COUNTING CHARRED LEAVES:
MACROBOTANICAL AND FUEL WOOD REMAINS OF EAGLE CAVE THROUGH TIME

A Thesis

by

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ABSTRACT

Eagle Cave (41VV167) is an archaeologically significant dry rock shelter located in the Lower Pecos Canyonlands in Val Verde County, Texas. Prior excavations by the Ancient Southwest Texas Project of Texas State University sampled Late Pleistocene and Archaic period earth-ovens and earth-oven-adjacent features from Eagle Cave. Using 10 sediment samples from the project, I determined how people's relationship with plants changed according to certain variables: feature type, environmental zone, plant seasonality, plant-use categories, and time. The hypotheses that macrobotanical and wood charcoal counts and weights changed with the variables were supported, with the exception of the hypotheses made about plant-use categories and time. This research contributes to knowledge regarding past diets by providing a comprehensive paleoethnobotanical study of plant-use at Eagle Cave. Results provide new data regarding the breadth of botanical consumption and fuel components at Eagle Cave, with implications throughout the Chihuahuan desert and south-central North America.

DEDICATION

This thesis proposal is dedicated in memory of my former co-chair, Dr. Alston Thoms, who passed away during the course of the project in the Summer of 2021. He was an inspiration and a kind figure towards me, his other students and co-workers, as well as the indigenous communities he worked alongside. I also dedicate this thesis proposal to my two partners, who have helped me through this process, and supported my efforts from near and afar. Finally, I would like to dedicate this project to the peoples, past and present, who live and have lived in southern and western Texas. Without their ingenuity, knowledge, and skills of survival in the arid lands that border the Rio Grande/Bravo, I wouldn’t have anything to present. It is my wish that this ancient knowledge be accessible to the peoples who call or once called this region home, near and far. It is my hope that someday I am able to build lasting friendships and collaborate with the peoples whom this knowledge is an ancestral birthright and apply the dormant knowledge for the betterment of the present-day communities.

ACKNOWLEDGEMENTS

My late co-advisor, Dr. Alston Thoms was the spark for this project. He introduced me to archaeobotanist Dr. Leslie Bush and his colleague Dr. Steve Black and helped me design my initial questions and hypotheses. While Dr. Thoms has now passed, my other co-advisor, turned main advisor, Dr. Heather Thakar has stepped up in his stead and has contributed significant amounts of her time and space to helping me complete this project. She offered me the use of her microscope and related equipment, both for the duration of my stay in Dr. Bush's lab, but also while completing the analysis in her own Archaeobotany Lab on the Texas A&M University College Station campus. She also offered endless advice on how to best proceed and troubleshoot my work, following the completion of the macrobotanical and anthracological analysis. She was also willing to help organize and facilitate a second research trip out to the Lower Pecos and Eagle Nest Canyon, in order to help complete the project.

Dr. Steve Black was a great facilitator for this project. He helped me search for the correct samples needed to assess ethnobotanical changes through time at Eagle Cave, and provided me with permission and additional contacts to continue my research. He also introduced me to Charles Koenig, one of the primary investigators at Eagle Cave back during the excavations associated with the Ancient Southwest Texas Project. Charles is one of foremost experts on Eagle Cave alive today, and this project would not have been possible without him, his advice, and his sample suggestions to kickstart this research. By meeting Charles, I was also privy to meet a whole host of other archaeologists and specialists associated with Shumla, the campus at which those who study the Lower Pecos congregate and conduct research, and the surrounding region.

Finally, this project would not have been possible without the aid of Dr. Leslie Bush. She contributed significantly to the project, by agreeing to provide her time and resources to my endeavors. She quite literally allowed me to share her lab and office space with her, and carefully crafted a curriculum in order to better learn paleoethnobotanical analysis through mutual readings and discussion. Dr. Bush is also a large portion of why I was able to see the analysis portion of this project to completion, by double-checking my difficult desert specimen identifications and clarifying why certain identifications were correct or otherwise. This hands-on learning process was something that I wholeheartedly appreciate and believe contributed to and furthered my knowledge and understanding of species in the region I chose to focus on.

CONTRIBUTORS AND FUNDING SOURCES

Contributors

My current advisor, Dr. Heather Thakar, offered me the use of her microscope and related equipment, while completing the macrobotanical analysis portion of this project.

Dr. Steve Black and Charles Koenig, one of his students, both of whom spearheaded the Ancient Southwest Texas Project excavations of Eagle Cave in the mid to late 2010s, offered me use of their excavated sediment samples, in order to facilitate this research.

I was also graciously allowed to use both the Shumla campus and the Skiles residence as bases of operation for my tours of the various shelters, including Eagle Cave, and plant collection endeavors in and around the canyon. The Skiles family is incredibly generous towards archaeologists investigating Eagle Nest Canyon, and I want to take this opportunity to thank them profusely.

Finally, this project would not have been possible without the aid of Dr. Leslie Bush. She contributed significantly to the project, by agreeing to provide her time and resources to my endeavors. She is also why I was able to see the analysis portion of this project to completion. She double-checked my difficult desert specimen identifications and clarified why certain identifications were correct or otherwise.

Funding Sources

This project was funded by a summer 2021 professional development grant from the Texas A&M Department of Anthropology, allowing me to train under Dr. Bush, and visit Eagle Cave in Langtry, Texas in the Summer of 2021.

NOMENCLATURE

Anthracology

The study of wood charcoal in an archaeological context, using methods common to archaeobotany

Archaeobotany

Also called paleoethnobotany; the study of archaeological plant remains used by human cultures

Archaic

An archaeological time period in North America characterized by the span of time from about 8,800 to 1,300 cal BP

Earth-Oven

A layered mounded thermal element in which people cook food, consisting of layers of rocks, food, fuel, moist packing material, and earth

Fire-cracked rock (FCR)

Rocks that have been transformed through continual heating, whether in an earth-oven, or in a boiling pit

Late Paleoindian

An archaeological time period in North America characterized by the span of time from about 9,800-8,800 cal BP

Late Pleistocene

129,000-11,700 years ago; An unofficial age in the geological timescale, terminating at the end of the Younger Dryas, which had temporarily reversed the warming trend after the Last Glacial Maximum

Lithics

The analysis of stone tools or chipped stone artifacts

Paleoindian

An archaeological time period in North America characterized by the span of time from about 12,000-9,800 cal BP

Rock shelter

A dry and shallow cave-like opening inset into a hill, cliff, or bluff

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INTRODUCTION

Eagle Cave (41VV167) is an archaeologically significant dry rock shelter located in Eagle Nest (Mile) Canyon, a tributary of the Rio Grande located on the northern cusp of the Chihuahuan desert, near Langtry, Texas in Val Verde County. Eagle Cave is nestled in the middle of a bio-cultural region known as the Lower Pecos, which is centered on the mouth of the Pecos River as it empties into the Rio Grande, extending northwards and south approximately 150km (Nielsen 2017). Eagle Nest Canyon contains multiple dry rock shelters, including Eagle Cave, Bonfire Shelter, Skiles Shelter, Kelley Cave, and Horse Trail Shelter, among many others in the region (Sobolik 1991; Sobolik 2008; Riley 2008; Riley 2012; Dering 2021). However, of the recorded rock shelters in Eagle Nest Canyon, Eagle Cave is by far the largest, measuring at 185 feet long, 87 feet deep, and the overhang is approximately 90 feet high (Ross 1965). These shelters were inhabited up to 13,000 years ago, for more than 10,000 years, based on dated artifacts, charcoal, bone, and pictographs, as well as by using lithic type chronology (Ross 1965; Sobolik 1991; Sobolik 2008; Riley 2008; Riley 2012; Turpin and Eling 2017; Dering 2021). Numerous artifacts that would have otherwise decayed in wetter climates have been found at these sites, including sandals, digging sticks, lithics, woven mats, and even buried human remains associated with the sites have been found (Sobolik 1991; Sobolik 2008; Riley 2008; Riley 2012; Dering 2021). Beyond Eagle Nest Canyon, other rock shelters exist and have been studied throughout the Lower Pecos (Sobolik 1991; Sobolik 2008; Riley 2008; Riley 2012; Dering 2021).

In this project, using the standardized counts and weights of identified and unidentifiable botanical specimens which I analyzed and identified, I aim to determine how people's relationship with plants, both macrobotanical and anthracological samples, changed according to certain variables. These changes are examined by feature type (earth-ovens and fire-cracked rock discard piles), environmental zone (desert upland, mixed environment, canyon riparian), seasonality of plant taxa (spring, summer, fall, winter), plant-use categories (seeds, fruits, leaves, stems, roots), and time (Paleoindian, late Paleoindian, early Archaic, middle Archaic, and late Archaic). Overall, I expect there to be more macrobotanical and anthracological samples found in the fire-cracked rock discard piles than in the earth-ovens (Black and Thoms 2014). I also expect there to be a variety of plants harvested from different environmental zones, given the location of Eagle Cave situated within the canyon and greater desert region. Plants harvested are also expected to be harvested during peak productivity. However, given the desert environment, this peak could be whenever available, given the infrequency of rain, hence why I expect people to harvest plants throughout the year. Furthermore, I expect people to have been using a wide variety of different plant-use categories, though, given the earth-oven and related fire-cracked rock discard contexts, I expect there to be predominantly geophytes and starchy remains, such as stems, roots, and fleshy leaves of desert rosettes. Finally, I expect that there will be greater counts and overall masses of macrobotanicals and anthracological samples as time progresses, with the most in the middle and late Archaic, given the preservation of perishables through time.

This research contributes to the growing body of knowledge regarding past diets and overall plant usage in south-central North America, by being the first comprehensive archaeobotanical study of plant use at Eagle Cave in the late Pleistocene and Archaic. Results provide not only new data regarding the breadth of dietary and fuel components at Eagle Cave, but also novel insights into similarities and differences as time passes through the late Pleistocene and Archaic, over a period of approximately 10,000 years.

LITERATURE REVIEW

History of Eagle Cave Archaeology

Prior to the most current 2014-2017 Ancient Southwest Texas Project excavations by Texas State University, Eagle Cave was first excavated in the 1930s by the Witte Museum (Ross 1965; Koenig et al. 2022). These excavations were poorly recorded, collected no tracible artifacts, and neglected to backfill the trenches, however, there is record of having found Texas mountain laurel/mescal bean (*Dermatophyllum secundiflorum*) (Fabaceae) beans and Mexican buckeye (*Ungnadia speciosa*) (Sapindaceae) seeds in the cave, which is evidence of psychotropic plant use (Davenport 1938; Ross 1965; Adovasio and Fry 1976; Boyd and Dering 1996; Koenig et al. 2022). However, the current whereabouts of the specimens are unknown (Ross 1965; Koenig et al. 2022). Following the excavations in the 1930s, significant excavations were conducted in the 1960s by the University of Texas at Austin (Ross 1965; Koenig et al. 2022). These excavations were primarily conducted in the center of the rock shelter, and one unit was taken to the bedrock (Koenig et al. 2022). Evidence of nearby bedrock mortars were documented, and hearths, depressions, pits, ovens, and a burial were uncovered (Ross 1965). Chipped stone artifacts, namely projectile points of the Parida, Pecos, Devils, and Rio Bravo series, knives, bifaces and unifaces, drills, gravers, milling stones, hammerstones, and even stone pipe were found, among others (Ross 1965). Bone and shell artifacts, such as awls, worked antler tines, modified ribs, worked catfish opercle, bone and shell beads, among others, were found (Ross 1965). Small clay artifacts of unknown usage were found as well (Ross 1965). Botanically related specimens were also uncovered, including mats, cordage, a variety of sticks, and a sandal (Ross 1965). While these excavations date occupation of Eagle Cave to approximately 6700

BCE at its earliest, to approximately 1000 BCE, based on changing projectile point styles, later excavations have dated occupation of Eagle Cave to far earlier (Ross 1965; Koenig et al. 2022) Excavations resuming in 2014 under the leadership of Dr. Steve Black and Charles Koenig, of Texas State University, found that occupation of Eagle Cave dated further back to the early Paleoindian period, approximately between 12,660 and 12,480 cal BP (Koenig et al. 2022). These excavations took place in order to study site formation processes and stratigraphy, earth-oven use, and Paleoindian subsistence patterns through floral and faunal remains (Koenig et al. 2022). Due to the proximity of Eagle Cave to another dry rock shelter and potential bison kill site, Bonfire Shelter, and similar association with chipped stone artifacts and *Bison antiquus* remains, it is possible that Eagle Cave was a camp for processing kill remains (Koenig et al. 2022). Furthermore, due to the nature of the macrobotanical assemblage examined, namely the presence of mesquite (*Prosopis* spp.) (Fabaceae) pods and beans, it is observed that the camp was occupied during the summertime (Koenig et al. 2022). While considerable work has been done on artifacts and stratigraphy from the Archaic, as well as a study of the Paleoindian occupation of the cave, little work has been done so far on the subsistence patterns (floral and faunal remains) of denizens of Eagle Cave throughout the late Pleistocene and Archaic. In this study, I aim to specifically examine the plant use and botanical subsistence patterns of Paleoindian, late Paleoindian, and early, middle, and late Archaic peoples occupying Eagle Cave.

Eagle Cave Climate

The climate of Eagle Cave, Eagle Nest Canyon, and the surrounding Lower Pecos region today is xeric in nature, with biota characteristic of the Chihuahuan desert in the dry uplands, and more mesic and riparian species on the canyon floor (Schmidt 1979; Turpin 1987; Turpin 2004;

Nielsen 2017). However, the Chihuahuan desert as a whole has not always been as arid as it is today. In the late Pleistocene and early Holocene (9,800-8,800 cal BP – late Paleoindian), there was a gradual drying of the grasslands in the area we know today as the Chihuahuan desert, paving the way for the colonization of xeric desert species (Schmidt 1979; Turpin 1987; Turpin 2004; Nielsen 2017). This climatic shift, coinciding with the decline of Pleistocene megafauna appeared to alter the lifeways of the Lower Pecos peoples, from the hunting and processing of large game to wild plant processing and hunting of smaller game (Schmidt 1979; Turpin 1987; Turpin 2004; Nielsen 2017). This arid trend continues to the present, with a brief mesic interlude at the beginning of the late Archaic (3,200-1,300 cal BP), characterized by increased concentrations of grass and pine pollen in strata, as well as by the return of bison to the region (Schmidt 1979; Bryant and Holloway 1985; Turpin 1987; Turpin 2004; Nielsen 2017). The relevance of increasing aridity in the Lower Pecos to this study can be qualified by potential shifts in subsistence patterns, from grassland plant and large game processing and consumption in the Paleoindian, to more xeric plant and small game processing and consumption throughout the Archaic, with a potential backwards shift in the late Archaic as moisture briefly returned to the desert.

Eagle Cave Flora

The flora of Eagle Cave, and the surrounding Eagle Nest Canyon is characterized presently by different species of cacti characteristic of the Chihuahuan desert, agaves, especially *Agave lechuguilla* (Asparagaceae), *Yucca* spp. (Asparagaceae), sotol (*Dasylirion* spp.) (Asparagaceae), various members of the Fabaceae family, namely mesquite (*Prosopis* spp.), *Senegalia* spp., and *Vachellia* spp., various members of the Rhamnaceae family, including hogplum (*Colubrina* spp.), *Condalia* spp., and coyotillo (*Karwinskia* spp.), ocotillo (*Fouqueria splendens*) (Fouqueriaceae), and Texas persimmon (*Diospyros texana*) (Ebanaceae), and other less common species in the desert uplands (Ross 1965; Sobolik 1991; Sobolik 2008; Riley 2008; Riley 2012; Dering 2021). In the canyonlands proper, there are more tree species, such as willow (*Salix* spp.) (Salicaceae), cottonwood (*Populus* spp.) (Salicaceae), walnut (*Juglans* spp.) (Juglandaceae), oak (*Quercus* spp.) (Fagaceae), hackberry (*Celtis* spp.) (Cannabaceae), and other more herbaceous species along the canyon's riparian zone (Ross 1965; Sobolik 1991; Sobolik 2008; Riley 2008; Riley 2012; Dering 2021). Two recent trips to Eagle Nest Canyon (Summer 2021 and Winter 2022), with associated plant identification and species lists, confirmed the continued presence of these species today. These plants were identified following the World Flora Online database of botanical nomenclature. Until recently (Koenig et al. 2021), there have been minimal studies of botanical remains found at the site. Furthermore, this study was conducted on Paleoindian and late Paleoindian remains (Koenig et al. 2021). Most research into the archaeobotany of the Lower Pecos Canyonlands has been conducted at other rock shelters throughout the region, primarily throughout the Archaic (Sobolik 1991; Sobolik 2008; Riley 2008; Riley 2012; Dering 2021). Based on these prior paleoethnobotanical studies, one can anticipate that Eagle Cave will contain similar Paleoindian and Archaic botanical assemblages to the rest of the rock shelters, though, as with each site there is the chance to find novel plant species.

Eagle Cave Fauna

The modern fauna of Eagle Cave, and the surrounding Eagle Nest Canyon is characterized by multiple mammalian species, large and small, as well as a wide variety of birds, reptiles, fish and amphibians (Blair 1950; Sobolik 1991; Sobolik 2008; Riley 2008; Riley 2012; Dering 2021; Koenig et al. 2021). Historically and until present, mammals such as javalina (Tayassuidae), deer, coyote (*Canis latrans*), jackrabbit, beaver (*Castor* sp.), rock squirrel (*Otospermophilus variegatus*), raccoon (*Procyon lotor*), skunk (Mephitidae), badger (Mustelidae), fox (*Vulpes* sp.), ringtail (*Bassariscus astutus*), grey wolf (*Canis lupus*), panther (*Puma concolor*), and black bear (*Ursus americanus*) have been found in the Lower Pecos (Blair 1950; Ross 1965). Birds, such as vultures (Cathartidae), sparrows (Passerellidae), wrens (Troglodytidae), turkeys (*Meleagris gallopavo*), ducks (Anatidae), doves (Columbidae), quail (Odontophoridae), and eagles (Accipitridae) are also present (Blair 1950; Ross 1965). There is also a myriad of reptiles, such as many species of snakes and lizards, myriapods like centipedes and millipedes, arachnids like scorpions and spiders, and insect life (Blair 1950; Ross 1965). Ancient deer (*Odocoileus* sp.), jackrabbit (*Lepus californicus)*, avian, rodent, and fish remains have been found in situ at Eagle Cave, with Pleistocene megafauna, such as *Bison antiquus* and mammoth (*Mammuthus* sp.) remains also being present (Sobolik 1991; Sobolik 2008; Riley 2008; Riley 2012; Dering 2021; Koenig et al. 2021). Additionally, ancient bighorn sheep (*Ovis canadensis*) dung radiocarbon dated to 12,500 cal BP was found, indicating that the site had at one point been occupied by bighorn sheep (Koenig et al. 2021; Mead et al. 2021). Prior zooarchaeological examinations of bulk matrix samples from pits, hearths, and earth-ovens, as well as coprolites, have shed some light onto the potential faunal dietary components of the Paleoindian and Archaic denizens of the Lower Pecos Canyonlands.

Eagle Cave Rock Art

Another major focus around Eagle Cave, and the Lower Pecos Canyonlands in general, is the study of ancient rock art on the rock shelter walls. This has been examined throughout the Lower Pecos Canyonlands, though recently, this study has expanded into the art found at Eagle Cave (Dering 2021; Koenig et al. 2021; Steelman et al. 2021). In Eagle Cave specifically, exploration has been undertaken to date the rock art using novel radiocarbon dating methods of plasma oxidation and mineral accretion (Steelman et al. 2021). The pictographs of Eagle Cave were dated to approximately 3690-3370 cal BP (Steelman et al. 2021). While there has been considerable interpretation of the Lower Pecos culture, identifying anthropomorphic and zoomorphic figures, as well as repeating patterns and pigments, the predominant reason why Lower Pecos rock art is relevant to this study is because of the botanical representations (Boyd and Dering 1996; Boyd 2003). Depictions of notable psychotropic plants, such as toloache/jimsonweed (*Datura* spp.) (Solanaceae), mescal bean (*Dermatophyllum secundiflorum*), and peyote (*Lophophora willamsii*) (Cactaceae) have been inferred from the rock art of multiple Lower Pecos rock shelters, indicating that these plants were potentially used by the occupying peoples (Boyd and Dering 1996). With specimens of mescal bean having been recorded at Eagle Cave, and other psychotropic plants at other sites, this further corroborates the hypothesis that these plants were being used by the peoples of the region (Boyd and Dering 1996).

Figure 1. Rock Art at Eagle Cave

METHODS*

Data Acquisition

This project was completed under Texas State's Ancient Southwest Texas Project (ASWT), in order to identify macrobotanical components from 10 samples from the Lower Pecos along the Texas-Mexico border. The time periods examined from the features range from 10,655-10,295 cal BP (Lot 33986); 10,375-9,915 cal BP (Lot 33338); 10,000-7,500 cal BP (Lot 34676); 6,500-5,500 cal BP (Lot 34669); 5,500-3,100 cal BP (Lot 33263); 4,500-3,000 cal BP (Lot 32458); 2,800 cal BP (Lot 32454); 3,155-2,955 cal BP (Lot 30876); 2,800-2,200 cal BP (Lot 33937); and 2,200-2,000 cal BP (Lot 30835). These samples are thus placed roughly between the Paleoindian (12,000-9,800 cal BP), late Paleoindian (9,800-8,800 cal BP), and early (8,800-5,500 cal BP), middle (5,500-3,200 cal BP), and late (3,200-1,300 cal BP) Archaic periods, archaeologically speaking (Table 1). The samples came from a dry rock shelter, site number 41VV167, Eagle Cave in Eagle Nest Canyon, Langtry, Texas, Val Verde County, United States. Each of the samples were taken either from confirmed earth-oven features, or fire-cracked rock discard zones (Table 1; Figure 2). The earth-oven and lens features are likely to contain direct evidence of plant remains that were either used as food, fuel, or packing material, while the fire-cracked rock discard zones are more likely to contain bits of charred plant remains that adhered to the rocks that were tossed out of the earth-oven contexts. Compared to prior work, this study examines both earth-ovens and fire-cracked rock discard zones. Earth-oven features are concave pits and are characterized by layers of larger fire-cracked rocks, ash, charcoal, burned residue, and other organics such as plant or faunal remains. Fire-cracked rock discard

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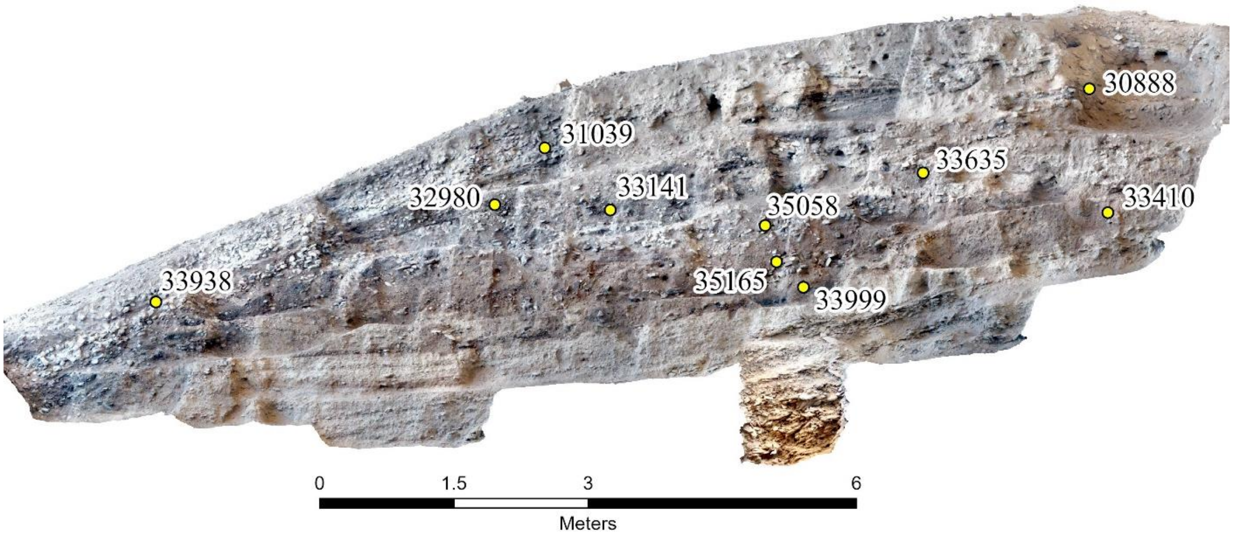
* Reprinted with permission from "A Newly Identified Younger Dryas Component in Eagle Cave, Texas" by Koenig et al., 2021. *American Antiquity*, 87, 379, Copyright 2021 by Charles Koenig.

zones are similar in content, albeit with smaller, unusable fire-cracked rock fragments, but tend to be more haphazard and strewn about, characteristic of refuse piles. This is the first study of earth-ovens and fire cracked rock discard zones from Eagle Cave during the Paleoindian and Archaic.

Table 1. Table Depicting the Assessed Lots Through Time

Paleoindian (12,000-9,800 cal BP)	**Late Paleoindian (9,800–8,800 cal BP)**	**Early Archaic (8,800-5,500 cal BP)**	**Middle Archaic (5,500-3,200 cal BP)**	**Late Archaic (3,200-1,300 cal BP)**
Lot 33986 - 33999 (Organic-rich lens from earth oven)	Lot 34676 - 35165 (FCR discard)	Lot 34669 - 35058 (Dense FCR discard)	Lot 33263 - 33635 (Ashy FCR discard)	Lot 32454 - 32980 (FCR discard below fiber layer)
Lot 33338 - 33410 (Earth oven heating element)			Lot 32458 - 33141 (FCR discard)	Lot 30876 - 30888 (Earth oven heating element)
				Lot 33937 - 33938 (Dense ashy FCR discard)
				Lot 30835 - 31039 (Dense ashy FCR discard with charcoal and fiber)

Figure 2. Cross-Section where Matrix Samples were Excavated. Reprinted and modified with permission from Koenig et al. 2021



The samples analyzed for this study were collected by Charles Koenig, a PhD candidate with Texas State University and the University of Wyoming during a 2014-2017 archaeological excavation of Eagle Cave in Eagle Nest Canyon. I analyzed the samples during the summer of 2021, in the laboratory of Dr. Leslie Bush, a Texas-specialized archaeobotanist.

10 one-liter bags of sediment comprised the sample set, which was dry sieved using increasingly finer sieves. In stacked sequential order, 4.75mm, 2.00mm, 1.00mm, 0.50mm, and eventually 0.25mm. The first four samples were dry sieved, lot numbers 33986, 33338, 34676, and 34669, as well as the eighth sample, lot number 30876. The first four samples were processed before recognizing the need for wet sieving later on, due to dust impacting identification quality and visibility. The eighth sample, lot number 30876 did not require wet sieving, due to the relative lack of dust. The procedure for dry sieving is as follows: first, the sediment was weighed in grams, and then the sediment was sieved using the stacked sieves. The 4.75mm and 2.00mm grade subsamples were initially analyzed and the components were sorted, using a 6-50 X stereozoom dissecting microscope, into individual categories of rocks, chert,

wood charcoal, various carbonized macrobotanicals, such as seeds, fruits, stems, spines, cladodes, nutshell, leaves, and bark, various uncarbonized macrobotanicals, faunal remains, and insect remains. The subsample macrobotanical components were identified, to at least the family level, but more often than not to genus level, and occasionally species. The samples were identified using a comparative collection in Dr. Bush's lab, of modern macrobotanical plant samples. Many of these comparative samples were collected in June 2021, directly from Eagle Nest Canyon. The archaeological samples were identified to family, sub-family, genus, or to species, by comparing them to multiple cross-sections, radial sections, and tangential sections of modern woody species, and fruits, seeds, and leaf fragments or other plant parts. These modern plant components were examined under the 6-50 X stereozoom dissecting microscope at variable magnifications, to determine if a potential match could be made with the ancient unknown samples. The 1.00mm, 0.50mm, and 0.25mm subsamples were randomized respectively, and split into 5mL increments a variable number of times. This number of times ranged from 2 splits to 5 splits, depending on the sample grain size (Table 2). The variance was determined by no longer finding novel identifiable macrobotanical species in successive subsample splits. After the macrobotanical components were identified, they were sorted by species, weighted, counted, and entered into Microsoft Excel. The scale used was capable of measuring weights with precision to 0.01 grams.

Table 2. Sample Lot Number Variance by Grain Size Splits and Sieve Status

Timeframe	**Lot Numbers**	**1.00mm Sample Splits**	**0.50mm Sample Splits**	**Wet or Dry Sieved**
Paleoindian	Lot 33986 - 33999	2	3	Dry
Paleoindian	Lot 33338 - 33410	2	3	Dry

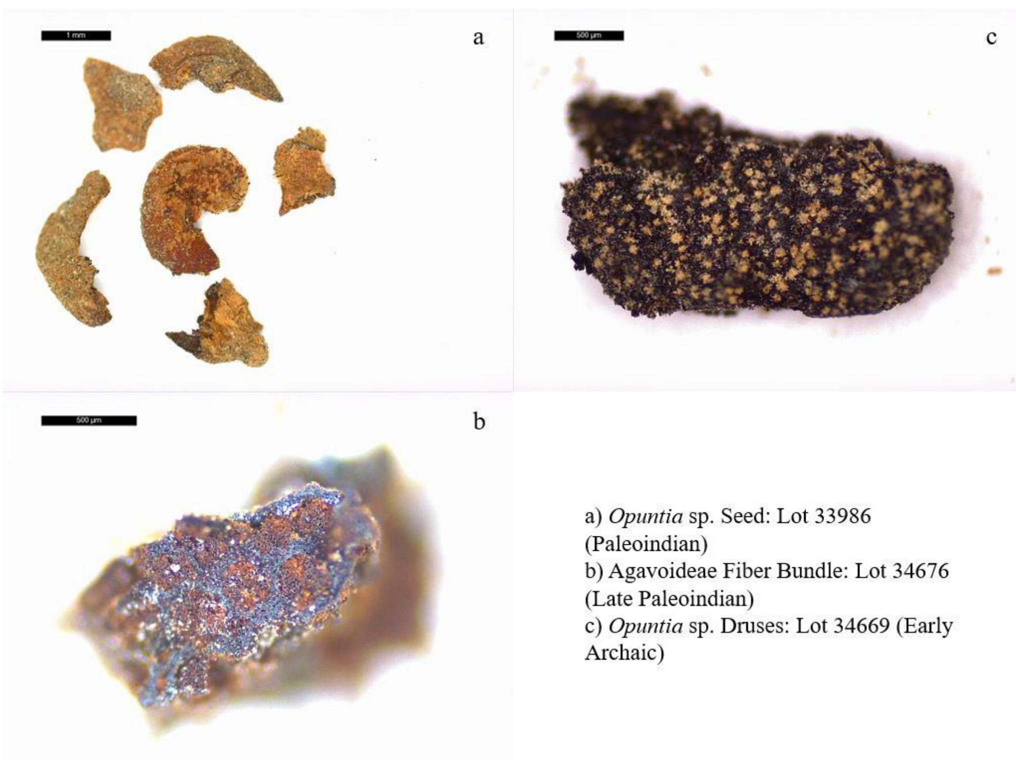
Late Paleoindian	Lot 34676 - 35165	2	3	Dry
Early Archaic	Lot 34669 - 35058	2	3	Dry
Middle Archaic	Lot 33263 - 33635	2	3	Wet
Middle Archaic	Lot 32458 - 33141	5	4	Wet
Late Archaic	Lot 32454 - 32980	2	3	Wet
Late Archaic	Lot 30876 - 30888	2	3	Dry
Late Archaic	Lot 33937 - 33938	3	4	Wet
Late Archaic	Lot 30835 - 31039	2	3	Wet

Significant quantities of dusty sediment obscured the material recovered in lot numbers 33263, 32458, 32454, 33937, and 30835. These 5 samples were wet sieved, using painter's mesh with holes at approximately 0.06mm wide in the shape of isosceles triangles, and a bucket of water. The ratio of 10mL water to 1mL baking soda was used, as the baking soda was useful in breaking apart clumps of sediment and floating the light fraction to the surface. Once wet sieved, the samples were removed to dry, and the water and leftover sediment was disposed of. Once dry, the samples were treated akin to the dry sieved samples and were sorted and identified accordingly. Using this wet sieve technique, the samples became considerably cleaner and easier to identify.

Data Analysis

Following the completion of macrobotanical and wood charcoal identifications, the counts and weights derived from the laboratory sorting procedures end up comprising the bases of all further analyses. Qualitative analyses include examining visual representations of the data for similarities and differences between the counts and weights of macrobotanicals and wood charcoal. These analyses are made to better understand the changes between time periods (Paleoindian, Late Paleoindian, Early Archaic, Middle Archaic, Late Archaic), environmental zone and general growth habitat of different taxa (desert upland, mixed environment, riparian), feature type containing different taxa (earth-oven versus fire-cracked rock discard pile), seasonality of different taxa (spring, summer, fall, winter), and overall plant-use categories (seeds, fruits, leaves, stems, roots), based on ethnographic records.

Figure 2. Macrobotanical Sample Examples



a) *Opuntia* sp. Seed: Lot 33986 (Paleoindian)
b) Agavoideae Fiber Bundle: Lot 34676 (Late Paleoindian)
c) *Opuntia* sp. Druses: Lot 34669 (Early Archaic)

RESULTS

Ecological and Ethnobotanical Comparisons

For qualitative analyses, the seasonality and relevant growth habits and habitats of the taxa identified in each sample had to be discerned. This was done by comparing the ancient identified species found in the samples, with the ecology of their present-day counterparts. Since the identified species present in the samples are all presently extant, and yet persist within the Chihuahuan desert region today, educated inferences about the ecology of the ancient species can be made (Table 3; Table 4). These comparisons were made possible by browsing current existing literature on the relevant plant ecologies, including seasonality and overall habitat of each taxon found in the samples examined. These comparisons can be used for further analyses, after visualizing the data in a series of plots.

Table 3. Seasonality and Ethnobotany of Major Taxa at Eagle Cave

Macrobotanical Taxon	Part Used	Summer	Fall	Winter	Spring	References
Chenopodium sp.	Seed	**X**	**X**			Reagan 1929; Castetter and Underhill 1935; Castetter and Opler 1936; Gifford 1936; Castetter et al. 1938; Castetter and Bell 1942; Barrett and Gifford 1943; Curtin 1949; Castetter and Bell 1951; Wyman and Harris 1951; Pennington 1963; Wilson and Heiser 1979; Bye 1981; Fritz 1984; Buskirk 1986; Gasser and
	Leaf	**X**			**X**	

						Kwiatkowski 1991; Moerman 1998; Hodgson 2001; Tull 2013; Cheatham et al. 2018; Powell 2018; Koenig et al. 2022
Amaranthus sp.	Seed	**X**	**X**			Reagan 1929; Castetter and Underhill 1935; Castetter and Opler 1936; Gifford 1936; Castetter et al. 1938; Castetter and Bell 1942; Barrett and Gifford 1943; Curtin 1949; Castetter and Bell 1951; Wyman and Harris 1951; Pennington 1963; Wilson and Heiser 1979; Bye 1981; Fritz 1984; Buskirk 1986; Gasser and Kwiatkowski 1991; Cheatham et al. 1995; Moerman 1998; Hodgson 2001; Tull 2013; Powell 2018; Koenig et al. 2022
	Leaf	**X**			**X**	
Rhus virens	Seed		**X**			Powell 1998; Moerman 1998
	Leaf	**X**	**X**	**X**	**X**	
Agave lechuguilla	Leaf	**X**	**X**	**X**	**X**	Castetter and Opler 1936; Castetter et al. 1938; Basehart 1960; Pennington 1963; Gentry 1982; Buskirk 1986; Cheatham et al. 1995; Moerman 1998; Dering 1999; Hodgson 2001; Miller and Kenmostu 2004; Tull 2013; Powell 2018; Koenig et al. 2022
	Stem	**X**	**X**	**X**	**X**	
Dasylirion sp.	Leaf	**X**	**X**	**X**	**X**	Bell and Castetter 1941; Brown 1988; Turpin 1991;
	Stem	**X**	**X**	**X**	**X**	

						Moerman 1998; Dering 1999; Powell 2018
Yucca sp.	Leaf	**X**	**X**	**X**	**X**	Russell 1908; Stevenson 1915; Gifford 1932; Castetter and Underhill 1935; Castetter and Opler 1936; Bell and Castetter 1941; Elmore 1944; Vestal 1952; Basehart 1960; Colton 1974; Dering 1979; Andrews and Adovasio 1980; Zigmond 1981; Buskirk 1986; Brown 1988; Moerman 1998; Powell 2018
	Fruit	**X**	**X**			
Nolinoideae	Leaf	**X**	**X**	**X**	**X**	Bell and Castetter 1941; Powell 2018
Echinocactus enneacanthus	Fruit	**X**	**X**			Everett and Alaniz 1981; Moerman 1998; Powell 2018
Mammillaria sp.	Fruit	**X**	**X**			Everett and Alaniz 1981; Moerman 1998; Powell 2018
Opuntia sp.	Fruit	**X**	**X**			Everett and Alaniz 1981; Johnston 1963; Campbell 1981; Covey 1983; Sobolik 1991; Foster 1998; Moerman 1998; Wade and Wade 2003
	Seed	**X**	**X**			
	Stem	**X**			**X**	
Diospyros texana	Fruit	**X**	**X**			Carlson and Jones 1939; Dering 1979; Powell 1998; Moerman 1998; Everett et al. 2002; Tull 2013
Fabaceae	Seed	**X**	**X**			Powell 1998; Moerman 1998
	Fruit	**X**	**X**			
Parkinsonia sp.	Fruit	**X**	**X**			Powell 1998; Moerman 1998
Prosopis glandulosa	Fruit	**X**	**X**			Hrdlicka 1908; Russell 1908; Castetter and Underhill 1935; Bell and Castetter 1937; Cosgrove 1947; Curtin 1949; Johnston 1963; Simpson 1977; Campbell 1981; Powell 1998;

						Moerman 1998; Dering 1999; Hodgson 2001
Juglans microcarpa	Fruit		**X**			Reagan 1929; Buskirk 1986; Powell 1998; Moerman 1998; Dering 1999
Sporobolus sp.	Seed	**X**	**X**			Castetter and Opler 1936; Castetter and Bell 1951; Vestal 1952; Colton 1974; Moerman 1998; Dering 1999; Powell 2000
Condalia sp.	Fruit	**X**	**X**			Russell 1908; Curtin 1949; Castetter and Bell 1951; Dering 1979; Powell 1998; Moerman 1998; Hodgson 2001; Everett et al. 2002; Wade and Wade 2003; Cheatham et al. 2018
Rhamnaceae	Fruit	**X**	**X**			Moerman 1998; Powell 2018
Allium drummondii	Root	**X**			**X**	Buskirk 1986; Cheatham et al. 1995; Moerman 1998; Powell 2018
Celtis sp	Fruit		**X**			Castetter and Underhill 1935; Castetter and Opler 1936; Gifford 1936; Carlson and Jones 1939; Elmore 1944; Everett and Alaniz 1981; Black 1986; Powell 1998; Moerman 1998; Everett et al. 2002; Cheatham et al. 2009
Juniperus sp.	Fruit	**X**			**X**	Moerman 1998; Powell 1998
	Leaf	**X**	**X**	**X**	**X**	
Solanum sp.	Fruit	**X**			**X**	Moerman 1998; Powell 2018
	Leaf	**X**	**X**		**X**	
	Root	**X**	**X**		**X**	

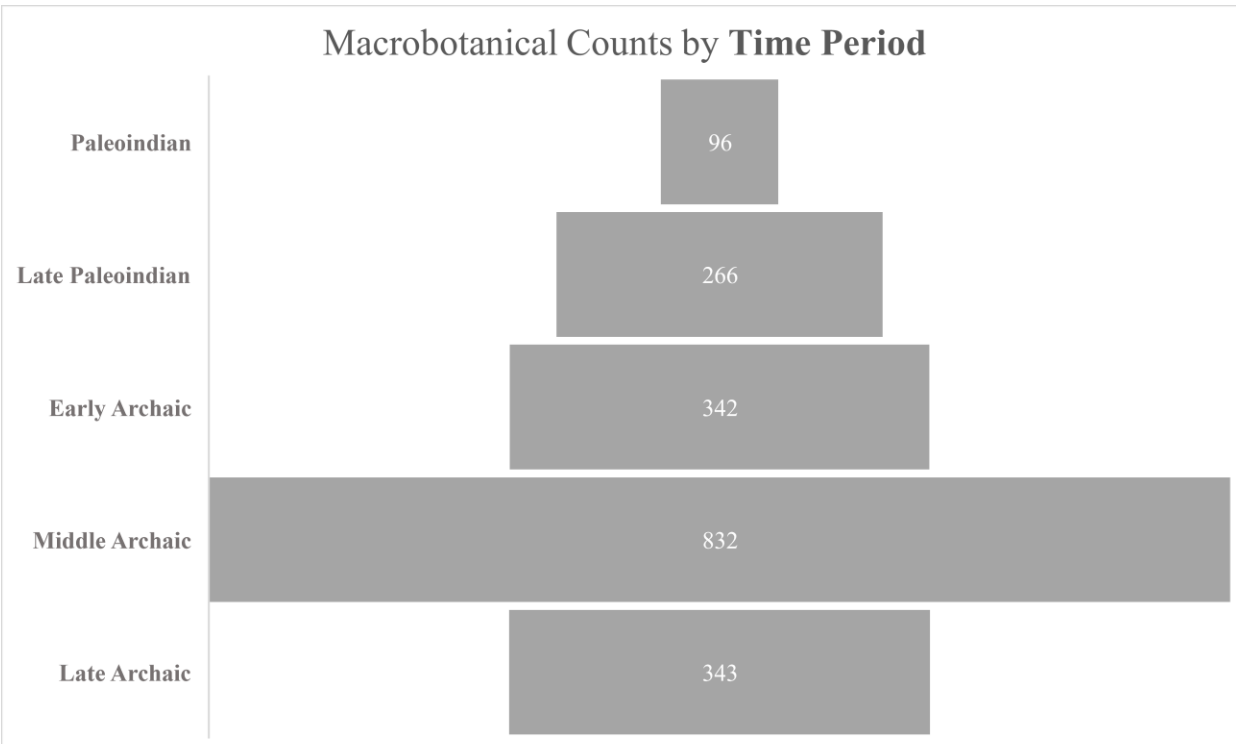
Table 4. Habitat of Major Taxa at Eagle Cave

Macrobotanical Taxon	Part Used	Desert Upland	Mixed Environment	Riparian	References
Chenopodium sp.	Seed		X		Powell 2018
	Leaf		X		
Amaranthus sp.	Seed		X		Powell 2018
	Leaf		X		
Rhus virens	Seed	X			Powell 1998; Vines 2004
	Leaf	X			
Agave lechuguilla	Leaf	X			Gentry 1982; Powell 2018
	Stem	X			
Dasylirion sp.	Leaf	X			Gentry 1982; Powell 2018
	Stem	X			
Yucca sp.	Leaf	X			Gentry 1982; Powell 2018
	Fruit	X			
Nolinoideae	Leaf	X			Gentry 1982; Powell 2018
Echinocactus enneacanthus	Fruit	X			Powell and Weedin 2004; Powell 2018
Mammillaria sp.	Fruit	X			Powell and Weedin 2004; Powell 2018
Opuntia sp.	Fruit	X			Powell and Weedin 2004; Powell 2018
	Seed	X			
	Stem	X			
Diospyros texana	Fruit		X		Powell 1998; Vines 2004
Fabaceae	Seed		X		Powell 1998; Vines 2004
	Fruit		X		
Parkinsonia sp.	Fruit	X			Powell 1998; Vines 2004
Prosopis glandulosa	Fruit	X			Powell 1998; Vines 2004
Juglans microcarpa	Fruit			X	Powell 1998; Vines 2004
Sporobolus sp.	Seed		X		Gould 2000; Powell 2000
Condalia sp.	Fruit	X			Powell 1998; Vines 2004
Rhamnaceae	Fruit		X		Powell 1998
Allium drummondii	Root			X	Powell 2018
Celtis sp	Fruit		X		Powell 1998; Vines 2004
Juniperus sp.	Fruit		X		Powell 1998; Vines 2004
	Leaf		X		
Solanum sp.	Fruit			X	Powell 2018
	Leaf			X	
	Root			X	

Qualitative Analyses by Time Period

By examining the data graphically, the most macrobotanicals were recovered from later in time, during the Archaic (Figure 4). Specifically, the middle Archaic time period samples were found to contain the most macrobotanicals at the site (Figure 4).

Figure 3. Macrobotanical Counts by Time Period



Likewise, the greatest mass of macrobotanicals was also found in the Archaic (Figure 5). However, the trend of macrobotanical mass gradually increases until its peak during the Late Archaic (Figure 5).

Figure 4. Macrobotanical Weights (g) by Time Period

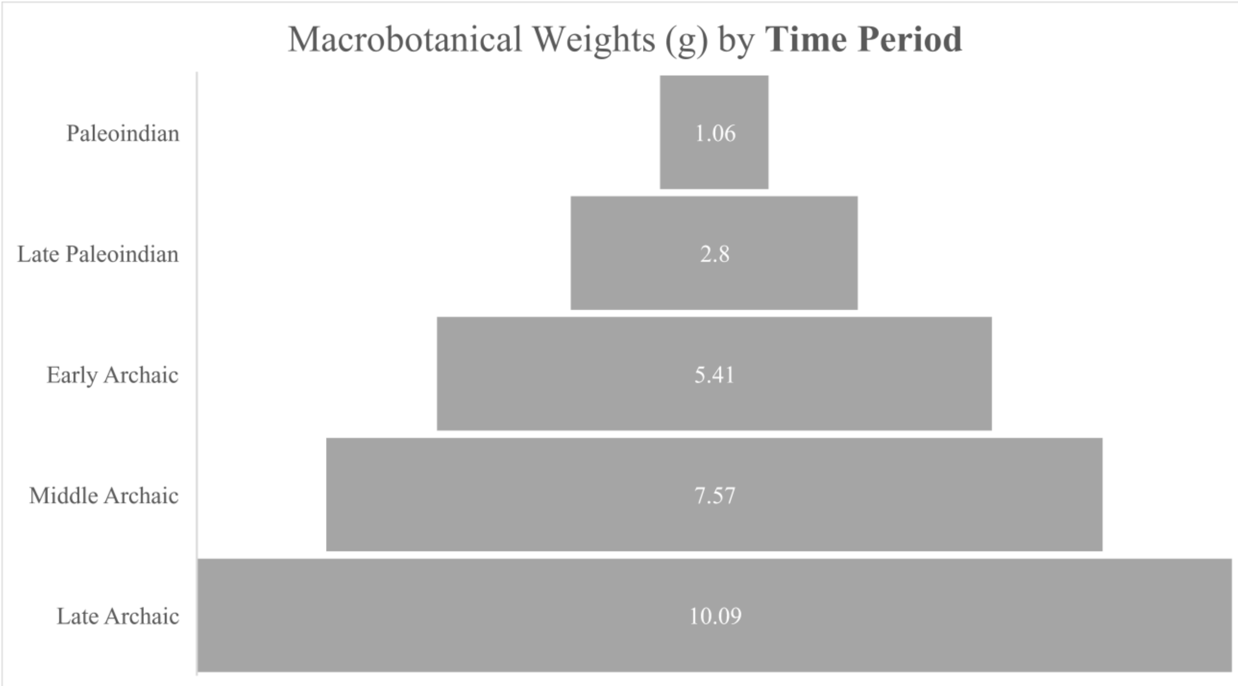
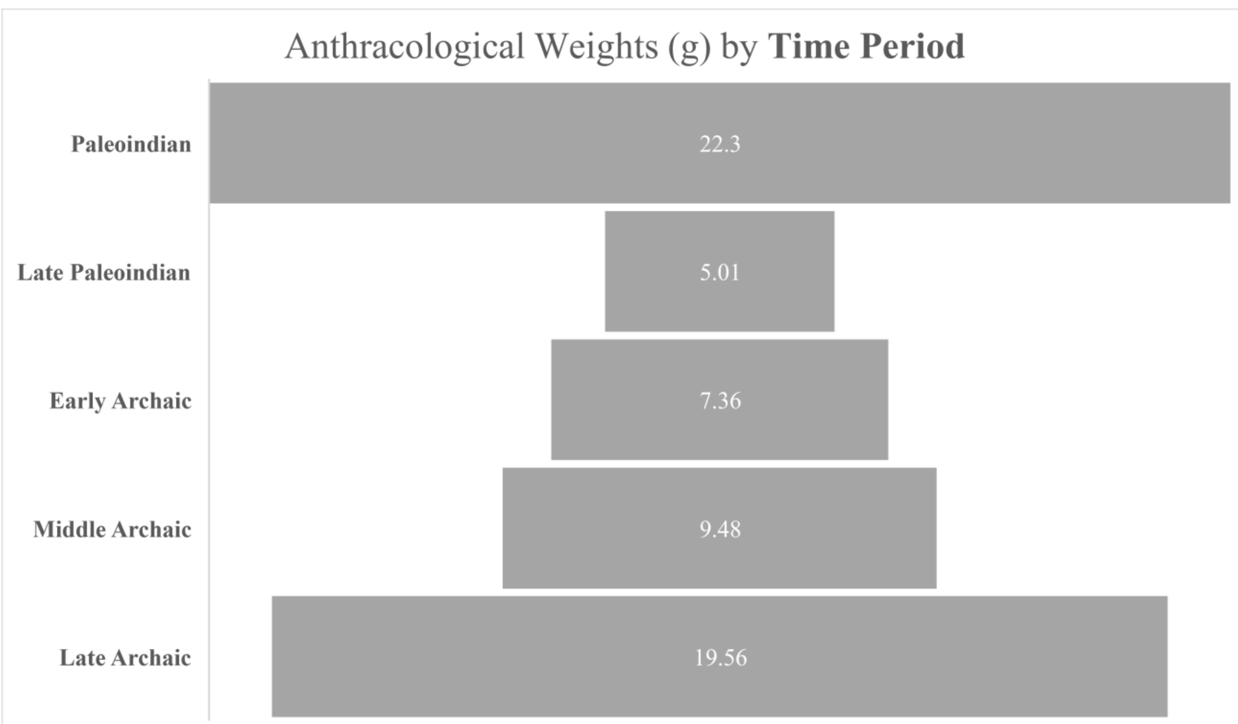


Figure 5. Anthracological Weights (g) by Time Period



Unlike the macrobotanicals, the wood charcoal weights demonstrate a polarizing trend, with the most mass being sampled from the beginning of the range during the Paleoindian, as well as during the late Archaic (Figure 6).

Qualitative Analyses by Feature Type

According to Figure 7, more macrobotanical remains were found in fire-cracked rock discard piles than in earth-oven features. Similarly in Figure 8, most of the mass of macrobotanical remains are contributed by those from fire-cracked rock discard piles over earth-oven features.

Figure 6. Macrobotanical Counts by Feature Type

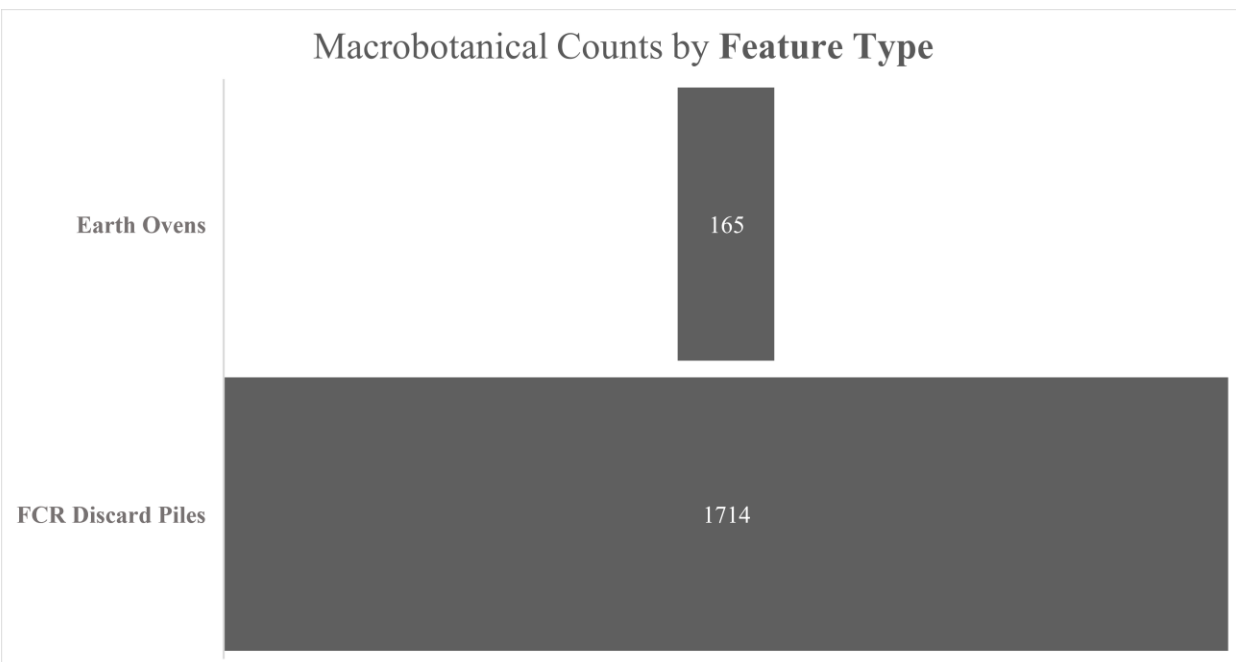
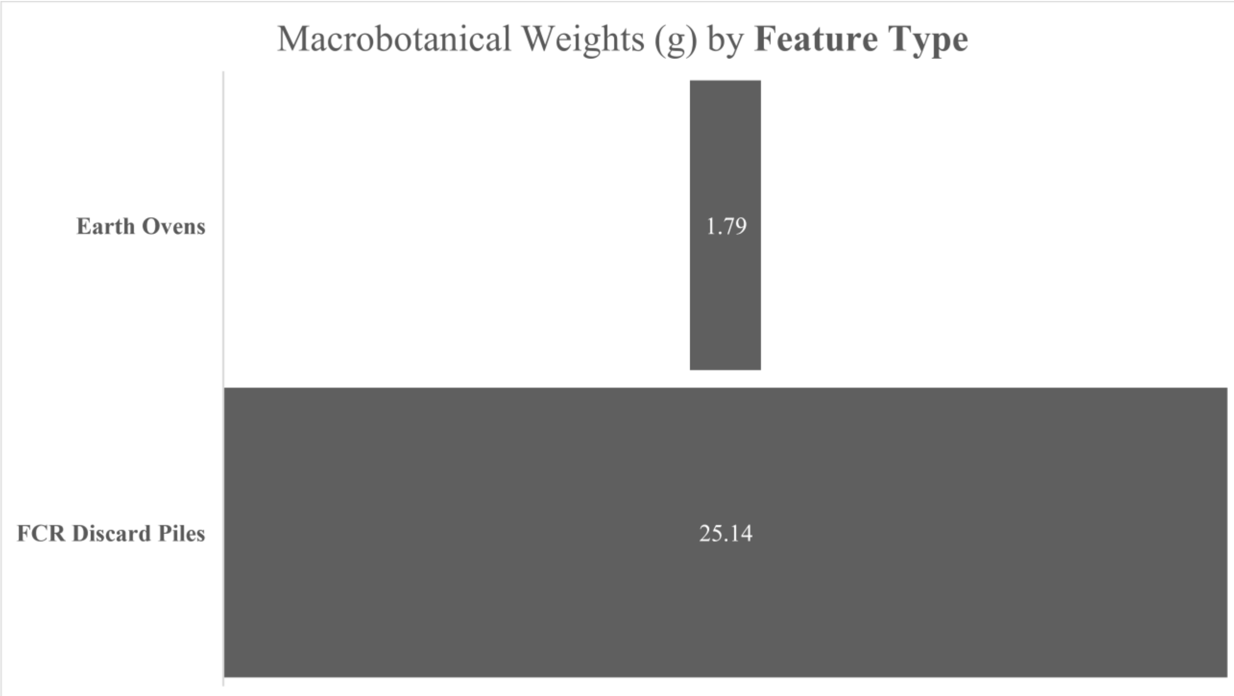
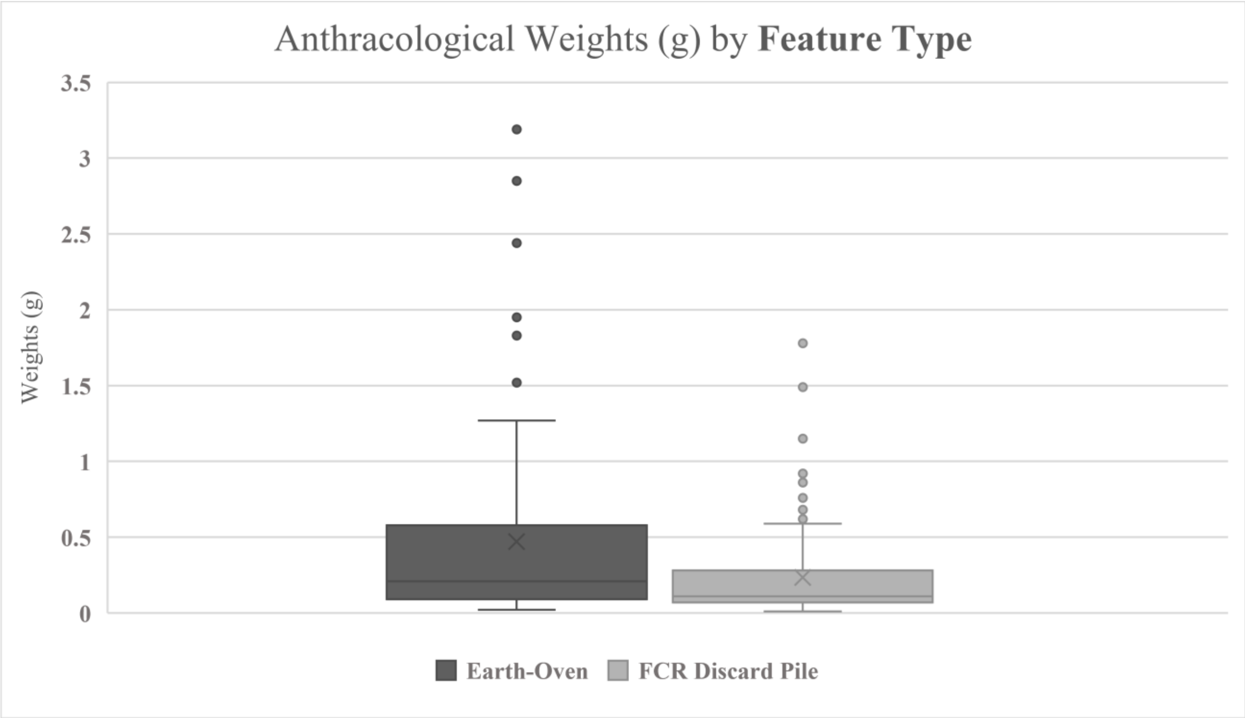


Figure 7. Macrobotanical Weights (g) by Feature Type



However, for the wood charcoal weights specifically, the earth-ovens tend to contain more massive wood charcoal fragments overall, as compared to the fire-cracked rock discard piles (Figure 10).

Figure 8. Anthracological Weights (g) by Feature Type



Qualitative Analyses by Plant Part-Use Category

Examining the results visually, the macrobotanical leaf fragments contribute to the combined weights the most, followed by fruits and seeds, then stems and roots (Figure 10). Furthermore, most of the macrobotanical remains found were either leaves or seeds (Figure 11). There is no analysis for the wood charcoal weights according to plant-use category, because wood charcoal is already, by nature, in its own plant-use category: wood.

Figure 9. Macrobotanical Weights (g) by Plant Part-Use Category

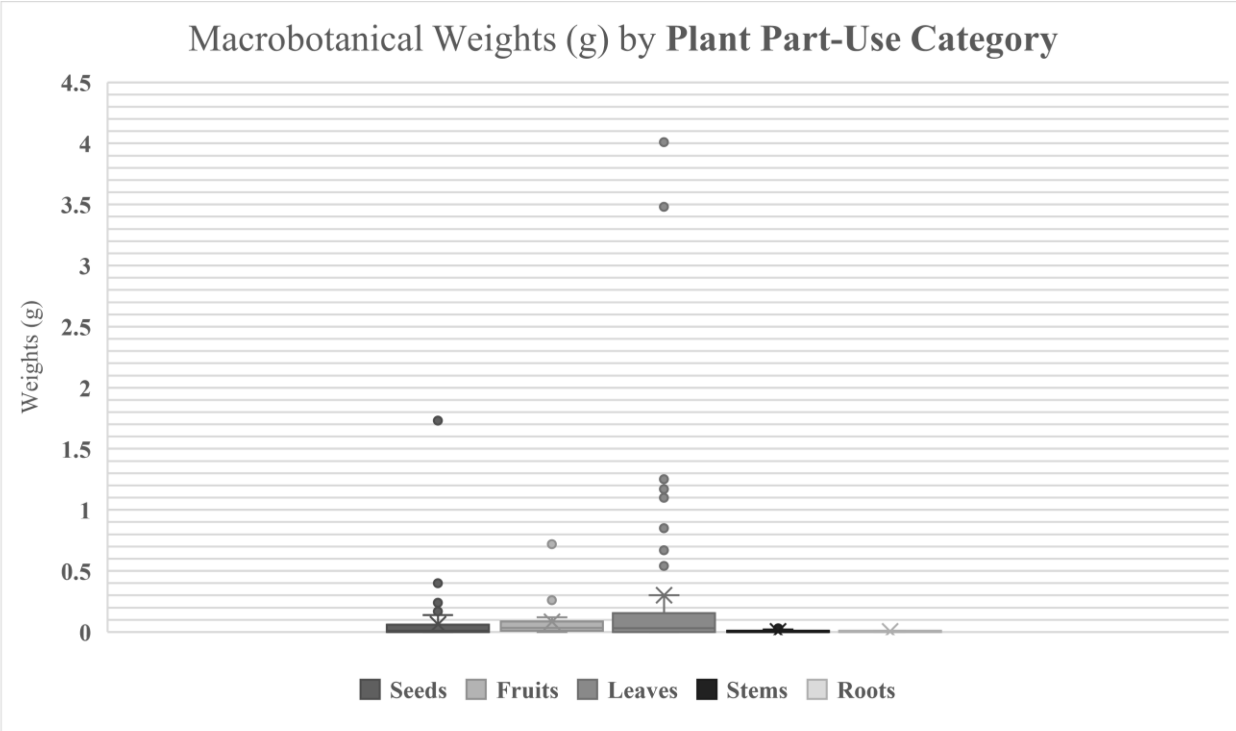
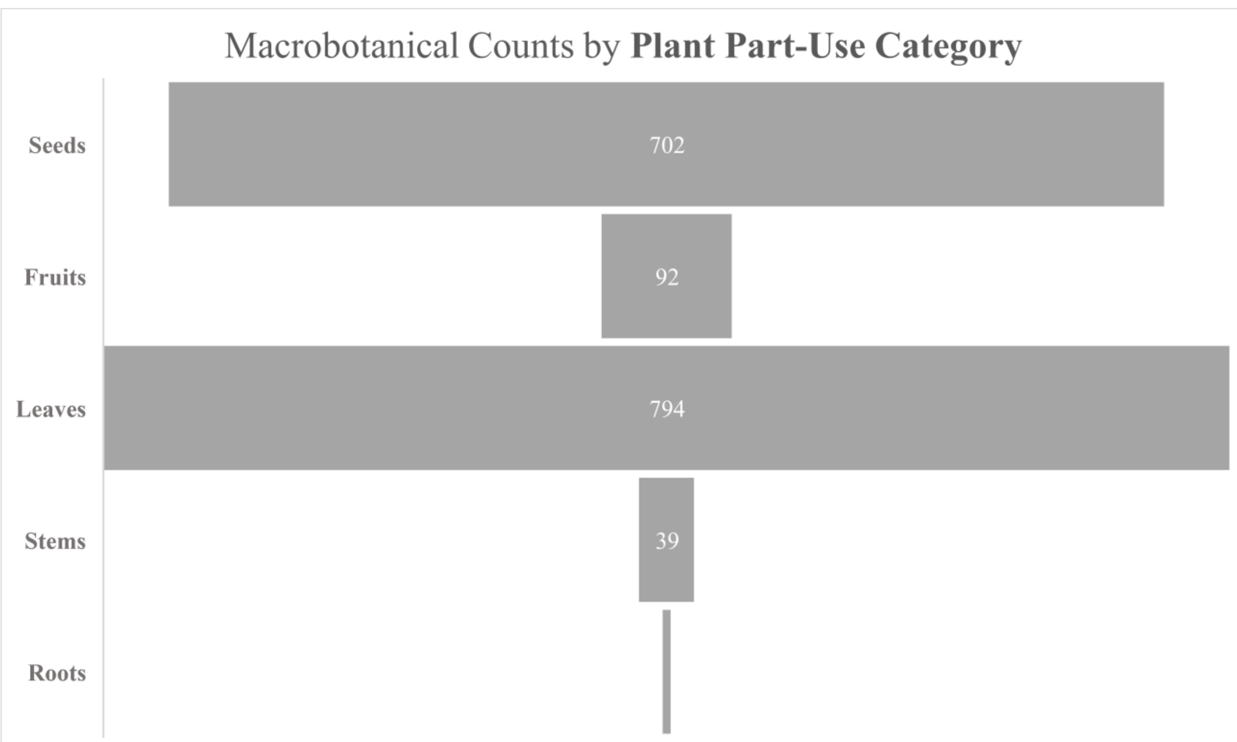


Figure 10. Macrobotanical Counts by Plant Part-Use Category



Qualitative Analyses by Plant Habitat

More macrobotanicals were found to grow in the desert upland environment over any mixed environment or riparian zone (Figure 12). Figure 13 reinforces this assertion, by depicting more massive macrobotanicals from the desert uplands, over riparian or mixed ecosystems. However, there are still macrobotanicals found from each type of environment, despite the predominance towards the desert upland environment (Figure 12; Figure 13). The wood charcoal weights reflect the same trend towards the desert upland, but there yet remains subsamples from the mixed and riparian environments as well, albeit in smaller quantities.

Figure 11. Macrobotanical Counts by Habitat

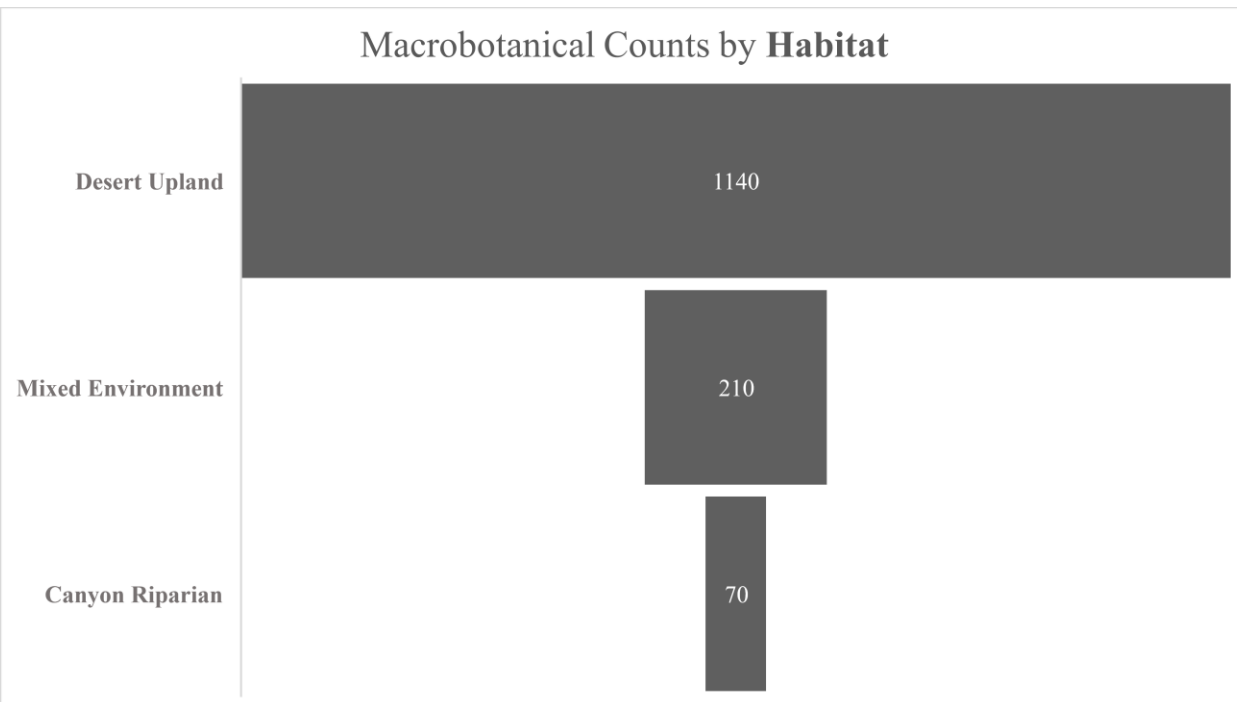


Figure 13. Macrobotanical Weights (g) by Habitat

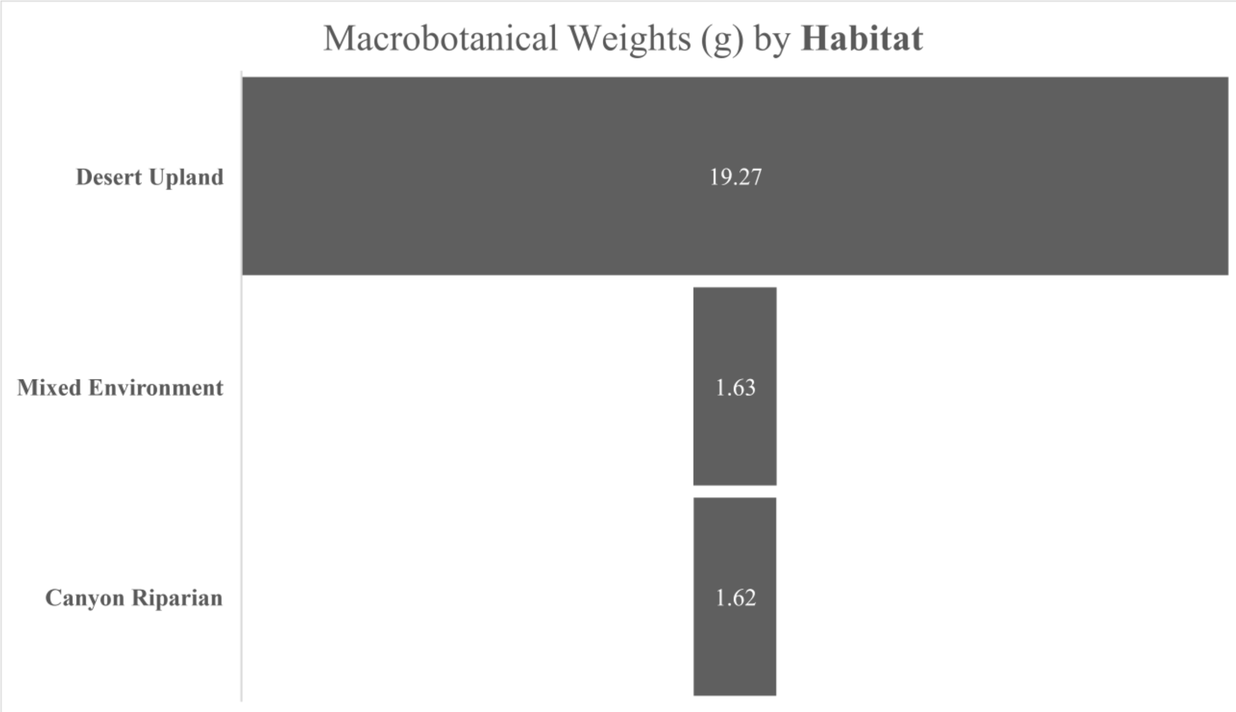
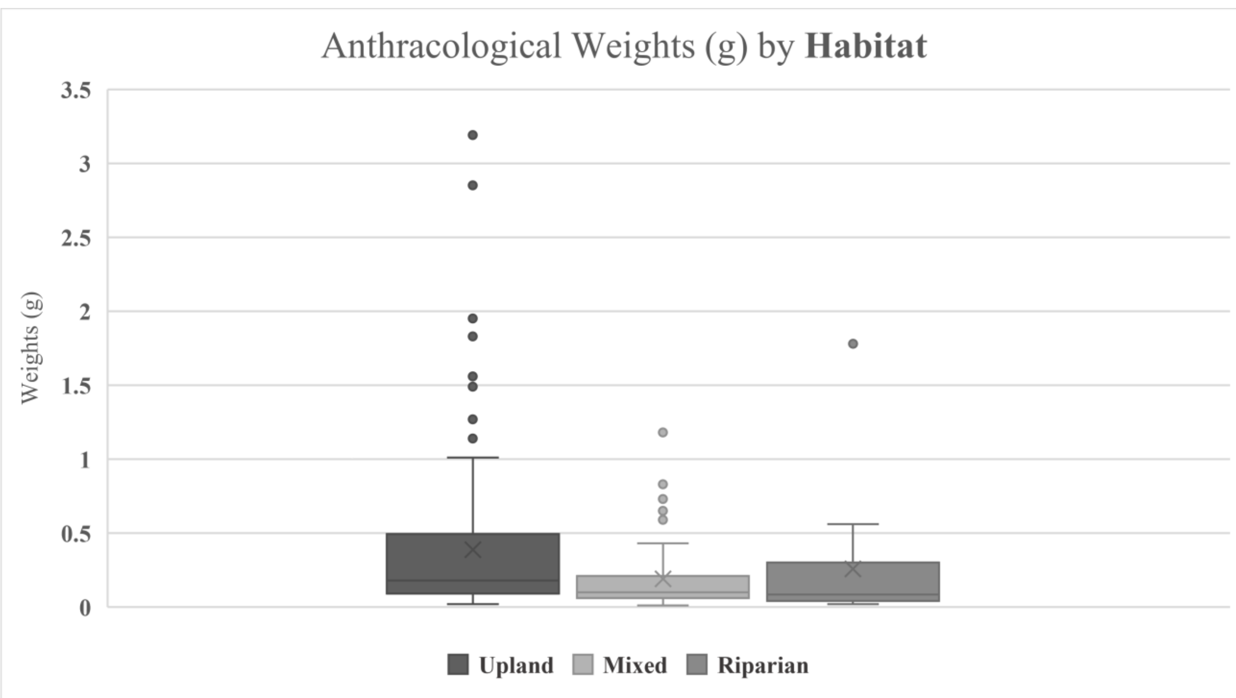


Figure 14. Anthracological Weights (g) by Habitat



Qualitative Analyses by Plant Seasonality

Most macrobotanical remains identified were found to be parts of plants typically harvested in the summer and fall, when compared to ethnographic reference on ethnobotanical relationships (Figure 15). Similarly, the summer and fall seasons maintain the most mass out of the sampled macrobotanical remains (Figure 16). The winter and spring seasons, however, for both the macrobotanical counts and weights are roughly equivalent (Figure 15; Figure 16). There is no analysis for the wood charcoal weights according to plant part-use seasonality, because wood charcoal, and by extension, wood, is an annually available resource.

Figure 12. Macrobotanical Counts by Plant Part-Use Seasonality

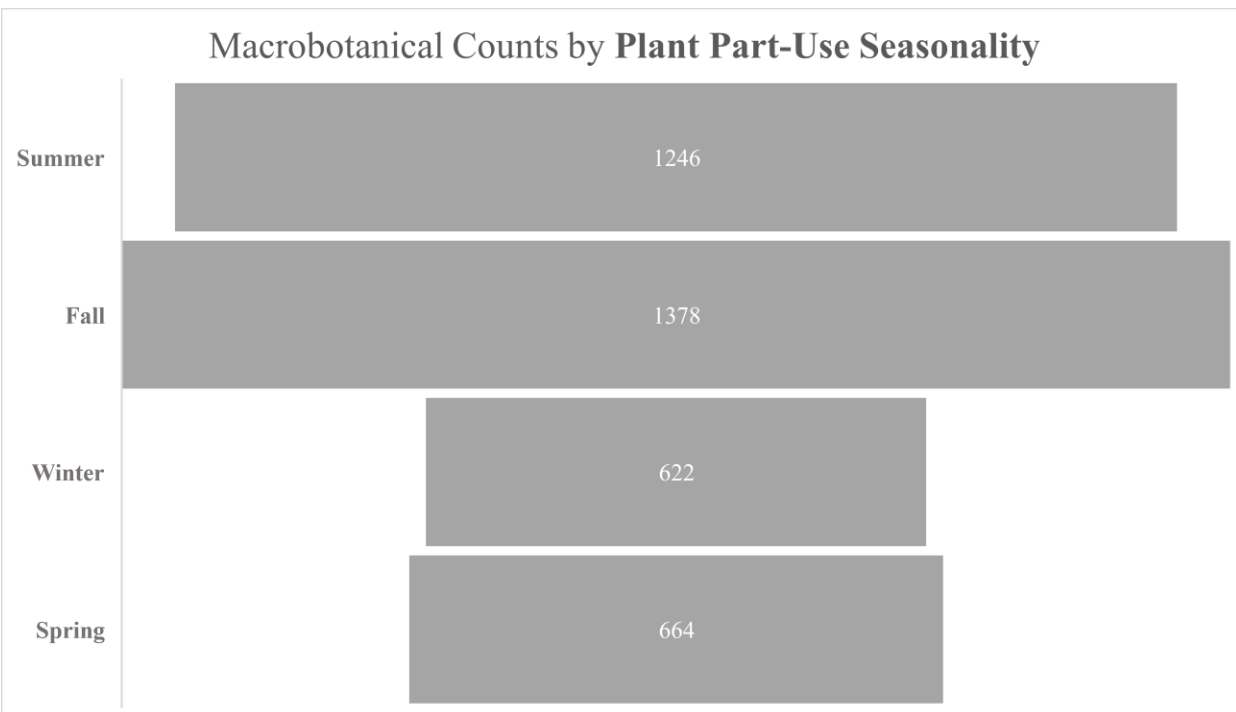
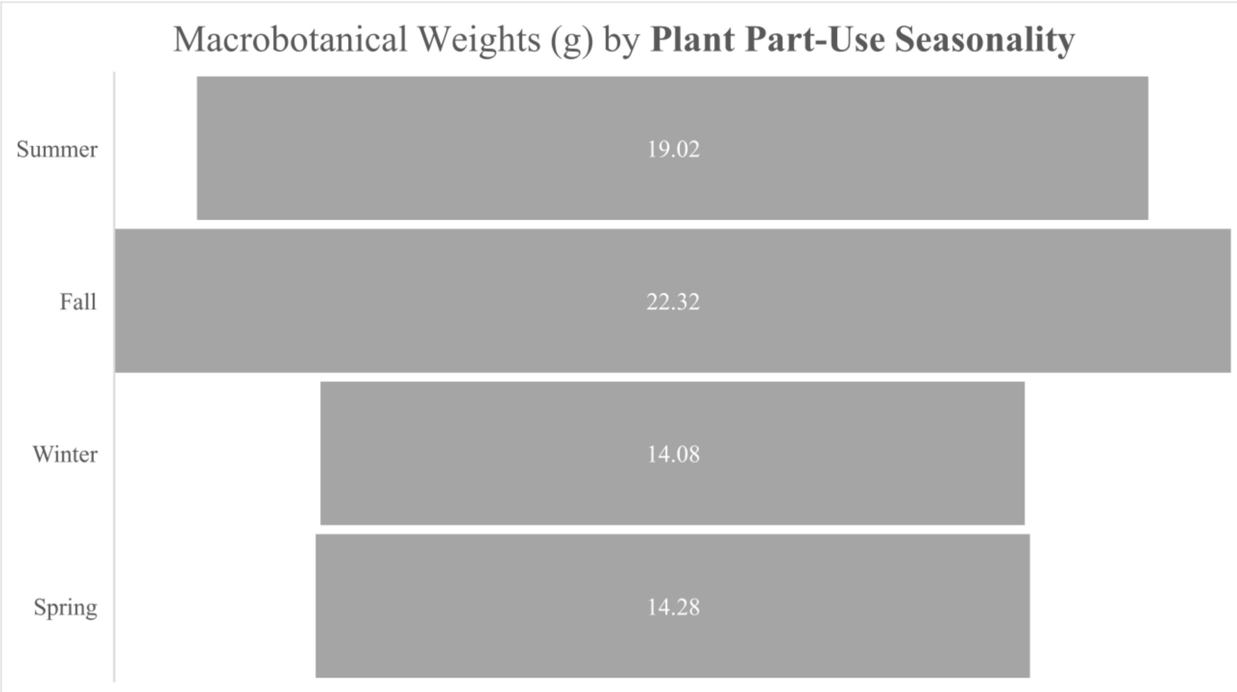


Figure 13. Macrobotanical Weights (g) by Plant Part-Use Seasonality



Qualitative Analyses by Plant Taxa

Of the wood charcoal samples examined, certain weights stood out through time. Specifically, many members of the family Fabaceae were present in high masses throughout the known occupational history of Eagle Cave, notably *Senegalia* spp. and *Prosopis* spp. (Figure 17). *Diospyros texana* also expressed higher weights throughout the occupational history of the rock shelter, as did *Condalia* spp., however, *Condalia* spp. trended towards the end of the Archaic (Figure 17). Smaller weights of *Juniperus* spp., as well as *Fraxinus greggii* were found solidly in the Paleoindian period (Figure 17). The late Paleoindian period is indicative of smaller weights of *Juglans microcarpa*, as well as *Fraxinus velutina* (Figure 17). Early in the Archaic, small quantities of a woody Asteraceae were found (Figure 17). Smaller weights of *Celtis pallida* and *Mahonia* spp. trended towards the middle of the Archaic, as well as *Fouquieria splendens* and members of the family Salicaceae, as did other members of the family Rhamnaceae, namely *Karwinskia humboltiana* and *Colubrina texensis* (Figure 17). Finally, the late Archaic is characterized by small masses of various families, including Anacardiaceae, Fagaceae, Asteraceae, Zygophyllaceae, Sapindaceae, Scrophulariaceae, and Rubiaceae (Figure 17).

While the later ages, namely throughout the Archaic, tend to have more macrobotanical counts overall than the late Pleistocene ages, certain individual taxa and plant-use categories stand out. Specifically, *Opuntia* spp. appears to dominate throughout the occupational history of Eagle Cave, from the late Pleistocene through the end of the Archaic (Figure 18). However, desert rosettes, namely members of the subfamily Agavoideae (*Agave* spp. and *Yucca* spp.) become increasingly important into the Archaic in earth-oven and adjacent features (Figure 18). Plants in the Asparagaceae family (all desert rosettes, *Agave* spp., *Yucca* spp., *Dasylirion* spp., and *Nolina* spp.), while found in lesser quantity, is still relevant throughout the occupational time frame, as is *Juglans microcarpa* (Figure 18). Smaller quantities of *Chenopodium* spp. and *Celtis* spp. were prominent throughout the latter end of the Archaic (Figure 18). Incrementally smaller counts of Poaceae, Rhamnaceae, Amaryllidaceae, Cupressaceae, Anacardiaceae, and Solanaceae were found throughout the occupational history of Eagle Cave as well (Figure 18).

Figure 14. Anthracological Taxa Weights (g) by Time Period

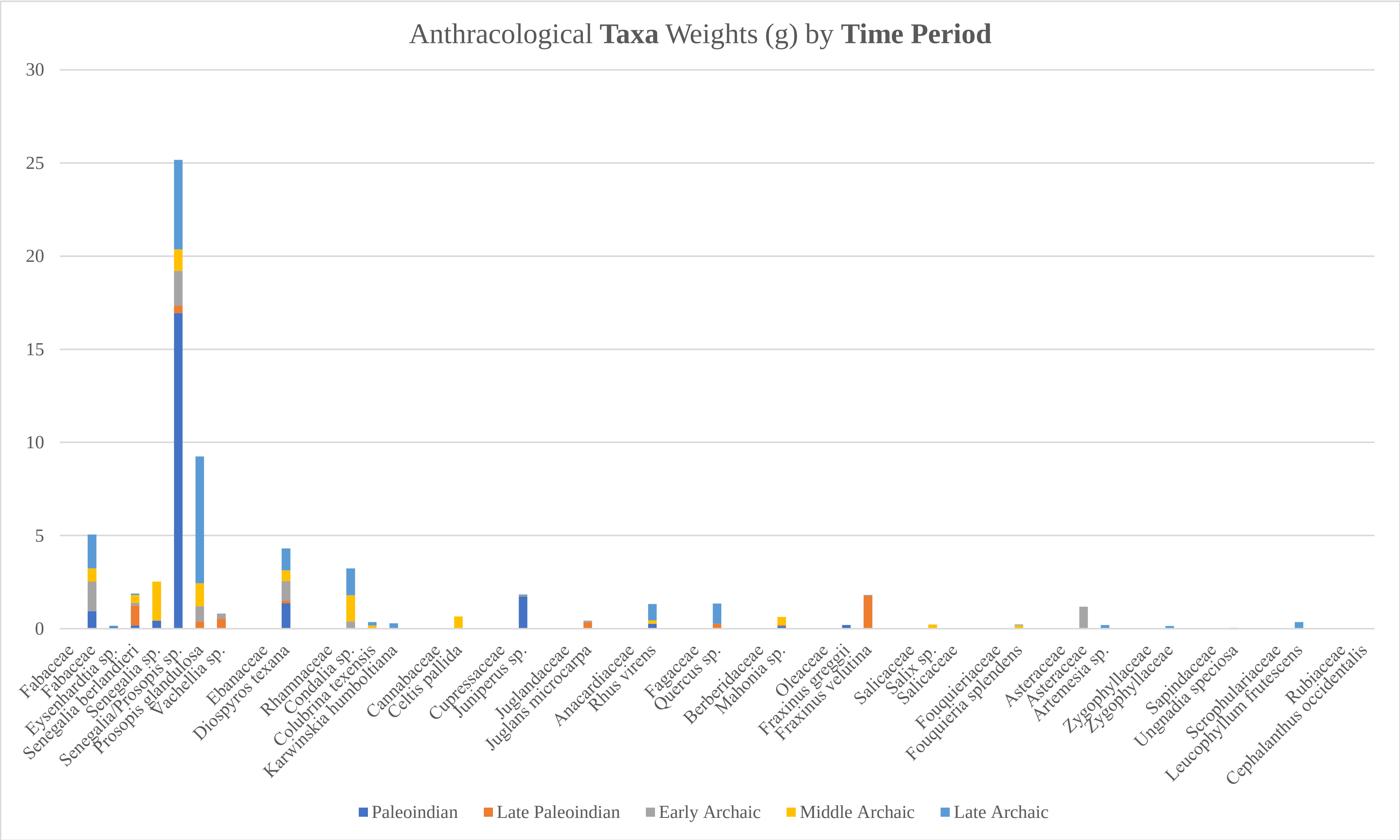
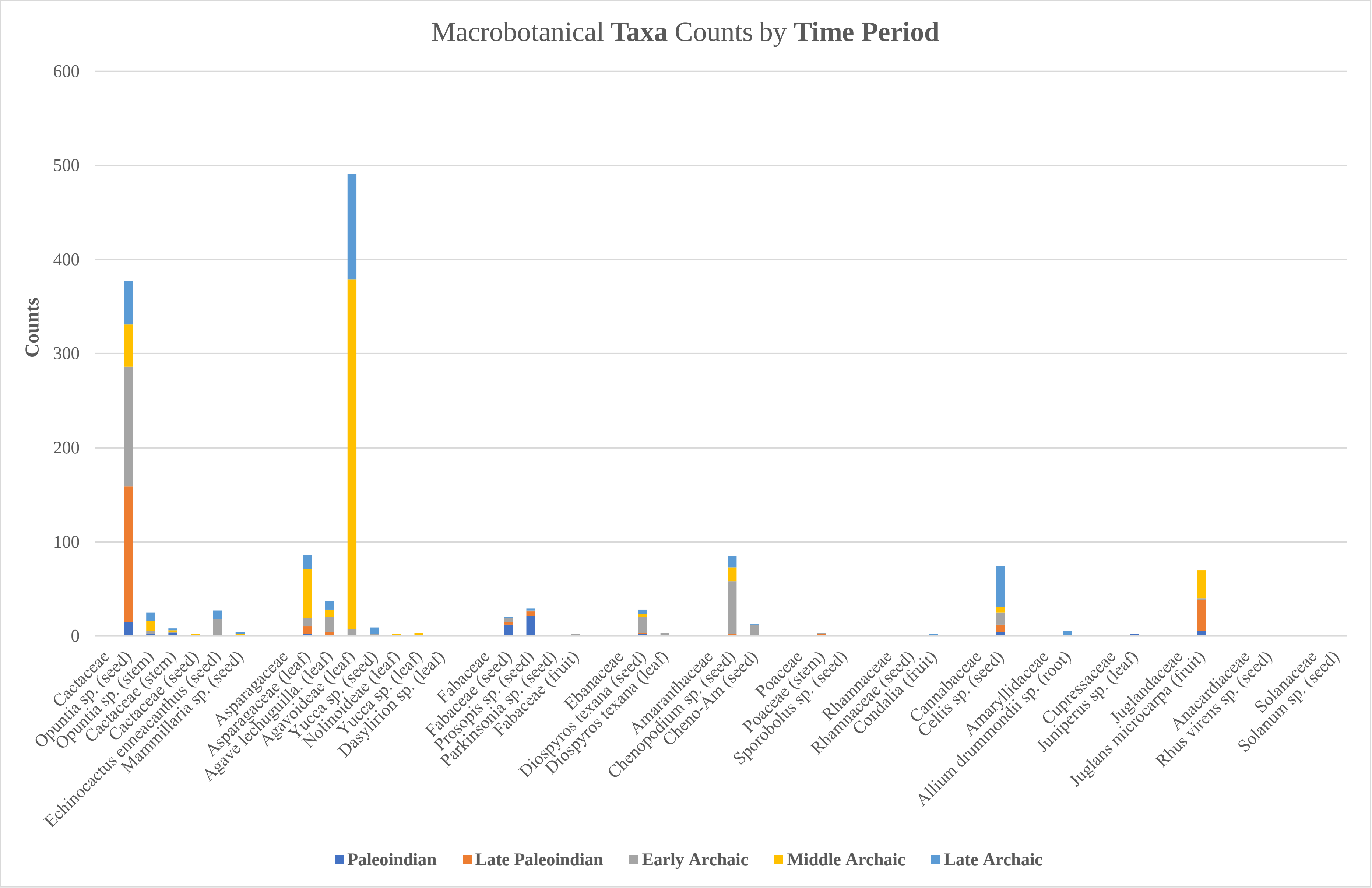


Figure 15. Macrobotanical Taxa Counts by Time Period



DISCUSSION

Cactaceae

Of the plant taxa found in the 10 samples examined from Eagle Cave strata, certain individual taxa stood out through time. *Opuntia* spp. was present throughout the occupational history of Eagle Cave (Figure 18). The seeds were found in high quantities, but traces of the cladodes (stem) were also present, albeit fewer in number (Figure 18). Preservation-wise, this makes sense, since seeds have a tough protective coat and are intended to last until germination, while cladodes are fleshier and soft, lending themselves to poorer preservation (Powell and Weedin 2004; Powell 2018). These patterns are indicative of general consumption of *Opuntia* spp. steadily through time, whether for food, in the case of the fruits and cladodes, or perhaps for green packing material in earth-ovens, for the cladodes. In the case of the fruit (containing numerous seeds), there is ethnographic evidence of peoples consuming *Opuntia* spp. fruits throughout their range (Everett and Alaniz 1981; Johnston 1963; Campbell 1981; Covey 1983; Sobolik 1991; Foster 1998; Moerman 1998; Wade and Wade 2003). *Opuntia* spp. (and other cacti) would be found exclusive to the desert upland environment, therefore contributing to respective counts and weights therein (Powell and Weedin 2004; Powell 2018). These fruits are a summer and early fall phenomenon, and warrant significant effort, and quantity, when harvesting (Powell and Weedin 2004; Powell 2018). *Opuntia* spp. fruits, like their cladode counterparts, grow spines and glochids (small hair-like spines), which need to be removed before consumption, lest the consumer experience significant irritation and potential laceration of their mouth, throat, and digestive tract (Moerman 1998; Powell and Weedin 2004; Powell 2018). According to the ethnographic records, people would roast *Opuntia* spp. fruits over fires, such as uncovered earth-ovens, in order to remove the spines and glochids (Everett and Alaniz 1981; Johnston 1963; Campbell 1981; Covey 1983; Sobolik 1991; Foster 1998; Moerman 1998; Wade and Wade 2003). There is also significant ethnographic evidence of *Opuntia* spp. cladodes being used as green packing material to create a steamy atmosphere inside the sealed earth-oven (Everett and Alaniz 1981; Johnston 1963; Campbell 1981; Covey 1983; Sobolik 1991; Foster 1998; Moerman 1998; Wade and Wade 2003). However, due to their proximity to the heat and flame, the cladodes would become charred and disintegrate, leaving behind less material, as seen in the excavated features.

Other than *Opuntia* spp., there are many cacti species throughout the Lower Pecos. Of the other two cacti species found within the strata samples, *Echinocactus enneacanthus* and *Mammillaria* spp., both are known to have edible fruits (Everett and Alaniz 1981; Moerman 1998; Powell 2018). While the seeds were found in small quantities, the seeds themselves are rather small, and can easily be consumed alongside the fruit, unlike the larger *Opuntia* spp. fruits, which is a possible explanation for why the seeds were so few (Moerman 1998; Powell 2018). Further analysis regarding the coprolites, potentially of human origin, found in Eagle Cave could shed some light onto the question thereof.

Asparagaceae

Whereas *Opuntia* spp. seeds appear to dominate throughout the occupational timeframe of Eagle Cave, desert rosette species, namely members of the subfamily Agavoideae (*Agave* spp. and *Yucca* spp.) become increasingly important into the Archaic in earth-oven and adjacent features (Figure 18). This could demonstrate importance, especially coming from earth-ovens and fire-cracked rock discard piles, since it is well known ethnographically that Agavoideae, especially *Agave* spp. was, and still is, cooked in earth-ovens (Castetter and Opler 1936; Castetter et al. 1938; Basehart 1960; Pennington 1963; Gentry 1982; Buskirk 1986; Cheatham et al. 1995; Moerman 1998; Dering 1999; Hodgson 2001; Miller and Kenmostu 2004; Tull 2013; Powell 2018; Koenig et al. 2022). However, this trend could also be coincidental, due to preservation issues, such as weathering and biotic factors impacting the older material for longer. Regardless, Agave spp., likely *Agave lechuguilla*, given the Chihuahuan desert locale (Gentry 1982; Powell 2018), was certainly an important consumptive species for the peoples occupying Eagle Cave throughout its occupation. Additionally, while *Agave* spp. was important, *Yucca* spp. was relevant as well (Figure 18). There are numerous ethnographic accounts of various peoples throughout its range consuming the petals, and especially the fruit and young not-yet-woody stalks, and using the fleshy leaves as green packing material in the earth-ovens (Russell 1908; Stevenson 1915; Gifford 1932; Castetter and Underhill 1935; Castetter and Opler 1936; Bell and Castetter 1941; Elmore 1944; Vestal 1952; Basehart 1960; Colton 1974; Dering 1979; Andrews and Adovasio 1980; Zigmond 1981; Buskirk 1986; Brown 1988; Moerman 1998; Powell 2018). *Yucca* spp. seeds were found preserved in the samples, primarily in the Paleoindian, but throughout time as well (Figure 18). This alludes to consumption of *Yucca* spp. fruits, which is supported by the ethnographic record.

While Agave spp. was clearly an important consumptive species, the family Asparagaceae (*Agave* spp., *Yucca* spp., *Dasylirion* spp., and *Nolina* spp.) while found in lesser quantity than Agavoideae specifically, was still prominent (Figure 12). The other members of Asparagaceae found in the Lower Pecos other than *Agave* spp. and *Yucca* spp. (*Dasylirion* spp., and *Nolina* spp.), are also widely known for their various ethnobotanical uses. *Dasylirion* spp. is also an earth-oven edible, and has been used by numerous peoples throughout its range as such (Bell and Castetter 1941; Brown 1988; Turpin 1991; Moerman 1998; Dering 1999; Powell 2018). However, perhaps more significantly, all four members of the family found in the Lower Pecos maintain tough fibrous leaves, making them excellent candidates for weaving mats, sandals and other wearable textiles, baskets, rope, nets, and more (Gentry 1982; Powell 2018). While not necessarily connected to earth-ovens, a refuse pile, such as the fire-cracked rock discard piles, would be an excellent place for broken or unwanted woven goods and textiles.

Fabaceae

While found in significantly lesser quantity, Fabaceae seeds and fruit components, especially *Prosopis* spp., were indicative of earlier time periods, the late Pleistocene into the beginning of the Archaic (Figure 18). There is significant ethnographic evidence of peoples throughout its range using *Prosopis* spp., but not specifically within earth-oven contexts, which could explain the lower count (Hrdlicka 1908; Russell 1908; Castetter and Underhill 1935; Bell and Castetter 1937; Cosgrove 1947; Curtin 1949; Johnston 1963; Simpson 1977; Campbell 1981; Powell 1998; Moerman 1998; Dering 1999; Hodgson 2001). However, there is evidence of significant use of *Prosopis* spp. wood, among other members of Fabaceae, in the earth-ovens and adjacent features, which could potentially explain why the seeds might be present (Figure 17). Furthermore, it is typically the fruit, not the seeds themselves that is consumed, indicating why the seeds may be the primary component left behind (Hrdlicka 1908; Russell 1908; Castetter and Underhill 1935; Bell and Castetter 1937; Cosgrove 1947; Curtin 1949; Johnston 1963; Simpson 1977; Campbell 1981; Powell 1998; Moerman 1998; Dering 1999; Hodgson 2001). Coprolites analysis of samples from Eagle Cave, human or otherwise, could shed some further light on this subject.

While *Prosopis* spp. is considerably important throughout its range, ecologically speaking there are dozens of Fabaceae family taxa throughout the Lower Pecos, some of which undoubtedly are of ethnobotanical relevance (Powell 1998; Moerman 1998). It is likely that people at Eagle Cave were using other species of Fabaceae for various purposes, including for fuel, that simply are not recorded in the ethnographic record for related and other historic and present-day peoples (Figure 17).

Ebanaceae

The seeds of *Diospyros texana* were found, albeit in lesser quantities, throughout the occupational history of Eagle Cave, but especially into the Archaic (Figure 18). The ethnographic record is rich with accounts of peoples throughout the plant's range, eating the astringent purple fruits (Carlson and Jones 1939; Dering 1979; Powell 1998; Moerman 1998; Everett et al. 2002; Tull 2013). It is likely people were eating or otherwise processing the fruits for consumption, and depositing the seeds in the fire-cracked rock discard pile. These piles would have presumably functioned as midden or refuse piles for spent fire-cracked rocks that have lost bulk and mass over time, limiting their use, but for other unwanted materials as well. However, the presence of a leaf fragment in a fire-cracked rock discard pile suggest that people were using the dense wood as fuel for the earth-ovens (Figure 17). This is reinforced by finding *Diospyros texana* wood charcoal remains in the samples analyzed (Figure 17).

Amaranthaceae

Chenopodium spp. (and *Amaranthus* spp.) were prominent throughout the latter end of the Archaic (Figure 18). This, like with the case of the Agavoideae, could be demonstrating increasing importance, or coincidental due to the preservation situation. Both taxa have small seeds that, in ethnographic accounts, were sometimes parched over flame, which could explain their proximity to the earth-oven features (Reagan 1929; Castetter and Underhill 1935; Castetter and Opler 1936; Gifford 1936; Castetter et al. 1938; Castetter and Bell 1942; Barrett and Gifford 1943; Curtin 1949; Castetter and Bell 1951; Wyman and Harris 1951; Pennington 1963; Wilson and Heiser 1979; Bye 1981; Fritz 1984; Buskirk 1986; Gasser and Kwiatkowski 1991; Moerman 1998; Hodgson 2001; Tull 2013; Cheatham et al. 2018; Powell 2018; Koenig et al. 2022).

There is also the possibility of people using their fresh leafy foliage as green packing material in the earth-ovens. However, this would have likely been turned to ash, and as such, no leaf fragments were found in the samples examined (Figure 18). While the foliage of both genera is edible and a common vegetable across their respective ranges, their lush growth habits lend themselves well to being earth-oven packing material (Reagan 1929; Castetter and Underhill 1935; Castetter and Opler 1936; Gifford 1936; Castetter et al. 1938; Castetter and Bell 1942; Barrett and Gifford 1943; Curtin 1949; Castetter and Bell 1951; Wyman and Harris 1951; Pennington 1963; Wilson and Heiser 1979; Bye 1981; Fritz 1984; Buskirk 1986; Gasser and Kwiatkowski 1991; Moerman 1998; Hodgson 2001; Tull 2013; Cheatham et al. 2018; Powell 2018; Koenig et al. 2022).

Poaceae

A few grass stems and a seed from the genus *Sporobolus* spp. were attributed to the middle Archaic (Figure 11; Figure 18). The grass stems could easily be remnants of green packing material for the earth-ovens, as could the *Sporobolus* spp. seed. However, the *Sporobolus* spp. could also be a potential edible remain. There is significant ethnographic evidence pointing towards the use of *Sporobolus* spp., as well as numerous other grass species, where the seeds were used for food (Castetter and Opler 1936; Castetter and Bell 1951; Vestal 1952; Colton 1974; Moerman 1998; Dering 1999; Powell 2000). It is entirely likely that the heat of the earth-oven simply turned much of the grassy remains to ash. Equally so, it is possible that grass remains simply don't preserve well, earth-oven aside, considering potential scavenging by animals or simple weather processes. Therefore, there remains the potential that the sample set which was examined was a poor representation for the actual average of Poaceae consumption in Eagle Cave.

Rhamnaceae

A few Rhamnaceae fruits and seeds were found in the samples analyzed, specifically pointing towards *Condalia* spp. as an identified taxon found during the late Archaic (Figure 18). There is ethnographic evidence available indicating the edibility of *Condalia* spp. fruits, however, little else about its ethnobotanical uses are known (Russell 1908; Curtin 1949; Castetter and Bell 1951; Dering 1979; Powell 1998; Moerman 1998; Hodgson 2001; Everett et al. 2002; Wade and Wade 2003; Cheatham et al. 2018). Given the context of seeds and fruit remains, it is likely that this constitutes fruit consumption and seed discard. However, it could also easily constitute the unintended combustion of *Condalia* spp. fruit while burning the wood as fuel. This follows, given that multiple examples of *Condalia* spp. wood were identified in the wood charcoal samples (Figure 17).

Cannabaceae

Smaller quantities of *Celtis* sp. were prominent throughout the latter end of the Archaic. This, like with Agavoideae and Amaranthaceae, could demonstrate increasing importance, or be coincidental due to preservation. *Celtis* spp. has very tough seed coats, potentially facilitating preservation through time (Powell 1998; Vines 2004). There is historic and present-day ethnographic evidence, indicating that people consume the *Celtis* spp. fruits throughout its range (Castetter and Underhill 1935; Castetter and Opler 1936; Gifford 1936; Carlson and Jones 1939; Elmore 1944; Everett and Alaniz 1981; Black 1986; Powell 1998; Moerman 1998; Everett et al. 2002; Cheatham et al. 2009). This suggests that peoples occupying Eagle Cave through time might do this as well. However, the presence of fragments of *Celtis* spp. wood charcoal identified in the samples also indicates that *Celtis* spp. wood was used to fire the earth-ovens (Figure 17). This could also be a potential source of the seeds. However, given the significant ethnographic record throughout the region and beyond, fruit consumption is likely.

Amaryllidaceae

While not in any great quantity, a significant find from the late Archaic was a single bulb cloak of an *Allium drummondii* (Figure 18). This indicates that people were consuming *Allium drummondii*, well known in the ethnographic record for its dietary, medicinal, textile, and dye uses (Buskirk 1986; Cheatham et al. 1995; Moerman 1998; Powell 2018). It is known to have been cooked for food purposes in earth-ovens, alongside other geophytes and edible carbohydrate-heavy plant parts (Buskirk 1986; Cheatham et al. 1995; Moerman 1998; Powell 2018), so it is entirely possible that this bulb cloak is a remnant of a much greater food-cooking process.

Cupressaceae

A single *Juniperus* spp. leaf scale was found in context from a sample dating back to the Paleoindian period (Figure 18). While this does not say a lot on its own, in context with the anthracological sub-samples taken, which include *Juniperus* spp. wood, it is likely that this leaf scale is a remnant of fueling the earth-ovens at Eagle Cave. It is possible that people were using *Juniperus* spp. for consumptive purposes, as there is ethnographic evidence of peoples using the foliage and bark for various ethnobotanically-relevant processes (Moerman 1998; Powell 1998). However, given the presence of *Juniperus* spp. wood charcoal in the samples, alongside the leaf scale, and the context of earth-ovens and adjacent features, I find it likely that this leaf scale is indicative of fuel use.

Juglandaceae

Juglans microcarpa is relevant during the middle of the occupational history of Eagle Cave (Figure 18). Nutshell fragments were found, indicating that people were consuming *Juglans microcarpa* fruits. This aligns with the ethnographic evidence of *Juglans microcarpa* use, primarily people fracturing the nuts to open them, and boil the meat to render off oil

(Reagan 1929; Buskirk 1986; Powell 1998; Moerman 1998; Dering 1999). It is possible that *Juglans microcarpa* fruits were consumed throughout the occupational history of Eagle Cave, not just during the middle period, however, it is likely that there was a specific event, such as a mast season for the *Juglans microcarpa* trees (Powell 1998; Vines 2004), or simply conditions leading to better preservation for that timeframe (Figure 18). However, there was also *Juglans microcarpa* wood charcoal found in the samples examined, primarily during the late Pleistocene time frame (Figure 17). While this is likely not related to the nutshell fragments identified, it is likely that these applications of *Juglans microcarpa* resources indicate continued use through the occupational history of Eagle Cave.

Anacardiaceae

A single *Rhus virens* seed was found in context from a sample dating back to the late Archaic period (Figure 18). While lacking most archaeobotanical context, when considering the multiple fragments of *Rhus virens* wood found in the anthracological sub-samples found throughout the occupational history of the rock shelter (Figure 17), it is possible that this seed is a byproduct of fueling the earth-ovens at Eagle Cave. Additionally, *Rhus virens* is a known edible and medicinal plant, with people consuming its fruit and leaves for a variety of purposes, including for seasoning (Powell 1998; Moerman 1998). It is possible that this seed is a result of the fruit being used in cooking practices and accidentally becoming charred in the process.

Solanaceae

A single *Solanum* spp. seed was found in context from a sample dating back to the late Archaic period (Figure 18). It is possible that this seed is a remnant of the green packing material provided to the earth-ovens at Eagle Cave. Additionally, some species of *Solanum* spp. are cultivated or foraged, and used for dietary or medicinal purposes, among other ethnobotanical uses, with ethnographic evidence to support it (Moerman 1998; Powell 2018). While the evidence for use of specific members of the genus is spotty specifically in the Chihuahuan desert, where the paleoethnobotanical record and ethnobotanical ethnographic record are both understudied, it is possible that people were consuming *Solanum* spp. in the Lower Pecos.

Time Period

Most macrobotanical remains were recovered from later in the Archaic, with the largest number of macrobotanicals having been recovered from the middle Archaic specifically (Figure 4). However, the most massive macrobotanical remains were recovered from the late Archaic specifically, followed in decreasing order until the Paleoindian period (Figure 5). Weathering, disturbances, and other destructive processes take time, so the less time spent inflicting damage upon the remains, the better (Pearsall 2015). This trend makes sense, to a degree, since these destructive processes are more likely to reduce the overall count, but not the average weight, of the macrobotanicals found in the samples (Pearsall 2015). However, this trend would suggest that the late Archaic would represent a higher count of archaeobotanical remains, over the middle Archaic, which according to the data, is not the case. Instead, this suggests that there was potentially a larger occupation at Eagle Cave during the middle Archaic, according to the larger number of macrobotanicals found in the samples. This finding aligns with previous work done at Eagle Cave focusing on the Archaic components, where most of the research has been focused, and much of the perishable material has been dated to (Ross 1965; Koenig et al. 2022). The increasing weights and larger counts towards the end of the Archaic period also aligns with the expected findings of this research: that there would be greater counts and overall masses of macrobotanicals and anthracological samples as time progresses, with the most in the middle and late Archaic.

Feature Type

Greater numbers of macrobotanical remains, as well as average weights of the samples were found in fire-cracked rock discard piles over earth-oven features (Figure 6; Figure 7). This trend follows, because the fire-cracked rock discard piles function as refuse for the earth-ovens (Black and Thoms 2014). Each time the ovens are fired, with new or still-usable stones, the remnants need to be cleaned and discarded from the ovens for the next round of cooking (Black and Thoms 2014). Therefore, the fire-cracked rock discard piles accumulate multiple firings-worth of earth-oven material, from fire-cracked rock that has become too small to use, to fuel and food remains, to remnants left behind by opportunistic scavengers scrounging around in the discard piles (Black and Thoms 2014). These repeated additions to the fire-cracked rock discard piles contribute to the overall counts and weights of the material in the pile and subtract from the earth-ovens overall. Therefore, the findings, indicate that there were indeed more macrobotanical and anthracological samples found in the fire-cracked rock discard piles than in the earth-ovens, supporting my hypothesis.

Plant Part-Use Category

Most of the weight from the various plant part-use categories were derived from leaf components, followed by fruits and seeds, then stems, and then roots (Figure 10). The weights align with the counts as well since most of the macrobotanicals identified were either leaves or seeds (Figure 11).

While leaves in general are not particularly massive, the majority of the leaves identified were Agavoideae or Asparagaceae, followed by *Agave lechuguilla* specifically (Figure 18). These desert succulents have thick, fibrous leaves that have significantly more mass and body to them than the average herbaceous or deciduous tree leaf (Gentry 1982; Powell 2018). This finding aligns with the currently understood research around the processing of desert rosettes, namely *Agave lechuguilla*, in the Lower Pecos Canyonlands and throughout the Chihuahuan desert (Castetter and Opler 1936; Castetter et al. 1938; Basehart 1960; Pennington 1963; Ross 1965; Gentry 1982; Buskirk 1986; Cheatham et al. 1995; Moerman 1998; Dering 1999; Hodgson 2001; Miller and Kenmostu 2004; Tull 2013; Powell 2018; Koenig et al. 2022).

The majority of the seeds found by far were *Opuntia* spp. seeds, which likely contributed to their overall total weight as well (Figure 18). This is because Opuntia spp. seeds are larger than most other Cactaceae seeds, and are dense (Powell and Weedin 2004; Powell 2018). *Opunita* spp. seeds have been found at archaeological sites throughout the Lower Pecos, and are ethnographically speaking an important resource for people in their ecological range (Everett and Alaniz 1981; Johnston 1963; Campbell 1981; Covey 1983; Sobolik 1991; Foster 1998; Moerman 1998; Wade and Wade 2003; Koenig et al. 2022).

These findings do not entirely align with my hypothesis that geophytes and other starchy remains, predominantly roots, stems, and fleshy leaves, would be present in the earth-ovens and related features. Despite finding a significant amount of leaf material from Agavoideae specifically, many different seeds were also found to contribute to both the mass and the counts as well. This differs from my hypothesis since few roots and proper stems were found in the earth-ovens and adjacent features. This indicates that the peoples of Eagle Cave were processing (or discarding) large amounts of Agavoideae, in addition to other seeded fruits, such as *Opuntia* spp., *Chenopodium* spp, *Celtis* spp., and *Juglans microcarpa*, to name a few, directly in their fired earth-oven features (Figure 18).

Plant Habitat

Most of the identified macrobotanicals, by counts and weights, were found to grow in the desert upland environment, over mixed environments or along the riparian zone (Figure 12; Figure 13). However, plants from each type of habitat were found, regardless of quantity or masses. Despite the significant stratification between the wetlands close to the river inside the canyon, and the arid uplands bordering the canyon, and everything in between, most species found in the excavated features were of desert origin. However, not all species were. This indicates that people were indeed traveling between the canyon and the uplands in search of foods and fuels for the earth-ovens. This aligns with my hypothesis that people would be using a variety of plants from different environmental zones, due to the proximity of Eagle Cave to all three habitat types.

Other rock shelters throughout the Lower Pecos Canyonlands demonstrate this environmental stratification as well, with rock shelters carved out of riparian canyon walls closely entangled with their desert upland counterparts (Sobolik 1991; Sobolik 2008; Riley 2008; Riley 2012; Dering 2021). In these arid lands, water is an important resource, and it likely benefits people greatly to be within close proximity to it (Sobolik 1991; Sobolik 2008; Dering 2021). However, the mobility of ancient peoples between such lowland riparian resources and upland desert resources suggest that the arid lands were equally as productive, and worth traveling to (Sobolik 2008; Dering 2021).

Plant Seasonality

Most macrobotanicals identified were found to be components of plants typically harvested in the summer and fall (Figure 15; Figure 16). This aligns with both the ethnographic evidence of how and when historic and present-day peoples were using certain species, as well as the ecological information regarding when certain species will produce desirable consumable components. In the Lower Pecos, most of the available nutritional resources are at peak during the summer and fall months, which aligns with prior research conducted on archaeobotanical plant seasonality and use in the Lower Pecos (Dering 1999). However, the winter and spring are also notable to maintain a few ethnobotanically relevant species, and many desert rosettes, such as *Agave lechuguilla* and *Dasylirion* spp. are available year-round (Castetter and Opler 1936; Castetter et al. 1938; Basehart 1960; Pennington 1963; Gentry 1982; Buskirk 1986; Cheatham et al. 1995; Moerman 1998; Dering 1999; Hodgson 2001; Miller and Kenmostu 2004; Tull 2013; Powell 2018; Koenig et al. 2022). Because of the desert climate that Eagle Cave is situated in, while certain resources are more likely to appear in given seasons, the overall seasonality of most species is somewhat variable, due to external factors such as temperature and access to water and the infrequency of rain (Schmidt 1979; Bryant and Holloway 1985; Turpin 1987; Turpin 2004; Nielsen 2017). This fluidity in producing harvestable ethnobotanicals is what led to my hypothesis that people would be harvesting consumables throughout the year, not only during peak seasons. This does appear to be the case, since while there are overall more plants found to be harvested primarily during the summer and the fall seasons, there is still evidence of plants that could be harvested throughout the year, or in the so-called off-season (Figure 15; Figure 16).

Fuel Wood

The most massive fragments of wood charcoal samples came from either end of the known occupational history of Eagle Cave: the Paleoindian period and the late Archaic period (Figure 6). While this partially aligns with my hypothesis that there will be higher weights of wood charcoal remains found during the end of the Archaic, the samples from the Paleoindian period stand as an outlier. It is possible that the preservation conditions of the Paleoindian context lent themselves well to maintaining the integrity and overall masses of the wood charcoal fragments found therein. It could also indicate that the late Pleistocene time periods at Eagle Cave were had higher populations and a more frequent occupation than previously believed. This finding requires further examination into the ethnobotanical history of the late Pleistocene occupations at Eagle Cave.

Overall, the earth-oven features tend to contain heavier wood charcoal fragments (Figure 9). Since heavier objects tend to settle at the bottom of pits, it makes sense that heavier fragments would have been left behind in the cleaning process after each oven's firing (Black and Thoms

2014). Furthermore, the earth-ovens are where the actual firing is taking place, so the fragments of wood and charcoal would be expected to be larger anyway (Black and Thoms 2014).

Furthermore, the heaviest wood charcoal from any archaeological context examined at Eagle Cave tends to consist of desert upland species, followed by riparian species, and finally by mixed environmental species (Figure 14). This indicates that potentially most of the wood came from desert upland contexts. However, whether the wood was harvested in the uplands above the canyon, or gathered as deadfall that fell into the canyon, remains to be demonstrated. Additionally, many desert woody species are simply denser than their more mesic and wetland counterparts (Powell 1998; Vines 2004). This added density, a xeric adaptation for survival (Powell 1998; Vines 2004), could contribute to the weight significantly.

Of the wood charcoal samples examined, certain weights stood out through time. The list of taxa identified is diverse, with 17 botanical families represented, with many more genera within (Figure 17). Fabaceae, notably *Senegalia* spp. and *Prosopis* spp., as well as Ebanaceae (*Diospyros texana*) were present throughout the occupational history of the rock shelter (Figure 17). This indicates that they may be particularly important species for fuel wood, or at the least, common. Other than these woods, a few other families were found throughout the late Pleistocene periods: Cupressaceae (*Juniperus* spp.) and Oleaceae (*Fraxinus greggii* and *Fraxinus velutina*), and Juglandaceae (*Juglans microcarpa*) (Figure 17). This lower diversity could be due to preservation issues with the wood charcoal, or perhaps due to a changing ecosystem, headed from arid grassland-savanna towards desertification at the end of the late Pleistocene (Schmidt 1979; Turpin 1987; Turpin 2004; Nielsen 2017). Furthermore, this mix of plants from different habitats indicates that early on, people were gathering various species, not just from one environmental zone. Into the Archaic, woods such as Asteraceae appeared briefly, whereas more xeric species, such as *Celtis pallida*, *Mahonia* spp., *Fouquieria splendens*, and desert members of Rhamnaceae such as *Karwinskia humboltiana* and *Colubrina texensis* trended towards the middle of the Archaic (Figure 17). This could very well be a factor of the gradual desertification process happening throughout the Chihuahuan desert. Additionally the more riparian family Salicaceae was found, further indicating the presence of riparian species in the canyon (Figure 17). More families, represented by smaller masses, including Anacardiaceae, Fagaceae, Asteraceae, Zygophyllaceae, Sapindaceae, Scrophulariaceae, and Rubiaceae were implicated in the late Archaic (Figure 17). This diversity, again, could be a factor of preservation issues, with more diversity preserved into the later time periods, or it could be a factor of authentic selection of a variety of different fuelwoods, likely based on what was most easily accessible.

These findings support the hypotheses held for the anthracological samples: that there was more wood charcoal found in the fire-cracked rock discard piles over the earth-ovens, that a variety of woods are harvested from different environmental zones, given easy access to a variety of species, and that there are greater masses of different species accessed towards the end of the known occupational history of the rock shelter.

SUMMARY AND CONCLUSIONS

By piecing together potential lifeways and habits people at Eagle Cave share with plants, one can better understand the changes through time and space that occurred with these relationships. This study confirms certain hypothesis held. First, there were indeed more macrobotanical and anthracological samples (both counts and weights) found in the fire-cracked rock discard piles over the earth-ovens. Second, there were indeed a great variety of plants harvested from different environmental zones, with the majority coming from the desert upland environment, for both potential consumptive purposes as well as for fuel wood. This indicates that people were indeed traveling in and out of Eagle Cave and the canyon itself, lending Eagle Cave a more intermittent and transient population, aligning with other current research on the rock shelters of the Lower Pecos Canyonlands. And third, overall, there were greater counts and overall masses of macrobotanicals and anthracological samples as time progressed. However, the trend was not entirely linear. The largest number of macrobotanicals were recovered from the middle Archaic, and the most mass of macrobotanicals were recovered from the late Archaic. Likewise, the most massive fragments of wood charcoal samples came from both the Paleoindian period and the late Archaic. This indicates that the occupational history of Eagle Cave specifically is more robust than previously thought, with more than just intermittent occupation of the cave. This point lends itself well to further research, especially into the earlier known occupational history of the rock shelter, into the late Pleistocene. Finally, there were indeed a wide variety of different plant-use categories found in the samples examined, though, given the earth-oven and related fire-cracked rock discard contexts, I had expected there to be predominantly geophytes and starchy remains. While leaves were found in excess, mostly derived from members of Agavoideae, there were an abundance of seeds and fruits found as well in both the earth-ovens and the fire-cracked rock discard pile contexts. This indicates that the earth-ovens and fire-cracked rock discard piles were being used to process (or discard) more than just starchy foods, such as *Agave lechuguilla*.

In the future, I aim to further examine Eagle Cave through an ethnobotanical lens, with more macrobotanical analysis forthcoming on more samples, and by using other archaeobotanical techniques, such as microbotanical analysis (pollen and phytoliths) on sediment, as well as coprolite analysis on the numerous coprolite found throughout Eagle Cave.

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APPENDIX

Carbonized Macrobotanical Compiled Data

Carbonized Macrobotanicals							
Family	**Taxon**	**Common Name**	**Plant Part**	**Count**	**(g)**	**Ubiquity (%)**	**(% of Total g)**
Amaranthaceae	*Chenopodium/ Amaranthus sp.*		Seed	12	<0.01	0.89	
Amaranthaceae	Cheno-am		Seed	1	<0.01	0.07	
Amaranthaceae	*Chenopodium sp.*	Goosefoot	Seed	88	<0.01	6.56	
Anacardiaceae	*Rhus virens*	Sumac	Seed	1	<0.01	0.07	
Asparagaceae	*Agave lechuguilla*	Lechuguilla	Leaf fragments	3	0.02	0.22	0.13
Asparagaceae	*Agave sp.*	Agave	Leaf fragments	33	1.36	2.46	8.84
Asparagaceae	Agavoideae		Leaf fragments	484	5.28	36.09	34.38
Asparagaceae	Asparagaceae		Fiber bundles	9	0.06	0.67	0.39
			Leaf fragments	55	0.36	4.10	2.34
			Epidermis	2	<0.01	0.15	
			Cake	2	0.02	0.15	0.13
			Spine	1	<0.01	0.07	
			Leaf base	3	0.35	0.22	2.27
			Stalk	5	0.01	0.37	0.06
Asparagaceae	*Dasylirion sp.*	Sotol	Leaf fragments	1	0.07	0.07	0.45
Asparagaceae	Nolinoideae		Stalk	2	0.02	0.15	0.13
Asparagaceae	*Yucca sp.*	Yucca	Seed	8	0.14	0.60	0.91
			Leaf	3	0.05	0.22	0.32
Cactaceae	Cactaceae		Skeleton	2	0.01	0.15	0.06
			Cladode	1	<0.01	0.07	
			Embryo	1	<0.01	0.07	
			Areole	2	0.01	0.15	0.06
			Flower scar	1	<0.01	0.07	
			Spine	3	0.01	0.22	0.06

Cactaceae	*Echinocactus enneacanthus*	Strawberry Hedgehog Cactus	Seed	27	<0.01	2.01	
Cactaceae	*Mammillaria sp.*	Nipple Cactus	Seed	2	0.01	0.15	0.06
Cactaceae	*Opuntia sp.*	Prickly Pear	Cladode	23	0.11	1.72	0.71
			Seed	156	0.87	11.63	5.65
Cactaceae	Opuntioideae		Fruit/flower base	1	0.07	0.07	0.45
Ebanaceae	*Diospyros texana*	Texas Persimmon	Seed	27	2.48	2.01	16.11
Fabaceae	Fabaceae		Seed	18	0.07	1.34	0.45
			Endocarp	2	0.05	0.15	0.32
			Exocarp	1	0.01	0.07	0.06
Fabaceae	*Parkinsonia sp.*	Palo Verde	Seed	1	0.01	0.07	0.06
Fabaceae	*Prosopis glandulosa*	Mesquite	Seed	29	0.52	2.16	3.38
Juglandaceae	*Juglans microcarpa*	Little Walnut	Nutshell	2	0.92	0.15	5.98
Juglandaceae	*Juglans sp.*		Nutshell	20	0.19	1.49	1.23
Poaceae	Poaceae		Stem	3	<0.01	0.22	
Poaceae	*Sporobolus sp.*	Dropseed	Seed	1	<0.01	0.07	
Rhamnaceae	*Condalia sp.*		Fruit	1	0.01	0.07	0.06
			Seed	1	0.03	0.07	0.19
Rhamnaceae	Rhamnaceae		Seed	1	0.01	0.07	0.06
		Unknown Macrobot	Epidermis	5	0.01	0.37	0.06
			Spine	2	0.02	0.15	0.13
			Stem	3	0.01	0.22	0.06
			Seed	26	0.10	1.94	0.65
			Starch/resin fragment	159	0.92	11.86	5.98
			Leaf fragment	1	0.08	0.07	0.52
			Bark	9	0.12	0.67	0.78
			Seed coat	3	<0.01	0.22	
			Fruit	2	0.03	0.15	0.19
			Rhizome	1	0.01	0.07	0.06
			Indeter. botanical	91	0.96	6.79	6.24
Total				1341	15.39	100	100

Uncarbonized Macrobotanical Compiled Data

Uncarbonized Macrobotanicals							
Family	**Taxon**	**Common Name**	**Plant Part**	**Count**	**(g)**	**Ubiquity (%)**	**(% of Total g)**
Amaryllidaceae	*Allium drummondii*	Onion	Bulb cloak	5	<0.01	1.28	
Asparagaceae	*Agave sp.*	Agave	Leaf fragment	1	1.25	0.26	11.23
Asparagaceae	Agavoideae		Leaf fragment	6	4.56	1.53	40.97
Asparagaceae	Asparagaceae		Leaf fragment	9	0.67	2.31	6.02
Asparagaceae	*Yucca sp.*	Yucca	Seed	1	0.03	0.26	0.27
Cactaceae	*Opuntia sp.*	Prickly Pear	Seed	94	0.57	24.10	5.12
			Cladode	1	<0.01	0.26	
Cannabaceae	*Celtis sp.*	Hackberry	Seed	73	1.34	18.71	12.04
			Endocarp	1	0.02	0.26	0.18
Cupressaceae	*Juniperus sp.*	Juniper	Leaf scale	2	<0.01	0.51	
Ebanaceae	*Diospyros texana*	Texas Persimmon	Seed	1	0.04	0.26	0.36
			Leaf fragment	3	<0.01	0.77	
Juglandaceae	*Juglans microcarpa*	Little Walnut	Nutshell	3	0.02	0.77	0.18
Juglandaceae	*Juglans sp.*		Nutshell	42	0.49	10.77	4.40
Solanaceae	*Solanum sp.*		Seed	1	<0.01	0.26	
		Unknown Macrobot	Epidermis	1	<0.01	0.26	
			Spine	3	<0.01	0.77	
			Capsule	7	<0.01	1.79	
			Leaf fragment	3	<0.01	0.77	
			Seed	5	0.01	1.28	0.09
			Wood	33	1.55	8.46	13.93
			Fiber bundle	3	<0.01	0.77	
			Bark	60	0.48	15.38	4.31
			Fruit	2	0.02	0.51	0.18
			Indeter. botanical	30	0.08	7.69	0.72
Total				390	11.13	100	100

Partially Carbonized Macrobotanical Compiled Data

Partially Carbonized Macrobotanicals

Family	Taxon	Common Name	Plant Part	Count	(g)	Ubiquity (%)	(% of Total g)
Cactaceae	*Opuntia sp.*	Prickly Pear	Seed	129	0.41	98.47	100
		Unknown Macrobot	Leaf fragment	2	<0.01	1.53	
Total				131	0.41	100	100