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Life by the Lake: Plant Use in Late Owens Valley Prehistory

Author
SANTY, JENNA

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Life by the Lake: Plant Use in Late Owens Valley Prehistory

A dissertation submitted in partial satisfaction of the
requirements for the degree Doctor of Philosophy
in Anthropology

by

Jenna Kathrynn Santy

Committee in charge:

Professor Amber VanDerwarker, Co-Chair

Professor Gregory Wilson, Co-Chair

Professor Jelmer Eerkens, University of California, Davis

Professor Emeritus Michael Jochim

December 2022

The dissertation of Jenna Kathrynn Santy is approved.

Jelmer Eerkens

Michael Jochim

Gregory Wilson, Committee Co-Chair

Amber VanDerwarker, Committee Co-Chair

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My committee has supported me through a lot of ups and downs during grad school. I would like to thank Michael Jochim, for always listening and giving me helpful feedback, and for helping me remember there are more important things in life than graduate school. I thank Jelmer Eerkens for guiding me through my earliest interest in California archaeology, and for supporting me in resurrecting the project that enabled me to finish. Thanks to Greg Wilson for stepping in as an advisor and guiding me through the NSF DDI process. Thanks to Amber VanDerwarker for taking time to help me learn an entirely new subdiscipline and for not giving up on me. Thank you for helping me across the finish line.

Many others in the UCSB community contributed to this work as well. I'd like to thank Majdolene Dajani, Kate Paulson, Anthony Gomes, Patrick McCoy and Winnie Liu for helping me process the samples analyzed in this manuscript. I'd like to thank Robin Roe and Karen Anderson for always answering my questions and helping me stay on track. Thanks to Steve Gaulin for helping me expand my vision of what anthropology is, and how what we all do here is connected. Thanks to Alicia Gorman, Weston McCool, Patricia Chirinos, Shayla Monroe, Sarah Noe, and Toni Gonzalez for helping me clarify my thinking, about research and school but also life in general. Thanks to Tina Panteleakos for listening and helping me work through it all.

I am beyond lucky to have such supportive friends who helped carry me at so many points during this process. I thank Jessica Kaplan and Elizabeth Weigler. Our cohort was small but mighty. We are bonded for life by this experience, and your resilience inspires me. Seeing you both live life on your own terms, make choices that are best for you, and move on with your lives after finishing gave me hope. I thank Erin Bornemann and Christina Friberg, for all the wine and baked goods, tears of laughter and sadness, and late night airing of grievances. The promise of our Palm Springs getaway is powering these last few weeks of work. Erin also did double duty as the editor who formatted this document, and I can't recommend her highly enough ☺. I thank Michael Arrigo and Stacie Townsend. Our friendship is one of the great blessings of my life. I'm honored to have traveled parallel paths with you as we all walked across our separate beds of coal, and I'm excited for when we can finally celebrate together via the ritual eating a Costco sheetcake.

My family has been incredibly supportive during this long process. Thanks to Liz and Tom Ruhrup and Kim and Scott Higgins for rooting for me and believing in me. Thanks to BK Santy, for keeping me on my toes and making me better at answering complicated questions. Thanks to Skip and Kathy Santy, whose support of and belief in me, in innumerable ways, made all of this possible. I can never thank you enough. And finally, thanks to Rudy Dinarte. We are strong because we support each other. That is what true partnership is. Thank you for believing in me, even in those moments when I didn't believe in myself.

DEDICATION

I dedicate this dissertation to the Nümü of Payahuunadü, and to all the land defenders and water protectors who are fighting for the future. Water is Life.

VITA OF JENNA KATHRYNN SANTY

June 2022

Courses Offered: Introduction to Biological Anthropology (lab + lecture); Introduction to Archaeology; Introduction to Cultural Anthropology; Native Peoples of California and the Great Basin; Magic, Witchcraft and Religion; Native Peoples of North America; Archaeology of California and the Great Basin; Hunter-Gatherers

Research Interests: incipient social complexity, household and communal organization, household archaeology; archaeobotany; subsistence practices, resource intensification; hunter-gatherers; California and Great Basin

EDUCATION AND ACADEMIC ACHIEVEMENTS

2022: In-progress: Ph.D. in Anthropology, UCSB (matriculation: Fall 2022)
2015: Advanced to Candidacy
2012: M.A. in Anthropology, UCSB
2009: B.A. in Anthropology *magna cum laude*, UC Davis
2009: B.A. in Art History *cum laude,* UC Davis
2009: Awarded Departmental Citation of Merit, UC Davis Anthropology Department
2009: Awarded Departmental Citation of Merit; UC Davis Department of Art History
2009: Honor's Thesis in Anthropology
Under the direction of Dr. Jelmer Eerkens, I analyzed the chemical compositions of soil samples from two Owens Valley house floors in an attempt to observe communal behavioral changes between 1500 and 300 years before present.

TEACHING EXPERIENCE

2018 Anthropology Instructor, Part-Time (Anth 101 Intro Bio Anth Lecture: Summer 2018, Fall 2021(online); Anth 110 Bio Anth Lab: Spring 2021, Fall 2021); Allan Hancock College, Santa Maria, CA
2020 Anthropology Instructor, Part-Time (Anth B1 Intro Bio Anth Lecture: Spring 2021; **2021** Anth B1L Bio Anth Lab: Fall 2020, Spring 2021) Bakersfield College, Bakersfield,
CA
2016 Instructor of Record, ANTH 127: Hunters and Gatherers (UCSB; Summer Session B)
Instructor of Record, ANTH 194P: Archaeological Field Methods and Practice (UCSB Summer Session A); a six-week field school where I taught seven undergraduates basic archaeological field techniques, including excavation,

survey, mapping with total station and Trimble; and basic lab techniques, including artifact processing and cataloguing.

2015 Head Teaching Assistant, ANTH 5: Introduction to Biological Anthropology (UCSB; Fall quarter)
Duties included teaching one weekly section and holding office hours; additionally, I was responsible for maintaining the course LMS, Gauchospace, for 400+ students; managing and maintaining course technology (specifically iClickers); corresponding with Disabled Students Program and creating alternative course accommodations; assisting with weekly TA meetings to discuss course content; finalizing the copy edit, layout, and collating of course exams; managing Parscore/scantron grading of exams; finalizing and submitted final course grades.

2011-2018 Teaching Assistant, (UCSB Department of Anthropology):
ANTH 2: Introduction to Cultural Anthropology (3 quarters)
ANTH 3: Introduction to Archaeology (1 quarter)
ANTH 5: Introduction to Biological Anthropology (10 quarters)
ANTH 7: Introduction to Biosocial Anthropology (Evolutionary Psychology) (2 quarters)
ANTH 121: Human Evolution (1 quarter)
ANTH 131: North American Indians (2 quarters)
ANTH 100: Archaeological Concepts (1 quarter)

Guest Lectures:
ANTH 121 - Human Evolution: "Evolutionary Mismatch and the EEA" (UCSB, Spring 2016; Spring 2017)
GEOG 330 - California Geography: "Indigenous California: Past and Present" (CSUN, Spring 2017; Fall 2017)
ANTH 162 - Origins of Food Production: "Foragers" (UCSB, Summer Session B 2017; and Winter 2018)
ANTH 3 - Introduction to Archaeology: "Indigenous California: Foragers From Prehistory to Today" (UCSB, Summer Session B 2019)

INSTRUCTIONAL DEVELOPMENT

2022 Workshop: Culturally Responsive Teaching (Bakersfield College)

2021 Certificate in Online Teaching (EDU 30: Intro to Online Learning Environments; EDU 31: Cultivating Online Learning Communities; EDU 32: Equity, Access, and Humanizing Online Learning) Bakersfield College, Bakersfield, CA

2018-2020 Community College Anthropology Teachers Association Annual Meeting.
Attended conference of community college anthropology teachers, discussing teaching best practices, equity, cultural responsive pedagogies, and other topics. Paso Robles, CA

2017-2018 Pedagogical Advisor, TA Development Program; UCSB Instructional Development
Responsibilities include planning and presenting workshops for TA development (examples include: Efficient and Effective Grading of Student

Work; Managing Teaching Related Anxiety); consulting with graduate student TAs to improve classroom practice (examples: increasing student engagement, designing effective assessments; effective questioning strategies; teaching problem solving, etc.); weekly meetings with supervisor and fellow graduate advisors to discuss program objectives, scheduling, and pedagogy.

2016 Completed STIA certificate (Summer Teaching Institute for Associates; UCSB Instructional Development)
STIA certification required attending workshops discussing pedagogy, classroom technology, active learning techniques, etc.; documenting and examining course progress and planning; weekly meetings with faculty mentor to discuss teaching.

AWARDS AND GRANTS

2017: UCSB Academic Senate Travel Grant
2017: UCSB Anthropology Department Fellowship (Winter Quarter)
2016: NSF Doctoral Dissertation Improvement Grant (NSF #1627005)
2016: Erasmus Grant; UCSB Department of Anthropology
2015: Anthropology Graduate Student Research Grant
2014: UCSB Graduate Division Humanities and Social Sciences Research Grant
2014: Anthropology Graduate Student Research Grant
2013: UCSB Summer Stipend Award
2012: UCSB Summer Stipend Award
2011: Member, UCSB Ethics Bowl Team, 1st place Ethics Bowl Competition, awarded by the Society for American Archaeology
2010: First Prize in SCA Student Paper Symposium for "The Organization of Domestic Space in Two Late Prehistoric Owens Valley House Floors"
2010: Awarded UCSB Dean's Fellowship for Graduate Study for 2010-2011 school year

PUBLICATIONS

2016 "The Promise of Ancient Starch Research: A Case Study from CA-SBA-53, a Middle Holocene Archaeological Site along Goleta Slough". *Journal for California and Great Basin Anthropology.*

INVITED SYMPOSIA

2019 "From the Coast to the Interior: Broad Trends in Prehistoric Plant Use From Southern and Eastern Alta California." 2019 SCA Meeting, Sacramento, CA.

2015 "Ancient Starch Research on the Santa Barbara Coast." 2015 SAA Meeting, San Francisco, CA.

PRESENTATIONS AND POSTERS

2017 "Life by the Lake: Plant Use in Late Owens Valley Prehistory." Presented at 2017 SCA Meeting, Fish Camp, CA.

2016 "Changing Household, Changing Community: A Proposed Dissertation Project in Owens Valley, CA". Presented at 2016 SCA Meeting, Ontario, CA.

2014 "The Promise of Ancient Starch Research in California: A Case Study from the Santa Barbara Coast." 2014 SCA Meeting, Visalia, CA.

2013 "Tracking the Transition to Acorn Processing: A Case Study from the Channel Coast." 2013 SCA Meeting, Berkeley, CA.

2012 "Culture Contact, Change, and Continuity at C.W. Cooper: Recent Data from a Mississippian Village in the Central Illinois River Valley." Paper presented at the 69th Southeastern Archaeological Conference Annual Meeting. Baton Rouge, LA. (Co-author Christina Friberg)

2010 "The Organization of Domestic Space in Two Prehistoric Owens Valley House Floors." Jenna Santy and Jelmer Eerkens. 2010 SCA Meeting, Riverside, CA.

2010 "Soil Chemistry, Features, and Households: A Comparison of Techniques." Jelmer Eerkens, Jeffrey Ferguson, and Jenna Santy. 2010 SCA Meeting, Riverside, CA.

2009 Presentation at Society for California Archaeology's Northern Data Sharing Meeting, Oct 17:
Presenters: Jelmer W. Eerkens and Jenna Santy, University of California, Davis.
Chemical vs Physical Features and the Organization of Domestic Space in Owens Valley.

2009 Poster Presented at UC Davis Undergraduate Research Conference: *The Organization of Space in Two Late Prehistoric Owens Valley Households.*

FIELD RESEARCH EXPERIENCE

June-August 2016: Households in Owens Valley Archaeological Project (HOVAP) Six-week undergraduate field school contributing data to my dissertation project.
January 2015: CA-INY-3904 Shovel Testing; dissertation pilot research, Owens Valley, CA
September 2014: CA-INY-3904 and -7749 Gradiometer Survey; dissertation pilot research, Owens Valley, CA
April 2014: Aubrey Site Gradiometer Survey, Eldred, IL
June-August 2012: Field Supervisor: Central Illinois River Valley Project, Lewiston, IL
August 2012: El Monton Archaeological Project, Santa Cruz Island, CA
August-September 2011: Federsee Archaeological Project, Bad Buchau, Germany
August-September 2011: El Monton Archaeological Project, Santa Cruz Island, CA
August-September 2010: El Monton Archaeological Project, Santa Cruz Island, CA
May 2010: Owens Valley House Floor Test Excavation, Owens Valley, CA
June-August 2008: UC Davis Field School, Vandenberg AFB, Lompoc, CA

CULTURAL RESOURCE MANAGEMENT EXPERIENCE

October 2022- present: Associate Archaeologist, Stantec Environmental Services Inc.

July-August 2019: Monitoring, Goleta Sanitation District Pipeline Replacement Project. Stantec; Goleta, CA.

September-December 2018: Phase I and extended Phase I, Ormat Battery Storage Facility. Stantec; Carpinteria, CA.

June 2015-September 2015: Sorting and plant identification for McCoy Bridge Project for TRC Garrow Associates; Amber VanDerwarker, PI. Goleta, CA.

May 2015: Survey and site assessment for Refugio Oil Spill; Applied Earthworks. Goleta, CA.

July-September 2014: Sorting for Sabal Trails Project for TRC Garrow Associates; Amber VanDerwarker, PI. Goleta, CA.

June-July 2010: Edwards AFB Survey and Site Assessment; ASM Affiliates, Inc. Lancaster, CA.

May 2010: El Centro Solar Fields Survey; RECON. El Centro, CA.

September 2009-March 2010: A variety of tasks and projects, including shell sorting, phase I survey, phase II excavation, and water screening; Laguna Mountain Environmental. San Diego, CA.

SERVICE AND OUTREACH

2012-2013: Secretary, Anthropology Graduate Students Association

2011-2012: Secretary, Anthropology Graduate Students Association

February 2017: Participant, World Archaeology Day

February 2016: Participant, World Archaeology Day

January 2012: UCSB Repository Outreach.
A morning with local third graders teaching archaeology.

September 2011: UCSB Repository Outreach.
An afternoon with local third graders teaching the importance of archaeology.

May 2011: UCSB Repository Outreach.
An afternoon with local high schoolers teaching about archaeology.

March 2011: UCSB Repository Outreach.
Working with a group of local sixth graders and teaching some basics of archaeology.

2010-2011: Anthropology Department Co-Representative, Graduate Student Association.

PROFESSIONAL ASSOCIATIONS

Member, Society for American Archaeology

Member, Society of California Archaeology

ABSTRACT

Life by the Lake: Plant Use in Late Owens Valley Prehistory

by

Jenna Kathrynn Santy

Questions of social reorganization, the adoption and spread of novel technologies, and subsistence shifts have long been of interest to archaeologists, but especially those working in both California and the Great Basin. Over the last 1,500-1,000 years in Payahuunadü, today known as Owens Valley, significant social and political changes have been observed archaeologically for the populations who resided in this area. Our greater understanding of these large-scale social changes as observed archaeologically dovetail well with paleoethnobotanical studies in the region. However, two issues related to the body of paleoethnobotanical data available for the region are identified and addressed in this dissertation: 1) the region lacked a comprehensive synthesis of paleoethnobotanical data and 2) most of the archaeological investigation have been limited to the Highway 395 corridor, which has resulted in uneven coverage of plant use data, especially on the valley shore (e.g., along the shores of Owens Lake).

This dissertation has three goals: 1) to synthesize existing data with regards to plant use from the late Newberry period (c. 3300 years Before Present [BP]) through the Contact period (c. 150 years BP); 2) to better understand how ancient residents

of Owens Valley used locations in the valley beyond the modern-day Highway 395 corridor; and 3) to examine the adoption and spread of bow-and-arrow and ceramic technologies, two events separated by roughly 600 years, through a paleoethnobotanical lens. To address these goals, I have synthesized existing paleoethnobotanical datasets for the region to create a comprehensive dataset, as well as analyzed extant archaeological materials from four lakeside sites for inclusion in the regional dataset: 1) CA-INY-3806/H, 2) INY-7448, 3) INY-8768, and 4) INY-5207.

This study considers the role resource intensification plays in social phenomena, including the sharing and storing of resources, and risk management and privatization, which have greater implications for the cascading effects of new technology, subsistence intensification, and social reorganization in the region. The spread of the bow-and-arrow around 1500 BP is hypothesized to have contributed to a social reorganization partially oriented around pinyon intensification. Thus, we would expect an increase in pinyon usage (as measured by an increase in archaeological pinyon abundance) between the Newberry and Marana periods. Similarly, if Newberry-era residents “underused” plants (Bettinger 2015:43), we might expect a more extensive, generalized plant assemblage in that era; this could look like greater usage of roots and tubers, which are often less energetically costly than seeds (Gremillion 2014). Later in time, correlated with the spread of pottery (c. 600 BP), privatization of other plant food is proposed to have happened in tandem with changes in land use, towards an increase in logistical mobility and use of more distant resources (Eerkens 2012b). In terms of land use, an increase in logistical foraging (where a forager travels afield in search of food before returning to a central base camp) could look like exploitation of environments beyond the immediate setting of the residential site. For example, in the Haiwee period, where foraging was potentially less logistical, we would expect there to be a higher degree of correlation between site environment (i.e., the environmental setting of the residential camo) and plant food environment (the environmental setting where the specific plant food is found). Residents of wetland sites would use more wetland plants, and upland sites would use more upland plants. In the more logistical Marana period, we would not necessarily expect this pattern; wetland sites could have plant foods from upland environs, and vice versa.

The Owens Valley is located in eastern California, along the eastern escarpment of the Sierra Nevada Mountains. This dissertation focuses on two periods in late Owens Valley prehistory: the Haiwee Period (1400-650 BP) and the Marana Period (650-150 BP), the latter which ended at Contact with Euro-American settlers. The earlier Newberry Period (3500-1400 BP) is also included to some degree, as it several important cultural characteristics emerged during that time relevant to the discussion from the other two time periods. This dissertation presents the results of the synthesized regional paleoethnobotanical dataset, which includes data from 40 sites dating between 3500 and 150 years BP. Lakeside plant use is specifically highlighted, via analyses from the four sites analyzed for this dissertation (previously listed). I specifically investigate ways in which people used these sites differently between the Haiwee and Marana periods, and what we can learn about settlement, mobility and seasonality of use from these datasets.

The synthesis of prehistoric plant use in the Owens Valley (Chapter 5) was based upon all documented archaeobotanical assemblages to date, and further aimed to evaluate how plant use (e.g., use of seeds) changed between the Newberry and Late Marana periods, how the intensification of pinyon is reflected in plant use data on the valley floor, and how the intentional plant use by the inhabitants of the valley reflect how the changes in land and habitat use through time are reflected in people's plant use. Plant foraging in the Newberry period seems to represent a generalized, logistically-oriented practice. Valley residents pursued a range of plant resources across the landscape, and brought those resources back to their base camp, leaving the ecologically varied plant assemblage seen archaeologically at Newberry occupations, including widespread, non-intensive use of pinyon. Plant use in the Haiwee period bears some striking similarities to the Newberry but with one notable exception: the rise in pinyon. By the Late Marana period, roughly 250-300 years ago, the domination of small seeds across assemblages, and presumably their use by valley floor residents, skyrocketed. Pinyon was still present, in amounts similar to previous times, but it seems clear that the plant subsistence focus of people living on the valley floor was seeds.

Analyses of the data from the Lakeside sites in the study (INY-7448, -5207, -3806/H, and -8768; Chapter 6) was aimed to investigate if there was a difference in plant use by those living at lakeside sites vs. those who did not, if these sites were subject to seasonal occupation, if local plant use trends conformed to the valley overall, and if wetland plants were specifically targeted by residents. One of the most striking trends is the relatively low percentage of weedy pioneers throughout time. At lakeside sites, in some contrast to other regional sites, seeds did not comprise a significant portion of the diet until the Late Marana period. Wetland plant resources were differentially targeted by site residents. By the Late Marana period, it seems likely that lakeside sites were annually reoccupied, perhaps as places where pottery was cached and wetland seed foods were gathered and processed. However, by the early Haiwee period, pinyon had already been incorporated into the diet of lakeside residents, in such amounts as to suggest pinyon was being intensified by people.

The primary contribution of this dissertation has been the generation of an extensive, synthetic dataset (Appendix A), comprising all known data regarding plant use in Owens Valley prehistory, building on previous research (Pierce 2002). The secondary contribution has been to add to the discussion of changing social and political organization in late prehistory, by looking at a crucial line of evidence – plant use visible through paleoethnobotanical analyses. This dissertation represents one more step toward improving our understanding how the residents of Payahuunadü made dynamic use of their surrounding landscape between 1500 BP and 150 BP, establishing a regional dataset that can provide a jumping off point for future researchers.

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Chapter 1: Introduction

Questions of social reorganization, the adoption and spread of novel technologies, and subsistence shifts have long been of interest to archaeologists. The pursuit of answers to these questions has animated investigations into the origins of agriculture, cities, complex hierarchical political formations, and large-scale human migrations, among many other monumental topics. On a much more intimate scale, these questions have also long been of interest to archaeologists working in California and the Great Basin.

Researchers in these places often study these questions in relation to the concept of subsistence intensification, which compares the ratio of energy generated by human foragers, in the form of edible calories, to energy expended to access those calories.

The ancestral indigenous peoples of California and the Great Basin have variably exerted and experienced these forces, like people everywhere, since time immemorial. However, archaeological evidence suggests that, at some point within the last ~1500-1000 years (depending on the specific place), the effects and results of these forces resulted in a series of shifts and reorganizations of native populations into the varied and complex social and political units documented and disrupted by Euro-American settlers during the 18th and 19th centuries. The research presented in this dissertation focuses on how the residents of Payahuunadü, also known today as Owens Valley (Figure 1.1), experienced and affected these forces, through the lens of plant use, beginning approximately 1500 years ago.

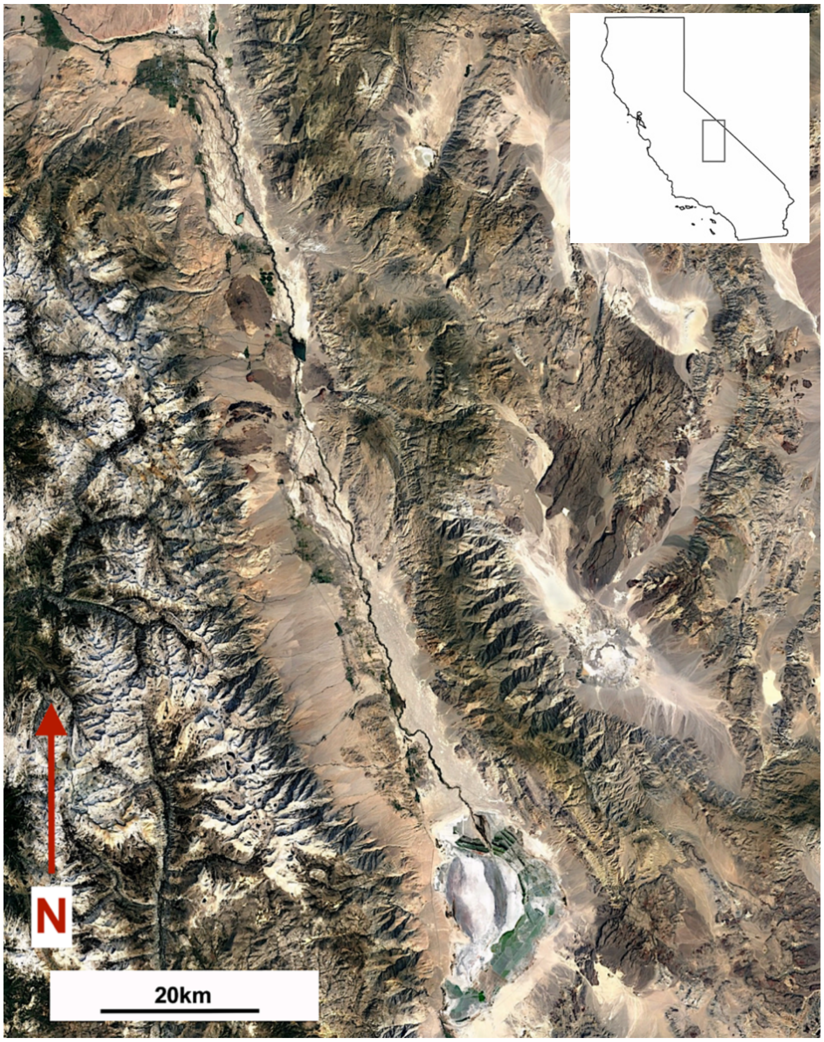

Figure 1. 1. Map of Owens Valley, showing Dry Lake to the south, Sierra Nevada Mountains to the west, and the Owens River running north to south. Credit: J. Santy.

The Owens Valley today bears little resemblance to itself scarcely a century ago. The Los Angeles Department of Water and Power occupied the region as a water colony beginning in the late 19th century, and diverted a significant amount of the region's water over the Sierra Nevadas to the greater Los Angeles metropolitan area (oviwc.org). Owens Lake, today a dry lake bed fed by a trickle of the recently restored Owens River, was once an expansive saline lake, covering more than 50,000 acres and up to 15 m deep (Reheis 2006), surrounded by marshes and wetlands, with numerous tributary creeks feeding it Sierra snowmelt. It would have been teeming with plant and animal life, and had, at contact, the highest density of indigenous inhabitants in the entire Great Basin (Steward 1933). There are several general trends that have been documented regarding human use of plants in Owens Valley prehistory, but the contours of these trends, their limits and extents, are not well understood. And while a basic culture history sequence has been established in the region, disagreements persist about the fundamental ways prehistoric societies were organized and how people used the landscape and resources around them. A few ideas, specifically relating to plant use, are generally agreed upon. One significant and well-documented trend is that inhabitants of the Owens Valley, around 600 years ago, started using more seeds (in terms of density) than earlier in time (Eerkens 2004). This change is thought to signify subsistence intensification, that is, a decrease in the foraging return rate, brought about by targeting resources with higher processing costs (seeds) compared to other plant food types (specifically geophytes and nuts). This increase in seed use is correlated with the arrival and adoption of pottery (Eerkens 2001). Prior to intensive seed use, pinyon became more important to the diets of valley residents as late as 1000 years ago, and potentially as early as 1500 years ago (Basgall and Delacorte 2012; Bettinger 2015). Beyond these statements, much else is the subject of debate.

Beyond these debates, plant use by prehistoric inhabitants of the Valley has been studied, with limited exception, only in a relatively narrow band of Owens Valley; there are microregional, locational gaps in the data available. Most of the existing data comes from gray literature produced according to laws requiring archaeological mitigation for large scale construction projects. In Owens Valley, those projects are most often related to the widening and/or realignment of Highway 395, the main traffic artery in eastern California connecting south (starting just north of Los Angeles) and north (past Lake Tahoe, through Reno, and up into Oregon and Washington), in the shadow of the eastern escarpment of the Sierra Nevada Mountains. Much of the work that has been done in the region by contract archaeologists, and paleoethnobotanists specifically, is of high quality; however, the literature is fragmented, and data about prehistoric plant use from sites beyond the "area of potential effects" (APE) in this corridor are uncommon.

The nature of contract work creates two issues. The first is that literature is fragmented, and while synthetic treatments have been given in both gray literature project reports (Pierce 2011, 2012) and academic articles (Pierce and Scholze 2016), a comprehensive synthesis of paleoethnobotanical data from this region has not been produced. The second is that most of the archaeological investigation has been limited to the Highway 395 corridor, which roughly follows the course of the Owens River before veering west and cutting across several of its tributary streams. As a result, plant use data exist for these areas, but lacks for others regions on the valley floor, such as along the shores of Owens Lake.

A final lingering question is the role of technology in changing subsistence patterns; how does the introduction of novel subsistence technologies contribute to change in the social and economic calculus of the food pursuit, specifically with regards to plant resources? During the periods of interest here, there were two separate but equally widespread technological adoption events in the region; the first was the bow-and-arrow, spreading across the valley c. 1400 years ago, and the second was pottery, which started spreading c. 600 years ago[1] and became widespread by c. 300 years ago. The significance of these two events has been widely theorized and discussed (Bettinger and Eerkens 1999; Bettinger 2013, 2015; Eerkens 2001, 2003, *inter alia*), but not specifically through the lens of paleoethnobotany and data directly speaking to plant use through time.

This dissertation has three goals. The first is to synthesize existing plant data with regards to plant use from the late Newberry period (c. 3300 years BP, roughly coeval with the end of the Archaic period, and the first era in prehistory for which significant paleoethnobotanical data exist) through the Contact period (c. 150 years BP). Does the seed-use trend documented by others hold up as a valley-wide trend? Can we make sense of how people used plants at the landscape level, that is, comparing the environments where sites are located with the resources used at those sites? Pinyon intensification is argued to have occurred during the Haiwee period; how is this trend evident in plant data? How does site location factor in to pinyon use and storage? Synthesizing the available plant data with the intention of understanding both central tendencies and significant variation, in light of existing hypotheses, is the first contribution this dissertation makes.

The second goal is to better understand how ancient residents of Owens Valley used locations in the valley beyond the modern-day Highway 395 corridor. Several important valley ecozones are represented in the corridor, but many are not. Major investigations have occurred between the towns of Independence and Bishop, encompassing parts of the Owens River and portions of several of its tributaries,

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[1] Eerkens and others (1999) noted that pottery was first documented in Owens Valley as early as c. 1200 years ago, but was rare until c. 600 years ago.

including Big Pine Creek, Independence Creek, and Taboose Creek. An important yet under-investigated microregion is that of then-Owens Lake (now Owens Dry Lakebed), which before Contact would have been teeming with plant and animal life-- on the lake itself, on the marshy wetlands bordering it, and the several (now dry) tributaries that would have fed it. This dissertation presents paleoethnobotanical data from four previously excavated sites along the shore of Owens Lake, and evaluates the role of lakeside sites in ancient human settlement patterns and lifeways.

A final goal is to examine the adoption and spread of bow-and-arrow and ceramic technology, two events separated by roughly 600 years, through a paleoethnobotanical lens. While the bow-and-arrow is not directly related to plant subsistence, the proposed effects of its adoption are (Bettinger 2015). These effects include social reorganization, changes in strategies of risk management, and shifts in the way food is or is not to be shared among non-family community members. Pottery, unlike the bow-and-arrow, is a technology that connects directly to the cooking and consumption of plants by people. We know that the increase in seed use correlates with an increase in ceramic use (Eerkens 2001, 2003), but again, the contours of this relationship remain subject to investigation. Similar to bow-and-arrow, the adoption of ceramics is hypothesized to correlate with shifts in social and community organization. Evaluating these two technological adoptions, with a focus on their implications for and significance to changing plant use through time, is another objective of this dissertation.

Before considering these questions, I provide the background necessary to place them in regional context. Chapter 2 describes the natural environment of the

Owens Valley, including its unique ecology as a well-watered desert. I then review the cultural and ethnographic history of the region, and discuss the paleoethnobotanical research that has been done there. I also present the four lakeside sites that contributed the materials analyzed as part of this dissertation.

Chapter 3 presents the theoretical frameworks necessary to understand the relationships between resource intensification, social organization, and technology. I also review the theoretically-oriented work of scholars who have extensively studied the relationship between these three dimensions in the region that this dissertation directly addresses.

Chapter 4 reviews the ways in which the data presented in this manuscript were gathered and analyzed. This includes a discussion of the methods for recovering and identifying macrobotanical remains from the four lakeside sites, creating a database of those specimens, as well as the methods of quantifying those remains and synthesizing them into the regional dataset.

Chapter 5 present the results of the synthesized regional paleoethnobotanical dataset, with data from 40 sites dating between 3500 and 150 years Before Present (BP). I review known ethnographic uses of plants found in archaeological assemblages, and present general trends in plant use through time. These trends include shifts in assemblage composition and habitat usage, and I explore what that means for how valley residents used plants and habitats throughout prehistory.

Chapter 6 focuses on lakeside plant use, highlighting data from the four sites analyzed for this dissertation. I specifically investigate ways in which people used these sites differently between the Haiwee and Marana periods, and what we can learn about settlement, mobility and seasonality of use from these datasets.

Chapter 7 is a discussion of plant use in Owens Valley prehistory specifically in light of previous research in the region investigating the adoption of the bow-and-arrow and the cascading effects in subsistence and social organization that adoption had, including its connection to the adoption of pottery technology six centuries later. I evaluate the plant evidence for early Haiwee-period intensification of pinyon, and discuss how plant data can contribute to discussions about the shift to a more privatized, nucleated social structure. I then discuss Marana period plant data in light of continuing resource intensification, culminating in the adoption of pottery by local inhabitants; I also consider the origins of the ‘proto-agricultural’ (Lawton et al. 1976) irrigation plots constructed by indigenous residents, the antiquity of which are unknown and subject to debate.

Finally, Chapter 8 summarizes the findings presented in this manuscript and considers future directions for research, paleoethnobotanical and otherwise, for investigating resource intensification, social structure, and technology in Owens Valley prehistory.

Chapter 2: Background and Cultural Context

When looking at the dry Owens Lake today, it is difficult to imagine how drastically different things were a century ago. With the completion of the California Aqueduct in 1913, which diverted water to slake the thirst of growing Los Angeles, the lake as it existed for thousands of years prior ceased to be. This dissertation focuses on two periods in late Owens Valley prehistory: the Haiwee Period (1400-650 BP), and the Marana Period (650-150 BP), the latter which ended at Contact with Euro-American settlers. Prior to these periods, the earlier Newberry Period (3500-1400 BP) saw several important cultural characteristics emerge, and thus is relevant to this discussion. While the materials analyzed for this project are from lake-adjacent sites, it is necessary to consider the full environmental and cultural context of the area. As such, the following chapter reviews the history of archaeological and paleoethnobotanical research in the Owens Valley, including work done under the aegis of both the academy and Cultural Resource Management.

Climate and Ecology

The southern Owens Valley is a true desert; it receives an average of six inches of rain and up to nine inches of snow annually. Peak summer temperatures often exceed 100°F, with winter temperatures dropping below freezing (32°F; usgs.gov). As expected, higher elevations receive more precipitation, usually as snow, and have lower average temperatures.

The steep eastern escarpment of the Sierra Nevada mountains results in a rain shadow effect, and denotes the transition from the California geographic province into the Great Basin (Liljebad and Fowler 1986). While the western slope is relatively better watered, snowmelt flowed year-round from several creeks that fed the Owens River and creeks such as Cottonwood and Carroll Creeks; all creeks and rivers ultimately flowed into Owens Lake, which has no further outlet. The lake's primary feeder creeks, from northernmost to southernmost were Carroll, Cottonwood, and Ash creeks; creeks north of Carroll Creek (including Lubken, Tuttle, and Lone Pine Creeks) fed the Owens River, which drain into the north end of Owens Lake.

The presence of the lake, the drainages, and the relatively steep slopes of the Sierras allowed peoples living in the Owens Valley access to a wide range of vertical ecosystems in a small horizontal area (Figure 2.1a,b; also see Bettinger 1975:22, Figure 2).

Biotic communities on the valley floor are typical for the high desert (elevation: 3700' above sea level) and include chaparral and grassland, with shadscale (*Atriplex*), sagebrush (*Artemisia*), and rabbitbrush (*Chrysothamnus*) dominating; jackrabbits, ground squirrels, coyotes, and skunks are endemic on the valley floor, as well as at higher elevations (Schoenherr 1992). Pinyon woodland, toward the eastern face of the Sierra Nevada and the western faces of the White and Inyo Mountains above 1500 m, is one of the most economically important biotic zones (Bettinger 1982:9-11); pinyon pine (*Pinus monophylla*) is the single most important staple food in late prehistory. Other economically important taxa such as manzanita (*Arctostaphylos*) and higher altitude sagebrush (*Artemisia*) are also found here. Notably, important animal taxa are found at these higher elevations,

Figure 2.1a. Biotic communities of Owens Valley. Image showing shadscale chaparral in foreground, Alabama Hills in mid-ground, and pinyon woodland and alpine zones in background. Photo taken facing northwest. Image credit: Jenna Santy

*Figure 2.1*b*: Owens Dry Lake, facing east, with Coso Range in background. Image credit: Jenna Santy.*

including bighorn sheep and mule deer. Between 2400-3300 m, pines dominate, including lodgepole and Jeffrey pines. Above 3600 m, the treeline, is the alpine zone; this zone was primarily used for hunting large game (Bettinger 1991a) and does not contain many economically important plant species.

Though it is difficult to imagine today, prehistoric inhabitants of the southern Owens Valley also would have had access to a variety of littoral habitats along the shore of Owens Lake and the many drainages that fed it. Residents had their choice of habitats; on the alkali lake itself, makeshift tule reed rafts were used for duck-hunting (Steward 1933:258). The shore of the lake provided brinefly larvae, and migrating shorebirds and waterfowl including grebes, avocets, phalaropes, and ducks; it also had vegetative communities with economically important plants like cattail and tule. Riparian habitats, of Owens River and the creeks that fed the lake, gave opportunities for fishing, including for the native tui chub and the Owens sucker[2]. Freshwater creeks also contained freshwater mussel; at higher altitudes (above 1500 m), trees such as willow, cottonwood, and birch grew along water courses. Creeks, of course, also were a draw for game animals, like deer and rabbit, throughout prehistory.

The lake today bears almost no resemblance to the descriptions of the early Euro-American visitors (Guinn 1917), who noted its expanse and the diversity of natural resources that surrounded it (Figure 2.2). However, the lake, throughout prehistory, has constantly changed, rising and falling during dynamic climatic regimes.

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[2] While the eastern Sierra is famous today for its trout fishing, four species (rainbow trout, brook trout, cutthroat trout, brown trout) were introduced as game fish; golden trout may or may not have been introduced, as they occur naturally in the western Sierra, and are found in only a few alpine and subalpine waterways on the eastern side.

Paleoclimate

Recent research has presented an extensive picture of Owens Lake during the Late Holocene, and convincingly linked lake levels to climate throughout time. Bacon et al.'s (2018) study combines both shoreline data and lake core data, and presents the most comprehensive model to date of lake levels during the middle and late Holocene. Between c. 1500-200 BP, the lake averaged between 1088-1090 m elevation, never dropping below 1086m, and occasionally rising as high as 1103m (for reference, Owens Lake today is a hypersaline brine pool, at 1084m).

Figure 2.2. Owens Lake c. 1900-1930. Facing east. Image credit: UCLA Library, LA Aqueduct Digital Platform.

A persistently low lake cycle from 1900-1600 BP was likely encouraged by high average temperatures; as the Newberry period ended, temperatures rose, but so did average precipitation. During the late Newberry and early Haiwee periods (1600-1100 BP), lake levels fluctuated, with three cycles of a ~20 year high period followed by a ~150 year low period; during this time, temperatures were on the higher side, with high variability in precipitation (Figure 2.3).

The 1086 m lowstand was a result of an episode of "extreme and persistent drought" (Bacon et al. 2018:287) between 1010 and 890 BP; this overlaps with globally-observed Medieval Climatic Anomaly, which lasted from 1300-700 BP. With the exception of a single short, anomalous interval of <20 years, the lake levels stayed low (under 1090 m) during an extended drought 1050-550 BP; this drought has been documented widely across the Western Great Basin.

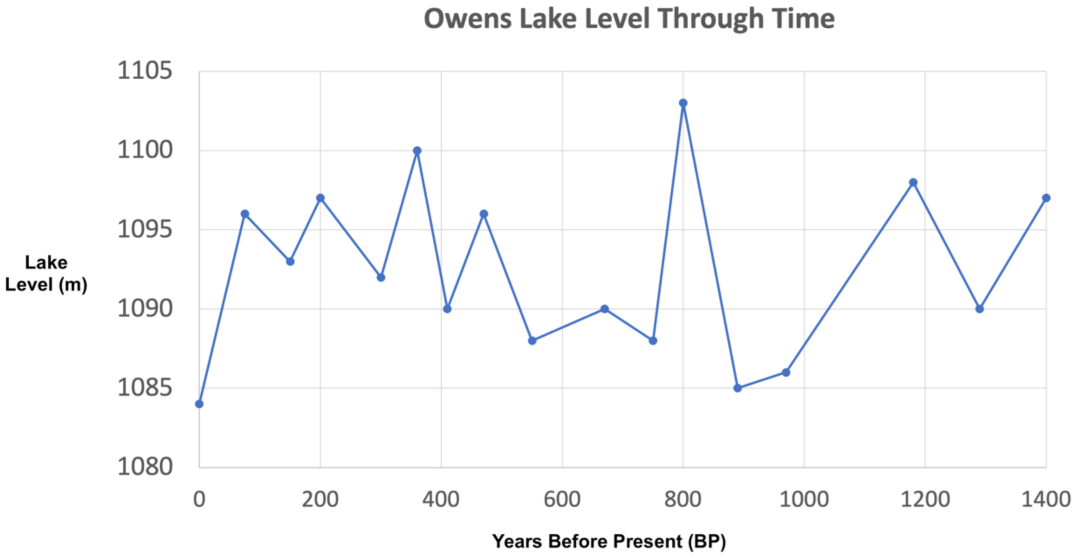

Figure 2.3. Level of Owens Lake, 1500 BP to present. The lake today is c. 1084 m; the historical highstand (1872 AD) was 1096 m. Image Credit: Jenna Santy, based on Bacon and colleagues (2018) and Reheis and colleagues (2014).

After 500 BP, lake levels fluctuate between high and low in intervals of 150-200 years; precipitation similarly varied, although temperatures were likely on the cooler side. Thus, the defining trend for the very late Holocene was one of unpredictable variability.

What is less understood is how these lake and climatic fluctuations affected the people who lived there. To a resident of the Owens Lake shore, what was the difference between a lake at 1086 m, and a lake at 1092 m? Was there a meaningful difference in lake size, or depth? Or rather, owing to local topography, perhaps the lake was not substantially larger or smaller, but perhaps the nutrient cycles that sustained populations of brine fly and birds were affected? While the lake habitats were likely economically important, the effects of regional climatic fluctuations on the riparian drainages channeling montane snowmelt into the lake are less well studied. Throughout the recent 2011-2017 California drought, Carroll Creek maintained a steady flow, with local residents not expressing concern over its viability (Julie Fought, personal communication). While the precipitation data available to paleoecology researchers is not fine-grained enough to reconstruct annual precipitation levels in this specific locale, the six-year averages are still useful. Prior to the construction of the LA aqueduct, which diverted waterways that otherwise fed the lake, Carroll Creek was one of the primary streams that watered the lake. Ultimately, it remains unknown whether creeks in prehistory ran dry during prolonged droughts.

Ethnography and History

Archaeological evidence suggests that peoples have lived in the Owens Valley for over 9,000 years (Basgall 1987). The Owens Valley Paiute hold that they are descendants of the Nümü, or original people of the land, who have lived there since the beginning of time (bishoppaiutetribe.com). The earliest Euro-American settlers arrived in the 1820s, but the peoples they encountered were not much discussed in writing until the 1860s. These mid-late 19th c. writings were created, as one might expect, to justify the exterminationist position that many whites in the region held toward the native inhabitants, and to argue for the displacement of those inhabitants from their lands (Bettinger 1991a). As such, those writings were not of much use to anthropologists interested in the lifeways of the indigenous peoples of the Valley, as in them "it is commonly difficult to separate fact from folklore" (Bettinger 1991a:463). It wasn't until the 1920s that ethnographers, including Julian Steward, most notably, took a genuine interest in the history and daily practice of native residents of the valley, and made efforts to record the cultural beliefs, practices, and lifeways that survived the wars, diseases, and forced assimilations experienced by the Paiutes since contact with white settlers.

Steward noted that while the Owens Valley Paiute had many cultural practices in common with other Paiute-Shoshone groups throughout the Great Basin, there were also a number of unique traditions that were not expected from a group typically classified within traditional cultural-historical schema as "simple hunter-gatherers". The Owens Valley Paiute were organized by geographic districts, with each district appointing a "headman", who organized pinenut collecting trips, communal hunting drives and "fandangos" (Steward 1933:304). These positions were at times passed down patrilineally, but could also be elected on the basis of leadership and organizing skills. Notably, headmen were not often particularly skilled hunters or fighters, and did not have coercive authority.

Each district also owned designated territories for hunting, gathering pine nuts, and fishing exclusionary to other groups. Permission was sometime granted when asked, but trespassing could lead to “fighting and rock-throwing” (Steward 1933:306) and was the most common cause of violence between districts.

Another job of the headman was to facilitate a separate atypical characteristic of hunter-gatherer groups: irrigation canals. These irrigation structures were used to passively grow economically important plant foods by diverting water from the Owens River and its tributaries. The construction of these ditches was directed and overseen by either district headmen themselves or by assistants that were appointed/elected each spring (Steward 1933:247). The most thorough description of one of these irrigation works was given by Steward, who relayed the annual construction cycle of a canal in the Bishop district: “the system comprised a dam in Bishop Creek Canyon a mile below the mountains and a ditch to each plot”; “the dam of boulders, brush, sticks, and mud was built by the irrigator, assisted by 25 men…”; the irrigation ditch was divided into plots, and the irrigator was responsible for ensuring the water was evenly dispersed through each plot by creating “small ditches and dams of mud, sod, and brush. “At harvest time, the dam was destroyed and water flowed down the main channel”, and fish were gathered from the ditch (1933:247).

Typically, men assisted with the construction of the irrigation project, and women were the primary harvesters of the plant products. Steward stated the harvested plants were not “planted, tilled, or cultivated” (Steward 1933:247). Ownership of the plots is not clear; Steward (1938:53) claimed that women owned portions of each plot, while Steward (1933:247) claims that irrigated land was communally harvested. Important plant seed foods called *sunu* (*Agropyron*), *mono* or *tsikava* (*Eragrostis*), *waiya* (*Elymus*), *pak* (*Helianthus*; Steward 1933:247) and occasionally *wata* (*Chenopodium*) and *pawai* (*Echninocloa*; Lawton et al. 1976) grew in and outside the periphery of the plots, where water would overflow. These seeds were, however, secondary to the intended products of these irrigation canals—roots, tubers, and corms, broadly referred to as underground storage organs, or USOs.

The two most important plant products harvested from these irrigation plots were starchy USOs called “tupusi” and “nahavita”, although the exact referents of those terms is debated. Steward interpreted tupusi as *Cyperus*, and nahavita as *Dichelostemma*, but ethnobotanists have questioned his assignations (Lawton et al. 1976; Fowler n.d.; Gill 2014). Rather, it seems most likely that the terms refer to the USOs themselves, as in, a root-food or a tuber-food, and not specific taxa. Lawton (et al. 1976) stated that nahavi most likely refers to corms of *Dichelostemma*, and ambivalently proposes that tupusi are roots of *Cyperus*. In contrast, Gill (2014) uses morphological data to persuasively argue that both tupusi and nahavi refer to corms of *Dichelostemma*, but for corms harvested in Fall (tupusi) and Spring (nahavi) respectively. Following Gill (2014), these irrigation features likely played an important role in providing food for Paiute families throughout the year, especially carbohydrate-rich geophytes.

It is worth noting where these irrigation features have been documented in the region. The furthest south was likely in the area of the town of Big Pine, though it has been proposed that some may have existed as far south as Independence (Lawton et al. 1976), but have been destroyed as a result of late 19th and 20th century development (Basgall and Delacorte 2011). As far as is known, there is no evidence of these features near the Alabama Hills, or the town of Lone Pine, nor close to Owens

Lake. There are several possible explanations for this. It could be a reflection of the differences between districts. It is possible the Pakwazinatu Paiute, who lived by the lake, did not have the same type of social organization as their neighbors to the north, perhaps owing to their peripheral location and close association with neighboring Shoshone groups. Another possibility is that, owing to their location near the lake, the Pakwazinatu did not have a need to irrigate, as they had access to miles of lake shore and three drainages with wetland plan resources. Geography could play a role as well, with northern Paiute groups having access to gently sloping drainages with linear access to the Owens River. Paiute groups around Lone Pine and the lake had the Alabama Hills as a physical barrier to the Owens River, and minimal acreage between the eastern slope of the Sierra and the lake itself. In any case, irrigation and irrigation features have not been associated with the Pakwazinatu Paiute.

Culture History

The vast majority of archaeological work completed in the region has happened via Cultural Resources Management (CRM), most of which was undertaken as a result of the realignment of Highway 395 and infrastructure improvements for the California Aqueduct. As a result, the majority of site data come from lowland valley floor sites, close to the Owens River and the tributaries that feed it. Much less research has been done in the foothills and uplands, or near the shores of the lake. It is this lattermost deficiency that this project aims to address. A broadly summarized regional chronology is presented here.

Early and Middle Holocene

Archaeological evidence of human habitation in the region reaches back more than 9000 years (Basgall 1987; Gilreath and Holanda 2000; Moratto et al. 2018). This evidence mostly takes the form of projectile points, and sites dating to the early Holocene are “relatively few” and “widely scattered” (Basgall and Delacorte 2011:14). Robust, stemmed points suggestive of early Holocene occupations have been found in the area, along with a formalized tool kits comprising scrapers, gravers, and occasionally crescents (Basgall and Delacorte 2011). Beyond their toolkit, limited archaeological data (primarily obsidian hydration-dated debitage) suggest an “extensive settlement range” with “comparatively high levels of residential mobility” in contrast to later time periods (Basgall and Delacorte 2011:15).

Perhaps even less is known about the lifeways of the Middle Holocene (c. 6000-3150 BP) peoples who lived here. A drop in obsidian hydration dates from this interval could reflect decreasing population numbers; this, combined with data suggesting remarkably low lake levels, could indicate a relatively inhospitable period of time in the region (Basgall 2009). It is likely that depositional processes deeply buried or destroyed evidence of human habitation of this period, especially considering that evidence of occupation dating to this time has been found in riparian areas, which are often dramatically subject to geomorphic processes. Human occupation during the middle Holocene in the valley was probably ephemeral at most places, with a handful of places on the landscape being subject to repeated re-use over time (such as at Little Lake, Deep Springs, and Fish Slough) (Basgall and Delacorte 2012:10-5; Basgall and Giambastiani 1995; Delacorte 1990).

Late Newberry (2500-1350 BP)

The Newberry period illustrates the transition between the sparse and extensive earlier occupation and the more intensive, landscape-altering periods of later prehistory. Much more is known about the late Newberry than the early; this knowledge was buoyed by the excavation of INY-1384/H, a multi-component habitation site near Bishop. Twelve late or terminal Newberry houses were excavated, and many features (Basgall and Delacorte 2012:10-5), dramatically increasing the number known late Newberry assemblages. The early Newberry period (c. 3150-2200 BP) remains poorly known archaeologically, with existing evidence suggesting an extensive, generalized foraging and landuse pattern similar to earlier times.

The other source of knowledge about lifeways in the Newberry period were the excavations of INY-30 (Basgall and McGuire 1988), which revealed three Newberry-period house floors. The authors found that Newberry period houses were "more substantial, occupied more intensively for longer periods, and were the loci for a greater range of processing and maintenance activities" (1988:152) than structures dating to later periods. Worth noting, as well, is that the authors noted a substantial decrease in house size between the Newberry and Marana periods, which suggests the shrinking of residential group size.

While the nature of Newberry settlement is debated, research by Basgall and Delacorte (2012) supports the interpretation of Newberry peoples as fairly mobile, occupying a given site at variable time over one to several years. Their excavation of INY-1384/H yielded 12 Newberry houses and many features, and provided the largest collection of Newberry contexts to date. Based on the INY-1384/H subsistence data, a standard Newberry assemblage does not exist, as it seems likely that mobile Newberry folks utilized resources in proximity to their residence, and whichever resources would be in season during the period of occupation. In terms of material culture, Newberry assemblages are typically associated with Elko dart points across eastern California and the Great Basin.

Scholars agree that subsistence intensified through time in the Owens Valley, and that the late Newberry period saw the beginnings of this intensification. Large game, like artiodactyls, are commonly seen in assemblages during this period, with less emphasis on small mammals and birds, though this pattern varies with site location and season of occupation (Zeanah and Leigh 2002:621). In terms of plant use, subsistence appears to have been relatively extensive, with a focus on plant foods from nearby environs, and limited but ubiquitous use of exotic plants, like pinyon, and relatively high taxa diversity (Pierce 2012). The predominant view of Newberry subsistence is one that varies depending on time of year and intensity of occupation.

Haiwee Period (1400-650BP)

One of the defining events of the Haiwee period was the introduction and spread of bow-and-arrow technology. Bettinger (2015) has argued that the bow-and-arrow facilitated a number of the subsistence and organizational shifts that occurred during the Haiwee period, but the extent of these shifts is not well understood. The shifts include an increase in subsistence intensification, specifically on pinyon, and a shrinking of trade networks, as measured by obsidian and marine shell beads. These changes are interpreted to mean constrained residential mobility, especially in comparison to the earlier Newberry period (Eerkens and Spurling 2008).

It also must be noted the Haiwee period is less understood compared with late Newberry and Marana periods. The following broad generalizations of Haiwee subsistence and settlement are made with the limits of existing data in mind.

In terms of subsistence, Haiwee period diets continue to become more intensive, compared to earlier Newberry and Archaic diets. Faunal data suggest that the increase in bow-and-arrow hunting led to resource depression of large game, and an increase in the pursuit of small game. A prior, limited regional synthesis by Pierce (2003) of several Haiwee sites suggests that plant data remain similar to the Newberry period, in terms of riparian to dryland plant use, but with an increase in pinyon density and ubiquity (Pierce 2003).

Although it has been argued that groups living in the Owens Valley during the Haiwee period were beginning to coalesce into semi-permanent villages with long term occupations, evidence for this proposition remains limited. No co-terminous Haiwee houses have been found within a single site, although this could be the result of limited excavation and low sample size. Decreasing mobility and perhaps circumscribed territories remain plausible, as suggested by Eerkens (2008), but minimal evidence for village sites currently exists (but see: Faull 2007; see also Chapter 7 for further discussion).

Marana Period (650 BP-Contact)

The most significant changes to subsistence, settlement, and social organization occurred during the Marana period. Why these changes occurred is the source of some debate, but researchers can largely agree on some basic facts about changes to population density, the advent and spread of novel technology such as pottery and a concomitant increase in the use of small seeds, and climatic instability. What remains debated are the relationship between these forces (and others) and hypothesized changes in social organization. Specifically, it has been proposed by Eerkens (2004, 2009, 2011) and Bettinger (2013, 2015) that Marana-period groups organized in smaller kin/household units and increasingly treated food resources as privately-held and family-owned goods. This pattern was in contrast to earlier periods, when subsistence resources were treated as communally owned and accessible. The evidence for the hypothesized changes to social and economic organization are summarized in greater detail in Chapter 3.

Arguably the most contested factor contributing to change in late Owens Valley prehistory is population growth. However, scholars increasingly accept that population growth, either via increased fertility or in-migration, happened during the Marana period and had an impact on the organization of Owens Valley groups. The evidence for population growth hinges largely on data showing an increase in settlement density during the Marana period, as measured by number of radiocarbon dates (Eerkens 2010). While number of radiocarbon dates is the most direct evidence for population growth, other lines of evidence provide indirect support for this proposition (see Polson 2009). Resource depression of large game has been documented in the region, likely beginning c. 1400 BP (Grayson 2001), coinciding with the arrival and spread of bow-and- arrow technology in the region. Around this same time, settlement evidence of high altitude habitation sites became more common, suggesting the exploitation of previously ignored habitats, likely due to population packing in higher-ranked lowland territories (Bettinger 1991a) and the need to go further afield to access high-ranking large game. While direct evidence for population growth can be difficult to see in the archaeological record, researchers working in the region largely agree that regional population growth occurred in during this period in late prehistory.

The Marana period was also the timeframe wherein pottery became a standard inclusion in material assemblages, especially at valley floor sites (Figure 2.4a, b). Eerkens (2000, 2003) has shown that pottery became common in Owens Valley assemblages during the Early Marana period, but increased dramatically in use c. 300 BP. Pottery is generally incompatible with high mobility, so its adoption and spread in the region could point toward a potential reorganization of settlement during this time period. The standard Owens Valley brownware has a narrow bottom and large orifice, making it a suitable cooking vessel. They are typically low-fired, with minimal surface treatment (Steward 1933; see Gayton 1929, Kelly 1964, and Voegelin 1941 for discussions of similar pottery types among neighboring Great Basin and Sierra Nevada groups).

At the same time, an increase in the exploitation of plants, as shown by changes in the density and ubiquity of small seeds in plant assemblages, has been well documented during the Marana period. At every Marana period site with published data (Wohlgemuth 1988; Pierce 2002, 2003, 2011), small seeds from desert-scrub habitats are both ubiquitous and dense. The middle and Late Marana periods were also when the first evidence for mass harvesting and processing features originated, emphasizing the importance of these low-ranked resources. However, seeds are particularly compatible with pottery, which allows for faster processing (i.e., cooking) of seed products. Seeds also store well (Minnis 1981), and an increase in storage has been proposed during the Marana period; however, there is minimal evidence that pottery was used to store seeds.

Figure 2.4a: Image of complete Owens Valley brownware vessel. Image Credit: Jenna Santy.

Figure 2.4b: Image of sherd, decorated with fingernail imprints. Image Credit: Jenna Santy.

History of Paleoethnobotanical Research in Owens Valley

Almost all of the dedicated paleothnobotanical research undertaken in eastern California has been done via CRM. Nevertheless, much of that work is of high quality, and provides solid foundational and comparative datasets for this dissertation project. The work I review here occurred in Owens Valley between Bishop and Olancha. Most of the work has taken place along the Owens River corridor in the central portion of the Valley, with a much smaller dataset from lake-adjacent sites on the southern end of Owens Lake.

The vast majority of work has been along the Highway-395 corridor; the highway runs approximately parallel to the Owens River and Owens Lake, and perpendicular to the many drainages that feed them. As such, the datasets from this area of the valley provide information on plant-use for these particular lowland, riparian habitats. Pierce (2002, 2003) is the primary source of both data and analysis from these areas, and synthesized much of the regional work that had been completed in the 20th century. Reddy (2003) completed work further south, near the southern end of the lake, which, prior to the study presented in this dissertation, was the only Owens Lake plant use study.

Pierce (2002) analyzed archaeobotanical remains from 15 contexts at seven sites, dating from the Newberry to the Protohistoric period. These sites were part of 26 in need of investigation along a 14-mile stretch of US 395 between the towns of Independence and Big Pine. In this report she also synthesizes data from 22 excavated house floors in the Owens Valley (in gray literature). Her main goal was to compare the use of different habitats, with an emphasis on how use of riparian plant resources changed through time. Notably, all of the sites with excavated house floors are located north of Owens Lake. Of the 22 house floors with data, 20 are located near "reliable sources of water, including springs, streams, or wetlands" (Pierce 2002:630), and two are located near the Owens River, which likely would have been the primary water source used by residents. Pierce notes that, for sites located on tributary streams, riparian taxa use appears steady through the Newberry and Haiwee periods, but began to decline in the Marana period in both ubiquity and density, continuing into the Late Marana/Protohistoric period (c. 300 BP). In contrast, at sites near the Owens River, data from the two excavated houses (and additional data from eight other hearth features) show a decrease in the ubiquity of riparian plants, but an increase in their density (Pierce 2002:631). Pierce suggests that Valley residents later in time were pursuing two different strategies of intensification; tributary residents were choosing to intensify gathering of shrubland plant foods, and river residents chose to target riparian foods. Alternatively, these patterns could represent the same group of people making different choices in different years, depending on the availability of resources (2002:631).

Distinguishing between tributary sites and river/lake sites is a categorization I use in this manuscript (*sensu* Pierce 2002). Here, tributary sites are defined as those whose closest freshwater source would have been one of the creeks or streams that feeds (or fed, in some cases) into the Owens River or Owens Lake. These sites tend to be in closer to upland landscapes and resources, and further from the extensive wetlands and marshes associated with the lower elevation lake and river. River/lake sites are classed as lowland, or wetland, sites, and are considered to have had closer access to those resources.

Pierce (2003) later analyzed samples from an additional 13 contexts at six sites near Independence, CA; she also synthesized data from an additional 79 features and midden contexts, from 33 sites (2003:228), making her study the most comprehensive in the region to date. Her study was one of the first to highlight the paucity of data from Newberry and Haiwee period contexts in the Valley; in the years since, additional Newberry contexts have been excavated and analyzed (Basgall and Delacorte 2012), as well as additional Haiwee contexts (Reddy 2003; this manuscript). An updated synthesis, including these data, is presented in Chapter 5. Pierce noted that, in spite of "…small sample size, lack of environmental and contextual diversity, and preservation bias" (2003:228), Newberry houses tended to have relatively high diversity compared to Haiwee houses, which themselves varied in diversity, richness, and density throughout the Hawiee period.

Compared to earlier in time, more robust and varied datasets came from Marana period contexts. Almost uniformly, Marana period sites have higher plant density, have high plant diversity values, and suggest a drastic increase in the use of small seeds. This pattern was initially observed by Wohlgemuth (1988), and has since been reinforced by additional archaeological study. Marana period sites also have more pinyon than earlier sites, suggesting intensified use and targeting of pinyon woodlands. Eerkens and colleagues (2004) have argued that the advent of intensive green-cone pinyon processing, wherein cones are harvested while green and cached to ripen, started after the beginning of the Marana period (c. 500 BP).

Reddy's (2003) analysis of several sites at the far southern end of the lake offers the only paleothnobotanical study of immediately lake-adjacent sites. Unlike analysis proffered by Pierce and herein, the majority of Reddy's data comes from column samples in general midden; only a limited number of her samples come from feature contexts. Reddy notes that the Newberry samples in her analysis conform to previously observed trends, in that they have a relatively high taxa diversity as well as taxa from a variety of environmental settings; both of these patterns could indicate an opportunistic, extensive foraging regime based on locally available resources (2005:757).

Reddy's Haiwee interpretations (2003:757-758) are reflective of the overall lack of Haiwee data that existed at the time of her study, a gap that this dissertation helps to close. While acknowledging that the Haiwee period is "probably the least understood in Owens Valley prehistory" (2003:757), Reddy highlights trends toward lower taxa diversity and "dominance of riparian taxa" at Haiwee/Marana transitional period sites. Interestingly, a feature interpreted as a seed processing activity area, reflective of intensive labor, supports the notion of increasing intensification during the transition and into the Marana period.

Sites Analyzed

In addition to the synthesis of previously existing data, one of the primary goals of this project was to analyze extant archaeological materials from four lakeside sites (Figure 2.5). These sites contain components dating from the Haiwee period through the Late Marana (Table 2.1). See Chapter 4 (Methods) for more information on the methods and history of analysis for these sites. Radiocarbon dating was overseen by Dr. Jelmer Eerkens, between 1999 and 2008.

Figure 2.5. Map of Owens Lake with analyzed sites. Credit: J. Santy

Table 2.1. Radiocarbon Dates for Lakeside Sites Analyzed

Site	Feature	C-14 Date	Cal BP*	Period
INY-3806/H	H (House) 1	1340 ± 60	1172-1354	Haiwee
	H 2	1400 ± 80	1173-1419	Haiwee
	H 3	1160 ± 60	1179-954	Haiwee
	F (Feature) 5	1180 ± 70	1272-996	Haiwee
INY-7448	H 4	1210 ± 30	1248-1058	Haiwee
	H 6	505 ± 25	548-505	Early Marana
	H 7	377 ± 36	505-315	Early Marana
INY-8768	H	650 ± 36	670-553	Early Marana
INY-5207	H 8	270 ± 70	496-138	Late Marana
	F 218	140 ± 90	316-contact	Late Marana

*Calculated using OxCal v4.4 (Bronk Ramsey 2009)

Figure 2.6. House 1 from INY-3806/H. Photograph from 1991 Excavations. Image Credit: Sacramento State Archaeological Research Center.

Figure 2.7. House floor from INY-5207. Image Credit: Jelmer Eerkens.

CA-INY-3806/H is a single component occupation, dating to the early Haiwee, located on an alluvial terrace west of the Owens Lake playa (Figure 2.6); it lies next to the remains of the now-diverted and dry Cottonwood Creek, which likely would have provided the prehistoric site inhabitants with a permanent source of water. During high stands of the lake, the site's residents also might have had access to marsh habitats and resources (Delacorte and McGuire 1993:56). It was excavated twice as part of UC Davis field schools, first in 1991, and then in 2006. These excavations yielded samples from three Haiwee period house floors (Eerkens 2003), botanical remains from which were analyzed as part of this dissertation project, CA-INY-8768 is a Marana-period site consisting of four loci located along three low ridges approximately 1.5 km from the western shore of the lake and also close to the Cottonwood Creek drainage. The site contained visible surface midden, a bedrock milling complex, and a visible house depression which was excavated; the materials from the house were analyzed as part of this project. It was excavated as part of a UC Davis field school in 2007.

CA -INY-5207 is a Marana period site, located on the north side of Point Bartlett and on an old lakeshore, containing several surface and subsurface deposits (Figure 2.7). It was excavated in 1997 by a crew of UCSB graduate students (Eerkens, personal communication). One definite living surface (dated to the Marana Period) and several features were identified.

CA-INY-7448 is a multicomponent archaeological site on ancient shore of Owens Lake. Several house depressions were excavated, with an initial phase as part of a UC Davis field school in 2007, and a later excavation over a long weekend in 2010. Five possible house features were sampled. For this project, samples from the three most securely dated contexts (one Haiwee house floor, and two Marana house floors) were analyzed and included in the data set.

In the following chapter, I build on this discussion of the human and natural history of the region by introducing and discussing relevant archaeological theory relating to plant subsistence and social organization, and discuss the questions animating this research.

Chapter 3: Resource Intensification and Social Relations in Theoretical Perspective

Resource intensification has long been a topic of discussion in Great Basin and California prehistory. As mentioned in Chapter 2, Owens Valley represents a nexus between these two regions, and has been ground zero for many of these discussions. In this chapter I lay the foundations of the phrase "resource intensification", and arrive at specific working definition of the term, since it is used to mean different things by different people. Intensification is intricately linked to social phenomena as well, and I discuss its relationship to the sharing and storing of resources, as well as risk management and privatization. Several scholars working in Owens Valley have presented explanations of how subsistence intensification co-occurred with the restructuring of social groups; I review in greater depth their arguments. I specifically discuss intensification and social reorganization as they relate to the adoption of novel technology, in this case the bow-and-arrow and pottery. Finally, I present a series of hypotheses and research questions guiding this work, in dialogue with the theoretical issues laid out in this chapter.

Intensification: Definitions and Theorizing

Intensification has several formal definitions, with two primary strains of logic. Bettinger and colleagues (2015:120) state that the "process of intensification generates increasing caloric yields per unit of space (land area) at decreasing levels of foraging efficiency, since each unit of energy extracted requires increasingly more intensive labor." Separately, Bettinger (2007:142) defines intensification as "adaptive change resulting from growth-induced resource stress", and separates it from its narrow association with food resources; rather, he links it to the "intrinsic capacity for population growth sufficient to cause resource stress leading to subsistence change and, potentially, social and technological change" (2001:142.) Wohlgemuth (2004), after Boserup (1965) and Brookfield (1972), defined intensification as "increased expenditure in resource acquisition and processing at the cost of decreased efficiency" (2004:10). Of note is that many of the early definitions of resource intensification, such as those of Brookfield and Boserup, predate the advent of human behavioral ecology (HBE), even though the concept of intensification is, at its core, an expression of the principles that underscore HBE-derived models. Before HBE existed to model these processes, archaeologists (and particularly those interested in subsistence pursuits) had an intuitive understanding of the costs and benefits inherent in pursuing various food resources.

Betts and Friesen nuance their definition of intensification by contrasting it with a similar, but potentially related process. They define intensification as "increased labor and/or capital inputs into a plot of land" (Betts and Friesen 2004:359), which does not preclude the *diversification* of resources procured. Rather, these procurement patterns reflect an increase in time/effort devoted to resource procurement (intensification), while acknowledging that resources were taken opportunistically, based on settlement location (diversification; Betts and Friesen 2004:359). Butler and Campbell (2004:337) define intensification as "increasing specialized resource use," noting a divestment from other resource choices and a narrowing of the diet breadth to target one or several key resources (in their case, salmon).

Both Betts and Friesen and Butler and Campbell hit upon a key point: intensification can refer to either a widening or a narrowing of the diet breadth; it does not necessarily have to be a widening of acceptable food options, as standard diet breadth models might suggest. Rather, increasing *technological* intensification could lead to a narrowing of the diet breadth, with the extra labor output assigned to making and using technology to ultimately make the handling process more efficient, as Butler and Campbell argued happened in the Pacific Northwest with the salmon harvest (2004). Bettinger and colleagues (2006) offer a model of technological intensification that improves upon an earlier contribution (Ugan et al. 2003). Bettinger factors in the time-effort of manufacturing novel technologies to be used in the food pursuit; new technology requires an initial time investment (and subsequent maintenance effort) that decreases foraging efficiency, at least initially. It increases the marginal cost (2006:545), but also increases production over time. Over time, with continued, long-term use, the technology should recoup its initial cost. In any case, the key point here is that intensification, depending on the particular circumstance, can refer to either a widening or a narrowing of the diet breadth, and a change in diet breadth in one direction should not be *a priori* assumed as intensification without evidence.

Morgan succinctly summarizes the difference between the two strains:

> The meaning of the term [intensification] became conflated with both a strict Boserupian definition that entails declining foraging efficiency (hereafter "intensification *sensu stricto* [*s.s*]") or alternatively as any means of increasing productivity (e.g., diversification, specialization, innovation), including those that ostensibly increased efficiency (hereafter "intensification *sensu lato* [*s.l.*]") [Morgan 2015:168].

Technological intensification (*à la* Bettinger et al. 2006) and salmon procurement in the Pacific Northwest (*à la* Butler and Campbell 2004) are intensification *sensu lato*: increased energy input for what will, ultimately, *increase* subsistence efficiency. Boserup, Wohlgemuth, and other California archaeologists most frequently use intensification *sensu stricto*: increasing energy input for what will, ultimately, *decrease* subsistence efficiency. In this dissertation, all uses of intensification are meant *sensu stricto*, unless otherwise noted.

Risk Management and Sharing vs. Storing

Intensification is often theorized as occurring in response to risk. In this section, I will lay a foundation for connecting resource intensification to risk management, with the ultimate goal of fleshing out the relationship between intensification and changes to social relations and organization. I review the different ways foragers respond to risk, and how those strategies either strengthen or weaken social bonds between individuals and/or small groups.

Wiessner (1982), building on Binford (1980) explicitly framed her model as risk theory, introducing ideas about risk management for the purposes of "reduc[ing] variance in social and natural resources" (1982:172). Wiessner (1982:172-173) lays out four ways in which foraging societies can reduce risk (*sensu* Reigel and Miller 1959):

(1) prevention of loss, through means such as ritual, controlled burning, or claims and defense of specific resource-laden territory;

(2) transfer of risk or loss from one party to another, such as potlatching (Piddocke 1969) or the unsanctioned use of another groups' resources or territory;

(3) storage or self-assumption of risk, that is, losses being covered by previous accumulation;

(4) pooling of risk, or risk sharing, which can take the appearance of "generalized reciprocity" as documented by Sahlins (1972) and others; that is, giving to those who need it, and alternating giver-receiver roles regularly.

It is in Wiessner's work that a seeming "sharing vs. storing" dichotomy arises, and presents a question that scholars continue to investigate: when foragers are hedging against risk of shortfall, when should one expect to see sharing, and when should one expect storing, in the archaeological record?

Sharing vs. Storing

Halstead and O'Shea's (1989) volume *Bad Year Economics* was devoted entirely to working through ideas of how ancient societies can and did react to risky situations, be they seasonal and regular, or the result of longer-term ecological change and disruption. In the introduction, the authors introduce the concept of predictability as being crucial in allowing groups to accurately assess risky situations. They define predictability as "the basic structure of variability—its frequency, duration, spatial scale, severity and regularity…" (Halstead and O'Shea 1989:1). At the heart of the discussion is the adaptive tension between regular, predictable scarcity events, and those that are of longer, more variable duration (such as long-term climate change.) Ultimately, while foraging groups have a range of strategies for managing predictable variability (such as sharing and storing), longer-term disruption can overstress existing coping mechanisms and catalyze upheaval and change in social and community organization; in other words, changes which we as archaeologists might identify as diachronic in nature. The authors also introduce their version of the cultural responses to variability, modifying those of Wiessner; they include mobility, diversification, storage, and exchange. Discussions of sharing vs. storing as responses to risk are especially relevant in a place like the Owens Valley, where it is broadly hypothesized that a shift occurred between (middle-) early and late prehistory, from a sharing-oriented economy to more of a storage oriented economy (Eerkens 2003).

Rowley-Conwy and Zvelebil (1989) break down the variable scales of resource fluctuation that hunter-gatherers (especially temperate and high-latitude groups) typically encounter: (1) seasonal variations within one year, (2) interannual variation between years, and (3) long-term variation extending over a generation or more (Rowley-Conwy and Zvelebil 1989:40). Especially relevant to this dissertation is problematizing the tradeoffs between the four responses to risk from the volume’s introduction, and consider why a group would choose storage over others. The other strategies—diversity, exchange, and mobility—are compatible and/or mutually exclusive with storage, and the extent of the resource fluctuation also contributes to which strategy or combination of strategies foragers find most appropriate. For example, storage and mobility are usually incompatible options, and storage is also a non-option during times of extended resource shortfalls (i.e., if there is a multi-year shortfall event, and there is nothing to store). While Rowly-Conwy and Zvelebil don't consider the social effects of sharing on community-level organization, they do associate the surplus that often accumulates in storage-oriented economies as being directly linked to incipient social complexity (1989:50). They specifically invoke the presence of surplus as being a primer for the material inequality and prestige-seeking behavior that so often seems to indicate incipient social-political complexity in hunter-gatherers.

While Rowly-Conwy and Zvelebil consider the social effects of storage, other scholars consider the social effects of sharing. Winterhalder (1986) modeled the circumstances under which one would expect to see resource pooling among foragers as a risk-reducing strategy, as well as considering the viability of alternative strategies to sharing (i.e., diversification.) Winterhalder defines risk as "probability of loss", or a "probability of falling below a fixed minimum requirement" (Winterhalder 1986:376) of calories, usually on a daily, but also longer-term basis. Thus, a forager who chooses to pursue a high-variance, high-calorie food source (such as a hunted ungulate) is pursuing a more risky strategy than the individual who chooses a low-variance, relatively low-calorie food source (such as many gathered plant foods) (Winterhalder 1986:384). Of course, this does not account for units with multi-strategy foragers, who may be pursuing different foraging goals (e.g., the goals of foragers in differing age or gender classes), but nonetheless provides a baseline definition for risk and an example of what risky behavior would look like.

Winterhalder also contributes to discussion of risk minimization in a way that builds on previous arguments of Wiessner (1982). Specifically, Winterhalder evaluates diversification as a strategy to avoid falling below a minimum threshold for risk acceptability. He tests the idea that, when the preferred foods are in low abundance, foragers should target lower-ranked foods as a backup strategy (1986:378-379.) Rather, depending on the quality of the backup foods, he finds it may be in an individual's best interest to, instead, enter into a reciprocal sharing relationship with others (1986:380). Pooling food with as few as one other independent forager can reduce risk by 30% (1986:380) and not decrease the caloric maximum; by contrast, diversifying to include even one additional lower-quality food source, risk (as measured by standard deviation) is reduced by 8%, but the caloric maximum is decreased by 6%. Clearly, for food sharing under the set of constraints laid out by Winterhalder (simple stochastic variance, no long term environmental/ecological changes), sharing brings in more calories, more reliably. However, Winterhalder's approach to diversification as a means of managing risk is necessarily oversimplified; the archaeological evidence suggests that risk management may in fact be a contributing factor explaining why a forager would choose to diversify *instead* of share, especially during periods of scarcity or longer-term environmental shifts, as discussed below. Nevertheless, sharing can be a highly effective strategy for minimizing the risk of falling below a minimum caloric threshold.

When to Share; When to Store

While considering the "sharing vs. storing" question, investigating societies where *some* foods are shared and *some* foods are stored can be illustrative. Too often sharing and storing are seen as dichotomous processes, but in reality they frequently co-occur. However, there are distinctive differences between foods that are more often shared and those that are more often stored; evidence of such decision making exists both archaeologically and ethnographically.

Bogaard and colleagues (2009, 2010) argue that the differences between foods that are shared and foods that are stored are socially mediated, and this differentiation aids in maintaining functional social ties. At Çatalhöyük, household groups lived in close quarters with easy access to other dwellings; consequently it was easy to know how much stored food your neighbors had. As cross-cultural data has shown, there is frequently an expectation for food sharing among small residential groups, and a variety of leveling mechanisms have been documented in small-scale societies to prevent any one person from acquiring too many possessions or designs on power (Lee 1969; Cashdan 1980; Woodburn 1982). Bogaard and colleagues argue that the residents of Çatalhöyük avoided the societal pressure to share their stored foods by prominently displaying auroch crania in their domiciles; the heads "had a religious overtone [and] also [served to remember] feasts, episodes of sharing that mitigated the provocations of a full larder" (2009:649). As a result, a division between private and public consumption was established, which allowed the food hoarding that would be necessary to sustain a sedentary, high-density settlement like Çatalhöyük (Twiss et al. 2008, Twiss 2012.) Also of importance in this study were the types of foods shared vs. those stored: animal foods, and particularly large mammals like aurochs and gazelles, were most commonly shared foods; plant foods like seeds and nuts were most commonly stored (Bogaard et al. 2010).

The question as to why animal foods (and particularly large game) tend to be shared and plant foods tend to be stored is one that anthropologists have been asking for decades (Kaplan et al. 1984; Gurven 2004), and is important to keep in mind when attempting to reconstruct the social and subsistence strategies of foragers in the past. Food with the highest likelihood of being shared are foods with high variances (that is, a forager's success in acquiring it is unpredictable) and large package size (that is, a lot of food comes at once; Kaplan et al. 1984; Gurven 2004). Large game is the textbook example of food resources that one would expect to be shared. In contrast, resources that have low variance and occur in small packages are the least likely to be shared; gathered plant foods correspond closely with this category. In Wiessner's work with the !Kung, she observed that hunted large game was shared widely with kin, fellow group members, and trading partners; plant foods were not. The reciprocal sharing networks activated by successful large game hunts have been hypothesized to be pivotally important in the course of human evolution (Wiessner 2002). In contrast, while the !Kung community viewed the plant resource patches as communally owned, once they were harvested, they became the property of the woman who picked them (2002:415). While plant foods may be shared, there is not the same expectation of sharing that exists with large game. Gurven (2004) noted that while plant food (gathered by Ache women) would be shared if there was surplus, a woman could also choose to stop foraging after acquiring enough calories for her family (2004:554), and would likely not be compelled to share by her neighbors.

Also relevant, especially for considerations of sharing vs. storing, is how much more suitable most plant foods are for storage than most animal foods. This suitability for storage dichotomy is captured in the literature surrounding back-loaded vs front-loaded resources (Tushingham and Bettinger 2013, 2019). The crux of the calculus is the point at which various food resources need to be processed, in terms of energetic investment. Many animal resources are front-loaded; that is, they have to be handled and processed very quickly after capture, or else they will spoil (think game meat, or fish that must be smoked prior to storage). In contrast, many plant resources are back-loaded, meaning they can be collected and then stored, with the bulk of energetic investment on the back-end, immediately prior to consumption. Nuts, seeds, and even roots and tubers can be stored for multiple months, if not longer, under ideal conditions, and with minimal preparation prior to stashing. Animal foods, however, typically require much greater processing to be suitable for storage, and cannot be stored as long without spoilage, especially in circumstances lacking refrigeration and in tropical and subtropical environs.

From Sharing to Storing

Storage is a way for coping with subsistence risk and often compatible with intensification, but can strain existing social networks that traditionally emphasize sharing; this is especially true among sedentary and semi-sedentary groups. A variety of coping mechanisms have been documented cross-culturally to minimize or defuse tension wrought by the choice to store food and decreased residential mobility (which goes hand-in-hand with storage). Kent (1995) documented the *sedentarization* (the process of becoming sedentary) of the Kutse, a Dobe-speaking group living in the Kalahari Desert; formerly nomadic hunter-gatherers, many became sedentary when a permanent well was drilled (Kent 1995:298). The stability of this resource was a major draw for formerly mobile small bands. As such, it was an opportunity to document, in real time, how social and spatial organization can change when formerly nomadic groups settle down. Kent documented that houses within the settlement were clustered according to extant sharing partnerships. Families that engaged in trading partnerships lived in dwellings that were situated close together and oriented towards one other; otherwise, the occupants of each house wanted privacy from their non-sharing neighbors (1995:307) so as to avoid conflict. This desire for privacy was new; prior to sedentism, people *only* lived in close proximity to other members of their sharing network, obviating a need to keep information from the eyes of neighbors. The settlement reorganization was an attempt to defuse conflict between neighbors "who never would have traditionally shared in the first place. It would be physically impossible to share with everyone living at Kutse—there are just too many people" (1995:307). While extant sharing networks survived, the increased population density and lack of existing social relationships amongst most residents precluded the formation of new ties.

A more complete breakdown of sharing networks was documented among sedentarized Aboriginal Australian groups by Gargett and Hayden (1991), who noted greater distances between dwellings, interpreting it to reflect and "a gradual breakdown of the traditional sharing ethic at settlements, coupled with a desire for greater privacy" (1991:27). As at Çatalhöyük, increased household self-sufficiency (as measured by increased storage) was socially mediated by large feasting events that were publicly commemorated by the display of auroch bucrania. The visible remnants of the feast were intended to defuse tension begat by unshared but known food stores of individual household groups (Bogaard et al. 2009; Twiss 2012).

A dimension of the transition between sharing and storing can often be environmental disruption, as well as the social upheaval that often comes with such disruption. Winterhalder and colleagues (1999:234, citing Colson 1979) discuss a boy of the Makah in the Pacific Northwest who, during a famine, developed a method for silently processing crabs so that he wouldn't be compelled to share; they also (1999:234 again, after Colson 1979) mention the Gwembe Tonga of Central Africa, who, during years of drought-induced famine, would bring food processing tasks inside so as to prevent neighbors from knowing how much food they had and from thus being compelled to share it. It's important to note that social decorum dictates than when one is compelled to share, one must; therefore, the goal is to acquire and process food resources without alerting individuals who may be in the vicinity and might ask for some of the resource. The relevant issue is that disruption of normal subsistence practices (as with the drought and famine mentioned above) can be one impetus for a breakdown of sharing networks, and thus a possible catalyst for social reorganization.

The studies cited here show the after effects of the reorganization from a communally-oriented, sharing-preferred subsistence regime towards an increasingly privatized, storage-oriented one. These forces (a shift to a storage-oriented economy, and a breakdown and reorganization of social networks) are proposed to have had a radical effect on the human history of Owens Valley, and were part of a proposed cascade of effects that started around 1500 years ago. The following section lays out the arguments for the timing of these events and their broader theoretical implications.

Intensification and Privatization in Southern Owens Valley Prehistory

Bettinger (2013, 2015) has argued that the arrival of the bow-and-arrow in California and the Great Basin altered the trajectory of human history by making hunting less risky than via atlatl; as a result, hunting groups did not need to be as large to ensure success. Thus, large game did not need to be pooled between as many people, because individual hunters were more successful (Bettinger 2013:119-121). This shift contributed to shrinking size of functional groups, from multiple family bands to smaller bands of “nuclear families augmented by an eclectic assortment” of other relatives who were otherwise incapable of surviving (2013:118).

Bettinger proposes two separate ways in which the arrival of the bow-and-arrow supported intensified plant foraging. First, shrinking band size meant shrinking food sharing networks, which were less necessary because hunting with the bow-and-arrow was more predictable (1999:152; 2013); this elevated predictability in turn meant that families could intensify plant gathering without being expected to share these resources, particularly with freeloading non-relatives (Bettinger 1999; Bettinger 2015:71). Secondly, the “surfeit of large game” distributed to the community at large facilitated the accrual of private plant stores (1999:152); much like at Çatalhöyük, the role of large mammal meat as a communal food enabled families to keep private stores of plant foods that were less subject to sharing expectations.

Beyond intensifying plant foods broadly, the changing role of plant foods supported the intensification of pinyon specifically. The argument for why pinyon intensified after the introduction of the bow-and-arrow is that pinyon is “nutritious and productive,” and used wherever it occurs (including other parts of the Great

Basin and the Southwest). Importantly, large game hunting and pinyon harvesting occur in the same habitat (mountain uplands) at the same time of year (autumn, typically; Bettinger 2015:71) allowing for families to travel together to pursue these resources.

The arrival and spread of pottery, beginning around 650 BP, signified another step toward the increasing privatization of plant resources. The advent of technology like pottery and seedbeaters (Eerkens 2003; Bettinger 2015:36) to more efficiently process small seeds and other plant foods, specifically, suggests that, by 600 BP, households (as proxies for single family bands) had fully invested in privatizable, storable plant food resources. Particularly relevant to this dissertation is Eerken's (2009, 2012a) study of the process of privatization in the prehistoric Owens Valley as it relates to the spread of pottery in the region. He posits that, in response to population packing, sedentism increased around 1500 BP; decreased mobility plus increased population strained existing social relations and fomented conditions for "free-riding" (that is, individuals who rely on social conventions of sharing without themselves contributing to the food supply). He argues that, prior to 1500 BP, groups were largely community-oriented, and an ethic of sharing prevailed; people knew their neighbors and maintained sharing and exchange relationships with them. After 1500 BP, with an influx of new people, there was increased incentive for freeloaders to take advantage of existing sharing networks without contributing equally (Eerkens 2012a). The evidence he cites in support of this privatization hypothesis is the rise of new subsistence pursuits including an emphasis on gathered plant foods. With more free-loaders, productive foragers should choose to target new resources that lack prior established sharing rules and could be hoarded in a socially acceptable way; this treatment is in contrast to large game foods, which likely had extensive and entrenched sharing rules attached to them, as is commonly seen in many foraging societies ethnographically (Eerkens 2012a:158). Archaeological evidence suggests that small seeds filled this new food role, as their archaeological densities increase drastically in late prehistory (especially after 700 BP), alongside technology enabling their more efficient processing (Eerkens 2001). In sum, not only would people have intensified subsistence as a response to population increase, targeting small seeds would also serve a social role as a privatizable foodstuff, exempt from sharing rules upon which free-loaders could capitalize. Small seeds, as a high-cost, low return food, are a sign of intensification, but also of changing inter-household relations in the wake of rising social instability. Data suggests that, later in time in the Owens Valley, some food processing tasks moved inside (Santy and Eerkens 2010), as happened with the Gwembe Tonga (Winterhalder et al. 1999, after Colson 1979).

Research Questions and Objectives

Broadly, this dissertation seeks to evaluate trends suggested by previous researchers working in the region, by compiling previous data from the grey literature, and presenting new data from four lakeside sites. The increase in seed density later in prehistory has been well and thoroughly documented; how can this increase be contextualized as part of changes in plant use by residents of Owens Valley?

Research hypothesis 1: If only plant density changes (i.e., an increase in seed density through time) are observed, that suggests an increase in population. If plant assemblage composition changes (i.e., an increase in the proportion of seeds in a given plant assemblage), that is suggestive of a change in plant use practices. Observing both trends (increasing seed density and seeds as a percentage of assemblage) suggests both forces (population growth and reorganization) occurred in tandem.

Research hypothesis 2: If pinyon was intensified c. 1200 years ago, we would expect to see several trends. First, we would expect Newberry-era subsistence to have low densities of pinyon, and potentially higher densities/percentages of resources like roots and tubers. Second, beginning in the Haiwee, pinyon nut shell in valley floor assemblages would increase in percentage and density. Finally, if pinyon density increases during the Marana period, that is suggestive of population growth; if pinyon density remains constant, but other plant resources increase in density, that is suggestive of subsistence reorganization and ratcheting intensification.

Settlement data and some existing plant use data suggest that intensification of pinyon started around 1200 years ago; are there changes in pinyon usage evident through time on the valley floor, with notable differences between Newberry, Haiwee, and Marana period assemblages? Site location data have been used by scholars to hypothesize differences in landscape use between the three periods; are there differences in how people used wetland vs upland plant resources through time?

Specifically, I seek to contribute to longstanding discussions of the cascading effects of new technology, subsistence intensification, and social reorganization in the region. The spread of the bow-and-arrow around 1500 BP is hypothesized to have contributed to a social reorganization partially oriented around pinyon intensification. Thus, we would expect an increase in pinyon usage (as measured by an increase in archaeological pinyon abundance) between the Newberry and Marana periods. Similarly, if Newberry-era residents "underused" plants (Bettinger 2015:43), we might expect a more extensive, generalized plant assemblage in that era; this could look like greater usage of roots and tubers, which are often less energetically costly than seeds (Gremillion 2014).

Research hypothesis 3: If foraging was less logistical, as proposed for the Haiwee period, than in the Newberry period, we would expect a high degree of correlation between site and resource habitat; if foraging was more logistically organized, we would expect a lower degree of correlation between site and resource habitat, i.e., wetland resources present at non-wetland sites.

In addition to the privatization of pinyon proposed by Bettinger, privatization of other plant foods is hypothesized to have continued later in time (Eerkens 2012a). Correlated with the spread of pottery, privatization is proposed to have happened in tandem with changes in land use, towards an increase in logistical mobility and use of more distant resources (Eerkens 2012b). As mentioned above, an increase in seed density is argued to reflect the increased privatization of plant foods, but beyond that, an increase in seeds as a *percentage* of plant food would be expected as well. In terms of land use, an increase in logistical foraging (where a forager travels afield in search of food before returning to a central base camp) could look like exploitation of environments beyond the immediate setting of the residential site. For example, in the Haiwee period, where foraging was potentially less logistical, we would expect there to be a higher degree of correlation between site environment (i.e., the environmental setting of the residential camo) and plant food environment (the environmental setting where the specific plant food is found). Residents of wetland sites would use more wetland plants, and upland sites would use more upland plants. In the more logistical Marana period, we would not necessarily expect this pattern; wetland sites could have plant foods from upland environs, and vice versa.

Summary and Conclusion

This chapter presented the ideas and concepts necessary to situate the cultural and organizational changes that occurred over the last 1500 years of Owens Valley prehistory within a broader theoretical context. Resource intensification has now been defined, along with a discussion of how changes to subsistence practices can affect changes in social organization, and vice versa. In the Owens Valley, a model explaining how the arrival of a novel technology affected change in group size, and how these processes contributed to a subsistence shift, has been proposed; this dissertation seeks to better elucidate the role of plant foods in social reorganization. The next chapter reviews the methodology used in the collection and analysis of the paleoethnobotanical data discussed in Chapters 5 and 6.

Chapter 4: Methods

The archaeological record only shows a fraction of what happened in the past. Preservation is the most significant factor that determines what archaeologists find, but factors like sampling and recovery strategies, and quantitative methods chosen for analysis can affect the accuracy of our data and bias our findings. In this chapter, I discuss how the project materials were collected, processed, and analyzed, as well as the conditions of preservation, and the sources of data.

Sampling

The materials discussed here were excavated and analyzed over the course of almost 30 years, by a variety of investigators. Thus, there was no systematic, coherent approach to the sampling strategies used to collect these materials. However, all samples across projects had their proveniences recorded and their volume recorded or estimated, allowing for comparison across sites. The contexts sampled were all associated with documented house features, and were gathered either from the house floors themselves or features found in association (hearths, storage pits). The materials found in these contexts do not represent primary refuse, as these features were almost certainly used as trash pits post-abandonment (Schiffer 1983). Rather, the materials dumped in these features were likely generated during one or several discrete periods of time; in prehistory, houses in the region were frequently burned upon abandonment (Basgall and Delacorte 2012) and then used as refuse deposits; post-use features like storage pits and cooking features are also often used secondarily as trash dumps, which is common cross-culturally

(Schiffer 1983). The certainty of context (domestic, associated with houses) and reliability of the radiocarbon dates from these samples (as opposed to a general midden, which can be generated by deposition across centuries) further allow for comparison across sites. Table 4.1 lists the samples and contexts analyzed for this project.

Table 4.1. Samples originally analyzed by PI for this project

Site	Feature	# samples analyzed	Description	Period	Soil L analyzed
INY-3806	House 1	4	Burned lens; house floor.	Haiwee	1.33
INY-3806	House 2	24	Burned lens; house floor.	Haiwee	8
INY-3806	House 3	6	Burned lens; house floor	Haiwee	2
INY-3806	Feature 21	1	Hearth	Haiwee	0.5
INY-8768	House 10	8	Burned lens; house floor	Marana	2.5

Preservation

Although all study sites are open-air, the desert environment of Owens Valley is ideal for preservation of charred organic materials. All plant remains included in this project were carbonized, either as a result of cooking events or what were likely post-abandonment burning events of houses, as has been documented prehistorically in the Owens Valley (Basgall and Delacorte 2012). However, not all carbonized plant remains preserve equally (Minnis 1981), with harder, fibrous material (like nutshells) preserving best, and greens and tubers preserving the worst. Thus, archaeological plant assemblages reflect the differential preservation of harder, denser seeds and nutshell. No tubers, rhizomes, or underground storage organs of any type were recovered during analysis. Rather than suggest that Owens Valley peoples were not consuming these foods (see Pierce and Scholze 2016), this fact instead testifies to the realities of differential preservation.

The three primary plant materials encountered during analysis were wood charcoal, nutshell, and seed remains. Nutshell, of both *Pinus* and *Quercus*, are among the best-preserved materials in the assemblage; seed remains include legumes, achenes and caryopses. Some specimens were likely accidentally deposited, attached to the site occupants or to the animals they ate (Gallagher 2014).

Processing Methods

Flotation Methods

The samples I processed and identified plant remains from -3806 and -8768 for plant remains were originally taken as soil samples for analysis across excavated house floors in 2006 and 2007 by UC Davis field school participants. The samples were taken systematically across the house floor at 50cm intervals in a grid-wise pattern. About 20 g of soil were removed from each sample and set aside to allow for future testing of the soil matrix. Samples volumes range between 0.25 and 0.75 liters. The samples were processed by bucket flotation, which were decanted at least two times until no charcoal pieces were visible floating upon or within the water column. The light fraction was decanted into fine chiffon cloth, tied up using labeled flagging tape and string, and hung to dry; heavy fractions were spread to dry on window screen mesh (1.0 mm) and left to dry in box screens.

Lab Methods

After drying, the samples were size-sorted in nested screens into 2.0 mm, 1.0 mm, and 0.5 mm fractions; residue <0.5 mm, in the pan, was sorted for seeds only. Wood charcoal was only pulled from the 2.0 mm fraction; nutshell was pulled from the 1.0 mm if it was not in the 2.0 mm of the same sample; any seeds and identifiable seed fragments were pulled from all sieve sizes. After it became clear that the heavy fractions contained, with limited exceptions, no carbonized plant remains, only the light fractions were lab processed. With the assistance of Dr. Amber VanDerwarker, I identified seeds to genus-level, when possible. Wood charcoal was weighed, while nutshell and seed weights and counts were recorded. Identifications were based on the UCSB Integrative Subsistence Laboratory Comparative Plant Collection and the Martin and Barkley Seed Identification Manual (Martin and Barkley 2004). All data were entered into a Microsoft Access database for stable data storage. No wood identification was conducted.

Previous Analysis of Existing Materials

Some of the plant remains reported and discussed in this dissertation were sorted and identified by two other paleoethnobotanists (Steve Martin and Wendy Pierce), under the direction of Dr. Jelmer Eerkens; these results were previously unpublished, but are incorporated, with attribution here, into this dissertation project.

Materials from INY-5207 and some from INY-3806 were sorted and identified in 1999 by Steve L. Martin (Martin n.d.). Martin sorted and identified plant remains from 12 flotation samples from three house floors and three features from INY-3806, all from the original 1991 excavations. In total, Martin identified over 350 plant specimens from INY-3806. Martin also sorted and identified plant remains from seven samples from the 1998 house floor excavations at INY-5207, totaling over identified 400 specimens. With the assistance of Dr. Amber VanDerwarker, I re-identified materials labeled either "unknown" and/or by Family, and was able to generate additional identifications from both the -3806 and -5207 materials (see Appendix A, "Owens Valley Paleoethnobotanical Dataset").

Materials from INY-7448 and some from INY-8768 were sorted and identified in 2006 by Wendy Pierce. Pierce sorted and identified plant remains from six samples from two contexts from INY-8768, all from the 2007 excavations. In total, Pierce identified 2200 specimens from INY-8768. Pierce also sorted and identified six samples from six contexts from the 2010 excavations at INY-7448, totaling 240 plant remains. As with Martin's materials, I re-identified materials labeled either "unidentified" and/or by Family, and was able to generate additional identifications, from both the -7448 and -8768 materials (see Appendix A for dataset).

Table 4.2. Samples analyzed by S. Martin, c. 1999, data included in this manuscript

Site	Sample No.	Feature	Description	AMS Date	Period	Soil Volume	Subsampled?
INY-3806	1	H1	House floor removal	1340 ± 60	Haiwee	2	N
INY-3806	3	H1	House floor removal	1340 ± 60	Haiwee	1.5	N
INY-3806	5	H2	Charcoal matting and post mold #6	1490 ± 70	Late Newberry /Early Haiwee	1.5	Y
INY-3806	2	H3	Central hearth from house floor	1160 ± 60	Haiwee	2	N
INY-3806	6	H3	House floor removal	1160 ± 60	Haiwee	2.5	Y
INY-3806	4	F5	Hearth	--	Haiwee	2	N
INY-3806	7	F6	Hearth	1180 ± 70	Haiwee	2	Y
INY-5207	8	H8	Burn area in SW corner	--	Marana	2	N
INY-5207	9	H8	Blue-gray area of house floor	--	Marana	4	Y
INY-5207	10	H8	House floor, west end	270 ± 70	Marana	5	N
INY-5207	11	H8	Compacted sediment from center of house	--	Marana	2	Y
INY-5207	12	H8	House floor, west rim matting	270 ± 70	Marana	0.5	N
INY-5207	13	H8	West end house floor, under millingstone	270 ± 70	Marana	1	N
INY-5207	22	H8/F22	House floor removal, east end	140 ± 90	Marana	1.5	N

Table 4.3. Samples analyzed by W. Pierce, c. 2008, data included in this manuscript

Site	Sample No.	Feature	Description	Period	Soil Volume	Subsampled?
INY-7448	7	H6	House fill.	Marana	1.8	Y
INY-7448	9	H4	House fill.	Haiwee	1.4	Y
INY-7448	10	H7	House fill.	Marana	3.2	N
INY-7448	11	H9	House fill.	Marana	unk	N
INY-8768	1A	H10	House fill.	Marana	1.75	Y
INY-8768	2	H10	House fill.	Marana	4.1	Y
INY-8768	3	H10	House fill.	Marana	1.4	Y
INY-8768	4	H10	House fill.	Marana	2.5	Y
INY-8768	5	F3	Hearth?	Marana	2.3	Y

Standard Paleoethnobotanical Measures and Statistics

Absolute and Standardized Counts

Absolute counts represent the quantity of plant remains recovered at the most basic level. These raw data, however, have limited value; it is almost impossible to compare absolute counts from different contexts, or sites, much less different regions, because the data, in raw form, are not functionally comparable (Popper 1988). Different materials preserve differentially (like robust nutshells, compared to leafy greens) and counts comparing materials from two such categories would be misleading, and not particularly illuminating as far as the extent of use or importance of the plant to the people who used it. Assemblages of different sizes cannot be reasonably compared: if one assemblage contains 10 acorn nutshell fragments in 50 liters of soil, and another contains 8 acorn fragments from 1 liter of soil, comparing acorn counts may mislead a potential investigator as to the importance of acorn in a given assemblage. It is thus necessary to standardize data in order to allow for reasonable comparison between assemblages.

Ubiquity is a standard paleoethnobotanical measure that suggests whether a particular taxon was used widely across the landscape or if use was more specialized and limited in geographic scope. Ubiquity denotes the presence of a given taxa out of all samples or contexts analyzed, expressed as a percentage (Popper 1988). Thus, if *Pinus* nutshell was present in 8 out of 10 samples, it would have a ubiquity of 80%. However, caution should be employed when using ubiquity for comparison between samples or sites. Because of differential preservation and the specific uses of various plant taxa, ubiquity values should not be interpreted as absolute measures of importance (VanDerwarker and Kruger 2012); *Pinus* nutshell would likely be more ubiquitous than chenopod seeds, because the seeds would be ground and consumed, whereas nutshell would be a byproduct of processing, and thus more likely to be deposited archaeologically. Ubiquity can also be skewed by how data are reported; if one context was sampled many times, the taxa present may have an artificially high ubiquity value (Popper 1988:61). Ubiquity is especially useful to track changes in the use of specific taxa over time.

The presence/absence data that ubiquity incorporates is useful, but has limited value; transforming raw counts into standardized density measures is ultimately necessary. Instead of absolute counts, standardized counts are often used as a way of sidestepping the aforementioned issues. Standardized counts are a form of ratio data, where the absolute counts are scaled by a "norming variable" in the denominator (Miller 1988:73), and are used to compare assemblages. There are two categories of ratio data, independent and dependent, and standardized counts can be either. Independent ratios are ratios where the numerator and denominator are "categorically independent" (VanDerwarker 2003:118); for example, in many regions, an assemblage's total plant weight is used to standardize plant counts (VanDerwarker 2003:119). Similarly, wood charcoal weight is often used for standardizing (Miller 1988:75), because density of charred remains can be interpreted as a proxy for intensity of occupation, or at least intensity of fire activity (Miller 1988:75; Pearsall 1983:129). Because of this lack of interdependency, independent ratios are appealing for data analysis purposes. While plant weight can be used instead of count when calculating these ratios, I mostly limit my quantification discussion to standardized plant counts because of how the data presented in this dissertation were collected (weight data were not systemically recorded). For this study I rely primarily on dependent ratio data, with one notable exception.

Density is an independent ratio calculated using the soil volume of the sample as the standardizing factor. The assumption underlying density is that, "all things being equal, larger sediment samples have more plant remains" (Miller 1988:73). Thus, density is a standardized measure allowing for useful comparison between two samples, even though they may be different sizes. With density, as with all independent ratios, the numerator and denominator are not expressed in the same units (density: plant count/soil liter; Miller 1988:74).

Dependent ratios are ratios where the numerator is incorporated into the denominator; for example, if a data set is standardized by total counts, the absolute count in the numerator is encompassed by the total count in the denominator (Miller 1988; VanDerwarker 2003). Percentage data are dependent ratios. The most common dependent ratio used in this study will be taxon count/total count, which will provide a proportion for a given taxon, which can then be multiplied by 100 to give a percentage. The two most abundant plant types encountered during this project were nutshell and seeds.

While I use standard bar graphs showing assemblage composition and coefficients of variation, these have limitations when it comes to showing meaningful differences in datasets. Thus, I also use box plots to graphically summarize the distributions of data between multiple assemblages as well as the dispersion of the data.

Box Plots

Box plots use ratio data to plot median, spread, and distribution (Figure 4.1). A particularly useful type of box plot to archaeologists is the notched box plot, wherein a notched “waist” represents the median value, with hinges at the 25th and 75th percentiles respectively, and whiskers extending out to represent the tail ends of the distribution (VanDerwarker 2006). If the notches of two plots do not overlap, then the distributions are significantly different, with 95% confidence (McGill et al.

1978:14). Occasionally the plots will have folded over hinges; this does not change the interpretation of the plot, but rather represents either skewed distributions and/or low sample sizes. Beyond the whiskers, outliers are represented by asterisks, and far outliers by open circles.

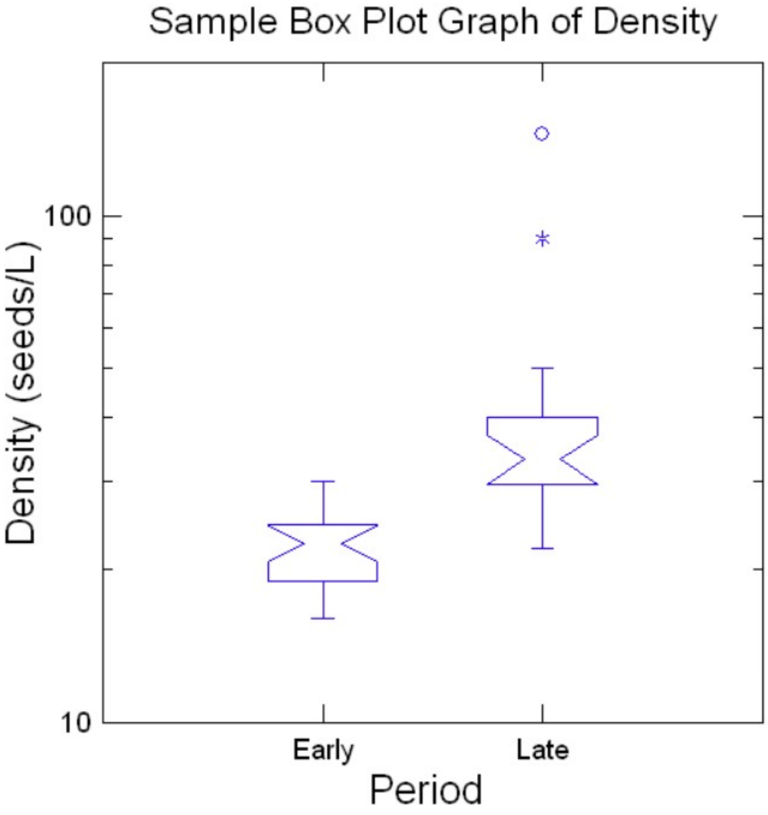

Figure 4.1. A sample notched boxplot graph.

Coefficients of Variation

One of the goals of this dissertation is comparing multiple assemblages in terms of plant habitats represented (wetlands, uplands, disturbance-preferred taxa) and plant parts represented (seeds, underground storage organs, nuts, greens, fruits). To measure how variable habitat exploitation was across sites, I use coefficients of variation to compare relative levels of variability. Low coefficients of variation suggest an assemblage is relatively tightly clustered (consistent means leading to low standard deviations); in contrast, a large coefficient of variation suggests a data set is more variable, even when accounting for assemblage size. On a relative scale, how similar are the data in a given dataset to each other (i.e., the coefficient of variation), and how dispersed is that dataset when compared to another (i.e., comparing coefficients of variation for two different data sets)? I apply these concepts in the following chapters.

Chapter 5: Synthesis of Prehistoric Plant Use in Owens Valley

This chapter provides a synthesis of all documented archaeobotanical assemblages reported in the Southern Owens Valley to date, including those analyzed as part of this dissertation project (which are elaborated upon independently in Chapter 6). The goal here is to evaluate several previously hypothesized trends, and use plant data to speak to some of the lingering questions researchers working in the region have. These include evaluating how plant use changed between the Newberry and Late Marana periods, with a focus on how the use of seeds changed. Another research goal is to assess how the intensification of pinyon is reflected in plant use data on the valley floor. And finally, how are changes in land and habitat use through time reflected in people's plant use? This chapter reviews ethnographically documented uses of plants found in archaeological assemblages and places those plants in a larger nutritional and ecological context. I then present a quantitative analysis of the synthetic dataset and highlight some trends and changes in plant use through prehistory. The final section connects those trends to existing questions in Owens Valley archaeology regarding both changes and continuity in plant use through time.

Ethnographically Documented Plant Use

Dozens of plant taxa have been identified in Owens Valley archaeological assemblages (Table 5.1), and while many have ethnographically documented uses as food or medicine, not all do. A plethora of high-quality ethnobotanical research has been undertaken in the Owens Valley and among Great Basin Paiute-Shoshone groups, starting with Julian Steward in the early 20th century (1933, 1938) and continuing through today (Rhode 2002; Fowler 1989). Plants with uses documented amongst the Paiute-Shoshone throughout the Great Basin will be noted as such, as will plants with documented uses among other California desert and mountain dwelling groups. Plants found in this area without any documented use will be treated separately.

Seeds

Seeds were among the most important plant foods among the Owens Valley Paiute (Pierce 2011, 2012; Reddy 2003). Grasses like *Stipa hymenoides* and *S. speciosa* were staple foods, and good sources of protein. Along with *Eragrostis* sp., these were among the tended plants found in irrigation tracts. Other irrigated seed plants included *Chenopodium,* a source of carbohydrates and protein, and *Helianthus,* a source of fats. Non-irrigated seed plants of importance included *Salvia* sp., *Mentzelia* sp., *Atriplex* sp., and *Juncus* sp. *(*which was also used for reeds). Somewhat less important, but still recognized by Paiute informants as being used on occasion, were grasses like *Sporobolus* sp*., Eriogonum* sp*.,* and *Hordeum* sp., *Oenothera* sp., *Suaeda* sp., *Descurainia* sp*.,* and *Sphaeralcea* sp.. Seed foods documented elsewhere in California, though not explicitly by Paiute informants, include grasses like Panicum and plants like *Cryptantha* sp. and *Amaranthus* sp.

Geophytes

Geophytes also known as plants containing underground storage organs (e.g., roots, tubers, and corms) were also important plant foods, especially as a source of carbohydrates. The irrigation tracts documented by Steward and discussed by Lawton and colleagues (1976) appear to have been used to spur growth of geophytes. Carbonized tubers from *Cyperus esculentus* and carbonized corms from *Dichelostemma* sp. have been documented (Pierce and Scholze 2016), though they are rare. And while no other carbonized geophytes have been found, the presence of seeds from geophyte-bearing plants, in this study, is considered circumstantial evidence of geophyte use. For example, *Eleocharis* sp. is proposed to have been another possible irrigation-encouraged geophyte-producing plant. *Schoenoplectus* sp. (referred to as *Scirpus* sp. throughout this manuscript for simplicity's sake, as that is how it is widely referred to among California paleoethnobotanists) and *Typha* sp. are also regarded as important geophyte-producing plants in the region, though no record exists of them as targets for irrigation. Both *Scirpus* sp. (bulrush) and *Typha* sp. (cattail) produced edible seeds as well, and *Typha* sp. also produced edible greens and pollen.

Nuts

Nuts were also a very important staple food source for Great Basin groups, and remain culturally important to Indigenous peoples living there today. They are highly nutritious in carbohydrates, fat, and amino acids. The quality of the fall crop of pine nuts from *Pinus monophylla,* specifically, was proposed by Steward (1933) to have been the key factor that determined the subsistence and settlement round for the rest of the year. Pine nut stands were one of the few natural resources subject to exclusionary ownership by Paiute groups, though when permission to access a group's territory was asked, it was usually granted. Acorns were also occasionally used, similarly to how California groups used them. Ethnographic records suggest valley inhabitants usually acquired acorns via trade (Steward 1933), as only a few small stands of oaks were known to exist in the valley and up in the foothills.

Fruits and Greens

Fruits and greens were the final pieces of the plant diet puzzle. Important fruit-bearing plants, providing carbohydrates, vitamins, and minerals, included Rosacea members such as *Rosa* sp*., Amelanchier* sp., and *Potentilla* sp. *Arctostaphylos* sp. berries were eaten fresh, or dried and stored, as were berries of *Sambucus sp.* and *Lycium* sp. Greens from *Trifolium* sp., *Amsinkia* sp*.,* and *Rumex* sp. were some of the first fresh foods available in spring.

There are many medicinal plants with documented uses, and I will limit discussion here to plants that have been found archaeologically. Many Paiute groups brewed medicinal tea from the *Ephedra* sp. leaf, which was used to treat a variety of internal ailments. The Owens Valley Paiute and Timbisha Shoshone also used the parched seeds as food (Rhode 2002). The roots and leaves of *Achillea* sp. were brewed and steeped to heal a variety of ailments from kidney troubles to cough and flu, or made into a poultice and applied to cuts. *Artemisia* sp. seeds were occasionally consumed as food, but more commonly the plant was used as medicine with decoctions of leaves used to treat fevers and as a cold remedy. *Gilia* sp. was used by some Great Basin groups to treat cuts and sores. While use of *Galium* sp. among the Paiute is unknown, it was used by the Ohlone, a group near the San Francisco Bay, to treat wounds, and as an antirheumatic and antidiahrrheal.

Carbonized seeds of several plants without known ethnographic uses have also been found in assemblages from Owens Valley. These include grasses like *Calamagrostis* sp., *Paspalum* sp., and *Poa* sp.; *Sesuvium* sp. specimens have been found frequently in archaeological contexts in the Great Basin, as in California, despite no ethnographic record of its use (Fauvelle et al. 2017).

Table 5.1 List of taxa known archaeologically in the region

Taxa	**Common Name**	**Secondary Use***
SEEDS		
Stipa hymenoides	Indian ricegrass	
Stipa speciosa	Desert needlegrass	
Achyrachaena mollis	Blow wives	
Agrostis sp.	Bent grass	
Amaranthus sp.	amaranth	G
Artemisia sp.	sage brush	
Astragalus sp.	milk vetch	
Atriplex sp.	saltbush	
Bromus sp.	brome grass	
Calandrinia sp.	red maids	
Carex sp.	sedge	
Chenopodium sp.	Goosefoot, Lamb's Quarters	G
Clarkia sp.	clarkia, farewell to spring	
Cryptantha sp.	cryptantha	
Delphinium sp.	larkspur	G
Deschampsia	hair grass	
Descurania sp.	Tansey mustard	G
Elymus sp.	squirrel tail, wild rye	
Ephedra sp.	ephedra, Mormon tea	G
Epilobium sp.	fuschia, willow herb	
Eragrostis sp.	lovegrass	
Eriogonum sp.	wild buckwheat	U
Helianthus sp.	sunflower	

Heliomeris sp.	goldeneye	
Hemizonia sp.	tarweed	
Hordeum sp.	wild barley	
Juncus sp.	rush	T
Lepidium sp.	pepper grass	G
Madia sp.	tarweed	
Malva sp.	mallow	G
Melica sp.	melic, onion grass	U
Mentzelia sp.	blazing star	
Mulenberghia sp.	muhly	T
Oenothera	evening primrose	
Panicum sp.	panic grass	
Phalaris sp.	canary grass	
Poa sp.	blue grass	
Polygonum sp.	knotweed	
Psorothamnus sp.	indigo bush	G
Puccinellia sp.	alkali grass	
Ruppia sp.	ditch grass	
Salvia sp.	sage	
Sesuvium sp.	sea purslane	S
Sphaeraclea sp.	globe mallow, desert mallow	F
Sporobolus sp.	sacaton, drop seed	
Suaeda sp.	seablite	G
Festuca michrostachys	fescue	
NUTS		
Pinus monophylla	pinyon	
Quercus sp.	acorn	
USOs/GEOPHYTES		
Allium sp.	wild onion	G
Cyperus sp.	nut grass, nutsedge, flat sedge	
Scirpus sp.	tule	S
Typha sp.	cat tail	G
FRUITS		
Amelanchier sp.	service berry	
Arctostaphylos sp.	manzanita	S
Lycium sp.	desert tomato	
Opuntia sp.	prickly pear	
Physalis sp.	ground cherry	
Potentilla sp.	cinquefoil	
Prunus andersonii	desert peach	

Ribes sp.	gooseberry, currant	
Rosa sp.	rose	
Rubus sp.	thimble berry, raspberry	
Sambucus sp.	elderberry	
Solanum sp.	nightshade	G
GREENS		
Amsinckia sp.	fiddleneck	S
Asclepias sp.	milkweed	
Claytonia sp.	miner's lettuce	U
Distichlis sp.	salt grass	
Eremalche sp.	mallow	
Erodium sp.	heron's bill, filaree	
Hydrocotyle	pennywort	
Lupinus sp.	lupine	
Nicotiana	tobacco	
Phacelia sp.	phacelia	
Portulaca sp.	purslane	S
Purshia sp.	antelope brush	
Ranunculus sp.	buttercup	S
Rumex sp.	dock	
Trifolium sp.	clover	S
Vicia/Lathrys	wild pea	S
Viola sp.	violet	
MEDICINE		
Achillea sp.	yarrow	
Chaenactis sp.	pin cushion, dusty maidens	
Galium sp.	bedstraw	
Gilia sp.	gilia	
Hypericum sp.	st. john's wort	
Marah sp.	wild cucumber, man-root	
Plantago sp.	plantain	S
Verbena sp.	vervain, verbena	

** G=greens, S=seeds, T=tool, U=USO/geophyte, F=fruits*

Paleoethnobotanical Data from Owens Valley

For this dissertation, I synthesize data from the last 30+ years of archaeological work in the Owens Valley, targeting site reports that contained paleoethnobotanical data. The sites providing these data are located as far south as

Olancha, and as far north as the Mono-Inyo county line (Figure 5.1). The data derive from sites along drainages on the western side of the valley, and sites close to the Owens River and Owens Lake on the valley floor. The dataset comprises assemblages from nine Newberry (3500-1400 BP) sites, 16 Haiwee (1400-650 BP) sites, 27 Early Marana (650-300 BP) sites, and eight Late Marana (300 BP- contact) sites (see Table 5.2; Appendix A).

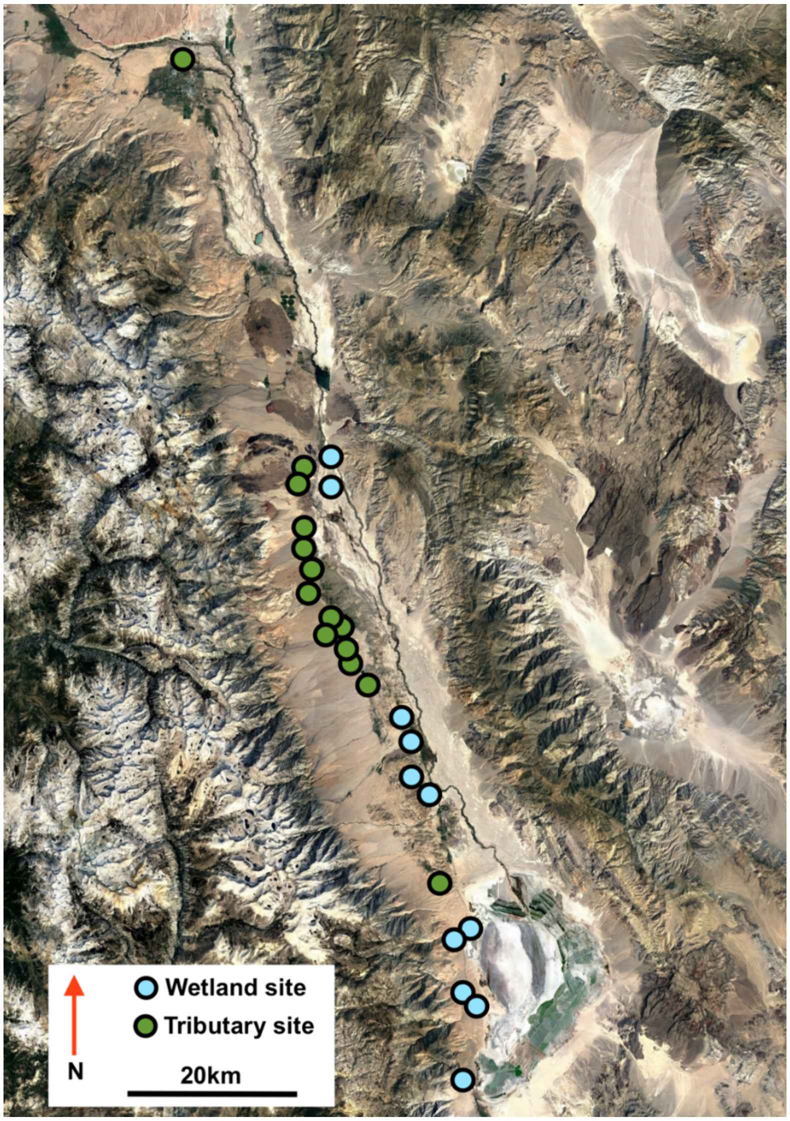

Figure 5.1. Map of sites included in study. Sites with assemblages with all analyses (see Table 5.2) are included here. Credit: J. Santy

Ubiquity

Ubiquity is a measure “frequency of occurrence” (VanDerwarker 2006:72) for a given plant taxon in assemblages, and gives information about the contexts and places certain plants were used. A taxon with a high ubiquity value means that taxon was used at many sites, across the landscape. A taxon with low ubiquity suggests spatially constricted use. *Pinus monophylla* is the most ubiquitous taxa in both the Newberry (68%; Table 5.3) and Haiwee (50%) periods, and falls to third-most ubiquitous in the Early Marana (45%); it does not rank in the top 5 for the Late Marana, but its ubiquity value (46%) remains relatively high. *Chenopodium* is the only taxon in the top 3 for all periods. From the Newberry to the Early Marana, the top 5 ubiquitous foods are a mix of seeds, nuts, and geophytes, but by the Late Marana period, the top 5 ubiquitous taxa are all seed taxa. These seeds include *Chenopodium* (77%), *Atriplex* (69%) and *Mentzelia* (69%).

Table 5.2. Sites with plant data, included in some or all analyses

Site	Author and Year	Newb	Haiw	EMar	LMar	All or Some Analyses?
INY-30	Wohlgemuth in Basgall and McGuire 1988	x	x	x		A
INY-5281	Pierce in Zeanah and Leigh 2002	x	x	x		A
INY-5397	Pierce in Basgall and Delacorte 2003	x	x	x		A
INY-5984	Reddy in Byrd and Hale 2003	x	x			S
INY-1384/H	Pierce and Scholze in Basgall and Delacorte 2012	x		x		A
INY-5276	Pierce in Zeanah and Leigh 2002	x		x		A
INY-1317	Reddy in Byrd and Hale 2003	x				A
INY-2146	Bettinger Delacorte and McGuire 1984	x				S
INY-6021	Reddy in Byrd and Hale 2003	x				S
INY-3769	Wohlgemuth in Delacorte 1999		x	x	x	A
INY-3778	Wohlgemuth in Delacorte 1999		x	x	x	A
INY-328	Wohlgemuth in Delacorte et al. 1995		x	x		S
INY-1700	Bettinger 1989		x	x		S
INY-2750	Wohlgemuth in Delacorte 1999		x	x		A
INY-7448	Eerkens and Pierce nd; Santy (this manuscript)		x	x		A
INY-1428	Gilreath and Holanda 2000		x			S
INY-3806/H	Eerkens 2003; Santy (this manuscript)		x			A
INY-3812	Wohlgemuth in Delacorte and McGuire 1993		x			S
INY-4266	Wohlgemuth in McGuire and Gilreath 1998		x			S
INY-5285/H	Pierce in Zeanah and Leigh 2002		x			A
INY-5761	Pierce in Basgall and Delacorte 2003		x			A
INY-1430	Gilreath 1995			x	x	S

INY-5207	Eerkens and Martin nd; Santy (this manuscript)				x	A
INY-5764	Pierce in Basgall and Delacorte 2003			x	x	A
INY-124	Wohlgemuth nd			x		S
INY-1434	Gilreath 1995			x		S
INY-1444	Gilreath 1995			x		S
INY-1447	Gilreath 1995			x		S
INY-1452	Gilreath 1995			x		S
INY-1991	Reddy in Byrd and Hale 2003			x		S
INY-4658	Pierce in Basgall and Delacorte 2011			x		A
INY-4663	Gilreath and Nelson 1999			x		S
INY-5273/H	Pierce in Zeanah and Leigh 2002			x		A
INY-5763	Pierce in Basgall and Delacorte 2003			x		A
INY-5877	Pierce in Zeanah and Leigh 2002			x		A
INY-8768	Eerkens and Pierce nd; Santy (this manuscript)			x		A
INY-5888	Pierce in Basgall and Delacorte 2011			x		A
INY-5757	Pierce in Basgall and Delacorte 2003				x	A
INY-5759	Pierce in Basgall and Delacorte 2003				x	A
INY-5875	Pierce in Zeanah and Leigh 2002				x	A

Table 5.3. Ubiquity of Plant Taxa by Period

Newberry	Ubiq (n=34)	%	**Haiwee**	Ubiq (n=28)	%
TAXA			TAXA		
Pinus monophylla	23	0.68	*Pinus monophylla*	14	0.50
Chenopodium sp.	19	0.56	*Chenopodium sp.*	12	0.43
Achnatherum hymenoides	17	0.50	*Scirpus sp.*	12	0.43
Scirpus sp.	17	0.50	*Juncus*	10	0.36
Mentzelia sp.	16	0.47	*Atriplex sp.*	8	0.29
Sporobolus sp.	16	0.47	*Artemisia tridentata*	5	0.18
Artemisia tridentata	14	0.41	*Mentzelia sp.*	5	0.18
Atriplex sp.	11	0.32	*Quercus*	5	0.18
Descurania sp.	11	0.32	*Salvia sp.*	5	0.18
Trifolium sp.	10	0.29	*Amaranthus sp.*	4	0.14
Eriogonum sp.	9	0.27	*Lycium sp.*	3	0.11
Juncus sp.	9	0.27	*Rosa sp.*	3	0.11
Typha sp.	9	0.27	*Sporobolus sp.*	3	0.11
Oenothera sp.	8	0.24	*Achnatherum hymenoides*	2	0.07

Early Marana	Ubiq (n=62)	%	**Late Marana**	Ubiq (n=13)	%
TAXA			TAXA		
Chenopodium sp.	35	0.57	*Chenopodium sp.*	10	0.77
Mentzelia sp.	33	0.53	*Atriplex sp.*	9	0.69
Pinus monophylla	28	0.45	*Mentzelia sp.*	9	0.69
Atriplex sp.	21	0.34	*Achnatherum hymenoides*	7	0.54
Scirpus sp.	20	0.32	*Artemisia tridentata*	6	0.46
Juncus	17	0.27	*Pinus monophylla*	6	0.46
Artemisia tridentata	15	0.24	*Sphaeraclea sp.*	4	0.31
Lycium sp.	13	0.21	*Cryptantha sp.*	3	0.23
Sporobolus sp.	13	0.21	*Descurania sp.*	3	0.23
Atriplex canescens.	11	0.18	*Helianthus sp.*	3	0.23
Typha sp.	11	0.18	*Hordeum sp.*	3	0.23
Achnatherum hymenoides	11	0.18	*Lycium sp.*	3	0.23
Descurania sp.	9	0.15	*Phacelia sp.*	3	0.23
Helianthus sp.	8	0.13	*Scirpus sp.*	3	0.23

Density

Noteworthy is that plant density during the Newberry and the Haiwee periods is essentially identical. The increase in overall plant density from the Haiwee period to the Marana period documented by previous work is seen here, with an additional increase into the Late Marana period (Figure 5.2a,b). While the increase from the Haiwee to the Early Marana is not statistically significant, the increase from Haiwee to Late Marana is, as evidenced by non-overlapping notches on the respective boxplots.

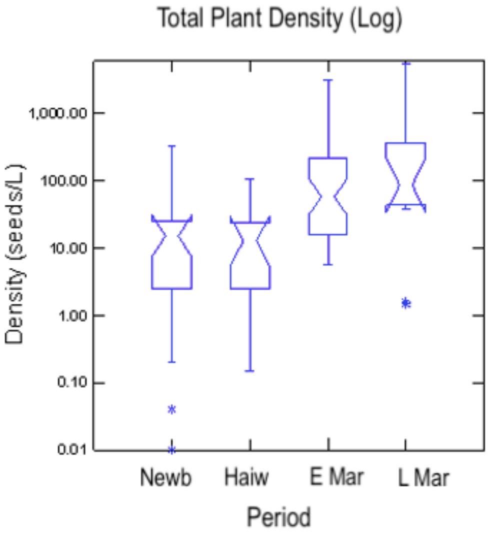

Figure 5.2a. Boxplot for total plant density by period.

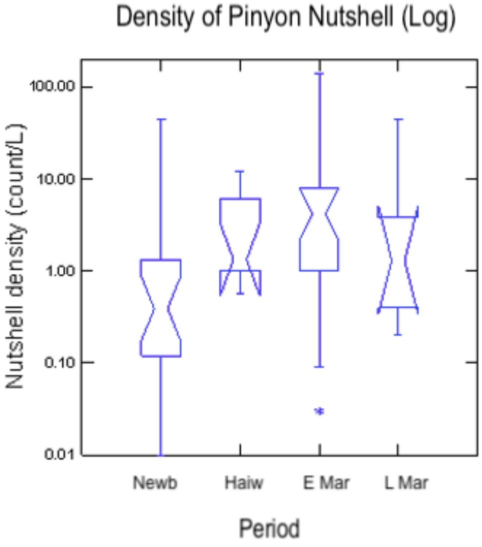

Figure 5.2b. Boxplot for density of pinyon nutshell by period.

The pine nutshell density data tell a slightly different story. Pinyon, in spite of its ubiquity, is lowest in density during the Newberry period. It increases substantially into the Haiwee period, but the further slight increase in the Early Marana reaches statistical significance (from the Newberry). Density of pinyon drops slightly in the Late Marana, though the difference is not statistically significant. Peak pinyon exploitation, among residents of the valley floor, appears to occur in the Early

Marana. This pattern supports the hypothesis that pinyon intensification began in the Haiwee period and peaked in the Early Marana. The drop during the Late Marana supports the hypothesis of skyrocketing seed usage among people living on the valley floor that occurred just prior to Euro-American contact.

Relative Percentages

Assemblage composition was calculated across two dimensions: food category and plant habitat type. Data presented here were compiled using counts of seeds and nutshell fragments. Therefore, this analysis is subject to some bias in that fragmented assemblages (i.e., where nutshell was broken into smaller pieces, thus inflating counts) could be interpreted as having greater density and abundance than non-fragmented ones. Percentages were calculated by summing all counts for a given site, then calculating the percentages for the site, then calculating a mean percentage for each period.

The food categories follow the food types discussed above (seeds, nuts, geophytes). The categories excluded are greens and fruits, as they do not significantly vary through time and do not comprise more than 10% of the assemblage in any time period.

Food part categories were determined using ethnographically available information. Foods with manifold edible parts (e.g., *Typha* comprising edible geophytes, seeds, and greens) were placed in their most commonly documented category (i.e., *Typha* is grouped as a geophyte).

Relative Percentages by Food Category

There are several notable patterns in the assemblage composition data (Figure 5.3). The first is the large percentage of seeds through time, in all periods; seeds comprise 50% of all plant foods, and at times considerably more. The typical Newberry plant assemblage comprises 60% seeds, 15% nuts, and over 20% geophytes. Seed abundance decreases in the Haiwee from the Newberry then rebounds in the Marana, peaking in the Late Marana. Nutshell abundance peaks in the Haiwee period, where nutshell comprises 20% of plant assemblages on average. The lowest abundance of nutshell on the valley floor is found in the Late Marana. Instead of a decrease in overall pinyon abundance, I posit that this pattern suggests that Late Marana people consumed the same absolute amount of pinyon as earlier, but used a proportionally greater amount of seeds, thus decreasing relative pinyon abundance.

The patterning in nutshell abundance clearly represents an increase in the importance of pinyon in the diet, potentially as an effect of pinyon intensification; the intensification process is proposed to have started after the onset of the Haiwee period, with the majority of upland pinyon camps post-dating 1000 BP (Bettinger 2015:70). The decrease of pinyon abundance on the valley floor during the Marana period seems to be correlated with the increasing importance of seeds in the diet. Alternately, this pattern could reflect a shift towards a more segmented seasonal settlement pattern that saw people bringing fewer pine nuts onto the valley floor from winter pinyon camps at higher elevations.

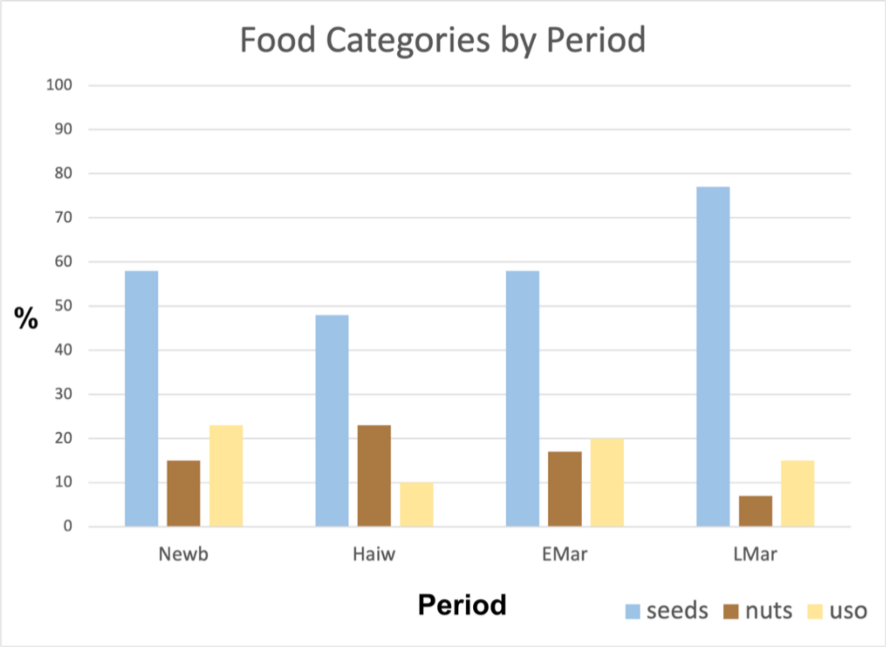

Figure 5.3. Relative percentage of plant assemblage by food category by period.

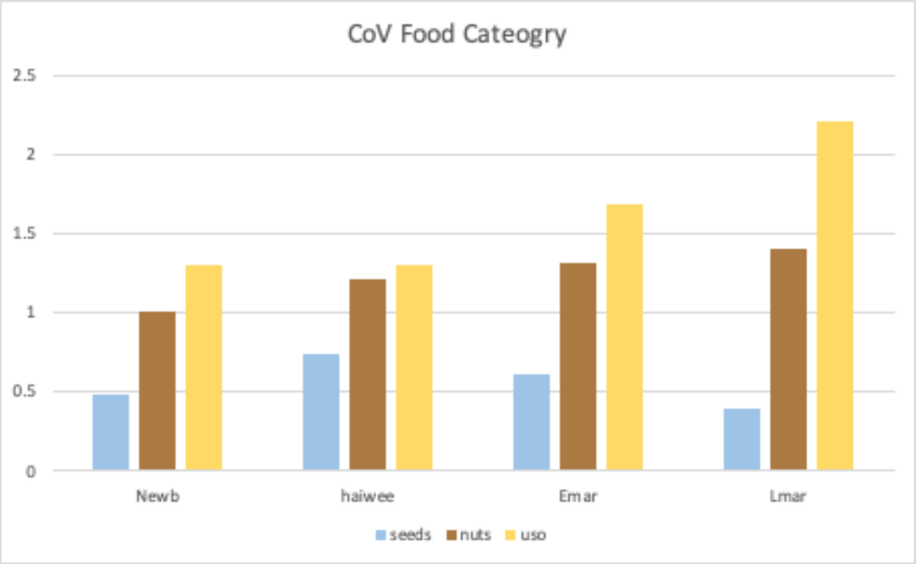

Figure 5.4. Coefficient of variation by food category through time.

These food category data show that Newberry and Early Marana assemblages are very similar to each other, despite being separated by the Haiwee period and almost 1000 years. However, despite the superficial similarity of the assemblages from these two periods, there are important differences. The first is the density of plant assemblages, as noted above; Early Marana assemblages are much denser than Newberry assemblages, at a level that is statistically significant. The second difference can be seen in a graph of coefficients of variation between periods (Figure 5.4). Coefficients of variation are a measure of how similar or different a group of assemblages is; if a time period has a low coefficient of variation, it suggests that assemblages dating to that period are relatively similar in terms of composition. A high coefficient of variation indicates more variability among plant assemblages from the different sites. Figure 5.4 shows that Newberry assemblages are more similar to one another than are Marana assemblages. Any given Newberry assemblage has a similar amount of seeds, nuts, and geophytes as any other Newberry assemblage. In contrast, Early Marana assemblages are more different from one another. This pattern supports the idea that Newberry-era foragers were practicing a less-intensive, more generalized plant subsistence strategy than in later periods. No matter where their basecamp was located, people targeted a similar range of foods.

In contrast, during the Marana period, plant assemblages suggest different Marana groups practicing more targeted, specialized plant foraging. Along these lines, the extremely low COV values for seeds and the high COV for geophytes sheds light on the ways in which plant use was changing in late prehistory. Seeds were a staple at essentially every Late Marana site; the abundance and use of nuts and geophytes, however, was much more variable from site to site. The high COV values for geophytes, especially, suggests that their presence at a site could be an indication of targeted foraging behavior; valley residents were pursuing geophyte resources in large quantities at some sites, perhaps based on the abundance of local resources, and not at all at other sites. Another possibility is that geophytes in this time period were being processed off-site.

Relative Percentages by Habitat

For calculating relative abundance based on plant habitat, I classified each taxon into one of three habitat categories: wetland, upland, and "disturbance" (also referred to as "weedy pioneers"). Plant habitat was determined using the Army Corps of Engineers Wetland Plant Database (usace.army.mil) and Calflora.org. I classify plants that are obligate wetland dwellers or occur frequently in wetland environments as "Wetland" taxa. Plants that are never or usually not found in wetlands are typed "Upland" taxa. The third category includes the "weedy pioneers." Weedy pioneers, as a category, refers to plants that occur broadly, across habitats (wet/dry/high altitude/low altitude, etc.) and plants that are disturbance-preferred. Many plants in the Poacaeae and Chenopodiacaeae families fall under this umbrella.

While I suspect the Newberry reliance on wetland plants might be an effect of small sample size, the percentage increase in upland plants during the Haiwee period is a very real effect that correlates to an increase in pinyon consumption, pinyon which was being brought from the pinyon belt in the uplands. And while upland plants decrease in abundance in the Early Marana and again in the Late Marana, I offer that this decrease relates directly to the increase in weedy pioneers (most of which are small seeds); I think this pattern has less to do with the fact that people ate less pinyon, an upland taxa (supported by the density data) and more to do with the fact that people began using a lot more seeds.

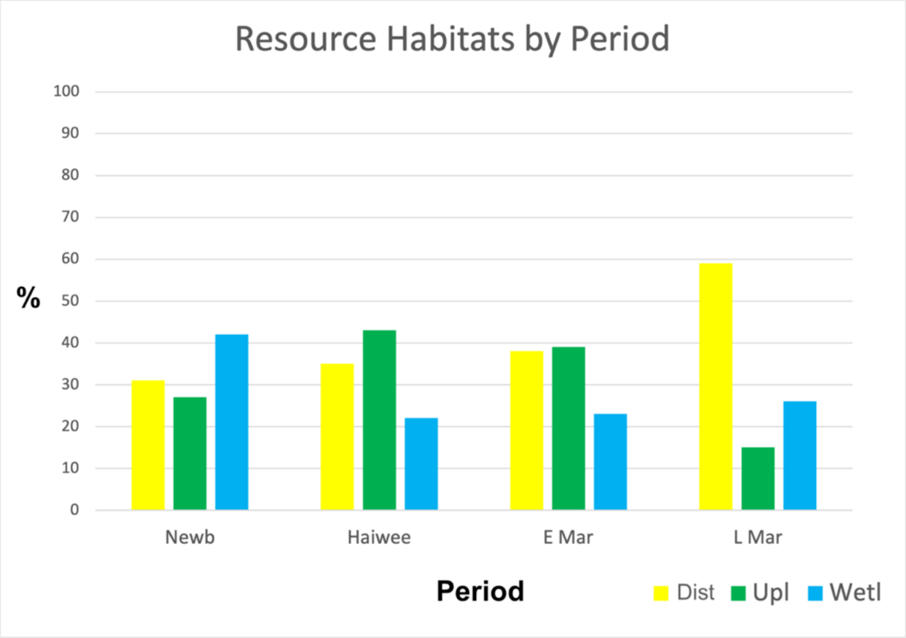

Figure 5.5. Bar chart showing relative percentages of habitats represented in plant assemblages by period.

The most salient trend in these relative percentage data (Figure 5.5) are the increase in weedy pioneers through time, comprising an average of 60% of Late Marana plant assemblages. Three factors could be contributing to this growth, neither of them mutually exclusive. First, as population in the valley grew (and it did, steadily, throughout prehistory [Polson 2009]), more people would create more sites and occupations, increasing the number of disturbed areas on the landscape for these plants to grow; thus, they could make up a larger percentage of the available, biomass. Second, weedy pioneers are largely correlated with seeds as a food category, which speaks to the increasing importance of seeds in the diets of Late Marana individuals. Third, as has been documented elsewhere in California and across the world, Indigenous people have been intentionally managing for millennia the landscape around them (Anderson 2005; Bird et al. 2005; Cuthrell et al. 2012, *inter alia*) and continue to do so today. In doing so, they clear land of plants that are less desirable, and support the growth and development of plants that are economically useful to them and the prey they pursue. The change in assemblage composition could be the result of intentional alteration of local landscapes by the people who lived there.

The inverse correlation between wetland and uplands suggests that one is pursued at the expense of the other, with weedy pioneers appearing independently of other resources. This pattern is not surprising, given the widespread proliferation of weeds, by their very definition. Indeed, scholars have argued that green-cone pinyon processing, a Marana-era phenomenon in which cones are picked prior to ripening in late summer, is a means of resolving the seasonality conflict between these two productive habitats (Eerkens et al. 2004). The curve of upland plants likely shows the intensification of pinyon beginning in the Haiwee period into the Early Marana, with valley residents subsequently pivoting to weedy pioneers in the Late Marana.

Another notable trend is the correlation of plant habitats to particular food categories. With limited exception, weedy pioneers correlate to the seeds category, wetland plants correlate to geophytes, and upland plants correlate to nuts, specifically pinyon (and acorns, in lesser amounts). As mentioned, the increase in upland plants during the Haiwee and Marana periods is likely a function of the intensification of pinyon ramping up into the Early Marana. These links between food category and plant habitat hold throughout time and across the valley. The exception occurs in the Late Marana, when the increase in seeds appears to be tied to an increase in weedy pioneers but also wetland plants. The significance of this trend will be discussed in Chapter 6, which will focus on lakeside (and thus, wetland) plant use specifically.

Site Habitat and Resource Habitat through Time

To evaluate if land use and habitat use changed through time, I compared the habitats of sites with the habitats of the archaeobotanical resources found at those sites. Sites were classified as either wetland or tributary (Table 5.4), based on their closest body of water. Wetland sites are those closest to the Owens River and Owens Lake; tributary sites are those closest to any of the smaller creeks (such as Lubken Creek or Big Pine Creek) that feed into the river or lake. In terms of the habitats of the sites, tributary sites are assumed to have better access to the upland plant communities. Wetland sites are assumed to have better access to wetland resources, like many geophytes and some seeds.

Table 5.4. Site Habitats by Period

Site Habitat	Newberry	Haiwee	Early Marana	Late Marana
Tributary	3	6	7	3
Wetland	3	3	10	4
Total	6	9	17	7

In terms of patterning, a site with a high degree of consonance or agreement is one in which the archaeobotanical assemblage broadly matches with the site environment. For example, if a tributary site has more upland plants than wetland plants, it counts as a match. A period with a higher degree of consonance suggests people living during that time were foraging more locally; a period with a lower degree of consonance suggests that people were foraging more logistically, bringing resources from other habitats to their residences.

The high degree of consonance between site habitat and plant habitat late in time is intriguing, as is the much lower consonance during the Newberry period (Figure 5.6). Newberry period sites, as seen in other datasets, show a generalized subsistence pattern; whether a site was located close to the lake/river (classified as "wetland"), or on a tributary creek to the west (classified as "tributary"), it likely had a mix of resources from wetland, upland, and disturbed habitats. But starting in the Haiwee period, wetland resources became increasingly limited to lacustrine/riverine sites, a trend that intensified into the Late Marana. Furthermore, tributary site assemblages are dominated by weedy pioneers, with upland resources (typified by pinyon) a distant second.

By the Late Marana period, low-lying valley sites closest to the lake or the Owens River were functionally specialized sites where people mainly targeted wetland resources. This trend is evident in the coefficient of variation data (Figure 5.7) for resource habitats as well, with wetland resources having greatest variability among Marana period sites. Evident as well is the consistent presence of weedy pioneers at early and especially Late Marana sites, attesting again the importance of weedy seeds to the diet. Even though these effects are muted in the strict consonance interpretation, a pattern showing movement away from the generalized foraging regime of the Newberry and toward a more localized foraging regime later in time is clear.

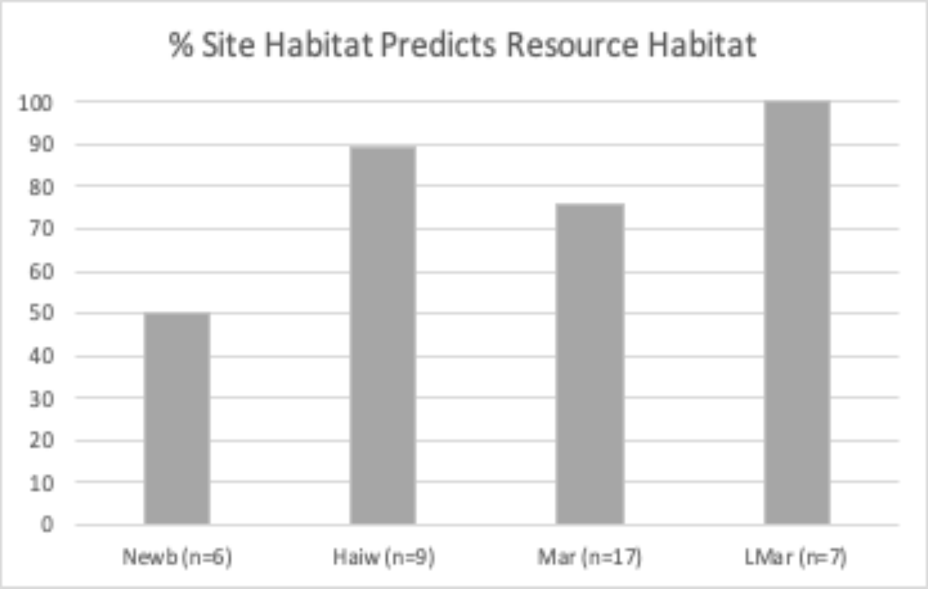

Figure 5.6. Consonance between habitats of resources found at a site and the habitat of the site itself. If all of the resources from a wetland site came from wetland (or weedy pioneer) habitats, then consonance would be 100%.

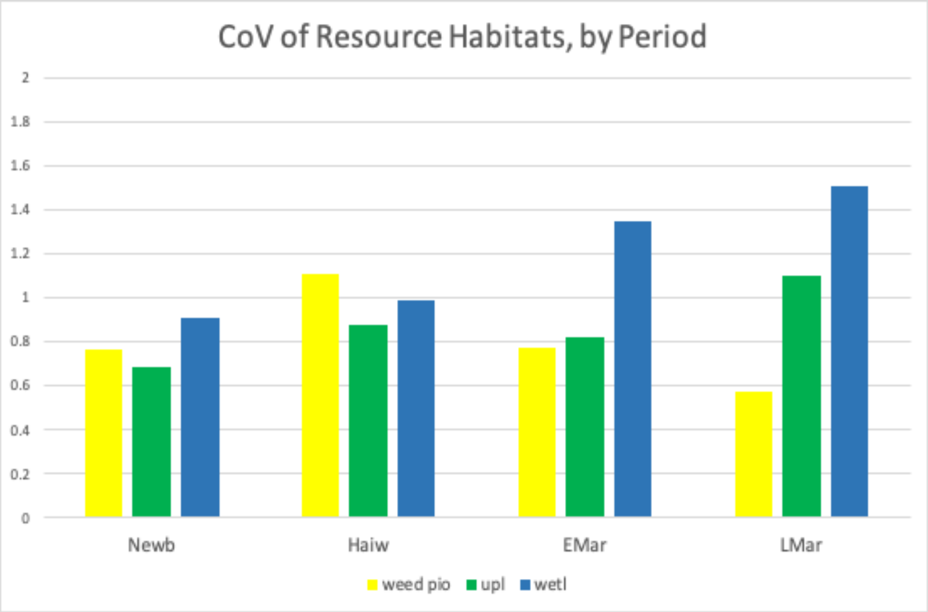

Figure 5.7. Coefficients of variation for habitats of resources by period.

Exploratory Data Analysis: Investigating Site Habitats and Resource Habitats through Time

As Figure 5.6 shows, the overlap between site location and resource location varies through time; as Figure 5.7 shows, the resource habitats used by site residents also vary through time. Using the data comprising Figures 5.6 and 5.7, I split the sites up even further, looking specifically at resources used at wetland-adjacent sites, and resources used at tributary-adjacent sites through time (Figures 5.8a-b). As the coefficient of variation is only useful for identifying broad patterning (see Chapter 4), only the most salient trends will be highlighted here.

The Newberry period CoV values are similar at both wetland and tributary sites, again reinforcing the generalized, diversified Newberry subsistence regime. Into the Haiwee period, different trajectories emerge. Upland plants (most likely pinyon) become considerably more variable at wetland sites, and weedy pioneers became much more variable at upland sites. At tributary Early Marana sites, increases in seed abundance becomes apparent: weedy pioneers were used broadly and consistently across tributary sites on the landscape. By the Late Marana, weedy pioneers were ubiquitous and abundant at all Late Marana tributary sites and most wetland sites. However, the low variability of wetland resources at wetland sites during this period suggests that residents at wetland sites were specifically and widely using those locales to target wetland resources.

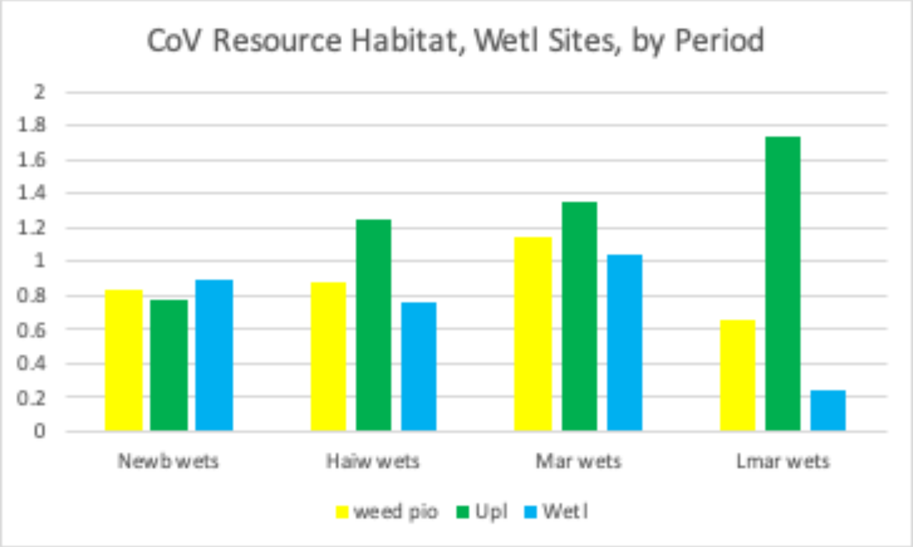

Figure 5.8a. Coefficient of variation of resource habitats at wetland-adjacent sites by period.

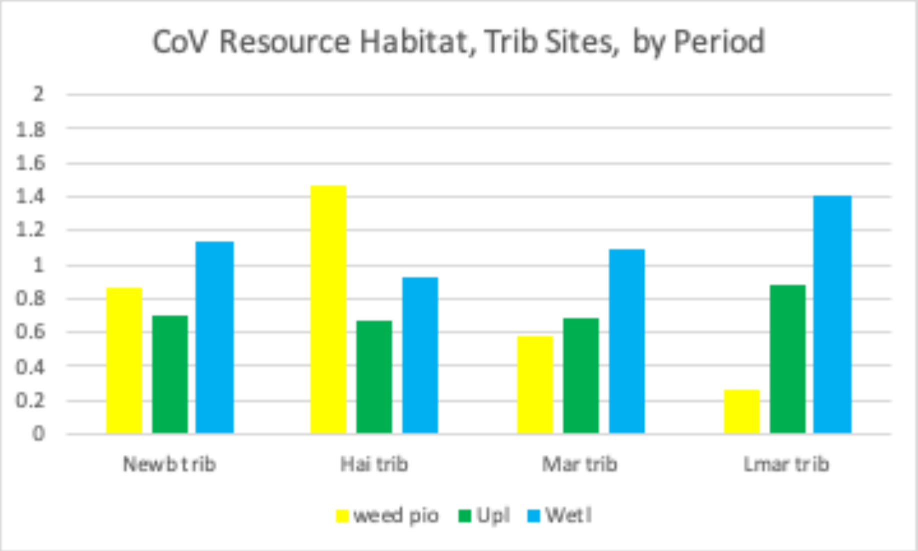

Figure 5.8b. Coefficient of variation of resource habitats at tributary sites by period.

Data Summary and Interpretation

Plant foraging in the Newberry period seems to represent a generalized, logistically-oriented practice. Valley residents pursued a range of plant resources across the landscape, and brought those resources back to their base camp, leaving the ecologically varied plant assemblage seen archaeologically at Newberry occupations. Pinyon use seems widespread across the landscape, as evidenced by its high ubiquity value, but was not used intensively, as evidenced by its low density in Newberry assemblages. This pattern supports the hypothesis of "brown cone" pinyon usage (Eerkens et al. 2004), wherein people would harvest the nuts upon ripening in the fall, but the nuts were likely not stored or cached beyond their season of availability. However, the Newberry period has the fewest weedy pioneers, and the most wetland plants, of any period. While the wetland plant number may be skewed by a relatively low sample size (n=6), the weedy pioneer statistic supports the idea that plant use was not as intensified *sensu stricto* (*à la* Morgan 2015) as it was in later time periods. The habitat data support the hypothesis that Newberry foragers were more logistically mobile than in later periods. Newberry sites have by far the least consonance between site habitat and resource habitat, suggesting they had central basecamps from which they made forays to non-proximal habitats to forage. Data from obsidian sources (Eerkens et al. 2008) and site survey (Bettinger 1999) support this idea.

Plant use in the Haiwee period bears some striking similarities to the Newberry but with one notable exception: the rise in pinyon. Overall plant density (as one proxy for use) stays constant, and each period's assemblages are similarly variable to one another. Across several dimensions, there remained a degree of consistency in how people used plants. However, pinyon usage (as measured by density and abundance) began to rise sharply in the Haiwee, suggesting incipient reorientation of foodways around plant use. Around this time, residential groups also appear to have changed the way they approached land use and resources; people exported more pinyon from the uplands into the valley, but otherwise used the resources that existed most immediately around them. If they were close to the river or lake, they made use of wetland resources, like *Scirpus* sp. and *Juncus* sp. If they were to the west, down one of the creeks that drains the Sierra snowmelt into the river, they used the resources available to them there, such as *Atriplex* sp. and *Stipa hymenoides*.

The spike in upland plants and nuts (overlapping categories) is likely related to the aforementioned advent of green cone pinyon harvesting, wherein humans knock green cones with fully formed nuts off the *P. monophylla* tree and cache them until needed (Bettinger and Baumhoff 1983). The green cones are roasted in fire, causing them to open up, making the nuts accessible. While green cone harvesting is more time- and energy-intensive than removing pine nuts from brown, open cones, it reduces competition from other pinyon consumers (squirrels, deer, bears, etc.) and allows the nuts to be safely stored.

The switch to green cone processing is thought to have occurred somewhere between 1300 and 1000 BP, as part of a suite of social and subsistence shifts (Bettinger 2015; Basgall and Delacorte 2011; Hildebrandt and Ruby 2006), including the spread of bow-and-arrow technology. The bow-and-arrow would make the uplands more attractive as an area for habitation, as both large and small game can be hunted at closer range and with more accuracy than with a spear thrower (Bettinger 2015). While it remains unclear which pattern started first, bow-and-arrow hunting or green cone processing, it is easy to see how they would support one another in terms of opportunity costs and the gendered division of labor. Assuming labor divisions documented ethnographically, in the upland fall, while men hunted, women led the pinyon harvest. The adoption of both certainly represents a shift in focus toward the uplands, most specifically the pinyon belts of the Sierra Nevadas to the west, and the Coso-Inyo-White Mountains to the east.

Throughout prehistory, seeds were an important dietary component for valley residents, but their importance took on a new dimension in the Marana period. Plant density dramatically increased, and seeds rebounded in abundance from their slight drop in the Haiwee period. Pinyon density also increased slightly. As weedy pioneer-seed resources and upland-pinyon resources became more consistently and widely used on the valley floor, the variability of wetland resources increased, suggesting more specialized use of these sites on the landscape. This represents a shift from the Haiwee period, when there was a more equal orientation between wetland and tributary sites (wetland sites for pursuing wetland resources, and tributary sites for pursuing upland resources); the Early Marana saw a shift towards more regular occupation of tributary sites, with wetland occupations becoming more opportunistic or more suitable for targeting non-plant resources.

By the Late Marana period, roughly 250-300 years ago, the domination of small seeds across assemblages, and presumably their use by valley floor residents, skyrocketed. The three most ubiquitous taxa are weedy pioneers, which were used broadly and consistently across the landscape, at both tributary and wetland sites. Wetland residential sites were used specifically for obtaining wetland seed resources, and tributary sites a base for pursuing weedy pioneers and, to a lesser extent, upland plants. Pinyon was still present, in amounts similar to previous times, but it seems clear that the plant subsistence focus of people living on the valley floor was seeds.

Wetland plants are highly variable, and environmentally circumscribed to use by people living close to wetlands. However, residents of those wetland sites were consistently targeting wetland resources, and the overall lack of upland resources at those sites suggests a highly localized, segmented settlement practice. Considering pottery is found overwhelmingly at these sites (Eerkens 2008), it can be safely argued that people living at these sites were specifically targeting local resources.

The following chapter hones in on these wetland sites, presenting data from four lakeside sites dating to the Haiwee and Marana periods, and examines in greater detail their use to people. After presenting that data, Chapter 7 will connect the patterns of plant use presented in Chapters 5 and 6 to the social and technological shifts hypothesized by previous scholars.

Chapter 6: Data from Lakeside Sites INY-7448, INY-5207, INY-3806/H, and INY-8768

This chapter presents data from five occupations of four lakeside sites, dating from the early Haiwee to the Late Marana periods. I consider the following questions: Did people living at lakeside sites use plants differently than those who didn't? How were these sites occupied seasonally? Do local changes in plant use conform to trends seen elsewhere in the valley? Did these lakeside residents target wetland plants, or did other factors contribute to decisions about plant use?

Paleoethnobotanical Data from Four Lakeside Sites

Plant remains from four previously excavated sites comprise the largest plant assemblage from the shores of Owens Lake to date. Some of these data were generated by other scholars (Martin n.d.; Pierce n.d.; see Chapter 4, Tables 4.1, 4.2, and 4.3), with additional analysis by the author. These data were gathered and analyzed as part of the Households in Owens Valley Archaeological Project, abbreviated as 'HOVAP' in the text.

Two samples from INY-8768 have been excluded from this analysis; these samples had large amounts of pine nutshell and *Ephedra* sp. seeds that overwhelmed statistical analysis and comparison to other sites. These samples will need to be treated separately as part of future work. The similarity of these two samples to each other, in terms of their extraordinary composition, suggest a special use feature that escaped notice during excavation but was luckily captured via flotation sampling. I exclude them from the following analyses (and those of the previous chapter), as they represent outliers from the site's central tendency.

Ubiquity

For the purposes of evaluating ubiquity, I counted distinct excavated contexts as samples from each site. Grouping the samples generated nine Haiwee samples and 10 Marana samples (the lone Late Marana lakeside site is counted in this number). While ubiquity is most useful when n>10, the data provided here are still informative.

The top four resources from each period comprise the same four taxa, but in mixed order. Pinyon is the most ubiquitous taxon for both periods, followed by *Scirpus* sp. and *Chenopodium* sp. (second-third and third-second, respectively, for the Haiwee and Marana periods), with *Atriplex* sp. in the fourth rank. However, beyond the top four resources, patterns diverge for the periods.

The most notable differences between the Haiwee and Marana periods is the ubiquity of seed-foods during the Marana period. With the exception of *Scirpus* (which also has edible seeds) and pinyon, the most ubiquitous resources are edible seeds. This conforms to Marana-period patterns documented elsewhere in the valley. Also worth mentioning is the presence of *Quercus* sp. in the Haiwee period assemblage, a nut resource that must have been harvested at some distance from the shores of the lake. Today, some of the closest oak trees are about 5 km west of Owens Lake, along Cottonwood Creek (Eerkens, personal communication).

Table 6.1. Ubiquity Values for Haiwee and Marana Period Lakeside Sites

Haiwee Period	ubiq (n=9)	%
TAXA		
P. monophylla	7	78%
Scirpus sp.	6	67%
Chenopodium sp.	6	67%
Atriplex sp.	5	56%
Sesuvium sp.	4	44%
Juncus sp.	4	44%
Quercus sp.	3	33%
Amaranthus sp.	2	22%
Carex sp.	2	22%
Phalaris sp.	2	22%
Rumex sp.	2	22%
Agrostis sp.	2	22%

Marana Period	ubiq (n=10)	%
TAXA		
P. monophylla	8	80%
Chenopodium sp.	7	70%
Scirpus sp.	6	60%
Atriplex sp.	5	50%
Mentzelia sp.	4	40%
Panicum sp.	3	30%
Suaeda sp.	3	30%
Juncus sp.	3	30%
Sesuvium sp.	2	20%
Agrostis sp.	2	20%
Calamagrostis sp.	2	20%
Ephedra sp.	2	20%
Phalaris sp.	2	20%
Sporobolus sp.	2	20%
Helianthus sp.	2	20%
Achnatherum sp.	2	20%

Density

Lakeside sites, like other sites, show a distinct increase in overall plant density between the Haiwee and Marana periods, although the difference does not quite reach statistical significance (Figure 6.1a,b). Pine nutshell density, however, did increase dramatically between the Haiwee period and Early Marana, before dropping again during the Late Marana.

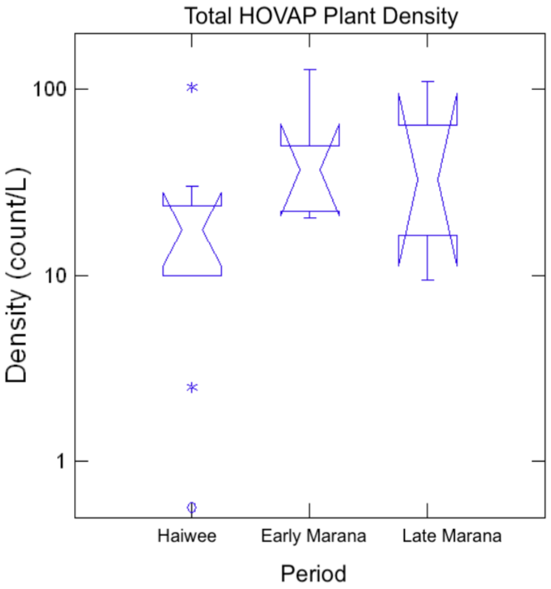

Figure 6.1a. Graph of total plant density between periods.

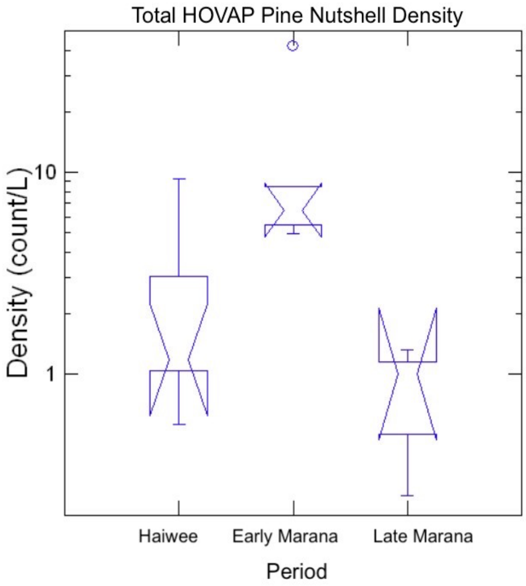

Figure 6.1b. Graph of pine nut density between periods.

Relative Percentages

With the caveat that the samples sizes are low (total n=5, Haiwee n=2, Early Marana n=2, Late Marana n=1), and that INY-8768 and INY-3806/H appear to be outlier sites for their respective time periods, I present the following assemblage composition data (Figure 6.2a,b).

The HOVAP data show similar trends as the valley-wide data, but with a few distinct differences. Through time, weedy pioneers and seeds both increase as a percentage of assemblage; and nuts and upland seeds both drop precipitously into the Late Marana period. However, Haiwee and Early Marana nut percentages are basically the same, with an increase in upland plants and a slight increase in nuts. This particular trend in the HOVAP data is due to an anomalously high amount of acorn found in the excavated structure at INY-8768; when the acorn is excluded, the trend follows the larger valley trend of a slight but steady decrease in nuts and upland plants from the Haiwee into the Early Marana period.

The location of the HOVAP sites, with proximity to drainages and the lake itself, appears to have had an effect on the choices site residents made in terms of plant use. The most obvious effect would be the large percentage of wetland plants used at INY-5207, the Late Marana site. Interestingly, almost none of the plant remains are from geophyte-primary plants; rather, almost the entire assemblage is seeds (98%), of which almost 60% are found in wetland contexts. As a result, only 35% of Late Marana plants are weedy pioneers, in contrast to the average 60% weedy pioneers of Late Marana plant used in the valley as a whole.

Site Habitat and Resource Habitat through Time

As with the valley wide data, I compared the habitats of the HOVAP sites to the habitats of the taxa found in the plant assemblage (Table 6.2). The patterning is clear; wetland resources dominate the assemblage at lakeside sites, during both the Haiwee and early and Late Marana periods. Four of five sites have wetland plants as the highest percentage, beating both weedy pioneers and upland plants. The lone holdout, INY-8768, is a somewhat anomalous feature with a large quantity of acorn and pine nutshell and *Ephedra* seeds, probably related to the two outlier samples that are excluded from the analyses presented in this manuscript. In any case, this patterning indicates the persistence through late prehistory of lakeside sites as places for residents to target lakeside resources.

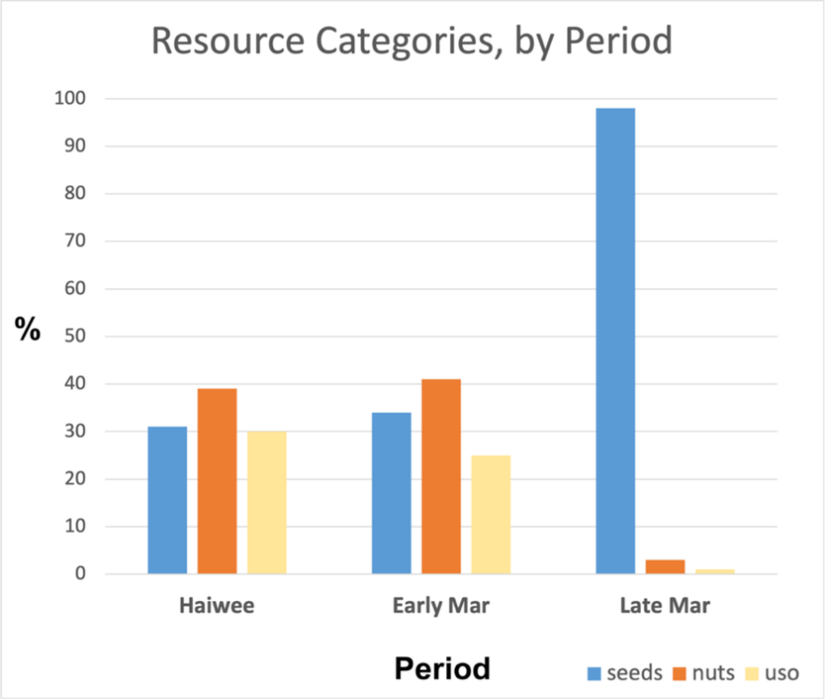

Figure 6.2a. Resource categories by period.

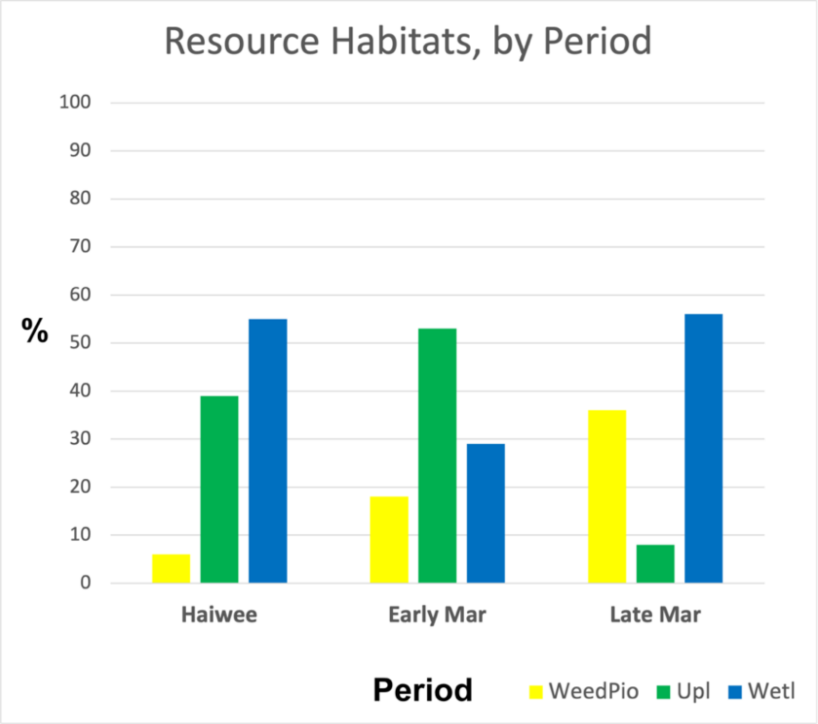

Figure 6.2b. Resource habitats by period.

Also worth noting is the assemblage composition of INY-5207, the lone HOVAP Late Marana site. Here, the wetland plant-dominated pattern holds, but with zero geophyte-primary plants represented in the assemblage. Like at other Late Marana sites, seeds reign supreme, but at this wetland-adjacent site the seeds were not necessarily weedy pioneers, but instead coming from the wetland itself. While the sample size of Late Marana lakeside sites is just one, this could be part of a micro-regional pattern: seeds were still key, but from local wetland environmental contexts.

Table 6.2. HOVAP Site habitats vs. resource habitats

Period	HOVAP site	WP	Upl	Wetl
Late Marana	INY-5207	0.36	0.08	0.56
Early Marana	INY-8768	0.13	0.73	0.14
Early Marana	INY-7448	0.23	0.32	0.45
Haiwee	INY-3806	0.12	0.28	0.60
Haiwee	INY-7448	0.00	0.50	0.50

Seasonality

Understanding what time(s) of year a site was occupied can tell us about how a site fits into a larger settlement pattern. Site seasonality was determined by looking at the bloom period of a plant (according to Calflora.org) and offsetting it by one month, to account for maturation of seeds (see: Gill 2015). For plants where the primary economic product was not seeds, seasonality is determined by season of availability for geophytes or nuts.

While most of the plant remains identified for HOVAP (and in the Owens Valley generally) are identified to genus level, ethnographic sources naming species can be used to narrow down the range of possibilities (Wohlgemuth, personal communication). Ethnographers have worked with indigenous residents of the Owens Valley and other Paiute-Shoshone groups throughout the Great Basin since Julian Steward's work in the 1930s (Steward 1933, 1938). This work continued through the late 20th and into the 21st centuries (Fowler 1989, Rhode 2002), and is ongoing today. As a result, there is a wealth of ethnobotanical knowledge to reference. For the purpose of determining season of occupation, I used this knowledge base to narrow down genus-level identification to likely species-level identification, allowing for seasonality profiles of higher resolution. For example, while there are 22 species of *Mentzelia* native to Inyo County, only two (*M. albicaulis* and *M. dispersa*) are documented as being used ethnographically (Rhode 2002). Thus, instead of the seasonality range of *Mentzelia* being February through October, it can instead be narrowed down to April-September.

While the degree of sedentism during late prehistory has been much discussed, the fact remains that little evidence supporting extended, multi-year occupations of single house structures has been found. Thus, for the purposes of the analysis of seasonality, I assume that the structures at the sites discussed here were not occupied over the course of more than three seasons, with one possible exception. While the plant assemblage is a key component in discerning season of occupation, the remainder of the archaeological assemblage also matters. If the site had a variety of other artifacts and ecofacts, suggesting a wide range of activity and intensity, those would contribute to a season of occupation designation. While such data is not easily available for the sites considered below, it would be necessary to make an assignation with a larger degree of certainty.

INY-3806/H (Figure 6.3) contains taxa from a range of seasons, but it is possible to deduce a general trend. This site has a fair number of taxa that are characteristic of spring/summer occupations (*Stipa* and *Descurainia* specifically), but also, interestingly, yielded some taxa associated with fall/winter occupations (like pinyon, acorn, and *Chenopodium*) but lacks others (*Typha, Artemisia*). As such, I propose these were houses occupied from spring into fall or winter; this hypothesis requires the inhabitants of the house bringing the remains of their winter pinyon/acorn cache down into the valley during spring, for the purpose of gathering recently or soon-to-be-available wetland resources. These folks then stayed through the summer before leaving in early fall to prepare for the upcoming pinyon harvest.

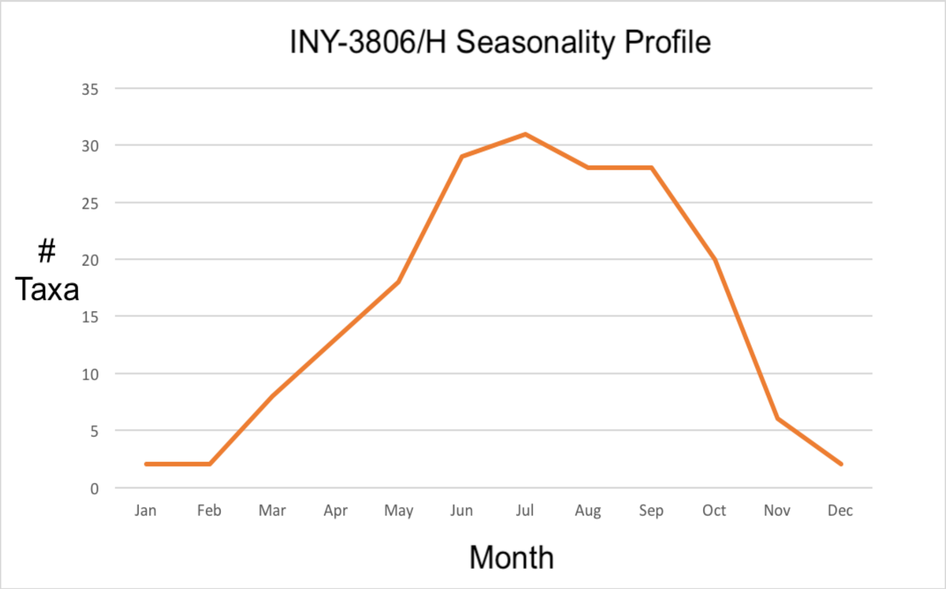

Figure 6.3. Seasonality profile of INY-3806/H.

An alternative interpretation, supported by the presence of storage pits found at INY-3806 (Eerkens 2003), could be that the seasonality patterning represents logistical mobility into the uplands, with residents bringing the pinyon crop to valley sites for storage through the fall and winter (Eerkens, personal communication). Analysis of the faunal remains at INY-3806 could shed more light on these trends.

INY-8768 was likely the result of a longer occupation (Figure 6.4). This plant assemblage is anomalous in a few ways, including a burned cache of pinyon nuts and *Ephedra* seeds, and a large amount of acorn nutshell. *Ephedra* is an early bloomer, starting as early as March. Assuming the pinyon/*Ephedra* feature is the result of the same occupation producing the rest of the assemblage, then it seems likely that the residents brought pine nuts and acorns with them upon moving into the valley in early spring, again pursuing wetland resources like *Scirpus* but with a larger emphasis on summer-fall disturbance taxa like *Chenopodium* and *Atriplex*. Also possible is that INY-8768 was itself an overwintering camp; residents could have imported acorn and pine nuts with the intention of staying near wetland resources and the lake through winter, perhaps periodically refreshing their supply. Either way, the residents burned a fair amount of nutshell during the course of their occupation. INY-8768 could represent a longer term occupation, but the rest of the archaeological assemblage (lithic, ceramic, faunal, groundstone, etc.) would need to be taken into account before such a hypothesis could be seriously considered.

INY-5207 (Figure 6.5) appears to represent something different than either INY-8768 or INY-3806. The taxa found here are dominated by summer-maturing wetland (*Juncus, Scirpus, Suaeda*) and weedy pioneer (*Atriplex, Chenopodium, Panicum*) seed plants. There is some pine nutshell, but on the whole the assemblage suggests a late spring-summer occupation whose residents probably moved on by early fall.

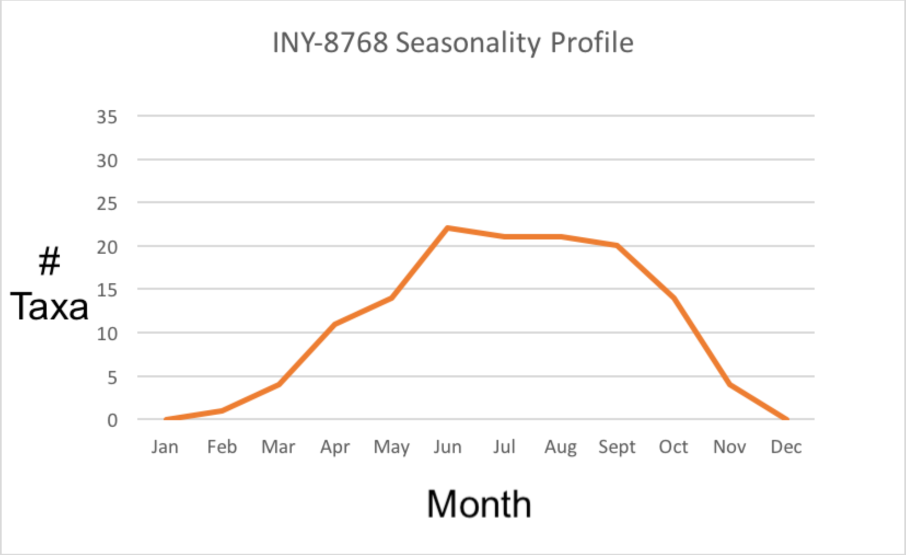

Figure 6.4. Seasonality profile of INY-8768.

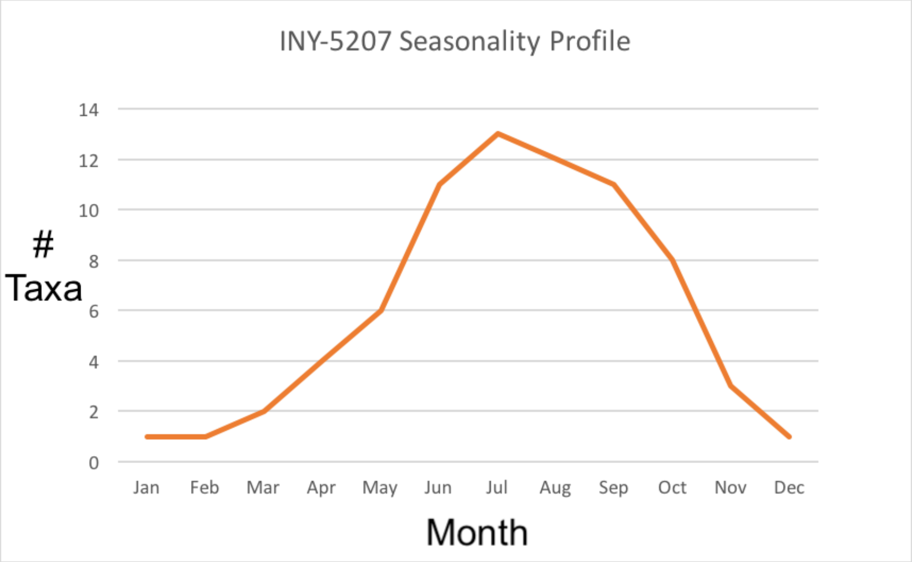

Figure 6.5. Seasonality profile of INY-5207.

Though the assemblages for INY-7448 are much smaller and less diverse than the other sites, a few observations are warranted. The Haiwee assemblage of INY-7448 (Figure 6.6) has acorn and pine nuts, as well as *Scirpus* and *Puccinellia*, two summer-ready wetland seed plants (though *Scirpus* is also an important geophyte),

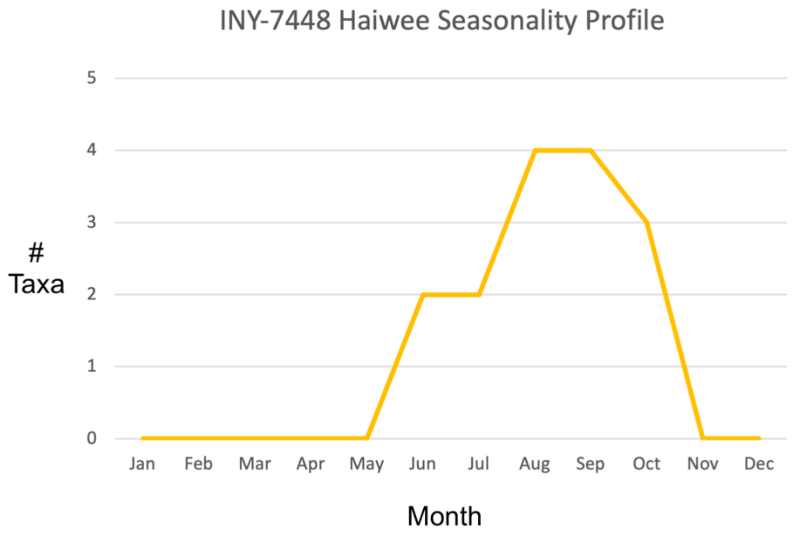

Figure 6.6. Seasonality in Haiwee-era INY-7448 assemblages.

suggesting a late spring-summer occupation targeting wetland resources by folks who brought some nuts with them. The Marana assemblage from INY-7448 (Figure 6.7) is dominated by pine nuts and *Scirpus*, with summer-fall weedy pioneers (*Chenopodium, Helianthus*), suggesting a late summer-early fall season, again with some imported pine nuts.

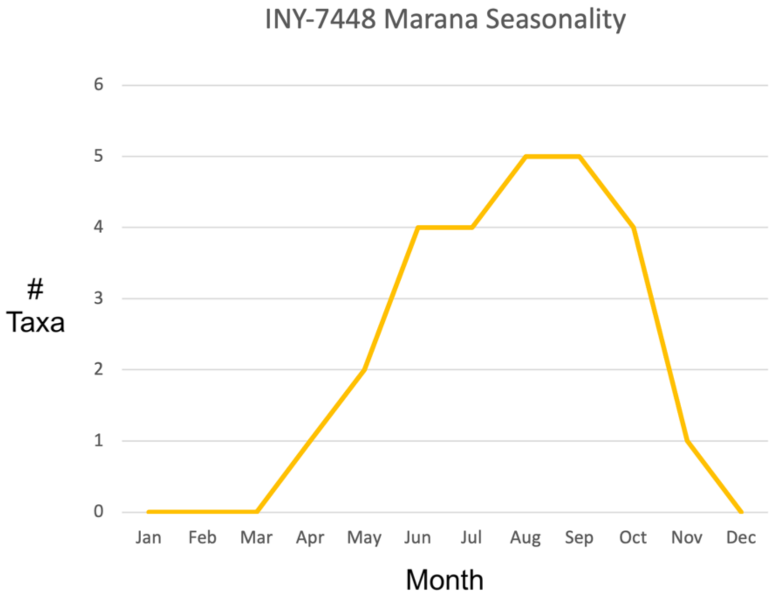

Figure 6.7. Seasonality in Marana-era INY-7448 assemblages.

Interpretation and Discussion

Overall, data show that many of the changes that occurred elsewhere in the valley (increases in plant density and the use of small seeds into the Marana, decrease in pinyon in the Late Marana) also occurred in this particular ecotone: a saline lake, near freshwater drainages, with access to at least some scrubland. However, there are some trends unique to lakeside sites that suggest such sites had a role in the subsistence system different than those situated along tributaries and in the uplands.

The Role of Wetland Sites in Late Prehistory

One of the most striking trends is the relatively low percentage of weedy pioneers throughout time. Haiwee period lakeside sites lack significant amounts of weedy pioneers (<10%), which makes sense under the assumption that intensification of plant foods, specifically seeds, didn't occur until later in the Haiwee period, continuing into the Marana period. It is possible to imagine that occupants of INY-7448 and INY-3806/H, which both date to the early and middle parts of the Haiwee period, reflect a subsistence-economic system in the early stages of reorganization; group size started to shrink, pinyon became a significant part of the diet, but entrenched intensification had not occurred. At lakeside sites, in some contrast to other regional sites, seeds did not comprise a significant portion of the diet until the Late Marana period, and only about a third of those seeds were weedy pioneers.

With the knowledge that upland plants were being imported, it is clear that wetland sites were specifically for the procurement and use of wetland plants. While this may seem like an obvious statement, it is increasingly clear that lowland, wetland sites were places of specialized procurement in a way that tributary-adjacent sites were not, especially later in time. This usage pattern exists despite the fact that tributary sites, located along streams and creeks, also have access to at least some wetland resources. Tributary sites more often reflect generalized procurement patterns, suggested by the coefficient of variance data discussed in Ch. 5.

Aside from plants, other resources would have made overwintering near wetlands appealing to valley residents. The most obvious is waterfowl, many of whom overwinter on Owens Lake, which remains today a renowned site for bird watching and hunting. The limited faunal data available for lakeside sites, from INY-3806/H (Eerkens 2004), suggest that waterfowl were an important food source for residents during the Haiwee period, and presumably the Marana period as well. Deer (specifically mule deer, *Odocoileus hemonius*) also come down into the foothills and onto the valley floor in winter, after spending summer and fall in the mountains.

One trend that has been documented at lakeside sites is the widespread presence of pottery. Eerkens (2008) notes that pottery is especially common in lakeside sites, suggesting that it figured into processing lakeside resources. Pottery is typically associated with seeds, which are ground and made into porridge and cooked in pots; there is less evidence of foods like geophytes being associated with pottery. It makes sense that the use of ceramics to process back-loaded resources (*sensu* Tushingham and Bettinger 2013) like seeds increased in tandem with the proportion of seeds in the diet.

Thoughts on Resource Tethering

Eerkens (2008) discusses the fundamental paradox at the heart of pottery use and spread amongst inhabitants of the Owens Valley about 600 years ago: how could pottery fit into a mobile settlement and subsistence system? Ultimately, Eerkens proposes that pottery functioned akin to site furniture (*sensu* Binford 1979) in that it was produced and cached at low-lying sites close to the Owens River and Owens Lake, and kept in place in anticipation of repeated use by the site inhabitants/pottery producers (who would have been one and the same). These sites were perhaps chosen for their access to resources used to make pottery (water, clay, sand) and for access to resources that can be processed with pottery (seeds, primarily). Thus, a form of resource tethering was enacted, unrelated to *a priori* territorial circumscription or population packing. The reason residents were tethered to wetland sites was because they were good enough, with suitable access to necessary resources, for folks to put down roots, so to speak, in the form of caching their pots for future use. Instead of carrying heavy, fragile pots to the mountains and back, the pots stayed *in situ*. The effect of widespread pottery adoption could also be related to semi-sedentism, as making pots requires the ceramicist to be in one place for several days or longer.

Summary

While there were some similarities in how site residents used plant resources at lakeside sites versus other sites in the valley, there are some important differences. Wetland plant resources were differentially targeted by site residents. By the Late Marana period, it seems likely that lakeside sites were annually reoccupied, perhaps as places where pottery was cached and wetland seed foods were gathered and processed. However, by the early Haiwee period, pinyon had already been incorporated into the diet of lakeside residents, in such amounts as to suggest pinyon was being intensified by people. Chapter 7 discusses hypotheses regarding the timing and implications of subsistence intensification in light of the plant use data presented here and in Chapter 5.

Chapter 7: Theorizing Plant Use in the Context of Technological and Social Reorganization

Resource intensification has long been a topic of discussion among archaeologists working in California broadly, and the Owens Valley specifically. Data compiled and analyzed as part of this manuscript bridges two technological phenomena, both considered alternately as evidence and/or drivers of intensification in this region: the spread of the bow-and-arrow during the Haiwee period (c. 1400 BP), and the advent and spread of pottery in the Marana period (c. 650 BP). The hypothesis presented here bridges the work of Bettinger (2015, Bettinger and Eerkens 1999), who is primarily concerned with the former, and Eerkens (2001, 2003, 2004, 2008, *inter alia*) who is primarily interested in the latter. The contribution of this manuscript is in providing the data specifically regarding plant use during late prehistory, which all arguments hinge on, and which has been under-addressed in the literature.

In Chapter 5, I presented plant data suggesting first an increased reliance on pinyon beginning around 1400 years ago, followed by an increased reliance on seeds. The first shift corresponded to the spread of bow-and-arrow technology, which portended a shift to smaller group sizes, and thus necessitated an increased use of plants as a fall-back food. The first manifestation of this pattern was an increased density of nutshell between the Newberry and the Haiwee period (see Figure 5.2); while pinyon was not intensively gathered for several more centuries, the increase in density could reflect the growing lengths of time groups were spending in the pinyon uplands, perhaps targeting large game found during pine nut season. Pine nuts were then transported back to the valley floor.

However, by the Marana period, seeds had become a target of intensification as well. The data presented in Chapter 5 suggest that seeds functioned as a primary lowland, non-winter plant food, with concerted increases in density and assemblage composition beginning around 650 years ago, correlating with the start of the Marana period. Around this time, pottery appears in large numbers in the archaeological record. In the Late Marana period, again not coincidentally, pottery density skyrocketed, along with seed use, as plant density continued to rise. Furthermore, as Eerkens has noted (2008), pottery seems to be uniquely associated with lowland sites, close to Owens River and Owens Lake. Bettinger (2015:71) has proposed that, at some point after the introduction of the bow-and-arrow and the shrinking of group size, sharing rules changed such that, while meat stayed a public good subject to sharing, gathered plant foods functioned as a private good, owned by the person who gathered them and their family. It was this shift in norms that allowed storage, in the form of caching pinyon nuts in the uplands, to proliferate. As plant intensification ratcheted outward, seeds became a new target for storage and formed a large percentage of the plant diet. Investment in technology that made processing seeds, both on the front-end (*sensu* Tushingham and Bettinger 2013), in the form of seedbeaters (Bettinger 2015:36-37), and on the back-end, in the form of ceramic pots for cooking, became attractive in a new way. Perhaps it was the appeal of pottery to women, for whom it represented an efficient way of processing large amounts of seeds (see Eerkens 2001), maybe stored, in an environment with other valuable resources, such as waterfowl or rabbits.

I propose that the dramatic increase in plant density between the Haiwee and Late Marana periods captures the steep population growth hypothesized to have started in the late Haiwee period (Polson 2009:107) that continued until Euro-American colonization. I also propose that, during the Late Marana, the slight decline in pinyon density, the ubiquity and abundance of weedy pioneers, and the hyperlocal use of wetland plant resources at lowland sites suggest continued population growth and the end of peak pinyon as a resource in the valley. Nevertheless, the practices around privatization of plant resources which started in the Haiwee period with pinyon spun out to encompass a variety storable plant resources at many places on the landscape, and contributed to the increasing appeal of pottery to residents of the valley floor.

Most specifically, the scenario laid out by Bettinger (2015) seems plausible. In short, he proposes that intensification did not happen as part of the natural course of population growth and/or resource depletion; rather, it happened as one in a series of cascading events to occur in the centuries that followed the introduction of the bow-and-arrow. The break from the Newberry period into the Haiwee period is marked by the transition from dart points (Elko series) to arrow points (Rose Springs/Eastgate series). Bettinger suggests that bow-and-arrow technology made hunting in smaller groups (or as a lone individual) more tenable, and even desirable, than the large groups required by the logistics of atlatl hunting. Resources did not need to be shared among as many mouths, making smaller average family groups more appealing than earlier in time. This decrease in optimal group size led to a shrinking of the average household group, as evidenced by decreasing house floor sizes between the Newberry period and Haiwee/Marana periods (Eerkens 2003;

Basgall and Delacorte 2011; Bettinger 2015). As pointed out by Winterhalder (1986), this means that there were fewer sharing partners to help buffer resource shortfall when hunts failed. It was at this point that the intensification of plant foods kicked off in earnest, as gathering (and eventually storing) plant foods was required as a risk-buffering strategy. The data presented in this manuscript show patterning in plant remains that supports the aforementioned sequence of events.

By the time of the Marana period, plant intensification and population increase generated the significant increase in plant density noted archaeologically. While families might have started coalescing in small bands again for short periods of time, social rules around food sharing had changed enough such that while meat, especially from large game, was perhaps subject to sharing, plant foods were not (Bettinger 2015:71, 91). This would be especially true if populations were increasing to such a degree that freeloaders became a problem, as has been hypothesized (Eerkens 2010). Thus, plants could be stored, and used, as a seasonal food source and as a buffer against hunting failure.

The end of peak pinyon in the Late Marana period refers to a plateau or even a decline in regional use by residents. Though pinyon was still ubiquitous, the shift toward seed privatization in the context of increasing population could mean that pinyon, as a resource, was “maxed out” by c. 250 BP. What does “maxed out” mean exactly? It is not a decrease in production on the part of the trees, nor is it resource depression as happens with large game. Rather, “maxed out” here means there exists the same amount of pinyon as there has always been, but there are more people. In economic terms, while the demand for pinyon may have been increasing, the supply did not, and thus residents began targeting alternative, storable foods. A valley resident might be used to annually gathering and storing pinyon, but maybe recently they had trouble gaining access to groves because they are all in use or claimed by others. So what is one to do? Perhaps individuals began to gather, store, and process other storable, back-loaded foods, which were subject to privatization—like seeds.

The Role of Disturbance-Preferred Taxa

Regarding the increase in use of seeds from weedy pioneers, such as those belonging to the Chenopodiaceae and Poaceae families, it is worth mentioning how increases in population could lead to a proliferation of these plant types. As more people settle on the landscape, alter it, and then move on to the next place, disturbance-preferred taxa like grasses and chenopods thrive (Piperno and Jones 2003). As population grew, and more sites were created and abandoned during the late Haiwee and Early Marana phases, weedy pioneers may have colonized new places on the landscape. Additionally, maybe the people living on the valley floor encouraged this growth, as these were economically useful plants to them. In contrast to pinyon, which perhaps had been maxed out, seeds from weedy pioneers only became more plentiful through time as more humans continued to disturb the environment. It is axiomatic among human behavioral ecology that, all else being equal, sheer abundance does not determine whether a food will be in the diet breadth; however, the diet breadth model does not factor in environmental and ecological disruption that human occupation of a landscape entails.

The Evolution of Key Features of Owens Valley Paiute Cultural Practice

The Owens Valley Paiute are known among anthropologists for a unique suite of cultural practices that differentiate them from other Great Basin and California Indigenous cultures. Ceramic ubiquity, territoriality and land ownership, and the construction and maintenance of irrigation features used to grow economically important plants are among these unique features. While the adoption and spread of ceramic technology among Owens Valley residents in late prehistory has been a major theme of this manuscript, the other factors have been less prominently featured. Nevertheless, using data from this manuscript, it is possible to envision a scenario under which these other traditions came to be.

Figure 7.1a. Map of town Big Pine in relation to Owens River and Baker and Big Pine Creeks. Vertical hashes (with 'Mono' inscribed) represent irrigation features. "Mono" is an economically important species of Eragrostis, a grass. Credit: Modified after Steward (1933)

One of the most striking features of pre-contact Paiute culture was the construction and maintenance of irrigation ditches used in the cultivation of economically important plant foods. These features were noted by Steward (1933), with the southernmost being near the town of Big Pine, all the way to north of Bishop (Figure 7.1a, b). As mentioned in Chapter 2, the management of these plots was overseen by a head irrigator, elected "at a popular meeting each spring" (1933:247); the plots themselves were open to all members of the community.

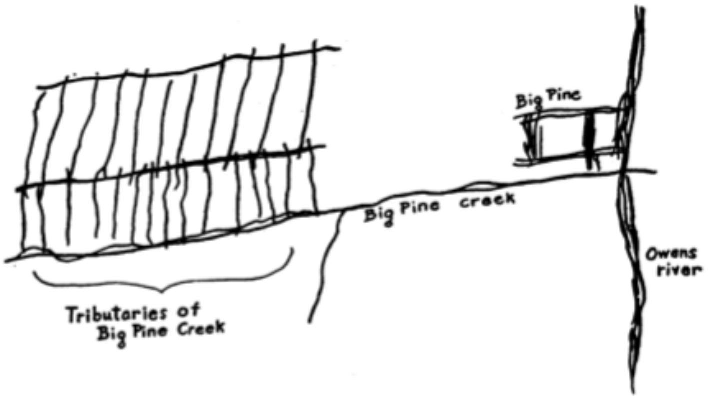

Figure 7.1b. Map drawn by Steward Paiute informant Jack Smith showing irrigation feature in greater details. Image Credit: After Steward (1933), Lawton and colleagues (1976).

According to Steward (1933), almost all the plants identified by Paiute informants as economically important and irrigated were disturbance preferred taxa. These include members of the Chenopodiaceae (chenopods) and Asteraceae (the daisy family, including sun flowers) families, but by far the taxa most commonly named by informants were grasses. These include taxa previously identified in the Owens Valley archaeologically (such as *Elymus* sp. and *Echinocloa* sp.), but several were unknown to Steward and listed only by their Indigenous names.

That disturbance-preferred taxa skyrocket as a proportion of plants used during the Late Marana period, while density remains constant to earlier in the

Marana, could be indicative of changing land use and social organization related to construction and use of these irrigation plots. Additionally, the consistent use of disturbance preferred taxa at tributary sites specifically potentially provides another point of support for this suggestion (see Figure 5.8b), since these irrigation features are only known to exist in proximity to creeks that drain into the Owens River, and not along the river itself.

While an effort was made during the course of this manuscript to grow our collective knowledge of the grasses of the eastern Sierra (Santy and VanDerwarker n.d.), there are still hundreds of unknown grass species that are difficult to identify by sight. If we learned to identify these grasses, and targeted archaeological sampling in habitation sites close to the irrigation features, we could potentially learn more about their antiquity and role in everyday life. This could be an avenue for future research.

The interpretation of data incorporating both upland and lowland plant taxa suggests how territorial circumscription, exclusion, and ownership could have evolved. Since pottery is a technological and energetic investment, it makes logical sense that once seeds became a target for storage and privatization, the widespread adoption of ceramic technology immediately followed. Before plant foods were treated as a private good, such an investment would may have made less sense, in terms of energy expenditure. However, storage and privatization meant that people could plan on staying somewhere for longer, living off stored food resources, and allowed enough time in one place to complete the ceramic production process. It also meant that people would prefer to stay close to places with abundant seed resources and access to raw materials, as is often the case near wetlands (Eerkens 2008).

Valley residents who decided to invest in ceramic technology often stored pots as site furniture (as they are too bulky and fragile to transport; see Binford 1979) for use when reoccupying the site at seasonal intervals. In this way, small residential groups would have been tethered to resources on the landscape, and were functionally territorially circumscribed.

By the Late Marana, foraging had become relatively localized and the inputs for a more formal system of territorial ownership were in place. Surveys show that as much as 70% of alpine pinyon camps date to c. 500 BP or later (Bettinger 2015:65; Eerkens et al. 2004), but by 300 BP pinyon density and abundance decreased on the valley floor. By this time, seeds (especially seeds from disturbance-preferred taxa like chenopods) skyrocketed in abundance on the valley floor, including at lakeside sites. Both of these settings require labor inputs in preparation for and in service of occupation. At pinyon camps in the mountains, groups built rock rings for green cone storage and caching tools for harvest. On the valley floor, residents gathered clay, which they then shaped and fired into finished pots, before finally caching them for future use (Eerkens 2008).

Under the circumstances mentioned above, one can see the foundation for district and communal ownership of territory documented by Steward (1933). Geographically bounded districts, comprising villages and overseen by a headman, owned rights to hunting, fishing, and seed gathering locales within their territory. These locales were open to all members of the district; access to outsiders was granted only in times of plenty, and trespassers were removed by headmen (Steward 1933: 305). Steward notes in passing that “brawls frequently occurred over pinenut land” (305), but does not clarify whether the brawls are between members of a single district, or members of different districts. Regardless, the practice of land ownership and territoriality arose out of the land use patterns documented by late prehistoric plant use data presented in this manuscript.

The construction and maintenance of irrigation canals for the purpose of tending economically important plants and district ownership of hunting, seed gathering, and fishing places both fit into a pattern of increasing land tenure and investment through time. These remarkable cultural practices (specifically, territorial ownership and construction of irrigation features) relate directly to plant use. They are both directly related to choices people made about how to allocate time and energy during a (potential) time of shifting social and cultural norms; and both are directly related to increasing energetic inputs into economically important resources, including plants. The ability to contextualize the development of these practices within the *longue duree* of Indigenous history of Payahunaadü (the original name for Owens Valley), particularly in regards to plant use, is a contribution of the work presented here.

Chapter 8: Conclusion and Final Thoughts

This dissertation had three primary goals. The first was to synthesize existing plant data with regards to plant use from the late Newberry period (c. 3300-1400 BP), to the Haiwee period (1400-650 BP), into the Early Marana (650-300 BP) and Late Marana (300-150BP). The second goal was to better understand how ancient residents of Owens Valley used locations in the valley beyond the modern-day Highway 395 corridor. A final goal was to examine the adoption and spread of bow-and-arrow and ceramic technology, two events separated by roughly 600 years, through a paleoethnobotanical lens.

Plant use in the Newberry (3300-1400 BP) period can be summarized as generalized and extensive, with resources from a variety of habitats. Pinyon was ubiquitous but in small amounts, suggesting non-intensive, brown-cone gathering in fall. Plant use during the Haiwee (1400-650 BP) period shows remarkable continuity, with identical plant overall plant density. However, pinyon density started to increase during the Haiwee, and decreasing ubiquity values suggest people began to target local resources preferentially. At the start of the Marana (650 BP), overall plant density increases sharply, with the bulk of the density coming from increases in seed abundance, and especially those from disturbance preferred taxa like Chenopodiacea and Poaceae. By the Late Marana (300-150 BP), seed density, abundance, and ubiquity peaked, indicating a dramatically different orientation towards plant foods.

These trends are echoed at lakeside sites, with some variation specific to the littoral, wetland setting. While wetland plants are unsurprisingly emphasized, data from a Late Marana lakeside site suggests highly specialized targeting of wetland seed plants, in addition to seeds from disturbance-preferred taxa by the Late Marana period.

Future Research Directions

There are several potential directions in which the research presented here could be built upon in the future. This dissertation presents data as aggregated by site and binned by period, but the data exist at finer grained levels, for example by house/feature, and using associated radiocarbon dates. Decreasing the scale of analysis would provide more information relating to seasonal occupation, land use, and group size through time.

This dissertation does not grapple with the proposed Numic expansion (Bettinger 1981, 1983) and any associated population replacements as a contributor to change in late prehistory. There exists similarity within several dimensions between Newberry and Haiwee plant use, suggesting continuity. While the Late Marana does appear to represent a departure, it is in line with trends elsewhere in California and the Great Basin. Nothing about the plant data, as it currently exists, indicates an obvious population replacement. Nevertheless, this is a question with more paths for evaluation.

Research into the age of documented irrigation features between Manzanar and Bridgeport (Steward 1933; Lawson et al. 1976) would aid in contextualizing the results of this dissertation. Currently the ages of these features are unknown. The community organization that would have been needed to construct these features appears at odds with the nucleation of small groups that occurred late in prehistory;

however, the plant foods associated with these features and the amount of effort required by valley inhabitants to tend and maintain their products suggest they may date to relatively late in prehistory. This avenue of research, like all of those named here, would benefit from inclusion and collaboration with Owens Valley Paiute tribal members, and from the historical knowledge of these features that may persist in the form of oral histories.

It is impossible to glean a clear picture of subsistence practice and change without synthesized data for the remainder of the subsistence regime. Much like existing archaeological plant data, the faunal data that exists for the eastern Sierra region is fragmented. Existing analysis, based on a few CRM site reports, suggests a marked increase in the pursuit of small game during the Haiwee period and into the Marana period. This aligns temporally with the pinyon intensification process, and supports the idea that shrinking group sizes contributed to the plant subsistence data analyzed in this manuscript. A synthesis and analysis of existing faunal data would provide a full picture of how men and women's subsistence practices coexisted and related to one another, and whether such relations changed through time.

Concluding Thoughts

As I see it, the primary contribution of this project has been the generation of an extensive, synthetic dataset (Appendix A), comprising all known data regarding plant use in Owens Valley prehistory, building on those that came before (Pierce 2002). The secondary contribution has been to add to the discussion of changing social and political organization in late prehistory, by looking at a crucial line of evidence (plant use). This dissertation represents one more step toward improving our understanding of this place, at this time, in history; however, it is my hope that with the dataset, future researchers can ask questions and find answers well beyond those presented here. Plant data has the capacity to tell us so much more about how human lifeways changed in the Payahuunadü over time.

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APPENDIX A: Paleoethnobotanical Dataset

(also available online at:

https://drive.google.com/drive/folders/1LGldDWw3SRMNCB_1aYVzyVeJ3uzMN8jM)

Table A.1. Newberry Period Data from INY-2146

BETTINGER ET AL. 1984	
Site Locus	INY-2146
Context	midden
Soil volume (L) (where available)	—

TAXA	DENSITY (SEED/L)
Achnatherum hymenoides	—
Achnatherum sp.	—
Agrostis sp.	—
Allium sp.	—
Amaranthus sp.	—
Amorphous	—
Amsinckia sp.	—
Arctostaphyos sp.	—
Artemisia sp.	—
Artemisia tridentata	—
Asteraceae	—
Astragalus sp.	—
Atriplex canescens	—
Atriplex sp.	1.3
Boraginaceae	—
Brassicaceae	—
Carex sp.	—
Chenopodiaceae	—
Chenopodium sp.	8.8
Cryptantha sp.	—
Cyperaceae	—
Cyperus sp. (tubers)	—
Deschampsia sp.	—
Descurania sp.	—
Epilobium sp.	—
Eragrostis sp.	—
Eremalche sp.	—
Eriogonum sp.	0.7
Erodium sp.	—
Fabaceae	—
Galium sp.	—
Gilia sp.	—
Helianthus sp.	—
Hordeum sp.	—
Juncus sp.	—
Leptochloa sp.	—
Lycium sp.	—

TAXA	DENSITY (SEED/L)
Malvaceae	—
Marah sp.	—
Mentzelia sp.	—
Mulenberghia sp.	—
Nicotiana sp.	—
Oenothera sp.	—
Panicum capillare cf.	—
Phacelia sp.	—
Phalaris sp.	—
Phragmites sp.	—
Physalis sp.	0.7
Pinus monophylla (undifferentiated)	—
Pinus sp.	—
Poa sp.	—
Poaceae	5.3
Polygonum/Rumex	—
Polypogon sp.	—
Portulaca sp.	—
Potamogeton sp.	—
Potentilla sp.	—
Puccinellia sp.	—
Purshia tridentata	—
Quercus (undifferentiated)	—
Rosa sp.	—
Rumex sp.	—
Ruppia sp.	—
Salvia sp.	—
Scirpus sp.	—
Sitanion hystrix	—
Sphaeralcea sp.	—
Sporobolus sp.	—
Trifolium sp.	—
Typha sp.	—
unidentifiable/ fragments	—
unidentified/unknown	—
Vigueria sp.	—
Vulpia microstachys	—

Table A.2. Newberry Period Data from INY-30

BASGALL AND MCGUIRE 1988					
Site Locus	INY-30				
Context	F 4	S 11	S 12	S 14	S 15
Soil volume (L) (where available)	—	—	—	—	—

TAXA	DENSITY (SEED/L)				
Achnatherum hymenoides	2.91	2.44	0.13	0.12	—
Achnatherum sp.	—	—	—	—	—
Agrostis sp.	—	—	—	—	—
Allium sp.	—	—	—	—	—
Amaranthus sp.	0.55	—	0.07	—	—
Amorphous	—	—	—	—	—
Amsinckia sp.	—	1.0	—	—	—
Arctostaphyos sp.	—	—	—	—	—
Artemisia sp.	—	—	—	—	—
Artemisia tridentata	0.55	0.67	—	0.09	—
Asteraceae	—	1.67	0.27	0.09	1.15
Astragalus sp.	—	—	—	—	—
Atriplex canescens	—	—	—	—	—
Atriplex sp.	—	—	—	0.09	—
Boraginaceae	—	—	0.8	—	—
Brassicaceae	—	0.33	—	0.63	—
Carex sp.	—	—	—	—	—
Chenopodiaceae	2.0	0.67	8.87	0.48	4.42
Chenopodium sp.	9.27	3.78	2.6	0.72	9.81
Cryptantha sp.	—	—	—	—	—
Cyperaceae	—	—	—	—	—
Cyperus sp. (tubers)	—	—	—	—	—
Deschampsia sp.	—	—	—	—	—
Descurania sp.	—	268.44	10.33	0.27	—
Epilobium sp.	—	—	—	—	—
Eragrostis sp.	—	—	0.8	—	—
Eremalche sp.	0.18	—	—	0.03	—
Eriogonum sp.	—	—	—	—	—
Erodium sp.	—	—	—	—	—
Fabaceae	0.55	—	—	—	1.54
Galium sp.	—	—	—	—	—
Gilia sp.	—	—	—	—	—
Helianthus sp.	0.18	—	—	0.09	—
Hordeum sp.	0.18	—	—	—	0.58
Juncus sp.	—	1.0	3.0	0.09	5.77
Leptochloa sp.	—	—	—	—	0.19

TAXA	DENSITY (SEED/L)				
Lycium sp.	6.0	1.0	0.07	0.09	—
Malvaceae	0.55	0.11	0.53	0.03	0.19
Marah sp.	—	—	—	—	—
Mentzelia sp.	—	7.56	0.6	0.12	4.04
Mulenberghia sp.	—	0.67	6.4	—	7.16
Nicotiana sp.	—	—	—	—	—
Oenothera sp.	—	—	—	—	—
Panicum capillare cf.	—	—	—	—	—
Phacelia sp.	—	—	—	—	—
Phalaris sp.	—	—	0.07	—	—
Phragmites sp.	—	0.33	0.4	—	—
Physalis sp.	—	—	—	—	—
Pinus monophylla (undifferentiated)	161.66	1.33	0.2	0.12	1.15
Pinus sp.	—	—	—	—	—
Poa sp.	0.73	1.33	—	—	4.77
Poaceae	7.46	2.67	1.3	0.21	1.54
Polygonum/Rumex	—	—	—	—	—
Polypogon sp.	—	—	0.2	—	—
Portulaca sp.	—	—	—	—	—
Potamogeton sp.	—	—	—	—	—
Potentilla sp.	—	—	0.6	2.83	—
Puccinellia sp.	—	—	—	—	—
Purshia tridentata	—	0.11	—	—	—
Quercus (undifferentiated)	0.18	—	—	0.03	—
Rosa sp.	6.0	—	—	—	—
Rumex sp.	—	—	0.67	—	—
Ruppia sp.	0.55	—	0.07	0.06	—
Salvia sp.	0.18	—	0.07	—	—
Scirpus sp.	3.82	0.11	1.07	0.09	0.77
Sitanion hystrix	—	—	—	—	0.19
Sphaeralcea sp.	—	—	0.07	0.06	0.19
Sporobolus sp.	0.36	3.0	2.2	0.18	3.65
Trifolium sp.	—	—	—	—	—
Typha sp.	—	—	28.4	34.79	—
unidentifiable/ fragments	—	—	—	—	—
unidentified/unknown	—	—	—	—	—
Vigueria sp.	—	—	0.4	—	—
Vulpia microstachys	—	—	—	—	0.38

Table A.3. Newberry Period Data from INY-1824 (Loc.6) and INY-1906 (Loc. 2)

GILREATH AND HILDEBRANDT 1995		
Site Locus	INY-1824 - Loc. 6	INY-1906 - Loc. 2
Context	F. 1 hearth	F. 3 Hearth
Soil volume (L) (where available)	—	—

TAXA	DENSITY (SEED/L)	
Achnatherum hymenoides	0.2	—
Achnatherum sp.	—	—
Agrostis sp.	—	—
Allium sp.	—	—
Amaranthus sp.	—	—
Amorphous	—	—
Amsinckia sp.	—	—
Arctostaphyos sp.	—	—
Artemisia sp.	—	—
Artemisia tridentata	—	—
Asteraceae	—	—
Astragalus sp.	—	—
Atriplex canescens	—	—
Atriplex sp.	—	—
Boraginaceae	0.18	—
Brassicaceae	—	—
Carex sp.	—	—
Chenopodiaceae	—	—
Chenopodium sp.	—	0.33
Cryptantha sp.	—	—
Cyperaceae	—	—
Cyperus sp. (tubers)	—	—
Deschampsia sp.	—	—
Descurania sp.	0.05	0.33
Epilobium sp.	—	—
Eragrostis sp.	—	—
Eremalche sp.	—	—
Eriogonum sp.	—	—
Erodium sp.	—	—
Fabaceae	—	—
Galium sp.	—	—
Gilia sp.	—	—
Helianthus sp.	—	—
Hordeum sp.	—	—
Juncus sp.	—	—

TAXA	DENSITY (SEED/L)	
Leptochloa sp.	—	—
Lycium sp.	0.25	—
Malvaceae	—	—
Marah sp.	—	—
Mentzelia sp.	0.2	—
Mulenberghia sp.	—	—
Nicotiana sp.	—	—
Oenothera sp.	—	—
Panicum capillare cf.	—	—
Phacelia sp.	—	1.0
Phalaris sp.	—	—
Phragmites sp.	—	—
Physalis sp.	—	—
Pinus monophylla (undifferentiated)	—	—
Pinus sp.	—	—
Poa sp.	—	—
Poaceae	—	—
Polygonum/Rumex	—	—
Polypogon sp.	—	—
Portulaca sp.	—	—
Potamogeton sp.	—	—
Potentilla sp.	—	—
Puccinellia sp.	—	—
Purshia tridentata	—	—
Quercus (undifferentiated)	—	—
Rosa sp.	—	—
Rumex sp.	—	—
Ruppia sp.	—	—
Salvia sp.	—	—
Scirpus sp.	—	—
Sitanion hystrix	—	—
Sphaeralcea sp.	—	—
Sporobolus sp.	—	—
Trifolium sp.	—	—
Typha sp.	—	—
unidentifiable/ fragments	—	—
unidentified/unknown	—	—
Vigueria sp.	—	—
Vulpia microstachys	—	—

Table A.4. Newberry Period Data from INY-1317 (Loc. 1), INY-5984 (So. Midden), and INY-6263 (W. Midden)

BYRD AND HALE 2005			
Site Locus	INY-1317 – Loc 1	INY-5984 – So. Midden	INY-6263 – W. Midden
Context	CU 18 midden	CU 1	CU 5 midden
Soil volume (L) (where available)	112.1	134.4	96.25

TAXA	DENSITY (SEED/L)		
Achnatherum hymenoides	—	—	—
Achnatherum sp.	—	—	0.03
Agrostis sp.	—	—	—
Allium sp.	—	0.015	—
Amaranthus sp.	—	—	—
Amorphous	0.018	0.01	0.12
Amsinckia sp.	—	—	—
Arctostaphyos sp.	—	—	—
Artemisia sp.	—	—	—
Artemisia tridentata	—	—	—
Asteraceae	—	—	—
Astragalus sp.	—	—	0.02
Atriplex canescens	—	—	—
Atriplex sp.	—	0.015	—
Boraginaceae	—	—	—
Brassicaceae	—	—	—
Carex sp.	—	—	—
Chenopodiaceae	—	—	0.11
Chenopodium sp.	0.098	—	—
Cryptantha sp.	—	—	—
Cyperaceae	—	—	—
Cyperus sp. (tubers)	—	—	—
Deschampsia sp.	—	—	—
Descurania sp.	—	—	0.01
Epilobium sp.	—	—	—
Eragrostis sp.	—	—	—
Eremalche sp.	—	—	—
Eriogonum sp.	—	—	0.05
Erodium sp.	—	—	—
Fabaceae	—	—	—
Galium sp.	—	—	—
Gilia sp.	—	—	—
Helianthus sp.	—	—	—
Hordeum sp.	—	—	—

TAXA	DENSITY (SEED/L)		
Juncus sp.	—	—	0.04
Leptochloa sp.	—	—	—
Lycium sp.	—	—	—
Malvaceae	—	—	—
Marah sp.	—	—	—
Mentzelia sp.	—	—	—
Mulenberghia sp.	—	—	0.02
Nicotiana sp.	—	—	—
Oenothera sp.	—	—	—
Panicum capillare cf.	—	—	—
Phacelia sp.	—	—	—
Phalaris sp.	—	—	—
Phragmites sp.	—	—	—
Physalis sp.	—	—	—
Pinus monophylla (undifferentiated)	0.036	0.01	0.09
Pinus sp.	—	—	—
Poa sp.	—	—	—
Poaceae	—	—	0.04
Polygonum/Rumex	—	—	—
Polypogon sp.	—	—	—
Portulaca sp.	—	—	—
Potamogeton sp.	—	—	—
Potentilla sp.	—	—	—
Puccinellia sp.	—	—	—
Purshia tridentata	—	—	—
Quercus (undifferentiated)	—	—	—
Rosa sp.	—	—	—
Rumex sp.	—	—	—
Ruppia sp.	—	—	—
Salvia sp.	—	—	—
Scirpus sp.	0.018	—	0.04
Sitanion hystrix	—	—	—
Sphaeralcea sp.	—	—	—
Sporobolus sp.	—	—	—
Trifolium sp.	0.018	—	—
Typha sp.	0.01	—	—
unidentifiable/ fragments	—	—	—
unidentified/unknown	—	—	—
Vigueria sp.	—	—	—
Vulpia microstachys	—	—	—

Table A.5. Newberry Period Data from INY-6021

BYRD AND HALE 2005				
Site Locus	INY-6021			
Context	CU 1 - Feature	CU 4 - Feature	CU 1	CU 4
Soil volume (L) (where available)	33.94	5.1	176.24	186.3

TAXA	DENSITY (SEED/L)			
Achnatherum hymenoides	—	—	0.07	—
Achnatherum sp.	0.27	0.39	0.04	—
Agrostis sp.	—	—	—	—
Allium sp.	0.03	—	0.03	—
Amaranthus sp.	—	—	—	—
Amorphous	0.03	—	0.15	—
Amsinckia sp.	—	—	—	—
Arctostaphyos sp.	—	—	—	—
Artemisia sp.	—	—	—	—
Artemisia tridentata	—	—	—	—
Asteraceae	—	—	—	—
Astragalus sp.	—	—	—	—
Atriplex canescens	—	—	—	—
Atriplex sp.	—	—	0.01	—
Boraginaceae	—	—	—	—
Brassicaceae	—	—	—	—
Carex sp.	—	—	—	—
Chenopodiaceae	—	—	0.03	—
Chenopodium sp.	—	—	—	—
Cryptantha sp.	—	—	0.02	—
Cyperaceae	—	—	0.01	—
Cyperus sp. (tubers)	—	—	—	—
Deschampsia sp.	—	—	—	—
Descurania sp.	—	—	0.03	—
Epilobium sp.	—	—	—	—
Eragrostis sp.	—	—	—	—
Eremalche sp.	—	—	—	—
Eriogonum sp.	0.27	—	—	—
Erodium sp.	—	—	—	—
Fabaceae	—	—	—	—
Galium sp.	—	—	0.03	—
Gilia sp.	—	—	—	—
Helianthus sp.	—	—	—	—
Hordeum sp.	—	—	—	—
Juncus sp.	4.07	4.4	2.62	—
Leptochloa sp.	—	—	—	—

TAXA	DENSITY (SEED/L)			
Lycium sp.	—	—	0.01	—
Malvaceae	—	—	—	—
Marah sp.	—	—	—	—
Mentzelia sp.	—	—	—	—
Mulenberghia sp.	0.32	—	0.11	—
Nicotiana sp.	—	—	—	—
Oenothera sp.	—	—	—	—
Panicum capillare cf.	—	—	—	—
Phacelia sp.	—	—	—	—
Phalaris sp.	—	—	—	—
Phragmites sp.	—	—	—	—
Physalis sp.	—	—	—	—
Pinus monophylla (undifferentiated)	0.03	0.2	0.02	0.01
Pinus sp.	—	—	—	—
Poa sp.	—	—	—	—
Poaceae	—	—	0.09	—
Polygonum/Rumex	—	—	—	—
Polypogon sp.	—	—	—	—
Portulaca sp.	—	—	—	—
Potamogeton sp.	—	—	—	—
Potentilla sp.	—	—	—	—
Puccinellia sp.	—	—	—	—
Purshia tridentata	—	—	—	—
Quercus (undifferentiated)	—	—	—	—
Rosa sp.	—	—	—	—
Rumex sp.	—	—	—	—
Ruppia sp.	—	—	0.21	—
Salvia sp.	—	—	—	—
Scirpus sp.	0.03	—	0.01	—
Sitanion hystrix	—	—	—	—
Sphaeralcea sp.	—	—	—	—
Sporobolus sp.	—	—	—	—
Trifolium sp.	—	—	—	—
Typha sp.	0.03	—	0.01	—
unidentifiable/ fragments	—	0.2	—	—
unidentified/unknown	—	—	0.01	—
Vigueria sp.	—	—	—	—
Vulpia microstachys	—	—	—	—

Table A.6. Newberry Period Data from INY-5281 and INY-5276 (Loc. A)

ZEANAH AND LEIGH 2002				
Site Locus	INY-5281			INY-5276 – Loc. A
Context	F 5	F 2	F 3	F 2
Soil volume (L) (where available)	17.0	12.0	11.0	22.0

TAXA	DENSITY (SEED/L)			
Achnatherum hymenoides	—	—	—	—
Achnatherum sp.	—	—	—	—
Agrostis sp.	—	—	—	—
Allium sp.	—	—	—	—
Amaranthus sp.	—	—	—	—
Amorphous	—	—	—	—
Amsinckia sp.	—	—	—	—
Arctostaphyos sp.	—	—	—	—
Artemisia sp.	—	—	—	—
Artemisia tridentata	—	—	—	—
Asteraceae	—	—	—	—
Astragalus sp.	—	—	—	—
Atriplex canescens	—	—	—	—
Atriplex sp.	—	—	—	—
Boraginaceae	—	—	—	—
Brassicaceae	—	—	—	—
Carex sp.	—	—	—	—
Chenopodiaceae	—	—	—	—
Chenopodium sp.	—	—	—	—
Cryptantha sp.	—	0.83	—	—
Cyperaceae	—	—	—	—
Cyperus sp. (tubers)	—	—	—	—
Deschampsia sp.	—	—	—	—
Descurania sp.	—	—	—	—
Epilobium sp.	—	—	—	—
Eragrostis sp.	—	—	—	—
Eremalche sp.	—	—	—	—
Eriogonum sp.	—	—	—	—
Erodium sp.	—	—	—	—
Fabaceae	—	—	—	0.18
Galium sp.	—	—	—	—
Gilia sp.	—	—	—	—
Helianthus sp.	—	—	—	—
Hordeum sp.	—	—	—	—
Juncus sp.	0.59	—	—	—
Leptochloa sp.	—	—	—	—

TAXA	DENSITY (SEED/L)			
Lycium sp.	—	—	—	0.05
Malvaceae	—	—	—	—
Marah sp.	—	—	—	—
Mentzelia sp.	—	—	—	—
Mulenberghia sp.	—	—	—	—
Nicotiana sp.	—	—	—	—
Oenothera sp.	—	—	—	—
Panicum capillare cf.	—	—	—	—
Phacelia sp.	—	—	—	—
Phalaris sp.	—	—	—	—
Phragmites sp.	—	—	—	—
Physalis sp.	—	—	—	—
Pinus monophylla (undifferentiated)	—	—	—	—
Pinus sp.	—	—	—	—
Poa sp.	—	—	—	—
Poaceae	—	—	—	—
Polygonum/Rumex	—	—	—	—
Polypogon sp.	—	—	—	—
Portulaca sp.	—	—	—	—
Potamogeton sp.	—	0.83	—	—
Potentilla sp.	—	—	—	—
Puccinellia sp.	—	—	—	—
Purshia tridentata	—	—	—	—
Quercus (undifferentiated)	—	—	—	—
Rosa sp.	—	—	—	—
Rumex sp.	—	—	—	—
Ruppia sp.	—	—	—	—
Salvia sp.	—	—	—	—
Scirpus sp.	0.59	6.25	1.18	—
Sitanion hystrix	—	—	—	—
Sphaeralcea sp.	—	—	—	—
Sporobolus sp.	—	—	—	—
Trifolium sp.	—	—	—	—
Typha sp.	—	—	—	—
unidentifiable/ fragments	—	5.33	0.27	1.36
unidentified/unknown	0.24	—	0.36	0.05
Vigueria sp.	—	—	—	—
Vulpia microstachys	—	—	—	—

Table A.7. Newberry Period Data from INY-1384/H (S8—S11)

BASGALL AND DELACORTE 2012				
Site Locus	INY-1384/H			
Context	S 8	S 9	S 10	S 11
Soil volume (L) (where available)	49.05	42.25	54.5	50.5

TAXA	DENSITY (SEED/L)			
Achnatherum hymenoides	—	—	—	—
Achnatherum sp.	0.08	0.09	0.02	0.16
Agrostis sp.	—	—	—	—
Allium sp.	—	—	—	—
Amaranthus sp.	—	—	—	—
Amorphous	0.1	0.31	0.02	0.04
Amsinckia sp.	—	—	—	—
Arctostaphyos sp.	—	—	—	—
Artemisia sp.	5.97	0.69	0.86	12.93
Artemisia tridentata	11.07	1.14	4.66	2.4
Asteraceae	0.49	0.24	0.22	0.04
Astragalus sp.	—	—	—	—
Atriplex canescens	0.02	—	0.02	—
Atriplex sp.	—	—	0.39	0.2
Boraginaceae	0.27	0.28	—	—
Brassicaceae	—	0.02	—	—
Carex sp.	—	—	—	0.02
Chenopodiaceae	0.59	1.75	—	1.09
Chenopodium sp.	4.51	4.5	1.89	2.32
Cryptantha sp.	—	—	—	—
Cyperaceae	—	—	—	—
Cyperus sp. (tubers)	0.84	0.07	0.09	
Deschampsia sp.	—	—	—	—
Descurania sp.	—	—	—	—
Epilobium sp.	—	—	—	0.04
Eragrostis sp.	—	—	—	—
Eremalche sp.	—	—	—	—
Eriogonum sp.	0.02	0.19	—	0.1
Erodium sp.	—	—	—	—
Fabaceae	110.72	3.34	1.16	0.24
Galium sp.	—	—	—	—
Gilia sp.	0.16	—	—	—
Helianthus sp.	0.1	0.07	—	0.02
Hordeum sp.	—	—	0.04	0.38
Juncus sp.	—	—	—	—
Leptochloa sp.	—	—	—	—
Lycium sp.	—	—	—	—

TAXA	DENSITY (SEED/L)			
Malvaceae	—	—	—	—
Marah sp.	—	—	—	—
Mentzelia sp.	0.71	0.09	0.02	0.1
Mulenberghia sp.	0.08	—	—	—
Nicotiana sp.	1.98	0.02	—	—
Oenothera sp.	2.24	0.64	0.31	0.4
Panicum capillare cf.	0.04	—	—	0.04
Phacelia sp.	—	—	—	—
Phalaris sp.	—	—	—	—
Phragmites sp.	—	—	—	—
Physalis sp.	—	—	—	—
Pinus monophylla (undifferentiated)	3.53	1.87	1.8	—
Pinus sp.	—	—	—	—
Poa sp.	—	—	—	—
Poaceae	0.55	1.85	0.55	0.38
Polygonum/Rumex	0.16	—	—	—
Polypogon sp.	—	—	—	—
Portulaca sp.	—	—	—	—
Potamogeton sp.	0.04	—	—	—
Potentilla sp.	0.06	—	—	—
Puccinellia sp.	—	—	0.04	—
Purshia tridentata	—	—	—	—
Quercus (undifferentiated)	—	—	—	—
Rosa sp.	—	—	—	0.02
Rumex sp.	—	—	—	—
Ruppia sp.	—	—	—	—
Salvia sp.	—	—	—	—
Scirpus sp.	—	0.05	—	0.04
Sitanion hystrix	—	—	—	—
Sphaeralcea sp.	—	—	—	—
Sporobolus sp.	5.59	1.59	0.06	0.3
Trifolium sp.	19.2	0.88	0.31	0.12
Typha sp.	—	—	1.83	0.2
unidentifiable/ fragments	159.8	4.45	0.44	2.51
unidentified/unknown	0.61	0.4	0.73	0.22
Vigueria sp.	—	—	—	—
Vulpia microstachys	—	—	—	—

Table A.8. Newberry Period Data from INY-1384/H (S12; S2—S4)

BASGALL AND DELACORTE 2012				
Site Locus	INY-1384/H			
Context	S 12	S 2	S 3	S 4
Soil volume (L) (where available)	42.0	54.5	13.0	26.25

TAXA	DENSITY (SEED/L)			
Achnatherum hymenoides	—	—	—	—
Achnatherum sp.	0.69	1.5	0.08	0.19
Agrostis sp.	—	—	—	—
Allium sp.	—	—	—	—
Amaranthus sp.	—	—	—	—
Amorphous	—	0.29	1.0	0.19
Amsinckia sp.	—	—	—	—
Arctostaphyos sp.	—	0.02	—	—
Artemisia sp.	1.19	9.96	0.92	0.46
Artemisia tridentata	30.26	0.7	0.54	6.02
Asteraceae	—	0.02	0.46	0.08
Astragalus sp.	—	—	—	—
Atriplex canescens	—	0.44	—	—
Atriplex sp.	0.76	1.21	2.31	1.03
Boraginaceae	—	—	—	—
Brassicaceae	—	—	—	—
Carex sp.	—	0.06	—	—
Chenopodiaceae	1.9	0.7	1.0	0.76
Chenopodium sp.	1.67	11.43	53.85	6.29
Cryptantha sp.	—	—	—	—
Cyperaceae	—	—	—	—
Cyperus sp. (tubers)	—	0.07	—	—
Deschampsia sp.	—	0.22 cf	—	—
Descurania sp.	0.14	0.02	—	—
Epilobium sp.	—	—	—	—
Eragrostis sp.	—	—	—	—
Eremalche sp.	—	—	—	—
Eriogonum sp.	0.17	0.13	0.23	—
Erodium sp.	—	—	—	—
Fabaceae	0.5	0.39	0.62	2.1
Galium sp.	—	—	—	—
Gilia sp.	—	—	—	—
Helianthus sp.	—	—	—	—
Hordeum sp.	—	—	—	—
Juncus sp.	—	—	—	—
Leptochloa sp.	—	—	—	—
Lycium sp.	—	—	—	—

TAXA	DENSITY (SEED/L)			
Malvaceae	—	—	—	—
Marah sp.	—	—	—	—
Mentzelia sp.	1.29	0.11	0.31	0.84
Mulenberghia sp.	—	—	—	—
Nicotiana sp.	0.1	—	—	—
Oenothera sp.	0.38	0.48	—	0.61
Panicum capillare cf.	—	0.35	1.08	—
Phacelia sp.	—	—	—	—
Phalaris sp.	—	—	—	—
Phragmites sp.	—	0.15 cf	1.69 cf	—
Physalis sp.	—	—	—	—
Pinus monophylla (undifferentiated)	0.21	1.49	1.08	0.95
Pinus sp.	—	—	—	—
Poa sp.	—	—	—	—
Poaceae	1.14	0.94	0.53	0.53
Polygonum/Rumex	—	—	—	—
Polypogon sp.	—	—	—	—
Portulaca sp.	—	—	—	—
Potamogeton sp.	—	—	—	—
Potentilla sp.	0.1	—	0.08	—
Puccinellia sp.	—	0.09	—	0.04
Purshia tridentata	—	—	—	—
Quercus (undifferentiated)	—	—	—	—
Rosa sp.	—	—	—	—
Rumex sp.	—	—	—	—
Ruppia sp.	—	—	—	—
Salvia sp.	—	—	—	—
Scirpus sp.	—	0.06	—	0.08
Sitanion hystrix	—	—	—	—
Sphaeralcea sp.	—	—	—	—
Sporobolus sp.	0.31	1.05	2.54	0.08
Trifolium sp.	0.52	0.09	—	0.07
Typha sp.	9.05	—	—	—
unidentifiable/ fragments	4.95	6.0	2.08	2.59
unidentified/unknown	0.76	0.39	0.38	0.95
Vigueria sp.	—	—	—	—
Vulpia microstachys	—	—	—	—

Table A.9. Newberry Period Data from INY-1384/H (S5—S7; S14)

BASGALL AND DELACORTE 2012				
Site Locus	INY-1384/H			
Context	S 5	S 6	S 7	S 14
Soil volume (L) (where available)	45.75	11.0	32.0	—

TAXA	DENSITY (SEED/L)			
Achnatherum hymenoides	—	—	—	—
Achnatherum sp.	0.07	0.09	0.44	0.13
Agrostis sp.	0.04			
Allium sp.	—	—	—	—
Amaranthus sp.	0.02			
Amorphous	0.5		0.22	
Amsinckia sp.	—	—	—	—
Arctostaphyos sp.	—	—	—	—
Artemisia sp.	0.04	1.27	0.94	0.2
Artemisia tridentata	0.17	2.0	14.72	0.47
Asteraceae	0.02	—	0.22	—
Astragalus sp.	—	—	—	—
Atriplex canescens	0.07	—	—	—
Atriplex sp.	0.11	—	0.13	0.87
Boraginaceae	—	—	—	—
Brassicaceae	—	—	—	—
Carex sp.	—	—	—	—
Chenopodiaceae	0.15	—	2.91	—
Chenopodium sp.	2.67	1.18	6.41	1.87
Cryptantha sp.	—	—	—	—
Cyperaceae	0.02	—	0.03	—
Cyperus sp. (tubers)	0.02	—	0.09	—
Deschampsia sp.	—	—	—	—
Descurania sp.	0.07	—	0.16	—
Epilobium sp.	—	—	—	—
Eragrostis sp.	—	—	—	—
Eremalche sp.	—	—	—	—
Eriogonum sp.	0.04	—	0.13	—
Erodium sp.	—	—	—	—
Fabaceae	0.92	—	0.44	0.73
Galium sp.	—	—	—	—
Gilia sp.	0.04	—	0.06	—
Helianthus sp.	—	—	—	—
Hordeum sp.	—	—	—	—
Juncus sp.	—	—	—	—
Leptochloa sp.	—	—	—	—
Lycium sp.	—	—	—	—

TAXA	DENSITY (SEED/L)			
Malvaceae	—	—	—	—
Marah sp.	0.07	—	—	—
Mentzelia sp.	0.13	0.45	2.13	0.07
Mulenberghia sp.	—	—	0.81	—
Nicotiana sp.	—	—	—	—
Oenothera sp.	0.11	—	0.34	—
Panicum capillare cf.	0.04	—	0.13	—
Phacelia sp.	—	—	—	—
Phalaris sp.	—	—	—	—
Phragmites sp.	—	—	—	—
Physalis sp.	—	—	—	—
Pinus monophylla (undifferentiated)	0.63	0.45	—	0.53
Pinus sp.	—	—	—	—
Poa sp.	—	—	—	—
Poaceae	1.75	0.27	0.56	0.67
Polygonum/Rumex	—	—	—	—
Polypogon sp.	—	—	—	—
Portulaca sp.	0.04	—	—	—
Potamogeton sp.	0.02	—	—	—
Potentilla sp.	1.03	—	—	—
Puccinellia sp.	0.17	—	—	—
Purshia tridentata	—	—	—	—
Quercus (undifferentiated)	—	—	—	—
Rosa sp.	—	—	—	—
Rumex sp.	—	—	—	—
Ruppia sp.	—	—	—	—
Salvia sp.	0.02	—	0.03	—
Scirpus sp.	0.09	—	0.03	—
Sitanion hystrix	—	—	—	—
Sphaeralcea sp.	—	—	—	—
Sporobolus sp.	0.44	0.18	0.63	0.13
Trifolium sp.	0.11	—	0.06	0.67
Typha sp.	—	7.27	—	—
unidentifiable/ fragments	3.5	0.27	7.88	2.6
unidentified/unknown	0.44	0.27	0.53	0.2
Vigueria sp.	—	—	—	—
Vulpia microstachys	—	—	—	—

Table A.10. Haiwee Period Data from INY-1700 (Loc. 2), INY-5761 (Loc. 2), and INY-328/H (Loc. B)

BETTINGER 1989	
Site Locus	INY-1700 - Loc. 2
Context	Structure 7
Volume (where available)	—

TAXA	DENSITY (SEED/L)
Achillea sp.	—
Achnatherum hymenoides	+
Achyrachaena mollis	—
Agrostis sp.	—
Amaranthus sp.	—
Amsinckia sp.	—
Aralia/Hydrocotyle	—
Arctostaphylos sp.	—
Artemisia ludoviciania	+
Artemisia sp.	—
Artemisia tridentata	+
Asteraceae	—
Astragalus sp.	—
Atriplex canescens	—
Atriplex sp.	+
Boraginaceae	—
Brassicaceae	—
Bromus sp.	—
Calamagrostis sp.	—
Calandrinia sp.	—
Carex sp.	—
cf. *Aristida* sp.	—
cf. Deschampsia sp.	—
Chenopodiaceae	—
Chenopodium sp.	+
Chenopodium/Atriplex	—
Clarkia sp. capsule	—
Clarkia sp. seeds	—
Claytonia sp.	—
Cryptantha sp.	—
Cyperaceae	—
Cyperus sp. seeds	—

TAXA	DENSITY (SEED/L)
Cyperus sp. tubers	—
Dantonia sp.	—
Delphinium sp.	—
Descurania sp.	—
Distichlis sp.	—
Eleocharis sp.	—
Ephedra sp.	—
Epilobium sp.	—
Eragrostis sp.	—
Eriogonum sp.	—
Erodium sp.	—
Euphorbiaceae	—
Fabaceae	—
Galium sp.	—
Gilia sp.	—
Helianthus sp.	—
Hemizonia sp.	—
Hordeum sp.	—
Hypericum sp.	—
Juncus sp.	—
Lagophylla sp.	—
Lepidium sp.	—
Lupine sp.	—
Lycium sp.	—
Madia sp.	—
Malvaceae	—
Malvia sp.	—
Marah sp.	—
Mentzelia sp.	+
Mulenberghia sp.	—
Myrica sp. cf	—
Nicotiana sp.	—
Oenothera sp.	—
Panicum capillare cf.	—
Panicum sp.	—
Paspalum sp.	—
Phacelia sp.	—
Phalaris sp.	—
Phragmites sp. cf.	—
Pinus monophylla (nutshell)	—
Pinus sabiniana nutshell	—
Pinus sp. nutmeat	—

TAXA	DENSITY (SEED/L)
Pinus sp. thin nutshell [Ponderosa, Sugar, Pinyon etc.]	—
Poaceae	—
Poaceae (identifiable)	—
Polygonum sp.	—
Polygonum/Rumex	—
Populus s*p.*	+
Potamogeton sp.	—
Potentilla sp.	—
Puccinellia sp.	—
Quercus (undifferentiated) nutshell	—
Ranunculus sp.	—
Rosa sp.	—
Rubus sp.	—
Rumex sp.	—
Ruppia sp	—
Salvia sp.	—
Sambucus sp.	—
Scirpus sp.	—
Sesuvium sp.	—
Solanum sp.	—
Sphaeralcea sp.	—
Sporobolus sp.	+
Sueda sp.	—
Trifolium sp.	—
Triticum sp.	—
Typha sp.	—
Umbellularia californica nutshell	—
Unidentifiable	—
Unidentified	—
unidentified Poaceae caryopsis	—
Unknown A	—
Vicia/Lathrys	—
Viola sp.	—

+ denotes presence

Table A.11. Haiwee Period Data from INY-5761 (Loc. 2)

BASGALL AND DELACORTE 2003	
Site Locus	INY-5761 - Loc. 2
Context	Feat. 2 house
Volume (where available)	—

TAXA	DENSITY (SEED/L)
Achillea sp.	—
Achnatherum hymenoides	—
Achyrachaena mollis	—
Agrostis sp.	—
Amaranthus sp.	—
Amsinckia sp.	—
Aralia/Hydrocotyle	—
Arctostaphylos sp.	—
Artemisia ludoviciania	—
Artemisia sp.	—
Artemisia tridentata	7.04
Asteraceae	0.05
Astragalus sp.	—
Atriplex canescens	—
Atriplex sp.	0.09
Boraginaceae	—
Brassicaceae	—
Bromus sp.	—
Calamagrostis sp.	—
Calandrinia sp.	—
Carex sp.	—
cf. *Aristida* sp.	—
cf. Deschampsia sp.	—
Chenopodiaceae	0.12
Chenopodium sp.	43.51
Chenopodium/Atriplex	—
Clarkia sp. capsule	—
Clarkia sp. seeds	—
Claytonia sp.	—
Cryptantha sp.	0.47
Cyperaceae	0.33
Cyperus sp. seeds	—
Cyperus sp. tubers	—
Dantonia sp.	—

TAXA	DENSITY (SEED/L)
Delphinium sp.	—
Descurania sp.	—
Distichlis sp.	—
Eleocharis sp.	—
Ephedra sp.	—
Epilobium sp.	—
Eragrostis sp.	—
Eriogonum sp.	—
Erodium sp.	—
Euphorbiaceae	—
Fabaceae	0.28
Galium sp.	—
Gilia sp.	—
Helianthus sp.	—
Hemizonia sp.	—
Hordeum sp.	—
Hypericum sp.	—
Juncus sp.	0.94
Lagophylla sp.	—
Lepidium sp.	—
Lupine sp.	0.02
Lycium sp.	—
Madia sp.	—
Malvaceae	—
Malvia sp.	—
Marah sp.	—
Mentzelia sp.	0.23
Mulenberghia sp.	—
Myrica sp. cf	—
Nicotiana sp.	—
Oenothera sp.	—
Panicum capillare cf.	—
Panicum sp.	0.44
Paspalum sp.	—
Phacelia sp.	—
Phalaris sp.	—
Cf. Phragmites sp.	—
Pinus monophylla nutshell	2.81
Pinus sabiniana nutshell	—
Pinus sp. nutmeat	—
Pinus sp. thin nutshell [Ponderosa, Sugar, Pinyon etc.]	—

TAXA	DENSITY (SEED/L)
Poaceae	0.19
Poaceae (identifiable)	—
Polygonum sp.	0.09
Polygonum/Rumex	—
Populus s*p.*	—
Potamogeton sp.	—
Potentilla sp.	—
Puccinellia sp.	—
Quercus (undifferentiated) nutshell	—
Ranunculus sp.	—
Rosa sp.	—
Rubus sp.	—
Rumex sp.	—
Ruppia sp	—
Salvia sp.	—
Sambucus sp.	—
Scirpus sp.	1.3
Sesuvium sp.	0.7
Solanum sp.	—
Sphaeralcea sp.	—
Sporobolus sp.	—
Sueda sp.	—
Trifolium sp.	—
Triticum sp.	—
Typha sp.	4.68
Umbellularia californica nutshell	—
Unidentifiable	—
Unidentified	—
unidentified Poaceae caryopsis	—
Unknown A	7.25
Vicia/Lathrys	—
Viola sp.	—

Table A.12. Haiwee Period Data from INY-328/H (Loc. B)

DELACORTE ET AL. 1995	
Site Locus	INY-328/H - Loc. B
Context	Feat. 2 hearth
Volume (where available)	—

TAXA	DENSITY (SEED/L)
Achillea sp.	—
Achnatherum hymenoides	—
Achyrachaena mollis	—
Agrostis sp.	—
Amaranthus sp.	—
Amsinckia sp.	—
Aralia/Hydrocotyle	—
Arctostaphylos sp.	—
Artemisia ludoviciania	—
Artemisia sp.	—
Artemisia tridentata	—
Asteraceae	—
Astragalus sp.	—
Atriplex canescens	—
Atriplex sp.	—
Boraginaceae	—
Brassicaceae	—
Bromus sp.	—
Calamagrostis sp.	—
Calandrinia sp.	—
Carex sp.	—
cf. *Aristida* sp.	—
cf. Deschampsia sp.	—
Chenopodiaceae	—
Chenopodium sp.	2.0
Chenopodium/Atriplex	—
Clarkia sp. capsule	—
Clarkia sp. seeds	—
Claytonia sp.	—
Cryptantha sp.	—
Cyperaceae	—
Cyperus sp. seeds	—
Cyperus sp. tubers	—
Dantonia sp.	—

TAXA	DENSITY (SEED/L)
Delphinium sp.	—
Descurania sp.	—
Distichlis sp.	—
Eleocharis sp.	—
Ephedra sp.	—
Epilobium sp.	—
Eragrostis sp.	—
Eriogonum sp.	—
Erodium sp.	—
Euphorbiaceae	—
Fabaceae	—
Galium sp.	—
Gilia sp.	—
Helianthus sp.	—
Hemizonia sp.	—
Hordeum sp.	—
Hypericum sp.	—
Juncus sp.	—
Lagophylla sp.	—
Lepidium sp.	—
Lupine sp.	—
Lycium sp.	—
Madia sp.	—
Malvaceae	—
Malvia sp.	—
Marah sp.	—
Mentzelia sp.	—
Mulenberghia sp.	—
Myrica sp. cf	—
Nicotiana sp.	—
Oenothera sp.	—
Panicum capillare cf.	—
Panicum sp.	—
Paspalum sp.	—
Phacelia sp.	—
Phalaris sp.	—
Cf. Phragmites sp.	—
Pinus monophylla nutshell	—
Pinus sabiniana nutshell	—
Pinus sp. nutmeat	—
Pinus sp. thin nutshell [Ponderosa, Sugar, Pinyon etc.]	—

TAXA	DENSITY (SEED/L)
Poaceae	—
Poaceae (identifiable)	—
Polygonum sp.	—
Polygonum/Rumex	—
Populus s*p.*	—
Potamogeton sp.	—
Potentilla sp.	—
Puccinellia sp.	—
Quercus (undifferentiated) nutshell	—
Ranunculus sp.	—
Rosa sp.	49.5
Rubus sp.	—
Rumex sp.	—
Ruppia sp	—
Salvia sp.	—
Sambucus sp.	—
Scirpus sp.	2.0
Sesuvium sp.	—
Solanum sp.	—
Sphaeralcea sp.	—
Sporobolus sp.	—
Sueda sp.	—
Trifolium sp.	—
Triticum sp.	—
Typha sp.	—
Umbellularia californica nutshell	—
Unidentifiable	—
Unidentified	—
unidentified Poaceae caryopsis	—
Unknown A	—
Vicia/Lathrys	—
Viola sp.	—

Table A.13. Haiwee Period Data from INY-2750 (Loc. A), INY-3769 (Loc. 5), INY-3778 (Loc. B)

DELACORTE 1999			
Site Locus	INY-2750 - Loc. A	INY-3769 - Loc. 5	INY-3778 - Loc. B
Context	Feat. 6 hearth/smear	Feat. 1 Structure	Feat 3/3A hearth
Volume (where available)	—	—	—

TAXA	DENSITY (SEED/L)		
Achillea sp.	—	—	—
Achnatherum hymenoides	—	—	—
Achyrachaena mollis	—	—	—
Agrostis sp.	—	—	—
Amaranthus sp.	—	—	—
Amsinckia sp.	—	—	—
Aralia/Hydrocotyle	—	—	—
Arctostaphylos sp.	—	—	—
Artemisia ludoviciania	—	—	—
Artemisia sp.	—	—	—
Artemisia tridentata	—	—	—
Asteraceae	—	—	—
Astragalus sp.	—	—	—
Atriplex canescens	—	—	—
Atriplex sp.	—	—	0.7
Boraginaceae	—	—	—
Brassicaceae	—	—	—
Bromus sp.	—	—	—
Calamagrostis sp.	—	—	—
Calandrinia sp.	—	—	—
Carex sp.	—	—	—
cf. *Aristida* sp.	—	—	—
cf. Deschampsia sp.	—	—	—
Chenopodiaceae	—	—	0.55
Chenopodium sp.	—	—	—
Chenopodium/Atriplex	—	—	—
Clarkia sp. capsule	—	—	—
Clarkia sp. seed	—	—	—
Claytonia sp.	—	—	—
Cryptantha sp.	—	—	—

TAXA	DENSITY (SEED/L)		
Cyperaceae	—	—	—
Cyperus sp.seeds	—	—	—
Cyperus sp. tubers	—	—	—
Dantonia sp.	—	—	—
Delphinium sp.	—	—	—
Descurania sp.	—	—	—
Distichlis sp.	—	—	—
Eleocharis sp.	—	—	—
Ephedra sp.	—	—	—
Epilobium sp.	—	—	—
Eragrostis sp.	—	—	—
Eriogonum sp.	—	—	—
Erodium sp.	—	—	—
Euphorbiaceae	—	—	—
Fabaceae	—	—	—
Galium sp.	—	—	—
Gilia sp.	—	—	—
Helianthus sp.	—	—	—
Hemizonia sp.	—	—	—
Hordeum sp.	—	—	—
Hypericum sp.	—	—	—
Juncus sp.	—	—	—
Lagophylla sp.	—	—	—
Lepidium sp.	—	—	—
Lupine sp.	—	—	—
Lycium sp.	—	—	—
Madia sp.	—	—	—
Malvaceae	—	—	—
Malvia sp.	—	—	—
Marah sp.	—	—	—
Mentzelia sp.	—	—	—
Mulenberghia sp.	—	—	—
Myrica sp. cf	—	—	—
Nicotiana sp.	—	—	—
Oenothera sp.	—	—	—
Panicum capillare cf.	—	—	—
Panicum sp.	—	—	—
Paspalum sp.	—	—	—
Phacelia sp.	—	—	—
Phalaris sp.	—	—	—
Cf. Phragmites sp.	—	—	—
Pinus monophylla nutshell	—	—	—

TAXA	DENSITY (SEED/L)		
Pinus sabiniana nutshell	—	—	—
Pinus sp. nutmeat	—	—	—
Pinus sp. thin nutshell [Ponderosa, Sugar, Pinyon etc.]	—	—	—
Poaceae	5.0	—	—
Poaceae (identifiable)	—	—	—
Polygonum sp.	—	—	—
Polygonum/Rumex	—	—	—
Populus s*p.*	—	—	—
Potamogeton sp.	—	—	—
Potentilla sp.	—	—	—
Puccinellia sp.	—	—	—
Quercus (undifferentiated) nutshell	—	—	—
Ranunculus sp.	—	—	—
Rosa sp.	—	—	—
Rubus sp.	—	—	—
Rumex sp.	—	—	—
Ruppia sp	—	—	—
Salvia sp.	—	—	—
Sambucus sp.	—	—	—
Scirpus sp.	—	0.5	—
Sesuvium sp.	—	—	—
Solanum sp.	—	—	—
Sphaeralcea sp.	—	—	—
Sporobolus sp.	—	—	—
Sueda sp.	—	—	—
Trifolium sp.	—	—	—
Triticum sp.	—	—	—
Typha sp.	—	—	0.31
Umbellularia californica nutshell	—	—	—
Unidentifiable	—	—	—
Unidentified	—	—	—
unidentified Poaceae caryopsis	—	—	—
Unknown A	—	—	—
Vicia/Lathrys	—	—	—
Viola sp.	—	—	—

Table A.14. Haiwee Period Data from INY-30

BASGALL AND MCGUIRE 1988			
Site Locus	INY-30		
Context	Feature 5	F 7 hearth	F. 7 hearth above f(?) 14
Volume (where available)	—	—	—

TAXA	DENSITY (SEED/L)		
Achillea sp.	—	—	—
Achnatherum hymenoides	—	—	—
Achyrachaena mollis	—	—	—
Agrostis sp.	—	—	—
Amaranthus sp.	—	—	9.0
Amsinckia sp.	—	—	—
Aralia/Hydrocotyle	—	—	—
Arctostaphylos sp.	—	—	—
Artemisia ludoviciania	—	—	—
Artemisia sp.	—	—	—
Artemisia tridentata	—	—	6.0
Asteraceae	—	—	—
Astragalus sp.	—	—	—
Atriplex canescens	—	—	—
Atriplex sp.	—	—	—
Boraginaceae	—	—	—
Brassicaceae	—	—	3.0
Bromus sp.	—	—	—
Calamagrostis sp.	—	—	—
Calandrinia sp.	—	—	—
Carex sp.	—	—	—
cf. *Aristida* sp.	—	—	—
cf. Deschampsia sp.	—	—	—
Chenopodiaceae	—	—	3.0
Chenopodium sp.	—	—	4.0
Chenopodium/Atriplex	—	—	—
Clarkia sp. capsule	—	—	—
Clarkia sp. seeds	—	—	—
Claytonia sp.	—	—	—
Cryptantha sp.	—	—	—
Cyperaceae	—	—	—
Cyperus sp. seeds	—	—	—
Cyperus sp. tubers	—	—	—

TAXA	DENSITY (SEED/L)		
Dantonia sp.	—	—	—
Delphinium sp.	—	—	—
Descurania sp.	—	—	—
Distichlis sp.	—	—	—
Eleocharis sp.	—	—	—
Ephedra sp.	—	—	—
Epilobium sp.	—	—	—
Eragrostis sp.	—	—	—
Eriogonum sp.	—	—	—
Erodium sp.	—	—	—
Euphorbiaceae	—	—	—
Fabaceae	—	—	—
Galium sp.	—	—	—
Gilia sp.	—	—	—
Helianthus sp.	1.5	—	—
Hemizonia sp.	—	—	—
Hordeum sp.	—	—	3.0
Hypericum sp.	—	—	—
Juncus sp.	19.5	—	27.0
Lagophylla sp.	—	—	—
Lepidium sp.	—	—	—
Lupine sp.	—	—	—
Lycium sp.	—	—	—
Madia sp.	—	—	—
Malvaceae	—	—	—
M*alvia* sp.	—	—	—
Marah sp.	—	—	—
Mentzelia sp.	1.5	—	—
Mulenberghia sp.	—	—	4.0
Myrica sp. cf	—	—	—
Nicotiana sp.	—	—	—
Oenothera sp.	—	—	—
Panicum capillare cf.	—	—	—
Panicum sp.	—	—	—
Paspalum sp.	—	—	—
Phacelia sp.	—	—	—
Phalaris sp.	—	—	—
Cf. Phragmites sp.	—	—	—
Pinus monophylla nutshell	—	—	1.17
Pinus sabiniana nutshell	—	—	—
Pinus sp. nutmeat	—	—	—

TAXA	DENSITY (SEED/L)		
Pinus sp. thin nutshell [Ponderosa, Sugar, Pinyon etc.]	—	—	—
Poaceae	5.5	7.0	—
Poaceae (identifiable)	—	—	—
Polygonum sp.	—	—	—
Polygonum/Rumex	—	—	—
Populus s*p.*	—	—	—
Potamogeton sp.	—	—	—
Potentilla sp.	—	—	—
Puccinellia sp.	—	—	—
Quercus (undifferentiated) nutshell	—	—	—
Ranunculus sp.	—	—	—
Rosa sp.	—	—	—
Rubus sp.	—	—	—
Rumex sp.	—	—	—
Ruppia sp	—	—	—
Salvia sp.	—	—	—
Sambucus sp.	—	—	—
Scirpus sp.	2.5	—	—
Sesuvium sp.	—	—	—
Solanum sp.	—	—	—
Sphaeralcea sp.	—	—	—
Sporobolus sp.	—	—	290.0
Sueda sp.	—	—	—
Trifolium sp.	—	—	—
Triticum sp.	—	—	—
Typha sp.	—	—	—
Umbellularia californica nutshell	—	—	—
Unidentifiable	—	—	—
Unidentified	—	—	—
unidentified Poaceae caryopsis	—	—	—
Unknown A	—	—	—
Vicia/Lathrys	—	—	—
Viola sp.	—	—	—

Table A.15. Haiwee Period Data from INY-1428

	GILREATH 1995	GILREATH AND HOLANDA 2000
Site Locus	INY-1428	INY-1428
Context	midden	midden
Volume (where available)	—	—

TAXA	DENSITY (SEED/L)	
Achillea sp.	—	—
Achnatherum hymenoides	—	0.12
Achyrachaena mollis	—	—
Agrostis sp.	—	—
Amaranthus sp.	—	—
Amsinckia sp.	—	—
Aralia/Hydrocotyle	—	—
Arctostaphylos sp.	—	—
Artemisia ludoviciania	—	—
Artemisia sp.	—	—
Artemisia tridentata	—	—
Asteraceae	—	—
Astragalus sp.	—	—
Atriplex canescens	—	—
Atriplex sp.	—	—
Boraginaceae	—	—
Brassicaceae	+	0.03
Bromus sp.	—	—
Calamagrostis sp.	—	—
Calandrinia sp.	—	—
Carex sp.	—	—
cf. *Aristida* sp.	—	—
cf. Deschampsia sp.	—	—
Chenopodiaceae	—	—
Chenopodium sp.	—	—
Chenopodium/Atriplex	—	—
Clarkia sp. capsule	—	—
Clarkia sp. seed	—	—
Claytonia sp.	—	—
Cryptantha sp.	—	—
Cyperaceae	—	—
Cyperus sp.seeds	—	—
Cyperus sp. tubers	—	—

TAXA	DENSITY (SEED/L)	
Dantonia sp.	—	—
Delphinium sp.	—	—
Descurania sp.	—	—
Distichlis sp.	—	—
Eleocharis sp.	—	—
Ephedra sp.	—	—
Epilobium sp.	—	—
Eragrostis sp.	—	—
Eriogonum sp.	—	—
Erodium sp.	—	—
Euphorbiaceae	—	—
Fabaceae	—	0.06
Galium sp.	—	—
Gilia sp.	—	—
Helianthus sp.	—	—
Hemizonia sp.	—	—
Hordeum sp.	—	—
Hypericum sp.	—	—
Juncus sp.	—	1.2
Lagophylla sp.	—	—
Lepidium sp.	—	—
Lupine sp.	—	—
Lycium sp.	—	1.0
Madia sp.	—	—
Malvaceae	—	0.09
M*alvia* sp.	—	—
Marah sp.	—	—
Mentzelia sp.	+	0.63
Mulenberghia sp.	—	—
Myrica sp. cf	—	—
Nicotiana sp.	—	—
Oenothera sp.	—	—
Panicum capillare cf.	—	—
Panicum sp.	—	—
Paspalum sp.	—	—
Phacelia sp.	—	—
Phalaris sp.	—	—
Cf. Phragmites sp.	—	—
Pinus monophylla nutshell	—	0.12
Pinus sabiniana nutshell	—	—
Paspalum sp.	—	—

TAXA	DENSITY (SEED/L)	
Pinus sp. thin nutshell [Ponderosa, Sugar, Pinyon etc.]	—	—
Poaceae	—	0.75
Poaceae (identifiable)	—	—
Polygonum sp.	—	—
Polygonum/Rumex	—	—
Populus s*p.*	—	—
Potamogeton sp.	—	—
Potentilla sp.	—	—
Puccinellia sp.	—	—
Quercus (undifferentiated) nutshell	—	1.0
Ranunculus sp.	—	—
Rosa sp.	—	—
Rubus sp.	—	—
Rumex sp.	—	—
Ruppia sp	—	—
Salvia sp.	+	2.25
Sambucus sp.	—	—
Scirpus sp.	—	0.21
Sesuvium sp.	—	—
Solanum sp.	—	—
Sphaeralcea sp.	—	—
Sporobolus sp.	—	—
Sueda sp.	—	—
Trifolium sp.	—	—
Triticum sp.	—	—
Typha sp.	—	—
Umbellularia californica nutshell	—	—
Unidentifiable	—	—
Unidentified	—	—
unidentified Poaceae caryopsis	—	—
Unknown A	—	—
Vicia/Lathrys	—	—
Viola sp.	—	—

Table A.16. Haiwee Period Data from INY-3812 (Loc. 1)

DELACORTE AND MCGUIRE 1993	
Site Locus	INY-3812 - Loc. 1
Context	structure
Volume (where available)	—

TAXA	DENSITY (SEED/L)
Achillea sp.	—
Achnatherum hymenoides	—
Achyrachaena mollis	—
Agrostis sp.	—
Amaranthus sp.	—
Amsinckia sp.	—
Aralia/Hydrocotyle	—
Arctostaphylos sp.	—
Artemisia ludoviciania	—
Artemisia sp.	—
Artemisia tridentata	—
Asteraceae	—
Astragalus sp.	—
Atriplex canescens	—
Atriplex sp.	—
Boraginaceae	—
Brassicaceae	—
Bromus sp.	—
Calamagrostis sp.	—
Calandrinia sp.	—
Carex sp.	—
cf. *Aristida* sp.	—
cf. Deschampsia sp.	—
Chenopodiaceae	0.67
Chenopodium sp.	—
Chenopodium/Atriplex	—
Clarkia sp. capsule	—
Clarkia sp. seed	—
Claytonia sp.	—
Cryptantha sp.	—
Cyperaceae	—
Cyperus sp.seeds	—
Cyperus sp. tubers	—
Dantonia sp.	—

TAXA	DENSITY (SEED/L)
Delphinium sp.	—
Descurania sp.	—
Distichlis sp.	—
Eleocharis sp.	—
Ephedra sp.	—
Epilobium sp.	—
Eragrostis sp.	—
Eriogonum sp.	—
Erodium sp.	—
Euphorbiaceae	—
Fabaceae	—
Galium sp.	—
Gilia sp.	—
Helianthus sp.	—
Hemizonia sp.	—
Hordeum sp.	—
Hypericum sp.	—
Juncus sp.	—
Lagophylla sp.	—
Lepidium sp.	—
Lupine sp.	—
Lycium sp.	—
Madia sp.	—
Malvaceae	—
Malvia sp.	—
Marah sp.	—
Mentzelia sp.	—
Mulenberghia sp.	—
Myrica sp. cf	—
Nicotiana sp.	—
Oenothera sp.	—
Panicum capillare cf.	—
Panicum sp.	—
Paspalum sp.	—
Phacelia sp.	—
Phalaris sp.	—
Cf. Phragmites sp.	—
Pinus monophylla nutshell	2.0
Pinus sabiniana nutshell	—
Pinus sp. nutmeat	—
Pinus sp. thin nutshell [Ponderosa, Sugar, Pinyon etc.]	—

TAXA	DENSITY (SEED/L)
Poaceae	—
Poaceae (identifiable)	—
Polygonum sp.	—
Polygonum/Rumex	—
Populus s*p.*	—
Potamogeton sp.	—
Potentilla sp.	—
Puccinellia sp.	—
Quercus (undifferentiated) nutshell	14.67
Ranunculus sp.	—
Rosa sp.	0.67
Rubus sp.	—
Rumex sp.	—
Ruppia sp	—
Salvia sp.	—
Sambucus sp.	—
Scirpus sp.	—
Sesuvium sp.	—
Solanum sp.	—
Sphaeralcea sp.	—
Sporobolus sp.	—
Sueda sp.	—
Trifolium sp.	—
Triticum sp.	—
Typha sp.	—
Umbellularia californica nutshell	—
Unidentifiable	—
Unidentified	—
unidentified Poaceae caryopsis	—
Unknown A	—
Vicia/Lathrys	—
Viola sp.	—

Table A.17. Haiwee Period Data from INY-1969 (Loc. 1) and INY-4266

MCGUIRE AND GILREATH 1998		
Site Locus	INY-1969 - Loc. 1	INY-4266
Context	midden	Feature 1
Volume (where available)	—	—

TAXA	DENSITY (SEED/L)	
Achillea sp.	—	—
Achnatherum hymenoides	—	—
Achyrachaena mollis	—	—
Agrostis sp.	—	—
Amaranthus sp.	0.17	—
Amsinckia sp.	—	—
Aralia/Hydrocotyle	—	—
Arctostaphylos sp.	—	—
Artemisia ludoviciania	—	—
Artemisia sp.	—	—
Artemisia tridentata	—	—
Asteraceae	—	—
Astragalus sp.	—	—
Atriplex canescens	—	—
Atriplex sp.	—	—
Boraginaceae	—	—
Brassicaceae	—	—
Bromus sp.	—	—
Calamagrostis sp.	—	—
Calandrinia sp.	—	—
Carex sp.	—	—
cf. *Aristida* sp.	—	—
cf. Deschampsia sp.	—	—
Chenopodiaceae	0.14	—
Chenopodium sp.	—	—
Chenopodium/Atriplex	—	—
Clarkia sp. capsule	—	—
Clarkia sp. seed	—	—
Claytonia sp.	—	—
Cryptantha sp.	—	—
Cyperaceae	—	—
Cyperus sp.seeds	—	—
Cyperus sp. tubers	—	—
Dantonia sp.	—	—

TAXA	DENSITY (SEED/L)	
Delphinium sp.	—	—
Descurania sp.	0.33	—
Distichlis sp.	—	—
Eleocharis sp.	—	—
Ephedra sp.	—	—
Epilobium sp.	—	—
Eragrostis sp.	—	—
Eriogonum sp.	—	—
Erodium sp.	—	—
Euphorbiaceae	—	—
Fabaceae	—	—
Galium sp.	—	—
Gilia sp.	—	—
Helianthus sp.	—	—
Hemizonia sp.	—	—
Hordeum sp.	—	—
Hypericum sp.	—	—
Juncus sp.	0.57	—
Lagophylla sp.	—	—
Lepidium sp.	—	—
Lupine sp.	—	—
Lycium sp.	—	—
Madia sp.	—	—
Malvaceae	—	—
Malvia sp.	—	—
Marah sp.	—	—
Mentzelia sp.	—	—
Mulenberghia sp.	—	—
Myrica sp. cf	—	—
Nicotiana sp.	—	—
Oenothera sp.	—	—
Panicum capillare cf.	—	—
Panicum sp.	—	—
Paspalum sp.	—	—
Phacelia sp.	—	—
Phalaris sp.	—	—
Cf. Phragmites sp.	—	—
Pinus monophylla nutshell	—	—
Pinus sabiniana nutshell	—	—
Pinus sp. nutmeat	—	—
Pinus sp. thin nutshell [Ponderosa, Sugar, Pinyon etc.]	—	—

TAXA	DENSITY (SEED/L)	
Poaceae	—	—
Poaceae (identifiable)	—	—
Polygonum sp.	—	—
Polygonum/Rumex	—	—
Populus s*p.*	—	—
Potamogeton sp.	—	—
Potentilla sp.	—	—
Puccinellia sp.	—	—
Quercus (undifferentiated) nutshell	—	—
Ranunculus sp.	—	—
Rosa sp.	—	—
Rubus sp.	—	—
Rumex sp.	—	—
Ruppia sp	—	—
Salvia sp.	—	0.22
Sambucus sp.	—	—
Scirpus sp.	—	—
Sesuvium sp.	—	—
Solanum sp.	—	—
Sphaeralcea sp.	—	—
Sporobolus sp.	—	—
Sueda sp.	—	—
Trifolium sp.	—	—
Triticum sp.	—	—
Typha sp.	—	—
Umbellularia californica nutshell	—	—
Unidentifiable	—	—
Unidentified	—	—
unidentified Poaceae caryopsis	—	—
Unknown A	—	—
Vicia/Lathrys	—	—
Viola sp.	—	—

Table A.18. Haiwee Period Data from INY-5984 (Northern Midden)

BYRD AND HALE 2005 (REDDY)	
Site Locus	INY-5984 - Northern Midden
Context	STU 3 hearth
Volume (where available)	4.4

TAXA	DENSITY (SEED/L)
Achillea sp.	—
Achnatherum hymenoides	—
Achyrachaena mollis	—
Agrostis sp.	—
Amaranthus sp.	—
Amsinckia sp.	—
Aralia/Hydrocotyle	—
Arctostaphylos sp.	—
Artemisia ludoviciania	—
Artemisia sp.	—
Artemisia tridentata	—
Asteraceae	—
Astragalus sp.	—
Atriplex canescens	—
Atriplex sp.	—
Boraginaceae	—
Brassicaceae	—
Bromus sp.	—
Calamagrostis sp.	—
Calandrinia sp.	—
Carex sp.	—
cf. *Aristida* sp.	—
cf. Deschampsia sp.	—
Chenopodiaceae	—
Chenopodium sp.	—
Chenopodium/Atriplex	—
Clarkia sp. capsule	—
Clarkia sp. seed	—
Claytonia sp.	—
Cryptantha sp.	—
Cyperaceae	—
Cyperus sp.seeds	—
Cyperus sp. tubers	—
Dantonia sp.	—

TAXA	DENSITY (SEED/L)
Delphinium sp.	—
Descurania sp.	—
Distichlis sp.	—
Eleocharis sp.	—
Ephedra sp.	—
Epilobium sp.	—
Eragrostis sp.	—
Eriogonum sp.	—
Erodium sp.	—
Euphorbiaceae	—
Fabaceae	—
Galium sp.	—
Gilia sp.	—
Helianthus sp.	—
Hemizonia sp.	—
Hordeum sp.	—
Hypericum sp.	—
Juncus sp.	—
Lagophylla sp.	—
Lepidium sp.	—
Lupine sp.	—
Lycium sp.	—
Madia sp.	—
Malvaceae	—
Malvia sp.	—
Marah sp.	—
Mentzelia sp.	—
Mulenberghia sp.	0.45
Myrica sp. cf	—
Nicotiana sp.	—
Oenothera sp.	—
Panicum capillare cf.	—
Panicum sp.	—
Paspalum sp.	—
Phacelia sp.	—
Phalaris sp.	—
Cf. Phragmites sp.	—
Pinus monophylla nutshell	12.27
Pinus sabiniana nutshell	—
Pinus sp. nutmeat	—
Pinus sp. thin nutshell [Ponderosa, Sugar, Pinyon etc.]	—

TAXA	DENSITY (SEED/L)
Poaceae	—
Poaceae (identifiable)	—
Polygonum sp.	—
Polygonum/Rumex	—
Populus s*p.*	—
Potamogeton sp.	—
Potentilla sp.	—
Puccinellia sp.	—
Quercus (undifferentiated) nutshell	—
Ranunculus sp.	—
Rosa sp.	—
Rubus sp.	—
Rumex sp.	—
Ruppia sp	—
Salvia sp.	0.23
Sambucus sp.	—
Scirpus sp.	—
Sesuvium sp.	—
Solanum sp.	—
Sphaeralcea sp.	—
Sporobolus sp.	—
Sueda sp.	—
Trifolium sp.	—
Triticum sp.	—
Typha sp.	—
Umbellularia californica nutshell	—
Unidentifiable	—
Unidentified	—
unidentified Poaceae caryopsis	—
Unknown A	—
Vicia/Lathrys	—
Viola sp.	—

Table A.19. Haiwee Period Data from INY-5281 and INY-5285/H

ZEANAH AND LEIGH 2002 (AB-BLACK)		
Site Locus	INY-5281	INY-5285/H
Context	F4	midden
Volume (where available)	15.5L	9.75L

TAXA	DENSITY (SEED/L)	
Achillea sp.	—	—
Achnatherum hymenoides	—	—
Achyrachaena mollis	—	—
Agrostis sp.	—	—
Amaranthus sp.	—	—
Amsinckia sp.	—	—
Aralia/Hydrocotyle	—	—
Arctostaphylos sp.	—	—
Artemisia ludoviciania	—	—
Artemisia sp.	—	—
Artemisia tridentata	2.0	5.13
Asteraceae	—	3.79
Astragalus sp.	—	—
Atriplex canescens	—	—
Atriplex sp.	—	—
Boraginaceae	—	—
Brassicaceae	—	—
Bromus sp.	—	—
Calamagrostis sp.	—	—
Calandrinia sp.	—	—
Carex sp.	—	—
cf. *Aristida* sp.	—	—
cf. Deschampsia sp.	—	—
Chenopodiaceae	—	—
Chenopodium sp.	—	1.03
Chenopodium/Atriplex	—	—
Clarkia sp. capsule	—	—
Clarkia sp. seed	—	—
Claytonia sp.	—	—
Cryptantha sp.	—	—
Cyperaceae	—	—
Cyperus sp.seeds	—	—
Cyperus sp. tubers	—	—
Dantonia sp.	—	—

TAXA	DENSITY (SEED/L)	
Delphinium sp.	—	—
Descurania sp.	—	2.05
Distichlis sp.	—	—
Eleocharis sp.	—	—
Ephedra sp.	—	—
Epilobium sp.	—	—
Eragrostis sp.	—	—
Eriogonum sp.	—	—
Erodium sp.	—	—
Euphorbiaceae	—	—
Fabaceae	—	—
Galium sp.	—	—
Gilia sp.	—	—
Helianthus sp.	—	—
Hemizonia sp.	—	—
Hordeum sp.	—	—
Hypericum sp.	—	—
Juncus sp.	—	—
Lagophylla sp.	—	—
Lepidium sp.	—	—
Lupine sp.	—	—
Lycium sp.	—	—
Madia sp.	—	—
Malvaceae	—	—
Malvia sp.	—	—
Marah sp.	—	—
Mentzelia sp.	—	—
Mulenberghia sp.	—	—
Myrica sp. cf	—	—
Nicotiana sp.	—	—
Oenothera sp.	—	—
Panicum capillare cf.	—	—
Panicum sp.	—	—
Paspalum sp.	—	—
Phacelia sp.	—	—
Phalaris sp.	—	—
Cf. Phragmites sp.	—	—
Pinus monophylla nutshell	0.71	—
Pinus sabiniana nutshell	—	—
Pinus sp. nutmeat	—	—
Pinus sp. thin nutshell [Ponderosa, Sugar, Pinyon etc.]	—	—

TAXA	DENSITY (SEED/L)	
Poaceae	0.65	0.82
Poaceae (identifiable)	—	—
Polygonum sp.	—	—
Polygonum/Rumex	—	—
Populus *sp.*	—	—
Potamogeton sp.	—	—
Potentilla sp.	—	—
Puccinellia sp.	—	—
Quercus (undifferentiated) nutshell	—	—
Ranunculus sp.	—	—
Rosa sp.	—	—
Rubus sp.	—	—
Rumex sp.	—	—
Ruppia sp	—	—
Salvia sp.	—	—
Sambucus sp.	—	—
Scirpus sp.	—	—
Sesuvium sp.	—	—
Solanum sp.	—	—
Sphaeralcea sp.	—	—
Sporobolus sp.	—	—
Sueda sp.	—	—
Trifolium sp.	—	—
Triticum sp.	—	—
Typha sp.	—	—
Umbellularia californica nutshell	—	—
Unidentifiable	—	—
Unidentified	—	—
unidentified Poaceae caryopsis	—	—
Unknown A	—	—
Vicia/Lathrys	—	—
Viola sp.	—	—

Table A.20. Haiwee Period Data from INY-3806/H and INY-7448

SANTY 2022 (THIS MANUSCRIPT)						
Site Locus	INY-3806/H					INY-7448
Context	H 1	H 2	H 3	F 5.199	F 6.199	H 4
Volume (where available)	4.25	17.77	6.5	2	2	1.4

TAXA	DENSITY (SEED/L)					
Achillea sp.	—	0.28	—	—	—	—
Achnatherum hymenoides	—	—	—	—	—	—
Achyrachaena mollis	—	—	—	—	—	—
Agrostis sp.	0.24	—	—	5.0	—	—
Amaranthus sp.	—	0.06	0.15	—	—	—
Amsinckia sp.	—	—	—	—	—	—
Aralia/Hydrocotyle	—	—	0.15	—	—	—
Arctostaphylos sp.	—	0.39	—	—	—	—
Artemisia ludoviciania	—	—	—	—	—	—
Artemisia sp.	—	—	—	—	—	—
Artemisia tridentata	—	—	—	—	—	—
Asteraceae	—	0.17	0.15	—	—	—
Astragalus sp.	—	—	—	0.5	—	—
Atriplex canescens	—	—	—	—	—	—
Atriplex sp.	0.94	0.17	0.15	—	—	—
Boraginaceae	—	—	—	—	—	—
Brassicaceae	—	—	—	—	—	—
Bromus sp.	—	—	—	—	—	—
Calamagrostis sp.	—	0.11	—	—	—	—
Calandrinia sp.	—	0.06	—	—	—	—
Carex sp.	0.23	0.17	—	—	—	—
cf. *Aristida* sp.	—	—	—	—	—	—
cf. Deschampsia sp.	—	—	—	—	—	—
Chenopodiaceae	—	0.11	0.77	—	—	—
Chenopodium sp.	0.23	0.06	—	—	0.5	—
Chenopodium/Atriplex	—	—	—	1.5	—	—
Clarkia sp. capsule	—	—	—	—	—	—
Clarkia sp. seeds	—	—	—	—	—	—
Claytonia sp.	—	—	—	—	—	—
Cryptantha sp.	—	—	—	—	—	—
Cyperaceae	0.47	0.28	—	—	—	—
Cyperus sp.seeds	—	—	0.15	—	—	—
Cyperus sp. tubers	—	—	—	—	—	—

TAXA	DENSITY (SEED/L)					
Dantonia sp.	—	0.06	—	—	—	—
Delphinium sp.	—	—	0.15	—	—	—
Descurania sp.	—	—	—	—	—	—
Distichlis sp.	—	0.11	—	—	—	—
Eleocharis sp.	—	0.11	—	—	—	—
Ephedra sp.	—	—	—	—	—	—
Epilobium sp.	—	—	—	—	—	—
Eragrostis sp.	—	0.06	—	—	—	—
Eriogonum sp.	—	—	—	—	—	—
Erodium sp.	—	0.06	—	—	—	—
Euphorbiaceae	—	—	—	—	—	—
Fabaceae	—	0.06	—	0.5	—	—
Galium sp.	—	—	—	—	—	—
Gilia sp.	—	—	—	—	—	—
Helianthus sp.	—	—	—	—	—	—
Hemizonia sp.	—	—	—	—	—	—
Hordeum sp.	—	—	—	—	—	—
Hypericum sp.	—	—	0.15	—	—	—
Juncus sp.	—	0.11	0.31	1.0	—	—
Lagophylla sp.	—	—	—	—	—	—
Lepidium sp.	—	—	—	—	—	—
Lupine sp.	—	—	—	—	—	—
Lycium sp.	—	0.06	—	—	—	—
Madia sp.	—	0.06	—	—	—	—
Malvaceae	—	—	—	0.5	—	—
Malvia sp.	—	—	—	—	—	—
Marah sp.	—	—	—	—	—	—
Mentzelia sp.	—	—	—	—	—	—
Mulenberghia sp.	—	—	—	—	—	—
Myrica sp. cf	—	0.06	—	—	—	—
Nicotiana sp.	—	—	—	—	—	—
Oenothera sp.	—	—	—	—	—	—
Panicum capillare cf.	—	—	—	—	—	—
Panicum sp.	—	0.06	—	—	—	—
Paspalum sp.	—	0.06	—	—	—	—
Phacelia sp.	—	—	—	—	—	—
Phalaris sp.	0.24	0.11	—	—	—	—
Cf. Phragmites sp.	—	—	—	—	—	—
Pinus monophylla nutshell	1.18	7.32	1.08	1.5	—	9.29
Pinus sabiniana nutshell	—	—	—	—	—	—
Pinus sp. nutmeat	—	—	—	—	—	—

TAXA	DENSITY (SEED/L)					
Pinus sp. thin nutshell [Ponderosa, Sugar, Pinyon etc.]	—	—	—	—	—	—
Poaceae	—	—	—	—	—	—
Poaceae (identifiable)	—	0.62	0.15	—	—	—
Polygonum sp.	—	0.56	—	—	—	—
Polygonum/Rumex	0.94	—	—	—	—	—
Populus s*p.*	—	—	—	—	—	—
Potamogeton sp.	—	—	—	—	—	—
Potentilla sp.	—	—	—	—	—	—
Puccinellia sp.	—	—	—	—	—	2.86
Quercus (undifferentiated) nutshell	—	0.39	0.77	—	—	1.43
Ranunculus sp.	—	—	—	—	—	—
Rosa sp.	—	—	0.15	—	—	—
Rubus sp.	—	—	—	—	—	—
Rumex sp.	1.88	0.06	—	—	—	—
Ruppia sp	0.24	—	—	—	—	—
Salvia sp.	—	—	—	—	—	—
Sambucus sp.	—	—	—	—	—	—
Scirpus sp.	4.24	5.8	1.38	0.5	—	7.86
Sesuvium sp.	0.47	0.17	0.15	—	—	—
Solanum sp.	—	0.17	—	—	—	—
Sphaeralcea sp.	—	—	—	0.5	—	—
Sporobolus sp.	—	0.06	—	—	—	—
Sueda sp.	0.94	—	—	—	—	—
Trifolium sp.	—	—	—	—	—	—
Triticum sp.	—	—	—	—	—	—
Typha sp.	—	—	—	—	—	—
Umbellularia californica nutshell	—	—	—	—	—	—
Unidentifiable	0.71	2.76	0.46	—	—	8.57
Unidentified	4.71	2.19	3.85	8.5	2.0	—
unidentified Poaceae caryopsis	—	—	—	—	—	—
Unknown A	—	—	—	—	—	—
Vicia/Lathrys	—	—	—	—	—	—
Viola sp.	—	0.11	—	—	—	—

Table A.21. Marana Period Data from INY-1700 (Loc. 1-3)

BETTINGER 1989					
Site Locus	INY-1700 - Loc. 1		INY-1700 - Loc. 2	INY-1700 - Loc. 3	
Context	Midden 1	Structure 3	Structure 9	Midden 3	Structure 16
Volume (where available)	—	—	—	—	—

TAXA	DENSITY (SEED/L)				
Achnatherum hymenoides	—	+	+	—	—
Achnatherum sp.	—	—	—	—	—
Agrostis sp.	—	—	—	—	—
Amaranthus sp.	—	—	—	—	—
Amelanchier sp.	—	—	—	—	—
Amorphous	—	—	—	—	—
Amsinckia sp.	—	—	—	—	—
Artemisia ludoviciana	—	—	+	—	—
Artemisia sp.	—	—	—	—	—
Artemisia tridentata	—	—	—	—	—
Asteraceae	—	—	—	—	—
Atriplex canescens	—	—	—	—	—
Atriplex sp.	—	—	+	—	—
Boehmeria cf.	—	—	—	—	—
Boraginaceae	—	—	—	—	—
Brassicaceae	—	—	—	—	—
Cactaceae	—	—	—	—	—
Calamagrostis sp.	—	—	—	—	—
Chaenactis sp.	—	—	—	—	—
Chenopodiaceae	—	—	—	—	—
Chenopodium sp.	—	—	—	—	—
Coleogyne ramosissima	+	—	—	—	+
Collomia sp. cf.	—	—	—	—	—
Cryptantha sp.	—	—	—	—	—
Cyperaceae	—	—	—	—	—
Cyperus sp. seeds	—	—	—	—	—
Cyperus sp. tubers	—	—	—	—	—
Deschampsia sp.	—	—	—	—	—
Descurania sp.	—	—	—	—	—
Cf. Desmodium sp.	—	—	—	—	—
Distichlis sp.	—	—	—	—	—
Elymus cinerus	—	—	—	—	—

TAXA	DENSITY (SEED/L)				
Ephedra sp.	—	—	—	—	+
Epilobium sp.	—	—	—	—	—
Eragrostis sp.	—	—	—	—	—
Eremalche sp.	—	—	—	—	—
Eriogonum sp.	—	—	—	—	—
Eriogonum sp.	—	—	—	—	—
Fabaceae	—	—	—	—	—
Forestiera pubescens	—	—	—	—	—
Galium sp.	—	—	—	—	—
Gilia sp.	—	—	—	—	—
Helianthus sp.	—	—	—	—	—
Hordeum sp.	—	—	—	—	—
Juncus sp.	—	—	—	—	—
Laminaceae	—	—	—	—	—
Lonicera sp.	—	—	—	—	—
Lupinus sp.	—	—	—	—	—
Lycium sp.	—	—	—	—	—
Madia sp.	—	—	—	—	—
Malvaceae	—	—	—	—	—
Malvella sp.	—	—	—	—	—
Melica sp.	—	—	—	—	—
Mentzelia sp.	—	+	+	—	+
Mulenberghia sp.	—	—	—	—	—
Nicotiana sp.	—	—	—	—	—
Oenothera sp.	—	—	—	—	—
Panicum sp.	—	—	—	—	—
Paspalum sp.	—	—	—	—	—
Phacelia sp.	—	—	—	—	—
Phalaris sp.	—	—	—	—	—
Phragmites sp.	—	—	—	—	—
Pinus monophylla (undifferentiated)	—	—	—	—	—
Plantago sp.	—	—	—	—	—
Poa sp.	—	—	—	—	—
Poaceae	—	—	—	—	—
Populus sp.	+	—	—	—	—
Potentilla sp.	—	—	—	—	—
Prunus andersonii	—	—	—	+	—
Puccinella sp.	—	—	—	—	—
Purshia tridentata	—	—	—	—	—
Quercus (undifferentiated)	—	—	—	—	—
Ruppia sp.	—	—	—	—	—
Salvia sp.	—	—	—	—	—

TAXA	DENSITY (SEED/L)				
Scirpus sp.	—	—	—	—	—
Sesuvium sp.	—	—	—	—	—
Solanaceae	—	—	—	—	—
Sphaeraclea sp.	—	—	+	—	—
Sporobolus sp.	—	+	—	—	—
Stipa sp.	—	—	+	—	—
Suaeda sp.	—	—	—	—	—
Trifolium sp.	—	—	—	—	—
unidentified tuber	—	—	—	—	—
Typha sp.	—	—	—	—	—
Unidentifiable	—	—	—	—	—
Unidentified seeds	—	—	—	—	—
Unidentified nutshell	—	—	—	—	—
unknown	—	—	—	—	—
Verbena sp.	—	—	—	—	—
Vigueria sp.	—	—	—	—	—
Viola sp.	—	—	—	—	—
Vulpia sp.	—	—	—	—	—

+ denotes presence

Table A.22. Marana Period Data from MNO-891 (Loc. 2)

WICKSTROM AND JACKSON 1993	
Site Locus	MNO-891 - Loc. 2
Context	F1 hearth
Volume (where available)	—

TAXA	DENSITY (SEED/L)
Achnatherum hymenoides	—
Achnatherum sp.	—
Agrostis sp.	—
Amaranthus sp.	—
Amelanchier sp.	—
Amorphous	—
Amsinckia sp.	—
Artemisia ludoviciania	—
Artemisia sp.	—
Artemisia tridentata	—
Asteraceae	—
Atriplex canescens	—
Atriplex sp.	—
Boehmeria cf.	—
Boraginaceae	—
Brassicaceae	0.12
Cactaceae	—
Calamagrostis sp.	—
Chaenactis sp.	—
Chenopodiaceae	—
Chenopodium sp.	1.06
Coleogyne ramosissima	—
Collomia sp. cf.	—
Cryptantha sp.	—
Cyperaceae	—
Cyperus sp. seeds	—
Cyperus sp. tubers	—
Deschampsia sp.	—
Descurania sp.	0.47
Desmodium cf.	—
Distichlis sp.	—
Elymus cinerus	—
Ephedra sp.	—

TAXA	DENSITY (SEED/L)
Epilobium sp.	—
Eragrostis sp.	0.71
Eremalche sp.	—
Eriogonum sp.	—
Eriogonum sp.	—
Fabaceae	—
Forestiera pubescens	—
Galium sp.	—
Gilia sp.	—
Helianthus sp.	—
Hordeum sp.	—
Juncus sp.	—
Laminaceae	—
Lonicera sp.	—
Lupinus sp.	—
Lycium sp.	—
Madia sp.	—
Malvaceae	—
Malvella sp.	—
Melica sp.	—
Mentzelia sp.	—
Mulenberghia sp.	0.12
Nicotiana sp.	0.12
Oenothera sp.	—
Panicum sp.	0.12
Paspalum sp.	—
Phacelia sp.	—
Phalaris sp.	—
Phragmites sp.	—
Pinus monophylla (undifferentiated)	—
Plantago sp.	—
Poa sp.	—
Poaceae	—
Populus sp.	—
Potentilla sp.	—
Prunus andersonii	—
Puccinella sp.	—
Purshia tridentata	—
Quercus (undifferentiated)	—
Ruppia sp.	—
Salvia sp.	—
Scirpus sp.	—

TAXA	DENSITY (SEED/L)
Sesuvium sp.	—
Solanaceae	—
Sphaeraclea sp.	—
Sporobolus sp.	—
Stipa sp.	0.12
Suaeda sp.	—
Trifolium sp.	2.12
unidentified tuber	—
Typha sp.	—
Unidentifiable	—
Unidentified seeds	—
Unidentified nutshell	—
unknown	—
Verbena sp.	—
Vigueria sp.	—
Viola sp.	—
Vulpia sp.	—

Table A.23. Marana Period Data from INY-124

WOHLGEMUTH ND	
Site Locus	INY-124
Context	midden
Volume (where available)	—

TAXA	DENSITY (SEED/L)
Achnatherum hymenoides	—
Achnatherum sp.	—
Agrostis sp.	—
Amaranthus sp.	—
Amelanchier sp.	—
Amorphous	—
Amsinckia sp.	—
Artemisia ludoviciania	—
Artemisia sp.	—
Artemisia tridentata	—
Asteraceae	—
Atriplex canescens	—
Atriplex sp.	—
Boehmeria cf.	—
Boraginaceae	—
Brassicaceae	—
Cactaceae	—
Calamagrostis sp.	—
Chaenactis sp.	—
Chenopodiaceae	1.15
Chenopodium sp.	0.38
Coleogyne ramosissima	—
Collomia sp. cf.	—
Cryptantha sp.	—
Cyperaceae	—
Cyperus sp. seeds	—
Cyperus sp. tubers	—
Deschampsia sp.	—
Descurania sp.	—
Desmodium cf.	—
Distichlis sp.	—
Elymus cinerus	—
Ephedra sp.	—

TAXA	DENSITY (SEED/L)
Epilobium sp.	—
Eragrostis sp.	—
Eremalche sp.	—
Eriogonum sp.	—
Eriogonum sp.	—
Fabaceae	0.39
Forestiera pubescens	—
Galium sp.	—
Gilia sp.	—
Helianthus sp.	—
Hordeum sp.	—
Juncus sp.	—
Laminaceae	—
Lonicera sp.	—
Lupinus sp.	—
Lycium sp.	—
Madia sp.	—
Malvaceae	6.26
Malvella sp.	—
Melica sp.	—
Mentzelia sp.	0.17
Mulenberghia sp.	—
Nicotiana sp.	—
Oenothera sp.	—
Panicum sp.	—
Paspalum sp.	—
Phacelia sp.	—
Phalaris sp.	—
Phragmites sp.	—
Pinus monophylla (undifferentiated)	—
Plantago sp.	—
Poa sp.	—
Poaceae	1.26
Populus sp.	—
Potentilla sp.	—
Prunus andersonii	—
Puccinella sp.	—
Purshia tridentata	—
Quercus (undifferentiated)	—
Ruppia sp.	—
Salvia sp.	—
Scirpus sp.	0.05

TAXA	DENSITY (SEED/L)
Sesuvium sp.	—
Solanaceae	—
Sphaeraclea sp.	—
Sporobolus sp.	—
Stipa sp.	—
Suaeda sp.	—
Trifolium sp.	—
unidentified tuber	—
Typha sp.	—
Unidentifiable	—
Unidentified seeds	—
Unidentified nutshell	—
unknown	—
Verbena sp.	—
Vigueria sp.	—
Viola sp.	—
Vulpia sp.	—

Table A.24. Marana Period Data from INY-4663

GILREATH AND NELSON 1999	
Site Locus	INY-4663
Context	midden
Volume (where available)	—

TAXA	DENSITY (SEED/L)
Achnatherum hymenoides	—
Achnatherum sp.	—
Agrostis sp.	—
Amaranthus sp.	—
Amelanchier sp.	—
Amorphous	—
Amsinckia sp.	—
Artemisia ludoviciania	—
Artemisia sp.	—
Artemisia tridentata	—
Asteraceae	—
Atriplex canescens	—
Atriplex sp.	0.51
Boehmeria cf.	—
Boraginaceae	—
Brassicaceae	—
Cactaceae	—
Calamagrostis sp.	—
Chaenactis sp.	—
Chenopodiaceae	—
Chenopodium sp.	11.64
Coleogyne ramosissima	—
Collomia sp. cf.	—
Cryptantha sp.	—
Cyperaceae	—
Cyperus sp. seeds	—
Cyperus sp. tubers	—
Deschampsia sp.	—
Descurania sp.	—
Desmodium cf.	—
Distichlis sp.	—
Elymus cinerus	—
Ephedra sp.	—

TAXA	DENSITY (SEED/L)
Epilobium sp.	—
Eragrostis sp.	—
Eremalche sp.	—
Eriogonum sp.	—
Eriogonum sp.	—
Fabaceae	—
Forestiera pubescens	—
Galium sp.	—
Gilia sp.	—
Helianthus sp.	—
Hordeum sp.	—
Juncus sp.	—
Laminaceae	—
Lonicera sp.	—
Lupinus sp.	—
Lycium sp.	—
Madia sp.	—
Malvaceae	—
Malvella sp.	—
Melica sp.	—
Mentzelia sp.	—
Mulenberghia sp.	—
Nicotiana sp.	—
Oenothera sp.	—
Panicum sp.	—
Paspalum sp.	—
Phacelia sp.	—
Phalaris sp.	—
Phragmites sp.	—
Pinus monophylla (undifferentiated)	—
Plantago sp.	—
Poa sp.	—
Poaceae	0.87
Populus sp.	—
Potentilla sp.	—
Prunus andersonii	—
Puccinella sp.	—
Purshia tridentata	—
Quercus (undifferentiated)	—
Ruppia sp.	—
Salvia sp.	—
Scirpus sp.	—

TAXA	DENSITY (SEED/L)
Sesuvium sp.	—
Solanaceae	—
Sphaeraclea sp.	—
Sporobolus sp.	—
Stipa sp.	—
Suaeda sp.	—
Trifolium sp.	—
unidentified tuber	—
Typha sp.	—
Unidentifiable	—
Unidentified seeds	—
Unidentified nutshell	—
unknown	—
Verbena sp.	—
Vigueria sp.	—
Viola sp.	—
Vulpia sp.	—

Table A.25. Marana Period Data from INY-5397 (Loc. 1), INY-5763 (Loc. 1), and INY-5764 (Loc. A)

BASGALL AND DELACORTE 2003			
Site Locus	INY-5397 – Loc. 1	INY-5763 – Loc. 1	INY-5764 – Loc. A
Context	midden	F. 2 hearth/refuse	F. 8 hearth
Volume (where available)	—	—	—

TAXA	DENSITY (SEED/L)		
Achnatherum hymenoides	—	—	—
Achnatherum sp.	—	—	—
Agrostis sp.	—	—	—
Amaranthus sp.	—	—	—
Amelanchier sp.	—	—	—
Amorphous	—	—	—
Amsinckia sp.	—	—	—
Artemisia ludoviciania	—	—	—
Artemisia sp.	—	—	—
Artemisia tridentata	—	—	—
Asteraceae	—	—	—
Atriplex canescens	1.0	—	—
Atriplex sp.	—	—	—
Boehmeria cf.	—	—	—
Boraginaceae	—	—	—
Brassicaceae	—	—	—
Cactaceae	—	—	—
Calamagrostis sp.	—	—	—
Chaenactis sp.	—	—	—
Chenopodiaceae	2.5	—	—
Chenopodium sp.	7.0	31.0	0.97
Coleogyne ramosissima	—	—	—
Collomia sp. cf.	—	—	—
Cryptantha sp.	—	—	—
Cyperaceae	—	—	—
Cyperus sp. seeds	—	—	—
Cyperus sp. tubers	—	—	—
Deschampsia sp.	—	—	—
Descurania sp.	—	—	—
Desmodium cf.	—	—	—
Distichlis sp.	—	—	—

TAXA	DENSITY (SEED/L)		
Elymus cinerus	—	—	—
Ephedra sp.	—	—	—
Epilobium sp.	—	—	—
Eragrostis sp.	—	—	—
Eremalche sp.	—	—	—
Eriogonum sp.	—	—	—
Eriogonum sp.	—	—	—
Fabaceae	—	1.3	—
Forestiera pubescens	—	—	—
Galium sp.	—	—	—
Gilia sp.	—	—	—
Helianthus sp.	—	—	—
Hordeum sp.	—	—	—
Juncus sp.	—	—	—
Laminaceae	—	—	—
Lonicera sp.	—	—	—
Lupinus sp.	—	—	—
Lycium sp.	—	—	—
Madia sp.	—	—	—
Malvaceae	—	—	—
Malvella sp.	—	—	—
Melica sp.	—	—	—
Mentzelia sp.	—	—	—
Mulenberghia sp.	—	—	—
Nicotiana sp.	—	—	—
Oenothera sp.	—	—	—
Panicum sp.	—	—	—
Paspalum sp.	—	—	—
Phacelia sp.	—	—	0.48
Phalaris sp.	—	—	—
Phragmites sp.	—	—	—
Pinus monophylla (undifferentiated)	—	4.15	—
Plantago sp.	—	—	—
Poa sp.	—	—	—
Poaceae	2.0	1.0	2.18
Populus sp.	—	—	—
Potentilla sp.	—	—	—
Prunus andersonii	—	—	—
Puccinella sp.	—	—	—
Purshia tridentata	—	—	—
Quercus (undifferentiated)	—	0.9	—
Ruppia sp.	—	—	—

TAXA	DENSITY (SEED/L)		
Salvia sp.	—	—	—
Scirpus sp.	—	—	0.48
Sesuvium sp.	—	—	—
Solanaceae	—	—	—
Sphaeraclea sp.	—	—	—
Sporobolus sp.	—	—	—
Stipa sp.	—	—	—
Suaeda sp.	1.0	—	—
Trifolium sp.	—	—	—
unidentified tuber	—	—	—
Typha sp.	—	—	—
Unidentifiable	—	—	—
Unidentified seeds	—	—	—
Unidentified nutshell	—	—	—
unknown	—	—	—
Verbena sp.	—	—	—
Vigueria sp.	—	—	—
Viola sp.	—	—	—
Vulpia sp.	—	—	—

Table A.26. Marana Period Data from INY-328 (Loc. B)

DELACORTE ET AL. 1995	
Site Locus	INY-328 - Loc. B
Context	F. 1 hearth
Volume (where available)	—

TAXA	DENSITY (SEED/L)
Achnatherum hymenoides	—
Achnatherum sp.	—
Agrostis sp.	—
Amaranthus sp.	—
Amelanchier sp.	—
Amorphous	—
Amsinckia sp.	—
Artemisia ludoviciania	—
Artemisia sp.	—
Artemisia tridentata	—
Asteraceae	—
Atriplex canescens	—
Atriplex sp.	—
Boehmeria cf.	—
Boraginaceae	—
Brassicaceae	—
Cactaceae	—
Calamagrostis sp.	—
Chaenactis sp.	—
Chenopodiaceae	—
Chenopodium sp.	2.0
Coleogyne ramosissima	—
Collomia sp. cf.	—
Cryptantha sp.	—
Cyperaceae	—
Cyperus sp. seeds	—
Cyperus sp. tubers	—
Deschampsia sp.	—
Descurania sp.	—
Desmodium cf.	—
Distichlis sp.	—
Elymus cinerus	—
Ephedra sp.	—

TAXA	DENSITY (SEED/L)
Epilobium sp.	—
Eragrostis sp.	—
Eremalche sp.	—
Eriogonum sp.	—
Eriogonum sp.	—
Fabaceae	—
Forestiera pubescens	—
Galium sp.	—
Gilia sp.	—
Helianthus sp.	—
Hordeum sp.	—
Juncus sp.	—
Laminaceae	—
Lonicera sp.	—
Lupinus sp.	—
Lycium sp.	—
Madia sp.	—
Malvaceae	—
Malvella sp.	—
Melica sp.	—
Mentzelia sp.	—
Mulenberghia sp.	—
Nicotiana sp.	—
Oenothera sp.	—
Panicum sp.	—
Paspalum sp.	—
Phacelia sp.	—
Phalaris sp.	—
Phragmites sp.	—
Pinus monophylla (undifferentiated)	—
Plantago sp.	—
Poa sp.	—
Poaceae	—
Populus sp.	—
Potentilla sp.	—
Prunus andersonii	—
Puccinella sp.	—
Purshia tridentata	—
Quercus (undifferentiated)	—
Ruppia sp.	—
Salvia sp.	—
Scirpus sp.	—

TAXA	DENSITY (SEED/L)
Sesuvium sp.	—
Solanaceae	—
Sphaeraclea sp.	—
Sporobolus sp.	—
Stipa sp.	—
Suaeda sp.	—
Trifolium sp.	—
unidentified tuber	—
Typha sp.	—
Unidentifiable	—
Unidentified seeds	—
Unidentified nutshell	—
unknown	—
Verbena sp.	—
Vigueria sp.	—
Viola sp.	—
Vulpia sp.	—

Table A.27. Marana Period Data from INY-2750 (Loc. A), INY-3769 (Loc. 13), INY-3769 (Loc. 24), and INY-3778 (Loc. B)

DELACORTE 1999						
Site Locus	INY-2750 - Loc. A	INY-3769 – Loc. 13		INY-3769 - Loc. 24	INY-3778 – Loc. B	
Context	F. 5 hearth/ shell	hearth	house	F. 1 shell feature /hearth	F. 5/5A hearth	F. 5/5A hearth
Volume (where available)	—	—	—	—	—	—

TAXA	DENSITY (SEED/L)					
Achnatherum hymenoides	—	—	—	—	—	—
Achnatherum sp.	—	—	—	—	—	—
Agrostis sp.	—	—	—	—	—	—
Amaranthus sp.	—	—	—	—	—	—
Amelanchier sp.	—	—	—	—	—	—
Amorphous	—	—	—	—	—	—
Amsinckia sp.	—	—	—	—	—	—
Artemisia ludoviciania	—	—	—	—	—	—
Artemisia sp.	—	—	—	—	—	—
Artemisia tridentata	—	—	—	—	—	—
Asteraceae	—	—	0.04	0.47	—	—
Atriplex canescens	—	—	—	—	—	—
Atriplex sp.	0.18	0.13	0.16	0.23	—	349.71
Boehmeria cf.	—	—	—	—	—	—
Boraginaceae	—	—	—	—	—	—
Brassicaceae	—	—	—	—	—	—
Cactaceae	—	—	—	—	—	—
Calamagrostis sp.	—	—	—	—	—	—
Chaenactis sp.	—	—	—	—	—	—
Chenopodiaceae	23.15	—	0.24	—	—	145.8
Chenopodium sp.	—	10.5	0.16	—	—	20.46
Coleogyne ramosissima	—	—	—	—	—	—
Collomia sp. cf.	—	—	—	—	—	—
Cryptantha sp.	—	—	12.0	—	—	—
Cyperaceae	—	—	—	—	—	—
Cyperus sp. seeds	—	—	—	—	—	—
Cyperus sp. tubers	—	—	—	—	—	—

TAXA	DENSITY (SEED/L)					
Deschampsia sp.	—	—	—	—	—	—
Descurania sp.	—	—	0.04	—	—	—
Desmodium cf.	—	—	—	—	—	—
Distichlis sp.	—	—	—	—	—	—
Elymus cinerus	—	—	—	—	—	—
Ephedra sp.	—	—	—	—	—	—
Epilobium sp.	—	—	—	—	—	—
Eragrostis sp.	—	—	—	—	—	—
Eremalche sp.	—	—	—	—	—	—
Eriogonum sp.	—	—	—	—	—	—
Eriogonum sp.	—	—	—	—	—	—
Fabaceae	—	—	—	—	0.06	—
Forestiera pubescens	—	—	—	—	—	—
Galium sp.	—	—	—	—	—	—
Gilia sp.	—	—	—	—	—	—
Helianthus sp.	—	—	—	—	—	0.17
Hordeum sp.	—	—	—	—	—	—
Juncus sp.	—	0.5	0.04	0.23	—	—
Laminaceae	—	—	—	—	—	—
Lonicera sp.	—	—	—	—	—	—
Lupinus sp.	—	—	—	—	—	—
Lycium sp.	—	0.13	0.04	—	—	0.34
Madia sp.	—	—	—	—	—	—
Malvaceae	—	0.13	0.04	—	—	—
Malvella sp.	—	—	—	—	—	—
Melica sp.	—	—	—	—	—	—
Mentzelia sp.	0.09	0.88	0.04	—	—	0.06
Mulenberghia sp.	—	—	—	—	—	—
Nicotiana sp.	—	—	—	—	—	—
Oenothera sp.	—	—	—	—	—	—
Panicum sp.	—	—	—	—	—	—
Paspalum sp.	—	—	—	—	—	—
Phacelia sp.	—	—	—	—	—	—
Phalaris sp.	—	—	—	—	—	—
Phragmites sp.	—	—	—	—	—	—
Pinus monophylla (undifferentiated)	0.09	0.25	0.44	—	—	3.56
Plantago sp.	—	—	—	—	—	—
Poa sp.	—	—	—	—	—	—
Poaceae	—	1.88	0.08	0.23	23.0	—
Populus sp.	—	—	—	—	—	—
Potentilla sp.	—	—	—	—	—	—
Prunus andersonii	—	—	—	—	—	—

TAXA	DENSITY (SEED/L)					
Puccinella sp.	—	—	—	—	—	—
Purshia tridentata	—	—	—	—	—	—
Quercus (undifferentiated)	—	—	—	—	—	—
Ruppia sp.	—	—	—	—	—	—
Salvia sp.	—	—	0.12	2.09	—	0.23
Scirpus sp.	0.27	0.25	—	—	—	2.01
Sesuvium sp.	—	—	—	—	—	—
Solanaceae	—	—	—	—	—	—
Sphaeraclea sp.	—	—	—	—	—	—
Sporobolus sp.	—	0.5	—	—	—	—
Stipa sp.	—	—	—	—	—	—
Suaeda sp.	—	—	—	—	—	—
Trifolium sp.	—	—	—	—	—	—
unidentified tuber	—	—	—	—	—	—
Typha sp.	54.95	245.0	870.16	—	—	78.16
Unidentifiable	—	—	—	—	—	—
Unidentified seeds	—	—	—	—	—	—
Unidentified nutshell	—	—	—	—	—	—
unknown	—	—	—	—	—	—
Verbena sp.	—	—	—	—	—	—
Vigueria sp.	—	—	—	—	—	—
Viola sp.	—	—	—	—	—	—
Vulpia sp.	—	—	—	—	—	—

Table A.28. Marana Period Data from INY-30 (Structures 1, 10, 13, and 5)

BASGALL MCGUIRE 1988				
Site Locus	INY-30			
Context	Structure 1	Structure 10	Structure 13	Structure 5
Volume (where available)	—	—	—	—

TAXA	DENSITY (SEED/L)			
Achnatherum hymenoides	—	—	—	0.5
Achnatherum sp.	—	—	—	—
Agrostis sp.	—	—	0.14	—
Amaranthus sp.	—	—	1.0	0.5
Amelanchier sp.	—	—	—	—
Amorphous	—	—	—	—
Amsinckia sp.	—	—	—	—
Artemisia ludoviciania	—	—	—	—
Artemisia sp.	—	—	—	—
Artemisia tridentata	—	0.36	0.14	—
Asteraceae	—	0.24	—	0.75
Atriplex canescens	—	—	—	—
Atriplex sp.	—	0.3	0.14	—
Boehmeria cf.	—	—	—	—
Boraginaceae	—	—	—	—
Brassicaceae	—	—	—	—
Cactaceae	—	—	—	—
Calamagrostis sp.	—	—	—	—
Chaenactis sp.	—	—	—	—
Chenopodiaceae	—	1.26	0.43	4.0
Chenopodium sp.	—	0.54	—	—
Coleogyne ramosissima	—	—	—	—
Collomia sp. cf.	—	—	—	—
Cryptantha sp.	—	0.18	—	—
Cyperaceae	—	—	—	—
Cyperus sp. seeds	—	—	—	—
Cyperus sp. tubers	—	—	—	—
Deschampsia sp.	—	—	—	—
Descurania sp.	—	161.32	—	—
Desmodium cf.	—	—	—	—
Distichlis sp.	—	—	—	—
Elymus cinerus	—	—	—	—
Ephedra sp.	—	—	—	—

TAXA	DENSITY (SEED/L)			
Epilobium sp.	—	—	—	—
Eragrostis sp.	—	—	—	—
Eremalche sp.	—	—	—	—
Eriogonum sp.	—	—	—	—
Eriogonum sp.	—	—	—	—
Fabaceae	—	—	0.29	4.5
Forestiera pubescens	—	—	—	—
Galium sp.	—	—	—	—
Gilia sp.	—	—	—	—
Helianthus sp.	0.1	—	—	4.0
Hordeum sp.	—	—	0.58	—
Juncus sp.	—	0.72	25.22	2.8
Laminaceae	—	0.12	—	0.25
Lonicera sp.	—	—	—	—
Lupinus sp.	—	—	—	—
Lycium sp.	—	—	—	—
Madia sp.	—	—	—	—
Malvaceae	—	0.06	—	—
Malvella sp.	—	—	—	—
Melica sp.	—	—	—	—
Mentzelia sp.	0.4	1.68	—	—
Mulenberghia sp.	—	—	—	0.75
Nicotiana sp.	—	—	—	—
Oenothera sp.	—	—	—	—
Panicum sp.	—	—	—	—
Paspalum sp.	—	—	—	—
Phacelia sp.	—	—	—	—
Phalaris sp.	—	0.12	—	—
Phragmites sp.	—	—	—	—
Pinus monophylla (undifferentiated)	—	—	—	4.5
Plantago sp.	—	—	—	—
Poa sp.	—	—	0.87	—
Poaceae	0.4	1.02	3.19	0.75
Populus sp.	—	—	—	—
Potentilla sp.	—	—	—	—
Prunus andersonii	—	—	—	—
Puccinella sp.	—	—	—	—
Purshia tridentata	—	—	—	—
Quercus (undifferentiated)	—	—	—	—
Ruppia sp.	49.5	4.37	0.14	—
Salvia sp.	—	—	—	—
Scirpus sp.	60.9	—	0.73	1.3

TAXA	DENSITY (SEED/L)			
Sesuvium sp.	—	—	—	—
Solanaceae	—	—	—	—
Sphaeraclea sp.	—	0.06	—	—
Sporobolus sp.	—	—	—	—
Stipa sp.	—	—	—	—
Suaeda sp.	—	—	—	—
Trifolium sp.	—	—	—	—
unidentified tuber	—	—	—	—
Typha sp.	—	3.05	1.3	4.8
Unidentifiable	—	—	—	—
Unidentified seeds	—	—	—	—
Unidentified nutshell	—	—	—	—
unknown	—	—	—	—
Verbena sp.	—	—	—	—
Vigueria sp.	—	—	—	0.5
Viola sp.	—	—	—	—
Vulpia sp.	—	—	—	—

Table A.29. Marana Period Data from INY-30 (Structures 6-9)

BASGALL MCGUIRE 1988				
Site Locus	INY-30			
Context	Structure 6	Structure 7	Structure 8	Structure 9
Volume (where available)	—	—	—	—

TAXA	DENSITY (SEED/L)			
Achnatherum hymenoides	—	—	—	—
Achnatherum sp.	—	—	—	—
Agrostis sp.	—	—	—	—
Amaranthus sp.	—	—	—	—
Amelanchier sp.	—	—	—	—
Amorphous	—	—	—	—
Amsinckia sp.	—	—	0.08	0.39
Artemisia ludoviciania	—	—	—	—
Artemisia sp.	—	—	—	—
Artemisia tridentata	0.43	—	1.17	—
Asteraceae	—	—	—	—
Atriplex canescens	—	—	—	—
Atriplex sp.	—	4.3	—	—
Boehmeria cf.	—	—	—	—
Boraginaceae	—	—	—	—
Brassicaceae	—	—	—	—
Cactaceae	—	—	—	—
Calamagrostis sp.	—	—	—	—
Chaenactis sp.	—	—	—	—
Chenopodiaceae	4.14	—	0.75	0.31
Chenopodium sp.	0.86	—	—	—
Coleogyne ramosissima	—	—	—	—
Collomia sp. cf.	—	—	—	—
Cryptantha sp.	—	—	0.08	—
Cyperaceae	—	—	—	—
Cyperus sp. seeds	—	—	—	—
Cyperus sp. tubers	—	—	—	—
Deschampsia sp.	—	—	—	—
Descurania sp.	—	—	—	—
Desmodium cf.	—	—	—	—
Distichlis sp.	—	—	—	—
Elymus cinerus	—	—	—	0.08
Ephedra sp.	—	—	—	—

TAXA	DENSITY (SEED/L)			
Epilobium sp.	—	—	—	—
Eragrostis sp.	—	—	—	—
Eremalche sp.	—	—	—	0.08
Eriogonum sp.	—	—	—	—
Eriogonum sp.	—	—	—	—
Fabaceae	0.43	—	—	0.08
Forestiera pubescens	—	—	—	—
Galium sp.	—	—	—	—
Gilia sp.	—	—	—	—
Helianthus sp.	—	—	0.08	0.08
Hordeum sp.	—	—	—	—
Juncus sp.	3.86	—	0.08	0.08
Laminaceae	—	—	—	0.16
Lonicera sp.	—	—	—	—
Lupinus sp.	—	—	—	—
Lycium sp.	—	—	0.33	0.47
Madia sp.	—	—	—	—
Malvaceae	—	—	0.25	—
Malvella sp.	—	—	—	—
Melica sp.	—	—	—	—
Mentzelia sp.	—	4.0	0.08	0.31
Mulenberghia sp.	—	—	—	—
Nicotiana sp.	—	—	—	—
Oenothera sp.	—	—	—	—
Panicum sp.	—	—	—	—
Paspalum sp.	—	—	—	—
Phacelia sp.	—	—	—	—
Phalaris sp.	—	—	—	—
Phragmites sp.	—	—	—	—
Pinus monophylla (undifferentiated)	7.86	1.17	2.0	5.7
Plantago sp.	—	—	—	—
Poa sp.	—	—	—	—
Poaceae	1.29	0.83	0.08	—
Populus sp.	—	—	—	—
Potentilla sp.	—	—	0.08	—
Prunus andersonii	—	—	—	—
Puccinella sp.	—	—	—	—
Purshia tridentata	0.14	—	—	—
Quercus (undifferentiated)	—	—	—	—
Ruppia sp.	—	0.17	—	—
Salvia sp.	—	—	—	0.08
Scirpus sp.	0.43	—	0.08	—

TAXA	DENSITY (SEED/L)			
Sesuvium sp.	—	—	—	—
Solanaceae	—	—	—	—
Sphaeraclea sp.	—	—	—	—
Sporobolus sp.	0.29	—	—	—
Stipa sp.	—	—	—	0.18
Suaeda sp.	—	—	—	—
Trifolium sp.	—	—	—	—
unidentified tuber	—	—	0.17	0.39
Typha sp.	—	7.0	—	—
Unidentifiable	—	—	—	—
Unidentified seeds	—	—	—	—
Unidentified nutshell	—	—	—	—
unknown	—	—	—	—
Verbena sp.	—	—	—	—
Vigueria sp.	—	—	—	—
Viola sp.	—	—	—	—
Vulpia sp.	—	—	—	—

Table A.30. Marana Period Data from INY-1430 (Loc. 2 and 4)

GILREATH 1995				
Site Locus	INY-1430 - Loc. 2	INY-1430 - Loc. 4		
Context	F. 1 hearth	F. 6 hearth	F. 7 hearth	F. 8 hearth
Volume (where available)	—	—	—	—

TAXA	DENSITY (SEED/L)			
Achnatherum hymenoides	—	—	+	—
Achnatherum sp.	—	—	—	—
Agrostis sp.	—	—	—	—
Amaranthus sp.	—	—	—	—
Amelanchier sp.	—	—	—	—
Amorphous	—	—	—	—
Amsinckia sp.	—	+	—	—
Artemisia ludoviciania	—	—	—	—
Artemisia sp.	—	—	—	—
Artemisia tridentata	—	—	—	—
Asteraceae	+	—	—	—
Atriplex canescens	—	—	—	—
Atriplex sp.	—	—	—	—
Boehmeria cf.	—	—	—	—
Boraginaceae	—	—	—	—
Brassicaceae	—	—	—	—
Cactaceae	—	—	—	—
Calamagrostis sp.	—	—	—	—
Chaenactis sp.	—	—	—	—
Chenopodiaceae	+	—	—	—
Chenopodium sp.	+	—	—	+
Coleogyne ramosissima	—	—	—	—
Collomia sp. cf.	—	—	—	—
Cryptantha sp.	—	—	—	—
Cyperaceae	—	—	—	—
Cyperus sp. seeds	—	—	—	—
Cyperus sp. tubers	—	—	—	—
Deschampsia sp.	—	—	—	—
Descurania sp.	—	—	—	—
Desmodium cf.	—	—	—	—
Distichlis sp.	—	—	—	—
Elymus cinerus	—	—	—	—
Ephedra sp.	—	—	—	—

TAXA	DENSITY (SEED/L)			
Epilobium sp.	—	—	—	—
Eragrostis sp.	—	—	—	—
Eremalche sp.	—	—	—	—
Eriogonum sp.	—	—	—	—
Eriogonum sp.	—	—	—	—
Fabaceae	—	—	—	—
Forestiera pubescens	—	—	—	—
Galium sp.	—	—	—	—
Gilia sp.	—	—	—	—
Helianthus sp.	—	—	—	—
Hordeum sp.	—	—	—	—
Juncus sp.	—	—	—	—
Laminaceae	—	—	—	—
Lonicera sp.	—	—	—	—
Lupinus sp.	—	—	—	—
Lycium sp.	—	—	—	—
Madia sp.	—	—	—	—
Malvaceae	—	—	—	—
Malvella sp.	—	—	—	—
Melica sp.	—	—	—	—
Mentzelia sp.	—	+	+	—
Mulenberghia sp.	—	—	—	—
Nicotiana sp.	—	—	—	—
Oenothera sp.	—	—	—	—
Panicum sp.	—	—	—	—
Paspalum sp.	—	—	—	—
Phacelia sp.	—	—	—	—
Phalaris sp.	—	—	—	—
Phragmites sp.	—	—	—	—
Pinus monophylla (undifferentiated)	—	—	—	—
Plantago sp.	—	—	—	—
Poa sp.	—	—	—	—
Poaceae	—	—	—	—
Populus sp.	—	—	—	—
Potentilla sp.	—	—	—	—
Prunus andersonii	—	—	—	—
Puccinella sp.	—	—	—	—
Purshia tridentata	—	—	—	—
Quercus (undifferentiated)	—	—	—	—
Ruppia sp.	—	—	—	—
Salvia sp.	—	—	—	—
Scirpus sp.	—	—	—	—

TAXA	DENSITY (SEED/L)			
Sesuvium sp.	—	—	—	—
Solanaceae	—	—	—	—
Sphaeraclea sp.	—	—	—	—
Sporobolus sp.	—	—	—	—
Stipa sp.	—	—	—	—
Suaeda sp.	—	—	—	—
Trifolium sp.	—	—	—	—
unidentified tuber	—	—	—	—
Typha sp.	—	—	—	—
Unidentifiable	—	—	—	—
Unidentified seeds	—	—	—	—
Unidentified nutshell	—	—	—	—
unknown	—	—	—	—
Verbena sp.	—	—	—	—
Vigueria sp.	—	—	—	—
Viola sp.	—	—	—	—
Vulpia sp.	—	—	—	—

Table A.31. Marana Period Data from INY-1434 (Loc. 1 and 2), INY-1444 (Loc. 1), INY-1447, and INY-1452

GILREATH 1995					
Site Locus	INY-1434 Loc. 1	INY-1434 Loc. 2	INY-1444 Loc. 1	INY-1447	INY-1452
Context	F. 1 hearth	F. 2 hearth	F. 2	F. 1 hearth & zone around F. 1	midden 20-30cm
Volume (where available)	—	—	—	—	—

TAXA	DENSITY (SEED/L)				
Achnatherum hymenoides	—	—	—	—	—
Achnatherum sp.	—	—	—	—	—
Agrostis sp.	—	—	—	—	—
Amaranthus sp.	—	—	—	—	—
Amelanchier sp.	—	—	—	—	—
Amorphous	—	—	—	—	—
Amsinckia sp.	—	—	—	—	—
Artemisia ludoviciania	—	—	—	—	—
Artemisia sp.	—	—	—	—	—
Artemisia tridentata	—	—	—	—	—
Asteraceae	—	—	—	—	—
Atriplex canescens	—	—	—	—	—
Atriplex sp.	—	—	—	—	—
Boehmeria cf.	—	—	—	—	—
Boraginaceae	—	—	—	—	—
Brassicaceae	—	—	—	—	—
Cactaceae	—	—	—	—	—
Calamagrostis sp.	—	—	—	—	—
Chaenactis sp.	—	—	—	—	—
Chenopodiaceae	—	+	—	—	—
Chenopodium sp.	—	—	—	—	—
Coleogyne ramosissima	—	—	—	—	—
Collomia sp. cf.	—	—	—	—	—
Cryptantha sp.	—	—	—	—	—
Cyperaceae	—	—	—	—	—
Cyperus sp. seeds	—	—	—	—	—
Cyperus sp. tubers	—	—	—	—	—
Deschampsia sp.	—	—	—	—	—

TAXA	DENSITY (SEED/L)				
Descurania sp.	—	—	—	—	—
Desmodium cf.	—	—	—	—	—
Distichlis sp.	—	—	—	—	—
Elymus cinerus	—	—	—	—	—
Ephedra sp.	—	—	—	—	—
Epilobium sp.	—	—	—	—	—
Eragrostis sp.	—	—	—	—	—
Eremalche sp.	—	—	—	—	—
Eriogonum sp.	—	—	—	—	—
Eriogonum sp.	—	—	—	—	—
Fabaceae	—	—	—	—	—
Forestiera pubescens	—	—	—	—	—
Galium sp.	—	—	—	—	—
Gilia sp.	—	—	—	—	—
Helianthus sp.	—	—	—	—	—
Hordeum sp.	—	—	—	—	—
Juncus sp.	—	—	—	—	—
Laminaceae	—	—	—	—	—
Lonicera sp.	—	—	—	—	—
Lupinus sp.	—	—	—	—	—
Lycium sp.	—	—	—	+	+
Madia sp.	—	—	—	—	—
Malvaceae	—	—	—	—	—
Malvella sp.	—	—	—	—	—
Melica sp.	—	—	—	—	—
Mentzelia sp.	—	+	—	+	+
Mulenberghia sp.	—	—	—	—	—
Nicotiana sp.	—	—	—	—	—
Oenothera sp.	—	—	—	—	—
Panicum sp.	—	—	—	—	—
Paspalum sp.	—	—	—	—	—
Phacelia sp.	—	—	—	—	—
Phalaris sp.	—	—	—	—	—
Phragmites sp.	—	—	—	—	—
Pinus monophylla (undifferentiated)	+	—	—	+	—
Plantago sp.	—	—	—	—	—
Poa sp.	—	—	—	—	—
Poaceae	—	—	—	—	—
Populus sp.	—	—	—	—	—
Potentilla sp.	—	—	—	—	—
Prunus andersonii	—	—	—	—	—
Puccinella sp.	—	—	—	—	—

TAXA	DENSITY (SEED/L)				
Purshia tridentata	—	—	—	—	—
Quercus (undifferentiated)	—	—	—	—	+
Ruppia sp.	—	—	—	—	—
Salvia sp.	—	—	—	+	—
Scirpus sp.	—	—	—	—	—
Sesuvium sp.	—	—	—	—	—
Solanaceae	—	—	—	—	—
Sphaeraclea sp.	—	—	—	—	—
Sporobolus sp.	—	—	—	—	—
Stipa sp.	—	—	—	—	—
Suaeda sp.	—	—	—	—	—
Trifolium sp.	—	—	—	—	—
unidentified tuber	—	—	+	—	—
Typha sp.	—	—	—	—	—
Unidentifiable	—	—	—	—	—
Unidentified seeds	—	—	—	—	—
Unidentified nutshell	—	—	—	—	—
unknown	—	—	—	—	—
Verbena sp.	—	—	—	—	—
Vigueria sp.	—	—	—	—	—
Viola sp.	—	—	—	—	—
Vulpia sp.	—	—	—	—	—

Table A.32. Marana Period Data from INY-1816 (Loc. 2), INY-1906 (Loc. 3), and INY-4329 (Loc. 2)

GILREATH AND HILDEBRANDT 1995			
Site Locus	INY-1816 – Loc. 2	INY-1906 – Loc. 3	INY-4329 – Loc. 2
Context	F. 2 hearth	F. 11 milling cluster	F. 19 hearth
Volume (where available)	—	—	—

TAXA	DENSITY (SEED/L)		
Achnatherum hymenoides	3.14	—	—
Achnatherum sp.	—	—	—
Agrostis sp.	—	—	—
Amaranthus sp.	—	—	—
Amelanchier sp.	—	—	—
Amorphous	—	—	—
Amsinckia sp.	—	—	—
Artemisia ludoviciania	—	—	—
Artemisia sp.	—	—	—
Artemisia tridentata	—	—	—
Asteraceae	—	—	—
Atriplex canescens	—	—	—
Atriplex sp.	—	—	—
Boehmeria cf.	—	—	—
Boraginaceae	—	2.25	0.22
Brassicaceae	—	—	—
Cactaceae	—	—	—
Calamagrostis sp.	—	—	—
Chaenactis sp.	—	—	—
Chenopodiaceae	—	—	—
Chenopodium sp.	—	—	—
Coleogyne ramosissima	—	—	—
Collomia sp. cf.	—	—	—
Cryptantha sp.	—	—	—
Cyperaceae	—	—	—
Cyperus sp. seeds	—	—	—
Cyperus sp. tubers	—	—	—
Deschampsia sp.	—	—	—
Descurania sp.	—	2.5	—
Desmodium cf.	—	—	—
Distichlis sp.	—	—	—

TAXA	DENSITY (SEED/L)		
Elymus cinerus	—	—	—
Ephedra sp.	—	—	—
Epilobium sp.	—	—	—
Eragrostis sp.	—	—	—
Eremalche sp.	—	—	—
Eriogonum sp.	—	—	—
Eriogonum sp.	—	—	—
Fabaceae	—	—	—
Forestiera pubescens	—	—	—
Galium sp.	—	—	—
Gilia sp.	—	—	—
Helianthus sp.	—	—	—
Hordeum sp.	—	—	—
Juncus sp.	—	—	—
Laminaceae	—	—	—
Lonicera sp.	—	—	—
Lupinus sp.	—	—	—
Lycium sp.	0.86	—	—
Madia sp.	—	—	—
Malvaceae	0.43	—	—
Malvella sp.	—	—	—
Melica sp.	—	—	—
Mentzelia sp.	0.29	20.0	—
Mulenberghia sp.	—	—	—
Nicotiana sp.	—	—	—
Oenothera sp.	—	—	—
Panicum sp.	—	—	—
Paspalum sp.	—	—	—
Phacelia sp.	—	—	—
Phalaris sp.	—	—	—
Phragmites sp.	—	—	—
Pinus monophylla (undifferentiated)	—	—	—
Plantago sp.	—	—	—
Poa sp.	—	—	—
Poaceae	0.29	—	—
Populus sp.	—	—	—
Potentilla sp.	—	—	—
Prunus andersonii	—	—	—
Puccinella sp.	—	—	—
Purshia tridentata	—	—	—
Quercus (undifferentiated)	—	—	—
Ruppia sp.	—	—	—

TAXA	DENSITY (SEED/L)		
Salvia sp.	0.43	—	—
Scirpus sp.	—	—	—
Sesuvium sp.	—	—	—
Solanaceae	—	—	—
Sphaeraclea sp.	—	—	—
Sporobolus sp.	—	—	—
Stipa sp.	—	—	—
Suaeda sp.	—	—	—
Trifolium sp.	—	—	—
unidentified tuber	—	—	—
Typha sp.	—	—	—
Unidentifiable	—	—	—
Unidentified seeds	—	—	—
Unidentified nutshell	—	—	—
unknown	—	—	—
Verbena sp.	—	—	—
Vigueria sp.	—	—	—
Viola sp.	—	—	—
Vulpia sp.	—	—	—

Table A.33. Marana Period Data from INY-1969 (Loc. 1)

MCGUIRE AND GILREATH 1998	
Site Locus	INY-1969 - Loc. 1
Context	F. 1
Volume (where available)	—

TAXA	DENSITY (SEED/L)
Achnatherum hymenoides	—
Achnatherum sp.	—
Agrostis sp.	—
Amaranthus sp.	—
Amelanchier sp.	—
Amorphous	—
Amsinckia sp.	0.08
Artemisia ludoviciania	—
Artemisia sp.	—
Artemisia tridentata	—
Asteraceae	0.23
Atriplex canescens	—
Atriplex sp.	—
Boehmeria cf.	—
Boraginaceae	—
Brassicaceae	—
Cactaceae	—
Calamagrostis sp.	—
Chaenactis sp.	0.92
Chenopodiaceae	—
Chenopodium sp.	—
Coleogyne ramosissima	—
Collomia sp. cf.	—
Cryptantha sp.	—
Cyperaceae	—
Cyperus sp. seeds	—
Cyperus sp. tubers	—
Deschampsia sp.	—
Descurania sp.	—
Desmodium cf.	—
Distichlis sp.	—
Elymus cinerus	—
Ephedra sp.	—

TAXA	DENSITY (SEED/L)
Epilobium sp.	—
Eragrostis sp.	—
Eremalche sp.	—
Eriogonum sp.	—
Eriogonum sp.	—
Fabaceae	0.31
Forestiera pubescens	—
Galium sp.	—
Gilia sp.	—
Helianthus sp.	—
Hordeum sp.	—
Juncus sp.	5.76
Laminaceae	—
Lonicera sp.	—
Lupinus sp.	—
Lycium sp.	—
Madia sp.	—
Malvaceae	—
Malvella sp.	—
Melica sp.	—
Mentzelia sp.	0.23
Mulenberghia sp.	—
Nicotiana sp.	—
Oenothera sp.	—
Panicum sp.	—
Paspalum sp.	—
Phacelia sp.	—
Phalaris sp.	—
Phragmites sp.	—
Pinus monophylla (undifferentiated)	—
Plantago sp.	—
Poa sp.	—
Poaceae	—
Populus sp.	—
Potentilla sp.	—
Prunus andersonii	—
Puccinella sp.	—
Purshia tridentata	—
Quercus (undifferentiated)	—
Ruppia sp.	—
Salvia sp.	0.62
Scirpus sp.	—

TAXA	DENSITY (SEED/L)
Sesuvium sp.	—
Solanaceae	—
Sphaeraclea sp.	—
Sporobolus sp.	—
Stipa sp.	—
Suaeda sp.	—
Trifolium sp.	—
unidentified tuber	—
Typha sp.	0.31
Unidentifiable	—
Unidentified seeds	—
Unidentified nutshell	—
unknown	—
Verbena sp.	—
Vigueria sp.	—
Viola sp.	—
Vulpia sp.	—

Table A.34. Marana Period Data from INY-5276, INY-5273/H, INY-5281, and INY-5877

ZEANAH AND LEIGH 2002 (PIERCE 2002)				
Site Locus	INY-5276	INY-5273/H	INY-5281	INY-5877
Context	F3	LF/F1	F1	F1
Volume (where available)	1.5L - 16 ID seeds/L	0.8L - 198.8 ID seeds/L	13L - 3.8 ID seeds/L	13L - 36.3 ID seeds/L

TAXA	DENSITY (SEED/L)			
Achnatherum hymenoides	—	—	—	—
Achnatherum sp.	—	—	—	—
Agrostis sp.	—	—	—	—
Amaranthus sp.	—	—	—	—
Amelanchier sp.	—	—	—	—
Amorphous	—	—	—	—
Amsinckia sp.	—	—	—	—
Artemisia ludoviciania	—	—	1.54	—
Artemisia sp.	—	—	—	—
Artemisia tridentata	—	—	—	6.46
Asteraceae	—	2.5	—	0.31
Atriplex canescens	—	—	—	—
Atriplex sp.	—	—	—	—
Boehmeria cf.	—	—	—	—
Boraginaceae	—	—	—	—
Brassicaceae	—	—	—	—
Cactaceae	—	—	—	—
Calamagrostis sp.	—	—	—	—
Chaenactis sp.	—	—	—	—
Chenopodiaceae	—	—	—	—
Chenopodium sp.	6.67	—	—	3.08
Coleogyne ramosissima	—	—	—	—
Collomia sp. cf.	—	—	—	—
Cryptantha sp.	—	—	0.31	—
Cyperaceae	—	—	—	—
Cyperus sp. seeds	—	—	—	—
Cyperus sp. tubers	—	—	—	—
Deschampsia sp.	—	—	—	—
Descurania sp.	6.67	—	—	1.54
Desmodium cf.	—	—	—	—

TAXA	DENSITY (SEED/L)			
Distichlis sp.	—	—	—	—
Elymus cinerus	—	—	—	—
Ephedra sp.	—	—	—	—
Epilobium sp.	—	—	—	—
Eragrostis sp.	—	—	—	—
Eremalche sp.	—	—	—	—
Eriogonum sp.	—	—	—	—
Eriogonum sp.	—	—	—	—
Fabaceae	2.67	—	0.31	—
Forestiera pubescens	—	—	—	—
Galium sp.	—	—	—	0.31
Gilia sp.	—	—	—	—
Helianthus sp.	—	—	—	—
Hordeum sp.	—	—	—	—
Juncus sp.	—	—	—	—
Laminaceae	—	—	—	—
Lonicera sp.	—	—	—	—
Lupinus sp.	—	—	—	—
Lycium sp.	—	30.0	—	—
Madia sp.	—	—	—	—
Malvaceae	—	—	—	—
Malvella sp.	—	—	—	—
Melica sp.	—	—	—	—
Mentzelia sp.	—	—	—	1.39
Mulenberghia sp.	—	—	—	—
Nicotiana sp.	—	—	—	—
Oenothera sp.	—	—	—	—
Panicum sp.	—	—	—	—
Paspalum sp.	—	—	—	—
Phacelia sp.	—	—	—	—
Phalaris sp.	—	—	—	—
Phragmites sp.	—	—	—	—
Pinus monophylla (undifferentiated)	—	138.75	1.38	9.23
Plantago sp.	—	—	—	—
Poa sp.	—	—	—	—
Poaceae	—	22.5	—	3.85
Populus sp.	—	—	—	—
Potentilla sp.	—	—	—	—
Prunus andersonii	—	—	—	—
Puccinella sp.	—	—	—	—
Purshia tridentata	—	—	—	—
Quercus (undifferentiated)	—	—	0.31	—

TAXA	DENSITY (SEED/L)			
Ruppia sp.	—	—	—	—
Salvia sp.	—	—	—	—
Scirpus sp.	—	—	+	0.15
Sesuvium sp.	—	—	—	—
Solanaceae	—	—	—	—
Sphaeraclea sp.	—	5.0	—	—
Sporobolus sp.	—	—	—	—
Stipa sp.	—	—	—	10.0
Suaeda sp.	—	—	—	—
Trifolium sp.	—	—	—	—
unidentified tuber	—	—	—	—
Typha sp.	—	—	—	—
Unidentifiable	—	—	—	—
Unidentified seeds	—	—	—	—
Unidentified nutshell	—	—	—	—
unknown	—	16.25	—	0.92
Verbena sp.	—	—	—	—
Vigueria sp.	—	—	—	—
Viola sp.	—	—	—	—
Vulpia sp.	—	—	—	—

Table A.35. Marana Period Data from INY-5888 (Loc. 1)

MANZANAR 2011 (PIERCE 2011)				
Site Locus	INY-5888 - Locus 1			
Context	Structure 2	Structure 3	Feature 4	Feature 20
Volume (where available)	9.0	28.8- six samples combined	6.0	5.8

TAXA	DENSITY (SEED/L)			
Achnatherum hymenoides	0.3	0.14	—	—
Achnatherum sp.	—	—	—	—
Agrostis sp.	—	—	—	—
Amaranthus sp.	—	—	—	—
Amelanchier sp.	—	—	—	—
Amorphous	—	—	—	—
Amsinckia sp.	—	—	—	—
Artemisia ludoviciania	—	—	—	—
Artemisia sp.	—	—	—	—
Artemisia tridentata	49.3	0.4	1.7	—
Asteraceae	—	0.34	—	—
Atriplex canescens	2.3	0.51	0.7	—
Atriplex sp.	153.0	3.1	4.0	7.3
Boehmeria cf.	—	—	—	—
Boraginaceae	—	—	—	—
Brassicaceae	2.2	—	—	—
Cactaceae	—	—	—	—
Calamagrostis sp.	—	—	—	—
Chaenactis sp.	—	—	—	—
Chenopodiaceae	6.7	12.92	6.7	12.0
Chenopodium sp.	3.1	10.91	6.3	8.0
Coleogyne ramosissima	—	—	—	—
Collomia sp. cf.	—	—	—	—
Cryptantha sp.	—	—	—	—
Cyperaceae	—	0.07	—	1.7
Cyperus sp. seeds	0.7	—	—	—
Cyperus sp. tubers	—	—	—	—
Deschampsia sp.	—	—	—	—
Descurania sp.	—	0.69	—	—
Desmodium cf.	—	—	—	—

TAXA	DENSITY (SEED/L)			
Distichlis sp.	—	—	—	—
Elymus cinerus	—	—	—	—
Ephedra spp. achenes	—	—	—	—
Epilobium sp.	—	—	—	—
Eragrostis sp.	—	—	—	—
Eremalche sp.	—	—	—	—
Eriogonum sp.	—	0.03	—	—
Eriogonum sp.	—	—	—	—
Fabaceae	3.8	—	—	1.7
Forestiera pubescens	—	—	—	—
Galium sp.	—	—	—	—
Gilia sp.	—	—	—	—
Helianthus sp.	—	—	—	—
Hordeum sp.	—	—	—	—
Juncus sp.	7.1	—	—	—
Laminaceae	—	—	—	—
Lonicera sp.	—	—	—	—
Lupinus sp.	—	—	—	—
Lycium sp.	0.4	—	0.3	—
Madia sp.	—	—	—	—
Malvaceae	—	—	—	—
Malvella sp.	—	—	—	—
Melica sp.	—	—	—	—
Mentzelia sp.	0.4	0.11	—	3.5
Mulenberghia sp.	—	0.34	—	—
Nicotiana sp.	—	—	—	—
Oenothera sp.	—	—	—	—
Panicum sp.	—	—	—	—
Paspalum sp.	—	—	—	—
Phacelia sp.	—	—	—	—
Phalaris sp.	—	—	—	—
Phragmites sp.	—	—	—	—
Pinus monophylla (undifferentiated)	—	0.04	0.3	—
Plantago sp.	—	—	—	—
Poa sp.	—	—	—	—
Poaceae	130.0	2.09	2.0	9.9
Populus sp.	—	—	—	—
Potentilla sp.	13.8	—	—	—
Prunus andersonii	—	—	—	—
Puccinella sp.	—	—	—	—
Purshia tridentata	—	—	—	—
Quercus (undifferentiated)	—	—	—	—

TAXA	DENSITY (SEED/L)			
Ruppia sp.	—	—	—	—
Salvia sp.	—	—	—	—
Scirpus sp.	0.4	—	—	—
Sesuvium sp.	—	—	—	—
Solanaceae	—	—	—	—
Sphaeraclea sp.	—	—	—	—
Sporobolus sp.	6.7	6.88	—	—
Stipa sp.	—	—	—	—
Suaeda sp.	—	—	—	—
Trifolium sp.	—	—	—	—
unidentified tuber	—	—	—	—
Typha sp.	—	0.69	—	—
Unidentifiable	222.0	20.86	197.0	16.0
Unidentified seeds	—	—	—	—
Unidentified nutshell	—	—	—	—
unknown	0.4	3.48	2.0	5.2
Verbena sp.	—	—	—	—
Vigueria sp.	—	—	—	—
Viola sp.	—	—	—	—
Vulpia sp.	—	—	—	1.4

Table A.36. Marana Period Data from INY-5888 (Loc. 2)

MANZANAR 2011 (PIERCE 2011)				
Site Locus	INY-5888 - Locus 2			
Context	Structure 1	Feature 5	Feature 3	Feature 1
Volume (where available)	41.5 - five samples combined	4.3	8.0	3.8

TAXA	DENSITY (SEED/L)			
Achnatherum hymenoides	0.14	—	—	—
Achnatherum sp.	—	—	—	—
Agrostis sp.	—	—	—	—
Amaranthus sp.	—	—	—	—
Amelanchier sp.	—	—	—	—
Amorphous	—	—	—	—
Amsinckia sp.	—	—	—	—
Artemisia ludoviciania	—	—	—	—
Artemisia sp.	—	—	—	—
Artemisia tridentata	4.26	2.4	—	—
Asteraceae	0.27	—	—	1.1
Atriplex canescens	0.24	8.9	0.5	—
Atriplex sp.	16.96	—	—	—
Boehmeria cf.	—	—	—	—
Boraginaceae	—	—	—	—
Brassicaceae	0.09	—	—	—
Cactaceae	—	—	—	—
Calamagrostis sp.	—	—	—	—
Chaenactis sp.	—	—	—	—
Chenopodiaceae	16.25	—	—	—
Chenopodium sp.	41.45	39.0	1.3	1.1
Coleogyne ramosissima	—	—	—	—
Collomia sp. cf.	—	—	—	—
Cryptantha sp.	—	—	—	—
Cyperaceae	0.25	1.0	—	—
Cyperus sp. seeds	0.11	0.2	—	—
Cyperus sp. tubers	—	—	—	—
Deschampsia sp.	—	—	—	—
Descurania sp.	5.49	—	—	—
Desmodium cf.	—	—	—	—

TAXA	DENSITY (SEED/L)			
Distichlis sp.	—	—	—	—
Elymus cinerus	—	—	—	—
Ephedra sp.	—	—	—	—
Epilobium sp.	—	—	—	—
Eragrostis sp. seeds	—	—	—	—
Eremalche sp.	—	—	—	—
Eriogonum sp.	0.33	—	—	—
Eriogonum sp.	—	—	—	—
Fabaceae	0.11	2.1	—	6.1
Forestiera pubescens	—	—	—	—
Galium sp.	—	—	—	—
Gilia sp.	—	—	—	—
Helianthus sp.	—	—	—	—
Hordeum sp.	—	—	—	—
Juncus sp.	0.25	—	—	—
Laminaceae	—	—	—	—
Lonicera sp.	—	—	—	—
Lupinus sp.	—	—	—	—
Lycium sp.	—	—	—	—
Madia sp.	—	—	—	—
Malvaceae	—	—	—	—
Malvella sp.	—	—	—	—
Melica sp.	—	—	—	—
Mentzelia sp.	0.57	0.5	—	—
Mulenberghia sp.	—	2.4	—	—
Nicotiana sp.	—	—	—	—
Oenothera sp.	—	—	—	—
Panicum sp.	—	—	—	—
Paspalum sp.	—	—	—	—
Phacelia sp.	—	—	—	—
Phalaris sp.	—	—	—	—
Phragmites sp.	—	—	—	—
Pinus monophylla (undifferentiated)	2.47	—	1.6	—
Plantago sp.	—	—	—	—
Poa sp.	—	—	—	—
Poaceae	3.65	1.9	1.4	—
Populus sp.	—	—	—	—
Potentilla sp.	0.81	—	—	—
Prunus andersonii	—	—	—	—
Puccinella sp.	—	—	—	—
Purshia tridentata	—	—	—	—
Quercus (undifferentiated)	—	—	—	—

TAXA	DENSITY (SEED/L)			
Ruppia sp.	—	—	—	—
Salvia sp.	—	—	—	—
Scirpus sp.	0.38	—	—	—
Sesuvium sp.	—	—	—	—
Solanaceae	—	—	—	—
Sphaeraclea sp.	—	—	—	—
Sporobolus sp.	11.16	—	—	—
Stipa sp.	—	—	—	—
Suaeda sp.	—	—	—	—
Trifolium sp.	—	—	0.5	—
unidentified tuber	—	—	—	0.3
Typha sp.	—	—	—	—
Unidentifiable	44.62	681.0	45.0	33.0
Unidentified seeds	—	—	—	—
Unidentified nutshell	—	—	—	—
unknown	0.55	—	6.0	1.0
Verbena sp.	—	—	—	—
Vigueria sp.	—	—	—	—
Viola sp.	—	—	—	—
Vulpia sp.	0.02	—	—	—

Table A.37. Marana Period Data from INY-4658 (Loc. 2)

MANZANAR 2011 (PIERCE 2011)				
Site Locus	INY-4658			
Context	Feature 4	Feature 3	Feature 6	Feature 5
Volume (where available)	9.0	10.0	10.0	8.25

TAXA	DENSITY (SEED/L)			
Achnatherum hymenoides	1.3	—	—	—
Achnatherum sp.	—	—	—	—
Agrostis sp.	—	—	—	—
Amaranthus sp.	—	—	—	—
Amelanchier sp.	—	—	—	—
Amorphous	—	—	—	—
Amsinckia sp.	—	—	—	—
Artemisia ludoviciania	—	—	—	—
Artemisia sp.	—	—	—	—
Artemisia tridentata	37.8	2.0	1.0	1.2
Asteraceae	1.2	—	—	—
Atriplex canescens	3.3	1.0	—	9.0
Atriplex sp.	3.3	—	—	—
Boehmeria cf.	—	—	—	—
Boraginaceae	—	—	—	—
Brassicaceae	—	—	—	—
Cactaceae	—	—	—	—
Calamagrostis sp.	—	—	—	—
Chaenactis sp.	—	—	—	—
Chenopodiaceae	6.9	—	1.0	3.6
Chenopodium sp.	26.0	5.0	7.4	11.4
Coleogyne ramosissima	—	—	—	—
Collomia sp. cf.	—	—	—	—
Cryptantha sp.	—	—	—	—
Cyperaceae	—	—	—	—
Cyperus sp. seeds	—	—	—	—
Cyperus sp. tubers	—	—	—	—
Deschampsia sp.	—	—	—	—
Descurania sp.	2.2	1.0	—	—
Desmodium cf.	—	—	—	—
Distichlis sp.	—	—	—	—
Elymus cinerus	—	—	—	—
Ephedra sp.	—	—	—	—
Epilobium sp.	—	—	—	—

TAXA	DENSITY (SEED/L)			
Eragrostis sp.	—	—	—	—
Eremalche sp.	—	—	—	—
Eriogonum sp.	—	—	0.4	—
Eriogonum sp.	—	—	—	—
Fabaceae	0.7	—	—	0.1
Forestiera pubescens	—	—	—	—
Galium sp.	—	—	—	—
Gilia sp.	—	—	—	—
Helianthus sp.	—	—	—	—
Hordeum sp.	—	—	—	—
Juncus sp.	0.4	1.0	24.4	0.5
Laminaceae	—	—	—	—
Lonicera sp.	—	—	—	—
Lupinus sp.	—	—	—	—
Lycium sp.	0.2	—	—	0.5
Madia sp.	—	—	—	—
Malvaceae	—	—	—	—
Malvella sp.	—	—	—	—
Melica sp.	—	—	—	—
Mentzelia sp.	6.9	1.4	2.0	3.4
Mulenberghia sp.	35.3	—	—	6.1
Nicotiana sp.	—	—	—	—
Oenothera sp.	—	—	—	—
Panicum sp.	—	—	—	—
Paspalum sp.	—	—	—	—
Phacelia sp.	—	—	—	—
Phalaris sp.	—	—	—	—
Phragmites sp.	—	—	—	—
Pinus monophylla (undifferentiated)	—	—	—	—
Plantago sp.	—	—	—	—
Poa sp.	—	—	—	—
Poaceae	34.2	27.4	97.0	46.7
Populus sp.	—	—	—	—
Potentilla sp.	23.0	—	1.0	1.2
Prunus andersonii	—	—	—	—
Puccinella sp.	—	—	—	—
Purshia tridentata	—	—	—	—
Quercus (undifferentiated)	—	—	—	—
Ruppia sp.	—	—	—	—
Salvia sp.	—	—	—	—
Scirpus sp.	—	—	—	—
Sesuvium sp.	—	—	—	—

TAXA	DENSITY (SEED/L)			
Solanaceae	—	—	—	—
Sphaeraclea sp.	—	—	—	—
Sporobolus sp.	23.3	1.0	1.0	63.0
Stipa sp.	—	—	—	—
Suaeda sp.	—	—	—	—
Trifolium sp.	—	—	—	—
unidentified tuber	—	—	—	—
Typha sp.	1.1	—	—	—
Unidentifiable	212.1	32.2	193.1	162.9
Unidentified seeds	—	—	—	—
Unidentified nutshell	—	—	—	—
unknown	0.1	0.1	3.0	4.0
Verbena sp.	—	—	—	—
Vigueria sp.	—	—	—	—
Viola sp.	—	—	—	—
Vulpia sp.	18.0	—	—	—

Table A.38. Marana Period Data from INY-1384/H

BASGALL AND DELACORTE 2012	
Site Locus	INY-1384/H
Context	S 13
Volume (where available)	31.25

TAXA	DENSITY (SEED/L)
Achnatherum hymenoides	—
Achnatherum sp.	0.38
Agrostis sp.	—
Amaranthus sp.	—
Amelanchier sp.	—
Amorphous	1.18
Amsinckia sp.	—
Artemisia ludoviciania	—
Artemisia sp.	2.06
Artemisia tridentata	7.64
Asteraceae	2.31
Atriplex canescens	0.36
Atriplex sp.	1.77
Boehmeria cf.	—
Boraginaceae	—
Brassicaceae	—
Cactaceae	—
Calamagrostis sp.	—
Chaenactis sp.	—
Chenopodiaceae	2.28
Chenopodium sp.	18.28
Coleogyne ramosissima	—
Collomia sp. cf.	—
Cryptantha sp.	—
Cyperaceae	—
Cyperus sp. seeds	—
Cyperus sp. tubers	0.03
Deschampsia sp.	—
Descurania sp.	—
Desmodium cf.	—
Distichlis sp.	—
Elymus cinerus	—
Ephedra sp.	—

TAXA	DENSITY (SEED/L)
Epilobium sp.	0.64
Eragrostis sp.	—
Eremalche sp.	—
Eriogonum sp.	—
Eriogonum sp.	0.13
Fabaceae	—
Forestiera pubescens	—
Galium sp.	—
Gilia sp.	—
Helianthus sp.	0.28
Hordeum sp.	1.96
Juncus sp.	—
Laminaceae	—
Lonicera sp.	—
Lupinus sp.	—
Lycium sp.	—
Madia sp.	0.02
Malvaceae	—
Malvella sp.	—
Melica sp.	—
Mentzelia sp.	0.2
Mulenberghia sp.	—
Nicotiana sp.	—
Oenothera sp.	0.42
Panicum sp.	0.65
Paspalum sp.	—
Phacelia sp.	—
Phalaris sp.	—
Phragmites sp.	13.42 cf
Pinus monophylla (undifferentiated)	44.52
Plantago sp.	—
Poa sp.	—
Poaceae	21.13
Populus sp.	—
Potentilla sp.	0.63
Prunus andersonii	—
Puccinella sp.	1.6
Purshia tridentata	—
Quercus (undifferentiated)	—
Ruppia sp.	—
Salvia sp.	—
Scirpus sp.	—

TAXA	DENSITY (SEED/L)
Sesuvium sp.	—
Solanaceae	—
Sphaeraclea sp.	—
Sporobolus sp.	14.73
Stipa sp.	—
Suaeda sp.	—
Trifolium sp.	0.37
unidentified tuber	—
Typha sp.	—
Unidentifiable	20.02
Unidentified seeds	—
Unidentified nutshell	—
unknown	17.07
Verbena sp.	—
Vigueria sp.	—
Viola sp.	—
Vulpia sp.	—

Table A.39. Marana Period Data from INY-8768, INY-7448, INY-5207

SANTY 2022 (THIS MANUSCRIPT)				
Site Locus	INY-8768		INY-7448	INY-5207
Context	H	Dprssn	H 6	H 8
Volume (where available)	9.0	10.0	10.0	8.25

TAXA	DENSITY (SEED/L)			
Achnatherum hymenoides	—	—	—	2.76
Achnatherum sp.	—	—	—	—
Agrostis sp.	0.07	—	—	0.97
Amaranthus sp.	0.07	—	—	—
Amelanchier sp.	0.13	—	—	—
Amorphous	—	—	—	—
Amsinckia sp.	—	—	—	—
Artemisia ludoviciania	—	—	—	—
Artemisia sp.	—	—	—	—
Artemisia tridentata	—	—	—	—
Asteraceae	—	—	—	—
Atriplex canescens	—	—	—	—
Atriplex sp.	2.02	—	—	1.86
Boehmeria cf.	0.07	—	—	—
Boraginaceae	—	—	—	—
Brassicaceae	—	—	—	0.14
Cactaceae	—	—	—	0.07
Calamagrostis sp.	0.39	—	—	—
Chaenactis sp.	—	—	—	22.21
Chenopodiaceae	2.28	—	—	15.45
Chenopodium sp.	3.26	—	2.5	1.1
Coleogyne ramosissima	—	—	—	—
Collomia sp. cf.	—	—	—	0.07
Cryptantha sp.	—	—	—	—
Cyperaceae	—	—	—	—
Cyperus sp. seeds	—	—	—	—
Cyperus sp. tubers	—	—	—	—
Deschampsia sp.	0.07	—	—	—
Descurania sp. seeds	—	—	—	—
Desmodium cf.	0.07	—	—	—
Distichlis sp.	0.07	—	—	—
Elymus cinerus	—	—	—	—
Ephedra sp.	0.26	79.44	—	—
Epilobium sp.	—	—	—	—

TAXA	DENSITY (SEED/L)			
Eragrostis sp.	0.2	—	—	—
Eremalche sp.	—	—	—	—
Eriogonum sp.	—	—	—	—
Eriogonum sp.	—	—	—	0.28
Fabaceae	0.26	1.67	1.0	—
Forestiera pubescens	—	—	—	0.07
Galium sp.	1.04	—	—	—
Gilia sp.	—	—	—	—
Helianthus sp.	0.07	—	—	—
Hordeum sp.	—	—	—	0.07
Juncus sp.	—	—	—	18.14
Laminaceae	—	—	—	—
Lonicera sp.	—	—	0.5	—
Lupinus sp.	—	—	—	0.83
Lycium sp.	—	1.67	—	—
Madia sp.	—	—	—	—
Malvaceae	—	—	—	0.21
Malvella sp.	—	—	—	0.21
Melica sp.	0.13	—	—	—
Mentzelia sp.	1.37	—	—	0.14
Mulenberghia sp.	—	—	—	—
Nicotiana sp.	—	—	—	—
Oenothera sp.	—	—	—	—
Panicum sp.	2.34	—	—	0.07
Paspalum sp.	0.13	—	—	—
Phacelia sp.	—	—	—	—
Phalaris sp.	2.0	—	—	0.28
Phragmites sp.	—	—	—	—
Pinus monophylla (undifferentiated)	5.14	42.22	5.5	1.31
Plantago sp.	0.07	—	—	—
Poa sp.	—	—	—	—
Poaceae	3.19	—	0.5	1.38
Populus sp.	—	—	—	—
Potentilla sp.	—	—	—	—
Prunus andersonii	—	—	—	—
Puccinella sp.	—	—	—	—
Purshia tridentata	—	—	—	—
Quercus (undifferentiated)	12.17	—	—	—
Ruppia sp.	0.07	—	—	—
Salvia sp.	—	—	—	—
Scirpus sp.	5.08	—	9.0	0.55
Sesuvium sp.	0.2	—	—	1.38

TAXA	DENSITY (SEED/L)			
Solanaceae	—	—	—	0.17
Sphaeraclea sp.	—	—	—	0.07
Sporobolus sp.	1.3	—	—	0.28
Stipa sp.	—	—	—	—
Suaeda sp.	—	1.67	—	0.07
Trifolium sp.	0.13	—	—	—
unidentified tuber	—	—	—	—
Typha sp.	0.13	—	—	—
Unidentifiable	6.45	1.67	1.0	—
Unidentified seeds	3.91	—	0.5	38.97
Unidentified nutshell	3.84	—	—	—
unknown	—	—	—	—
Verbena sp.	—	—	—	0.28
Vigueria sp.	—	—	—	—
Viola sp.	0.07	—	—	—
Vulpia sp.	—	—	—	—

Table A.40. Protohistoric—Late Marana Period Data from INY-5757

BASGALL AND DELACORTE 2003				
Site Locus	INY-5757			
Context	F. 7 hearth	flot 2 assoc F. 1	midden assoc F. 1	midden assoc F. 3
Volume (where available)	—	—	—	—

TAXA	DENSITY (SEED/L)			
Achnatherum hymenoides	0.2	—	—	—
Amsinckia sp.	2.2	—	—	—
Artemisia tridentata	190.4	122.0	0.39	—
Asteraceae	1.2	—	0.2	—
Atriplex canescens	0.4	—	—	—
Atriplex sp.	0.2	—	—	0.64
Boraginaceae	6.0	7.0	—	0.32
Brassicaceae	0.2	—	—	—
cf. Ambrosia artemisifolia	0.5	—	—	—
Chenopodiaceae	155.0	31.25	—	—
Chenopodium sp.	126.4	5138.5	15.22	22.9
Cryptantha sp.	20.4	5.0	0.78	—
Cyperus sp. seeds	—	—	—	—
Descurania sp.	45.7	—	—	4.8
Ephedra sp.	0.2	—	—	—
Fabaceae	1.0	0.25	—	—
Galium sp.	—	—	0.78	—
Gilia sp.	—	—	—	—
Helianthus sp.	0.2	—	—	—
Hordeum sp.	3.29	1.0	2.44	—
Juncus sp.	—	—	—	—
Lamiaceae	—	—	—	—
Lycium sp.	3.6	—	1.95	—
Malvaceae	—	1.0	—	—
Marah sp.	—	—	—	—
Mentzelia sp.	1388.2	113.0	24.2	12.8
Mulenberghia sp.	591.1	—	—	—
Panicum sp.	—	—	—	—
Phacelia sp.	20.2	—	—	—
Pinus monophylla (undifferentiated)	0.2	0.25	—	0.64
Poa sp.	—	—	—	—
Poaceae	1229.4	29.5	13.66	6.08
Psorothamnus sp.	0.4	0.25	—	—
Quercus (undifferentiated)	0.25	—	—	—
Ruppia cirrhosa	—	—	—	—

TAXA	DENSITY (SEED/L)			
Salvia sp.	—	—	—	—
Scirpus sp.	—	—	—	—
cf. Sesuvium velutinum	0.15	—	—	—
Sphaeraclea sp.	—	3.0	0.78	0.96
Sporobolus sp.	—	—	0.39	—
Stipa sp.	18.4	5.25	3.12	—
Suaeda sp.	18.2	—	0.78	—
Tridens muticus sp.	—	—	—	—
Trifolium sp.	0.2	—	—	1.6
Typha sp.	—	—	—	—
Unidentified	—	—	—	—

Table A.41. Protohistoric—Late Marana Period Data from INY-5759 (Loc. A) and INY-5764 (Non-Loc.)

BASGALL AND DELACORTE 2003			
Site Locus	INY-5759 – Loc. A		INY-5764 – Non-Loc.
Context	F. 12 hearth	F. 11 midden	F. 13 hearth
Volume (where available)	—	—	—

TAXA	DENSITY (SEED/L)		
Achnatherum hymenoides	—	—	—
Amsinckia sp.	—	—	—
Artemisia tridentata	—	—	8.9
Asteraceae	—	—	—
Atriplex canescens	—	—	—
Atriplex sp.	—	—	1.8
Boraginaceae	0.33	—	—
Brassicaceae	—	—	4.0
cf. Ambrosia artemisifolia	—	—	—
Chenopodiaceae	1.3	—	—
Chenopodium sp.	—	0.73	3.6
Cryptantha sp.	—	—	—
Cyperus sp. seeds	—	—	—
Descurania sp.	—	—	—
Ephedra sp.	—	—	—
Fabaceae	—	—	1.8
Galium sp.	—	—	—
Gilia sp.	—	—	—
Helianthus sp.	—	—	—
Hordeum sp.	—	—	—
Juncus sp.	—	—	—
Lamiaceae	—	—	—
Lycium sp.	—	—	—
Malvaceae	0.66	—	—
Marah sp.	—	—	—
Mentzelia sp.	8.0	—	10.67
Mulenberghia sp.	—	—	—
Panicum sp.	—	—	—
Phacelia sp.	0.66	—	—
Pinus monophylla (undifferentiated)	—	—	6.22
Poa sp.	—	—	—
Poaceae	15.3	0.73	10.76
Psorothamnus sp.	—	—	—

TAXA	DENSITY (SEED/L)		
Quercus (undifferentiated)	—	—	—
Ruppia cirrhosa	—	—	—
Salvia sp.	—	—	—
Scirpus sp.	—	—	1.78
cf. Sesuvium velutinum	—	—	—
Sphaeraclea sp.	—	—	—
Sporobolus sp.	—	—	—
Stipa sp.	—	—	—
Suaeda sp.	—	—	—
Tridens muticus sp.	—	—	—
Trifolium sp.	—	—	—
Typha sp.	—	—	—
Unidentified	—	—	—

Table A.42. Protohistoric—Late Marana Period Data from INY-3796 (Loc. 18) and INY-3778 (Loc. B)

DELACORTE 1999		
Site Locus	INY-3796 – Loc. 18	INY-3778 – Loc. B
Context	F. 1 hearth/shell	F. 1 hearth/shell
Volume (where available)	—	—

TAXA	DENSITY (SEED/L)	
Achnatherum hymenoides	—	—
Amsinckia sp.	—	—
Artemisia tridentata	—	—
Asteraceae	—	—
Atriplex canescens	—	—
Atriplex sp.	0.13	20.59
Boraginaceae	—	—
Brassicaceae	—	—
cf. Ambrosia artemisifolia	—	—
Chenopodiaceae	—	37.37
Chenopodium sp.	—	5.59
Cryptantha sp.	—	—
Cyperus sp. seeds	—	—
Descurania sp.	—	—
Ephedra sp.	—	—
Fabaceae	—	—
Galium sp.	—	—
Gilia sp.	—	—
Helianthus sp.	—	—
Hordeum sp.	—	—
Juncus sp.	—	—
Lamiaceae	—	—
Lycium sp.	—	0.08
Malvaceae	—	—
Marah sp.	—	—
Mentzelia sp.	—	—
Mulenberghia sp.	—	—
Panicum sp.	—	—
Phacelia sp.	—	—
Pinus monophylla (undifferentiated)	—	—
Poa sp.	—	—
Poaceae	—	—
Psorothamnus sp.	—	—

TAXA	DENSITY (SEED/L)	
Quercus (undifferentiated)	—	—
Ruppia cirrhosa	—	—
Salvia sp.	0.13	—
Scirpus sp.	—	0.08
cf. Sesuvium velutinum	—	—
Sphaeraclea sp.	—	—
Sporobolus sp.	—	—
Stipa sp.	—	—
Suaeda sp.	—	—
Tridens muticus sp.	—	—
Trifolium sp.	—	—
Typha sp.	—	305.51
Unidentified	—	—

Table A.43. Protohistoric—Late Marana Period Data from INY-1430 (Loc. 5)

GILREATH 1995	
Site Locus	INY-1430 – Loc. 5
Context	midden
Volume (where available)	—

TAXA	DENSITY (SEED/L)
Achnatherum hymenoides	+
Amsinckia sp.	—
Artemisia tridentata	—
Asteraceae	—
Atriplex canescens	—
Atriplex sp.	—
Boraginaceae	+
Brassicaceae	—
cf. Ambrosia artemisifolia	—
Chenopodiaceae	+
Chenopodium sp.	+
Cryptantha sp.	—
Cyperus sp. seeds	—
Descurania sp.	—
Ephedra sp.	—
Fabaceae	—
Galium sp.	—
Gilia sp.	—
Helianthus sp.	—
Hordeum sp.	—
Juncus sp.	—
Lamiaceae	—
Lycium sp.	—
Malvaceae	—
Marah sp.	—
Mentzelia sp.	+
Mulenberghia sp.	—
Panicum sp.	—
Phacelia sp.	—
Pinus monophylla (undifferentiated)	—
Poa sp.	—
Poaceae	+
Psorothamnus sp.	—
Quercus (undifferentiated)	—
Ruppia cirrhosa	—
Salvia sp.	—

TAXA	DENSITY (SEED/L)
Scirpus sp.	—
cf. Sesuvium velutinum	—
Sphaeraclea sp.	+
Sporobolus sp.	—
Stipa sp.	—
Suaeda sp.	—
Tridens muticus sp.	—
Trifolium sp.	—
Typha sp.	—
Unidentified	—

Table A.44. Protohistoric—Late Marana Period Data from INY-1906 (Loc. 2-3), INY-4243, and INY-4267

BASGALL AND DELACORTE 2003					
Site Locus	INY-1906 – Loc. 2	INY-1906 – Loc. 3	INY-4243		INY-4267
Context	F. 9 hearth	F. 10b hearth	Hearth 1 by rock ring	Hearth 2 by rock ring	F. 3 hearth
Volume (where available)	—	—	—	—	—

TAXA	DENSITY (SEED/L)				
Achnatherum hymenoides	0.82	—	71.43	769.43	0.14
Amsinckia sp.	—	—	—	—	—
Artemisia tridentata	—	—	—	—	—
Asteraceae	—	—	—	—	—
Atriplex canescens	—	—	—	—	—
Atriplex sp.	—	—	—	—	—
Boraginaceae	0.09	0.09	—	—	—
Brassicaceae	—	—	—	—	—
cf. Ambrosia artemisifolia	—	—	—	—	—
Chenopodiaceae	—	—	—	—	—
Chenopodium sp.	0.18	—	—	3.08	—
Cryptantha sp.	—	—	—	—	—
Cyperus sp. seeds	—	—	—	—	—
Descurania sp.	—	—	—	0.31	—
Ephedra sp.	—	—	—	—	—
Fabaceae	—	—	—	—	—
Galium sp.	—	—	—	—	—
Gilia sp.	—	—	—	—	—
Helianthus sp.	—	—	—	—	—
Hordeum sp.	—	—	—	—	—
Juncus sp.	—	—	—	—	—
Lamiaceae	—	—	—	—	—
Lycium sp.	—	—	—	—	—
Malvaceae	—	—	—	0.15	—
Marah sp.	—	—	—	—	—
Mentzelia sp.	1.09	0.17	0.58	1.08	0.14
Mulenberghia sp.	—	—	—	—	—
Panicum sp.	—	—	—	—	—
Phacelia sp.	—	—	—	—	—
Pinus monophylla (undifferentiated)	—	—	—	—	—
Poa sp.	—	—	—	—	—
Poaceae	—	—	0.14	0.15	—

TAXA	DENSITY (SEED/L)				
Psorothamnus sp.	—	—	—	—	—
Quercus (undifferentiated)	—	—	—	—	—
Ruppia cirrhosa	—	—	—	—	—
Salvia sp.	1.23	—	—	—	—
Salvia sp.	—	—	—	—	—
Scirpus sp.	—	—	—	—	—
cf. Sesuvium velutinum	—	—	—	—	—
Sphaeraclea sp.	—	—	—	—	—
Sporobolus sp.	—	—	—	0.15	—
Stipa sp.	—	—	—	—	—
Suaeda sp.	—	—	—	—	—
Tridens muticus sp.	—	—	—	—	—
Trifolium sp.	—	—	—	—	—
Typha sp.	—	—	—	—	—
Unidentified	—	—	—	—	—

Table A.45. Protohistoric—Late Marana Period Data from INY-1928 (Loc. 1)

MCGUIRE AND GILREATH 1998			
Site Locus	INY-1928 – Loc. 1		
Context	F. 1 hearth	F. 1-3	F. 2 hearth
Volume (where available)	—	—	—

TAXA	DENSITY (SEED/L)		
Achnatherum hymenoides	2.71	—	—
Amsinckia sp.	0.14	—	0.33
Artemisia tridentata	—	—	—
Asteraceae	—	0.3	—
Atriplex canescens	—	—	—
Atriplex sp.	—	—	—
Boraginaceae	—	—	—
Brassicaceae	—	—	—
cf. Ambrosia artemisifolia	—	—	—
Chenopodiaceae	—	—	—
Chenopodium sp.	—	—	26.0
Cryptantha sp.	—	—	—
Cyperus sp. seeds	—	—	—
Descurania sp.	0.71	0.5	—
Ephedra sp.	—	—	—
Fabaceae	0.86	—	—
Galium sp.	—	—	—
Gilia sp.	—	—	—
Helianthus sp.	—	—	—
Hordeum sp.	—	—	—
Juncus sp.	1.43	—	26.67
Lamiaceae	—	—	—
Lycium sp.	3.0	—	—
Malvaceae	0.57	—	—
Marah sp.	—	0.2	—
Mentzelia sp.	0.29	0.3	1262.0
Mulenberghia sp.	—	—	—
Panicum sp.	—	—	—
Phacelia sp.	0.36	—	—
Pinus monophylla (undifferentiated)	—	—	—
Poa sp.	10.57	—	—
Poaceae	2.29	0.4	—
Psorothamnus sp.	—	—	—
Quercus (undifferentiated)	—	—	—
Ruppia cirrhosa	—	—	—

TAXA	DENSITY (SEED/L)		
Salvia sp. seeds	37.07	0.6	18.0
Scirpus sp. achenes	—	—	—
Sesuvium velutinum?	—	—	—
Sphaeraclea sp.	—	—	—
Sporobolus sp.	0.29	—	—
Stipa sp.	—	—	—
Suaeda sp.	—	—	—
Tridens muticus sp.	—	—	—
Trifolium sp. (seeds	—	—	—
Typha sp. eeds	—	—	—
Unidentified	—	—	—

Table A.46. Protohistoric—Late Marana Period Data from INY-5875

LEIGH AND ZEANAH 2002		
Site Locus	INY-5875	
Context	F. 1	F. 2
Volume (where available)	7.75L	18.25L

TAXA	DENSITY (SEED/L)	
Achnatherum hymenoides	—	—
Amsinckia sp.	—	—
Artemisia tridentata	4.39	21.64
Asteraceae	1.55	7.12
Atriplex canescens	—	—
Atriplex sp.	3.61	P
Boraginaceae	—	—
Brassicaceae	—	—
cf. Ambrosia artemisifolia	—	—
Chenopodiaceae	21.42	—
Chenopodium sp.	2.32	—
Cryptantha sp.	—	—
Cyperus sp. seeds	5.16	—
Descurania sp.	110.97	—
Ephedra sp.	—	—
Fabaceae	—	—
Galium sp.	—	—
Gilia sp.	3.87	—
Helianthus sp.	0.65	8.6
Hordeum sp.	—	—
Juncus sp.	—	—
Lamiaceae	10.32	—
Lycium sp.	—	—
Malvaceae	—	—
Marah sp.	—	—
Mentzelia sp.	136.0	—
Mulenberghia sp.	68.39	—
Panicum sp.	5.42	P
Phacelia sp.	1.29	—
Pinus monophylla (undifferentiated)	2.32	44.88
Poa sp.	—	—
Poaceae	118.71	5.8
Psorothamnus sp.	—	—
Quercus (undifferentiated)	—	1.1
Ruppia cirrhosa	2.71	—
Salvia sp. seeds	17.03	—

TAXA	DENSITY (SEED/L)	
Scirpus sp. achenes	—	0.55
Sesuvium velutinum?	—	—
Sphaeraclea sp.	—	—
Sporobolus sp.	1.29	—
Stipa sp.	3.1	0.55
Suaeda sp.	—	—
Tridens muticus sp.	254.45	—
Trifolium sp. (seeds	—	—
Typha sp. eeds	—	—
Unidentified	0.26	—
Unknown B	1.16	—

Table A.47. Protohistoric—Late Marana Period Data from INY-5207

SANTY 2022 (THIS MANUSCRIPT)	
Site Locus	INY-5207
Context	F. 218.22
Volume (where available)	1.5

TAXA	DENSITY (SEED/L)
Achnatherum hymenoides	—
Amsinckia sp.	—
Artemisia tridentata	—
Asteraceae	—
Atriplex canescens	—
Atriplex sp.	1.33
Boraginaceae	—
Brassicaceae	—
cf. Ambrosia artemisifolia	—
Chenopodiaceae	5.33
Chenopodium sp.	5.33
Cryptantha sp.	—
Cyperus sp. seeds	—
Descurania sp.	—
Ephedra sp.	—
Fabaceae	—
Galium sp.	—
Gilia sp.	—
Helianthus sp.	—
Hordeum sp.	—
Juncus sp.	5.33
Lamiaceae	—
Lycium sp.	—
Malvaceae	—
Marah sp.	—
Mentzelia sp.	2.0
Mulenberghia sp.	—
Panicum sp.	—
Phacelia sp.	—
Pinus monophylla (undifferentiated)	—
Poa sp.	—
Poaceae	—
Psorothamnus sp.	—
Quercus (undifferentiated)	—
Ruppia cirrhosa	—

TAXA	DENSITY (SEED/L)
Salvia sp. seeds	—
Scirpus sp. achenes	—
Sesuvium velutinum?	—
Sphaeraclea sp.	—
Sporobolus sp.	—
Stipa sp.	—
Suaeda sp.	—
Tridens muticus sp.	—
Trifolium sp. (seeds	—
Typha sp. eeds	—
Unidentified	18.0
Unknown B	—