment cores for different proxies—indirect measurements of the ancient environment—including pollen and charcoal to reconstruct vegetation and fire activity, respectively, and the geochemistry of the sediments to determine changes in mineral (clastic) and organic (detritus gyttja) inputs that tells us about erosional events and aquatic productivity, respectively.

In Colorado, the best lakes to collect paleoenvironmental data are typically found above 3000 m (9840 ft). These lakes formed at the end of the last ice age

2022 *Multidisciplinary Research at the La Botica Site, Conejos County, Colorado*, edited by Mark D. Mitchell, pp. 29-42. Research Contribution 115. Paleocultural Research Group, Broomfield, Colorado.

(about 17,000 years ago) when glaciers retreated and scoured out the landscape or left behind blocks of ice that created depressions. Lakes formed by remnant ice depressions are called kettle lakes and they are the most common type of glacial lake in Colorado. On rare occasions natural lakes form after a landslide or a large debris flow creates a deep depression suitable for holding water for a long period of time. Locations above 3000 m are also high enough that the lakes did not dry out during warmer and drier times than today, conditions which halted deposition of particles and degraded them. For example, pollen (made of a chemically inert biological polymer called sporopollenin) preserves well as long it is consistently wet or constantly dry and is protected from ultraviolent radiation.

There are many limitations to paleoenvironmental data from lakes. The proxies are simply that, indicators of what the environment was once like, and each has different levels of understanding in the scientific community. For example, pollen has been well studied for more than a century and we understand how it is dispersed, transported, and deposited in different environments through observation and models. Pollen that is found in lake sediment cores is primarily carried by the wind; plants that pollinate by animal agency are not well represented in lake sediment cores. It is also very difficult to identify a pollen grain down to the species level, so family- or genus-level identifications are often only possible. In several cases, we can use our understanding of an area's flora and plant geography to narrow the pollen identification to a particular species or group of species. Another limitation is that not all plants produce the same amount of pollen per anther or cone and some grains are more easily dispersed than others. Modern pollen samples and models are used to help interpret the ancient record.

Continuous fire reconstructions (fire frequency and biomass burning) using charcoal has been around for the last 30 years or so. In that short time the community of scientists studying charcoal has developed some very sophisticated models of charcoal transport and deposition, as well as analysis techniques that allow us to reconstruct fire activity through time. However, to reconstruct fire activity, fires had to burn hot enough to produce charcoal, but not so hot that the biomass fuel was completely combusted. So, not all environments produce a fire history, but typically montane and subalpine forests of Colorado contain good charcoal records. Finally, we are unable to distinguish the species of plants the charcoal came from, except for grasses.

Paleoenvironmental records from lake sediment cores taken in the southeastern San Juan Mountains and the Sangre de Cristo and Sawatch ranges of Colorado provide insights on Holocene climatic and vegetation changes and patterns in the region. Notably, these changes include the expansion and contraction of treeline, alterations in vegetative structure and composition, and corresponding changes in fire regimes. While there is evidence for climate effects on vegetation and fire dynamics in the region, contiguous records in the southeastern San Juan Mountains are rare, and most occur above 3000 m. The paleoenvironmental summary that follows provides information on the responsiveness of the ecosystem to climate fluctuations since deglaciation about 18,000 years ago in Colorado, with a specific focus on the records nearest to the La Botica site. To provide context, the summary spans a longer time than the period of occupation at the site. A new vegetation and fire record from Beaver Lake (3000 m), the closest site to La Botica, that spans the last 5,000 years is presented at the end of the chapter for more location-specific changes. Two additional paleoenvironmental records, from Cumbres Bog (Johnson *et al.* 2013), located nearby and at a similar elevation to Beaver Lake, and from San Luis Lake (Yuan *et al.* 2013), northeast of Alamosa, Colorado, provide the closest records on vegetation and hydroclimate conditions, respectively (figure 3.1A).

Southern Colorado Paleoenvironmental History

Full-Glacial and Late-Glacial Period (~20,000 – 14,700 cal B.P.)

The longest (20,000 cal B.P.) paleoecological record for the San Juan Mountains indicates that the area was still glaciated and cold and dry at 18,000 cal B.P. (Johnson *et al.* 2011; Johnson *et al.* 2013)[1]. Multiple regional studies indicate that gradual warming and deglaciation occurred between about 16,000 and 18,000 cal B.P. (Benson *et al.* 2005; Briles *et al.* 2012; Brugger 2006; Guido *et al.* 2007; Johnson *et al.* 2011; Johnson *et al.* 2013). As the amount of solar radiation increased, the climate warmed, and soils started to develop with the establishment of alpine tundra at most locations above 3000 m (Anderson, Allen, Toney, Jass, and Bair 2008; Johnson *et al.* 2011; Johnson *et al.* 2013). Hydroclimate data from San

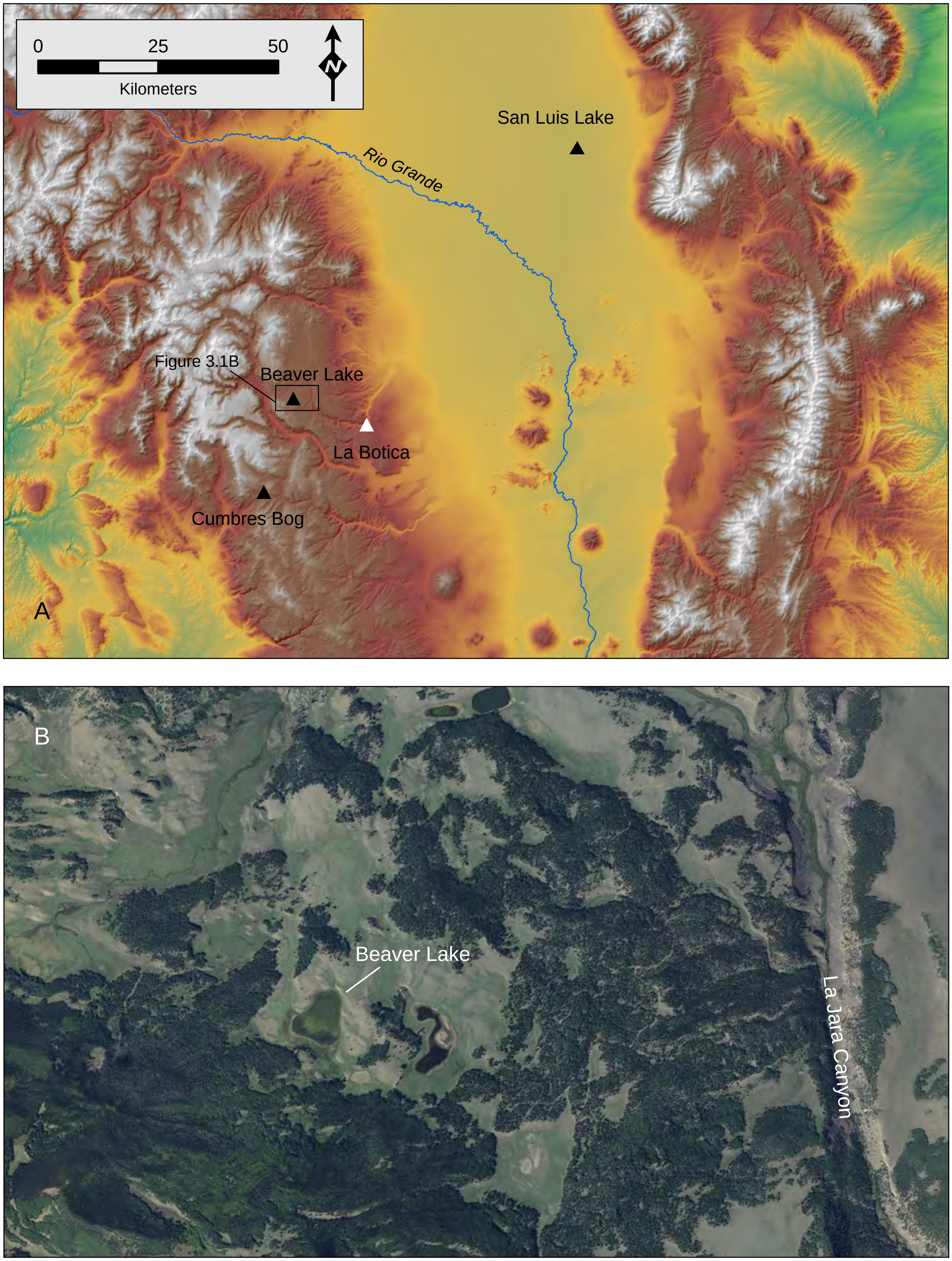


Figure 3.1. Top: map of the San Luis Valley showing the locations of three paleoenvironmental sample sites discussed in the text and their relationships to the La Botica site; lower: Google Earth image showing Beaver Lake and the surrounding landscape.

Luis Lake suggests a rapid dry to wet transition called the "Big Wet" event (Yuan *et al.* 2013), which resulted in the lake overflowing between 15,600 and 15,200 cal B.P. (figure 3.2A).

Bølling-Allerød Period (14,700 – 12,900 cal B.P.)

Regional records show a consistent warming trend corresponding with the Bølling-Allerød interstadial period (about 13,700 to 12,900 cal B.P.), with peak Pleistocene temperatures occurring around this time (Johnson *et al.* 2011; Johnson *et al.* 2013). Hydroclimate data from San Luis Lake indicate conditions were dry (figure 3.2). Regional pollen records show a dominance of non-arboreal *Artemisia* and *Poaceae* pollen, with the presence of *Brassicaceae*, *Asteraceae*, *Sarcobatus*, and *Betula* (Anderson, Allen, Toney, Jass, and Bair, 2008; Anderson *et al.* 2018; Briles *et al.* 2012; Jiménez-Moreno *et al.* 2008; Jiménez-Moreno and Anderson 2013; Jiménez-Moreno *et al.* 2019). Also, in this interval the first indication that conifers (*Pinus*, *Picea*, *Abies*, and *Juniperus*) are on the landscape. The addition of conifer pollen indicates a transition from alpine tundra to open spruce forest beginning around 14,000 cal B.P. regionally.

Younger Dryas Chronozone (12,900 – 11,700 cal B.P.)

The Younger-Dryas cold period is evident in most regional records, with temperatures typically warmer than the Late-Glacial period, but markedly cooler than the Bølling-Allerød interstadial and the Holocene. The San Luis Lake basin was wetter than before due to increased winter precipitation (figure 3.2). Younger Dryas glacial advances are seen regionally in the Southern Rocky Mountains in Colorado (Reasoner and Jodry 2000), in addition to northern New Mexico's Sangre de Cristo Mountains (Anderson *et al.* 2018; Armour *et al.* 2002). Paleoecological records for Colorado's southern San Juan Mountains indicate vegetation responses either to cool conditions with long periods of ice cover returning around 12,500 cal B.P. (Johnson *et al.* 2013) or to deglaciation contemporaneous with the end of the Younger Dryas (Toney and Anderson 2006). This body of evidence suggests there was a distinct forest response to Younger Dryas cooling that caused the downward shift of treeline and decreased wetland species and lake productivity in the region (Jiménez-Moreno *et al.* 2019; Jiménez-Moreno and Anderson 2013; Reasoner and Jodry 2000; Toney and Anderson 2006). Briles

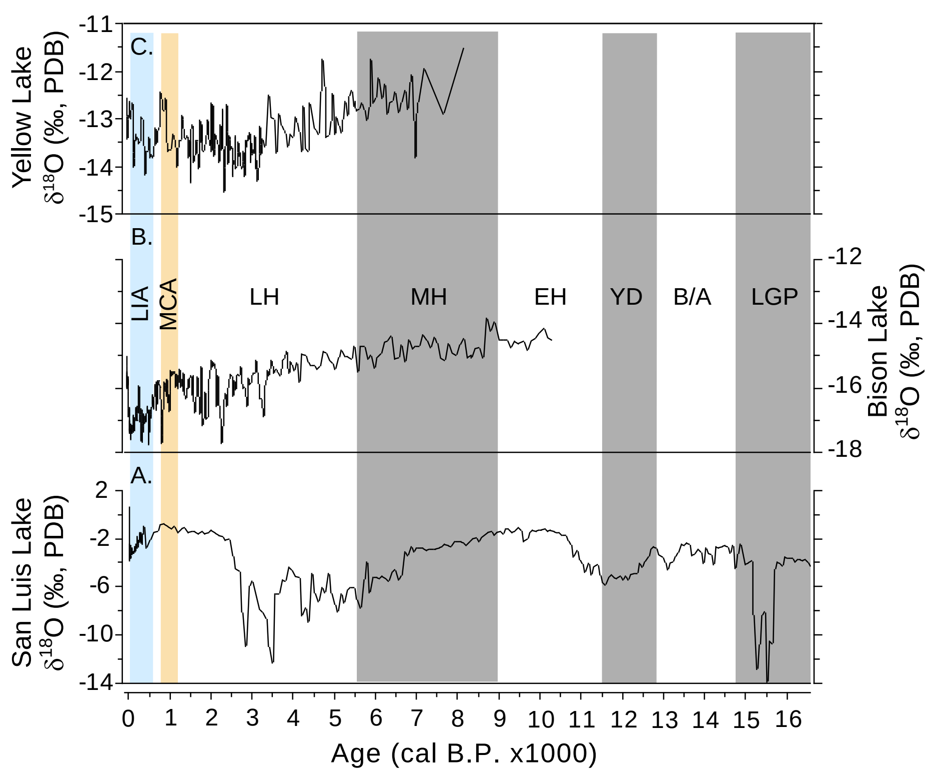


Figure 3.2. Oxygen isotope records from (A) San Luis Lake (Yuan et al. 2013); (B) Bison Lake (Anderson 2011); and (C) Yellow Lake (Anderson 2012). LIA=Little Ice Age; MCA=Medieval Climate Anomaly; LH=Late Holocene; MH=Middle Holocene; EH=Early Holocene; YD=Younger Dryas Chronozone; B/A= Bølling – Allerød Period; LGP=Late Glacial Period.

and others (2012) suggests longer growing seasons and cool, wet conditions resulted in the expansion of forests near Gunnison, Colorado that likely supported Native American populations in the area.

Early Holocene (11,700 – 9000 cal B.P.)

The transition from the Younger Dryas chronozone to the Early Holocene is associated with significant warming. Northern Hemisphere solar radiation averaged about 8 percent higher in summer months than today, which contributed to warmer temperatures and forest expansion (Anderson, Allen, Toney, Jass, and Bair 2008; Kutzbach and Guetter 1986). Shifts from clay to organic lake sediment combined with stable magnetic susceptibility values suggest more productive environments and less aeolian sediment inputs after 11,500 cal B.P. (Johnson *et al.* 2013).

Increases in *Picea*/*Artemisia* and *Pinus*/*Artemisia* pollen ratios along with overall reductions in non-arboreal pollen across records indicate significant vegetation shifts toward more forest (Anderson, Allen, Toney, Jass, and Bair 2008; Jiménez-Moreno *et al.* 2008; Johnson *et al.* 2013). Most regional pollen records also indicate upper and lower elevation forest expansion (Briles *et al.* 2012; Jiménez-Moreno *et al.* 2019; Jiménez-Moreno and Anderson 2013; Reasoner and Jodry 2000; Toney and Anderson 2006). Forest expansion is largely inferred in regional pollen records where *Artemisia* and *Poaceae* decline and conifer species substantially increase, especially *Pinus*. The increase in *Pinus* regionally likely reflects expansion of *P. ponderosa* forests at lower elevations. In addition, *Quercus*, *Pseudotsuga*, *Juniperus*, and *Alnus* become abundant during this time, further supporting the inference that there was regional warming and forest expansion at low elevations. Peaks in subalpine species pollen and macrofossils also indicate greater forest.

The summer monsoon in southern Colorado intensified during this period (figure 3.2), which is supported by the *Pinus* expansion, increases in wood cellulose deuterium, increases in aquatic algae and wetland species, and diatom assemblages that indicate wet summer conditions (Anderson, Jass, Toney, Allen, Cisneros-Dozal, Hess, Heikoop, and Fessenden 2008; Anderson et al. 2018; Briles *et al.* 2012; Friedman *et al.* 1988; Jiménez-Moreno and Anderson 2013; Johnson *et al.* 2013; Toney and Anderson 2006).

Middle Holocene (9000 – 5500 cal B.P.)

Regional paleoclimate records for the Middle Holocene show considerable temperature variation, with warm temperatures modulated by multiple, brief cold periods (Jiménez-Moreno *et al.* 2008; Johnson *et al.* 2013; Yuan *et al.* 2013). However, cold periods had little impact on biological productivity (Johnson *et al.* 2013). Subalpine forests transitioned to mixed conifer forests with maximum percentages of white *Pinus*-type (*Pinus strobiformis*, *P. flexilis*, and *Pinus edulis*), yellow *Pinus*-type (*Pinus ponderosa* and *Pinus contorta*), *Pseudotsuga menziesii*, and *Betula* (*B. fontinalis*) pollen (Anderson, Jass, Toney, Allen, Cisneros-Dozal, Hess, Heikoop, and Fessenden 2008; Anderson et al. 2018; Briles *et al.* 2012; Feiler *et al.* 1997; Jiménez-Moreno et al 2008; Jiménez-Moreno *et al.* 2019; Jiménez-Moreno and Anderson 2013). Total pollen and tree pollen accumulation rates were high, suggesting that forests were likely becoming more closed through the period (Toney and Anderson 2006). Increases in non-arboreal pollen (*Artemisia* and *Poaceae*) suggests sagebrush steppe expansion from lower elevations.

Regional lakes record shallow lake phases and significant dry periods occurring between about 9000 and 4000 cal B.P. (figure 3.2) (Anderson, Jass, Toney, Allen, Cisneros-Dozal, Hess, Heikoop, and Fessenden 2008; Jiménez-Moreno *et al.* 2008; Shuman *et al.* 2009; Yuan *et al.* 2013). A marked dry period occurred from 8500 to 6400 cal B.P. with evidence of lowered water tables and complete loss of the wetland environment in the Southern Rocky Mountains (Anderson, Jass, Toney, Allen, Cisneros-Dozal, Hess, Heikoop, and Fessenden 2008). Peak temperatures in northern New Mexico are indicated by consistently high magnetic susceptibility, low *Picea*/*Artemesia* pollen ratios, and lowered groundwater tables during the Middle Holocene (Anderson *et al.* 2018; Jiménez-Moreno *et al.* 2008). Finally, increases in fire frequency and declines in the sedimentation rate further point to drier conditions (Toney and Anderson 2006). The occurrence of lower lake levels and absence of persistent water at many sites may be local expressions of long-term drought conditions across the southwest.

Late Holocene (5500 – Present cal B.P.)

Regional records indicate that climate varied significantly during the Late Holocene, but that the climate was generally cooler relative to the Early and Middle Holocene (Jiménez-Moreno *et al.* 2008, 2021; Johnson *et al.* 2013; Yuan *et al.* 2013). Summer solar radiation decreased through the Late Holocene while winter insolation increased (Kutzbach and Guetter 1986). The solar radiation changes coincide with increased El Nino/Southern Oscillation (ENSO) activity (Jiménez-Moreno *et al.* 2021), revealing the impact of large-scale climatic variation on vegetation in the region (Anderson Jass, Toney, Allen, Cisneros-Dozal, Hess, Heikoop, and Fessenden 2008; Anderson, Allen, Toney, Jass, and Bair 2008; Jiménez-Moreno *et al.* 2008, 2019; Johnson *et al.* 2013; Toney and Anderson 2006). Periods of strong ENSO warm phases may have led to increased spring and summer snowpack resulting in cooler and dry summers in the San Juan Mountains. Alternatively, periods of strong cold phase ENSO events may have led to warmer winters and longer, wetter summers. Increases in *Abies* may also indicate increased winter precipitation from a strengthened ENSO and higher soil moisture. Yuan and others (2013) indicate increasing water levels at San Luis Lake through the Late Holocene, with overflow events between 3500 and 3000 cal B.P. (the Neopluvial event). They note that these are similar to events that occurred in the late-glacial period (the Big Wet event). The Late Holocene and Late-Glacial period events likely have similar climate mechanisms at play, including a cooling of the North Pacific and the southward displacement of the Pacific Jet Stream and Intertropical Convergence Zone. Both pluvial events were also widespread across lakes in the desert Southwest.

Hydroclimate records from Bison and Yellow lakes, located near Steamboat Springs, Colorado, indicate a switch in the timing of precipitation from summer rain to winter snow that occurred after 3500 cal B.P. with more precipitation variability (figure 3.2B and C) (Anderson 2011, 2012). However, after 3000 cal B.P. at San Luis Lake, Yuan and others (2013) suggest that there was a rapid decrease in precipitation that resulted in reduced stream flows and hydrological closure of the lake (figure 3.2A). This rapid moisture shift in south-central Colorado, and continued seasonal variability at the northern lakes, suggests a northward displacement of the Pacific Jet Stream.

Two notable climate events, including the Medieval Climate Anomaly (MCA, 1250 to 850 cal B.P.) and the Little Ice Age (LIA, 600 to 200 cal B.P.), have impacted vegetation and fire regimes as discussed in detail later in the chapter. At San Luis Lake, the ratio of summer-to-winter precipitation increased gradually through the Late Holocene and peaked during the MCA. A slight excursion in summer-to-winter ratios occurred during the LIA, indicating more winter precipitation (figure 3.2A). Annual temperature data based on tree-ring data quantify the differences between these events that we can compare with other environmental proxies. Based on these data, modern temperatures exceeded those during the MCA, while during the LIA they were annually 1°C cooler than during the MCA. Overall, during this time, data reflect transitions toward mixed conifer forests of *Picea*, *Pinus*, and *Abies* that are present in the region today (Anderson, Allen, Toney, Jass, and Bair 2008; Anderson, Jass, Toney, Allen, Cisneros-Dozal, Hess, Heikoop, and Fessenden 2008; Jiménez-Moreno *et al.* 2008, 2019; Johnson *et al.* 2013; Toney and Anderson 2006). Details on Late Holocene vegetation and fire regime changes from Beaver Lake, including comparison with other regional paleoenvironmental reconstructions, are discussed in the next section.

Beaver Lake Paleoenvironmental Record

Modern Climate and Vegetation

Beaver Lake (37°11’50.77”N, 106°23’01.03”W) lies at 3000 m, at the montane-subalpine transition in the eastern San Juan Mountains in south-central Colorado (figure 3.1B). Large areas around the lake are treeless and composed mostly of plants found at much lower elevations including grasses, herbs, and *Artemisia*. Grazing and human landscape management has affected the area and may be keeping these areas open. Beaver Lake is located 16 km slightly north and west of the La Botica site (figure 3.1A). Modern climate of eastern San Juan Mountains is characterized by high precipitation during spring (average about 550 mm) and summer (about 750 mm), with drier falls and winters (about 150 and 375 mm, respectively). (Data averaged from the Lily Pond SNOTEL station [NRCS 2022].) Average temperatures in summer are 11° C (52° F) and -6° C (21° F) in winter. Decadal-scale climate variability of the region is significantly influenced by ENSO and Pacific Decadal Oscillation (PDO) activity (Jiménez-Moreno *et al.* 2021).

Plant communities in the region are defined by elevational variations in climate. The lowest elevations (below 1500 m) are largely mountain shrub communities, with *Quercus gambelii* (Gamble oak), *Purshia tridentata* (antelope bitterbrush), *Peraphyllum ramosissimum* (squaw-apple), *Fendlera* *rupicola* (fendlerbush), and *Cercocarpus montanus* (mountain mahogany). This association transitions into a pygmy woodland that occurs between about 1500 and 2400 m and is primarily composed of piñon pine (*Pinus edulis*) and juniper (including Utah juniper, *Juniperus osteosperma,* and Rocky Mountain juniper, *Juniperus scopulorum*) (Anderson, Jass, Toney, Allen, Cisneros-Dozal, Hess, Heikoop, and Fessenen 2008; Floyd-Hanna *et al.* 1996; Johnson *et al.* 2013). At the upper edge of this zone, from about 2000 to 2400 m, it is common to find mixed stands of *Pinus ponderosa* (Ponderosa pine), *Quercus gambelii* (Gambel oak), and *Pseudotsuga menziesii* (Douglas fir), often with nearly pure stands of *Pinus ponderosa*. From about 2400 to 2700 m, the vegetation changes to a montane coniferous forest, consisting of *Pseudotsuga menziesii* (Douglas fir), *Abies concolor* (white fir), *Pinus strobiformis* (southwestern white pine), *Pinus ponderosa* (ponderosa pine), *Picea pungens* (Colorado blue spruce), *Populus tremuloides* (quaking aspen), *Quercus gambelii* (Gambel oak) and *Acer glabrum* (Rocky Mountain maple). Above 2700 m, the subalpine zone is dominated by *Picea engelmannii* (Engelmann spruce) and *Abies lasiocarpa* (subalpine fir); in the north, *Pinus contorta* (lodgepole pine) is also present (Anderson, Jass, Toney, Allen, Cisneros-Dozal, Hess, Heikoop, and Fessenen 2008; Johnson *et al.* 2013; Weber and Wittmann 1996). Above 3300 m, the alpine zone begins and the presence of trees diminishes. This zone consists of compact, low-growing perennials, including grasses (Poaceae) and sedges (Cyperaceae), as well as deep-rooted mat plants, such as moss campion (*Silene acaulis*), alpine bistort (*Bistorta bistortoides*), mountain avens (*Acomastylis rossii*), elephant's head (*Pedicularis groenlandica*) and cinquefoil (*Potentilla* sp.) (Anderson, Jass, Toney, Allen, Cisneros-Dozal, Hess, Heikoop, and Fessenen 2008; Jamieson *et al.* 1996).

Methods

A 4.84-meter continuous sediment core was extracted from Beaver Lake in June 2018 using a modified Livingstone piston corer from an approximately 1 m deep section of the lake. In addition, a 1-m core was taken with a Klein short corer to preserve the mud-water interface and capture the top sediments. In the lab, lithology was described, the core was subsampled at 0.5-cm intervals, and each sample was measured for sediment magnetic susceptibility using a Bartington MS2 sensor to determine clastic inputs. During the subsampling, macrofossils (which were very sparse) were set aside for radiocarbon dating. Where no macrofossils were present, organic sediment was taken for a radiocarbon date. Radiocarbon dating was conducted at from Lawrence Livermore National Laboratory. Bacon age-depth modeling software was used to characterize sediment deposition (Blaauw and Christen 2011).

Pollen analysis provides information regarding changes in local forest composition and structure. Pollen samples were collected and analyzed from the Beaver Lake core at 5-cm increments. After initial pollen analysis, additional samples were prepared from the top portion of the core (the upper approximately 30 cm). Established laboratory methods were followed for processing all pollen samples (Faegri and Iversen 1985). Potassium hydroxide and acetolysis were used to remove organic material, and hydrofluoric acid was used to remove silicates. Slides were prepared and counted using a light microscope. Lycopodium tracers were added to allow for pollen concentration calculation (grains/cm^3). Grains were identified to the lowest taxonomic level possible using the pollen lab reference library. *Pinus* grains were separated into Diploxylon (likely *P. contorta*-type) and Haploxylon (*P. flexillis*- or *P. edulis*-type). All other grains were identified and counted at the genera or family levels. Pollen percentage data and accumulation rates were calculated to reconstruct forest structure and composition, respectively. Both were calculated at each sample depth using the following equations.

Pollen percentages:

$$\left(\frac{taxa\ grain\ count}{\sum all\ grains}\right) \times 100$$

The nonarboreal to arboreal ratio was also calculated to help identify changes in the forest structure using the following equation:

$$\frac{\sum nonarboreal\ pollen\ grains - \sum arboreal\ pollen\ grains}{\sum nonarboreal\ pollen\ grains + \sum arboreal\ pollen\ grains}$$

Higher amounts of arboreal pollen indicate a more closed canopy. A more open forest structure is indicated by increases in nonarboreal pollen from grasses, shrubs, and other steppe species.

Macroscopic charcoal (larger than 125 μm) was analyzed to reconstruct the local fire history of Beaver Lake using the sieve method (Whitlock and Larsen 2001). Samples, at contiguous 0.5-cm intervals, were treated with bleach to remove humic matter and then filtered through a 125-μm sieve. Macroscopic charcoal pieces were counted in a gridded petri-dish using a stereomicroscope. Charcoal counts were analyzed using the statistical program CharAnalysis (Higuera 2022; Higuera *et al.* 2010). A nonarboreal-to-arboreal charcoal ratio (NAC/AC) was calculated, similar to the pollen ratios describe previously, that indicates the relative levels of trees or grasses burned.

CharAnalysis uses charcoal particle counts and sample volumes and ages and interpolates them to the median sample resolution (yr/sample). The program then distinguishes between background charcoal (BCHAR) and charcoal accumulation rates (CHAR) using charcoal concentrations (particles/cm^3) and the sedimentation rate (cm^2/yr). CHAR is reported in units of particles per centimeter per year (particles/cm^2/yr). BCHAR represents a running average of charcoal accumulation rates through time. BCHAR reflects changes in the rate of total charcoal production (biomass) and changes in secondary charcoal deposition from extra-local sources (Higuera *et al.* 2010). The signal-to-noise index (SNI) is a statistical measurement of the separation between BCHAR and peak events. The larger the separation (generally above 3 for this record), the higher the confidence that a fire event occurred in the record (Higuera *et al.* 2014). A local threshold value (99 percent) was used to identify CHAR peaks beyond BCHAR levels using a noise distribution model based upon a 1-mean Gaussian distribution. If a peak in CHAR exceeded the threshold, a local fire event was identified. Peak magnitude (particles/cm^2/peak), or the amount of CHAR above BCHAR, has been used as an indicator of fire severity, although proximity of the fire events to the lake and wind direction could also influence peak magnitude.

Results and Discussion

Core Lithology and Chronology

The entire length of the Beaver Lake core was composed of fine detritus gyttja (Munsell color 2.5Y 2.5/1). Three radiocarbon dates make up the chronology for Beaver Lake (table 3.1 and figure 3.3). The mean accumulation at the site is about 10 years/cm, which is half that of Cumbres Bog located roughly 20 km southwest of Beaver Lake (Johnson *et al.* 2013). Both sites lie at similar elevations, are composed of fine detritus gyttja for the past 5,000 years, and have a distinct sedimentation rate change at about 2500 cal B.P. Magnetic susceptibility values are initially high at Beaver Lake (roughly 0.3 to 1 SI), drop significantly after 3500 cal B.P. (less than 0.1 SI), and remain low until 200 cal B.P. when values increase thereafter (0.3 SI) (figure 3.4). Interestingly, the magnetic susceptibility signatures are similar for both Beaver Lake and Cumbres Bog. For example, both sites show sustained diamagnetic (less than 0 SI) values after 1500 cal B.P., with values over 0 SI only at about 1000 and after 200 cal B.P. The timing of sedimentation change at about 2500 cal B.P. and correspondence of magnetic susceptibility values at both sites, suggest chronological congruency and a similar erosion history. The initial high magnetic susceptibility prior to 3500 cal B.P. suggests increased clastic inputs into the lake due to erosion from the surrounding topography, possibly due to the wetter conditions associated with the Neopluvial events recorded at San Luis Lake. The increase in moisture and cooler conditions through the Late Holocene would have made resources plentiful. However, after 3500 cal B.P., rapid declines in magnetic susceptibility indicate a decrease in erosional events likely due to increased aridity which would have made resources scarce and unpredictable.

Pollen

The pollen record indicates a gradual shift from conifers (*Pinus* and *Picea*) after 5000 cal B.P. to steppe-associated species (*Artemisia* and *Poaceae*) (figure 3.4). The transition in plant community is apparent in the non-arboreal to arboreal (NAP/AP) ratios that are around -0.24 at 5500 cal B.P. and increase to 0.24 at the start of the LIA. The change in vegetation was likely the result of gradual warming and increased aridity. *Pinus* is the dominant conifer between 5000 and 4800 cal B.P., with more *Picea* in the forest between 4800 and 3500 cal B.P. during what Yuan and others (2013) identifies as outflow events of the San Luis Lake due to high stream flows. This change in spruce abundance suggests a multi-century period of wet conditions that extended from the San Luis Valley up to higher elevations in the nearby mountains. Between 3500 and 2500 cal B.P., *Picea* and *Pinus* percentages decline and non-arboreal pollen percentages increase, corresponding to the closing of the San Luis Lake due to decreased stream flows. The shift to a steppe plant community continues between 2500 and 1500 cal B.P., with *Artemisia* increasing and

Table 3.1. Radiocarbon age determinations for the Beaver Lake sediment core.

Lab ID	Material	Age (^{14}C yr B.P.)	Sample Depth[1] (cm)	Core
CAMS 181751	Seed	1950±30	124.5	C2D2
CAMS 181752	Seed	3045±30	323.0	C2D4
CAMS 181753	Sedge	4970±30	436.5	C2D7

[1] Cm below the sediment-water interface.

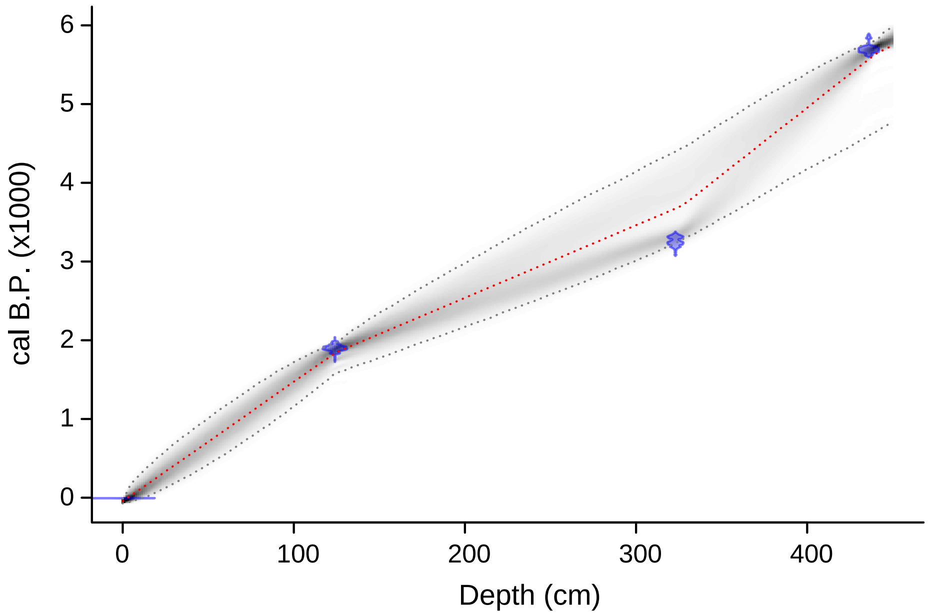


Figure 3.3. Age-depth model for Beaver Lake (see table 3.1 for age information). Purple symbols are the calibrated ages along with the probability distribution. Red line is the mean of all iterations and the dashed gray lines are the 95 percent confidence interval of all model runs.

Pinus and *Picea* declining. The shift towards a more open steppe community is most pronounced between 1000 and 400 cal B.P., which is contemporaneous with the MCA. During the MCA, *Pinus* reached its lowest abundance of the record (16 percent). Percentages of *Pinus* less than 20 percent indicate very few pines occupied the landscape around the lake.

The close relationship between the pollen record at Beaver Lake and the moisture record at San Luis Lake suggests that the La Botica site likely experienced favorable growing conditions and plentiful resources up until about 3500 cal B.P., with significant droughts and shifts to xerophytic species thereafter. High percentages of Cupressaceae (juniper) and low percentages of shrub and herb pollen found in packrat middens near La Botica around 3000 cal B.P. may indicate the high moisture levels (chapter 4). The increase in shrub and herb pollen and decrease in Cupressaceae pollen in the midden record at about 2500 cal B.P. likely indicates the shift to more arid conditions. The most pronounced aridity and unfavorable conditions occurred between 1000 and 400 cal B.P. at both Beaver and San Luis lakes. The pollen in the middens during this time indicate high pine and xerophytic shrub and herb percentages. After 400 cal B.P., *Pinus* percentages at Beaver Lake rebound to levels similar to those before the MCA, likely in response to the cooler and wetter conditions of the LIA. While the LIA was a break from continuous aridity, *Picea* did not increase at Beaver Lake and the San Luis Lake did not experience outflow events. Conditions during the LIA at La Botica resulted in the establishment of more mesophytic plant types such as juniper and fruit bearing rosaceous trees and shrubs based on pollen identified in a midden from the LIA (chapter 4).

Cumbres Bog also records a gradual decrease in forest to more steppe species during the last 5,000 years (Johnson *et al.* 2013). The record does indicate an earlier rise in *Pinus* and *Picea* than at Beaver Lake around 1500 cal B.P. Cumbres Bog is situated further west of the San Luis Valley than Beaver Lake and valley heating and decreased effective moisture probably resulted in warmer conditions and greater aridity at Beaver Lake. For example, Cumbres Bogs levels of *Pinus* are about 15 percent less overall with

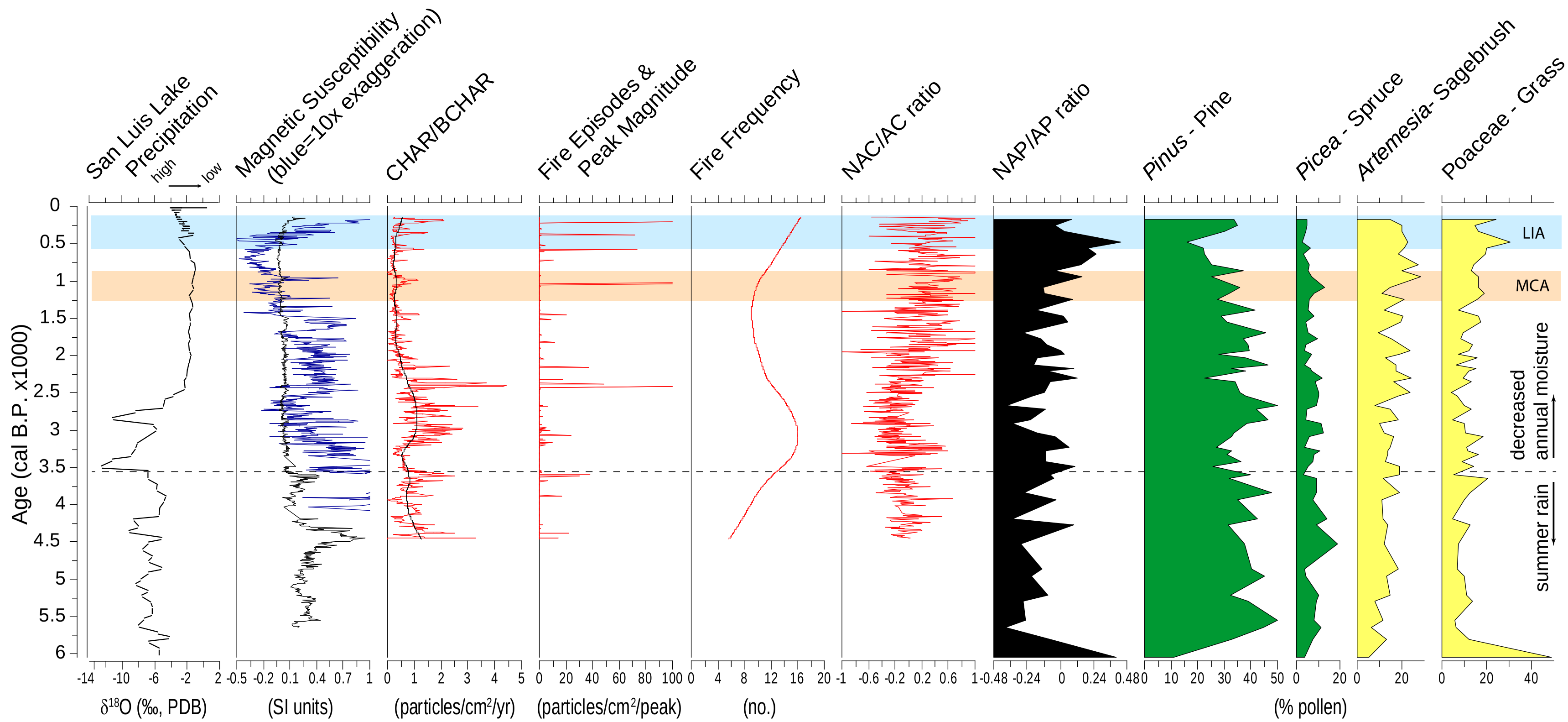


Figure 3.4. Left column: San Luis Lake oxygen isotope record indicating precipitation levels Yuan and others (2013). Right 10 columns: Beaver Lake magnetic susceptibility in black (with blue 10x exaggeration); charcoal in red (CHAR, BCHAR [black line], peak magnitude for each fire episode, fire frequency, and non-arboreal-to-arboreal charcoal ratio); and pollen (non-arboreal-to-arboreal charcoal ratio in black, conifers in green, and steppe species in yellow). Medieval Climate Anomaly (MCA) shown by orange bar. Little Ice Age (LIA) shown by blue bar. The dashed line indicates the change in timing of precipitation based on oxygen isotope records from Colorado (Anderson 2011, 2012; Yuan et al. *2013).*

higher *Picea*, *Abies*, *Quercus*, and Cupressaceae percentages than at Beaver Lake. Differences in timing of vegetation changes of nearby sites due to valley heating has been observed elsewhere in the western U. S. (Briles *et al.* 2008).

Charcoal

The charcoal record, in conjunction with the pollen record, is useful for identifying complex dynamics among climate, vegetation, and fire (figure 3.4). Charcoal accumulation rates (CHAR) were moderate and variable between 4500 to 3500 cal B.P., low between 3500 and 3100 cal B.P., highest between 3150 and 2500 cal B.P., low between 2500 and 1500 cal B.P., and moderate and variable for the remainder of the record. Peak magnitudes were initially low prior to 2500 cal B.P. and were larger thereafter (7 peaks above 40 particles/cm/peak). The NAC/AC ratio corresponds well with the NAP/AP ratio. Specifically, prior to 2500 cal B.P. the NAC/AC ratio averaged about -0.2 and rose to 0.2 thereafter, suggesting that more wood charcoal was initially burned and then transitioned to more grass charcoal as forest transitioned to steppe.

The charcoal data provides a high-resolution marker of the timing of the forest to steppe transition that corresponds with the lower-resolution pollen data. The change in the type of charcoal burned happens rapidly over a 500-year period. This transition in the type of charcoal ratios suggests the sensitivity of both vegetation and fire regime to the rapid changes in moisture recorded at San Luis Lake (Yuan *et al.* 2013). Fire frequency (or activity) was low initially (roughly 6 fires/1000 years), highest during the forest-steppe transitions between 3500 to 2500 cal B.P. (up to 16 fires/1000 years), moderate (about 9 fires/1000 years) until 400 cal B.P. when more steppe was present, and then increased up to 16 fires/1000 years as pine increased through the remainder of the record.

In summary, fire frequency was moderate when steppe was prevalent and higher when forest was present. There does not appear to be any evidence for human modified fire regime at Beaver Lake as the charcoal data corresponds to local changes in climate. However, the tree-ring fire record at La Botica indicates changes in fire activity related to human population patterns and land management (chapter 5). However, given the difference in elevation of the sites, the limited human influence at upper elevations, and the difference in plant communities and related fire regimes at the sites, it is not expected humans were altering fire activity at Beaver Lake.

Conclusions

The Beaver Lake paleoenvironmental record, and other local paleoclimate records, indicate increased aridity after 3500 cal B.P. with drought particularly pronounced during the MCA. Conifer-dominated forest transitioned to steppe after 3500 cal B.P., and especially during the MCA, with a noticeable change in fire regime (less biomass burned and higher amounts of non-arboreal to arboreal charcoal burned). Conditions during the MCA were unlike anything recorded during the Holocene at Beaver Lake. Closer to the La Botica site, the pollen data from woodrat middens suggest more Cupressaceae (juniper) and *Pinus* prior to 2500 cal B.P., and then they decline through the MCA with slight increases in xerophytic shrubs and herbs, indicating increased aridity toward the present. However, the botanical remains in the middens suggest little plant community change in comparison to the pollen, so this may indicate the canyons did not change as much relative to the surrounding landscape in response to the increased aridity.

Although Beaver Lake is 16 km to the northwest of the La Botica site, climate changes since the last ice age impacted both locations. La Botica is a botanical refugia today resulting from microclimates and the geological and topographical complexity of the La Jara Canyon (chapter 2). These conditions likely protected the site from long-term droughts of the later Late Holocene and allowed it to maintain a diverse plant community. The stability of the botanical record from the middens near La Botica, suggest that the site itself may have been spared from climate change. However, based on long-distance transported pollen in the middens and those preserved in the Beaver Lake sediment core, the plant communities beyond the La Jara Canyon and around Beaver Lake responded in concert with climate fluctuations. The climate variability and shift in ecosystems would have made subsistence difficult beyond the canyon due to the level of uncertainty in year-to-year weather conditions, especially drought, and survivability and production of resources. However, the protected canyon may have allowed for more predictable long-term resources.

Endnote

[1] Dates are reported in this chapter as calendar years before the present (cal B.P.), defined as 1950 CE.

Acknowledgements. We thank Kristen Birdshire, Erin Mckay, and Hannah Rivers for helping with coring Beaver Lake. Permission to core Beaver Lake was granted by the Colorado State Land Board, Division of Natural Resources.

References Cited

Anderson, Lesleigh
2011 Holocene Record of Precipitation Seasonality from Lake Calcite $\delta^{18}O$ in the Central Rocky Mountains, United States. *Geology* 39(3):211-214. DOI: https://doi.org/10.1130/G31575.1
2012 Rocky Mountain Hydroclimate: Holocene Variability and the Role of Insolation, ENSO, and the North American Monsoon. *Global and Planetary Change* 92-93:198-208. DOI: https://doi.org/10.1016/j.gloplacha.2012.05.012

Anderson, R. Scott, Craig D. Allen, Jaime L. Toney, Renata B. Jass, and A. N. Bair
2008 Holocene Vegetation and Fire Regimes in Subalpine and Mixed Conifer Forests, Southern Rocky Mountains, USA. *International Journal of Wildland Fire* 17(1):96-114. DOI: https://doi.org/10.1071/WF07028

Anderson, R. Scott, Renata B. Jass, Jaime L. Toney, Craig D. Allen, Luz M. Cisneros-Dozal, Marcey Hess, Jeff Heikoop, and Julianna Fessenden
2008 Development of the Mixed Conifer Forest in Northern New Mexico and Its Relationship to Holocene Environmental Change. *Quaternary Research* 69(2):263–275. DOI: https://doi.org/10.1016/j.yqres.2007.12.002

Anderson, R. Scott, Hanna R. Soltow, and Gonzalo Jiménez-Moreno
2018 Postglacial Environmental Change of a High-Elevation Forest, Sangre de Cristo Mountains of South-Central Colorado. DOI: https://doi.org/10.1130/2018.2536(13)

Armour, Jake, Peter J. Fawcett, and John W. Geissman
2002 15 k.y. Paleoclimatic and Glacial Record from Northern New Mexico. *Geology* 30(8):723-726.

Benson, Larry, Richard Madole, Gary Landis, and John Gosse
2005 New Data for Late Pleistocene Pinedale Alpine Glaciation from Southwestern Colorado. *Quaternary Science Reviews* 24(1–2):49–65. DOI: https://doi.org/10.1016/j.quascirev.2004.07.018

Blaauw, Maarten, and J. Andrés Christen
2011 Flexible Paleoclimate Age-Depth Models Using an Autoregressive Gamma Process. *Bayesian Analysis* 6(3):457-474. DOI: https://doi.org/10.1214/11-BA618

Briles, Christy E., Cathy Whitlock, Patrick J. Bartlein, and Philip E. Higuera
2008 Regional and Local Controls on Postglacial Vegetation and Fire in the Siskiyou Mountains, Northern California, USA. *Palaeogeography, Palaeoclimatology, Palaeoecology* 265(1–2):159-169. DOI: https://doi.org/10.1016/j.palaeo.2008.05.007

Briles, Christy E., Cathy Whitlock, and David J. Meltzer
2012 Last Glacial-Interglacial Environments in the Southern Rocky Mountains, USA and Implications for Younger Dryas-Age Human Occupation. *Quaternary Research* 77(1):96-103. DOI: https://doi.org/10.1016/j.yqres.2011.10.002

Brugger, Keith A.
2006 Late Pleistocene Climate Inferred from the Reconstruction of the Taylor River Glacier Complex, Southern Sawatch Range, Colorado. *Geomorphology* 75(3-4):318-329. DOI: https://doi.org/10.1016/j.geomorph.2005.07.020

Faegri, Knut, and Johs. Iversen
1985 *Textbook of Pollen Analysis*. 4th Edition. Hafner Press, New York.

Feiler, Eric J, R Scott Anderson, and Peter A Koehler
1997 Late Quaternary Paleoenvironments of the White River Plateau, Colorado, U.S.A. *Arctic and Alpine Research* 29(1):53–62. DOI: https://doi.org/10.1080/00040851.1997.12003215

Floyd-Hanna, Lisa, Albert Spencer, and William Romme
1996 Biotic Communities of the Semiarid Foothills and Valleys. In *The Western San Juan Mountains: Their Geology, Ecology and Human History*, edited by Rob Blair, pp. 143–158. University Press of Colorado, Niwot.

Friedman, Irving, Paul Carrara, and Jim Gleason
1988 Isotopic Evidence of Holocene Climatic Change in the San Juan Mountains, Colorado. *Quaternary Research* 30(3):350–353. DOI: https://doi.org/10.1016/0033-5894(88)90010-5

Guido, Zackry S., Dylan J. Ward, and Robert S. Anderson
2007 Pacing the Post-Last Glacial Maximum Demise of the Animas Valley Glacier and the San Juan Mountain Ice Cap, Colorado. *Geology* 35(8):739–742. DOI: https://doi.org/10.1130/G23596A.1

Higuera, Philip E.
2022 CharAnalysis: Diagnostic and Analytical Tools for Sediment-Charcoal Analysis. Electronic resource, http://phiguera.gitbug.io/Charnalysis, accessed February 15, 2022.

Higuera, Philip E., Christy E. Briles, and Cathy Whitlock
2014 Fire-Regime Complacency and Sensitivity to Centennial- through Millennial-Scale Climate Change in Rocky Mountain Subalpine Forests, Colorado, USA. *Journal of Ecology* 102(6):1429-1441. DOI: https://doi.org/10.1111/1365-2745.12296

Higuera, Philip E., Daniel G. Gavin, Patrick J. Bartlein, and Douglas J. Hallett
2010 Peak Detection in Sediment–Charcoal Records: Impacts of Alternative Data Analysis Methods on Fire-History Interpretations. *International Journal of Wildland Fire* 19(8):996–1014.

Jamieson, David, William Romme, and Preston Somers
1996 Biotic Communities of the Cool Mountains. In *The Western San Juan Mountains: Their Geology, Ecology and Human History*, edited by Rob Blair, pp. 159–174. University Press of Colorado, Niwot.

Jiménez-Moreno, Gonzalo, and R. Scott Anderson
2013 Pollen and Macrofossil Evidence of Late Pleistocene and Holocene Treeline Fluctuations from an Alpine Lake in Colorado, USA. *The Holocene* 23(1):68-77. DOI: https://doi.org/10.1177/0959683612450199

Jiménez-Moreno, Gonzalo, R. Scott Anderson, and Jacqueline J. Shinker
2021 ENSO, Sun and Megadroughts in SW USA During the Last 11,000 Years. *Earth and Planetary Science Letters* 576 (2021). DOI: https://doi.org/10.1016/j.epsl.2021.117217

Jiménez-Moreno, Gonzalo, R. Scott Anderson, Bryan N. Shuman, and Ethan Yackulic
2019 Forest and Lake Dynamics in Response to Temperature, North American Monsoon and ENSO Variability During the Holocene in Colorado (USA). *Quaternary Science Reviews* 211(1):59-72. DOI: https://doi.org/10.1016/j.quascirev.2019.03.013

Jiménez-Moreno, Gonzalo, Peter J. Fawcett, and R. Scott Anderson
2008 Millennial- and Centennial-Scale Vegetation and Climate Changes During the Late Pleistocene and Holocene from Northern New Mexico (USA). *Quaternary Science Reviews* 27(13–14):1442–1452. DOI: https://doi.org/10.1016/j.quascirev.2008.04.004

Johnson, Bradley G., Martha Cary Eppes, John A. Diemer, Gonzalo Jiménez-Moreno, and Anthony L. Layzell
2011 Post-Glacial Landscape Response to Climate Variability in the Southeastern San Juan Mountains of Colorado, USA. *Quaternary Research* 76(3):352-362. DOI: https://doi.org/10.1016/j.yqres.2011.08.006

Johnson, Bradley G., Gonzalo Jiménez-Moreno, Martha Cary Eppes, John Diemer, and Jeffery Stone
2013 A Multiproxy Record of Postglacial Climate Variability from a Shallowing, 12-m Deep Sub-Alpine Bog in the Southeastern San Juan Mountains of Colorado, USA. *The Holocene* 23(7):1028-1038. DOI: https://doi.org/10.1177/0959683613479682

Kutzbach, John E., and Peter J. Guetter
1986 The Influence of Changing Orbital Parameters and Surface Boundary Conditions on Climate Simulations for the Past 18,000 Years. *Journal of Atmospheric Sciences* 43(16):1726–1759. DOI: https://doi.org/10.1175/1520-0469(1986)043<1726:TIOCOP>2.0.CO;2

Natural Resources Conservation Service [NRCS]
2022 Lily Pond SNOTEL Data. Electronic resource, https://www.nrcs.usda.gov/wps/portal/wcc/home/snowClimateMonitoring/30YearNormals/, accessed January 30, 2022.

Reasoner, Mel A., and Margaret A. Jodry
2000 Rapid Response of Alpine Timberline Vegetation to the Younger Dryas Climate Oscillation in the Colorado Rocky Mountains, USA. *Geology* 28(1):51-54. DOI: https://doi.org/10.1130/0091-7613(2000)28<51:RROATV>2.0.CO;2

Shuman, Bryan N., Anna K. Henderson, Steven M. Colman, Jeffery R. Stone, Sherilyn C. Fritz, Lora R. Stevens, Mitchell J. Power, and Cathy Whitlock
2009 Holocene Lake-Level Trends in the Rocky Mountains, U.S.A. *Quaternary Science Reviews* 28(19-20):1861-1879. DOI: https://doi.org/10.1016/j.quascirev.2009.03.003

Toney, Jaime L., and R. Scott Anderson
2006 A Postglacial Palaeoecological Record from the San Juan Mountains of Colorado USA: Fire, Climate and Vegetation History. *The Holocene* 16(4):505-517. DOI: https://doi.org/10.1191/0959683606hl946rp

Weber, William A., and Ronald C. Wittmann
1996 *Colorado Flora, Eastern Slope*. University Press of Colorado, Niwot.

Whitlock, Cathy, and Chris Larsen
2001 Charcoal as a Fire Proxy. In *Tracking Environmental Change Using Lake Sediments, Vol. 3: Terrestrial, Algal, and Siliceous Indicators*, edited by John P. Smol, John B. Birks, William M. Last, Raymond S. Bradley, and Keith Anderson, pp. 75–97. Developments in Paleoenvironmental Research. SpringerLink, Dordrecht, Netherlands.

Yuan, Fasong, Max R. Koran, and Andrew Valdez
2013 Late Glacial and Holocene Record of Climatic Change in the Southern Rocky Mountains from

Sediments in San Luis Lake, Colorado, USA. *Palaeogeography, Palaeoclimatology, Palaeoecology* 392:146–160. DOI: https://doi.org/10.1016/j.palaeo.2013.09.016

4 Paleoenvironment: The Woodrat Midden Record

Camille A. Holmgren, Gregory J. Bream, Kristy L. Duran, and Christy E. Briles

Much of what we know about the long-term vegetation history of arid and semi-arid environments comes from fossil rodent middens. In dry environments at lower-elevations, continuous depositional environments (such as wetlands) with long, well-preserved pollen records useful for reconstructing past vegetation changes are scarce. Instead, researchers have relied on middens, which are deposits containing leaves, seeds, flowers, fruits, and twigs, as well as fecal pellets, insects, bones, and pollen that represent the dens of rodents. These materials are encased in a rock-hard crystallized urine matrix known as amberat that protects them from decay. Middens may be preserved for tens of thousands of years in rock shelters, crevices, caves, and even under large boulders in arid and semi-arid areas (figure 4.1). In North America, middens are made by members of the genus *Neotoma*, commonly called woodrats or packrats because of their collecting and midden building behavior.

Fossil rodent middens provide a wealth of information about past environments. The large amount of organic material (fecal pellets, plant material) contained within middens means they can be easily radiocarbon dated, while the well-preserved plant macrofossils can often be identified to the genus, species, or even subspecies level. This high taxonomic resolution is matched by high spatial resolution. Because woodrats have a limited foraging range of less than 50 m from their den (Vaughan 1990), middens provide a localized snapshot of the plant community growing at a site. By collecting and collating a series of middens of different ages from an area, researchers can reconstruct changes in plant community composition through time including

2022 *Multidisciplinary Research at the La Botica Site, Conejos County, Colorado*, edited by Mark D. Mitchell, pp. 43-56. Research Contribution 115. Paleocultural Research Group, Broomfield, Colorado.

Figure 4.1. State University of New York – Buffalo State students holding a midden from Canyon del Rancho full of Pinus edulis *and* Juniperus cf. scopulorum *macrofossils. This midden was collected from the rock shelter in the background.*

the appearance or disappearance of key species, as well as infer associated changes in climatic conditions.

For example, midden studies have documented the displacement of species downslope in response to cooler and wetter conditions during the last glacial. During this period, much of the area currently occupied by the North American deserts instead supported chaparral and pinyon-juniper-oak woodland. Similarly, at higher elevations, mixed conifer woodland and forest moved downslope to replace pinyon-juniper woodland, while now-restricted spruce-fir forest extended down to an elevation of about 2000 m in the Southern and Central Rocky Mountains (Betancourt 1990, 2004). The fate of desert vegetation during the last glacial has been less clear. Long surmised to have been confined to areas below 300 m in Death Valley and around the Gulf of California, it now appears that desert elements survived as smaller, disparate populations on dry microsites within chaparral or woodland, rather than as intact associations within refugia (Holmgren *et al.* 2014). In addition to these traditional types of reconstructions, the archive of accumulated materials and data from middens is increasingly being used for morphological, isotopic, geochemical, and genetic studies as well as for populating biogeographical and ecological models (for examples see: Becklin *et al.* 2014; Borrelli and Holmgren 2016; Butterfield *et al.* 2019a, 2019b; Diaz *et al.* 2016; Hofreiter *et al.* 2003; Holmgren *et al.* 2019; Kuch *et al.* 2002; Smith and Betancourt 2006; Terwilliger *et al.* 2002; Van de Water *et al.* 1994).

There are, however, some caveats to working with middens. Although most *Neotoma* species are dietary generalists and collect a large percentage of the local plant species, preferential collection of favored foods can introduce bias into middens, with some taxa being absent or underrepresented and others overrepresented compared to the local plant community (Borrelli and Holmgren 2016; Dial and Czaplewski 1990; Vaughan 1990). As a result, species presence or absence data are generally considered more robust than relative abundance data. Middens are also biased towards vegetation growing on rocky hillslopes with sufficient rock for preservation rather than valleys or other open terrain. In addition, deposition of middens is episodic, so they do not form a continuous record. Similarly, the duration of the depositional episode is uncertain, although most middens are thought to accumulate over a few years to decades (Finley 1990). Finally, middens can be temporally mixed and contaminated by younger or older materials, especially when dens are reused or partially excavated by subsequent generations of rodents or when high humidity causes the outer midden surface to moisten and entrap younger material. Researchers must thus take care to remove the outer weathering surface or "rind" to eliminate any modern material adhering to the midden surface and be alert for incongruous species co-occurrences in a midden. In the case of suspected contamination, multiple individual taxa from the same midden must be radiocarbon dated to determine whether mixing has occurred.

Despite these limitations, middens are arguably the most useful and ubiquitous source of data for understanding the vegetation history of arid and semi-arid lands. Since their discovery in the 1960s (Wells and Jorgensen 1964), more than 2,500 middens have been dated and analyzed in North America (Betancourt 2004; Betancourt *et al.* 1990). Yet, gaps in midden coverage remain and relatively few midden studies exist for the Southern Rocky Mountains in Colorado and the San Luis Valley. As such, our goal was to produce a midden record from the vicinity of the La Botica site in order to determine how the vegetation community may have changed over time, especially during the past approximately 5,000 years of human use. A long-term record from this area will serve as a baseline and provide context for understanding patterns of change or stability in this culturally significant plant community.

Midden Collection Site

Because the La Botica archaeological site itself lacked rock shelters or crevices suitable for midden preservation, middens were collected from the surrounding area. A total of 16 middens were collected, with 15 of these coming from Canyon del Rancho within the La Jara State Wildlife Area, located 3 km from the La Botica site (figures 4.2 and 4.3). These middens were all collected along a ledge within about 1500 m of each other. One additional midden was collected within La Jara Canyon, roughly opposite the creek from the La Botica site. All middens were collected from elevations between 2487 and 2603 m, comparable to the La Botica site at about 2600 m.

Vegetation along La Jara Creek changes from the San Luis valley floor to the east as one moves westward and to higher elevations within the canyon. In the lower elevations of the foothills, Great Plains grassland vegetation transitions into shrubland vegetation and Southern Rocky Mountain pinyon-juniper woodland with *Pinus edulis* and *Juniperus scopulorum*. This pinyon-juniper woodland dominates from about 2400 to 2900 m. Especially at the upper elevations of its range, pinyon-juniper woodland intermingles with and transitions into mixed conifer woodlands with *Pinus ponderosa* var. *scopulorum* and smaller amounts

Figure 4.2. Photograph of the Canyon del Rancho midden site. Middens were collected from crevices and rock shelters at the base of the massive cliffs seen in the photo.

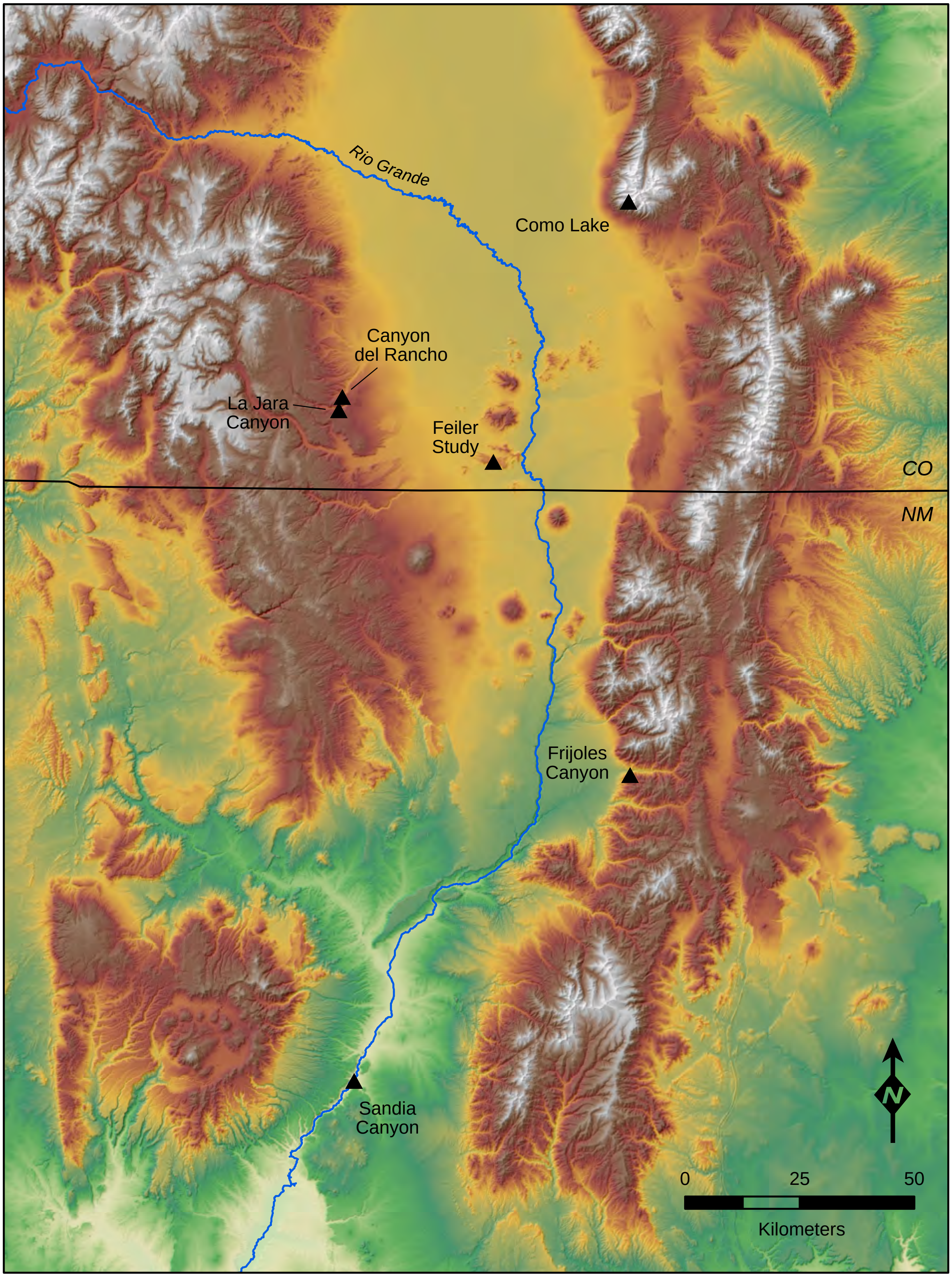


Figure 4.3. Map showing the locations of the Canyon del Rancho and La Jara Canyon midden sites, as well as those of other records mentioned in the text.

of *Pseudotsuga menziesii*, and *Pinus contorta*. At higher elevations above about 3200 m, *Pinus contorta* is joined by *Abies concolor*, *Juniperus communis*, *Picea engelmannii*, and patchy stands of *Populus tremuloides* (Ackerfield 2015; Dixon 1971). A variety of shrubs, herbs, and grasses are also found in these woodland and forest communities.

Vegetation growing at the midden sites (within about 50 m on the hillslopes) includes a mix of grassland, shrubland, and pinyon-juniper woodland elements and is dominated by *Pinus edulis*, *Atriplex canescens*, *Artemisia frigida*, *Rhus trilobata*, and *Yucca glauca*. Other vegetation includes the tree *Juniperus scopulorum*, and a variety of shrubs, cacti, and herbs including *Ericameria nauseosa*, *Eriogonum* spp., *Gutierrezia sarothrae*, *Mentzelia albicaulis*, *Mirabilis multiflora*, *Oenothera pallida*, *Opuntia polyacantha*, *Ribes*, *Sphaeralcea coccinea*, and *Verbascum thapsus*. Also found are several grassland species including *Achnatherum hymenoides*, *Bouteloua gracilis*, *Bromus tectorum*, and *Heterostipa comata*. Two of these species, *Bromus tectorum* and *Verbascum thapsus*, are introduced. The adjacent La Jara Canyon supports areas of riparian and wetland vegetation along the valley floor, although these are at a considerable distance from the midden sites and well beyond the foraging range of the woodrats. A list of all plant taxa discussed in the text, along with their common names, is presented in table 4.1.

Methods

Midden collection involved using a rock hammer and chisel to free the cemented middens from the rock shelters and remove the outer, weathered surfaces. In cases where middens were located in the same rock shelter but appeared to be discrete units, they were collected separately and given unique designations. Similarly, if middens appeared to be layered, layers were carefully separated and treated as individual samples. Plant species growing within 100 m of the sites were identified and their relative abundances quantified. Reference specimens of plants were also collected from the midden sites, the La Botica site, the surrounding region, and the Adams State University herbarium to aid in plant fossil identification.

In the lab, the middens were processed and analyzed using standard procedures (Spaulding *et al.* 1990). After removing small (20-30 g) subsamples for voucher specimens and pollen analysis, the remaining midden was soaked in water for 1-3 weeks to dissolve the urine matrix. Materials were then wet sieved and dried in a low-temperature oven. Dried materials were sieved using 1- and 2-mm mesh screens to separate plant fragments by size and facilitate sorting. Macrofossils were identified using a binocular stereozoom microscope and quantified using a relative abundance scale of 0 to 5 (0=0 fragments, 1=1 fragment, 2=2-24 fragments, 2.5=25-49 fragments, 3=50-74 fragments, 3.5=75-99 fragments, 4=100-149 fragments, 4.5=150-199 fragments, 5=200+ fragments). Botanical nomenclature follows Ackerfield (2015).

Pollen subsamples for nine middens spanning the length of the record were processed following procedures outlined in Holmgren and others (2006). At least 300 pollen grains were counted for all samples except CDR 111 (255.5 grains counted). After 300 grains, microscope slides were scanned for poorly represented types.

Radiocarbon dating was performed on *Pinus edulis* needles or *Juniperus scopulorum* seeds from the middens. Pretreatment and tandem accelerator mass spectrometer (AMS) measurements were done at the W. M. Keck Carbon Cycle Accelerator Mass Spectrometry Laboratory at the University of California – Irvine. Dates were calibrated using the IntCal 13 curve in the OxCal 4.3 program (Bronk Ramsey 2009; Reimer *et al.* 2013) and are reported herein as the midpoint of the calibrated age range before present (cal B.P.). Uncalibrated dates from other studies discussed herein have also been calibrated to facilitate discussion of patterns and trends.

Results

Radiocarbon Dates

The midden record spans the mid-Holocene until present. Radiocarbon dates for the middens ranged from 4780 to 140 cal B.P. with a few temporal gaps (table 4.2). There is a gap of 1,930 years between the middens dated at 4780 and 2850 cal B.P. and another gap of 1,100 years between the middens dated at 2230 and 1130 cal B.P. All other gaps are a few hundred years or less. Also, although there are some middens with the same radiocarbon age or overlapping standard deviations (LJC 107 and CDR 108, CDR 111 and 103A, CDR 106 and 109, CDR 103C and 101A), all of these pairs come from different rock shelters and are clearly discrete middens.

Table 4.1. List of all plant taxa mentioned in text and corresponding common names.

Family	Scientific Name	Common Name
Agavaceae	*Yucca* sp.	Spanish bayonet
Agavaceae	*Yucca glauca*	Great Plains yucca
Amaranthaceae	*Atriplex canescens*	fourwing saltbush
Amaranthaceae	*Chenopodium* sp.	goosefoot
Anacardiaceae	*Rhus trilobata*	skunkbush sumac
Apiaceae	Apiaceae seed	
Asteraceae	*Antennaria parvifolia*	small-leaf pussy-toes
Asteraceae	*Artemisia frigida*	prarie sagewort
Asteraceae	*Artemisia tridentata*	big sagebrush
Asteraceae	*Bahia dissecta*	cutleaf
Asteraceae	*Cirsium* sp.	thistle
Asteraceae	*Ericameria nauseosa*	rubber rabbitbrush
Asteraceae	*Erigeron* sp.	fleabane, daisy
Asteraceae	*Gutierrezia sarothrae*	broom snakeweed
Asteraceae	cf. *Hymenopappus filifolius*	fineleaf hymenopappus
Asteraceae	*Packeria/Erigeron*	groundsel/fleabane
Berberidaceae	*Berberis fendleri*	Fendler's barberry
Boraginaceae	*Cryptantha/Oreocarya*	cryptantha
Boraginaceae	*Lappula occidentalis* var. *occidentalis*	Western stickseed
Boraginaceae	*Lithospermum multiflorum*	Southwestern stoneseed
Brassicaceae	*Boechera/Descuriania* sp.	rockcress/tansy mustard
Brassicaceae	*Descurainia* sp.	tansy mustard
Brassicaceae	*Draba/Lepidium*	withlow grass/peppergrass
Brassicaceae	*Lepidium*	peppergrass
Cactaceae	*Coryphantha vivipara*	pincushion cactus
Cactaceae	*Echinocereus* cf. *viridiflorus*	nylon hedgehog cactus
Cactaceae	*Opuntia polyacantha*	plains pricklypear
Capparaceae	*Polanisia* sp.	clammyweed
Chenopodiaceae	*Atriplex canescens*	fourwing saltbush
Chenopodiaceae	*Chenopodium* sp.	goosefoot
Cupressaceae	*Juniperus monosperma*	one-seed juniper
Cupressaceae	*Juniperus scopulorum*	Rocky Mountain juniper
Cyperaceae	*Carex* sp.	sedge
Fabaceae	*Astragalus/Oxytropis*	milk vetch/locoweed
Fabaceae	*Lupinus* sp.	lupine
Grossulariaceae	*Ribes* sp.	currant, gooseberry
Grossulariaceae	*Ribes* cf. *inerme*	whitestem gooseberry
Hydrangeaceae	*Jamesia Americana*	fivepetal cliffbush
Hydrophyllaceae	*Phacelia* sp.	phacelia
Iridaceae	*Iris missouriensis*	Rocky Mountain iris
Loasaceae	*Mentezelia albicaulis*	white-stem blazingstar
Loasaceae	*Mentezelia* cf. *multiflora*	Adonis blazingstar
Malvaceae	*Spharalcea coccinea*	scarlet globemallow
Malvaceae	cf. *Spharalcea* sp.	globemallow
Nyctaginaceae	*Mirabilis* cf. *linearis*	narrowleaf four o'clock
Nyctaginaceae	*Mirabilis multiflora*	Colorado four o'clock
Nyctaginaceae	*Mirabilis oxybaphoides*	smooth spreading four o'clock
Onagraceae	*Oenothera pallida*	Pale evening primrose
Onagraceae	*Oenothera* sp.	Evening primrose

Table 4.1. List of plant taxa (*continued*).

Family	Scientific Name	Common Name
Orobanchaceae	*Castilleja* sp.	Indian paintbrush
Pinaceae	*Picea engelmannii*	Engelmann spruce
Pinaceae	*Pinus contorta*	lodgepole pine
Pinaceae	*Pinus edulis*	pinyon pine
Pinaceae	*Pinus ponderosa* var. *scopulorum*	ponderosa pine
Pinaceae	*Pseudotsuga menziesii*	Douglas fir
Plantaginaceae	*Penstemon* cf. *linariodes*	toadflax penstemon
Poaceae	*Achnatherum hymenoides*	Indian ricegrass
Poaceae	*Bouteloua gracilis*	blue grama
Poaceae	cf. *Bromus lanatipes*	wooly brome
Poaceae	*Bromus tectorum*	cheatgrass
Poaceae	*Elymus elymoides*	squirreltail
Poaceae	*Hesperostipa comate*	needle and thread
Poaceae	cf. *Muhlenbergia montana*	mountain muhly
Polygonaceae	*Eriogonum* sp.	buckwheat
Polygonaceae	Polygonaceae seed	
Portulacaceae	*Portulaca* sp.	purslane
Rosaceae	*Potentilla* sp.	cinquefoil
Rosaceae	*Prunus* sp.	cherry, peach, plum
Rosaceae	*Rosa blanda*	smooth rose
Rosaceae	*Rubus idaeus* var. *strigosus*	red raspberry
Salicaceae	*Populus tremuloides*	aspen
Scrophulariaceae	*Verbascum thapsus*	woolly mullein
Solanaceae	*Solanum* sp.	nightshade

Table 4.2. Rodent midden site data and radiocarbon dates from Canyon del Rancho (CDR) and La Jara Canyon (LJC), in south-central Colorado.

Midden Designation	Elevation (m)	Aspect	Material Dated	Age (^{14}C yr B.P.)	UCI AMS No.	2-σ Date Range (cal B.P.)	Midpoint Date (cal B.P.)
CDR 110	2527	S	*P. edulis* needles	85±20	210146	31-257	140
LJC 107	2603	SSE	*J. scopulorum* seeds	135±20	210143	10-274	140
CDR 108	2530	S	*P. edulis* needles	155±20	210144	1-284	140
CDR 111	2527	S	*J. scopulorum* seeds	330±20	210147	310-463	390
CDR 103A	2518	S	*P. edulis* needles	330±25	210135	308-468	390
CDR 109	2530	S	*P. edulis* needles	625±20	210145	554-659	610
CDR 106	2527	S	*J. scopulorum* seeds	630±20	210142	556-660	610
CDR 103B	2518	S	*J. scopulorum* seeds	910±20	210136	768-914	840
CDR 101B	2549	S	*P. edulis* needles	995±20	210134	803-959	880
CDR 103C	2518	S	*J. scopulorum* seeds	1170±20	210137	1007-1177	1090
CDR 101A	2549	S	*J. scopulorum* seeds	1190±20	210133	1063-1178	1120
CDR 112	2527	S	*P. edulis* needles	1260±20	210148	1176-1274	1130
CDR 104A	2527	S	*J. scopulorum* seeds	2205±20	210138	2151-2310	2230
CDR 104B	2527	S	*J. scopulorum* seeds	2395±20	210139	2351-2485	2420
CDR 104C	2527	S	*J. scopulorum* seeds	2750±20	210140	2782-2917	2850
CDR 105	2487	SSE	*P. edulis* needles	4230±20	210141	4709-4851	4780

Vegetation Record

Midden macrofossils from more than 60 taxa were identified to genus or species, providing a detailed vegetation history for the site. Relative abundances of plant macrofossils are shown in figure 4.4. One notable trend is the persistence of many species. Almost a third of the species identified in the oldest midden were also found in the youngest middens. Several of these, including *Pinus edulis*, *Juniperus* cf. *scopulorum*, *Artemisia frigida*, *Atriplex canescens*, *Opuntia*, *Chenopodium*, *Cirsium*, *Mirabilis* cf. *linearis*, *Prunus*, *Rhus trilobata*, *Yucca*, and the grass *Achnatherum hymenoides*, are not only persistent but abundant throughout the macrofossil record. Other grasses found throughout the record include *Bouteloua gracilis*, *Bromopsis lanatipes*, *Elymus elymoides*, and *Heterostipa comata*.

It was not possible to conclusively identify the juniper macrofossils found in the midden to species. Both *Juniperus scopulorum* and *Juniperus monosperma* are found in the area today, although *J. scopulorum* was the only species growing in the immediate vicinity (within about 50 m) of the middens. *J. monosperma* is a smaller, shrubby tree, usually branching near the base and with an open, rounded crown. *J. scopulorum*, on the other hand, is usually single-stemmed and a more narrow, conical tree. In middens, these two species can typically be distinguished by the presence of small teeth along the leaf margins in *J. monosperma* and their absence in *J. scopulorum*. However, *J. monosperma* collected at both the La Botica site and Adams State Herbarium lacked teeth, suggesting this characteristic is somewhat plastic. Without this character, we could not differentiate between the two species in the middens based on twigs, which comprised the vast majority of juniper fossils. Seeds were also encountered, but their overlapping sizes and similar morphologies precluded using them to distinguish between species. Nevertheless, based the dominance of *J. scopulorum* in the valley today, we suspect the vast majority, if not all, of fossil juniper twigs are likely from this species. We therefore refer to juniper macrofossils as *J.* cf. *scopulorum* in figure 4.4 and throughout this chapter. Still, it remains possible that some of the juniper may be *J. monosperma*.

A few species were found only in the youngest middens. Taxa appearing sometime after about 2200 cal B.P. include *Antennaria parvifolia*, *Artemisia tridentata*, *Carex*, *Castilleja*, *Jamesia americana*, *Lepidium*, *Mentezelia albicaulis*, *Penstemon* cf. *linariodes*, and an unidentified Apiaceae seed. These late appearances in the midden record may reflect recent arrivals at the site. On the other hand, all of these species had very low abundances in the middens, suggesting their absence from the oldest four middens could be due to their rarity within the community. Additionally, 12 out of the 16 middens (75 percent) in this study date to 1130 cal B.P. or later, so the absence of these species in the older middens might be a sampling artifact.

The pollen record contained significantly fewer species and lower taxonomic resolution, but overall reflected patterns seen in the macrofossils. Notably, arboreal pollen was dominated by *Pinus* and Cupressaceae (figure 4.5). Haploxylon-type pine pollen is most likely *P. edulis* based on its abundance in the macrofossil record, although longer-distance transport of *P. aristata*, *P. flexilis*, and *P. strobiformis* is certainly possible. Likewise, there are two species of Diploxylon-type pines found in Colorado and both are seen in the macrofossil record: *P. contorta* (occasional) and *P. pondersosa* (frequent). The only genus of Cupressaceae in Colorado is *Juniperus*. As in the macrofossils, *Juniperus* is one of the dominant taxa in all but the earliest midden.

Other trees present in the pollen record are *Abies*, *Picea*, and *Psuedotsuga menziesii*. Of these, only *Psuedotsuga menziesii* is found in the macrofossils. However, *Abies concolor* is present nearby at the La Botica site and *Picea* cf. *engelmanii* is found roughly 10 km to the north at higher elevation in Ra Jadero Canyon around the La Jara Reservoir. The regional presence of these two species suggests windborne transport may account for the presence of their pollen, but not macrofossils, in the middens.

Shrub and herb pollen is dominated by the Amaranthaceae, Asteraceae (especially *Artemisia*), and Poaceae families. The Amaranthaceae pollen likely reflects *Atriplex canescens*, which is abundant in the macrofossils, and two species of *Chenopodium*. *Artemisia* pollen is probably mostly *Artemisia frigida*, which is common throughout the macrofossil record, whereas *Artemisia tridentata* is present in just one midden. Macrofossils suggest several species would have contributed to the non-Artemisia Asteraceae pollen. Similarly, the Poaceae pollen likely consists of several different grass taxa that were present throughout the macrofossil record, as described previously.

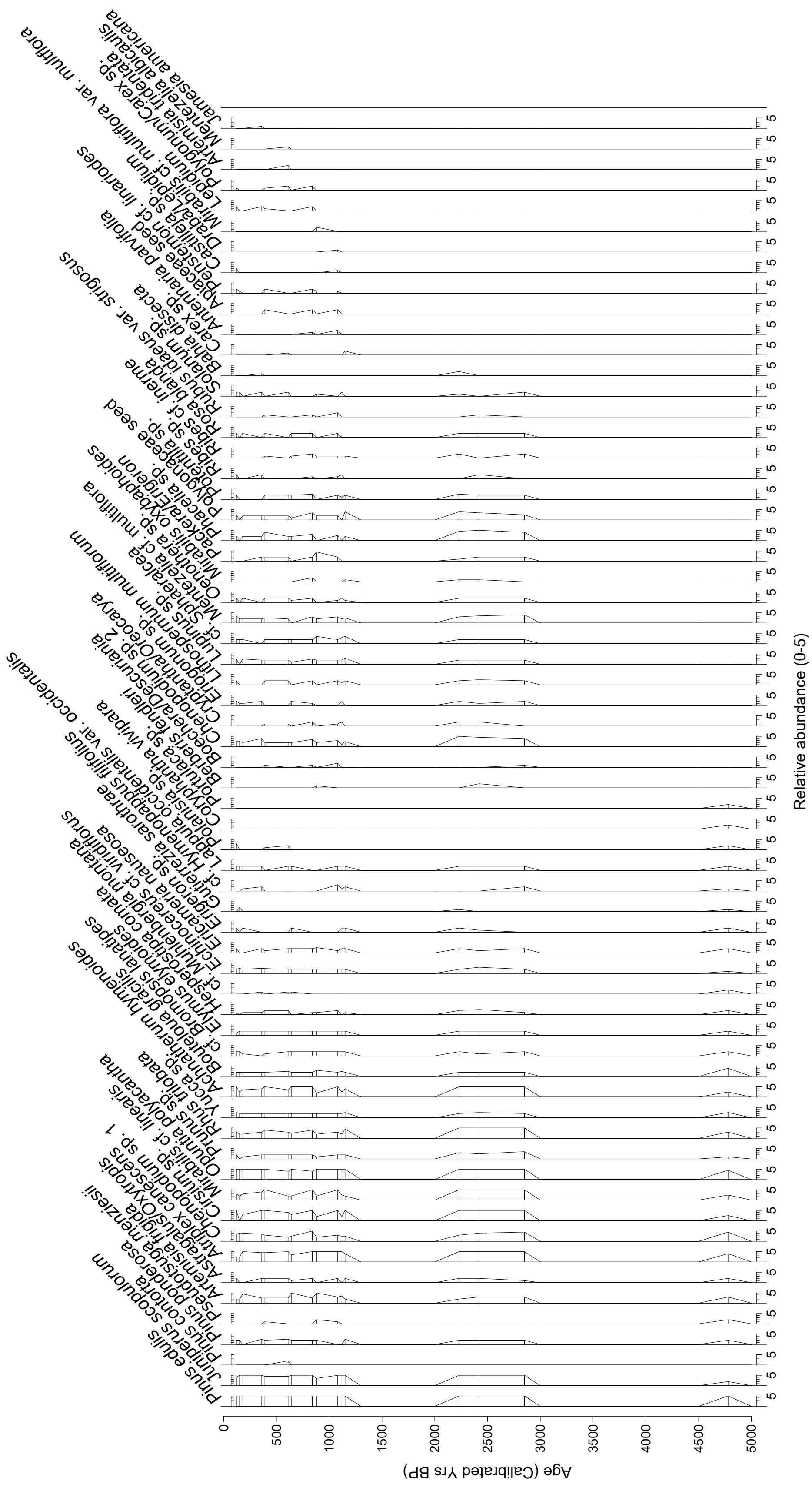


Figure 4.4. Plant macrofossil abundance through time.

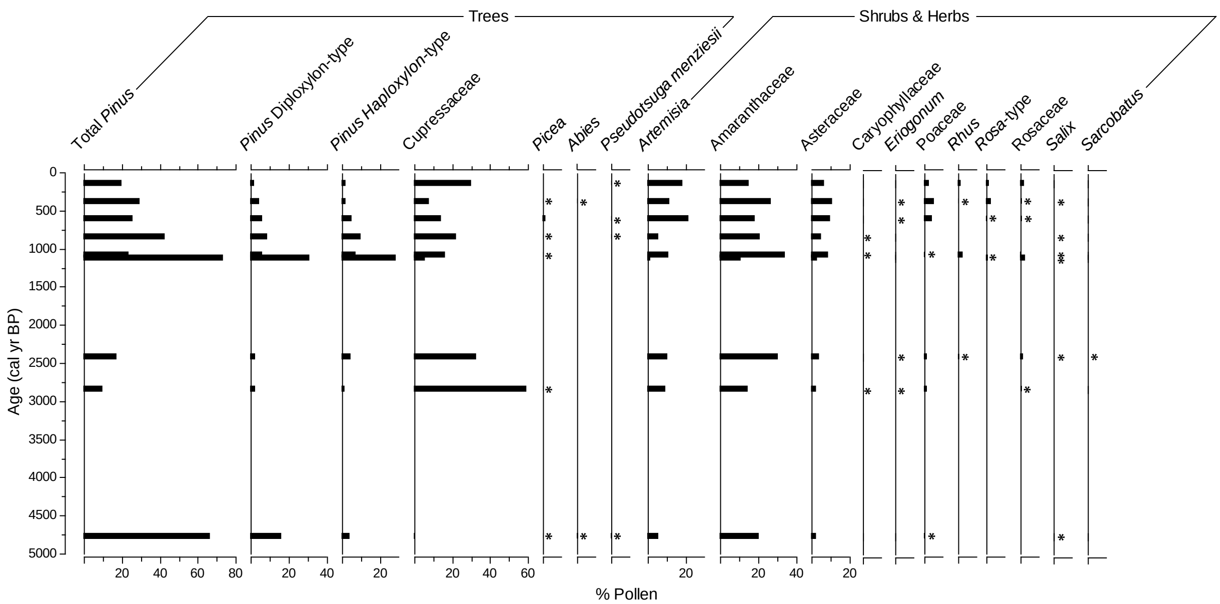


Figure 4.5. Pollen percentages through time.

Discussion

Stability in the Plant Community

Although the midden record does not span the entire period of human usage of the La Botica site, it does provide a taxonomically detailed record of vegetation reaching back almost 5,000 years. A key finding from the study is that the plant community has been remarkably stable over the period of record. In particular, the preponderance of *Pinus edulis* and *Juniperus* cf. *scopulorum* in the middens indicates pinyon-juniper woodland has dominated the area since at least the mid-Holocene. The persistence of other plants found at the site today, including all the subdominant shrub and succulent species as well as several grassland elements, further demonstrates the stability of the vegetation community.

Notably, several of the persistent species are ethnobotanical plants noted in Bye and Linares (1986). These include *Artemisia frigida*, *Chenopodium*, *Eriogonum*, *Mirabilis multiflora* or *M. oxybaphoides*, *Oenothera*, *Opuntia polyacantha*, *Pinus edulis*, *Pinus ponderosa*, *Ribes*, *Rhus trilobata*, *Rosa blanda*, and *Sphaeralcea coccinea.* A couple of other ethnobotanical species were found in the middens but were uncommon. These include *Artemisia tridentata*, *Coryphantha vivipara*, and *Portulaca*. *A. tridentata* is a particularly important plant to Native Americans and Hispanos of the San Luis Valley, where it is used both as a medicinal plant and in spiritual practices. The overall stability in plant community composition in the area, including many of the ethnobotanical species, may well have contributed to the persistent human use of the La Botica site.

Colorado Pinyon Biogeography

Pinus edulis (Colorado pinyon) is both the most abundant species in the middens (represented by more than 200 macrofossils in every midden) and the dominant species at the midden sites today, comprising 10 percent or more of the plant cover. It is a culturally, historically, and ecologically important species that has been used for food, medicine, fuel, and as a building material on the Colorado Plateau (Lanner 1981). In light of its importance, much has been done to understand the biogeographic history of the species (Anderson and Feiler 2009; Emslie *et al.* 2015; Lanner and Van Devender 1998). Although *P. edulis* is the most widespread pinyon species today and the only one found in Colorado, during the last ice age it was apparently restricted to areas from western Texas and south-central New Mexico (Lanner and Van Devender 1998) to the western Grand Canyon in Arizona (Betancourt 1990; Cinnamon and Hevly 1989; Cole *et al.* 2013). Subsequently, as conditions warmed rapidly during late Pleistocene and early Holocene, *P. edulis* spread across the Colorado Plateau and northward along both sides of the Rocky

Mountains following the Colorado River and Rio Grande corridors (Cole *et al.* 2013; Lanner and Van Devender 1998). Much remains unknown, however, about the dynamics of this northerly migration, especially along the Rio Grande corridor (Esmlie *et al.* 2015).

On the eastern side of the Rocky Mountains, few prior midden or pollen studies are available from northern New Mexico or south-central Colorado to provide evidence of *P. edulis* history along the Rio Grande corridor (see figure 4.3 for sites discussed in this section). In northern New Mexico, a single late Holocene midden from Frijoles Canyon in Bandolier National Monument dated to 3440 cal B.P. contained abundant *P. edulis* (Betancourt and Turner 1988). *P. edulis* was also found in a series of middens from Sandia Canyon near Los Alamos, although the oldest of these is just 2560 cal B.P. (Spaulding 1992). Because *P. edulis* had already reached Frijoles Canyon to the north almost a millennium earlier, its presence in the oldest Sandia Canyon midden is best considered as a minimum date for its arrival there.

In south-central Colorado, two prior studies from the Rio Grande corridor provide additional information. A series of five dated middens located at the southern end of the San Luis Valley and about 40 km east-southeast of the La Botica study area, contained pinyon-type pollen in a midden dating to 11,320 cal B.P. (Feiler 1998). The lack of *P. edulis* macrofossils in this midden, combined with the fact that pine pollen is commonly transported long distances, means this may reflect regional, rather than local, *P. edulis* presence. Similarly, *P. edulis* pollen is present by 10,850 cal B.P. in a core from Como Lake in the Sangre de Cristo Mountains on the east side of the San Luis Valley (Shafer 1989). Although pollen at both of these sites may indicate regional rather than local presence, it is consistent with pinyon's high abundance in the Canyon del Rancho middens by the mid-Holocene.

Because our record is based on macrofossils of *P. edulis*, including an AMS date directly on *P. edulis* needles for our oldest midden, its local presence at the study site by 4780 cal B.P. is unambiguous. Taken together, these studies suggest that *P. edulis* may have been able to migrate quickly up the Rio Grande corridor into south-central Colorado during the late Pleistocene and early Holocene and was certainly established in the La Botica area by the mid-Holocene. Such a northward migration of pinyon after deglaciation has been linked to warming temperatures and expansion of summer monsoonal precipitation (Betancourt 1987; Lanner and Van Devender 1988; Toney and Anderson 2006), the latter of which appears to have been restricted to areas south of about 35^{0}N latitude during the glacial period (Holmgren *et al.* 2007). The importance of summer precipitation has been demonstrated in distributional (Cole *et al.* 2013) and ecophysiological (West *et al.* 2007) studies of *P. edulis*.

In addition, phylogeographic studies have helped to determine the source of *P. edulis* populations in the area. As discussed previously, midden data suggests that the species was confined to refugia in Texas and New Mexico and in central Arizona during the glacial period. *P. edulis* populations in northern New Mexico and south-central Colorado (near the town of Walsenburg) contain haplotypes derived from both ancestral populations in Texas-New Mexico and central Arizona (Duran *et al.* 2012). This suggests the San Luis Valley may have been an area where migrants from both refugia met as the species migrated northward (Duran *et al.* 2012).

Extralocal and Invasive Species

Although the overall plant community was remarkably stable, some changes were noted. First, small amounts of *Pinus ponderosa* were frequently present in middens, along with occasional *Pseudotsuga menziesii* and *Pinus contorta*. These species are found within Canyon del Rancho and La Jara Canyon today but are not present in the immediately vicinity of the midden collection sites. The midden collection sites are located on dry, rocky slopes with southerly aspects, which may be too xeric for these species today. Nevertheless, their presence in the middens means that isolated individuals or small stands of these species grew near the midden sites at various times in the past, perhaps establishing during periods of somewhat cooler or wetter conditions. *P. menziesii* in particular has quite large and heavy pollen that isn't transported very far, so its presence in the pollen record suggests it was likely growing nearby. Because there are no strong patterns among the presence/absence records for these species, however, we hesitate to infer more detailed climatic information or trends from them.

Finally, the presence of two non-native species at the site today, *Bromus tectorum* and *Verbascum thapsus*, demonstrates the recent influence of humans in the area. Neither of these species were encountered in the middens, consistent with their relatively recent introductions. *V. thapsus* was likely introduced into North America several times for use as a piscicide (Wilhelm Jr. 1974) but has also been cultivated for medicinal purposes (Bye and Linares 1986). Listed as a noxious weed in Colorado, it is most common in disturbed areas such as roadsides and grazed areas; hence in drier climates where open ground and disturbance are relatively common, it can become dominant within ecosystems (Fornwalt *et al.* 2010). Still, *V. thapsus* is somewhat limited by its inability to compete with other species (Reinartz 1984). *Bromus tectorum*, on the other hand, is one of the most competitive invasive species in the western United States and can profoundly alter the fire regime in pinyon-juniper woodlands (Floyd *et al.* 2004; Korb and Wu 2011). Its ability to regenerate rapidly after fire further promotes its spread, fine fuel availability, and larger, ever-more-intense fires (Brooks *et al.* 2004). The presence of *B. tectorum* thus has the potential to alter ecosystem properties and represents a much greater threat to, and an important management concern for, this landscape.

Conclusions

This study helps to fill a gap in midden coverage in south-central Colorado, an area with few prior midden records. Spanning the mid-Holocene to present, the midden record documents the stability of several species. This stability in plant community composition may have facilitated the long-term human collection and use of ethnobotanical species at the nearby La Botica site. The study also adds important insights into the biogeography of *P. edulis*, establishing its presence by 4780 cal B.P. Despite the stability seen in the midden record, the establishment of non-native species in the area presents a threat to this area and its unique archaeological and cultural history.

Acknowledgements. We thank Angie Krall, Chloe Mokadam, Daniel Potts, Nicholas Quilty-Koval, M. Lisa Rizzo, and Austin Smith for assistance in the field and laboratory. We thank Daniel Potts for the photographs included herein. Data were collected under an Archaeological Resources Act permit (No. C-79004) issued to Paleocultural Research Group by the Bureau of Land Management.

References Cited

Ackerfield, Jennifer
2015 *Flora of Colorado*. Botanical Research Institute of Texas Press, Fort Worth.

Anderson, R. Scott, and Eric Feiler
2009 Holocene Vegetation and Climate Change on the Colorado Great Plains, USA, and the Invasion of Colorado Piñon (*Pinus edulis*). *Journal of Biogeography* 36:2279-2289.

Becklin, Katie M., Juliana S. Medeiros, Kayla R. Sale, and Joy K. Ward
2014 Evolutionary History Underlies Plant Physiological Responses to Global Change Since the Last Glacial Maximum. *Ecology Letters* 17:691-699.

Betancourt, Julio L.
1987 Paleoecology of Pinyon-Juniper Woodlands: Summary. In *Proceedings of the Pinyon-Juniper Conference*, compiled by Richard L. Everett, pp. 129-140. U.S. Department of Agriculture, Forest Service Technical Report INT-215. U.S. Forest Service Intermountain Research Station, Ogden, Utah.
1990 Late Quaternary Biogeography of the Colorado Plateau. In *Packrat Middens—the Last 40,000 Years of Biotic Change*, edited by Julio L. Betancourt, Thomas R. Van Devender, and Paul S. Martin, pp. 259-292. University of Arizona Press, Tucson, Arizona.
2004 Arid Lands Paleobiogeography: The Fossil Rodent Midden Record in the Americas. In *Frontiers in Biogeography: New Directions in the Geography of Nature*, edited by Mark V. Lomolino and Lawrence R. Heaney, pp. 27-46. Sinauer, Sunderland, Massachusetts.

Betancourt, Julio L., Thomas R. Van Devender, and Paul S. Martin (editors)
1990 *Packrat Middens—the Last 40,000 Years of Biotic Change*. University of Arizona Press, Tucson, Arizona.

Betancourt, Julio L., and Ray M. Turner
1992 Potential for Packrat Midden Studies in the Area of Bandelier National Monument. Unpublished report, Bandelier National Monument, Los Alamos, New Mexico.

Borrelli, Michael P., and Camille A. Holmgren
2016 Dietary Modifications of Packrats in Response to Changing Plant Communities: Evidence from Fossil Plant Cuticles Spanning >55,000 Years in Sonoran Desert Packrat Middens. *Journal of Arid Environments* 135:1-8.

Bronk Ramsey, Christopher
2009 Bayesian Analysis of Radiocarbon Dates. *Radiocarbon* 51(1):337-360.

Brooks, Matthew L., Carla M. D'Antonio, David M. Richardson, James B. Grace, Jon E. Keeley, Joseph M. DiTomaso, Richard J. Hobbs, Mike Pellant, and David Pyke

2004 Effects of Invasive Alien Plants on Fire Regimes. *BioScience* 54(7):677-688.

Butterfield, Bradley J., Camille A. Holmgren, R. Scott Anderson, and Julio L. Betancourt

2019a Extinction Debt and Delayed Colonization Have Comparable but Unique Effects on Plant Community-Climate Lags Since the Last Glacial Maximum. *Global Ecology and Biogeography* 28:1067-1077.

2019b Life History Traits Predict Colonization and Extinction Lags of Desert Plant Species Since the Last Glacial Maximum. *Ecology* 100(10) https://doi.org/10.1002/ecy.2817

Bye, Robert A., Jr., and Edelmira Linares

1986 Ethnobotanical Notes from the Valley of San Luis, Colorado. *Journal of Ethnobiology* 6(2):289-306.

Cinnamon, S.K., and R.H. Hevly

1988 Late Wisconsin Macroscopic Remains of Pinyon Pine on the Southern Colorado Plateau, Arizona. *Current Research in the Pleistocene* 4:47-48.

Cole, Kenneth L., Jessica F. Fisher, Kirsten Ironside, Jim I. Mead, and Peter Koehler

2013 The Biogeographic Histories of *Pinus Edulis* and *Pinus Monophylla* Over the Last 50,000 Years. *Quaternary International* 310:96-110.

Dial, Kenneth P., and Nichola J. Czaplewski

1990 Do Woodrat Middens Accurately Represent the Animals' Environments and Diets? The Woodhouse Mesa Study. In *Packrat Middens—the Last 40,000 Years of Biotic Change*, edited by Julio L. Betancourt, Thomas R. Van Devender, and Paul S. Martin, pp. 43-58. University of Arizona Press, Tucson, Arizona.

Diaz, Francisca P., Matías Frugone, Rodrigo A. Gutiérrez, and Claudio Latorre

2016 Nitrogen Cycling in an Extreme Hyperarid Environment Inferred from $\delta^{15}N$ Analyses of Plants, Soils and Herbivore Diet. *Scientific Reports* 6:1-14.

Dixon, Hobart N.

1971 Flora of the San Luis Valley. In *San Luis Basin (Colorado)*, edited by H.L. James, pp. 133-136. New Mexico Geological Society 22nd Annual Fall Field Conference Guidebook. Socorro, New Mexico.

Duran, Kristy L., Alicia Pardo, Jeffery B. Mitton, and Pauline Ladiges

2012 From Middens to Molecules: Phylogeography of the Piñon Pine, *Pinus Edulis. Journal of Biogeography* 39(8):1536-1544.

Emslie, Steven D., Larry Coats, and Eva Oleksy

2015 Packrat Middens and the Holocene Palaeohistory of Colorado Piñon (*Pinus edulis*) in Western Colorado. *Journal of Biogeography* 42:565-574.

Feiler, Eric

1998 *Analysis of Eleven Packrat Middens Collected in the Rio Grande Riparian Corridor, Southern San Luis Valley, Colorado*. Research Contribution 4. Paleocultural Research Group, Flagstaff, Arizona. Submitted to the Bureau of Land Management, Alamosa, Colorado, and Rio Grande Restoration, Taos, New Mexico.

Finley, Robert B., Jr.

1990 Woodrat Ecology and Behavior and the Interpretation of Paleomiddens. In *Packrat Middens—the Last 40,000 Years of Biotic Change*, edited by Julio L. Betancourt, Thomas R. Van Devender, and Paul S. Martin, pp. 28-42. University of Arizona Press, Tucson, Arizona.

Floyd, M. Lisa, David D. Hanna, and William H. Romme

2004 Historical and Recent Fire Regimes in Pinon–Juniper Woodlands on Mesa Verde, Colorado, USA. *Forest Ecology and Management* 198(1-3):269–289.

Fornwalt, Paula J., Merrill. R. Kaufmann, and Thomas J. Stohlgren.

2010 Impacts of Mixed Severity Wildfire on Exotic Plants in a Colorado Ponderosa Pine-Douglas-fir Forest. *Biological Invasions* 12:2683–2695.

Hofreiter, Michael, Julio L. Betancourt, Alicia P. Sbriller, Vera Markgraf, and H. Gregory McDonald

2003 Phylogeny, Diet and Habitat of an Extinct Ground Sloth from Cuchillo Curá, Neuquén Province, Southwest Argentina. *Quaternary Research* 59:364-378.

Holmgren, Camille A., Julio L. Betancourt, M. Cristina Peñalba, José Delgadillo, Kristin Zuravnksy, Kimberly L. Hunter, Kate A. Rylander, and Jeremy L. Weiss

2014 Evidence Against a Pleistocene Refugium in the Lower Colorado River Basin. *Journal of Biogeography* 41:1769-1780.

Holmgren, Camille A., Julio L. Betancourt, and Kate A. Rylander

2006 A 36,000-yr B.P. Vegetation History from the Peloncillo Mountains, Southeastern Arizona, USA. *Palaeogeography, Palaeoclimatology, Palaeoecology* 240: 405-422.

Holmgren, Camille A., Kimberley L. Hunter, and Julio L. Betancourt

2019 Creosote Bush (*Larrea tridentata*) Ploidy History Along Its Diploid-Tetraploid Boundary in Southeastern Arizona-Southwestern New Mexico, USA. *Journal of Arid Environments* 164:7-11.

Holmgren, Camille A., Jodi Norris, and Julio L. Betancourt

2007 Inferences about Winter Temperatures and

Summer Rains from the Late Quaternary Record of C_4 Perennial Grasses and C_3 Desert Shrubs in the Northern Chihuahuan Desert. *Journal of Quaternary Science* 22(2):141-161.

Korb, Julie E., and Rosalind Y. Wu
2011 Fire, Climate, and Forest Health. In *The Eastern San Juan Mountains: Their Geology, Ecology, and Human History*, edited by Rob Blair and George Bracksieck, pp. 151-172. University Press of Colorado, Boulder, Colorado.

Kuch, Melanie, Nadin Rohland, Julio L. Betancourt, Claudio Latorre, Scott Steppan, and Hendrik N. Poinar
2002 Molecular Analysis of a 11,700-year-old Rodent Midden from the Atacama Desert, Chile. *Molecular Ecology* 11(5): 913-924.

Lanner, Ronald M.
1975 Piñon Pines and Junipers of the Southwestern Woodlands. In *Proceedings of a Symposium on the Pinyon-Juniper Ecosystem*, edited by Gerald F. Gifford and Frank E. Busby, pp. 1-17. Utah State University, Logan, Utah.

Lanner, Ronald M., and Thomas R. Van Devender
1998 The Recent History of Pinyon Pines in the American Southwest. In *The Biogeography and Ecology of* Pinus, edited by David M. Richardson, pp. 171-182.Cambridge University Press, Cambridge, United Kingdom.

Reimer, Paula J., Edouard Bard, Alex Bayliss, J. Warren Beck, Paul G. Blackwell, Christopher Bronk Ramsey, Caitlin E. Buck, Hai Cheng, R. Lawrence Edwards, Michael Friedrich, Pieter M. Grootes, Thomas P. Guilderson, Haflidi Haflidason, Irka Hajdas, Christine Hatté, Timothy J. Heaton, Dirk L. Hoffmann, Alan G. Hogg, Konrad A. Hughen, K. Felix Kaiser, Bernd Kromer, Sturt W. Manning, Mu Niu, Ron W. Reimer, David A. Richards, E. Marian Scott, John R. Southon, Richard A. Staff, Christian S.M. Turney, Johannes van der Plicht
2013 IntCal 13 and Marine 13 Radiocarbon Age Calibration Curves, 0-50,000 years cal B.P. *Radiocarbon* 55(4):1869-1887.

Reinartz, James A.
1984 Life History Variation of Common Mullein (*Verbascum thapsus*): I. Latitudinal Differences in Population Dynamics and Timing of Reproduction. *Journal of Ecology* 72:897–912.

Shafer, David
1989 The Timing of Late Monsoon Precipitation Maxima in the Southwest United States. Unpublished Ph.D. dissertation, Department of Geosciences, University of Arizona, Tucson.

Smith, Felisa A., and Julio L. Betancourt
2006 Predicting Woodrat (*Neotoma*) Responses to Anthropogenic Warming from Studies of the Paleomidden Record. *Journal of Biogeography* 33:3061-2076.

Spaulding, W. Geoffrey
1992 *Late Quaternary Paleoclimates and Sources of Paleoenvironmental Data in the Vicinity of Los Alamos National Laboratory*. Unpublished report, Bandelier National Monument, Los Alamos, New Mexico.

Spaulding, W. Geoffrey, Julio L. Betancourt, Lisa K. Croft, and Kenneth L. Cole
1990 Packrat Middens: Their Composition and Methods of Analysis. In *Packrat Middens—the Last 40,000 Years of Biotic Change*, edited by Julio L. Betancourt, Thomas R. Van Devender, and Paul S. Martin, pp. 59–84. University of Arizona Press, Tucson, Arizona.

Terwilliger, Valery J., Julio L. Betancourt, Steven W. Leavitt, and Peter K. Van de Water
2002 Leaf Cellulose δD and $\delta^{18}O$ Trends with Elevation and Climate in Semi-Arid Species. *Geochimica et Coscomochima Acta* 66:3887-3900.

Toney, Jaime L., and R. Scott Anderson
2006 A Postglacial Palaeoecological Record from the San Juan Mountains of Colorado USA: Fire, Climate, and Vegetation History. *The Holocene* 16(4):505-517.

Van de Water, Peter K., Steven W. Leavitt, Julio L. Betancourt
1994 Trends in Somatal Density and $^{13}C/^{12}C$ Ratios of *Pinus flexilis* Needles During Last Glacial/Interglacial Cycle. *Science* 264(5156):239-243.

Vaughan, Terry A.
1990 Ecology of Living Packrats. In *Packrat Middens—the Last 40,000 Years of Biotic Change*, edited by Julio L. Betancourt, Thomas R. Van Devender, and Paul S. Martin, pp. 14-27. University of Arizona Press, Tucson, Arizona.

Wells, Phil V., and Clive D. Jorgensen
1964 Pleistocene Wood Rat Middens and Climatic Change in Mohave Desert: A Record of Juniper Woodlands. *Science* 143:1171-1174.

West, Adam G., Kevin R. Hultine, Kelley G. Burtch, and James R. Ehleringer
2007 Seasonal Variations in Moisture Use in a Piñon-Juniper Woodland. *Oecologia* 153:787-798.

Wilhelm, Gene, Jr.
1974 The Mullein: Plant Piscicide of the Mountain Folk Culture. *The Geographical Review* 64:235-252.

5

Paleoenvironment: The Tree-Ring Record

Peter M. Brown and Scott E. Ingram

Linking climate and environmental histories with human history has been the focus of a great deal of archaeological and paleoecological research (Nelson *et al.* 2016). Extended droughts, pluvials (wet periods), or periods of abrupt colder or warmer conditions have influenced major upheavals in past social dynamics (e.g., Cordell *et al.* 2007; DeMenocal 2001; Kohler *et al.* 2008; Van West and Dean 2000). Until our relatively recent industrial and technological innovations, human societies have been intimately tied into their surrounding biotic and abiotic environments. Documenting the longer-term climate and environmental variability of an archaeological site provides an ecological context for human land use and can help explain human behavioral changes documented through archaeological investigations.

Environmental histories provide a background for understanding human resource limitations across multiple spatiotemporal scales. At the same time, humans often have modified their landscapes through their resource use. One means humans have to affect landscape change is wildfire (Allen 2002; Anderson 2006; Pyne 1982; Swetnam *et al.* 2016). Wildfires are started both by natural lightning ignitions and by accidental and purposeful human ignitions. Humans set fires for hunting, warfare, and to enhance food resources, such as acorns or huckleberries (e.g., Anderson 2006). Accidental ignitions also likely occurred, often simply as a consequence of abandoned campfires just as occurs today. However, the historical influence of humans as a source of ignitions in landscapes in the Southwest and Southern Rocky Mountains was place- and time-specific, as lightning has undoubtedly always had a ubiquitous

2022 *Multidisciplinary Research at the La Botica Site, Conejos County, Colorado*, edited by Mark D. Mitchell, pp. 57-67. Research Contribution 115. Paleocultural Research Group, Broomfield, Colorado.

influence on wildfire starts across the region (Allen 2002; Swetnam *et al.* 2016).

In this chapter we use tree-ring data to both infer precipitation variability and to document changes in fire frequency and timing that may be related to climate change and human activity in and near the La Botica site in southern Colorado over the past four-plus centuries. Instrumental climate data provided by nearby stations document only relatively short-term climate variation since the 1890s or early 1900s, whereas tree-ring chronologies can provide annual reconstructions of climate variables over multi-century time scales. Correlations between tree growth and precipitation are especially strong in water-limited regions such as the San Luis Valley (e.g., Woodhouse *et al.* 2002).

This chapter describes the development of a 441-year ring-width chronology from ponderosa pine (*Pinus ponderosa*) trees growing in and near the La Botica site and the relationship of that chronology to a record of local mean annual precipitation modeled using a climatologically-aided interpolation dataset (PRISM 2018). We also reconstruct the timing of past fires in and near La Botica going back to the mid-1200s using fire-scarred trees. Fire scars are areas of cambial mortality resulting from lower intensity fires that burn through surface fuels such as leaf litter, grasses and other herbaceous plants, or shrubs (Brown 2015). Often long sequences of multiple fire scars are found on trees in forested ecosystems that experienced frequent, episodic, low intensity fires (e.g., Falk *et al.* 2011), such as ponderosa pine forests growing on the fringes of the San Luis Valley. We also infer potential or likely human impacts in the fire history, and how both climate and fire may have affected populations present at La Botica for the past 400 years.

Methods

Field Methods

We collected increment cores from 21 living ponderosa pine trees in the immediate vicinity of La Botica to develop a ring-width chronology (site LAF-A in figure 5.1; see Ingram and others [2018] for a full description of methods and results). Larger, older trees were preferentially selected to produce as long a climate chronology as possible for the site. All trees sampled were ponderosa pine (*Pinus ponderosa*). Ponderosa pine is the dominant overstory tree at the site and is typically sensitive to climate conditions—especially precipitation amounts—before and during growing seasons. One-seed juniper (*Juniperus monosperma*) and Rocky Mountain juniper (*J. scopulorum*) are also present but are more difficult to crossdate and appeared to not be as old as the ponderosa pines. Trees were selected mainly from slopes on the perimeter of the site. Trees on slopes with shallow or rocky soils tend to be more sensitive to precipitation variation than those on level ground with deeper soils. A minimum of two cores per tree were sampled at about 40 cm above ground level.

To develop the fire history, we sampled fire-scarred trees in two sites. One sample included trees growing in and near La Botica (LAF-A). The other included trees located in a stand on a bench above La Jara Canyon, about 3 km west and 100 m in elevation above La Botica (LAF-B; figure 5.1). The goal with sampling the two sites was to contrast fire frequency, timing, and seasonality at La Botica with a nearby location to see if recognizable human signatures are present (e.g., increased fire frequency or differences in seasonality) that may be absent in a presumably more “natural” fire regime in a stand of trees located away from the site. Sampling involved cutting full or partial cross sections from fire-created “catfaces” using a chainsaw. A total of 26 trees were sampled, including 13 trees each in LAF-A and LAF-B. Only two living trees were sampled to minimize damage to older trees, with the rest consisting of stumps, snags, or logs. All were ponderosa pine except for a single Douglas-fir (*Pseudotsuga menziesii*) from LAF-B.

We did not cut cross section samples from five living scarred trees at La Botica that had been noted and sampled during earlier archaeological surveys. These were identified as culturally modified trees (CMTs) during the initial recording of the site and interpreted as “peeled trees,” which reflect harvest by Native Americans of the trees’ “inner bark,” the nutritious phloem layer found between the bark and wood. However, the shape and characteristics of the scarring indicate that they were produced by fire and not human activities, although all had evidence of axe chop marks in the scar surfaces that were made after the initial injury that formed the scar had occurred (see chapter 6, this volume). This chopping was likely for “fatwood,” the resin-soaked heartwood formed as part of the compartmentalization process after tree injury (Smith *et al.* 2016; Smith and Sutherland 2001). We were able to make use of a previous effort to find the dates of the scars through a series of increment cores taken on each tree (Crosser *et al.* 2009); those

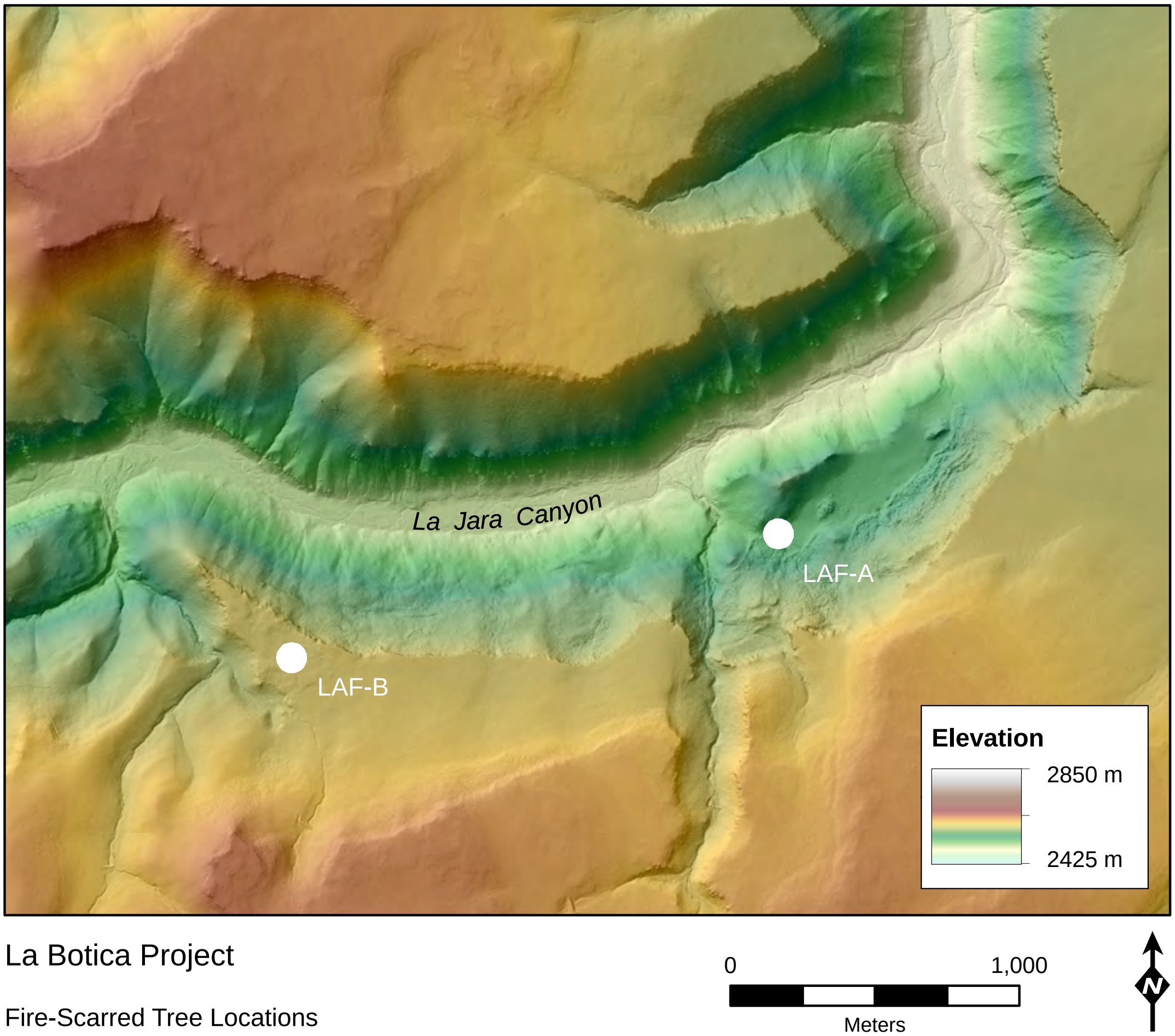


Figure 5.1. Locations of two clusters of fire-scarred trees collected from the La Botica site. The LAF-A fire chronology includes trees found in the west and central portions of the site itself. The LAF-B trees were growing on a bench above and to the west of the main site. Trees collected for the La Botica ring-width chronology are from LAF-A. Color bands represent elevation.

results are summarized below with other fire-scar data.

Laboratory Methods

Increment cores were glued to wooden core mounts for stability and cross sections were stabilized as needed using construction adhesive and backing boards. To see cell structure in ring series all samples were surfaced to 400 grit sandpaper using a combination of hand planers, belt sanders, and hand sanding. Ring series were crossdated using skeleton plot and visual techniques under 7 to 30x dissecting microscopes (Speer 2010). Crossdating is the principal procedure in dendrochronology and relies on cross-matching in-common patterns of annual ring growth between trees that are affected by annual climate variation. Crossdating is able to account for ring anomalies such as locally absent ("missing") rings and intra-annual latewood bands ("false rings"). Crossdating also permits dating of remnant (dead) trees by cross-matching their ring patterns with absolutely dated patterns from living trees.

Thirteen cores from nine of the oldest living trees were deemed most suitable for measurement and development of a ring-width chronology for climate reconstruction. We measured ring widths on the cores using a Velmex Tree Ring Measuring system and Cybis imaging software (Cybis Elektronik 2017). After measuring, data were checked for accuracy using correlation coefficients in software program COFECHA (Holmes 1983). We used software program ARSTAN to detrend ring-width data and create a chronology. A negative exponential, linear regression of negative slope, or horizontal line was employed for detrending of ring-with measurements.

We assigned dates for fire scars recorded on fire-scarred cross sections once crossdating of ring series was assured using visual methods. Each fire scar also was assigned a position within the ring boundaries to assess possible fire seasonality. Time spans of trees and dates of fire scars were compiled and analyzed in the program FHX2 (Grissino-Mayer 2001) for assessment of fire frequency, possible fire extent based on percentages of trees scarred for each fire year, and fire seasonality.

Comparisons to Climate Variability

We compared the ring-width chronology to three sources of climate data: (1) monthly instrumental weather data from the station closest to La Botica located at Manassa, Colorado (Station 055322; 37°09'04.9"N, 106°12'45.4"W; 1893 to 2016 CE [WRCC 2018]); (2) monthly PRISM modeled precipitation and temperature data (PRISM 2008); and (3) monthly Palmer drought severity indices (PDSI) for Colorado Climate Division 5, the Rio Grande Basin (NCDC 2018). We used program DENDROCLIM2002 (Biondi and Waikul 2004) to test statistical relationships between the La Botica residual chronology and the three climate data sets. Manassa is likely to have experienced climatic conditions similar to La Botica since the two sites are only about 25 km apart. PRISM is a model product based on climate monitoring networks and modeling techniques to interpolate point location climate conditions. The Colorado Climate Division data are a regional average of climate stations from the upper Rio Grande River valley where the La Botica site is located.

We also used superposed epoch analysis (SEA) to assess average annual climate conditions for reconstructed fire years at La Botica. We also compare climate during years prior to fire years to assess antecedent climate conditions. SEA tests for significant climate conditions ($p<0.01$) during fire and antecedent years using bootstrapped confidence intervals based on average annual climate values with the same number of years as fire-year data sets. We tested fire years against both a reconstruction of summer PDSI for the San Luis Valley (Grid Point 132, 37.5°N, 105°W [Cook *et al.* 2004]) and the La Botica ring-width chronology. Fire years used include the entire period of record and those broken out by time periods identified in the fire chronology, which is described in the "Fire History" section.

Results and Discussion

Climate History

Increment cores sampled from living trees span 441 years from 1577 to 2017 CE. One core was dated to 1577, while the core with the second longest record dated to 1605. Three other cores span the period from the mid-17th century to the present. We selected and combined 13 of the longer series into a ring-width chronology for La Botica that extends from 1579 to 2017. The chronology has a mean inter-series correlation of 0.762 ($p<0.001$), indicating very strong in-common fidelity to annual climate variability. Of the three climate data series tested, the chronology correlates best with annual precipitation (previous year September to current August) estimated from PRISM data ($r=0.65$, $p<0.001$) (figure 5.2). This result supports the applicability and representativeness of the chronology for understanding past precipitation variability at La Botica. However, we did not construct a formal climate reconstruction from the data at this time. In general, climate reconstructions are made from regional series of chronologies which we did not do for this study.

Potential precipitation extremes (represented by low and high growth indices) were identified using threshold values in 9- and 21-year interval running averages in the La Botica ring-width chronology (figures 5.3 and 5.4; tables 5.1 and 5.2). Interval averages accommodate but do not ignore anomalous years within an extreme period that likely do not end the extreme period. For example, a single wet year during a multi-year dry period would not end the dry period or necessarily replenish soil moisture or, in the case of human history at La Botica, food resources that depend on wetter conditions. For detecting extreme period impacts on human

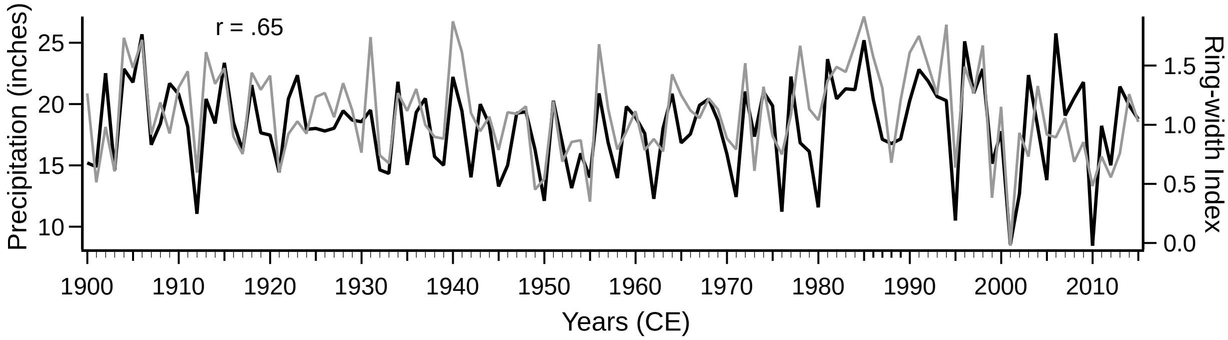


Figure 5.2. La Botica ring-width chronology (black line) and instrumental mean annual (previous September to current August) precipitation from PRISM (grey line). Correlation between the two is 0.65 (p<0.001).

Table 5.1. Multi-year low-growth and high-growth periods (representing droughts and pluvials, respectively) identified in the La Botica ring-width chronology using a 9-year running average.

Low Growth	High Growth
1652 – 1670	1606 – 1617
1681 – 1686	1632 – 1640
1748 – 1753	1690 – 1703
1773 – 1782	1709 – 1725
1791 – 1806	1757 – 1768
1843 – 1848	1834 – 1840
1895 – 1900	1850 – 1857
1942 – 1963	1904 – 1913
1973 – 1977	1982 – 1997
1999 – 2005	

Table 5.2. Multi-year low-growth and high-growth periods (representing droughts and pluvials, respectively) identified in the La Botica ring-width chronology using a 21-year running average.

Low Growth	High Growth
1648 – 1677	1696 – 1733
1773 – 1811	1760 – 1767
1936 – 1972	1829 – 1833
	1850 – 1863
	1907 – 1920
	1977 – 2000

behavior, a 9-year interval duration was selected as a compromise between shorter durations which would not as faithfully represent trends in the proxy climate data, and longer durations which could obscure climate variation that would have been potentially meaningful for human behavior. A 21-year interval is also presented to identify longer-term trends in the climate data useful for identifying potentially more profound environmental impacts on human dynamics at La Botica.

Fire History

We were able to crossdate 11 trees from LAF-A and all 13 sampled trees from LAF-B to develop fire chronologies for La Botica and the nearby forest (figure 5.5). Both sites contained older remnant trees and we were able to extend the tree-ring chronology for La Botica back to 1198. We were not able to determine fire scar dates from the five living trees sampled previously with increment borers. The cores and scar margins were generally in poorer shape than what we were able to determine from the cross section samples. However, we suspect based on our crossdating that all fire-scar dates are in the range of those found on fire-scar sections.

We did not see any differences in fire timing, seasonality, or spatial patterns between the two sites, but instead identified four distinct time periods that occurred synchronously at both (figure 5.5). From the beginning of the fire histories in the late 1300s or early 1400s until 1684, both sites recorded relatively frequent fires, but most were recorded on only one or at most a few trees (Period I). In addition, few of the fire dates were recorded at both sites. The presence of scars on only a single tree or a few trees for any year suggests these were relatively small, patchy fires did not burn extensively through the area. This was followed by a 101 year-long hiatus in fires from 1684 to 1785 that occurred in both sites (Period II).

Following this hiatus, fires occurred less frequently but more synchronously both within and between sites from 1785 to the mid-1800s (Period III). Synchronously recorded fire scars suggests that fires

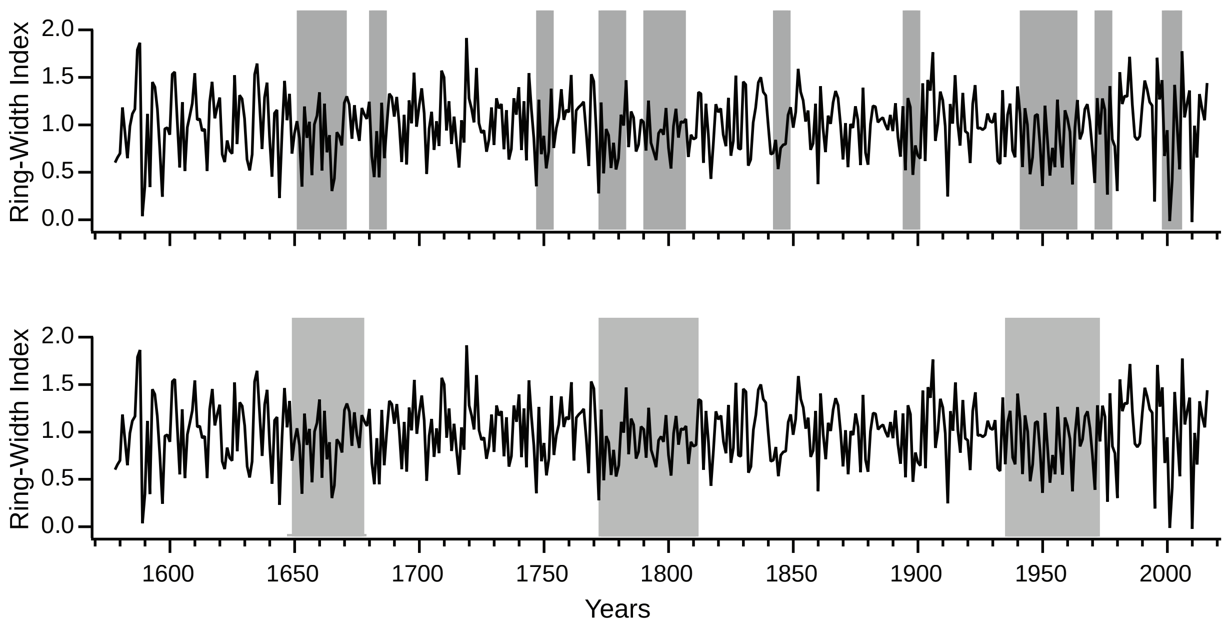


Figure 5.3. Multi-year periods of low growth (grey boxes) in the La Botica ring-width chronology (black line), computed with 9-year (top) and 21-year (bottom) running averages.

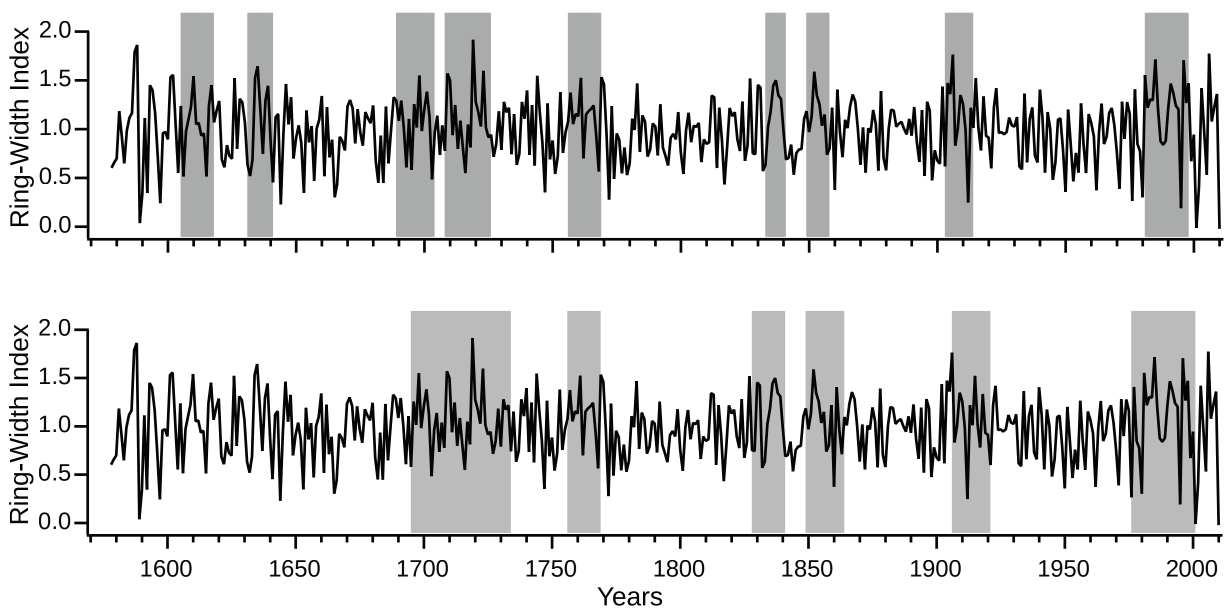


Figure 5.4. Multi-year periods of high growth (grey boxes) in the La Botica ring-width chronology (black line), computed with 9-year (top) and 21-year (bottom) running averages.

were larger in extent during Period III than during Period I, possibly as a result of the longer intervals between fires that would have led to greater buildup of fuel amounts and continuity. All fire dates during Period III were recorded on trees in both sites except for 1864, which was recorded only at LAF-A. The final period (Period IV) is seen in both fire chronologies and was a period of fire exclusion coeval with a substantial increase in Euro-American settlement throughout the region. This latter period is common in fire histories throughout the Rocky Mountains and Southwest (e.g., Brown and Wu 2005; Swetnam *et al.*

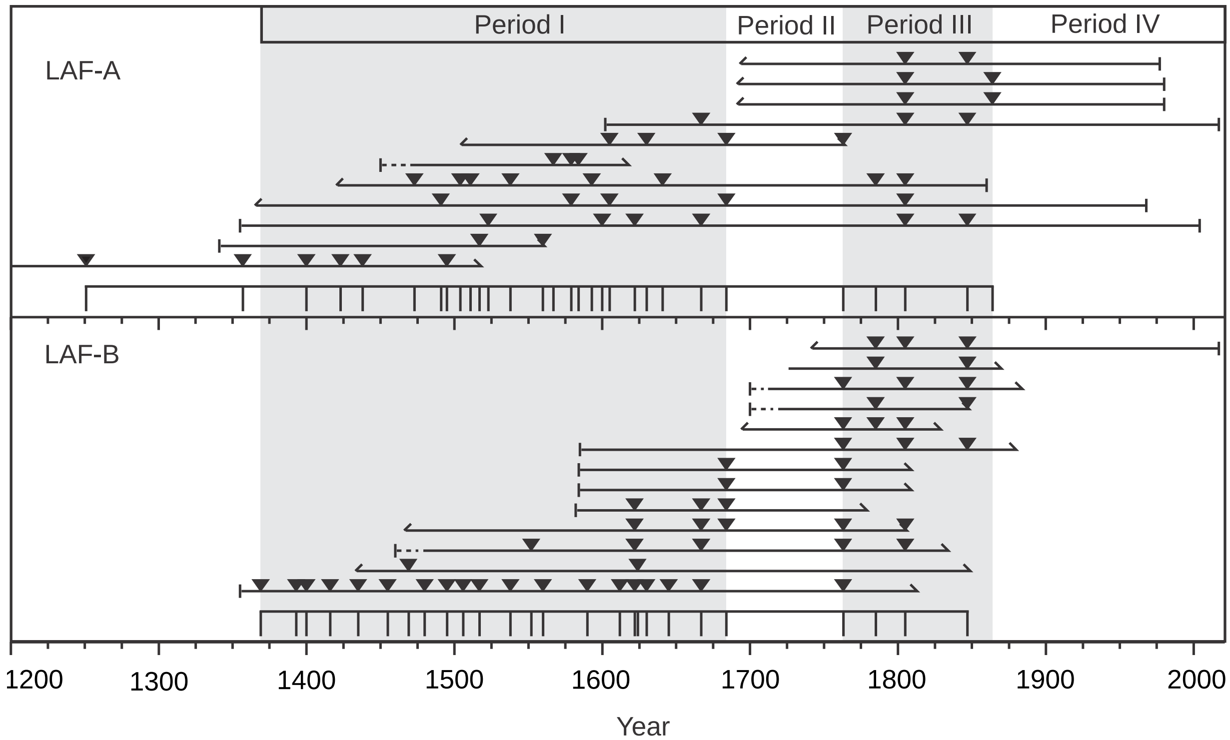


Figure 5.5. Fire chronologies for sites LAF-A (top) and LAF-B (bottom). Time spans of individual trees are represented by horizontal lines with dates of fire scars represented by inverted triangles. Vertical or slanted tic marks at the beginning of each tree span represent pith or inside dates (respectively) while vertical or slanted tic marks at the end of each span represent bark or outside dates (respectively). Dashed portions of tree spans represent estimated number of rings to pith. Short vertical lines at the bottom of each panel are fire dates recorded on any tree at each site.

2016). The last fire date recorded in LAF-A was 1864 and the last date recorded in LAF-B was 1847.

For site LAF-A, mean fire intervals (MFI) were significantly different ($p<0.5$) between Periods I and III in a t-test of means: from 1350 to 1684 the MFI was 14 years (range 4 to 43 years), and from 1785 to 1864 the MFI almost doubled to 25 years (range 17 to 42 years). There was a corresponding shift in fire seasonality, with the earlier period recording twice as many early-season fires while the latter recorded twice as many late-season fires. Similar patterns in both fire frequency and seasonality were recorded in the LAF-B chronology. The MFI from 1350 to 1684 was 15 years (range 2 to 30 years), and from 1785 to the last fire in 1847 MFI again almost doubled to 28 years (range 20 to 42 years). MFIs at LAF-B also were significantly different ($p<0.5$) in a t-test, and seasonality also followed the same pattern as LAF-A, with more early-season fires in Period I and more late-season fires in Period III. Superposed epoch analysis testing mean summer PDSI during fire years against mean PDSI of the entire period also documents that fires occurred during drought years in the early portion of the records (Period I) but not the latter (Period III) (figure 5.6). A similar pattern was noted using the La Botica ring-width chronology (data not shown), which also confirms the applicability for the ring-width chronology for drought reconstructions (*sensu* Swetnam and Brown 2010).

Implications for Human History at La Botica

Threshold values in the ring-width chronology for La Botica identify periods of potentially exceptional dry or wet periods that may have had greater impact on human populations or resource availability at the site (figures 5.3 and 5.4; tables 5.1 and 5.2). Exceptional periods are defined as those 9- and 21-year intervals in the first (dry) or fourth (wet) quartile of the distribution of interval averages. These threshold values are arbitrary but assumed to represent periods that may have influenced resource productivity

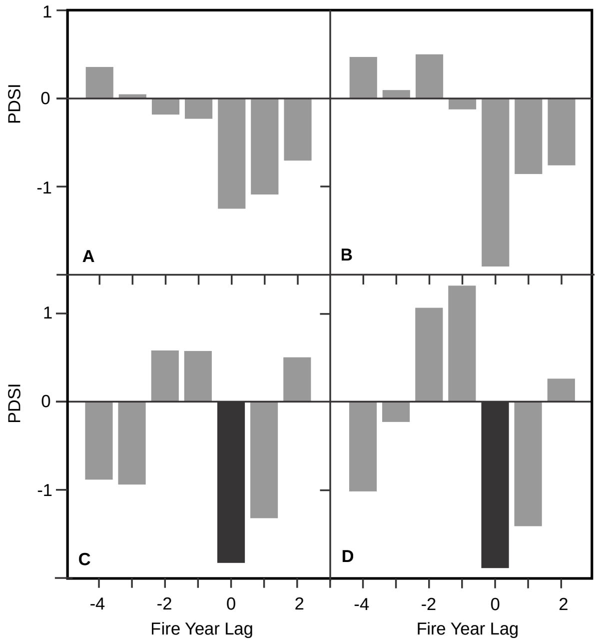


Figure 5.6. Superposed epoch analysis of mean summer PDSI during fire years for: A) LAF-A, Period III; B) LAF-B, Period III; C) LAF-A, Period I; D) LAF-B, Period I. Fire year lag 0 is mean of fire years for each site and period. Significant departures (p<0.01) are marked by black histograms.

or human perceptions of productivity relative to typical conditions. Periods of relatively higher radial tree-growth likely reflect periods more favorable to resource productivity whereas periods of relatively lower radial tree-growth may reflect periods less favorable to resource productivity. Fewer resources may suggest that people in the area may have had to activate a repertoire of adaptive strategies to lessen the risk of resource shortfalls, such as movement or migration, dietary change, trade, or modifications to gathering or agricultural strategies. As a last resort, movement from areas of lesser to greater resource productivity is a world-wide human strategy for lessening shortfall risk.

It is important to note, however, that knowledge of past climatic conditions that affect resource productivity and inferred variation in resource "supply" must be compared to the "demand" for these resources by humans. Such demands are a function of human population levels and a plethora of unknown cultural behaviors beyond the scope of this study and the available archaeological evidence. It is entirely possible that during periods of below average tree growth and possible reduced resource productivity, humans may have been unaffected if these below-average conditions remained sufficient for meeting human needs. Further understanding of how resource limitations may have played out at La Botica depends on a better understanding of the archaeology of the site and potential changes in occupation.

We did not find any differences in fire frequency, timing, or seasonality between the two sites at La Botica, suggesting that any potential human signature in fire regimes was more widespread than only at the site itself. However, temporal patterns in the fire history data suggest possible relationships with changes in human land use through time. Patchy, frequent fires in the early portion of the chronologies (Period I; figure 5.5) may have been the result of a greater number of human ignitions that tended to reduce fuel continuity, leading to smaller fires than if fuels were more continuous across the landscape. It is possible this period is reflective of a larger human population that resulted in more opportunities for either purposeful or accidental fire starts. Fires in semi-arid forests and grasslands burn mainly through surface fuels, and widespread fire occurrence depends on the amount and continuity of grass and herbaceous understories.

This pattern is similar to what Swetnam and others (2016) found in the Jemez Mountains in northern New Mexico, not far south of our study area at La Botica. Prior to 1680, the Jemez fire history also documents frequent but relatively smaller fires, similar to Period I at La Botica. Changes in the fire regime there also occurred starting around 1680, which Swetnam and others suggest may be the result of the 1680 Pueblo Revolt and depopulation of previously occupied areas. A similar pattern of abandonment of the area around La Botica also could have occurred at this time, leading to a reduction of frequent, patchy fires during Period II. However, Swetnam and others did not find a long hiatus in fires as we found at La Botica, but rather shifts in both fire extent and longer intervals between fires, similar to what we found in Period III in the La Botica record. This suggests that complicating factors other than human dynamics may have been responsible for the long fire hiatus of Period II. For example, Brown and Wu (2005) report a long interval without fires from 1684 to 1724 in their fire history at Archuleta Mesa located about 100 km west of La Botica, which they suggest was the result of a dampening of wet/dry climate oscillations affected by the El Niño-Southern Oscillation and subsequent cycles of fine fuel buildup and drying. However, Brown and Wu did not see any shift in fire frequencies or spatial patterns before or after this hiatus, perhaps because human population pressures were not present at their site. The La Botica fire chronology prior to 1685 also is similar to the nearby Hot Creek site (about 20 km north of La Botica [Brown *et al.* 2000]), which recorded patchy, frequent fires up to the late 1700s, followed by a synchronous site-wide fire in 1802. There was then a general lack of fires after this date, until two synchronous fires recorded in 1893 and 1896.

In contrast to the pattern of frequent, relatively small fires during Period I, the fire regime of Period III is possibly what may have occurred under a more "natural" fire regime without impacts from human ignitions (see also Swetnam *et al.* 2016). Intervals between fires were longer, and when fires did occur they were more synchronous within and between sites. There was also a shift in fire timing within rings, with more early season fires in Period I in contrast to more late season fires in Period III; this also may represent more human starts during Period I earlier in growing seasons. This also was the conclusion of Swetnam and others (2016) for the Jemez Mountains, which saw a change to less frequent but more extensive fires after the Pueblo Revolt and likely abandonment of previously heavily occupied landscapes. However, the relationship between climate and fires in Period I compared to Period III is opposite what may be expected in a human rather than natural fire regime, and of what Swetnam and others (2016) found in their data. There is a recognizable climate signature in the timing of fires in the earlier period in the form of drought affecting fire occurrence whereas there is not in the latter (figure 5.6). If humans were increasing fires through added ignitions, we would expect that a drought signal in fire starts would be less evident. However, it is possible that we have too few fires in Period III to be able to discern the climate signal in the SEA; we were able to test only five fire dates from LAF-A and only four from LAF-B for the SEA. These may be too few for the statistical analysis to adequately define a significant result. The trend is for fire years to be drought years during Period III (figures 5.6a and 5.6b), but these were not significant in SEA.

The period of fire exclusion (Period IV) seen in the La Botica sites is common to all fire chronologies throughout the Southwest and Southern Rocky Mountains (e.g., Brown *et al.* 2000; Brown and Wu 2005; Grissino-Mayer *et al.* 2004; Swetnam and Baisan 1996; Swetnam *et al.* 2016). The most commonly cited cause for cessation of historical fire patterns at this time was widespread livestock grazing that accompanied Euro-American settlement that began in the middle to late 1800s. Pre-settlement wildfires that produced fire scars were primarily surface fires fueled by grass and herbaceous understories in relatively open and productive ponderosa pine forests, woodlands, and grasslands. Livestock grazing reduced fine fuel amounts and continuity to the point that even when a fire was able to start, it was not able to burn far. The town of San Luis on the eastern side of the San Luis Valley (about 70 km due east of La Botica) was among the first Euro-American settlements in the region, founded in April 1851. Although early grazing history is sparse, presumably early Spanish settlers started sheep and cattle grazing throughout the valley at about that time. There is a possible historic sheep trail through and on the slope above La Botica (chapter 6, this volume), possible evidence of the impact that this land use activity would have had on fire spread in the site and larger area beginning in the mid-1800s. Later, beginning in the early twentieth century, active fire suppression efforts by land management agencies would have further reduced fire occurrence and spread up to the present day.

Conclusions

The tree-ring record from La Botica consists of both tree-growth and fire-scar datasets that extend our understanding of fire and climate dynamics back several centuries before the present, overlapping with at least some of the human history reconstructed from the archaeology of the site. Our data document changes in both tree growth and fire regime characteristics that not only provide context for possible resource limitations for human populations, but in the case of the fire regime also likely reflect changes in resource use and population dynamics in the site and larger region. The earliest period of frequent, patchy fires before 1684 may reflect the presence of a relatively large human population causing increased fire ignitions, both purposeful and accidental. After this it is possible that La Botica saw the effects of population movement after the Pueblo Revolt of 1680, with abandonment of the site, which—possibly coupled with climate changes at the time (Brown and Wu 2005)—resulted in a complete cessation of fires for over a century. Fires started up again in 1785, and the period after that may reflect natural ignitions and patterns of fuel accumulation until the mid-1800s, when fires again cease completely. This latest period of fire exclusion continues to the present day, and there is evidence that this period was initially directly caused by patterns of livestock grazing that reduced fuel continuity and fire spread. Active fire suppression by land management agencies has further contributed to the lack of fires through the twentieth and twenty-first centuries. Thus, we see both known and suspected impacts of population and changes in resource uses at La Botica reflected in natural ecosystem patterns and processes, and how those changes in turn may have affected population dynamics and resource use through time at La Botica.

Acknowledgements. We thank Mark Mitchell and Paleocultural Research Group for funding and logistical help in the field. We especially thank the students of Colorado College's course, "Past Climates and Human History of the Southwest" - Sierra Melton, Ian Culver, Mason Culver, Robin Grathwohl, and Patrick Kerwin – and the co-instructor for the course, Eric Leonard, for their invaluable help in the field and in development of the La Botica ring-width chronology. The Colorado College Anthropology and Geology Departments also provided funding for field work for the course.

References Cited

Allen, Craig D.
2002 Lots of Lightning and Plenty of People: An Ecological History of Fire in the Upland Southwest. In *Fire, Native Peoples, and the Natural Landscape*, edited by Thomas R. Vale. Island Press, Washington, D. C.

Anderson, M. Kat
2006 The Use of Fire by Native Americans in California. In *Fire in California's Ecosystems*, edited by Neil G. Sugihara, Jan W. Van Wagtendonk, Kevin E. Shaffer, Joann Fites-Kaufman, and Andrea E. Thode, pp. 417-430. University of California Press, Berkeley, California.

Biondi, Franco, and Kishor Waikul
2004 DENDROCLIM2002: A C++ Program for Statistical Calibration of Climate Signals in Tree-Ring Chronologies. *Computers & Geosciences* 30(3):303-311.

Brown, Peter M.
2015 Dendrochronology, Fire Regimes. In *Encyclopedia of Scientific Dating Methods*, edited by W. Jack Rink and Jeroen W. Thompson, pp. 204-204. Springer Science+Business Media, Dordrecht, Germany.

Brown, Peter M., Michael G. Ryan, and Thomas G. Andrews
2000 Historical Fire Frequency in Ponderosa Pine Stands in Research Natural Areas, Central Rocky Mountains and Black Hills, US. *Natural Areas Journal* 20:133-139.

Brown, Peter M., and Rosalind Wu
2005 Climate and Disturbance Forcing of Episodic Tree Recruitment in a Southwestern Ponderosa Pine Forest. *Ecology* 86:3030-3038.

Cook, Edward R., David M. Meko, David W. Stahle, and Malcolm K. Cleaveland
2004 North American Summer PDSI Reconstructions. IGBP PAGES/World Data Center for Paleoclimatology. Data Contribution Series # 2004–045. NOAA/NGDC Paleoclimatology Program, Boulder, Colorado. Electronic resource, http://www.ncdc.noaa.gov/paleo/pdsidata.html.

Cordell, Linda S., Carla R. Van West, Jeffrey S. Dean, and Deborah A. Muenchrath
2007 Mesa Verde Settlement History and Relocation: Climate Change, Social Networks, and Ancestral Pueblo Migration. *Kiva* 72(4):391-417.

Cybis Elektronik
2017 CDendro and CooRecorder. Electronic resource, http://www.cybis.se/forfun/dendro/index.htm.

deMenocal, Peter B.
2001 Cultural Responses to Climate Change During the Late Holocene. *Science* 292(5517):667–673.

Falk, Donald A., Emily K. Heyerdahl, Peter M. Brown, Calvin Farris, Peter Z. Fulé, Donald McKenzie, Thomas W. Swetnam, Alan H. Taylor, and Megan L. Van Horne
2011 Multi-scale Controls of Historical Forest-fire Regimes: New Insights from Fire-scar Networks. *Frontiers in Ecology and the Environment* 9: 446–454.

Grissino-Mayer, Henri D.
2001 FHX2—Software for Analyzing Temporal and Spatial Patterns in Fire Regimes from Tree Rings. *Tree-Ring Research* 57:115–124.

Grissino-Mayer, Henri D., William H. Romme, M. Lisa Floyd, and David D. Hanna
2004 Climatic and human influences on fire regimes in the southern San Juan Mountains, Colorado, USA. Ecology 85:1708–1724.

Holmes, Richard L.
1983 Computer-Assisted Quality Control in Tree-Ring Dating and Measurement. *Tree-Ring Bulletin* 43:69-78.

Ingram, Scott E., Peter M. Brown, Eric Leonard, Sierra Melton, Ian Culver, Mason Culver, Robin Grathwohl, and Patrick Kerwin
2018 *A 439-Year Tree-Ring Width Chronology for*

the La Botica Archaeological Site (5CN106), Conejos County, Colorado. Colorado College, Colorado Springs, Colorado. Prepared for Paleocultural Research Group, Broomfield, Colorado.

Kohler, Timothy A., Mark D. Varien, Aaron Wright, and Kristin A. Kuckelman
2008 Mesa Verde Migrations: New Archaeological Research and Computer Simulation Suggest Why Ancestral Puebloans Deserted the Northern Southwest United States. *American Scientist* 96:146–153.

National Climatic Data Center [NCDC]
2018 NNDC Climate Data Online. Electronic resource, https://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp#, accessed 28 May 2018.

Nelson, Margaret C., Scott E. Ingram, Andrew J. Dugmore, Richard Streeter, Matthew A. Peeples, Thomas H. McGovern, Michelle Hegmon, Jette Arneborg, Keith W. Kintigh, Seth Brewington, Katherine A. Spielmann, Ian A. Simpson, Colleen Strawhacker, Laura E. L. Comeau, Andrea Torvinen, Christian K. Madsen, George Hambrecht, and Konrad Smiarowski
2016 Climate Challenges, Vulnerabilities, and Food Security. *Proceedings of the National Academy of Sciences* 113:298-303.

PRISM Climate Group, Oregon State University [PRISM]
2008 PRISM Climate Data. Electronic resources, http://prism.oregonstate.edu, accessed 20 May 2018.

Pyne, Stephen J.
1982 *Fire in America - A Cultural History of Wildland and Rural Fire*. Princeton University Press, Princeton, New Jersey.

Smith, Kevin T., Estelle Arbellay, Donald A. Falk, and Elaine Kennedy Sutherland
2016 Macroanatomy and Compartmentalization of Recent Fire Scars in Three North American Conifers. *Canadian Journal of Forest Research* 46:535-542.

Smith, Kevin T., and Elaine Kennedy Sutherland
2001 Terminology and Biology of Fire Scars in Selected Central Hardwoods. *Tree-Ring Research* 57:141–147.

Speer, James H.
2010 *Fundamentals of Tree-Ring Research*. The University of Arizona Press, Tucson.

Swetnam, Thomas W., and Christopher H. Baisan
1996 Historical Fire Regime Patterns in the Southwestern United States Since 1700. In *Fire Effects in Southwestern Forests,* edited by Craig D. Allen, pp. 11-32. Proceedings of the 2nd La Mesa Fire Symposium, Forest Service General Technical Report RM-GTR-286. U.S. Department of Agriculture, Los Alamos, New Mexico.

Swetnam, Thomas W., and Peter M. Brown
2010 Climatic Inferences from Dendroecological Reconstructions. In *Dendroclimatology: Progress and Prospects*, edited by Malcolm K. Hughes, Henry F. Diaz, and Thomas W. Swetnam, pp. 263-295. Developments in Paleoenvironmental Research Vol. 11, Springer.

Swetnam, Thomas W., Joshua Farella, Christopher I. Roos, Matthew J. Liebmann, Donald A. Falk, and Craig D. Allen
2016 Multiscale Perspectives of Fire, Climate and Humans in Western North America and the Jemez Mountains, USA. *Philosophical Transactions of the Royal Society B: Biological Sciences* 371(1696). DOI: https://doi.org/10.1098/rstb.2015.0168.

Van West Carla R., and Jeffery S. Dean
2000 Environmental Characteristics of the A.D. 900-1300 Period in the Central Mesa Verde Region. *Kiva* 66:19-44.

Western Regional Climate Center [WRCC]
2018 Historical Climate Information. Electronic resource, https://wrcc.dri.edu/CLIMATEDATA.html, accessed 26 April 2018.

Woodhouse, Connie A., Jeffery J. Lukas, and Peter M. Brown
2002 Drought in the Western Great Plains, 1845-56: Impacts and Implications. *Bulletin of the American Meteorological Society* 83:1485-1493.

6

Archaeology of the La Botica Site

Mark D. Mitchell

Indigenous Americans first came to La Botica some 7,500 years ago and returned regularly throughout the Late Holocene. Few other documented sites in the San Luis Valley preserve a record of consistent use spanning such a long period. What can the artifacts and features preserved at La Botica—stone tools, pottery sherds, hearths, and culturally modified trees—tell us about how the site was used in the past and by whom? Did the nature of that use change over time? How was Native American use of La Botica's resources integrated into the structure of the regional cultural landscape?

In addition to its importance for understanding native land use, the archaeology of the La Botica site is also important for the study of San Luis Valley Hispano traditions. La Botica is the only documented medicinal plant gathering locality in the region. Artifacts left at the site by Hispano visitors can add to what is known about local folk medicine practices.

Although the cultural significance of the plants growing at La Botica was recognized more than 30 years ago, its archaeological significance has only recently been understood. A portion of the site was first documented during a 2005 inventory undertaken by the National Park Service and Fort Lewis College (Wells and Baughman 2008). Fort Lewis College survey teams returned to the site during 2006 and 2009 to conduct additional reconnaissance work (Crosser *et al*. 2009). Mitchell (2020) provides a detailed account of PCRG's 2018 archaeological field investigation, along with comprehensive data on the documented features and artifacts. During 2019, PCRG Research Director Mark Mitchell analyzed artifacts previously collected by Fort Lewis College,

2022 *Multidisciplinary Research at the La Botica Site, Conejos County, Colorado*, edited by Mark D. Mitchell, pp. 69-99. Research Contribution 115. Paleocultural Research Group, Broomfield, Colorado.

which are permanently housed at Great Sand Dunes National Park and Preserve. This chapter integrates field data obtained by Fort Lewis College with field and lab data obtained by PCRG.

Overview of the 2018 Fieldwork

The 15-hectare (37-acre) La Botica archaeological site completely encompasses the tread of an abandoned strath terrace (paleofluve) perched some 110 to 120 m below the rim of the La Jara Canyon and 70 to 80 m above the modern floodplain of La Jara Creek (figure 6.1) (see chapter 2, this volume). The site is bounded on the east and south by talus slopes and on the north and west by the remnant valley margin. Apart from a portion of its western end, the terrace surface has no modern hydrologic connection to La Jara Creek; precipitation that falls on the terrace drains toward a central basin where it pools and infiltrates or evaporates.

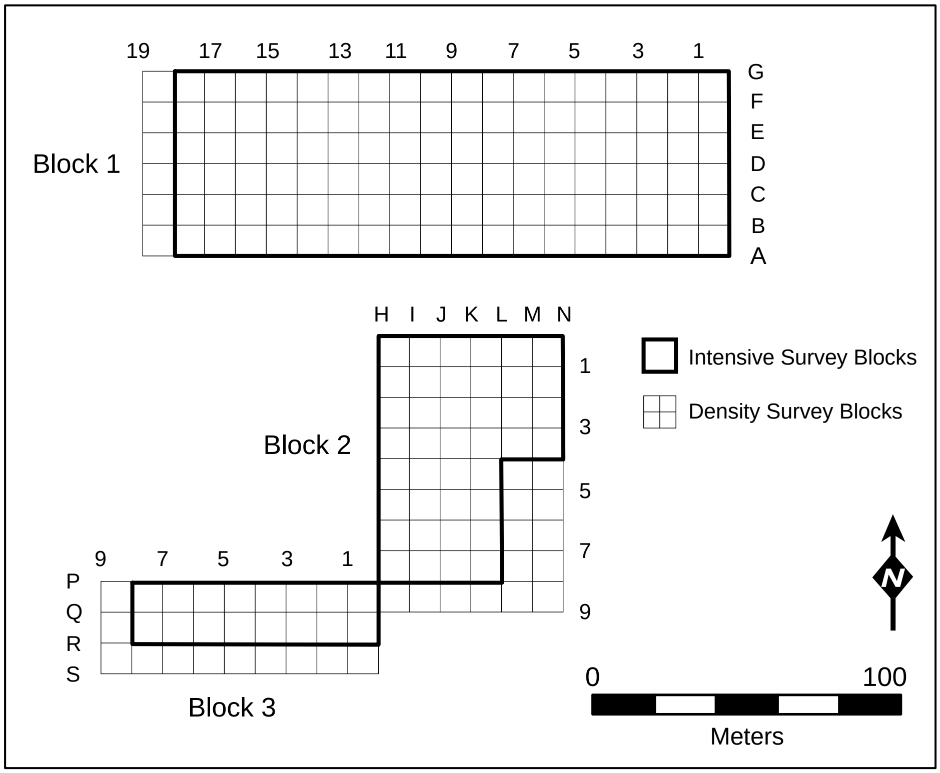
Surface data were collected from three defined blocks or areas located north, east, and south of the central hydrologic depression (figure 6.2). An alphanumeric system was used to designate grid squares for an intensive artifact inventory. Alphanumeric points were also used to designate data collection nodes for an artifact density survey.

The "point-quarter" (P-Q) method was used to objectively quantify the density of lithic flakes. The P-Q method was first developed for ecological applications but also has been effectively applied to archaeological cases (e.g. Ahler *et al*. 1979). The method is based on the fact that artifact density is a function of the distances between objects, where density is the inverse of the squared mean distance between observed artifacts and a defined data collection point.

Transect spacing within the 20 x 20-m intensive inventory blocks was approximately 1 to 2 m. Survey crews systematically searched each block for chipped and ground stone tools, pottery sherds, and cultural features. Non-diagnostic tools, including handstones, millingstones, drills, scrapers, and so forth, were tallied by survey block. Mapping-grade GPS data were collected on temporally diagnostic artifacts (projectile points and pottery). Several of the

Figure 6.1. Oblique Google Earth image of the La Botica site showing the locations of the three artifact-density survey blocks.

Figure 6.2. Schematic map showing the alphanumeric survey grid system.



documented diagnostic artifacts were located outside the boundaries of the intensive inventory blocks.

Ground visibility within the survey areas was good to excellent (figure 6.3). Big sagebrush (*Artemisia tridentata*) is the dominant plant species within the survey areas. Grasses and forbs mostly are lacking, and leaf litter has accumulated only around the bases of larger sagebrush plants. Minor variations in visibility occurred among the three survey areas: the best visibility occurred in Block 1, while somewhat more limited visibility occurred on the east side of Block 2 and the south side of Block 3. The poorest visibility occurred on the boundary between the sagebrush community and the surrounding mixed conifer community, which roughly coincided with the toe of the talus slope.

In addition to these surface data, subsurface data were obtained from seven 1 x 1-m excavation squares. Three squares were placed over possible cultural features located on the south side of the site. The remaining four squares were opened to obtain soil stratigraphic data. Two of those soil pits were located on the east end of the site, while two others were located in the hydrologic basin near the center of the site. A small collection of artifacts consisting of lithic flakes, pottery sherds, and a chipped stone tool

Figure 6.3. Photograph showing typical ground visibility within the survey blocks.

was recovered from surface and subsurface contexts in these seven tests. Another 30 pottery sherds were collected from the surface. No chipped or ground stone tools were collected from the surface.

Survey Results

Point-Quarter Flake Density Survey

Figure 6.4 illustrates the results of the P-Q density survey. (For clarity, the survey blocks are shown schematically; refer to figure 6.1 for the locations of the density survey blocks within the overall site boundary.) Each cell in figure 6.4 represents a 10 x 10-m (100 m^2) area centered on an alphanumeric data collection point. The five gray tones represent calculated density values expressed as flakes/m^2. Among the 233 sampled cells, six contained no flakes, while 23 contained more than 2 flakes/m^2. Most cells contained between 0 and 0.5 flakes/m^2. The cell with the highest density contained 14.3 flakes/m^2. Based on these data, the 2.33 ha covered by the density survey contains an estimated 19,300 flakes or an aggregate mean of 0.83 flakes/m^2 (table 6.1). If the highest-density cell is removed, the aggregate mean drops slightly to 0.77 flakes/m^2, or an estimated 17,900 flakes within the surveyed area. Figure 6.5 illustrates the distribution of flake densities by survey cell.

Flaking debris is unevenly distributed within the site boundary. The largest concentration, both in terms of extent and density, occurs on the west side of Block 1. Three smaller and less dense concentrations occur on the east side of Block 1, on the north side of Block 2, and on the south side of Block 2 and the east side of Block 3.

The three smaller concentrations occur along the toe of the talus slope, roughly conterminous with the area where late Holocene sediment is best preserved. By contrast, the large concentration on the west side of Block 1 occurs in an eroded portion of the site, immediately north of the central depression. Surface geomorphology is described more fully later in the chapter.

Intensive Inventory

A total of 41 20 x 20-m grids (1.64 hectares or 4.1 acres) were examined during the intensive inventory.

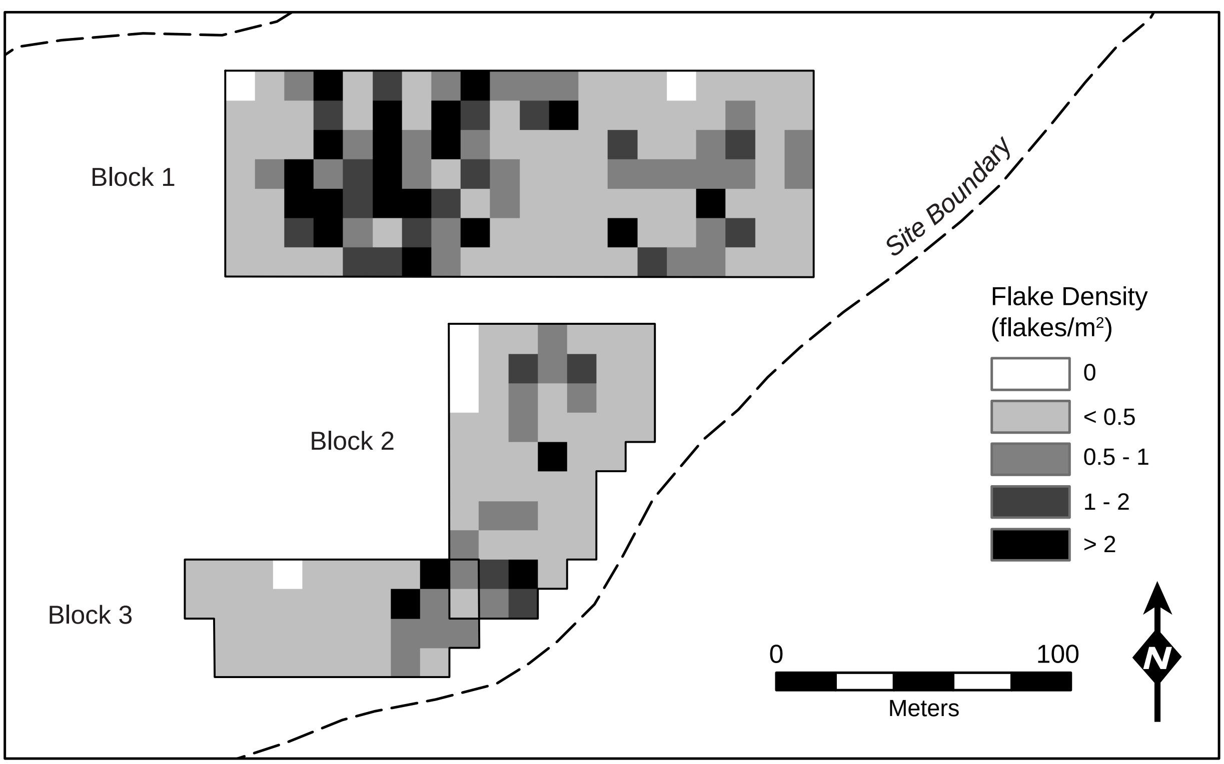


Figure 6.4. Map showing the results of the P-Q density survey. Each cell represents a 10 x 10-m area; refer to figure 6.1 for the locations of the survey blocks within the site.

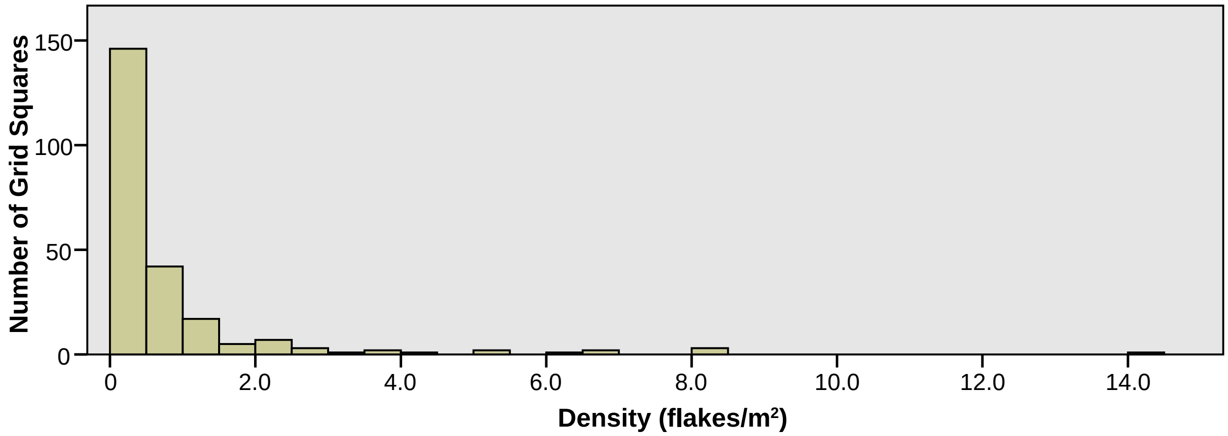


Figure 6.5. Histogram showing the distribution of flake densities among 233 survey grid squares.

Table 6.1. Distribution of calculated flake density values among 233 grid cells.

Density Class (flakes/m^2)	Number of 10 x 10-m Cells	Estimated Total Flake Count for Density Class
0.0	6	0
< 0.5	140	2,563
0.5-1.0	44	3,198
1.0-2.0	20	2,746
>2.0	23	10,789
Total	233	19,296

Figure 6.6 illustrates the results. Each grid or cell in figure 6.6 encompasses 400 m^2, an area four times that of the density survey cells. The lower panel of the figure shows the distribution of 59 ground stone tools, while the upper panel shows the distribution of 39 chipped stone tools. (A total of 84 non-diagnostic tools were documented in 2018; however, the illustrated tool frequencies also include six projectile points documented within the 2018 inventory blocks as well as eight chipped stone tools [including projectile points] plotted during the 2009 Fort Lewis College inventory. Few ground stone tools were plotted in 2009 and those that were occurred outside the boundaries of the 2018 inventory blocks.)

No tools were identified in eight of the 41 intensive inventory grids. Sixteen grids contained no ground stone tools, while 18 contained no chipped stone tools. The largest number of tools in a single grid was nine and the mean is 2.4 tools/grid. Figure 6.7 illustrates the frequency distributions of chipped and ground stone tools.

Sixty percent of the assemblage consists of ground stone tools or tool fragments, yielding a mean density of 1.4 tools/grid. The mean density of chipped stone tools is 1.0 tool/grid. Differences exist between the distributions of ground and chipped stone tools. The distribution of ground stone tools is similar to that of flaking debris: the largest concentration occurs on the west side of Block 1 and smaller frequencies occur closer to the toe of the talus slope. By contrast, chipped stone tools are moderately more common adjacent to the talus slope. These differences, though minor, may reflect spatial variations in assemblage function.

Stronger contrasts are evident in the distributions of projectile points and pottery sherds. Figure 6.8 illustrates those distributions, both inside and outside the survey blocks. Illustrated specimens include those plotted in 2018 as well as those plotted in 2009. As shown in the upper panel, projectile points were distributed throughout the inventory blocks, including along the toe of the talus slope and in the eroded area north of the hydrologic basin. By contrast, the distribution of pottery sherds, shown in the lower panel, was confined to the toe of the talus slope. However, dart points, which predate the production of pottery, were more common in Block 1, while arrow points were more common along the toe of the talus slope, where the pottery sherds also were found.

These distributions suggest that Archaic groups—

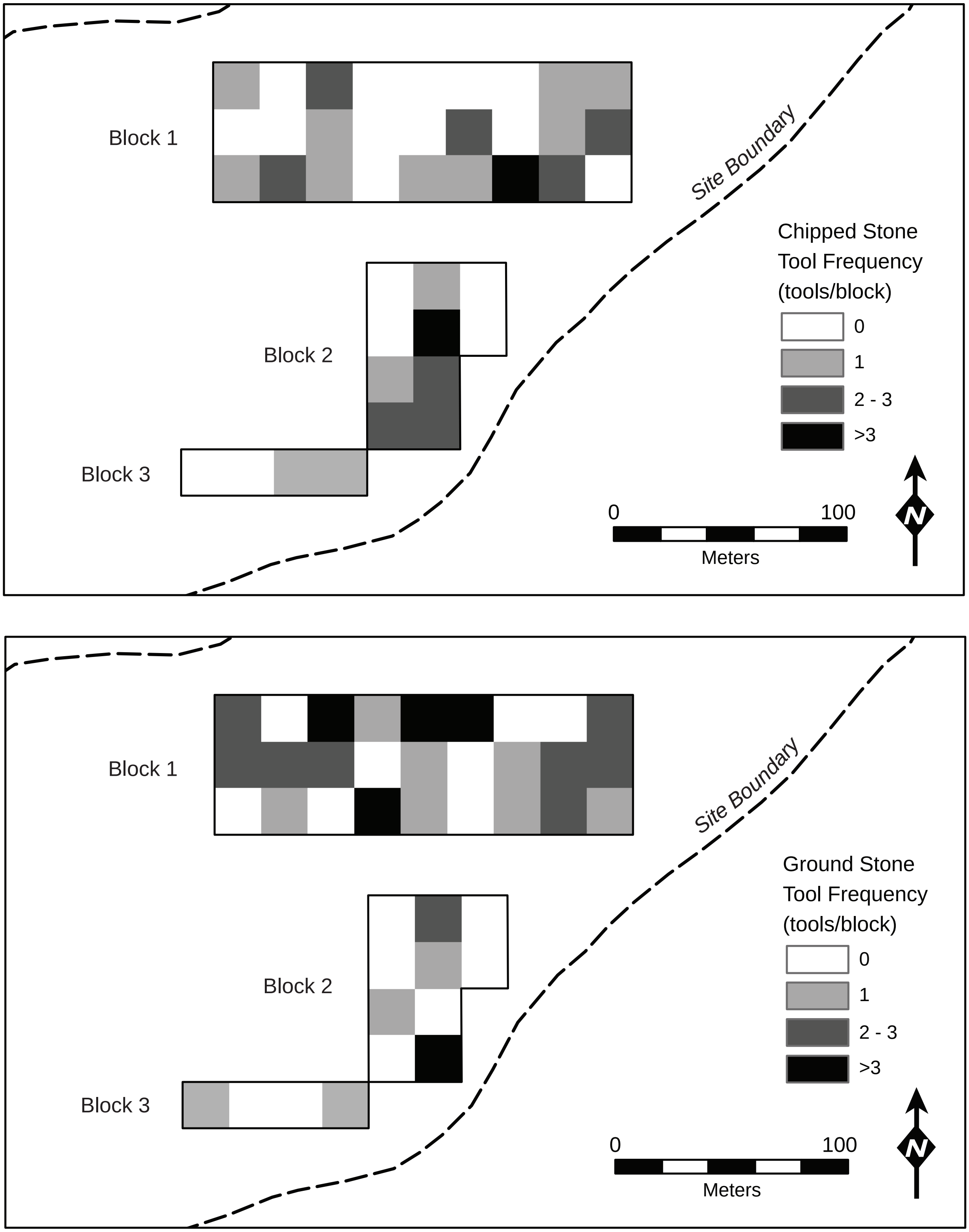


Figure 6.6. Maps showing the distributions of chipped stone (upper panel) and ground stone (lower panel) tools within the survey blocks. Each cell represents a 20 x 20-m area.

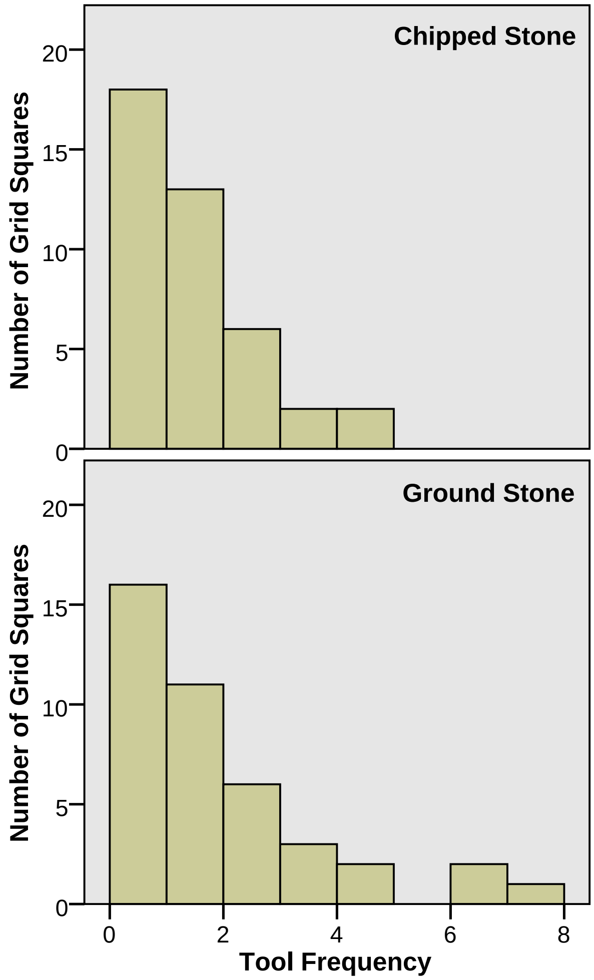


Figure 6.7. Histogram showing the frequency distributions of chipped stone (upper panel) and ground stone (lower panel) tools among the 41 grid squares.

who manufactured dart points but did not use ceramic containers—used the entire site area, while Late Prehistoric groups—who manufactured both arrow points and pottery—focused their occupancy on the portions of the site closest to the talus slope. These distributions further suggest that the large concentration of flaking debris and ground stone tools located on the west end of Block 1 dates primarily or exclusively to the Archaic period and, moreover, that a potential spatial variation in assemblage function, with ground stone tools more common on the west side of Block 1 and chipped stone tools more common along the toe of the talus slope, in fact reflects a modest temporal change in site use.

Historical Artifacts

A small assemblage of recent metal artifacts is present at La Botica. Nearly all of the documented specimens occur in a single concentration located on the site's south side. The assemblage primarily consists of sanitary food cans, tobacco cans, sardine cans, and miscellaneous manufactured and handmade camp equipment. Manufactured camp equipment includes a friction-fit lid with a wire loop handle and a detached strap handle, possibly representing a single coffee pot. Handmade camp equipment includes a funnel and baling wire loops. Isolated artifacts documented elsewhere on the site—including a sheet-metal stove, a soldered can, and a fragment of a horseshoe—may have been displaced from the primary concentration. In 2009, the Fort Lewis College survey team also documented an informal stacked log fence on the site's western end that may represent the remains of a temporary corral (Crosser *et al*. 2009). A remnant of a constructed trail begins on the canyon rim south of the site and descends the valley slope above the site. Whether the trail was specifically built to access La Botica is not known. Its age is also not known.

Apart from a single aluminum pull tab, most of the cans date to the early twentieth century. Sanitary cans, the most abundant type, were widely available after 1904. A cut can lid embossed with the word "Sanitary" likely was manufactured between 1904 and 1908, although a few such cans may have been produced after World War I (Rock 1989:65, 198). A can fragment with a soldered seam could date to the 1890s, while the sardine cans could have been produced after World War I or later. Tobacco tins with hinged lids were first produced in 1907.

These data point to only limited use of the site for habitation during the twentieth century. The number, distribution, and ages of the historical artifacts suggests a single early twentieth-century occupation.

Culturally Modified Trees

Several CMTs were observed but not formally documented at La Botica when it was first recorded in 2005. The 2009 Fort Lewis College survey identified five possible CMTs (Crosser *et al*. 2009). A Bureau of Land Management site-monitoring crew later identified two additional possible CMTs. During the 2018 fieldwork, PCRG crews revisited and reevaluated each of the previously documented potential CMTs and determined that four of the seven previously

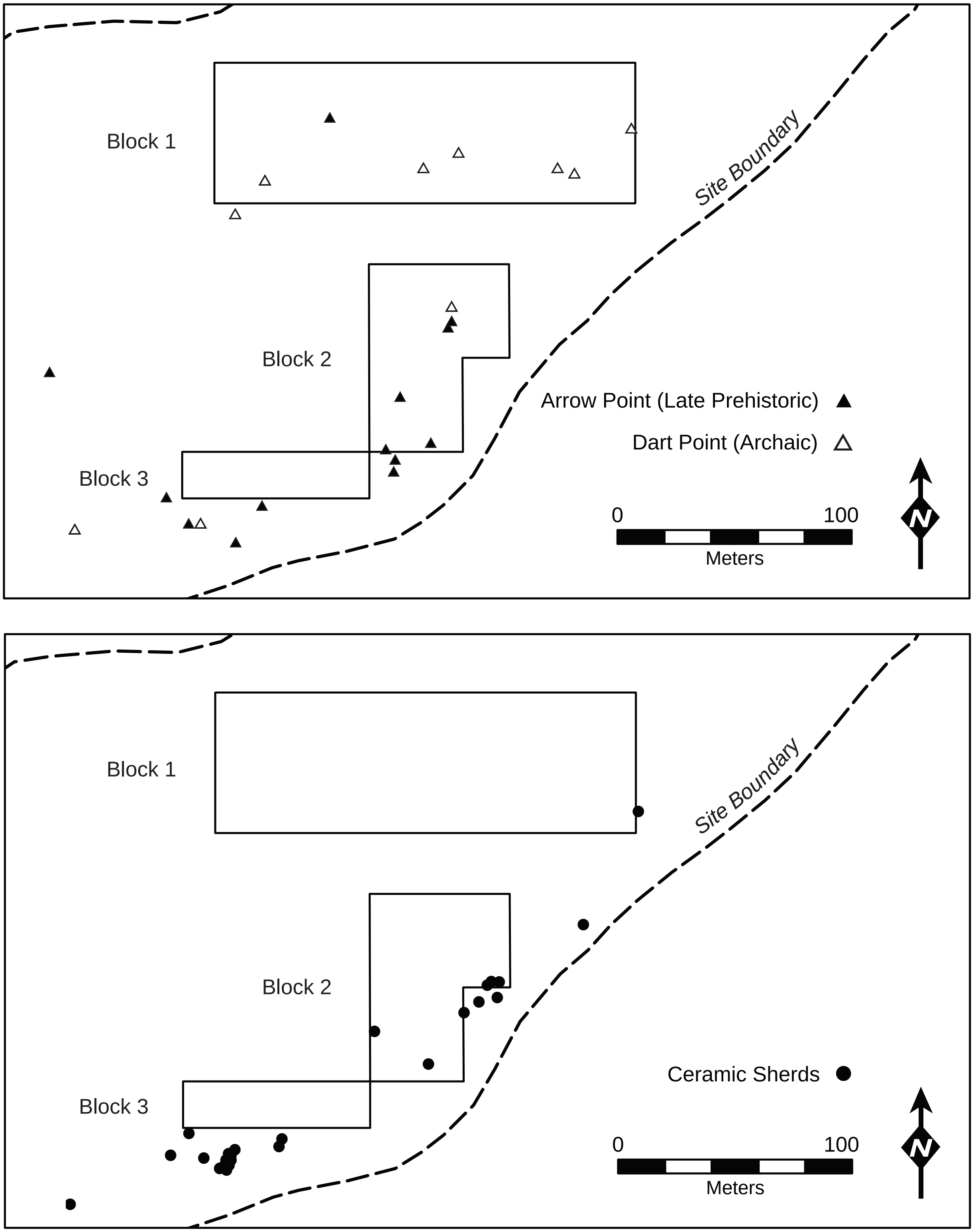


Figure 6.8. Maps showing the distributions of projectile points (upper panel) and pottery sherds (lower panel).

recorded CMTs are not culturally modified. However, for the sake of clarity the original numbering system has been retained. The crews also identified and documented an additional peeled (cambium) tree.

CMT2 consists of a ponderosa pine that exhibits an ax-cut fire scar. The scar exhibits the typical morphology of a "cat face" fire scar produced by a surface burn: a triangular injury that begins at the ground surface and tapers evenly to a narrow or pointed termination. Subsequent cultural modification of the fire scar may reflect harvest of pitch-infused "fatwood." Slivers or chunks of such fatwood commonly were used as fire starter.

CMT4 is a ponderosa pine that includes two ax-cut faces. Scar 1 may reflect fatwood harvest. Scar 2 represents a cambium peel that was subsequently hewn, also likely for fatwood (figure 6.9).

CMT5 is a large-diameter ponderosa pine that exhibits a single scar surface. Most of the scar was chopped with an ax. Because little of the original scar remains, it is difficult to determine whether it was initially created by peeling or by a ground fire or lightning scar. The scar could have also been originally created by peeling and been burned later. Nevertheless, the height of the scar base above the current ground surface, combined with the lack of significant evidence of burning near the base of the scar or on the edges of the scar, suggests that the bark may have been removed by peeling prior to the burning.

Figure 6.9. Photograph of CMT 4 showing multiple axe cuts on the scar face. (Photo courtesy of Marilyn Martorano.)

CMT8 consists of a very large cambium peel on a dead-and-down ponderosa pine. The peeled face is approximately 93 cm wide and 140 cm long. Numerous ax cuts are visible on and adjacent to the peeled surface. The scar face, which now faces downward, shows two cut marks that likely represent the initial peeling cut. Subsequent cut marks on the scar face may be related to wood removal. One narrow strip of wood, measuring 6 cm wide, 47 cm long, and up to about 2.5 cm deep, appears to have removed on the one side of the scar.

Talus Blockfield Cavities

Small cavities or shelters formed by large boulders near the base of the blockfield were examined for artifacts, archaeological deposits or features, and woodrat middens. Most of the cavities were too small to provide substantial shelter. In several cases, the floor of the cavity was damp, the boulders forming the cavity walls were covered with moss, and water could be heard trickling inside the blockfield behind the cavity. Artifacts mostly were absent from all of the inspected cavities, and no woodrat middens were observed (see chapter 4, this volume). However, PCRG crew member Larry Scarbrough discovered that at least one of the damp cavities contained an accumulation of clear ice (figure 6.10). Crew members previously had observed that cool air emanated from several cavities. Table 6.2 lists temperature readings taken inside five cavities, three of which were located in depressions at the base of the blockfield. The readings were taken at about noon on a clear, calm

Table 6.2. Minimum temperatures recorded within five cavities or shelters at the base of the talus blockfield.

Cavity Number	In Depression?	Temperature (°F/°C)
3	Y	19/-7
4	Y	25/-4
1	Y	30/-1
2	N	40/4
5	N	49/9

Figure 6.10. Photographs of a blockfield cavity. ***Left****: Looking down into the depression;* ***top right****: close-up of moss-covered boulders in the cavity;* ***bottom right****: ice with embedded moss (Larry Scarbrough photo).*

day during the first week of June. Contemporaneous temperatures varied by as much as 30°F and all three of the cavities located in depressions exhibited temperatures below freezing. The "Local Influences on Environment" section of chapter 2 provides additional discussion on the presence of ice deposits within the talus blockfield.

Excavation Results

Subsurface testing at La Botica was undertaken with two goals in mind. The first was to learn more about the site's depositional history and the processes affecting its archaeological deposits. The second goal was to investigate the age, function, and stratigraphic context of near-surface cultural features. Four of the seven excavation squares opened in 2018 were designed to address the former goal, while three were designed to address the latter. Table 6.3 summarizes data on each of the seven excavation squares, the locations of which are illustrated in figure 6.11.

Soil Stratigraphic Excavations

Four excavation squares were opened to investigate the site's surface geomorphology and depositional history. The positions of these four squares were based on a preliminary in-field analysis of depositional processes, rather than on the distribution of surface artifacts or cultural features. Two squares (Units 2 and 3) were placed in the central depositional basin located immediately west of Block 2. Two other squares (Units 1 and 4) were placed on the east end of the site.

Units 1 and 4

Unit 4 was located roughly 10 m beyond the toe of the blockfield, in an area that based on surface characteristics appeared to have been largely unaffected by Holocene erosion. A healthy sage and bunch grass community surrounded the excavation square and leaf litter covered much of the surface. Excavation of four general levels to a depth of 40

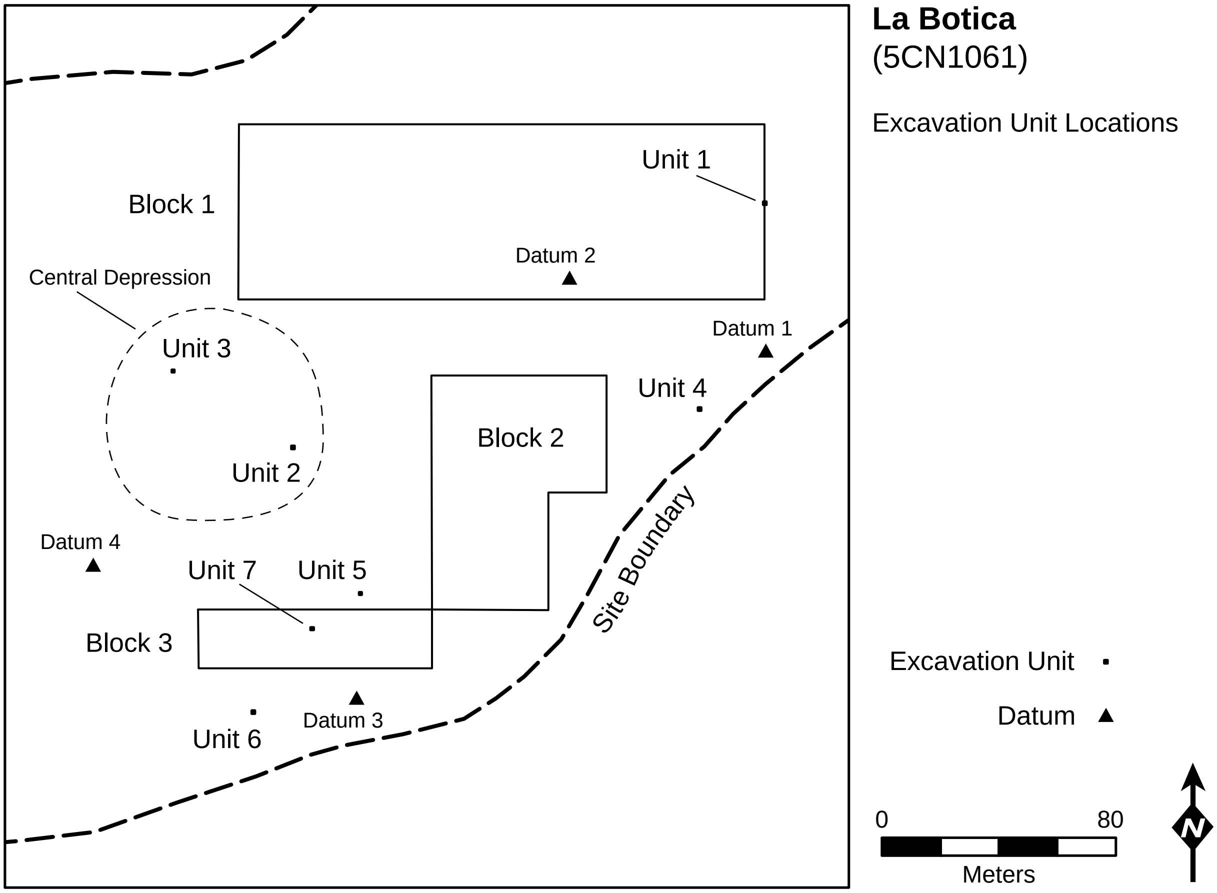


Figure 6.11. Map showing the locations of seven test excavation units. Also shown are the locations of four permanent site datums and three survey blocks.

cm confirmed that the soil-stratigraphic sequence is essentially intact in that portion of the site.

Four soil horizons were exposed in Unit 4 (table 6.4; figure 6.12). The upper 18 cm consisted of the modern A horizon. Beneath the A horizon was an approximately 7-cm-thick AB horizon that contained numerous animal burrows. The lowest two soil horizons consisted of Bt horizons.

Unit 4 also yielded limited archaeological data (table 6.5). A layer of scattered burned and unburned stones was encountered in levels 2 and 3, between about 15 and 31 cm below the modern surface. The majority occurred between about 20 and 27 cm, primarily within the lower AB and upper Bt1 horizons. Although a hearth was not identified within the unit, the distribution of burned stones suggests that one may exist in the vicinity, possibly to the south.

The two recovered pottery sherds, which are described later in this chapter's "Material Culture" section, likely date to between 1250 and 1550 CE.

Table 6.3. Test excavation unit data.

Unit Type	Unit Number	Number of Levels	Excavation Volume (liters)
Soil Strata	1	3	290
	2	2	400 (600[a])
	3	3	546 (375[a])
	4	4	387
Feature	5	2	140[b]
	6	1	26 (47[c])
	7	1	60[b]
Total		16	1,896 (975[a])

[a] Additional unscreened volume.
[b] Includes sediment originally assigned to feature level.
[c] Additional possible feature volume.

This indicates that stripping of the A horizon across much of the site likely occurred after about 700 B.P. Although the age of the burned rocks encountered in Unit 4 is not known, their position within the lower AB and upper Bt1 horizons indicates that sediment

Table 6.4. Unit 4 soil horizon descriptions.

Depth (cm)	Horizon	Description
0-18	A	Weak, very fine granular structure; soft consistence (dry); clear, wavy boundary
18-25	AB	Moderate, medium granular structure; hard consistence (dry); clear, wavy boundary
25-36	Bt1	Moderate, fine angular blocky structure; hard consistence (dry); few, faint clay films in pores; abrupt, wavy boundary
36-40+	Bt2	Moderate, medium granular structure; hard consistence (dry); few, faint clay films in pores; clay films slightly more abundant than in Bt1

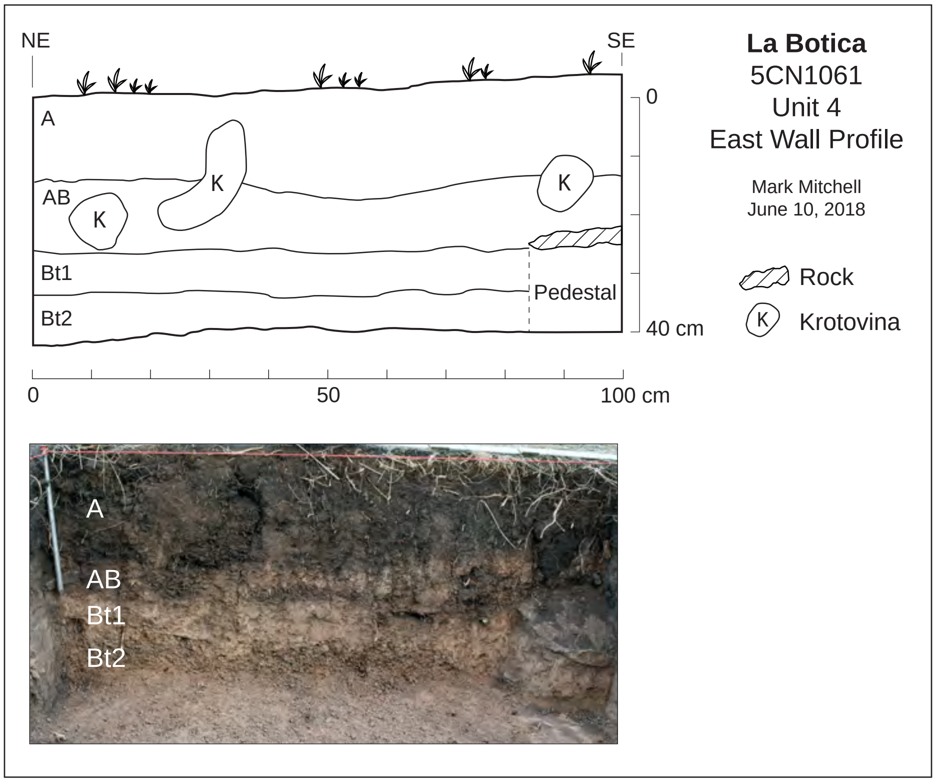


Figure 6.12. Drawing and photograph of the east profile of Unit 4.

accumulation and soil formation occurred after the rock was deposited. This in turn suggests that at least two archaeological components are present in this portion of the site: a lower component represented by chipped stone artifacts and the scatter of burned stones and an upper component represented by chipped stone artifacts and pottery.

Unit 1 was located roughly 75 m north-northeast of Unit 4 and 45 m beyond of the toe of the blockfield. The surface adjacent to Unit 1 appeared to have been affected to some extent by sheetwash erosion. Vegetation around the excavation square consisted of mature sage and sparse bunch grass. Three excavation levels were removed from Unit 1, revealing four soil horizons. The uppermost consisted of a weak 8-cm-thick A horizon. Beneath the A horizon was a 6-cm-thick AB and two Bt horizons, the upper of which was 9 cm thick and the lower of which was more than 7 cm thick. The relatively weak development of the A horizon in Unit 1 compared to that in Unit 4 likely reflects surface erosion in the area around Unit 1.

Twelve flakes were recovered from the first level (0-10 cm below the modern surface), 11 of which were made from basalt. The twelfth was made from rhyolite. Three small, angular cobbles were mapped on the surface, none of which were burned. A single obsidian flake was recovered from level 2 (10-20 cm), although it may have been dislodged from the unit wall in level 1. No flakes were recovered from level 3 (20-30 cm) and no other artifacts were encountered in the unit.

Table 6.5. Inventory of artifacts recovered from Unit 4 organized by general excavation level.

General Level	Depth (cm SD)	Artifacts
1	0-10	1 flake; 2 sherds
2	10-20	1 flake
3	20-30	2 flakes; 9 burned rocks (2.05 kg)
4	30-40	[none]

Units 2 and 3

Two excavation squares were opened in the site's central hydrologic basin (figure 6.13). Unit 2 was located on the southeast edge of the basin, while Unit 3 was located approximately 50 m to the northwest. The surface of the basin appears to be level (but see the discussion on surface elevations later in this section) and supports a dense cover of bunch grass. A mature sage community, including individual plants reaching nearly 2 m in height, surrounds the basin. Big sage (*Artemisia tridentata*) prefers well-drained soil; the presence of fine-grained sediment within the basin, combined with periodic ponding of surface water, likely explains the absence of sage within the basin (Kelly Kindscher, personal communication 2018).

A southwest-northeast line of cobbles and boulders bisects the basin. The tops of the boulders and cobbles are mostly flush with the modern surface. Larger boulders occur on the southwestern end of the line. On the northeast, immediately outside the basin, the line of cobbles is more substantial, is tightly interlocked, and stands 10 to 20 cm above the surface.

Standard archaeological field methods, including level control and dry screening, were applied to three 20-cm-thick levels in Unit 2 (0-60 cm below surface) and two levels (0-40 cm below surface) in Unit 3. Recovered artifacts include an obsidian projectile point fragment and four size grade 3 (¼-½ in) lithic flakes. Sparse natural cobbles also occurred in the first level in each unit.

Because these few artifacts appeared to be out of context, as described later in this section, and because controlled excavation below 60 cm in Unit 2 and 40 cm in Unit 3 proved challenging due to the clay content of the sediment, further excavation was conducted without screening or level control. The maximum depth of Unit 2 was approximately 130 cm and the maximum depth of Unit 3 was approximately 110 cm. No cultural materials were observed below 60 cm in Unit 2 or 40 cm in Unit 3.

Tables 6.6 and 6.7 provide soil horizon descriptions for Units 2 and 3, respectively. Similar horizons were observed in both units (figure 6.14). However, textural differences between horizons in each unit, particularly between the deepest horizons, point to slightly different parent material sources.

The modern soil is represented by an A horizon and two AB horizons. All three likely formed in transported A horizon sediment that washed into the

Figure 6.13. Photograph of the central hydrologic basin.

Table 6.6. Unit 2 soil horizon descriptions.

Depth (cm)	Horizon	Description
0-6	A	Weak, fine, granular structure; slightly hard consistence (dry); clear, smooth boundary
6-24	AB1	Moderate, medium, angular blocky structure; slightly hard consistence (dry); clear, smooth boundary
24-42	AB2	Moderate, fine, angular blocky structure; slightly hard consistence (dry); few, faint clay films on ped faces; clear, smooth boundary
42-87	2Btb1	Strong, coarse, columnar prismatic structure; <10% gravel; extremely hard consistence (dry); common prominent clay films on ped faces, pores, and mineral grains; clear, smooth boundary
87-130+	3Btb2	Strong, medium, angular blocky structure; hard consistence (dry); many prominent clay films on ped faces, pores, and mineral grains

Table 6.7. Unit 3 soil horizon descriptions.

Depth (cm)	Horizon	Description
0-14	A	Weak, fine, granular structure; slightly hard consistence (dry); clear, smooth boundary
14-32	AB1	Moderate, fine, angular blocky structure; hard consistence (dry); clear, smooth boundary
32-66	AB2	Moderate, fine, angular blocky structure; hard consistence (dry); clear, smooth boundary
66-77	Ab	Moderate, fine, angular blocky structure; hard consistence (dry); few, distinct clay films on mineral grains; clear, smooth boundary
77-80	2ABb	Medium, very fine, angular blocky structure; slightly hard consistence (dry); common, distinct clay films on ped faces and mineral grains; clear, smooth boundary
80-100	2Btb1	Strong, coarse, columnar prismatic structure; <10% gravel; extremely hard consistence (dry); many prominent clay films on ped faces, pores, and mineral grains; clear, smooth boundary
100+	2Btb2	Strong, medium, angular blocky structure; <10% gravel; extremely hard consistence (dry); common distinct clay films on ped faces, pores, and mineral grains

Figure 6.14. Photograph of the south profile of Unit 3. The scale is 1 m in length.

central basin from the surrounding terrace surface. Aeolian deposition also likely contributed sediment to the basin. A broad, shallow swale extends into the central basin from the toe of the talus slope; however, unbroken vegetative cover within the swale indicates that surface flow occurred recently. The swale may represent a relic feature. Alternatively, it may have been formed by subsurface flow derived from intermittent melting of the blockfield ice core coupled with subsidence due to infiltration of fine-grained sediment into coarse blockfield deposits (see chapter 2 for additional discussion).

A single buried soil was exposed in Units 2 and 3. This well-developed soil primarily formed in silty clay loam containing sparse, rounded, coarse sand and fine gravel. The Ab and 2ABb horizons of the soil were only present in Unit 3. However, the distinctive characteristics of the 2Btb1 horizons in both tests indicate that a single soil is represented.

Although the modern surface of the basin appears level, the surface adjacent to Unit 2 is in fact roughly 16 cm higher than the surface adjacent to Unit 3. In addition, and despite their proximity and common location within the central basin, cognate horizons occur at different depths in the two tests. Figure 6.15 illustrates those differences. Because the Ab and 2ABb horizons were removed from the southeast side of the basin (the area around Unit 2), the original depth of the buried soil there cannot be determined precisely. However, the clay content and columnar structure of the 2Btb1 horizon likely made it resistant to aeolian erosion. If the upper surface of the 2Btb1 horizon is intact, then the estimated depth of the buried soil was 50 to 55 cm higher on the southeast side of the basin than on the northwest.

The most parsimonious explanation for the observed differences between the two units is the presence of an obstruction or barrier between the two halves of the basin—which is just 60 to 65 m in diameter—that blocked the flow of surface water and the deposition of sediment. The line of stones that angles across the basin between the two test units may represent the top of a bedrock structure that only recently has been buried by sediment. This may also explain the differential preservation of the Ab horizon in Unit 3: before the basin was filled with sediment, the northwestern side of the basin was lower, which permitted deeper ponding and greater vegetation growth. That growth helped limit the effects of the aeolian erosion that stripped away the Ab horizon on the southeastern side of the basin.

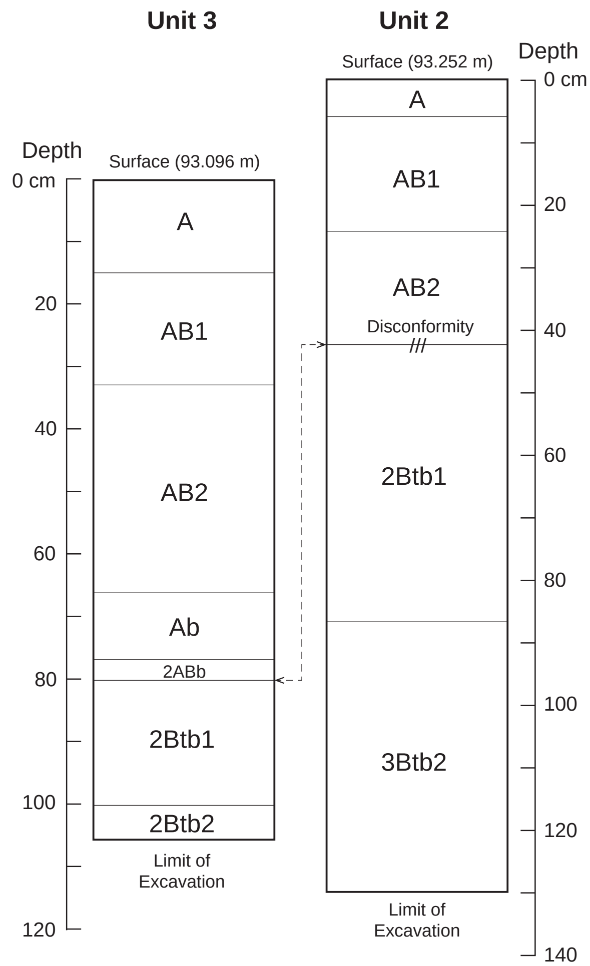


Figure 6.15. Schematic profiles of Unit 2 (west wall) and Unit 3 (south wall). The dashed line connects cognate horizons.

A bulk sample of sediment from the Ab horizon in Unit 3 yielded a radiocarbon age of 7686±44 ^{14}C yr B.P. (table 6.8). The radiocarbon age was determined on total soil organic matter (SOM), which includes a mixture of younger and older carbon. The age therefore represents the apparent mean residence time (AMRT) of accumulated organic matter (Campbell *et al*. 1967). In general the AMRT is always younger than the time that pedogenesis began (Matthews 1985). The radiocarbon age therefore approximates of the age of burial and should be considered a minimum age of the soil (Holliday 2004).

Optically stimulated luminescence (OSL) dates were obtained on samples from the 2Btb1 horizon in both Units 2 and 3 and from the 3Btb2 horizon in Unit 2. OSL ages range from about 9300 B.P. to about 14,700 B.P. (see chapter 2, this volume).

Table 6.8. AMS radiocarbon dating results.

Catalog Number	Material	Unit	Horizon	Lab Code	Percent Modern Carbon	Age (^{14}C yr B.P.)[a]	2-σ Calibrated Date (cal B.P.)
3012	Sediment	3	Ab (66-77 cm SD)	D-AMS 025512	38.41±0.21	7686±44	8558-8399

[a] Corrected ages based on unreported δ^{13}C values.

These chronometric data indicate that the sediment filling the central basin began to accumulate no later than the late Pleistocene and early Holocene. Following a period of stability, accumulation resumed sometime after about 8500 cal B.P. Subsequent accumulation consisted primarily of transported A horizon sediment.

Figure 6.16. Photograph of a deflated hearth in Block 1. The tape measure is oriented east-west and is 1 m in length.

Feature Excavations

Forty-five cultural features described as "hearths" were identified during the Fort Lewis College's inventory (Crosser *et al*. 2009). Forty-two were attributed to the site's Native American occupants, one was attributed to recent settlers, and two were not specifically attributed. All were exposed on the surface (deflated or partially deflated) and were described as concentrations of burned rock and charcoal-stained sediment. A majority were less than 50 cm in maximum dimension, and several were as small as 25 cm in maximum dimension.

PCRG's survey documented three concentrations of burned rock that likely represent hearth features, as well as several other concentrations of burned earth and charcoal-stained sediment. One of the burned rock concentrations was located in the southwest portion of Block 1. That feature consisted of approximately 60 quartz latite and basalt cobbles ranging in maximum dimension from 1 to 18 cm (figure 6.16). Two cobbles exhibited definite evidence of burning. Eleven lithic flakes were associated with the cobble scatter, including one obsidian flake, two Cumbres chert flakes, and eight basalt flakes. The hearth, which measured 2.3 m east-west by 1.25 m north-south, had been heavily disturbed by sheetwash erosion and possibly by trampling; its fill had been entirely removed by erosion. The hearth may have originally been circular in plan and roughly 1 m in diameter.

Two other cobble concentrations possibly representing deflated hearths were located adjacent to Block 3 (figure 6.17). Cobbles representing a variety of rock types ranged in maximum dimension from 5 to 15 cm. The larger of the two concentrations measured 2.3 m east-west by 1.9 m north-south. Lithic flakes and burned bone occurred on the surface nearby. The smaller feature measured 1 m east-west by 66 cm north-south. No artifacts were observed in the vicinity. In both cases, the fine-grained fill of these possible features had been removed by erosion.

Three possible hearths, consisting of concentrations of burned earth and charcoal-stained sediment, were also documented within and adjacent to Block 3. One of the three (designated Feature 2) was associated with lithic flakes and a pottery sherd. Excavation Units 5, 6, and 7 were opened to better understand the age, function, condition, and stratigraphic context of these possible hearth features.

Feature 2 proved to be a shallow, unlined, and irregular basin roughly 10 cm deep and 50 cm in diameter (figure 6.18). The fill, roughly one-fifth of which (11 liters) was collected in bulk for later lab analysis, contained abundant burned earth and charcoal, along with small flecks of vitrified plant tissue and a fragment of calcined micromammal bone. Although Feature 2 exhibited some of the hallmarks of a cultural feature, abundant evidence of surface burning from a wildland fire in Block 3 casts doubt on that interpretation. The presence of

Figure 6.17. Photographs of two possible deflated hearth features. The tape measure is pulled to 1 m in each photograph.

a single calcined animal bone could be indicative of the feature's cultural origin or it could simply be fortuitous. On balance, the evidence suggests that Feature 2 may represent a hearth but also that that interpretation should be regarded with caution.

The two other possible features investigated in 2018 proved to be root burns rather than cultural features. Both consisted of surface-visible concentrations of burned earth and charcoal-stained sediment. A single chert flake was observed on the surface adjacent to one concentration, but no artifacts were observed adjacent to the other. Excavation subsequently revealed that both concentrations were amorphous in plan and profile. In both cases, the distribution of charcoal-stained sediment was amorphous and discontinuous. Most of the burned earth was confined to the surface and located above the charcoal-stained sediment—the reverse of what would be expected of a constructed hearth.

These results prompted additional examination of other rock concentrations and possibly charcoal-stained sediment the modern surface within and adjacent to Block 3. Apart from the previously described concentrations of burned rock, numerous apparent concentrations of tabular cobbles occur on the slope below the blockfield (figure 6.19). Many of these concentrations appear relatively coherent; however, their attributes suggest that they do not in fact represent cultural features. The stones comprising them do not exhibit evidence of burning; most are platy pieces of local Pliocene lava (see chapter 2, this

Figure 6.18. Photograph of Feature 2 after excavation.

volume). The stones are roughly equidistant from one another and primarily occur on the eroded surface in a single layer. If these concentrations represented the partially deflated remains of basin features, then one would expect them to exhibit stacked or interlocking stones in the center of the concentration and fewer stones on the perimeter. Few or no artifacts were associated with the stone concentrations and in fact very few chipped stone artifacts are located anywhere within the Block 3 survey area. In some cases, the matrix between the stones exhibited staining, but that staining was primarily due to its organic content, rather than to the presence of charcoal fines.

The surface within Block 3 is highly eroded. Remnant patches of A horizon sediment are held in place by the roots and stems of shrubs, but much of the A horizon and a portion of the B horizon has been stripped away by sheetwash (figure 6.20). Tabular stones similar to those comprising the apparently discrete concentrations line many of the rills created by surface runoff. A similar discontinuous pavement of stones was exposed in excavation of Unit 4 within B horizon sediment. These observations suggest that the concentrations of tabular stones were emplaced by surface erosion prior to the deposition of the sediment in which the modern soil formed. The apparent coherence of these concentrations may simply reflect ancient erosional features such as channels or cobble dams, which either permitted or inhibited the local deposition of stones by surface flow.

Also apparent within and adjacent to Block 3 is abundant evidence for recent wildland fire, including

Figure 6.19. Photograph of a natural concentration of tabular cobbles on the slope below the toe of the talus slope.

Figure 6.20. Photograph of active surface erosion in Block 3. The A horizon and a portion of the B horizon has been stripped away.

fragments of branches or boles exhibiting burning only on their upper surfaces, numerous scattered chunks of charcoal, and surface concentrations of burned earth. Two of the excavated concentrations of burned earth and charcoal definitely represent locations where sage plants burned in place and Feature 2 may also represent the same phenomenon.

Thus, the surface and subsurface data obtained during 2018 suggest that fewer hearth features are present at the site than previously believed. At least some and perhaps most of the rock concentrations previously identified as hearths are instead fortuitous concentrations of naturally occurring local stones emplaced—and later exposed—by erosion. Visible evidence of localized burning, including charcoal staining and burned earth, reflects natural processes rather than the activities of the site's occupants. Although concentrations of burned rock representing deflated hearths do occur at the site, the total number of such features is likely to be lower than previously estimated.

Material Culture

Non-Diagnostic Chipped and Ground Stone Tools

Ground stone tools make up 70 percent of the non-diagnostic tool assemblage documented during the 2018 field investigation (table 6.9). Thirty-nine ground stone specimens are handstones, 16 are millingstones, and 4 are indeterminate fragments. Over 80 percent were made from various igneous rock types, while the balance were made from sandstone. Twenty-five of the ground stone tools (42 percent) exhibit evidence of burning. The proportion of burned handstones (49 percent) is larger than the proportion of burned millingstones (19 percent), a pattern that likely reflects the use of recycled handstone fragments as boiling stones.

Just under 40 percent of the handstones (n=15) exhibit multiple grinding facets. Seventeen exhibit a single facet. The number of facets could not be determined for seven specimens. Seven handstones are complete and intact, while 32 are represented by fragments. All of the millingstones exhibit a single flat or shallowly concave grinding surface. Two are complete and intact, while 14 are represented by fragments.

The inventory of 25 non-diagnostic chipped stone tools includes 11 biface fragments, six unpatterned flake tools, five scrapers, and three cores. Most of the bifaces are represented by edge fragments exhibiting general use wear. One is a fragment of a projectile point blade. One may be a projectile point tip and another may be a drill base; however, both are too fragmented to determine their original morphology or function. Two likely are fragments of early-stage bifaces.

One of the five scrapers exhibits intensive edge grinding. The remaining specimens exhibit moderate but unspecified use-wear. One of the five is an expedient (unpatterned) tool. Five of the six modified flake tools exhibit use-modification, while one exhibits sequential pressure flake removals on the working edge. All three of the cores are exhausted.

Both cryptocrystalline and coarse igneous raw materials are represented: nine of the chipped stone tools were made from chert or chalcedony, two were made from obsidian, and 14 were made from rhyolite or basalt. Four non-diagnostic chipped stone tools, including three of the bifaces and one of the flake tools, exhibit evidence of burning.

The Fort Lewis College crew also collected data on non-diagnostic tools during 2009 (table 6.10). Because they left non-diagnostic specimens in place, many of the same items were also tallied by the PCRG crew in 2018. However, the Fort Lewis College crew inventoried a larger area, including a significant portion of the site located west of PCRG's Block 3.

As was true of the PCRG sample, 70 percent of the Fort Lewis College assemblage consists of ground stone tools. The proportions of bifaces, scrapers, and flake tools also are similar in the two samples. The primary difference between the PCRG sample and the Fort Lewis College sample is the number of cores present in the latter. This may indicate that lithic tool production was somewhat more common in the area west of Block 3 that it was in other parts of the site.

Projectile Points

A total of 36 projectile points have been documented at La Botica (table 6.11). Eleven were identified during the 2018 field investigation, 23 were identified during the 2009 Fort Lewis College investigation, and three were identified during the initial 2005 documentation. (One of the three specimens identified in 2005 [2006.20] refits with FS11, which was identified in 2009; those two specimens are combined into a single case, yielding a total of 36 cases.) Just one of the 2018 specimens was collected; the remaining 10 were photographed and described in the field and

Table 6.9. Crosstabulation of non-diagnostic chipped and ground stone tools documented during 2018.

	Tool Type					
Raw Material	Ground Stone	Biface	Scraper	Flake Tool	Core	Total
Basalt or dacite		3	1			4
Chalcedony		3				3
Chert		3	1	2		6
Unspecified igneous	44		1			45
Obsidian		2				2
Rhyolite	4		1	4	3	12
Sandstone	11					11
Schist			1			1
Total	59	11	5	6	3	84

Table 6.10. Crosstabulation of non-diagnostic chipped and ground stone tools documented by Fort Lewis College during 2009.

	Tool Type						
Raw Material	Ground Stone	Biface	Scraper	Flake Tool	Tested Cobble	Core	Total
Basalt or dacite	19	2		1		1	23
Chert		5		5		5	15
Conglomerate	5						5
Granite	3						3
Unspecified igneous	39		1			1	41
Obsidian		1				1	2
Quartzite	1	1				1	3
Rhyolite	21	1	3		1	9	35
Unknown	1						1
Total	89	10	4	6	1	18	128

left in place. All of the 2005 and 2009 specimens were collected. PCRG Project Archaeologist Chris Johnston analyzed the collection using photographs and metric and nominal data collected in the field or by Mitchell at the Great Sand Dunes National Park and Preserve curation facility. Detailed descriptions of the 2018 collection are provided in Mitchell (2020).

Roughly two-thirds of the collection was made from igneous stone (table 6.12). One specimen—which likely is the oldest—was made from a buff-colored rhyolite that may come from a source locality in English Valley, which is located 65 km north of La Botica. The other 22 igneous specimens were made from dark-colored volcanics, including obsidian, basalt, and dacite. Several obsidian points were made from the distinctive Polvadera Peak (El Rechuelos) stone quarried at the Valles Caldera, located 150 km the south of La Botica. The mineralogy of the other dark volcanics in the collection is complex; however, most of the La Botica specimens likely were made from stone quarried within the Taos Plateau volcanic field (Shackley 2011, 2013; Boyer *et al.* 2001). A prominent source of dacite is located on San Antonio Mountain, on the northern end of the Taos Plateau volcanic field, 35 km south-southeast of La Botica.

The remaining specimens were made either from orthoquartzite or from fine-grained cryptocrystalline stone. Two of the quartzite specimens were made from the Trickle Mountain (Alkali Creek) quartzite source located approximately 105 km north of La Botica (Mitchell and Falk 2017). The provenance of the chert and chalcedony specimens mostly is unknown. However, several were made from material quarried on Cumbres Pass, which is approximately 30 km southwest of La Botica (Spero and Hoefer 1999).

Table 6.13 presents data on the portion representation of the La Botica projectile point assemblage. Overall, more than half of the specimens are represented by proximal (base) fragments, while about one-third are complete or nearly so. In general, proximal fragments may be more common on sites where hunting equipment is repaired (Hofman

Table 6.11. Projectile point summary data.

Year	Specimen ID	Raw Material	Completeness	Type[b]	Figure Reference
2018	PP1	Obsidian	Proximal	Armijo Stemmed	-
	PP2	Chalcedony	Nearly complete	Side-notched arrow	6.23[A]
	PP3	Basalt	Proximal	Armijo Stemmed	-
	PP4	Rhyolite	Proximal	Jay	6.21[A]
	PP5	Obsidian	Proximal	San Jose Stemmed A	-
	PP6	Quartzite	Nearly complete	Armijo Stemmed	6.22[A]
	PP7	Quartzite	Proximal	Unspecified	-
	PP8	Chert	Proximal	Unspecified	-
	PP9	Basalt	Proximal	San Jose Side-notched	-
	PP10	Quartzite	Midsection	Side-notched arrow	-
	PP11	Obsidian	Proximal	Unspecified	-
2009	FS1	Basalt	Complete	Armijo Stemmed	6.22[C]
	FS4	Basalt	Nearly complete	Side-notched arrow	-
	FS11[a]	Obsidian	Midsection	Unspecified	-
	FS12	Chert	Proximal	Side-notched arrow	-
	FS13	Chert	Complete	Side-notched arrow	-
	FS14	Chert	Proximal	Corner-notched arrow	-
	FS15	Chert	Proximal	Side-notched arrow	-
	FS16	Chert	Proximal	En Medio or Armijo Corner-Notched	6.21[C]
	FS17	Dacite	Midsection	Corner-notched arrow	-
	FS18	Dacite	Proximal	San Jose Stemmed A	6.21[D]
	FS19	Chert	Nearly complete	Corner-notched arrow	-
	FS20	Chert	Nearly complete	Corner-notched arrow	6.23[C]
	FS22	Dacite	Complete	Armijo Stemmed?	-
	FS23	Basalt	Proximal	Armijo Stemmed	6.22[B]
	FS24	Basalt	Proximal	Armijo Stemmed	-
	FS26	Dacite	Proximal	Augustin Contracting Stem	6.21[B]
	FS27	Dacite	Midsection	Unspecified	-
	FS29	Dacite	Proximal	San Jose Square Stemmed or Armijo Stemmed	-
	FS33	Dacite	Proximal	En Medio Side-notched	-
	FS34	Basalt	Proximal	Armijo Stemmed	-
	FS35	Obsidian	Midsection	Corner-notched arrow	-
	FS37	Dacite	Proximal	San Jose Side-notched	6.21[E]
	FS40	Chalcedony	Nearly Complete	Side-notched arrow (reworked into drill)	6.23[B]
2005	2006.21	Dacite	Distal	Unspecified	-
	2006.22	Dacite	Nearly complete	En Medio Corner-notched	6.23[D]

[a] FS11 refits with 2006.20, which was collected in 2005.
[b] Type attributes from Chapin (2017).

1999; Keeley 1982). By contrast, complete points may reflect inadvertent loss during hunting. At La Botica, complete specimens are statistically more common among the arrow point assemblage. This could indicate that the site was used differently by Archaic hunter-gatherers (primarily as a base camp) than by Late Prehistoric hunter-gatherers (primarily as a hunting destination). However, tool assemblage diversity data (discussed previously) and pottery data (discussed later) suggest that site occupancy was focused primarily on plant processing, regardless of when that occupancy occurred. These data may indicate that arrow retooling more commonly involved the discard of nearly complete or complete projectile points.

The La Botica projectile point assemblage reflects use of the site throughout much of the Holocene (table 6.14). Chronological data are based entirely on

Table 6.12. Projectile point raw material distribution.

Raw Material	Frequency
Obsidian	5
Dacite	10
Basalt	7
Rhyolite	1
Quartzite	3
Chert or Chalcedony	10
Total	36

Table 6.13. Distribution of projectile point completeness classes. Two technologically indeterminate specimens are excluded.

	Technological Class		
Completeness Class	Dart	Arrow	Total
Proximal (Base)	17	3	20
Midsection	1	3	4
Nearly Complete	2	5	7
Complete	2	1	3
Total	22	12	34

Pearson Chi-Square=10.375; *df*=3; *p*=.016

projectile point style and technology, an approach that can produce misleading results (Reed and Metcalf 1999:86). Nevertheless, type designations were assigned to the extent possible. The types primarily are those defined for the Oshara tradition (Irwin-Williams 1973), as re-defined by Chapin (2005, 2017).

Six of the 36 points are too fragmented to assign to a specific type. Based on metric and technological criteria, four of the six untyped points are dart points that date to the Archaic stage. The remaining two untyped specimens could represent either dart or arrow points.

The oldest specimen in the collection is a basal fragment of a Jay point (figure 6.21[A]). The numerical age range of Jay points is unknown; however, they may be roughly contemporaneous with Western Stemmed points, which first appeared at about 10,700 cal B.P. (about 9500±50 B.P.) and were manufactured until about 7550 cal B.P. (about 6500±50 B.P.) (Chapin 2017:89).

The most abundant type in the collection is Armijo Stemmed points, which date to between 3500 and 2500 B.P. (roughly encompassing the Late Archaic period) (figure 6.22). Overall, 60 percent of the typed specimens are dart points primarily dating to the Middle Archaic or Late Archaic. The remainder of the typed specimens are arrow points. Five of the 12 arrow points date to the early Late Prehistoric (a period known as the Developmental in the Arkansas River basin and as the Early Ceramic in the Platte River basin in eastern Colorado) (figure 6.23[C]). Seven of the arrow points are side-notched forms that could have been produced as recently as the middle of the nineteenth century (figure 6.23[A,B]).

Pottery

A total of 32 pottery sherds were collected during 2018, including 30 from the surface and two from the subsurface in Unit 4. These 32 specimens represent at least seven different vessels, each of which has been assigned a numerical designation. The Fort Lewis College survey team also documented pottery at the site in 2009. The 17 sherds they collected,

Table 6.14. Projectile point type distribution. Types are arranged in order of increasing age.

Type	Estimated Age (B.P.)[a]	Specimen Frequency
Side-notched arrow point	850– 100	7
Corner-notched arrow point	1600 –850	5
En Medio Corner- or Side-Notched	2800 –1600	2
Augustín Contracting Stem	3500 – 2000	1
Armijo Stemmed	3500 – 2500	8
En Medio or Armijo Corner-Notched	4000 – 1600	1
San Jose Square Stemmed or Armijo Stemmed	4000+ – 2500	1
San Jose Side-Notched	4500+ – 3500	2
San Jose Stemmed A	5000 – 3500	2
Jay	Late Paleoindian-Early Archaic	1
[Unspecified]	-	6
Total		36

[a] Arrow point ages are reported as calendar years B.P.; dart point ages are reported as uncalibrated radiocarbon years B.P. The numerical age range of Jay points is unknown. Date ranges for Oshara tradition dart types are provided by Chapin (2017).

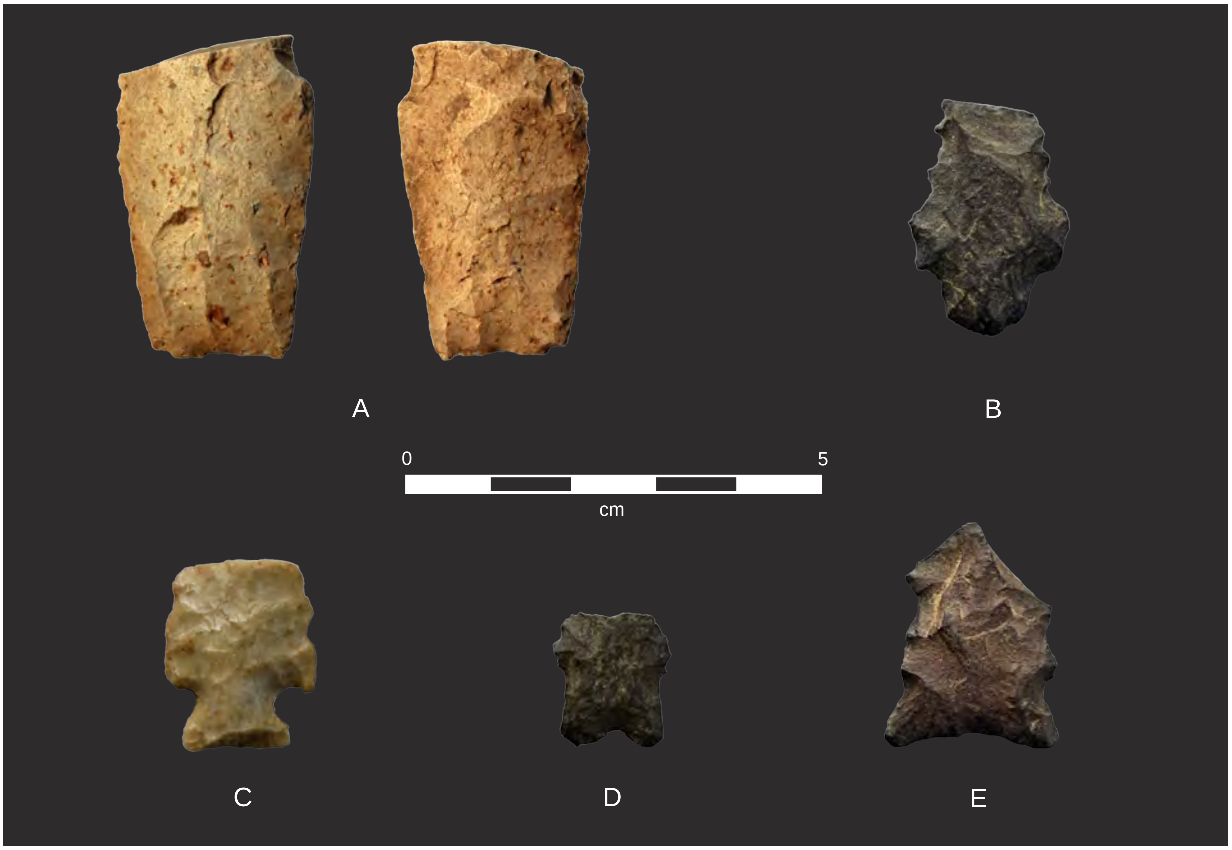
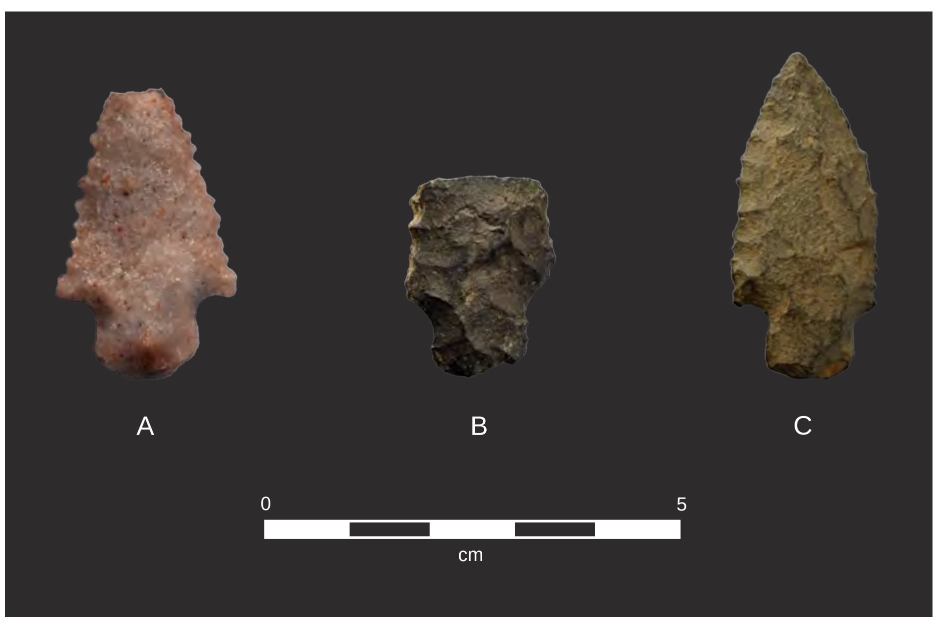


Figure 6.21. Photographs of projectile points. A: Jay (PP4); B: Augustin Contracting Stemmed (FS26); C: En Medio Corner-Notched or Armijo Corner-Notched (FS16); D: San Jose Stemmed A (FS18); E: San Jose Side-Notched (FS37). The Jay point may be made from English Valley rhyolite.

Figure 6.22. Photographs of Armijo Stemmed projectile points. A: PP6; B: FS23; C: FS1. PP6 is made from Alkali Creek (Trickle Mountain) Quartzite.



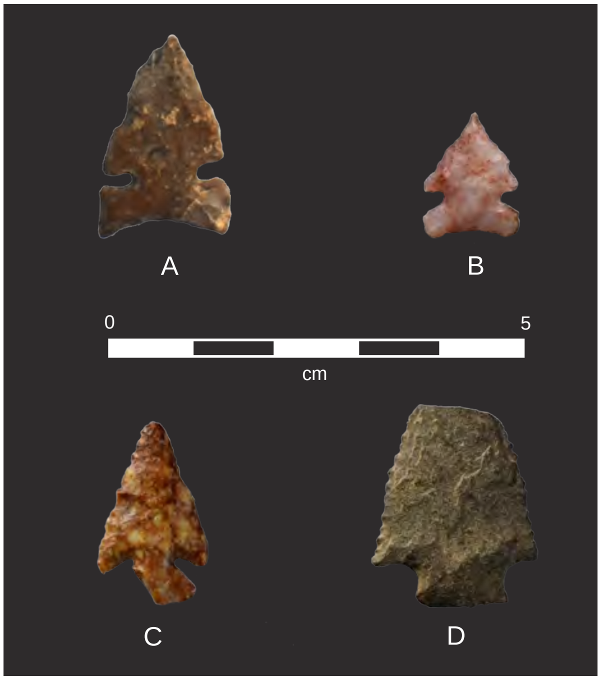


Figure 6.23. Photographs of projectile points. A: Side-notched arrow point (PP2); B: Side-notched arrow point re-worked into a drill (FS40); C: Corner-notched arrow point (FS20); D: En Medio Corner-Notched (2006.22). FS40 is made from Cumbres Pass chert.

which Mitchell examined during a 2019 visit to the Great Sand Dunes curation facility, represent at least three different vessels, which have been assigned alphabetical designations. Two of the seven vessels defined for the 2018 collection also are represented by sherds collected in 2009 (Vessels 1/A and 7/C). Thus, fragments of a total of eight different pots have been identified at the site (table 6.15).

Figure 6.24 illustrates the spatial distribution of the eight identified vessels. Attribute data were used to combine individual sherds into vessels; however, the spatial distribution of collected sherds also supports the vessel designations. Mitchell (2020) provides detailed descriptions of the vessels comprising the 2018 collection.

Table 6.16 summarizes typological data on the eight defined pottery vessels. Four of the eight are Taos Gray vessels produced by Northern Tiwa potters living in the Taos district (figures 6.25[Vessel 1/A,Vessel 3,Vessel 4)] and 6.26[Vessel 5]). Taos Gray ware includes Taos Gray Plain and undecorated fragments of Taos Gray Incised, Taos Gray Corrugated, and Taos Gray Neckbanded (Levine 1994; Office of Archaeological Studies [OSA] 2020a; Wetherington 1968; Wilson 2007). Both Taos Gray Plain and Taos Gray Incised vessels occur in the La Botica assemblage. Production of Taos Gray began about 1100 CE and may have continued into the early eighteenth century (Levine 1994). Taos Gray Incised was most common during the Valdez phase, from 1100 to 1225 CE, although production continued through the end of the Talpa phase (1225 – 1350 CE).

Pottery exhibiting the characteristics of Vessel 2 (figure 6.25) was produced across the Central and Southern Plains during the Late Prehistoric. In the Arkansas River basin in southeastern Colorado, cord-roughened pottery first appeared during the Developmental period (100 – 1050 CE) (Kalasz *et al.* 1999). Fine, obliterated cord roughening may have been more common during the succeeding Diversification period (1050 – 1450 CE). However, the attribute that best discriminates Developmental period from Diversification period pottery is vessel shape, which cannot confidently be determined from the single La Botica sherd. Nevertheless, Vessel 2 is cautiously attributed to the Diversification period.

Vessel 6 may be assignable to a poorly defined group of Northern Rio Grande mica-tempered wares (figure 6.26) (Warren 1981; Wilson 2007). Utility wares tempered with crushed rock containing mica appeared "early in the ceramic history of the Rio Grande," and Wilson (2007:18) assigns this group to the period between 1350 and 1450 CE. Warren (1981) suggests a later and longer period between 1450 and 1700 CE. However, it is not clear whether the La Botica specimens exhibit the surface treatment attributes of these wares.

Vessel 7/C may be assignable to the Jemez Smeared/Indented Corrugated type produced on the Pajarito Plateau between about 1250 and 1550 CE (figure 6.26) (OSA 2020b). Two of the three sherds representing Vessel 7/C were recovered from A horizon sediment in Unit 4 during 2018; a third sherd representing the vessel was recovered from the surface during 2009.

Vessel B is a brownware that exhibits many of the characteristics of Dinetah (Gobernador) Textured Gray (figure 6.26) (OSA 2020c). However, Greubel and Cater (2020) recommend a cautious approach to the identification of brownware vessels represented only by sherds, owing to the similarities between some Dinetah Gray and some Uncompahgre Brown pots. Both types are roughly contemporaneous: Dinetah (Gobernador) Textured Gray was manufactured from the early sixteenth century to the end of the

Table 6.15. Metric and nominal data on eight pottery vessels.

Vessel Designation[a]	No. of Sherds[b]	Mean Sherd Weight (g)	Mean Thickness (mm)[c]	Exterior Surface Color	Paste Color	Surface Treatment	Decorative Technique
1/A	6/13	1.74	5.03	7.5YR 5/1 – 5/2	7.5YR 8/1	Plain	None visible
2	1/0	7.13	6.09	7.5YR 4/2	5YR 5/4	Cord roughened	None visible
3	3/0	1.68	4.66	7.5YR 4/1	7.5YR 6/2	Plain	None visible
4	6/0	4.45	6.07	7.5YR 5/4	10YR 3/1	Plain	Incised
5	11(1)/0	3.53	5.97	7.5YR 4/3 – 5/3	7.5YR 4/3	Plain	Incised, punctate
6	2/0	2.32	4.60	7.5YR 4/1 – 4/2	10YR 2/1	Plain	Incised?
7/C	1(1)/1	3.50	5.17	sediment stained	10YR 7/3	Indented corrugated	None visible
B	0/3	7.97	6.32	7.5YR 4/1	10YR 2/1	Plain	None visible

[a] Numbers indicate vessel designations assigned to specimens collected during 2018; letters indicate vessel designations assigned to specimens collected during 2009.
[b] Values to the left of the backslash indicate the number of sherds collected during 2018; values to the right indicate the number collected during 2009. Numbers in parentheses indicate possibly associated sherds.
[c] Derived from minimum and maximum sherd thickness measurements.

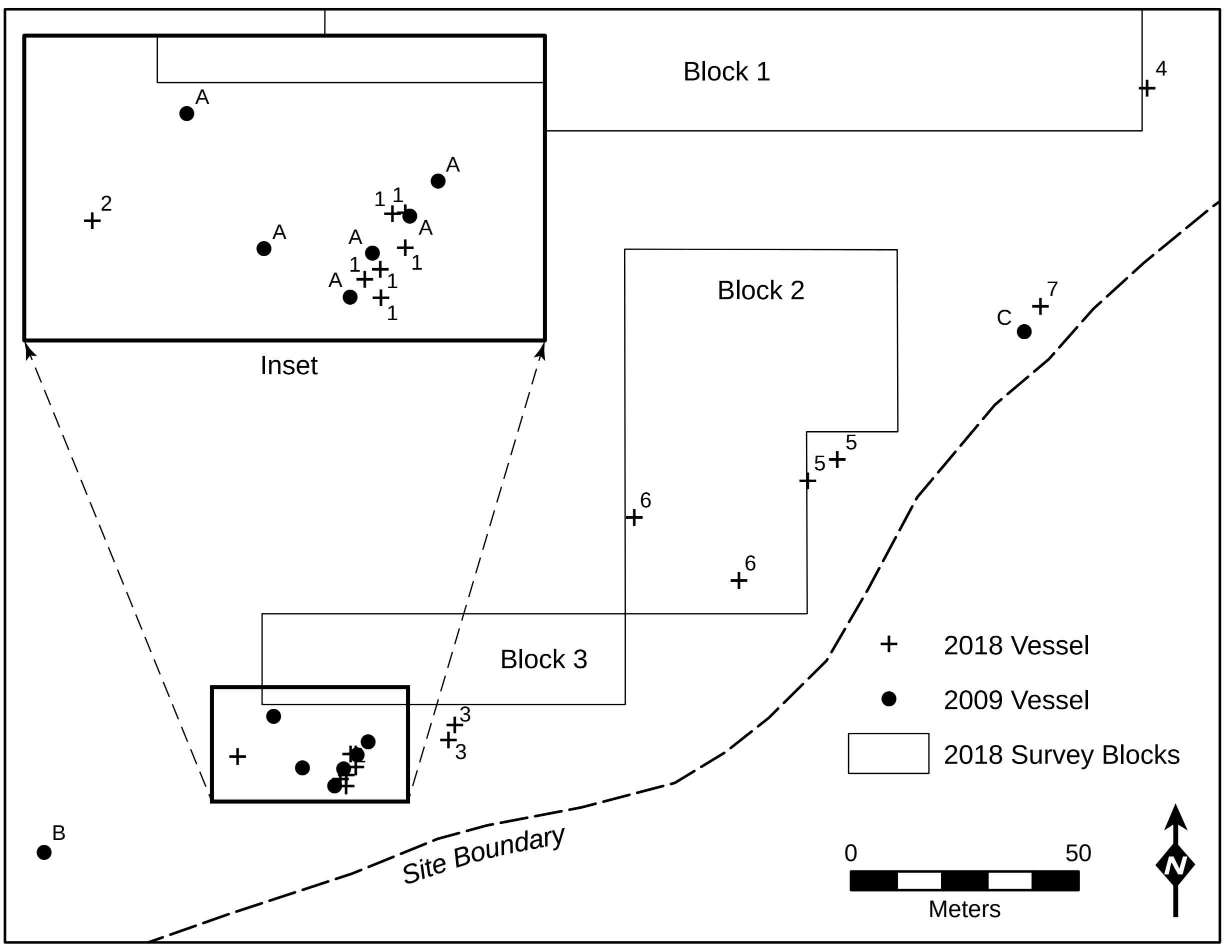


Figure 6.24. Distribution of pottery vessels. Vessels documented during 2018 are represented by crosses, while vessels documented in 2009 are represented by filled circles. The inset shows a cluster of vessel fragments located south of Block 3.

Table 6.16. Typological data on eight pottery vessels.

Vessel Designation[a]	No. of Sherds[b]	Ware	Type	Estimated Age (CE)
1/A	19	Taos Gray	Taos Gray Plain	1100-early 1700s
2	1	[Unspecified]	[Cord roughened]	1050-1450
3	3	Taos Gray	Unspecified	1100-early 1700s
4	6	Taos Gray	Taos Gray Incised	1100-1350
5	11(1)	Taos Gray	Taos Gray Incised	1100-1350
6	2	[Unspecified]	Mica-tempered (?)	1350-1450? 1450-1700?
7/C	2(1)	Jemez Gray	Jemez Smeared/Indented Corrugated (?)	1250-1550
B	3	Navajo Gray	Dinetah (Gobernador) Textured Gray	Early 1500s-late 1800s

[a] Numbers indicate vessel designations assigned to specimens collected during 2018; letters indicate vessel designations assigned to specimens collected during 2009.
[b] Numbers in parentheses indicate possibly associated sherds.

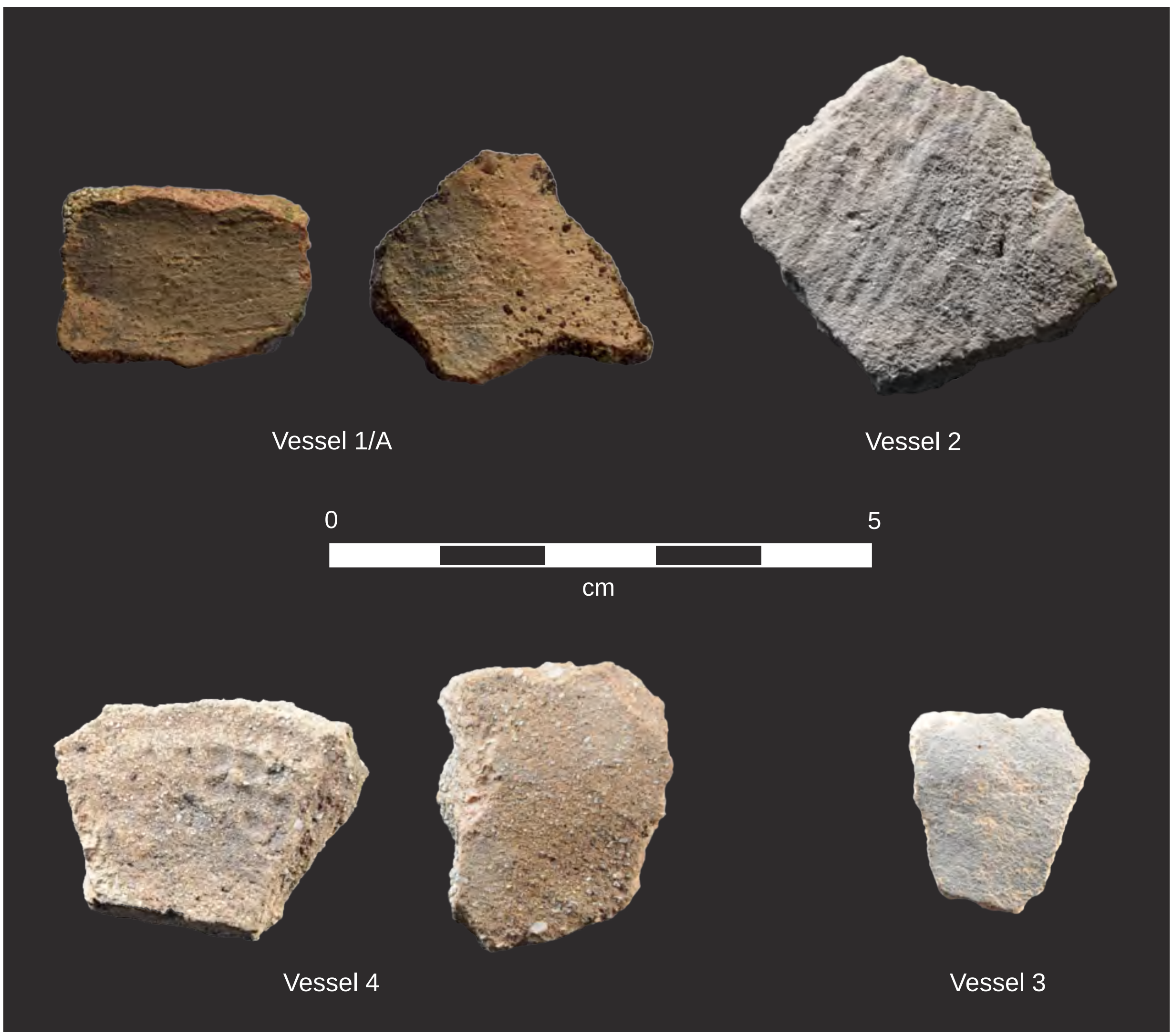


Figure 6.25. Photographs of pottery vessels. Vessel 1/A: FS5 (2009); Vessel 2: CN1006 (2018); Vessel 4: CN1009 (2018); Vessel 3: CN1008 (2018). Sherds illustrated on-stance, with orifice side on the top.

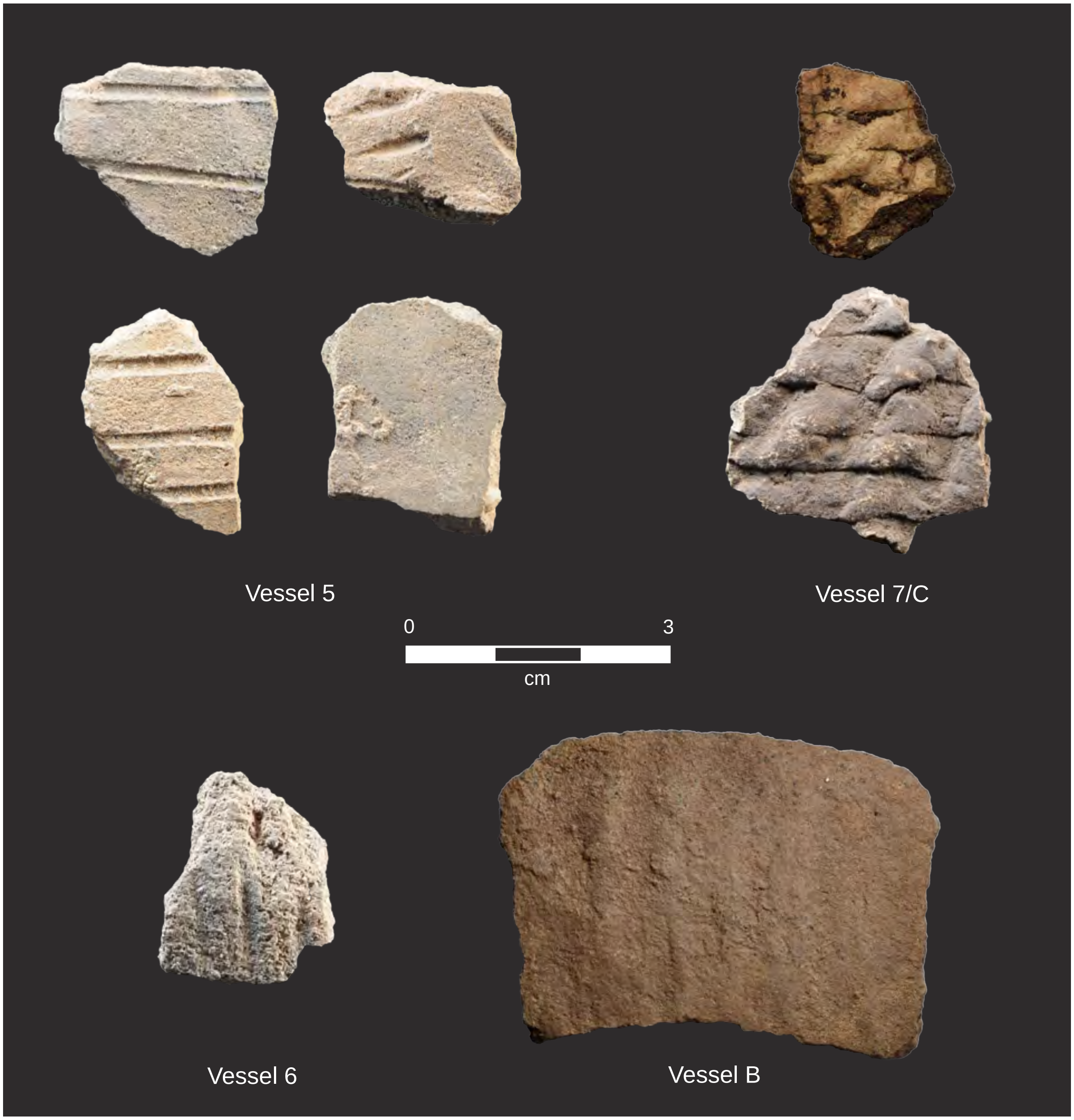


Figure 6.26. Photographs of pottery vessels. Vessel 5: CN1010 (2018); Vessel 7/C: FS36 (2009) [upper] and CN2003 (2018) [lower]; Vessel 6: CN1012 (2018); Vessel B: FS31 (2009). Sherds illustrated on-stance, with orifice side on the top.

nineteenth century, while Uncompahgre Brown was manufactured from the late fourteenth or early fifteenth centuries into the nineteenth century.

The estimated ages of the La Botica vessels encompass an 800-year span. The oldest may be the Taos Incised vessels, which were primarily produced during the Valdez phase between 1100 and 1225 CE. Production of Taos Incised ended about 1350 CE, at the end of the Talpa Phase. The single cord-roughened sherd representing a Plains vessel may date to approximately the same period, while the Jemez Gray vessel and the possible mica-tempered vessel may be somewhat younger. Vessel B may be the youngest of the eight and may have been produced as late as the nineteenth century.

All eight of the identified vessels were utility or culinary jars manufacture elsewhere and transported to La Botica. At least two of the pots—Vessel 1/A and Vessel 5—represent "pot drops," vessels broken catastrophically on site. All of the collected sherds were recovered from the surface, apart from two of the three that make up Vessel 7/C.

As noted previously in the "Intensive Inventory" section, all of the pottery vessel fragments observed at La Botica were concentrated on the site's southern edge, close to the toe of the talus slope. This suggests that many of the native people who visited the site in the last 900 years focused their activities in that area.

Summary: Site Function, Occupation History, and Cultural Affiliation

Archaeological data on chipped stone flaking debris, stone tools, pottery vessels, metal artifacts, and cultural features offer insights on the range of activities carried out at La Botica and on the site's history of occupation.

Site Function

Stone tool type data indicate a primary focus by the site's Native American occupants on plant processing, along with a secondary focus on tool kit refurbishment and late-stage tool production.

Ground stone tools make up 70 percent of the tool assemblage documented in 2018. The presence of intact, usable millingstones and handstones suggests that grinding tools were cached at the site in anticipation of future use. Ground stone tools are abundant in every part of the site—including in concentrations interpreted as primarily Archaic in age as well as those interpreted as Late Prehistoric in age. This pattern suggests that plant processing was the principal focus of the site's indigenous visitors throughout the period of occupation.

All of the observed pottery consists of utility ware sherds that were produced elsewhere and transported to La Botica, a pattern indicating that the pottery was brought to the site in anticipation of a specific need. Although the particular task or tasks for which pottery vessels were used is not known, the fact that only culinary wares are represented coupled with the prevalence of ground stone tools at the site suggests that pottery also may have been used for processing or preparing seeds, leaves, or other comestible or medicinal plant parts. Pottery may also have been used to transport water to the site from La Jara Creek.

The chipped stone tool assemblage is dominated by projectile points, more than half of which are represented by proximal (base) fragments. This pattern suggests that re-tooling of hunting gear, rather than hunting itself, was an important activity. Other tasks represented by the chipped stone tool assemblage include general cutting and scraping activities and stone tool production and maintenance. The diversity and number of non-diagnostic chipped stone tools are limited. The 2018 assemblage includes 10 biface fragments, six unpatterned flake tools, five scrapers, three cores, and one non-diagnostic fragment of a projectile point blade. Two of the tools likely are fragments of early-stage bifaces.

The large number of lithic flakes present at La Botica stands in contrast to the small number of chipped stone tools. Density estimates suggest that as many as 19,000 flakes may be present. In combination with data on the numbers and portions of tools present, this contrast suggests that lithic reduction focused mainly on mid- to late-stage tool finishing and routine tool repair and re-purposing, rather than on primary production.

The small number of rock-filled hearths documented at the site likely represent stone boiling rather than meat or plant roasting, based on the sizes and arrangements of constituent burned rocks. The near absence of burned or calcined bone fragments further suggests that intensive animal carcass processing (including bone grease rendering) did not occur at La Botica.

In sum, the archaeological evidence indicates that most of the Indigenous Americans who came to La Botica did so to obtain specific resources or for a specific purpose. Specialized use of that type suggests that task groups, which represented only a portion of the larger community, were the primary occupants. The amount of time they spent at La Botica likely was shorter than the amount of time they spent in contemporaneous base camps.

Ethnographic data collected in the twentieth century demonstrate that La Botica is one of several medicinal plant gathering localities visited by San Luis Valley Hispano communities (see chapter 7; Bye and Linares 1986). However, the archaeological footprint of recent visitors is manifestly limited. Nearly all of the documented metal artifacts occur in a single concentration. The items in the concentration point to one or a small number of occupations dating to the early twentieth century. Generalized camp debris is represented. Recent visitors may have come to the site to gather medicinal plants or they may have come to herd sheep or to recreate. Regardless, it seems clear that the organization of Hispano plant gathering at La Botica differed from the organization of Native American plant gathering. Whereas Indigenous Americans both gathered and processed plant resources at La Botica, in combination with a limited range of other activities, Hispano peoples appear to have performed processing tasks elsewhere. The duration of their visits may also have been shorter.

Occupation History and Cultural Affiliation

Primary deposition of fine-grained deposits at La Botica occurred during the Late Pleistocene and Early Holocene. At least within the site's central hydrologic basin, a stable surface was present until about 8500 cal B.P. After that time—and likely coincident with a regional warming and drying trend—sediment was transported into the basin by surface erosion, burying the Early Holocene soil. American Indian use of the site may have begun at about that time. However, surface and subsurface data from outside the central basin indicate that deposition and subsequent soil formation also occurred after the initiation of the 8500 cal B.P. erosional event. Carver and Beeton (2014) identify multiple episodes of aggradation and surface stability in the La Jara Canyon that date to the Late Holocene; however, surfaces comparable to the Early Holocene soil at La Botica do not appear to be preserved in the local alluvial record.

Widespread erosion of La Botica's surface likely began after 700 B.P. Today, most of the site's archaeological deposits have been stripped away by sheetwash and aeolian erosion.

Although artifact density estimates indicate that thousands of lithic flakes are present at La Botica, the stone tool data suggest that that the size of the flaking debris assemblage is primarily a product of the number of occupations, rather than their intensity. However, neither the precise number of occupations, nor the lengths of the intervals between them, are known.

Despite the evidence for a time-transgressive functional emphasis on plant processing, spatial data on projectile points, flaking debris, and pottery indicate that different parts of the site were used during different periods. La Botica's Archaic occupants appear to have occupied most of the site. A notable concentration of artifacts likely dating to the Archaic stage occurs immediately north of the site's central basin. By contrast, the site's Late Prehistoric occupants appear to have focused their activities along the toe of the talus slope on the site's southern perimeter. That part of the site may contain the highest plant species diversity and may be the primary habitat for many of the species valued for their medicinal and comestible parts.

Temporally diagnostic artifacts point to intermittent occupation of La Botica throughout the Middle and Late Holocene. At least 22 of the 36 documented projectile points are dart points that were produced during the Archaic stage. The oldest is a Jay-style point that may date to the Late Paleoindian or Early Archaic periods. Consistent if not regular use of the site began by about 4500 or 5000 B.P. (roughly 5800 to 5000 cal B.P.). Whether the site was used as a specialized plant gathering and processing locality prior to that time is unknown; the fact that the earliest use is represented by a single specimen suggests that the importance of the site for plant processing may only have emerged later.

A dozen arrow points, along with pottery vessels indicate continued occupancy during the Late Prehistoric. Five of the 12 arrow points date to the first millennium, between about 1600 and 850 B.P. Seven more post-date 850 B.P. (1100 CE). Most of the documented pottery vessels appear to have been produced between about 1100 and 1450 CE. Peeled ponderosa pines point to Native American use of the site during the eighteenth or nineteenth centuries, as does the presence of at least one brownware vessel.

Data on stone tool raw material provenance and on pottery vessels indicate that many different Indigenous American groups were drawn to the botanical resources available at La Botica. A wide variety of lithic raw materials are represented in the flaking debris and chipped stone tool assemblages. Materials from known sources include orthoquartzite from Trickle Mountain (Alkali Creek) located roughly 100 km to the north (figure 6.22[A]), obsidian from the Valles Caldera 150 km to the south, and chert from Cumbres Pass 25 km to the southwest (figure 6.23[B]. Other raw materials include rhyolite possibly from a source in English Valley 65 km to the north (figure 6.21[A]) and dacite from San Antonio Mountain or other sources in the Taos Plateau volcanic field (figure 6.21[B]). This distribution suggests that La Botica's occupants came to the site from multiple directions. However, the cultural identities of the site's Archaic-stage occupants are not known.

Northern Tiwa pottery is the best represented type. Pottery produced in the Southern Plains is also represented, as is pottery that may have been produced on the Pajarito Plateau and in portions of the Northern Rio Grande outside the Taos Valley. These data indicate that both Pueblo and Plains groups came to La Botica during the last millennium. One pottery vessel was produced by either a Navajo or a Ute potter. The presence of several peeled ponderosa pines points to occupancy by Utes, Jicarilla Apaches, Navajos, or another group of Historic period hunter-gatherers.

The presence of recent historical artifacts indicates use of the site by local San Luis Valley residents during the twentieth century. The functional characteristics of the metal artifact assemblage suggest a camp occupation of modest duration.

Acknowledgements. This chapter benefitted from the contributions of numerous PCRG staff and research affiliates. I thank PCRG Project Archaeologist Chris Johnston for analyzing the projectile point assemblage. PCRG Research Affiliate Marilyn Martorano documented the site's culturally modified trees. Britni Rockwell, PCRG's Lab Supervisor and Volunteer Coordinator, coordinated data collection. Britni also managed the complex logistics of the field operation. I thank Dan Haas, Bureau of Land Management Colorado State Archaeologist, for permission to study previously collected artifacts curated at Great Sand Dunes National Park and Preserve and Fred Bunch, Chief of Resource Management at Great Sand Dunes, for coordinating access. I also am indebted to Mona Charles, who provided invaluable spatial and other data obtained during Fort Lewis College's 2009 reconnaissance project at La Botica.

References Cited

Ahler, Stanley A., Timothy Weston, and Emery L. Mehrer
1979 *Controlled Surface Reconnaissance in the Buchfink Cultivated Tract, Knife River Indian Villages National Historic Site, 1978*. Department of Anthropology, University of North Dakota. Submitted to the National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

Boyer, Jeffrey L., James L. Moore, and Lisa A. Ooten
2001 Volcanic Chipped Stone Quarries: A Preliminary Investigation of Major Material Sources on the Taos Plateau. In *Chipped Stone Material Procurement and Use: Data Recovery Investigations Along NM 522, Taos County, New Mexico*, edited by Jeffrey L. Boyer and James L. Moore, pp. 99-118. Archaeology Notes 292. Museum of New Mexico, Office of Archaeological Studies, Santa Fe.

Bye, Robert A., Jr., and Edelmira Linares
1986 Ethnobotanical Notes from the Valley of San Luis, Colorado. *Journal of Ethnobiology* 6(2):289-306.

Campbell, C. A., E. A. Paul, D. A. Rennie, and K. J. McCallum
1967 Factors Affecting the Accuracy of the Carbon-Dating Method in Soil Humus Studies. *Soil Science* 104:81–85.

Carver, Daniel P., and Jared M. Beeton
2014 Holocene Landscape Evolution and Geoarchaeology of Low-Order Streams in the Rio Grande Basin, San Juan Mountains, Colorado, USA. *Quaternary Research* 82:331-341.

Chapin, Nicholas M.
2005 Hunter-Gatherer Technological Organization: The Archaic Period in Northern New Mexico. Unpublished Ph.D. dissertation, Department of Anthropology, University of New Mexico, Albuquerque.
2017 *Oshara Revisited: The Archaic Period in Northern New Mexico*. Anthropological Papers 10. University of New Mexico, Maxwell Museum of Anthropology, Albuquerque.

Crosser, Ian, Mona Charles, J. Robbins, and Adrienne Anderson
2009 Colorado Cultural Resource Inventory forms for site 5CN1061. Prepared by Fort Lewis College, Durango, Colorado. Submitted to History Colorado – Office of Archaeology and Historic Preservation, Denver.

Greubel, Rand A., and John D. Cater
2020 Ute and Navajo Cultural Interaction during the Protohistoric and Early Historic Periods. In *Spirit Lands of the Eagle and Bear: Numic Archaeology and Ethnohistory in the Rocky Mountains and Borderlands*, edited by Robert H. Brunswig, pp. 218-256. University Press of Colorado, Louisville.

Hofman, Jack L.
1999 Folsom Fragments, Site Types, and Assemblage Formation. In *Folsom Lithic Technology*, edited by Daniel S. Amick, pp. 122-143. Archaeological Series 12. International Monographs in Prehistory, Berghahn, New York.

Holliday, Vance T.
2004 *Soils in Archaeological Research*. Oxford University Press, Oxford.

Irwin-Williams, Cynthia
1973 *The Oshara Tradition: Origins of Anasazi Culture*. Contributions in Anthropology 5(1).

Paleoindian Institute, Eastern New Mexico University, Portales.

Kalasz, Stephen M., Mark D. Mitchell, and Christian J. Zier

1999 Late Prehistoric Stage. In *Colorado Prehistory: A Context for the Arkansas River Basin*, edited by Christian J. Zier and Stephen M. Kalasz, pp. 141-263. Colorado Council of Professional Archaeologists, Denver.

Keeley, Lawrence H.

1982 Hafting and Retooling: Effects on the Archaeological Record. *American Antiquity* 47(4):789-809.

Levine, Daisy F.

1994 Ceramic Analysis. In *Studying the Taos Frontier: The Pot Creek Data Recovery Project*, edited by Jeffrey L. Boyer, James L. Moore, Daisy F. Levine, Linda Mick-O'Hara, and Mollie S. Toll, pp. 339-366. Archaeology Notes 68. Museum of New Mexico, Office of Archaeological Studies, Santa Fe.

Matthews, J.A.

1985 Radiocarbon Dating Surface and Buried Soils: Principles, Problems, and Prospects. In *Geomorphology and Soils*, edited by Keith S. Richards, Roger R. Arnett, and Stephen Ellis, pp. 269-288. Allen and Unwin, London.

Mitchell, Mark D.

2020 *Archaeological Research During 2018 at the La Botica Site, Conejos County, Colorado.* Research Contribution 114. Archaeological Investigations in the San Luis Valley 6. Paleocultural Research Group, Broomfield, Colorado. Submitted to History Colorado – State Historical Fund and the Office Archaeology and Historic Preservation, Denver, Colorado. [OAHP Document CN.SHF.R16]

Mitchell, Mark D., and Carl R. Falk

2017 *Archaeology of the Upper Crossing Stone Enclosures, Saguache County, Colorado*. Research Contribution 99. Archaeological Investigations in the San Luis Valley 3. Paleocultural Research Group, Broomfield, Colorado. Submitted to History Colorado – State Historical Fund, Denver, Colorado, and the Bureau of Land Management, San Luis Field Office, Monte Vista, Colorado.

Office of Archaeological Studies [OSA]

2020a Taos Gray Ware. Electronic resource, http://ceramics.nmarchaeology.org/typology/ware?p=40, accessed July 24, 2020.

2020b Jemez Smeared/Indented Corrugated. Electronic resource, http://ceramics.nmarchaeology.org/typology/type?p=217, accessed July 24, 2020.

2020c Dinetah (Gobernador) Textured Gray. Electronic resource, http://ceramics.nmarchaeology.org/typology/type?p=330, accessed December 15, 2020.

Reed, Alan D., and Michael D. Metcalf

1999 *Colorado Prehistory: A Context for the Northern Colorado River Basin*. Colorado Council of Professional Archaeologists, Denver.

Rock, Jim

1989 *Tin Canisters: Their Identification*. Electronic document, https://digital.sou.edu/digital/collection/p16085coll5/id/2210/rec/5, accessed April 7, 2020.

Shackley, M. Steven

2011 Sources of Archaeological Dacite in Northern New Mexico. *Journal of Archaeological Science* 38:1001-1007.

2013 The Geochemistry and Archaeological Petrology of Volcanic Raw Materials in Northern New Mexico: Obsidian and Dacite Sources in Upland and Lowland Contexts. In *From Mountaintop to Valley Bottom: Understanding Past Land Use in the Northern Rio Grande Valley, New Mexico*, edited by Bradley J. Vierra, pp. 17-32. University of Utah Press, Salt Lake City.

Spero, Vince, and Ted Hoefer III

1999 Distribution and Sources of Lithic Material in the Rio Grande Basin. In *Colorado Prehistory: A Context for the Rio Grande River Basin*, edited by Marilyn A. Martorano, Ted Hoefer III, Margaret A. Jodry, Vince Spero, and Melissa L. Taylor, pp. 186-191. Colorado Council of Professional Archaeologists, Denver.

Warren, A. Helene

1981 The Micaceous Pottery of the Rio Grande. In *Collected Papers in Honor of Erik Kellerman Reed*, edited by Albert H. Schroeder, pp. 149-165. Papers 6. Archaeological Society of New Mexico, Albuquerque.

Wells, Susan J., and Steven M. Baumann

2008 Summary of Inventory Results. In *Archeological Inventory and National Register Evaluation for the Baca Land Exchange La Jara Reservoir Parcels, Conejos County, Colorado*. Publications in Anthropology 101. National Park Service, Western Archeological and Conservation Center, Tucson, Arizona.

Wetherington, Ronald K.

1968 *Excavations at Pot Creek Pueblo*. Publication 6. Fort Burgwin Research Center, Taos, New Mexico.

Wilson, Gordon P.

2007 *Guide to Ceramic Identification: Northern Rio Grande Valley and Galisteo Basin to AD 1700.* Second edition. Technical Series Bulletin 12. Laboratory of Anthropology, Santa Fe, New Mexico.

7

Traditional Use

Sean O'Meara, Shawn Kelley, and
Charles N. Saenz

An integral part of understanding the significance of the La Botica site involves the perspectives of local communities and traditionally associated tribes whose history in the area spans a period from time immemorial to the present. Native American communities in particular have a complex and multidimensional connection that predates European colonial governments. The Southern Ute Indian Tribe, for example, maintains an unbroken cultural connection to the San Luis Valley since the time of their creation and even following their forced removal by the U. S. government from their ancestral lands beginning in 1868. Tribal historians recall that Ute people continued to access the area, some remained in the lands and resisted removal by hiding their Indigenous identities, and the area remained a part of their cultural history, reinforced through their language, songs, ceremonies, and stories. In the past 30 years, Ute people have reinforced these connections through government-to-government consultation with multiple federal and state agencies throughout the San Luis Valley and brought children and elders as part of tribal science, technology, engineering, and math (STEM) projects and other cultural preservation programs. As the late Alden Naranjo of the Southern Ute Indian Tribe explained:[1]

> *You know the history, our history, it's so complex and it's got a lot of details and … I don't think it could ever be written down in a book. And I would think that if somebody wrote a book of ALL the things we did as the Ute group, as the Ute Nation, of ALL the things we did,*

2022 *Multidisciplinary Research at the La Botica Site, Conejos County, Colorado*, edited by Mark D. Mitchell, pp. 101-132. Research Contribution 115. Paleocultural Research Group, Broomfield, Colorado.

of all the thirteen bands … it would be like Shakespeare's books. Or like the Bible … volumes of it. And I think that basically goes for every tribe. Because of all the things that happened, things that took place, where they were moved, how they were moved, who they were, different groups that they had, bands that they had, clans that they had. The story of the Native people of this country, it's never been really told. If I was to write a book, it would be from my perspective, then someone else would write a book and add on to that or whatever. But it's the history of our people, just in the Valley here, is BIG … It's basically the same story that goes on anywhere in the world of different groups of people, who they were, how they were, what they did, their customs [and] their spirituality. All that. It's big. Nobody really knows [it all], just partial history of each people in this world. So, and then we add ours onto it, you know it's just like going to school. You take American history, you take Spanish history, Mexican history, the history of Mexico, that area, history of South America, the history of Canadian groups. Everywhere, it's all big. But it's never ALL been told. Because a lot of that information that they had, were not to be told. It was supposed to be kept. You only talked about it on the surface part of it. Like the tip of an iceberg. The rest of it all, is secret.

This traditional use study of the multidisciplinary project yielded specific oral histories and first-person accounts about the use of and historic connections to La Botica. These accounts should be privileged above other means of historical research because they often reflect the untold lived experience of communities who know and relate to this landscape on a personal level where they and their families have engaged for centuries, and in some cases millennia, in a process of biofeedback understood academically as traditional ecological knowledge. A large portion of this knowledge has been passed down generationally, among historic and current descendent communities, and pertains to culturally significant landmarks and traditionally important botanicals, as well their uses in the greater San Luis Valley (the Valley). This chapter describes some of the history, as told by community and tribal representatives, whose cultural connections and perspectives associated with La Botica and the plant community, as well as those found in the greater La Jara Canyon area, remain intact.

Participants shared this information in an effort to preserve some of the lived history of people who spent their lives caring for and living off the land. For Indigenous people, such as the Navajos and Southern Utes, these insights have the power to transform plant species lists into a living library—invoking historical memories and providing insight into the needs of people that date back hundreds of years and, for associated Indigenous communities, since time immemorial. For the Hispano communities in the Valley, La Botica represents a history and way of life that their ancestors relied on to live and thrive for nearly two centuries. The site, and the lifeways it supports, continue to be important for self-reliance, cultural continuity, identity, and sense of place.

The English language is a relative newcomer to the Valley. In this chapter, we include a number of words shared with us by representatives in their Native languages. These include terms in languages spoken by the Navajos, Spanish, and Utes. Unless otherwise noted, the spelling and translations were provided by the speaker; however, translations and spellings may vary among speakers of a given language as well as among communities and families, especially among Indigenous languages that are not traditionally written. The unique dialect of San Luis Valley Spanish (Cobos 2003; Lopez 2020), as well as the Ute and Navajo terms and perspectives recorded during this study hint at the vast, multidimensional understanding and history of this place.

Regarding the Ute orthography used in this chapter, the Southern Ute Indian Tribe uses an orthography developed by Givón (2011, 2013a, 2013b) as the official writing system of the tribe. However, differences in pronunciation and the use of specific terms persist among the three Ute tribes and the Ute terms presented in this chapter were provided by and reviewed by tribal research participants and the Southern Ute Cultural Preservation Department.

The Spanish term "La Botica," as a concept, describes a natural pharmacy, a location where conditions provide a unique habitat for a variety of rare and important plants, which when coupled with generational knowledge of harvesting and use and supported through traditional management, lends itself to becoming a special place. The term La Botica, as some community members acknowledge, can be used to describe countless places in the Valley and was first recorded by Bye and Linares (1986) during their ethnobotanical study of the area in the early 1980s. The locations of other "La Boticas" might only be known by a family from the community or Indigenous representatives.

Ethnographic fieldwork took place over two field seasons and conformed to the American Anthropological Association's guidelines on ethical research (AAA 2012). Table 7.1 and figure 7.1 list the communities and tribes that participated in the study, as well as an earlier study at La Botica for the La Jara Canyon Oral History Project undertaken by the Colorado State Land Board (SLB) in 2017. Due to scheduling conflicts, representatives from Taos Pueblo, Santa Clara Pueblo, and additional community members were unable to participate. Representatives were interviewed and traveled to the La Botica Site, other places within the La Jara Canyon, and in multiple communities in the Valley.

This chapter synthesizes information provided by Indigenous representatives and community members who participated in this project. It should be noted that within these communities or groups cultural practices, spiritual beliefs, and oral traditions are passed down through families and other kinship systems such as bands and clans. While many families and sub-groups may share similar beliefs, cultural practices can differ among individuals and families.

Protocols for divulging information differ among communities and even within a community. Some members may feel comfortable sharing certain types of information, while others must adhere to protocols that limit the amount of information that can be shared. Thus, each person or family is responsible only for the information that is attributed to them, and they retain inalienable rights to that information. It is neither responsible or possible to represent one unified Navajo, Ute, or Hispano lifeway. However, these examples paint a picture of the continuous connections to the botanical resources found at La Botica and of the site's ongoing cultural significance.

Previous Work

This study builds upon the contemporary work by tribes, communities, ethnobotanists, ethnographers, and historians working in the San Luis Valley. Ethnobotanical research with associated Native American tribes, pueblos, and the local community began over 100 years ago. Bye and Linares (1986) appear to be the first to document Hispano uses of plants found at La Botica and Duran (2018) continues research into this topic. Ute ethnobotany was first formally recorded in 1909 by Chamberlin (1909) and the Ute Ethnobotany Project (Chapoose *et al.* 2012; McBeth 2008) expanded and revised that work in a collaborative project between the Ute Indian Tribe of the Uintah and Ouray Reservation and several organizations across Colorado. A traditional use study (Kelley *et al.* 2019) undertaken by the Great Sand Dunes National Park and Preserve (GRSA) provided an additional opportunity for Ute elders and representatives to review and comment upon Ute traditional resources, including plants.

Elmore (1944) was one of the first to compile ethnobotanical information related to Navajo people. However, contemporary projects by NMSU (2018) and Mayes and Lacy (1989) are sources currently recommended by the Navajo Nation Heritage and Historic Preservation Department. Kelley and others (2019) also describes many plant and animal resources significant for the tribes who participated in this study as well as many others who are traditionally associated with the Valley. Eleven tribes and pueblos participated in that study, including the Southern Ute

Table 7.1 Tally of Native American and Hispano community participants in the La Botica site traditional use study.

Community or Tribe	Number of Participants	Year
Capulin, Colorado	6[A]	2017, 2018
Jicarilla Apache Nation	3[A]	2017, 2018
La Jara, Colorado	1[A]	2017, 2018
Navajo Nation	3	2019
San Luis, Colorado	1	2018
Southern Ute Indian Tribe	3[A]	2017, 2018

[A] Some participants took part in the 2017 Colorado State Land Board oral history project.

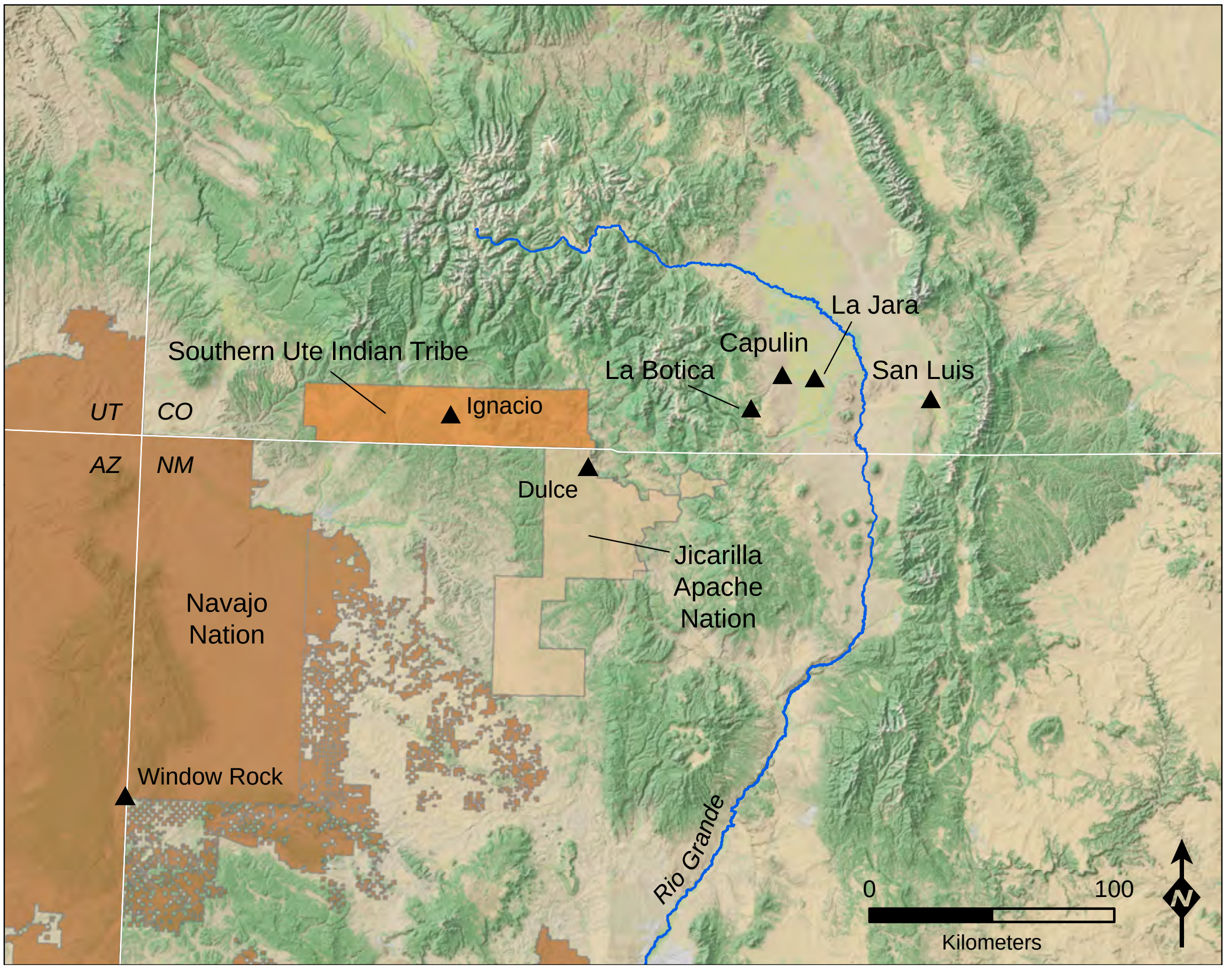


Figure 7.1. Locations of Native American and Hispano communities who participated in the La Botica project.

Indian Tribe, Ute Mountain Ute Tribe, Ute Indian Tribe of the Uintah and Ouray Reservation, Pueblo of Tesuque, Taos Pueblo, Santa Clara Pueblo, Pueblo of Picuris, Navajo Nation, Jicarilla Apache Nation, Hopi Tribe (First Mesa Tewa Village), and A:shiwi (Zuni Tribe of the Zuni Reservation).

Ethnographic and cultural information documented in the Valley also informed this chapter (Simmons 1999; Stoffle, Toupal, Medwied-Savage, O'Meara, Van Vlack, Dobyns, and Fauland 2008; Stoffle, Van Vlack, Toupal, O'Meara, Dobyns, and Arnold 2008; Wescott *et al.* 2016; White 2005). Also important is the ongoing work of the Sangre de Cristo National Heritage Area, whose mission "is to promote, preserve, protect, and interpret [the Valley's] profound historical, religious, environmental, geographic, geologic, cultural, and linguistic resources" (SdCNHA 2013). Beeton and others (eds., 2020) also discusses the history and culture of the San Luis Valley.

Contemporary Perspectives and Traditional Use

Both Hispano and tribal communities have documented traditional use in the San Luis Valley. In addition to the Hispano communities of San Luis, Capulin, and La Jara, at least 19 federally recognized Native American tribes are affiliated with the Valley (USFS 2022:3). These tribes include the Comanche Nation of Oklahoma, Hopi Tribe, Jicarilla Apache Nation, Navajo Nation, Pueblo of Acoma, Pueblo of Cochiti, Pueblo of Laguna, Pueblo of Nambe, Pueblo of Ohkay Owingeh, Pueblo of Picuris, Pueblo of Santa Ana, Pueblo of Santa Clara, Pueblo of Santo Domingo, Pueblo of San Ildefonso, Pueblo of Taos, Pueblo of Zuni, Southern Ute Indian Tribe, Ute Indian Tribe of the Uintah and Ouray Reservation, and the Ute Mountain Ute Tribe.

The La Botica traditional use study built upon an oral history project undertaken at La Botica by the

SLB in 2017 involving cultural advisors and historic preservation staff from the Southern Ute Indian Tribe, the Jicarilla Apache Nation, and Hispano community members from the communities of Capulin, San Luis, and La Jara. While multiple tribes expressed interest in participating in research trips to La Botica in 2018 and 2019, only representatives from the Southern Ute Indian Tribe, Navajo Nation, Jicarilla Apache Nation, and local community members were able to attend. Due to cultural protocols discussed previously, the Jicarilla Apache Nation commentary pertaining to La Botica is not reported in this chapter. The Jicarilla Apache Nation maintains that the San Luis Valley, which includes La Botica, is a part of Jicarilla Apache aboriginal territory and the United States Land Claims commission recognized this claim in 1971 (Nordhaus 1995:112). Tiller (1992) provides more information on Jicarilla Apache history.

The following ethnohistories and traditional use information is organized according to participating community and includes the Southern Ute Indian Tribe, the Navajo Nation, and affiliated Hispano communities. Each community focused on their own ethnographic themes and traditional resources of interest.

Southern Ute Indian Tribe

The Núuchiu, or Ute people, maintain that they have continuously occupied Colorado and Núuchiu Tʉvʉpʉ, which translates to "Ute Lands," since the time of their creation, and have no history of migration (figure 7.2). The San Luis Valley was traditionally occupied primarily by members of the Kapúuta as well as the Moghwachi bands until their forced removal onto the reservation following the Ute Treaty of 1868 between the majority of the Ute bands and the U. S. government, and the subsequent Brunot Agreement of 1873 (Kappler 1904: 990-996; SUIT 2020).

An 1851 map of New Mexico Territory shows the approximate locations of the Ute bands in the valley (figure 7.3) as well as the Jicarilla Apaches. In addition to Ute oral history, there are numerous historical accounts that place the Ute people in the San Luis Valley prior to the arrival of the first European immigrants in the sixteenth century. In Southern Ute oral history, the Valley is considered the traditional territory of the Kapúuta band, although overlap and interactions with other Ute bands occurred. Ms. Cassandra Atencio explained the band locations:

> *My people lived in this area before we were removed and put on the reservation. These would be the Moghwachi and the Kapúuta Bands, that make up the Southern Ute Indian Tribe. And the Kapuuta were the ones that lived around this area, and we moved up and down this corridor of the San Luis Valley and the Moghwachiu sometimes came this way. We ranged all the way down to Abiquiú, New Mexico [and many other places in the region], traded in Taos, New Mexico, and wintered and moved with the seasons.*

Today the Southern Ute tribal headquarters is located in Ignacio, Colorado approximately 80 miles west of La Botica. The Southern Ute Indian Reservation encompasses 1,060 mi^2 (2,740 km^2) in La Plata, Archuleta, and Montezuma counties, Colorado. The southern boundary is the Colorado-New Mexico state line.

Representatives from the Southern Ute Indian Tribe have participated in a wide range of cultural and natural resource projects in the Valley and throughout Colorado (Hopkins *et al*. 2020; Kelley and O'Meara 2016; Kelley *et al.* 2017; Kelley *et al.* 2019; O'Meara *et al*. 2021; White 2005; see Ott 2010:73-87 for a more complete bibliography). Other studies have documented Ute ethnohistory and traditional resource use in Colorado (Jefferson *et al.* 1972; Lyman and Denver 1970; McBeth 2007, 2008, 2010, 2019; SUIT 2020; Stoffle, Van Vlack, Toupal, O'Meara, Dobyns, and Arnold 2008). Prior to the start of this study, Ms. Cassandra Atencio, Southern Ute Indian Tribe Native American Graves Protection and Repatriation (NAGPRA) Coordinator, participated in an oral history project funded by the SLB in 2017 (figure 7.4). In 2018, Mr. Alden Naranjo, Jr., tribal elder and historian of the Southern Ute Indian Tribe, participated in ethnographic field visits (figure 7.5). Mr. Naranjo discussed the Southern Ute cultural landscape of the region. Specific themes he discussed included Ute trails, traditional use plants, and interactions between Ute people and Spanish settlers.

Mr. Naranjo noted that there were multiple trails in the Valley that went from the town of San Luis to Antonito, Los Mogotes, and over to Chama, New Mexico. Ute people practiced a seasonal round, where they would travel through their band territories throughout the year, visiting specific areas to harvest plants, hunt, and to practice their lifeways. According

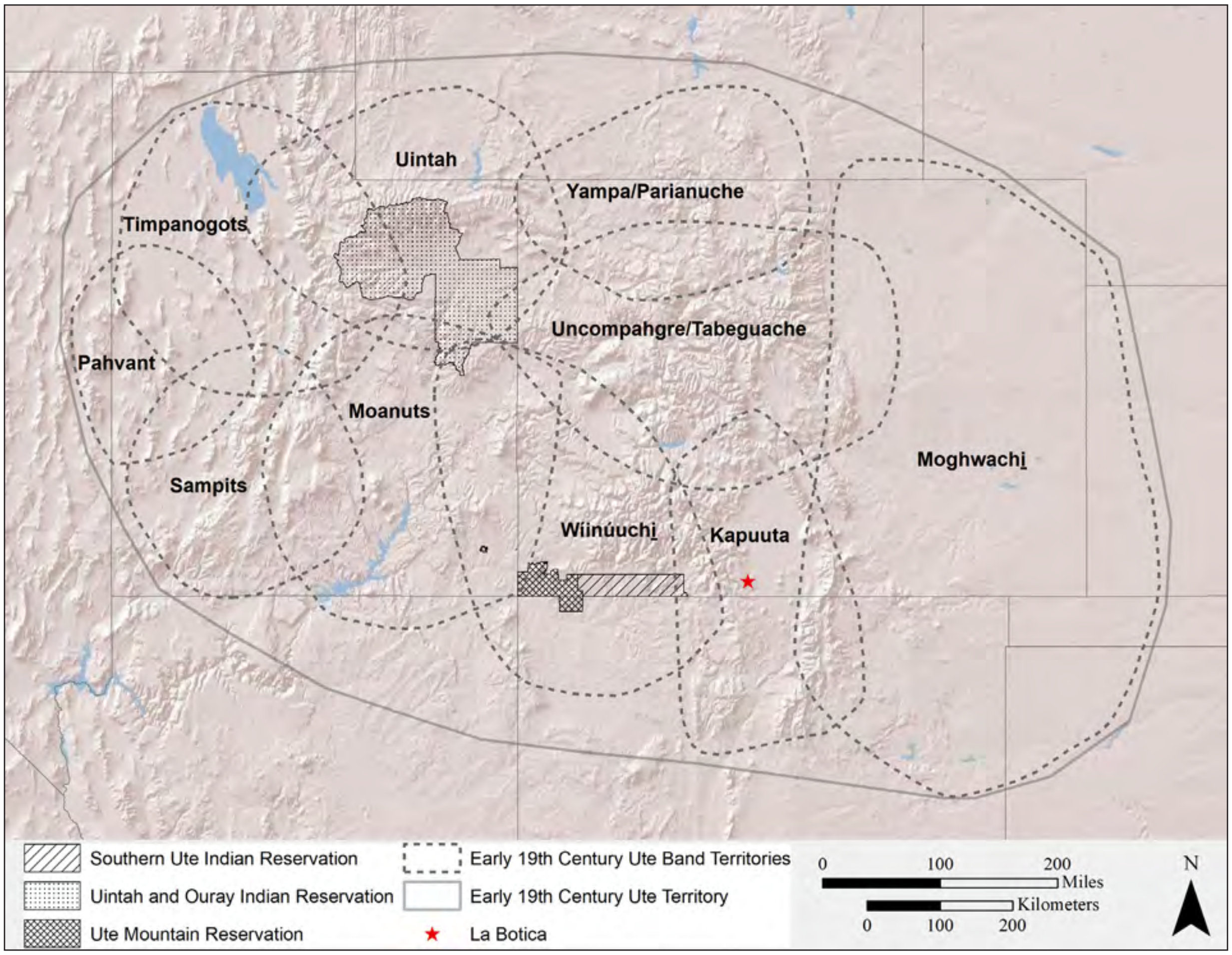


Figure 7.2. Traditional Ute band territories and aboriginal territory provided by Mr. Alden Naranjo, Jr. in 2019. (Map courtesy of Southern Ute Indian Tribe and Anthropological Research, LLC.)

to Mr. Naranjo, Ute people would travel into the mountains during the spring to harvest plants, camping in one spot only for a short time, and then would move to a new area. Along the way they would consume plants and animals fresh but also dry and store food to access during the winter months. Deer, elk, and bison were staple meats that would be dried during the traveling seasons and then became staples during the winter months.

There were a lot of fresh birds consumed as well, including geese and other bird eggs. Ute people knew where the migration routes were and where to go to get food from place to place. The Valley was abundant with all of these resources. Alden Naranjo explained:

> *Back then they had, I don't know, we called it wild onions. I don't know if there's any up in that area or not but there used to be plants like that. Chokecherries, currants, and other edible plants that grew in that area. So, along the river, then going up towards Los Mogotes, and over towards Chama. A lot of that. That's why they would move in the spring towards the mountains because they knew a lot of these plants were coming into maturity, or that they could start to be used. So, then, as the weather changed, they start moving back to lower elevations where a lot of that was still coming into being used. So, they didn't camp one spot very long because, well you know the other thing is that they would move to where they knew that a lot of these plants grew. So, they would move to that area and pick whatever they needed to pick and then move off into the other areas to pick. Meanwhile, while they were doing that, where they were camping, they would*

Figure 7.3. Portion of a map of the Territory of New Mexico compiled by John G. Parke and drawn by Mr. Richard H. Kern. (Image from the Warren Heckrotte Map Collection courtesy Stanford University Libraries.)

Figure 7.4. Cassandra Atencio of the Southern Ute Indian Tribe. (Courtesy Colorado State Land Board.)

Figure 7.5. Alden Naranjo, Jr. surveying the La Botica site on June 7, 2018. (Photograph by Shawn Kelley.)

> *dry these edible plants. Dry them, and then store them. Maybe in a rocky crevice or whatever. Store them there so that in the wintertime they could go back to those places and use them, pick them up. So, a lot of times, they would bring and get those plants, bring them along with them. So, for instance, if they are hunting deer or elk, the bison, mountain sheep or whatever, then they would dry the meat. So that was kind of the staple food that they used during the wintertime. So, when spring came then they would get fresh meat and plants and things like that [...] that's when they harvest the ponderosa. And also, the red willow for medicinal uses that they had. Even out here you can see there are some plants out here that they used the roots and the plants themselves. Wild asparagus, you know, things like that that they had. Plus, they had a lot of the birds. So, they were getting fresh eggs [...] especially the geese [...] Certain things like that that they would, they knew where they were at, knew where their migration was going through, knew when they could get all these, the animals or birds or the plants or whatever. They knew where they could go to pick that up. So, this area, this San Luis Valley here, it's a big area so they would go from one place to another in the area. So, you got mountains here, you got antelopes here, you got deer here. You have elk here. Maybe they had mountain sheep, mountain goats and things like that that they hunted. So, the resources were rich, so they could go different places and harvest that. [And] fish too.*

Ms. Atencio described Ute seasonal travel in this way:

> *We lived in family units. We weren't like Plains people; we weren't like anybody else where we lived as a big tribe. We were in family units, and so when we come together in the spring, and then get ready to disperse out [to different areas] so that way we wouldn't deplete the land ... This place would probably be only able to sustain [the families for] just for so long, and then you would move on. So, we moved and followed the seasons. So, as it's getting hotter, and as these things are drying up, as that snow is melting, you move further up, because those plant species are starting to come alive, the higher that you go. But right here, you would utilize it as a family unit, so that way you wouldn't deplete the resources.*

Concerning the La Botica site specifically, Ute trails and encampments in this area are recorded in the oral history of the elders. During the winter months, a lot of the Utes in the area would move south towards Abiquiu and Chama, New Mexico. Religious and cultural events were held in San Ignacio and at Ute Mountain, located near Taos on the southern portion of the Valley. These stories were told by elders in both Spanish and Ute, depending on what they were talking about. Many of the Ute names for these places remain (table 7.2).

Ms. Atencio discussed other areas of importance to Ute people:

> *We were over there by the natural arch, which is called Bear's Den, and La Garita. We were over there by Sand Dunes and all around that. Sangre de Cristo (Piaroghoavi 'ɵaa), they call that "the serpent's back," and Mount Blanca (Piaroghoavi Yʉchi) was the serpent's head. And we know that we were here, because of oral history and the evidence of the peeled trees. We used the medicinals, and so when you find those—and especially in this area—this is where our people were at… We continue to talk about this area as part of our ancestral homelands even after being removed to the reservation. The U.S. government placed us in with…Ute Mountain Utes, and that was their land, across Wolf Creek Pass, more or less. So, when the settlers came, and Europeans came, and the railroad, and farmers, and ranchers came is when we were being moved out, in the middle 1800s.*

Prior to the period of removal, Spanish settlement in the San Luis Valley was restricted to certain areas. Garrett Briggs, NAGPRA Apprentice, noted that the Spanish were aware of the Utes' intimate knowledge of the mountains and were unwilling to engage in warfare following the Pueblo Revolt of 1680. Mr. Naranjo noted that the Spanish and the Utes generally had an informal agreement in the Valley:

> *The relationship that we had with the Spanish was they would move into an area and, for a settlement or farming around that area, in that settlement only; not to expand out or anything like that. That was the deal that they used to have with the Spanish and the Utes.*

Many Ute people intermarried with Spanish settlers and during the relocation period of the 1860s, remained in the valley with their families and hid the fact they were Utes by speaking Spanish to U. S. soldiers who were relocating Ute people to the newly established reservations. Mr. Naranjo elaborated on those relationships and how Ute people remained in the valley:

> *A lot of old timers said that some of our people had married into some of the Spanish families or the Spanish vice-a-versa. So, a lot of them had Spanish names. So those that had Spanish names that had families in the San Luis Valley during the removal stayed because they didn't want to leave their families, so they stayed. And they were asked by the federal officials if*

Table 7.2. Ute place names in the San Luis Valley.

Ute Term	Translation	Other or Modern Term
Pariyʉwʉgava̱	Elk Hill	San Antonio Peak
Pariyʉpɵtɵ'nichi̱	Elk Point	
Núuwʉgava̱	Ute Hill	Ute Mountain
'avatʉpáapúupatukwinʉ	Big water, where it flows	Rio Grande River
Kuchutʉkachikáavi̱	Kiowa Mountain	
Kukwachighani̱	"Where the Spanish Live/Lived"	Antonito, San Luis, and other Hispano townsites
Sɵ̀ɵchighani̱	"Where the Soldiers Lived"	The area around Manassa, Colorado
Kuchusɵ́ɵchighani̱	"Where the Black Soldiers Are"	Fort Garland, where African American troops (Buffalo Soldiers) were stationed
Piaroghoavi̱ 'ɵaa	The serpent's back	Sangre de Cristo Mountains
Piaroghoavi̱ Yʉchi̱	The serpent's head	Mount Blanca

there were any Utes in that family, a lot of them spoke Spanish, and a lot of them didn't want to say that they were Ute, so they would only answer in Spanish. So, they would ask [you], "Are you Ute?" And you would say, "No." And you would only answer in Spanish. So that's how a lot of the families around here have either Navajo, Apache and Ute, maybe Comanche blood. And some of them have inquired if we can find some of their ancestral relatives. We have a partial list of some of the people that were in the area at one time, but they only go by the names that were given to them, whether in Spanish or English, but there are no Indian names, so we don't know who they are, so we can't tell them who their families would be or who they're descended from. So, it's hard to trace that back because a lot of the people that are asking now, their grandparents may not have told them that dimension, that they were Native. Because I guess maybe it was bad to say that you were Native back in that time. So, a lot of them just said, well I'm Spanish. We have a lot, several families in Ignacio also that have Native blood but we don't know who their ancestors are either. Because a lot of them moved into that area after that area was settled, after 1868.

Mr. Naranjo also discussed the trading relationship between Ute people and other regional tribes and the Hispano community:

They traded deer hides, they traded slaves for metal ware that the Spanish had, and also for horses and mules. Maybe cows or sheep or whatever. … And they would use their buckskins that they tanned and also, they would sell slaves that they had captured from the other tribes. In fact, a lot of the families have either Apache, Navajo, Pueblo or whatever Native blood and they've been trying to find their ancestors for whatever reason, I don't know.

Southern Ute Traditional Use Plants

Plants harvested in the area by Ute people include wild onion (*Allium* spp.), chokecherry (*Prunus virginiana*), wild asparagus (*Asparagus officinale*), currants (*Ribes* spp.), ponderosa pine (*Pinus ponderosa*), willow (*Salix* spp.), red willow (*Cornus* spp.), and many others. During the 2018 field visit, it was not possible to hike to the La Botica site with Mr. Naranjo. When compared with the modern botanical inventory for La Botica and adjacent areas, which includes 199 species (appendix A), 63 have known recorded traditional Ute uses (table 7.3; appendix B). However, all plants found within Ute aboriginal territory are viewed as significant and part of the Ute cultural landscape. Ute plant knowledge is traditionally maintained through oral history and not shared with the larger public in order to preserve these plant species and not bring unwanted attention or misuse to them.

Table 7.3. Ute traditional use plants found at the La Botica site.

Latin Name	Common Name
Achillea millefolium	yarrow
Achnatherum hymenoides	Indian rice-grass
Allium cernuum	wild onion; nodding onion
Antennaria spp.	pussytoes
Arctostaphylos uva-ursi	kinnikinnick, bear berry
Artemisia frigida	fringed sage
Artemisia tridenta	big sagebrush
Ascomycota (Division)	lichen
Astragalus spp.	milkvetch
Berberis repens	Oregon grape, barberry
Bryophyta (Division)	moss
Calochortus gunnisonnii	mariposa lily
Carex spp.	sedge
Castilleja integra	whole leaf Indian paintbrush
Cercocarpus montanus	mountain mahogany
Chenopodium spp.	lamb's quarters
Cirsium spp.	thistle
Cystopteris spp.	bladder fern
Equisetum arvense	field horsetail, common horsetail
Equisetum laevigatum	smooth scouring-rush
Erigeron canus	hoary fleabane
Eriogonum spp.	buckwheat
Erysimum spp.	western wallflower
Fragaria vesca	woodland strawberry
Grindelia squarrosa	curly cup gumweed
Gutierrezia sarothrae	snakeweed
Heterotheca villosa	hairy false golden-aster
Ipomopsis aggregata	scarlet gilia
Juncus balticus	Baltic rush
Juniperus communis	common juniper

Table 7.3. Ute traditional use plants found at the La Botica site (*continued*).

Latin Name	Common Name
Juniperus monosperma	one-seed juniper
Juniperus scopulorum	Rocky Mountain juniper
Ligusticum porteri	oshá; bear root, Porter's lovage
Lithospermum spp.	stone seed
Lomatium spp.	Biscuitroot, desert parsley
Maianthemum racemosum	feathery false lily of the valley
Mentha arvensis	wild mint
Oenothera spp.	evening primrose
Opuntia polycantha	plains prickly pear
Penstemon spp.	penstemon
Pinus contorta	lodge pole pine
Pinus edulis	piñon pine
Pinus ponderosa	ponderosa pine
Populus angustifolia	narrowleaf cottonwood
Populous tremuloides	aspen
Potentilla anserina	silverweed cinquefoil
Prunus virginiana	chokecherry
Pseudotsuga menziesii	Douglas fir
Rhus trilobata	three-leaf sumac
Ribes aureum	golden currant
Ribes cereum	western red currant, wax currant
Ribes inerme	white stem gooseberry
Ribes leptanthum	trumpet gooseberry
Rosa acicularis ssp. Sayi	wild rose
Rosa woodsii	Wood's rose
Rubus ideaus	raspberry
Rumex spp.	dock
Salix lucida	shining willow
Salix spp.	willow
Taraxacum officinale	common dandelion
Tellima spp.	tellima
Verbascum thaspus	common mullein
Yucca glauca	soap weed yucca

Nihokahaa' Diné Bila' Ashdla'ii (Navajo Nation)

The San Luis Valley is a vital and living landscape for Navajos or Nihokahaa' Diné Bila' Ashdla'ii ("five fingered earth surface people"). Navajos have strong cultural connections to La Jara Canyon, the San Luis Valley, and the greater cultural landscape. The information included in this section was shared during research for this and other regional projects. Representatives provided information about Navajo cultural attachments to southern Colorado and the greater southwest region. These attachments were created in distant times and have been sustained through cultural practices including ceremony, pilgrimage, and traveling to the region for continued resource use and collection. These practices are commemorated at rock art, and other archaeological sites, and remembered through oral history that includes Navajo place names (Kelley *et al.* 2019:4.7-4 – 4.7-6).

The Navajo world is encircled by four sacred mountains. The mountains each represent a cardinal direction. To the east is Sisnaajiní, translating to "the black belt around the mountain," which is known to Navajos as White Shell Mountain and is associated with the color white. Sisnaajiní is known in English as Mount Blanca and is located northeast of La Jara Canyon across the San Luis Valley in the Sangre de Cristo Mountains (figure 7.6). The southern mountain, Tsoodził, translating as "the blue mountain" or Turquoise Mountain, is associated with the color turquoise. Tsoodził is known in English as Mount Taylor, located near Grants, New Mexico. To the west is Dook'o'oosłíįd, translating to "[snow] never melts on top" or Abalone Shell Mountain, and is associated with the color yellow. Dook'o'oosłíįd is known in English as the San Francisco Peaks, located near Flagstaff, Arizona. The northern mountain, Dibé Ntsaa, translating to "big sheep" or Jet Stone Mountain, is associated with the color black. Dibé Ntsaa is known in English as Hesperus Mountain, the highest peak in the La Plata subrange of the San Juan Mountains, and is located near Durango, Colorado (Kelley *et al.* 2019:4.7-4 – 4.7-5; Martin *et al.* 2011:7).

Important regional rivers also tie into the Navajo cultural landscape. The four boundary rivers are known generally as Tooh. The rivers include the Rio Grande to the east, the Little Colorado River to the south, the Colorado River and Green River drainages to the west, and the San Juan River to the north (Kelley *et al.* 2019:4.7-6; Martin *et al.* 2011:8). La Jara Creek is a tributary flowing into the Rio Grande; the confluence located northeast of La Jara Canyon, Colorado.

Mountains, rivers, landforms, and other resources are part of Navajo perceptions of traditional cultural properties, or places (TCPs) (Kelley *et al.* 2019:4.7-5 – 4.7-7). The Navajo Nation publication *Significant Traditional Cultural Properties of the Navajo People* describes Navajo TCPs:

> Navajo traditional history tells us that all things were created and placed on the

Figure 7.6. Mount Blanca and the Sangre de Cristo Range as seen from the La Botica site on July 28, 2019; view to the west. (Photograph by Shawn Kelley.)

> earth by the Deities. Navajos revere and consider the earth and universe as sacred. This worldview must be respected in order to begin to understand the sacredness of Navajoland. Gender was created to enable reproduction and life. In this way, the Navajo refer to the environment as male and female - for example, mother earth and father sky, male and female mountains, etc. But within the overall sacredness of the earth and the universe, there are specific places within Navajoland that are considered by Navajo people to be highly sensitive. These regions are subject to Navajo traditional laws which require these specific places to be protected and ideally kept in their pristine context. These locations are sources of power which are used for protection, healing, stability, and the continued existence of harmony/ balance of all Navajo people. Again, these places may or may not exhibit evidence of human activity and may simply be embedded in the landscape [Martin *et al.* 2011:5].

The Navajo Nation has taken part in formal consultation in the San Luis Valley and is a signatory to the San Luis Valley Interagency NAGPRA Memorandum of Agreement with the National Park Service, Bureau of Land Management, U. S. Forest Service, and U. S. Fish and Wildlife Service. They have participated in consultation at the GRSA, including in a traditional use study where they shared extensive information about their cultural connections and use of resources in the San Luis Valley (Kelley *et al.* 2019). Martin and others (2011), White (2005), and Wescott and others (2016) also documented Navajo traditional resource use and ethnohistory of the region. Staff members of the Navajo Nation's Heritage and Historic Preservation Department (NNHHPD) and Tribal Historic Preservation Office (THPO), as well as a hataałii (Navajo singer or medicine person who works with NNHHPD as part of an advisory council for ethnographic studies and other consultations), participated in this project. Mr. Timothy Begay, Traditional Cultural Specialist at NNHHPD; Ms. Tamara Billie, Senior Archaeologist at NNHHPD; and Mr. Emery Begay, Hataałii Advisory Council (HAC) member for NNHHPD, participated in ethnographic fieldwork for the project. The group discussed Navajo ethnohistory, the cultural landscape in the San Luis Valley, interpretation of petroglyphs, and ethnobotanical information. Specific themes included Navajo connections to the San Luis Valley and southern Colorado, the importance of the cultural landscape, landforms such as Sisnaajiní (Mount Blanca) and cultural connectedness, Navajo ethnobotany and natural resource use, interpretation of the petroglyph panels, and interactions and relationships between other Native American groups and Spanish settlers.

The Navajo Nation is the largest reservation in the United States at more than 27,000 mi^2 (70,000 km^2). This includes reservation and trust lands in Arizona, New Mexico, and Utah. The reservation is divided into five agencies consisting of over 110 chapters. The Navajo Nation also owns land in Colorado, including the recent acquisition of portions of the Wolf Springs and Boyer ranches, located just east of the San Luis Valley. The Navajo Nation's headquarters, as well as the NNHHPD and THPO, are in Window Rock, Arizona, approximately 200 miles southwest of La Jara, Colorado.

Navajo representatives have stated that the region and its landforms tie into oral history stories and the origins of multiple ceremonies. In southern Colorado, part of the tapestry of oral history is related to the Warrior Twins, named Naayéé' neezghá (Monster Slayer) and Tóbájíschíní (Born for Water). For example, the Mountain Top Way ceremony that deals with wildlife is associated with Warrior Twins journeys. Oral history ties ceremonies to different ancestral places. These ceremonies are still practiced today. Vital cultural connections are maintained to the places associated with the ceremonies when they are practiced (Kelley *et al.* 2019:4.7-6 – 4.7-9). Navajo ceremonies that were also mentioned include Hózhǫǫjí (Blessing Way), Na'at'oyee (Shooting Way), Iináájií (Life Way), Dziłk'ijí (Mountain Top Way), Níłch'ijí (Wind Way), Tł'ééjí or Yeii bícheii (Night Way), Naayéé'ee (Protection Way or Slaying of Monsters); Anaa'jí (Enemy Way), and Tó'yee (Water Way).

La Botica

The group visited La Botica during July 2019 (figure 7.7). While there, a number of important resources were discussed. The group observed an ice cave and seep or spring located along the edge of the site (figure 7.8). Representatives noted that this was a significant place, in particular because air blew out of it. Moss found growing on the rocks would be used ceremonially as well (figure 7.9). Moss is also used in the center of sand paintings. The ice cave and spring is considered a Navajo TCP. In Navajo, such places are called Níłch'í bíghaan, which means "House of the Wind." Níłch'í diǹe, "Wind People," reside in caves and in the ground and they make wind. Wind People are where prayers and songs come from. In addition, Wind People help distribute seeds, moving them so they can spread to new places. There are different colors of Wind People: black, blue, yellow, white, and striped Wind People. The striped Wind People's air is what we, as humans, and all land creatures, breath. It is oxygen and keeps humans alive and sustained. The place where Wind People live is critical to life.

Multiple ceremonial and medicinal plants were observed and discussed by Navajo representatives. These included a ponderosa pine that is a culturally modified tree (CMT). Navajo practice tree peeling. The Navajo term for ponderosa pine is ńdíshchíí'. The term for peeling ponderosa tree bark is ńdíshchíí'bidadozi, meaning "where the ponderosa was scraped or torn." Generally, the practice of peeling trees is small in scale and usually related to ceremonies. The bark is used for ceremonial purposes and has been discussed during other regional projects consulting with Navajos (Kelley *et al.* 2019). In addition, the group observed a lightning struck tree. Lightning struck trees are culturally significant resources and can be considered TCPs when used by medicine people. Lightning struck trees are important for Navajo ceremony and healing. The group also observed a Douglas fir sapling that appeared to have been chewed by an animal (figure 7.10). The bark of evergreen trees that have been gnawed, or scared by the antlers of deer or elk, are used as livestock medicine.

While at the site the group observed multiple archaeological artifacts. These included ground stone and lithic material (figure 7.11). Noolyínii i—obsidian—was discussed at the site. In northern New Mexico, obsidian usually comes from the Jemez Mountains or the Grants area.

The group discussed overall impressions from the

Figure 7.7. Navajo Nation tribal representatives and ethnographer at La Botica on July 28, 2019. From left to right: Tamara Billie, Emery Begay, Tim Begay, and Shawn Kelley. (Photograph by Shawn Kelley.)

fieldwork and recommendations. Representatives noted the importance that the entire region plays in Navajo oral history, traditions, and cultural practices that continue to occur to this day. Coming to visit sites in ancestral areas, such as La Botica, being in the San Luis Valley and seeing mountains like Sisnaajiní help contextualize these places and their relationships to each other. Through visitation and pilgrimage, they continue to be part of Navajo identity and are connected to where they live today. For example, when driving to visit La Botica, representatives and an ethnographer stopped at a high vantage point to observe Sisnaajiní, Mount Blanca, from across the San Luis Valley (figure 7.6). Sisnaajiní, being one of the four sacred peaks in Navajo, is a critical part of Navajo culture and is a pilgrimage place. When discussing Navajo connections to Sisnaajiní and the surrounding area during a traditional use study at GRSA (Kelley *et al.* 2019:4.7-6), Mr. Tim Begay commented:

> *The relationship is continuous. And for Navajo … we have such a wide land base reservation … it doesn't matter if you're from Eastern Agency or from Western Agency, that connection is still there, so you can be living halfway into Arizona, but you still have that connection to Mount Blanca, and it's in Colorado. And it should be of equal weight as Christianity views Jerusalem, in that same sense. Just because our oral history and our ceremonial history is not written, and it is not black and white, doesn't mean it carries less weight or it's a Peter Pan story or it's folklore.*

Navajo Nation Traditional Use Plants

Over 32 traditional use plant species were observed or discussed by Navajo Nation tribal representatives during fieldwork in the region (appendix C). Representatives noted that a number of plants utilized were observed in La Jara Canyon and at La Botica. The Navajo word for plants is Nanise', which means "to grow" (Dinétahdóó 2005; Mayes and Lacy 1989). The importance of plants is noted in *Navajo Plant Use: An Introduction* (Dinétahdóó Cultural Heritage Education Foundation 2005:2): "We respect all plants because they keep us alive and keep living things healthy." Navajos traditionally use plants based on a variety of cultural and environmental factors. Many different species of plants have ceremonial, medicinal, culinary, domestic or utilitarian, or other uses (Kelley *et al.* 2019:4.7-10). For example, certain combinations of plants are prepared by traditional Navajo medicine practitioners and are given to a patient or are part of ceremonies. In addition to the plants described

Figure 7.8. The "Ice Cave" at La Botica Site, a significant Navajo ethnographic resource on July 26, 2019. (Photograph by Sean O'Meara.)

Figure 7.9. Moss growing on boulders around the "Ice Cave" at the La Botica site on July 26, 2019. (Photograph by Shawn Kelley.)

in appendix C, a number of Navajo traditional use plant species have been previously identified in other projects (Begay and Begay 2002; Bryan and Young 1940; Kelley *et al.* 2019; Mayes and Lacy 1989; Mayes and Rominger 1994; NMSU 2018; Roberts *et al.* 1995). When compared with the modern botanical inventory for La Botica and adjacent areas, which includes 199 species (appendix A), 50 have recorded traditional Navajo uses (table 7.4). The list of plant species reported in this chapter is not exhaustive and additional work is recommended to more fully understand Navajo ethnobotany of the area. In particular, the NNH&HPD recommends that future projects involve multiple hataałii, Navajo herbalists, and weavers. Additional plants found at La Botica may have historic and contemporary importance to Navajo people.

In addition to plants, multiple culturally important animal species were also observed during the visit to La Botica and the La Jara Canyon. This included magpies and beaver. Beaver is known as cha'aa which means "stout" in Navajo. Several magpies were seen on the trip. The feathers of magpies, known as ęę'ą'įį (eéáii) in Navajo, are used ceremonially.

Table 7.4. Navajo traditional use plants found at the La Botica site.

Latin Name	Common Name
Achillea millefolium	yarrow
Achnatherum hymenoides	Indian ricegrass
Allium cernuum	nodding onion
Arctostaphylos uva-ursi	bear berry; kinnikinnick
Artemisia frigida	fringed sage
Artemisia tridentata	big sagebrush
Berberis repens	Oregon grape
Bouteloua gracilis	blue grama grass
Castilleja integra	wholeleaf Indian paintbrush
Cercocarpus montanus	mountain mahogany
Chenopodium spp.	lamb's quarters
Equisetum laevigatum	scouring rush; horsetail
Ericameria nauseosus	rabbitbrush
Eriogonum microthecum	slender buckwheat
Eriogonum racemosum	redroot buckwheat
Erysimum capitatum	western wallflower
Gutierrezia spp.	snakeweed
Heterotheca villosa	hairy golden aster
Humulus lupulus	common hops
Hymenoxys richardsonii	Colorado rubberweed; pingue; owl's claws
Ipomopsis aggregata	scarlet gilia

*Figure 7.10. A damaged Douglas fir (*Pseudotsuga menziesii*) observed at the La Botica site on July 28, 2019. (Photograph by Shawn Kelley.)*

Figure 7.11. Lithics observed by Navajo Nation tribal representatives at the La Botica site on July 28, 2019. (Photograph by Shawn Kelley.)

Table 7.4. Navajo traditional use plants found at the La Botica site (*continued*).

Latin Name	Common Name
Juncus balticus	Baltic rush
Juniperus communis	common juniper
Juniperus scopulorum	Rocky Mountain juniper
Lycium pallida	wolfberry
Mentha arvensis	wild mint
Muhlenbergia spp.	muhly
Opuntia polyacantha	plains prickly pear
Penstemon barbatus	scarlet bugler; beardlip penstemon
Penstemon strictus	Rocky Mountain penstemon
Pinus edulis	piñon pine
Pinus ponderosa	ponderosa pine
Plantago spp.	plantain
Populus angustifolia	narrowleaf cottonwood
Populous tremuloides	aspen
Portulaca oleracea	purslane
Potentilla spp.	cinquefoil
Prunus virginiana	chokecherry
Pseudotsuga menziesii	Douglas fir
Quercus gambelii	gambel oak
Rhus trilobata	three-leaf sumac
Ribes cereum	wax currant
Ribes leptanthum	trumpet gooseberry
Rosa spp.	wild rose
Rosa woodsia	Wood's rose
Salix exigua	sandbar; coyote willow
Symphoricarpos spp.	snowberry
Taraxacum officianale	dandelion
Thalictrum fendleri	meadow rue
Yucca glauca	small soapweed yucca

Hispano Communities

La Jara Canyon, and the La Botica site, constitute an important area for many Hispano families in the region. As discussed previously, there are many places in the region known to some as "La Botica." They are vibrant, bio-diverse systems utilized for their resources including traditional use plants. Some of these areas are adaptively managed over generations by the families and communities that use them. Certain "La Boticas" are sites known only to those that use and care for these places. Such knowledge is kept within families and is passed on through the generations. This project sheds light on this sensitive and revered part of the land and history for the Hispano communities in the region and we do so with the utmost respect in order to preserve these places, their history, and associated lifeways. In this section we discuss traditional and ongoing resource use generally in the region and specifically in the La Jara Canyon.

Detailed discussions of Hispano and Euro-American history of the region are explored in many regional histories, including Athearn (1985), Lopez (2020), and Simmons (1999). The Sangre de Cristo National Heritage Area also provides resources on their website (www.sangreheritage.org/), including oral history interviews with a number of community members. The Hilos Culturales/Cultural Threads website (www.hilosculturales.org) includes links to film modules and information about *El Alba Magazine*, an online publication highlighting Hispano art and culture in southern Colorado.

During 2018, the ethnographers met with a number of community members at their homes and in the field and had phone conversations with many others. A community open house was held at the Parish Hall of Saint Joseph Church in Capulin, Colorado. In addition, dozens of community members were contacted over the phone. Individuals formally consulted for this project include Mr. Avelino Muniz, Ms. Teresa Vigil, Mr. Nelson Paul Martinez and Mr. Pete Vigil. Mr. Dennis Lopez also gave a lecture to the entire project team at the research site. In addition to the interviews and conversations held during 2018, the text in this section also draws on oral history interviews and research conducted in June 2017 for the SLB. This includes interviews with Ms. Andrea Benton Maestas, Mr. Bernal "Tony" Maestas, Ms. Veronica Medina, Mr. Avelino Muniz, Mr. Joseph Valdez, and Ms. Angie Krall.

Regional Hispano Land Use and Early Settlement

During the late Spanish period, there was a growing population in northern New Mexico that was searching for land to expand into along with political interest from the colonial government to settle its northern frontier regions. Land served as a means for persons marginalized by Spanish social institutions to exit from a cycle of exploitation (Gonzales 2014). Among these groups were mestizos, variously described as persons of mixed European and Mexican Indian ancestry or persons of majority Native ancestry, and genízaros, a Christianized population of American Indians (Gonzales 2014; Magnaghi 1990). In many cases, members of the latter group were treated as domestic servants; some settled in remote, northern areas of colonial New Mexico at Abiquiú, Las Trampas, Ranchos de Taos, and Ojo Caliente, where they provided a kind of perimeter defense for the province. Many such persons also leveraged their location and identities to trade with the Utes and other tribes. One notable example includes Andrés Muñiz, a genízaro who was hired to accompany the 1776 Domínguez-Vélez de Escalante expedition as an interpreter. Along with his brother, Lucrecio, a landowner in Ojo Caliente who joined the expedition uninvited, the friars chided Andrés for carrying on an illicit trade along the expedition route (Ebright and Hendricks 2006). While formal distinctions like genízaro and mestizo officially disappeared with the end of Spanish rule (Sánchez 2019), they persisted in the socio-economic fabric of New Mexico as it entered the Mexican Period (1821-1848). Determined to improve their position within the society of northern New Mexico, descendants of both groups comprised the early settlers of the San Luis Valley.

Authorities of the new Mexican republic, like their Spanish predecessors, viewed settlement as a means to create a kind of buffer on their border with Native American tribes that lived and used the area and to protect their imperial interests from U. S. traders, trappers, and explorers who had started to become more prevalent in Taos and Santa Fe and areas to the north. In efforts to set up permanent settlement, the Mexican government gave out land grants in their frontier regions. The first recorded Mexican-era land grant in the area was the Conejos Grant that conveyed land to approximately 50 families in 1842 along the banks of the Conejos River (Athearn 1985:49-50; Simmons 1999).

Seasonal herding was the activity that first brought many families from northern New Mexico to what is today southern Colorado to pasture their sheep during warmer months, expanding their range and flocks as early as the 1830s. In 1848, Ojo Caliente native and Ute interpreter "Tata" Atanasio Trujillo led a group of persons from El Rito to farm blue corn and wheat along the San Antonio River for the brief growing season of that year before planning a return the following year to attempt permanent settlement. However, the San Luis Valley was a core part of Ute and Jicarilla Apache territory and was frequented by other Native American groups already experiencing encroachment from trappers, traders, and other tribes. Expressing great concern for the Navajos, Trujillo nonetheless asked for Ute protection, remarking that "[the Utes] have promised me to defend me from the other Indians who would wish to hinder … the families which are going to settle there" (Trujillo 1976:13). Thomas G. Andrews (2000) has explained Ute support for Trujillo's settlement in the context of the sudden expansion of Anglos into the surrounding region. Unlike the newcomers, the Utes shared significant cultural affinities with the persons in Trujillo's party. However, Hispano families were unable to establish permanent settlement until the American period (Simmons 1999).

The two main events that facilitated permanent settlement of southern Colorado were the cession of the region from Mexico in the Treaty of Guadalupe Hidalgo in 1848 following the U.S. war with Mexico and the subsequent treaty the U. S. government made with the Utes in 1849. Regarded as the first permanent settlement, La Plaza de los Manzanares, later Garcia, Colorado, was populated by 1849 (Tushar 1975). San Luis was incorporated in 1851 and the neighboring towns of San Pedro, San Pablo, and San Acacio took shape around that time (Saenz 2020; Simmons 1999). San Luis retains the first recorded acequia water rights in Colorado with the establishment of the Peoples Ditch in 1852 (Athearn 1985). On the other side of the valley, permanent settlement might have started earlier, but the first permanent settlement of the Conejos Grant occurred with the founding of Guadalupe and Conejos in 1854. Additional settlement followed at Paisaje in 1856 and Las Mesitas in 1857. Capulin, the closest town in proximity to La Botica, was settled in 1857 (Saenz 2020; Simmons 1999; Swadesh 1974).

Many Hispano families moving to the area were from previous frontier areas in northern New Mexico or from settlements adjacent to Pueblos and other American Indian communities, including Abiquiu, Espanola, El Rito, and Taos. Many of these families were of mestizo and genízaro ancestry, possessed Native servants, and engaged in trade with Indigenous peoples. Archeological research at the Trujillo Homesteads National Historic Landmark adjoining GRSA yielded sherds from San Juan Red-on-Tan, Tewa, Taos Micaceous, and possibly Apache pottery (Simmons and Martorano 2007) that was used at the site during the late nineteenth century.

Slavery increased in New Mexico during the Mexican period and continued in what would become Colorado well after the Emancipation Proclamation came into effect. An anti-peonage law issued at the federal level in 1867 attempted to curb the evolution of the practice in New Mexico to avert legal scrutiny after abolition (Kiser 2017). For the San Luis Valley, the list compiled in 1865 by Indian agent Lafayette Head offered a clear picture of how prevalent the practice had become. It contained the names of 148 women and children resident in Conejos and Costilla counties, which then divided the Valley, including large numbers of persons identified as Navajos and Utes, a small number of persons listed as Apaches and Paiutes, and even one person described as "California." More recently, Sánchez (2019) reviewed records for Huérfano, Las Ánimas, and Saguache counties and revisited records for the San Luis Valley to find an additional 238 persons based upon data recorded in the 1870 Census. The practice was pervasive in the region, and imbued descendants of these persons who persist in the region today with a mixed Indo-Hispanic legacy.

A number of community members consulted for this project discussed their mixed Hispano and Native American ancestry. Genealogical connections to Utes, Navajos, Apaches, Comanches, Cheyennes and multiple Pueblos were specifically mentioned.

Regional family histories are examples of settlement patterns in southern Colorado shared by some multi-generational families who continue to live in the region. For example, Ms. Medina related the following in 2017:

> *My grandmother [Rosana Quintana] was living in the San Luis area, outside of San Luis. Her mother, my great-grandmother, lived down in Garcia. I don't know if you've ever heard of the Plaza de los Manzanares down there … She was one of that Manzanares clan that lived in that little plaza down there—my great-grandmother. And then when she married my great-grandfather, they moved to San Luis—well, San Pablo, outside of San Luis—and lived there until she was about sixteen. And then my great-grandfather and his brother were having some feuding, and things were getting kind of hot, so he decided to move to the La Jara Canyon Creek here in our area: Loaded up all his stuff in his wagon, and they moved to the La Jara Creek area … They just bought up some property and moved. And then my grandmother married a local, a Quintana, my grandfather. But she was originally from the San Luis area …*

it goes way back to the late 1600s, like my 14th generation grandfather came up from Mexico City with one of the expeditions—Miguel de Quintana was his name—and settled in the area outside of Española called Santa Cruz de la Cañada … It's kind of by Chimayo. He settled there with one of the expeditions that came up from Mexico City.

When discussing the history of settlement in the region in 2017, Mr. Avelino Muniz gave the following description of his family's settlement in the area, along with other Hispano settlers in the valley that were followed by subsequent waves of predominantly Mormon and Protestant Anglo settlers:

They were in there about the '50s [1850s], and they were moving around. When the Homestead Act came in place, some of the Spanish people knew about it; most of them didn't. Most of them didn't know how to read or write, so they didn't know anything about it. So, they just came and they squatted in this area, and they just kind of stayed there. They didn't have any rights to the land. So, a few of the people, like my great-grandfather, they used to work for judges, lawyers, so he could learn how to read and write. After they came back and he re-settled up over here, above Capulin here, it was by the La Jara Reservoir. That's where they homesteaded. He was taking a lot of the people from around here to file on their land, and they didn't even know where Del Norte was, and that's where you had to go to file for your land, for that homestead. And a lot of people had been living on the land for a while, but they didn't know what to do, they didn't know where to go, nobody would tell them. So, he took a lot of the people up there, and they filed for the land and saved it. Consequently, a lot of the other people, that nobody was taking them up there, they didn't know how to get there, they just didn't know what to do, they ended up losing their land. And a lot of them lost that land in about the 1880s when the Mormons came in. And the Mormons knew about it, and they moved in the wintertime, most of them around Las Mesitas and Manassa, back in that area. And these people had been in there for about forty years, so they had that land pretty well cleaned up and they were farming it. And then that next spring, they went up into Del Norte, and they filed on that land and come and kicked them out. Damnedest thing you ever seen, and it's in the Mormon history book of what happened, and how they ended up in that land … about that time the Protestants were moving into the Antonito area, and they were moving around Del Norte, they were moving around a lot, and their first priority was education. In fact, in Del Norte they had what they called a university. So, it was interesting how their priorities were just totally different.

The activities that were occurring on the land included grazing, agriculture, hunting, and gathering wild plants. Historically, a major activity was sheep herding. As discussed previously, sheep herding was one of the first activities that brought many people to the region. During his interview in 2017, Mr. Muniz discussed how important the region has been for sheep herding. In his comments he talks about the history of sheep herding and the changes over the years:

So, we had people in this area who had a lot of sheep. There was no place to sell them, so they just kept accumulating sheep … They were carding some wool. The sheep didn't have that much wool. It's a different kind of sheep. They only had a little bit of wool on top of their back, so it wasn't the wool sheep, it was just kind of a meat kind of sheep … They used to call them the Indian breed, because they were just kind of real small sheep. But they just couldn't sell them, there was no place to sell them. The only time that they could sell those things was after the 1880s when the mines came in, and the miners came in. And then they would herd those sheep up to the mines, and they would sell those sheep to the miners … That's the only time that they had the opportunity to sell sheep. Until then, they were just accumulating sheep.

… it's really interesting how that happened.

> *There were big sheepmen in this country. Some of them had 15,000-20,000 head of sheep. But they didn't know what to do, until they could get somebody that would pay them for it.*
>
> *… This country was made with sheep. I mean there was lots of sheep, and everybody in this country at one time, that's what it was. And then back during the war [World War II], into '45, the United States government was buying sheep, mutton, and lamb. And they were using the meat to feed the soldiers. They were using the wool to make the blankets, the clothing for the soldiers, and they were using the fat that they rendered off those sheep to pack the bullets in their cases, so they could ship those bullets all over the country, and they would not rattle …*
>
> *… And then after the war, since the government stopped buying the sheep, a lot of them decided—well, a lot of people started coming in here with cows. So, they decided, "We'll be cowboys. We'll go out and buy us a cowboy hat and some boots and we'll cowboy." But they tried to run those cows like they were running sheep, on almost nothing. That didn't work, so we had a lot of people who just went broke after that. And that happened back around the '50s.*

Although the majority of sheep herding has died out, there are a few families in the valley that continue to run sheep and a number who also graze cattle. The range that sheep herders used for their sheep was once vast. One individual recounted how their grandfather would take sheep from La Jara Canyon all the way to the Pagosa Springs area in the summers.

Community members described how many families who were living in La Jara Canyon started leaving during the depression, a trend of selling land and abandonment that continued until the 1950s and 1960s when most families living in the canyon had moved out, especially from the upper reaches of La Jara Canyon. Of those families that stayed in the region, many moved from La Jara Canyon to Capulin, La Jara, and Alamosa. Waddell and Martinez (2020) have recently connected this process of migration to a practice of discriminatory lending, which forced many families to sell their land because they were unable to secure loans that would have otherwise allowed them to make improvements on existing property or purchase adjoining land. Some residents retained ownership of lands that they continue to use for ranching and some farming. In recent decades, however, some people, mostly from outside of the region, have started moving back into La Jara Canyon.

Traditional Resource Use in La Jara Canyon

A number of community members discussed the importance of multiple natural resources found in and around La Jara Canyon. La Jara Canyon has a long history of use by residents of the region from the communities of Capulin, La Jara, Antonito, Conejos, Mogote and others. Use of the canyon includes plant collection, animal grazing, farming, hunting, fishing, recreation, and—historically—sheep herding. Family homesteads also occurred in the canyon.

For example, during an interview Veronica Medina discussed the importance of La Jara Canyon for her family and her grandmother's use of traditional plants. Ms. Medina's grandmother, Rosanna Quintana, was interviewed in the early 1980s about her medicinal plant knowledge and resource use. When relating the history of her grandmother and their families tied to La Jara Canyon to Mr. Kelley during 2017, Ms. Medina related the following:

> VM: *Her name was Rosanna Quintana, and she grew up in that area of La Jara Creek, that whole area. She moved there when she was sixteen, with her family … Canyon de La Jara is what they called it, La Jara Canyon … It was probably where the little bridge is. Right in that area.*
>
> SK: *I understand there were quite a few other families [living there in La Jara Canyon].*
>
> VM: *Yes, quite the little township there. And they would come in their buggies, into town, to shop. They'd come in their horse-and-buggies. They would hunt in that area. That was before needing licenses, so they if needed meat, they would just go out and shoot a deer ... elk and deer … They did go hunting down there quite a bit. During*

> *the hunting season, they still hunt … And fishing ... And I would go with my mother, fishing, down in that area. My father hunted in that area where the White Cliffs … the Peñasco [Blanco] … that's where my father used to do a lot of hunting in that area—and grandfather … we would go down there and picnic. There's a lot of rattlesnakes down there, so we kind of steered, had to … My mother would always warn us, "Be careful with the rattlesnakes!" So, we would go, but only certain seasons. Rabbit hunting, did a lot of rabbit hunting down there.*

Ms. Medina also related that her family would collect piñon nuts when in season, along with other activities in the canyon.

Summary of Field Visits and Discussion of La Jara Canyon

During June 2018, Mr. Kelley met with Mr. Muniz at his ranch and small orchard located south of Capulin along La Jara Creek. Mr. Muniz noted that the area was what would be called in Spanish el ancon, or a beach. It was not fenced until the 1980s. Mr. Muniz shared detailed information about his property and La Jara Canyon. Mr. Muniz explained during a previous interview in 2017 with Mr. Kelley about how he negotiated the purchase of the property when he was 13 years old:

> *My grandfather was Augustin. As we were going by, they came out and stopped us going down the road, and they said, "Hey, why don't you buy this land from us? We're going to leave, we're going to go to Oregon." … So, on the way back home, it was about twelve miles, Grandpa and I had a pretty good argument, and I kept telling Grandpa, "We have to buy that land. We have to buy that land. It's right next to us. We have to buy that land!" So, by the time we got over here—I was thirteen years old, I was driving the pickup for him—so he tells me, "You go back over there and buy that land, and if you get cheated, it's your life." O.K., off I went back. So, then I come back and I told Grandpa, "I bought the land." He said, "What did you give for it?" It was 240 acres I bought, and I told him, "I have to take those people six old butcher ewes and $35." And he said, "What?! Are you sure that's what it is?" "Yeah." So, we always had a pen of old ewes that we used to use for … There was about ten of us in the family there, all kinds of grandkids that he was raising. He said, "Let's load them." We went and loaded six old ewes, and we took off. Got over there and he [asks them], "Did you guys make a deal with him?" And they said, "Yeah, we made a deal with him." And he said, "Are you going to honor that deal?" They said, "Yes." He said, "What's the deal?" "He owes us six old ewes and $35." And Grandpa says, "That pays for everything?" "That pays for everything." And he said, "O.K., there's the six old ewes there, here's the $35. We'll pick you guys up tomorrow, we'll go to the courthouse, we'll get the papers signed." And they said, "That's fine," because they wanted to leave. So, the next day we show up, and Grandpa used to have a Lincoln, so we show up and I'm driving that Lincoln up that dirt road. (laughs) He said, "O.K., I want to get on. Let's go get those papers signed." So, this one guy was there, he said he was married to the one Muñoz lady, and he said, "No, no, he doesn't have a driver's license. We could get caught. We don't want to get caught." And Grandpa said, "Well, O.K., you drive. You've got a driver's license?" "Yeah." "O.K., you drive. He'll sit there with you in the front there to make sure you're driving right." (chuckles) So, here we go to the courthouse. We got the deal done. That was 1953. It's four miles past Dominguez Crossing, once you pass the creek.*

Mr. Muniz showed Mr. Kelley around his homesite that was previously owned by the Muñoz family. This included the location of multiple former habitation sites and architecture in the vicinity (figure 7.12). On the east bank of La Jara Creek there is a foundation and the archaeological remains of a cellar that Mr. Muniz related a story about how this place got the name of La Botica due to "white lightning bottles" that were kept there by a former resident, whose name is not known:

> *... everybody else had pretty much pigs*

Figure 7.12. Mr. Muniz discussing his homesite in La Jara Canyon on June 8, 2018. (Photograph by Shawn Kelley.)

> *or a few sheep or things like that. In the summertime the woman had to pull weeds to feed the pigs, and I guess, according to him [Amarante Ruybal], those pigs were just nothing but razorbacks—skinny. He said, "Oh my God, ugly old things. You've never seen such ugly pigs." But then in the wintertime, they'd turn them loose on that piece [of land], and he said by the springtime those things were just really fat … Yeah, and then they'd haul them, load them on wagons, and take them to Alamosa and sell them. He said that's where the botica comes in place now …*
>
> *… botica is right next to my place, that's where it is … It's on the east side of the [La Jara] Creek, in the bottom, right next to the creek … way before the bend in the river. And the old man, he's the first one that had a Model A up over there, and there's Model A parts all over the place. Evidently when something broke down, they'd just tear it apart. So, in the fall time, they would load up all those pigs, and they'd take them to Alamosa. Then when he'd come back, he would go into his little root cellar there. Now this is a regular root cellar, probably 12 by 10 [feet] or something like that. And he would go in there, and everybody thought, "Hey, that's where he's sticking his money. He's sticking his money in there to hide it." Well, it wasn't the money, it was the white lightning that he was taking in there. And he had bottles of it, and he hauled a whole bunch of bottles in there, and that's what kept him going for a whole year. (laughs) So that went on for years and years, and then when he died, all of his relations, the first thing they did was go in there and dig that thing up. Well, that's all they found, was bottles in there … And that's what they called "the botica." (laughs) Everybody thought they were going to come out with a lot of money, and that's all they found, was old empty bottles. (laughs)*

According to Mr. Muniz the entire area around the cellar was known as "La Botica." Mr. Muniz remembered conversations with Mr. Amarante Ruybal, who was a sheep herder who spent years in the canyon dating back to the early twentieth century. Mr. Amarante Ruybal, collected edible and medicinal plants, including many that grew at the location where Mr. Muniz owns his ranch. A number of medicinal plants were in this area until the 1980s. Mr. Muniz noted that from conversations with other community members a number of people collected the plants in the area. Mr. Muniz was not sure who owned the property prior to the Muñoz family, from whom he purchased the property in the early 1950s. Mr. Muniz describes what he learned from Mr. Amarante Ruybal about traditional plant use at his ranch in the following excerpt from a 2017 interview:

> *Where all the medicinal plants were, is in that place that I have. And there was all kinds of herbs in that place. And they had planted them really neat. There's areas in there where they had big spots of plants, you know. So, when I started taking care of that place, to me they didn't mean anything, I didn't know what they were for ... And then one day Mr. [Amarante] Ruybal comes and he says, "Hey, I'm going to look for some …" They used to call it like lamb's quarters. They called that calites and they used to use that as spinach, and that's what they used to come pick. There was this other one that had round leaves, and they called them ... Sleepies! They called them sleepies, dormilones ... They had really planted a lot of herbs in that place, those people ... I think it was probably part of the Munoz family that used to live there before we did. He said [Mr. Amarante Ruybal], "… People for years have planted stuff in there, and everybody used to come and get their herbs from them."*

After looking at Mr. Muniz's property, Mr. Kelley and Mr. Muniz embarked on a driving tour of La Jara Canyon, visiting a number of sites. Mr. Muniz described some of the families who lived in the canyon and the activities that used to occur in La Jara Canyon. For example, just below the La Botica site, Mr. Muniz identified the location of a sawmill (figure 7.13) owned by a "French" family; however, he was unsure of their last name, and according to other community members were referred as "Los Frances:"

> *There used to be a sawmill up in there. French people had a sawmill back in there, right at that curve … They logged that country for several years, and that's who it was. The Game and Fish ended up with that property now … It was on the northwest side of the creek. And they used to hire a lot of people. Did you notice, before you got to that cattle guard [Cañon del Rancho], that there's some writings [inscriptions on the rock cliff] ... Well those people used to work for them, used to be camped down in there. That's what they used to spend their time doing, writing their names up in there. [SK: At Cañon del Rancho?] ... Yeah. And that's where they were at. And then there were a lot of other people living in that area, but they never had possession of the land.*

When Mr. Muniz was asked about his knowledge of the location of the La Botica site, he responded that he understood it was called Los Alamitos ("Little Cottonwoods," referring to aspen trees that grow there). This is a place name used by other community members as well. According to Mr. Muniz, Tobias and Asciclo Gonzalez used to run sheep on the mesa lands above the La Botica site. Mr. Muniz also commented that the Quinlan family ran cattle in the area above the site.

During August 2018, Mr. Kelley met with Mr. Paul Nelson Martinez in Capulin, Colorado. They commenced a driving tour of La Jara Canyon to visit the area around La Botica and see the former homesite of Mr. Martinez's grandparents. A hike into La Botica proper was not possible due to a looming thunderstorm. Mr. Martinez related that his grandparents Alfonso Dominguez and Ralfaelita Dominguez (nee Trujillo) settled in La Jara Canyon sometime in the early 1900s. They had a place a little bit west of La Botica, just before the first water crossing of the road after the bend in La Jara Creek, where the creek turns east-west. It is located below white cliffs (not as far west as the "Peñasco Blanco" area), on the north side of La Jara Creek. The homesite was just north of where the road is today, just before the water crossing of La Jara Creek (figure 7.14).

Mr. Martinez's grandfather also made an ojito, a "little spring" or "water hole," just west of the first water crossing of La Jara Creek. The ojito is located just north of the road, along with a small canal that was used for conveying water for their homesite (figure 7.15). The buildings have not been standing in over 60 years, but Mr. Martinez went to the area with his mother and other family members. Mr. Martinez noted that his grandmother later lived in multiple locations in La Jara Canyon over the years before moving into Capulin. His grandparents also operated a sawmill on

Figure 7.13. The location of the historic "French Family" sawmill in La Jara Canyon on June 8, 2018. (Photograph by Shawn Kelley.)

Figure 7.14. Mr. Martinez at the approximate location of his grandmother's former homesite near the water crossing of La Jara Creek on August 25, 2018. (Photograph by Shawn Kelley.)

top of Don Ysidro Mesa, located across the canyon to the north and west of La Botica. The family would cut lumber from the mesa. The sawmill was accessible via a road that traverses up Canon de los Ranchos. Mr. Martinez recalled his grandmother telling a story of coming back on the road to the sawmill in a wagon and the wagon lost control and the family had to jump from the wagon just before it crashed and rolled. Mr. Martinez shared that his grandmother Rafaelita was a curandera and she used to go to La Botica to collect plants; however, he does not remember which ones. Mr. Martinez also recalled visiting La Botica with his father to collect a fern-like plant that was used to cure stomach ailments. Mr. Martinez pointed out multiple plants that are traditionally used, including cedar, sumac, and currants (figure 7.16).

Many community members discussed going into the canyon for different resources including hunting, fishing and collecting. They also related that visiting the canyon is a way of teaching younger generations in the community about the place and its history.

Hispano Community Traditional Use Plants

Areas such as La Botica, La Jara Canyon, and other commons in the San Luis Valley are important to local community health, subsistence, and connection to the landscape. The information in this section comes from San Luis Valley community members consulted

Figure 7.15. The historic ojito used for conveying water to Mr. Martinez's family homesite on August 25, 3018. (Photograph by Shawn Kelley.)

during this project related to La Botica. Wild plant use remains a strong part of the culture and helps maintain diet and health. This is well illustrated by Ms. Teresa Vigil when she read her story about her grandmother and the importance of quelites or wild spinach, entitled "El Quelite:"

> *Quelite is lamb's quarters … People mostly think it's just a weed. But for us it was necessary and like my little story, I'd rather read you the little story because it tells it all. And in the story, it's my mother's name, Manuelita. In the story, it's trying to tell us that we are still connecting to our ancestors because this is what they survived on … And the story is called "El Quelite." And it's a little old lady that has a yearning to taste that fresh thing, coming, waiting for spring … She goes. "Quiero hallar un fresco quelita," said Manuelita in the early spring. Quelita, lambs' quarters, was the prize of the search. The wild spinach of the village. It was considered almost sacred as the cold winter lacked fresh farm-made produce. It meant new life. Nourishment. Every cook had a special way of preparing it. As spring went into early summer, the*

*Figure 7.16. Mr. Martinez discussing traditional uses of currants (*Ribes *spp.) in La Jara Canyon on August 25, 2018. (Photograph by Shawn Kelley.)*

> *children and adults were gathering the tasty leaves to dry for the winter. Certain greens were gathered, dried, and put into recycled four sacks. In the winter when the greens were needed, the dried leaves were placed in tepid water and new life came to the wild spinach. It was then cooked and enjoyed. People who were productive knew they must gather quelites to appreciate the gifts of spring during the long cold winter. Manuelita now walked along the dry garden. An earthy fragrance of onion reached her nose. She was elderly now and did not move too fast or bend easily. She took a long stick and poked the ground until an onion came up. It had remained in the warm ground waiting for spring. She pushed away the dry leaves and the weed and suddenly she saw a bright green quelite. And then a few more. Manuelita bent down carefully and gathered a small bag of the wild spinach. She clutched them tightly to her chest as if the plant were a precious child. In the kitchen she cleaned the quelites to cook and said, "Oh, how delicious this will be." Out came a piece of salted pork that was now chopped with the onion. Next, they were sautéed until translucent, slightly crisp, and then the quelites were added. The wonderful aroma made her feel young again. She danced a gentle whirl around the kitchen. "Ay, que delicioso." Her humble little bowl of quelites disappeared and folded into her warm tortillas. Manuelita was satisfied. "Ay, que buen dia, gracias senor." So that's a quelite.*

The practice of harvesting wild plants was more prevalent among earlier generations. However, there are a number of families that continue to pass this information along and find it critical to teach younger generations this part of their history and culture. To understand how knowledge transmission occurred in previous generations, Mr. Kelley (SK) asked Ms. Medina (VM) about how she thought information was passed down in her family through the generations and about when her grandmother, Ms. Rosana Quintana, would have learned about plants:

> VM: *Her mother probably used them, and her grandmother, and just down through the generations they passed that lore down of the herbal remedies. And she used to use a lot of massage therapy to cure. You know, like if somebody was impacted, had bowel impactions, she would massage the stomach area to relieve them of that. Well, back then, they couldn't afford to go see a doctor, so they had to take care of things themselves...*
>
> SK: *And do you have any stories about how some of that information was passed on, or any stories that stick in your mind from your grandmother?*
>
> VM: *Just that she would always be boiling up her things, her teas or whatever they were. She passed it down to my mother and my aunts, but they never used them, they never believed in them for some reason. So, it kind of got lost with the generation above myself—my mother, my aunts. I know my mother said she didn't quite believe that they would work, which is unfortunate. But I worked with the elderly, and I was a case manager, a long-term care case manager, and a lot of the elderly that I worked with in the Antonito, La Jara, Conejos County area, still used a lot of these remedies. They still believed in them—the elderly. But I think now, with this generation, the Baby Boomer generation, probably it's gone, it's going to be gone …*
>
> SK: *... did you ever go out and collect with either your grandmother or mother?*
>
> VM: *I never did, never did. She always had her little bags of stuff, but she knew where to get them. And I think a lot of times she wanted to keep it a secret, so she had her own little, like botica, go in her own little … She knew what area to go get her osha.*

When asked about La Botica during the interview, Ms. Medina conveyed that families had specific places they went to gather and there were likely multiple "la boticas." The prior passage relates the importance of traditional resources to the community, especially in earlier times when access to modern healthcare and stores was not readily available. The discussion also demonstrates the concept that multiple areas within places like La Jara Canyon were relied upon for traditional plant harvesting.

When discussing the importance of traditional plants to the community, Ms. Teresa Vigil responded with an explanation that weaves together Native American and Hispano understanding of plants and how the spiritual belief in plants is an important part of their use and effectiveness:

> *... when the Native [Americans] traveled around, they were very conscious of that and so they tried to use what was in their midst ... and some people would say, "I don't do anything except osha." They're so, the belief is so strong. Or, "I don't do anything except yerba buena." You know? Everybody has their favorite or something that agrees with them. So yeah, they definitely gathered things like that …*
>
> *... If you were going to birth, it was raspberry leaf with something else. That kind of thing. If you got a snake bite, a lot of people believed in osha. I heard the sheep herder tell me, in herding sheep he got bit by a snake and there was a plant growing right near there and he cut it open and was able to put that on it and saved his life. Well, you hear stories of hunters who would put them around their shoes to ward off the snakes. And I wondered why grandma had it around the house … they believed that the snake don't like the smell or something or it may be a folklore kind of thing ... But they used to do that. But there was just so many different remedies …*

Ms. Vigil also described how in working in a clinical setting with patients recovering from substance abuse issues, the nurses and staff would introduce elements of therapy that included being outside, taking patients to gardens and serving them traditional foods. This helped patients heal through connecting them to their past, family memories, and to their communities.

Table 7.5 is a list of 39 plants discussed during interviews and field visits with individuals across the valley (see appendix D). It is not an exhaustive list, but represents the plants discussed. Many plants in addition to those discussed in this chapter are likely utilized (Bye and Linares 1986).

Table 7.5. Hispano traditional use plants found at the La Botica site.

Latin Name	Common Name
Achillea millefolium	yarrow
Alcea spp.	hollyhock
Artemisia tridentata	big sagebrush
Asparagus officinalis	asparagus
Cahomilla recutita	chamomile
Cercocarpus montanus	mountain mahogany
Chenopodium spp.	lamb's quarters
Echinocereus triglochidiatus	scarlet hedgehog cactus
Ephedra spp.	joint fir
Fragaria spp.	wild strawberry
Grindelia spp.	gumweed
Juniperus monosperma	one-seed juniper
Lavandula spp.	lavender
Levisticum officinale	oshá; European lovage
Ligusticum porteri	oshá
Mentha spp.	wint
Mentha pulegium	pennyroyal
Nicotiana attenuate.	wild tobacco
Opuntia polyacantha	plains prickly pear
Pinus edulis	piñon pine
Pinus ponderosa	ponderosa pine
Populus spp.	cottonwood
Portulaca oleracea	purslane
Prunus virginiana	chokecherry
Rhus trilobata	three-leaf sumac
Ribes spp.	currant
Ribes leptanthum	trumpet gooseberry
Rosa woodsia	Wood's rose
Rudbeckia ampla	cutleaf coneflower
Sambucus spp.	elderberry
Sphaeralcea coccinea	scarlet globemallow
Syringa spp.	lilac
Tanacetum spp.	tansy
Taraxacum officianale	dandelion
Thelesperma spp.	cota
Verbascum Thapsus	mullein
Yucca spp.	yucca
Zea maize	corn

Summary and Conclusions

La Botica presents an exceptional instance of shared Indigenous and Hispano cultural practices surrounding the use of wild plant life and the management of a natural landscape. Many local families have lived in the region for multiple generations, spanning back as far as the mid-

1800s. Permanent settlement of the region during the nineteenth century by persons who were the descendants of Native Americans points to significant overlaps in terms of usage and understanding of the site among Indigenous and Hispano communities. Their descendants continue to use the La Jara Canyon for important cultural practices such as plant collecting, hunting, and fishing. Some own property where they practice agriculture. It is a location they take younger generations to learn about place and develop a closer connection to family history and identity.

Our research found that La Botica and La Jara Canyon continue to hold significance for those communities we interviewed. For the Native American representatives, their visit to the site allowed them to physically reconnect with the place and they immediately were drawn to the abundance of wild plants that continue to play an important role in their culture today. La Botica is representative of a place where land stewardship continued even as the demographics and land use patterns have changed. As evidenced by the site's current protections, La Botica continues to inspire a conservation ethic in those who encounter it. As Angie Krall, formerly Heritage Program Manager for the Rio Grande National Forest summarized in 2017:

> *A lot of that history for Hispano people was learning from the Indigenous who came before, and who actually, in many cases in the south part of the Valley, married in. There were Utes and Apaches that married in, so there's a lot of Indigenous blood that flows through the veins of the people in the south Valley, because these folks have been here for upwards of seven generations now, and their really unique populations speak a dialect of Spanish that's really different—lots of words here that don't exist anywhere else in the Spanish world. I mean, there's a lot of people who may not want to speak about it—it's a really sacred place.*

During the research for this project, it became clear that La Botica, and other significant resources in La Jara Canyon are important and should be protected. To better understand the site, representatives who attended fieldwork recommend having additional visits with consulting communities such as the northern Pueblos and additional San Luis Valley community members who were unable to participate in the study. The unique topography, habitat and history of La Botica make it an ideal location to teach younger generations about their culture and these places. Ms. Atencio shared these thoughts about what she'd like her children, grandchildren, and future generations to know about La Botica:

> *I'd like them to be able to come out here, and to be able to see evidence of our people being here, instead of it being chopped down or turned into a recreational area or seeing those sherds and people picking them up. I'd like to see them managed by protection, or being able to come out so they can visit, so that way they know that reservation life isn't the only places that we were at ... I want my grandkids, and those ones that haven't been born yet, to know, and that way they understand who they are and where they came from, and they're not tied to just that place [the reservation], that we were all over—especially in this area, that we were here a lot. Other tribes may say that, but for us Ute people, we always say this is our home, this is our land, this is where we came from. We don't talk about moving around, we say, "We came from that Valley. We came from the San Luis Valley, we came from the Front Range, that's where we lived." Other tribes say that they came through or they came up, but we know that we lived here, our stories tell us that. And so that's what I want them to know, so that way when they come here, they're able to come and visit, and they're able to come and pick [plants], and they're able to see it, and maybe they might get something out of it too.*
>
> *And maybe we might be able to come around, to visit with the trees and with these ponderosas, and bring the [youth] out here as a group ... Maybe [we could pick a ponderosa out somewhere in the San Luis Valley and utilize it the way we use to] do it at that time of year and document it. That way it keeps it going, alive, and keeps it alive, and keeps us alive, and keeps our identity, that [it is] one more thing that's not forgotten. And I want them to know that, so that way they know this place, so that*

way our footprints aren't erased. Too many times, you know, it talks about that in our creation story, having to defend our land and defend about who we are, and about where we were at ... It ... talks about that by saying that we were of the mountains, and the other tribes were going to be a thorn in our side, and that we would have to fight. And that's how I think about these things today, is that now we're fighting for our own kids to know it ... To re-put our footstep down, and to make sure that our footprints are not forgotten. And that's part of what I do at my job, what I want to do is that I'm here to make sure that our footprints aren't erased, that we're remembered [as Utes], that they know that ... And ... for me, being Ute, that's who I think about and how I see this place as being Ute land, Núuchiu Tʉvʉpʉ.

La Botica is also a site of converging cultures and interactions. The local community and associated tribes are in the best position to articulate these intangible values and should be the leaders in interpreting, celebrating, and protecting La Botica in the years to come.

In Memoriam

Mr. Alden Naranjo, Jr. (1941-2020) was a Southern Ute tribal member and was active for decades in preserving and educating about Ute history and culture in the San Luis Valley and around the world. He grew up in Ignacio, attended the Ute Vocational School, graduated from St. Catherine's Indian School in Santa Fe, New Mexico, and attended Merritt College in California. Alden enlisted in the U. S. Army during the Vietnam War. Over his 40 years working for the tribe, Alden spent 20 years as Native American Graves Protection and Repatriation Act (NAGPRA) Coordinator, 16 years as a police officer, two years working for the Division of Wildlife and two years as a probation officer as well as a historian. He was a member of Keepers of the Treasures, which predated NAGPRA. He was a spiritual leader for many tribal members and throughout the world. He traveled the State of Colorado and the world advocating and educating about Native American culture, spirituality, and rights. He was the President of the Native American Church of the Southern Ute Indian Reservation and the U. S. chapters. Alden was a traditional dancer, a Sun Dancer and participant of his spirituality. Alden's lineage includes Chief Buckskin Charley, Edwin Cloud, and Samuel Burch.

Mr. Alden Naranjo, Jr. near Great Sand Dunes National Park and Preserve. (Photo courtesy Fred Bunch.)

Endnote

[1] Indented, italicized text represents transcribed comments provided by cultural advisors, elders, and tribal representatives.

Acknowledgements. This chapter was made possible with the partnership, participation, and assistance of many great people and organizations. This study was made possible by the Colorado State Land Board, and in particular Mindy Gottsegen; the Sangre de Cristo National Heritage Area; History Colorado; Mark Mitchell, Chris Johnston and all the staff and volunteers of PCRG; as well as fellow researchers Kristy Duran, Marilyn Martorano, and Kelly Kindscher.

The stories told here are from the Native American and local communities that hold this special place as sacred land, and we thank them for all sharing. In addition to those named in the chapter we would also like to thank: Manuel Chacon, Julia Chacon, Joe

Vieira, Ernest Valdez, Thomas and Joann Ruybal and family, Reyes Garcia, Ray Valdez, Dee Ann Espinoza, Chris Ortiz, Virginia Simmons, and Arnie Valdez. We would also like to thank Vivian Rivera and Saint Joseph's Catholic Church and Parish for hosting our community meetings and announcing our project in their newsletter. In addition to the Native partners mentioned in the chapter we would like to sincerely thank Ms. Shelly Thompson, Cultural Preservation Director of the Southern Ute Indian Tribe; Mr. Richard Begay, Tribal Historic Preservation Officer, Navajo Nation Heritage and Historic Preservation Division; Bryan Vigil, Former President of the Jicarilla Apache Nation Culture Committee; Maureen Olson, Member of the Jicarilla Apache Nation Tribal Historic Preservation Office Advisory Board, Vernon Petago, Former Director of the Jicarilla Apache Nation Cultural Affairs Department; and Dr. Jeffery Blythe, Jicarilla Apache Nation Tribal Historic Preservation Officer. Although not able to participate during the fieldwork we would like to thank the Ute Mountain Ute Tribe, Pueblo of Santa Clara, and Pueblo of Taos for their interest and dialogue. We would also like to thank our federal agency partners: Fred Bunch, Andrew Valdez, Kathy Faz, and Dewane Mosher at Great Sand Dunes National Park and Preserve; Angie Krall and Marcy Reiser at the U. S. Forest Service, Rio Grande National Forest; and Marvin Goad at the Bureau of Land Management, San Luis Valley Field Office. We recognize there are many other Native American communities and local community members that have connections to La Botica.

References Cited

American Anthropological Association [AAA]
2012 AAA Principles of Professional Responsibility. Electronic resource, https://www.americananthro.org/LearnAndTeach/Content.aspx?ItemNumber=22869, accessed June 15, 2020.

Andrews, Thomas G.
2000 Tata Atanasio Trujillo's Unlikely Tale of Utes, Nuevomexicanos, and the Settling of the Colorado's San Luis Valley. *New Mexico Historical Review* 75(1):4-42.

Athearn, Frederic J.
1985 *Land of Contrast: History of Southeast Colorado*. Cultural Resources Series 17. Bureau of Land Management, Denver, Colorado.

Begay, Richard M. and Steve Begay
2003 *Nihikéyah Nahazʼá: Our Place in This Land*. Navajo Nation Historic Preservation Department, Window Rock, Arizona.

Bryan, Nonabah G., and Stella Young
1940 *Navajo Native Dyes: Their Preparation and Use*. U. S. Department of the Interior, Bureau of Indian Affairs Education Division. Chilocco Indian Agricultural School, Chilocco, Oklahoma.

Beeton, Maxwell, Charles Nicholas Saenz, and Benjamin James Waddell (Editors)
2020 *The Geology, Ecology, and Human History of the San Luis Valley*. University Press of Colorado, Louisville.

Chamberlin, Ralph V.
1909 Some Plant Names of the Ute Indians. *American Anthropologist* 11(1):27–40.

Chapoose, Betsy, Sally McBeth, Sally Crum, and Aline La Forge
2012 Planting A Seed: Ute Ethnobotany, A Collaborative Approach in Applied Anthropology. *The Applied Anthropologist* 32(1):2–11.

Cobos, Ruben
2003 *A Dictionary of New Mexico and Southern Colorado Spanish*. Museum of New Mexico Press, Santa Fe.

Dinétahdóó
2005 *Navajo Plan Use: An Introduction*. Dinétahdóó Cultural Heritage Education, Upper Fruitland, New Mexico.

Duran, Kristy L.
2020 Plants and Ethnobotany of the San Luis Valley. In *The Geology, Ecology and Human History of the San Luis Valley*, edited by Jared M. Beeton, Charles N. Saenz, and Benjamin J. Waddell, pp. 336–367. University Press of Colorado, Louisville.

Ebright, Malcolm, and Rick Hendricks
2006 *The Witches of Abiquiú: The Governor, the Priest, the Genízaro Indians, and the Devil*. University of New Mexico Press, Albuquerque.

Elmore, Francis H.
1944 Ethnobotany of the Navajo. Monograph of the University of New Mexico and the School of American Research Number 8. School of American Research, Santa Fe, NM.

Givón, Thomas
2011 *Ute Reference and Grammar*. John Benjamins Publishing, Philadelphia.
2013a *Ute Dictionary*. John Benjamins Publishing, Philadelphia.
2013b *Ute Texts*. John Benjamins Publishing, Philadelphia.

Gonzales, Moises
2014 The Genizaro Land Grant Settlements of New Mexico. *Journal of the Southwest* 56(4):583-602.

Hopkins, Maren P., Barry Price Steinbrecher, Michael C. Spears, and T.J. Ferguson.
2020 *Ethnographic Overview of Chimney Rock*

National Monument, San Juan National Forest, Colorado. Anthropological Research, LLC, Tucson, Arizona. Submitted to Paleocultural Research Group, Broomfield, Colorado, and the San Juan National Forest, Durango, Colorado.

Jefferson, James, Robert Delaney, and Gregory C. Thompson
1972 *The Southern Utes: A Tribal History*. Edited by Floyd A. O'Neil. Southern Ute Indian Tribe, Ignacio, Colorado.

Kappler, Charles J.
1904 *Indian Affairs Laws and Treaties: Volume II, Treaties*. U. S. Government Printing Office ,Washington, D. C.

Kelley, Shawn, and Sean O'Meara
2016 *Capulin Volcano National Monument: Ethnographic Overview and Assessment*. Parametrix, Albuquerque, New Mexico.

Kelley, Shawn, Sean O'Meara, Damon Hill, and Karen Koestner
2017 *U. S. Air Force Academy Ethnographic and Ethnobotanical Survey*. Parametrix, Albuquerque, New Mexico.

Kelley, Shawn, Sean O'Meara, Damon Hill, and Marilyn Martorano
2019 *Traditional Use Study for Great Sand Dunes National Park and Preserve*. Parametrix, Albuquerque, New Mexico.

Kiser, William S.
2017 *Borderlands of Slavery: The Struggle over Captivity and Peonage in the American Southwest*. University of Pennsylvania Press, Philadelphia.

Lopez, Dennis
2020 The Spanish Dialect of the Upper Rio Grande Region. Electronic resources, https://www.sangreheritage.org/oral-histories, accessed June 18, 2020.

Lyman, June, and Norma Denver
1970 *Ute People: An Historical Study*. Edited by Floyd A. O'Neil and John D. Sylvester. Uintah School District, Salt Lake City, Utah, and the Western History Center, University of Utah.

Magnaghi, Russell M.
1990 Plains Indians in New Mexico: The Genízaro Experience. *Great Plains Quarterly* 10(2):86-95.

Martin, Judy, Robert M. Begay, and Steven Begay
2011 *Significant Cultural Properties of the Navajo People*. Traditional Culture Program, Navajo Nation Historical Preservation Department, Window Rock, Arizona.

Mayes, Vernon O., and Barbara Bayless Lacy
1989 *Nanise', A Navajo Herbal: One Hundred Plants from the Navajo Reservation*. Navajo Community College Press, Tsaile, Arizona.

Mayes, Vernon O., and James M. Rominger
1994 *Navajoland Plant Catalog*. National Woodlands Publishing Company, Lake Ann, Michigan.

McBeth, Sally
2007 *Native American Oral History and Cultural Interpretation in Rocky Mountain National Park*. Submitted to the National Park Service, Rocky Mountain National Park, Intermountain Region, Denver.
2008 *Ute Ethnobotany Project*. Submitted to the U. S. Forest Service, Grand Mesa, Uncompahgre and Gunnison National Forests, Delta, Colorado, and the Bureau of Land Management, Grand Junction Field Office, Grand Junction, Colorado.
2010 *Ethnographic Overview Draft 2: Colorado National Monument*. University of Northern Colorado, Greeley. Submitted to the National Park Service, Intermountain Region, Denver.
2019 *Native Peoples of the Florissant Valley: Florissant Fossil Beds National Monument Ethnographic Overview Assessment*. University of Northern Colorado, Greeley. Submitted to the National Park Service, Intermountain Region, Denver.

New Mexico State Universities Extension Office [NMSU]
2018 Selected Plants of Navajo Rangelands. Electronic resources, http://navajorange.nmsu.edu/browse.php, accessed May 23, 2019.

Nordhaus, Robert J.
1995 *Tipi Rings: A Chronicle of the Jicarilla Apache Land Claim*. Bowarrow Publishing Company, Albuquerque, New Mexico.

O'Meara, Sean, Maren P. Hopkins, Michael C. Spears, and T. J. Ferguson.
2021 *Ute Ethnographic and Ethnobotanical Research in the Bonita Peak Mining District*. Anthropological Research, LLC, Tucson, Arizona. Submitted to the Southern Ute Indian Tribe, Ignacio, Colorado.

Ott, Richard
2010 *Perspectives on Ute Ethnohistory in West Central Colorado*. Dominquez Archaeological Research Group, Grand Junction, Colorado. Submitted to the Ute Indian Tribe of the Uintah and Ouray Reservation, the Ute Mountain Ute Tribe, the Southern Ute Indian Tribe, and the Bureau of Land Management, Colorado State Office, Glenwood Springs Field Office, Grand Junction Field Office, and Uncompahgre Field Office. Electronic resource, https://www.historycolorado.org/sites/default/files/media/documents/2017/ute_ethno_references.pdf, accessed on June 14, 2020.

Roberts, Alexa, Richard M. Begay, and Klara B. Kelley
1995 *Bits'íís Ninéézi (The River of Neverending Life): Navajo History and Cultural Resources of the Grand Canyon and Colorado River*. Navajo Nation Historic Preservation Department, Window Rock,

Arizona.

Saenz, Charles N.
2020 Colorado's Hispanic Frontier: Spanish Exploration and the Early Settlement of the Conejos and Sangre de Cristo Land Grant. In *The Geology, Ecology, and Human History of the San Luis Valley*, edited by Jared M. Beeton, Charles N. Saenz, and Benjamin J. Waddell, pp. 333-357. University Press of Colorado, Louisville.

Sánchez, Virginia
2019 Survival of Captivity: Hybrid Identities, Gender, and Culture in Territorial Colorado. In *Nación Genízara: Ethnogenesis, Place and Identity in New Mexico*, edited by Moises Gonzales and Enrique R. Lamadrid, pp. 173-224. Albuquerque: University of New Mexico Press.

Sangre de Cristo National Heritage Area [SdCNHA]
2013 *Sangre de Cristo National Heritage Area Management Plan*. Electronic resource, https://www.sangreheritage.org/mangagement-plan/, accessed June 15, 2021.

Simmons, R. Laurie, and Marilyn A. Martorano
2007 Guns, Fire, and Sheep: History and Archaeology of the Trujillo Homesteads in the San Luis Valley, Colorado. *Southwestern Lore* 73(3):1-20.

Simmons, Virginia
1999 *Land of the Six-Armed Cross*. Pruett Press, Boulder, Colorado.

Southern Ute Indian Tribe [SUIT]
2020 History of Southern Ute. Electronic resource, https://www.southernute-nsn.gov/history/, accessed June 14, 2020.

Stoffle, Richard W., Rebecca Toupal, Jessica Medwied-Savage, Sean O'Meara, Kathleen Van Vlack, Henry Dobyns, and Heather Fauland
2008 *Ethnohistoric and Ethnographic Assessment of Contemporary Communities along the Old Spanish Trail*. Bureau of Applied Research in Anthropology, University of Arizona, Tucson.

Stoffle, Richard W., Kathleen Van Vlack, Rebecca Toupal, Sean O'Meara, Henry F. Dobyns, and Richard Arnold
2008 *American Indians and the Old Spanish Trail*. Tucson, AZ: Bureau of Applied Research in Anthropology, University of Arizona.

Swadesh, Frances Leon
1974 *Los Primeros Pobladores: Hispanic Americans of the Ute Frontier*. Notre Dame University Press, South Bend, Indiana.

Tiller, Veronica E. Velarde
1992 *The Jicarilla Apache Tribe: A History*. University of Nebraska Press, Lincoln.

Trujillo, Tata Atanasio
1976 Recuerdos. Translated by Ruth Marie Coleville. *San Luis Valley Historian* 8(4):8-19.

Tushar, Olibama López
1975 *The People of "El Valle:" A History of the Spanish Colonials in the San Luis Valley*. Distributed by El Camino Real Bookstore, Denver, Colorado.

United States Forest Service [USFS]
2022 Rio Grande National Forest – Assessment 12 Areas of Tribal Importance. Electronic resource, https://www.fs.usda.gov/nfs/11558/www/nepa/100663_FSPLT3_5320137.pdf,accessed on January 25, 2022

Waddell, Benjamin J., and Victoria Martinez
2020 The Political Economy of Discriminatory Lending in the San Luis Valley. In *The Geology, Ecology, and Human History of the San Luis Valley*, edited by Jared M. Beeton, Charles N. Saenz, and Benjamin J. Waddell, pp. 393-414. University Press of Colorado, Louisville.

Wescott, Konnie, Jennifer M. Abplanap, Jeff Brown, Brian Cantwell, Merrill Dicks, Brian Fredericks, Angie Krall, Katherine E. Rollins, Robert Sullivan, Arnie Valdez, Bruce Verhaaren, Joseph Vieira, Lee Walston, and Emily Zvolanek.
2016 *San Luis Valley – Taos Plateau Landscape-Level Cultural Heritage Values and Risk Assessment Final Report*. Argonne National Laboratory, Argonne, Illinois. Submitted to the Bureau of Land Management, Denver, Colorado.

White, David R.M.
2005 *Seinanyédi: An Ethnographic Overview of Great Sand Dunes National Park and Preserve*. Prepared for the National Park Service. Applied Cultural Dynamics, Santa Fe, New Mexico. Submitted to the National Park Service, Great Sand Dunes National Park and Preserve, Mosca, Colorado.

8

People, Plants, and Place

Mark D. Mitchell

… for us Ute people, we always say this is our home, this is our land, this is where we came from.

Cassandra Atencio, Southern Ute Indian Tribe
NAGPRA Coordinator

Wherever I go, the Valley goes with me.

Ken Salazar, U. S. Secretary of the Interior

People don't need anthropologists—or botanists or geologists—to tell them what is important about the landscapes they inhabit. The connections with the land and its resources that people experience through their daily activities or learn about through family histories or creation stories are palpable; endorsement is unneeded and, in truth, unwanted. The intimate connections between the many dimensions of community or cultural identity and specific landscapes or landscape elements are self-evident to those who experience them.

But if the intimate cultural significance of the landscape is not at issue, it remains important for those who seek to understand how human communities function to appreciate the ways in which the connections between people and

2022 *Multidisciplinary Research at the La Botica Site, Conejos County, Colorado*, edited by Mark D. Mitchell, pp. 133-139. Research Contribution 115. Paleocultural Research Group, Broomfield, Colorado.

places are forged and maintained. Such work focuses on the characteristics of places and on the genealogies of human use that those places engendered.

The need to understand people's long-term connections to places has become more urgent as the speed at which landscapes are altered has increased under the growing demands of human occupancy. Over the last two centuries, the effects on the North American landscape have accelerated under the pressure of human-fueled climate change, industrial agriculture, suburban and exurban sprawl, expanding industrial and transportation infrastructure, and other forces. Many of the places with which human societies established connections prior to European colonization are no longer accessible to them or have been fundamentally altered. Preservation of the significant places that remain—or reconstruction of those that have been altered or alienated—compels an understanding of how they are important to the communities that value them.

A Persistent Place in Colorado's San Luis Valley

This book describes the characteristics of a persistent place—a location to which people returned repeatedly over many generations or, in this case, many millennia—and considers the relationships between that place and the broader socionatural landscape. Each of the preceding chapters offers one perspective on the La Botica locality and its setting. As is true for an individual person, places have unique biographies. One could hope for a detailed memoir of a place that documents its changing characteristics, provides a census of the people who visited, and catalogs what they did when they were there. In fact, anthropologists, biologists, and geologists commonly have glimpses, out-of-focus snapshots, of that biography from which to piece together the meaning of a place for the people who experienced it in the past.

La Botica's geologic and geographic setting includes several uncommon attributes that set it apart from other localities in the region. The events responsible for those uncommon characteristics began long before the evolution of modern humans in Africa and under climatic conditions that would be unrecognizable today. The La Jara Canyon was initially formed following the breach of ancient Lake Alamosa—a closed or endorheic lake that nearly covered the floor of the San Luis Valley—roughly 400,000 years ago. Downcutting was aided by meltwater flowing from extensive alpine glaciers that blanketed the eastern San Juan Mountains prior to that time. By about 200,000 or 250,000 years ago, the floor of the La Jara Canyon had reached the level of the La Botica site surface. At about that same time—200,000 years ago—La Jara Creek was dammed by a landslide that filled the canyon. Downcutting eventually resumed but in a new channel that left La Botica perched mid-slope. Later landslides further isolated La Botica and created a locally closed basin conducive to the formation of an intermittent wetland.

Other locations in the region share some of La Botica's attributes, including similar elevation, landform, aspect, and geologic setting. However, none wholly replicate La Botica's distinctive features, making it a virtually unique environment. A critical aspect of that uniqueness may be the occurrence of ice deposits within the talus blockfield. Cool air draining from the blockfield during the growing season may be one factor that promotes the notable diversity of plant species—including culturally significant species—that grow along the site's eastern and southern flanks. The microenvironment produced by that cold-air drainage may have permitted the growth of species that otherwise would only occur at higher elevations or in wetter, more well-protected settings. Ice-filled cavities may also have served as natural cold storage chambers used—and perhaps augmented—by human groups in the past, permitting the preservation of meat and other foodstuffs well into the summer season.

Proxy paleoenvironmental data derived from lake cores, woodrat middens, and tree rings offer glimpses of La Botica's ancient environment during the period of human occupancy. Lake core data reveal broad regional patterns. The earliest documented occupation at La Botica (described later in the chapter) occurred during the Middle Holocene (9,000 – 5,500 years ago), a period marked by variable temperatures with generally warm conditions punctuated by brief cold periods. Overall, the climate was dry. An especially dry period occurred between about 8,500 and 6,400 years ago, which caused lakes and wetlands on the floor of the San Luis Valley to shrink and sagebrush steppe in the foothills to expand.

Regular use of La Botica increased during the Late Holocene (5,500 years ago to the present). Temperatures generally were lower during the Late Holocene than during preceding Middle Holocene. However, precipitation was variable, with both very wet and very dry periods evident in the multiple datasets. Regional data indicate a notably wet period early in the Late Holocene, followed by gradual drying.

Data from Beaver Lake, the lacustrine record closest to La Botica, point to increasingly dry conditions in the eastern San Juan Mountains after about 3,500 years ago that reached a maximum during the Medieval Climate Anomaly between about 1,000 and 700 years ago. Cooler and wetter conditions returned during the subsequent Little Ice Age (400 to 150 years ago).

The woodrat midden record suggests that La Jara Canyon and La Botica may have been shielded to some extent from the regional drying trend documented in the lake core data. The persistence of many plant species in middens spanning the period from about 3,000 to 400 years ago points to overall stability in the local vegetation community. Notably persistent are several of the culturally significant plants that attracted human use of the area. Two invasive species common in the region today—cheatgrass and common mullein—are not present in the middens, suggesting that broad-scale ecological disturbances resulting from settlement are recent phenomena.

The tree ring record documents both wet and dry periods in the recent past, along with changes in the frequency and scale of wildland fires. The local availability of culturally significant plants may have been affected by short-term changes in precipitation. However, the impacts of changes in plant abundance on human communities are difficult to measure without knowing more about the demands people put on key resources. It is possible, for example, that the abundance of certain species at La Botica never fell below a minimum threshold necessary to satisfy demand, even during the driest years.

Tree-ring data spanning more than six centuries suggest that changes in the number and severity of wildfires may be associated to some degree with changes in human occupancy. Between the late 1300s and the late 1600s CE (Common Era), fires were relatively small and frequent, possibly indicating regular use of the area by Indigenous peoples. People may have set fires to manipulate local vegetation communities or may inadvertently have started them. Fire was absent from the landscape for about a century following the Pueblo Revolt of 1680. That absence may indicate that the La Jara Canyon was visited only infrequently during that period. Regular fires returned in the late 1700s, but they were less frequent and larger than those of the pre-Pueblo Revolt period. This pattern of larger but somewhat less frequent fires may reflect a natural pattern of wildland fire ignition during a period of infrequent human occupancy. A period of fire exclusion began in the middle of the nineteenth century. The absence of fires during this period likely corresponds to the initiation of livestock grazing and the consequent removal of fine fuels, coupled with active suppression by early settlers and later by private landowners and federal land managers.

Archaeological data from La Botica provide clues about how people used the site and the region in the past. Although the age of the first visit to the site is not known, the oldest tangible evidence of human occupancy dates to roughly 7,500 years ago. That age estimate is based on archaeologists' current understanding of patterns of morphological change in hunting equipment associated with the Oshara tradition, a topic currently under active debate (Chapin 2017; Johnston 2021).

Better evidence is available for consistent if not regular use of La Botica. Nearly two-thirds of the temporally diagnostic weapons were produced by Archaic stage groups prior to about 1,600 years ago. About one third of those could have been manufactured as early as 4,000 or 5,000 years ago. Regional paleoenvironmental data indicate that the initiation of regular use occurred as the region was becoming drier. About half of the Archaic projectiles likely date to the millennium between 3,500 and 2,500 years ago. That apparent pulse of more frequent or more intensive occupation was a regional phenomenon that has been documented at other sites in the San Luis Valley (Johnston 2021). Drier conditions were unmistakable during that period; however, the woodrat midden data suggest that La Botica and the La Jara Canyon may have been a refuge that offered access to plants and other resources that were unavailable elsewhere under a drier climatic regime.

The occurrence of pottery and arrow points at La Botica indicate continued use of the site after 1,600 years ago (350 CE). Most of the pottery vessels date to the period between 1100 and 1450 CE and represent a second pulse of frequent or intensive occupancy at La Botica. That pulse occurred during to the second half of the dry and warm Medieval Climate Anomaly, again suggesting that the microenvironments present at La Botica provided shelter for culturally significant plant species.

At least one pottery vessel postdating 1450 CE also occurs at the site, which along with a small number of peeled ponderosa pines, points to use of the site during the Historic period after 1600 CE. However, that late use—which occurred during the cool and wet Little Ice Age—appears to have been less frequent or less intense than during the earlier two pulses of occupation. Evidence for the most recent use of the site consists of a small number of metal artifacts that likely date to the early twentieth century.

The types of artifacts present at La Botica demonstrate that the primary activity undertaken by the site's Indigenous visitors was plant harvesting and processing. Nearly three-quarters of the documented tools consist of millingstones or handstones, which were used in combination to grind seeds or other foodstuffs in preparation for transport or cooking. Pottery at the site—which consists of cooking rather than serving vessels—may also have been used for processing or preparing seeds, leaves, or other comestible or medicinal plant parts.

Ground stone tools occur in every part of the site, suggesting that most visitors made use of them. In addition, intact, useable grinding implements were left at the site in anticipation of future use. However, different parts of the site were used during different periods. Fragments of Archaic weapons occur throughout the site. By contrast, pottery vessel fragments and contemporaneous arrow points occur primarily along the eastern and southern edges of the site, close to the toe of the talus slope where the highest diversity of plant species is found today. The fact that later use of the site was restricted to a smaller area may indicate that Late Prehistoric groups were more focused on harvesting the plant species found in that part of the site. Alternatively, that shift may indicate that the sizes of earlier Archaic stage groups were larger than those of later groups and therefore that their camps also were larger.

The chipped stone tools at the site, which make up about a quarter of the tool assemblage, consist primarily of projectile points. Although projectile points are components of hunting gear, the portions of the points present in the collection indicate that they were discarded or lost during the process of re-tooling or equipment refurbishment, rather than during hunting itself. That pattern is stronger for the Archaic stage assemblage than it is for the Late Prehistoric stage assemblage, a difference may reflect a change in site use. However, the difference in portion representation may also reflect differences in the re-tooling process.

The small number and low diversity of non-projectile chipped stone tools indicates that few other types of activities, such as hide processing or craft production, took place at La Botica. The large number of lithic flakes present on the site surface could indicate that stone tool production occurred there. However, the absence of stone tool production failures indicates that the flake assemblage reflects tool repair or recycling rather than primary tool production. The large number of waste flakes likely reflects repeated short-term use of the site rather than longer-term or more intensive use.

This pattern of activity—defined by a principal focus on one task, in this case plant processing—is a characteristic of special-use sites occupied by dedicated task groups. Task groups commonly are composed of a subset of the overall community or band, such as able-bodied adults or people with special skills like plant identification. Task groups visit special-use sites for a specific purpose, often during a particular time of year. When their work is complete, they return with the resources they collected to a primary residential camp where older adults, children, or other community members remained during their absence. A limited range of ancillary activities, such as hunting kit refurbishment or food preparation, also occurs at special-use sites but they are not the primary purpose for a visit to a particular locality.

The specialized use of La Botica appears to have been a regular feature of Indigenous American occupancy throughout their period of use, possibly apart from the first documented use and—as described by Ute cultural specialists—the most recent period of use. However, that pattern of specialized use appears to have been especially strong during the late pulse of occupation, when use of the site was confined primarily to area of highest plant diversity.

The early twentieth century artifact assemblage does not obviously reflect plant processing activities. Instead, the assemblage appears to reflect a small number of short-term camps. Because plant collection is known to have occurred at the site (Bye and Linares 1986), the limited archaeological footprint of nineteenth- and twentieth-century visitors, along with the generalized character of the metal artifact assemblage that they left behind, appears to indicate that processing of medicinal or comestible plants occurred elsewhere. Plant harvesting trips to the site during the late 1800s and 1900s may only infrequently have involved overnight stays, in contrast with the dominant pattern of Indigenous use. Whereas Indigenous Americans both gathered and processed plant resources at La Botica, in combination with a limited range of other activities, Hispano peoples appear to have performed processing tasks elsewhere.

Data on the provenance of chipped stone tool raw materials and pottery vessels—none of which were made on-site—indicate that many different groups of Indigenous Americans were drawn to the botanical resources available at La Botica and the La Jara Canyon. Many of the raw materials used to make projectile points and other tools are known to outcrop south of the site in the northern Rio Grande valley. However, material from sources located north and west of La Botica also were used to make stone tools. Most of the pottery vessels were produced in the northern Rio Grande; however, one vessel was produced on the Southern Plains. These distributions indicate that the people who came to La Botica did so from several different directions.

The cultural identities of the site's Archaic stage occupants are not known. It nevertheless seems certain that many different groups used La Botica's resources during the two or three millennia of occupation represented by the preponderance of the Archaic projectile points. The more recent pulse of occupation, represented by multiple pottery vessels and side-notched arrow points, likely reflects Pueblo use, especially use by Northern Tiwa (Taos and Picuris) people. A fragment of a brownware vessel reflects use by Utes or Navajos, possibly as late as the nineteenth century. The peeled ponderosas at the site are undated, but also likely date to the late eighteenth century or the nineteenth century.

Ethnobotanical and traditional use data demonstrate that intimate connections exist between multiple human communities and the landscape of which La Botica is a part. However, the meanings those connections encode are bound up with specific group and individual identities. Utes, Navajos, and Hispanos all regard the area as special, although for different reasons. For Utes, the San Luis Valley is a part of Núuchiu Tʉvʉpʉ, "Ute Lands," their homeland since the time of their creation. Navajos, too, experience a vital cultural connection to the San Luis Valley, a connection that was (and is) sustained though regular pilgrimage for ceremony and resource collection. Rock art and oral history commemorate Navajo connections to the region. For Hispano communities in the San Luis Valley, the region was central to their nineteenth and early twentieth century efforts to colonize New Mexico's northern frontier. It remains pivotal to their history and identity, both a manifestation of independence and self-sufficiency and, later, or disenfranchisement. Many other groups—Jicarilla Apaches and Pueblo communities among them—also experience deep connections with the region.

However, people's connections to the landscape are more complex than cultural affiliation alone. Inter-community and intra-community differences also exist in the knowledge people hold about a place or a region or about the meanings they take from it. In addition, some information about a place is held only by authorized specialists.

The wild plants available at La Botica, or at other similar natural pharmacies, are more than simply resources that fulfill particular functions or needs. They also are bound up with a way of life and a cultural history. They connect people to their community, to their history, and to their identity. Different plant species can be regarded as mnemonics, tangible markers of intangible histories. For these reasons, plants and the habitats they occupy are sources of cultural power for those who can read them.

Not all of the 199 plant species currently documented at La Botica are regarded as culturally significant. Among those that are, significant overlap exists in the inventories identified by different groups. However, the specific uses different people identify for particular species sometimes differ. These inventories of important medicinal and comestible plants likely are dynamic. For example, both Utes and local Hispanos identify common mullein as a culturally significant medicinal plant, although it is not native to North America and likely became established in the San Luis Valley only in the second half of the nineteenth century (Remaley 2005).

Culturally significant plants are not the only feature that brought people to La Botica in the past. For the Navajos, ice-filled cavities at the site are home to Wind People, who are critical to sustaining life. Other physical features of the site, or of the La Jara Canyon, may have been equally important to other groups. Naming such features is an important way of connecting the landscape to specific histories.

Summary

It is evident that La Botica was persistently visited by many different groups over thousands of years. Few other known archaeological sites in the region preserve a record of regular occupancy as lengthy as the record preserved at La Botica. That occupancy continues, at least conceptually, today: the region—the foothills of the eastern San Juan Mountains and the La Jara Canyon—figures prominently in the history and culture of numerous American Indian tribes and local Hispano communities.

Harvesting of wild plant resources was and is a central feature of Indigenous and Hispano use of the region. Ethnobotanical research identifies a profusion of culturally significant plant species growing at, and adjacent to, La Botica. The modern plant inventory for the site includes a large number of species, including several that are rare and imperiled. Archaeological data demonstrate that plant processing was the primary focus of Indigenous American use of the site, possibly beginning 4,000 or 5,000 years ago. The persistence of medicinal and comestible plant harvesting and processing evident in the La Botica record suggests that the locality was a destination, rather than an incidental stop along a corridor. The site's geography—an isolated, difficult-to-reach landform perched within the La Jara Canyon—supports that reading.

Geological and geographical data demonstrate that La Botica's key characteristics are rare if not unique in the region. A critical aspect of that uniqueness may be the presence of ice-filled cavities—which may have helped to create a microclimate on the site's perimeter that has promoted plant species diversity. Woodrat midden data suggest that La Botica and the La Jara Canyon may have been protected from the worst of the Late Holocene's multi-millennium period of aridity.

Not only was La Botica a persistent place; it also was a special place.

Making Places

Meaningful places are more than constellations of abstract affordances; they are archives of the lives of the people who visited and valued them. A meaningful, persistent place "reminds people of their past and teaches them how to cope with the present and plan for the future" (Zedeño and Bowser 2009:13). An understanding of the ways in which communities establish and maintain connections to the land is therefore central to an understanding of their identities and histories.

How do people encode and conserve knowledge about special places and how is that knowledge transmitted between generations or among communities? Constructed monuments invested with cultural significance sometimes mark special places. Elsewhere, and perhaps especially for mobile groups, mountains, lakes, or other features of the landscape serve as meaningfully constituted markers. At La Botica, the plants—or perhaps the cohesive community of plants—that brought people there may have served a similar function. Their culturally constituted uses, and the specific roles they play in stories, songs, and histories, merge the physical places they grow with the identities of the people who harvest them. Social remembrance of the plants' cultural meanings connects people to La Botica. "Place," Ruth Van Dyke (2008:278) observes, "might be defined as the intersection of memory and landscape."

Transmission of shared, social memories is crucial to the formation of personal and cultural identity. People come to understand who they are in part by learning about where and how their ancestors lived. Perhaps especially but by no means exclusively for hunter-harvesters, knowledge about the cultural significance of plants, animals, and minerals and the places they are found is central to that process. Communication of knowledge about places is also central to the interactions between communities. The incorporation of Indigenous people into San Luis Valley Hispano households that occurred during the nineteenth century provided occasions for sharing botanical knowledge as well as knowledge about special places. Trade was another context for information sharing. The proximate measure of successful or productive exchange may be commensurate value, but trade cannot occur in the absence of a social relationship between parties. That relationship may not require trust, but it does require information.

Why do places persist? John Welch (2009) argues that a landscape imbued with meaning is a reservoir of cultural rights, a vehicle for fulfilling obligations among community members, and a classroom for instructing new generations. Meaningful places are a nexus for identity and history and, ultimately, social reproduction. As long as the people who value them return—or reconstitute them in the face of alienation or modification—they will persist. The study of places and how they are forged can contribute, in a small way, to their longevity.

Epigraphs. The epigraphs to this chapter are drawn from transcribed comments presented in chapter 7 (Atencio) and from the forward to *The Geology, Ecology, and Human History of the San Luis Valley* (2020, University Press of Colorado) (Salazar).

References Cited

Bye, Robert A., Jr., and Edelmira Linares
1986 Ethnobotanical Notes from the Valley of San Luis, Colorado. *Journal of Ethnobiology* 6(2):289-306.

Chapin, Nicholas
2017 *Oshara Revisted: The Archaic Period in Northern New Mexico*. Anthropological Papers 10. Maxwell Museum of Anthropology, University of New Mexico, Albuquerque.

Johnston, Christopher M.
2021 *Projectile Points from the Scott Miller Site, Rio Grande County, Colorado*. Research Contribution 120. Archaeological Investigations in the San Luis Valley 8. Paleocultural Research Group, Broomfield, Colorado. Submitted to the U. S. Fish and Wildlife Service, Lakewood, Colorado.

Remaley, Tom
2005 Fact Sheet: Common Mullein. Plant Conservation Alliance, Alien Plant Working Group. Electronic resource, https://www.invasive.org/alien/fact/veth1.htm, accessed May 12, 2022.

Van Dyke, Ruth M.
2008 Memory, Places, and the Memorialization of Landscape. In *Handbook of Landscape Archaeology*, edited by Bruno David and Julian Thomas, pp. 277-284. Routledge, New York.

Welch, John R.
2009 Reconstructing an Ndee Sense of Place. In *The Archaeology of Meaningful Places*, edited by Brenda J. Bowser, and Maria Nieves Zedeño, pp. 149-162. University of Utah Press, Salt Lake City

Zedeño, Maria Nieves, and Brenda J. Bowser
2009 The Archaeology of Meaningful Places. In *The Archaeology of Meaningful Places*, edited by Brenda J. Bowser, and Maria Nieves Zedeño, pp. 1-14. University of Utah Press, Salt Lake City.

Appendix A: Modern Plant Inventory

The 199 plant species listed include those observed at or near the La Botica site during multiple field sessions beginning in 2013. The list was compiled by Kelly Kindscher, Professor of Environmental Studies and Senior Scientist at the Kansas Biological Survey at the University of Kansas, based on observations made by Kindscher, Kristy Duran (Faculty Director of Undergraduate Research and Professor of Biology at Metropolitan State University of Denver), Carol English (Colorado State Land Board), and Sean O'Meara (O'Meara Heritage Consulting, LLC). The list is current through February 2021.

Scientific Name	Common Name	Family	Location Observed	Observer(s)
Abies concolor	white fir	Pinaceae	La Botica	English 2017; Kindscher 2013
Achillea millefolium	yarrow	Asteraceae	La Botica; Riparian Area	English 2017; Kindscher 2013; O'Meara 2018
Achnatherum hymenoides	Indian ricegrass	Poacea	La Botica; Rock Art Site	English 2017; O'Meara 2018
Achnatherum pinetorum	pine needlegrass	Poacea	La Botica	English 2017
Achnatherum robustum	sleepygrass	Poacea	La Botica	English 2017
Allium cernuum	nodding onion	Alliaceae	La Botica	English 2017; Kindscher 2013
Alnus incana	grey alder	Betulaceae	Riparian Area	Kindscher/O'Meara 2018
Androsace septentrionalis	pygmyflower rockjasmine	Primulaceae	La Botica	English 2017; Kindscher 2018
Anemone patens var. *Multiflora*	pasque flower	Ranunculaceae	La Botica	English 2017
Antennaria parviflora	small leaf pussy-toes	Asteraceae	Lat Botica	Duran 2020
Antennaria rosulata	Kaibab pussy-toes	Asteraceae	La Botica	English 2017; Kindscher 2018
Arceuthobium douglasii	Douglas fir dwarf mistletoe	Viscaceae	La Botica	Duran 2020
Arctostaphylos uva -ursi	kinnikinnick	Ericaceae	La Botica	English 2017
Artemisia carruthii	Carruth's sagewort	Asteraceae	La Botica	English 2017
Artemisia frigida	prairie sagewort; fringed sage	Asteraceae	La Botica, Rock Art Site; Rim	English 2017; O'Meara 2018
Artemisia tridentata	big sagebrush	Asteraceae	La Botica; Rock Art Site; Rim	Kindscher 2013; O'Meara 2018
Artemisia tridentata var. *vaseyana*	Vasey's sagebrush	Asteraceae	La Botica	English 2017
Artenisia tridentata ssp. *Tridentata*	big sagebrush	Asteraceae	La Botica	English 2017
Ascomycota Family	lichen	Ascomycota	Campsite	O'Meara 2018
Astragalus agrestis	purple milkvetch	Fabaceae	La Botica	English 2017
Astragalus drummundii	Drummond's milkvetch	Fabaceae	La Botica	English 2017
Astragalus ripleyi	Ripley's milkvetch	Fabaceae	La Botica	English 2017; Kindscher 2013
Bahia dissecta	ragleaf bahia	Asteraceae	La Botica	Kindscher 2013
Berberis fendleri	Colorado barberry	Berberidaceae	La Botica	English 2017; Kindscher 2013
Berberis repens; Mahonia repens	Oregon grape; creeping barberry	Berberidaceae	La Botica	English 2017; Kindscher 2013
Boechera lignifera	desert rockcress	Brassicaceae	La Botica	Duran 2020
Boechera spathifolia	spoonleaf rockcress	Brassicaceae	La Botica	English 2017
Bouteloua gracilis	blue grama	Poacea	La Botica	English 2017; Kindscher 2013
Bouteloua hirsuta	hairy grama	Poacea	La Botica	Kindscher 2013
Bromus carniatus	California brome	Poacea	La Botica	English 2017
Bromus tectorum	cheatgrass	Poacea	La Botica	English 2017
Bryophyta (Division)	moss		Riparian Area	O'Meara 2018
Calochortus gunnisonii	sego lily; mariposa lily	Liliaceae	La Botica	English 2017; O'Meara 2019
Carex deflexa var. *bootii*	Boott's sedge	Cyperaceae	La Botica	English 2017
Carex duriuscula	needleleaf sedge	Cyperaceae	La Botica	English 2017

Scientific Name	Common Name	Family	Location Observed	Observer(s)
Carex gravida var. *lunelliana*	Lunell's heavy-fruited sedge	Cyperaceae	La Botica	English 2017
Carex inops subsp. *heliophila*	sun sedge	Cyperaceae	La Botica	English 2017
Carex occidentalis	western sedge	Cyperaceae	La Botica	English 2017
Carex tahoensis	Tahoe sedge	Cyperaceae	La Botica	English 2017
Castilleja integra	wholelead Indian paintbrush	Orobanchaceae	La Botica; Rock Art Site; Rim	English 2017; Kindscher 2013; O'Meara 2018
Castilleja linariifolia	Wyoming paintbrush	Orobanchaceae	La Botica	English 2017; Kindscher 2018
Cercocarpus montanus	alderleaf mountain mahogany; birchleaf mountain mahogany	Rosaceae	La Botica; Riparian Area	English 2017; Kindscher 2013; O'Meara 2018
Chaetopappa ericoides	rose heath	Asteraceae	La Botica	English 2017
Cheilanthes fendleri	Fendler's fern	Pteridaceae	La Botica	English 2017
Chenopodium berlandieri	pitseed goosefoot	Amaranthaceae	La Botica	Kindscher 2013
Chenopodium graveolens	fetid goosefoot	Amaranthaceae	La Botica	Kindscher 2013
Chenopodium incanum var. *incana*	mealy goosefoot	Amaranthaceae	La Botica	English 2017
Chenopodium leptophyllum	narrowleaf goosefoot	Amaranthaceae	La Botica	Kindscher 2013
Chenopodium watsonii	mealy goosefoot	Amaranthaceae	La Botica	English 2017
Chrysothamnus depressus	dwarf rabbitbrush	Asteraceae	La Botica	English 2017
Chrysothamnus linifolius	spreading rabbitbrush	Asteraceae	La Botica	English 2017
Chrysothamnus vaseyi	Vasey's rabbitbrush	Asteraceae	La Botica	English 2017
Chrysothamnus viscidiflorus	viscid rabbitbrush	Asteraceae	La Botica	English 2017
Cirsium arvense	Canada thistle	Asteraceae	La Botica	English 2017; Kindscher 2013
Cirsium spp.	thistle	Asteraceae	Riparian Area	Kindscher/O'Meara 2018
Clematis columbiana var. *columbiana*	rock clematis	Ranunculaceae	La Botica	English 2017
Coryphantha vivpara; Escobaria missouriensis	pincushion cactus; Missouri foxtail cactus	Cactaceae	La Botica	English 2017; Kindscher 2018
Cystopteris fragilis	brittle bladder fern	Dryopteridaceae	La Botica	English 2017
Cystopteris spp.	fragile fern	Dryopteridaceae	La Botica	Kindscher 2013
Descurainia sophia	herb sophia; flixweed	Brassicaceae	Riparian Area; La Botica	English 2017; Kindscher/O'Meara
Echinocereus triglochidiatus	claret cup, scarlet hedgehog cactus	Cactaceae	Riparian Area	Kindscher/O'Meara 2018
Echinoereus viridiflorus	nylon hedgehog cactus	Cactaceae	La Botica	English 2017
Elymus elymoides	squirreltail	Poacea	La Botica	English 2017; Kindscher
Equisetum arvensis	scouringrush horsetail	Equisetaceae	Riparian Area	Kindscher/O'Meara 2018
Equisetum laevigatum	smooth horsetail	Equisetaceae	Riparian Area	Kindscher/O'Meara 2018
Ericameria nauseosa	rubber rabbitbush	Asteraceae	La Botica; Rock Art Site	English 2017; Kindscher 2013; O'Meara 2018
Ericameria parryi	Parry's rabbitbrush	Asteraceae	La Botica	English 2017

Scientific Name	Common Name	Family	Location Observed	Observer(s)
Erigeron canus	hoary daisy	Asteraceae	La Botica	English 2017
Erigeron consimilis	cushion daisy	Asteraceae	La Botica	English 2017
Erigeron engelmannii	Englemann's daisy	Asteraceae	La Botica	English 2017
Erigeron flagellaris	trailing daisy	Asteraceae	La Botica	English 2017
Erigeron tracyi	running daisy	Asteraceae	La Botica	English 2017
Erigeron vreelandii	Vreeland's erigeron	Asteraceae	La Botica	Kindscher 2013
Eriogonum alatum	winged buckwheat	Polygonaeae	La Botica	English 2017
Eriogonum jamesii var. *jamesii*	Jame's buckwheat	Polygonaeae	La Botica	English 2017; Kindscher 2013
Eriogonum microthecum	slender buckwheat	Polygonaeae	La Botica	English 2017; Kindscher 2013
Eriogonum racemosum	redroot buckwheat	Polygonaeae	La Botica	English 2017
Erysimum capitatum	western wallflower	Brassicaceae	Rock Art Site	O'Meara 2018
Festuca arizonica	Arizona fescue	Poacea	La Botica	English 2017; Kindscher 2013
Fragaria vesca ssp. *Bracteata*	woodland strawberry	Rosaceae	La Botica	English 2017
Galium boreale	northern beadstraw	Rubiaceae	La Botica	English 2017
Gayophytum diffusum	diffuse groundsmoke	Onagraceae	La Botica	English 2017
Gentianan affinis	Rocky Mountain gentain	Gentianaceae	La Botica	English 2017
Geranium richardsonii	Richardson's geranium	Geraniaceae	Riparian Area	Kindscher/O'Meara 2018
Grindelia squarossa	gum weed	Asteraceae	Riparian Area	Kindscher 2013; Kindscher/ O'Meara 2018
Gutierrezia sarothrae	broom snakeweed	Asteraceae	La Botica; Rim	English 2017; Kindscher 2013; O'Meara 2018
Heliomeris multiflora	showy goldeneye	Asteraceae	La Botica	English 2017
Hesperostipa comata	needle-and-thread	Poacea	La Botica	English 2017; Kindscher 2013
Heterotheca villosa	hairy false goldenaster	Asteraceae	La Botica	Kindscher 2013
Holodiscus dumosus	mountain rush; ocean spray; rockspirea	Rosaceae	La Botica	English 2017; Kindscher 2013
Humulus lupulus	common hops	Cannabaceae	Riparian Area	Kindscher/O'Meara 2018
Hymenopappus filifolius	fine-leaf hymenopappus	Asteraceae	La Botica	Duran 2020
Hymenoxys richardsonii var. *floribunda*	Colorado rubberweed	Asteraceae	La Botica; Rock Art Site	English 2017; O'Meara 2019
Ipomopsis aggregata ssp. *collina*	scarlet gilia	Polemoniaceae	La Botica	English 2017; Kindscher 2013
Iris missouriensis	Rocky Mountain iris	Iridaceae	Riparian Area	Kindscher/O'Meara 2018
Jamesia americana	fivepetal cliffbush	Hydrangeaceae	La Botica	English 2017; Kindscher 2018
Juncus arcticus var. balticus	artic rush	Cyperaceae	La Botica	English 2017; Kindscher 2013; Kindscher/O'Meara 2018
Juniperus communis	common juniper	Cupressaceae	La Botica; Riparian Area	English 2017: Kindscher 2013; O'Meara 2018

Scientific Name	Common Name	Family	Location Observed	Observer(s)
Juniperus monosperma	oneseed juniper	Cupressaceae	La Botica; Rock Art Site; Riparian Area	Kindscher 2013; O'Meara 2018
Juniperus scopulorum	Rocky Mountain juniper	Cupressaceae	La Botica	English 2017; Kindscher 2013
Koeleria macrantha	junegrass	Poacea	La Botica	English 2017; Kindscher 2013
Lactuca serriola	prickly lettuce	Asteraceae	Riparian Area	Kk/So
Lappula occidentalis var. *occidentalis*	western stickweed; flatspine stickseed	Boragenaceae	La Botica	English 2017; Kindscher 2013
Linum austral	flax	Linaceae	La Botica	Kindscher 2018
Linum australe	flax	Linaceae	Riparian Area	Kindscher/O'Meara 2018
Linum perenne	wild blue flax	Linaceae	Riparian Area	Kindscher/O'Meara 2018
Lithospermum multiflora	southwestern stoneseed	Boragenaceae	La Botica	English 2017
Lomatium grayi	Gray's desert parsley	Apiaceae	La Botica	Duran 2020
Lomatium triternatum var. *platycarpum*	Great Basin Desert parsley	Apiaceae	La Botica	English 2017
Lupinus argenteus; Lupinus sericeus var. *sericeus*	silvery lupine	Fabaceae	La Botica	English 2017; Kindscher/O'Meara 2018
Lupinus kingii	King's lupine	Fabaceae	La Botica; Riparian Area	
Lycurus phleoides	common wolfstail	Poacea	La Botica	Kindscher 2013
Lygodesmia juncea	rush skeletonweed	Asteraceae	La Botica	English 2017
Machaeranthera bigelovii	Bigelow's tansyaster	Asteraceae	La Botica	Kindscher 2013
Maianthemum racemosum ssp. *Amplexicaule*	large false Solomon's seal	Ruscaceae	La Botica	English 2017
Maianthemum stellatum	false Solomon's seal; starry flase lily of the valley	Ruscaceae	La Botica	English 2017; Kindscher 2013
Melilotus officinalis	yellow sweet clover	Fabaceae	Riparian Area	Kindscher/O'Meara 2018
Mentha arvensis	wild mint	Lamiaceae	Riparian Area	Kindscher/O'Meara 2018
Mentzelia thompsonii	Thompson's stickleaf	Loaceae	La Botica	English 2017
Mirabilis linearis	narrowleaf four o'clock	Nyctaginaceae	La Botica; Rock Art Site	English 2017; O'Meara 2018
Mirabilis spp.	four o'clock	Nyctaginaceae	La Botica	Kindscher 2013
Muhlenbergia filiculmis	slimstem muhly	Poacea	La Botica	English 2017
Muhlenbergia montana	mountain muhly	Poacea	La Botica	English 2017
Muhlenbergia richardsonsis	mat muhly	Poacea	La Botica	Kindscher 2013
Muhlenbergia spp.	muhly	Poacea	Riparian Area	Kindscher/O'Meara 2018
Myosotis spp.	forget me not	Boraginaceae	Riparian Area	Kindscher/O'Meara 2018
Nassella viridula	green needlegrass	Poacea	La Botica	Kindscher 2013
Oenothera albicaulis	whitest evening primrose	Onagraceae	La Botica	English 2017; Kindscher 2013
Opuntia polycantha var. *polycantha*	starvation prickley pear	Cactaceae	La Botica	English 2017; Kindscher 2013

Scientific Name	Common Name	Family	Location Observed	Observer(s)
Opuntia polycantha var. *trichophora*	grizzly bear cactus	Cactaceae	La Botica	English 2017
Orthocarpus luteus	yellow owl's clover	Orobanchaceae	La Botica	English 2017
Oryzopsis asperifolia	roughleaf ricegrass	Poacea	La Botica	Kindscher 2013
Oxytropis lambertii	purple locoweed	Fabaceae	La Botica; Riparian Area	English 2017; Kindscher/O'Meara 2018
Packera cana	woolly groundsel	Asteraceae	La Botica	English 2017
Packera neomexicana	New Mexico groundsel	Asteraceae	La Botica	English 2017
Pascopyrum smithii	weatern wheatgrass	Poacea	La Botica	English 2017
Pediocactus simpsonii	mountain cactus	Cactaceae	La Botica	English 2017
Penstemon barbatus	scarlet bugler; beardlip penstemon	Plantaginaceae	Riparian Area	Kindscher/O'Meara 2018; English 2017
Penstemon caespitosus	mat penstemon	Plantaginaceae	La Botica	Duran 2020
Penstemon crandallii var. *ramaleyi (*A. Nelson*)* CC. Freeman	penstemon	Plantaginaceae	La Botica	Kindscher 2013
Penstemon griffinii	Griffin's penstemon	Plantaginaceae	La Botica	English 2017; Kindscher 2013
Penstemon linarioides	toadflax penstemon	Plantaginaceae	La Botica; Rock Art Site	English 2017; O'Meara 2019
Penstemon strictus	Rocky Mountain penstemon	Plantaginaceae	La Botica	English 2017
Penstemon virgatus	one-side penstemon	Plantaginaceae	La Botica	English 2017
Physaria montana	mountain bladderpod	Brassicaceae	La Botica	English 2017
Physaria rectipes	straight bladderpod	Brassicaceae	La Botica	Duran 2020
Pinus contorta	lodgepole pine	Pinaceae	La Botica	English 2017
Pinus edulis	pinon pine; pinyon pine	Pinaceae	La Botica; Rock Art Site	English 2017; Kindscher 2013; O'Meara 2018
Pinus ponderosa var. *scopulorum*	ponderosa pine	Pinaceae	La Botica	English 2017; Kindscher 2013
Piptatherum micranthum	littleseed ricegrass	Poacea	La Botica	English 2017
Plantago major	broadleaf plantain	Plantaginaceae	Riparian Area	Kindscher/O'Meara 2018
Poa cusickii	Cusick's bluegrass	Poacea	La Botica	English 2017
Poa interior	inland bluegrass	Poacea	La Botica	English 2017
Populus angustifolia	narrow-leaf cottonwood	Salicaceae	Riparian Area	Kindscher/O'Meara 2018
Populus tremuloides	aspen	Salicaceae	La Botica, Riparian Area	English 2017; O'Meara 2018
Portulaca oleracea	little hog weed		La Botica	Kindscher 2013
Potentilla anserina	silverweed	Rosaceae	Riparian Area	Kindscher/O'Meara 2018
Potentilla fruticosa	shrubby cinquefoil	Rosaceae	Riparian Area	Kindscher/O'Meara 2018
Potentilla gracilis	slender cinquefoil	Rosaceae	Riparian Area	Kindscher/O'Meara 2018
Prunus virginiana	chokecherry	Rosaceae	La Botica; Riparian Area	Kindscher 2013; O'Meara 2018 English 2017

Scientific Name	Common Name	Family	Location Observed	Observer(s)
Pseudocymopterus montanus	alpine false spring parsely	Apiaceae	La Botica	Kindscher 2013
Pseudotsuga menziesii var. *glauca*	Douglas fir	Pinaceae	La Botica	English 2017; Kindscher 2013
Puccinellia nuttalliana	Nuttall's alkali grass	Poacea	La Botica	English 2017
Rhus trilobata	three-leaf sumac; skunkbush sumac	Anacardiaceae	La Botica	English 2017; Kindscher 2013
Ribes aureum	golden currant	Grossulariaceae	La Botica	Kindscher 2013
Ribes cererum	wax currant	Grossulariaceae	La Botica	English 2017
Ribes inerme	whitestem gooseberry	Grossulariaceae	La Botica	Kindscher 2013
Ribes leptanthum	trumpet gooseberry	Grossulariaceae	La Botica	English 2017
Rosa acicularis ssp. *Sayi*	wild rose	Rosaceae	La Botica	English 2017
Rosa arkansana	prairie rose	Rosaceae	La Botica	Kindscher 2013
Rosa woodsia	Wood's rose	Rosaceae	La Botica	Kindscher 2018
Rubus idaeus	American red raspberry	Rosaceae	La Botica	Kindscher 2013; English 2017
Rudbeckia laciniata	cutleaf coneflower	Asteraceae	Riparian Area	Kindscher/O'Meara 2018
Rumex crispus	curley dock	Polygonaeae	Riparian Area	O'Meara 2018
Rumex triangulivalvis	Mexican dock	Polygonaeae	Riparian Area	Kindscher/O'Meara 2018
Salix lucida	shining willow	Salicaceae	Riparian Area	Kindscher/O'Meara 2018
Salix spp.	willow	Salicaceae	Riparian Area	Kindscher/O'Meara 2018
Scrophularia lanceolata	lanced-leaved figwort	Scrophulariaceae	Riparian Area	Kindscher/O'Meara 2018
Solidago canadensis	Canada goldenrod	Asteraceae	La Botica	Kindscher 2013
Solidago multiradiata var. *scopulorum*	Rocky Mountain goldenrod	Asteraceae	La Botica	English 2017
Sphaeralcea coccinea	scarlet globemallow	Malvaceae	La Botica	English 2017
Symphoricarpos albus	common snowberry; mountain snowberry	Caprifoliaceae	La Botica; Riparian Area	English 2017; Kindscher/O'Meara 2018
Taraxacum officianale	dandelion	Asteraceae	La Botica	Kindscher 2013; O'Meara 2019
Tetradymia canescens	common horsebrush	Asteraceae	La Botica	English 2017
Thalictrum fendleri	meadow rue	Ranunculaceae	Riparian Area	Kindscher/O'Meara 2018
Thermopsis rhombifolia	golden bean	Fabaceae	Riparian Area	Kindscher/O'Meara 2018
Thinopyrum intermedium	intermediate wheatgrass	Poacea	Riparian Area	Kindscher/O'Meara 2018
Townsendia exscapa	stemless Easter daisy	Asteraceae	La Botica	English 2017
Tragopogon dubius	yellow salsify	Asteraceae	Rock Art Site	O'Meara 2018
Tragapogon pratensis	meadow salisfy	Asteraceae	La Botica	Duran 2020
Uritca dioica ssp. *gracilis*	stinging nettle	Urticaceae	La Botica	English 2017; Kindscher 2013
Verbascum thapsus	wooly mullein	Scrophulariaceae	La Botica	English 2017
Veronica anagallis-aquatica	water speedwell	Scrophulariaceae	Riparian Area	Kindscher/O'Meara 2018
Vicia Americana	American vetch	Fabaceae	Riparian Area	Kindscher/O'Meara 2018
Woodsia neomexicana	New Mexico cliff fern	Dryopteridaceae	La Botica	English 2017

Scientific Name	Common Name	Family	Location Observed	Observer(s)
Xanthisma spinulosum	spiny goldenweed	Asteraceae	La Botica	English 2017
Yucca glauca	soapweed yucca	Agavacea	La Botica	Kindscher 2013
Yucca neomexicana	New Mexico Spanish bayonet	Agavacea	La Botica	English 2017

Appendix B:
Ute Plant List

Sixty-three of the 199 plant species documented at or near La Botica (appendix A) have known recorded traditional Ute uses. However, all plants found within Ute aboriginal territory are viewed as significant and part of the Ute cultural landscape. Ute plant knowledge is traditionally maintained through oral history and not shared with the larger public in order to preserve these plant species and not bring unwanted attention or misuse to them.

Scientific Name	Common Name	Traditional Use(s)
Achillea millefolium	yarrow	Medicinal
Achnatherum hymenoides	Indian rice-grass	Food
Allium cernuum	wild onion; nodding onion	Food
Antennaria spp.	pussytoes	Unspecified
Arctostaphylos uva-ursi	kinnikinnick, bear berry	Unspecified
Artemisia frigida	fringed sage	Medicinal
Artemisia tridenta	big sagebrush	Medicinal
Ascomycota (Division)	lichen	Medicinal
Astragalus spp.	milkvetch	Unspecified
Berberis repens	Oregon grape, barberry	Unspecified
Bryophyta (Division)	moss	Utilitarian
Calochortus gunnisonnii	mariposa lily	Food
Carex spp.	sedge	Unspecified
Castilleja integra	whole leaf Indian paintbrush	Food
Cercocarpus montanus	mountain mahogany	Food, Medicinal, Utilitarian
Chenopodium spp.	lamb's quarters	Food
Cirsium spp.	thistle	Food
Cystopteris spp.	bladder fern	Unspecified
Equisetum arvense	field horsetail, common horsetail	Unspecified
Equisetum laevigatum	smooth scouring-rush	Utilitarian
Erigeron canus	hoary fleabane	Unspecified
Eriogonum spp.	buckwheat	Medicinal
Erysimum spp.	western wallflower	Unspecified
Fragaria vesca	woodland strawberry	Food
Grindelia squarrosa	curly cup gumweed	Unspecified, Medicinal
Gutierrezia sarothrae	snakeweek	Unspecified
Heterotheca villosa	hairy false golden-aster	Unspecified
Ipomopsis aggregata	scarlet gilia	Utilitarian
Juncus balticus	Baltic rush	Unspecified
Juniperus communis	common juniper	Food
Juniperus monosperma	one-seed juniper	Ceremonial
Juniperus scopulorum	Rocky Mountain juniper	Ceremonial, Food

Scientific Name	Common Name	Traditional Use(s)
Ligusticum porteri	oshá; bear root, Porter's lovage	Ceremonial, Medicinal
Lithospermum spp.	stone seed	Medicinal
Lomatium spp.	Biscuitroot, desert parsley	Medicinal, Food
Maianthemum racemosum	feathery false lily of the valley	Unspecified
Mentha arvensis	wild mint	Ceremonial, Food
Oenothera spp.	evening primrose	Unspecified
Opuntia polycantha	plains prickly pear	Food, Medicinal
Penstemon spp.	penstemon	Unspecified
Pinus contorta	lodge pole pine	Utilitarian
Pinus edulis	piñon pine	Food, Utilitarian
Pinus ponderosa	ponderosa pine	Ceremonial, Food, Medicinal, Utilitarian
Populus angustifolia	narrowleaf cottonwood	Ceremonial, Utilitarian
Populous tremuloides	aspen	Food, Medicinal, Utilitarian
Potentilla anserina	silverweed cinquefoil	Unspecified
Prunus virginiana	chokecherry	Food
Pseudotsuga menziesii	Douglas fir	Utilitarian
Rhus trilobata	three-leaf sumac	Food, Utilitarian
Ribes aureum	golden currant	Food
Ribes cereum	western red currant, wax currant	Food
Ribes inerme	white stem gooseberry	Food
Ribes leptanthum	trumpet gooseberry	Food
Rosa acicularis ssp. Sayi	wild rose	Unspecified
Rosa woodsii	Wood's rose	Food
Rubus ideaus	raspberry	Food
Rumex spp.	dock	Food
Salix lucida	shining willow	Utilitarian
Salix spp.	willow	Ceremonial, Medicinal, Utilitarian
Taraxacum officinale	common dandelion	Food
Tellima spp.	tellima	Unspecified
Verbascum thaspus	common mullein	Medicinal
Yucca glauca	soap weed yucca	Food, Utilitarian

Appendix C:

Navajo Plant List

Over 32 traditional use plant species were observed or discussed by Navajo Nation tribal representatives during fieldwork in the region. Representatives noted that a number of plants utilized were observed in the La Jara Canyon and at the La Botica site. The list is not exhaustive and additional work is recommended to more fully understand Navajo ethnobotany of the area. Additional plants found at La Botica may have historic and contemporary importance to Navajo people.

Data Category	Species Data
Scientific Name	*Achillea millfolium*
Common Name	western yarrow
Navajo Name	hazéíyiltsee'í (Mayes and Lacey 1989:137)
Translation Provided	"chipmunk tail medicine"
Use Category	medicinal
Parts of the Plant	leaves; root
Description of Uses	The roots of this plant are used medicinally, and the leaves are us as an emetic.
Scientific Name	*Arctostaphylos uva ursi*
Common Name	kinnickinick
Navajo Name	danas; dinastsoh (Mayes and Lacey 1989:62)
Translation Provided	"big berry plant"
Use Category	ceremonial
Parts of the Plant	leaf
Description of Uses	This plant is used in ceremonies as medicine.
Scientific Name	*Artemesia frigida*
Common Name	fringed sage
Navajo Name	tóyikáál (NMSU 2018)
Translation Provided	"water holder"
Use Category	ceremonial
Parts of the Plant	unspecified
Description of Uses	This plant is used in ceremonies.

Data Category	Species Data
Scientific Name	*Artemesia tridentata*
Common Name	big sagebrush
Navajo Name	ts'ahtsoh (NMSU 2018)
Translation Provided	unspecified
Use Category	ceremonial, medicinal; domestic
Parts of the Plant	unspecified
Description of Uses	This culturally important plant and is used in certain ceremonies and in weaving.
Scientific Name	*Bouteloua gracilis*
Common Name	blue gramma grass
Navajo Name	tł'oh nástasí (Mayes and Lacey 1989:45); tł'ohnást'ąsi (NMSU 2018)
Translation Provided	unspecified
Use Category	ceremonial; medicinal
Parts of the Plant	unspecified
Description of Uses	Blue grama grass is a culturally important plant used in ceremonies.
Scientific Name	Bryophyta (Division)
Common Name	moss
Navajo Name	unspecified
Translation Provided	unspecified
Use Category	ceremonial
Parts of the Plant	unspecified
Description of Uses	This is a culturally important plant.
Scientific Name	*Cercocarpus montanus*
Common Name	mountain mahogany
Navajo Name	tsé'ásdaazii (NMSU 2018)
Translation Provided	"heavy rock"
Use Category	ceremonial; domestic
Parts of the Plant	unspecified
Description of Uses	This is a culturally important plant for domestic and ceremonial purposes.

Data Category	Species Data
Scientific Name	*Ericameria nauseosus*
Common Name	rabbitbrush
Navajo Name	k'iiłtsoí nitsaaígíí (Mayes and Lacey 1989:87); ch'ildiilyésiits'óóz (NMSU2018)
Translation Provided	unspecified
Use Category	ceremonial; domestic
Parts of the Plant	unspecified
Description of Uses	This is a culturally important plant and has ceremonial and domestic uses as a dye.
Scientific Name	*Eriogonum microthecum*
Common Name	slender buckwheat
Navajo Name	izeé bisnideeshchii'(NMSU2018)
Translation Provided	"black root medicine"
Use Category	unspecified
Parts of the Plant	root
Description of Uses	This plant has medicinal and ceremonial uses.
Scientific Name	*Eriogonum racemosum*
Common Name	redroot buckwheat
Navajo Name	azeé biijíchii'
Translation Provided	"red root medicine"
Use Category	ceremonial; medicinal
Parts of the Plant	root
Description of Uses	This plant has medicinal and ceremonial uses.
Scientific Name	*Erysimum capitatum*
Common Name	western wallflower
Navajo Name	Iináájií azeé
Translation Provided	"lifeway medicine"
Use Category	ceremonial; medicinal
Parts of the Plant	root
Description of Uses	The root is used medicinally.
Scientific Name	*Gutierrezia* spp.
Common Name	snakeweed
Navajo Name	Ch'il diilyésii dzaa (NMSU 2018); Ch'il diilyésii yazhi
Translation Provided	unspecified
Use Category	ceremonial
Parts of the Plant	unspecified
Description of Uses	This is a culturally important plant. Navajo people recognize two different types of this plant. This one is considered the small brown stem snakeweed.

Data Category	Species Data
Scientific Name	*Gutierrezia* spp.
Common Name	snakeweed
Navajo Name	ch'il diilyésiisoh (Mayes and Lacey 1989115)
Translation Provided	"big dodge weed" (Mayes and Lacey 1989:115)
Use Category	ceremonial
Parts of the Plant	unspecified
Description of Uses	This is a culturally important plant. Navajo people recognize two different types of this plant. This one is considered the white stem snakeweed.
Scientific Name	*Hymenoxys richardsoni*
Common Name	bitterweed
Navajo Name	né'éshjaa' yilkee'é (NMSU 2018)
Translation Provided	"owl-like foot," "owl's foot"
Use Category	medicinal
Parts of the Plant	root; leaf
Description of Uses	The roots are used medicinally. The leaves are used as an emetic.
Scientific Name	*Ipomopsis aggregata*
Common Name	scarlet gilia
Navajo Name	dáhí tééhii'dáá
Translation Provided	"hummingbird food"
Use Category	veterinary medicine, ceremonial, food
Parts of the Plant	flower
Description of Uses	This is a culturally important plant. This plant is used medicinally for horses and sheep. The flower's nectar is edible.
Scientific Name	*Juniperus communis*
Common Name	common Juniper
Navajo Name	gad
Translation Provided	unspecified
Use Category	ceremonial; medicinal; food; domestic
Parts of the Plant	leaves, seeds, wood
Description of Uses	This type of juniper is boiled and used as an ipecac. The plant has ceremonial uses. Ash from the leaves is used a culinary ingredient for blue corn dishes. The wood used for fires, and habitation structures.
Scientific Name	*Lycium* spp.
Common Name	wolf berry
Navajo Name	haasch'ééhdą́ą́' (NMSU 2018)
Translation Provided	unspecified
Use Category	food
Parts of the Plant	fruit
Description of Uses	Berries are used as food.

Data Category	Species Data
Scientific Name	*Muhlenbergia* spp.
Common Name	muhly
Navajo Names	béé'azhóó
Translation Provided	"brush"
Use Category	domestic/hygiene
Description of Uses	The dried stems of this grass are pulled up from the base and collected to make brushes for grooming.
Scientific Name	*Oryzopsis hymenoides*
Common Name	Indian rice grass
Navajo Name	nididlídii (Mayes and Lacey 1989:102); Ndídlídii (NMSU 2018)
Translation Provided	"scorched" (Mayes and Lacey 1989:102)
Use Category	ceremonial; food; animal feed; medicinal
Parts of the Plant	seed
Description of Uses	This plant has ceremonial uses. It is also good for horses to eat and is used as a cold medicine; seeds are collected by burning the plant. Seeds are ground and made into a porridge.
Scientific Name	*Penstemon barbatus*
Common Name	scarlet bugler; beardlip penstemon
Navajo Name	łį́į́' dą́ą́'
Translation Provided	"horse food"
Use Category	veterinary medicine
Parts of the Plant	whole plant
Description of Uses	The whole plant is used as a medicine for livestock.
Scientific Name	*Penstemon strictus*
Common Name	Rocky Mountain penstemon
Navajo Names	tsédídééh (NMSU 2018)
Translation Provided	unspecified
Use Category	ceremonial
Parts of the Plant	flower
Description of Uses	This is a culturally important plant.

Data Category	Species Data
Scientific Name	*Pinus ponderosa*
Common Name	ponderosa pine
Navajo Name	ńdíshchí́í'(NMSU 2018)
Translation Provided	unspecified
Use Category	ceremonial; domestic
Parts of the Plant	bark; cambium
Description of Uses	The tree is used ceremonially. The term for peeling ponderosa tree bark is ńdíshchí́í'bidadozi, meaning "where the ponderosa was scraped or torn"; wood used for habitation structures; black ash from the bark is used in ceremonies.
Scientific Name	*Poaceae* Family
Common Name	unidentified grass
Navajo Name	ńdíshchí́í' béya'béézhóó
Translation Provided	"the grass that grows under the pine tree."
Use Category	domestic
Parts of the Plant	stem
Description of Uses	The dried stems of this grass are pulled up from the base and collected to make hair brushes.
Scientific Name	*Prunus virginiana*
Common Name	chokecherry
Navajo Name	shashdą́ą́' (Mayes and Lacey 1989:26); didzédik'ǫ́zhí (NMSU 2018)
Translation Provided	"bear food"
Use Category	medicine, domestic
Parts of the Plant	fruit; bark
Description of Uses	This is a culturally important plant used as a medicine.
Scientific Name	*Pseudotsuga menziesii*
Common Name	Douglas fir
Navajo Name	ch' oh
Translation Provided	unspecified
Use Category	ceremonial
Parts of the Plant	unspecified
Description of Uses	This plant is used ceremonially.

Data Category	Species Data
Scientific Name	*Rhus trilobata*
Common Name	three-leaf sumac
Navajo Name	k'įį' (Mayes and Lacey 2016:122); ch'ilłichiin (NMSU 2018) for the berry of the plant.
Translation Provided	unspecified
Use Category	ceremonial; food; domestic
Parts of the Plant	branch, stems; fruit
Description of Uses	Sumac is important for ceremonies and as a food. Sumac has a fruit, or berry, (ch'ilłichiin) that is edible. The berries can be made into a drink or mixed with other foods to make a pudding or porridge. The branches (k'įį') are pliable and can be used to make ceremonial and domestic objects.
Scientific Name	*Rosa woodsii*
Common Name	wild rose
Navajo Name	chǫǫh (NMSU 2018)
Translation Provided	unspecified
Use Category	ceremonial, food
Parts of the Plant	stems, fruit
Description of Uses	This is an important ceremonial plant. Rose hips are also edible.
Scientific Name	*Salix* spp.
Common Name	willow
Navajo Name	k'ai' łibáhígíí (Mayes and Lacey 1989:134); k'ei'łibáhí (NMSU 2018)
Translation Provided	"grey/tan willow"
Use Category	ceremonial
Parts of the Plant	unspecified
Description of Uses	This is an important ceremonial plant.
Scientific Name	*Taraxus officinale*
Common Name	dandelion
Navajo Name	bééshyilt'ą́ą'í (NMSU 2018)
Translation Provided	unspecified
Use Category	medicine
Parts of the Plant	root; leaf
Description of Uses	unspecified
Scientific Name	*Typha latifolia*
Common Name	broadleaf cattail
Navajo Name	t'ęęł nitsaaígíí (Mayes and Lacey 1989)
Translation Provided	"wide cattail"
Use Category	unspecified
Parts of the Plant	unspecified
Description of Uses	This is a culturally important plant.

Data Category	Species Data
Scientific Name	*Verbascum thapsus*
Common Name	mullein
Navajo Name	nát'ohtsoh
Translation Provided	"big tobacco"
Use Category	ceremonial
Parts of the Plant	leaf
Description of Uses	Eight broad leaves are collected and dried and then smoked for the Beauty Way and other ceremonies
Scientific Name	*Yucca* spp.
Common Name	yucca
Navajo Name	tsá'ászeh (NMSU 2018)
Translation Provided	unspecified
Use Category	ceremonial; food; domestic
Parts of the Plant	leaf; root; fruit
Description of Uses	Yucca has multiple uses. The leaves are made into cordage; the blossoms and fruit (hashk'aan) are edible; and the roots are used for soap. The root can be used dry or fresh for daily cleaning.

References Cited

Mayes, Vernon O., and Barbara Bayless Lacy
1989 *Nanise', A Navajo Herbal: One Hundred Plants from the Navajo Reservation*. Navajo Community College Press, Tsaile, Arizona.

New Mexico State Universities Extension Office [NMSU]
2018 Selected Plants of Navajo Rangelands. Electronic resources, http://navajorange.nmsu.edu/browse.php, accessed May 23, 2019.

Appendix D:
Hispano Plant List

Included are detailed data on 39 plant species discussed during interviews and field visits with individuals across the valley. The list is not exhaustive, but represents the plants discussed. Many plants in addition to those listed here also were utilized.

Data Category	Species Data
Scientific Name	*Achillea lanulosa*
Common Name	yarrow
Spanish Name	plumajillo, plumajillo de la sierra
Use Category	medicine
Parts of the Plant	leaf
Description of Uses	This plant is used in the treatment of diabetes.
Scientific Name	*Alcea* spp.
Common Name	hollyhock
Spanish Name	malva arbórea, flor de San José (Cobos 2003)
Use Category	medicine
Parts of the Plant	flower; leaf; root
Description of Uses	This plant is used to soften the skin.
Scientific Name	*Artemisia tridentata*
Common Name	big sagebrush
Spanish Name	chamiso hediondo
Use Category	medicine
Parts of the Plant	unspecified
Description of Uses	unspecified
Scientific Name	*Asparagus officinalis*
Common Name	asparagus
Spanish Name	espárrago
Use Category	food, medicine
Parts of the Plant	shoot
Description of Uses	The young shoots of this plant are eaten.

Data Category	Species Data
Scientific Name	*Cercocarpus montanus*
Common Name	mountain mahogany
Spanish Name	unspecified
Use Category	unspecified
Parts of the Plant	unspecified
Description of Uses	unspecified
Scientific Name	*Chamomilla recutita*
Common Name	chamomile
Spanish Name	manzanilla
Use Category	medicine, food
Parts of the Plant	stem; leaf; flower
Description of Uses	The aerial parts are made into a tea.
Scientific Name	*Chenopodium* spp.
Common Name	wild spinach, lamb quarters
Spanish Name	quelites
Use Category	food
Parts of the Plant	leaf
Description of Uses	Picked in the spring when leaves are tender and boiled fresh and consumed as spinach or dried and stored for consumption later in the year when the plant is not available fresh.
Scientific Name	*Echinocereus triglochidiatus*
Common Name	scarlet hedgehog cactus; claret cup
Spanish Name	pitaya
Use Category	food
Part of the Plant	fruit
Description of Uses	The fruit, or pitaya, can be eaten.
Scientific Name	*Ephedra* spp.
Common Name	joint fir, Mormon tea, Indian tea
Spanish Name	canutillo
Use Category	medicine
Parts of the Plant	stem
Description of Uses	Used in the treatment of urinary tract infections.

Data Category	Species Data
Scientific Name	*Fragaria* spp.
Common Name	strawberry, wild strawberry
Spanish Name	fresa
Use Category	food
Parts of the Plant	fruit
Description of Uses	The berries are eaten fresh.
Scientific Name	*Grindelia* spp.
Common Name	gumweed
Spanish Name	grindelia
Use Category	medicine
Parts of the Plant	unspecified
Description of Uses	unspecified
Scientific Name	*Juniperus monosperma*
Common Name	one-seed juniper
Spanish Name	cadron, sabina
Use Category	food, medicine, fueld
Parts of the Plant	cone; needle; wood
Description of Uses	The cones (berries) are picked and used medicinally. The needles and cones are used to make potpourri.
Scientific Name	*Lavandula* spp.
Common Name	lavender
Spanish Name	alucema
Use Category	medicine
Parts of the Plant	unspecified
Description of Uses	unspecified
Scientific Name	*Levisticum officinale*
Common Name	osha, European lovage
Spanish Name	osha del campo, osha del jardin
Use Category	medicine
Parts of the Plant	root
Description of Uses	This plant has similar medicinal uses to osha de la sierra (*Lingusticum porteri*).
Scientific Name	*Ligusticum porter*
Common Name	oshá, bear root, mountain lovage
Spanish Name	oshá, osha de la sierra, chuchupate
Use Category	medicine, food
Parts of the Plant	root
Description of Uses	The roots are chewed and ingested for multiple internal ailments including respiratory and digestive health, used to keep rattle snakes away.

Data Category	Species Data
Scientific Name	*Mentha* spp.
Common Name	spearmint, mint
Spanish Name	yerba buena
Use Category	food, medicine
Parts of the Plant	leaf
Description of Uses	The leaves of this plant have multiple medicinal uses including being brewed into a tea for treating stomach ailments.
Scientific Name	*Mentha pulegium*
Common Name	pennyroyal, pennyroyal mint
Spanish Name	poleo
Use Category	medicine
Parts of the Plant	leaf
Description of Uses	unspecified
Scientific Name	*Nicotiana attenuate*
Common Name	wild tobacco
Spanish Name	punche, punche mexicano
Use Category	medicine
Parts of the Plant	leaf
Description of Uses	The dried leaves are smoked.
Scientific Name	*Opuntia polycantha*
Common Name	plains prickly pear
Spanish Name	nopal; tuna (fruit)
Use Category	food
Parts of the Plant	fruit; pad
Description of Uses	The fruit and pads are eaten.
Scientific Name	*Pinus edulis*
Common Name	piñon pine
Spanish Name	piñon
Use Category	food, medicine, fuel
Parts of the Plant	nut; sap; wood
Description of Uses	Piñon seeds or nuts are harvested and consumed. The sap, or tremintina, has multiple uses and the wood is burned as a fuel wood
Scientific Name	*Pinus ponderosa*
Common Name	ponderosa pine
Spanish Name	ponderosa
Use Category	medicine, fuel
Parts of the Plant	wood; sap; cone
Description of Uses	Pinecones are used for firestarter. The wood and sap are also used for fire.

Data Category	Species Data
Scientific Name	*Populus* spp.
Common Name	cottonwood
Spanish Name	alamo
Use Category	medicine, food, animal feed
Parts of the Plant	buds, other
Description of Uses	The inner bark is used to wrap broken bones to aid in healing. This plant is also used as fodder for animals when other food is not available.
Scientific Name	*Portulaca oleracea*
Common Name	common purslane
Spanish Name	verdolaga
Use Category	food
Parts of the Plant	leaf
Description of Uses	The young leaves are eaten, usually in the spring and early summer.
Scientific Name	*Prunus virginiana*
Common Name	chokecherry
Spanish Name	capulin
Use Category	food
Parts of the Plant	fruit
Description of Uses	The fruit is harvested and preserved for eating in the fall.
Scientific Name	*Rhus trilobata*
Common Name	three leaf sumac
Spanish Name	lemita
Use Category	food
Parts of the Plant	fruit
Description of Uses	The fruit is eaten.
Scientific Name	*Ribes* spp.
Common Name	currant
Spanish Name	grojella, grosella
Use Category	food
Parts of the Plant	fruit
Description of Uses	The fruit is eaten.
Scientific Name	*Ribes leptanthum*
Common Name	gooseberry
Spanish Name	garambuyo
Use Category	food
Parts of the Plant	fruit
Description of Uses	The fruit is eaten.

Data Category	Species Data
Scientific Name	*Rosa woodsia*
Common Name	wildrose
Spanish Name	champes; rosa de castilla
Use Category	food, medicine
Parts of the Plant	fruit; leaf
Description of Uses	Champes, or rosehips, are eaten as a food, turned into syrup or jelly. The rose can also be used for drinking as a tea and used topically for skin and mouth sores. The flower petals are used to make rosa de castilla.
Scientific Name	*Rubus ideaus*
Common Name	raspberry
Spanish Name	frambuesa
Use Category	food, medicine
Parts of the Plant	fruit;leaf
Description of Uses	The fruit is eaten fresh and the leaves are used medicinally.
Scientific Name	*Rudbeckia ampla*
Common Name	cutleaf coneflower
Spanish Name	dormilones
Use Category	food
Parts of the Plant	unspecified
Description of Uses	Parts of this plant are eaten and are considered a type of quelita
Scientific Name	*Sambucus* spp.
Common Name	elderberry
Spanish Name	chaucauco, flor sauco
Use Category	food, medicine,
Parts of the Plant	fruit; leaf; wood
Description of Uses	This is considered an important medicinal plant that is good for the immune system. The leaves can be used for the skin and thicker branches can be used to make flutes, however the center of the stem is considered poisonous, so caution must be taken.
Scientific Name	*Sphaeralcea coccinea*
Common Name	scarlet globemallow
Spanish Name	yerba de la negrita
Use Category	medicine
Parts of the Plant	root; flower
Description of Uses	This plant is used to treat skin ailments.
Scientific Name	*Syringa* spp.
Common Name	lilac
Spanish Name	lila
Use Category	medicinal
Parts of the Plant	unspecified
Description of Uses	This plant is used medicinally.

Data Category	Species Data
Scientific Name	*Tanacetum* spp.
Common Name	tansy
Spanish Name	ponso, tanaceto
Use Category	unspecified
Parts of the Plant	unspecified
Description of Uses	This plant is used traditionally but no specific uses were provided.
Scientific Name	*Taraxacum officianale*
Common Name	dandelion
Spanish Name	diente de leon, amargón, chicoria
Use Category	food, medicine
Parts of the Plant	leaf; root; flower
Description of Uses	The roots are used to treat liver ailments and the greens and flowers are edible. The flowers can also be used to make wine.
Scientific Name	*Thelesperma* spp.
Common Name	green thread, cota
Spanish Name	cota, te de cota
Use Category	medicine, food
Parts of the Plant	leaf; stem; flower
Description of Uses	The leaves, stems and flowers are dried and boiled and consumed as a tea
Scientific Name	*Verbascum thapsus*
Common Name	mullein
Spanish Name	punchón
Use Category	medicine
Parts of the Plant	leaf
Description of Uses	The dried leaves are smoked as a treatment for respiratory ailments.
Scientific Name	*Yucca* spp.
Common Name	yucca
Spanish Name	yucca; palmilla
Use Category	food; cleaning; cordage
Parts of the Plant	leaf; root; fruit
Description of Uses	Yucca has multiple uses. The roots, or palmilla, are used for soap and shampoo and the fruit is eaten.
Scientific Name	*Zea maize*
Common Name	corn
Spanish Name	maize
Use Category	food, medicine
Parts of the Plant	seed, silk
Description of Uses	Corn silk is used to treat urinary tract ailments and the corn kernels are a staple in a large array of traditional meals.

Reference Cited

Cobos, Ruben
2003 *A Dictionary of New Mexico and Southern Colorado Spanish*. Museum of New Mexico Press, Santa Fe.

Paleocultural Research Group is a member-supported, 501[c][3] nonprofit organization that conducts scientific research, trains students, and educates the public on the archaeology of the Great Plains and Rocky Mountains. PCRG's public archaeology projects use state-of-the-art field and lab methods to investigate human communities and their relationships to the natural environment, from North America's earliest American Indian inhabitants to nineteenth-century traders and settlers. PCRG broadly disseminates its research findings to professional and general audiences, raising awareness of Plains and Rocky Mountains archaeology and fostering preservation of the archaeological resources those regions contain.

Administrative Office and Lab:
585 Burbank Street, Unit A
Broomfield, Colorado 80020
Mailing Address:
P.O. Box 745309
Arvada, Colorado 80006

Phone: (303) 439-4098

To join PCRG or to find out more about PCRG research, visit us online at **paleocultural.org** or find us on Facebook.