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THE COMPOSITIONAL ANALYSIS OF SHELL-FILLED PITS FOUND AT SILVER GLEN SPRINGS LOCUS A (8LA1W)

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THE COMPOSITIONAL ANALYSIS OF SHELL-FILLED PITS FOUND AT SILVER GLEN SPRINGS LOCUS A (8LA1W)

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BY THE COMMITTEE CONSISTING OF

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DEDICATION

To my family and friends, who have supported me and my insanity during my academic years. Without them, this thesis would not have been completed at all.

獻詞

致我的家人與朋友, 感謝你們在我求學歲月中，一路支持著我和我那瘋狂不羈的念想。若沒有你們，這篇論文根本無法完成。

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ABSTRACT

THE COMPOSITIONAL ANALYSIS OF SHELL-FILLED PITS FOUND AT SILVER GLEN SPRINGS LOCUS A (8LA1W)

In this thesis, I hypothesize that the shell-filled pits of Silver Glen Springs Locus A (8LA1W), will have generalized characteristics that are shared over multiple cultural periods in the region. The pits are mechanisms for cultural perpetuation that modified the landscape through social practices. On a detailed level, the shell-fill material of the pits will differ between the pits due to changes over time in the environment and the methods used to harvest the *Viviparus sp.* snails. I argue that shell sites, particularly shell-filled pits, are multifaceted in function and integral to connecting a community to their environment and cultural past through place-making. To support this narrative, I analyzed material from shell-filled pits that span multiple cultural phases in early Middle Archaic (8990-8600 cal BP) to Episode II of the Mt. Taylor period (6350-5700 cal BP) and compared this information to other research that analyzed material from the early Middle Archaic (8900-7400 cal BP) and the later Orange period (4600-3500 cal BP).

More specifically, I examine the contents of excavated shell-filled pits from Locus A of Silver Glen Springs (8LA1W) in central Florida. I analyze and compare the composition of the features based on their material sizes, shell species composition, and measurements of the *Viviparus sp.* shells. These attributes were interpreted to understand pit function.

The data collected from this research revealed patterns in the sizing of materials within the shell-filled pits of the features, as well as variations in the quantity of different mollusk species between features. Typologies were identified to explain the correlation between mollusk species and the cultural phases of the Mt. Taylor period. I conclude that the general material

deposited into the pits of Silver Glen Springs remained consistent throughout its occupation from the early Middle Archaic (8990-8600 cal BP) to Episode II of the Mt. Taylor period (6350-5700 cal BP), indicating cultural continuity in pit use, resource utilization, and cultural practices.

Chapter 1: Introduction

The shell sites along the St. Johns River in northeast Florida are part of a larger narrative about the landscape's habitation throughout multiple cultural periods. Globally, hunter-gatherer groups constructed shell sites for multiple purposes, including ceremony, monuments, ritualization, and cultural perpetuation through place-making (Thompson and Andrus 2011; Marquardt 2010; Meehan 1975; Randall 2015). During the early Middle Archaic and the later Mt. Taylor period, communities around the St. Johns River exploited shellfish and other aquatic resources due to their abundance as a form of subsistence and resource material (Marquardt 2010:567; Randall 2013:195; Randall 2015; Randall and Sassaman 2017). The remnants of shellfish that communities left behind resulted in considerable accumulations that became incorporated into the region's cultural landscape. The shells were mobilized in the landscape for multiple purposes, including constructing shell sites such as mounds, pits, and rings (Gilmore 2016:4).

> *"Shell mounds,…, accreted gradually at resource-rich locations through everyday, nondiscursive practices of refuse disposal, whereas later shell rings reflect efforts to repurpose excess waste by arranging it in ways that helped address practical ecological challenges"* [Marquardt 2010a, 2010b qtd. In Gilmore 2016:4].

While the shell sites described by Marquardt are visible features in the landscape, concealed in the landscape of Silver Glen Springs Locus A are shell-filled pits. Once the pits were no longer used, they would be refilled with discarded shells (Gilmore 2016:9). These roasting pits were used for cooking food, including shellfish and other vertebrates. Some of the shell-filled pits were selected for analysis in this thesis due to evidence of thermal alteration.

Some of the backfilling of these pits indicates a rapid, singular depositional event, which indicates a short temporal opening of the pits.

This thesis has two primary objectives. The first objective is to argue that the construction and subsequent modifications to the shell-filled sites at the Silver Glen Springs Complex (SGSC) served to reinforce the community's cultural identity over time. The second point is to contribute to the understanding of the selection and processing of the mollusk material found in the shell-filled pits of Silver Glen Springs Locus A.

In this thesis, I analyzed the contents of pits from features excavated at the Silver Glen Springs Locus A site. The analyzed feature material dates primarily to the Mt. Taylor period (7400–4600 cal BP), with some of the material dating to the early Middle Archaic period (8990–8600 cal BP). Locus A is part of the Silver Glen Springs Complex, which is located to the southwest of Lake George, part of the St. Johns River System (Figure 3-1). These shell-filled pits date before and during the construction of Locus A and span multiple Episodes of the Mt. Taylor period. The pits are not visible at a surface level and are discreet in the landscape. The features were selected based on multiple factors, including previous knowledge of their dating from earlier research, evidence of burning at the base of some features, and differences in mollusk composition observed during excavation (e.g., bivalve shells versus *Viviparus sp.* shells).

I hypothesize that the shell-filled pits of Silver Glen Springs Locus A (8LA1W), constructed during different temporal periods, will reflect similarities in construction and material. This is due to their role in cultural perpetuation through repetitive social practices that modified the landscape. However, the *Viviparus sp.* shells used in constructing the shell-filled pits will differ in size between pits due to changes over time in the environment and the methods used to harvest the *Viviparus sp.* snails. The conclusion of this research has identified statistical similarities in the overall species composition of the shell-filled pits, with the size-graded material exhibiting distinctive differences between the features. Additionally, the *Viviparus sp.* shells from different features can be categorized into four distinct groups, which may be associated with ages of deposition.

My analysis of the feature materials from Silver Glen Springs Locus A identified patterns in the sizing of the materials within the shell-filled pits of the features, as well as differences that appear over time in these features. While the general content of the depositional pits are similar, the specific individual factors of the shell-filled pits are indicators of temporal distinctions between the features. I examined the species composition of the ¼" materials from the features. I identified possible instances of cultural revitalization practices across different temporal periods due to the similarity in the size of the material throughout the features. I also analyzed a sample set of *Viviparus sp.* shells, focusing on the studied features, and identified a correlation between shell size and the associated temporal period. These groupings of shells highlight the correlation between the size of the shell and its temporal deposition. Collectively, these analyses contribute to understanding the materials deposited within the pits, their implications, and the selection patterns of the people at Silver Glen Springs.

I include work by Nicole Cerimele (2017) and Meggan Blessing (2011) to supplement my analysis. Cerimele's analysis of early Middle Archaic material from Silver Glen Springs offers insight into the faunal composition of the earlier shell-filled pits and the community's posited subsistence patterns. Blessing's comparative analysis of the faunal material ranged from the early Mt. Taylor period to the Orange period of Silver Glen Springs. She offers a similar method of analysis to Cerimele while including the analysis of *Viviparus sp.* shells. Blessing's analysis of the *Viviparus sp.* shells supplements information regarding a larger temporal context (Blessing 2011:189).

I propose that shell sites are multifaceted and serve different functions within a community over time. The initial construction and the maintenance of the shell site act as a form of place-making. Acts of place-making reinforce the cultural connection between the community and the landscape. The information gathered from the shell-filled pits suggests an intentional selection of material to bury into the pit features. The materials reflect evidence of cultural change over time while trying to maintain the core characteristics of the pits to the point of replication for some of the later deposits. I suggest that the pit replications are not meant to be exact but enhanced replications to honor the past and apologize for disturbing the spatial and temporal threshold between the past and the present. I argue that creating and filling the shell-filled pits acts as a form of intentional place-making in the landscape, ensuring the continuance of social memory across multiple generations. My results support the argument that the communities surrounding the Silver Glen Springs area used the shell sites as an anchor for social memories over multiple generations and cultural phases.

The following chapter (Chapter 2) addresses the archeological theory used in this thesis. The chapter is broken down into four components, starting with the generalized roles of hunter-gatherers and their contextualization during the Archaic period in Florida. Adding to the discussion is the inclusion of the shell sites, their role in society, and how they served as the central placemaking activity during the Mt. Taylor period. I further discuss the role of place-making as a method to reinforce social memory and how the shell-filled pits add significance to the shell sites regarding cultural reinforcement.

Chapter 3 discusses the environmental background and ecological factors of Silver Glen Springs Complex and the St. Johns River. I first detail the geological context of the site and its relationships with the surrounding hydrological features. I follow up by briefly discussing climate and ecological aspects of the environment, then going in-depth regarding the current faunal species and their correlation to the paleoenvironment of Silver Glen Springs.

Following the environmental discussion, Chapter 4 elaborates on the cultural chronology of Silver Glen Springs, briefly going over the Paleoindian period and then going into a deeper dive into the Archaic period that encompasses the Mt. Taylor period and the Orange Period. I conclude the chapter by discussing the later Woodland and Mississippian periods, where the mortuary practices along the St. Johns River saw a cultural change (Wallis 2008; Sutton 2021:18).

Chapter 5 contextualizes the archeological aspects of the Silver Glen Springs Complex (SGSC) and the features that were analyzed. This chapter elaborates on the specific details of the site that were not addressed in the earlier chapters and provides more insight into how the features contribute to the narrative of Locus A as an archeological component of the complex. Chapter 6 is the methodology chapter, which covers how the materials from the deposits were collected and processed. In addition, I address why I decided to analyze the material as I did and what additional sources of information I included.

The ¼” material and their data are presented in Chapter 7 (¼” Data Analysis). The overall chapter is segmented to discuss the features and their internal results while comparing them to the average data of the collected research. This chapter summarizes the raw data to understand the composition of the analyzed depositional material and the general trends observed during data collection.

Chapter 8, the secondary analysis chapter, presents a statistical comparison of features and their composition. The data is analyzed first on a macro scale, then on a micro scale. First, I discuss the overall composition of the collected feature material in terms of size-graded material. Then, I focus on the ¼" material and the species components making up that ¼" material. My final analysis method focuses on sampling measurements from the *Viviparus sp.* shells from the ¼" material from each feature. The final chapter (Chapter 9: Conclusion) is where I connect the results of my data analysis to my argument that the shell-filled pits are a form of place-making that reinforces the social memory of the community, thereby concluding this thesis. Overall, this thesis contributes to the understanding of Silver Glen Springs and how the shell-filled pits contribute to the cultural narrative.

Chapter 2: Cultural Theory

Introduction

In this thesis, I analyze the composition of the shell-filled pits from the Silver Glen Springs Complex (SGSC) and the *Viviparus sp.* shells found in these deposits. The results from the analysis contribute to understanding the composition of these shell-filled pits and possible selection preferences when collecting *Viviparus sp.* My work contributes to the current discussion of intentional cultural practices used by the people of northeast Florida to reinforce their cultural identity (Cerimele 2017:6). The construction and utilization of shell-filled pits to create a culturally significant landscape is conceptualized as place-making activities that influence multiple generations, not only in the past and present but also in the future. My simplified definition of place-making is attributing significance/meaning to an area through multiple social interactions that can occur at an "individual praxis" or a collective level (Wieczorek 2019:4; Gilmore 2019: 6,203; Randall 2015:203).

This chapter focuses on four main components: (1) A brief discussion of hunter-gatherer societies, (2) a discussion on the role of shell matrix sites in societies and their extension beyond refuse and monumentality, (3) the role of place-making activities as a form of purposeful cultural reinforcement, and (4) the utilization of social memory across generations. These components contribute to interpreting the shell deposits found in Silver Glen Springs and support my hypothesis regarding the role of place-making activities in society.

Hunter-Gatherers

The people living during the Mt. Taylor period of northeast Florida are categorized as hunter-gatherers. Early archaeological theory did not associate hunter-gatherer groups with complex cultural/social practices, as seen in Lewis Morgan's unilineal progressive social evolution theory (Trigger 2010:153). Due to ethnographic and archaeological research, this simplification of hunter-gatherer groups in academia has changed in recent decades. Hunter-gatherer groups do not primarily rely on agriculture but rather use a foraging subsistence model that relies heavily on ecological knowledge of the region (Binford 1980; Trigger 2010:525). While hunter-gatherer societies were once generalized as egalitarian, research has shown that this generalization is a fallacy built on biases that have gone unchecked until research on "complex" hunter-gatherer societies developed (Sassaman 2004).

As research progressed, the categorical identification of social systems shifted to the interrelationships between social hierarchies and the network of communication and exchange within a society (Sassaman 2004). These social components support a narrative emphasizing the importance of resources and insinuating the necessity of social influence to obtain desirable goods.

Non-local goods in the archeological record indicate trade and/or mobility between different geographical areas. There is abundant evidence of wide-ranging participation in exchange networks during the Mt. Taylor period. An archaeological example of this geographical movement during the period is the *Strombus gigas* implements from the Harris Creek site (8VO24). *Strombus gigas* is a marine species that is environmentally constrained to southern Florida and would need human intervention to be transported to a freshwater central Florida geographical area (Wheeler et al. 2000; Quinn et al. 2008).

Further evidence of mobility during the Mt. Taylor period comes from isotopic analysis of the Harris Creek site burials. Quinn and colleagues' (2008) isotopic analysis of enamel from ten individuals indicates immigration to the Harris Creek site from distant areas (Quinn et al. 2008). While the majority of the tested individuals showed isotopic evidence of growing up primarily on local terrestrial and freshwater resources, two individuals had strontium levels associated with coastal regions in the vicinity, and another set of individuals had oxygen isotopes that indicate an origin from either Virginia or Tennessee (Quinn et al. 2008).

The utilization of mortuary mounds to inter the deceased in a collective physical location reveals information regarding the cultural practices of the Mt. Taylor period. This specifically regards the social memory of the population and how it was shaped and reformulated by those who saw and contributed to these mounds (Wallis 2008). Mortuary mounds of this period are localized to the St. Johns River and the surrounding vicinity. Numerous adult individuals are interred in these shell mounds, as exemplified by the Harris Creek (8VO24) (n=175 individuals) (Quinn et al. 2008; Randall 2015). This social practice indicates coordination and possible management in the community regarding the internment of the dead. These mortuaries played a significant role in a community with their enduring use for hundreds of years during Episode II of the Mt. Taylor period. Evidence indicates mortuary mounds during Episode III of the Mt. Taylor period were built more rapidly (Randall 2015:252). This practice could serve as a form of cultural reinforcement of shared history and traditions within a community over time (Wallis 2008). The role of mortuary mounds does not extend to the Orange period, with no mounds known to date, and other burial alternatives are unknown (Gilmore 2016:46).

Social histories within a community are not limited to the physical modification of the landscape but are also reflected in the subsistence practices of a community. Evidence of hunting and gathering during the Mt. Taylor period is seen in the shell mounds and their deposits. Hunting is evident from the faunal remains of terrestrial, avian, reptilian, and aquatic species (Cerimele 2017). Molluscan species (including snails and bivalves) are generally associated with gathering due to decreased exertion when collecting (Meehan 1975). Information regarding Mt.

Taylor Period molluscan subsistence practices is uncertain, including the methodology and labor required to harvest. In general, gastropods are seen as an accessible form of subsistence for multiple communities over time and are evident globally in shell matrix sites.

Information regarding gender roles in hunter-gatherer societies is derived from ethnographic studies and archaeological information. Modern ethnographic research involving gender roles within hunter-gatherer societies does not directly reflect pre-colonial hunter-gatherer societies. However, these societies still provide information regarding social patterns commonly found in hunter-gatherer societies (Classen 1996). In addition, archaeological information has provided insight into social dynamics and patterns in a regional context.

This is exemplified by Classen in her article on the Shell Mound Archaic (SMA) and the role of labor organizations based on gender roles (1996). In the early 1990s. Classen (1996:247) points out that Nurit Goldman-Finn (personal communication 1993), Sassaman (1993), and Classen (1991) discussed how technological effects in societies were not prioritized by early archeologists. They identified a correlation between the innovation of new technology and the subsequent shifts in the "social practices on the labor organization in the Middle and Late Archaic" (Classen 1996:247). Classen suggests that while technology improvements benefited a culture, a shift in technology that affected women had a greater impact when compared to men (Classen 1996:247). New technology could shift the power dynamics of labor organizations, which are often correlated with gendered roles.

Archaeological records indicate that grave goods can reflect patterns of gendered divisions of labor within a community. An example would be the burials from Indian Knoll; female grave goods were associated with domestic equipment, while male grave goods were composed of tools made for hunting and fishing (Classen 1996:248). The quantity and quality of these grave goods would indicate an individual's prestige within their community.

Prestige within a community could be associated with respect, power, and increased control over resources. Classen (1996) quotes Sassaman in her article regarding his findings on the Savannah River and the use of increased individual labor to construct mounds (Classen 1996:248). The increased contribution to constructing mounds correlates with improving an individual's status within their community. Therefore, provisioning more shell material for mound construction led to cultural changes.

Shell Sites

Shell sites are found globally near aquatic resources. The term shell site encompasses the various means of intentional or unintentional shell disposal/dispersal by humans (Randall 2015:164; Waselkov 1987). Marquardt, in his 2010 article, describes shell mounds as a type of sediment: "particulate matter that has been transported by some process from one location to another" (Marquardt 2010a: 554). He quantifies this sediment transportation as being done in some manner by humans, which encompasses mollusk shells (Marquardt 2010a). While mollusk shells are the predominant components of shell sites, additional components such as faunal remains, ceramics, lithics, and burials may be incorporated.

The formation of these shell sites is a type of terraforming that has a significant impact on the landscape, maintaining multigenerational significance and permanent environmental changes. Specifically, terraforming is identified as intentional improvements to a landscape to make it more habitable (Grier and Schwadron 2017).

Based on cross-cultural patterns of shell placement, archaeologists have sought to create formation typologies regarding shell sites. This typology regarding shell sites includes middens, mounds, ridges, rings, fields, and deposits. Labeling these shell sites is determined by their physical appearance in the environment (Randall 2015:164; Waselkov 1987; Widmer 2014). The typologies of these sites reflect the evolution of the sites at their final stage of development. The role of shell sites can evolve due to variations in shell accumulation practices, as well as changes in the site's significance to a community across multiple cultural periods (Classen 1991).

Shell sites are commonly associated with middens in the archaeological field (Stein 1992:6). The concept of shell middens is heavily tied to the initial research into the first shell site in Denmark, which was considered a "kjokkenmodding" or in English a "kitchen refuse" site back in 1851 (Randall 2015:5; Waselkov 1987:139). The term midden overall implies refuse (trash) that has been intentionally deposited into a ditch or pit as a method of trash disposal (Needham and Spence:1997; Randall 2015:5). This conceptualization of middens created limitations on how shell sites were perceived and interpreted in the archaeological record. An excellent example of misinterpretation regarding shell sites comes from Jeffries Wyman's interpretation of shell mounds in the St. Johns River. He inferred that the human remains found within the mounds correlated with cannibalism instead of the mound acting as a burial site (Wyman 1973:68).

Wyman's interpretation of shell sites is derived from multiple factors of biases and assumptions. One of these biases is related to the consumption of shellfish as an indicator of a "lower form of culture" and impoverishment (Meehan 1975:15). Another perception of Wyman's was the understanding that shell sites only served the role of refuse deposits leading to his interpretation of cannibalism (Randall 2015b:4). Due to the perception of middens as refuse deposits only, archaeological research on shell sites was constrained to a more processual interpretation of the materials found at the shell sites (Stein 1992:7).

Shell sites are well documented in the Southeast as the Shell Mound Archaic (SMA) phenomenon, with sites appearing around 8900 cal BP on a widespread scale in the region where earthen mounds also play a significant role in the cultural landscape (Classen 2010:32; Cerimele 2017:10). As more research was done on shell sites, an understanding was developed that these shell formations were not limited to refuse but rather extended to multiple functions. A noticeable correlation regarding the shell sites was the cultural significance of earthen mounds in North America and how shell mounds may have a similar function (Randall 2015:17). Ethnographic accounts of hunter-gatherer tribes who contribute to shell works provide further support for the multi-functionality of shell sites (Thompson and Andrus 2011; Marquardt 2010a; Meehan 1975).

The extension of these cultural functions includes monuments, habitation areas, mortuary areas, ritualization, social memory, and reinforcement of cultural identity (Thompson and Andrus 2011; Marquardt 2010; Meehan 1975; Randall 2015). The shells contribute evidence of the culture's subsistence practices and the maximization of resources (Randall 2015:57; Classen 1991:283).

The term monument implies human intention in constructing a structure not dedicated solely to habitation purposes. Monuments may serve multiple social functions during and after the monument's construction. Monuments can indicate social stratification and prestige in a community or territorial division between different regional groups (Randall 2015:56). The construction of shell sites during the Florida Archaic is poorly understood. However, a correlation can be seen at some shell sites between feasting events and the mass deposition of shells (Thompson and Andrus 2011: 319).

Shell deposition at shell sites can occur episodically, continuously, or as a singular event. The accretion of shell could occur through singular or repetitive events, such as seasonal or daily use (Hausmann and Meredith-Williams 2017; Gilmore 2015). The duration of these deposits, which occur over multiple cultural periods of occupation in the area, varies in size. Frequently, the formation of shell sites occurs within inhabited areas. Shell rings or ridges may serve as demarcations of habitation areas for some communities. This can be exemplified by the Sapelo Island Shell Ring Complex (SISRC), where research has identified the complex as a habitation site (Thompson and Andrus 2011). The connection between the mobility of people, the duration of inhabiting an area, and the occurrence of shell deposition is crucial in understanding the contents of shell sites and the processes used to select and deposit material at these sites.

Research has been conducted on the mobility patterns of individuals buried at the Harris Creek (8VO24) ossuary, categorizing three mobility patterns: residential, logistic mobility, and permanent migration. The accessibility of these sites also applies to mortuary mounds and their location in the landscape. The Harris Creek site (8VO24) is a mortuary mound with numerous individuals interred in the shell matrix of the mound (Quinn et al. 2008; Aten 1999). The Harris Creek site and related sites on Tick Island are composed of ten distinctive layers of deposits with some areas as thick as 20 – 25 feet of shell material (Aten 1999; Jahn 1978:8). The burials found at the Harris Creek site are located mainly in layers 3 and 4 (Aten 1999:144). Given the complexity of the Harris Creek site's stratigraphy, the effort required to develop the site indicates a significant amount of manpower and dedication.

Shell-filled Pits. Shell-filled pits, as a type of shell site, have gradually gained more prominence in the archaeological field as a reservoir of information beyond subsistence data. Research conducted on the shell-filled pits of Silver Glen Springs has expanded the significance of the depositional pits that are heavily scattered throughout the area (Randall 2015; Gilmore 2015; Sassaman et al. 2011).

Gilmore highlighted that the architecture of the pits is relatively unstable and can collapse due to rainfall (Gilmore 2015:111). The filling of the pits at Silver Glen Springs has been noted to be consistent with minimal variation in the material being deposited into the pits (Gilmore 2015:108). This minimal variation and consistency in the pits has enabled the interpretation of the pits to be included as a significant form of cultural reproduction (Gilmore 2015:108). The bottom of the pits and the fill reflect evidence of thermal alterations, possibly associated with roasting pits and feasting events. The shell sites of Silver Glen Springs and the Mt. Taylor period are mainly composed of *Viviparus sp.*, *Pomacea sp*., and freshwater bivalves (*Unionidae*) (Randall 2015:115).

The pits have been hypothesized to have been filled rapidly due to a lack of evidence for pit collapses and the presence of sand mantles that level the layers between the fill (Gilmore 2015:108). Evidence shows that some of the pits dug at the site intersected with older pits, as indicated by stratigraphic evidence (Gilmore 2015:113). These intersections are theorized as intentional actions to interact with the past and revitalize the connection between the past and present (Gilmore 2015:113).

To reiterate, the formation of shell sites and their presence in the landscape reinforce the connection between individuals, their community, and their environment (Randall and Sassaman 2017). People live in the environment; they modify it and form a personal connection derived from ancestral and personal knowledge of the landscape and raise future generations in the same conditions. The identity of an individual and community is based on experience and knowledge. Shell sites are multi-functional and should not be reductively categorized into a singular role.

Place-Making

I interpret place-making as broadly conceptualizing human interaction with the environment to create a space modified by human intent, thereby shaping cultural practices and identity. This interpretation is derived from the research done by Randall and others regarding the application of "landscape inhabitation as a history" (Randall 2015:17). The inhabitation of a landscape reflects the cultural development of a community, including the unique evolution of individuals and the general collective in their social and environmental interactions (Randall 2015:67; Cerimele 2017; O'Donoughue and Gilmore 2015).

> "These ways of inhabiting are always in a state of becoming and emerge from a constant interplay between people, environmental processes, material conditions, and a recognition of a past through social memory" [Randall 2015:67].

Placemaking is not limited to functionalism or utilitarianism but serves a higher need in a psychological and social sphere on multiple levels. Placemaking is essential to establishing identity. Modifying the surroundings establishes a connection between oneself and the environment. This conceptualization is like the principle of "inscription" (Randall 2015:11). Inscription is interpreted as "the physical alteration of the natural world,…, as well as the imposition of social meaning on those modifications" (Wilson and David 2002). Therefore, I connect the creation and continuous deposition of shell sites as a form of placemaking. The shell sites are alterations to the physical world through social deposition practices in a concentrated space. Similar to the construction of buildings, an area must be chosen as the foundation, resource procurement and management need to occur, and the continual maintenance of the shell site becomes incorporated into the surrounding community. Direct action is not necessary for indirect effects to occur. This can be exemplified by the cultural impact of pre-existing shell sites on a descendant population.

These pre-existing shell sites have been documented as the home of the ancestors and are considered sacred grounds like modern graveyards (Meehan 1975). Mortuary spaces are seen as connections to the past but are also active spaces in the community as the dead are continuously interred. These spaces are continuously maintained physically and socially as places of connection between the living and the deceased. They connect the past, present, and future generations. This connection could be seen as cosmological, a spiritual subliminal space where different metaphysical areas of existence interact.

Cosmology and futurism. Place-making is closely tied to the concepts of terraforming, futurism, and cosmology. The intersection of these concepts supports a complex indigenous perspective regarding the interactions with the non-human world, places, and processes (Randall and Sassaman 2017:11; Cornum 2015). Randall and Sassaman elaborate on the role of terraforming as a "relational construct through which real and speculative experiences in time and place are negotiated" (Randall and Sassaman 2017:11). Where terraforming acts as a mechanism to transform the psychosocial environment of an individual and a community. This revision to the landscape shifts the narrative of the future interpretations of these environmental relations and the communities. These shifts have been identified as the "middle-ground" by Randall and Sassaman (2017).

This "middle ground" is conceptualized by Randall and Sassaman, where actions are transformed into moments of self-determination that have the potential to acknowledge and redirect the community's anxieties (Randall and Sassaman 2017:10). Present concerns about the physical and psychosocial aspects of the population create anxiety regarding the current and future well-being of the community. These concerns can also address the cosmological understanding of the world. The evolution of cultural knowledge and interactions with other communities can, over time, alter a community's cosmological understanding and necessitate a new narrative.

> *"hunter-gatherer communities resituated themselves in time, the landscape, and the cosmos amid what we call here the 'middle ground'. The middle ground is a multi-temporal conceptual space, where cosmology, history, and landscapes intersect"* [Randall and Sassaman 2017:10].

Randall and Sassaman draw a comparison between the middle-ground and the Middle World plane of existence found in numerous Indigenous American societies (Randall and Sassaman 2017:12). The Upper World plane (air/sky/space) is associated with a more spiritual and omniscient presence. At the same time, the Middle World is the human plane of existence, and the Under World is associated with the subterranean aspects of the world, including the deceased and primordial water (OKLA HOMMA "Origins Theater" 2021).

This connects with the shell-sites of SGSC and how environmental changes, such as sea-level elevation, may have altered the interactions between the Middle World and the Under World. Difficulties in adapting to environmental changes may cause cultural behaviors to shift or be abandoned to survive on a psychosocial level. Shell sites require maintenance to persist in a cultural landscape or become overgrown and socially forgotten. Social abandonment of cultural practices could be a sign of cultural change and the erosion of practices in a community's long-term social memory.

Social Memory

Social memory is defined as "acts of collective remembrance about activities or events that have occurred (or thought to occur) in a particular space" (Van Dyke and Alcock 2003). Memories are not uniform in nature but rather malleable, constantly shifting and evolving between identities, individuals, groups, and time and reconstructed by the mind. Memories can be repeatedly experienced, replicated, reenacted, and retold by individuals who created the memories or by others who observed or learned about the memories. This can be seen through the engagement of ritual practices, narratives of the past, and the manifestation of said memories through objects and commemorative places in the landscape (Van Dyke and Alcock 2003:4).

The formation of a memory is intrinsic to human identity, and by extension, to social and cultural identities. Societies are created by individuals interacting with one another to form social networks and create communities. As time passes, cultural practices develop based on past interactions. Engagement with memories ensures their continuity over time. This engagement can be seen in ritual deposition practices referencing earlier histories and traditions at shell sites (Randall 2015). Shell sites at Silver Glen Springs show signs of re-engagement, with new shell deposition building off old shell sites. Deposited material can reflect information on the depositors, the age of the deposit (radiocarbon dating), the types of resources available, and the deposition method. Silver Glen Springs Locus A contains features that have been interacted with cross-generationally.

As discussed earlier in the chapter, the shell deposits are stratified at Silver Glen Springs, with some pits having been dug into these stratified layers and then refilled with material. This can be interpreted as a form of interaction with the past (Randall 2015:229). The deposits were resurfaced and capped with new material, possibly indicating a change in the community's social memory and a shift to new traditions (Randall 2015:232). Another significant interpretation of the shell-filled pits is that they serve as a form of commemoration. The original role of the pits was associated with mounding and feasting ceremonies, which were communal experiences to reinforce social structures (i.e, hierarchies and systems of exchange). However, with later pits being dug, there was an increased complexity in the filling method of the pits. The intersection between the past and present acted to reaffirm the authority of the past, while maintaining "well-established shell-mound traditions but altering them in important and strategic ways" (Gilmore 2015:114).

Reproducing history revitalizes past knowledge, engages present experiences, and shapes future generations (Randall and Sassaman 2017). Social memory acts as a form of education for a community. It teaches present and future generations how past generations have adapted and survived in the landscape. However, ecological or social events can alter the significance of social memory and the need to reengage with these memories. Significant changes to a society and its way of life can reflect the necessity to learn anew and create new social memories to thrive.

Conclusion

Hunter-gatherer societies in northeast Florida constructed shell sites to reinforce their cultural identity. The construction and maintenance of shell sites are sociological and cosmological evidence of this identity. I argue that shell sites are not uniform in function but rather multifunctional. That shell sites enable generational exchanges of information through placemaking and social memory. The deposition process at shell sites is not limited to the discarding of refuse but also an act of cultural reinforcement. This cultural reinforcement occurs not only in the mounding of shell sites but also in the formation of shell-filled pits that modify the landscape less overtly.

The deposited shell pits of Silver Glen Springs were created and buried before the mounding of shells at Silver Glen Springs. These discrete burials in the landscape were not visible to the general observer. Knowledge of these shell depositions would have to be shared between individuals who participated in or observed the creation of the shell pits and maintained the memory and intention behind their creation. Based on these theories, I argue that the formation of shell-filled pits was a form of place-making that ensured the establishment of identity in the landscape. The transmission of this social memory within the community reinforces the people's ties to the land. The role of the ancestors who dug the shell-filled pits and the descendants who maintain the information and continue to dig the shell-filled pits reaffirms their connection to the local landscape.

Chapter 3: Environmental Background

The Silver Glen Springs watershed is part of the St. Johns River System and the focal point for this thesis. The first part of this chapter contextualizes the location of Silver Glen Springs, which is connected to Lake George in the St. Johns River system (Figure 3-1). The second section discusses the modern conditions of the St. John's River system, followed by a review of the paleoenvironment of the St. John's River system. I first discuss the modern conditions, including the hydrology of the river system and how it relates to Lake George, the current climate of Florida, the current ecological components of the area in terms of fauna and flora, and the soil composition of the region. In the following segment, I broadly discuss the paleoenvironment and then focus on the Archaic period of Florida and the Silver Glen Springs watershed. This section similarly mirrors the composition of the modern environmental segment of this chapter, but I include a discussion of the role of changing sea levels during the Archaic period. The period's paleoclimate and hydrology will be generalized for the Florida region. As for the ecological components of the past, this will be supplemented with archaeological information.

Overall, reviewing both the paleoenvironment and the contemporary environment reveals an ecosystem that can sustain a population of freshwater gastropods and the people who exploited them, as evidenced by the shell sites around the St. Johns River System.

Location

The area of focus for this thesis is around Silver Glen Springs (Figure 3-1), one of three springs that flow into Lake George. Lake George is a brackish lake in central Florida, also known as Lake Welaka. It is the second-largest lake in Florida after Lake Okeechobee. It is a part of the St. Johns River system (Bourgerie 1999:7). The research location of the Silver Glen

Springs shell mound site is managed by the Juniper Club LLC and is a counterpart to other archaeological sites managed by the Ocala National Forest (Randall 2015).

The St. Johns River system (Figure 3-2) runs northward from just north of Vero Beach, Florida, to east of Jacksonville, Florida. This is one of the few freshwater river systems in the U.S.A. that flows north into the Atlantic Ocean (Bourgerie 1999:2). The St. Johns River is a significant natural resource in the region and has been utilized continuously since its initial occupation around 12,000 years ago (Randall 2015:9; St. Johns River Water Management District 2024). Human activities have affected the conditions of the river. Invasive species, human recreation/modifications, and climate change have impacted the natural development of the river system (Gilmore 2016:87; Pinto et al. 2023:3). While humans before the 18th and 19th centuries have been modifying the landscape to suit their needs, modern changes to the landscape have been more rapid compared to the modifications done before colonial contact (Miller 1998:40). Examples of changes to the landscape surrounding the river system include shell sites found nearby, and the practice of draining wetlands that are associated with the river system (Pinto et al. 2024).

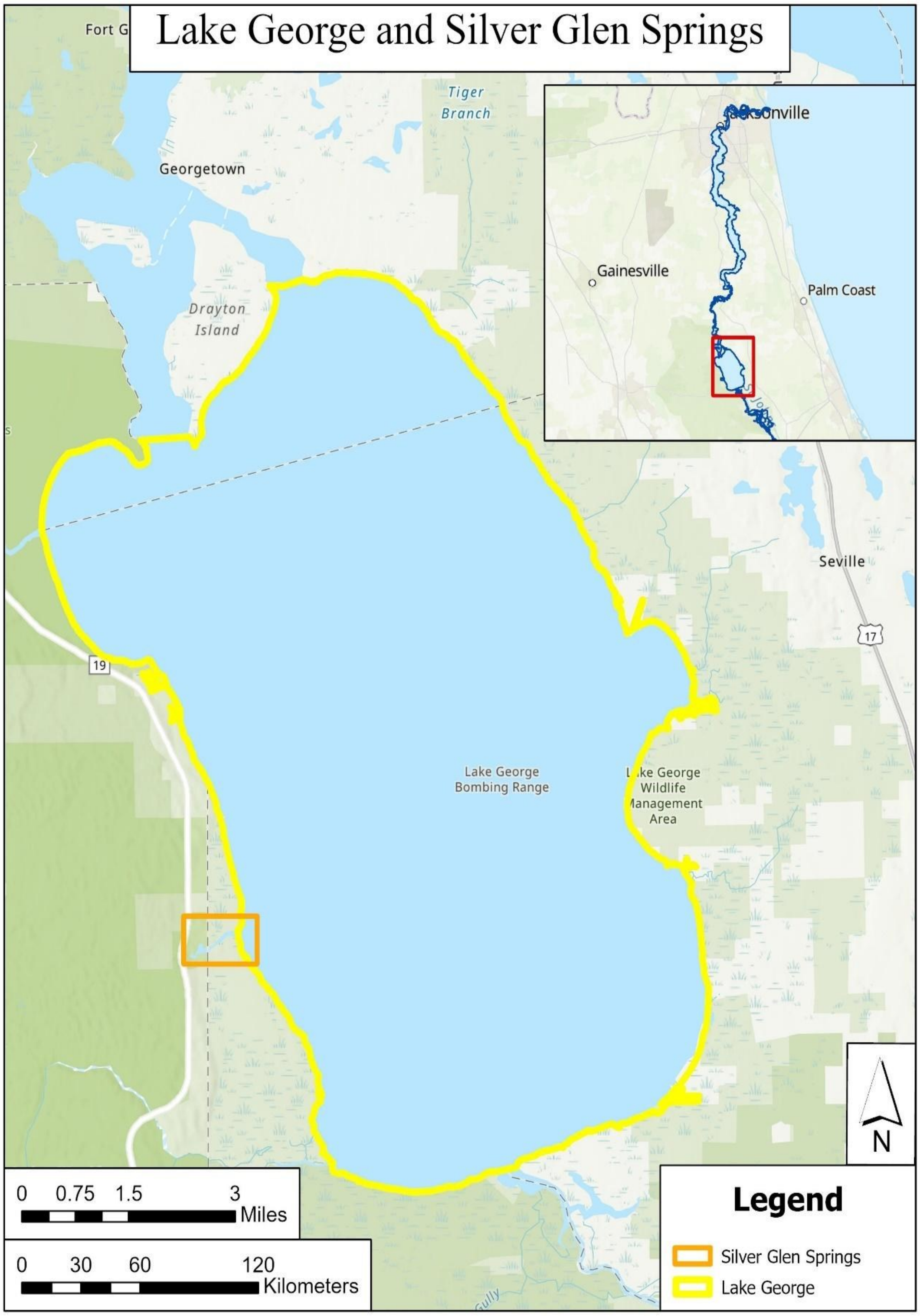


Figure 3-1. Lake George and the Location of the Silver Glen Springs Complex

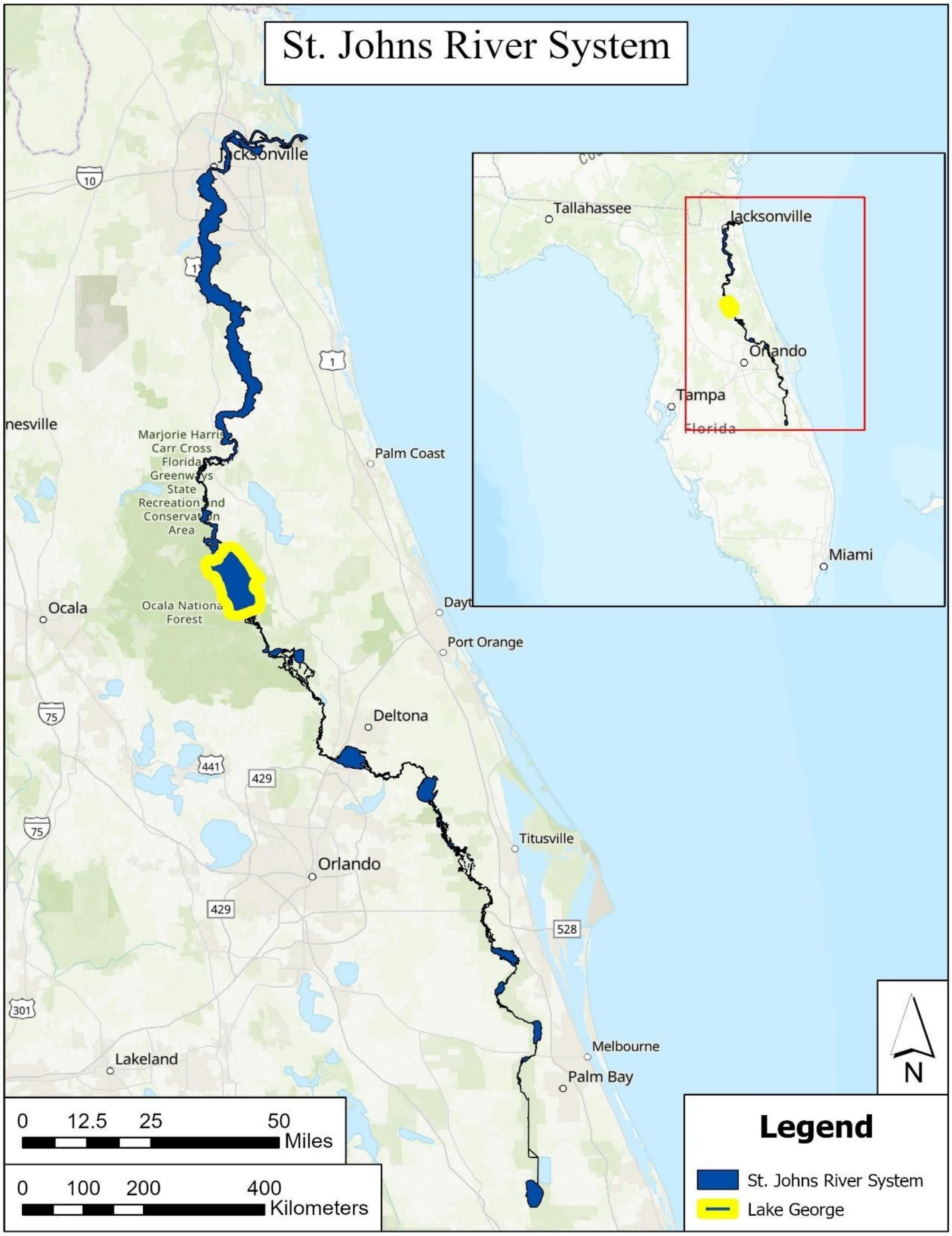


Figure 3-2. Map of the St. Johns River System with Lake George identified

Current Hydrology

The current hydrology of the St. John's River is divided into five sections: the upper, middle, and lower basins, the Lake George basin, and the Ocklawaha River basin (St. Johns River Water Management District 2024; Pinto et al. 2023:3). Silver Glen Springs is located on the southern portion of Lake George. The interpretation of how Lake George is characterized varies between groups and reports. The "State of the River Report for the Lower St. Johns River Basin" report describes the Lake George basin as "the area between the confluence of the Wekiva River and St. Johns River, and that of the Ocklawaha River and the St. Johns River" (Pinto et al. 2023:3; DeLotelle 1991:4-7). To be explicit, Lake George is within this zone of description. Other discussions locate Lake George in the middle valley of the St. Johns River, "the St. Johns Offset" (Rainville 2019:24; Randall 2015:89).

Silver Glen Springs is considered an artisanal first-magnitude spring (Harris et al. 2017:i). A first-magnitude spring is a spring that extrudes greater than $2.8m^3/s$ of water (Randall 2015:106). The spring is a part of the Floridan aquifer system (FAS) (Upchurch et al. 2019). The FAS can be defined as a system of highly permeable carbonate rocks that filter rainwater that either holds the filtered rainwater in karsts or extrudes them due to hydraulic pressure into springs (Miller 1986:46; Upchurch et al. 2019). The FAS is composed of dolomite and limestone. It is made up by three segments: The Upper Floridian Aquifer (UFA), the Middle Confining Unit (MCU), and the Lower Floridian Aquifer (LFA) (Upchurch et al. 2019). The St. Johns River Water Management District identifies Silver Glen Springs to be a part of the Upper Floridian Aquifer.

Since Silver Glen Springs is considered artisanal, the water supplying the spring is from a confined aquifer (Upchurch et al. 2019). This allows hydraulic pressure to extrude the water through two vents found at the springs. The water extruded into the spring has a salinity of 0.96 ppt, making the spring area more of an estuary spring than a pure freshwater spring (Harris et al. 2017:A-6). In addition, this salinity is higher than that of Lake George by 0.34 ppt (Harris et al. 2017:A-6).

Water from the Silver Glen Springs vents is usually above 22°C year-round (Harris et al. 2017:10). The water temperature from Lake George fluctuates between 7 to 32°C, with the median above 25°C between May and October. Lake George is identified as a shallow eutrophic lake with an average depth of two meters and a maximum depth of six meters with a sand bottom (Srifa 2016; DeLotelle 1991:7). As for Silver Glen Spring, the deepest depth of the Spring ranges from 5.49 to 12.19 meters.

The opacity of Silver Glen Springs makes the springs an idyllic swimming area with an opacity so clear that the Secchi Disk Transparency (SDT) is unavailable. As opposed to that, the Secchi (ft) for Lake George is 1.97 on average (Harris et al. 2017:30). Visibility of 1.97 ft is not uncommon for a eutrophic ecosystem and exemplifies the difference in clarity between an idyllic spring and a more conventional lake (Green et al. 1996:2).

The connection between Silver Glen Springs, Lake George, and the St. Johns River is notable. Silver Glen Springs Run is the pathway connecting the spring to Lake George and has an overall environmental composition similar to the spring. The salinity of the water can change between the colder and warmer seasons, with the salinity of the spring during colder months moving to the top of the water column of Lake George and the water of Lake George intruding at the bottom of the Spring run (Harris et al. 2017:A-6). The flow from the St. John's River affects the flow of Lake George, which is supplemented by three streams, one of them being Silver Glen.

Climate

The climate of Earth has changed with the progression of the Anthropocene. The world's average temperature has significantly increased since 1975 (GISTEMP Team 2024; Hansen et al. 2010). The shift in global temperatures, an increase in precipitation has been documented as well (Mahjabin and Abdul-Aziz 2020). This shift in climate has been attributed to global warming (Irizarry et al. 2010). Global warming has had a significant impact on the environment, including rising sea levels and an increase in intensive cyclone activities (Randall 2015:100).

As for the current climate of Lake George and the surrounding area, modern-day Florida is identified as a humid subtropical climate with two primary seasons – wet and dry (Cerimele 2017:38; Randall 2015:99; Kroening 2004:5). The wet season begins in June and ends in September with the rest of the months considered a drier period. The wet season sees an increase in precipitation due to it being tropical storm season, with La Nina and El Nino affecting the number of tropical cyclones (Cerimele 2017:38; Randall 2015:99; Kroening 2004:5). The number and severity of storms have increased with global warming and are frequently more intensive than previous hurricanes of the past (Garner 2023).

Ecology

The area around Silver Glen Springs comprises multiple zones coming together to form a rich ecological system with varied components. This includes the basin area of Silver Glen Springs, Silver Glen Springs Run, the Ocala National Forest, and Lake George (Walsh et al. 2009:68). The general terrestrial vegetation around the area is composed of evergreen oaks (*Quercus sp*.), cedar, saw palm (*Serenoa repens*), scrub palmettos (*Sabal etonia*), and pine (*Pinus sp.*) trees (Wetlands Solution Inc. 2010:X-8; Mohlenbrock 1976:309). Other riparian plant species are found around the spring itself, including "red maple (*Acer rubrum*), Pignut hickory

(*Carya glabra*), southern red cedar (*Juniperus stiliciola*), and bald cypress (*Taxodium distichum*) trees" (Cerimele 2017:42).

Aquatic Vegetation

Submersed aquatic vegetation (SAV) found in Silver Glen Spring and Run include "eel grass (*Vallisneria americana*), water milfoils (*Myriophyllum sp.),* hydrilla, coontail (*Ceratophyllum demersum*), and strap-leaf sagittaria (*Sagittaria kurziana*) (Cerimele 2017:40; Wetland Solutions 2010:X-26; Pandion Systems Inc. 2003:15). Eel grass composes a significant percentage of the vegetation in the spring, about 46% or 10 acres (Pandion Systems Inc. 2003:15). This number has changed with a report from the Florida Fish and Wildlife Conservation Commission (FWC) discussing damages from Hurricane Irma and the need to reestablish eelgrass growth in the spring (Segelson 2022). A notable invasive plant problem was present in 41.9% of the studied area by Pandion Systems Inc. These species included a non-native *Myriophyllum* and a non-native hydrilla (Pandion Systems Inc. 2003:16).

In addition to non-native plant species being an issue in the spring, algae have become a major ecological concern. Algae are a significant threat to any water system, due to their ability to block out sunlight where they grow. The blocking of sunlight limits the amount of oxygen in the water, in addition to the production of toxins by the algae (William et al. 2007; Pinto et al. 2023). Research has identified some non-native harmful algae species in Silver Glen Springs, including *Lyngbya wollei* and *Vaucheria spp.* (Stevenson et al. 2007:25). A particular problematic algae strand is the more prevalent blue algae (Cyanobacteria) that have been found in the St. Johns River system and Lake George (Pinto et al. 2023). At Lake George, samples of *Komarekiella sp., a cyanobacteria,* were recovered from a dermal mat on stranded dolphins. These cyanobacteria and their bloom have been blamed for the unexplained dolphin mortalities in Florida (Pinto et al., 2023). This increase in cyanobacteria has been linked to the rising water temperature found at Lake George (Srifa et al. 2016).

Lake George has three primary vegetative zones: emergent, submerged, and floating (Koenig and Eilers 2006:4). A total of 54 plant species were documented, 9 of which were non-native and 6 identified as pest species. Native Water Pennyworth (*Hydrocotyl umbellate)* was found to be the most abundant at Lake George. Melaleuca trees (*Melaleuca quinquenervia*) were identified as non-native invasive species that compete against native plant species (Koenig and Eilers 2006:4).

Vertebrates

Numerous modern faunal species live around the Silver Glen Springs area. Some mammalian examples include the white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), several species of squirrel (*Sciurus sp.*), river otters (*Lutra Canadensis*), wild boar (*Sus scrofa*), and black bears (*Ursus americanus floridanus*) (Cerimele 2017:42; Pandion Systems Inc. 2007: 20). The reptilian aspect of the area includes alligators (*Alligator mississippiensis*), aquatic turtles, and snakes. These snakes include the infamous water moccasin amid other harmless species (Ocala National Forest 2019:62). Nicole Cerimele's thesis conducts a more in-depth analysis of animal species in the area (Cerimele 2017).

As for the area's avian population, a mixture of migratory and native bird species frequent the area. There are numerous bird species, including ospreys, bald eagles, multiple heron species, vultures, hawks, and wild turkeys (Pandion Systems Inc. 2003:18; Cerimele 2017:93). The more migratory Aves belong to the duck family and songbird species (Cerimele 2017:42).

There are also protected animals that call Silver Glen Springs and the surrounding areas home. This includes the Florida manatee (*Trichechus manatus*) and the Silver Glen Spring Cave crawfish (*Procambarus ortmannicus attiguus*) (Pandion Systems Inc. 2007:19; Hobbs Jr. and Franz 1992; Cerimele 2017:42; Harris et al. 2017). The Florida manatee favors warm bodies of water and frequents Silver Glen Springs for its consistent water temperatures during the cooler months.

Numerous bony fish species (*Osteichthyes*) are found in the waterways of Silver Glen Springs and Lake George (Cerimele 2017). Cerimele mentions at least 20 known species, these include popular fishing species such as the largemouth bass (*Micropterus salmoides*) and mullet (*Mugil cephalus.*) (DeLotelle 1991:55; Walsh et al. 2009:51; Cerimele 2017). A comingling of freshwater and saltwater fish species can be found in the estuary environment of Silver Glen Springs. Freshwater fish include the Florida gar (*Lepisosteus platyrhincus*) and the brown bullhead (*Ameiurus nebulosus*) (DeLotelle 1991:55). Blue crabs are also present in Lake George (Ehnert-Russo et al. 2022).

Invertebrates

Invertebrates, specifically mollusks, play a significant role in the Florida landscape, as exemplified by the shell sites that dot the Florida landscape. The main shell composition of Locus A is composed of *Viviparus georgianus* (banded mystery snail), *Pomacea paludosa* (Florida apple snail), *Planorbella scalaris* (mesa ram's horn), *Elimia floridensis,* ram horn snails, bivalves (*Elliptio sp.),* and terrestrial snails. Documentation of the current gastropod population in the region is spotty. Woodruff's documentation at Silver Glen Springs from the 1990s included apple snails (*Pomacea paludosa*), goblin elimia (*Elimia vanhyningiana*), *Gyraulus parvus*, and *Planorbella sp.* according to the 2010 appendices report from Wetland Solutions Inc. (Wetland Solutions Inc. 2010: X-32; Woodruff 1993). A lack of banded mystery snails is notable given the significant volumetric composition found at Locus A.

Viviparus georgianus

There is a lack of information on the distribution of *Viviparus georgianus* (banded mystery snail) in the St. Johns River system, Silver Glen Springs, and Lake George. However, due to human intervention, the banded mystery snail has become an invasive species in the northern parts of the United States (David et al. 2020). This has allowed more research to be collected on the species. The native range of *V. georgianus* is the southeast region of Florida (Alabama, Georgia, Florida, and the Mississippi River) (Clench 1962; David Et al. 2017). The origin of the name banded mystery snail is from the "mystery" of fully formed baby snails appearing (University of Wisconsin 2014). The females of this species are "iteroparous and brood their young (ovovivipary)" (David et al. 2017; Jokinen et al. 1982).

The life history was researched by Jokinen et al. (1982). The authors focused on the reproductive and development cycle of the snail and their migratory pattern in a eutrophic lake in Connecticut (Jokinen et al. 1982). This migratory pattern may be reflective of behavior at Lake George (see below). The life span for the species is described as 2 years for males and 3 years for females with the average male size width around 15.5 mm at death, while the females continue to grow to the maximum width (mm) of the upper teens into the lower 20s at the time of death. The females live a year longer to reproduce. Their growth patterns were comparable to the Chinese mystery snail (*Cipangopaludina chinensis*). The growth rates of *V. georgianus* were found to be rapid in warmer waters and negligible in colder waters. Mortality rates are low for young snails, with the death of older snails being an organized event in the late spring.

Reproduction is a singular life event. Females will brood a single clutch of eggs for nine months during their third year (27-36 months old). This clutch will contain 3 to 24 eggs with an average clutch size of 11.1 (Jokinen et al. 1982:8). They release the young in April and die around 38 months of age around May. The snails are found dead in waters around 3-4 meters deep. The snail population demonstrated a migratory pattern where they aggregate in deeper water in the winter at the edge of the Potamogeton zone which is around 2-4 meters deep. During late April, the snails will start migrating to shallower waters and aggregate together to an area of 1 to 4 meters, with most of them occurring at 2 to 3 meters deep. During July and August, the snails come together to reproduce. Older male and female snails migrate together, with younger snails lagging to overwinter in deeper water (Jokinen et al. 1982:9).

The fertilization pattern documented by Jokinen and colleagues is more applicable to *Viviparus georgianus* found in northern habitats, with life patterns identified as different for the Florida-located snails. The *Viviparus georgianus* studied were found to incubate two possible sets of broods at the time of fertilization by a male. The time of incubation is similar to that of Connecticut populations. However, the second brood seems to be fertilized in the late fall with the initial brood being fertilized in the early spring. Vail interprets this as “fertilization, sequential developmental stages, and births were able to occur at any time” (Vail 1978:85). It was also noted by Jokinen et al. that the Florida snails were larger in terms of average adult length (around 32-34 mm), larger young at birth (≤ 7.5 mm diameter), and no sexual dimorphism in terms of body length between males and females (Jokinen et al. 1982:10; Vail 1978:93).

The foodways regarding *Viviparus georgianus* are not well documented in the Americas and no longer occur. The consumption of Chinese mystery snails (*Cipangopaludina chinensis*) is still practiced in Asia and has occurred since the early Holocene (Li. Et al., 2013; Zhang et al. 2021:abstract). The mystery snails in China were identified as a seasonal secondary non-staple resource that supplemented the nutrition and subsistence of people during certain times of the year (Li et al. 2013).

Pomacea paludosa (Florida Apple Snail)

Pomacea paludosa is noted by the Florida Cooperative Fish & Wildlife Research Unit as playing a significant role in the St. Johns River system due to its role as a primary food source for the endangered Florida snail kite (*Rostramits sociabilis*) (Darby et al. 1997:1). The report by Darby et al. goes into significant detail about the life cycle of the Florida apple snail (Darby et al. 1997). They are larger in size in comparison to mystery snails and, therefore, able to provide more meat.

Other Gastropods. Smaller gastropod species within the shell fill include *Rasp Elimia,* which is also known as *Elimia floridensis or Pleuroceridae floridensis,* and *Mesa Ram Horn's (Planorbella scalari*s) (Thompson 1999). These smaller species have relatively unknown life histories. However, they could reveal information due to their frequency in specific cultural periods, particularly the Mesa Rams Horn and its possible correlation with Episode I of the Mt. Taylor period (Randall, personal communication 2025). The Mesa Ram's Horn environmental habitats are associated with marshes and lakes and have a high frequency in Feature 148 (Thompson 1999:77). In addition to smaller snail shells, there are the remnants of freshwater bivalves (*Unionidae*)—clam and oyster shells. These bivalve shells play a significant role in differentiating layers in the shell-filled pits. Their roles within the fills are not certain, but maybe indicators of seasonal deposition or specific events (Randall 2015).

Invasive Species

The ecology of St. Johns River has shifted over time due to environmental changes and human intervention. One of the main species concerned is the *Hydrilla verticillata,* which outcompetes native plant species and affects water conditions and flow. This also applies to invasive fish species, which threaten native species due to competition and the lack of predators (Pinto et al. 2023).

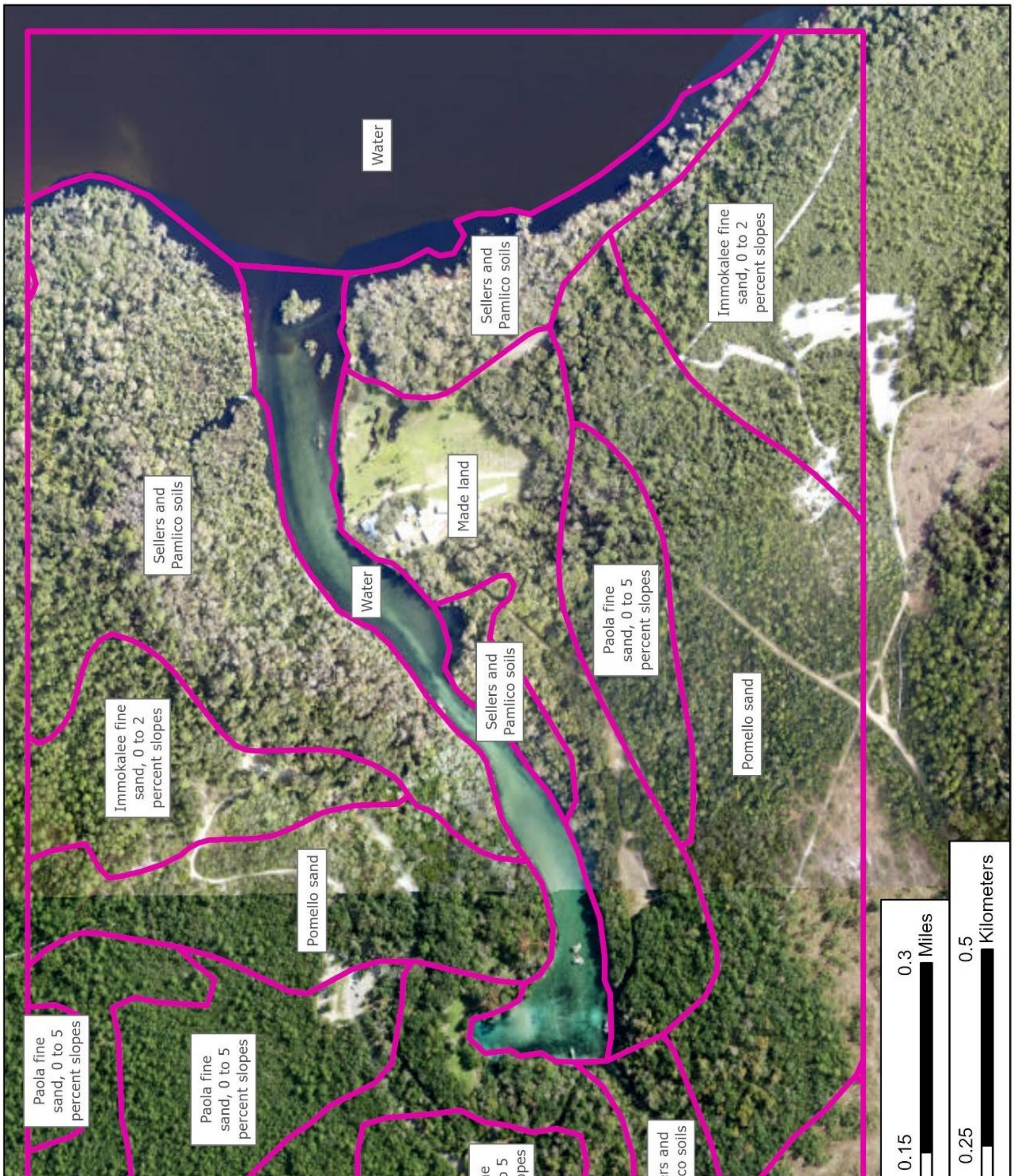


Figure 3-3. Soil Composition of the area surrounding Silver Glen Springs

Soil Composition

Unsurprisingly, a variety of soils are present around Silver Glen Springs. This is visible in Figure 3-3, a soil map derived from the Web Soil Survey website run by the USDA Natural Resources Conservation Service (NRCS) (Soil Survey Staff 2024a). Sequentially, the most prevalent to least prevalent soil are as follows: Paola, Immokalee, Pomello, Sellers, and Pamlico. The Paola soils “consist of very deep, excessively drained soils that formed in sandy marine sediments. Paola soils are found on hills, ridges, and flats on marine terraces” (Soil Survey Staff 2024b). Immokalee soils “consist of very deep, very poorly drained soils that formed in sandy marine sediments. Immokalee soils are on flatwoods and low broad flats on marine terraces” (Soil Survey Staff 2024b). Pomello soils “consists of very deep, moderately well to somewhat poorly drained soils that formed in sandy marine sediments. Pomello soils are on ridges, hills, and knolls in the flatwoods on marine terraces” (Soil Survey Staff 2024b). Seller soils consist of “very deep, very poorly drained, rapidly permeable soils in low, depressional areas and poorly defined drainage ways. They formed in sandy marine sediments” (Soil Survey Staff 2024b). Pamlico soils consist of “very poorly drained soils that formed in decomposed organic material underlain by dominantly sandy sediment. The soils are on nearly level flood plains, bays, and depressions of the Coastal Plain” (Soil Survey Staff 2024b).

The southern portion of the springs run is identified as man-made by the Soil Survey website (Soil Survey Staff 2024a). The technical report states that man-made soils are areas heavily impacted by cutting or filling. This impact was caused by the shell mining that occurred in 1923. The mining reworked the soil deposits across the terrace edge (Randall et al. 2011:17; Soil Survey Staff 2024a).

Paleoenvironment of the St. Johns River System

The Earth has faced many environmental changes since the Last Glacial Maximum (LGM) that occurred 20,000-22,000 years ago. Give or take a couple of thousands of years, it was around this period that humans started populating the Americas (Llamas 2016). Evidence of people populating Florida occurred around 14,500 to 16,000 years ago (Halligan et al. 2016). During the transitions between the late Pleistocene and the Holocene, the terrestrial environment saw a loss of land with the inundation of rising sea levels (Hine et al. 2016). The deglaciation of the LGM through global warming occurred between 18 to 8 kya. At the end of the deglaciation, around 8kya, “sea level was within ~10–20 m (33–67 ft) of its current position.” (Hine et al. 2016:475). Afterward, the sea levels continued to rise to current levels at a gradual rate.

A second pulse of glacial melting (Melt Water Pulse 1b) started around 10,000 BP, reducing the paleolandscape and forcing humans to change settlement methods and foraging ranges. This took place over the next 5,000 to 6,000 radiocarbon years (Faught and Donoghue 1997; Frazier 1974; Faught 2004).

Paleoclimate

Melt Water Pulse 1b is connected to the onset of the Preboreal warming period (Blanchon 2011; Faught 2004). Another major climate event that occurred during the Archaic period was the Hypsithermal (Middle-Holocene Climatic Optimum or Altithermal), which occurred between 8900–5800 cal BP (Cerimele 2017:46; Randall 2015; Anderson and Sassaman 2012). Global temperatures increased during the Hypsithermal, directly causing the rise of global sea levels. It is suspected during this period that the “modern climate of predominantly summer precipitation derived from thundershowers was established in the mid-Holocene” (Watts and Hansen

1994:174; Willard 2007). Therefore, seasonal patterns during this period would be approximate to modern-day seasonal patterns.

Hydrology

With the rising sea levels, Florida's hydrology patterns have significantly shifted. It is calculated during the Mt. Taylor period that a sea level rise of 3- 4 mm occurred yearly, which correlates to a loss of 12 meters of land mass around the Gulf Coast during this period (Randall 2015:93; Faught and Donoghue 1997). This change in sea levels would greatly shift the amount of water in the Florida Aquifer System (FAS). During the Pleistocene, the St. John's River would not have been as expansive as it is currently, it would be "dry or intermittent in its lower reaches" with the lower sea levels (Thulman 2012:78). It wouldn't be until about 7,000 years ago that the present "water regime" would settle (Randall 2011:14). There was initial speculation that springs would not be flowing until into the Holocene (Miller 1998; Randall 2011:14). However, evidence from Salt Springs indicates water flow as early as 9,000 years ago (O'Donoughue et al. 2011; Randall 2011:14). This can establish the possible viability of Silver Glen Springs to an earlier period than Miller would suggest. However, the guaranteed stabilization of springs would occur during the establishment of sea levels around 5,000 cal BP (Cerimele 2017: 47; Zarikian et al. 2005; Clausen et al. 1979). Overall, the increase in sea levels shifted the water tables that enabled the St. Johns River to develop into a significant water system.

Paleoenvironment

With the onset of climate and hydrology changes, there would also be a shift in the ecological environment. Pollen records of the past can reflect a shift in the environmental ecosystem. Pollen records from 15 cal kyr BP from the Northern half of Florida reflect a shift in plant dominance from hickory (oak) to pine (Willard 2007). Willard's pollen analysis indicates that Northen Florida was composed of a closed oak scrub forest with areas of prairie-like vegetation between 10 to 10–5 cal kyr BP. This initial identification of pine replacing oak trees implies a transition from a drier environment to a warmer, wetter, environment. The prairie-like vegetation would transform into a more wetland environment with the prominence of *Taxodium* (Juniper) and swamp shrubs (Watts and Stuvier 1980:326). While the southern half of Florida would see this transition around 6000–5000 cal BP, the northern portion of Florida would see this transition around 8500–7500 cal BP (O'Donoughue 2015:68).

Conclusion

Based on the environmental information provided in this chapter, there is a clear demonstration that people during the Archaic period faced an ever-changing environment. The people around the St. Johns River would see a transformation from a drier climate, to wetter, humid environments. The climate shift gradually diminished the amount of land available and increased aquatic environments. This change in hydrology is suspected of enabling the right environmental conditions to allow the *Viviparus georgianus* to flourish in the St. Johns River (Miller 1998:68). While there may have been a loss of land, there was a shift in hydrology that enabled a "new, rich environment to be exploited" (Miller 1998:68). The paleoenvironmental analysis reveals the development of similar environmental conditions around 8,600 cal BP to modern-day conditions. Analysis of modern-day environmental conditions enables an analogous comparison to the past.

Chapter 4: Cultural Chronology

In this chapter, I review the cultural chronology of the St. Johns River system in Florida. I discuss the initial peopling of Florida during the Paleoindian period, followed by an introduction to the early Archaic with a focus on the Mt. Taylor period during the middle Archaic. The subsequent chronology after the Mt. Taylor Period includes the Late Archaic, Woodland, and Mississippian periods of Florida. This chronology is exemplified by Table 4-1 below.

Table 4-1: Cultural Chronology of the St. Johns River System

Temporal Periods	Cultural Periods	Phases	Cal BP	Notable Sites
Paleoindian			13,500-11,700	Page Ladson
Early Archaic			11,700-9000	
Middle Archaic			9000-5800	Windover
	Mt. Taylor		7400-4600	Silver Glen Run
		Episode I	7400-6350	
		Episode II	6350-5700	
Late Archaic		Episode III	5700-4600	Thornhill Lake Phase
	Orange		4600-3500	
Woodland	St. Johns	St. Johns I	3500-1250	
Mississippian		St. Johns II	1250-500	
European Contact			500	

Paleoindian Period

Florida's paleoenvironment during the Paleoindian phase (13,500 – 11,700 cal BP) saw significantly lower sea levels (90 to 80 meters below sea levels) with a more exposed continental shelf (Miller 1998; 45). Paleoindian sites have been located around the Big Bend region of Florida and along the St. Johns River system. These sites are rare and frequently found underwater, indicating other Paleoindian sites are underwater. These sites would include the Page-Ladson (8JE591) site found in the Aucilla River and the Lake George Point Site in Lake George (8PU1470) (Halligan 2012; Thulman 2012). The Page-Ladson site is entirely underwater and requires scuba diving to access the site material easily. Not only is the site physically challenging to access, but also visibly tricky to access with the murky tribulation of the water

(Halligan 2012). Another challenging site to access is Lake George Point, which is located near the shores of Lake George and in the shallow water there (Thulman 2012).

Data from these Paleoindian sites is primarily derived from lithic material and reflects a change in typology from pre-Clovis to Clovis to Suwanee (Anderson and Sassaman 2012). The environment of the St. Johns River during the Paleo-period saw climatic changes toward the end with megafauna becoming extinct (Miller 1998). With the extinction of megafauna, a shift in dietary practices would need to occur. While dietary practices may appear to be the major force in determining mobility patterns, arguments suggest that prioritizing potable water was the key factor in mobility patterns (Dunbar 2012:202). This would explain why most Paleoindian sites are located near springs and other freshwater sources. These springs would not only provide fresh drinking water but also access to karst topography that exposed the limestone beds of the Florida Aquifer System (FAS) (Miller 1992:51).

These limestone beds would provide the necessary materials to make stone tools while being near an accessible water source that could attract game. This somewhat applies to Lake George, where surface water would be highly accessible, and numerous Middle Paleoindian lithic projectile points have been located in the vicinity (Thulman 2009:259). The only caveat is the lack of chert outcroppings surrounding the St. Johns River system. This implies that Paleoindians were attracted to the area for other purposes and traveled with their lithic tools to the site. I interpret that there was an abundance of resources that were worth traveling for, and that the St. Johns River was an excellent provider of said resources.

Early Archaic

Northeast Florida's early Archaic (11,700-8900 Cal BP) saw an environmental and hydrological shift at the end of the Young Dryas (Miller 1992). Sea levels were higher, and due to the increase in water flow at these springs, activity around them increased (Miller 1992). This shift in sea levels meant a change in the coastline, pushing populations inward (Miller 1992).

Early Archaic sites are frequent, with multiple sites characterized by Bolen and Kirk points. These sites are frequently found in the peninsular region of Florida, with a transition period of absence noticeable in the archaeological record (Faught 2004). This gap is attributed to environmental or climatic changes. However, a population rebound between the end of the Younger Dryas and the early Holocene is supported by the increased production of lithic materials, particularly Bolen tools (Halligan et al. 2023).

Bolen populations had a wider range of mobility than the Paleoindian populations in Florida. Bolen sites are found south of the panhandle above central Florida (Halligan et al. 2023). These sites are clustered around springs, possibly taking advantage of "ecotones" (Halligan et al. 2023).

Middle Archaic (9,000 – 5,800 Cal BP)

Discussion of the Middle Archaic in this thesis is reviewed in two main segments. Pre-Mt. Taylor/early Middle Archaic (9,000–7,400 Cal BP) and Mt. Taylor (7,400–4,600 Cal BP). Mt. Taylor itself is segmented into three Episodes (I, II, and III). These Episodes are characterized by "changes in distribution and disposition of shell-bearing sites" (Randall 2013:195).

Most of the early Middle Archaic information is derived from the Windover site (8BR246) in central Florida. The classification of the chronological period of Windover varies between Early Archaic and Middle Archaic. For the intent of this paper, Windover is identified as an early Middle Archaic site due to cultural characterizations associated with the Middle Archaic.

These characterizations include the prominent utilization of aquatic resources as opposed to more terrestrial resources seen in the Early Archaic periods (Tuross et al. 1994; Randall 2015).

Windover is significant as a mortuary pond that contained hundreds of burials and artifacts that are well preserved and protected with peat. Significant biological information (preserved brain tissue and collagenous tissue), as well as dietary and technological insight (lithic, wooden, and textiles), were obtained from the unusual preservation (Doran 2002). Seasonal use of the site has been indicated through paleobotany, and the pollen analysis of the site indicates a primarily summer/fall occupation of the site (Tuross et al. 1994). This indicates seasonal mobility within the community, a pattern seen in Mt. Taylor period communities. Their diet reflects a transition between terrestrial to aquatic resources, although there is no direct evidence for shellfish consumption at Windover (Randall 2015:133; Tucker 2009:30). However, terrestrial deposits at Silver Glen Springs demonstrate that people at this time did have a riverine orientation that included shellfish exploitation.

Mortuary deposition practices from this period indicate elemental connections with the dead. One female burial found at the Little Salt Springs site (8SO18) dates to 7794–7592 cal BP towards the end of the early Middle Archaic period (Wentz and Gifford 2007; Cerimele 2017:29). This burial found the female wrapped in grapevines upon internment, a similar practice is noted at the Windover site, with remains wrapped in textiles. The association of water and death is seen in numerous cultures, not limited to the Americas but also globally, such as the Berawan of Long Jegan in Malaysia (Wentz and Gifford 2007: 335). This symbolic connection between water and death may connect water burials to shell burials, with shells closely associated with water and the land.

Mt. Taylor Period (7,400-5,800 Cal BP)

The shell sites of Mt. Taylor are associated with the St. Johns River and nearby Atlantic coast and intracoastal waterway. Archeological evidence dates shellfishing as early as the early Middle Archaic as a characteristic of the river valley and its associated shell sites (Randall 2013:196). These shell sites would characteristically be composed of *Viviparus sp.*, *Pomacea sp.,* and bivalve shells (Blessing 2011; Randall 2013; Randall 2015). These earlier shell sites were composed of single ridges (Randall 2015:174).

Several different hypotheses are proposed to explain the origins and significance of shell sites, including refuse disposal, practical response to environmental changes, ritualized feasting, or ceremonial monument construction (Marquardt 2010:567; Randall 2013:195; Randall 2015; Randall and Sassaman 2017). I argue that the shell sites of the Mt. Taylor period are multifaceted in their roles but primarily act as a form of terraforming, "landscape inhabitation of history" (Randall 2015:12). This phrase encompasses the idea that through the process of a community living in a environment, where "meanings and associations" are formed between locations and temporal events (Randall 2015:12). Allowing multiple generations to interact with one another, with the remembrance of the past generations, the experience of the present generations, and the education of the future generations visible in the cultural landscape (Randall 2015:17; Harjo 2019; Randall and Sassaman 2017).

The material culture of the Mt. Taylor period includes the "Florida Archaic Stemmed" type, a catch-all category for broad-bladed stemmed lithic hafted bifaces, including Newman bifaces (Sassaman et al. 2011:24). Most of the lithic material utilized is identified as "thermally altered chert or silicified coral" (Sassaman et al. 2011: 24). These thermally altered materials correlate to the chert deposits found around the karsts in Florida. Stone tools also appear in the archaeological record as banner stones and possible abrading/finishing stones found at Hontoon Island (Wheeler and McGee 1994:373). Bannerstones in the surrounding sites are associated with the Thornhill Lake phase of the Mt. Taylor period and are evidence of inter and intraregional trade (Endonino 2008:162). Other implements of note are wood, bone, and shell tools that were found in the Groves' Orange Midden site. These implements were modified to fulfill specific tasks associated with fishing, such as bone fids or personal adornments, such as bone pins and beads (Wheeler and McGee 1994a). Marine shell tools were made throughout the Mt. Taylor period, but those made of *Strombus gigas* shells were possibly restricted to the Thornhill Lake phase (Randall 2015:142). The introduction of ceramic artifacts into the archaeological record of the St. Johns River Valley is not associated with the Mt. Taylor period but with the succeeding Orange period (Endonino 2017).

It is unclear how gastropods were harvested during the Mt. Taylor period. However, gastropods such as *Viviparus sp.* live in shallow areas of water and seasonally group together during mating season (see Chapter 3). This mating season, around July and August, coincides with the seasonal mobility patterns of the Mt. Taylor period of inland occupation during the winter and coastal occupation in the summer (Randall 2015:134). Canoes may have been used to access the snails that were further submerged. Canoes and canoe paddles have been dated to 6,000 cal BP in Florida (Wheeler et al. 2003; Wheeler and McGee 1994b). A net would be able to harvest the snails when they cluster together for the mating period, when they can have a density of up to 500-800/m^2 individuals, with the greatest density occurring around 2-3 meters below the surface (Jokinen et al. 1982:9 and 15). *Pomacea sp.* seems to share a similar reproductive timing pattern to that of *Viviparus sp.,* with significant differences in reproductive practices (Hurdle 1973). The seasonality of the snails may have incentivized mobility patterns.

Subsistence Practices

Earlier research into the subsistence practices of hunter-gatherers framed aquatic resources as a marginal factor in their diets, with terrestrial resources composing the bulk of their diets (Cerimele 2017:8). Later subsistence model research shifted this interpretation of aquatic resources from a marginal component (Gates of Hell) to a predominant role (Garden of Eden) (Cerimele 2017:8; Erlandson 2001:290). The "Gates of Hell" is the theory that pedestals the value of big-game hunting and diminishes the value of gathered resources because big-game hunting was the driving force in human evolutionary development (Erlandson 2001:291). Under the "Gates of Hell" theory, aquatic resources were acquired through gathering and had low productivity value (Erlandson 2001:291). In contrast, the "Garden of Eden" theory equates aquatic environments to cornucopias (Erlandson 2001:90). Aquatic environments had various resources to exploit (fish and shellfish) that were relatively accessible and inexhaustible in quantity (Erlandson 2001:290). These changes in narrative apply to research along the St. Johns River system and associated shell sites, including the Mt. Taylor cultural area (Cumbaa 1976; Russo et al. 1992).

This thesis focuses on the malacology aspect of the Silver Glen Springs Locus A (8LA1W); however, further research has been conducted on Silver Glen Springs's zoological aspects, including non-mollusk components (Cerimele 2017; Randall et al. 2011). Blessing's research identified faunal components of the site relating to the Mt. Taylor Episodes I, II, Thornhill Lake (III), and the Orange period (Blessing 2011:193). While mollusk shells (banded mystery shells and apple snails) were the predominant component of the zooarchaeological assemblage, the vertebrate assemblage was analyzed and was significantly composed of fish

(MNI 72.3%) (Randall et al. 2011:175). Other vertebrates decreasing in significance were turtles, mammals, snakes, and birds (Randall et al. 2011:175).

Cerimele's research focused on the non-mollusk faunal assemblage of Locus A in Silver Glen Springs, dating to the early Middle Archaic and the Mt. Taylor period (Cerimele 2017:108). Her analysis revealed consistency in faunal composition for collected samples from the two periods, reflecting a "generalized subsistence strategy between the two time periods" (Cerimele 2017:108). Like Blessing's findings, Cerimele's faunal analysis of the multiple vertebrate assemblages was predominantly fish, followed by reptiles, mammals, and birds (Blessing 2011:175; Cerimele 2017:101). Cerimele saw that, over time, the assemblage saw an increased presence of mammals and reptiles, with fish maintaining the predominant composition of the samples (Cerimele 2017:102).

Blessing and Cerimele's research revealed that the zooarchaeological composition of Silver Glen Springs was composed of resources sourced from the local environment, with significant utilization of the aquatic water system and less emphasis on terrestrial faunal resources. These two analyses support the "Garden of Eden" theory regarding the reliance on the St. Johns River system for subsistence by the local populations of the Silver Glen Springs area. While the zooarchaeological assemblages of the Mt. Taylor period are evident in the landscape, evidence of plant consumption is lacking in the archeological record due to the lack of preservation. Information regarding plant consumption is dependent on isotopic analysis of dental remains.

Isotopic research has been conducted on Mt. Taylor period remains from the Harris Creek site (8VO24) (Quinn et al. 2008). These remains revealed a diet reliant on the St. Johns River system with consumption of resources from terrestrial and aquatic environments (Quinn et al. 2008:2352). The exact distribution of fauna and faunal resource consumption is not known. However, the isotopic data from the enamel of individuals at the Harris Creek site affirms the consumption of both C_3 plants and fauna remains (Quinn et al. 2008:2352).

Overall, the research above supports the narrative that the people of Silver Glen Springs during the Mt. Taylor period utilized aquatic resources as a significant component of their diet. While environmental conditions may have been shifting, there was enough variety and abundance to sustain a population over multiple generations without the need to develop and exploit different resources.

Episode I (7400-6350 Cal BP)

Episode I of the Mt. Taylor period is characterized by the onset of shellfishing around (7660-7260 cal BP) (Randall 2013:204). This period saw significant environmental changes that occurred due to the transition of Florida from an arid to wet climate. This climate change correlates with the hypsithermal (Cerimele 2017:46; Randall 2015; Anderson and Sassaman 2012). The hypsithermal caused a change in hydrology and terrain while establishing a new climate pattern similar to the modern seasonal patterns of Florida. This seasonal change would incentivize people to alter their lifeways. This includes the social and geographical patterns that were established during the early Middle Archaic. With water levels rising, former utilization sites such as Windover would need to be abandoned, and new practices established (Randall 2013:205).

Two sites are associated with Episode I, the Live Oak Mound site (8VO41) and the Hontoon Dead Creek Mound site (8VO214). Both are identified as shell ridges that were constructed 2 km away from each other (Randall 2013:205). They are similar in "size, environmental location, and arrangement" (Randall 2013:205). Due to the shell mining from the early 20th century, the shell sites of the St. Johns River have been damaged and reduced, creating an incomplete history of the St. Johns River Valley. Live Oak Mound has seen some vandalism and looting but appears to be mainly intact. It is uncertain whether this site is a mortuary mound, but local reconnaissance suggests that burials were located at the site (Sassaman 2003:71). Hontoon Dead Creek Mound is certainly a mortuary site and remained relatively intact in opposition to the shell site on the north end of Hontoon Island (8VO202) (Sassaman 2005:83). Hontoon Dead Creek Mound is a part of the Hontoon Mound Complex, where numerous shell sites are located on Hontoon Island and are associated with one another. A significant pattern associated with Episode I sites are nodes on top of the shell field. These nodes (nodules) are areas of “elevated anomalies” within the landscape (Randall et al. 2007:6). They could be identified as mounded areas of the shell that are out of place in the landscape. Unfortunately, due to the looting pits found across the Live Oak Mound, the extent of these nodes and their context in the landscape has been lost (Sassaman 2003:75).

These nodes have been located at the base of the Live Oak mound and the Hontoon Dead Creek mound and seem to follow a “linear pattern along the terrace edge” (Randall 2013:206). Node 1 from the Hontoon Dead Creek mound is of interest due to its construction similarities to the depositional features found in Silver Glen Spring Locus A. “Node 1 is ovoid in shape, measures 13 x 10m, and is only 50cm high” (Randall 2013:206). While this node is extruded atop the mound, like the shell-filled pits from Silver Glen Springs, the deposition of the shells occurred before the significant deposit and development of the major shell sites (i.e. Hontoon Dead Creek Mound and Locus A). The composition of the node is notably composed of “concreted crushed and whole mystery snails and bivalve shell, along with charcoal and vertebrae faunal bone” (Randall 2013:206). An absence of apple snails is notable for Mt. Taylor sites. Node 1 is characterized as a “discrete residential deposit that was resurfaced once” (Randall 2013:206).

While Node 1 is a feature of interest, the overall composition of the Hontoon Dead Creek mound and the Live Oak mound is significant in its episodic depositions identified as “stages” (Randall 2013). Four stages of depositions were identified for the Hontoon Dead Creek mound, and each stage was capped between stages with a thick “1-meter mantle” (Randall 2013:206). Variations of composition would be found at each stage, with some layers reflecting a specific composition and alternation between layers. A key characteristic found in some layers would be the presence of thermal alterations. These thermal alterations are identified as burned material, including shells, sand, ash, and other burned matter.

Wet site deposits are also identified during Episode I. A similarity has been found between the Groves’ Orange Midden site (8VO2601), with strata correlating to the Mt.Taylor period, with stratum V being “coeval” with the Hontoon Dead Creek complex that Hontoon Creek Dead mound is associated with. Stratum IV is identified as a correlation to a transition period between Episodes I and II. Material culture has been found in this stratum that is associated with the known cultural range of Episode II. This may imply that the cultural range known in Episode II was pre-established in Episode I (Randall 2013:207).

Episode II (6350-5700 Cal BP)

Episode II is characterized by the creation of new shell ridges and the abandonment of shell sites from Episode I. These former occupation sites may have been abandoned due to an increase in water accumulation around the former habitation areas (Randall 2013:207). This increase may have been the stabilization of water levels to near modern levels with the increase in precipitation and water levels. In addition, the appearance of marine shell vessels in mortuary mounds indicates an extension of mobility (Randall 2013:210).

The inundation of water may have signaled a time of separation between the new and old due to water being associated with death. On a practical level, the formerly utilized shell sites would be inconvenient to access and live on, causing less productivity; on a more spiritual level, the encroaching of water to the occupation site may have indicated a need for change and demarcation from the living and the dead. This premise shares similarities to the Anbarra of Australia, who were interviewed about abandoned shell mounds of forgotten ancestors known as "dead men" (Meehan 1975:242). These dead men were separated into the world of dreaming (Meehan 1975:242). Other interpretations have observed:

> "*A growing body of evidence suggests that coastal cemeteries were relocated landward in anticipation of the inevitable relocation of settlements subject to flooding*" [Randall and Sassaman 2017:19].

With the rising water levels, new shell ridges would be constructed "near wetlands, channel segments, and spring runs" (Randall 2013:207). This would lead to the construction of Silver Glen Springs shell sites, in particular, Locus A (8LA1W). This would also be the development of the Harris Creek site (8VO24) and the Thornhill Lake site (8VO58).

While shell sites are usually damaged on some level over time, the shell site at Silver Glen Springs saw a significant impact from shell mining. Wyman described Silver Glen Springs visually, but he did not provide precise measurements of the site's condition, let alone Locus A (Randall 2015b). Mining destroyed what information was available from the later deposits of the shell sites. However, the earlier and initial deposits are still intact for research.

Excavation from Locus A reveals multiple layers of stratigraphy with later depositions cutting into these established layers. These depositional cuts into the original stratigraphy of the shell sites are interpreted as social-cultural as opposed to functional. These perforations into the layered stratigraphy created in the past have been interpreted as a form of terraforming that not only altered the physical landscape but also the cosmological and spiritual perceptions and realities (Randall and Sassaman 2017). The cosmological effects of digging into the shell-sites to target ancestral shell pits disturb the relational understanding of the delineation between the past, present, and future, as well as the underworld and the upperworld. Possible reasoning for intruding into the cosmological realm of the ancestors through physical interruption may be a sign of environmental and ecological changes that shook the foundations of the community, and that intervention (possibly desperate), needed to be made (Randall, personal communications 2023).

This is further supported by these interpretations:

> *"Pits open up and intercept the below world, while at the same time, they bundle matter and social relations when they are filled. We suggest that this new, and long-lasting tradition of pit digging provided the context for reworking the relationships between community, new ecologies, and time*." [Randall and Sassaman 2017:17]

The duration and chronology of when the shell-filled pits were opened and closed on Locus A are unknown. However, the initial capping of the shell depositions that formed the original layers is dated to 6,300–5940 cal BP. The capping used a "mantle of tan/brown sand across the entire ridge" that is coeval across the ridge (Randall 2013:207). More layers were added on top of the sand mantle, with deposits repetitive of Mt. Taylor shell compositions, including evidence of burning and shallow pits.

The revitalizing of Locus A saw a specific pattern seen in other revitalized shell sites of Mt. Taylor origin. This pattern focused on starting anew on the formerly inhabited shell sites while respecting and honoring the past. This primarily consists of clearing vegetation and debris from the original area and creating a capped layer that is on top of the old layer to deviate from the old and new activity. Locus A seems to have a more specified pattern of practice that has been documented (Randall and Sassaman 2017:18).

> Terraforming consisted of "*locating the earlier deposits, clearing vegetation, digging pits that both mirrored and provided encounters with earlier deposits and capping these activities with a layer of earth*." [Randall and Sassaman 2017:18]

Besides Locus A of the Silver Glen Springs site, the Harris Creek site (8VO24) provides information regarding the mortuary patterns associated with Episode II. Episode II is known for the increased construction of mortuary mounds during the Mt. Taylor period. The Harris Creek site (8VO24) is an excellent representation of these mortuary mounds during the Mt. Taylor period. This mound is multi-component in terms of cultural phases with ceramic evidence from the St. Johns Period (Jahn and Bullen 1978:11). One hundred seventy-five individuals were excavated from the mound with some burials showing evidence of traumatic injury (Bullen 1961; Quinn et al. 2008). Multiple periods of internment were observed with the capping of successive layers to grow the mound and to separate the mortuary periods. Nodes and ridges are noted to have been similarly constructed to the ones found at the Hontoon Dead Creek Village site (Randall 2013:209).

Episode III (5700-4600 Cal BP)

Episode III is identified as a contemporary period with the Thornhill Lake Phase (Cerimele 2017:34; Endonino 2010:109). The Thornhill Lake Phase is Episode III which is characterized by a shift in cultural patterns. In particular, “the reorganization of land use, mortuary ritual and exchange relationships” (Randall 2013, p. 210). There was a transition from the occupied sites of Episode II to newly occupied areas in Episode III. New shell fields and ridges were being constructed while some sites would become focused areas of shell deposition. The focus would lead to the enlargement of mounded shell sites, with some sites being “twice the scale” of mounds found in earlier periods of Mt. Taylor (Randall 2013:210). Newly developed sites associated with Episode III include the Bowers Bluff No. 2 (8LA88B), Locus B at 8LA1W, and Blue Springs Midden B (8VO43). Other sites would include Silver Glen Springs, Bluffton (8VO22), Deleon Springs (8VO30), and the Lake Monroe Outlet Midden (8VO53).

Occupation preferences would shift closer to spring pools, channels of confluence, and transition areas from springs to run (Randall 2013:211). These occupation preferences saw a shift to shell-free terraces with increased lithic evidence. This change in settlement pattern may be associated with changes seen in the hydrology of the St. Johns River Valley. The elevation of shell sites saw no priority toward avoidance of higher water levels or increased periods of saturation (Randall 2013:211).

Burial mounds act as an excellent indicator of cultural shifts. Mortuary mounds found in Episode III are characterized by substituting new sacred spaces over old sacred spaces, leading to the “re-utilization” of older burial mounds such as the Thornhill Lake site. (Randall 2015:251). Evidence from the Silver Glen Springs Mound saw the creation of a new mortuary mound using shell deposits from older occupations, possibly as a form of “sanctification” (Randall 2015:251). A focus on the reproduction of the mortuary practices of the past seems evident from an interment from the Bluffton Burial Mound. However, while the intent of reproduction is apparent in the stratified composition of the Bluffton Burial Mound, the mound would take on the new characteristic of “conical burial mounds” (Randall 2013:213).

More changes observed during Episode III include increased evidence of mobility and trade networks in the archaeological record, with the increasing appearance of *Strombus giga* celts and the identification of non-local banner stones and pendants (Endonino 2010:112). Mobility patterns are hypothesized to have become more sedentary (Randall 2013:196).

Orange Period (4600-3500 Cal BP)

The Orange Period would see the first appearance of pottery along sites of the St. Johns River Valley. This ceramic technology introduction from the coastal communities of Georgia created a shift in cultural practices once again in the Mt. Taylor community (Endonino 2017:116). The technology would initially spread through the established trade network, which supplied banner stones in Episode III. Ceramics would be the principal traded material of the period, with a frequent decrease in material exchange during the Mt. Taylor period, including banner stones, pendants, lithics, and marine resources.

With this new cultural knowledge, settlement and monumental construction patterns would arise to reflect this cultural shift (Randall 2008:15). New occupation sites would appear adjacent to former occupation areas, with the role of these sites shifting from a singular sacred role to more communal-driven centers of gathering (Endonino 2017:117). The use of shell sites as mortuaries during this period does not appear in the archaeological record. This shift in land usage is reflected at the Silver Glen Springs Complex, where the shell monument was altered to a “U” shape construction associated with other circular shell structures of the Orange period.

Locus B at Silver Glen Springs (8LA1W) is an example of reutilization during the Orange period (Gilmore 2015:127). During the pre-ceramic period, Locus B was used as a small-scale intermittent settlement and later evolved into a "specialized shellfish-processing locality replete with scores of massive, overlapping pits" (Gilmore 2015:102). These pits ranged in size from being "broad, deep basins to narrow, straight-sided shafts" (Gilmore 2015:130; Gilmore 2011). The structure of these pits was identified as heterogeneous, and "all the pits contain some quantity of shell, the frequency, composition, condition (i.e., degree of crushing, burning, and weathering)" (Gilmore 2015:131). Gilmore believes that the depositing of shells into the pits was a form of orientation "toward achieving a particular future by preconfiguring a lasting point of reference into the landscape" (Gilmore 2015:137).

The Woodland and the Mississippian (3500 -500 Cal BP)

The Woodland period (correlates with the St. Johns I period) would see a shift in mortuary practices along the St. Johns River to smaller sand mounds while maintaining the practice of using shell sites (Wallis 2008; Sutton 2021:18). Pottery in the area would develop in complexity, creating distinctive pottery phases such as Swift Creek. This period would see the rise of social interactions outside of the St. Johns region, with the increase in diverse ceramic designs that can be connected to ceremonial use and an increase in trade (Wallis et al. 2010).

The Mississippian period (correlates with the St. Johns II period) towards the end would mark the demarcation of the new world encountering the old world with the appearance of European colonists. Before European contact, the population density in the area had increased, and the development of check-stamped pottery would proliferate (Sutton 2021:18).

Conclusion

Over time, shell sites became an integral part of the landscape. They acted as intermittent sources of information (regarding identity and history) for the communities living in the surrounding areas. The persistence of the shell sites reflects the enduring nature of past cultural practices to maintain cultural identity and knowledge. While the destruction of the shell sites hampers archeological information about the hunter-gatherer communities of Silver Glen Springs, the remaining shell sites provide significant insight into their cultural practices.

Chapter 5: Silver Glen Springs Archaeological Context

Site Description

Silver Glen Springs Watershed (SGSW) is adjacent to Lake George and part of the St. Johns River system (Figure 3-1). It is associated with the Silver Glen Springs Run (8LA⅛MR3601) archeological complex, which had its components destroyed by shell mining in the early 1920s (Sassaman et al. 2011:iii). The original documentation by Jefferies Wyman in 1875 identifies three shell ridges, with the most prominent shell ridge forming a U-shape (300 meters long, 10 meters high) (Randall 2015:33).

Fieldwork was conducted at 8LA1 by the St. Johns Archeological Field School 2007-2010 and field seasons 2011 and 2016, including excavating the escarpments, subsurface deposits, and a six-meter long trench (Sassaman et al. 2011; Randall 2014; Cerimele 2017). The fieldwork on the complex identified "two U-shaped shell mounds, two linear shell ridges, and additional shell and non-shell-bearing deposits arranged along Silver Glen Springs Run" (Cerimele 2017: 49). Archeological evidence dates the earliest human activities in the area (Lake George) to the middle Paleoindian and early Archaic periods (Sassaman et al. 2011:23; Thulman 2009:259).

8LA1

Silver Glen Complex is multi-component and divided into three segments: an east (8LA1- E), a west (8LA1-W), and a north margin of the spring run. 8LA1-E was once a massive U-shaped mound of shell that was mined for shell in 1923. Information has been retrieved from the mound's southern portion due to the preserved subsurface remnants. The footprint and basal strata of the deposit remained to allow documentation of the footprint of the mound's south ridge (Sassaman et al. 2011: iii). The northern portion of the mound's subsurface deposit was severely damaged by mining, preventing the retrieval of any significant information (Sassaman et al. 2011: iii).

It is currently documented that 8LA1-West is divided into loci: Locus A, Locus B, and Locus C. Two additional loci (D and E) have been identified but not yet published (Randall, personal communications 2025). Locus A, the focus of this thesis, is an ovoid-shaped deposit that is the remnants of a "200-m-long shell ridge dating to the middle part of the Mt.Taylor period (ca. 6300- 5750 years ago) " (Sassaman et al. 2011:3; Cerimele 2017:50). The earliest dates associated with Locus A come from early-phase pit deposits that are located beneath it (8900-6900 cal BP) (Randall and Sassaman 2017:15). Today, the terrain of the locus is identified as a "central linear depression" flanked by escarpments caused by shell mining (Cerimele 2017:49). It is currently composed of subsurface deposits that are up to a meter deep with "mining escarpments averaging about two meters high" (Sassaman et al. 2011:iii).

Two distinctive phases of pits were identified underneath Locus A (Randall 2017; Cerimele 2017:50). The first phase was located during the 2012 field season. They excavated a block of 2 x 2-meter units on the eastern portion of the mound (Randall 2024). The goal was to identify architectural features at the site. While no post holes were found, numerous shell-filled pits were found (Randall 2024). The 2016 field season excavated the areas outside the shell mound contours, with several large shell-filled pits identified. These pits date to the second phase of occupation (Randall 2024).

Locus B is a small shell ridge nose that is not impacted by shell mining. Zachery Gilmore has conducted extensive research on Locus B. His research dated Locus B to the Thornhill Lake phase and the Orange period (Randall et al. 2011:41).

Locus C is a large shell ridge nose that overlooks the spring pool of Silver Glen and is associated with a later cultural period (St. Johns I/ II) (Sassaman et al. 2011). The locus is speculated to be part of a village site, but further excavation is needed to confirm this (Sassaman et al. 2011).

Dating of Silver Glen Springs

Silver Glen Springs, as a shell site, encompasses many cultural periods, including multiple Episodes of Mt. Taylor. The Silver Glen Springs Complex area was reoccupied multiple times, with some of the earliest radiocarbon dating of pit use from 8900–7000 cal BP (Randall and Sassaman 2017:15). Many of these cultural periods saw the development of shell sites, with their function evolving over time (Gilmore 2015:114). Gilmore posits that the intrusion into older pits was accidental but gradually developed into a deliberate event that encompassed a stronger credibility of ancestral authority and allowed for deliberate access to the older shell pits at specific periods of time to increase their impact and meaning in the event (Gilmore 2015:117).

If the pits show evidence of intrusion, the earlier components of the early Middle Archaic period are at the lower levels of the shell site. These pits can be intercepted or overlaid by other pits dug during the Mt. Taylor period Episodes. Locus A had 2 to 3 meters of deposits from Episode II on top of some of the pits that were examined in this thesis (Sassaman et al. 2011:163). Figure 5-8 from Feature 148 may reflect this interruption of refilling the pit and reusing the older material at the top of the pit (Randall 2024).

At the base of Locus B, the occupation is initially dated ca. 5750 to 4600 cal BP A secondary phase was dated to ca. 4500-4000 cal BP, where a pattern of intensive pit digging is noted. A final phase during the Orange period saw the capping of the shell site utilizing clean shells on top of the "pit-pocked" surface of the complex ca. 4000-3800 cal BP (Sassaman, Gilmore, and Randall 2011:iv).

Locus A (8LA1W) shows an occupation that started around 6100 cal BP and ended around 5700 cal BP, approximately 450 years (Randall 2015:193 and 196). However, this period of occupation does not reflect the period of reutilization. As discussed earlier, at least two phases of occupation were identified: one preceding the Mt. Taylor period and one occurring during the Mt. Taylor period.

In this thesis, I examined pits that were almost exclusively dated by radiocarbon dating from Locus A, which reflects a broad period of deposition at the site. Table 5-1. reflects the known radiocarbon dates of the analyzed features of this paper. Other radiocarbon dates have been collected from Locus A.

Table 5-1: Feature Chronology

Feature	Test Unit	Dating	Cultural Phase
127	71	6190-5940 cal BP	Episode II
141	72	6190-5940 cal BP	Episode II
142	72	8990-8600 cal BP	Early Middle Archaic
146	70	6440-6300 cal BP	Episode I/II
148	73	6190-5940 cal BP	Episode II
149	71	6190-5940 cal BP	Episode II
201	96	8990-8600 cal BP	Early Middle Archaic
205	96	8600-6300 cal BP	Middle Archaic/Episode I
212	100	6190-5940 cal BP	Episode II
215	103	6190-5940 cal BP	Episode II
216	103	6190-5940 cal BP	Episode II

Feature Descriptions

Table 5-2: Summary of Feature Characteristics

Feature	TU	Width (cm)	Length (cm)	Depth (cm)	Volume (m^3)	ID	Burned Base
127	71	147	250	31	3.83	Shell-filled Pit	Yes
141	72	170	62	25	1.06	Shell-filled Pit	Possible
142	72	93	93	38+	1.03	Shell-filled Pit	No
146	70	120	70	30	0.85	Shell-filled Pit	Yes
148	73	147	N/A	96	N/A	Shell-filled Pit	Yes
149	71	N/A	55	55	N/A	Shell-filled Pit	Possible
201	96	115	N/A	85	N/A	Shell-filled Pit	Possible
205	96	100	N/A	66	N/A	Shell-filled Pit	No
212	103	60	90	78	1.38	Shell-filled Pit	Yes
215	103	163+	117+	123	7.57	Shell-filled Pit	Yes
216	103	48+	44+	25	0.17	Shell-filled Pit	No

Feature 127

This feature was excavated in the 2012 field season. The pit feature is identified as a shallow basin with a concreted and burned base. Four strata (i-iv) were identified as having high shell density. A portion of this feature (Feature 127A) intruded into Test Unit (TU) 73. Field notes describe the feature as being composed of whole and crushed *Pomacea sp.* (apple snail), *Viviparus sp.,* and bivalve shells with large "clasts of charcoal found throughout" (Randall 2024). Beneath the four stratum layers were two lower strata with crushed bivalve shells with semi-concreted fine sand and shells with an ample amount of charcoal present in strata v, with rubified sand associated with thermal oxidation found in strata vi (Randall 2024).

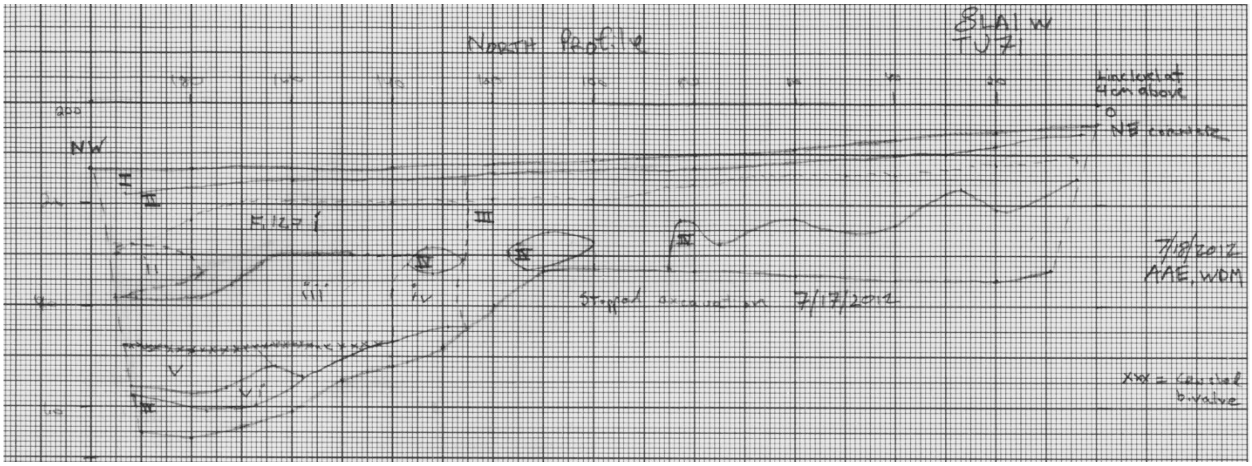


Figure 5- 1: Feature 127 cross section. Lower case roman numerals are feature lenses (Randall 2024).

Figure 5- 2: Photograph of TU71 north wall profile. Notice the orange lens of sand underlying the concreted base of feature 127 in the northwest corner of the unit (Randall 2024).

Feature 141

This feature was excavated in the 2012 field season and is in the southern portion of TU 72. The pit feature is identified as shallow (~50 cm deep) and was bisected by the south profile of Test Unit 72. Four strata were excavated from the feature, with bivalve shells found throughout the deposit. Patches of lighter tan sand may indicate that the base of the pit was burned.

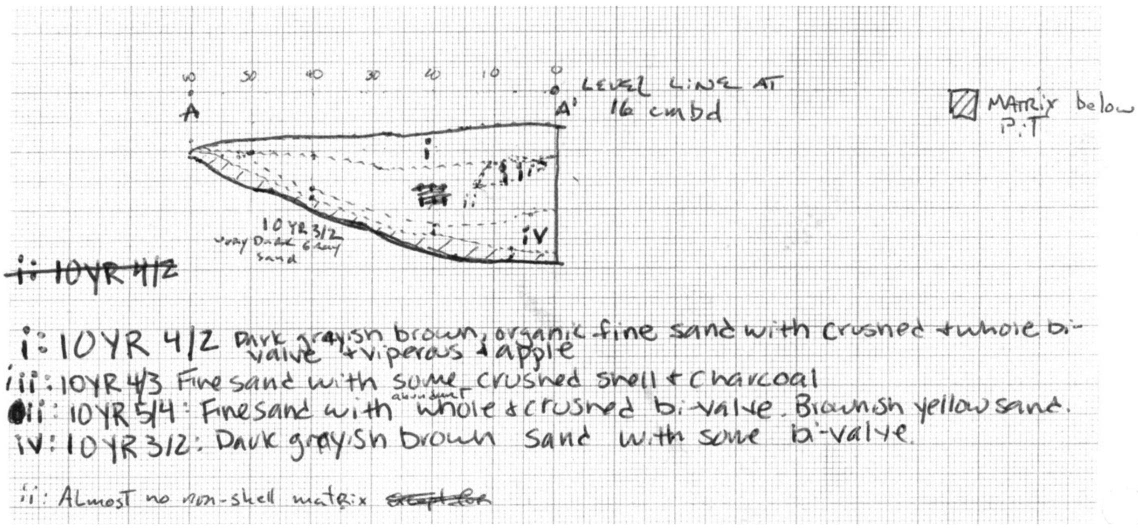


Figure 5-3:Cross section of Feature 141 Profile Map (Randall 2024)

Figure 5-4: TU72 South Profile, Feature 141 is the dense concent material in the unit (Randall 2024)

Feature 142

This feature is part of the TU 72 excavation and was not identified until the end. Radiocarbon dating dates this feature using an unmodelled 2-sigma age range of 8990-8600 cal BP, earlier than the Mt. Taylor period. It was initially identified as a circular pit feature that may have emanated from a higher origin to create a possible depth of 100 cm instead of the assessed 38 cm depth (Randall 2024). The feature is described as having no burned base but does contain charcoal material.

Figure 5-5: Overview Photo of Bisected Feature 142 (Randall 2024)

Feature 146

This feature is identified as a shallow basin filled with shells and a burned base. It was excavated as part of the slot trench that ran through TU 70. A notable characteristic is the appearance of ashy fine sand and an abundance of charcoal in strata ii, which sits atop the base composed of rubified sand from thermal oxidation (Randall 2024). Charcoal from this feature has been radiocarbon-dated and dated to an unmodelled 2-sigma age range of 6440-6300 cal BP.

Figure 5-6: Photograph of the North Wall of Trench I in TU72. Feature 146 is evident as a shell-filled basin (Randall 2024)

Feature 148

This feature is unique in stratigraphy and is identified as a shell-filled pit with evidence of thermal alteration at its base. The pit is posited to be circular and associated with a possible intrusion from Episode II. It has a width of 147 cm and a depth of at least 96 cm. It is part of Test Unit 73 slot trench and is "truncated by the subsequent digging and filling of Feature 127" (Randall 2024). Unfortunately, extensive collection from the feature did not occur, as layers were targeted explicitly due to field constraints (Randall 2025 Personal Communication). This limited the collection of shell fill from the feature to distinctive layers that appeared significant to the stratigraphy.

The fill of the pit is distinctive in its characteristics, with the top half of the feature being comprised of fine dark sand and mainly comprised of crushed and whole *Viviparus sp.* shells (Randall 2024). In the center of this layer is another layer composed mainly of whole *Pomacea sp*. This is best illustrated in Figure 5-8 Randall 2024). Another layer of interest is the fine, dark sand at the corner of the base layer, which interrupts the layers of fine sand that contain evidence of thermal alterations. This layer is interpreted as the part of the original burned base of the pit, but was later refilled with material, and the original material was later used to refill the top of the pit (Randall 2024).

Figure 5- 7: Photograph of TU73 Trench 1, south wall showing feature 148 (Randall 2024)

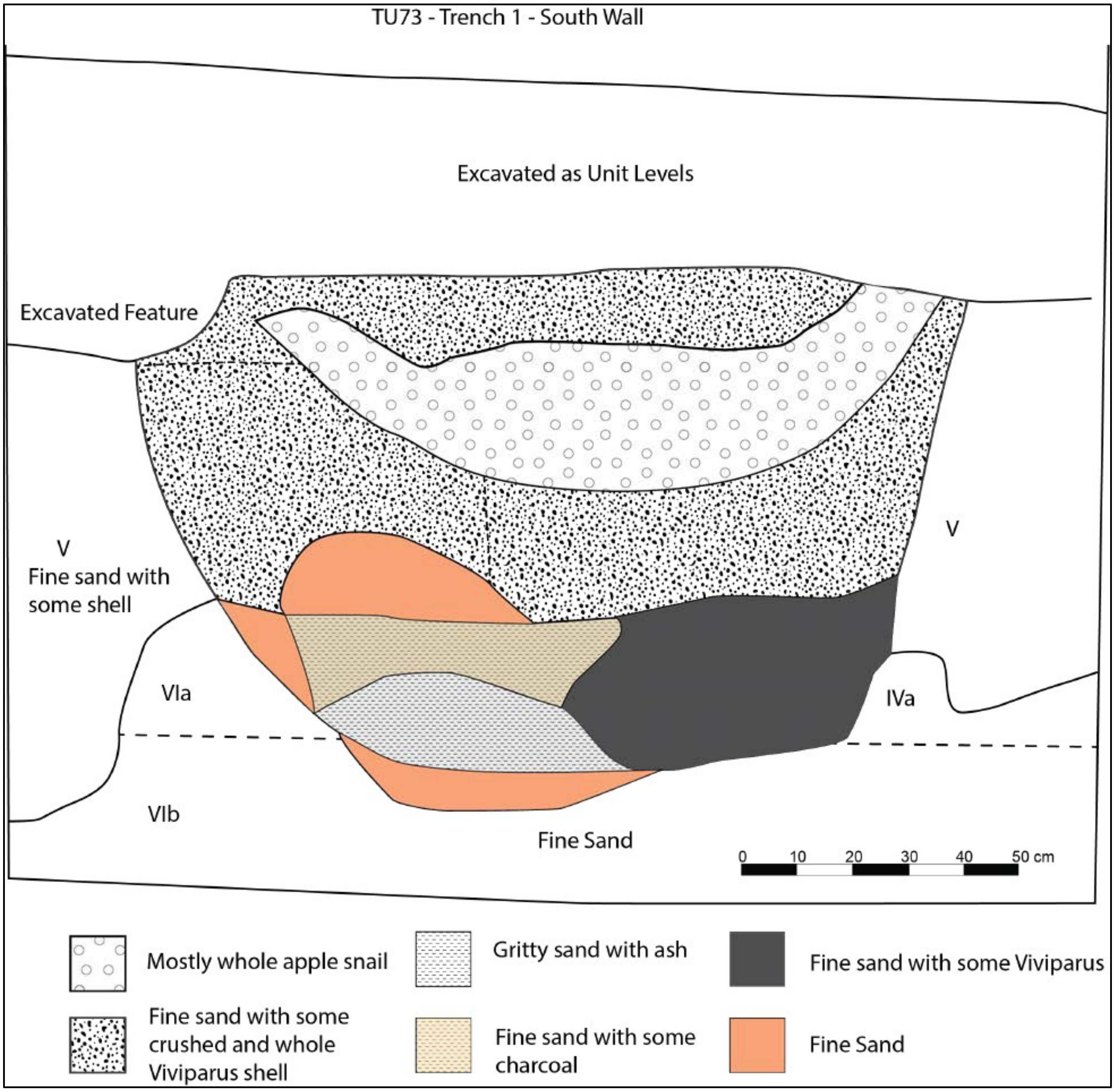


Figure 5- 8: Illustration of TU73 Trench 1, south wall showing Feature 148 with colored stratigraphy (Randall 2024)

Feature 149

This feature is identified as a shell-filled pit that may have a burned base (Randall 2024). It is part of the western side of Test Unit 71 and is characterized by the strong presence of whole *Pomacea sp.* (apple snails) and some bivalve shells, with *Viviparus sp.* shells present in the ashy fine sand (Randall 2024). The burned base is identified by the underlying fine sand concretion that has traces of crushed shells (Randall 2024). This feature is moderately deep at 55 cm depth with a width of 55cm.

Figure 5-9: Photograph of the West profile of TU72. Feature 149 is evident as the dense shell. (Randall 2024)

Feature 201

This feature was first recognized at 35 cmbd, with excavation beginning at 40 cmbd. The completed area of excavation ended with a width of ~115 cm and a depth of ~ 85 cm. Noted in the feature form, a dark stain of soil was noticed in addition to the occasional shell. The feature eventually became a component of Slot Trench 1, with the continued excavation identifying a center concreted cluster of shell and charcoal. This feature has been identified as dating back to the early Middle Archaic.

Feature 205

This feature was first recognized in Slot Trench #2 at a depth of 66 cmbd and excavated to 100 cm wide. This feature had a notable concentration of shell below a shell-free layer. Additionally, it was noted that the bone material was abundant in the feature fill. No evidence of thermal alteration was noted in the feature documentation. This feature has been identified as an older, shell-filled pit dating to the Middle Archaic/Episode I period.

Feature 212

This feature was excavated in the 2016 field season as part of Test Unit 100. It was located on the possible margins of the primary shell mound. Excavation has determined that the feature is stratified and has a complex relationship with subsequent features in the unit. This feature is identified as a shell-filled pit with whole and crushed *Viviparus sp.* shells and crushed clam shells (Randall 2024). This feature is underlain by a layer of concrete shell and partially oxidized/rubified sand. This may indicate prior burning in the pit before infilling. A charcoal sample was radiocarbon-dated to a 2-sigma age range of 6190-5940 cal BP.

Figure 5- 10:Photograph of Feature 212, showing the bisected base and fill extending into the test unit. (Randall 2024)

Feature 215

This feature was excavated on the outer margins of the shell mound and identified as a large, stratified shell-filled pit with a burned base. It was excavated as part of Test Unit 103, and the feature measures 117 cm long, 163 cm wide, and 123 cm deep. Evidence of lighter rubified sand at the bottom of the feature indicates thermal oxidation from fire. This feature was visually observed to consist of stratified layers of *Viviparus sp.* and bivalve shells (Randall 2024).

Figure 5- 11: Photograph of the East Profile of TU103. Feature 215 is the shell-filled pit within the profile. Feature 216 is the dark, mostly shell-free feature in the southeast corner of the unit, intruding into Feature 215. (Randall 2024)

Feature 216

Feature 216 is identified as a shell-free pit that intrudes into the top of Feature 215 (Randall 2024). This feature is identified through a dark, probably organic fill that is mostly shell-free. Bag Units 5162, 5163, and 5164 were collected from this feature through flotation. A radiocarbon sample was obtained from this feature and was dated with an unmodelled 2-sigma age range of 6190-5940 cal BP.

Figure 5- 12: Photograph of bisected Feature 216, which intrudes into Feature 215. (Randall 2024)

Table 5-3: Evidence of Thermal Alteration from Analyzed Feature ¼” Material

Bag Unit	Feature	Test Unit	Recovery Method	Dating	ID	Burned Base	Burned Material (g)	Concretions (g)	¼" Weight
4021	127	71	⅛” Water Screen	Episode II	Shell Fill Pit	Yes	20.01	0	867.01
4022	127	71	Flotation	Episode II	Shell Fill Pit	Yes	0.02	1	1660.4
4050	141	72	Flotation	Episode II	Shell Fill Pit	Possible	10.4	7.1	1511
4049	141	72	Flotation	Episode II	Shell Fill Pit	Possible	15	9.5	1275.5
4075	142	72	Flotation	early Middle Archaic	Shell Fill Pit	No	2.6	4.15	
4076	142	72	⅛” Water Screen	early Middle Archaic	Shell Fill Pit	No	-	2.05	
4069	142	72	⅛” Water Screen	early Middle Archaic	Shell Fill Pit	No			403
4099	146	70	⅛” Water Screen	Episode I/II	Shell Fill Pit	Yes	5.4	4.7	338.5
4096	146	70	Flotation	Episode I/II	Shell Fill Pit	Yes	-	0.45	
4089	146	70	Flotation	Episode I/II	Shell Fill Pit	Yes			1000.5
4309	148	73	Flotation	Episode II	Shell Fill Pit	Yes	-	16.8	
4307	148	73	Flotation	Episode II	Shell Fill Pit	Yes			
4306	149	71	Flotation	Episode II	Shell Fill Pit	Possible	4.3	-	389
5027	201	96	Flotation	early Middle Archaic	Shell Fill Pit	Possible	-	4.7	
5024	201	96	Flotation	early Middle Archaic	Shell Fill Pit	Possible	-	15.2	
5055	205	96	Flotation	Middle Archaic/ Episode I	Shell Fill Pit	No	-	161.8	
5202	212	100	Flotation	Episode II	Shell Fill Pit	Yes	0.6	-	2087
5156	215	103	⅛” Water Screen	Episode II	Shell Fill Pit	Yes	6.21	3.6	207
5173	215	103	Flotation	Episode II	Shell Fill Pit	Yes	-	4.9	2011

Table 5-3: Evidence of Thermal Alteration from Analyzed Feature ¼" Material

Bag Unit	Feature	Test Unit	Recovery Method	Dating	ID	Burned Base	Burned Material (g)	Concretions (g)	¼" Weight
5162	216	103	Flotation	Episode II	Shell Free Pit	No	1.4	-	210
5163	216	103	Flotation	Episode II	Shell Free Pit	No			
5164	216	103	Flotation	Episode II	Shell Free Pit	No	-	-	185.5

Evidence of Thermal Alterations

Thermal alterations indicate cultural alterations to material and provide insight into cultural practices. Many of the shell-filled pits from Locus A have a bottom stratum that shows evidence of being burned (Randall 2024). The materials from the deposit were analyzed for thermal alterations based on visual discoloration of the shell. This method is not foolproof in accurately identifying shells that have interacted with heat. An increasing amount of research has been conducted on the varying effects of thermal alterations on shell material (Oertle and Szabo 2022).

Shells are altered by heat physically, chemically, and structurally at a microscopic level (Oertle and Szabo 2022). Lower heat temperatures do not cause the traditional visual alterations usually associated with burned shells. The effects of direct thermal alterations are not visually present in shells cooked indirectly by steam or boiling (Oertle and Szabo 2022). In addition, extremely high temperatures, when in contact with direct heat, can cause the shells to look like they were affected by calcification associated with the natural degradation of the shell material (Milano et al. 2016:17). With these factors considered, the full extent of thermal alterations within the study is not fully understood. However, the lack of direct thermal alterations may indicate information regarding the processing of mollusks at Silver Glen Springs.

The ¼” material from the analyzed features was analyzed for burned shell and concretions possibly associated with thermal alterations. Table 5-3 reflects the low presence of noticeably thermal-altered material. Meanwhile, the bag units represent a small portion of the excavated features and test units, possibly not fully representing the extent of the deposits. However, suppose the quantity of shell material shows little evidence of direct heat contact. In that case, it may be that the shells were either not processed by direct roasting or, if they were, they were processed at extremely high temperatures, possibly more than 500°C, based on the images from the Milano et al. (2016:17) study. While the snail species used by Milano et al. is not *Viviparus sp.*, the high-temperature thermal alterations are similar to shells observed in the material analysis of this thesis (2017).

Overall, the shell-filled pits found at 8LA1-W seem to show evidence of thermal alterations at the base of the pits but no firm evidence of thermal alteration in the deposited material. This analysis hopefully provides insight into the directions of the research regarding Silver Glen Springs and how people in the area may have processed the large number of shells for consumption or other purposes.

Chapter 6: Methods

The methodology section will be broken into two sections: one reviewing the material recovery methods and the other examining the analysis process of the depositional pit contents. The St. John’s Archeological Field School was hosted by the University of Oklahoma and the University of Florida in the summers of 2010, 2012, 2016, and 2018. The material analyzed is primarily from the 2012 and 2016 summer field seasons (8LA1W). The collected material was stored at the University of Oklahoma's Laboratory of Landscape Archaeology, where my analysis was conducted under the guidance of Dr. Asa Randall, one of the directors of the field schools.

To reiterate the intent of this thesis, I hypothesize that the content of the shell-filled pits will reveal temporally specific information. While the general content of the shell-filled pits is consistently the same, on an intentional scale of analysis, the size of the *Viviparus sp.* shells and the size-graded material will reflect a difference in frequency due to different practices and environmental conditions utilized at the time of deposition.

Previous research done by Meggan Blessing and Nicole Cerimele analyzed the zooarchaeological components of Silver Glen Springs (Blessing 2011; Cerimele 2017). The research conducted for this thesis will focus on the archeomalacological components of Silver Glen Springs Locus A. The contents of the pits are indistinguishable from one another in terms of zooarchaeological species composition (Randall, personal communication 2024; Blessing 2011:208; Cerimele 2017:108). Due to the conformity of the shell fill between the multiple pits, I sought other avenues of differentiation for my thesis research. The variation in the size composition of the material and the snail shells themselves was an avenue for differentiation that had not been researched.

Blessing (2011) analyzed materials across time (cultural periods) and space (multiple sites) to understand the depositional practices associated with shell sites in the Middle St. Johns River Valley (Randall et al. 2013:173). Cerimele analyzed faunal material from Silver Glen Springs (8LA1) across time (cultural periods), focusing on the implications of the material in association with the environment (Cerimele 2017:xii). My thesis aims to gain further insight into the shell species composition and shell selection characteristics of the shell deposits at the Silver Glen Springs Locus A, focusing on the implication of the shell distribution in the features (shell pits) associated with shell gathering and processing methods. Implications could expand the shell collection preferences regarding size or other physical features.

It is unknown how or what selection method was used when shells were collected or how they were processed (Randall et al. 2013:174). Using the procedures described by Blessing as the basis of the research, statistical information can be gathered to identify and verify patterns seen in the shell assemblage (Randall et al. 2013:189). This statistical information quantifies the gastropod species variation and the variation within the *Viviparus sp.* measurements and their weight to allow a cross-comparison between features.

Recovery Methods

The St. John's Archaeological Field School is located on the southern half of Lake George at the Silver Glen Spring archaeological site. The site has been investigated for years, with the Locus A shell mound being a focus for the 2012 and 2016 field schools. Locus A had shell and shell-free pits found beneath the mound and its immediate vicinity. While the 2012 field school attempted to locate structural post holes, shell-filled pit features were located instead of their intended target (Randall 2024:1).

The field schools excavated five 2x2 meter units at the eastern half of Locus A. These units were arranged in a 6x4 meter block (Figure 6-1) (Randall and Sassaman 2012:248). Subsequent 2x2 units were excavated in 2013, 2016, and 2016 (Randall 2024:1). Students and staff excavated these units in arbitrary 10 cm levels. Excavated materials were processed on-site. The material found at arbitrary levels was dry sieved through ¼" mesh at the site. A sample from the excavated bulk features was used in bulk flotation.

> "Features were bisected. The first half of the feature was generally taken as ⅛" water screen. Then, the feature was drawn, described, and sampled. The floatation samples were taken as a bulk sample from the core of the feature, and then the remaining pit fill was taken as ⅛" water screen." – [Randall, personal communications 2024]

Flotation samples were processed in a Flotech machine into light and heavy fractions. I only examined the heavy fractions in this thesis. The remaining bulk feature samples were water-screened through ⅛" mesh and bagged on-site. Staff from the University of Oklahoma brought these samples to the Laboratory of Landscape Archaeology (Cerimele 2017:60).

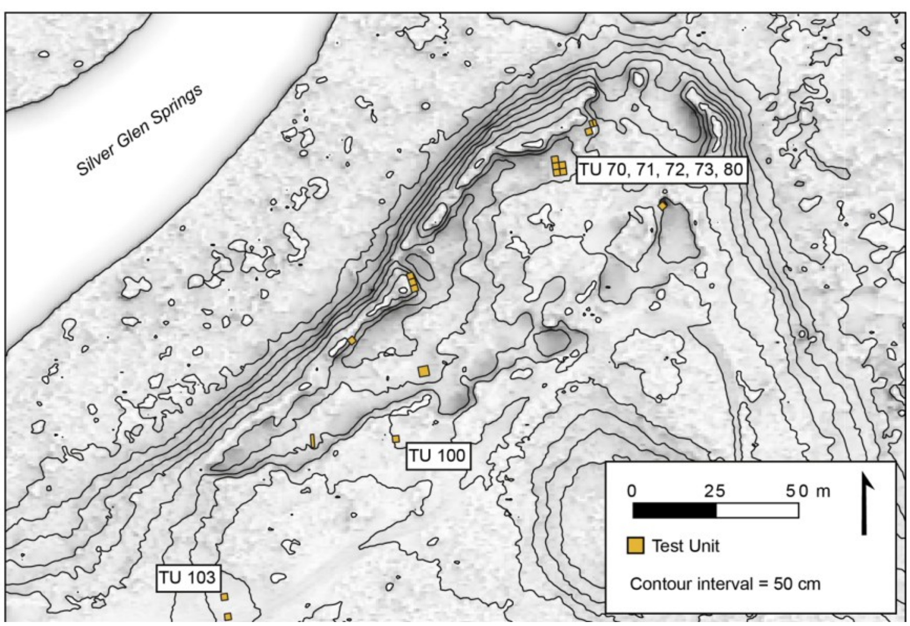


Figure 6-1. Analyzed Test Unit locations in the Locus A area. (Image from Randall 2024:1)

Analyzed Materials

Table 6-1: Analyzed bag provenience and recovery type

Feature	Chronology	Recovery	Bag Unit	Test Unit
127	Episode II	⅛” Water Screen	4021	71
		Flotation	4022	71
141	Episode II	Flotation	4049	72
		Flotation	4050	72
142	Episode II	⅛” Water Screen	4069	72
146	Episode I	Flotation	4089	70
		⅛” Water Screen	4099	70
149	Episode II	Flotation	4306	71
212	Episode II	Flotation	5202	100
215	Episode II	⅛” Water Screen	5156	103
		Flotation	5173	103
216	Episode II	⅛” Water Screen	5162	103
		Flotation	5163	103
		⅛” Water Screen	5164	103

The analyzed material for Silver Glen Spring Locus A is housed at the Laboratory of Landscape Archaeology. As discussed, the material was presorted into bags in the field based on their provenience. Most of the proveniences selected for analysis were identified as features with a burned bottom in the field. The burned bottoms of the features are of significant interest due to the cultural significance of thermal alterations. Other features selected for analysis had unique characteristics. Most of the samples analyzed were float samples or water-screened samples.

All measurements were taken using the metric system. All weights were recorded in grams, and volume was recorded in liters. The initial steps to analyzing a bag began with recording the unsorted material's weight (g) and volume (ml or L). The material was then sifted into stacked geologic meshed screens. Five mesh sizes were used in the sifting process: ¼”, <⅛”,

>⅛”, < 2mm, and > 2mm”. The volume and weight of material in each mesh size were then recorded and separated into individually labeled bags.

Once each bag unit has been analyzed, the collected data fell into three primary categories: size-graded material, faunal identification of the ¼” sifted material, and the measurement of *Viviparus sp.* shells. Analysis of the three categories reflects some data modifications, particularly in weight and volume between processing phases. This is due to a loss in weight and volume between phases, which is often attributed to human error. Differences between size-graded and ¼” faunal materials reflect this, as the initial size grading includes all contents, while faunal analysis excludes concretions and debris. Therefore, the total weight and volume of ¼” material will decrease between the size-graded data and the processed ¼” material.

Analysis Process of ¼”material

The analysis was conducted on the material sized by the ¼” sifting. This size was selected for analysis because most of the intact shells resided at this grade size and contributed to the bulk of the volume in the pits of Silver Glen Springs. By analyzing the material at this size grade, an emphasis can be placed on the snail shells themselves and what they may represent in terms of the collection method between features. By understanding the preferences for shell size in the shell-fill, a further understanding of the deposition process can be established. The species of shells were used as categories to statistically compare ratios, which provides more accurate information about the features at an equitable level regarding differing weights and volumes between features.

The ¼” material was sorted by hand into categories based on species and any modifications. These primary categories were *Viviparus georgianus* (Banded Mystery Snail), *Pomacea paludosa* (Florida Apple Snail), *Planorbella scalaris* (Mesa Ram’s Horn), *Elimia* *floridensis,* rams horn snails, freshwater bivalves (*Elliptio sp.*), terrestrial snails, and faunal material. Charcoal was sequestered in a test tube when found. Within these categories are sub-categories for sample variations, including a separation between complete (intact) and incomplete shell specimens, thermal alterations, human modifications, and concretions. Thermal alterations were identified based on physical appearance. Thermal alterations were identified by the presence of soot on the material and a change in the coloration of the material (Oertle and Szabo 2023). Once sorted, the categories' weights (g) and volumes (ml) were recorded on a catalog sheet and then transferred to an Excel file. This process would be repeated for each bag analyzed.

Biases in ¼" Screens

The ¼" material was selected for analysis due to the larger volumetric composition of materials when compared to the sifted material smaller than ¼". Unfortunately, while the ¼" material can provide information based on volume, this larger volume does not accurately represent dietary practices (Russo et al. 1992:102-103). Russo et al. compared their research to Cumbaa's 1976 study that analyzed the contents of a midden using ¼" data (Russo et al. 1992). It was noted in the study that Cumbaa used linear allometry, which has the drawback of mischaracterizing the meat contribution of an animal based on faunal remains (Russo et al. 1992: 102). Russo et al. address the issues of ¼" faunal material analysis by including 1/16" and using weight allometry that focused on the weight of the meat of the snails and shell weight ratios (Russo et al. 1992:103). Analysis of the faunal material for Silver Glen Springs has been conducted on 1/16" material by Cerimele (2017); however, that research did not focus on the invertebrate composition of the deposits and is a possible direction for future research (Cerimele 2017).

Viviparus sp. Shell Analysis

After sorting the ¼" material, a secondary analysis was conducted. The *shells of Viviparus sp.* are the dominant component of shell sites in the area. Earlier research by Blessing found a correlation between cultural periods and the sizes of the *Viviparus sp.* shells (Blessing 2011: 189). Based on her research method, I implemented the same methodology to the features I had available for analysis. This is to investigate whether there are differences due to pit technology, food processing, and other sources of variation. Complete *Viviparus sp.* shells suited for analysis were randomly selected from each bag unit. For each bag, 100 shells or all the shells if there were less than 100 shells were analyzed. Multiple measurements were recorded for each shell in Excel. The total shell height (mm), diameter (mm), and weight (g) were measured, along with the length (mm) and width (mm) of the shell's aperture. Measurements were conducted using a digital caliper (mm) and a digital scale (± 0.01g). Punctures (Figure 6-2) and thermal alterations (Figure 6-3) of the shell were noted. Figure 6-3 illustrates the measurement methods on the *Viviparus sp.* shells (Image based on Katoh 1992:26).

Figure 6-2. Punctured Shell from Feature 149 (Bag Unit #4306)

Figure 6-3. Burned Shell from Feature 127 (Bag Unit #4022)

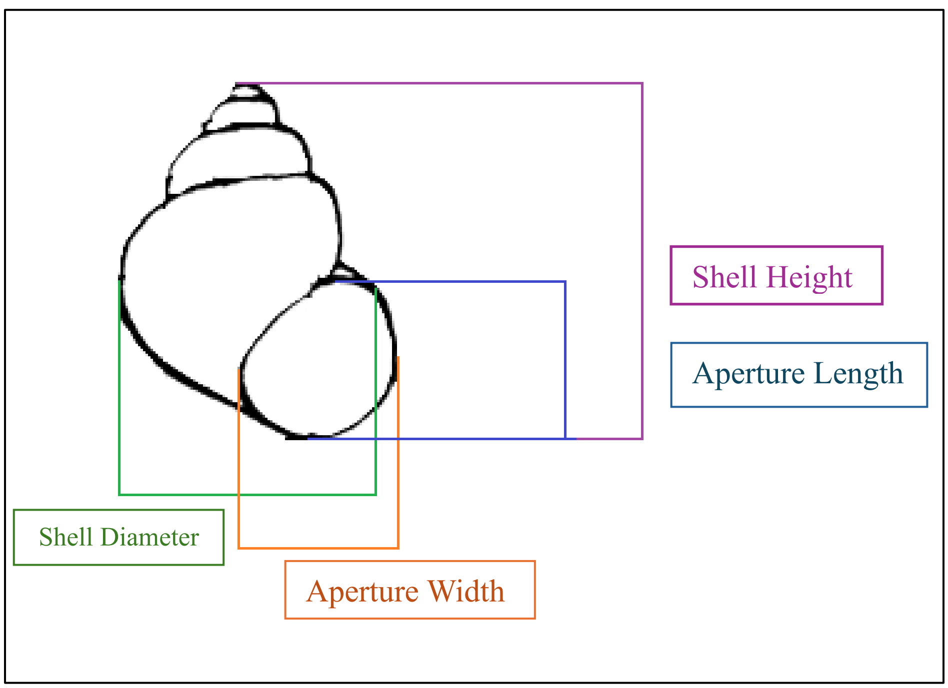


Figure 6- 4. *Viviparus sp.* Measurement Method

Chapter 7: ¼" Data Analysis

The data for this chapter's analysis is derived from my data collection and will incorporate some data collected by OU undergraduate student volunteer Susannah Pyatt in 2017 (Randall, personal communications 2024). The data analysis was done by analyzing individual bag units (BU). However, I will focus on contextualizing features instead of individual bag units. Previous data collected by Pyatt will be applied to the ¼" faunal analysis segment and the *Viviparus sp.* material segment analysis. Therefore, the analysis regarding different screening sizes will utilize only the data collected recently. The collected data fall into three categories: size-graded material (sieved), identified faunal material from ¼" sifted material, and the measurement of *Viviparus sp.* shells.

The contents of this chapter are descriptive, introducing the data collected and the statistical data for each feature. Each feature will begin with a broader discussion of the feature and become more detailed. The features will begin with a description that includes their bag units (BU), the collection method for each bag unit, and their distinctive characteristics. Following the general information for the feature is the presentation of statistical data tables for each research category, along with a summary of the implications of these tables.

Feature information is introduced at a broad level, progressing to a detailed level of analysis (size-graded material to *Viviparus sp.* measurements*)*. Details begin with the size-graded material of the bag units comprising a feature and the summation of the bag units that make up the feature, organized by weight (g) and volume (L).

Following the overall size-grade composition is the identification of the faunal species within the ¼" size-graded material of the feature. The ¼" screened material will be composed of *Viviparus sp.*, Apple Snails (*Pomacea sp.*), Mesa Ram's Horn, bivalves, *Elimia sp.*, unidentified faunal bones (UID) – Mammalian, and terrestrial snails. Finally, each feature will conclude with the presentation of the *Viviparus sp.* shell measurements, accompanied by tables that identify the sample method for data collection, the sample size (count), and the average measurements for the sample size. The measurements include the height (mm), diameter (mm), aperture length (mm), aperture width (mm), weight (g), and the percentage of punctures found.

The chapter concludes with a summary that highlights the overall trends in the data. Data from this chapter identify the descriptive components of the shell fill that comprise the shell-filled pits of Silver Glen Springs – Locus A (8LA1W) and highlight detailed differences between the shell-filled pits. This supports the hypothesis that the general composition of the shell-filled pits is consistent at a generalized level but deviates at a more detailed level.

Section 1: Summary of Features

Below are three tables. Table 7-1 reflects the data collected for the thesis and contextualizes the recovery method for each bag unit, organized by feature number. Table 7-2 reflects the data collected by Susannah Pyatt in 2017, along with the associated recovery method. Table 7-3 presents the data on the initial and processed weight and volume of Bag Units recovered through flotation.

Table 7-1: Data Analyzed

Feature	Chronology	Recovery	Bag Unit	Test Unit
127	Episode II	⅛" Water Screen	4021	71
		Flotation	4022	71
141	Episode II	Flotation	4049	72
		Flotation	4050	72
142	early Middle Archaic	⅛" Water Screen	4069	72
146	Episode I/II	Flotation	4089	70
		⅛" Water Screen	4099	70
149	Episode II	Flotation	4306	71
212	Episode II	Flotation	5202	100
215	Episode II	⅛" Water Screen	5156	103
		Flotation	5173	103
216	Episode II	⅛" Water Screen	5162	103
		Flotation	5163	103
		⅛" Water Screen	5164	103

Table 7-2: Previous Analyzed Data

Feature	Chronology	Recovery	Bag Unit	Test Unit
142	early Middle Archaic	Flotation	4075	72
		⅛" Water Screen	4076	72
146	Episode I/II	Flotation	4096	70

Table 7-3: Floated Material Processed Data (Rounded)

Feature	Bag #	Test Unit	Unprocessed Initial Volume (L)	Heavy Fraction - Processed Volume (L)	Heavy Fraction to Unprocessed Volume Ratio
127	4022	71	6	5.49	0.92
141	4049	72	5	4.15	0.83
141	4050	72	5	5.26	1.05
146	4089	70	17	4.48	0.26
149	4306	71	5	6.14	1.23
212	5202	100	--	5.72	---
215	5173	103	13	7.43	0.57
216	5163	103	13.25	0.83	0.06

Feature 127

The contents of Feature 127 are dated to Episode II of the Mt. Taylor period (6190-5940 cal BP). It is composed of two bag units (4021 and 4022) that were recovered using different methods (water screening and flotation, respectively). The containing bag for BU 4021 was labeled as ¼" dry screened, and the analyzed material was reflective of this recovery type. Therefore, there is a lack of other size-graded material. Bag Unit 4022 has a float ratio of 0.92 (Heavy fraction/ Unprocessed Volume Ratio) (Table 7-3). This float ratio corroborates the high shell density observed during excavation (Randall 2024). Since BU 4021 was identified as ¼" dry sieved material, BU 4022 will be the only source of information regarding the size grade composition of Feature 127. Table 7-4 (weight) and Table 7-5 (volume) present the data regarding the screened composition of Feature 127.

Table 7-4: Feature 127 Screened Material-Weight (g)

	Weight (g)		Screened Ratio	
	BU 4021	BU 4022	BU 4023	BU 4024
	⅛" Water Screen	Flotation	⅛" Water Screen	Flotation
Total	870	2430	1.0	1.0
¼"	870	1660	1.0	0.7
>⅛"	--	280	--	0.1
<⅛"	--	130	--	0.1
>2mm	--	200	--	0.1
<2mm	--	150	--	0.1

Table 7-5: Feature 127 Sieved Material- Volume (L) (Rounded)

	Volume(L)		Sieved Ratio	
	BU 4021	BU 4022	BU 4023	BU 4024
	⅛" Water Screen	Flotation	⅛" Water Screen	Flotation
Total	1.9	5.5	1.0	1.0
¼"	1.9	4.6	1.0	0.8
>⅛"	--	0.5	--	0.1
<⅛"	--	0.2	--	0.0
>2mm	--	0.2	--	0.0
<2mm	--	0.1	--	0.0

Overall, Tables 7-4 and 7-5 reflect a size preference for material greater than ¼" in Feature 127. Tables 7-6 (weight) and 7-7 (volume) reflect the faunal composition of the ¼" material of Feature 127. There is a preference for *Viviparus sp.* snails, (*Pomacea sp.*) apple snails, and bivalves in Feature 127. This is reflected in the weight and volume of the shell ratios, with *Viviparus sp.* being the most dominant in weight and ratio for both BU.

Table 7-6: ¼" Faunal Analysis Weight(g) (Rounded)

	Weight (g)			Species Ratio		
¼" Material Composition	BU 4021	BU 4022	Combined Weight	BU 4021	BU 4022	Combined Weight
Total	830	1646	2478	1.0	1.0	1.0
Viviparus sp.	565	1292	1858	0.7	0.8	0.8
Apple Snail	85	128	213	0.1	0.1	0.1
Mesa Ram's Horn	15	24	39	0.0	0.0	0.0
Bivalve	127	144	270	0.2	0.1	0.1
Elimia sp.	24	51	75	0.0	0.0	0.0
Mammalian fauna	15	8	23	0.0	0.0	0.0
Terrestrial Snails	0	0	0	0.0	0.0	0.0

Table 7-7: ¼" Faunal Analysis Volume (L)
(Rounded)

	Volume (L)			Species Ratio		
¼" Material Composition	BU 4021	BU 4022	Combined Volume	BU 4021	BU 4022	Combined Volume
Total	1.8	4.9	6.8	1.0	1.0	1.0
Viviparus sp.	1.4	3.3	4.6	0.7	0.6	0.7
Apple Snail	0.3	0.6	0.9	0.1	0.1	0.1
Mesa Ram's Horn	0.1	0.5	0.5	0.0	0.1	0.1
Bivalve	0.2	0.2	0.4	0.1	0.1	0.1
Elimia sp.	0.0	0.1	0.1	0.0	0.0	0.0
Mammalian fauna	0.0	0.2	0.2	0.0	0.0	0.0
Terrestrial Snails	0.0	0.0	0.0	0.0	0.0	0.0

Bag Units 4021 (water screened) and 4022 (flotation) revealed minimal evidence of physical cultural modification when processing the ¼" material for Feature 127. The catalog sheet for BU 4021 notes charcoal and one thermally altered shell, with similar notes for BU 4022.

The shell measurements (length, width, aperture height, aperture width, and weight) of *Viviparus sp.* for Feature 127 are within the range of the average measurements for all the aggregated shell measurements (1287 measured shells) in this study. Table 7-8 investigates the statistical averages for the *Viviparus sp.* measurements of Feature 127. There are no significant outliers regarding the *Viviparus sp.* measurements.

Table 7-8: Feature 127 *Viviparus sp.* Measurement Averages (Rounded)

	BU 4021	BU 4022	Combined	Study Aggregate
Sample Method	Random	Random	Random	
Count	100	100	200	1287
Height (mm)	19.7	19.8	19.8	20.0
Diameter(mm)	15.9	15.9	15.9	16.0
Aperture Length(mm)	12.3	12.6	12.4	12.5
Aperture Width(mm)	9.5	9.6	9.5	9.7
Weight (g)	1.1	1.1	1.1	1.1
Puncture %	0.0	1.0	0.0	8.3

Feature 141

Feature 141 is composed of bag units 4049 and 4050, which were recovered from the northern half of the feature through flotation. The feature is dated to Episode II of the Mt. Taylor period. This pit was predominantly composed of bivalves, apple snails, and *Viviparus sp.,* with little shell matrix in the lower portion of the feature. It is uncertain if the base of the feature was burned. BU 4049 (flotation) retained 83% of the volumetric material post-flotation processing (Table 7-3). BU 4050 (flotation) retained a significant post-volumetric amount of material (5.26 L) compared to the initial volumetric composition at collection (5 L), at 105% (Table 7-3). This may be attributed to imprecise measurements taken during the field collection. Tables 7-9 (weight) and Tables 7-10 (volume) reflect a similarity in size-graded composition materials between the two BUs that compose Feature 141. However, BU 4049 (10%; flotation) seems to have a larger ratio of >2mm content compared to BU 4050 (3%; flotation).

Table 7-9: Feature 141 Size Grade Material (Weight) (Rounded)

	Weight (g)		Sieved Ratio	
	BU 4049	BU 4050	BU 4049	BU 4050
	Flotation	Flotation	Flotation	Flotation
Total	2840	3584	1.0	1.0
¼"	1275	1511	0.5	0.4
>⅛"	575	867	0.2	0.2
<⅛"	286	355	0.1	0.1
>2mm	283	102	0.1	0.0
<2mm	296	202	0.1	0.1

Table 7-10: Feature 141 Size Grade Material (Volume) (Rounded)

	Volume(L)		Sieved Ratio	
	BU 4049	BU 4050	BU 4049	BU 4050
	Flotation	Flotation	Flotation	Flotation
Total	4.1	5.3	1.0	1.0
¼"	2.8	3	0.7	0.6
>⅛"	0.9	1.1	0.2	0.2
<⅛"	0.3	0.4	0.1	0.1
>2mm	0.4	0.4	0.1	0.1
<2mm	0.2	0.3	0.1	0.1

BU 4049 (flotation) and BU 4050 (flotation) have different species compositions for the ¼" analysis. Based on Table 7-11, BU 4049 is composed significantly of *Viviparus sp.* (73%) compared to BU 4050 (flotation), which is composed of bivalves (71%). This is similarly reflected in the volumetric aspects, as seen in Table 7-12 (flotation). Both BU were bagged in the same area (E ½), so seeing this difference within a feature is interesting. It is noted in the excavation notes that bivalves and apple snails had a more dominant presence in comparison to *Viviparus sp.* (Randall 2014).

Evidence of cultural modification is unclear, with BU 4049 (flotation) containing more evidence of thermal alteration than BU 4050 (flotation). The content that showed thermal alterations for BU 4049 (flotation) includes some bivalve fragments, UID bone fragments, charcoal, and a singular *Elimia* shell. BU 4050 (flotation) thermally altered content consisted of charcoal and UID bone.

Table 7-11: ¼" Faunal Analysis Weight (g) (Rounded)

	Volume (L)			Species Ratio		
¼" Material Composition	Bag 4049	Bag 4050	Combined Weight	Bag 4049	Bag 4050	Combined Weight
Total	1240	1507	2480	1.0	1.0	1.0
Viviparus sp.	908	242	1860	0.73	0.16	0.42
Apple Snail	63	168	210	0.05	0.11	0.08
Mesa Ram's Horn	11	6	40	0.01	0.00	0.01
Bivalve	228	1063	270	0.18	0.71	0.47
Elimia sp.	15	9	75	0.01	0.01	0.01
Mammalian fauna	15	20	20	0.01	0.01	0.01
Terrestrial Snails	0	0	0	0.00	0.00	0.00

Table 7-12: Faunal Analysis Volume (L)
(Rounded)

	Volume (L)			Species Ratio		
¼" Material Composition	BU 4049	BU 4050	Combined Volume	BU 4049	BU 4050	Combined Volume
Total	2.7	3.2	5.9	1.0	1.0	1.0
Viviparus sp.	2.1	0.6	2.7	0.8	0.2	0.5
Apple Snail	0.2	0.7	0.9	0.1	0.2	0.1
Mesa Ram's Horn	0.0	0.0	0.0	0.0	0.0	0.0
Bivalve	0.3	1.9	2.2	0.1	0.6	0.4
Elimia sp.	0.0	0.0	0.1	0.0	0.0	0.0
Mammalian fauna	0.0	0.0	0.1	0.0	0.0	0.0
Terrestrial Snails	0.0	0.0	0.0	0.0	0.0	0.0

As for the *Viviparus sp.* of Feature 141, the shells of this unit are larger than the average of this study, as seen in Table 7-13 of the shell measurement (length, width, aperture height, aperture width, and weight). BU 4050 (flotation) shells, on average, are slightly larger than BU 4049. The only area of analysis that BU 4049 (8%; flotation) outpaces BU 4050 (3%; flotation) is the presence of punctures in the *Viviparus sp.* shell.

Table 7-13: Feature 141 *Viviparus sp.* Measurement Averages
(Rounded)

	BU 4049	BU 4050	Combined	Study Aggregate
Sample Method	Random	Random	Random	
Count	100	100	200	1287
Height (mm)	20.9	21.8	19.8	20.0
Diameter(mm)	16.7	17.0	15.9	16.0
Aperture Length(mm)	13.0	13.4	12.4	12.5
Aperture Width(mm)	10.0	10.3	9.5	9.7
Weight (g)	1.3	1.4	1.1	1.1
Puncture %	8.0	3.0	0.0	8.3

Feature 142

Feature 142 (early Middle Archaic) is composed of Bag Units 4069 (W ½; water screen), 4075 (E ½; flotation), and 4076 (E ½; ⅛" water screen). BU 4075 (flotation) and 4076 (⅛" water screen) originate from Susannah Pyatt's data collection and will have the data only incorporated into the ¼" faunal analysis and the *Viviparus sp.* analysis segment. The feature description presented in Table 7-3 only considers the excavated area of the feature. Bag Unit 4069 was recovered by ⅛" water screening and is almost entirely composed of ¼" size graded material, as seen in Tables 7-14 and 7-15. The initial weight of BU4069 makes it one of the smaller bag units in this study.

Table 7-14: Feature 142 Size Grade Material (Weight) (Rounded)

	Weight (g)	Sieved Ratio
	Bag Unit 4069	
	⅛" water screen	
Total	418	1.00
¼"	403	0.97
>⅛"	9	0.02
<⅛"	0	0.00
>2mm	1	0.00
<2mm	4	0.01

Table 7-15: Feature 142 Size Grade Material (Volume) (Rounded)

	Volume (L)	Sieved Ratio
	Bag Unit 4069	
	⅛” water screen	
Total	1.27	1.00
¼"	1.25	0.99
>⅛"	0.01	0.01
<⅛"	0.00	0.00
>2mm	0.00	0.00
<2mm	0.00	0.00

Like some of the other BUs analyzed in this chapter, BU 4069 (water screen) mainly comprises *Viviparus sp.* shells, followed by bivalve and apple snails as seen in Tables 7-16 and 7-17. When analyzed for cataloging, the materials show little signs of thermal alteration, save for a few bivalves and UID shell fragments. The previous analysis shows a deviation for BU 4075 and BU 4076 in Table 7-18. BU 4075 is composed of 57% *Viviparus sp.* shell and 32% bivalve fragments, while BU 4076 is more like BU 4069, with a 72% composition of *Viviparus sp.* and a composition of 21% bivalve shells. BU 4069 has a higher composition of apple snails at 8% compared to BU 4076 at 3%. The similarity between BU 4069 and BU 4076 can be attributed to both being recovered through ⅛” water screen.

Table 7-16: ¼” Faunal Analysis Weight (g) (Rounded)

¼" Material Composition	Weight (g)	Species Ratio
	Bag Unit 4069	
	⅛” water screen	
Total	387	1.0
Viviparus sp.	277	0.7
Apple Snail	32	0.1
Mesa Ram's Horn	12	0.0
Bivalve	43	0.1
Elimia sp.	4	0.0
Mammalian fauna	13	0.0
Terrestrial Snails	4	0.0

Table 7-17: ¼” Faunal Analysis Volume (L) (Rounded)

¼" Material Composition	Volume (L)	Species Ratio
	Bag Unit 4069	
	⅛” water screen	
Total	1.05	1.00
Viviparus sp.	0.88	0.83
Apple Snail	0.05	0.05
Mesa Ram's Horn	0.03	0.03
Bivalve	0.04	0.04
Elimia sp.	0.02	0.01
Mammalian fauna	0.04	0.03
Terrestrial Snails	0.00	0.00

Table 7- 18: ¼" Previous Faunal Analysis Weight
(Rounded)

	Weight (g)		Species Ratio	
	BU 4075	BU 4076	BU 4075	BU 4076
¼" Material Composition	Flotation	⅛" water screen	Flotation	⅛" water screen
Total	40.8	203.0	1.00	1.00
Viviparus sp.	23.1	146.7	0.72	0.57
Apple Snail	3.3	6.8	0.03	0.08
Mesa Ram's Horn	1.0	1.5	0.01	0.02
Bivalve	13.0	42.3	0.21	0.32
Elimia sp.	0.4	1.4	0.01	0.01
Mammalian fauna	0.0	4.4	0.02	0.00
Terrestrial Snails	0.0	0.0	0.00	0.00

As for the *Viviparus sp.* of Feature 142, Bag Units 4075 (flotation) and 4076 (water screen) are included in this analysis segment. Table 7-19 includes the recently collected shell measurements, and Table 7- 21 contains the previously collected shell measurements. The previously collected shell measurements are smaller than BU 4069. The previous shell measurements comprise all the total measurable shells in BU 4075 (flotation) and BU 4076 (water screen). BU 4076 and BU 4069, having the same recovery method, may explain why the shell height average (mm) of *Viviparus sp.* is similar. Overall, this feature has *Viviparus sp.* shell measurements that are smaller than the average of the measured shells collected in this study (Tables 7-19 and 7-20).

Table 7-19: Feature 142 Recent *Viviparus sp.* Measurement Averages (Rounded)

	BU 4069	Study Aggregate
Sample Method	Random	
Count	100.0	1287.0
Height (mm)	18.9	20.0
Diameter(mm)	15.4	16.0
Aperture Length(mm)	11.9	12.5
Aperture Width(mm)	9.2	9.7
Weight (g)	0.9	1.1
Puncture %	21.0	8.3

Table 7- 20: Feature 142 Previous *Viviparus sp.* Measurement Averages (Rounded)

	BU 4075	BU 4076	Study Aggregate
Sample Method	Total	Total	
Count	20.0	80.0	1287
Height (mm)	18.1	19.0	20.0
Diameter(mm)	13.8	14.6	16.0

Feature 146

Feature 146 (Episode I/II) is composed of Bag Units 4089 (S ½ ; flotation), 4099 (N ½; ⅛" water screen), and 4096 (N ½; flotation). Bag Units 4089 (flotation) and 4099 (⅛" water screen) were part of the recently analyzed material, while Bag Unit 4096 is from the previously researched material. Volumetrically, for Feature 146, ¼" material makes up most of this feature, as seen in Table 7-22. This is followed by >⅛" material for BU 4089 (flotation) and 4099 (water screen) in terms of volume. Afterward, the volumetric composition differs between BU 4089 (flotation) and BU 4099 (water screen). This volumetric difference can be attributed to BU 4089 being recovered through flotation while BU 4099 was recovered through water screening. BU 4089 (flotation) shows the most significant change in terms of volume between the initial unprocessed material (17L) to the processed flotation material (4.48L). This is a 26% production of material seen in Table 7-3 and is one of the more significant material losses during the flotation process.

Table 7-21: Feature 146 Size Grade Material (Weight) (Rounded)

	Weight (g)		Sieved Ratio	
	BU 4089	BU 4099	BU 4089	BU 4099
	Flotation	⅛" water screen	Flotation	⅛" water screen
Total	2371	3063	1.0	1.0
¼"	1001	1619	0.4	0.5
>⅛"	444	339	0.2	0.1
<⅛"	380	189	0.2	0.1
>2mm	514	102	0.2	0.0
<2mm	33	815	0.0	0.3

Table 7-22: Feature 146 Size Grade Material (Volume) (Rounded)

	Volume(L)		Sieved Ratio	
	BU 4089	BU 4099	BU 4089	BU 4099
	Flotation	⅛" water screen	Flotation	⅛" water screen
Total	4.5	6.0	1.0	1.0
¼"	2.7	4.6	0.6	0.8
>⅛"	0.8	0.5	0.2	0.1
<⅛"	0.5	0.3	0.1	0.0
>2mm	0.5	0.1	0.1	0.0
<2mm	0.0	0.6	0.0	0.1

Tables 7-23 and 7-24 are the weighted compositions of the ¼" material for Feature 146. Table 7-24 is derived from the previously collected data. The overall composition of the ¼" material is *Viviparus sp.* shells, with apple snails being the secondary composition for Table 7-23 and bivalves for Table 7-24. The volumetric composition of Table 7-25 reflects the ratios found in Table 7-23.

Table 7-23: ¼” Faunal Analysis Weight (g)
(Rounded)

	Weight (g)			Species Ratio		
¼" Material Composition	BU 4089	BU 4099	Combined Weight	BU 4089	BU 4099	Combined Weight
Total	976	1614	2590	1.0	1.0	1.0
Viviparus sp.	767	1398	2165	0.8	0.9	0.8
Apple Snail	71	81	152	0.1	0.1	0.1
Mesa Ram's Horn	65	70	135	0.1	0.0	0.1
Bivalve	50	42	92	0.1	0.0	0.0
Elimia sp.	23	19	43	0.0	0.0	0.0
Mammalian fauna	0	4	4	0.0	0.0	0.0
Terrestrial Snails	0	1	1	0.0	0.0	0.0

Table 7-24: Previous ¼” Faunal Analysis Weight (g)
(Rounded)

	Weight (g)	Sieved Ratio
¼" Material Composition	Bag Unit 4096	
	Flotation	
Total	1974	1.00
Viviparus sp.	1600	0.81
Apple Snail	104	0.05
Mesa Ram's Horn	73	0.04
Bivalve	150	0.08
Elimia sp.	21	0.01
Mammalian fauna	25	0.01
Terrestrial Snails	0	0.00

Table 7-25: ¼” Faunal Analysis Volume (L)
(Rounded)

	Volume (L)			Species Ratio		
¼" Material Composition	BU 4089	BU 4099	Combined Volume	BU 4089	BU 4099	Combined Volume
Total	2.6	4.5	7.0	1.00	1.00	1.00
Viviparus sp.	2.1	3.8	5.9	0.81	0.86	0.84
Apple Snail	0.3	0.4	0.7	0.10	0.10	0.10
Mesa Ram's Horn	0.1	0.1	0.2	0.05	0.02	0.03
Bivalve	0.1	0.1	0.1	0.02	0.01	0.01
Elimia sp.	0.0	0.1	0.1	0.02	0.01	0.01
Mammalian fauna	0.0	0.0	0.0	0.01	0.00	0.00
Terrestrial Snails	0.0	0.0	0.0	0.00	0.00	0.00

As for the Viviparus composition of Feature 146, the averages for this feature's shell measurements are smaller than those for all the shells measured in this study. This can be seen in Table 7-26 and Table 7-27.

Table 7-26: Feature 146 Recent *Viviparus sp.* Measurement Averages (Rounded)

	BU 4089	BU 4099	Study Aggregate
Sample Method	Random	Random	
Count	100.0	100.0	1287.0
Height (mm)	19.0	18.9	20.0
Diameter(mm)	15.3	15.1	16.0
Aperture Length(mm)	11.9	11.8	12.5
Aperture Width(mm)	9.2	9.2	9.7
Weight (g)	0.9	0.9	1.1
Puncture %	9.0	9.0	8.3

Table 7-27: Feature 146 Previous *Viviparus sp.* Measurement Averages (Rounded)

	BU 4096	Study Aggregate
Sample Method	Random	
Count	270.0	1287
Height (mm)	17.8	20.0
Diameter(mm)	13.8	16.0

Feature 149

Feature 149 (Episode II) is singularly composed of Bag Unit 4306 (STR I; flotation). The size-graded material for BU 4306 (flotation) is mainly composed of ¼” material, followed by <2mm material. The decreased volume of ¼” may be attributed to the fact that this BU was recovered through flotation. The initial volume collected for flotation was 5L, while the post volume from flotation was 6.14L of material. This is a 123% increase in material, as seen in Table 7-3. This increase in volume may be attributed to several factors, such as the presence of more compressed material in the field or insufficient compression during measurements in the lab.

Table 7-28: Feature 149 Size Grade Material (Weight) (Rounded)

	Weight (g)	Sieved Ratio
	Bag Unit 4306	
	Flotation	
Total	2439	1.00
¼"	1676	0.69
>⅛"	70	0.03
<⅛"	173	0.07
>2mm	131	0.05
<2mm	389	0.16

Table 7-29: Feature 149 Size Grade Material (Volume) (Rounded)

	Volume (L)	Sieved Ratio
	Bag Unit 4306	
	Flotation	
Total	6.5	1.00
¼"	5.4	0.83
>⅛"	0.1	0.01
<⅛"	0.2	0.03
>2mm	0.2	0.03
<2mm	0.6	0.10

Feature 149 is distinctive in that it is mainly composed of bivalve fragments in terms of both weight and volume. It is secondarily composed of *Viviparus sp.* and apple snails. Feature 149 is also distinctive in having *Viviparus sp.* shell measurements larger than the total average (Table 7-32). This feature has fewer punctures than the total average for this analysis (Table 7-32).

Table 7-30: ¼" Faunal Analysis Weight (g) (Rounded)

¼" Material Composition	Weight (g)	Sieved Ratio
	Bag Unit 4306	
	Flotation	
Total	1666	1.00
Viviparus sp.	310	0.19
Apple Snail	187	0.11
Mesa Ram's Horn	3	0.00
Bivalve	1147	0.69
Elimia sp.	4	0.00
Mammalian fauna	16	0.01
Terrestrial Snails	0	0.00

Table 7-31: ¼" Faunal Analysis Volume (L) (Rounded)

¼" Material Composition	Volume (L)	Sieved Ratio
	Bag Unit 4306	
	Flotation	
Total	5.4	1.0
Viviparus sp.	0.6	0.1
Apple Snail	1.9	0.4
Mesa Ram's Horn	0.0	0.0
Bivalve	2.8	0.5
Elimia sp.	0.0	0.0
Mammalian fauna	0.0	0.0
Terrestrial Snails	0.0	0.0

Table 7-32: Feature 149 Recent *Viviparus sp.* Measurement Averages (Rounded)

	BU 4306	Study
Sample Method	Random	Aggregate
Count	100.0	1287.0
Height (mm)	20.3	20.0
Diameter(mm)	16.1	16.0
Aperture Length(mm)	12.7	12.5
Aperture Width(mm)	9.8	9.7
Weight (g)	1.2	1.1
Puncture %	3.0	8.3

Feature 212

Feature 212 (Episode II) is composed of Bag Unit 5202 (E ½; flotation). The majority of the analyzed material is composed of ¼" size-graded material. This is reflected in the weighted and volumetric composition of the bag unit in Tables 7-33 and 7-34.

Table 7-33: Feature 212 Size Grade Material (Weight) (Rounded)

	Weight (g)	Sieved Ratio
	Bag Unit 5202	
	Flotation	
Total	2594.0	1.00
¼"	2087.0	0.80
>⅛"	47.5	0.02
<⅛"	5.8	0.00
>2mm	20.3	0.01
<2mm	434.9	0.17

Table 7-34: Feature 212 Size Grade Material (Volume) (Rounded)

	Volume (L)	Sieved Ratio
	Bag Unit 5202	
	Flotation	
Total	5.72	1.00
¼"	5.42	0.95
>⅛"	0.00	0.00
<⅛"	0.00	0.00
>2mm	0.00	0.00
<2mm	0.30	0.05

BU5202 (flotation) is mainly composed of *Viviparus sp.* shells, and the cataloging of the ¼" material shows few signs of thermal alteration, save for some concretions and burned UID shell fragments. The composition of the ¼" material for Feature 212 can be seen in Tables 7-35 and 7-36. It should be noted that this feature contains a minimal amount of composition diversity compared to other features (7-36). The average shell measurements for Feature 212 are larger than those for the entire study, as shown in Table 7-37. Also, the presence of punctures in this sample is lower than the average for this study (Table 7-37).

Table 7-35: ¼" Faunal Analysis Weight(g) (Rounded)

¼" Material Composition	Weight (g)	Sieved Ratio
	BU 5202	
	Flotation	
Total	2068	1.00
Viviparus sp.	1978	0.96
Apple Snail	14	0.01
Mesa Ram's Horn	15	0.01
Bivalve	31	0.01
Elimia sp.	21	0.01
Mammalian fauna	9	0.00
Terrestrial Snails	0	0.00

Table 7-36: ¼" Faunal Analysis Volume (L) (Rounded)

¼" Material Composition	Volume (L)	Sieved Ratio
	Bag Unit 5202	
	Flotation	
Total	5.41	1.00
Viviparus sp.	5.23	0.97
Apple Snail	0.04	0.01
Mesa Ram's Horn	0.03	0.01
Bivalve	0.04	0.01
Elimia sp.	0.05	0.01
Mammalian fauna	0.02	0.00
Terrestrial Snails	0.00	0.00

Table 7-37: Feature 212 Recent *Viviparus sp.* Measurement Averages (Rounded)

	BU 5202	Study Aggregate
Sample Method	Random	
Count	100.0	1287.0
Height (mm)	22.2	20.0
Diameter(mm)	17.0	16.0
Aperture Length(mm)	13.4	12.5
Aperture Width(mm)	10.5	9.7
Weight (g)	1.4	1.1
Puncture %	3.0	8.3

Feature 215

Feature 215 (Episode II) is composed of Bag Units 5156 (W ½; ⅛" water screen) and 5173 (flotation; NE Section). BU 5173 had an initial material volume of 13L collected for flotation, and the post-flotation process produced 7.43L of material. This is 57% of the initial collected flotation material, as seen in Table 7-3. This is a significant loss of volume, which may indicate a significant amount of sand and smaller particulates lost. This feature was noted as having a high density of shells in the soil profile (field notes). The size-graded material of this feature is more mixed in composition compared to some of the other features in this study.

Table 7-38: Feature 215 Size Grade Material (Weight) (Rounded)

	Weight (g)		Sieved Ratio	
	BU 5156	BU 5173	BU 5156	BU 5173
	⅛" water screen	Flotation	⅛" water screen	Flotation
Total	2584	4288	1.00	1.00
¼"	1438	2011	0.56	0.47
>⅛"	207	325	0.08	0.08
<⅛"	525	176	0.20	0.04
>2mm	113	200	0.04	0.05
<2mm	301	1343	0.12	0.31

Table 7-39: Feature 215 Size Grade Material (Volume)
(Rounded)

	Volume(L)		Sieved Ratio	
	BU 5156	BU 5173	BU 5156	BU 5173
	⅛” water screen	Flotation	⅛” water screen	Flotation
Total	5.05	7.43	1.00	1.00
¼"	3.80	5.80	0.75	0.78
>⅛"	0.38	0.60	0.07	0.08
<⅛"	0.38	0.20	0.07	0.03
>2mm	0.15	0.21	0.03	0.03
<2mm	0.35	0.88	0.07	0.12

The ¼” composition of Bag Units 5156 (⅛” water screen) and 5173 (flotation) is similar. *Viviparus sp.* is the primary contributor to the ¼” material, followed by apple snails and bivalves, respectively. This can be seen in Tables 7-40 and 7-41. This is reflective of the initial observed composition from the field notes. The *Viviparus sp.* shell measurements for Feature 215 are smaller than the average of this study. This can be seen in Table 7-42.

Table 7-40: ¼” Faunal Analysis Weight(g)
(Rounded)

	Weight (g)			Species Ratio		
¼" Material Composition	BU 5156	BU 5173	Combined Weight	BU 5156	BU 5173	Combined Weight
Total	1332	2459	3791	1.00	1.00	1.00
Viviparus sp.	1036	1820	2856	0.78	0.74	0.75
Apple Snail	160	439	599	0.12	0.18	0.16
Mesa Ram's Horn	11	22	34	0.01	0.01	0.01
Bivalve	90	135	225	0.07	0.06	0.06
Elimia sp.	17	33	50	0.01	0.01	0.01
Mammalian fauna	18	10	27	0.01	0.00	0.01
Terrestrial Snails	0	0	0	0.00	0.00	0.00

Table 7-41: ¼" Faunal Analysis Volume (L) (Rounded)

	Volume (L)			Species Ratio		
¼" Material Composition	BU 5156	BU 5173	Combined Volume	BU 5156	BU 5173	Combined Volume
Total	4.03	6.38	10.41	1.00	1.00	1.00
Viviparus sp.	3.00	4.80	7.80	0.74	0.75	0.75
Apple Snail	0.80	1.21	2.01	0.20	0.19	0.19
Mesa Ram's Horn	0.03	0.05	0.07	0.01	0.01	0.01
Bivalve	0.15	0.25	0.40	0.04	0.04	0.04
Elimia sp.	0.02	0.05	0.07	0.00	0.01	0.01
Mammalian fauna	0.03	0.03	0.06	0.01	0.00	0.01
Terrestrial Snails	0.00	0.00	0.00	0.00	0.00	0.00

Table 7-42: Feature 215 Recent *Viviparus sp.* Measurement Averages (Rounded)

	BU 5156	BU 5173	Study Aggregate
Sample Method	Random	Random	
Count	100.0	100.0	1287.0
Height (mm)	19.5	20.5	20.0
Diameter(mm)	15.7	16.4	16.0
Aperture Length(mm)	12.2	12.8	12.5
Aperture Width(mm)	9.5	10.0	9.7
Weight (g)	1.0	1.2	1.1
Puncture %	4.0	5.0	8.3

Feature 216

Feature 216 (Episode II) is identified as a shell-free pit that intrudes into the top of Feature 215. Bag Units 5162 (⅛" water screen; S ½), 5163 (flotation; N ½), and 5164 (⅛" water screen; N ½)were collected from this feature. Due to this feature's low shell density, the total volume collected for each bag unit is comparatively less than that of the other bag units in this study. The volumetric composition of the bag units follows the pattern of ¼", >⅛", <2mm, <⅛", and >2mm. This can be seen in Table 7-44. The initial collection of BU 5163 flotation material was 13.25L; however, after post-flotation processing, only 0.83L remained – a 6% material production for Feature 216.

Table 7-43: Feature 216 Size Grade Material (Weight) (Rounded)

	Weight (g)			Sieved Ratio		
	BU 5162	BU 5163	BU 5164	BU 5162	BU 5163	BU 5164
	⅛" water screen	Flotation	⅛" water screen	⅛" water screen	Flotation	⅛" water screen
Total	443.5	522.5	324.5	1.00	1.00	1.00
¼"	210.0	240.1	185.5	0.47	0.46	0.57
>⅛"	50.7	69.5	41.3	0.11	0.13	0.13
<⅛"	16.9	40.0	13.8	0.04	0.08	0.04
>2mm	9.9	61.4	6.9	0.02	0.12	0.02
<2mm	156.5	109.9	76.3	0.35	0.21	0.24

Table 7-44: Feature 216 Size Grade Material (Volume) (Rounded)

	Volume (L)			Sieved Ratio		
	BU 5162	BU 5163	BU 5164	BU 5162	BU 5163	BU 5164
	⅛" water screen	Flotation	⅛" water screen	⅛" water screen	Flotation	⅛" water screen
Total	0.88	0.83	0.63	1.00	1.00	1.00
¼"	0.65	0.75	0.55	0.74	0.91	0.88
>⅛"	0.10	0.15	0.06	0.11	0.18	0.10
<⅛"	0.02	0.05	0.01	0.02	0.06	0.02
>2mm	0.01	0.05	0.01	0.01	0.06	0.01
<2mm	0.08	0.07	0.03	0.09	0.08	0.04

The ¼" material for Feature 216 shows deviations in terms of composition (Table 7-45). This feature is prominent in vertebrate fauna composition when compared to other features in the study. However, the dominant composition for the ¼" material remains the *Viviparus sp.* shells. Another note of interest from analysis is that the calcification of the *Viviparus sp.* shells in this feature, is reminiscent of burned shells from a *P. turbinates* shell study (Milano et al. 2016).

Table 7-45: ¼" Faunal Analysis Weight(g) (Rounded)

	Weight (g)				Species Ratio			
¼" Material Composition	BU 5162	BU 5163	BU 5164	Combined Weight	BU 5162	BU 5163	BU 5164	Combined Weight
Total	200	230	185	615	1.00	1.00	1.00	1.00
Viviparus sp.	152	140	158	450	0.76	0.61	0.85	0.73
Apple Snail	0	21	12	33	0.00	0.09	0.06	0.05
Mesa Ram's Horn	1	1	2	4	0.01	0.00	0.01	0.01
Bivalve	2	13	6	22	0.01	0.06	0.03	0.03
Elimia sp.	1	2	1	4	0.00	0.01	0.01	0.01
Mammalian fauna	44	52	6	102	0.22	0.23	0.03	0.17
Terrestrial Snails	0	0	0	0	0.00	0.00	0.00	0.00

Table 7-46: ¼" Faunal Analysis Volume (L) (Rounded)

	Volume (L)				Species Ratio			
¼" Material Composition	BU 5162	BU 5163	BU 5164	Combined Volume	BU 5162	BU 5163	BU 5164	Combined Volume
Total	0.57	0.75	0.56	1.89	1.00	1.00	1.00	1.00
Viviparus sp.	0.48	0.43	0.50	1.40	0.83	0.62	0.89	0.74
Apple Snail	0.00	0.10	0.04	0.14	0.00	0.15	0.06	0.07
Mesa Ram's Horn	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Bivalve	0.00	0.03	0.01	0.04	0.01	0.04	0.02	0.02
Elimia sp.	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01
Mammalian fauna	0.09	0.13	0.01	0.22	0.16	0.18	0.01	0.12
Terrestrial Snails	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The *Viviparus sp.* measurements for Feature 216 show differences between the bag units (Table 7-47). The measurements for BU 5162 (⅛" water screen) and BU 5164 (⅛" water screen) are smaller than the average of this study. Bag Unit 5163 (flotation) has measurements that are larger than the average of this study. However, this may be attributed to the smaller count available for measurement from each BU.

Table 7-47: Feature 216 Recent *Viviparus sp.* Measurement Averages (Rounded)

	BU 5162	BU 5163	BU 5164	Study Aggregate
Sample Method	Total	Total	Total	
Count	55.00	56.00	76.00	1287
Height (mm)	18.81	20.21	19.38	20.0
Diameter(mm)	14.66	15.78	15.51	16.0
Aperture Length(mm)	12.38	12.62	12.18	12.5
Aperture Width(mm)	9.22	10.00	9.54	9.7
Weight (g)	0.75	0.98	0.89	1.1
Puncture %	36.36	23.21	10.53	8.3

Conclusion

Analysis of the archeological features of this study reveals a pattern of similarity between pit deposits in terms of shell-filled material. This chapter supports the generally understood composition of the pits at Silver Glen Springs. It reiterates that the material of the pits is mainly composed of >¼" size-graded materials, with a primary composition of *Viviparus sp.* shells within the ¼" material, with apple snails and bivalve shell fragments composing the remaining majority. The detailed differences of the features and their bag units are reflected in the three different categories of analysis.

Table 7-48: Burned Material Weight (g) in 8LA1W Features (Rounded)

Feature	Test Unit	Pit Type	Burned Base	Total ¼" Weight (g)	Thermal Weight (g)	Weight (g) Ratio: Thermal/Total ¼"
127	71	Shell Fill Pit	Yes	2478	21.0	0.009
141	72	Shell Fill Pit	Possible	2747	22.1	0.008
142	72	Shell Fill Pit	No	630	1.6	0.003
146	70	Shell Fill Pit	Yes	4564	5.4	0.001
149	71	Shell Fill Pit	Possible	1666	4.3	0.003
212	10	Shell Fill Pit	Yes	2068	0.6	0.000
215	103	Shell Fill Pit	Yes	3791	6.2	0.002
216	10	Shell-Free Pit	No	615	1.4	0.002

These different categories of analysis identified specific attributes regarding the material analyzed. These attributes include thermal alterations and shell measurement. Some of the pit features are described as having a burned base in the excavation documents. However, the frequency of thermal alterations from the collected fill material of the pits does not reflect an equivalent amount of thermal alteration evidence expected from a burned pit. This is reflected in Table 7-48 where the presence of thermally altered material is negligible to the overall composition of the features. The table only utilizes the weight of the materials due to the low volumetric density of the thermal material on their own, leading to non-practical applications.

The shell measurements collected by Pyatt (2017) and Blessing (2011) prior to this study are from pre-Mount Taylor pits and have smaller measurements than those obtained in this study. This may indicate that smaller *Viviparus sp.* shells were collected before the Mt. Taylor period, due to differences in collection methods or environmental conditions. This is further elaborated in the following chapter.

Chapter 8: Secondary Data Analysis

The role of this chapter is to synthesize the information gathered from the features and discuss the data through secondary analysis. I consider two questions relevant to the samples:

- Question 1: Are there any differences between samples that archaeological sampling practices in the lab or field can explain?
- Question 2: Are there differences in the composition of features that may inform our interpretations of feature function, gathering practices, or seasonality?

My secondary analysis examines all the features through statistical comparison. The collected data are analyzed in three segments. First, the size-graded compositions of the features are analyzed to assess their similarities and differences. This comparison identifies whether the material size is consistent across features. The size of the material may indicate a continuous use of gathering or selection methods. Second, the composition of gastropod species within the features is analyzed to observe any potential shifts in species over time. If there are changes in species composition, what may these changes imply? Finally, measurements of the *Viviparus sp.* shells collected from each feature are compared, offering potential insight into how or when the species was gathered or processed. Through understanding the composition of the pit deposits, insight into the cultural practices of the Mt. Taylor period is summarized, including how long these practices were maintained over time, and what variations have occurred over that period.

Question 1

Many factors affect the distribution of size material found in the shell-fill of the pits at Locus A. Cultural factors can affect these results, including environmental conditions, selection preferences, and seasonality of the deposition. While these cultural factors are significant, the material collected can affect the archaeological recovery method used in the field.

The initial recovery method (flotation or water screening) of material from the field affects the resulting material collected. The material collected by ⅛" water screening will also contain ¼" material and material larger than ⅛", but it does not comprehensively reflect the feature composition because material smaller than ⅛" is lost. In general, flotation is a more comprehensive collection method that retains more material for analysis (Russo 1988).

The method used to sample archaeological deposits can create biases. An example of this would be the higher retention of terrestrial faunal remains that occurs when using > ¼" screens in comparison to the aquatic faunal remains of fish, which are better retained when using screens smaller than ¼" (Russo 1988:166). With the ¼" screening, deer was presumed to be a significant dietary contributor; however, when 1/16 " screens were utilized, fish remains were retained and reflected a more significant role in dietary practices in comparison to deer (Russo 1988:166). The float samples from the analyzed features will provide comprehensive information on the size of materials found in the pit deposits.

Feature Comparisons

The Kruskal-Wallis Test is the nonparametric equivalent of one-way ANOVA (Xia 2020). This test is best suited for the data set due to its non-parametric composition. Non-parametric refers to data that does not have a set range of distribution. The Kruskal-Wallis null hypothesis is that the collected measurements all have similar meanings, therefore implying they come from the same population. I statistically compared the floated feature materials based on weight (g) and volume (L) using the Kruskal-Wallis test. The primary data used for this test are presented in Appendix 8-1A. The data was identified as non-parametric because the differences in sample size and distribution of the material were unknown. Two separate hypotheses were tested using primary data:

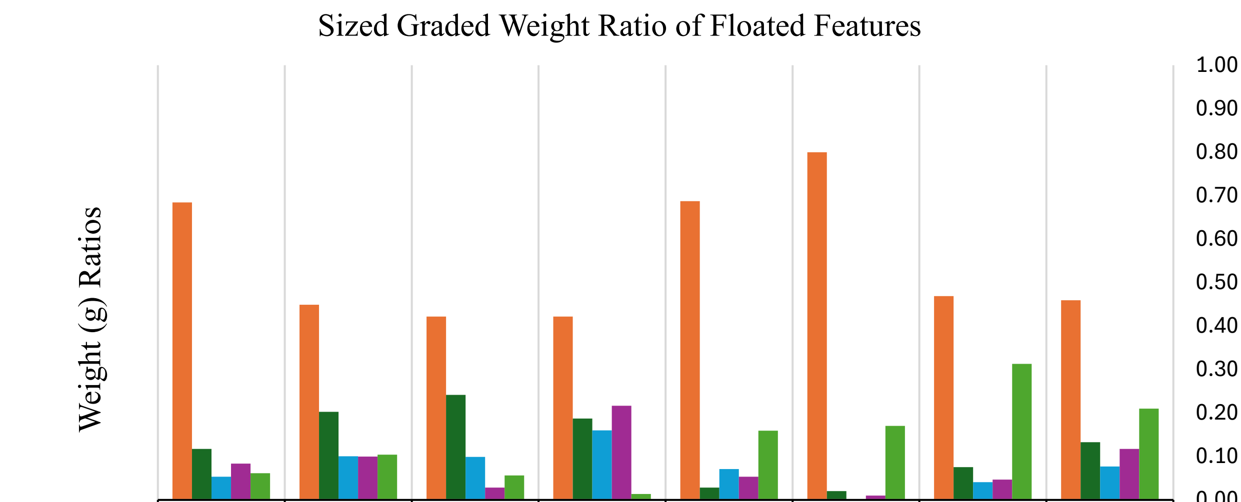
1. Is there a statistically significant difference in the weight(g) and volume(L) distribution between the bag units of the features?
    - Null Hypothesis: There is no statistically significant difference between the bag units composing the features in terms of the distribution of weight and volume of the shell-filled material.
2. Do different size-graded materials have different weight (g) and volume (L) distributions between the bag units comprising the features?
    - Null Hypothesis: There is no difference in the weight and volume distribution of the size-graded material between the analyzed features and their corresponding bag units.

The first null hypothesis for this test is that there is no statistically significant difference between the features (and their bag units) regarding the weight and volume distribution of the size-graded material. The second null hypothesis is that there is no statistically significant difference between the features and their size-graded material in terms of weight and volume. The results of the test are presented in Table 8-1 below.

Table 8-1: Kruskal-Wallis Statistical Results on Floated Material

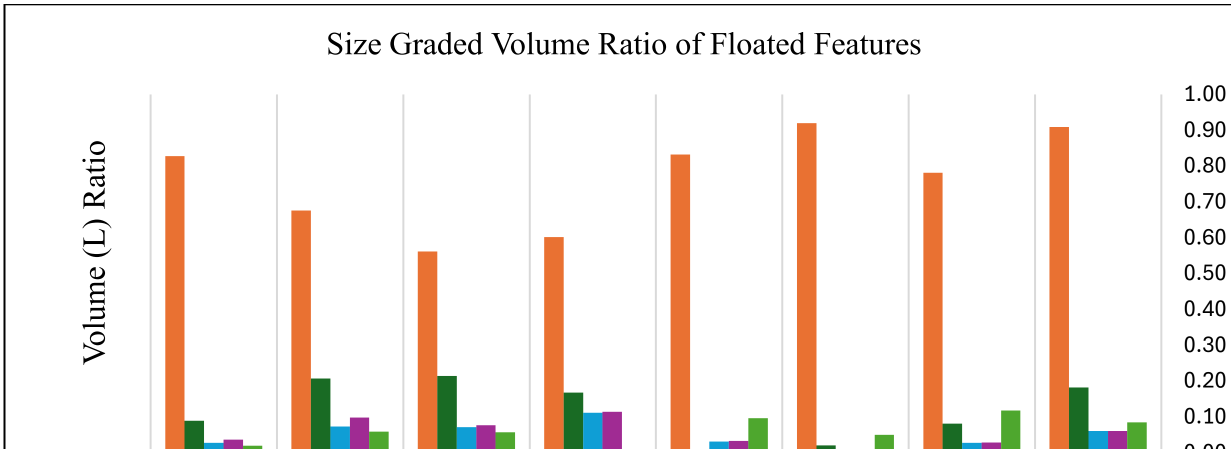
Measurement	Independent Variable	P-Value (0.05)	Null Hypothesis	Question being assessed	Degree of Freedom
Weight	Feature	0.244	Accepted	Do different bags have different weight distributions?	7
Weight	Size-Graded Material	0.004	Rejected	Do different size categories have different weight distributions?	4
Volume	Feature	0.355	Accepted	Do different bags have different volume distributions?	7
Volume	Size-Graded Material	<0.001	Rejected	Do different size categories have different volume distributions?	4

The results of the Kruskal-Wallis Test support a statistically significant difference between the weight and volume of size-graded material across the different distributions of screen size, rejecting the null hypothesis. The Kruskal-Wallis Test also indicates no significant difference between the different bag units of the features analyzed and their distribution of size-graded material. The rejection of the null hypothesis indicates that there is a bias in the sizing of the shell-fill material. This is probably due to the increased frequency of ¼” material compared to other screen-sized material groups, which can be seen in Figures 8-1 and 8-2. These figures present the ratios of weight and volume for the screened material recovered from the bag units by flotation. Post Hoc statistics of Table 8-1 are available in the appendix (Appendix: 8-1B).



Feature(BU)	127(4022)	141(4049)	141(4050)	146(4089)	149(4306)	212(5202)	215(5163)	216(5173)
1/4"	0.68	0.45	0.42	0.42	0.69	0.80	0.47	0.46
<1/8"	0.12	0.20	0.24	0.19	0.03	0.02	0.08	0.13
>1/8"	0.05	0.10	0.10	0.16	0.07	0.00	0.04	0.08
<2 mm	0.08	0.10	0.03	0.22	0.05	0.01	0.05	0.12
> 2mm	0.06	0.10	0.06	0.01	0.16	0.17	0.31	0.21

Figure 8-1. The weight ratio of the processed materials through size grading for features recovered through flotation.



Feature (BU)	127(4022)	141(4049)	141(4050)	146(4089)	149(4306)	212(5202)	215(5163)	216(5173)
1/4"	0.83	0.68	0.56	0.60	0.83	0.92	0.78	0.91
<1/8"	0.09	0.21	0.21	0.17	0.01	0.02	0.08	0.18
>1/8"	0.03	0.07	0.07	0.11	0.03	0.00	0.03	0.06
<2 mm	0.04	0.10	0.08	0.11	0.03	0.00	0.03	0.06
> 2mm	0.02	0.06	0.06	0.01	0.10	0.05	0.12	0.08

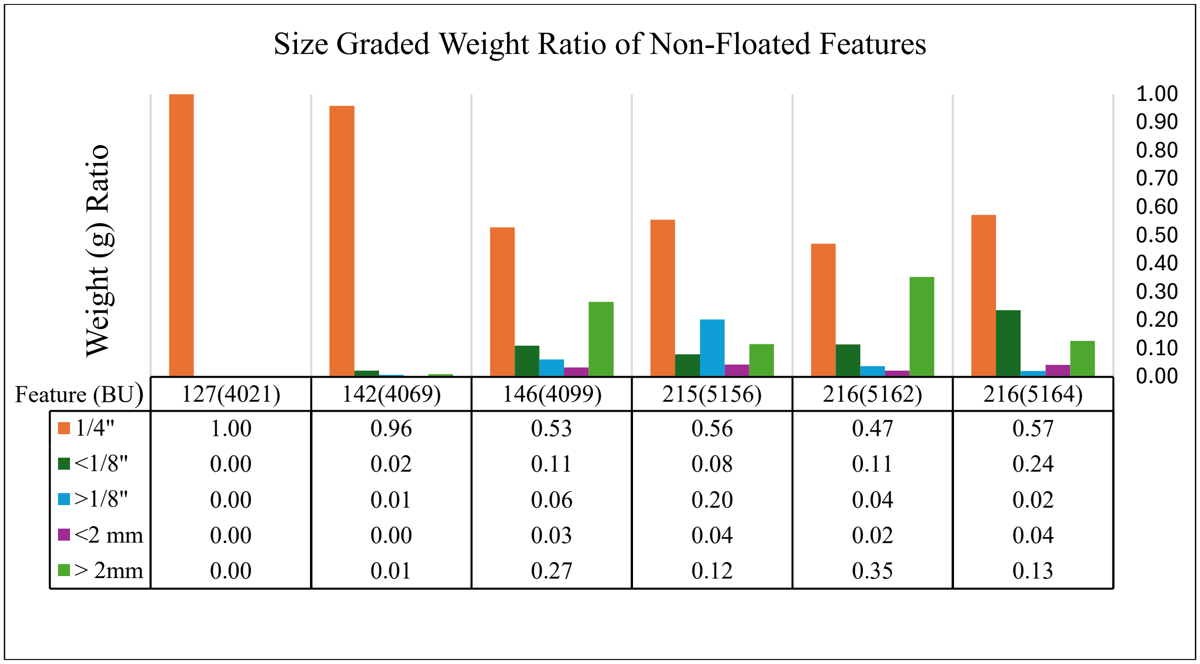
Figure 8-2. The table presents the volume ratio of the processed materials through size grading for features recovered through flotation.

Visually, the volumetric and weighted ratio of the screened material from samples recovered through flotation supports the dominance of material greater than ¼” followed by <⅛” material and >2 mm material that occasionally interchange position, followed by the diminishing screen sizes. The results of the Kruskal-Wallis test support the visual observations in the above figures. In addition, a Friedman Test was conducted to support the findings on the weight and volume ratios. The test revealed a p-value (p=0.05) of 0.965 and 0.966, which accepts the null hypothesis that there is no statistically significant difference between the ratios of the bag units. The Friedman test is another non-parametric test that compares multiple measurements of the same variables across groups; results for this test are in Appendix 8-1C.

Table 8-2: Kruskal-Wallis test for non-floated materials

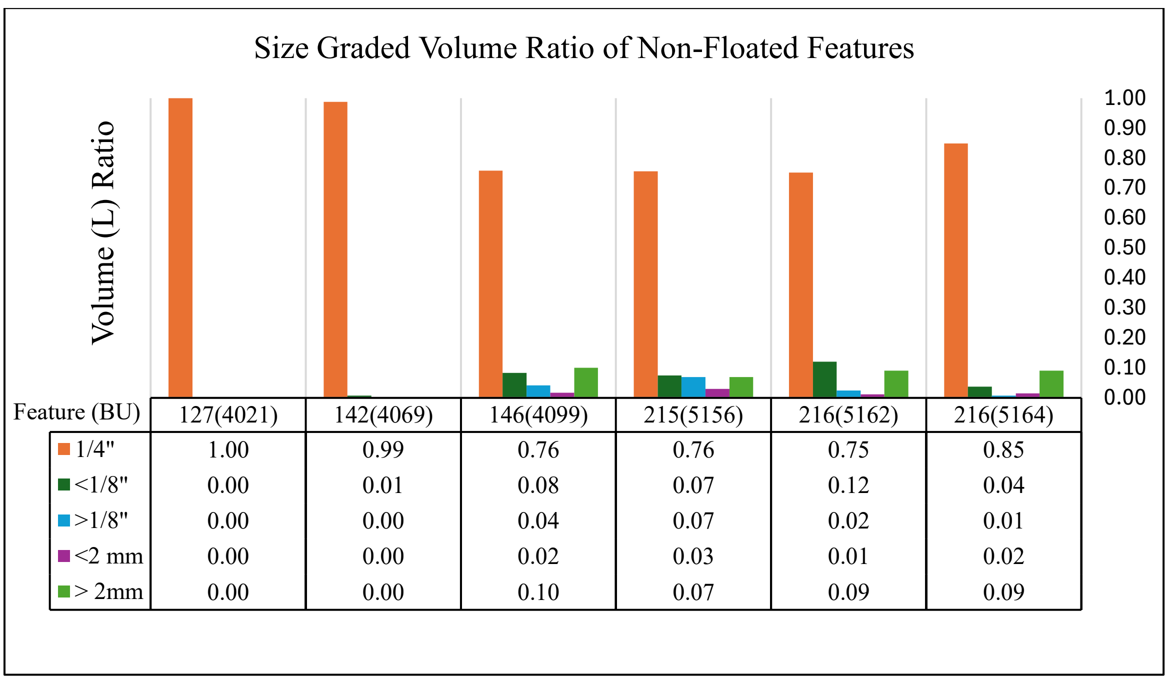
Measurement	Independent Variable	P-Value (0.05)	Null Hypothesis	Question being assessed	Answer	Degree of Freedom
Weight	Features	0.016	Rejected	Do different bags have different weight distributions?	Yes	5
Weight	Size-Graded Material	0.029	Rejected	Do different size categories have different weight distributions?	Yes	4
Volume	Features	0.056	Rejected	Do different bags have different volume distributions?	Yes	5
Volume	Size-Graded Material	0.005	Rejected	Do different size categories have different volume distributions?	Yes	4

The features recovered through ⅛” water screening in Figures 8-3 and 8-4 show a different pattern. Via the Kruskal-Wallis test, a statistically significant difference is observed regarding the non-floated material. There is a difference between the distribution of size-grade material across the bag units. This is unsurprising because some bag units were recovered from different portions of the features. The method of recovery will dictate what material is collected from the field.



Feature (BU)	127(4021)	142(4069)	146(4099)	215(5156)	216(5162)	216(5164)
1/4"	1.00	0.96	0.53	0.56	0.47	0.57
<1/8"	0.00	0.02	0.11	0.08	0.11	0.24
>1/8"	0.00	0.01	0.06	0.20	0.04	0.02
<2 mm	0.00	0.00	0.03	0.04	0.02	0.04
> 2mm	0.00	0.01	0.27	0.12	0.35	0.13

Figure 8-3. The bar graph of the weight ratio of the processed materials through size grading for features not recovered by flotation.



Feature (BU)	127(4021)	142(4069)	146(4099)	215(5156)	216(5162)	216(5164)
1/4"	1.00	0.99	0.76	0.76	0.75	0.85
<1/8"	0.00	0.01	0.08	0.07	0.12	0.04
>1/8"	0.00	0.00	0.04	0.07	0.02	0.01
<2 mm	0.00	0.00	0.02	0.03	0.01	0.02
> 2mm	0.00	0.00	0.10	0.07	0.09	0.09

Figure 8-4. Bar graph of the volume ratio of the processed materials through size grading for features not recovered by flotation.

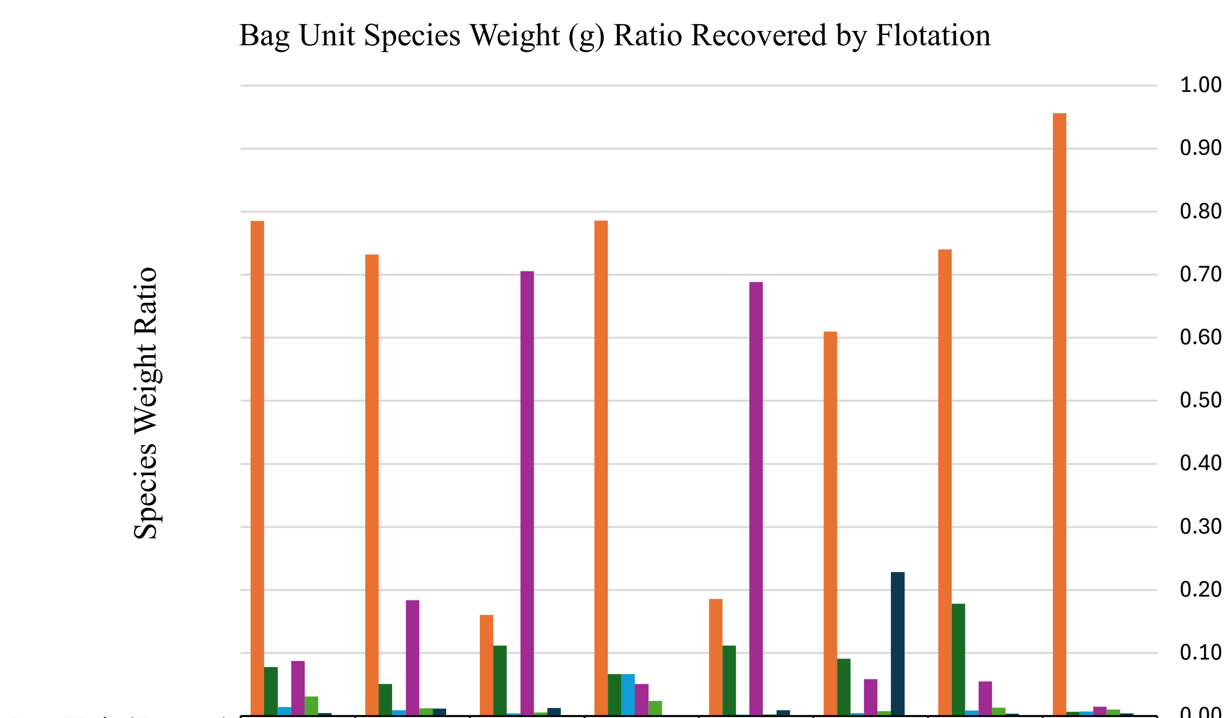
Since only the ¼” materials were analyzed from the bag units, the species composition of the <⅛” size graded material and the >2mm size graded material is unknown. Both size grades are secondary in the total composition of the features and may contribute insight regarding the collection and deposition practices of smaller faunal material. The results may shed light on either dietary practices or possible depositing methods. Cerimele’s 2017 research examined water-screened materials that included <⅛” material and was able to identify a diverse amount of animal species from the <⅛” material (Cerimele 2017). Most of the recovered material was identified as fish bones (Actinopterygii). It seems plausible that a significant portion of the <⅛” material screened reflects a similar composition.

Question 2

Excavation of the depositional features from the 2012 and 2016 field schools noted the consistent appearance of *Viviparus sp.* (banded mystery snails), *Pomacea* sp. (apple snails), and bivalve shells (Sassaman, Gilmore, and Randall 2011; Randall 2024). While these are the primary shell species observed at Mt. Taylor shell sites, the distribution of these shells is uncertain. It is assumed that *Viviparus sp.* shells are the most dominant, followed by bivalves or apple snail shells.

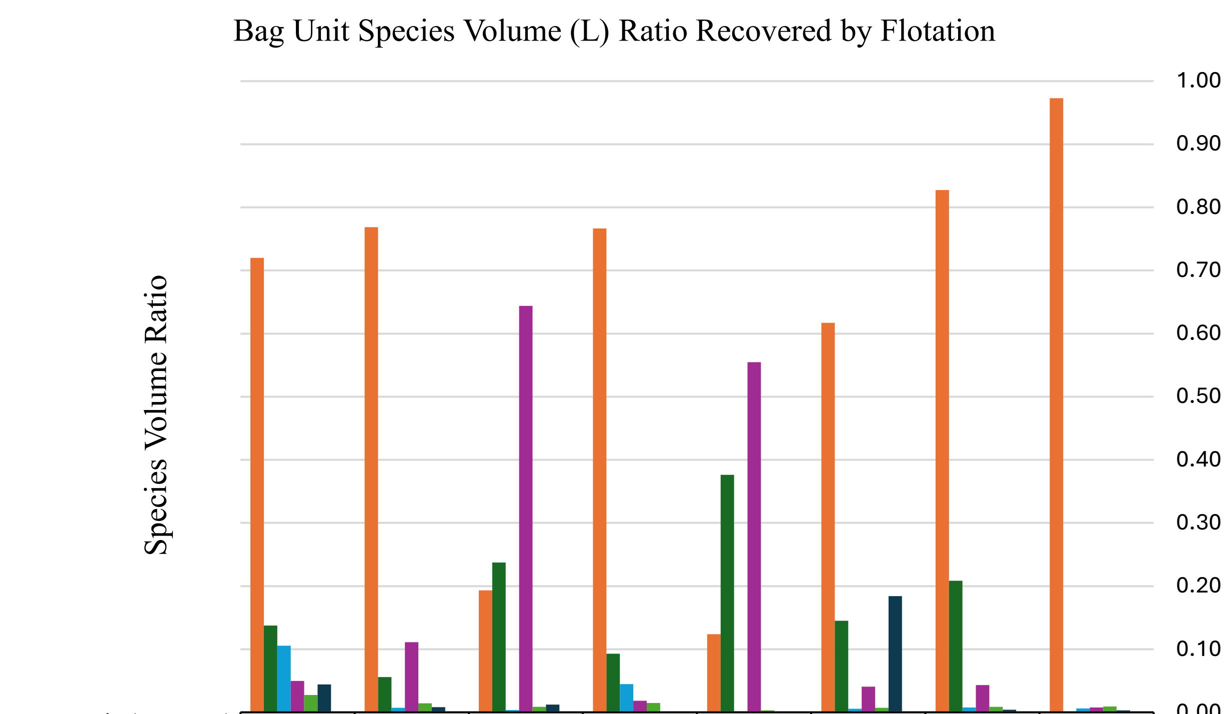
Analysis of the feature components reveals an increased presence of *Viviparus sp.* shells; however, some units exhibited an overwhelming abundance of bivalve shells compared to those of *Viviparus sp.* This trend is notable in features recovered through flotation as opposed to other methods. It is hypothesized that the excavation methods when collecting shell material (picking versus scraping) may have influenced the size of the bivalve shell material (Randall, personal communications 2024). The excavation methods may have retained larger bivalve fragments for the flotation samples and smaller bivalve fragments in the water sampling (Randall, personal communications 2024). The initial visual observations of Features 141 (Episode II) and 149 (Episode II) identified the deposit's main composition as bivalve and apple snail shells with possible thermal alteration (Randall 2024). Another trend is the increased presence of vertebrate fauna in the assemblage recovery through non-flotation methods. This is unsurprising given that non-flotation methods retain material more frequently, with "water screen samples almost always larger volumetrically pre-processing than float samples" (Randall, personal communications 2024).

Figure 8-5 visually represents the floated features and their species weight distribution, expressed as percentages. Most shell features are dominated by *Viviparus sp.*, while bivalves are noticeably more abundant in Features 141 (4050) and 149 (Episode II). The features are dated to Episode II of the Mt. Taylor period, but they are from different Test Units (Table 5-2). These differences will be expanded upon later in the chapter, including the observations regarding the Mesa Rams Horn shells in Features 127 (Episode II) and 146 (Episode I and II), with the increased presence of the Mesa Ram's Horn most notable in Figure 8-6. Figure 8-6 is the volumetric representation of the species composition, with *Pomacea sp.* (apple snails) having an increased representation in the data. This is due to the apple snail shell's physical nature: adult shells of the species are volumetrically large, but the shells are friable and are subject to post-depositional fragmentation (including the excavation phase). Many feature descriptions note the visible presence of *Pomacea sp.* (apple snails). Still, it is not well represented in the materials collected due to its friable nature and tendency to become fragmented.



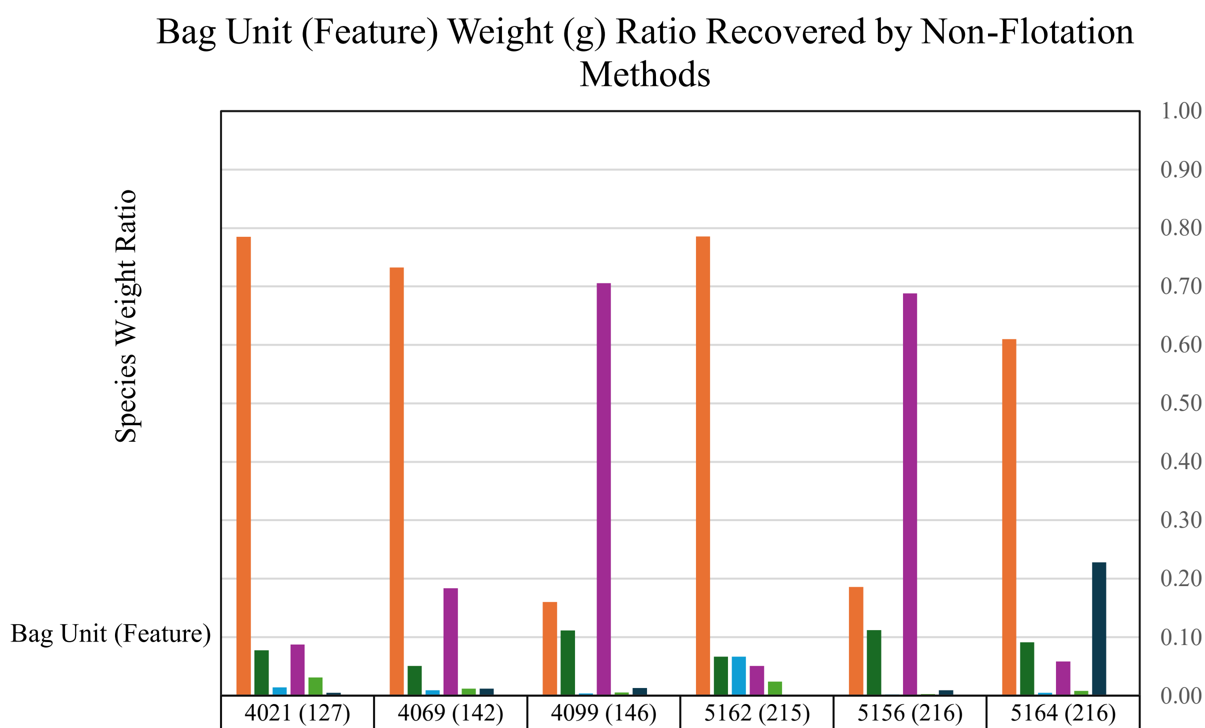
Bag Unit (Feature)	4022 (127)	4049 (141)	4050 (141)	4089 (146)	4306 (149)	5163 (216)	5173 (215)	5202 (212)
Vivaparus	0.79	0.73	0.16	0.79	0.19	0.61	0.74	0.96
Apple Snail	0.08	0.05	0.11	0.07	0.11	0.09	0.18	0.01
Mesa Ram's Horn	0.01	0.01	0.00	0.07	0.00	0.00	0.01	0.01
Bivalve	0.09	0.18	0.71	0.05	0.69	0.06	0.06	0.01
Elimia	0.03	0.01	0.01	0.02	0.00	0.01	0.01	0.01
Vertfauna	0.00	0.01	0.01	0.00	0.01	0.23	0.00	0.00
Terestrial Snails	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Figure 8-5. The figure presents the weight-species ratio for features recovered by flotation.



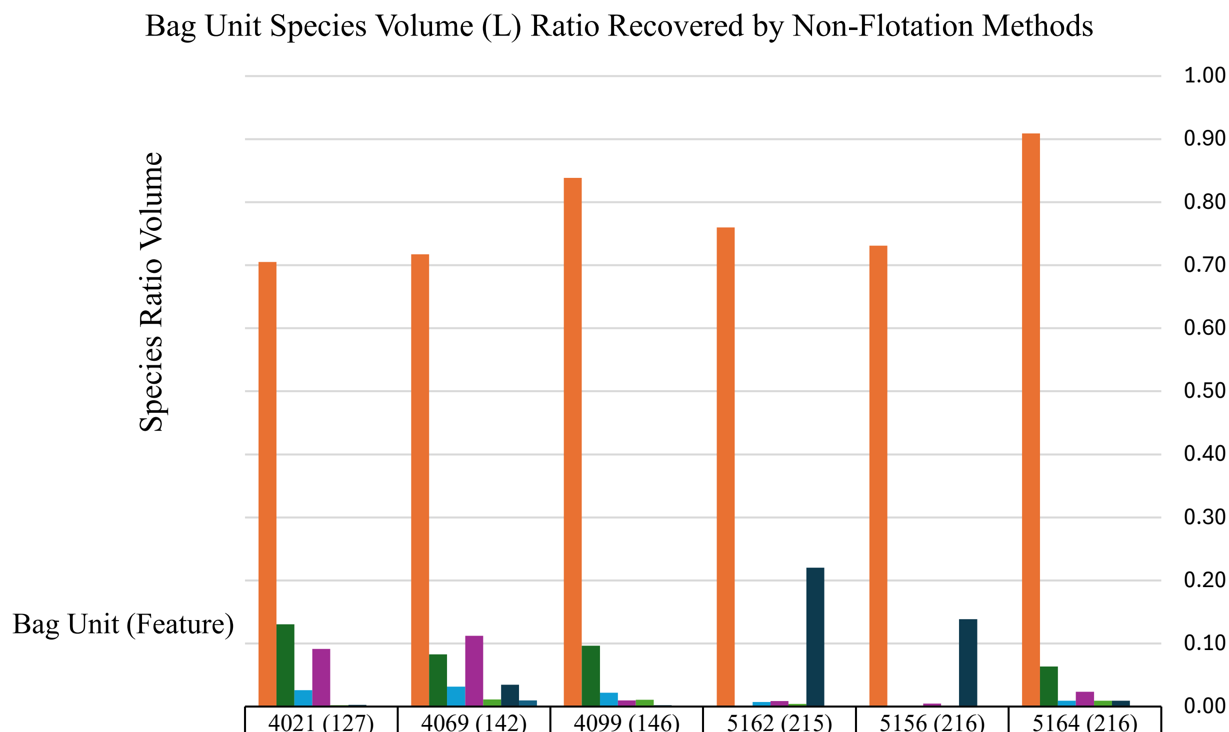
Bag Unit (Feature)	4022 (127)	4049 (141)	4050 (141)	4089 (146)	4306 (149)	5163 (216)	5173 (215)	5202 (212)
Vivaparus	0.72	0.77	0.19	0.77	0.12	0.62	0.83	0.97
Apple Snail	0.14	0.06	0.24	0.09	0.38	0.15	0.21	0.00
Mesa Ram's Horn	0.11	0.01	0.00	0.04	0.00	0.01	0.01	0.01
Bivalve	0.05	0.11	0.64	0.02	0.55	0.04	0.04	0.01
Elimia	0.03	0.01	0.01	0.01	0.00	0.01	0.01	0.01
Vertfauna	0.04	0.01	0.01	0.00	0.00	0.18	0.00	0.00
Terestrial Snails	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Figure 8-6. The figure presents the volumetric-species ratio for features recovered by flotation.



Bag Unit (Feature)	4021 (127)	4069 (142)	4099 (146)	5162 (215)	5156 (216)	5164 (216)
Vivaparus	0.79	0.73	0.16	0.79	0.19	0.61
Apple Snail	0.08	0.05	0.11	0.07	0.11	0.09
Mesa Ram's Horn	0.01	0.01	0.00	0.07	0.00	0.00
Bivalve	0.09	0.18	0.71	0.05	0.69	0.06
Elimia	0.03	0.01	0.01	0.02	0.00	0.01
Vertfauna	0.00	0.01	0.01	0.00	0.01	0.23
Terestrial Snails	0.00	0.00	0.00	0.00	0.00	0.00

Figure 8-7. The figure presents the weight-species ratio for features not recovered by flotation.



	4021 (127)	4069 (142)	4099 (146)	5162 (215)	5156 (216)	5164 (216)
Vivaparus	0.70	0.72	0.84	0.76	0.73	0.91
Apple Snail	0.13	0.08	0.10	0.00	0.00	0.06
Mesa Ram's Horn	0.03	0.03	0.02	0.01	0.00	0.01
Bivalve	0.09	0.11	0.01	0.01	0.00	0.02
Elimia	0.00	0.01	0.01	0.00	0.00	0.01
Vertfauna	0.00	0.03	0.00	0.22	0.14	0.01
Terestrial Snails	0.00	0.01	0.00	0.00	0.00	0.00

Figure 8-8. The figure presents the volumetric-species ratio for features not recovered by flotation.

The feature material collected from non-floated recovery methods is heavily dominated by *Viviparus sp.* shells, with a higher ratio of vertebrate fauna (Figures 8-7 and 8-8). There is a minimal presence of the bivalve species, with a more substantial presence of *Pomacea sp.* (apple snails). The species composition remains similar when comparing floated and non-floated feature material. Therefore, for this sample data set, the species composition difference is not based on recovery methods but rather on the features. This is further supported by the feature descriptions (Randall 2024).

Hierarchical Clustering

Using SPSS, a hierarchical clustering diagram was created to group the analyzed bag units from the study. The diagram was based on the species weight ratio composition of the ¼" size-graded material (Figure 8-9). The Ward Method was used for clustering, with linkages based on squared Euclidean distance. Squared Euclidean distance speeds up the computational calculation of the linkages of the equations. Five groups were identified as having the most similarities in species composition based on weight ratio. SPSS formed these groups; a table of the ratios used is found in the appendix (Appendix 8-2A), along with the supporting statistical clustering (Appendix 8-2B).

The first group consists of bag units, BU 4050 (Feature 141; Flotation; Episode II) and BU 4306 (Feature 149; Flotation; Episode II), which are significantly composed of bivalve material and contain lower amounts of *Viviparus sp.* shells (Table 8-3). The second group comprises BU 4075 (Feature 127; Flotation; Episode II) and BU 5055 (Feature 205; Flotation; Middle Archaic/Episode I), characterized by a composition of approximately 60% *Viviparus sp.* and a higher rate of bivalve shells, at 25% or higher. These bag units are derived from different features collected through flotation and date back to differing cultural periods (Table 8-3).

Group 3 (Table 8-3) is composed of BU 5162 (Feature 216; ⅛" Water Screen; Episode II), BU 4307 (Feature 148; Flotation; Episode II), and BU 5163 (Feature 216; Flotation; Episode II). This group is characterized by a majority of *Viviparus sp.* shells, with a ratio of around 60-70%, and is secondarily composed of faunal bone material, at a ratio of approximately 15-25%.

Groups 4 (Table 8-3) and 5 are very similar in composition; however, the key difference is a higher ratio of *Viviparus sp.* in Group 4 (~80-95%), with relatively similar ratios among the other species. Group 5 has a slightly lower ratio composition of *Viviparus sp.* shells and a slightly increased ratio of bivalve shells (~11%) compared to the other species (Table 8-4).

Group 4 is composed of Bag Units 4099 (Feature 146), 4309 (Feature 148), 5164 (Feature 216), 5024 (Feature 201), and 5202 (Feature 212). BU 4099 and BU 5164 were recovered by ⅛" water screening, with the other bag units recovered by flotation. BU 4099 is dated to Episode I, while BU 5024 is dated to the early Middle Archaic period, and the other bag units are dated to Episode II.

Group 5 is more diverse in terms of chronology, and it comprises 10 bag units (Table 8-3). BU 4021 (Feature 127), 4069 (Feature 142), 4076 (Feature 142), and 5156 (Feature 216) were recovered by ⅛" Water Screening, with the other bag units recovered by flotation. BU 4069 (Feature 142), 4076 (Feature 142), and 5027 (Feature 201) are dated to the early Middle Archaic; BU 4089 (Feature 146) and 4096 (Feature 146) are dated to Episode I, and the rest of the bag units date to Episode II.

Bag units from the features are broken into these different groups due to their varying species composition ratios. This may be attributed to the location from which the bag unit was collected or the method used to recover it for collection. The varying temporal periods of the groups may be indicative of intentional replication of previous pit fill patterns, which will be discussed in the chapter's discussion section later.

Table 8-3: Hierarchical clustering groups based on ¼" species composition weight (g) ratio

Group	**Bag Units**	**Feature**	**Test Unit**	**Recovery Method**	**Dating**
1	4050	141	72	Flotation	Episode II
1	4306	149	71	Flotation	Episode II
2	4075	142	72	Flotation	early Middle Archaic
2	5055	205	96	Flotation	Middle Archaic/ Episode I
3	5162	216	103	⅛" Water Screen	Episode II
3	4307	148	73	Flotation	Episode II
3	5163	216	103	Flotation	Episode II
4	4099	146	70	⅛" Water Screen	Episode I
4	4309	148	73	Flotation	Episode II
4	5164	216	103	⅛" Water Screen	Episode II
4	5024	201	96	Flotation	early Middle Archaic
4	5202	212	100	Flotation	Episode II
5	4021	127	71	⅛" Water Screen	Episode II
5	4069	142	72	⅛" Water Screen	early Middle Archaic
5	4049	141	72	Flotation	Episode II
5	4076	142	72	⅛" Water Screen	early Middle Archaic
5	5027	201	96	Flotation	early Middle Archaic
5	4022	127	71	Flotation	Episode II
5	4096	146	70	Flotation	Episode I
5	4089	146	70	Flotation	Episode I
5	5156	215	103	⅛" Water Screen	Episode II
5	5173	215	103	Flotation	Episode II

Table 8-4: Averages of Group 4 and 5 Species Weight (g) Ratios

Average Species Ratio	Group 4	Group 5
Viviparus sp.	0.88	0.75
(*Pomacea*) Apple Snail	0.03	0.08
Mesa Ram's Horn	0.02	0.02
Bivalve	0.03	0.11
Elimia sp.	0.01	0.02
Vert faun	0.03	0.02
Terrestrial Snails	0.00	0.00

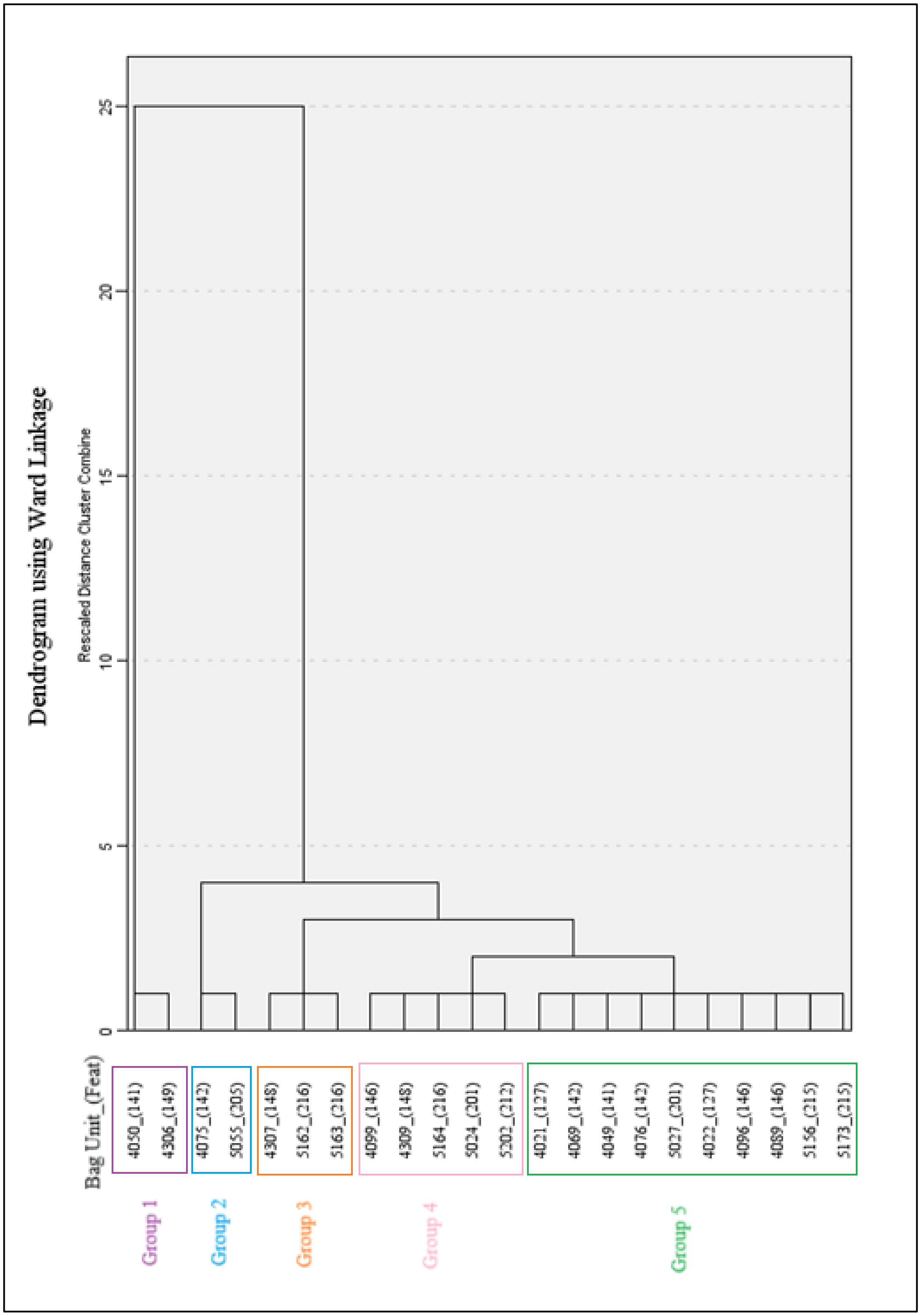


Figure 8- 9. Dendrogram of Species Weight Ratio Composition Similarities between Bag Units

Table 8-5: Ranking of Other Mollusk Species Weight Ratios

Bag Unit	Feature	Test Unit	Recovery Method	Dating	Feature Volume (m^3)	Burned Base	*Pomacea sp.* Rank	Mesa Ram's Horn Rank	*Elimia sp.* Rank
4050	141	72	Flotation	Episode II	1.06	Possible	3	1	2
4306	149	71	Flotation	Episode II	N/A	Possible	3	1	1
4075	142	72	Flotation	early Middle Archaic	1.03	No	2	2	2
5055	205	96	Flotation	Middle Archaic /Episode I	N/A	No	2	3	1
5162	216	103	⅛" Water Screen	Episode II	0.17	No	1	2	1
4307	148	73	Flotation	Episode II	N/A	Yes	1	3	2
5163	216	103	Flotation	Episode II	0.17	No	2	1	2
4099	146	70	⅛" Water Screen	Episode I	0.85	Yes	2	3	2
4309	148	73	Flotation	Episode II	N/A	Yes	1	3	2
5164	216	103	⅛" Water Screen	Episode II	0.17	No	2	2	2
5024	201	96	Flotation	early Middle Archaic	N/A	Possible	1	2	2
5202	212	100	Flotation	Episode II	1.38	Yes	1	2	2
4021	127	71	Flotation	Episode II	3.83	Yes	2	2	4
4069	142	72	⅛" Water Screen	early Middle Archaic	1.03	No	2	3	2
4049	141	72	Flotation	Episode II	1.06	Possible	2	2	2
4076	142	72	⅛" Water Screen	early Middle Archaic	1.03	No	1	2	2
5027	201	96	Flotation	early Middle Archaic	N/A	Possible	1	3	1
4022	127	71	Flotation	Episode II	3.83	Yes	2	2	4
4096	146	70	Flotation	Episode I	0.85	Yes	2	3	2
4089	146	70	Flotation	Episode I	0.85	Yes	2	4	3
5156	215	103	⅛" Water Screen	Episode II	7.57	Yes	3	2	2
5173	215	103	Flotation	Episode II	7.57	Yes	4	2	2

Table 8-5 ranks weight ratios from the species composition of the bag units from 1 to 4 arbitrarily. Due to time constraints, significant tests were not implemented to compare chronological periods. The lower the number, the less significant the mollusk species is in the composition of the bag units. Overall, the frequency of *Pomacea sp.* is associated with features dated to Episode II of the Mt. Taylor period and an association with the burned bases of the features. The role of the size of a feature is indeterminate.

For Mesa Ram's Horn, based on Table 8-4, there appears to be a stronger association with earlier cultural periods; however, they are frequent in Feature 148, which is dated to Episode II (Rank 3 and 4). Indications of thermal alterations do not seem to correlate with the presence of Mesa Ram's Horn in the features (Table 8-1), nor with the volumetric size of the features. The highest ranking for *Elimia sp.* is associated with features dating to Episode II and is a part of Group 5. However, *Elimia sp.* does appear across multiple cultural phases. The frequency of the species may correlate with the presence of a burned base. Overall, the species composition ranking is arbitrary but does provide some insight into the significance of other mollusks besides *Viviparus sp.* at Silver Glen Springs.

Viviparus sp. Measurements

Research conducted by Blessing took shell measurements of *Viviparus sp.* to track changes in snail selection size and "the implications these changes could have for shellfish procurement and consumption" (Blessing 2011:189). Her research found that *Viviparus sp.* during the Mt. Taylor period, "regardless of which phase, had an average diameter ≤ 16.2 mm" Blessing 2011:189). On average, the shells measured from the Mt. Taylor period were smaller than those measured from the Orange period. The implications of these measurements were unclear to Blessing regarding the different sizes. However, the evidence from Blessing's research disproves Cumbaa's hypothesis regarding the overharvesting of snails during the Orange period and the correlated decrease in species snail size through time (Blessing 2011:194).

Total Viviparus sp. Analysis. The average diameter of the collected *Viviparus sp.* shell measurements in this research is smaller in comparison to the average ¼" shell diameter (width) collected by Blessing in the 2011 technical report (Blessing 2011). Most of the measurements collected by Blessing are from samples dated to Episode III, at the end of the Mt. Taylor period, Thornhill Lake Phase and the Orange period. The average diameter for the shells measured by Blessing ranged from 13.7 mm to 19.6 mm with the 13.7mm dating to the Early Mt. Taylor Phase. The Thornhill Lake Phase and the Orange Period start at an initial 15.1 mm. If the measurement from the Early Mt. Taylor Phase is removed, the average width is 16.6 mm. The average of all the *Viviparus sp.* shell measurements is seen in Table 8-6. This aligns with the known information that the *Viviparus sp.* shells collected from earlier periods are smaller in size compared to those from later periods.

Table 8-6: Average Shell Measurement for *Viviparus sp.* (Rounded)

Aggregated Shell Measurements	Total Average
Total Count	1287.00
Average Height (mm)	20.02
Average Diameter (mm)	15.95
Average Aperture Length (mm)	12.50
Average Aperture Width (mm)	9.68
Average Weight (g)	1.08
Average Puncture Frequency	8.32

The average of the shell measurements for each feature is seen in Table 8-7 below. This table does not include measurements not collected during this study. Pyatt's previous measurements did not include aperture or weight measurements. Table 8-8 contains the previously collected measurements from Pyatt features (Pyatt 2017).

Table 8-7: Average *Viviparus sp.* shell measurements for features in this study

Feature	127	141	142	146	149	212	215	216	Study Aggregate
Sample Method	Random	Random	Random	Random	Random	Random	Random	Total	
Count	200.0	200.0	100.0	200.0	100.0	100.0	200.0	187.0	1287.0
Height (mm)	19.8	21.3	18.9	18.9	20.3	22.2	20.0	19.5	20.0
Diameter(mm)	15.9	16.9	15.4	15.2	16.1	17.0	16.1	15.3	16.0
Aperture Length(mm)	12.4	13.2	11.9	11.8	12.7	13.4	12.5	12.4	12.5
Aperture Width(mm)	9.5	10.1	9.2	9.2	9.8	10.5	9.7	9.6	9.7
Weight (g)	1.1	1.4	0.9	0.9	1.2	1.4	1.1	0.9	1.1
Puncture %	0.0	5.5	21.0	9.0	3.0	3.0	4.5	21.9	8.3

Table 8-8: Average feature *Viviparus sp.* shell measurements from Pyatt's research

Feature	142	146
Sample Method	Total	Random
Count	100.0	270.0
Height (mm)	18.5	17.8
Diameter(mm)	14.2	13.8

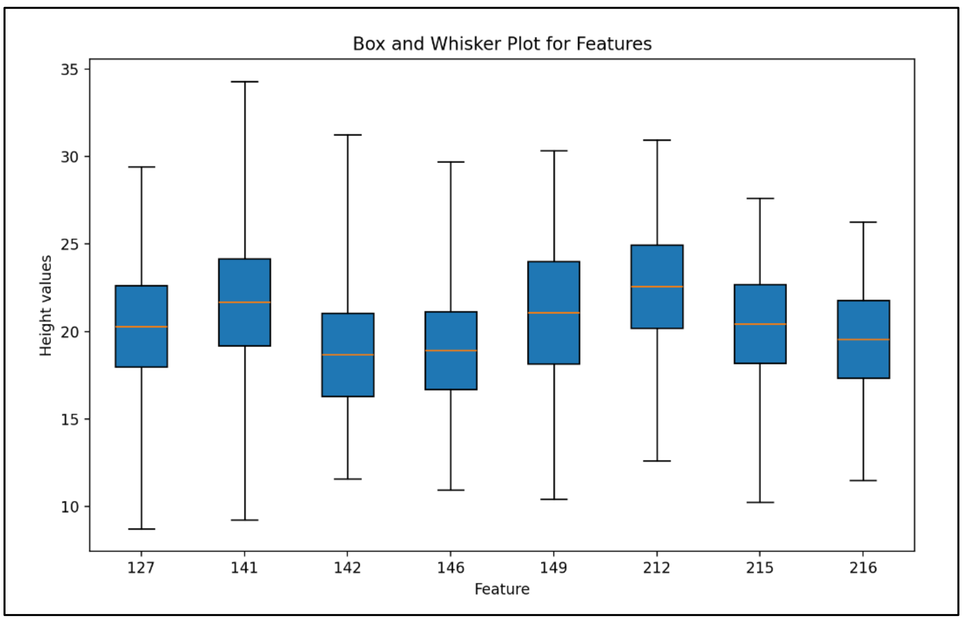


Figure 8-10. Average Height Measurements (mm) for *Viviparus sp.* by feature

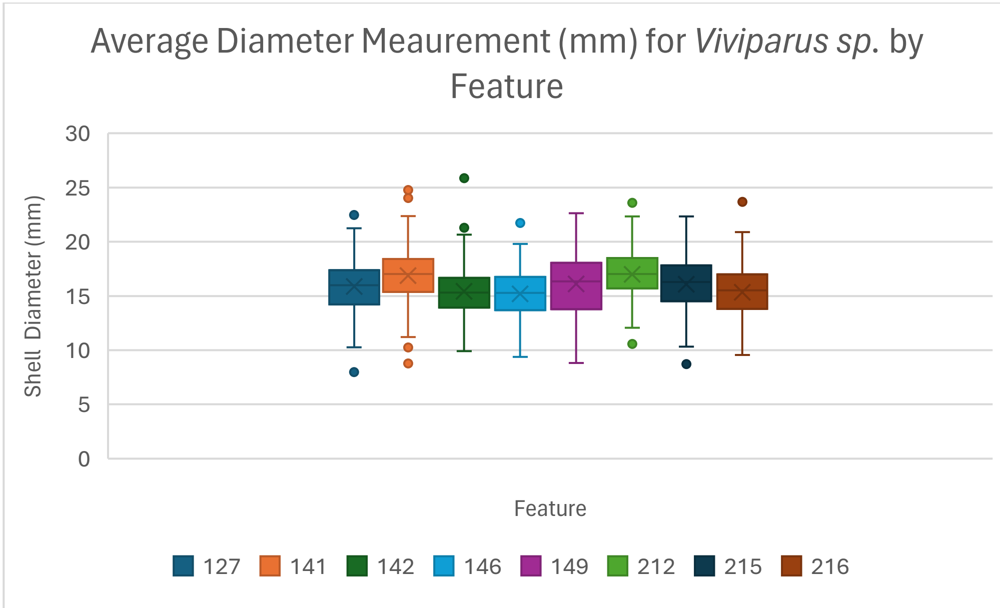


Figure 8-11. Average Height Measurements (mm) for *Viviparus sp.* by feature

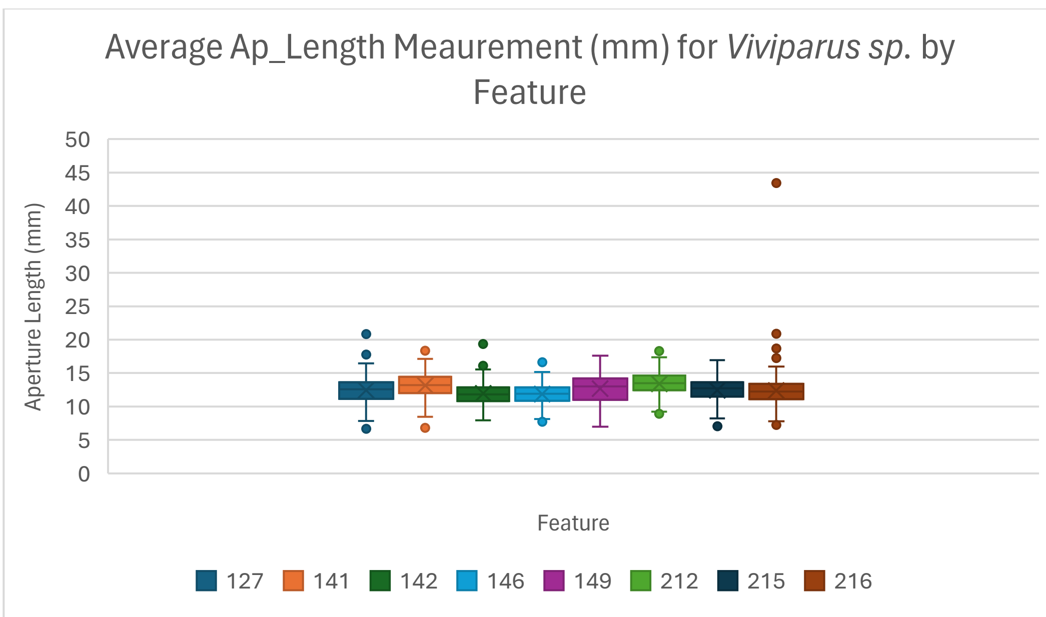


Figure 8-12. Average Aperture Length Measurements (mm) for *Viviparus sp.* by feature

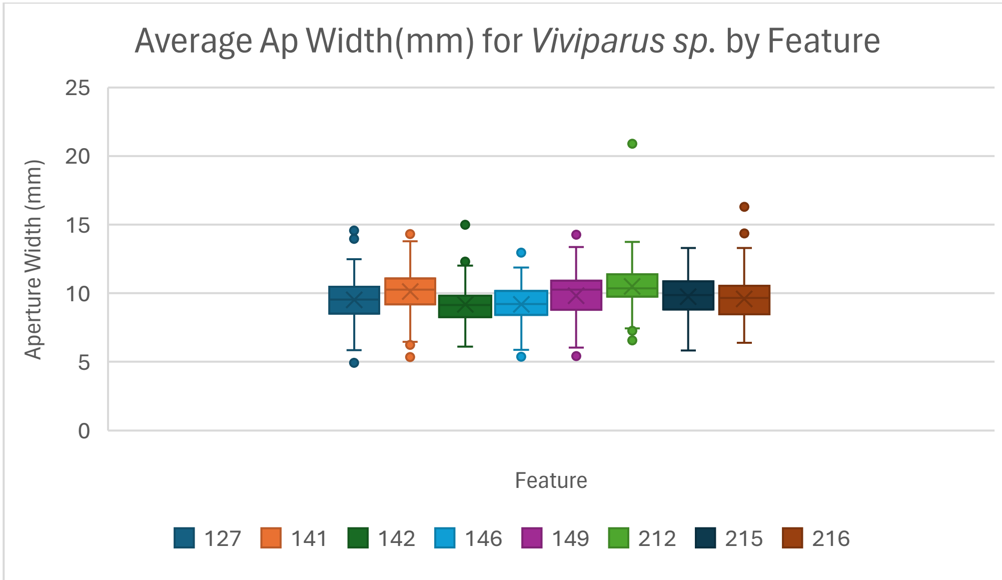


Figure 8-13. Average Aperture Width Measurements (mm) for *Viviparus sp.* by feature

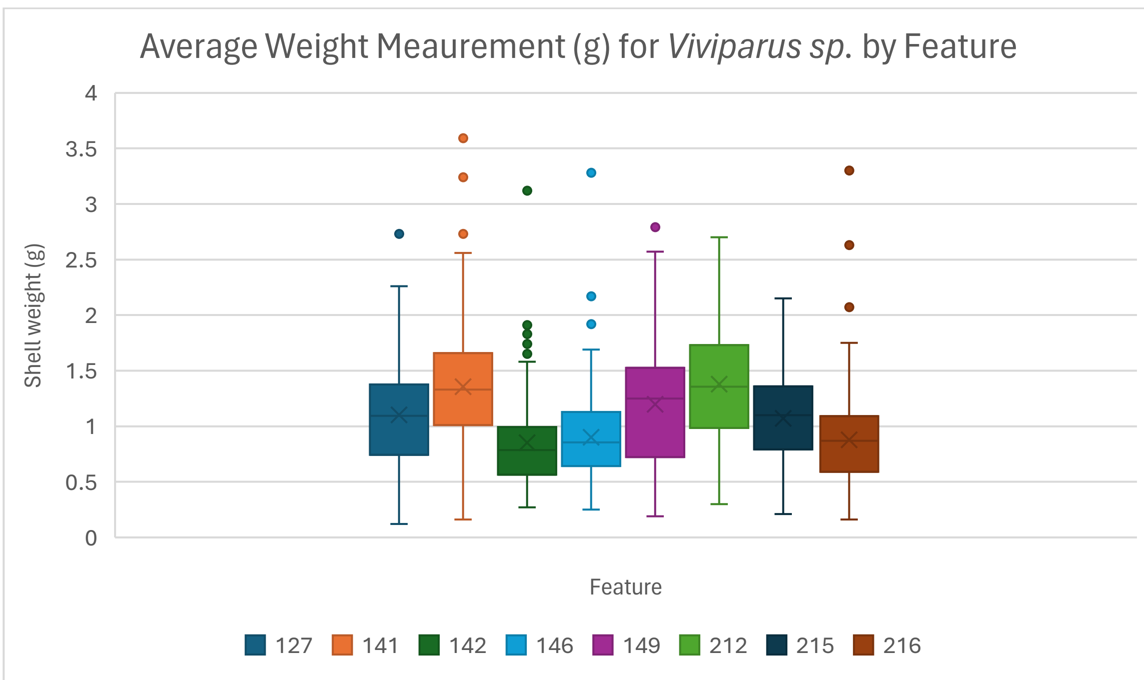


Figure 8-14. Average Weight Measurements (g) for *Viviparus sp.* by feature

Figures 8-10 to 8-14 are box and whisker plots that compare the averages and ranges of the shell measurements for each feature. Visually, these figures reflect a shared range of measurements and similar medians, with minimal variation in the measured features.

The box and whisker plots provide visual statistics that support these observations. All measurements were statistically analyzed using non-parametric testing. Statistical analysis was done through SPSS, which implemented the Kruskal-Wallis Test. The results of the Kruskal-Wallis test rejected the null hypothesis for all measurements, indicating a statistically significant difference between the features and their measurements. The statistics revealed a limited probability that the shell measurements of the features are statistically linked. This indicates that the features have unique *Viviparus sp.* measurements, which lack shared traits. Appendix 8-3 will contain the post-hoc data for the Kruskal-Wallis test.

Table 8-9: Kruskal-Wallis Test Results

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The distribution of Full_Height is the same across categories of Feature.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.
2	The distribution of Full_Diameter is the same across categories of Feature.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.
3	The distribution of Ap_Length is the same across categories of Feature.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.
4	The distribution of Ap_Diameter is the same across categories of Feature.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.
5	The distribution of Shell_Weight is the same across categories of Feature.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.

a. The significance level is .050.
b. Asymptotic significance is displayed.

The following Figures 8-15 to 8-19, visually show the rejection of the null hypothesis. They compare the measurements between the features pairwise. The features that share a high probability of statistical similarity in terms of measurements are identified with a blue line, while those that do not are red.

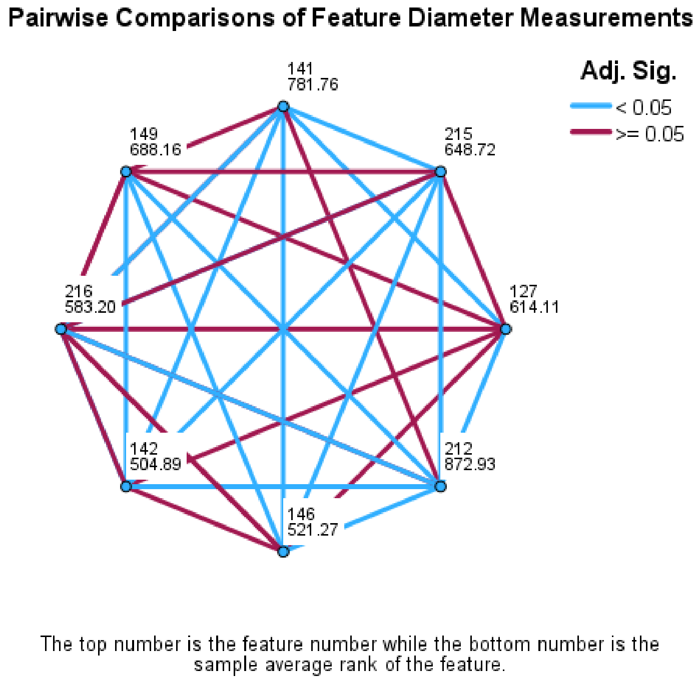


Figure 8-15. Pairwise Comparison Visual of *Viviparus sp.* Diameter Shell Measurements

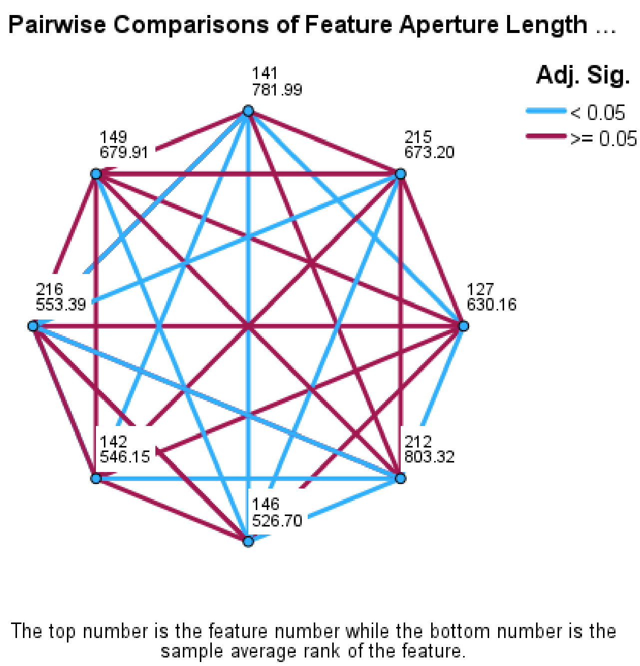


Figure 8-16. Pairwise Comparison Visual of *Viviparus sp.* Aperture Length Shell Measurements

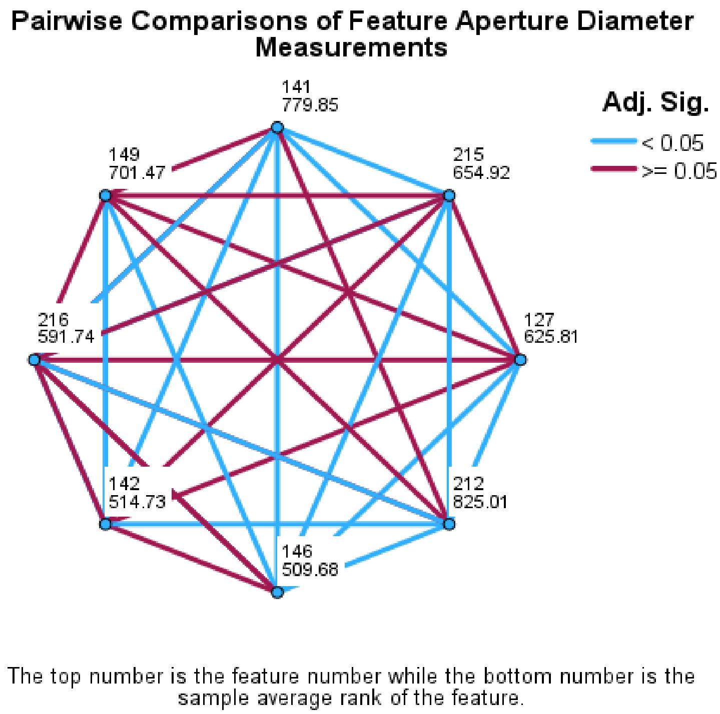


Figure 8-17. Pairwise Comparison Visual of *Viviparus sp.* Aperture Diameter Shell Measurements

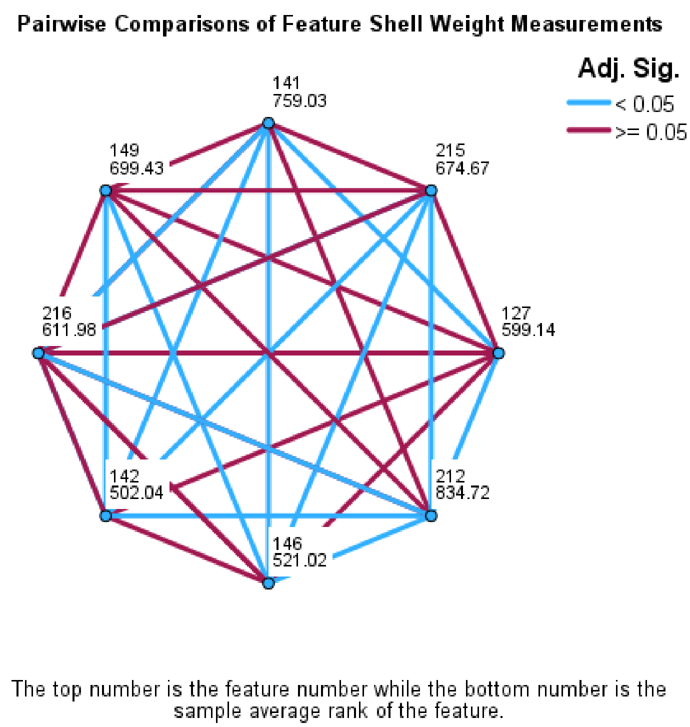


Figure 8-18. Pairwise Comparison Visual of *Viviparus sp.* Shell Weight Measurements

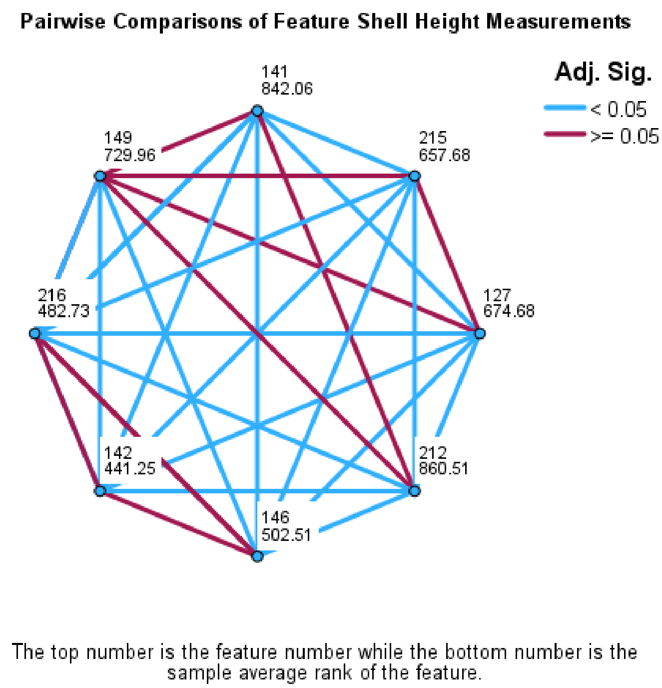


Figure 8-19. Pairwise Comparison Visual of *Viviparus sp.* Shell Height Measurements

Table 8-10: Number of Feature Relations with <0.05 Pairwise Comparison Significance

Feature #	Diameter	Aperture Length	Aperture Diameter	Weight	Height
127	2	2	3	2	2
141	5	4	5	4	4
142	4	2	3	4	4
146	4	4	5	4	4
149	3	1	2	2	2
212	6	4	5	5	5
215	4	2	3	3	3
216	2	3	2	2	2

Table 8-10 summarizes the number of relationships between features that have a significance <0.05 between different features (blue line). Features 127 (Episode II), 149 (Episode II), and 216 (Episode II) have the least number of shared significances among other features. Features 141(Episode II) and 212 (Episode II) share the most significance with other features. Of the pairwise comparisons, the diameter measurement had the most shared significance, while the aperture length had the least. The increased significance of the diameter of the shells may indicate a preference for collecting based on diameter.

Viviparus sp. Measurements and Cultural Periods. An alternative method for grouping the *Viviparus sp.* measurements is to categorize them based on cultural periods. By applying the Kruskal-Wallis test to this method of categorization, only three cultural periods were compared, as the shell measurements encompassed only the early Middle Archaic, Episode I (Mt. Taylor), and Episode II (Mt. Taylor).

Between the three cultural periods, two classes of measurements were used. The first class included all five categories: height, diameter, aperture length, aperture diameter, and weight. This class included more in-depth measurements of the *Viviparus sp.* shells but had limited variations of samples from different cultural periods, with a majority from Episode II. The second class of measurements only utilized two categories of measurement: height and diameter. These measurements included work done by Pyatt in 2017, who only recorded the two categories and measurements from this thesis. While not as in-depth with the measurement, Pyatt's work included more samples from different cultural periods.

For the Kruskal-Wallis test, the first class saw no statistical similarities between the five categories of measurements and the three cultural periods (Table 8-9). In comparison, there is a statistical significance in the distribution of *Viviparus sp.* shell measurements between the early Middle Archaic and Episode I (Mt. Taylor), as seen in Table 8-11. Since only two cultural periods were being compared, SPSS automatically utilized the Mann-Whitney test, another non-parametric test. The results are that the sample sizes for the early Middle Archaic (n = 100) and Episode I (n = 200) are relatively small and may not accurately reflect actual trends (Table 8-12;

Appendix 8-4A for supplemental statistical data). A larger sample size would be needed to confirm any statistical significance. This is where the second class of measurement is applicable.

Table 8- 11: Kruskal-Wallis Results for *Viviparus sp.* Measurements and Cultural Periods

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The distribution of Shell Height (mm) is the same across categories of Cultural Period.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.
2	The distribution of Shell Width (mm) is the same across categories of Cultural Period.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.
3	The distribution of Aperature Height is the same across categories of Cultural Period.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.
4	The distribution of Aperature Width is the same across categories of Cultural Period.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.
5	The distribution of Shell Weight is the same across categories of Cultural Period.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Table 8-12: Mann-Whitney Results for *Viviparus sp.* Measurements and the early Archaic and Episode I.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The distribution of Shell Height (mm) is the same across categories of Cultural Period.	Independent-Samples Mann-Whitney U Test	.576	Retain the null hypothesis.
2	The distribution of Shell Width (mm) is the same across categories of Cultural Period.	Independent-Samples Mann-Whitney U Test	.688	Retain the null hypothesis.
3	The distribution of Aperature Height is the same across categories of Cultural Period.	Independent-Samples Mann-Whitney U Test	.909	Retain the null hypothesis.
4	The distribution of Aperature Width is the same across categories of Cultural Period.	Independent-Samples Mann-Whitney U Test	.560	Retain the null hypothesis.
5	The distribution of Shell Weight is the same across categories of Cultural Period.	Independent-Samples Mann-Whitney U Test	.059	Retain the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

The second class of statistical analysis of the *Viviparus sp.* shell measurements, which only used height and diameter, revealed no statistically significant patterns between any of the cultural periods (Table 8-13; Appendix 8-4B). The sample sizes for each cultural period were increased early Archaic (n=280), Episode I (n=573), and Episode II (n=1261). While the measurements in this class are not as extensive as those in the first class of statistical analysis, they reduce the significance of the smaller sample sizes from the early Archaic (n = 100) and Episode I (n = 200).

Table 8-13: Kruskal-Wallis Results for *Viviparus sp.* Measurements using only Height and Diameter

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.^{a,b}	Decision
1	The distribution of Shell Height (mm) is the same across categories of Cultural Period.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.
2	The distribution of Shell Width (mm) is the same across categories of Cultural Period.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

The results of this analysis reveal an inconclusive connection between the *Viviaprus sp.* shell measurements and the cultural periods of early Archaic and Episode I (Table 8-12). In general, the statistical results of Tables 8-11 and 8-13 support the results of no patterns between *Viviaprus sp.* measurements and cultural periods.

Viviparus sp. Growth Size

Viviparus sp. shell measurements show a correlation between height and diameter, with adult snails being taller than their width, while juvenile snails are wider than their height (Jokinen et al. 1982). A curvilinear relationship was not observed in the collected shell measurements, indicating that most of the shells collected were adult snails. This correlates with the fact that the examined shells were from ¼” screened material, which would select larger shells, indicating the adults of the species. This bias in the research does not accurately reflect the relationship between the Mt. Taylor community and specimen selection. Figures 8-20 to 8-22 reflect the linear relationship between the snail height and diameter measurements.

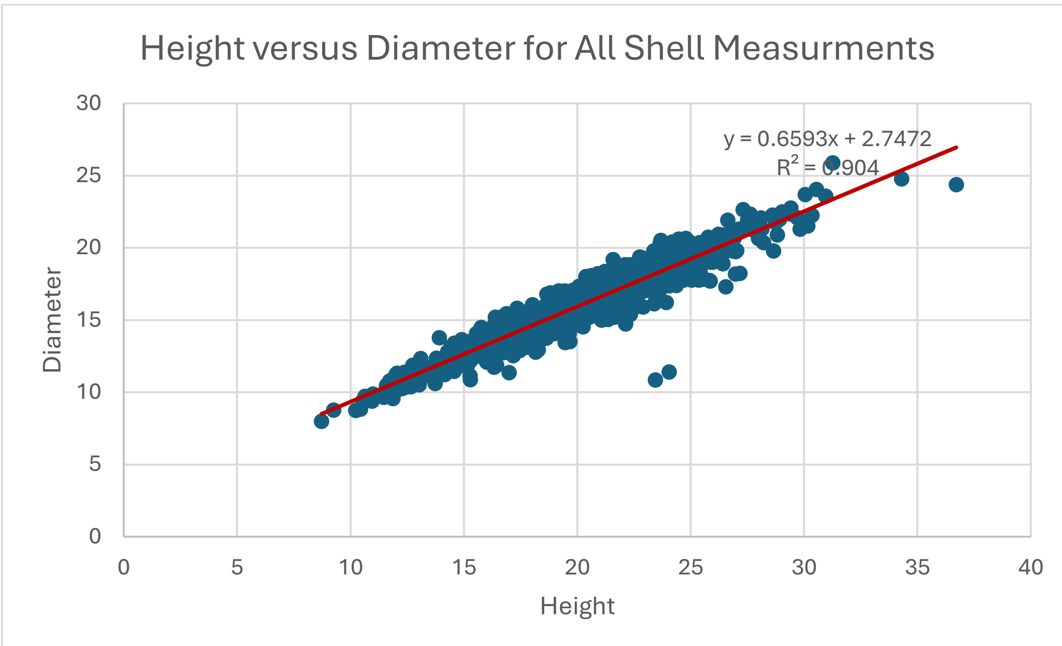


Figure 8-20. Linear representation of height versus diameter shell measurements for all shell measurements

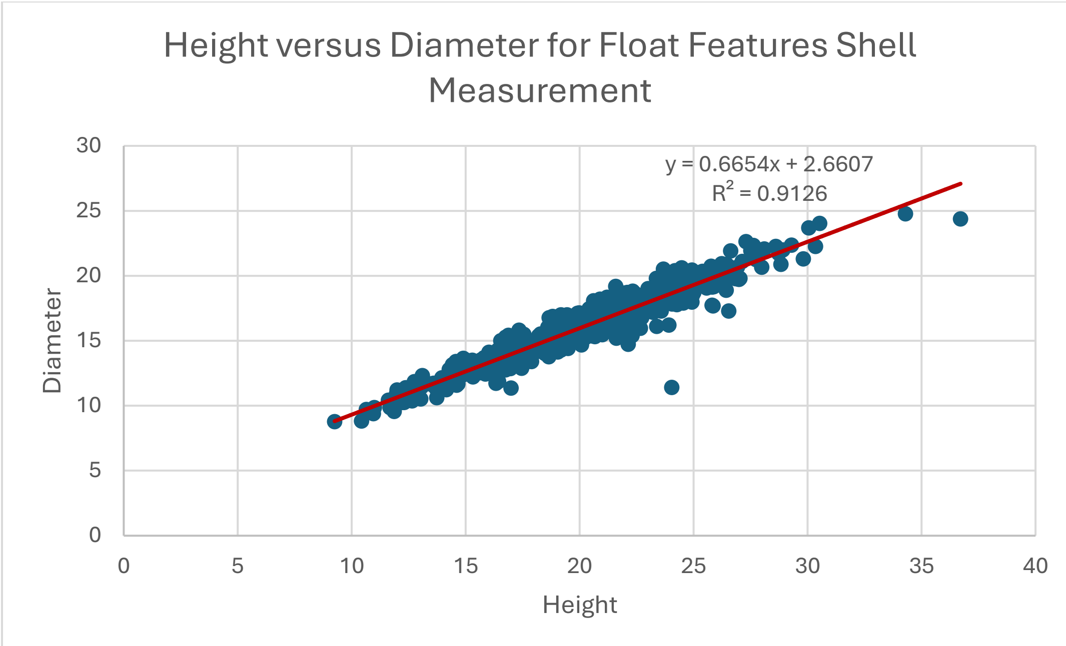


Figure 8-21. Linear representation of height versus diameter shell measurements for shells recovered through flotation

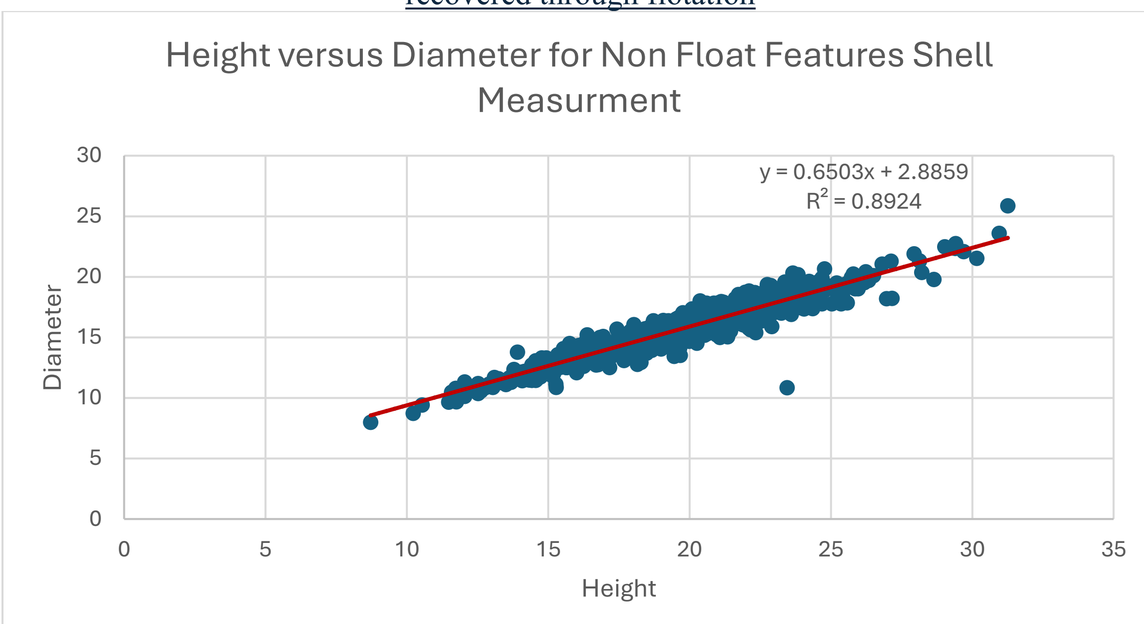


Figure 8-22. Linear representation of height versus diameter shell measurements for shells not recovered through flotation

Discussion

Coalescing the information gathered from the ¼" analysis and the secondary data, interpretations will be made about the implications of the shell deposits found at Silver Glen Springs—Locus A. These implications include pondering the methodologies used to collect the shell materials placed into the deposits and the intent behind the deposits. Multiple components of the deposits were analyzed, including their features and bag units, physical description (thermal alterations), species composition, the relationship between shell measurements and cultural periods, and the size of *Viviparus sp.* shells.

While collection methods may have skewed some information regarding the composition of the deposits, a significant portion was composed of material larger than ¼" screen size. This reflects a selection for material greater than ¼" in size. Smaller-sized material was collected from the gathered material but was not analyzed. Cerimele, Blessing, and other researchers examined materials that were smaller than ¼" and identified multiple faunal species that contributed to the diets of the Silver Glen Springs community (Cerimele 2017; Blessing 2011; Russo 1988). The prominence of gastropods in the ¼" material can be attributed to the large quantity of snails that were processed. In addition, the robust nature of shells limits the amount of disintegration while in the compact soil and the intentional depositing of the shells that protected them from the elements.

One of the earliest deposits is Feature 142, which dates to the early Middle Archaic (Table 5-1). This feature was identified as a circular pit feature that possibly had a greater depth than documented (Randall 2024). The feature comprises three bag units (4069, 4075, and 4076) (Table 7-1). This feature stands out due to the increased presence of bivalve shells in BU 4075 (flotation), the overall ratio composition for the BU is 57% for *Viviparus sp.,* 32% for bivalve shells, 8% for *Pomacea sp.* (apple snails), etc. (Table 7-18). This differs from BU 4076 (⅛" water screen), which saw an increase in *Viviparus sp,* (72%), bivalves (21%), and *Pomacea sp.* (apple snails) (21%) (Table 7-18). The measurements for the *Viviparus sp.* shells were smaller than the study's average, which is unsurprising, given Blessing's findings that earlier periods have smaller shell sizes than later periods. This is exemplified by her measurements from samples dating to the Mt. Taylor period and those from the Orange period, negating Cumbaa's earlier assumptions of overharvesting leading to smaller snail populations (Blessing 2011:194). As a point of personal interest, BU 4069 (⅛" water screen) had 8% of the shells analyzed punctured, which may indicate an early practice of puncturing the shells where the initial unprocessed material is small (Table 7-19). In addition, during excavation, the bottom of the pit did not exhibit signs of thermal alteration but did contain charcoal. During processing, it yielded ~2 grams of burned material out of the 386 grams of material (Table 7-48).

The latest dated features are from Episode II of the Mt. Taylor period (6190-5940 cal BP) (Table 5-1). Feature 216 had an increased presence in vertebrate faunal material (18%), the highest of the analyzed features (Table 7-46). The average *Viviparus sp.* shell size are larger than the average of the study, supporting the trend found by Blessing that later cultural periods at Silver Glen Springs saw an increased selection for larger *Viviparus sp.* shells. This trend of selecting larger *Viviparus sp.* over time may indicate that cultivation or harvesting processes have been selected for larger mystery banded shells. This hypothesis regarding cultivation is difficult to prove and would need additional archeological evidence. The selection of larger shells would ensure that no snails were overharvested or harvested too early. Another possibility is that only the highest-quality shells would be deposited at the shell site. However, this seems less feasible due to the vast quantity and diversity of shell material found. Other suggestions include snail demographics regarding a surplus of females, climatic effects that would increase the detritus for feeding and so on (Randall, personal communications 2024).

Of the species composition for the analyzed features, Features 141 (Episode II) and 149 (Episode II) contain a significant number of bivalve shells (47% and 69%, respectively) (Tables

7-11 and 7-30). These features were described as possibly having burned bases when excavated. Additionally, upon processing, these features exhibited an increase in volume compared to their initial recorded volume (Table 7-3). The shells of these features are larger than the average of this study (Tables 7-13 and 7-32). Data analyzed from Feature 141 saw 25.4 g of burned material and 16.6 g of concreted material (Table 5-3). The feature description did not note the concretions in the soil profile, even with it being one of the earlier units excavated.

For Feature 149, 4.30 g of burned material was documented, but no concretion was identified during analysis (Table 5-3). This is unexpected since the feature description documented crushed shells that were concreted (Randall 2012). There is a possibility that these concretions were smaller than ¼", but this is unlikely. These two features are significant in identifying anomalies in cultural behavior when other feature compositions are mainly composed of mystery-banded snails. Due to the similarities between the two features, they were created around the same period.

The size of the *Viviparus sp.* shells from Features 141 and 149 are larger than the averages of this study, indicating a later Mt. Taylor period; however, the strong presence of bivalve shells is reminiscent of early Middle Archaic deposition patterns found in Feature 142. This is an interesting implication since there is a 2,000-year gap between the two composition patterns.

Contextualizing Features 141 and 149, which have a significant amount of shell material compared to Feature 142, and their lack of material raises questions about their correlation. It is possible that during the middle-to-late Mt. Taylor periods (Episodes), older Middle Archaic shell deposits were observed by the later Mt. Taylor population, who then replicated the composition of the deposits. The reasoning was to interact with the past in response to then-contemporary events that were culturally altering, as discussed in Chapter 2. If that were the case, calling upon the past and responding in excess may have been a way to atone for interfering with spiritual and temporal boundaries.

Table 8-3 illustrates the hierarchical clustering of bag units based on their species composition. This clustering method utilized Ward's method and squared Euclidean distance. Squared Euclidean distance was utilized due to its ability to speed up the computation of the Euclidean method by negating the original square root in the equation of the method. Groups 4 and 5 are the largest of the clusters and are composed of bag units that contain a ratio of *Viviparus sp.* shells greater than 75%, with the remaining 25% being more varied. These groups contain features that have been radiocarbon-dated, spanning the period before the Mt. Taylor event and its duration. The measurements include those from Pyatt; therefore, only the height and diameter of the *Viviparus sp.* shell measurements can be statistically compared. Statistically, there are no similarities between the Bag Units of Groups 4 and 5 (Appendix Table 8-5) based on the height and diameter of the shells. A Kruskal-Wallis supported these findings ($p<0.05$) (Table 8-13).

Using hierarchical clustering again, four subsets were identified in the data from Groups 4 and 5 based on the means of the bag units. (Figure 8-23; Appendix 8-6). This scatter plot visually represents the clustering of the bag units based on the mean measurements of the height and diameter of the *Viviparus sp.* shells. While most of Group 4 and 5 had *Viviparus sp.* measurements taken, BU 4099 did not and is excluded. Subset 1 comprises the middle group of Bag Units that span multiple cultural phases. *Viviparus sp.* shell measurements were not collected for this unit and were removed from the clustering of Figure 8-23 and Table 8-14. Subset 2 contains Feature 141 (Episode II) and Feature 215 (Episode II). Feature 141 has a bag unit that is in Group 1 (Table 8-3), which is mainly composed of bivalve shells. The *Viviparus sp.* average measurements of Subset 2 support the hypothesis that the later cultural phase had larger shell measurement averages. Subset 3 (BU 5202 Feature 212) radiocarbon dates to Episode II, which also aligns with the findings that *Viviparus sp.* shells are larger in the later cultural phases (Blessing 2011) (Table 8-14). Subset 4 has the smallest mean averages of Groups 4 and 5, with two bag units identified as having been in earlier cultural phases, as indicated by Feature 201, which dates to the early Middle Archaic (Table 8-14).

Combining the information from Figure 8-3, Table 8-14, and Figure 8-9, the data suggests that the composition of the features from the shell-filled pits reflects some patterns. Group 1 (BU 4050 and 4306) dates to Episode II and is identified as the group with the highest weight ratio of bivalve shells. Groups II (BU 4075 and 5055) have a secondarily high ratio of bivalve shell weight, but are preceded by the *Viviparus sp.* weight ratio. BU 4075 is dated to Episode II, and BU 5055 is dated to the Middle Archaic/Episode I. Increased presences of bivalve shells in shell-filled pits are associated with earlier temporal periods (Randall, personal communications, 2024). However, bivalves can appear in the record to indicate a seasonal transition of resources or a potential feasting event.

Group 3 is primarily composed of *Viviparus sp.* material, with a secondary majority ratio of faunal material. This group is composed of features that date to Episode II. The increased vertebrate fauna presence in ¼” material might indicate intentional depositing of shell-filled material in certain patterns.

Groups 4 and 5 are mainly composed of *Viviparus sp.* material at a ratio of 75% in terms of weight. Group 4 has a slightly higher ratio of *Viviparus sp.* material by weight, while Group 5 has a high ratio of *Viviparus sp.* material but a slight presence of bivalve (~11%) (Table 8-4).

These groups are composed of multiple features and varying temporal periods. These groups are notably the most diverse in chronology while maintaining a similar ¼" species ratio composition.

Table 8-13. Kruskal-Wallis Test of Group 4 and 5 *Viviparus sp.* Measurements

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The distribution of Full_Height is the same across categories of Bag_Number.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.
2	The distribution of Full_Diameter is the same across categories of Bag_Number.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

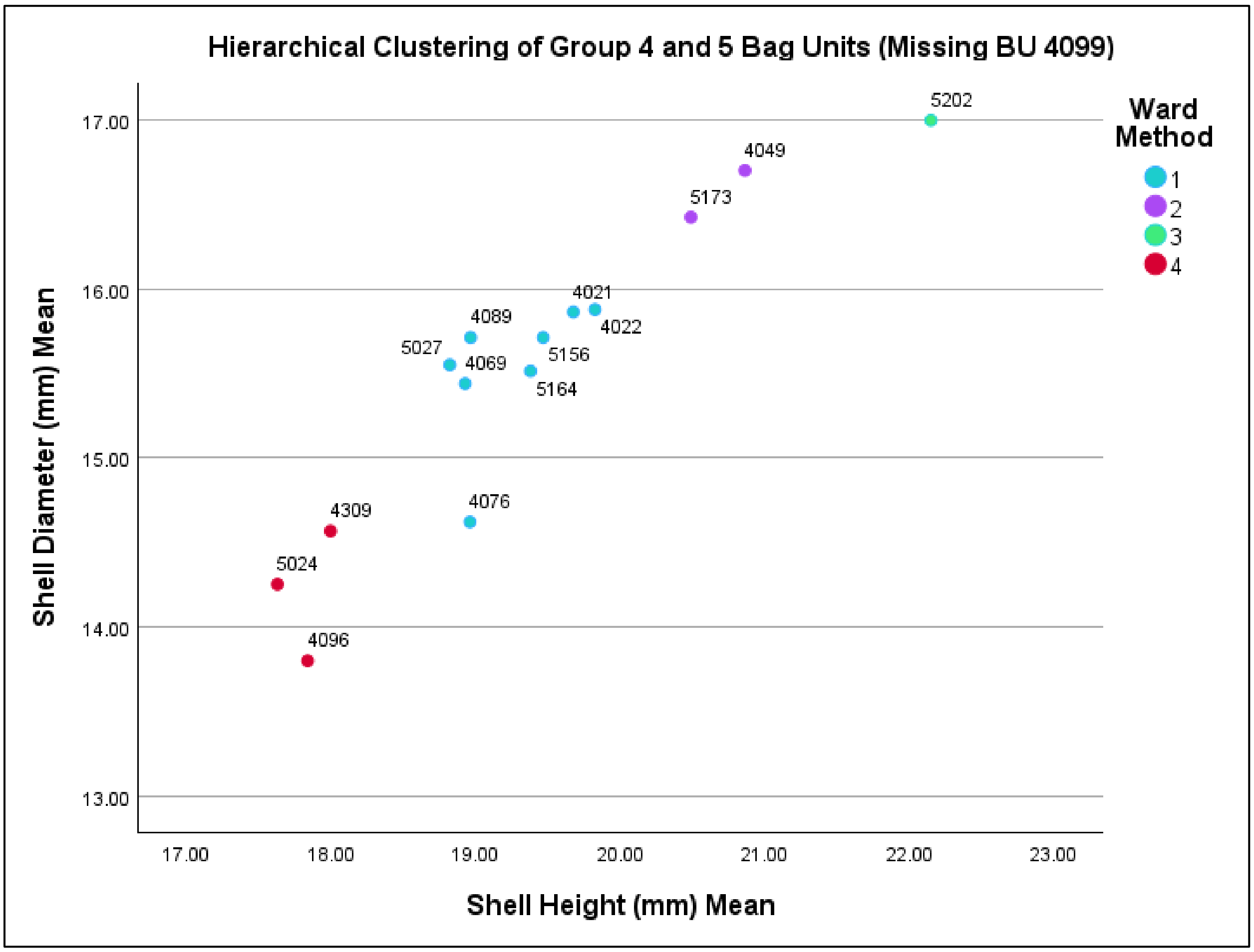


Figure 8- 23. Group 4 and 5 Subsets based on the Average Measurements of *Viviparus sp.* Shell

Table 8-14: Group 4 and 5 Subsets and their Associated Chronology

Group	Bag Units	Feature	Test Unit	Recovery Method	Dating	Subset
4	4099	146	70	⅛" Water Screen	Episode I	N/A
5	4076	142	72	⅛" Water Screen	early Middle Archaic	1
5	4069	142	72	⅛" Water Screen	early Middle Archaic	1
5	5027	201	96	Flotation	early Middle Archaic	1
5	4021	127	71	⅛" Water Screen	Episode II	1
5	5156	215	103	⅛" Water Screen	Episode II	1
4	5164	216	103	Flotation	Episode II	1
5	4022	127	71	Flotation	Episode II	1
5	4089	146	70	Flotation	Episode I/Episode II	1
5	4049	141	72	Flotation	Episode II	2
5	5173	215	103	Flotation	Episode II	2
4	5202	212	100	Flotation	Episode II	3
4	4309	148	73	Flotation	Episode II	4
5	4096	146	70	Flotation	Episode I	4
4	5024	201	96	Flotation	early Middle Archaic	4

Based on the collected data and research, the act of creating shell pits may be interpreted as possibly breaching spiritual barriers between the living and the dead (ancestors and the current generation). As discussed earlier, the Mt. Taylor period faced environmental changes to the landscape that affected traditional ways of life. The patterns seen in the shell deposition can be observed as patterns of cultural change over time. While there are cultural changes, there are consistent patterns within the depositions. Notably, there is a limited variation in the shell species deposited into the features. It was identified that a variety of vertebrate faunal material was present at Silver Glen Springs; the abundance of *Viviparus sp.* as the main component of the shell sites suggests a dietary reliance on this species. However, the method by which the Silver Glen Springs community collected and processed the gastropods is unknown. While the pit deposits have evidence of burning, the analyzed material from the ¼" screen does not have obvious evidence of thermal alterations (Table 5-3). These thermal alterations could have been missed due to the similarities of calcification (Milano et al. 2016).

The thesis argues that cultural practices would be replicated over time to reinforce cultural identity over multiple generations, strengthening a community's and individual identities. The analyzed material revealed statistically significant differences between the excavated features and their internal composition. On a broad scale, the overall size of the material and its components remained consistent. However, the more detailed variations associated with time delineate the features and their associated cultural phases. Bivalves are heavily associated with earlier cultural phases, with the mixed signs of Feature 141 (Episode II) and 149 (Episode II) affecting the interpretation of depositions. The dating of these features could support my argument regarding the replication of past cultural practices to solidify concurrent and future identities.

Additionally, the increasing size of *Viviparus sp.* shells at the shell sites over time suggests a shift in the selection and processing of the species. This also includes the variation in shell species outside of *Viviparus sp.* and bivalves (Table 8-4). Not only was the size of the *Viviparus sp.* changing, but so was the significance of vertebrate fauna in the archeological record. Later cultural periods in Silver Glen Springs may have shifted their focus from aquatic resources to more terrestrial resources.

Conclusion

The data analyzed for this thesis identified some patterns in the depositional deposits of Silver Glen Springs Locus A. Using the data recovered from flotation, there is a preference for ¼" sized material, followed by either >⅛" material or <2mm material. The recovery method used when collecting material from the shell deposits correlates with retaining material at a higher frequency. This is reflected in the more frequent occurrence of bivalve shells in the material recovered through flotation and the retention of vertebrate fauna material through non-flotation methods.

The measurements collected from the *Viviparus sp.* shells maintain the pattern that the shells collected before and during the Mt. Taylor period are smaller than those collected after the Mt. Taylor period. This trend in shell size also reflects limited connections with the cultural periods found on the St. Johns River (Table 8-3). Further analysis of the shell-filled material from the pits would reveal patterns in the intentional depositional patterns of the Mt. Taylor culture and their relationships. The overall characteristics of the shell-filled pits are consistent, but the materials reflect a distinctive identity associated with cultural phases.

Chapter Nine: Conclusion

This thesis analyzed the excavated material from Silver Glen Springs – Locus A (8LA1W-Locus A). I hypothesized that the characteristics of the shell-filled pits are similar at a broader level but exhibit distinctive characteristics at a more detailed level, associated with different cultural phases. The contents of the shell-filled pits contribute to understanding two lines of inquiry. One aspect is the insight into the selection and processing of mollusks during the occupation of Silver Glen Springs, and how this selection process changed over time. The other aspect of the study is the overall implication of shell-filled pits and their role in cultural transmission through social memory, as well as the reinforcement of cultural identity through the terraforming of the local landscape through place-making. The deposits are records that reflect intentional cultural continuance practices in the landscape. First, I will explain how the information from Chapters 7 and 8 contributes to the inquiries asked in this thesis. Then, I will elaborate on the more theoretical aspects of my argument. I will conclude this thesis by discussing the future research directions for the Silver Glen Springs Complex.

The information gathered in Chapter 7 is descriptive, presenting data by individual features and focusing on the bag units that comprise those features. By identifying statistical similarities and differences between bag units in a feature, information is revealed about the different strata of the feature. These differences in strata are noted in the field notes and are supported statistically with the bag unit analysis. An example of this difference in strata is Feature 141 and its four levels (Randall 2024). I argue that the differences in strata composition are intentional physical alterations to the subterranean landscape that reinforce the engagement between people and their actions of place-making. In addition, the different mollusk compositions reflect subsistence practices by the hunter-gatherers during the utilization of Locus A.

Mollusk shells are multifunctional in the archeological record; they reveal information about the foodways of a community and act as construction material to form habitation areas. The size and species of mollusks, when documented, can indicate when (season) or how (method) the collection of subsistence occurred. The different strata and their distinctive layers of mollusk shells could indicate temporal breaks between the deposits (Randall 2013:207). Some of these breaks could represent short, intermittent breaks or revitalizing breaks spanning multiple generations. These breaks can indicate either a change due to seasonal factors or changes resulting from the consumption of different substances between the different points of deposition. Another interpretation is that the difference in deposition layers was purposeful. The pits were filled in a specific manner with different layers of mollusk species. The intent behind the layering could be connected to moments of feasting, ritualization, and/or replication of past deposits. With the numerous shell-filled pits found at Locus A, the filling of these pits could represent a shared cultural practice that reinforces traditions within the community, as addressed by Gilmore (2015).

The statistical analysis in Chapter 8 examines the features in relation to one another. The chapter examined three levels of analysis based on the materials collected from the features. One level examined the statistical distribution of the material sizes, with the features mainly composed of ¼" material. The second level analyzed the varying species that comprised the ¼" material. This aspect contributes to understanding the subsistence practices and what factors may have influenced the species' composition. The final level of analysis is a sample set of *Viviparus sp.* shells from the ¼" material of each feature.

From these levels of inquiry, trends were identified regarding the dating of the deposits and their contents. The data support earlier research regarding the increasing size of *Viviparus sp.* shells over time in the SGSC area (Blessing 2011). The data regarding species composition reveals a limited change to the mollusk species selection at the SGSC during its occupation from the early Middle Archaic to the Orange period (Blessing 2011; Gilmore 2015). This repetition in species composition indicates an environment that could sustain the exploitation of the selected species over a substantial amount of time (Cerimele 2017). This sustained pattern of exploitation is evidence of cultural continuance via subsistence practices over multiple generations.

I reiterate that the creation and maintenance of shell sites serve multiple roles in hunter-gatherer societies. Based on the information gathered in this thesis, I argue that creating and filling the shell-filled pits is a form of intentional place-making in the landscape that ensures the continuance of social memory across multiple generations. The hidden nature of the pits indicates these facets of cultural significance. The discretion of the pits suggests that the knowledge of the pits must be passed down between different generational groups and that this knowledge plays a role in cultural continuity, solidifying the connection between a community and the land. Gilmore and Randall both suggest that the pits may have been unintentionally relocated but were then incorporated into the cultural practices as an intentional act overtime (Randall 2015; Gilmore 2015). The seasonal mobility of the Mt. Taylor period people, as indicated by the bioarcheological information from Harris Creek, may suggest a cultural need for the community to reestablish their connection to the landscape due to the pattern of seasonal mobility (Quinn et al. 2008; Randall 2015:133).

Some of the pits analyzed were dug after the shell mound at Locus A was formed. As discussed in Chapter 4, the construction of the shell-filled pits acted on multiple dimensions of significance. The pits not only affected the history and memories of the SGSC community, but it also affected the cosmological interactions of the people. The pits not only played a role in creating cultural practices to be shared between generations but also created a direct connection between the living and the spiritual world. Not only can memories be formed and preserved, but help and communication can be accessed during periods of environmental upheaval. Calling upon the aid of the past to improve the current and future conditions of the community creates an obligation between the different generations to maintain and support the cultural identity of the community (Gilmore 2015).

I summarize my earlier argument from Chapter 2, that the formation and maintenance of shell-filled pits at the Silver Glen Springs Complex (SGSC), particularly Locus A (8LA1W), served as a form of place-making that ensured the establishment of community identity in the landscape. The continued utilization and terraforming of the SGSC from the early Archaic to the Orange period represent a history of inhabitation in the landscape. The act of place-making incorporates many methods of self-determination, allowing a middle-ground to develop, where the intersection between cosmology, spiritualism, and the physical realm can occur. The continued modifications to the landscape by digging previous pits and forming new pits extends the role of pits from refuse to social activities that impact the past, present, and future.

Through the shell-filled pits scattered throughout Locus A, researchers can gain insight into the social practices that reinforce a community's identity and how that information is passed to different generations. The cultural history of a community is embedded in the landscape through multiple means of alteration and maintenance indicative of place-making. The landscape embodies not only the physically visible components of the environment but also the meta-physical aspects of the environment and the connection between the living and spiritual world

(Harjo 2019:17). By considering the non-corporeal effects of human action during the Archaic period, there is an increase in the understanding of cultural transmission.

The results presented in this thesis contribute to the growing body of knowledge regarding shell sites at the Silver Glen Springs Complex and their roles in Archaic society. The information gathered in this thesis supports the discussion that shell-filled pits have a greater role than utilitarian domestic use. My results identify distinctive traits within the contents of the shell-filled pits and how they correlate with cultural phases and events during the Archaic period. While this thesis could not clearly define the subsistence methods used to harvest the mollusk, I contributed information to the selection and the processing of the shells within the shell-filled pits. Overall, the shell material found at Silver Glen Springs is an intrinsic component to understanding the history of the Mt. Taylor community.

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Appendix

Table 8-1A

Processed Weight Data

Bag #	4021	4022	4049	4050	4069	4089	4099	4306	5156	5162	5163	5164	5173	5202
Unit	71	71	72	72	72	70	70	71	103	103	103	103	103	100
Feature	127	127	141	141	142	146	146	149	215	216	216	216	215	212
Recovery	⅛" Water Screen	FLOT	FLOT	FLOT	1/8" H2O	FLOT	1/8" H2O	FLOT	1/8" H2O	1/8" H2O	FLOT	1/8" H2O	FLOT	FLOT
Total	867.01	2433.2	2832.8	3037.2	420.7	2362.6	3062.9	2438.7	1846.80	442.39	522.5	323.80	4506.9	3094.10
1/4"	867.01	1667.5	1265.9	1511.7	403	991.1	1619.3	1676.20	1438	208.39	240.1	185.50	2463.9	2087
<1/8"	0	284.00	575.5	867	9.4	444	338.5	69.5	207	50.70	69.5	76.30	325	47.5
>1/8"	0	129.60	285	355	3	379.5	188.5	173	524.5	16.90	40.0	6.90	176	5.8
<2 mm	0	202.10	406.5	101.5	0.7	514	102.1	131	113	9.90	61.4	13.80	199.5	20.3
> 2mm	0	150.00	295.5	202	4.2	32.5	814.5	389	301	156.50	109.9	41.30	1342.5	434.9

Processed Volume Data

Bag #	4021	4022	4049	4050	4069	4089	4099	4306	5156	5162	5163	5164	5173	5202
Total	1.789	6.095	4.507	5.441	1.265	4.315	6	6.474	4.258	0.827	0.63	0.663	8.274	5.9235
1/4"	1.789	5.15	2.757	3.241	1.25	2.555	4.55	5.389	3.8	0.622	0.55	0.563	6.389	5.415
<1/8"	0	0.49	0.85	1.125	0.01	0.75	0.5	0.05	0.375	0.1	0.06	0.025	0.6	0.1
>1/8"	0	0.15	0.3	0.375	0.001	0.5	0.25	0.2	0.35	0.02	0.01	0.005	0.2	0.015
<2 mm	0	0.2	0.375	0.4	0.001	0.51	0.1	0.21	0.15	0.01	0.01	0.01	0.21	0.025
> 2mm	0	0.105	0.225	0.3	0.003	0	0.6	0.625	0.35	0.075	0.03	0.06	0.875	0.3

Processed Weight Data Ratios

Bag lot	4021	4022	4049	4050	4069	4089	4099	4306	5156	5162	5163	5164	5173	5202
Total	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1/4"	1	68.53	44.69	49.77	95.79	41.95	52.87	68.73	77.86	47.11	46	57.29	54.67	67.45
<1/8"	0	11.67	20.32	28.55	2.23	18.79	11.05	2.85	11.21	11.46	13	23.56	7.21	1.54
>1/8"	0	5.33	10.06	11.69	0.71	16.06	6.15	7.09	28.40	3.82	8	2.13	3.91	0.19
<2 mm	0	8.31	14.35	3.34	0.17	21.76	3.33	5.37	6.12	2.24	12	4.26	4.43	0.66
> 2mm	0	6.16	10.43	6.65	1.00	1.38	26.59	15.95	16.30	35.38	21	12.75	29.79	14.06

Processed Volume Data Ratios

Bag Lot	4021	4022	4049	4050	4069	4089	4099	4306	5156	5162	5163	5164	5173	5202
Total	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1/4"	1	84.50	61.17	59.57	98.81	59.21	75.83	83.24	89.24	75.21	91	84.92	77.22	91.42
<1/8"	0	8.04	18.86	20.68	0.79	17.38	8.33	0.77	8.81	12.09	18	3.77	7.25	1.69
>1/8"	0	2.46	6.66	6.89	0.08	11.59	4.17	3.09	8.22	2.42	6	0.75	2.42	0.25
<2 mm	0	3.28	8.32	7.35	0.08	11.82	1.67	3.24	3.52	1.21	6	1.51	2.54	0.42
> 2mm	0	1.72	4.99	5.51	0.24	0.00	10.00	9.65	8.22	9.07	8	9.05	10.58	5.06

Appendix: 8-1B

Flotated Material : Size Grade Comparison

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The distribution of Weight is the same across categories of Size_Grade.	Independent-Samples Kruskal-Wallis Test	.004	Reject the null hypothesis.
2	The distribution of Volume is the same across categories of Size_Grade.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Weight Across Size Grade

Independent-Samples Kruskal-Wallis Test Summary

Total N	40
Test Statistic	15.607[a]
Degree Of Freedom	4
Asymptotic Sig.(2-sided test)	.004

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Size_Grade

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
>1/8"-<2 mm	.625	5.845	.107	.915	1.000
>1/8"-> 2mm	4.875	5.845	.834	.404	1.000
>1/8"-<1/8"	5.000	5.845	.855	.392	1.000
>1/8"-1/4"	20.125	5.845	3.443	<.001	.006
<2 mm-> 2mm	-4.250	5.845	-.727	.467	1.000
<2 mm-<1/8"	4.375	5.845	.749	.454	1.000
<2 mm-1/4"	19.500	5.845	3.336	<.001	.008
> 2mm-<1/8"	.125	5.845	.021	.983	1.000
> 2mm-1/4"	15.250	5.845	2.609	.009	.091
<1/8"-1/4"	15.125	5.845	2.588	.010	.097

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Volume Across Size Grade

Independent-Samples Kruskal-Wallis Test Summary

Total N	40
Test Statistic	19.500[a]
Degree Of Freedom	4
Asymptotic Sig.(2-sided test)	<.001

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Size_Grade

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
>1/8"-<2 mm	1.688	5.841	.289	.773	1.000
>1/8"-> 2mm	2.875	5.841	.492	.623	1.000
>1/8"-<1/8"	7.375	5.841	1.263	.207	1.000
>1/8"-1/4"	22.438	5.841	3.841	<.001	.001
<2 mm-> 2mm	-1.188	5.841	-.203	.839	1.000
<2 mm-<1/8"	5.688	5.841	.974	.330	1.000
<2 mm-1/4"	20.750	5.841	3.553	<.001	.004
> 2mm-<1/8"	4.500	5.841	.770	.441	1.000
> 2mm-1/4"	19.563	5.841	3.349	<.001	.008
<1/8"-1/4"	15.063	5.841	2.579	.010	.099

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Floated Material: Feature Comparison

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The distribution of Weight is the same across categories of Feature.	Independent-Samples Kruskal-Wallis Test	.244	Retain the null hypothesis.
2	The distribution of Volume is the same across categories of Feature.	Independent-Samples Kruskal-Wallis Test	.355	Retain the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Weight Across Feature

Independent-Samples Kruskal-Wallis Test Summary

Total N	40
Test Statistic	9.125[a]
Degree Of Freedom	7
Asymptotic Sig.(2-sided test)	.244

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Feature

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
5163-5202	-5.700	7.393	-.771	.441	1.000
5163- 4306	10.200	7.393	1.380	.168	1.000
5163- 4022	10.500	7.393	1.420	.156	1.000
5163- 4050	14.300	7.393	1.934	.053	1.000
5163- 4089	14.700	7.393	1.988	.047	1.000
5163- 5173	-16.500	7.393	-2.232	.026	.718
5163- 4049	17.700	7.393	2.394	.017	.467
5202- 4306	4.500	7.393	.609	.543	1.000
5202- 4022	4.800	7.393	.649	.516	1.000
5202- 4050	8.600	7.393	1.163	.245	1.000
5202- 4089	9.000	7.393	1.217	.223	1.000
5202- 5173	10.800	7.393	1.461	.144	1.000
5202- 4049	12.000	7.393	1.623	.105	1.000
4306- 4022	.300	7.393	.041	.968	1.000
4306- 4050	4.100	7.393	.555	.579	1.000
4306- 4089	4.500	7.393	.609	.543	1.000
4306- 5173	-6.300	7.393	-.852	.394	1.000
4306- 4049	7.500	7.393	1.014	.310	1.000
4022- 4050	-3.800	7.393	-.514	.607	1.000
4022- 4089	-4.200	7.393	-.568	.570	1.000
4022- 5173	-6.000	7.393	-.812	.417	1.000
4022- 4049	-7.200	7.393	-.974	.330	1.000
4050- 4089	-.400	7.393	-.054	.957	1.000
4050- 5173	-2.200	7.393	-.298	.766	1.000
4050- 4049	3.400	7.393	.460	.646	1.000
4089- 5173	-1.800	7.393	-.243	.808	1.000
4089- 4049	3.000	7.393	.406	.685	1.000
5173- 4049	1.200	7.393	.162	.871	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Volume Across Features

Independent-Samples Kruskal-Wallis Test Summary	
Total N	40
Test Statistic	7.749[a]
Degree Of Freedom	7
Asymptotic Sig.(2-sided test)	.355

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Feature

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
5163-5202	-2.800	7.388	-.379	.705	1.000
5163- 4022	7.300	7.388	.988	.323	1.000
5163- 4306	8.500	7.388	1.150	.250	1.000
5163- 4089	11.700	7.388	1.584	.113	1.000
5163- 4049	13.300	7.388	1.800	.072	1.000
5163- 5173	-14.100	7.388	-1.908	.056	1.000
5163- 4050	15.100	7.388	2.044	.041	1.000
5202- 4022	4.500	7.388	.609	.542	1.000
5202- 4306	5.700	7.388	.772	.440	1.000
5202- 4089	8.900	7.388	1.205	.228	1.000
5202- 4049	10.500	7.388	1.421	.155	1.000
5202- 5173	11.300	7.388	1.529	.126	1.000
5202- 4050	12.300	7.388	1.665	.096	1.000
4022- 4306	-1.200	7.388	-.162	.871	1.000
4022- 4089	-4.400	7.388	-.596	.551	1.000
4022- 4049	-6.000	7.388	-.812	.417	1.000
4022- 5173	-6.800	7.388	-.920	.357	1.000
4022- 4050	-7.800	7.388	-1.056	.291	1.000
4306- 4089	3.200	7.388	.433	.665	1.000
4306- 4049	4.800	7.388	.650	.516	1.000
4306- 5173	-5.600	7.388	-.758	.448	1.000
4306- 4050	6.600	7.388	.893	.372	1.000
4089- 4049	1.600	7.388	.217	.829	1.000
4089- 5173	-2.400	7.388	-.325	.745	1.000
4089- 4050	3.400	7.388	.460	.645	1.000
4049- 5173	-.800	7.388	-.108	.914	1.000
4049- 4050	-1.800	7.388	-.244	.808	1.000
5173- 4050	1.000	7.388	.135	.892	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Appendix 8-1C

Non-Floated Material

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The distribution of Weight is the same across categories of Feature.	Independent-Samples Kruskal-Wallis Test	.016	Reject the null hypothesis.
2	The distribution of Volume is the same across categories of Feature.	Independent-Samples Kruskal-Wallis Test	.056	Retain the null hypothesis.

a. The significance level is .050.
b. Asymptotic significance is displayed.

Weight Across Feature

Independent-Samples Kruskal-Wallis Test Summary

Total N	30
Test Statistic	13.934[a]
Degree Of Freedom	5
Asymptotic Sig.(2-sided test)	.016

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Feature

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
4021.00-4069.00	-2.800	5.562	-.503	.615	1.000
4021.00-5164.00	-5.600	5.562	-1.007	.314	1.000
4021.00-5162.00	-7.600	5.562	-1.367	.172	1.000
4021.00-5156.00	-15.600	5.562	-2.805	.005	.075
4021.00-4099.00	-15.800	5.562	-2.841	.004	.067
4069.00-5164.00	-2.800	5.562	-.503	.615	1.000
4069.00-5162.00	-4.800	5.562	-.863	.388	1.000
4069.00-5156.00	-12.800	5.562	-2.302	.021	.320
4069.00-4099.00	-13.000	5.562	-2.337	.019	.291
5164.00-5162.00	2.000	5.562	.360	.719	1.000
5164.00-5156.00	10.000	5.562	1.798	.072	1.000
5164.00-4099.00	10.200	5.562	1.834	.067	1.000
5162.00-5156.00	8.000	5.562	1.438	.150	1.000
5162.00-4099.00	8.200	5.562	1.474	.140	1.000
5156.00-4099.00	.200	5.562	.036	.971	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.
a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Volume Across Feature

Independent-Samples Kruskal-Wallis Test Summary

Total N	30
Test Statistic	10.789[a]
Degree Of Freedom	5
Asymptotic Sig.(2-sided test)	.056

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Feature

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
4021.00-4069.00	-3.400	5.556	-.612	.541	1.000
4021.00-5162.00	-6.100	5.556	-1.098	.272	1.000
4021.00-5164.00	-9.700	5.556	-1.746	.081	1.000
4021.00-5156.00	-13.600	5.556	-2.448	.014	.216
4021.00-4099.00	-14.600	5.556	-2.628	.009	.129
4069.00-5162.00	-2.700	5.556	-.486	.627	1.000
4069.00-5164.00	-6.300	5.556	-1.134	.257	1.000
4069.00-5156.00	-10.200	5.556	-1.836	.066	.996
4069.00-4099.00	-11.200	5.556	-2.016	.044	.657
5162.00-5164.00	-3.600	5.556	-.648	.517	1.000
5162.00-5156.00	7.500	5.556	1.350	.177	1.000
5162.00-4099.00	8.500	5.556	1.530	.126	1.000
5164.00-5156.00	3.900	5.556	.702	.483	1.000
5164.00-4099.00	4.900	5.556	.882	.378	1.000
5156.00-4099.00	1.000	5.556	.180	.857	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig.[a, b]	Decision
1	The distribution of Weight is the same across categories of Size_Grade.	Independent-Samples Kruskal-Wallis Test	.029	Reject the null hypothesis.
2	The distribution of Volume is the same across categories of Size_Grade.	Independent-Samples Kruskal-Wallis Test	.005	Reject the null hypothesis.

a. The significance level is .050.
b. Asymptotic significance is displayed.

Weight Across Size Grade

Independent-Samples Kruskal-Wallis Test Summary	
Total N	30
Test Statistic	10.770[a]
Degree Of Freedom	4
Asymptotic Sig.(2-sided test)	.029

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Size_Grade

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
<2 mm->1/8"	-2.167	5.077	-.427	.670	1.000
<2 mm-<1/8"	4.000	5.077	.788	.431	1.000
<2 mm-> 2mm	-4.833	5.077	-.952	.341	1.000
<2 mm-1/4"	15.250	5.077	3.004	.003	.027
>1/8"-<1/8"	1.833	5.077	.361	.718	1.000
>1/8"-> 2mm	2.667	5.077	.525	.599	1.000
>1/8"-1/4"	13.083	5.077	2.577	.010	.100
<1/8"-> 2mm	-.833	5.077	-.164	.870	1.000
<1/8"-1/4"	11.250	5.077	2.216	.027	.267
> 2mm-1/4"	10.417	5.077	2.052	.040	.402

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Volume Across Size Grase

Independent-Samples Kruskal-Wallis Test Summary	
Total N	30
Test Statistic	14.741[a]
Degree Of Freedom	4
Asymptotic Sig.(2-sided test)	.005

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Size_Grade

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
<2 mm->1/8"	-.833	5.072	-.164	.869	1.000
<2 mm-> 2mm	-3.667	5.072	-.723	.470	1.000
<2 mm-<1/8"	5.083	5.072	1.002	.316	1.000
<2 mm-1/4"	17.083	5.072	3.368	<.001	.008
>1/8"-> 2mm	2.833	5.072	.559	.576	1.000
>1/8"-<1/8"	4.250	5.072	.838	.402	1.000
>1/8"-1/4"	16.250	5.072	3.204	.001	.014
> 2mm-<1/8"	1.417	5.072	.279	.780	1.000
> 2mm-1/4"	13.417	5.072	2.645	.008	.082
<1/8"-1/4"	12.000	5.072	2.366	.018	.180

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Appendix 8-2A

¼" Screened Material Species Ratios

Bag #	*Vivaparus*	Apple Snail	Mesa Ram's Horn	Bivalve	*Elimia*	Vert.fauna	Terrestrial Snails
4021	0.68	0.10	0.02	0.15	0.03	0.02	0.00
4022	0.79	0.08	0.01	0.09	0.03	0.00	0.00
4049	0.73	0.05	0.01	0.18	0.01	0.01	0.00
4050	0.16	0.11	0.00	0.71	0.01	0.01	0.00
4069	0.72	0.08	0.03	0.11	0.01	0.03	0.01
4089	0.79	0.07	0.07	0.05	0.02	0.00	0.00
4099	0.87	0.05	0.04	0.03	0.01	0.00	0.00
4306	0.19	0.11	0.00	0.69	0.00	0.01	0.00
5156	0.78	0.12	0.01	0.07	0.01	0.01	0.00
5162	0.76	0.00	0.01	0.01	0.00	0.22	0.00
5163	0.61	0.091	0.00	0.058	0.01	0.228	0.00
5164	0.85	0.06	0.01	0.03	0.01	0.03	0.00
5173	0.74	0.18	0.01	0.06	0.01	0.00	0.00
5202	0.96	0.01	0.01	0.01	0.01	0.00	0.00

Appendix 8-2B

Clustering

Case Processing Summary[a,b]					
Cases					
Valid		Missing		Total	
N	Percent	N	Percent	N	Percent
22	14.3	132	85.7	154	100.0

a. Squared Euclidean Distance used
b. Ward Linkage

Ward Linkage

Agglomeration Schedule

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	4	13	.000	0	0	21
2	3	7	.001	0	0	11
3	9	12	.002	0	0	5
4	2	10	.003	0	0	6
5	9	22	.005	3	0	12
6	2	8	.007	4	0	15
7	1	5	.009	0	0	13
8	11	20	.011	0	0	16
9	18	19	.013	0	0	15
10	6	16	.017	0	0	20
11	3	15	.020	2	0	13
12	9	14	.025	5	0	14
13	1	3	.033	7	11	17
14	9	17	.043	12	0	18
15	2	18	.054	6	9	17
16	11	21	.076	8	0	19
17	1	2	.110	13	15	18
18	1	9	.193	17	14	19
19	1	11	.305	18	16	20
20	1	6	.461	19	10	21
21	1	4	1.745	20	1	0

Appendix 8-3

Independent-Samples Kruskal-Wallis Test

Full_Height across Feature

Independent-Samples Kruskal-Wallis Test Summary	
Total N	1287
Test Statistic	108.976[a]
Degree Of Freedom	7
Asymptotic Sig.(2-sided test)	<.001

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Feature

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
142.00-146.00	-16.378	45.520	-.360	.719	1.000
142.00-216.00	-78.311	46.044	-1.701	.089	1.000
142.00-127.00	109.223	45.520	2.399	.016	.460
142.00-215.00	-143.828	45.520	-3.160	.002	.044
142.00-149.00	-183.270	52.562	-3.487	<.001	.014
142.00-141.00	276.870	45.520	6.082	<.001	.000
142.00-212.00	-368.040	52.562	-7.002	<.001	.000
146.00-216.00	-61.933	37.807	-1.638	.101	1.000
146.00-127.00	92.845	37.167	2.498	.012	.350
146.00-215.00	-127.450	37.167	-3.429	<.001	.017
146.00-149.00	-166.893	45.520	-3.666	<.001	.007
146.00-141.00	260.493	37.167	7.009	<.001	.000
146.00-212.00	-351.663	45.520	-7.725	<.001	.000
216.00-127.00	30.912	37.807	.818	.414	1.000
216.00-215.00	65.517	37.807	1.733	.083	1.000
216.00-149.00	104.959	46.044	2.280	.023	.634
216.00-141.00	198.559	37.807	5.252	<.001	.000
216.00-212.00	289.729	46.044	6.292	<.001	.000
127.00-215.00	-34.605	37.167	-.931	.352	1.000
127.00-149.00	-74.048	45.520	-1.627	.104	1.000
127.00-141.00	-167.648	37.167	-4.511	<.001	.000
127.00-212.00	-258.818	45.520	-5.686	<.001	.000
215.00-149.00	39.443	45.520	.866	.386	1.000
215.00-141.00	133.043	37.167	3.580	<.001	.010
215.00-212.00	224.213	45.520	4.926	<.001	.000
149.00-141.00	93.600	45.520	2.056	.040	1.000
149.00-212.00	-184.770	52.562	-3.515	<.001	.012
141.00-212.00	-91.170	45.520	-2.003	.045	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.
a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Full_Diameter across Feature

Independent-Samples Kruskal-Wallis Test Summary	
Total N	1287
Test Statistic	86.360[a]
Degree Of Freedom	7
Asymptotic Sig.(2-sided test)	<.001
a. The test statistic is adjusted for ties.	

Pairwise Comparisons of Feature					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
146.00-142.00	19.450	45.520	.427	.669	1.000
146.00-216.00	-26.690	37.807	-.706	.480	1.000
146.00-127.00	103.460	37.167	2.784	.005	.150
146.00-215.00	-146.503	37.167	-3.942	<.001	.002
146.00-149.00	-153.210	45.520	-3.366	<.001	.021
146.00-141.00	255.298	37.167	6.869	<.001	.000
146.00-212.00	-276.625	45.520	-6.077	<.001	.000
142.00-216.00	-7.240	46.044	-.157	.875	1.000
142.00-127.00	84.010	45.520	1.846	.065	1.000
142.00-215.00	-127.053	45.520	-2.791	.005	.147
142.00-149.00	-133.760	52.562	-2.545	.011	.306
142.00-141.00	235.848	45.520	5.181	<.001	.000
142.00-212.00	-257.175	52.562	-4.893	<.001	.000
216.00-127.00	76.770	37.807	2.031	.042	1.000
216.00-215.00	119.812	37.807	3.169	.002	.043
216.00-149.00	126.520	46.044	2.748	.006	.168
216.00-141.00	228.607	37.807	6.047	<.001	.000
216.00-212.00	249.935	46.044	5.428	<.001	.000
127.00-215.00	-43.043	37.167	-1.158	.247	1.000
127.00-149.00	-49.750	45.520	-1.093	.274	1.000
127.00-141.00	-151.838	37.167	-4.085	<.001	.001
127.00-212.00	-173.165	45.520	-3.804	<.001	.004
215.00-149.00	6.707	45.520	.147	.883	1.000
215.00-141.00	108.795	37.167	2.927	.003	.096
215.00-212.00	130.123	45.520	2.859	.004	.119
149.00-141.00	102.088	45.520	2.243	.025	.698
149.00-212.00	-123.415	52.562	-2.348	.019	.528
141.00-212.00	-21.328	45.520	-.469	.639	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.
a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Ap_Length across Feature

Independent-Samples Kruskal-Wallis Test Summary	
Total N	1287
Test Statistic	95.395[a]
Degree Of Freedom	7
Asymptotic Sig.(2-sided test)	<.001

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Feature					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
146.00-142.00	5.050	45.520	.111	.912	1.000
146.00-216.00	-82.063	37.807	-2.171	.030	.839
146.00-127.00	116.128	37.167	3.124	.002	.050
146.00-215.00	-145.243	37.167	-3.908	<.001	.003
146.00-149.00	-191.790	45.520	-4.213	<.001	.001
146.00-141.00	270.165	37.167	7.269	<.001	.000
146.00-212.00	-315.330	45.520	-6.927	<.001	.000
142.00-216.00	-77.013	46.044	-1.673	.094	1.000
142.00-127.00	111.078	45.520	2.440	.015	.411
142.00-215.00	-140.193	45.520	-3.080	.002	.058
142.00-149.00	-186.740	52.562	-3.553	<.001	.011
142.00-141.00	265.115	45.520	5.824	<.001	.000
142.00-212.00	-310.280	52.562	-5.903	<.001	.000
216.00-127.00	34.064	37.807	.901	.368	1.000
216.00-215.00	63.179	37.807	1.671	.095	1.000
216.00-149.00	109.727	46.044	2.383	.017	.481
216.00-141.00	188.102	37.807	4.975	<.001	.000
216.00-212.00	233.267	46.044	5.066	<.001	.000
127.00-215.00	-29.115	37.167	-.783	.433	1.000
127.00-149.00	-75.663	45.520	-1.662	.096	1.000
127.00-141.00	-154.038	37.167	-4.144	<.001	.001
127.00-212.00	-199.203	45.520	-4.376	<.001	.000
215.00-149.00	46.548	45.520	1.023	.307	1.000
215.00-141.00	124.923	37.167	3.361	<.001	.022
215.00-212.00	170.088	45.520	3.737	<.001	.005
149.00-141.00	78.375	45.520	1.722	.085	1.000
149.00-212.00	-123.540	52.562	-2.350	.019	.525
141.00-212.00	-45.165	45.520	-.992	.321	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.
a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Ap_Diameter across Feature

Independent-Samples Kruskal-Wallis Test Summary	
Total N	1287
Test Statistic	89.863[a]
Degree Of Freedom	7
Asymptotic Sig.(2-sided test)	<.001

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Feature

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
142.00-146.00	-18.988	45.520	-.417	.677	1.000
142.00-127.00	97.100	45.520	2.133	.033	.922
142.00-216.00	-109.944	46.044	-2.388	.017	.475
142.00-215.00	-172.630	45.520	-3.792	<.001	.004
142.00-149.00	-197.390	52.562	-3.755	<.001	.005
142.00-141.00	256.993	45.520	5.646	<.001	.000
142.00-212.00	-332.685	52.562	-6.329	<.001	.000
146.00-127.00	78.113	37.167	2.102	.036	.996
146.00-216.00	-90.956	37.807	-2.406	.016	.452
146.00-215.00	-153.643	37.167	-4.134	<.001	.001
146.00-149.00	-178.403	45.520	-3.919	<.001	.002
146.00-141.00	238.005	37.167	6.404	<.001	.000
146.00-212.00	-313.698	45.520	-6.891	<.001	.000
127.00-216.00	-12.844	37.807	-.340	.734	1.000
127.00-215.00	-75.530	37.167	-2.032	.042	1.000
127.00-149.00	-100.290	45.520	-2.203	.028	.772
127.00-141.00	-159.893	37.167	-4.302	<.001	.000
127.00-212.00	-235.585	45.520	-5.175	<.001	.000
216.00-215.00	62.686	37.807	1.658	.097	1.000
216.00-149.00	87.446	46.044	1.899	.058	1.000
216.00-141.00	147.049	37.807	3.889	<.001	.003
216.00-212.00	222.741	46.044	4.838	<.001	.000
215.00-149.00	24.760	45.520	.544	.586	1.000
215.00-141.00	84.363	37.167	2.270	.023	.650
215.00-212.00	160.055	45.520	3.516	<.001	.012
149.00-141.00	59.603	45.520	1.309	.190	1.000
149.00-212.00	-135.295	52.562	-2.574	.010	.281
141.00-212.00	-75.693	45.520	-1.663	.096	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.
a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Shell_Weight across Feature

Independent-Samples Kruskal-Wallis Test Summary	
Total N	1287
Test Statistic	191.675[a]
Degree Of Freedom	7
Asymptotic Sig.(2-sided test)	<.001

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Feature					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
142.00-216.00	-41.483	46.043	-.901	.368	1.000
142.00-146.00	-61.258	45.518	-1.346	.178	1.000
142.00-215.00	-216.430	45.518	-4.755	<.001	.000
142.00-127.00	233.430	45.518	5.128	<.001	.000
142.00-149.00	-288.705	52.560	-5.493	<.001	.000
142.00-141.00	400.810	45.518	8.805	<.001	.000
142.00-212.00	-419.260	52.560	-7.977	<.001	.000
216.00-146.00	19.775	37.806	.523	.601	1.000
216.00-215.00	174.947	37.806	4.627	<.001	.000
216.00-127.00	191.947	37.806	5.077	<.001	.000
216.00-149.00	247.222	46.043	5.369	<.001	.000
216.00-141.00	359.327	37.806	9.504	<.001	.000
216.00-212.00	377.777	46.043	8.205	<.001	.000
146.00-215.00	-155.173	37.166	-4.175	<.001	.001
146.00-127.00	172.173	37.166	4.633	<.001	.000
146.00-149.00	-227.448	45.518	-4.997	<.001	.000
146.00-141.00	339.553	37.166	9.136	<.001	.000
146.00-212.00	-358.003	45.518	-7.865	<.001	.000
215.00-127.00	17.000	37.166	.457	.647	1.000
215.00-149.00	72.275	45.518	1.588	.112	1.000
215.00-141.00	184.380	37.166	4.961	<.001	.000
215.00-212.00	202.830	45.518	4.456	<.001	.000
127.00-149.00	-55.275	45.518	-1.214	.225	1.000
127.00-141.00	-167.380	37.166	-4.504	<.001	.000
127.00-212.00	-185.830	45.518	-4.083	<.001	.001
149.00-141.00	112.105	45.518	2.463	.014	.386
149.00-212.00	-130.555	52.560	-2.484	.013	.364
141.00-212.00	-18.450	45.518	-.405	.685	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.
a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Appendix 8-4A

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The distribution of Shell Height (mm) is the same across categories of Cultural Period.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.
2	The distribution of Shell Width (mm) is the same across categories of Cultural Period.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.
3	The distribution of Aperature Height is the same across categories of Cultural Period.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.
4	The distribution of Aperature Width is the same across categories of Cultural Period.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.
5	The distribution of Shell Weight is the same across categories of Cultural Period.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Independent-Samples Kruskal-Wallis Test

Shell Height (mm) across Cultural Period

Independent-Samples Kruskal-Wallis Test Summary

Total N	1287
Test Statistic	46.666[a]
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	<.001

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Cultural Period

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
early Archaic-Episode I	-16.378	45.520	-.360	.719	1.000
early Archaic-Episode II	-178.074	39.004	-4.565	<.001	.000
Episode I-Episode II	-161.697	28.821	-5.610	<.001	.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Shell Width (mm) across Cultural Period

Independent-Samples Kruskal-Wallis Test Summary	
Total N	1287
Test Statistic	34.962[a]
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	<.001

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Cultural Period

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
Episode I-early Archaic	19.450	45.520	.427	.669	1.000
Episode I-Episode II	-150.989	28.821	-5.239	<.001	.000
early Archaic-Episode II	-131.539	39.004	-3.372	<.001	.002

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Aperture Height across Cultural Period

Independent-Samples Kruskal-Wallis Test Summary	
Total N	1287
Test Statistic	49.832[a]
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	<.001

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Cultural Period

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
Episode I-early Archaic	5.050	45.520	.111	.912	1.000
Episode I-Episode II	-174.635	28.821	-6.059	<.001	.000
early Archaic-Episode II	-169.585	39.004	-4.348	<.001	.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Aperture Width across Cultural Period

Independent-Samples Kruskal-Wallis Test Summary	
Total N	1287
Test Statistic	47.523[a]
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	<.001

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Cultural Period

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
early Archaic-Episode I	-18.988	45.520	-.417	.677	1.000
early Archaic-Episode II	-181.268	39.004	-4.647	<.001	.000
Episode I-Episode II	-162.280	28.821	-5.631	<.001	.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Shell Weight across Cultural Period

Independent-Samples Kruskal-Wallis Test Summary	
Total N	1287
Test Statistic	76.054[a]
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	<.001

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Cultural Period

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
early Archaic-Episode I	-61.258	45.518	-1.346	.178	.535
early Archaic-Episode II	-251.963	39.003	-6.460	<.001	.000
Episode I-Episode II	-190.706	28.820	-6.617	<.001	.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Independent-Samples Mann-Whitney U Test

Hypothesis Test Summary

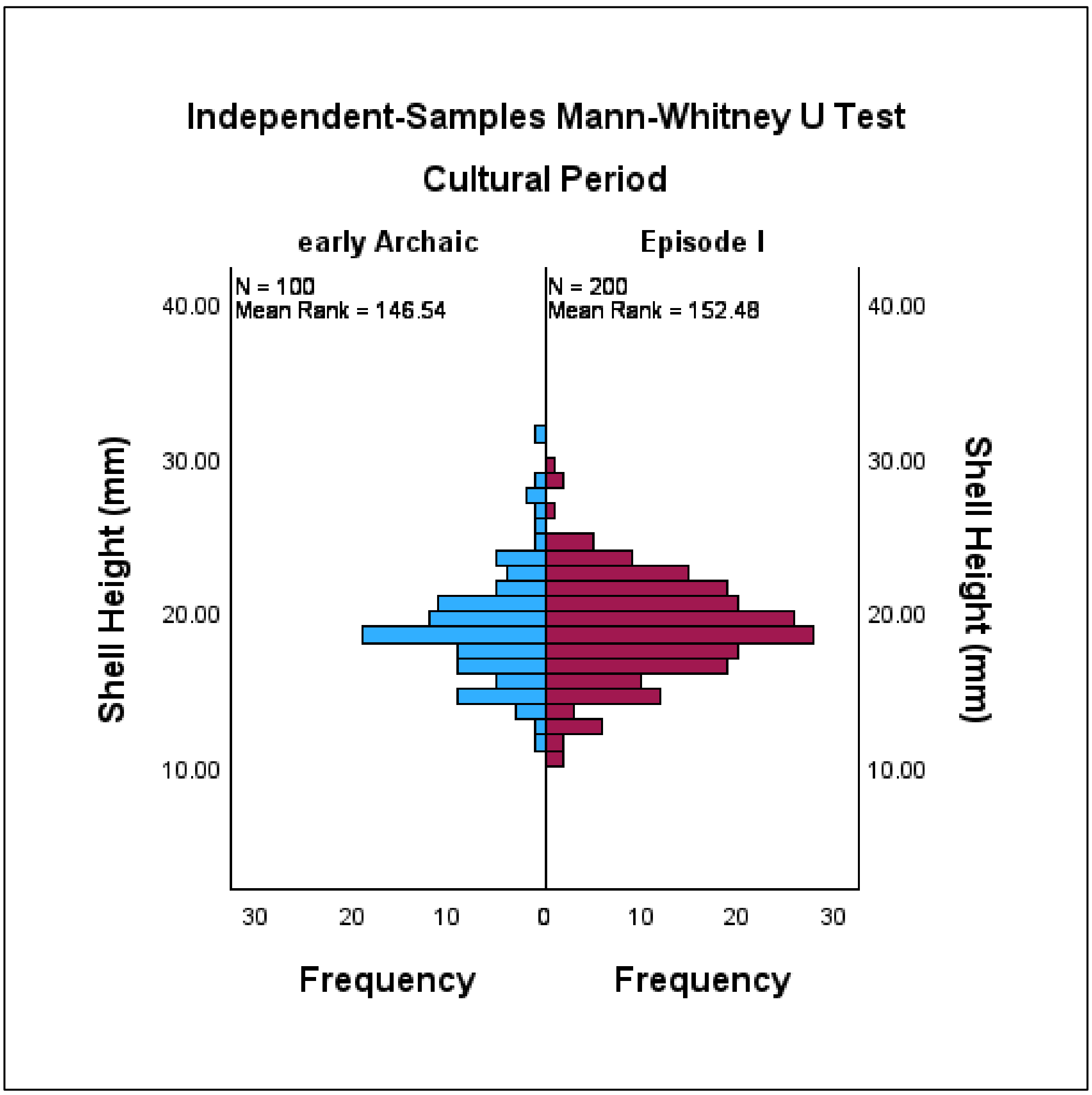
	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The distribution of Shell Height (mm) is the same across categories of Cultural Period.	Independent-Samples Mann-Whitney U Test	.576	Retain the null hypothesis.
2	The distribution of Shell Width (mm) is the same across categories of Cultural Period.	Independent-Samples Mann-Whitney U Test	.688	Retain the null hypothesis.
3	The distribution of Aperature Height is the same across categories of Cultural Period.	Independent-Samples Mann-Whitney U Test	.909	Retain the null hypothesis.
4	The distribution of Aperature Width is the same across categories of Cultural Period.	Independent-Samples Mann-Whitney U Test	.560	Retain the null hypothesis.
5	The distribution of Shell Weight is the same across categories of Cultural Period.	Independent-Samples Mann-Whitney U Test	.059	Retain the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

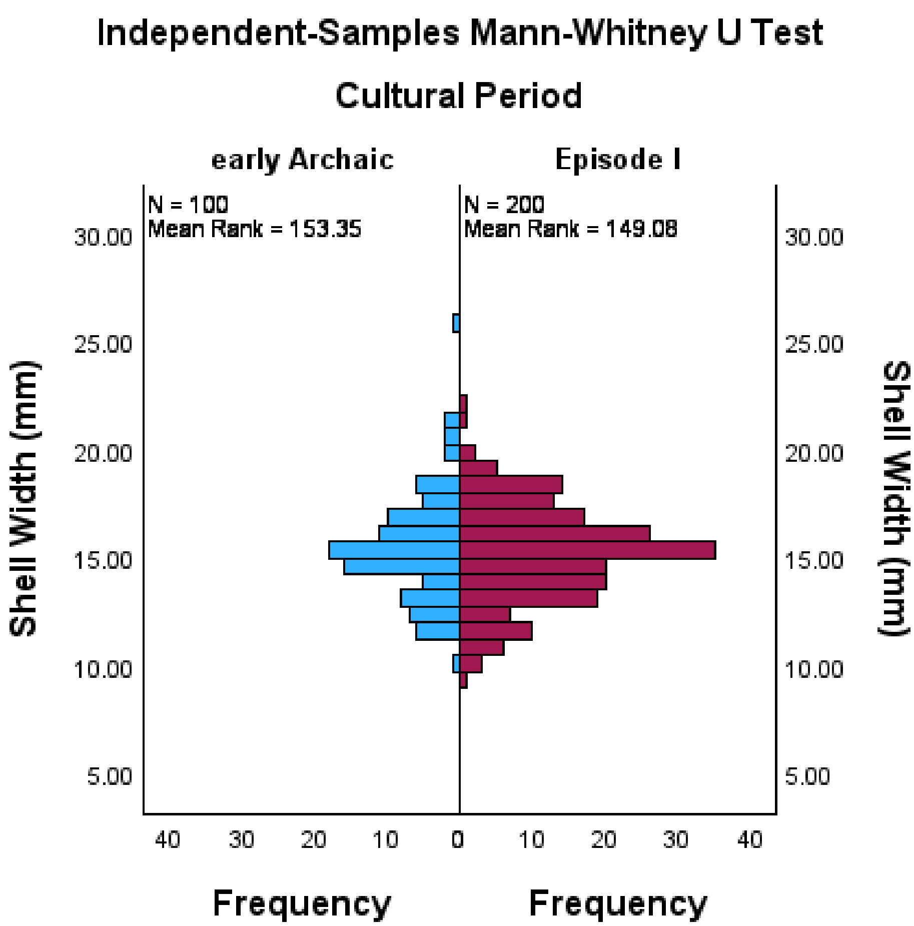
Shell Height (mm) across Cultural Period

Independent-Samples Mann-Whitney U Test Summary	
Total N	300
Mann-Whitney U	10396.500
Wilcoxon W	30496.500
Test Statistic	10396.500
Standard Error	708.281
Standardized Test Statistic	.560
Asymptotic Sig.(2-sided test)	.576



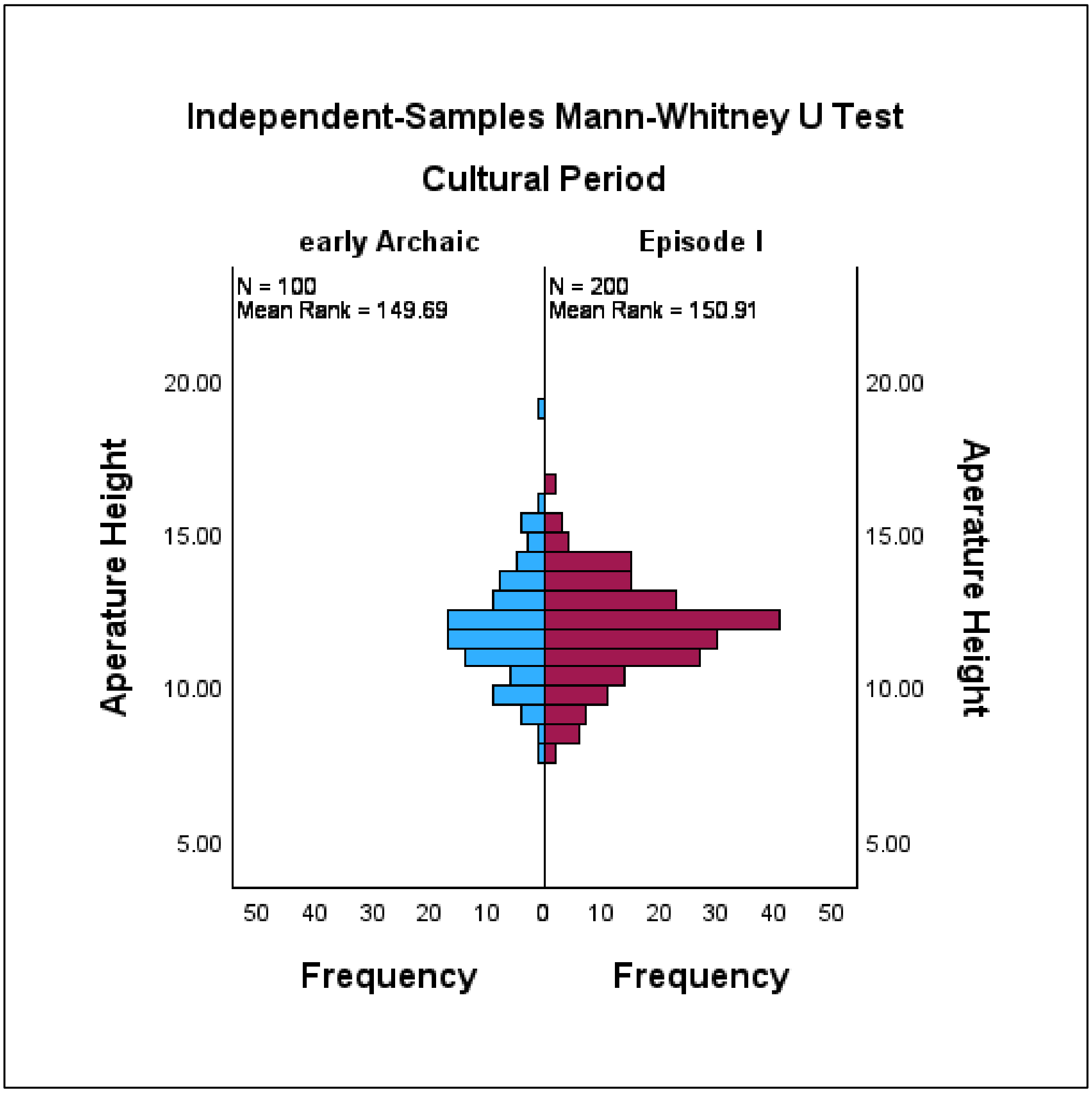
Shell Width (mm) across Cultural Period

Independent-Samples Mann-Whitney U Test Summary	
Total N	300
Mann-Whitney U	9715.500
Wilcoxon W	29815.500
Test Statistic	9715.500
Standard Error	708.279
Standardized Test Statistic	-.402
Asymptotic Sig.(2-sided test)	.688



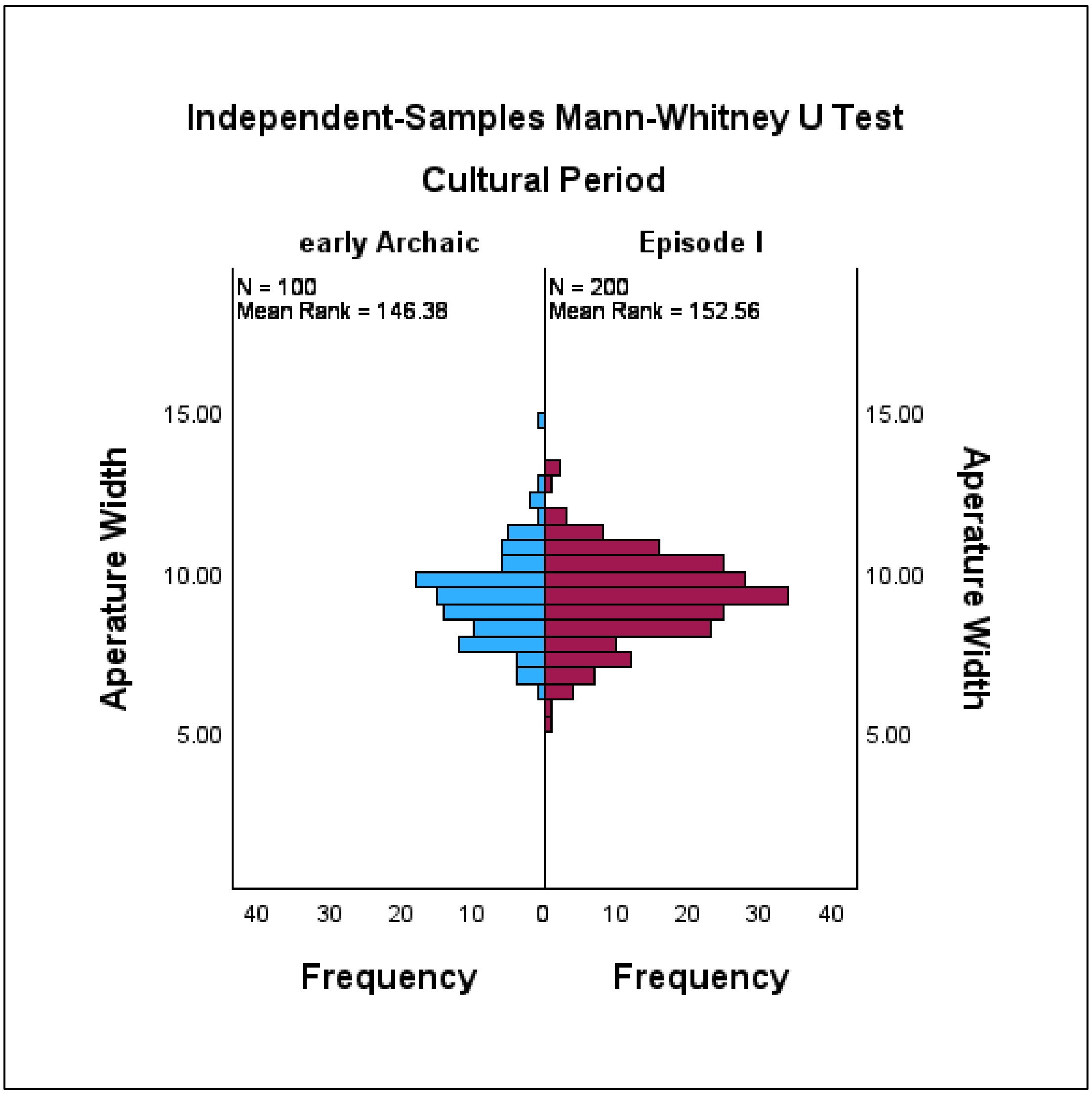
Aperture Height across Cultural Period

Independent-Samples Mann-Whitney U Test Summary	
Total N	300
Mann-Whitney U	10081.000
Wilcoxon W	30181.000
Test Statistic	10081.000
Standard Error	708.277
Standardized Test Statistic	.114
Asymptotic Sig.(2-sided test)	.909



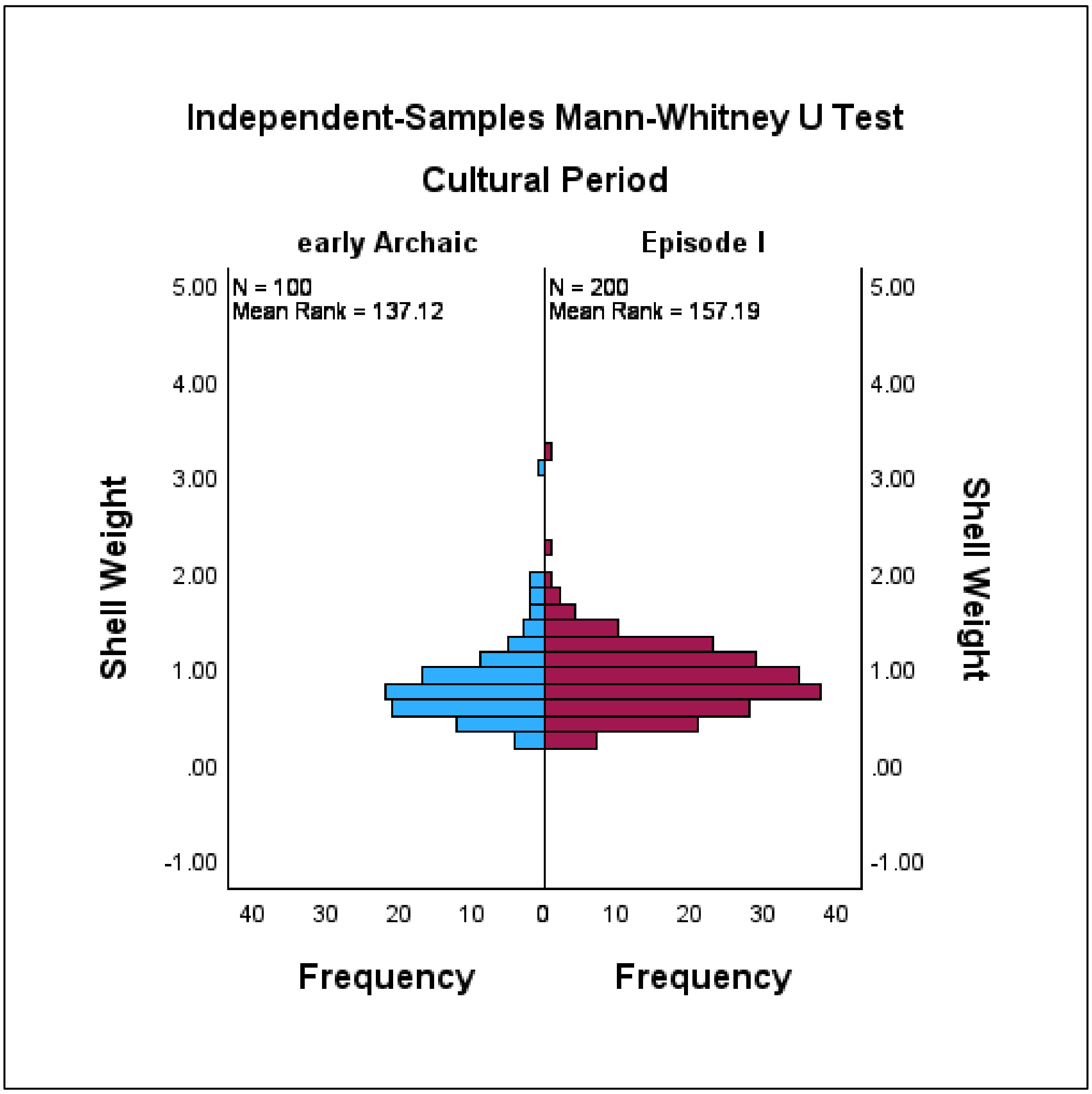
Aperture Width across Cultural Period

Independent-Samples Mann-Whitney U Test Summary	
Total N	300
Mann-Whitney U	10412.500
Wilcoxon W	30512.500
Test Statistic	10412.500
Standard Error	708.271
Standardized Test Statistic	.582
Asymptotic Sig.(2-sided test)	.560



Shell Weight across Cultural Period

Independent-Samples Mann-Whitney U Test Summary	
Total N	300
Mann-Whitney U	11338.000
Wilcoxon W	31438.000
Test Statistic	11338.000
Standard Error	708.214
Standardized Test Statistic	1.889
Asymptotic Sig.(2-sided test)	.059



Appendix 8-4B

Independent-Samples Kruskal-Wallis Test

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The distribution of Shell Height (mm) is the same across categories of Cultural Period.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.
2	The distribution of Shell Width (mm) is the same across categories of Cultural Period.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Shell Height (mm) across Cultural Period

Independent-Samples Kruskal-Wallis Test Summary

Total N	2114
Test Statistic	137.994[a]
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	<.001

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Cultural Period

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
Episode 1-early Archaic	177.738	44.507	3.993	<.001	.000
Episode 1-Episode 2	-357.293	30.752	-11.618	<.001	.000
early Archaic-Episode 2	-179.555	40.325	-4.453	<.001	.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Shell Width (mm) across Cultural Period

Independent-Samples Kruskal-Wallis Test Summary	
Total N	2114
Test Statistic	195.958[a]
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	<.001

a. The test statistic is adjusted for ties.

Pairwise Comparisons of Cultural Period

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
Episode 1-early Archaic	242.774	44.507	5.455	<.001	.000
Episode 1-Episode 2	-428.554	30.752	-13.936	<.001	.000
early Archaic-Episode 2	-185.781	40.325	-4.607	<.001	.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Appendix 8-5

Nonparametric Tests: Independent-Samples Kruskal-Wallis Test

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The distribution of Shell Height is the same across categories of Bag Units	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.
2	The distribution of Shell Diameter is the same across categories of Bag Units.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.

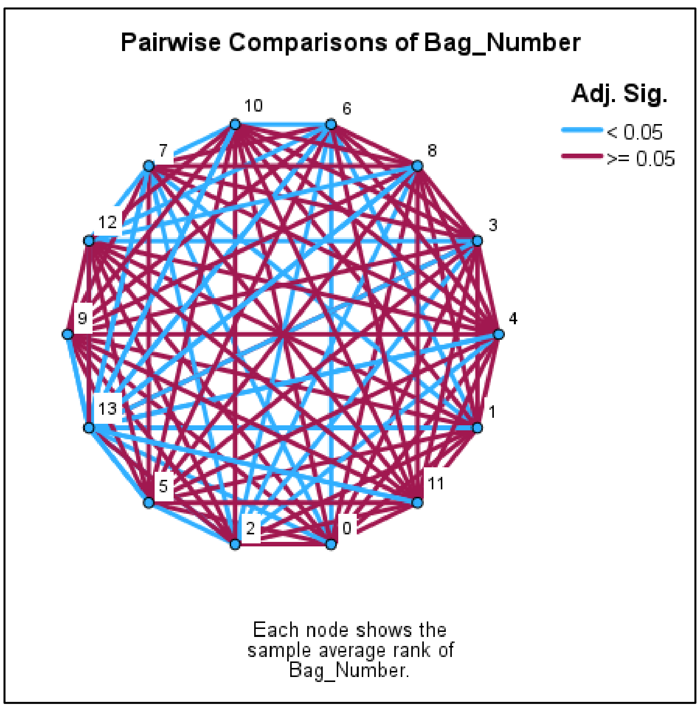
a. The significance level is .050.
b. Asymptotic significance is displayed.

Height across Bag Units

Independent-Samples Kruskal-Wallis Test Summary

Total N	1430
Test Statistic	174.533[a]
Degree Of Freedom	13
Asymptotic Sig.(2-sided test)	<.001

a. The test statistic is adjusted for ties.



Pairwise Comparisons of Bag Number					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
5024.00- 4096.00	28.230	76.151	.371	.711	1.000
5024.00- 4309.00	39.763	80.887	.492	.623	1.000
5024.00- 4069.00	129.517	82.902	1.562	.118	1.000
5024.00- 4076.00	149.360	85.434	1.748	.080	1.000
5024.00- 5027.00	-153.273	93.785	-1.634	.102	1.000
5024.00- 4089.00	162.362	82.902	1.958	.050	1.000
5024.00- 5164.00	-213.213	86.088	-2.477	.013	1.000
5024.00- 5156.00	-235.957	82.902	-2.846	.004	.403
5024.00- 4021.00	242.827	82.902	2.929	.003	.309
5024.00- 4022.00	255.032	82.902	3.076	.002	.191
5024.00- 5173.00	-342.647	82.902	-4.133	<.001	.003
5024.00- 4049.00	387.842	82.902	4.678	<.001	.000
5024.00- 5202.00	-519.857	82.902	-6.271	<.001	.000
4096.00- 4309.00	-11.534	44.797	-.257	.797	1.000
4096.00- 4069.00	101.287	48.341	2.095	.036	1.000
4096.00- 4076.00	121.131	52.566	2.304	.021	1.000
4096.00- 5027.00	-125.043	65.267	-1.916	.055	1.000
4096.00- 4089.00	134.132	48.341	2.775	.006	.503
4096.00- 5164.00	-184.983	53.622	-3.450	<.001	.051
4096.00- 5156.00	-207.727	48.341	-4.297	<.001	.002
4096.00- 4021.00	214.597	48.341	4.439	<.001	.001
4096.00- 4022.00	226.802	48.341	4.692	<.001	.000
4096.00- 5173.00	-314.417	48.341	-6.504	<.001	.000
4096.00- 4049.00	359.612	48.341	7.439	<.001	.000
4096.00- 5202.00	-491.627	48.341	-10.170	<.001	.000
4309.00- 4069.00	89.753	55.502	1.617	.106	1.000
4309.00- 4076.00	109.597	59.218	1.851	.064	1.000
4309.00- 5027.00	-113.510	70.735	-1.605	.109	1.000
4309.00- 4089.00	122.598	55.502	2.209	.027	1.000
4309.00- 5164.00	-173.449	60.158	-2.883	.004	.358
4309.00- 5156.00	-196.193	55.502	-3.535	<.001	.037
4309.00- 4021.00	203.063	55.502	3.659	<.001	.023
4309.00- 4022.00	215.268	55.502	3.879	<.001	.010
4309.00- 5173.00	-302.883	55.502	-5.457	<.001	.000

4309.00- 4049.00	348.078	55.502	6.271	<.001	.000
4309.00- 5202.00	-480.093	55.502	-8.650	<.001	.000
4069.00- 4076.00	-19.844	61.942	-.320	.749	1.000
4069.00- 5027.00	-23.756	73.031	-.325	.745	1.000
4069.00- 4089.00	-32.845	58.400	-.562	.574	1.000
4069.00- 5164.00	-83.696	62.841	-1.332	.183	1.000
4069.00- 5156.00	-106.440	58.400	-1.823	.068	1.000
4069.00- 4021.00	113.310	58.400	1.940	.052	1.000
4069.00- 4022.00	125.515	58.400	2.149	.032	1.000
4069.00- 5173.00	-213.130	58.400	-3.650	<.001	.024
4069.00- 4049.00	258.325	58.400	4.423	<.001	.001
4069.00- 5202.00	-390.340	58.400	-6.684	<.001	.000
4076.00- 5027.00	-3.913	75.893	-.052	.959	1.000
4076.00- 4089.00	-13.001	61.942	-.210	.834	1.000
4076.00- 5164.00	-63.852	66.146	-.965	.334	1.000
4076.00- 5156.00	-86.596	61.942	-1.398	.162	1.000
4076.00- 4021.00	93.466	61.942	1.509	.131	1.000
4076.00- 4022.00	105.671	61.942	1.706	.088	1.000
4076.00- 5173.00	-193.286	61.942	-3.120	.002	.164
4076.00- 4049.00	238.481	61.942	3.850	<.001	.011
4076.00- 5202.00	-370.496	61.942	-5.981	<.001	.000
5027.00- 4089.00	9.089	73.031	.124	.901	1.000
5027.00- 5164.00	-59.940	76.629	-.782	.434	1.000
5027.00- 5156.00	-82.684	73.031	-1.132	.258	1.000
5027.00- 4021.00	89.554	73.031	1.226	.220	1.000
5027.00- 4022.00	101.759	73.031	1.393	.164	1.000
5027.00- 5173.00	-189.374	73.031	-2.593	.010	.866
5027.00- 4049.00	234.569	73.031	3.212	.001	.120
5027.00- 5202.00	-366.584	73.031	-5.020	<.001	.000
4089.00- 5164.00	-50.851	62.841	-.809	.418	1.000
4089.00- 5156.00	-73.595	58.400	-1.260	.208	1.000
4089.00- 4021.00	80.465	58.400	1.378	.168	1.000
4089.00- 4022.00	92.670	58.400	1.587	.113	1.000
4089.00- 5173.00	-180.285	58.400	-3.087	.002	.184
4089.00- 4049.00	225.480	58.400	3.861	<.001	.010
4089.00- 5202.00	-357.495	58.400	-6.122	<.001	.000
5164.00- 5156.00	22.744	62.841	.362	.717	1.000
5164.00- 4021.00	29.614	62.841	.471	.637	1.000

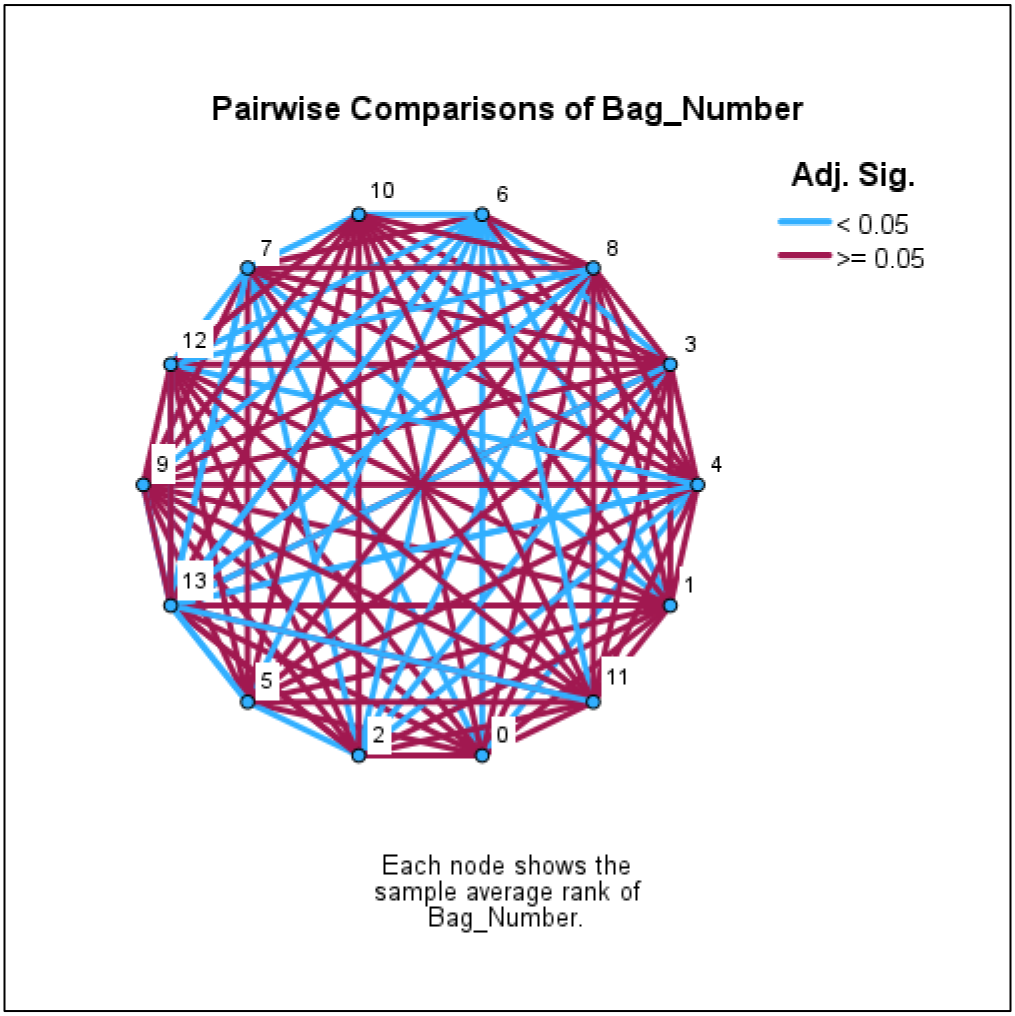
5164.00- 4022.00	41.819	62.841	.665	.506	1.000
5164.00- 5173.00	-129.434	62.841	-2.060	.039	1.000
5164.00- 4049.00	174.629	62.841	2.779	.005	.496
5164.00- 5202.00	-306.644	62.841	-4.880	<.001	.000
5156.00- 4021.00	6.870	58.400	.118	.906	1.000
5156.00- 4022.00	19.075	58.400	.327	.744	1.000
5156.00- 5173.00	-106.690	58.400	-1.827	.068	1.000
5156.00- 4049.00	151.885	58.400	2.601	.009	.846
5156.00- 5202.00	-283.900	58.400	-4.861	<.001	.000
4021.00- 4022.00	-12.205	58.400	-.209	.834	1.000
4021.00- 5173.00	-99.820	58.400	-1.709	.087	1.000
4021.00- 4049.00	-145.015	58.400	-2.483	.013	1.000
4021.00- 5202.00	-277.030	58.400	-4.744	<.001	.000
4022.00- 5173.00	-87.615	58.400	-1.500	.134	1.000
4022.00- 4049.00	-132.810	58.400	-2.274	.023	1.000
4022.00- 5202.00	-264.825	58.400	-4.535	<.001	.001
5173.00- 4049.00	45.195	58.400	.774	.439	1.000
5173.00- 5202.00	-177.210	58.400	-3.034	.002	.219
4049.00- 5202.00	-132.015	58.400	-2.261	.024	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.
a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Shell Diameter across Bag Unit

Independent-Samples Kruskal-Wallis Test Summary	
Total N	1430
Test Statistic	229.379[a]
Degree Of Freedom	13
Asymptotic Sig.(2-sided test)	<.001

a. The test statistic is adjusted for ties.



Pairwise Comparisons of Bag_Number					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
4096.00- 5024.00	-66.570	76.151	-.874	.382	1.000
4096.00- 4309.00	-120.318	44.797	-2.686	.007	.658
4096.00- 4076.00	124.593	52.565	2.370	.018	1.000
4096.00- 4069.00	248.079	48.341	5.132	<.001	.000
4096.00- 4089.00	252.309	48.341	5.219	<.001	.000
4096.00- 5164.00	-288.702	53.622	-5.384	<.001	.000
4096.00- 5027.00	-294.769	65.267	-4.516	<.001	.001
4096.00- 5156.00	-327.814	48.341	-6.781	<.001	.000
4096.00- 4022.00	334.674	48.341	6.923	<.001	.000
4096.00- 4021.00	338.709	48.341	7.007	<.001	.000
4096.00- 5173.00	-432.064	48.341	-8.938	<.001	.000
4096.00- 4049.00	475.799	48.341	9.843	<.001	.000
4096.00- 5202.00	-515.654	48.341	-10.667	<.001	.000
5024.00- 4309.00	53.749	80.886	.665	.506	1.000
5024.00- 4076.00	58.023	85.434	.679	.497	1.000
5024.00- 4069.00	181.510	82.901	2.189	.029	1.000
5024.00- 4089.00	185.740	82.901	2.240	.025	1.000
5024.00- 5164.00	-222.132	86.088	-2.580	.010	.898
5024.00- 5027.00	-228.199	93.785	-2.433	.015	1.000
5024.00- 5156.00	-261.245	82.901	-3.151	.002	.148
5024.00- 4022.00	268.105	82.901	3.234	.001	.111
5024.00- 4021.00	272.140	82.901	3.283	.001	.094
5024.00- 5173.00	-365.495	82.901	-4.409	<.001	.001
5024.00- 4049.00	409.230	82.901	4.936	<.001	.000
5024.00- 5202.00	-449.085	82.901	-5.417	<.001	.000
4309.00- 4076.00	4.274	59.218	.072	.942	1.000
4309.00- 4069.00	127.761	55.502	2.302	.021	1.000
4309.00- 4089.00	131.991	55.502	2.378	.017	1.000
4309.00- 5164.00	-168.383	60.158	-2.799	.005	.466
4309.00- 5027.00	-174.450	70.734	-2.466	.014	1.000
4309.00- 5156.00	-207.496	55.502	-3.739	<.001	.017
4309.00- 4022.00	214.356	55.502	3.862	<.001	.010
4309.00- 4021.00	218.391	55.502	3.935	<.001	.008
4309.00- 5173.00	-311.746	55.502	-5.617	<.001	.000

4309.00- 4049.00	355.481	55.502	6.405	<.001	.000
4309.00- 5202.00	-395.336	55.502	-7.123	<.001	.000
4076.00- 4069.00	123.486	61.942	1.994	.046	1.000
4076.00- 4089.00	-127.716	61.942	-2.062	.039	1.000
4076.00- 5164.00	-164.109	66.146	-2.481	.013	1.000
4076.00- 5027.00	-170.176	75.893	-2.242	.025	1.000
4076.00- 5156.00	-203.221	61.942	-3.281	.001	.094
4076.00- 4022.00	210.081	61.942	3.392	<.001	.063
4076.00- 4021.00	214.116	61.942	3.457	<.001	.050
4076.00- 5173.00	-307.471	61.942	-4.964	<.001	.000
4076.00- 4049.00	351.206	61.942	5.670	<.001	.000
4076.00- 5202.00	-391.061	61.942	-6.313	<.001	.000
4069.00- 4089.00	-4.230	58.399	-.072	.942	1.000
4069.00- 5164.00	-40.623	62.841	-.646	.518	1.000
4069.00- 5027.00	-46.690	73.030	-.639	.523	1.000
4069.00- 5156.00	-79.735	58.399	-1.365	.172	1.000
4069.00- 4022.00	86.595	58.399	1.483	.138	1.000
4069.00- 4021.00	90.630	58.399	1.552	.121	1.000
4069.00- 5173.00	-183.985	58.399	-3.150	.002	.148
4069.00- 4049.00	227.720	58.399	3.899	<.001	.009
4069.00- 5202.00	-267.575	58.399	-4.582	<.001	.000
4089.00- 5164.00	-36.393	62.841	-.579	.563	1.000
4089.00- 5027.00	-42.460	73.030	-.581	.561	1.000
4089.00- 5156.00	-75.505	58.399	-1.293	.196	1.000
4089.00- 4022.00	82.365	58.399	1.410	.158	1.000
4089.00- 4021.00	86.400	58.399	1.479	.139	1.000
4089.00- 5173.00	-179.755	58.399	-3.078	.002	.190
4089.00- 4049.00	223.490	58.399	3.827	<.001	.012
4089.00- 5202.00	-263.345	58.399	-4.509	<.001	.001
5164.00- 5027.00	6.067	76.628	.079	.937	1.000
5164.00- 5156.00	39.112	62.841	.622	.534	1.000
5164.00- 4022.00	45.972	62.841	.732	.464	1.000
5164.00- 4021.00	50.007	62.841	.796	.426	1.000
5164.00- 5173.00	-143.362	62.841	-2.281	.023	1.000
5164.00- 4049.00	187.097	62.841	2.977	.003	.265
5164.00- 5202.00	-226.952	62.841	-3.612	<.001	.028
5027.00- 5156.00	-33.045	73.030	-.452	.651	1.000
5027.00- 4022.00	39.905	73.030	.546	.585	1.000

5027.00- 4021.00	43.940	73.030	.602	.547	1.000
5027.00- 5173.00	-137.295	73.030	-1.880	.060	1.000
5027.00- 4049.00	181.030	73.030	2.479	.013	1.000
5027.00- 5202.00	-220.885	73.030	-3.025	.002	.227
5156.00- 4022.00	6.860	58.399	.117	.906	1.000
5156.00- 4021.00	10.895	58.399	.187	.852	1.000
5156.00- 5173.00	-104.250	58.399	-1.785	.074	1.000
5156.00- 4049.00	147.985	58.399	2.534	.011	1.000
5156.00- 5202.00	-187.840	58.399	-3.216	.001	.118
4022.00- 4021.00	4.035	58.399	.069	.945	1.000
4022.00- 5173.00	-97.390	58.399	-1.668	.095	1.000
4022.00- 4049.00	-141.125	58.399	-2.417	.016	1.000
4022.00- 5202.00	-180.980	58.399	-3.099	.002	.177
4021.00- 5173.00	-93.355	58.399	-1.599	.110	1.000
4021.00- 4049.00	-137.090	58.399	-2.347	.019	1.000
4021.00- 5202.00	-176.945	58.399	-3.030	.002	.223
5173.00- 4049.00	43.735	58.399	.749	.454	1.000
5173.00- 5202.00	-83.590	58.399	-1.431	.152	1.000
4049.00- 5202.00	-39.855	58.399	-.682	.495	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.
a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Appendix 8-6

Case Processing Summary[a]					
Cases					
Valid		Missing		Total	
N	Percent	N	Percent	N	Percent
14	100.0	0	.0	14	100.0

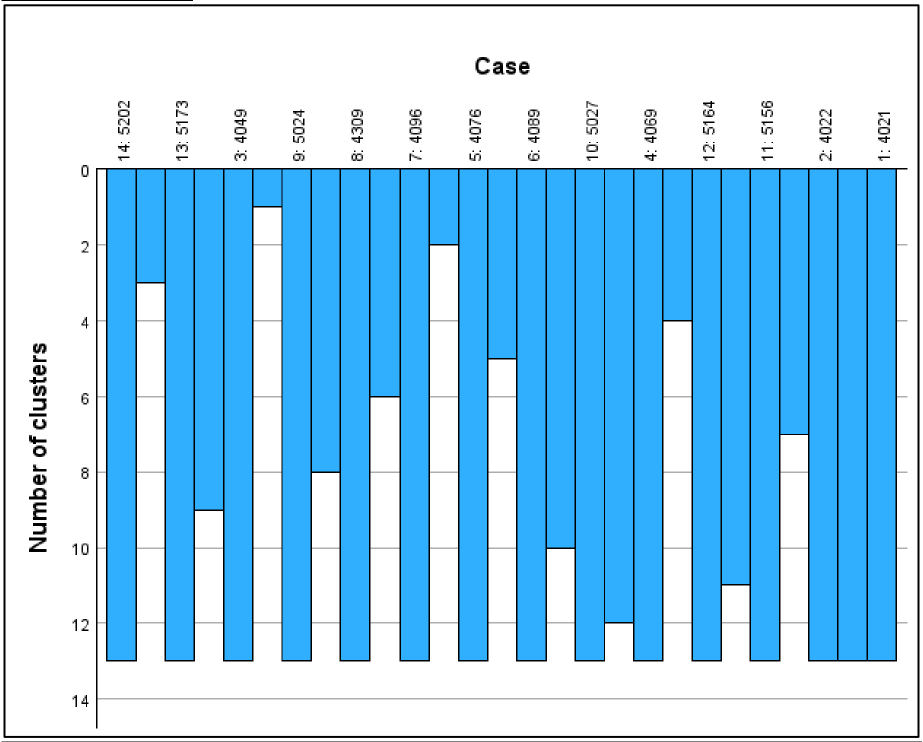
a. Ward Linkage

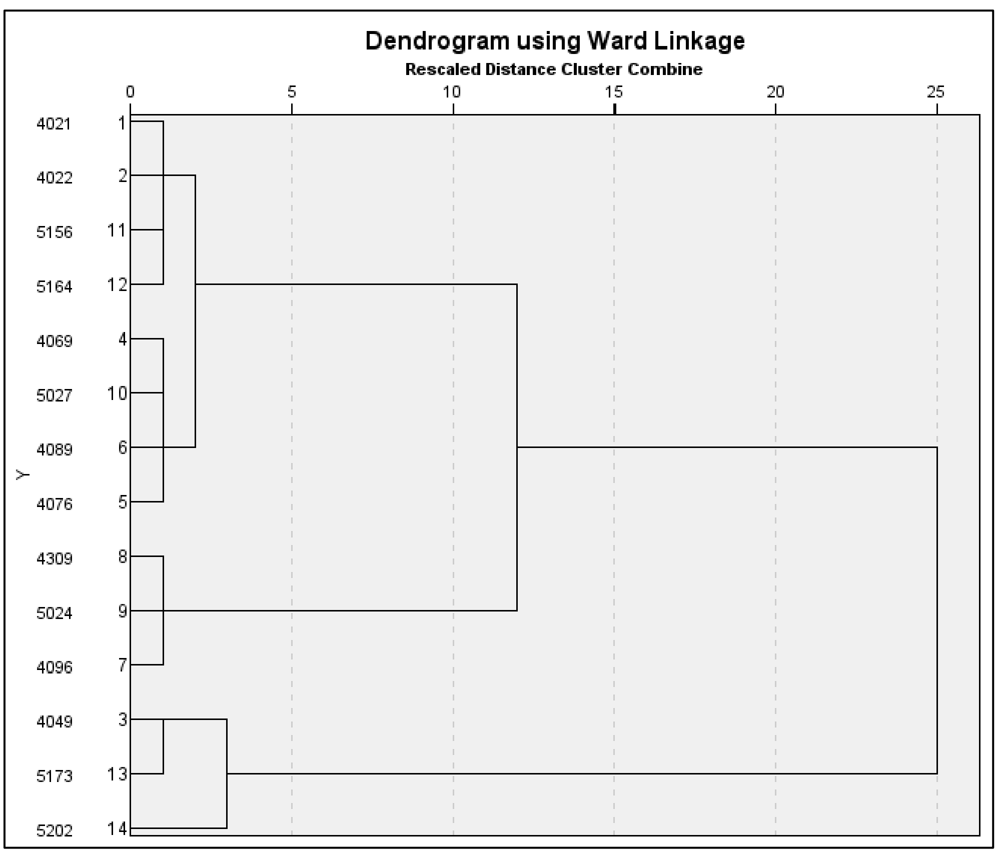
<u>Ward Linkage</u>

Agglomeration Schedule

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	1	2	.011	0	0	7
2	4	10	.023	0	0	4
3	11	12	.047	0	0	7
4	4	6	.084	2	0	9
5	3	13	.192	0	0	11
6	8	9	.309	0	0	8
7	1	11	.483	1	3	10
8	7	8	.731	0	6	12
9	4	5	1.406	4	0	10
10	1	4	2.637	7	9	12
11	3	14	4.210	5	0	13
12	1	7	12.546	10	8	13
13	1	3	30.614	12	11	0

Vertical Icicle:





Proximity Matrix

Case	Squared Euclidean Distance													
	1:4021	2:4022	3:4049	4:4069	5:4076	6:4089	7:4096	8:4309	9:5024	10:5027	11:5156	12:5164	13:5173	14:5202
1:4021	.000	.022	2.110	.741	2.057	.527	7.642	4.503	6.790	.828	.067	.210	.975	7.403
2:4022	.022	.000	1.755	.999	2.328	.765	8.270	5.063	7.468	1.114	.156	.331	.740	6.657
3:4049	2.110	1.755	.000	5.340	7.946	4.575	17.572	12.771	16.458	5.490	2.926	3.609	.216	1.743
4:4069	.741	.999	5.340	.000	.671	.076	3.876	1.627	3.096	.024	.366	.210	3.411	12.812
5:4076	2.057	2.328	7.946	.671	.000	1.192	1.936	.933	1.910	.885	1.448	.973	5.589	15.817
6:4089	.527	.765	4.575	.076	1.192	.000	4.935	2.253	3.922	.047	.251	.211	2.827	11.785
7:4096	7.642	8.270	17.572	3.876	1.936	4.935	.000	.615	.249	4.036	6.315	5.318	13.921	28.819
8:4309	4.503	5.063	12.771	1.627	.933	2.253	.615	.000	.234	1.649	3.475	2.810	9.664	23.156
9:5024	6.790	7.468	16.458	3.096	1.910	3.922	.249	.234	.000	3.110	5.512	4.659	12.902	27.975
10:5027	.828	1.114	5.490	.024	.885	.047	4.036	1.649	3.110	.000	.443	.313	3.544	13.168
11:5156	.067	.156	2.926	.366	1.448	.251	6.315	3.475	5.512	.443	.000	.047	1.552	8.847
12:5164	.210	.331	3.609	.210	.973	.211	5.318	2.810	4.659	.313	.047	.000	2.060	9.873
13:5173	.975	.740	.216	3.411	5.589	2.827	13.921	9.664	12.902	3.544	1.552	2.060	.000	3.085
14:5202	7.403	6.657	1.743	12.812	15.817	11.785	28.819	23.156	27.975	13.168	8.847	9.873	3.085	.000

This is a dissimilarity matrix