MORPHOMETRIC AND DECORATIVE VARIABILITY IN COMPLETE AND NEAR-COMPLETE MIDDLE AND LATE WOODLAND VESSELS FROM THE FRONTENAC AXIS

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Abstract

Morphometric and Decorative Variability in Complete and Near-Complete Middle and Late Woodland Vessels from the Frontenac Axis

Joshua T. Garrett

This thesis examines morphometric variability and decorative variability and complexity at the intervessel and intravessel levels in samples of complete and near-complete Middle and Late Woodland vessels. The purpose of this study is to determine how a better understanding of variability in Middle and Late Woodland period pottery can help interpret fragmentary assemblages and supplement minimum number of vessels estimates (MNV) and estimated vessel equivalents (EVE): two common methods of pottery quantification. This study also permitted the full characterization of the Charleston Lake and South Lake vessels with associated photographs.

The results of this study indicate that sherd thickness and design can be used to confidently assign vessel fragments to single vessels, thereby improving minimum number of vessels estimates, and the process of measuring brokenness and completeness for estimated vessel equivalents. Three sherd thickness conversion indexes provide archaeologists with a way to relate non-diagnostic and non-fitting sherds to their original vessels by the measure of sherds in relation to rims or paired portions (eg. Rim and neck, neck and shoulder, body and shoulder, and body and base). With the use of the sherd thickness conversion indexes, an efficient method of MNV estimation is proposed.

Keywords: pottery quantification, morphometry, variability, minimum number of vessels, estimated vessel equivalents, design, technofunction, Woodland, ceramics

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I dedicate this thesis to my brother, Jakob. I would never have succeeded without his ceaseless support and pride. I cherished our phone calls, explaining to him what I was studying, what and where I had been excavating, and hearing his absolute curiosity. I only regret that I did not finish this sooner, so that he could have seen it complete.

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Contents

List of Figures

List of Tables

Chapter 1

Introduction

1.1 Purpose and Sample

The Charleston Lake and South Lake pottery assemblages provide a unique opportunity to study the morphometric and design characteristics of vessels in their near-complete form. There are 27 Middle Woodland vessels spanning from the earliest Point Peninsula types like pseudoscallop shell stamped, to transitional late Middle Woodland vessels such as Sandbanks and Princess Point. Eighteen of the vessels are Late Woodland, spanning from early Late Woodland types such as Pickering, to contact-period types like Huron Incised.

Pottery is one of the most abundant resources of archaeological material culture in eastern North America after the advent of cermamic technology in the Early Woodland period. However, complete vessels are exceedingly rare. Archaeological sites are rich in large assemblages of fragmented pottery that provide archaeologists with a glimpse of the social environments lived by people in the Woodland Period. However, there are many processes acting on ceramic artifacts that inhibit their study. The fragmentation of ceramic vessels may bias accurate measures of type frequencies. To ameliorate this issue, archaeologists have developed methods of pottery quantification to relate fragmented pottery to whole vessels.

Some studies have attempted to replicate breakage patterns in controlled settings to test methods of pottery quantification used on archaeological assemblages (Chase, 1985). However, such studies cannot be replicated with Woodland Period pottery, which are far more variable in morphometry, decoration, composition, density, temper, firing temperature, and are subject to post-depositional forces. Most methods of pottery quantification are unable to utilize non-diagnostic or non-fitting sherds because they cannot be assigned to a specific vessel. As such, this study focuses on quantifying variability in morphometry (vessel wall thickness) and variability and complexity of design.

In this study, the guiding research goal is to determine how complete vessels of Woodland Period pottery can help improve estimates of minimum number of vessels (MNV) or estimated vessel equivalents (EVE) from fragmented assemblages. This thesis aims to refine archaeological techniques of MNV and EVE by examining wall thickness variability and design variability and complexity in a sample of 45 complete and near-complete vessels typologically attributed to the Middle and Late Woodland periods. I measure both wall thickness and design variability and complexity at the intervessel and intravessel levels (or between-vessel variability and within-vessel variability) using statistical modelling, measures of central tendency and dispersion, and non-parametric hypothesis testing. Further, non-parametric hypothesis tests are used to determine how Middle and Late Woodland vessels differ in either morphometric characteristics or design variability and complexity.

1.2 Why Quantify Pottery?

Pottery, being handmade and a learned craft, is produced in a social context and is thus directly related to the behaviour and practices of the people who made and used pots. Pottery can tell us about subsistence strategies, trade, raw material procurement, site occupation and abandonment, social interaction, and site formation processes (Arthur, 2002; Bollong, 1994; Feathers, 2006; Gallivan, 2010; Kooiman, 2016; MacNeish, 1952; Miloglav, 2020; Orton, Tyers, and Vince, 1993; Rice, 1987; Ritchie and MacNeish, 1949; Varien and Mills, 1997:141-191; Woosley, 2018; Wright, 1966). For instance, the frequency and abundance of a pottery type can be used to infer the period, duration, and intensity of site occupation. Specific vessel forms and sizes can be used to infer subsistence practices or site organization. The presence of ceramic types not usually found in certain geographic areas can be used to infer trade or interaction.

However, pottery sherds alone cannot help to answer these kinds of archaeological questions. Events during a vessel's use-life such as everyday breakage or the reuse of broken vessels for other purposes can alter the frequency of sherds representative of certain types, forms, and material make-up. Further, taphonomic processes such as bioturbation, site reoccupation (trampling/anthroturbation), and freeze-thaw are constantly acting upon buried artifacts, further fragmenting recoverable pottery.

Vessels do not often break in the same ways or to the same degree. It is clear from any fragmented assemblage that whole sections of vessels are sometimes missing, meaning that it is possible that some kinds of vessels are also entirely missing. Subsequently, any classification and quantification using sherd counts can lead to erroneous misinterpretations of vessel type frequencies. To measure the true frequency of ceramic types, an estimate of whole vessels must be made. Thus, archaeologists require a method by which they can confidently assign series of sherds to whole vessels to make inferences about archaeological sites.

1.3 Common Methods of Ceramic Quantification

Mentioned above, two related methods of ceramic quantification are used regularly in both academic archaeological research and cultural resource management projects: minimum number of vessels (MNV) (Burgh, 1959), and estimated vessel equivalents (EVE) (Orton, 1975). There are a variety of other methods (discussed in Chapter 2) that are derived from the same principles involved in both MNV and EVE. Briefly, however, MNV involves using sherd counts, weights, sherd/rim mending, and decoration (or type) to place sherds into groups that tentatively represent the minimum number of vessels present in an assemblage (analogous to the zooarchaeological and forensic methods of MNI, or minimum number of individuals). Alternatively, researchers have also used the maximum number of vessels. This, obviously, reflects subjective interpretations on the part of the researcher mirroring the lumpers versus splitters debates in biology.

EVE's are based on MNV estimates but include considerations of brokenness and completeness to ameliorate inherent flawed assumptions in MNV estimation: that all vessels break into the same number of sherds, and that all vessels are present to some degree, albeit fragmented. Brokenness (Orton, 1975) is a measure of fragmentation inherent to pottery of specific sizes, types, forms, and paste types. For instance, large vessels may break into many more sherds than smaller vessels, and thus by sherd count and design alone, an MNV estimation will see the larger vessels overrepresented on any particular site. Taphonomic processes in post-depositional environments subsequently intensify fragmentation as well. Completeness (Orton, 1985a; Schiffer, 1987: 282) refers to the proportion of the original pot actually present in an assemblage (and sometimes in separate assemblages if one is looking at inter-site or inter-unit comparisons). In theory, brokenness and completeness provide a measure of how much of each vessel survived, and an unbiased estimate of vessel type frequency within and between assemblages.

A third, less common method of ceramic quantification is the pottery information equivalent, or PIE, approach. Developed by Orton and Tyers (1992: 170), the PIE approach derives a statistic from the EVE by using a scaling factor appropriate to the assemblage under study, changing the 'size' of the assemblage, but not the composition (Orton, 1993:173). The PIE-SLICE program was released for this purpose (Orton and Tyers, 1993). This statistical package allows researchers to determine that "an assemblage with 'size' n of pies contains as much information (in the statistical sense) of n whole pots" (Orton, 1993: 174). This method allows archaeologists to treat the degree of retrievable data as representative of vessels. Additionally, the PIE now acts as count data, allowing researchers to study assemblages using statistical techniques such as correspondence analysis and log-linear analysis (Baxter and Cool, 1995: 90; Orton and Tyers, 1992: 163).

While both the EVE and PIE methods have shown great promise and have been used with some success, both are time consuming and require either statistical competency, or a take-it-on-faith approach to the PIE-SLICE statistical package. Realistically, the appropriate method to use is often determined by the goals of the study. The EVE approach is more accurate than MNV estimations in transforming an assemblage of sherds to an assemblage of vessels but requires a lengthy process in calculating completeness and brokenness. As well, the EVE method cannot use undiagnostic sherds in the calculation of brokenness and completeness. It also does not ameliorate the issue shared by the MNV approach of whether whole vessels are simply just missing. The PIE approach, as mentioned above, requires technical statistical knowledge and also does not solve the missing vessels issue. In fact, as with most archaeological assemblages, the data are simply missing.

Most archaeological excavations in North America take place alongside private and commercial development in the cultural resource management industry (CRM). CRM excavations, and the subsequent analysis of the recovered artifacts, are limited by both time and funding. MNV estimations are relatively quick and inexpensive, making MNV the most likely method of ceramic quantification to be used today. Archaeologists must also be able to compare assemblages from different sites, so estimates of vessel parent populations can provide practical and theoretical advantages for interpretation. For that reason, this study focuses on the analysis of complete and near-complete vessels to determine how the morphometry and design variability of Middle and Late Woodland vessels can aid archaeologists in the reconstruction of fragmented assemblages and determine a minimum number of vessels present in an assemblage.

1.4 Research Questions

To determine how morphometric and design variability in Woodland period pottery can transform a fragmented assemblage to a minimum number of vessels estimate, 10 research questions guide the analysis in this study. To achieve this, variability must be examined at the assemblage level and at the level of the individual vessel (intervessel and intravessel variability). The first six questions address vessel wall thickness variability, rim diameter variability, the statistical relationship between vessel parts, and temporal trends in vessel wall thickness in the Woodland period. The questions are:

1) Is intravessel wall thickness variability higher than intervessel variability?

2) What is the relationship between vessel wall thickness and rim diameter?

3) What is the relationship between vessel wall thickness variability and vessel completeness?

4) How much does rim diameter vary in Woodland period vessels?

5) What is the relationship of vessel wall thickness between each vessel portion?

6) What are the differences in rim diameter or vessel wall thickness between the Middle and Late Woodland periods?

The last four questions address design variability and complexity. Sherds are frequently attributed to single vessels by their design, or type, and whether sherds mend. But if vessel design is highly variable, or variably complex, this method may not be practical. The questions are:

1) Is intravessel decorative complexity and variability higher than intervessel decorative complexity and variability in Woodland Period vessels?

2) What is the relationship between decorative complexity and variability and rim diameter?

3) What is the relationship between decorative complexity and variability and vessel completeness?

4) What are the differences between Middle and Late Woodland period decorative complexity and variability?

To answer these questions, I use an array of linear regression analyses, non-parametric statistical tests, and measures of central tendency and dispersion.

1.5 Summary

The Charleston Lake and South Lake assemblages provide the opportunity to examine morphometric variability and design variability and complexity in Middle and Late Woodland vessels. In this study, I use complete and near-complete Woodland Period vessels to explore morphometric variability and design variability and complexity to aid in pottery quantification. My research also provides the archaeological community with a unique dataset typically unattainable due to the fragmented nature of archaeologically derived ceramic assemblages. Additionally, photographs and complete descriptions of each vessel analyzed in this thesis can be found in Appendix E.

In the following chapter (Chapter 2—Context and Aims) I provide a review of the Charleston Lake and South Lake assemblages, a literature review, as well as further discussion on the relevance of the research questions outlined in this chapter. In the literature review, I describe the importance of ceramic censuses, historical and contemporary methods of ceramic quantification, and the practical and theoretical limitations of parent population estimation. I then provide a detailed outline of how the data were collected and how the analysis was performed in the Methodology chapter (Chapter 3). This includes a detailed discussion of the statistical methods I use in this study and their relevance and applicability to the questions I have asked. In Chapter 4, I outline the results of my analysis of vessel wall thickness variability, the relationship between vessel wall thickness and rim diameter, the relationship between vessel wall thickness variability and vessel completeness, the relationship between vessel portions within a vessel, and the differences in wall thickness between the Middle and Late Woodland periods. In Chapter 5, I present the results of my analysis of design complexity and variability. My key interpretations of the results from chapters 4 and 5 are found in the Discussion chapter (Chapter 6). Lastly, I provide a review of the research goals and questions guiding this thesis and a discussion about the limitations of this study and future research directions in Chapter 7 (Conclusions).

Chapter 2

Context and Aims

This chapter expands on the purpose of this study introduced in Chapter 1 and places it within its theoretical and methodological context. I begin with a literature review exploring historic and contemporary methods of pottery quantification, their applicability to archaeology and archaeologists, and the most commonly used methods in North American archaeology today. Next, I discuss the purpose of this thesis in relation to the review of pottery quantification methods. After, I characterize the ceramic assemblages used for analysis in this study and discuss the archaeology and geology of Charleston Lake and South Lake. The chapter concludes with a summary.

2.1 Historic and Contemporary Methods of Pottery Quantification

Pottery in archaeological contexts is frequently found in varying degrees of fragmentation, leaving archaeologists to try to make inferences about the past using large assemblages of pottery sherds. There is a long history of methodological attempts at using pottery sherds to answer archaeological questions. Orton's (1993: 169-184) historic review provides a useful summary of ceramic quantification developments in archaeology. The counting of sherds and organizing them into self-similar groups is the basis of ceramic seriation. Sir Flinders Petrie (1899) was the first to use seriation to chronologically organize Egyptian graves using pottery sherds. Seriation works on the assumption that ideological trends cause small changes in artifact production such that they have a “beginning”, “middle”, and “end” over time. Such a trend creates the battleship curve exemplified in Deetz and Dethlefsen (1967: 29-37). This method allows archaeologists to create relative dating schemes for archaeological sites, their occupation, and their abandonment. This approach garnered attention in North America and was subsequently adopted by Kroeber (1916) and Spier (1917). In the last two decades, seriation has been reinvigorated by evolutionary archaeology (e.g., O’Brien and Lyman, 2000; Shennan, 2008) as the patterns identified by Petrie (1899) are useful for understanding cultural transmission processes.

However, seriation is not productive for all archaeological contexts. One major flaw is that most ceramic assemblages are not found in closed systems like firmly sealed graves or crypts. Rather, especially in North America, ceramic assemblages are typically accumulated over long occupation histories, are subject to a post-depositional history that variably increases the frequency of artifacts, and sites are frequently disturbed or have complex stratigraphy due to glacial movement. Large vessels may break into many more smaller pieces, and the breakage pattern of small vessels may generate similarly-sized fragments to those of larger vessels, but fewer per vessel. Broken vessels, or just parts of broken vessels, may be reused for games or utilitarian purposes. Bioturbation and anthroturbation can exacerbate the level of brokenness in an assemblage. Type frequencies can also be biased by excavation methodology. For example, it can be influenced by how much of the site was excavated or how the soil was screened. Last, it is often the case in fragmented assemblages that parts of vessels are simply missing, leading to the possibility that some vessels are entirely missing.

All these issues present a challenge to bridge pottery data with theory. To make inferences about chronology, distribution, or function (and therefore, human behaviour), archaeologists must be able to compare vessels and type frequencies, not sherds. Bridging this divide allows archaeologists to move from the archaeological context, working with just refuse, to the systemic context in which vessels existed in a behavioural system (Schiffer, 1972: 156-165).

After the emergence of the concept of seriation, variants of minimum number of vessel estimations methods were used. Newall and Krieger's (1949: 75-78) work—attempting to use sherd weights to estimate "vessel batches"—inspired the development of the minimum number of vessels estimates when Burgh (1959) and Baumhoff and Heizer (1959) seriously challenged the efficacy of using sherd counts to calculate type frequencies. Earlier and contemporaneous attempts at using sherd weights can be found in Gamio (1922), Gifford (1951), and King (1949). Weighing sherds seemed to produce results that move toward an estimate of vessel parent populations. Because vessel walls must have a certain thickness to support its own weight, fragments have varying weights even when they are similar sizes and counts. Having some reference of vessel type weight and using the weight of a fragmented assemblage provided a more accurate measure of the number of full vessels represented in the assemblage. Solheim (1960) discovered that accounting for both count and weight provided more information than either of them individually.

Dawson (1971) introduced the idea of scoring sherds by what fraction of the whole they represent (typically some fraction between 0 and 1). This method provided a way to make comparisons between assemblages so that larger vessels are no longer overrepresented. A similar method was arrived at by Egloff (1973) and Fulford (1973). Egloff created rim diameter measurement charts that scored the degree of rim present as a percentage of the total—a method still commonly in use today. Estimating how much vessel is present based on rim and base preservation is known as the estimated vessel equivalent (EVE) coined by Orton (1975). Two significant concepts in the estimation of vessel equivalents are brokenness and completeness.

Brokenness (Orton 1975) is a measure of fragmentation inherent to pottery of specific sizes, types, forms, and paste types. For instance, large vessels may break into many more sherds than smaller vessels, and thus by sherd count and design alone, an MNV estimation will see the larger vessels over-represented in an assemblage. Taphonomic processes in post-depositional environments subsequently intensify fragmentation as well. Completeness (Orton, 1985; Schiffer, 1987: 282) refers to the proportion of the original pot actually present in an assemblage (and sometimes in separate assemblages if one is looking at inter-site or inter-unit comparisons). In theory, brokenness and completeness provide a measure of how much of each vessel survived, and an unbiased estimate of vessel type frequency within and between assemblages.

EVEs by their nature produce datasets that are sparse, and as a result statistical tests may be precluded. To ameliorate this issue, with the advent of appropriate methods of analyzing compositional data statistically (Aitchisen, 1986), Orton and Tyers (1992: 170) developed the pottery information equivalent, or PIE. Orton and Tyers then released a statistical program to use with this approach—the PIE-SLICE program (Orton and Tyers, 1993). The PIE-SLICE program allows researchers to statistically scale an assemblage to a 'size'—using EVEs—without altering the composition of the assemblage. This transformation creates the PIE, which can then be said to contain as much information as n vessels. In this case, the degree of retrievable data acts as the number of vessels present in an assemblage. Because PIEs represent vessels, PIEs are count data. A dataset of PIEs is no longer sparse and does not contain small numbers, making statistical methods and comparisons unbiased toward any type.

Other efforts to improve EVEs have developed, like the modulus of rupture (Corredor and Vidal, 2015: 4-5). The modulus of rupture uses rim counts and an adjusted breakage rate based on the assumption that accidental breakage is a stable trend. This method has not seen much use since its publication. For one thing, that vessels break—by accident or otherwise—at a stable rate, and that vessels fracture into a stable number of sherds, is both incorrect in some cases (Chase, 1985), or unproven. In North America, the variability in open-air firing temperatures and duration, or the variability in paste consistency and thermal resilience, renders the assumption of stable fracturing highly unlikely.

Other methods have focused on the use of 3D technology and computer simulation to identify characteristics of sherds that the human eye cannot detect. Sablatnig and Menard (1997) attempted to create an automated classification machine that uses 3D analyses of sherd surfaces to assign them to classes. Halir and Flusser (1997) proposed a method using laser planes and a measure of a sherds' radius to create an arc that reconstructs the vessels diameter (wherever that sherd should fit), with which they claim to have obtained an error range of 2-3 mm. Üçoluk and Toroslu (1999), noting the difficulties of recreating vessels when parts are missing, created an algorithm (the Noise Tolerant algorithm) utilizing sherd boundary curvature and torsion scalars to ameliorate errors due to missing vessel parts.

More recent methods have taken a pipeline approach to generate the missing pieces of a vessel by pairing "3D digitization, data analysis, processing, and additive manufacturing" (Eslami, 2020: 41; Kalasarinis and Koutsoudis, 2019). This approach uses Structure from Motion/Multiview Dense Stereovision (SFM/MVS) photogrammetry to create a 3D model, data processing to predict the missing sherds, and a 3D printer to replicate the vessel.

Di Angelo, Di Stefano, and Pane (2017: 118-128) recently developed a method to automatically produce a dimensional characterization of pottery using 3D high point density modelling to recognize significant geometrical features of ceramic sherds. The method was developed to eliminate constraints on time and money by tailoring the application for the goals of archaeological pottery characterization. Using the 3D high point density model, their technique algorithmically performs sherd measurements accurate to within 0.064 mm. Three phases—identification of feature segmentation, axis identification, and dimensional feature evaluation—allow the computer-based method to automatically measure the dimensional characteristics of a sherd assemblage. Subsequently, this method should allow a large number of ceramic artifacts to be processed quickly and with much more accuracy than the traditional manual approach.

The digitization of archaeological data for ceramic quantification is a promising field. However, not all archaeologists have access to 3D technologies or the technical knowledge to develop similar programs, and their development is costly.

2.2 This Study

MNV and EVE are still the most popular methods of ceramic quantification in archaeology. These methods typically rely solely on the rim, neck, or basal portions of vessels, while shoulder and body sherds are often neglected unless they can be refitted. Without knowing which vessels the undiagnostic and non-fitting sherds belong to, sherd weight is sometimes used to estimate the number of vessels that they represent. A sherd-weight-to-vessel conversion includes a consequential assumption: that larger vessels have thicker walls, and thicker sherds therefore represent larger vessels. However, if those assumptions are incorrect, sherd-weight-to-vessel conversion will provide overestimates or underestimates. The complete and near-complete vessels used in this thesis provide the opportunity to test the assumption that larger vessels have thicker walls. If it is not the case that sherd weight is an accurate measure of vessel completeness, another method of utilizing undiagnostic fragments for pottery quantification must be developed.

The ability to assign undiagnostic sherds or non-fitting sherds to vessels in a fragmented assemblage can provide more information about the vessels and the people that used them than just rims, necks, or bases alone. The difficulty in assigning undiagnostic and non-fitting sherds is obvious. Even in the case that decorated sherds are present, so rarely are full vessels found that it is unknown just how much decorative variability can exist on a single vessel, and therefore what decorated sherds belong to a single vessel if they do not refit.

This study seeks to document variability in vessel wall thickness as well as decorative variability and complexity in Middle and Late Woodland vessels. With complete and near-complete vessels, vessel wall thickness and design trends can be quantified to seek relationships within and between vessels. Capturing overall variability trends in Woodland period vessels should provide insight into how a fragmented assemblage can be converted into either minimum number of vessels estimations or estimated vessel equivalents. If the results of these analyses can refine either MNV or EVE methods, it will improve the expedient methods of ceramic quantification preferred in North American archaeology.

2.3 The Charleston and South Lake Ceramic Assemblages

Swayze's (1976) discovery of a small prehistoric open-air site on the Red Horse Lake portage trail led to an investigation in the waters of Charleston Lake along the steep rock face encountered when accessing the portage route (see Figure 2.1 for map). The water here plummets to about 90 ft, with rock shelves occurring at various depths. Ken Cassavoy discovered the ceramic vessels in Charleston Lake on multiple rock shelves between 30-60 feet in depth (Cassavoy, 1976; Wright, 1980: 55-56). Further investigations of the area

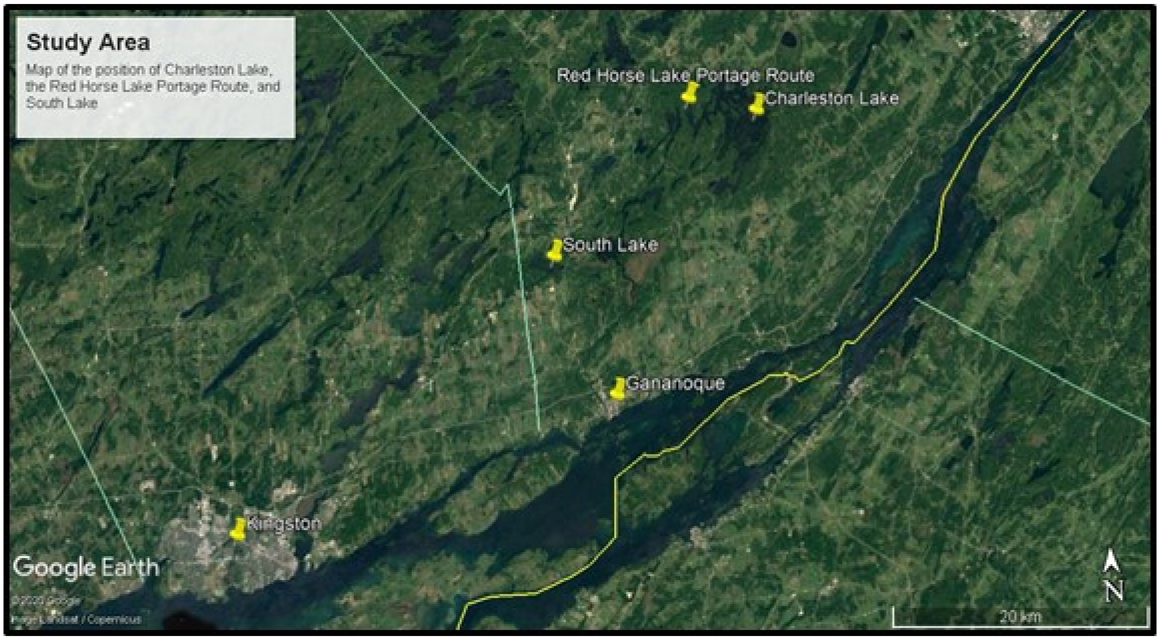

Figure 2.1: Location of Charleston Lake and the Red Horse Lake Portage Trail; South Lake; and two nearby cities (Kingston and Gananoque) (Image from Google Earth 2020).

resulted in the recovery of a combined 80 vessels from Charleston Lake and South Lake. Wright speculates that the ceramic vessels were deposited as a result of accidents that occurred during the portage, though it is also possible they may have been spilled out of a tipped canoe or broken at a nearby site and disposed of in the waters at the portage landing.

Some of the vessels found underwater have castellations, which Wright designates as incipient rounded, incipient pointed, and rounded, following Reid's work (Reid, 1975:80; Wright, 1980:61). Many vessels were modelled by hand, made by slabs fixed together using a paddle and anvil technique related both to shaping of the vessel and decorative zoning. Some vessels also demonstrate an attempt at fixing cracks by drilling holes through the vessels and tying them together. Wright notes that the repair holes seem only to be found when breaks occur around the shoulder and neck (Wright, 1980:60-61). Table 2.1 summarizes the Middle Woodland vessel types Wright identified.

Wright himself did not posit a time frame for each vessel type but placed the Middle Woodland vessels in the mid-to-late Point Peninsula series of wares (AD 300 to AD 1000) (1980: 61). Wright based his ceramic interpretations on Ritchie and MacNeish (1949), who give temporal ranges for ceramic types within the Point Peninsula Complex in terms

Table 2.1: Middle Woodland Vessel Types Identified by Wright in the Charleston Lake Assemblage.

Type	Date
St. Lawrence Pseudo-scallop Shell	300 BC-AD 100
Vinette Dentate	300 BC-AD 100
Vinette Complex Dentate	300 BC-AD 500
Point Peninsula Rocker Stamp	300 BC-AD 500
Kipp-Island Criss-Cross	AD 500-AD 1000
Point Peninsula Corded	AD 500-AD 1000
Jack's Reef Corded Collar	AD 500-AD 1000
Jack's Reef Punctate	AD 700-AD 1000
Wickham Corded Punctate	AD 700-AD 1000

of 'early', 'middle', or 'late'. The dates I provide in Table 2.1 are based on Ritchie and MacNeish's Point Peninsula division into early, middle, and late phases and general radiocarbon trends in the literature (Spence, Pihl, and Murphy, 1990: 125-169). There has been much revision to the ceramic chronology of southern, central, and eastern Ontario since Ritchie and MacNeish. For example, Curtis (2002) created a revised temporal framework for the Point Peninsula Complex in the Rice Lake Region, Hart and Brumbach (2003) questioned the legitimacy of the Owasco taxon, arguing that early Owasco pottery types were contemporaneous with late Point Peninsula pottery types, and Finlayson (1977) defined the Middle Woodland Saugeen Culture of Southwestern Ontario. The dates in Table 2.1 represent general temporal trends not specific to any particular region of Ontario. Table 2.2 below is a summary of the Late Woodland vessels Wright identified.

Table 2.2: Late Woodland Vessel Types Identified by Wright in the Charleston Lake Assemblage.

Type	Date
Wickham Corded Punctate	AD 700-1000
Pickering	AD 900-1300
Glen-Meyer	AD 900-1300
Carpenter Brook Cord-on-Cord	AD 1000-1100
Canandaigua Plain	AD 1100-1200
Owasco Corded Collar	AD 1200-1300
Roebuck Low Collar	AD 1400-1650

Wright believes that this collection is representative of an Early St. Lawrence Iroquoian tradition (1000-1300 A.D) that reflects both an Owasco and Pickering influence. Morrison (1976) supports this conclusion by positing Charleston Lake as a regional manifestation of the Owasco-Pickering relationship similar to the regional manifestations of the Princess Point and Owasco Great Basin horizon suggested by Stothers (Stothers, 1977:152-153; Wright, 1980: 69).

The South Lake assemblage also garnered attention due to some unique vessels that were recovered. They appeared similar to some of the unfamiliar vessels in the Charleston Lake assemblage that Wright tentatively assigned to the Point Peninsula tradition. Daechsel and Wright (1988) devised a new ceramic tradition for eastern Ontario based on these unidentifiable vessels, which they termed the Sandbanks Tradition. Six vessels from the South Lake assemblage and five from the Charleston Lake assemblage are used to create a chronology from Early Sandbanks to Late Sandbanks between AD 700-900 (Daechsel and Wright, 1988). Daechsel and Wright argue that Sandbanks should be a distinct tradition because they are highly similar to Princess Point vessels, but are geographically separated from the Princess Point region, and because they believe vessels from the Gananoque region are more influenced by northwestern New York ceramic developments than those seen in southwestern Ontario. While only 11 vessels were used to define the Sandbanks Tradition, Daechsel and Wright say that of the 80 vessels found, over half are of the Sandbanks type. No further research on the Sandbanks type has since been published.

I also undertook a reanalysis of the pottery types represented in the Charleston Lake and South Lake assemblages. Photographs and descriptions of each vessel used in this study can be found in Appendix E.

2.4 The Archaeology and Geology of Charleston Lake and South Lake

Charleston Lake is located north of Kingston Ontario near the Thousand Islands section of the St. Lawrence River. Charleston Lake and Red Horse Lake are part of an extensive lake and river network that make up a prehistorically significant travel and transportation route. The waters of these lakes and rivers end up draining into the St. Lawrence River via the Gananoque River. Wright's initial description of the Charleston Lake ceramic collection succinctly characterizes the geography of the area:

> [Charleston Lake] is located along the contact of two distinct physiographic zones, the Frontenac Axis and the Ottawa-St. Lawrence Lowlands (Wynne- Edwards 1967, Wilson 1964). The Frontenac Axis is part of the southern Canadian Shield which forms a narrow bridge of Precambrian rock extending from the Laurentian Plateau in the north to the Adirondacks in the south. The geological feature of the Ottawa-St. Lawrence Lowlands which is of archaeological interest is the Nepean Formation (Wynne-Edwards 1967). It consists of buff-coloured sandstone overlying quartz pebbles and cobble conglomerates. Sections of this conglomerate along the south peninsula of Charleston Lake have undergone differential weathering and erosion, creating concavities with solid sandstone overhangs. These rock overhangs were utilized prehistorically as temporary habitation sites (Wright, 1980:54).

One of the rock shelters Wright mentions is Gordon's Rock Shelter—formerly the Charleston Lake Rock Shelter—that can be found in Slack's Bay. This shelter was used by both indigenous and euro-Canadian travellers. It is composed of one large overhanging limestone formation roughly 50 feet above the lake. Gordon (1969) performed the first archaeological investigation of the rock shelter and excavated 21 five-foot-square units, roughly six to eight inches deep, or until they hit bedrock (Gordon, 1969: 49). Stratigraphy on the site was complex, but the artifacts represent a lengthy occupation. Gordon reports that "[e]xcavated materials include sherds from three pottery vessels, several bone points, bone scrapers, one piece of worked stone, large amounts of unworked bone, two musket balls, a broken gun flint, and a metal buckle" (Gordon, 1969: 52). Two of the vessels resemble the Jack's Reef Corded Collar type (AD 500-700), and the third appears to be an Owasco Herringbone type (AD 600-900) (Gordon, 1969: 56). Worked bone and historic artifacts make up the rest of the assemblage along with the bones of birds, fish, beaver, deer, and moose.

There have been 32 archaeological sites located on Charleston Lake, eight of which are rock shelters, one pictograph site, and one petroform (Gordon, 1969; Morrison, 1976; Pelshea, 1976, 1977; Swayze, 1975, 1976; Swayze and Bridges, 1973; Wright, 1980: 55). Jackson's Point open-air site represents a seasonal hunting and fishing station used in late spring and early fall (Hamalainen, 1975:70). Jackson's Point Rock Shelter also contained evidence of prehistoric occupation where ceramics affiliated with the St. Lawrence Iroquois of the Late Woodland period were found (Morrison, 1976).

No other published material is available for South Lake, aside from Daechsel and Wright's (1988) conference presentation defining the Sandbanks Tradition. South Lake shares the same geology as Charleston Lake, but is a much shallower body of water and is connected to Red Horse Lake and Charleston Lake by a series of creeks, streams, and rivers.

2.5 Summary

The purpose of this chapter was to review the historic and contemporary methods of pottery quantification to contextualize the aims of this thesis. The most common methods of ceramic quantification are minimum number of vessels estimations and estimated vessel equivalents. Both are somewhat expedient and are the preferred methods in archaeology today. The Charleston Lake and South Lake assemblages, being composed of complete and near-complete vessels, provide the opportunity to explore statistical relationships between Middle and Late Woodland pottery and explore morphometric and design variability inherent to vessels in their complete form. Documenting the extent of variability in whole vessels could provide the means to more accurately assign undiagnostic and non-fitting sherds to their vessels in fragmented assemblages. In doing so it may provide more reliable MNV estimates and EVE measures. Last, the character of both assemblages was discussed, as well as the geology and archaeology of the Charleston Lake and South Lake regions.

Chapter 3

Methodology

Ceramic is a durable material and a significant component of the archaeological record that offers archaeologists access to past human behavioural patterns. Although manufactured from a durable material, pottery vessels are subject to fragmentation through taphonomic processes and thus archaeologists must work with broken samples of this cultural material. Relating the variability observed in fragmentary assemblages of broken pottery to the whole vessels from which they are derived is a complex undertaking (Baumhoff and Heizer, 1959; Burgh, 1959; Egloff, 1973; Fulford, 1973; Newall and Krieger, 1949; Orton, 1985; Orton, 1993: 169-184; Orton, Tyers, and Vince, 1994: 166-181; Rice, 1987: 201-205; 288-293; Schiffer, 1987: 282; Solheim, 1960).

I first discuss the sample and data collection procedures for morphometric variability, then the statistical procedures employed. Next, I outline the sample and data collection procedures for decorative variability and complexity, including how the attribute coding system works, followed by the statistical procedures used in the analysis of decorative variability and complexity.

3.1 Morphometry: The Sample and Data Collection

In this study, I used two assemblages obtained from Charleston Lake at the Red Horse Portage Trail in Kingston, Ontario, and South Lake near Gananoque, Ontario (Figure 1). Due to differential preservation, not all vessels retained all six of the portions that contain information about vessel morphometry (see Figure 7.1 in Appendix D for vessel anatomy). Table 3.1 below reports the sample.

Table 3.1: Vessel Portion Preservation and Number of Measurements Taken for Analysis.

	Lip	Rim	Neck	Shoulder	Body	Base	Number of Measurements
Middle Woodland	26	27	27	24	17	5	504
Late Woodland	18	18	18	17	11	3	340
Total	44	45	45	41	28	8	844

Determining what percentage of a vessel is preserved, unless all vessel portions are present, is a subjective process as missing portions cannot be measured. To determine how much of the vessel is preserved in the Charleston and South Lake assemblages, I used rim diameter and shoulder morphology (where applicable) as a guide in assuming exactly how much of the vessel might have broken away. Appendix F provides the criteria used to determine vessel completeness.

Briefly, in the case of the neck and shoulder portions, the preservation of the rim served as a proxy for how much of the neck and shoulder are preserved. I used the morphology of the shoulder to determine how much of the body portion was missing: if the curvature of the shoulder indicated the vessel is globular, or suggested it was tapering to a base, an estimate was made based on these observations. Approximating basal preservation is relatively straightforward—vessel wall curvature delimits where the body portion ends, and the basal portion begins and thus what is left on a vessel can be easily estimated.

To determine the extent of variability in vessel wall thickness, I measured each vessel (in millimeters) using a set of calipers. I measured the wall thickness of each vessel in four different places on each of the six vessel portions for a potential total of 24 measurements per vessel. To divide the vessels into four sectors, I used the length of the extant rim divided by four. This process generated 504 observations of vessel wall thickness for Middle Woodland vessels and 340 observations of vessel wall thickness for Late Woodland vessel. A total of 844 observations of vessel wall thickness on 45 Middle and Late Woodland vessels comprise the sample body for the analysis of morphometric variability (Table 3.1).

There is a potential sampling bias using this method. Dividing the vessels into four sectors independent of vessel completeness could lead to more complete fragments having more variability than less complete fragments independent of the vessels' absolute size. Measurements on less complete fragments were taken closer to one another than measurements taken on more complete fragments. As completeness increases, there is more surface area to assess variability. Section 3.2 discusses statistical tests used to explore whether completeness affects the measure of variability.

I estimated rim preservation by measuring the length of the extant rim section on each vessel and by using rim diameter chart measurements. I used rim diameter to determine the total projected circumference of the vessel when it was intact. Then I divided the length of the rim by the total circumference to determine what percentage of the rim is preserved.

3.2 Morphometry: The Statistics

To quantify the degree of variability in vessel wall thickness, its relationship to vessel completeness and rim diameter, and differences between Middle and Late Woodland vessels, I used Mann-Whitney U tests, linear regression analyses, Spearman's rank order correlation tests, measures of central tendency and dispersion, and summary statistics. I used the statistical programming language R (Version 3.6.2) to perform the statistical tests.

To test whether variability in vessel wall thickness is higher at the intravessel level than the intervessel level, I used the coefficient of variation as a standardized measure, reported as a percentage. Deriving the coefficient of variation for all Middle Woodland vessels and all Late Woodland vessels faciliates comparison, subsequently highlighting the level of morphometric variability in each time period. I used the same method to derive a coefficient of variability for each individual vessel. The coefficient of variation of individual vessels reflects intravessel variation while the coefficient of variation derived for both the whole Middle Woodland sample and Late Woodland sample reflects intervessel variability. The coefficient of variation of each vessel is then compared to the coefficient of variation for both the Middle and Late Woodland samples.

To test whether vessel wall thickness changes between the Middle and Late Woodland periods, I used two-tailed Mann-Whitney U tests. The null hypothesis of this test is that the two independent variables are from the same population. In the case of this study, the null hypothesis was rejected at the 95% confidence interval, or p=<0.05 (two tailed). Rejecting the null hypothesis is interpreted as having found statistically significant differences in the wall thicknesses of Middle and Late Woodland vessels.

I used linear regression analysis to test for differences in mean vessel wall thickness and mean rim diameter in the Middle and Late Woodland vessels, and to determine whether these trends are stable over time. Performing linear regression analysis requires the creation of a linear model, plotting it on a scatter plot with a line of best fit, interpreting the summary statistics of the model, and interpreting the diagnostic linear model plots. Creating a linear model requires specifying a dependent and independent variable. The dependent variable in this analysis is mean vessel wall thickness, while the independent variable is rim diameter. There are six sets of rim diameter and vessel wall thickness models: one for the lip, rim, neck, shoulder, body, and base. This process, then, requires 12 linear regression models—six models to analyze the Middle Woodland vessels, and six models to analyze the Late Woodland vessels.

Of importance to this study are the Residual Standard Error, R-Squared, Multiple R-Squared, and F-value of each linear model. Residual Standard Error is a basic quantification of how well the model is predicting the data. The smaller the RSE, the more accurately the model is predicting the expected values. The R-Squared statistic compares the distance of the actual values from the mean to the distance of the estimated values from the mean. It explains how well the regression line predicts or estimates the actual values. The Multiple R-Squared statistic performs a similar role: it is the R-Squared statistic for the whole model, which reports the percentage of variation in the response variable (mean vessel wall thickness, for example) that is explained by the predictor variable (rim diameter, for example). Lastly, the F-statistic measures the significance of the whole model and reports a p-value to indicate whether the null hypothesis can be rejected.

In the case of linear regression models, the null hypothesis is that there is no relationship between the dependent and independent variables. The null hypothesis is accepted when the F-statistics' p-value is greater than 0.05. I interpreted this as indicating that there is no relationship between wall thickness and rim diameter measurements. Rejecting the null hypothesis was interpreted as having found no relationship between mean vessel wall thickness and rim.

Outliers were checked for errors in recording or misused data. Outliers in linear regression models can severely impact the efficacy of the model. Conversely, outliers can be significant. It could be the case that one vessel of either period is simply much thinner or much thicker than the rest of the assemblage, or that a vessel with a large rim diameter has thin walls. These observations are important to archaeologists because they highlight the variability that can be expected of fragmentary assemblages.

Completeness may influence the measure of variability—as the portion of vessel preserved increases in size, so too does the amount of analyzable surface area. However, if variability is not found to be related to the level of completeness, then variability must be explained by some other influence. To determine whether variability in vessel wall thickness is impacted by the level of preservation, and not some other variable, I used Spearman's rank order correlation tests and linear regression analysis.

Spearman's rank order correlation test measures the strength and direction of a monotonic relationship between two ranked variables. A monotonic relationship is one in which if one variable increases, the other variable tends to increase or decrease. The trend does not necessarily have to be linear, only that the variables are either negatively or positively correlated. Therefore, two assumptions about the data must be satisfied for Spearman's rank order correlation tests: that the data are ordinal, interval, or ratio (ranked in some logical way), and that there is a monotonic relationship. The Spearman's rank order correlation test will produce a correlation coefficient, Rs, that denotes the strength of the relationship between the two variables ranging anywhere between 1 and -1. An Rs of 1 is a perfect positive correlation, an Rs of 0 denotes the lack of any correlation between the two variables, and an Rs of -1 indicates a perfect negative correlation. In this study, Spearman's rank order correlation test tests the completeness scores of each vessel in each time period against the coefficient of variation of each vessel portion in each time period. For example, the coefficient of variation of vessel wall thickness for the neck portion of all Middle Woodland vessels in this study will be tested against the completeness scores of all Middle Woodland vessels in this study.

Further, I explored the relationship between vessel completeness and vessel wall thickness variability using linear regression analyses. The coefficient of variation of vessel wall thickness for each vessel portion is the dependent variable and the proportion of vessel preserved is the independent variable. The hypothesis is that as the size of the proportion of vessel increases, so too will the coefficient of variation. This effect is due to the increase in surface area. With more surface area to record thickness measurements, there should be more variability in hand-made pottery. Alternatively, if this trend is not detected, it would mean that vessel wall thickness variability is low and that the potters of the Middle and Late Woodland periods were adept at creating vessel walls of consistent thickness.

To explore within-vessel wall thickness relationships, I tested the relationship between paired-portions (rim and neck, neck and shoulder, shoulder and body, body and base) using linear regression analyses, following the same interpretive criteria as those outlined above. In Middle Woodland vessels, I performed four linear regression analyses comparing: rim thickness to neck thickness, neck thickness to shoulder thickness, shoulder thickness to body thickness, and body thickness to basal thickness. I undertook an additional four linear regression analyses for Late Woodland vessels.

Finally, I used Mann-Whitney U-tests to test for differences between Middle and Late Woodland vessels. One test was performed to compare rim diameters of the Middle and Late Woodland period and one test was performed to compare mean vessel wall thickness between the Middle and Late Woodland period. In both cases, if $p= >0.05$, the null hypothesis that the values in each sample are derived from the same population is accepted. If the null hypothesis is rejected, the values in each sample are interpreted to be from two different populations.

3.3 Decoration: The Sample and Data Collection

The same vessels used in the analysis of morphometry were used in the analysis of design complexity and variability. The attribute recording system I use is novel, and a distinction between complexity and variability in vessel design needs to be made. Complexity and variability are both measures that affect the quantification of a fragmented assemblage when trying to assign non-fitting decorated sherds to a vessel. Complexity in design refers to the number of constituent elements, while variability refers to the degree to which the constituent elements change across a vessel. As illustrated by the use of an arbitrary letter scheme, design can be 1) invariably complex: ABCDE ABCDE ABCDE; 2) variably complex: AECDB BCEDA CADEB; 3) invariable and non-complex: AB AB AB AB; and 4) non-complex but variable: AB BA AB BA. In this system, two measures of complexity are used: Elemental Complexity Scores (ECS) and Design Complexity Scores (DCS). Variability was measured by calculating the central tendency and dispersion of the design complexity scores. Below, I expand on how the attribute recording system is employed and how decorative complexity and variability are measured.

The attribute recording system I developed is based off Robert Pihl's coding system used for the Hogsback Site (Pihl, pers. comm. 2019). The recording system I used relies on the interpretation of decorative choices made by the potter. Each vessel is divided into four equal sectors proportionate to the length of the extant rim divided by four. Complexity is generated by changes in four main components or variables of decoration: element placement, tool type, technique of tool use, and configuration of tool impression. Element placement refers to vessel portions, or sub-portion zones. For example, a cord-wrapped stick impression might be found on the upper, middle, or lower neck, or horizontal linear incised lines can be from the rim to the base. There are a minimum of 32 variables analyzed on each vessel, which can be found in Table 3.2 below.

The number of variables can expand from 32 if a vessel has more constituent elements, and therefore greater complexity. Decorative elements, interior decorative elements, exterior surface treatment, and interior surface treatment are expandable components of this method. If a vessel has multiple types of decorative tool use and configurations, secondary surface treatments, multiple rim or lip designs, and complex interior motifs, the researcher can add these. For example, there may be a need to record many decorative elements (and therefore placement, tool, technique, and configuration), and so the researcher would add Decorative Element 1, Decorative Element 2, Decorative Element 3; etc.

There are a total of 185 attributes in this recording system: 14 under tool type, 10 under technique, 22 under configuration, 35 under element placement, six under rim type, eight under rim orientation, 13 under rim profile, 13 under rim shape, 13 under lip shape, eight

Table 3.2: Variables Considered in Attribute Analysis.

Rim Design Tool	Interior Decorative Element 1 Technique
Rim Design Technique	Interior Decorative Element 1 Configuration
Rim Design Configuration	Rim Type
Lip Element Placement	Rim Orientation
Lip Design Tool	Exterior Rim Profile
Lip Design Technique	Interior Rim Profile
Lip Design Configuration	Rim Shape
Decorative Element 1 Placement	Lip Shape
Decorative Element 1 Tool	Lip Angle
Decorative Element 1 Technique	Exterior Surface Treatment Placement
Decorative Element 1 Configuration	Exterior Surface Treatment Type
Interior Rim Design Tool	Interior Surface Treatment Placement
Interior Rim Design Technique	Interior Surface Treatment Type
Interior Rim Design Configuration	Base Morphology
Interior Decorative Element 1 Placement	Castellation
Interior Decorative Element 1 Tool	Neck Morphology

under lip angle, 13 under exterior surface treatment, 13 under interior surface treatment, four under base morphology, four under neck morphology, and nine under presence or absence of castellations (Appendix C). A total of 64 observations are made on each vessel portion (lip, rim, neck, shoulder, body, and base) for a possible total of 384 observations per vessel. I recorded attributes using Microsoft Excel. Four rows were required to analyze each vessel broken into four sectors. An average of 49 columns were required to record the attributes of each vessel. More or fewer columns indicate more or less decorative complexity.

I measured decorative complexity and variability using two concepts: Elemental Complexity Score (ECS) and Decorative Complexity Score (DCS). Elemental complexity is a value representing attribute changes within the vessel. Decorative complexity refers to the overall density of attributes and attribute changes within a vessel. ECS is a cumulative score determined by each observation in each sector. It ranges from 0.25-1.0. A score of 0.25 represents no change, and a score of 1.0 represents maximum change. An ECS of 0 is not possible, as leaving portions or the whole vessel plain is considered a decorative choice. Table 3.3 provides an example: a vessel has a lip with right-oblique incised lines, which changes to horizontal lines, then to left oblique lines, then back to horizontal lines: ////||||\\\\||||.

Table 3.3: Example of How Elemental Complexity Score is Measured.

Sector	Lip Element Placement	Lip Tool	Lip Technique	Lip Configuration
S1	TL	SPL	IN	RO
S2	TL	SPL	IN	HZ
S3	TL	SPL	IN	LO
S4	TL	SPL	IN	HZ
ECS	0.25	0.25	0.25	0.75

There is an ECS for every component analyzed. For element placement, it is possible that the incised lines on the lip could move from the front of the lip in sector one, to the back of the lip in sector 2, medially for sector 3, and then back to the front of the lip, which would make the ECS for Lip Element Placement 0.75 instead of 0.25. The changes in each component of decoration—placement, tool type, tool technique, and configuration—all get their own ECS scores. The sum of all the ECS values is the DCS. The ECS is important because while a greater DCS means greater complexity, a vessel can still be highly variable but non-complex. If a vessel has a low DCS but a high ECS, it means that there is change in attributes, but the overall motif—the mosaic of attributes that make up the motif—is simple. If a vessel has low ECS but a high DCS, it means that there are many decorative components—and therefore high complexity—but they do not vary.

The lowest DCS possible in this system is 8, which would represent an entirely plain vessel, or a vessel with a very simple and standardized design. A vessel can be entirely decorated, but still have a small DCS—for example, a vessel that has right oblique cord-wrapped stick impressions from the rim to base. In that instance, only one decorative element is recorded (cord-wrapped stick, impressed, right oblique) on one placement (rim to base). The DCS increases if the impressions change—if for example the impressions change from right oblique to left oblique at the shoulder and continue to the base. Theoretically, there is no limit to how high the decorative complexity score can be: the more decorative elements added to the vessel in complex configurations, the higher the DCS will be. In this assemblage, the highest decorative complexity score (DCS 25) was documented in vessel BdGa-12-76-20 (Pickering, Scugog Classic Bossed). Table 3.4 is an example of a simple vessel design.

Table 3.4: Example of Measuring Complexity Using Attribute Recording. (Codes for Attributes: CWS=Cord-wrapped Stick; ST=Stamped; RO=Right Oblique; RtB=Rim to Base; PL=Plain; NC=Non-collared; NCS=Non-collared, Straight; OFL=Outflaring; CA=Concave; CE=Convex; F=Flat; RA=Right Angle; C=Conoidal; SCO=Slightly Constricted; NOC=Not Castellated)

Variable	Sector 1	Sector 2	Sector 3	Sector 4	ECS
Rim					
Tool	CWS	CWS	CWS	CWS	0.25
Technique	ST	ST	ST	ST	0.25
Configuration	RO	RO	RO	RO	0.25
Lip					
Placement	Top	Top	Top	Top	0.25
Tool	CWS	CWS	CWS	CWS	0.25
Technique	ST	ST	ST	ST	0.25
Lip Configuration	RO	RO	RO	RO	0.25
Decorative Element 1					
Placement	RtB	RtB	RtB	RtB	0.25
Tool	CWS	CWS	CWS	CWS	0.25
Technique	ST	ST	ST	ST	0.25
Configuration	RO	RO	RO	RO	0.25
Rim Interior Design					
Tool	PL	PL	PL	PL	0.25
Technique	PL	PL	PL	PL	0.25
Configuration	PL	PL	PL	PL	0.25
Interior Decorative Element 1					
Placement	RtB	RtB	RtB	RtB	0.25
Tool	PL	PL	PL	PL	0.25
Technique	PL	PL	PL	PL	0.25
Configuration	PL	PL	PL	PL	0.25
Rim					
Type	NC	NC	NC	NC	0.25
Orientation	OFL	OFL	OFL	OFL	0.25
Exterior Rim Profile	CA	CA	CA	CA	0.25
Interior Rim Profile	CE	CE	CE	CE	0.25

Shape	NCS	NCS	NCS	NCS	0.25
Lip					
Shape	F	F	F	F	0.25
Angle	RA	RA	RA	RA	0.25
Exterior Surface Treatment 1					
Placement	PL	PL	PL	PL	0.25
Type	PL	PL	PL	PL	0.25
Interior Surface Treatment 1					
Placement	PL	PL	PL	PL	0.25
Type	PL	PL	PL	PL	0.25
Base					
Morphology	C	C	C	C	0.25
Neck					
Morphology	SCO	SCO	SCO	SCO	0.25
Castellations	NOC	NOC	NOC	NOC	0.25
Decorative Complexity Score					8

3.4 Decoration: The Statistics

I used measures of central tendency and dispersion to quantify variability in decorative complexity at the intervessel and intravessel levels. Measures of central tendency and dispersion of the ECS for individual vessels captured variability at the intravessel level, while the central tendency and dispersion of the DCS for the Middle and Late Woodland samples captured variability at the intervessel level. I used Spearman's rank order correlation tests and linear regression analyses to determine if there is a significant relationship between decorative variability and complexity and rim diameter, and to explore any relationships between decorative variability and complexity and vessel completeness. I then used Mann-Whitney U-tests to establish whether there are significant differences in decorative variability and complexity between Middle and Late Woodland vessels.

If there is a significant and positive relationship between decorative variability or complexity and vessel completeness, it suggests that variability and complexity will increase with less fragmented vessels and that assigning non-fitting decorated sherds to a single vessel would be difficult with highly fragmented assemblages. However, if a significant and negative relationship exists, it suggests that the design found on even highly fragmented vessels can be assumed to belong to vessels with similar decorative elements. If neither a significant positive or significant negative relationship is established, it suggests design variability and complexity cannot be used to assign non-fitting decorated sherds to a single vessel. It should be noted that there is more than likely a threshold here at which decorative complexity and variability and vessel completeness will be certainly positive: fragments so small that there is no room for much decoration and variation. However, it is likely the case that the vessels in my samples are too large to detect that relationship.

3.5 Summary

In this chapter, I provided the statistical procedures I used to explore morphometric variability and decorative complexity and variability in Middle to Late Woodland vessels. The morphometric analysis involves quantifying variability at the intervessel and intravessel levels using central tendency and dispersion. Further, I used Spearman's rank order correlation tests, linear regression analyses, and Mann-Whitney U-tests to explore the relationships between wall thickness and rim diameter, wall thickness variability and vessel completeness, to assess whether wall thickness between paired-portions is related, and whether there are statistically significant differences in wall thickness between Middle and Late Woodland vessels.

The analysis of decorative complexity and variability involve data derived from a novel attribute recording system I designed to quantify Woodland Period pottery design complexity and variability. I analyzed the vessels at the intervessel and intravessel levels using the central tendency and dispersion of the elemental complexity scores and decorative complexity scores. Further, I used linear regression analyses, Spearman's rank order correlation tests, and Mann-Whitney U-tests to explore the relationship between decorative variability and complexity and rim diameter, decorative variability and complexity and vessel completeness, and whether there are statistically detectable differences in decorative variability and complexity between the Middle and Late Woodland periods. Following, in Chapter 4, I report the results of the analysis of morphometric variability in Middle and Late Woodland vessels.

Chapter 4

Results: Morphometry

In this chapter, I present the results of the analysis of morphometric variability in the sample of Middle and Late Woodland vessels examined in this study. The process of quantifying variability produced a sizeable dataset suitable for statistical analysis. I report the results in the form of graphs, tables, summary statistics, and written observations. My interpretations can be found in Chapter 7.

Here, I report: 1) intervessel morphological variability in Middle Woodland vessels; 2) the relationship between rim diameter and vessel wall thickness in Middle Woodland vessels; 3) intravessel morphological variability in Middle Woodland vessels; 4) rim diameter variability in Middle Woodland vessels; 5) the relationship between vessel wall thickness variability and vessel completeness in Middle Woodland vessels; 6) the relationships in vessel wall thickness between each vessel portion in Middle Woodland vessels; 7) intervessel morphological variability in Late Woodland vessels; 8) the relationship between rim diameter and vessel wall thickness in Late Woodland vessels; 9) intravessel morphological variability in Late Woodland vessels; 10) rim diameter variability in Late Woodland vessels; 11) the relationship between morphological variability and vessel completeness in Late Woodland vessels, and lastly; 12) the relationships between each vessel portion in Late Woodland vessels; and 13) statistical analysis of differences in vessel morphometry between the Middle and Late Woodland periods.

4.1 Intervessel Morphometric Variability in Middle Woodland Vessels

In this section, I present intervessel wall thickness variability in the form of the mean, standard deviation, and coefficient of variation derived from four measurements on each vessel part (when present) on each of the 27 vessels in this sample. The raw data used for this portion of the analysis is found in Appendix A. A summary statistical characterization of Middle Woodland vessel wall thickness dispersion is also displayed in Table 4.1 and Figure 4.1 below.

Table 4.1: Intervessel Wall Thickness Variability in Middle Woodland Vessels (n=27).

Vessel Part	Lip	Rim	Neck	Shoulder	Body	Base
n=	26	27	27	27	17	5
Mean (mm)	7.03	8.15	8.24	7.03	7.33	9.30
Standard Deviation	2.16	1.82	2.05	1.93	2.03	2.52
Coefficient of Variation	30.73	22.33	24.88	27.45	27.7	27.10
Range (mm)	3-11	4-13	5-14	4-12	3-12	6-14

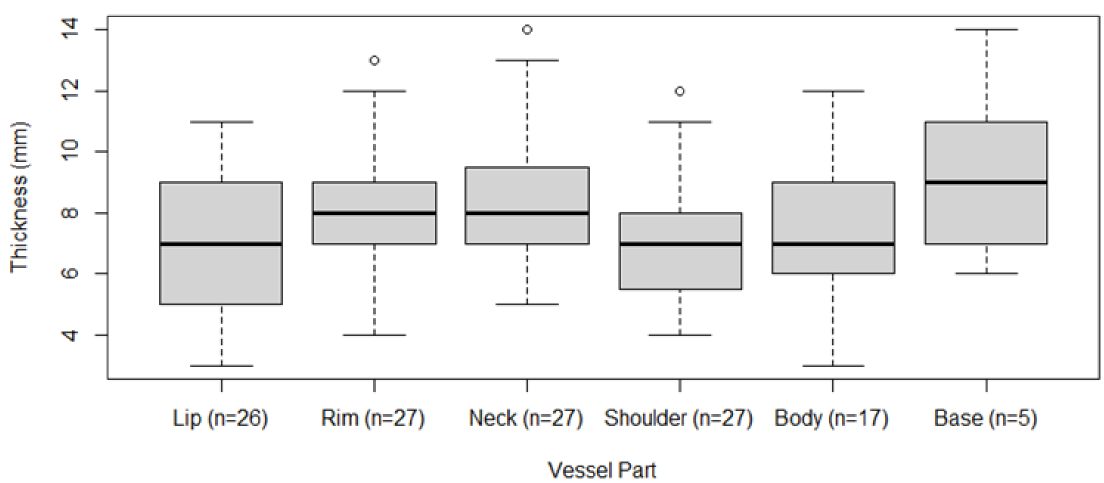

Figure 4.1: Boxplots of Vessel Part Wall Thickness Dispersion in Middle Woodland Vessels (n=27)

The average range for vessel wall thickness in this sample of Middle Woodland vessels is 8.5 mm. The highest amount of variability in thickness is seen in the lip part. Conversely, the rim is the most standardized vessel part. The base has an intermediate amount of variability compared to other vessel parts in this Middle Woodland sample. It also constitutes one of the thicker parts of the Middle Woodland samples.

The ‘wave’ pattern seen in Figure 4.1 is significant and may point to a techno-functional manufacturing template used in the Woodland Period. Vessel wall thickness goes from thin in the lip, thick in the rim and neck, thin in the shoulder and body, and thick in the base. This pattern will be discussed further in Chapter 6.

4.2 The Relationship Between Rim Diameter and Vessel Wall Thickness in Middle Woodland Vessels

The relationship between rim diameter and vessel wall thickness in the Middle Woodland sample is reported in this section. Rim diameter is used frequently in archaeological literature as a proxy for vessel size (DeBoer, 1974; Egloff, 1973; Millet, 1979b; Orton, 1982, 1987; Plog, 1985). If rim diameter is related to vessel size, vessel wall thickness must be related to rim diameter because, as vessels get larger, the walls must be made thicker in order to withstand the vessel’s own weight when being formed from wet clay, cured, and fired (Rice, 1987). The results of the Spearman’s rank order correlation tests support a positive relationship between vessel wall thickness and rim diameter (Table 4.2). Outliers in vessel wall thickness are present in the rim, neck, and shoulder parts.

Table 4.2: Results of Spearman’s Rank Order Correlation Tests: Relationship Between Vessel Wall Thickness and Rim Diameter in Middle Woodland Vessels (n=27).

Statistic	Lip	Rim	Neck	Shoulder	Body	Base
n=	26	27	27	24	17	5
S=	1743.60	1483.20	1551.30	1251.20	374.33	6.66
Rs=	0.40	0.55	0.53	0.52	0.54	0.67
p=	0.04	0.003	0.005	0.008	0.03	0.22

Table 4.2 demonstrates that the null hypothesis of no relationship can be rejected for

each vessel part excepting the base. The lip thickness of Middle Woodland vessels has a moderately strong, and significant relationship with rim diameter, while the rim, neck, shoulder, and body thicknesses have strong relationships with rim diameter. The lack of any relationship between rim diameter and vessel base thickness is explained by a small sample size. However, vessel bases may generally be thicker than the rest of the vessel, regardless of vessel size. Basal parts of Middle Woodland vessels may have a unique signature given that they must withstand higher impact pressures while being set down on a variety of surfaces. To further explore these relationships, I performed linear regression analyses comparing vessel wall thickness of each vessel portion to rim diameter. Figures 4.2, 4.3, and 4.4 are scatterplots representing the relationship between all vessel parts and rim diameter in this sample of Middle Woodland vessels.

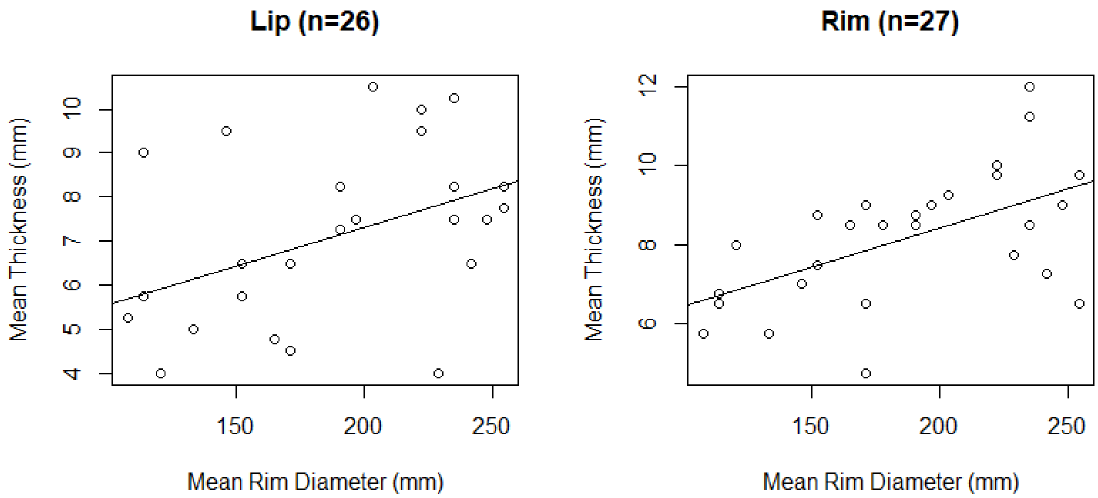

Figure 4.2: Scatterplots of the Relationship Between Lip and Rim Thickness and Rim Diameter in Middle Woodland Vessels (n=27)

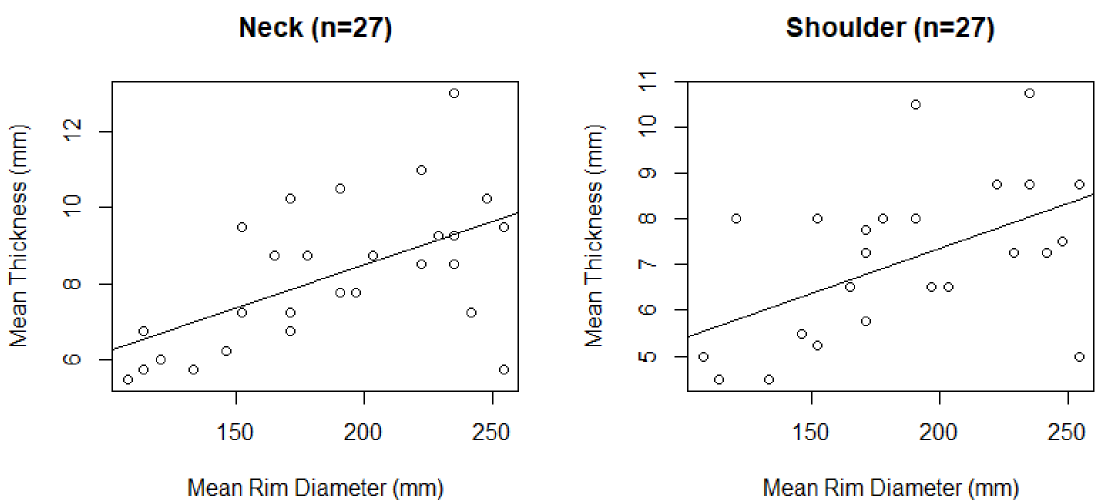

Figure 4.3: Scatterplots of the Relationship Between Neck and Shoulder Thickness and Rim Diameter in Middle Woodland Vessels (n=27)

As demonstrated by the results of the Spearman's rank order correlation tests and linear regression analyses, there is a strong, positive, linear trend (with outliers) between vessel wall thickness and rim diameter in Middle Woodland vessels. However, there is considerable deviation from a continuous linear distribution. The fit of the linear model is reported in Table 4.3.

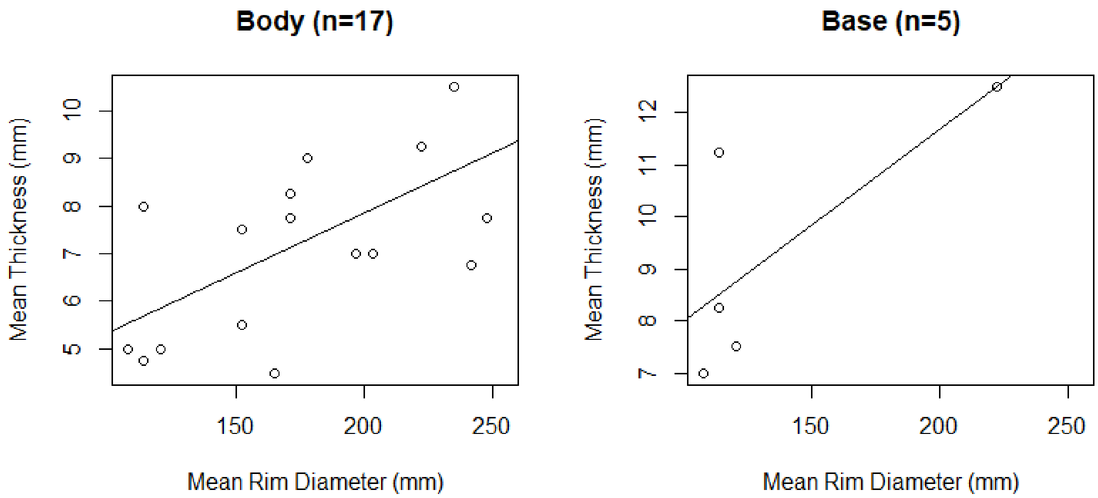

Figure 4.4: Scatterplots of the Relationship Between Body and Base Thickness and Rim Diameter in Middle Woodland Vessels (n=27)

Table 4.3: Fit of Linear Regression Models for each Vessel Part on Middle Woodland Sample (n=27) Testing the Relationship Between Vessel Wall Thickness and Rim Diameter.

Statistic	Lip	Rim	Neck	Shoulder	Body	Base
Residual Standard Error	1.86	1.42	1.59	1.53	1.52	1.89
Degrees of Freedom	24	25	25	23	15	3
Multiple R-Squared	0.17	0.31	0.32	0.28	0.4	0.55
Adjusted- R-Squared	0.14	0.28	0.29	0.25	0.36	0.4
F-Statistic	5.06	11.29	11.53	8.93	9.97	3.6
P-Value	0.03	0.002	0.002	0.006	0.006	0.15

4.3 Intravessel Morphometric Variability in Middle Woodland Vessels

The results for intravessel morphological variability in the sample of Middle Woodland vessels (n=27) are derived from four measurements on each vessel part taken on each Middle Woodland vessel. The results are reported in the form of means, standard deviations, and coefficients of variation. Boxplots and tables of ranges in mean, standard deviation, and coefficients of variation are found below (Table 4.4 and Figures 4.5 and 4.6).

Interestingly, the neck, shoulder, and body have considerable variation. However, three

Table 4.4: Range of Vessel Wall Thickness Statistics in Middle Woodland Sample (n=27).

Dispersion	Lip	Rim	Neck	Shoulder	Body	Base
n=	26	27	27	27	17	5
Mean (mm)	4-10.50	4.75-12.00	5.5-13.00	4.5-10.75	4.5-10.50	7-12.50
SD (mm)	0-1.41	0-1.50	0.5-2.06	0.5-2.06	0-1.73	0.82-1.73
CV (%)	0-20.41	0-17.67	4.87-23.56	4.65-28.28	0-28.28	11.6-15.18

vessels in this sample have parts with minimal wall thickness variation. For handmade ceramic vessels, a standard deviation and coefficient of variation of zero are unexpected.

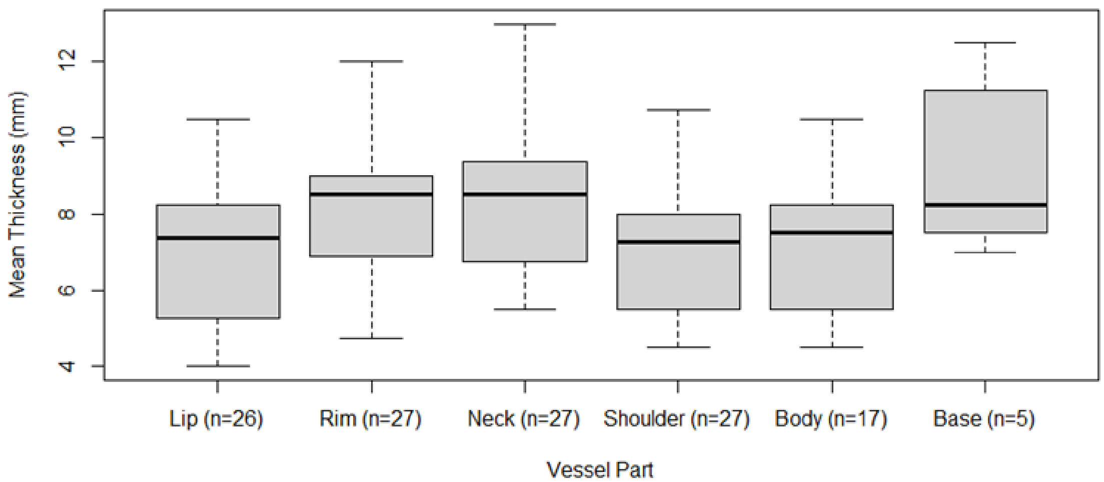

Figure 4.5: Boxplots of Mean Vessel Wall Thickness in this Sample of Middle Woodland Vessels (n=27)

The boxplots above in Figure 4.5 display the variation in mean wall thicknesses by vessel part. The boxplot in Figure 4.6 reports the dispersion of intravessel coefficients of variation for this sample of Middle Woodland vessels.

In Figure 4.5, a clear pattern emerges: vessel wall thickness changes from low to high on the lip, rim, and neck; then to low on the shoulder and body; then to high on the base. A similar pattern is expressed in the coefficient of variation: variation is lower in the lip rim, and base, and higher in the neck, shoulder, and body. This pattern has not been previously documented in Woodland vessels from this region and is hypothesized as reflecting a

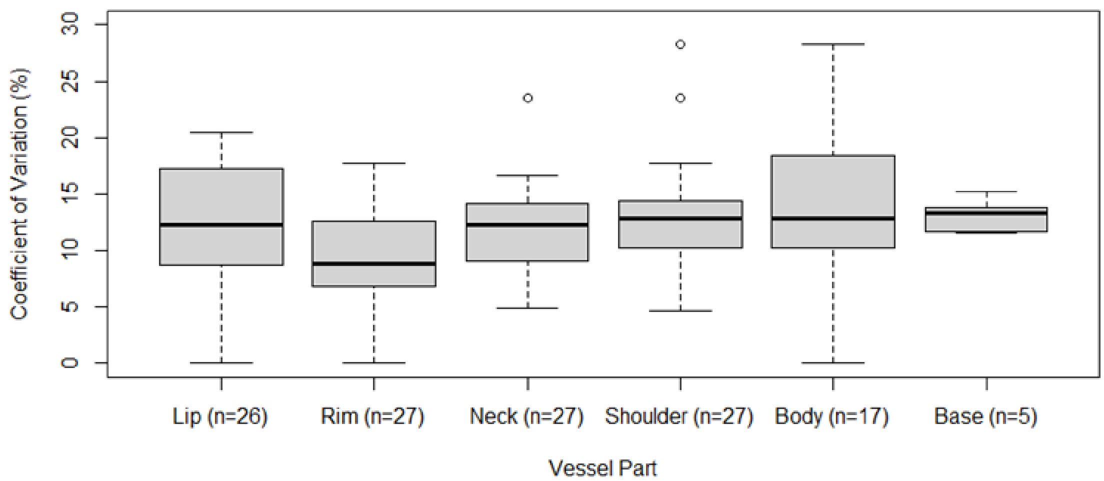

Figure 4.6: Range in Coefficients of Variation in Middle Woodland Vessel Wall Thickness with Highly Consistent Vessel Parts Included (n=27)

techno-functional template for vessel manufacture. As mentioned above, the implications of this are discussed in further detail in Chapter 6.

4.4 Rim Diameter Variability in Middle Woodland Vessels

Rim diameter is an important piece of information archaeologists derive from ceramic sherd assemblages. Frequently, rim diameter is used as a proxy for vessel size in ceramic analysis. Vessel size provides an essential interpretive standpoint in the characterization of a site. Larger vessels suggest long-term occupation, feasting, or high-cost resource procurement and processing; smaller vessels may suggest a more short-term occupation and cookware (Braun 1980, Hally 1982, 1983; Kooiman 2016; Shapiro 1984). A significant challenge for archaeologists is that ceramic vessels, being handmade, are variable, and thus rim diameter measurements might be dependent on the preservation of the rim examined. As archaeological assemblages are typically fragmented, reconstructing rim size is therefore prone to error. An understanding of rim diameter variability can help provide a framework for deriving error estimates for rim diameters in Middle Woodland fragmentary ceramic assemblages.

Table 4.5: Intravessel Rim Diameter Variability in Middle Woodland Vessels (n=27)

Vessel	Diameter (mm)	Extant Length (mm)	Total (%)	1/4	1/2	3/4
78-90-V21	152.4	75.0	15.7	203.2	152.4	152.4
BcGb-6-V20	254.0	145.0	18.2	254.0	254.0	254.0
BcGb-6-V18	228.6	133.0	18.5	203.2	228.6	228.6
p7C-V24	127.0	91.0	19.0	152.4	152.4	152.4
78-26-p26c	177.8	117.0	20.9	177.8	177.8	177.8
C80-56-V32	203.2	136.0	21.3	152.4	203.2	203.2
78-13	203.2	155.0	21.6	203.2	203.2	203.2
BdGa-12-V41	279.4	196.0	22.3	152.4	254.0	279.4
76-5	203.2	152.0	24.0	152.4	152.4	177.8
BcGb-6-V4	254.0	223.0	27.9	203.2	228.6	254.0
76-14	177.8	169.0	30.3	127.0	152.4	152.4
76-6	177.8	180.0	32.2	152.4	177.8	177.8
BcGb-6-V10	254.0	275.0	34.5	177.8	203.2	254.0
76-19	228.6	276.0	38.4	254.0	228.6	228.6
P3-78-V22	127.0	155.0	38.8	152.4	127.0	127.0
76-1	228.6	287.0	40.0	152.4	254.0	279.4
76-8	152.4	192.0	40.1	152.4	152.4	152.4
P78-16-V21	152.4	202.0	42.2	203.2	254.0	152.4
BcGb-6-V21	177.8	240.0	43.0	203.2	203.2	203.2
76-2	101.6	141.0	44.2	152.4	101.6	101.6
76-4	177.8	220.0	45.9	152.4	152.4	203.2
76-10	254.0	420.0	47.8	254.0	254.0	254.0
76-3	127.0	209.0	52.4	101.6	127.0	127.0
76-1	101.6	194.0	60.8	101.6	127.0	101.6
76-7	101.6	330.0	100.0	127.0	127.0	101.6
77-1	254.0	823.0	100.0	228.6	254.0	254.0
BdGa-12-V27	228.6	658.0	100.0	254.0	228.6	228.6

I measured rim diameter in three places per vessel: once at ¼ of the rim section, once at ½, and once at ¾ of the rim section. In Table 4.5 above, rim diameter measurements made on smaller portions of each extant rim frequently provide both underestimations and overestimations. I performed a Spearman's rank order correlation test searching for a correlation between the percent of absolute error and the percent of total vessel circumference using only vessel rims that are 50-100% complete.

I measured each rim in four equal sections (the total extant rim length, divided by four), converted to a percentage of the vessel's complete circumference. I took the differences between rim diameter measurements taken from ¼ of the extant rim and ¾ of the extant rim, and from ½ of the extant rim and ¾ of the extant rim, converted them to a percentage of the total circumference, and used those values as the absolute error percentage of each measurement. I then plotted the absolute error percentage against the percentage of the total circumference from each of the three measurements to look for a correlation.

There is no linear relationship between the percent of absolute error in rim diameter measurements and the percent of total circumference represented by each extant rim. Similarly, the Spearman's rank order correlation test did not produce significant results. This may be the result of small sample size. The test produced an Rs of -0.18 and a p-value of 0.61.

4.5 The Relationship Between Wall Thickness Variability and Vessel Completeness in Middle Woodland Vessels

I undertook an analysis of the relationship between wall thickness variability and vessel completeness. I measured variability by taking four measurements of wall thickness on each vessel part (the lip, rim, neck, shoulder, body, and base) and calculated the mean, standard deviation, and coefficient of variability from the four measurements on each vessel part. My hypothesis is that less complete vessels tend to have less variation in thickness—with more surface area for analysis, variation should increase. I performed Spearman's rank order correlation tests to discern any monotonic relationship between wall thickness variability and vessel completeness. Table 4.6 below reports the results.

Table 4.6: Results of Spearman's Rank Order Correlation Tests Determining the Relationship Between Wall Thickness Variability and Vessel Completeness of Each Vessel Portion in Middle Woodland Vessels (n=27)

Statistic	Lip	Rim	Neck	Shoulder	Body	Base
n=	26	27	27	27	17	5
S=	1527.1	1412.7	2712.3	1992.7	758	22
Rs=	0.48	0.57	0.17	0.23	0.07	-0.1
p=	0.01	0.002	0.39	0.26	0.79	0.95

The results indicate that there is a positive, monotonic relationship between thickness variability in the lip and rim portions and vessel completeness in Middle Woodland vessels. I performed linear regression analyses to determine the linearity of this relationship. Below are the results. I created six models—one each for the lip, rim, neck, shoulder, body, and basal portions of this sample of Middle Woodland vessels (n=27) (Figures 4.7. 4.8, and 4.9).

Except for the rim, the fit of these models does not support the hypothesis that variability is dependent on vessel completeness (Table 4.7). Rim thickness is weakly but significantly correlated to vessel completeness, with more complete vessels showing slightly more variation than less complete vessels. These results are useful, as they suggest that fragments representing low vessel completeness are representative of the vessel's average

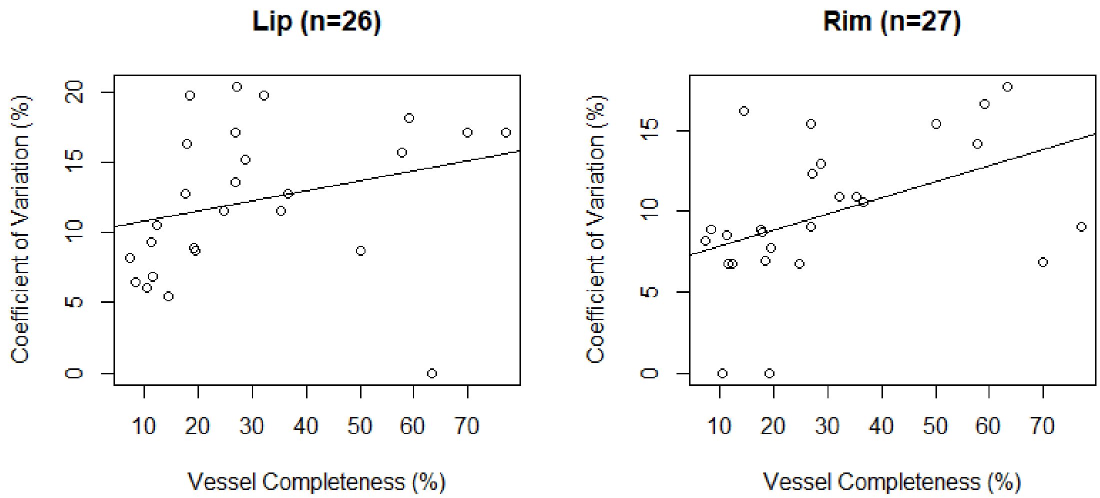

Figure 4.7: Scatterplots Demonstrating Relationship Between Vessel Completeness and the Coefficient of Variation for the Lip and Rim in the Middle Woodland Sample

wall thickness—excepting the rims, where more complete vessels may be necessary to capture the central tendency. In this sample, it appears that fragments of the lip, neck, shoulder, body, and basal parts, comprising just 10% of the whole vessel, provide a representative amount of variability expected of the whole vessel. To be sure, vessel fragments representing 20% completeness will provide a reliable estimation of vessel variability. In vessel rims, fragments representing between 30-40% vessel completeness are required to capture the central tendency of thickness.

Table 4.7: Fit of Linear Models Produced to Test Association Between Vessel Wall Thickness Variability and Vessel Completeness in Middle Woodland Vessels (n=27)

Statistic	Lip	Rim	Neck	Shoulder	Body	Base
Residual Standard Error	5.16	4.02	4.3	4.97	7.13	1.74
Degrees of Freedom	24	25	25	23	15	3
Multiple R-Squared	0.08	0.21	0.009	0.07	0.006	0.02
Adjusted- R-Squared	0.04	0.18	-0.03	0.03	-0.06	-0.31
F-Statistic	2.03	6.55	0.23	1.62	0.10	0.05
P-Value	0.17	0.01	0.64	0.20	0.76	0.83

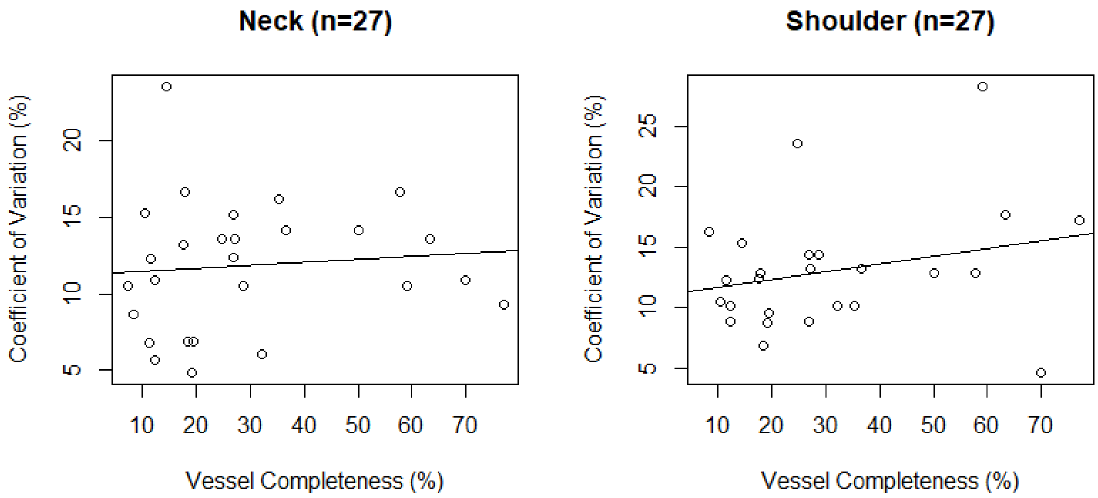

Figure 4.8: Scatterplots Demonstrating Relationship Between Vessel Completeness and the Coefficient of Variation for the Neck and Shoulder in the Middle Woodland Sample

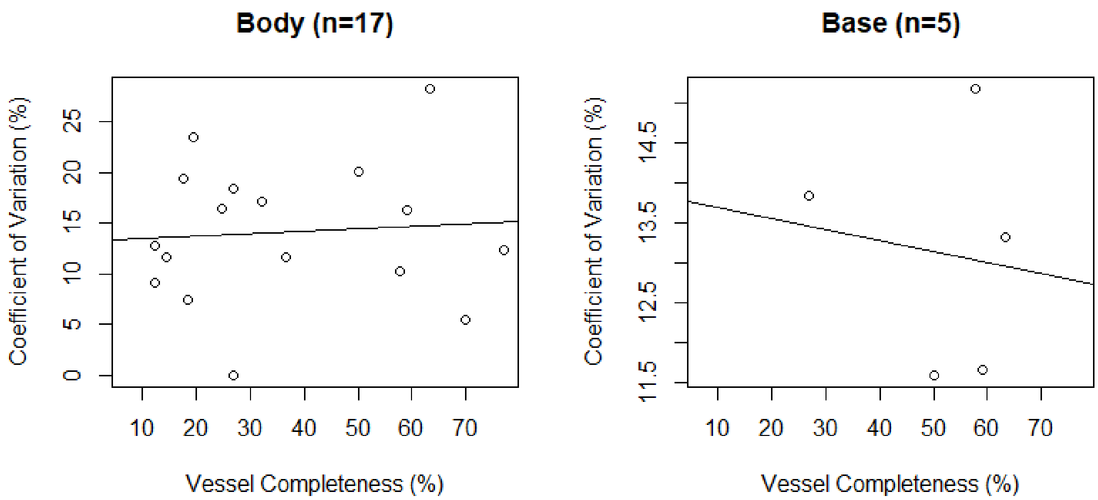

Figure 4.9: Scatterplots Demonstrating Relationship Between Vessel Completeness and the Coefficient of Variation for the Neck and Shoulder in the Middle Woodland Sample

4.6 The Relationship of Vessel Wall Thickness Between Each Vessel Portion in Middle Woodland Vessels

I used linear regression analyses to explore the relationship of wall thickness between paired-portions: the rim and neck, neck and shoulder, shoulder and body, and body and base. A positive relationship between these vessel portions would allow sherds to be related to one another even when vessel portions are missing in a fragmented assemblage. Figure 4.10 below is a scatterplot demonstrating the relationship between neck thickness and rim thickness with neck measurements acting as the dependent variable. Table 4.8 reports the fit of the model.

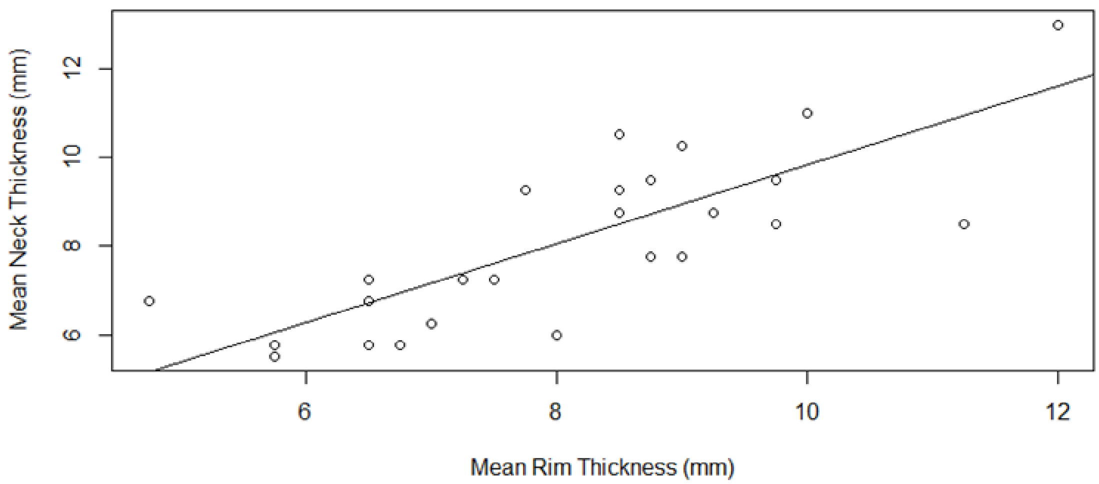

Figure 4.10: Linear Regression Scatterplot Relating Neck Thickness to Rim Thickness in Middle Woodland Vessels

Table 4.8: Fit of the Model Relating Neck Thickness to Rim Thickness in Middle Woodland Vessels

Statistic	Result
Residual Standard Error	1.18
Degrees of Freedom	25
Multiple R-Squared	0.63
Adjusted R-Squared	0.61
F-Statistic	41.95
P-Value	0.0000009

There is a significant, positive, linear correlation between neck thickness and rim thickness. As rims get thicker, so too does the neck. This result suggests that neck thickness can be predicted from rim thickness if neck sherds are missing from a fragmented assemblage. Figure 4.11 below is a scatterplot demonstrating the relationship between shoulder thickness and neck thickness. Table 4.9 reports the fit of the model.

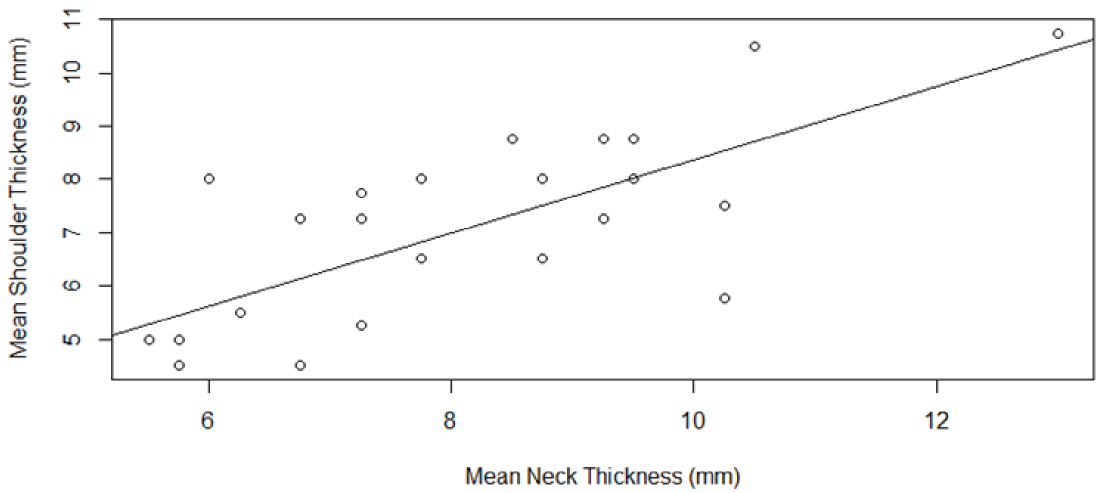

Figure 4.11: Linear Regression Scatterplot Relating Shoulder Thickness to Neck Thickness in Middle Woodland Vessels

Table 4.9: Fit of the Model Relating Shoulder Thickness to Neck Thickness in Middle Woodland Vessels

Statistic	Result
Residual Standard Error	1.24
Degrees of Freedom	23
Multiple R-Squared	0.53
Adjusted R-Squared	0.51
F-Statistic	26.06
P-Value	0.00004

There is a significant, positive, linear relationship between shoulder thickness and neck thickness. As neck thickness increases, so too does shoulder thickness. This result suggests that shoulder thickness can be predicted from neck thickness. Figure 4.12 below is a scatterplot relating body thickness to shoulder thickness, and Table 4.10 below reports the fit of the model.

There is a significant, positive, linear correlation between body thickness and shoulder thickness. This result suggests that shoulder thickness can be used to predict body thickness

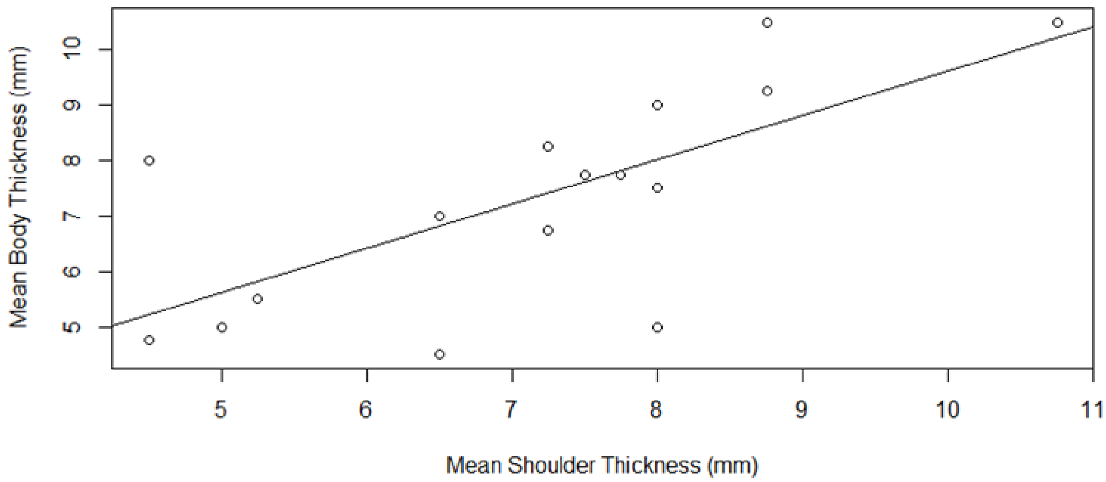

Figure 4.12: Linear Regression Scatterplot Relating Body Thickness to Shoulder Thickness in Middle Woodland Vessels

Table 4.10: Fit of the Model Relating Body Thickness to Shoulder Thickness in Middle Woodland Vessels

Statistic	Result
Residual Standard Error	1.4
Degrees of Freedom	15
Multiple R-Squared	0.49
Adjusted R-Squared	0.46
F-Statistic	14.41
P-Value	0.002

in fragmented assemblages. Figure 4.13 below is a scatterplot relating basal thickness to body thickness, and Table 4.11 reports the fit of the model.

There is a significant, positive, linear relationship between basal thickness and body thickness. This result suggests that body thickness can be used to predict basal thickness in fragmented assemblages.

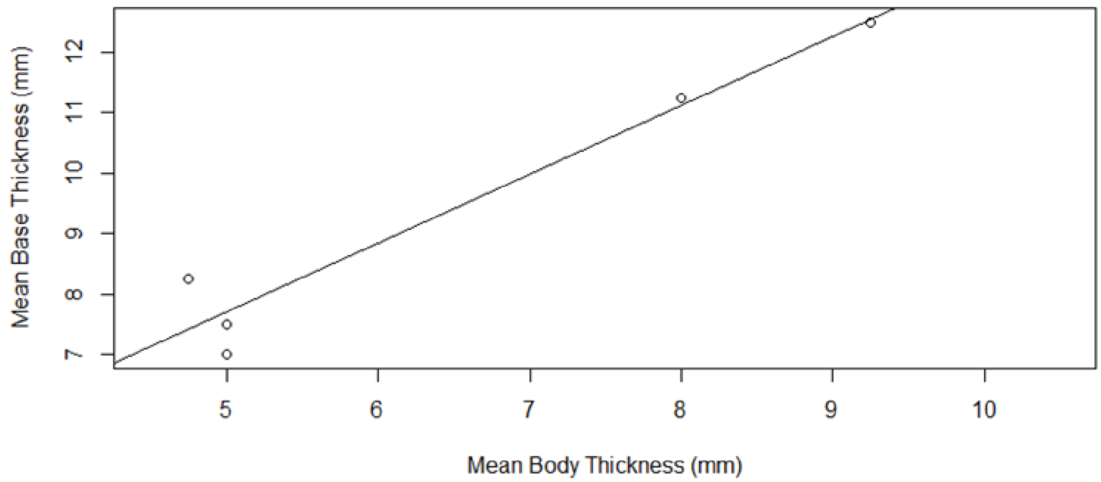

Figure 4.13: Linear Regression Scatterplot Relating Basal Thickness to Body Thickness in Middle Woodland Vessels

Table 4.11: Fit of the Model Relating Basal Thickness to Body Thickness in Middle Woodland Vessels

Statistic	Result
Residual Standard Error	0.64
Degrees of Freedom	3
Multiple R-Squared	0.95
Adjusted R-Squared	0.93
F-Statistic	54
P-Value	0.005

4.7 Intervessel Morphometric Variability in Late Woodland Vessels

I present intervessel wall thickness variability here in the form of the mean, standard deviation, and coefficient of variation derived from four measurements on each vessel part on each of the 18 vessels in this sample. Appendix A reports the raw data used for this portion of the analysis. A summary statistical characterization of Late Woodland vessel wall thickness dispersion is also displayed in Table 4.12 and Figure 4.14 below.

Table 4.12: Dispersion of Intervessel Wall Thickness in Late Woodland Vessels (n=18)

Dispersion	Lip	Rim	Neck	Shoulder	Body	Base
n=	18	18	18	17	11	3
Mean (mm)	7.28	9.32	7.47	6.4	5.93	8.5
SD (mm)	2.18	1.79	1.47	2.02	1.61	2.24
CV (%)	29.95	19.21	19.68	31.56	27.15	26.35
Range (mm)	2-11	7-14	4-12	3-13	3-9	5-12

Mean vessel wall thickness in this sample of Late Woodland vessels falls between 5.93 mm and 9.32 mm. The thickest part of Late Woodland vessels is the rim, likely due to the introduction of collars. Not considering the rim, however, the basal portion is the thickest. Again, this is likely due to the need for a sufficiently thick basal wall to withstand impact pressures from being set down on a variety of surfaces.

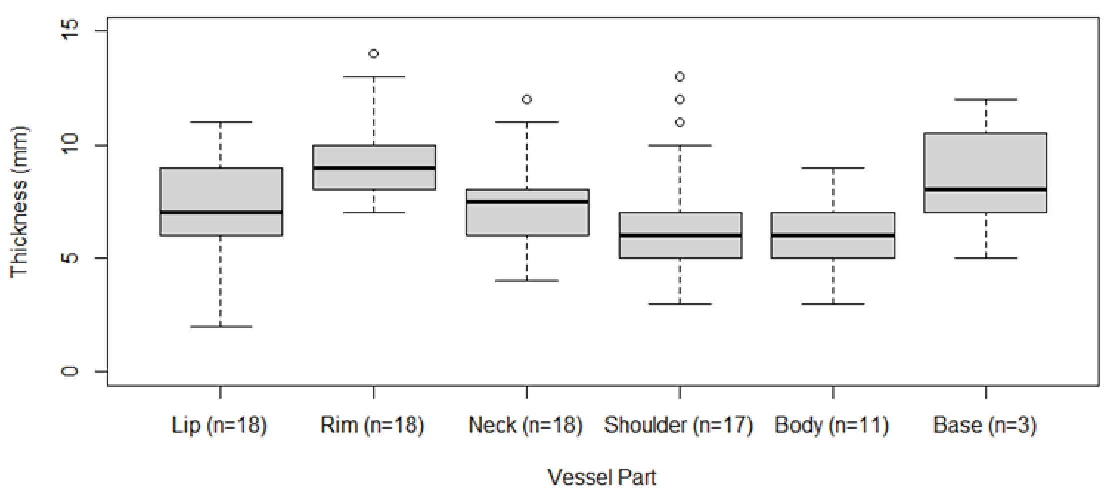

Figure 4.14: Boxplots Showing Range in Vessel Wall Thickness Between Late Woodland Vessels (n=18)

Figure 4.14 illustrates that the dispersion around the median for each of the vessel parts in this sample of Late Woodland vessels exhibits the same pattern as that found in the Middle Woodland vessels: low in the lip, higher in the rim, low in the neck, much lower in the shoulder and body, and high in the basal portion.

4.8 The Relationship Between Rim Diameter and Vessel Wall Thickness in Late Woodland Vessels

To explore the relationship between vessel wall thickness and rim diameter in this sample of Late Woodland vessels (n=18), I performed Spearman's rank order correlation tests on each vessel part. Table 4.13 below reports the results.

Table 4.13: Results of Spearman's Rank Order Correlation Tests of Mean Vessel Wall Thickness and Mean Rim Diameter Relationships in Late Woodland Vessels (n=18)

Statistic	Lip	Rim	Neck	Shoulder	Body	Base
n=	18	18	18	17	11	3
S=	392.35	876.14	951.84	1111	300.55	6
rs=	0.60	0.10	0.021	-0.36	-0.37	-0.50
p=	0.009	0.71	0.94	0.15	0.27	1

The lip is the only vessel part that exhibits a positive, significant, monotonic relationship between wall thickness and rim diameter in this sample of Late Woodland vessels. The thickness of the rim, neck, shoulder, body, and basal portions of Late Woodland vessels do not seem to be affected by increasing or decreasing rim diameters. I performed a linear regression analysis on all six parts of Late Woodland vessels to determine whether rim diameter offers some predictability in vessel wall thickness. Figures 4.15, 4.16, and 4.17 below shows the scatterplots with a line of best fit.

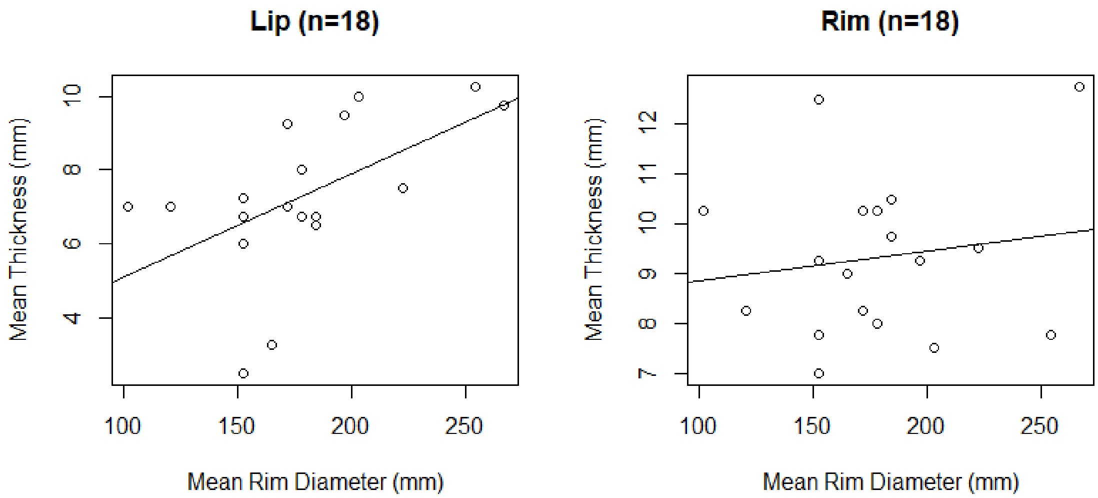

Figure 4.15: Scatterplots Relating Mean Lip and Rim Thickness to Mean Rim Diameter in Late Woodland Vessels

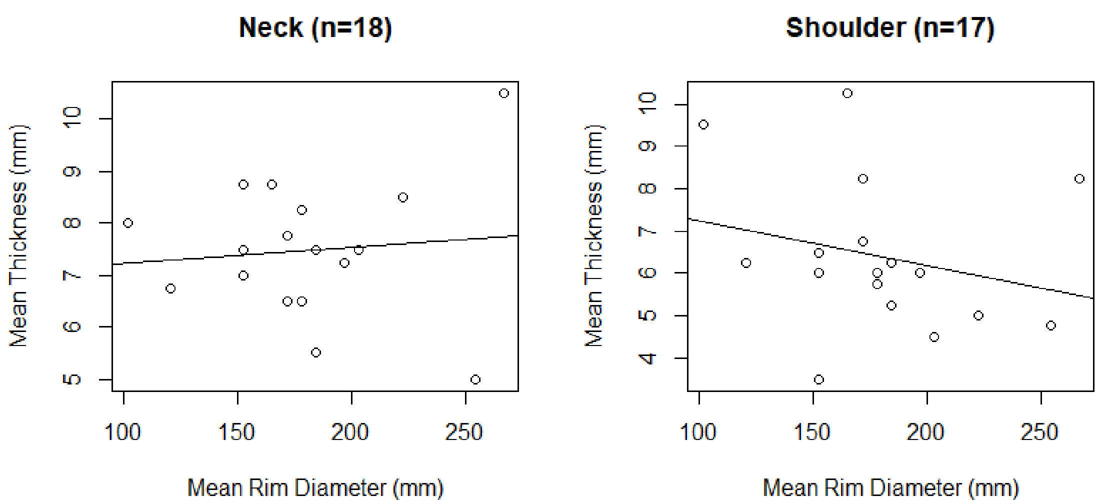

Figure 4.16: Scatterplots Relating Mean Neck and Shoulder Thickness to Mean Rim Diameter in Late Woodland Vessels

The scatterplot for the lip indicates a strong, positive, linear relationship between vessel wall thickness and rim diameter. All vessel parts, aside from the lip, show little relationship to rim diameter in Late Woodland vessels. Table 4.14 below reports the summary statistics of the linear regression models indicating the fit of the models.

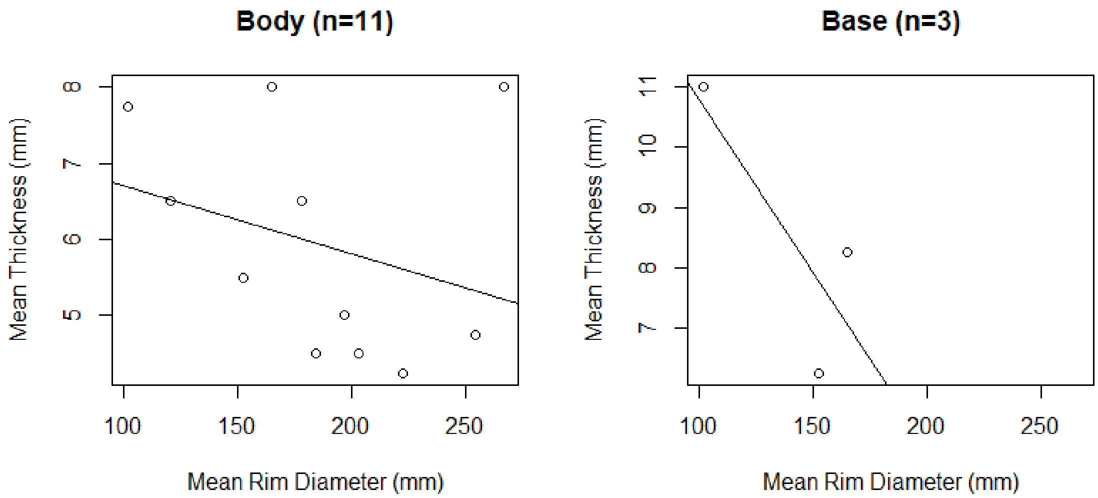

Figure 4.17: Scatterplots Relating Mean Body and Base Thickness to Mean Rim Diameter in Late Woodland Vessels

Table 4.14: Fit of Linear Regression Models Testing the Relationship Between Vessel Wall Thickness and Rim Diameter in Late Woodland Vessels (n=18)

Statistic	Lip	Rim	Neck	Shoulder	Body	Base
Residual Standard Error	1.79	1.64	1.3	1.77	1.48	1.97
Degrees of Freedom	16	16	16	15	9	1
Multiple R-Squared	0.3	0.02	0.01	0.06	0.09	0.66
Adjusted R-Squared	0.26	-0.03	-0.05	0.0002	-0.006	0.32
F-Statistic	7.02	0.38	0.17	1	0.94	1.94
P-Value	0.01	0.5	0.69	0.33	0.36	0.4

4.9 Intravessel Morphometric Variability in Late Woodland Vessels

I calculated intravessel morphometric variability from the sample of Late Woodland vessels (n=18) using four measurements on each vessel part of each Late Woodland vessel. The results are reported in the form of means, standard deviations, and coefficients of variation in Table 4.15. Boxplots and of ranges in mean, standard deviation, and coefficients of variation are found below.

In comparison to Middle Woodland vessels, there is considerable consistency in vessel

Table 4.15: Range of Vessel Wall Thickness Statistics for Each Vessel Part in the Late Woodland Sample (n=18)

Statistic	Lip	Rim	Neck	Shoulder	Body	Base
n=	18	18	18	17	11	3
Range of Mean (mm)	2.5-10.50	7-12.75	5-10.50	3.5-10.25	4.25-8	6.25-11
Range of SD (mm)	0-1.41	0-2.63	0-1.73	0-3.00	0.5-1.41	0.82-1.23
Range of CV (%)	0-23.09	0-25.65	0-17.21	0-31.57	8.88-22.52	7.42-15.31

wall thickness. The lip, body, and basal parts of these Late Woodland vessels show standard deviations below 1.5 mm, while the rim, neck, and shoulder parts show variation above 1.5 mm to a maximum of 3 mm (in the shoulder). Some Late Woodland vessels show minimal variation in the lip, rim, neck, and shoulder parts. The coefficient of variation indicates that the neck (except for the base, which has a small sample size) is the most standardized, while the highest amount of variation is found in the shoulder. This may be due to the Late Woodland tradition of making the rim/neck and shoulder/body sections separately and attaching them together prior to firing.

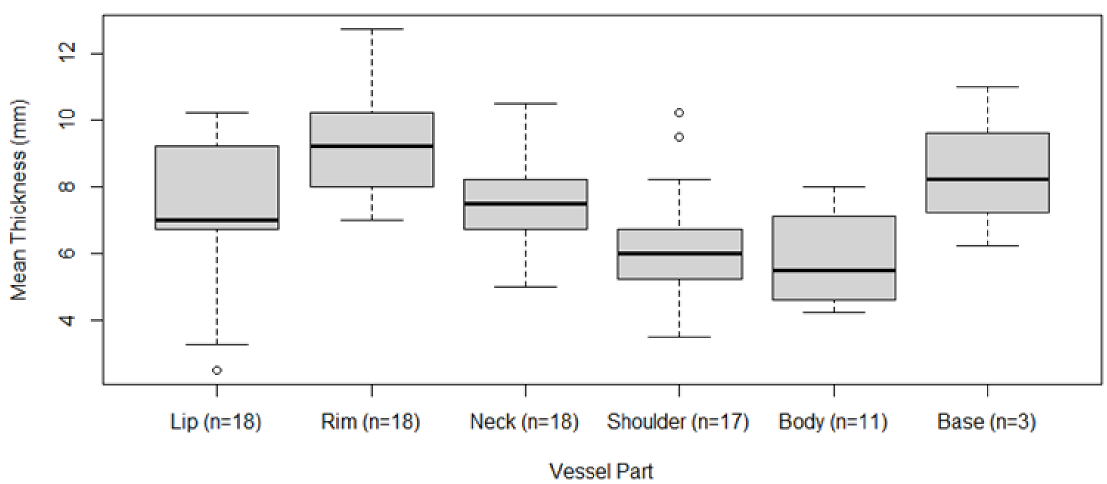

Figure 4.18: Boxplots Showing Intravessel Mean Thickness Variation Trends in Late Woodland Vessels (n=18)

The multi-stage vessel construction pattern may lead to higher variation at the neck to shoulder attachment point. The basal part also shows a smaller amount of variability, though it has a small sample size. The thickest part of Late Woodland vessels appears to be the rim, while the thinnest part of Late Woodland vessels appears to be the body. That the body is the thinnest vessel part is consistent with functional and adaptive interpretations of new vessel wall thinning techniques in the Late Woodland period (Braun, 1983, 2010; Fox 1990: 171-188; Hart, 2012; Hart and Brumbach 2009; Kooiman 2016; MacNeish, 1952; Ritchie and MacNeish 1949). Figure 4.18 reports these trends in a boxplot.

4.10 Rim Diameter Variability in Late Woodland Vessels

As previously mentioned, rim diameter measurements are essential tools archaeologists use to help characterize ceramic-rich sites. Understanding variation in rim symmetry and how this might influence the accurate estimation of rim diameter will help archaeologists adjust their rim diameter determinations when analyzing fragmentary assemblages. Table 4.16 below reports the raw data used for determining the relationship between rim size, proportion, and rim diameter estimates.

Table 4.16: Intravessel Rim Diameter Variability in Late Woodland Vessels (n=18)

Vessel	Diameter (mm)	Extant Length (mm)	Total (%)	1/4	1/2	3/4
76-17	152.4	84.0	17.5	152.4	152.4	152.4
BcGb-6-V5	152.4	90.0	18.8	152.4	152.4	152.4
BcGb-6-14	203.2	153.0	24.0	152.4	152.4	177.8
BcGb-6-V8	177.8	144.0	25.8	177.8	203.2	203.2
BcGb-6-23	177.8	186.0	33.3	177.8	177.8	177.8
76-11	152.4	165.0	34.5	152.5	177.8	177.8
BcGb-6-V2	152.4	185.0	38.6	152.4	152.4	152.4
BcGb-6-V13	127.0	158.0	39.6	152.4	152.4	177.8
76-18	228.6	287.0	40.0	101.6	127.0	127.0
76-22	254.0	330.0	41.3	203.2	228.6	228.6
BcGb-6-V19	152.4	200.0	41.8	254.0	254.0	254.0
76-20	177.8	250.0	44.8	177.8	177.8	177.8
BcGb-3-V2	254.0	370.0	46.4	254.0	254.0	254.0
BcGb-3-V1	177.8	455.0	81.5	177.8	177.8	177.8
BcGb-6-V3	152.4	398.0	83.1	152.4	152.4	152.4
BcGb-6-9	101.6	303.0	95.0	101.6	101.6	101.6
76-21	203.2	377.0	100.0	203.2	203.2	203.2
BcGb-6-V1	228.6	660.0	100.0	228.6	228.6	228.6

The vessels in the Late Woodland sample were highly consistent, and thus did not yield a dataset amenable to a Spearman's rank order correlation test.

4.11 The Relationship Between Wall Thickness Variability and Vessel Completeness in Late Woodland Vessels

This section replicates the statistical procedures I used to determine whether sherd thickness variability is dependent on vessel completeness for Middle Woodland vessels. I performed six Spearman's rank order correlation tests and linear regression analyses—one each for the lip, rim, neck, shoulder, body, and basal parts in this sample of Late Woodland vessels (n=18). I then plotted the coefficient of variation for each Late Woodland vessel's parts against vessel completeness. Table 4.17 below reports the results of the Spearman's rank order correlation tests.

Table 4.17: Results of Spearman's Rank Order Correlation Tests Correlating Vessel Portion Thickness Variability and Vessel Completeness in Late Woodland Vessels (n=18)

Statistic	Lip	Rim	Neck	Shoulder	Body	Base
n=	18	18	18	17	11	3
S=	1045.10	884.28	785.22	695.71	359.95	8
Rs=	-0.08	0.09	0.19	0.15	-0.64	-1
p=	0.76	0.73	0.45	0.57	0.04	0.33

The results of the Spearman's rank order correlation tests show that there is no monotonic relationship between wall thickness variability and vessel completeness, excepting the body. There appears to be a significant, negative monotonic relationship between body thickness variability and vessel completeness in Late Woodland vessels. I used linear regression analyses to determine if this relationship is linear and significant. Figures 4.19, 4.20, and 4.21 below show the scatterplots for each vessel part indicating the strength and relationship between completeness and sherd thickness variability.

The scatterplots above indicate little relationship between vessel wall thickness variability and vessel completeness. The body portion of Late Woodland vessels have a p-value approaching significance, but fails to reach significance. Table 4.18 reports the fit of the models for interpretation.

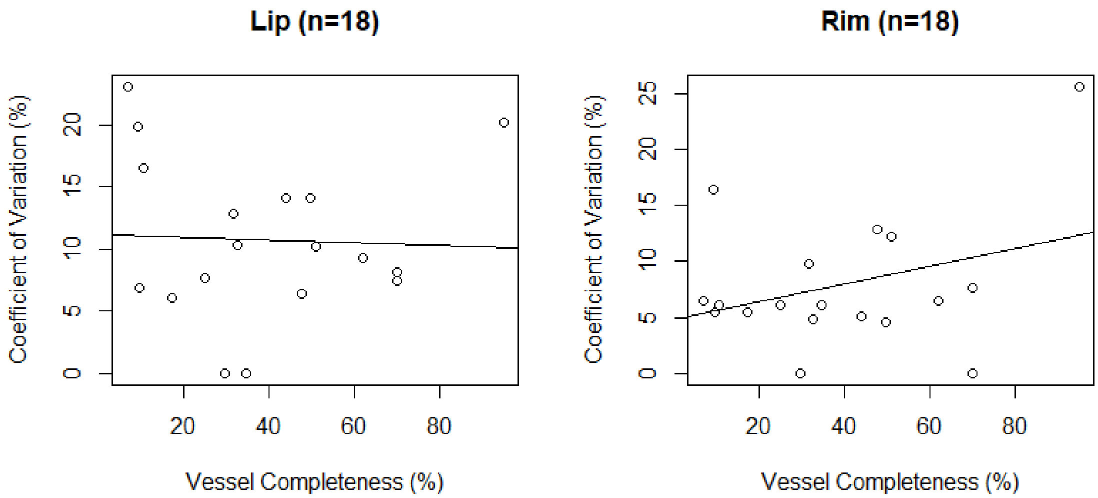

Figure 4.19: Scatterplots Testing Correlation Between the Coefficient of Variation of the Lip and Rim and Vessel Completeness in Late Woodland Vessels

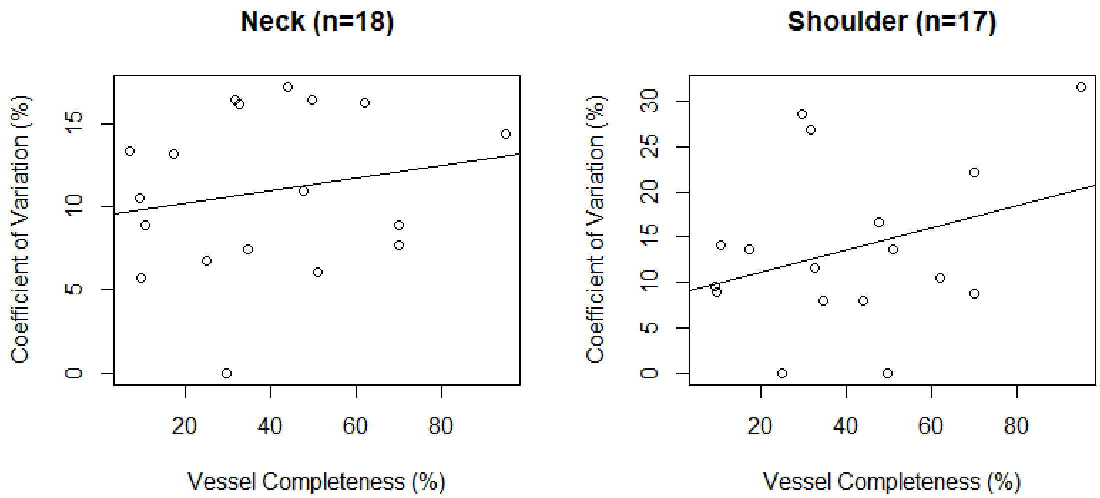

Figure 4.20: Scatterplots Testing Correlation Between the Coefficient of Variation of the Neck and Shoulder and Vessel Completeness in Late Woodland Vessels

Table 4.18: Fit of Linear Regression Models Testing the Correlation Between Vessel Wall Thickness Variability and Vessel Completeness in Late Woodland Vessels (n=18)

Statistic	Lip	Rim	Neck	Shoulder	Body	Base
Residual Standard Error	6.62	5.85	4.91	8.86	3.8	1.67
Degrees of Freedom	16	16	16	15	9	1
Multiple R-Squared	0.001	0.11	0.04	0.11	0.33	0.93
Adjusted- R-Squared	-0.06	0.05	-0.02	0.05	0.25	0.86
F-Statistic	0.03	1.97	0.6	1.77	4.34	13.7
P-Value	0.86	0.18	0.45	0.2	0.07	0.17

Overall, the linear regression models produced for each vessel part indicate that there is no significant relationship between vessel wall thickness and vessel completeness, linear or otherwise.

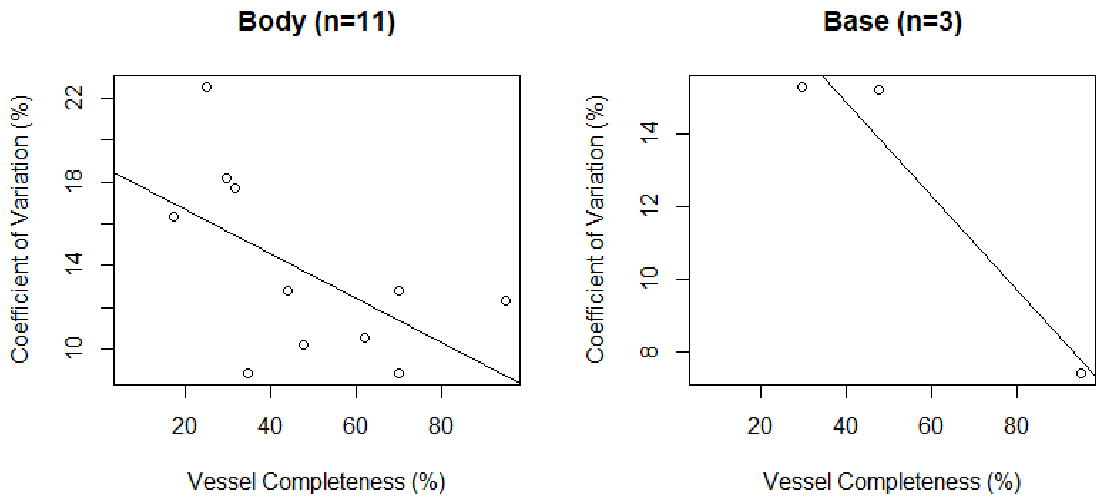

Figure 4.21: Scatterplots Testing Correlation Between the Coefficient of Variation of the Body and Base and Vessel Completeness in Late Woodland Vessels

4.12 The Relationship of Vessel Wall Thickness Between Each Vessel Portion in Late Woodland Vessels

I used linear regression analyses to determine the relationship between the neck and rim, shoulder and neck, body and shoulder, and base and body in Late Woodland vessels. Figure 4.22 below is a scatterplot demonstrating the relationship between neck thickness and rim thickness in Late Woodland vessels. Table 4.19 reports the fit of the model.

There is a nearly significant, positive, linear relationship with outliers between neck thickness and rim thickness. A weak relationship between rim thickness and neck thickness may be expained by the Late Woodland development of collared vessels. Variability should be kept in mind if attempting to relate rim thickness to neck thickness in a fragmented Late Woodland assemblage. Figure 4.23 below is a scatterplot relating shoulder thickness to neck thickness in Late Woodland vessels, and Table 4.20 reports the fit of the model.

There is a significant, positive, linear trend between shoulder thickness and neck thickness in Late Woodland vessels. This result suggests that neck thickness offers some predictability of shoulder thickness in Late Woodland vessels. Figure 4.24 below is a scatterplot relating body thickness to shoulder thickness in Late Woodland vessels, and Table

4.21 reports the fit of the model.

There is a significant, positive, linear correlation between body thickness and shoulder thickness. As shoulder thickness increases, so too does body thickness. This result suggests that shoulder thickness can be used to predict the thickness of body sherds in a fragmented assemblage. Figure 4.25 below is a scatterplot relating basal thickness to body thickness in Late Woodland vessels, and Table 4.22 reports the fit of the model.

There is a poor relationship between basal thickness and body thickness in Late Woodland vessels. A small sample size may The lack of a significant relationship between the base and body of Late Woodland vessels is likely due to a small sample size used for the analysis (n=3).

There is a strong and significant correlation between the neck and shoulder, and shoulder and body portions of Late Woodland vessels. There is a nearly significant relationship between neck thickness and rim thickness, but it failed to reach significance. Rim thickness may still offer some predictability for neck thickness, but rim thickness variability should be considered in an applied setting.

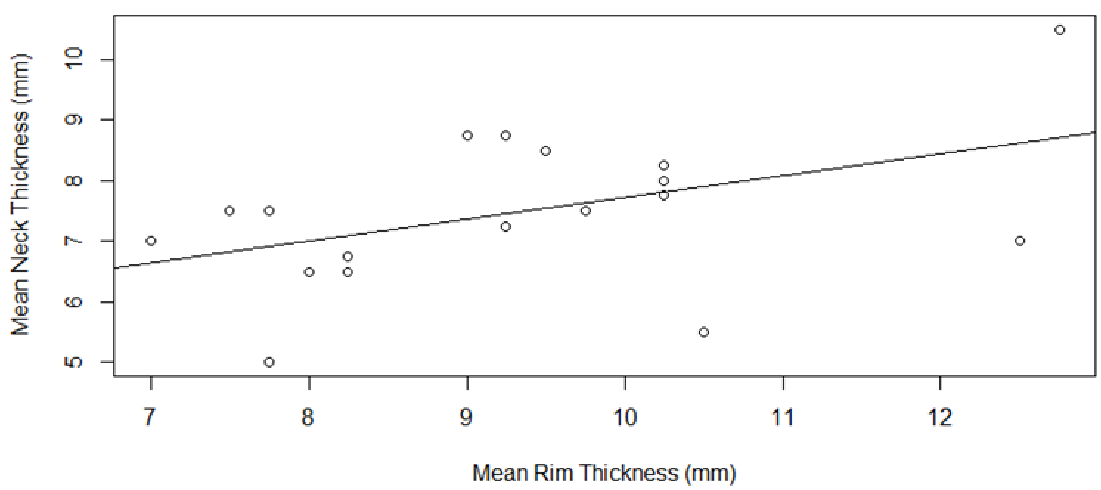

Figure 4.22: Linear Regression Scatterplot Relating Neck Thickness to Rim Thickness in Late Woodland Vessels

Table 4.19: Fit of the Model Relating Neck Thickness to Rim Thickness in Late Woodland Vessels

Statistic	Result
Residual Standard Error	1.17
Degrees of Freedom	16
Multiple R-Squared	0.2
Adjusted R-Squared	0.16
F-Statistic	4.15
P-Value	0.06

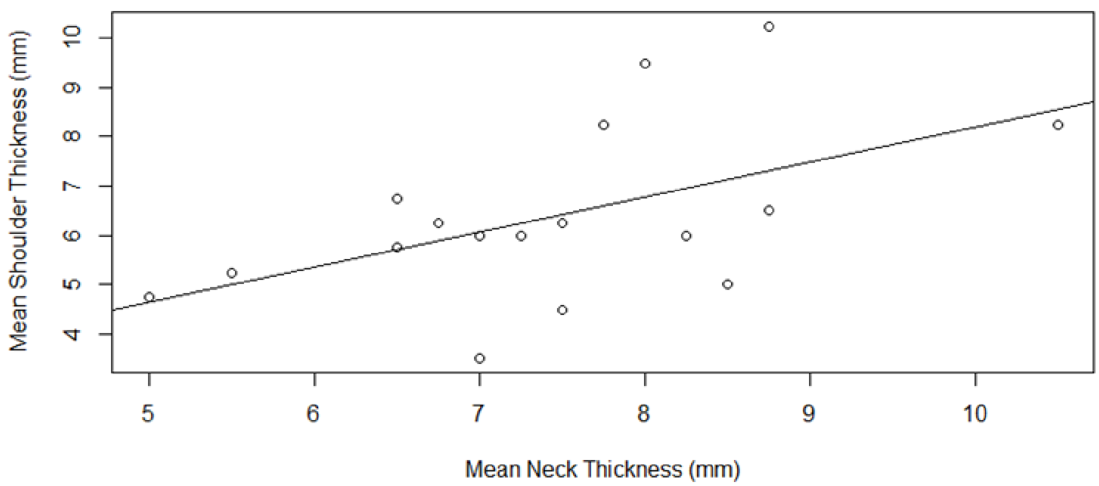

Figure 4.23: Linear Regression Scatterplot Relating Shoulder Thickness to Neck Thickness in Late Woodland Vessels

Table 4.20: Fit of the Model Relating Shoulder Thickness to Neck Thickness in Late Woodland Vessels

Statistic	Result
Residual Standard Error	1.56
Degrees of Freedom	15
Multiple R-Squared	0.27
Adjusted R-Squared	0.22
F-Statistic	5.62
P-Value	0.03

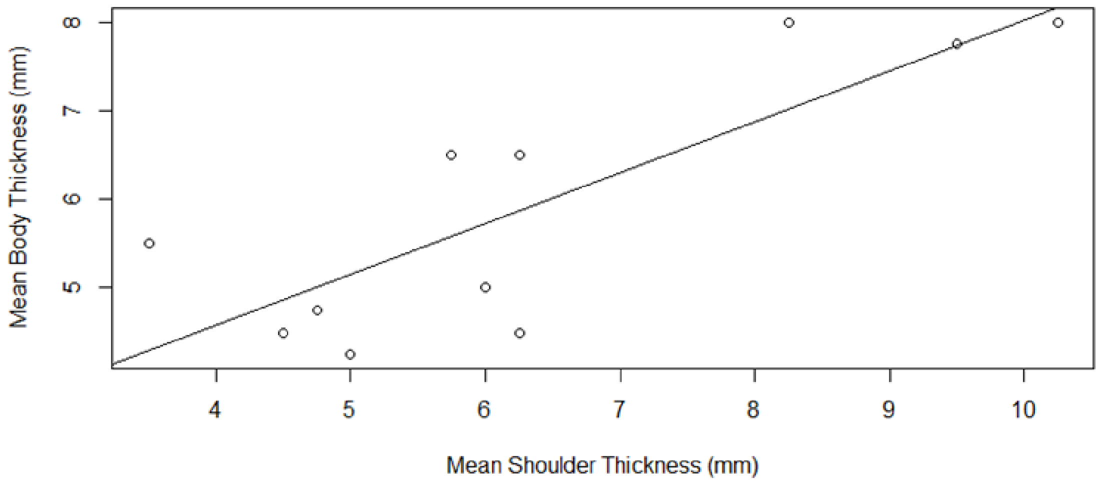

Figure 4.24: Linear Regression Scatterplot Relating Body Thickness to Shoulder Thickness in Late Woodland Vessels

Table 4.21: Fit of the Model Relating Body Thickness to Shoulder Thickness in Late Woodland Vessels

Statistic	Result
Residual Standard Error	0.88
Degrees of Freedom	9
Multiple R-Squared	0.68
Adjusted R-Squared	0.64
F-Statistic	18.7
P-Value	0.002

Table 4.22: Fit of the Model Relating Basal Thickness to Body Thickness in Late Woodland Vessels

Statistic	Result
Residual Standard Error	2.19
Degrees of Freedom	1
Multiple R-Squared	0.58
Adjusted R-Squared	0.16
F-Statistic	1.38
P-Value	0.45

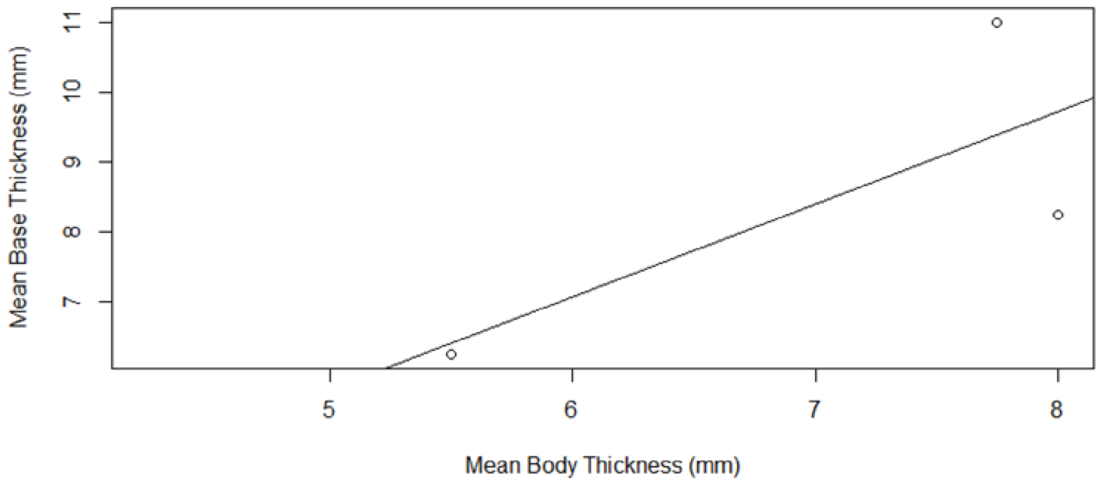

Figure 4.25: Linear Regression Scatterplot Relating Basal Thickness and Body Thickness in Late Woodland Vessels

4.13 Evaluating Change in Vessel Wall Thickness and Rim Diameter Between the Middle and Late Woodland Periods

General trends in ceramic manufacture between the Middle and Late Woodland period help archaeologists understand chrono-cultural developments in the past and help temporally anchor archaeological sites by the design and morphometry of the ceramic vessels present. I used Mann-Whitney U-tests to determine if there are statistically detectable differences in wall thickness and rim diameter between the Middle and the Late Woodland periods. Table 4.23 reports the results.

Table 4.23: Results of Mann-Whitney U-tests Performed to Highlight Wall Thickness Changes Between the Middle and Late Woodland Periods

Statistic	Lip	Rim	Neck	Shoulder	Body	Base	Rim Diameter
W=	218.5	151.0	298.5	257.0	134.0	9.5	273.0
P=	0.72	0.03	0.20	0.26	0.06	0.65	0.49

Table 4.24: Comparing Rim Thickness Between the Middle and Late Woodland Period Vessels

Dispersion	Middle Woodland	Late Woodland
Mean (mm)	8.15	9.32
SD (mm)	1.82	1.80
CV (%)	22.33	19.31

The p-value comparing vessel wall thickness in the lip, neck, shoulder, base, and rim diameter between the Middle and Late Woodland samples indicate that, statistically, each sample is derived from the same population. However, the rim has a p-value of 0.03 (two-tailed), indicating a statistically detectable difference in rim thickness between the Middle and Late Woodland periods. Middle Woodland vessels tend to have thinner rims than Late Woodland vessels (Table 4.24); however, Late Woodland rim thickness tends to be less variable. The p-value for the body portion of Middle and Late Woodland period vessels is approaching significance (p=0.06). These results are consistent with the understanding of rim collar developments and changes in vessel wall thinning techniques between the Middle and Late Woodland periods. Lastly, there does not appear to be a significant change in rim diameter between Middle and Late Woodland period vessels in this sample of Woodland Period vessels (n=45).

I used a Mann-Whitney U test to test for differences in rim diameter between the Middle and Late Woodland periods. The results (Table 4.25) demonstrate that there is no statistically detectable difference in rim diameter between the Middle and Late Woodland periods.

Table 4.25: Results of Mann-Whitney U-test Exploring Differences in Rim Diameter Between Middle and Late Woodland Vessels

Statistic	Result
W=	273
p=	0.49

4.14 Summary

A sizeable dataset on vessel wall thickness in Middle and Late Woodland vessels was analyzed in this chapter. A summary of the tests and results are presented in Tables 4.26 and 4.27 below. Significantly, I identified a pattern in both Middle and Late Woodland vessels. This pattern, I interpret as a techno-functional template utilized by Woodland Period potters wherein Middle and Late Woodland vessels were made to be thin at the lip, thick at the rim and neck, thin at the shoulder and body, and thick again at the base. This pattern reflects a conscious consideration of the durability, functionality, and utility of Woodland Period ceramic vessels. The rim and neck of ceramic vessels require sturdy construction to withstand the potentially hazardous tasks of placing, removing, and stirring the contents of the vessels. The shoulder and the body of Woodland Period ceramic vessels were made to be thin likely for functionality—a thinner shoulder and body help to transfer heat to the contents of the vessels much more efficiently than thicker-bodied vessels (Braun, 1983, 2010; Brody 1979; Henrickson and McDonald 1983; Rice, 1987; Schiffer and Skibo, 1987; Van Vlack 1964; but see: Bowen and Harry 2019). The base was likely made thicker to endure day-to-day wear when being set down on a variety of surfaces, placed in fires, or put in storage. Furthermore, thin vessel walls–made to be even, with little variation–improve thermal shock resistance such that vessels are more resistant to cracking and spalling during heating and cooling (Amberg and Hartstook, 1946; Braun, 1983; Kingery, 1955; Rice, 1987; Tite et al, 2001).

Table 4.26: Chapter 4 Summary of Statistical Analyses and Results

Correlation	Test	Result
Wall Thickness and Rim Diameter in Middle Woodland Vessels		
Lip	Spearman's Rank Order	Significant, positive
Rim	Spearman's Rank Order	Significant, positive
Neck	Spearman's Rank Order	Significant, positive
Shoulder	Spearman's Rank Order	Significant, positive
Body	Spearman's Rank Order	Significant, positive
Base	Spearman's Rank Order	No correlation
Lip	Linear Regression	Significant, positive
Rim	Linear Regression	Significant, positive
Neck	Linear Regression	Significant, positive
Shoulder	Linear Regression	Significant, positive
Body	Linear Regression	Significant, positive
Base	Linear Regression	No correlation
Wall Thickness and Rim Diameter in Late Woodland Vessels		
Lip	Spearman's Rank Order	Significant, positive
Rim	Spearman's Rank Order	No correlation
Neck	Spearman's Rank Order	No correlation
Shoulder	Spearman's Rank Order	No correlation
Body	Spearman's Rank Order	No correlation
Base	Spearman's Rank Order	No correlation
Lip	Linear Regression	Significant, positive
Rim	Linear Regression	No correlation
Neck	Linear Regression	No correlation
Shoulder	Linear Regression	No correlation
Body	Linear Regression	No correlation
Base	Linear Regression	No correlation
Variability and Vessel Completeness in Middle Woodland Vessels		
Lip	Spearman's Rank Order	Significant, positive
Rim	Spearman's Rank Order	Significant, positive
Neck	Spearman's Rank Order	No correlation
Shoulder	Spearman's Rank Order	No correlation
Body	Spearman's Rank Order	No correlation
Base	Spearman's Rank Order	No correlation
Lip	Linear Regression	No correlation
Rim	Linear Regression	Significant, weakly positive
Neck	Linear Regression	No correlation

Shoulder	Linear Regression	No correlation
Body	Linear Regression	No correlation
Base	Linear Regression	No correlation
Variability and Vessel Completeness in Late Woodland Vessels		
Lip	Spearman's Rank Order	No correlation
Rim	Spearman's Rank Order	No correlation
Neck	Spearman's Rank Order	No correlation
Shoulder	Spearman's Rank Order	No correlation
Body	Spearman's Rank Order	Significant, negative
Base	Spearman's Rank Order	No correlation
Lip	Linear Regression	No correlation
Rim	Linear Regression	No correlation
Neck	Linear Regression	No correlation
Shoulder	Linear Regression	No correlation
Body	Linear Regression	No correlation
Between Vessel Portions in Middle Woodland Vessels		
Neck and Rim	Linear Regression	Significant, positive
Shoulder and Neck	Linear Regression	Significant, positive
Body and Shoulder	Linear Regression	Significant, positive
Base and Body	Linear Regression	No correlation
Between Vessel Portions in Late Woodland Vessels		
Neck and Rim	Linear Regression	No correlation
Shoulder and Neck	Linear Regression	Significant, weakly positive
Body and Shoulder	Linear Regression	Significant, positive
Base and Body	Linear Regression	No correlation
Differences Between Middle and Late Woodland		
Lip Thickness	Mann-Whitney	No difference
Rim Thickness	Mann-Whitney	Significant difference
Neck Thickness	Mann-Whitney	No difference
Shoulder Thickness	Mann-Whitney	No difference
Body Thickness	Mann-Whitney	No difference
Base Thickness	Mann-Whitney	No difference
Rim Diameter	Mann-Whitney	No difference

Table 4.27: Summary of the Results from the Analysis of Vessel Morphometry

Research Question	Result
Is intravessel wall thickness variability higher than intervessel variability?	No. Variability in wall thickness is higher between vessels than within vessels in both Middle and Late Woodland pottery.
What is the relationship between vessel wall thickness and rim diameter?	Rim diameter and vessel wall thickness are strongly and significantly correlated in Middle Woodland vessels, but Late Woodland vessels lack this relationship.
What is the relationship between vessel wall thickness variability and vessel completeness?	Vessel wall thickness variability and vessel completeness are not significantly correlated.
What is the relationship of vessel wall thickness between each vessel portion?	There is a strong and significant correlation between paired portions in both Middle and Late Woodland vessels.
How much does rim diameter vary in Woodland period vessels?	Rim diameter variability is low.
What is the difference between vessel wall thickness or rim diameter between the Middle and Late Woodland periods?	There are no statistically significant differences in vessel wall thickness or rim diameter between Middle and Late Woodland vessels, with the exception of rim thickness.

Chapter 5

Results: Decoration

In this chapter, I present the results of the analysis of decorative variability in the samples of Middle (n=27) and Late Woodland vessels (n=18) examined in this study. I report the central tendency and dispersion, the results of statistical analyses, and key observations. This chapter presents: 1) intervessel decorative variability and complexity in the Middle Woodland period; 2) intravessel decorative variability and complexity in the Middle Woodland period; 3) the relationship between decorative complexity and variability and rim diameter in Middle Woodland vessels; 4) the relationship between decorative complexity and variability and vessel completeness in Middle Woodland vessels; 5) intervessel decorative variability and complexity in the Late Woodland period; 6) intravessel decorative variability and complexity in the Late Woodland period; 7) the relationship between decorative complexity and variability and rim diameter in Late Woodland vessels; 8) the relationship between decorative complexity and variability and vessel completeness; and, 9) if there are statistically significant differences in decorative complexity and variability between the Middle and Late Woodland periods. Chapter 3 (Methods) provides a detailed discussion about the attribute recording system (see below), and definitions of variability and complexity.

5.1 Intervessel Decorative Variability and Complexity in Middle Woodland Vessels

In this section, I report decorative variability and complexity at the intervessel level. Understanding how much variability and complexity changes between vessels in the same time period can provide archaeologists with an understanding of decorative trends and how they might relate to minimum number of vessels estimates, estimated vessel equivalents, and reconstruction efforts.

Elemental complexity, decorative complexity, and variability (Chapter 3, Section 3.3) were calculated using a novel attribute recording system, described in Chapter 4. To answer the questions outlined in Chapter 1, I quantified complexity and variability at the intervessel level in Middle Woodland vessels. I calculated the mean, standard deviation, and coefficient of variation using the elemental complexity and decorative complexity scores from every Middle Woodland vessel in the sample. The results are reported in Table 5.1 below. Figure 5.1 are histograms of the elemental complexity scores and decorative complexity scores.

Table 5.1: Intervessel Decorative Complexity, Variability, and Dispersion in Middle Woodland Vessels (n=27)

Statistic	Elemental Complexity	Decorative Complexity
Mean	0.27	13.43
SD	0.08	4.22
CV (%)	29.6	31.45

The mean elemental complexity score for Middle Woodland vessels is 0.27. Given that 0.25 is the lowest ECS, most vessels do not have much elemental complexity and demonstrate consistency in decorative tools used, techniques of application, and configurations. Because the mean elemental complexity score is so low, a coefficient of variation of 29.6% suggests that given a large assemblage, one can expect almost 30% more elemental complexity in some Middle Woodland vessels.

Total vessel decorative complexity, DCS, has a mean of 13.43 with a large standard deviation and coefficient of variation. The lowest DCS assignable in this attribute system

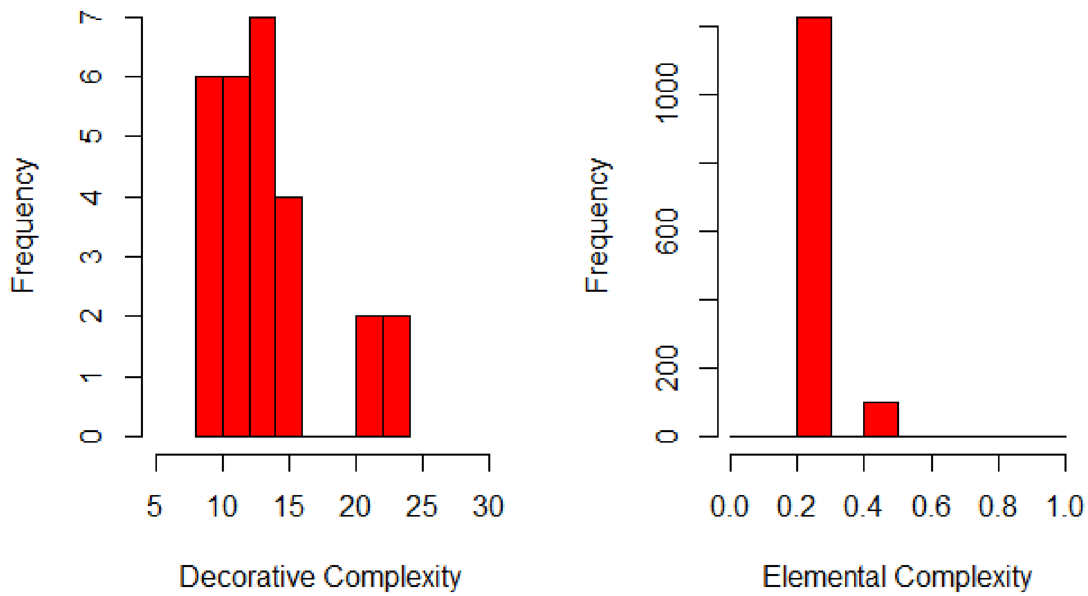

Figure 5.1: Histogram Demonstrating Trends in Decorative and Elemental Complexity Scores for Middle Woodland Vessels (n=27)

is 8, suggesting that while most vessels are relatively consistent with low complexity, some vessels exhibit higher variability and complexity than others. It may be that complexity is temporally sensitive and that types in the early, middle, and late Middle Woodland period may exhibit more decorative complexity and variability.

5.2 Intravessel Decorative Variability and Complexity in Middle Woodland Vessels

To establish how much decorative complexity and variability is expressed within vessels, I derived the mean, standard deviation, and coefficient of variation from the elemental complexity scores for each vessel. Table 5.2 below reports the range in decorative variability scores, and the central tendency and dispersion of the elemental complexity scores.

As indicated at the intervessel level, some Middle Woodland vessels are both highly

Table 5.2: Range of Decorative Complexity Scores, Mean Elemental Complexity Scores, Standard Deviation, and Coefficient of Variation for Middle Woodland Vessels (n=27)

Range in DCS	Range in Mean ECS	Range in SD	Range in CV	n=
8-23.25	0.25-0.37	0-0.18	0-50.0	27

complex and highly variable, while most are non-complex, non-variable, or non-complex but variable. The maximum decorative complexity score of 23.25 indicates a high level of design complexity. The maximum coefficient of variation indicates a high level of variability. The most variable vessel in the Middle Woodland sample is vessel BdGa-12-76-16-'V21'—a Princess Point vessel near the Middle to Late Woodland transition. Histograms showing the range in decorative complexity and variability in Middle Woodland vessels can be seen in Figure 5.2 below.

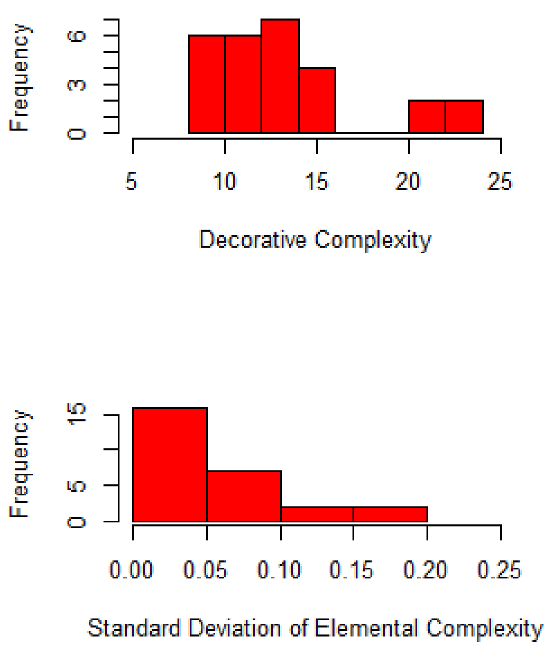

Figure 5.2: Histograms Showing Intravessel Decorative Complexity and Variability in Middle Woodland Vessels (n=27)

5.3 The Relationship Between Rim Diameter and Decorative Variability and Complexity in Middle Woodland Vessels

This section reports the results of a linear regression analysis relating decorative complexity scores to rim diameter (as a proxy for vessel size). Figure 5.3 demonstrates the relationship between decorative complexity and rim diameter in this sample of Middle Woodland vessels (n=27). Table 5.3 reports the fit of the model.

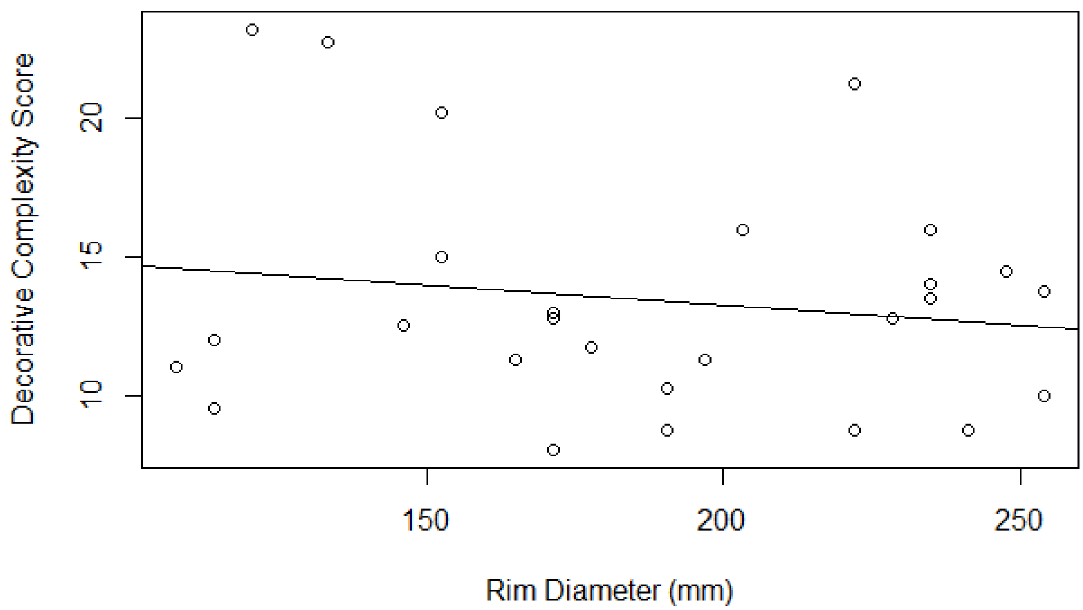

Figure 5.3: Linear Regression Analysis of Decorative Complexity Scores and Mean Rim Diameter in Middle Woodland Vessels (n=27)

The linear regression analysis revealed that there is a non-significant, non-linear relationship between decorative complexity and rim diameter in the Middle Woodland sample. This suggests that larger vessels do not have more constituent decorative elements than smaller vessels—design motifs are likely enlarged to fit the size of the vessel, rather than adding more constituent elements to fill up the space.

Table 5.3: Fit of The Linear Regression Model Testing the Relationship Between Decorative Complexity Score and Mean Rim Diameter as a Proxy for Vessel Size in this Sample of Middle Woodland Vessels (n=27)

Statistic	Result
Residual Standard Error	4.25
Degrees of Freedom	25
Multiple R-Squared	0.03
Adjusted R-Squared	0.013
F-Statistic	0.67
P-Value	0.42

5.4 The Relationship Between Vessel Completeness and Decorative Variability and Complexity in Middle Woodland Vessels

This section reports the results of Spearman's rank order correlation tests and linear regression analyses relating elemental complexity, decorative complexity, and variability (CV) to vessel completeness. Table 5.4 below reports the results of the Spearman's rank order correlation tests.

Table 5.4: Results of Spearman's Rank Order Correlation Tests Correlating Elemental Complexity, Decorative Complexity, and Decorative Variability with Vessel Completeness in Middle Woodland Vessels (n=27)

Statistic	Elemental Complexity	Decorative Complexity	CV
S=	3279.1	2519.2	3145.2
Rs=	-0.001	0.23	0.04
p=	0.99	0.25	0.84

The results of the Spearman's rank order correlation tests indicate that there is no monotonic relationship between elemental complexity, decorative complexity, or the coefficient of variation and vessel completeness. I performed a linear regression analysis to further explore these relationships. Figure 5.4 below is a scatterplot demonstrating the relationship between elemental complexity and vessel completeness. The fit of the model is reported in

Table 5.5.

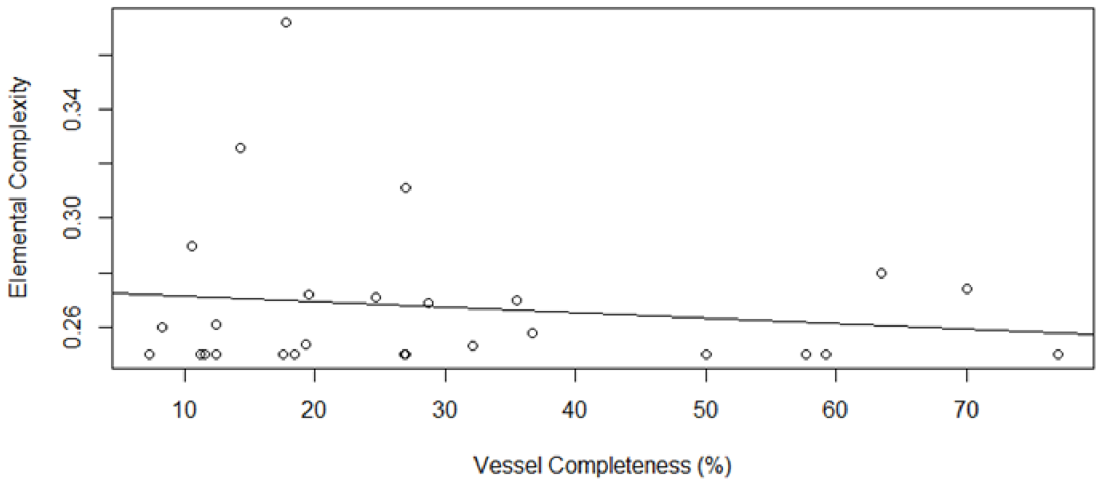

Figure 5.4: Scatterplot Demonstrating the Relationship Between Elemental Complexity and Vessel Completeness in Middle Woodland Vessels (n=27)

Table 5.5: Fit of the Linear Regression Model Testing the Relationship Between Elemental Complexity and Vessel Completeness in Middle Woodland Vessels (n=27)

Statistic	Result
Residual Standard Error	0.02
Degrees of Freedom	25
Multiple R-Squared	0.02
Adjusted R-Squared	-0.02
F-Statistic	0.50
P-Value	0.49

The linear regression model and fit demonstrate that there is no statistically significant linear relationship between elemental complexity and vessel completeness in Middle Woodland vessels, suggesting that even less complete vessels are indicative of the degree of attribute change across the surface of a complete vessel. Figure 5.5 and Table 5.6 below report the relationship between decorative complexity scores and vessel completeness.

There appears to be no relationship between vessel completeness and decorative complexity. Figure 5.5 and Table 5.6 show that there is a non-significant, non-linear relationship

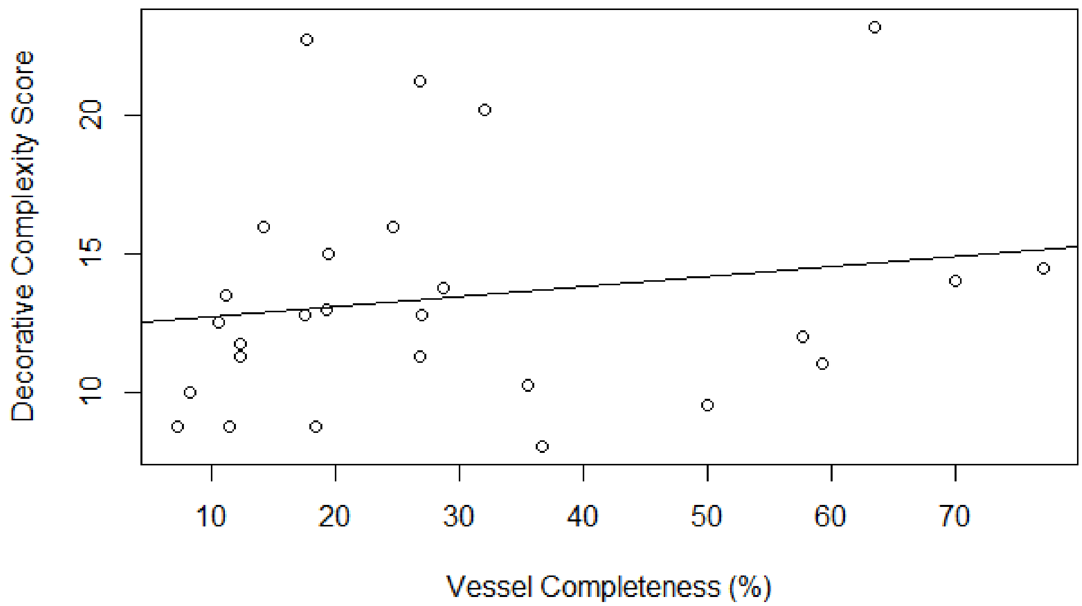

Figure 5.5: Linear Regression Scatterplot Demonstrating the Relationship Between Decorative Complexity Score and Vessel Completeness in Middle Woodland Vessels (n=27)

Table 5.6: Fit of the Linear Regression Model Testing the Relationship Between Decorative Complexity Score and Vessel Completeness in Middle Woodland Vessels (n=27)

Statistic	Result
Residual Standard Error	4.24
Degrees of Freedom	25
Multiple R-Squared	0.031
Adjusted R-Squared	-0.008
F-Statistic	0.80
P-Value	0.38

between decorative complexity and vessel completeness in the Middle Woodland sample. This suggests that fragments that represent low vessel completeness may still be representative of the vessels overall decorative complexity. Decorative complexity appears to be captured with fragments representing 10-30% vessel completeness. I also performed linear regression analysis to determine the relationship between decorative variability (CV) and vessel completeness. Figure 5.6 is a scatterplot for visualizing the relationship, and Table

5.7 reports the fit of the model.

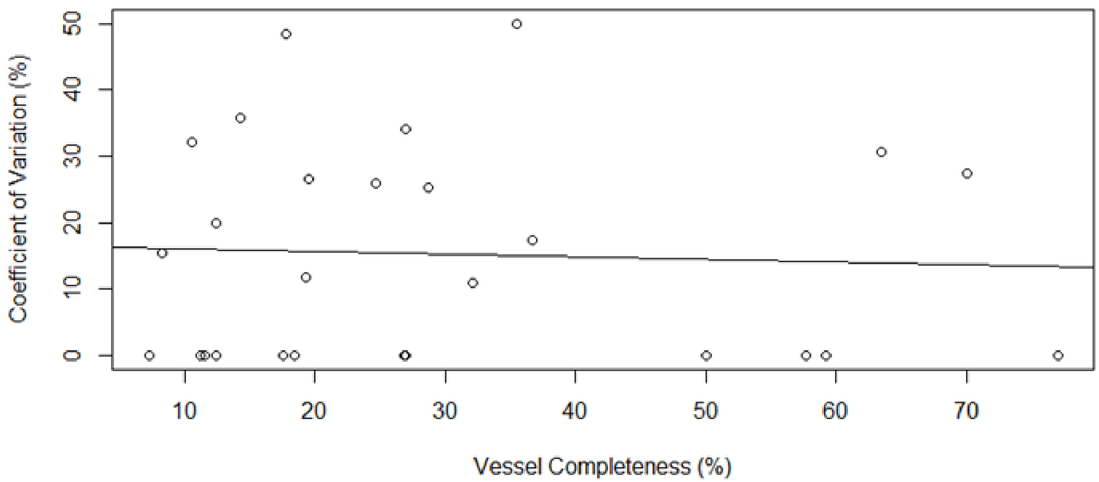

Figure 5.6: Linear Regression Scatterplot Demonstrating the Relationship Between Decorative Variability and Vessel Completeness in Middle Woodland Vessels (n=27)

Table 5.7: Fit of the Linear Regression Model Relating Decorative Variability and Vessel Completeness in Middle Woodland Vessels (n=27)

Statistic	Result
Residual Standard Error	16.70
Degrees of Freedom	25
Multiple R-Squared	0.002
Adjusted R-Squared	-0.04
F-Statistic	0.06
P-Value	0.82

The results of the linear regression analysis suggest that decorative variability is not affected by vessel completeness. Overall, there does not appear to be any relationship between decorative variability, decorative complexity, elemental complexity, and vessel completeness. The significance of this is that ceramic decorative style does not change dramatically on a single vessel. However, the use of decorative complexity and variability for pottery quantification will not alleviate the bias in type frequencies in fragmented assemblages. Of note is that decorative complexity, while variable from vessel to vessel, is generally stable.

5.5 Intervessel Decorative Variability and Complexity in Late Woodland Vessels

This section reports the quantification of decorative variability in a sample of Late Woodland vessels (n=18) using the same method and reporting format as that found in section 5.1. Table 5.8 below reports the decorative variability score, mean, standard deviation of the elemental complexity scores, and coefficient of variability, capturing the quantity of variability between vessels in the Late Woodland period. Figure 5.7 are histograms for visualizing the trend.

Table 5.8: Intervessel Decorative Variability, Complexity, and Dispersion in Late Woodland Vessels (n=18)

Statistic	Elemental Complexity	Decorative Complexity
Mean	0.28	13.1
SD	0.22	4.37
CV	39.3	33.36

As with Middle Woodland intervessel decorative variability and complexity, Late Woodland vessels tend to be variable but non-complex. That is with exceptions, however. The mean elemental complexity score in the Late Woodland sample is slightly higher than in the Middle Woodland sample, and the standard deviation indicates that there is more movement away from the mean elemental complexity score. Additionally, the coefficient of variation suggests that Late Woodland vessels are also more variable in design.

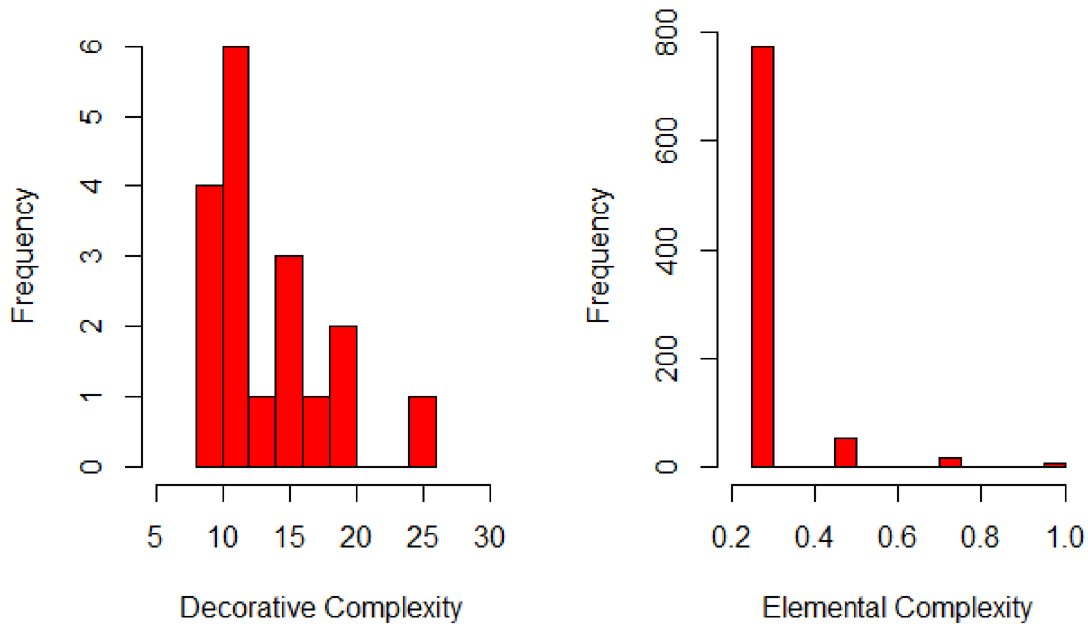

Figure 5.7: Histogram of Late Woodland Deorative and Elemental Complexity Scores (n=18)

5.6 Intravessel Decorative Variability in Late Woodland Vessels

I calculated intravessel decorative variability and complexity in Late Woodland vessels by deriving the mean, standard deviation, and coefficient of variation on each vessel using their elemental complexity scores. The decorative complexity score was also calculated from the elemental complexity scores of each vessel. Table 5.9 below reports the range in the decorative complexity scores, means of the elemental complexity scores, standard deviations of the elemental complexity scores, and coefficients of variation in individual Late Woodland vessels.

At the intravessel level, it is evident that there is more variability in design complexity. Elemental complexity scores are low, with some exceptions, suggesting that specific vessels are exhibiting a lot more complexity in decoration. The coefficient of variation suggests significant movement away from the mean, which is generally close to the lowest elemental

Table 5.9: Intravessel Decorative Variability and Complexity in Late Woodland Vessels (n=18)

Statistic	Result
Range in Decorative Complexity Score	8.25-25
Range in Mean Elemental Complexity Score	0.25-0.43
Range in SD	0-0.24
Range in CV	0-56.24

complexity score (0.25), meaning some vessels are highly variable. On the contrary, over half of the vessels in the Late Woodland sample (n=18) have no variability at all. Evidently, Late Woodland vessels are, more often than not, highly consistent and standardized across the surface of the vessels. As with the Middle Woodland sample, the increase in complexity in some vessels may be temporally sensitive. Significantly, the two most complex and variable vessels in the Middle and Late Woodland samples are both from the Middle to Late Woodland transition (Princess Point and Pickering). Histograms in Figure 5.8 demonstrate the range in decorative complexity scores, mean elemental complexity scores, the standard deviation of elemental complexity scores, and overall decorative variability.

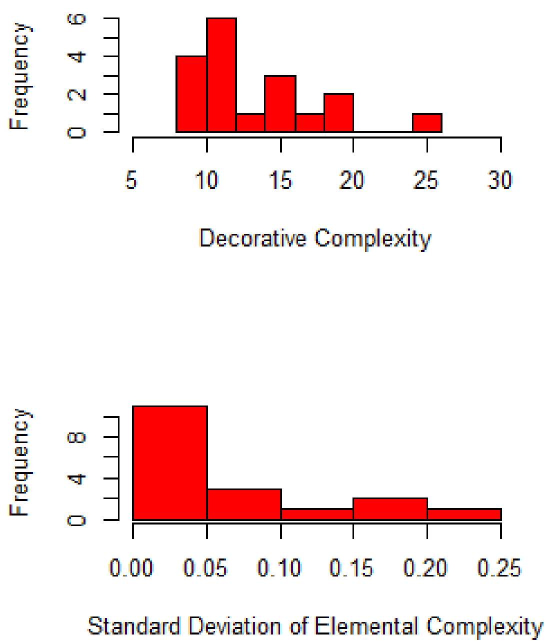

Figure 5.8: Histograms Showing Intravessel Decorative Complexity and Variability in Late Woodland Vessels (n=18)

5.7 The Relationship Between Rim Diameter and Decorative Variability and Complexity in Late Woodland Vessels

In this section I report the results of linear regression analyses relating decorative complexity scores to rim diameter (as a proxy for vessel size). Figure 5.9 demonstrates the relationship between decorative complexity and rim diameter in this sample of Late Woodland vessels (n=18). Table 5.10 reports the fit of the model.

The scatterplot shows a non-significant, slightly negative, non-linear relationship. The fit of the model is poor. These results demonstrate that there is no relationship between decorative complexity and rim diameter. As with the Middle Woodland sample, it appears that decorative complexity does not increase with vessel size. Rather, the decorative motif applied to a vessel is scaled to its size—larger vessels do not have more decorative constituent elements than smaller vessels.

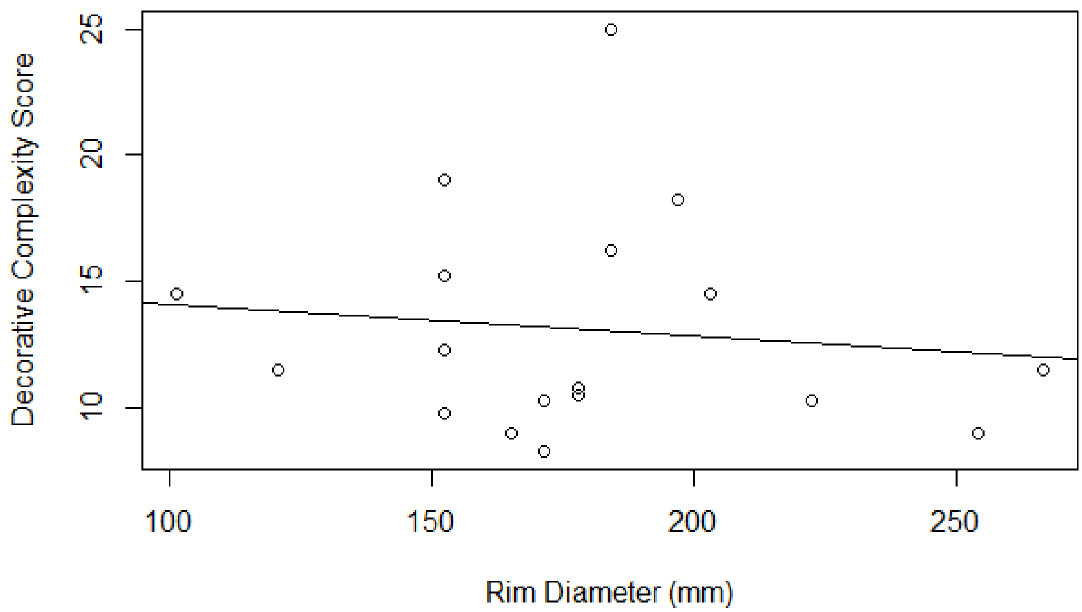

Figure 5.9: Scatterplot Relating Decorative Complexity Scores and Rim Diameter in Late Woodland Vessels (n=18)

Table 5.10: Fit of the Linear Regression Model Testing the Relationship Between Decorative Complexity and Rim Diameter in Late Woodland Vessels (n=18)

Statistic	Result
Residual Standard Error	4.47
Degrees of Freedom	16
Multiple R-Squared	0.01
Adjusted R-Squared	-0.05
F-Statistic	0.23
P-Value	0.64

5.8 The Relationship Between Vessel Completeness and Decorative Variability and Complexity in Late Woodland Vessels

I used Spearman's rank order correlation tests and linear regression analyses to determine whether elemental complexity, decorative complexity, or variability (CV) are related to vessel completeness. Table 5.11 below reports the results of the Spearman's rank order correlation tests.

Table 5.11: Results of Spearman's Rank Order Correlation Tests Correlating Elemental Complexity, Decorative Complexity and Decorative Variability to Vessel Completeness in Late Woodland Vessels (n=18)

Statistic	Elemental Complexity	Decorative Complexity	CV
S=	1308.9	1211.1	1308.9
Rs=	-0.35	-0.25	-0.35
p=	0.15	0.32	0.15

The Spearman's rank order correlation tests suggest that there is no monotonic relationship between elemental complexity, decorative complexity, or decorative variability, and vessel completeness in Late Woodland vessels. I performed linear regression analyses to further explore these relationships. Figure 5.10 below is a scatterplot for visualizing the relationship between elemental complexity and vessel completeness, and Table 5.12 reports the fit of the model.

The scatterplot and fit of the model suggest that elemental complexity and vessel completeness are not significantly related. This suggests that less complete vessels are still representative of the extent of attribute change on the whole vessel. Figure 5.11 below is a scatterplot demonstrating the relationship between decorative complexity and vessel completeness, and Table 5.13 reports the fit of the model.

The scatterplot above demonstrates a non-significant and non-linear relationship. The fit of the model is poor, indicating that there is no significant relationship between decorative complexity and vessel completeness in this sample of Late Woodland vessels (n=18).

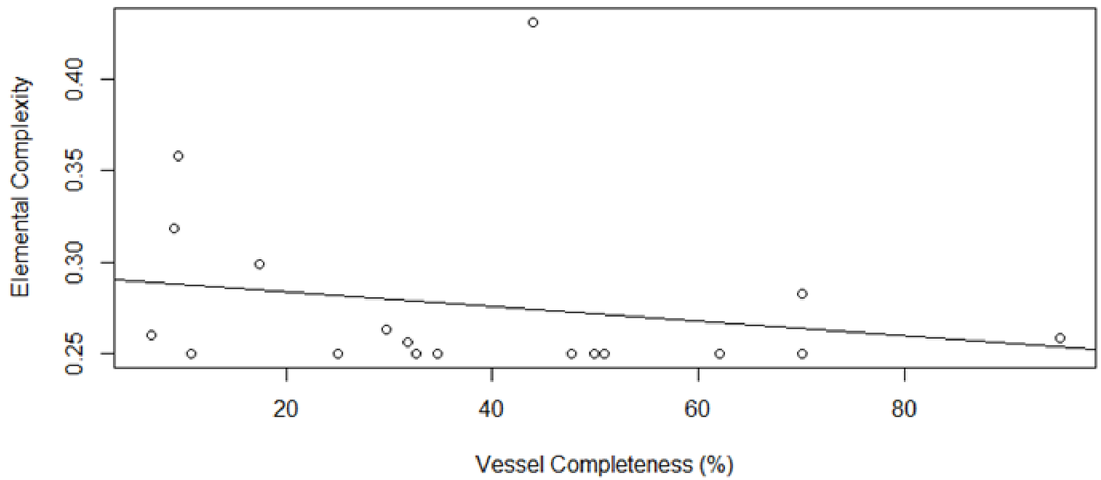

Figure 5.10: Scatterplot Demonstrating the Relationship Between Elemental Complexity and Vessel Completeness in Late Woodland Vessels (n=18)

Table 5.12: Fit of the Linear Regression Model Relating Elemental Complexity and Vessel Completeness in Late Woodland Vessels (n=18)

Statistic	Result
Residual Standard Error	0.05
Degrees of Freedom	16
Multiple R-Squared	0.04
Adjusted R-Squared	-0.02
F-Statistic	0.70
P-Value	0.42

Figure 5.12 below is a scatterplot demonstrating the relationship between decorative variability (CV) and vessel completeness, and Table 5.14 reports the fit of the model.

The scatterplot and fit of the model demonstrate that there is no relationship between decorative variability and vessel completeness in Late Woodland vessels. This suggests that decorative and elemental complexity and variability are not affected by vessel completeness and that even smaller, less complete fragments demonstrate overall decorative variability and complexity.

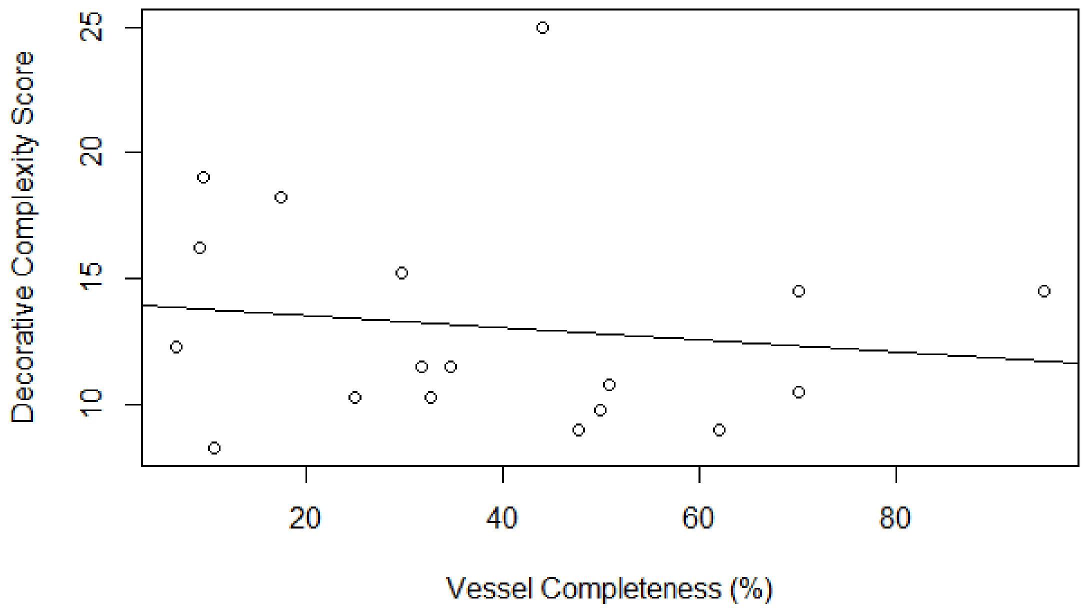

Figure 5.11: Scatterplot of the Relationship Between Decorative Complexity and Vessel Completeness in Late Woodland Vessels (n=18)

Table 5.13: Fit of the Linear Regression Model Testing the Relationship Between Decorative Complexity and Vessel Completeness in Late Woodland Vessels (n=18)

Statistic	Result
Residual Standard Error	4.46
Degrees of Freedom	16
Multiple R-Squared	0.02
Adjusted R-Squared	-0.04
F-Statistic	0.30
P-Value	0.59

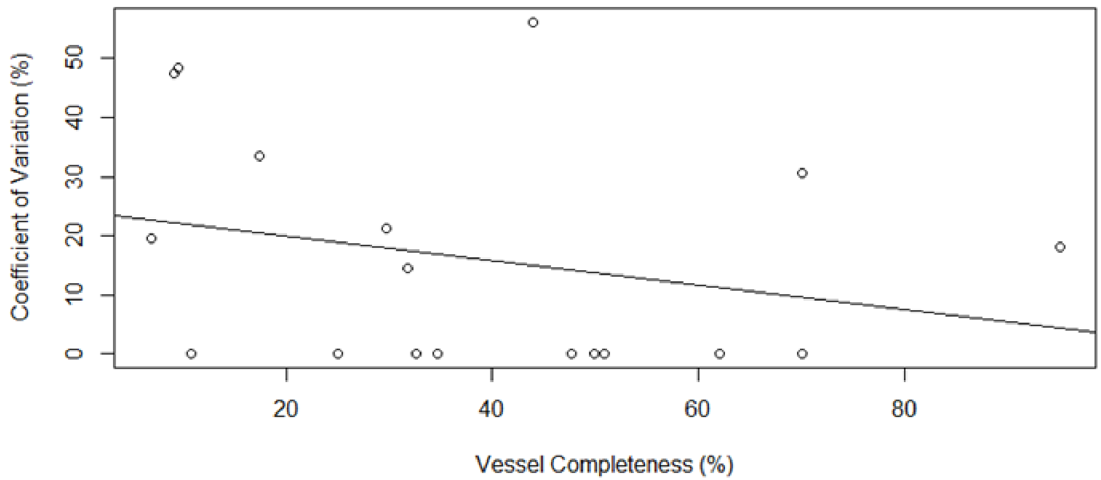

Figure 5.12: Scatterplot of the Relationship Between Decorative Variability and Vessel Completeness in Late Woodland Vessels (n=18)

Table 5.14: Fit of the Linear Regression Model Relating Decorative Variability and Vessel Completeness in Late Woodland Vessels (n=18)

Statistic	Result
Residual Standard Error	19.48
Degrees of Freedom	16
Multiple R-Squared	0.07
Adjusted R-Squared	0.01
F-Statistic	1.20
P-Value	0.29

5.9 Evaluating Change in Decorative Variability and Complexity Between the Middle and Late Woodland Periods

I undertook an analysis of the differences between decorative complexity and variability in the Middle and Late Woodland periods. Mann-Whitney U-tests were used to determine whether there was a significant difference between decorative complexity or variability between the Middle and Late Woodland periods. Table 5.15 below reports the results.

Table 5.15: Mann-Whitney U-test Comparing Variability and Complexity Between the Middle and Late Woodland Periods (n=45)

Statistic	Complexity	Variability
w=	229	238
p=	0.75	0.91

I found no significant differences in decorative complexity or variability between the Middle and Late Woodland periods. Mentioned above, there are likely times within both the Middle and Late Woodland periods during which decorative complexity increases for a short time. Suggested above, these vessels are often Middle to Late Woodland transitional vessels.

5.10 Summary

The primary observations made in this chapter are summarized in Table 5.16 below. At the intervessel level, Middle Woodland vessels have a low mean elemental complexity score, indicating that Middle Woodland motifs do not change much across the surface of a vessel. The mean decorative complexity score is 13.43 (the lowest possible being 8). This indicates that Middle Woodland vessels have simple motifs replicated in standard ways. Also, 44 % of the Middle Woodland sample have a coefficient of variation of zero, indicating that many vessels are non-complex and non-variable. High variability is seen in vessels with high complexity. Decorative tools are used in multiple ways in sub-part vessel zones, either by altering the orientation of the decorative tool, by using multiple decorative tools, or by using one decorative tool in different ways (e.g. cord-wrapped stick used for impressing, incising, and punctating). In sum, variability between vessels can be high if more complex Middle Woodland types are present, but variability and complexity is generally low. Middle Woodland vessels that are more variable and complex may be temporally sensitive—the most complex and variable vessel in the sample is a Princess Point vessel at the Middle to Late Woodland transition period.

I found that, at the intravessel level, variation and complexity has a broad range. Few vessels are complex, although they can vary across the surface. As mentioned above, there are notable exceptions. Variability can be high, although 12 vessels have no variability at all, and five have coefficients of variation under 20%. This suggests that Middle Woodland vessels are generally simple and invariable. However, if complexity and variability are temporally sensitive, and a fragmented assemblage is composed of multi-component deposits, the presence of some highly complex and variable Middle Woodland vessels will make it difficult to assign sherds to vessels using measures of decorative complexity and variability.

Linear regression analysis indicated that there is not a significant relationship between the decorative complexity scores and rim diameter in Middle Woodland vessels. The plot and the fit of the model report a non-significant, negative relationship. This suggests that larger vessels do not have more complex motifs—typically motifs are likely enlarged to fit the size of the vessel, rather than adding more constituent decorative elements.

Linear regression analysis was also used to test the relationship between decorative complexity scores and vessel completeness. The plot and fit of the model report a non-significant, non-linear, positive relationship. Decorative complexity is not affected by vessel completeness. This is likely the result of the fact that the number of constituent decorative elements does not increase with vessel size, and therefore does not increase on more complete fragments which might typically be derived from larger vessels. Additionally, that decorative complexity does not increase with vessel completeness suggests that even less complete vessel fragments can be indicative of a vessels' overall complexity. The analysis demonstrated that decorative complexity and variability can be captured on vessels that are between 10-30% complete.

I found that Late Woodland vessels, at the intervessel level, demonstrate a slight increase in complexity and variability over Middle Woodland vessels. Generally, most Late Woodland vessels are non-complex and non-variable, and so variability and complexity are relatively stable between vessels. As with Middle Woodland vessels, there are exceptions. The elemental complexity scores demonstrate that design can vary across the surface, though the number of constituent elements is mostly consistent across vessels.

At the intravessel level, decorative variability and complexity is variable from vessel to vessel. The ranges demonstrate that some Late Woodland vessels have high decorative variability and complexity; however, nine out of 18 vessels in the Late Woodland sample have no variation at all. Generally, Late Woodland vessels are non-complex and non-variable. A small population of Late Woodland vessels demonstrate high levels of decorative variability and complexity. Noted above, the two most variable vessels—Princess Point and Pickering—in the Middle and Late Woodland samples are from the Middle to Late Woodland transition period (AD 500 to AD 1000).

I found that there is no relationship between vessel complexity and vessel completeness in Late Woodland vessels—the same result found with the Middle Woodland sample. If complexity does not increase with vessel completeness, it suggests that less complete vessels are representative of their overall complexity. As with the Middle Woodland sample, complexity is captured on fragments representing 10-30% vessel completeness. I also used linear regression analysis to determine the relationship between decorative complexity and rim diameter (as a proxy for vessel size). I found no significant relationship, indicating that vessel complexity does not increase with vessel size; rather, motifs are scaled to the size of the vessel. Larger vessels do not have more constituent decorative elements than small vessels. The significance of these results and how they pertain to the quantification of pottery from a fragmented assemblage is discussed in the following chapter (Chapter 7: Discussion).

Table 5.16: Summary of Results from the Analysis of Woodland Period Pottery Design Complexity and Variability

Research Question	Result
What are the differences in design complexity and variability between Middle and Late Woodland vessels?	There are no statistically significant differences in design complexity and variability between Middle and Late Woodland vessels.
How variable and complex are design motifs in Middle Woodland vessels?	Middle Woodland vessels have a moderate amount of design complexity and variability; though some transitional Middle to Late Woodland vessels show considerably more complexity and variability.
How variable and complex are design motifs in Late Woodland vessels?	Late Woodland vessels are slightly more complex and variable in their design than Middle Woodland vessels but are still considered moderate. There is a high degree of decorative consistency in Late Woodland vessels. The most variable and complex Late Woodland vessel is from the Pickering Phase.
Is intravessel decorative variability and complexity higher than intervessel decorative variability and complexity?	Decorative complexity and variability are higher at the intravessel level. This suggests that decorative motifs are not highly variable, and that traditional sherd-matching by decoration remains a reliable method of sherd-to-vessel assignment.
What is the relationship between design complexity and variability and vessel completeness?	There is no relationship between design complexity and variability and vessel completeness. Less complete vessels are representative of overall complexity and variability.
What is the relationship between design complexity and variability and rim diameter?	There is no relationship between design complexity and variability and vessel size. Larger vessels do not have more decorative constituent elements than smaller vessels.

Chapter 6

Discussion

In this chapter, I review the results and provide interpretations of the quantitative analyses exploring variability in both design and morphometry in samples of complete to near-complete vessels typologically associated with the Middle and Late Woodland periods. My goal in this thesis was to understand how the quantification of decorative and morphometric variability in Middle and Late Woodland vessels can help archaeologists interpret fragmentary ceramic assemblages to make inferences based on vessel-to-vessel comparisons, rather than sherd counts.

To address this research problem, I sought to answer the following six main questions regarding vessel wall thickness variability in both Middle and Late Woodland vessels: 1) Is intravessel morphological variability higher than intervessel variability? 2) What is the relationship between vessel wall thickness and rim diameter? 3) What is the relationship between vessel wall thickness and vessel completeness? 4) How much does rim diameter vary in Woodland Period vessels? 5) What is the relationship of vessel wall thickness between each vessel portion in Woodland Period vessels? And, 6) What are the differences in rim diameter or vessel wall thickness between the Middle and Late Woodland periods?

Additionally, I asked the following four questions regarding decorative variability and complexity in Middle and Late Woodland vessels: 1) Is intravessel decorative complexity and variability higher than intervessel decorative complexity and variability in Woodland Period vessels? 2) What is the relationship between decorative complexity and variability and rim diameter in Woodland Period vessels? 3) What is the relationship between decorative complexity and variability and rim diameter in Woodland Period vessels? 3) What is the relationship between decorative complexity and variability and rim diameter in Woodland Period vessels? 3) What is the relationship between decorative complexity and variability and vessel completeness in Woodland Period vessels? And, 4) What are the differences in decorative complexity and variability between Middle and Late Woodland vessels?

Tables 4.27 and 5.16 provide a summary of the results. This chapter includes: a discussion of the interpretive goals of this study, a review and discussion of the techno-functional pattern found in both Middle and Late Woodland vessels, a review of decorative variability and complexity and how they relate to pottery quantification, and the proposal of an improved method of MNV estimation using the results of the morphometric and decorative variability analyses. The chapter concludes with a summary.

6.1 Interpretive Goals

Pottery is one of the most abundant sources of material culture recovered from archaeological sites in North America after the advent of ceramic technology. Archaeologists in North America subsequently analyze, catalogue, interpret, and conserve vast assemblages of fragmented ceramic vessels from the Early, Middle, and Late Woodland periods. Whether it is pottery, lithic debitage, or faunal remains, what is recovered from an archaeological site is only a sample of the population from which the artifacts are derived. The goals of archaeology are to discover, interpret, and explain past human behaviour by making inferences from material culture remains which provide only a glimpse of reality. When we think about material culture and how it pertains to past human behaviour, it is obvious that people did not use lithic debitage, they used tools; people did not hunt bones, they hunted animals; and so too, people did not use sherds, they used pots.

In pottery analysis, two concepts exemplify this fact: life assemblages and death assemblages (Orton 1993: 178). Life assemblages are the original population present during their use-lives, while death assemblages are those we recover. The breaking and reusing of ceramic vessels, use and discard rates, variable breakage rates, variable production rates, and post-depositional and taphonomic processes significantly affect the composition of a ceramic assemblage (not to mention excavation methodology, which can greatly bias a sample from a site).

Lithic assemblages allow the reconstruction of life assemblages because, while lithic tools are frequently carried away from sites, small flakes of lithic debitage often remain where stone was worked. That is not the case with pottery, where whole vessels can be present on a site for a long time but can be taken away and therefore never reflected in a recovered assemblage. It is apparent in any fragmented ceramic assemblage that portions of vessels are just simply missing—either due to post-depositional processes, or some other aspect of its use-life. This fact, says Orton (1993), prevents us from ever reconstructing the life assemblage of pottery from the death assemblage. The best that we can do is estimate how many vessels we have from their fragments.

That the life assemblage or parent population of pottery is irrecoverable is significant because it means that measures of vessel type frequency are biased. Variable breakage rates in vessels of different sizes, paste compositions, or stylistic types can inflate type counts or make some types appear less frequent. Seriation, spatial analysis, functional analysis, or social status studies cannot be carried out if the true vessel type frequency cannot be quantified. To move past the inherent biases in sherd counts, pottery quantification is an essential step to bridge ceramic data and archaeological theory. Once some unbiased count of vessels (for instance: minimum number, or estimated equivalent) is established, it is possible to answer archaeological questions.

Many methods of pottery quantification have been proposed and used since Petrie (1899) first used seriation to chronologically organize Egyptian graves (see Chapter 3: Context and Aims for a discussion of historic and contemporary methods of pottery quantification). However, minimum number of vessels estimation (MNV) and estimated vessel equivalents (EVE) are the most widely used methods of pottery quantification in archaeology because they are relatively simple and efficient. MNV and EVE typically focus on rim and basal sherds, while great quantities of non-fitting decorated sherds, and undecorated body sherds are ignored. The analysis of vessel wall thickness variability and decorative complexity and variability in this thesis attempts to improve these methods by quantifying variability in whole vessels such that non-fitting and undecorated sherds can be assigned to single vessels.

I examined morphometric variability—in this thesis, the thickness of every part of a vessel (lip, rim, neck, shoulder, body, and base)—between vessels and within vessels. Intervessel variability provides an idea of how much variability can be expected in a fragmented assemblage from either the Middle or Late Woodland periods. Intravessel variability provides an idea of how much variability a single vessel in either the Middle or Late Woodland periods will exhibit. Both approaches allow researchers to relate fragments to whole vessels by their morphometric characteristics. If the lip, rim, neck, shoulder, body, or basal portions of Woodland period vessels follow thickness criteria—either in and of themselves or related to vessel size or some other function therein—then it should be possible to assign fragmented sherds to thickness categories. Complemented by the typological and rim and basal sherd analysis typical to common quantification methods, this analysis should allow archaeologists to assign once ignored sherds to their vessels, improving our ability to estimate the number of vessels present in a fragmented assemblage. This is particularly helpful if there are undecorated sherds from vessels whose diagnostic portions are completely missing. It also ameliorates some of Orton's concerns about MNV estimates not being able to account for missing vessels (though, vessels that are completely missing are, of course, completely missing).

My analysis of intervessel and intravessel decorative variability and complexity served to establish how complex decorative motifs can be on Woodland Period vessels and how variable design can be across the surface. Fragmented assemblages are rife with sherds designed with the same tools; however, the organization of the design made with these tools are type-specific (the grouping of attributes), meaning that relying on just a fraction of the decorative characteristics represented by fragmented sherds can lead to the misinterpretation of which sherds belong to which vessels. Common methods of pottery quantification use typology to group sherds to vessels, but typically just the rim or neck portions of vessels (particularly in Late Woodland vessels) are analyzed for design despite decoration often reaching the shoulder and body of vessels, and in some cases the base (more commonly seen in Middle Woodland vessels). The ability to confidently assign undiagnostic decorated sherds to vessel groups can further improve MNV and EVE estimations.

6.2 Technofunctional Templates in Middle and Late Woodland Period Pottery

One of the most significant results I found in analyzing intervessel and intravessel morphometric variability is that Middle and Late Woodland period pottery have the same patterns in vessel wall thickness throughout their entirety. Figure 6.1 below shows that both Middle and Late Woodland vessels have a thin lip, thicker rim and neck, thinner shoulder and body, and a thicker base. This pattern, I hypothesize to be a functional adaptation with likely origins in the Early Woodland period as Vinette 1 vessels gained utility value.

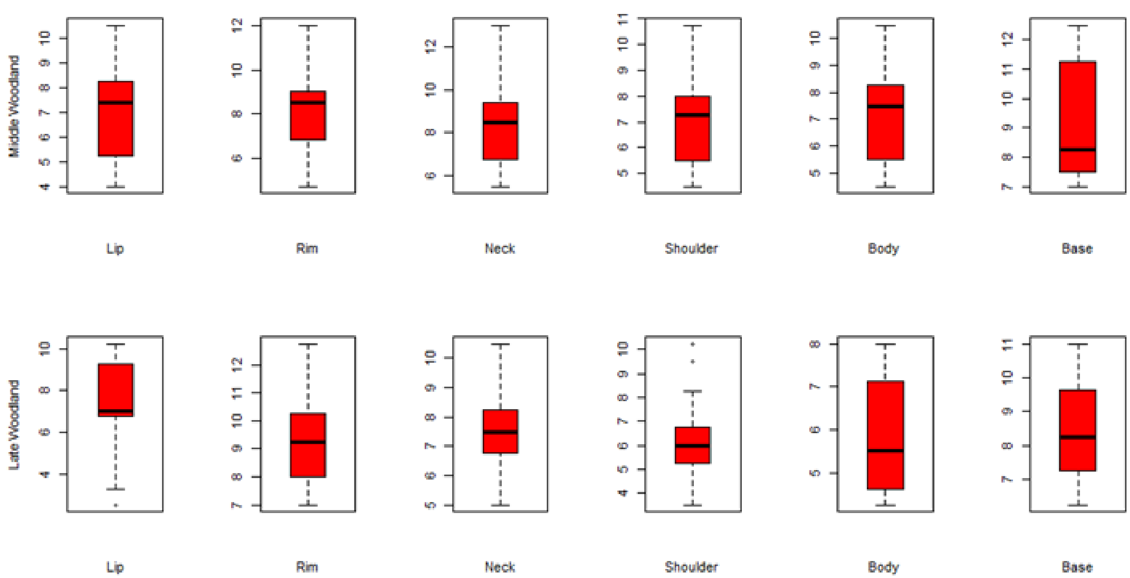

Figure 6.1: Vessel Wall Thickness Trends in Middle and Late Woodland Vessels (n=45)

The vessel wall thickness trends above reflect technological and functional adaptations. Lip thickness is directly related to rim thickness—as rims get thicker, so too do vessel lips. If there is a function for the lip portion of vessels, it likely relates to actions like pouring. The rim and neck portions were made thicker to withstand the placing, removing, and stirring of the vessel contents. The shoulder is a transition zone from neck to body where the shoulder wall begins to get thinner in order to blend into the body portion. The body is made thinner for more efficient heat transfer for cooking or boiling (Braun, 1983, 2010; Brody 1979; Henrickson and McDonald 1983; Rice, 1987; Schiffer and Skibo, 1987; Van Vlack 1964; but see: Bowen and Harry 2019). The base is made thicker likely to withstand various impact pressures from being set down or placed in or above a fire.

The coefficient of variation for wall thickness variability in both the Middle and Late Woodland periods are relatively even. Consistency in the thickness across a vessel is key to a durable vessel. As Braun (1983, 2010) proposed, if the wall of a vessel is unevenly thick, the rate and extent of expansion under heat will be variable across the surface of the vessel and will cause premature fracture. Middle and Late Woodland potters evidently understood to some degree the physical mechanics required of a vessel to improve efficiency and durability. This functional pattern in vessel walls is useful for organizing sherds into vessel part categories, which can serve as a foundation to build MNV and EVE measurements upon.

The techno-functional patterning ubiquitous in Middle and Late Woodland vessels lends itself to a line of evidence in support of cultural continuity in Ontario, New York, and Quebec. The in-situ vs. migration debate (Ritchie, 1980; Snow, 1996) regarding the origins of Northern Iroquoians has led to much debate regarding how archaeologists have organized and interpreted archaeological data in relation to prescriptions of ethincity to the archaeological record (William and Watts, 1999). While weighing in on this debate is beyond the scope of this thesis, the techno-functional patterning seen in both Middle and Late Woodland vessels should be explored through the lense of communities of practice, social learning, and modes of cultural transmission in relation to the recently prevaling theories of ethnogenesis (Birch, 2015; Hart and Engelbrecht 2012; Moore, 1994). Woodland Period vessels follow a nearly identical pattern in vessel wall thickness, suggesting that this is an ideal form for a ceramic vessel to serve it's purpose which has been shared across space and time. The transmission of these ideas from generation to generation suggests that there is continuity between people in the Woodland Period. However, another interpretation of these processes is that potters in the Woodland Period arrived at this techno-functional template in a form akin to convergent evoltution whereby individuals, having relied closely on pottery vessels as a utility item, gradually but independently selected for the same vessel forms.

6.3 Morphometric Variability in Middle and Late Woodland Period Pottery

Intervessel variability in wall thickness is higher than intravessel variability in both the Middle and Late Woodland periods. I found one exception—Late Woodland vessel shoulders. The multi-stage construction process used in the manufacture of Late Woodland vessels explains this finding. The shoulder to body transition area is a common point of attachment for the rim and neck section to the body and base. Middle Woodland vessels, being coiled, have greater consistency here, as only coils need to be made a similar size. In the case of Late Woodland vessels, the attachment and smoothing of the shoulder to the body likely creates inconsistency at this locus. It may also be the case that different potters make the two sections: one who makes the rim and neck, and another who makes the body and base.

It is significant that intervessel wall thickness variability is higher than intravessel variability. It means that sherds that belong to the same vessel and the same vessel portion do not vary much from each other. Sherds can be sorted into vessel portion categories with confidence. Using rim diameter to predict vessel wall thickness would help this process greatly.

Linear regression analyses and Spearman's rank order correlation tests demonstrated that rim diameter is a robust predictor of vessel wall thickness in Middle Woodland vessels. As rim diameter increases, so too does wall thickness in all vessel portions. However, that is not the case in Late Woodland vessels—the only exception being the lip portion. The lip portion likely relates to rim diameter because an appropriately-sized vessel lip aids in pouring or is simply aesthetically pleasing. The strong correlation between rim diameter and vessel wall thickness in Middle Woodland vessels is significant because it means that rims can now be related to all other vessel portions in an assemblage of Middle Woodland sherds. Knowing that intravessel variation is low, rim diameter can be used to predict how thick each vessel portion should be. Lacking a clear correlation between rim diameter and vessel wall thickness, Late Woodland vessels present a challenge in using this method for MNV or EVE estimates. However, low intravessel variability suggests that if sherds are organized into vessel portion categories and are typologically related to the same vessel, matching sherd thicknesses from each portion can provide some information about which sherds belong to which vessel.

Further supporting the idea that sherds can be organized into vessel categories using their metric properties and rim diameter, my analysis of the correlation between vessel wall thickness variability and vessel completeness demonstrated that there was no significant relationship between these two variables. Spearman's rank order correlation tests suggest a positive monotonic relationship in the lip and rim of Middle Woodland vessels, and a negative monotonic relationship in the body of Late Woodland vessels. Linear regression analyses demonstrates that these relationships are not significantly linear. This is important because it means that even sherds representing low vessel completeness are demonstrative of their overall variability. This result is to be expected if intravessel variation is low.

Linear regression analyses also demonstrated that there is a strong, significant correlation between paired portions in both Middle and Late Woodland assemblages. Paired portions are those that are directly connected to one another. Neck thickness can be predicted by rim thickness, shoulder thickness can be predicted from neck thickness, body thickness can be predicted from shoulder thickness, and base thickness can be predicted from body thickness. However, there is no correlation between base and body in Late Woodland vessels most likely due to sample size, and the relationship between rim thickness and neck thickness is below the significance threshold ($p=>0.05$).

My analysis of rim diameter variability demonstrated that rim diameter measurements taken on less complete rims are not less accurate than rim diameter measurements taken on more complete rims. This is an odd result, because it is assumed that hand-made vessels will vary to some degree through the arc of their orifice. Late Woodland vessels demonstrated an appreciable degree of consistency in their rims—half of the sample (eight vessels out of 18) had coefficients of variation of zero. That rim diameter measurements do not get more accurate with more of the rim to measure may be due to a small sample size. Only five Middle Woodland vessels had fully complete rims to test for rim diameter estimation.

Another significant and surprising result is that there is no significant difference between Middle and Late Woodland wall thickness. The rim portion is the only significant difference—Late Woodland vessel rims are generally much thicker than Middle Woodland rims. This is quite likely due to the advent of collared vessels. The body portion had a nearly significant result ($p=0.06$) but failed to break the significance threshold. Lip, neck, shoulder, body, and basal thickness measurements are statistically identical between the Middle and Late Woodland periods. Rim diameters also do not change—vessels in the Middle and Late Woodland period are made to be similar sizes.

This result contradicts Hart's (2012: 3470-3474) proposal that vessel walls thinned over time because of increased maize processing. The differences between our results may stem from regional differences, as Hart and Brumbach's study on pottery change is based in the Finger Lakes region (2009). In their study, Hart and Brumbach measured the thickness from sherds of all vessel portions—being careful to avoid areas that were obviously thickened or constricted—and used those measurements to seek a correlation between rim diameter and vessel wall thickness. However, if the techno-functional template identified in Middle and Late Woodland vessels in this study is consistent throughout eastern North American Woodland Period pottery, the lumping of measurements from all vessel portions in their analysis may have biased their dataset.

Subsequently, Hart (2012) relied on the assumption that rim diameter and wall thickness are positively correlated in his study relating pottery wall thinning to increased maize processing. He used wall thickness measurements ($n=492$) from 246 rim sherds and vessel-size-adjusted thickness measurements on 227 rim sherds (thickness (mm)/diameter (cm)). However, there is an issue in using rim sherd thickness to track vessel thinning over time.

Hart's approach assumes that all vessel portions contribute to the same function. Maize processing is a water-based form of cooking, and Hart concluded that pottery thinned to obtain increased cooking and boiling efficiency. The rim of a vessel, however, is not heated directly and therefore does not contribute to the cooking efficiency of a vessel. Further, if my study is correct in concluding that there is no relationship between rim diameter and vessel wall thickness in Late Woodland vessels, then the adjusted thickness equation that

Hart used to compile his dataset has further misinformed his analysis.

To briefly explore this issue, I used Hart's method of adjusted wall thickness (thickness (mm)/ rim diameter (cm)) on rim thickness in my dataset. There is a significant, positive trend toward thicker rims in Late Woodland vessels. The results are in Table 6.1. Lacking a C14 chronology, I typologically divided the assemblage into six time-steps (early, middle, and late phases in both the Middle and Late Woodland) and tested them for a correlation using a Spearman's rank order correlation test ($R_s=0.4$; $p=0.07$)

My sample suggests that Late Woodland rims thickened over time, which is likely the result of the development of collared vessels. The body portions of vessels are the only parts that contribute to a vessels' (assumed) primary function—transferring heat to water/food. The rim, neck, and base all contribute to a secondary function: durability. These portions need to withstand the pressures from adding, removing, and stirring contents, and from being set down or inflicted with all the bumps and bangs of everyday life. That there is no direct correlation between rim diameter and the thickness of other vessel portions in Late Woodland vessels is an unsurprising result due to the multi-stage nature of Late Woodland pottery production. The relationship between paired portions in Late Woodland vessels is also a logical result: the lip, rim, and neck are made together, and subsequently share similar thickness patterns. The shoulder, body, and base are made from one piece, and they too subsequently share a pattern in thickness. The attachment point between neck and shoulder must be smoothed out by hand, the result of which creates a relationship between neck thickness and shoulder thickness, though it is more variable.

The absence of a significant relationship between rim diameter and body thickness in Late Woodland vessels should be explored further. There are mechanical limitations related to the size of the vessel that limit how thin the walls can be, but they were not explored in this analysis. It could be the case that the rim and neck, and body and base were made and dried separately, then attached together and left to dry again. That way, the vessel walls were already firm enough to support the vessel shape before firing. Further, it could be that vessels were later supported from the interior of the vessel during drying and firing. Another explanation for the differences between my analysis and Hart's analysis of vessel wall thickness changes is that the assemblages I analyzed for this thesis may not have an appropriate sample size, vessels large enough to detect the relationship, or a combination of the two potential biases. It could be that a significant relationship between wall thickness and rim diameter is only detectable on larger vessels.

6.4 Decorative Variability and Complexity in Middle and Late Woodland Period Pottery

Complexity and variability of design is higher at the intravessel level than the intervessel level in both Middle and Late Woodland periods. This result, however, is likely due to the presence of a small number of highly complex vessels creating a large range in coefficients of variation. The raw data for decorative complexity and variability demonstrate that both Middle and Late Woodland vessels are relatively simple. Many vessels have coefficients of variation of zero exemplifying a notable degree of decorative consistency. This result is good because it offers up reliability when matching decorated sherds that do not fit together. In a fragmented assemblage, sherds that demonstrate similar decorative motifs are more likely to fit to the same vessel than to have come from a different vessel.

Linear regression analyses demonstrated that design complexity and variability in both Middle and Late Woodland vessels are not correlated to either vessel completeness or rim diameter. This result is interesting. It suggests that complexity and variability in less complete fragments is still representative of a vessels' overall complexity, and that motifs do not become more or less complex or variable as size increases. Vessel types are standardized such that when they are applied to a vessel, the decorative elements used are simply enlarged to the size of the vessel rather than adding more constituent elements to the vessel.

Additionally, statistical analysis demonstrated that there is no significant difference between Middle and Late Woodland decorative complexity. A few vessels demonstrate high complexity and variability—the most complex vessels are from the Middle to Late Woodland transition period. Overall, however, decorative complexity remains stable across both the Middle and Late Woodland periods.

6.5 Putting the Pieces Together: Using Sherd Thickness in Ceramic Quantification

The results above demonstrate that Middle and Late Woodland vessels have a clear technological pattern driven by functional needs. This pattern can aid in reconstructing vessels and provide more accurate MNV and EVE estimates because undecorated body sherds and non-fitting decorated sherds can now be assigned with greater confidence to vessels according to their decorative and metric characteristics. Pottery quantification in cultural resource management quite often involves simply counting sherds and matching motifs to propose a measure of the number of vessels in the fragmented assemblage. This method may be inappropriate and provide a biased description of an archaeological site or assemblage. If a Middle Woodland vessel with pseudoscallop shell stamping broke into 50 sherds, and three Late Woodland vessels (each with some variation of linear incised design) broke into 5 pieces respectively, it would be easy to conclude that the site is overwhelmingly Middle Woodland. Making matters more complicated, Middle Woodland vessels often have decoration well below the shoulder, meaning that even more Middle Woodland types would appear to be present. This issue is compounded by the reality of archaeological excavation (site sampling strategies versus full recovery, for instance) and taphonomic processes.

A minimum number of vessels or estimated vessel equivalent can be arrived at through a simple process (see Figure 6.4 for a flowchart of this process). This process is easier when working with Middle Woodland sites, as Middle Woodland vessels tend to follow morphometric patterns predicated on their rim diameters. For Late Woodland vessels, the process is a little more arduous. The process begins by separating sherds by type (if multi-component) and then by their location on the vessel (rim, neck, shoulder, body, and base) as best as possible. For Middle Woodland assemblages, rim diameter should be measured on all eligible extant rims sufficiently preserved for accurate rim diameter measurement. Table 6.1 provides an index for rim diameter to vessel portion thickness.

Using the table below, Middle Woodland sherds can be sorted into vessels by matching the metric patterns of neck, shoulder, and body sherds to their rims. This index reports small ranges in thickness, but there is more variability present in each portion. My analysis

Table 6.1: Conversion Index for Estimating Vessel Wall Thickness in Middle Woodland Vessels Using Rim Diameter

Rim Diameter (mm)	Rim (mm)	Neck (mm)	Shoulder (mm)	Body (mm)
100	6.0-6.5	5.5-7.0	4.5-5.0	5.0-6.0
150	7.0-8.0	6.0-8.0	5.5-7.5	6.0-7.0
200	8.0-8.5	7.5-9.5	6.5-7.5	7.0-9.0
250	8.0-10.0	8.0-10.0	7.0-9.0	7.0-10.0

did not break the samples down into decorative or functional types beyond either Middle or Late Woodland. Both decorative or functional types may have thicker walls than other vessels with similar rim diameters. The values reported above, however, are indicative of the relationship between rim diameter and vessel portion thickness on average. If some portions are missing, Table 6.2 below can be used to relate each vessel portion to each other.

Table 6.2: Conversion Index for Middle Woodland Wall Thickness Prediction (mm)

Rim to Neck		Neck to Shoulder		Shoulder to Body		Body to Base	
5.0-6.0	5.5-6.5	5.0-6.0	5.0-6.0	4.0-5.0	4.5-5.0	4.0-5.0	7.0-8.0
6.0-7.0	5.5-7.0	6.0-7.0	5.0-7.5	5.0-6.0	5.0-6.0	5.0-6.0	7.5-9.0
7.0-8.0	6.0-7.0	7.0-8.0	6.5-8.0	6.0-7.0	5.0-7.0	6.0-7.0	8.5-9.5
8.0-9.0	7.5-10.0	8.0-9.0	7.0-9.0	7.0-8.0	5.0-8.0	7.0-8.0	9.5-11.0
9.0-10.0	7.5-10.0	9.0-10.0	7.0-9.0	8.0-9.0	7.0-9.0	8.0-9.0	10.5-12.0
10.0-11.0	8.0-11.0	10.0-11.0	7.5-10.0	9.0-10.0	8.0-9.0	9.0-10.0	11.0-12.0
11.0-12.0	8.0-12.0	11.0-12.0	9.0-11.0	10.0-11.0	9.0-10.5		

The table above provides the means to predict what each vessel portion should measure compared to its' counterparts. For example, if you have a rim measuring between 5-6 mm, the neck portion should be between 5.5-6.5 mm, and so on. Of course, moderate variation exists in the central tendency of each vessel part, and this should be kept in mind when using these conversion indexes practically. Table 6.3 below is the conversion index for Late Woodland vessels. Data for the basal portion of Late Woodland vessels are missing due to small sample size.

Table 6.3: Conversion Index for Late Woodland Vessel Wall Thickness Prediction (mm)

Rim to Neck		Neck to Shoulder		Shoulder to Body	
7.0-8.0	5.0-7.5	5.0-6.0	5.0-5.5	3.0-4.0	4.0-5.5
8.0-9.0	6.5-7.5	6.0-7.0	5.0-7.0	4.0-5.0	4.5-5.5
9.0-10.0	7.0-8.0	7.0-8.0	5.0-7.0	5.0-6.0	5.0-6.0
10.0-11.0	7.5-9.0	8.0-9.0	6.0-9.0	6.0-7.0	5.0-6.5
11.0-12.0	7.5-9.0	9.0-10.0	7.0-9.0	7.0-8.0	5.5-6.5
12.0-12.0	7.0-11.0	10.0-11.0	8.0-10.0	8.0-9.0	6.5-7.5
				9.0-10.0	7.0-8.0
				10.0-11.0	7.0-8.0

The rim to neck thickness conversion index for Late Woodland vessels should be used with caution. A nearly significant, and weakly positive relationship exists between neck thickness and rim thickness, and the values above may not be accurately relied on. Ignoring the neck and rim portions, using the conversion indexes above, non-fitting and undecorated sherds can be confidently assigned to individual vessels. After having sorted sherds into their tentative vessel groups, the analyst must then measure each sherd and place them into a thickness grouping within a vessel group. Potential issues arise here: some sherds may belong to vessels that are simply missing, while others may not fit within the ranges specified in the conversion indexes. If there are sherds whose metric characteristics seem to defy the thickness ranges for a vessel group, but seem typologically similar, it is likely that it belongs to another vessel. Any sherds that are difficult to group in any way should be left for reanalysis post-sorting. At that point, the analyst may need to make subjective decisions about where they fit or exclude them altogether.

A potential issue is inherent to this method of ceramic quantification: identical or nearly identical vessels. If there are multiple vessels of the same type, size, and rim diameter, they may be inseparable when sorting fragments into vessel groups. Minimum number of vessels estimations have always suffered this bias and have given underestimations in controlled settings. However, this method provides a more reliable way to utilize once-ignored sherds and subsequently improves minimum number of vessels estimations, as well as measures of brokenness and completeness required for estimated vessel equivalents. This method is also relatively quick and efficient. The typical manner of organizing pottery sherds is merely supplemented with measurements using a set of outside calipers.

6.6 Summary

Both Middle and Late Woodland vessels are notably consistent, with low to moderate vessel wall thickness variability. Variability and complexity of design in both Middle and Late Woodland periods are moderate. The use of typological assignment using fragmented sherds is a reliable way of assigning decorated sherds to the same vessel. There is a significant, positive, linear correlation between the thickness of vessel portions in both Middle and Late Woodland vessels, offering the ability to predict how thick each vessel portion should be from rim to base. A significant, positive, linear correlation also exists between rim diameter and vessel wall thickness in Middle Woodland vessels, providing another avenue to assign sherds to vessel groups. The indexes, however, do not provide a way of relating unpaired vessel portions to one another (rim to shoulder, rim to body, rim to base, neck to body, or neck to base). The indexes do allow the analyst to predict the thicknesses in stepwise fashion. Missing vessel portions can then be accounted for if sherds with the predicted metric characteristics are missing. The method provided in this thesis provides an improvement on minimum number of vessels estimations, and a way to refine estimated vessel equivalents by extracting more information needed to measure brokenness and completeness.

The limitations of this method were noted long ago by Orton (1993): vessels of similar types, or vessels that are simply missing, cannot be accounted for, subsequently skewing a measure of the life assemblage from which a fragmented assemblage is derived. Subjective determinations on the part of the analyst are necessary to make that distinction, if possible. Sherds that do not seem to fit the metric profile of the vessel group they are believed to belong to must be subjectively assigned to a vessel or ignored altogether. Limitations aside, this study has demonstrated that sherd thickness can aid MNV and EVE estimations. The continued use of MNV and EVE estimations in Ontario helps to accurately interpret archaeological sites throughout the country. By doing so, assemblage compositions can be compared at the intersite and intrasite levels, allowing archaeologists to answer archaeological questions.

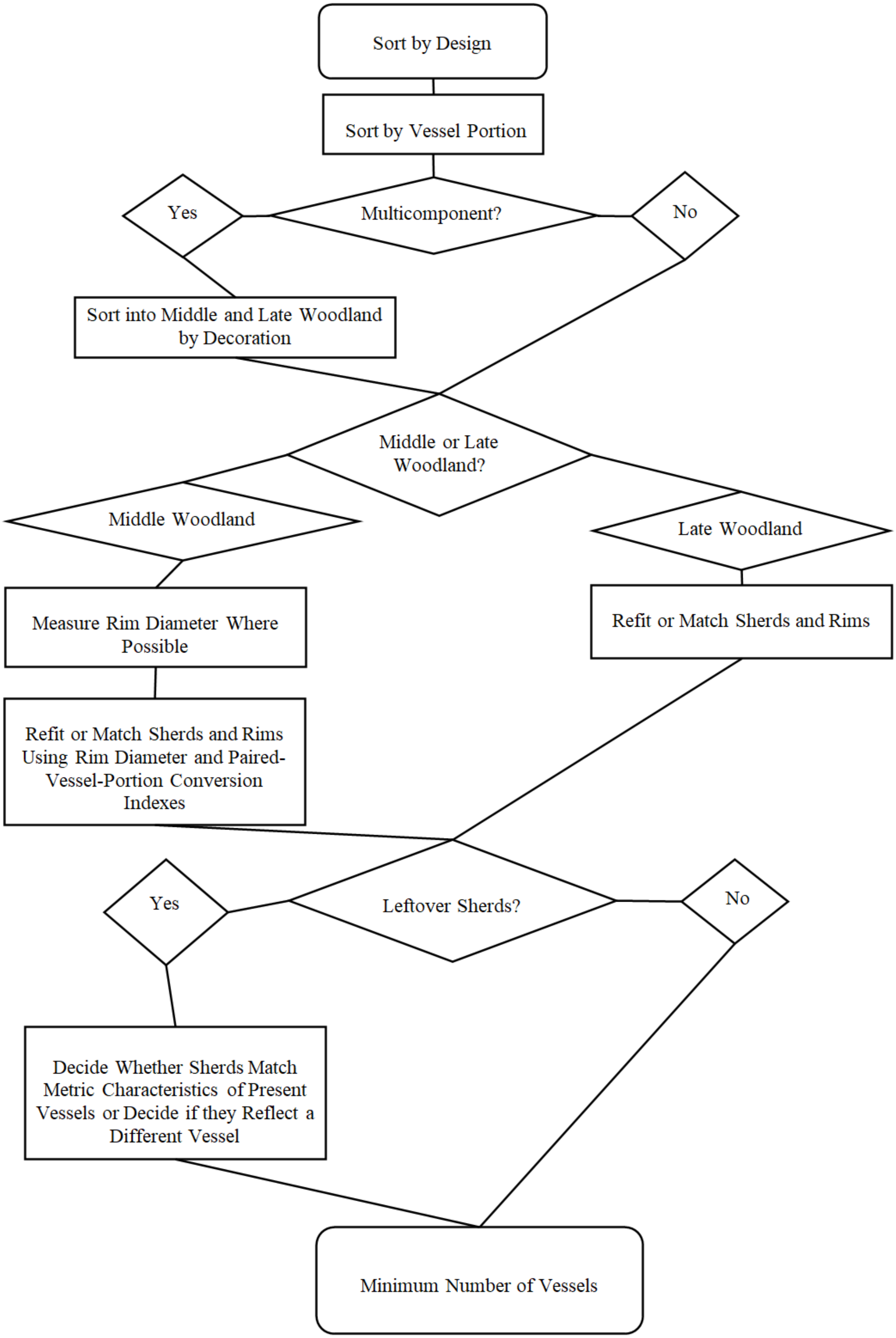

Figure 6.2: Flowchart for MNV Estimation Process Using Sherd Thickness Conversion Indexes

Chapter 7

Conclusion

7.1 Summary of Thesis Goals, Results, and Interpretations

The research goal in this study was to establish the extent to which an understanding of the full range of morphometric and decorative variability in Woodland Period pottery can aid in the quantification of fragmented assemblages. Pottery quantification is a necessary step in bridging archaeological theory with ceramic data. By establishing vessel type frequency, it is possible to make inferences about an archaeological site: the predominance of certain types defines the time and duration of site occupation, functional types define the purpose of a site or behaviours within, and the quantity of vessels provides some measure of site population and demography. These are only a few avenues of research made possible by pottery quantification. Vessel type frequency based on sherd count alone may be an unreliable and biased method of pottery analysis due to the nature of post-depositional taphonomy, as well as events during a vessels' use-life. Vessels do not break in the same number of fragments, and variables such as vessel size, paste and temper recipe, vessel function, and variable potting skills all affect the degree to which vessels fragment. If archaeologists are to make inferences and deductions from pottery analysis, they must be able to work at the level of whole vessels, not sherds. I studied vessel wall thickness variability at the intervessel and intravessel level to establish whether variability is higher between vessels or within vessels. I explored the relationship between vessel wall thickness and rim diameter, as well as the relationship between vessel wall thickness variability and vessel completeness. I also sought to establish whether there are statistically detectable differences between Middle and Late Woodland vessels.

The results indicate that vessel wall thickness variability is higher at the intervessel level than the intravessel level, meaning that vessels themselves have low variability internally. There is a significant relationship between vessel wall thickness and rim diameter in Middle Woodland vessels, but the relationship is not present in Late Woodland vessels. The lack of this relationship in Late Woodland vessels is attributed to the multi-stage manufacture process generally used after the Middle Woodland period. Strong relationships between the neck and rim, shoulder and neck, shoulder and body, and base and body were discovered in both Middle and Late Woodland samples. The strong correlation between rim diameter and vessel wall thickness in Middle Woodland vessels allowed for the development of a conversion index by which Middle Woodland rims can be used to predict the thickness of its other vessel portions, allowing analysts to identify which sherds belong to which vessel, even if the sherds are missing. The relationship between the rim and neck, shoulder and neck, body and shoulder, and base and body in both Middle and Late Woodland vessels permitted the development of conversion indexes to assign sherds to vessels, even if rims are missing.

Variability in vessel wall thickness in both Middle and Late Woodland vessels was found to be poorly correlated with vessel completeness. This means that vessel wall thickness variability is expressed in less-complete fragments. Sherds representing between 10-20% of the whole vessel are sufficient to capture the central tendency of thickness. This consistency is attributed to technofunctional needs wherein potters understood, to some degree, the physical characteristics of fired clay: that variably thick vessel walls were susceptible to premature breakage due to varying expansion rates under heat.

I also found that there are no statistically significant differences in morphometric properties between Middle and Late Woodland vessels, excepting the rim which is attributed to the development of collared vessels in the Late Woodland period. A statistical difference between the body portions of Middle and Late Woodland vessels approached significance but did not break the critical value of $p=<0.05$. This is an interesting result, and contrary to the popular belief in Middle and Late Woodland pottery differences in North American archaeology. Rim diameter is stable between the Middle and Late Woodland periods. I found decorative variability and complexity to be both non-complex and moderately variable in both the Middle and Late Woodland periods. Late Woodland vessels tend to be slightly more complex. The most highly complex and variable vessels tend to be from the Middle to Late Woodland transitional period. Intravessel complexity and variability tends to be higher than intervessel complexity and variability in both the Middle and Late Woodland periods. However, the presence of some highly complex and variable vessels obscures the notable degree of consistency exhibited by many Middle and Late Woodland vessels. This pattern in decorative variability and complexity is attributed to temporal factors not captured in this analysis.

Further, decorative variability and complexity are not correlated with either rim diameter or vessel completeness in both the Middle and Late Woodland period samples. This suggests that decorative motifs do not get more complex or variable as vessel size increases: motifs are likely proportioned to the size of the vessel being decorated, rather than adding more constituent elements. Decorative complexity and variability also seem to be captured on less complete vessels. These results suggest that vessel motifs do not change drastically across their surface, and thus the typical method of typological attribution remains a reliable method of sherd assignment.

Finally, and significantly, I found a techno-functional pattern of vessel wall thickness in both Middle and Late Woodland vessels—a pattern which has yet to be seen in Ontario archaeology. On average, both Middle and Late Woodland vessels have a lip proportioned to their rims. The rim, neck, and base are thicker than the shoulder and body of ceramic vessels. This pattern is interpreted as functional because a thicker rim and neck protects the vessel from breaking when stirring, adding, or removing contents. The shoulder thins because it must be smoothed into the body. The body is made to be thin for efficient heat transfer. A thinner vessel wall allows heat to transfer to the contents much more easily, and the vessel walls do not have to expand much, increasing thermal shock resistance (Braun 1983, 2010). Last, the base must be made thick in order to withstand impact pressures from being set down or placed in or above a fire.

The techno-functional pattern in Middle and Late Woodland period vessels may have its origins in the Early Woodland period. The pattern is ubiquitous throughout the sample, suggesting that it was present in the earliest Middle Woodland vessels. There is much speculation about the reasons why ceramic vessels were first adopted. Many studies suggest Vinette 1 vessels were originally used for a single purpose, but that that purpose varied from region to region (eg. boiling nuts or fish for oil) (Hanson et al., 2019; Skibo, Malainey, and Kooiman, 2016; Taché and Craig, 2015). However, that ceramic vessels were used for a wide variety of purposes in the Middle Woodland period indicates that Vinette 1 vessels likely saw an increase in utility value at some point before the Middle Woodland period began. If potters began to consider their utility in the Early Woodland period, functionality might have been a strong candidate for improvement, assuming there is continuity between Vinette 1 vessels and the Point Peninsula Complex.

7.2 Study Limitations

The foremost limitation to this study is the recovery context of the Charleston and South Lake assemblages. Both assemblages were recovered from underwater contexts in a network of lakes and rivers on the Frontenac Axis. The Charleston Lake assemblage was discovered on various subsurface rock shelves at the put-in of the Red Horse Lake Portage Route linking Charleston Lake and Red Horse Lake. The South Lake vessels were found as part of an underwater archaeological survey headed by Ken Cassavoy in the late 1970's after the discovery of the Charleston Lake vessels. Wright (1980) proposed that the vessels were discarded at this location because they broke during travel. However, it is equally likely that the vessels broke while travelling the portage, at a site near the portage, or when getting out of the canoe when arriving at the portage. No matter how the vessels ended up underwater—in the case of either South Lake or Charleston Lake—the vessels in both assemblages may be representative of vessels chosen specifically for travel by canoe.

The types of vessels brought along on canoe trips may have been selected for by size and function. It may be the case that vessels brought along in canoes have to be a certain size and weight so as not to compromise the balance and buoyancy of the canoes. They may also be specifically cooking vessels. Many vessels in both the Charleston Lake and South Lake assemblages have carbonized cooking residue and signs of use-wear. Bringing along manageably sized cooking vessels is a consideration contemporary backpackers and canoeists make.

With that in mind, the metric profiles I captured in my analyses may be indicative of cooking vessels in general, and not representative of the wide range of vessels that may have been utilized in the Woodland Period. Other vessels may have been used regularly that are not reflected in these assemblages—for instance, vessels used for long, slow boils; storage vessels; feasting vessels; trading vessels; or ceremonial vessels. It is not known if there are functionally specific vessels in the Middle or Late Woodland period in Ontario, or, if they do exist, what their morphometric characteristics are. Kooiman (2016: 221-225), however, suggests that there is no relationship between vessel form and function on two large Middle and Late Woodland sites in Upper Michigan.

A second limitation to this study regards how the samples were analyzed. Both the Middle and Late Woodland samples have types that span the breadth of each period—from early Middle Woodland to late Middle Woodland, and early Late Woodland to late Late Woodland. Breaking the samples down into their sub-period time frames could reveal more nuanced differences between vessels of the same time period, or in comparison to other time periods. However, the sample size would be too small to analyze early, middle, and late Middle and Late Woodland vessels and compare them in that fashion. Capturing the general trends in both the Middle and Late Woodland periods is a more reliable approach to this data, and still offered up interesting insights.

7.3 Further Research

Functional analysis is a promising approach to pottery analysis, both in North America and globally. In North America, the origin of handmade ceramic vessels is not yet fully understood, nor the processes by which pottery became ubiquitous on Woodland period sites. Recent research into Vinette 1 pottery functions suggest that they were originally used for a single purpose. Lipid biomarkers in early pottery from Upper Michigan and around the Great Lakes suggests that they were typically used to process fish and nuts for oil (Hanson et al., 2019; Skibo, Malainey, and Kooiman, 2016; Taché and Craig, 2015), and earlier research also speculated on the use of Vinette 1 vessels to boil acorns (Jackson, 1986). Other researchers have focused on function by type (Braun, 2010), but studies like these are few in Ontario archaeology. A better understanding of Woodland period pottery use in Ontario and North America is essential for making inferences about human behaviour and the social contexts in which pottery was used.

Significantly for this study, the method of ceramic quantification presented here requires practical use in case studies. While Orton may have reservations about MNV estimates, they are far superior to simple sherd counts. The cultural resource management industry carries out the bulk of archaeological excavation in North America today. Balancing the demands of the development industry, the interests of First Nations groups, and the financial success of the business alters the excavation methodologies and the degree to which artifacts are analyzed. Cheap, efficient methods of ceramic quantification are necessary to appeal to CRM companies and academics alike. The method provided in this study provides a way to quantify ceramic assemblages cheaply and efficiently, and it allows analysts to relate sherds to vessels by their metric and typological properties, even if they are undecorated or some portions of the vessels are missing. There is a need to encourage ceramic quantification in the cultural resource management industry so that when funded research projects have access to CRM assemblages and grey literature, comparisons can be made on a vessel-to-vessel basis, allowing more informative inferences and interpretations.

Also needed in North American archaeology, particularly in Ontario, is a program for underwater archaeological survey. The northern US states and most of Canada consist of vast networks of creeks, streams, rivers, ponds, and lakes that served as the most efficient method of travel for millennia. People lived on and beside waterways since the first arrival in the Pre-Palaeoindian period. Deglaciation and isostatic rebound have altered water levels throughout the American continent multiple times in history, and many sites are inundated today. Bodies of water provide excellent anaerobic environments to preserve organic materials, slowing taphonomic processes that would typically accelerate the degradation of artifacts on terrestrial sites. Well preserved artifacts present the opportunity to study their characteristics in full, and the relationship between inundated sites and terrestrial sites can reveal the significance of place-making in prehistory.

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Appendix A: Morphometry Raw Data

Table 7.1: Raw Data for Middle Woodland Morphometry (n=27), in millimeters. L=Lip, R=Rim, N=Neck, S=Shoulder, B=Body, Ba=Base, RD=Rim Diamater, RL=Rim Length, C=Percent Complete.

Vessel #	L	R	N	S	B	Ba	RD	RL	C
76-1	5	5	5	7	5	6	101.6	194.0	60.8
76-1	6	6	5	5	4	7	101.6	194.0	60.8
76-1	4	5	6	4	5	8	101.6	194.0	60.8
76-1	6	7	6	4	6	7	127.0	194.0	60.8
76-10	10	11	9	9			254.0	420.0	47.8
76-10	8	10	11	9			254.0	420.0	47.8
76-10	8	10	9	8			254.0	420.0	47.8
76-10	7	8	9	9			254.0	420.0	47.8
76-14	5	8	8	5	4		127.0	169.0	30.3
76-14	6	7	7	5	5		152.4	169.0	30.3
76-14	6	8	7	5	7		152.4	169.0	30.3
76-14	6	7	7	6	6		177.8	169.0	30.3
76-19	9	8	9	9	11		228.6	276.0	38.4
76-19	8	9	11	11	11		228.6	276.0	38.4
76-19	9	8	9	9	12		228.6	276.0	38.4
76-19	7	9	8	6	8		254.0	276.0	38.4
76-2	11	6	7	5	8	13	101.6	141.0	44.2
76-2	8	8	6	5	8	12	101.6	141.0	44.2
76-2	8	7	5	4	9	11	101.6	141.0	44.2
76-2	9	6	5	4	7	9	152.4	141.0	44.2
76-3	4	9	6	8	5	7	101.6	209.0	52.4
76-3	4	9	7	9	3	7	127.0	209.0	52.4
76-3	4	6	5	9	6	7	127.0	209.0	52.4
76-3	4	8	6	6	6	9	127.0	209.0	52.4
76-4	4	4	8	8	7		152.4	220.0	45.9
76-4	4	5	6	8	9		152.4	220.0	45.9
76-4	5	5	6	6	9		177.8	220.0	45.9
76-4	5	5	7	7	8		203.2	220.0	45.9

76-5	4	6	8	8	6		152.4	152.0	24.0
76-5	5	7	8	9	7		152.4	152.0	24.0
76-5	5	7	6	7	9		177.8	152.0	24.0
76-5	4	6	7	7	9		203.2	152.0	24.0
76-6	7	9	11	6			152.4	180.0	32.2
76-6	7	9	10	5			177.8	180.0	32.2
76-6	6	9	10	6			177.8	180.0	32.2
76-6	6	9	10	6			177.8	180.0	32.2
76-7	7	12	13	11	10		228.6	658.0	100.0
76-7	9	11	14	10	10		228.6	658.0	100.0
76-7	6	13	11	11	11		228.6	658.0	100.0
76-7	8	12	14	11	11		254.0	658.0	100.0
76-8	6	8	10	9	6		152.4	192.0	40.1
76-8	7	9	10	8	9		152.4	192.0	40.1
76-8	8	8	9	8	7		152.4	192.0	40.1
76-8	5	10	9	7	8		152.4	192.0	40.1
76-9	4	7	11	8			152.4	287.0	40.0
76-9	4	7	8	8			228.6	287.0	40.0
76-9	5	9	9	7			254.0	287.0	40.0
76-9	3	8	9	6			279.4	287.0	40.0
77-1	7	9	9	8	7		228.6	823.4	100.0
77-1	9	8	10	9	9		254.0	823.4	100.0
77-1	6	9	11	7	7		254.0	823.4	100.0
77-1	8	10	11	6	8		254.0	823.4	100.0
78-13	10	7	6	5	7		203.2	155.0	21.6
78-13	10	10	9	7	8		203.2	155.0	21.6
78-13	11	10	9	7	7		203.2	155.0	21.6
78-13	11	10	11	7	6		203.2	155.0	21.6
78-26 p26c		8	10	7	8		177.8	117.0	20.9
78-26 p26c		9	8	8	9		177.8	117.0	20.9
78-26 p26c		8	8	9	10		177.8	117.0	20.9
78-26 p26c		9	9	8	9		177.8	117.0	20.9
78-90 V21	4	8	9	7	4		152.4	75.0	15.7
78-90 V21	5	8	9	6	5		152.4	75.0	15.7
78-90 V21	5	9	9	6	5		152.4	75.0	15.7
78-90 V21	5	9	8	7	4		203.2	75.0	15.7
BcGb-6-V10	8	8	8	9	11	11	177.8	275.0	34.5
BcGb-6-V10	9	9	10	9	10	11	203.2	275.0	34.5
BcGb-6-V10	10	11	9	10	9	14	254.0	275.0	34.5
BcGb-6-V10	11	11	7	7	7	14	254.0	275.0	34.5
BcGb-6-V18	10	10	10				203.2	133.0	18.5
BcGb-6-V18	10	10	10				228.6	133.0	18.5
BcGb-6-V18	11	9	12				228.6	133.0	18.5
BcGb-6-V18	9	11	12				228.6	133.0	18.5

BcGb-6-V20	7	7	6	6			254.0	145.0	18.2
BcGb-6-V20	8	7	6	5			254.0	145.0	18.2
BcGb-6-V20	8	6	6	4			254.0	145.0	18.2
BcGb-6-V20	8	6	5	5			254.0	145.0	18.2
BcGb-6-V21	6	8	9	6	7		177.8	240.0	43.0
BcGb-6-V21	7	10	7	7	7		203.2	240.0	43.0
BcGb-6-V21	9	9	8	6	7		203.2	240.0	43.0
BcGb-6-V21	8	9	7	7	7		203.2	240.0	43.0
BcGb-6-V4	11	10	9				203.2	223.0	27.9
BcGb-6-V4	10	11	8				228.6	223.0	27.9
BcGb-6-V4	9	12	8				254.0	223.0	27.9
BcGb-6-V4	11	12	9				254.0	223.0	27.9
BdGa-12-V27	5	6	6	5	5	8	101.6	330.0	100.0
BdGa-12-V27	6	8	8	4	4	9	101.6	330.0	100.0
BdGa-12-V27	6	6	7	4	4	7	127.0	330.0	100.0
BdGa-12-V27	6	6	6	5	6	9	127.0	330.0	100.0
BdGa-12-V41	7	7	7	7	7		152.4	196.0	22.3
BdGa-12-V41	6	8	8	7	6		254	196.0	22.3
BdGa-12-V41	8	7	7	7	7		279.4	196.0	22.3
BdGa-12-V41	5	7	7	8	7		279.4	196.0	22.3
C80-56 V32	8	8	11	11			152.4	136.0	21.3
C80-56 V32	7	8	12	12			203.2	136.0	21.3
C80-56 V32	7	9	10	9			203.2	136.0	21.3
C80-56 V32	7	9	9	10			203.2	136.0	21.3
P3-78 V22	5	5	5	4			127.0	155.0	38.8
P3-78 V22	6	6	6	5			127.0	155.0	38.8
P3-78 V22	5	6	7	5			127.0	155.0	38.8
P3-78 V22	4	6	5	4			152.4	155.0	38.8
P78-16 V21		9	10	9	9		152.4	202.0	42.2
P78-16 V21		7	8	8	8		152.4	202.0	42.2
P78-16 V21		9	8	8	7		203.2	202.0	42.2
P78-16 V21		8	9	6	8		254.0	202.0	42.2
p7C v24	9	7	6	5			127.0	91.0	19.0
p7C v24	10	7	7	6			152.4	91.0	19.0
p7C v24	10	7	7	6			152.4	91.0	19.0
p7C v24	9	7	5	5			152.4	91.0	19.0

Table 7.2: Raw Data for Late Woodland Morphometry (n=18), in millimeters. L=Lip, R=Rim, N=Neck, S=Shoulder, B=Body, Ba=Base, RD=Rim Diamater, RL=Rim Length, C=Percent Complete.

Vessel #	L	R	N	S	B	Ba	RD	RL	C
76-17	2	8	8				152.4	84.0	17.5
76-17	2	8	8				152.4	84.0	17.5
76-17	3	8	8				152.4	84.0	17.5
76-17	3	7	6				152.4	84.0	17.5
BcGb-6-V5	7	9	9	6			152.4	90.0	18.8
BcGb-6-V5	8	9	9	7			152.4	90.0	18.8
BcGb-6-V5	7	9	9	7			152.4	90.0	18.8
BcGb-6-V5	7	10	8	6			152.4	90.0	18.8
BcGb-6-V19	8	9	7	8			152.4	200.0	18.8
BcGb-6-V19	6	8	7	7			152.4	200.0	18.8
BcGb-6-V19	8	8	6	6			177.8	200.0	18.8
BcGb-6-V19	6	8	6	6			203.2	200.0	18.8
BcGb-6-V14	9	9	7	6	5		177.8	153.0	24.0
BcGb-6-V14	9	9	8	7	4		203.2	153.0	24.0
BcGb-6-V14	10	9	8	5	5		203.2	153.0	24.0
BcGb-6-V14	10	10	6	6	6		203.2	153.0	24.0
BcGb-6-V8	6	9	5	6			177.8	144.0	25.8
BcGb-6-V8	8	10	6	5			177.8	144.0	25.8
BcGb-6-V8	5	13	6	5			177.8	144.0	25.8
BcGb-6-V8	7	10	5	5			203.2	144.0	25.8
BcGb-6-23	8	10	9	9			152.5	186.0	33.3
BcGb-6-23	10	10	8	7			177.8	186.0	33.3
BcGb-6-23	10	10	8	9			177.8	186.0	33.3
BcGb-6-23	9	11	6	8			177.8	186.0	33.3
76-11	6	7	7	3	4	5	152.4	165.0	34.5
76-11	6	7	7	3	6	7	152.4	165.0	34.5
76-11	6	7	7	3	6	7	152.4	165.0	34.5
76-11	6	7	7	5	6	6	152.4	165.0	34.5
BcGb-6-V2	3	8	10	12	7	8	152.4	185.0	38.6
BcGb-6-V2	4	8	9	11	9	10	152.4	185.0	38.6
BcGb-6-V2	3	10	8	8	8	7	177.8	185.0	38.6
BcGb-6-V2	3	10	8	10	8	8	177.8	185.0	38.6
BcGb-6-V13	7	8	7	6	7		101.6	158.0	39.6
BcGb-6-V13	7	9	6	6	6		127.0	158.0	39.6
BcGb-6-V13	7	8	7	6	7		127.0	158.0	39.6
BcGb-6-V13	7	8	7	7	6		127.0	158.0	39.6
76-18	8	10	9	5	3		203.2	287.0	40.0
76-18	7	9	8	5	4		228.6	287.0	40.0
76-18	8	10	9	5	5		228.6	287.0	40.0
76-18	7	9	8	5	5		228.6	287.0	40.0

76-22	11	11	12	11	8		254.0	330.0	41.3
76-22	8	13	11	6	9		254.0	330.0	41.3
76-22	10	14	8	7	9		254.0	330.0	41.3
76-22	10	13	11	9	6		304.0	330.0	41.3
76-20	8	9	7	6	4		177.8	250.0	44.8
76-20	7	10	6	6	5		177.8	250.0	44.8
76-20	6	10	8	6	4		177.8	250.0	44.8
76-20	6	10	9	7	5		203.3	250.0	44.8
BcGb-3-V2	9	8	5	5	5		254.0	370.0	46.4
BcGb-3-V2	11	8	6	5	4		254.0	370.0	46.4
BcGb-3-V2	11	8	5	5	5		254.0	370.0	46.4
BcGb-3-V2	10	7	4	4	5		254.0	370.0	46.4
BcGb-3-V1	8	10	8	5			177.8	455.0	81.5
BcGb-3-V1	7	10	9	7			177.8	455.0	81.5
BcGb-3-V1	8	9	8	6			177.8	455.0	81.5
BcGb-3-V1	9	12	8	6			177.8	455.0	81.5
BcGb-6-V3	6	13	6	6			152.4	398.0	83.1
BcGb-6-V3	6	12	8	6			152.4	398.0	83.1
BcGb-6-V3	7	13	6	6			152.4	398.0	83.1
BcGb-6-V3	8	12	8	6			152.4	398.0	83.1
BcGb-6-V9	6	10	7	7	8	11	101.6	303.0	95.0
BcGb-6-V9	7	14	7	11	7	12	101.6	303.0	95.0
BcGb-6-V9	9	8	9	13	9	11	101.6	303.0	95.0
BcGb-6-V9	6	9	9	7	7	10	101.6	303.0	95.0
76-21	10	7	8	4	4		203.2	632.0	100.0
76-21	9	8	7	4	5		203.2	632.0	100.0
76-21	11	8	7	6	5		203.2	632.0	100.0
76-21	10	7	8	4	4		203.2	632.0	100.0
BcGb-6-V1	7	8	7	5	6		228.6	660.0	100.0
BcGb-6-V1	7	8	7	6	7		228.6	660.0	100.0
BcGb-6-V1	7	8	6	6	6		228.6	660.0	100.0
BcGb-6-V1	6	8	6	6	7		228.6	660.0	100.0

Appendix B: Decoration Raw Data

Table 7.3: Raw Data for the Analysis of Decorative Variability and Complexity in Middle Woodland Vessels (n=27). C=Percent Complete, DCS=Decorative Complexity Score, ECS=Elemental Complexity Score, SD=Standard Deviation, CV=Coefficient of Variation (%), MRD=Mean Rim Diameter (mm)

Vessel #	C	DCS	ECS	SD	CV	MRD
76-1	59.16	11.00	0.25	0.00	0.00	107.95
76-10	28.68	13.75	0.27	0.07	25.23	254.00
76-14	19.52	15.00	0.27	0.07	26.66	152.40
76-19	24.68	16.00	0.27	0.07	25.91	234.95
76-2	57.70	12.00	0.25	0.00	0.00	114.30
76-3	63.48	23.25	0.28	0.09	30.62	120.65
76-4	36.72	8.00	0.26	0.05	17.40	171.45
76-5	17.60	12.75	0.25	0.00	0.00	171.45
76-6	19.32	13.00	0.26	0.03	11.83	171.45
76-7	70.00	14.00	0.27	0.08	27.40	234.95
76-8	32.06	20.25	0.25	0.03	11.05	152.40
76-9	27.00	12.75	0.25	0.00	0.00	228.60
77-1	77.00	14.50	0.25	0.00	0.00	247.65
78-13	14.32	16.00	0.33	0.12	35.71	203.20
78-26 p26c	12.36	11.75	0.26	0.05	19.96	177.80
78-90 V21	12.42	11.25	0.25	0.00	0.00	165.10
BcGb-6-V10	26.90	21.25	0.31	0.11	34.17	222.25
BcGb-6-V18	7.24	8.75	0.25	0.00	0.00	222.25
BcGb-6-V20	8.28	10.00	0.26	0.04	15.40	254.00
BcGb-6-V21	26.80	11.25	0.25	0.00	0.00	196.85
BcGb-6-V4	11.16	13.50	0.25	0.00	0.00	234.95
BdGa-12-V27	50.00	9.50	0.25	0.00	0.00	114.30
BdGa-12-V41	18.46	8.75	0.25	0.00	0.00	241.30
C80-56 V32	11.52	8.75	0.25	0.00	0.00	190.50
P3-78 V22	17.76	22.75	0.37	0.18	48.50	133.35
P78-16 V21	35.44	10.25	0.27	0.17	50.00	190.50
p7C v24	10.60	12.50	0.29	0.10	32.20	146.05

Table 7.4: Raw Data for the Analysis of Decorative Variability and Complexity in Late Woodland Vessels (n=18). C=Percent Complete, DCS=Decorative Complexity Score, ECS=Elemental Complexity Score, SD=Standard Deviation, CV=Coefficient of Variation (%), MRD=Mean Rim Diameter (mm)

Vessel #	C	DCS	ECS	SD	CV	MRD
76-11	29.70	15.25	0.26	0.06	21.23	152.40
76-17	6.90	12.25	0.26	0.05	19.61	152.40
76-18	25.00	10.25	0.25	0.00	0.00	222.25
76-20	43.96	25.00	0.43	0.24	56.24	184.18
76-21	70.00	14.50	0.25	0.00	0.00	203.20
76-22	31.78	11.50	0.26	0.04	14.56	266.50
BcGb-3-V1	50.90	10.75	0.25	0.00	0.00	177.80
BcGb-3-V2	62.00	9.00	0.25	0.00	0.00	254.00
BcGb-6-23	32.62	10.25	0.25	0.00	0.00	171.48
BcGb-6-V1	70.00	10.50	0.28	0.09	30.61	177.80
BcGb-6-V13	34.68	11.50	0.25	0.00	0.00	120.65
BcGb-6-V14	17.43	18.25	0.30	0.10	33.51	196.85
BcGb-6-V19	10.76	8.25	0.25	0.00	0.00	171.45
BcGb-6-V2	47.72	9.00	0.25	0.00	0.00	165.10
BcGb-6-V3	49.82	9.75	0.25	0.00	0.00	152.40
BcGb-6-V5	9.60	19.00	0.36	0.17	48.43	152.40
BcGb-6-V8	9.16	16.25	0.32	0.15	47.37	184.15
BcGb-6-V9	95.00	14.50	0.26	0.05	18.07	101.60

Appendix C: Decorative Attributes Considered

Table 7.5: Raw Data for the Analysis of Decorative Variability and Complexity in Late Woodland Vessels (n=18)

Tool Type	
CO	Corded
CW	Cord-Wrapped Stick
FA	Fabric
STB	Stylus, Broad
STN	Stylus, Narrow
PSS	Pseudoscallop Shell Stamp
PT	Punctate Tool
SPA	Annular Stamp
SPC	Circular Stamp
SPDS	Dentate Stamp
ODLT	Oval Dentate-like Tool
SPL	Linear Stamp
XX	Indeterminate
Tool Technique	
DS	Drag-Stamped

IM	Impressed
IN	Incised
ST	Stamped
PL	Plain
RS	Rocker-Stampled
PP	Push-Pull
N	Notched
XX	Indeterminate

Configuration

PL	Plain
HZ	Horizontal
VE	Vertical
LO	Left-Oblique
RO	Right-Oblique
PB	Punctate with Boss
PN	Punctate, No Boss
DPB	Double Punctate, with Boss
DPN	Double Punctate, no Boss
ZZ	Zig-zag
PTS	Plaits
HPL	Horizontal Plaits
SIHZ	Superimposed Horizontal
SIVE	Superimposed Vertical
SILO	Superimposed Left-Oblique
SIRO	Superimposed Right-Oblique
SIPB	Superimposed Punctate, with Boss
SIPN	Superimposed Punctate, no Boss
SIDPB	Superimposed Double Punctate, with Boss
SIDPN	Superimposed Double Punctate, no Boss

SIZZ	Superimposed Zig-Zag
CX	Criss-Cross
VPL	Vertical Plaits

Element Placement

BA	Base
BO	Body
NK	Neck
UN	Upper Neck
LN	Lower Neck
NB	Neck to Body
NBA	Neck to Base
SH	Shoulder
US	Upper Shoulder
RI	Rim
RU	Upper Rim
RM	Middle Rim
RL	Lower Rim
RN	Rim to Neck
WH	Whole
SBA	Shoulder to Base
NS	Neck to Shoulder
RS	Rim to Shoulder
RB	Rim to Body
SL	Lower Shoulder
SB	Shoulder to Body
IBO	Interior Body
IRI	Interior Rim
IRU	Interior Upper Rim
IRM	Interior Middle Rim

IRL	Interior Lower Rim
INK	Interior Neck
INU	Interior Upper Neck
INB	Interior Neck to Body
ISB	Interior Shoulder to Body
BB	Body to Base
INL	Interior Lower Neck
INS	Interior Shoulder
RBA	Rim to Base

Rim Type

CO	Collared
NC	Non-Collared
AP	Appliqué
IR	Irregular
XX	Indeterminate

Rim Orientation

IN	Insloping
IC	Insloping and Chanelled/Rolled
VE	Vertical
OU	Outflaring
OE	Outflaring and Everted
IR	Irregular
XX	Indeterminate

Rim Profile

CV	Concave
CX	Convex
ST	Straight

CVX	Convex over Concave
CXV	Concave over Convex
SOV	Straight over Concave
SOX	Straight over Convex
CVV	Concave over Concave
CXX	Convex over Convex
OCV	Oblique over Convex
IR	Irregular
XX	Indeterminate

Rim Shape

COPA	Collared, poorly developed, angular
COPR	Collared, poorly developed, rounder
COWA	Collared, well developed, angular
COWR	Collared, well developed, rounded
NCNE	Non-collared, even/straight
NCNN	Non-collared, taper
NCNP	Non-collared, expanded
NCNT	Non-collared, thickened
TAPR	Applique, thick, round
TAPA	Applique, thick, angular
APR	Applique, thin, round
APA	Applique, thin, angular
XX	Indeterminate

Lip Shape

CV	Concave
FL	Flat
GR	Grooved
PI	Pinched

RL	Rolled
IR	Irregular
SP	Splayed
ST	Stepped
RO	Round
PO	Pointed
BV	Bevelled
XX	Indeterminate

Lip Angle

IAC	Insloping, Acute
IOB	Insloping, Obtuse
RT	Right Angle
OOB	Outsloping, Obtuse
OAC	Outsloping, Acute
IR	Irregular
XX	Indeterminate

Lip Element Placement

FL	Front Lip
IL	Inside Lip
FIL	Front and Inside
FM	Front and Medial
TLF	Top Lip, Front
TL	Top Lip
ME	Medial
TLI	Top Lip, Inside
FTI	Front, Top, and Inside
XX	Indeterminate

Surface Treatment

CS	Check-Stamped
CSS	Smoothed Check-Stamp
CB	Combed
CM	Cord-Malleated
SMM	Smoothed Cord-Malleated
BR	Brushed
MA	Malleated, Irregular
SM	Smoothed
SR	Scarified
WI	Wiped
NT	Net
FA	Fabric
NA	Not Applicable
XX	Indeterminate

Base Morphology

SUC	Sub-conoidal
CON	Conoidal
GLO	Globular
XX	Indeterminate

Neck Morphology

SLC	Slightly Constricted
VCO	Very Constricted
NCO	Not Constricted
XX	Indeterminate

Castellations

NL	Null

NU	Nubbin
PO	Pointed
RO	Rounded
TU	Turret
SP	Scalloped, Round
SQ	Scalloped, Square
XX	Indeterminate

Appendix D: Anatomy of a Vessel

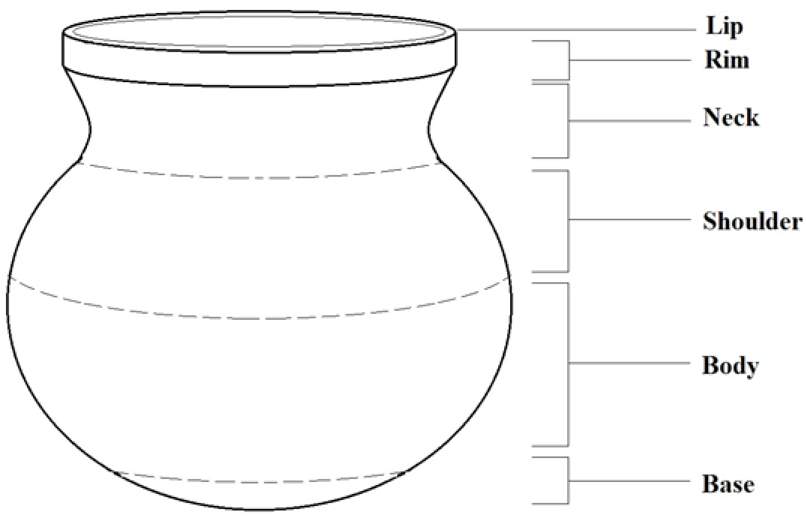

Figure 7.1: Anatomy of a Vessel

Lip

The lip of a ceramic vessel is located at the uppermost termination of the vessel walls, sitting atop the rim. Some vessels have outflaring rims that are everted away from the vessel, and as such, the lip sometimes overhangs in front of the rim. It can be visualized as the "top" of the rim.

Rim

The rim is the uppermost portion of a ceramic vessel. Many Woodland vessels have collars, or appliqué, that accentuate the rim portion. In collared vessels, the collar is often regarded as the rim. In non-collared vessels, the top 3 cm of the vessel are considered them if there is no real distinction between the rim and the neck.

Neck

The neck portion of a vessel is located below the rim and above the shoulder, and is often constricted in Woodland Period vessels. On vessels without constriction, the neck is considered as the portion below the top 3cm of the vessel, and above the shoulder.

Shoulder

The shoulder portion of a vessel is where the rim and neck begin to transition to the body. Often, the shoulder projects outward in a swooping fashion and then curves back in toward the vessel as it joins the body.

Body

The body portion of a vessel is the widest part of Woodland Period vessels and often constitutes the bulk of the vessel. It can be difficult to distinguish where the shoulder ends, and the body begins. In general, the shoulder faces upward and terminates where the surface begins to point sideways, demarcating the beginning of the body portion.

Base

The basal portion of Woodland Period vessels can also be difficult to demarcate. Middle Woodland vessels often have conoidal and sub-conoidal basal portions, while Late Woodland vessels often have rounded or globular bases. The base is demarcated when the body begins to angle back in toward the vessel, and the surface begins to face downward.

Appendix E: Criteria for Vessel Completeness Estimation

I organized the Middle and Late Woodland samples into completeness categories using the criteria outlined in Table 7.6. Each vessel portion was then assigned a percentage of completeness based off of the overall inferred size of the vessel, surface morphology, and rim diameter. Subsequently, the completeness percentages for each vessel portion (lip, rim, neck, shoulder, body, and base) were summed. Overall vessel completeness was calculated by finding what percent of 600 (each vessel portion having a score out of 100%) each extant vessel is. For example, a vessel may have 45 percent of the lip and rim, 30 percent of the neck, 20 percent of the shoulder, 10 percent of the body, and no basal portion: 45 + 45 + 30 + 20 + 10 + 0 = 150 ; 150/600 = 0.25.

Table 7.6: Vessel Completeness Estimation Criteria

Vessel Completeness (%)	Criteria
10-20	Vessels that have less than 20% of the rim and, at minimum the lip and rim portions intact.
20-40	Vessels that have 20-40% of the rim and at least 3-5 vessel portions. Or, vessels with under 45% rim preservation and only 4 vessel portions.
40-60	Vessels that have 40-60% of the rim and at least 4-6 vessel portions. Or, vessels with under 65% rim preservation but only 4 vessel portions.
60-80	Vessels that have 60-80% of the rim and at least 5-6 vessel portions. Or, vessels with under 85% rim preservation but only 5 vessel portions
80-100	Vessels that have 80-100% of the rim and at least 5-6 vessel portions.

Appendix F: The Charleston and South Lake Vessels

7.4 Charleston Lake Vessels

Figure 7.2: Vessel BdGa-12 C80-56 V32

This vessel is a grit-tempered pot with abnormally large chunks of quartz inclusions (8-12mm). The rim profile is in-sloping, without a collar. The vessel walls are quite thick. The lip is flat with the edges slightly rounded. The vessel is decorated from the rim to the neck a short distance above the shoulder. Due to surface exfoliation, it is difficult to distinguish the tool type used. It appears to be an oval dentate-like tool applied horizontally in an overlapping fashion. These impressions may also be a cord-wrapped stick. The shoulder has cord impressions—these could have been applied individually, or these markings are from a corded net or fabric used in the manufacture process. The rim section of this vessel was smoothed prior to decoration and firing, and the interior was brushed. Clear coil breaks are present on the bottom of the preserved vessel section. The rim of this vessel is "wavy"—the dip and rise evident on this vessel may indicate incipient rounded castellations. Vessel form, temper type and paste condition, coil manufacture, and vessel morphology suggests that this vessel belongs to the Point Peninsula horizon and reflects the Point Peninsula Corded type.

Figure 7.3: Vessel BdGa-12-41

Vessel 41 of the Charleston Lake assemblage is a tall, grit-tempered vessel with an out-flaring rim, a flat and highly everted lip, and slightly constricted neck. The interior of the vessel appears very friable, crumbly, and its colour suggests a low firing temperature. The exterior rim and neck are decorated with three bands of right oblique dentate-like tool impressions. From the neck down, the entire vessel is decorated with horizontal plaits of dentate-like tool rocker stamping. The lip is decorated with right oblique dentate-like tool stamping, while the interior of the rim has horizontal dentate-like tool stamping. There are coil breaks. It appears that the exterior surface of the vessel was smoothed before decoration and firing; however, the interior is too exfoliated to determine surface treatment methods. The morphology and dentate rocker stamping suggest that this vessel reflects the Point Peninsula Rocker Stamp type.

Figure 7.4: Vessel BdGa-12-27

Vessel 27 of the Charleston Lake assemblage is a small globular vessel that has been partially reconstructed. Over half of this vessel is the original. This vessel is not mentioned in either Wright's 1980 analysis of the Charleston Lake vessel, nor the Daechsel and Wright's (1988) Sandbanks Tradition paper. The neck is tightly constricted with a short neck that curves into an out-flaring rim. The lip is flat with rounded edges. This vessel is decorated primarily with weak punctates made with a stylus-like tool. The rim has what looks like push-pull impressions made with a stylus-like tool. The neck has two horizontal bands of single weak punctates made with a stylus-like tool with a plain space delimiting them. From the shoulder to the base are fabric or net impressions from the construction process. The anvil marks cannot be felt on this vessel due to conservation efforts; however, the fabric or net impressions suggests that this vessel was likely thinned and shaped with the paddle and anvil method. The lip has a medial groove running around the vessel orifice with weak punctates superimposed on top of the groove. There are tool impressions on the interior of the rim, but they have been filled in with a chemical preservative compound—they look like vertical lines of weak punctates, but they could have been CWS or dentate impressions. The rim of this vessel was smoothed prior to decoration and firing. The interior appears smoothed but cannot be determined due to conservation efforts. The shape and design of this vessel matches Wright and Daeschel's description of the Middle

Sandbanks Phase; the weak punctates associated with this vessel design and morphology suggests it may be transitional between the Middle and Late Sandbanks phases (A.D 800-900).

Figure 7.5: Vessel BdGa-12-76-20

Vessel 20 of the Charleston Lake assemblage is grit-tempered, globular vessel with a constricted neck, out-flaring and collared rim, and incipient round castellation. The lip is flat and insloping, with a medial groove in certain places. This vessel is decorated in both bands and zones. The exterior rim has crescent shaped stamps right under the lip on the left side of the vessel. There are push-pull stamp marks from a stylus-like tool that has a 3mm wide tip. On the incipient castellation there is a 3.5cm wide section of vertical linear tool stamp impressions on the exterior rim. On the right is push-pull impressions from a stylus-like tool with a very narrow point, while below are the push-pull impressions from the stylus-like tool. On the bottom of the poorly developed round collar are bossing from interior round punctates. The upper neck is decorated with a band of right oblique linear tool stamping that appears to have been dragged to the right and pressed in at a left angle. The neck is decorated with push-pull impressions from a stylus-like tool—the impression begins with a sunflower seed shape to a thin line to a sunflower seed shape. Just above the shoulder at the bottom of the neck are right oblique linear tool stamp impressions. From the lower neck to the base is plain. The lip of this vessel has right oblique linear tool stamp impressions and is grooved in certain spots. The interior rim has the same sunflower seed shaped push-pull stylus-like tool impressions oriented in a right oblique fashion. Underneath are the punctates that created the exterior bossing. From the shoulder to the base the vessel appears to have fabric or net impressions from the construction of the vessel, but they are partially smoothed over. The rim section and interior of the vessel were smoothed prior to decoration and firing. The interior also has anvil marks from the paddle and anvil method of vessel construction. There are two drill-holes from repair efforts. The morphology of the drill suggests the drill tip was triangular. The rim section appears to have been made separately and it has wipe mark striations that stop at the shoulder. The interior rim, neck, and shoulder sections have carbonized food residue. This vessel shows a great deal of similarity to some vessels at the Ault Park site—in particular, image five on Plate XV in Wright (1966: 187). It is likely a Scugog Classic Bossed variant of the Pickering Branch.

Figure 7.6: Vessel BdGa-12-78-13

Vessel 13 of the Charleston Lake assemblage is a grit-tempered vessel. The rim profile is straight with a flat, thickened, vertical lip with angular edges. The rim is decorated with right oblique CWS impressions with two horizontal CWS impressions below, separated by a plain space acting as a delimiter. On the neck there are exterior circular punctates with small, almost imperceptible interior bossing. From the neck to the base the vessel exterior is vertically corded. These impressions appear to have been impressed by hand, unless a net or bag was pushed into the sides of this vessel. The twists of the cords are visible in the clay. The lip is decorated with right oblique CWS impressions that turn to vertical CWS impressions (maybe as a result of a left-handed potter extending their reach). The interior is plain with horizontal striations from wiping. The thickened lip is the result of folding clay over from the interior to the exterior to create the rim shape. There is a drill hole from repair efforts on the left side of the vessel. This vessel was coil constructed. Interior anvil marks indicate the vessel was shaped and thinned with the paddle and anvil method. This vessel is very similar to some of the vessels of the Melocheville Tradition, which show a high degree of similarity to vessels of the Sandbanks Tradition and Princess Point.

Figure 7.7: Vessel BdGa-12 P7c V24

Vessel "24" of the Charleston Lake assemblage is a grit-tempered vessel with a very slightly outflaring rim and a flattened lip that has been pressed down to the point that it overhangs the walls of the vessel. The lip is decorated with left oblique CWS impressions on top, with horizontal CWS impressions on the front of the lip. Under the lip on the rim are horizontal CWS impressions. The rim has circular punctates from a stylus-like tool with a 5mm wide tip which create bossing on the interior. From the punctates down are plaits of horizontal CWS impressions which are delimited by vertical plain spaces about 1.5cm wide. This vessel is broken from the shoulder down. The interior is undecorated aside from the bossing. There is a great deal of carbonized food residue from cooking. Anvil marks present on the interior suggest the paddle and anvil method of vessel formation. It is difficult to determine if this vessel was formed by coiling or slabs and fillets. This vessel is difficult to assign a type. The exterior punctations and interior bossing, and the use of cord-wrapped stick impressions suggests that this vessel belongs to the late Point Peninsula phase, but also reflects similarities to early Sandbanks vessels.

Figure 7.8: Vessel BdGa-12-78-16-“V21”

Vessel 16, or P78-16, is a coarse pot with grit temper, an out-flaring rim that may have had rounded scalloped/nubbin castellations, and a globular body. The lip on this vessel has exfoliated away; however, the fracture pattern of the rim suggests that the vessel had rounded scalloped/nubbin castellations. The rim is decorated with left oblique incised lines made with a stylus-like tool with a 3mm wide tip. The stylus-like tool is likely the end of the CWS tool used to create the horizontal CWS impressions that stretch from the rim to the shoulder. These impressions are unevenly and inconsistently placed and often overlap each other. The incised lines of the rim are similarly “sloppy”. From the shoulder to the base the vessel is left plain. On the right of the vessels exterior is a left oblique CWS impression—three of them side by side—that stretches from the rim, through the horizontal CWS impressions, to the shoulder. It interrupts the body design. The interior is decorated with both vertical and right oblique CWS impressions stretching from the rim down to variable lengths. These impressions are pressed into the clay softly in some spots, rough in others, and there is no consistency in the length of the impression—from 1.5cm to 7cm long. There is carbonized food residue on the interior. Also, there appears to be scratches and striations that may be evidence of use-wear. This vessel has chunky grit tempering and a laminated clay fabric. I believe this vessel was modelled by hand and shaped with the paddle and anvil method of construction; however, coils may have been used for some portion of this vessel as they seem to be visible in the profile of breaks. This vessel shows a high degree of similarity to Princess Point vessels—in particular, the Moyers Flat vessel. It may also reflect and early Sandbanks Tradition vessel.

Figure 7.9: Vessel BdGa-12-78-3-“V22” (P3-78 V22)

Vessel 3 of the Charleston Lake assemblage is a straight rimmed vessel with a very poorly developed “collar”. This “collar” is simply a slightly thickened rim section about 1cm wide. It is only 1 mm higher than the normal surface. The lip is mostly flat with angular edges. This is a grit-tempered vessel that was coil constructed yet has a laminated appearance. This vessel has a complex decoration made up of dentate-like tool impressions in various orientations. The rim has a band of vertical dentate-like impressions which appear to have been drag-stamped. On the neck region are similar horizontal dentate-like impressions. The neck to shoulder has left oblique, vertical, and horizontal dentate-like impressions. On the shoulder, near the break, it appears that there may have been some rocker stamping but there is too little left to determine for sure. The lip has right oblique dentate-like tool impressions, as well as the interior rim. About 2cm below the interior decoration is a band of right oblique incised lines made with a very fine-tipped stylus-like too. Horizontal and oblique striations are present on the interior suggesting this vessel was brushed or wiped. There is also carbonized food residue. Wright (1980) sees similarities between Vinette Dentate and Complex Dentate of the Point Peninsula phase. The incipient collar and some lamination in the clay fabric suggests this vessel may occur late in the sequence. It also shows similarity to the later Uren Corded type.

Figure 7.10: Vessel BdGa-12-78-90 V21

“Vessel 21” of the Charleston Lake assemblage is a grit-tempered pot. The rim is outflaring with a flat and highly everted lip, and a slightly constricted neck. The rim exterior is decorated with right oblique incised lines made with a stylus-like tool with a 3 mm wide tip. From the bottom of the rim to the lower neck are horizontal CWS impressions that are unevenly applied to the vessel—they overlap in some places. Also, the CWS tool seems to bend every so often and create a curved impression. The CWS tool is roughly 5cm long. The horizontal impressions were applied in a plait-like fashion. On the shoulder are opposed left and right oblique CWS impressions creating a chevron or herringbone pattern. Below these, just above where the vessel broke, are left oblique to almost vertical CWS impressions with no spacing—they overlap somewhat. The interior rim is decorated with right oblique to almost vertical CWS impressions. The lip has CWS impressions running medially creating a grooved look. The lip is mostly flat with angular edges but is everted to the point where it is vertical. Anvil marks are present from the paddle and anvil method of vessel construction. There is a great deal of carbonized food residue on the interior. Horizontal striations on the interior are left from a brushed or wiped surface treatment. The exterior vessel surface appears to have been smoothed prior to decoration and firing. A coil break indicates the coil method of vessel construction. This vessel is likely a Princess Point or Early Sandbanks Tradition vessel, and is similar to vessel BdGa-12-78-16-“V21”.

Figure 7.11: Vessel BdGa-12-78-26c P26c

Vessel 26 of the Charleston Lake assemblage is a grit-tempered pot with an out-flaring rim and a slightly constricted neck. The lip has exfoliated away and is difficult to determine shape. The rim is decorated with vertical linear tool impressions. The neck is decorated with horizontal CWS impressions. At the lower neck and shoulder transition the design changes to right oblique CWS impressions which are interrupted by left oblique CWS impressions on the right portion of the vessel. Just below the shoulder is missing. The interior has horizontal plaits of CWS rocker stamping with some vertical CWS stamping. Carbonized food residue is adhered to the interior in the grooves of tool impressions. Coil breaks on the shoulder indicate the coil method of vessel construction. Anvil marks on the interior suggests the vessel was shaped with the paddle and anvil method. The exterior is too exfoliated to determine surface treatment, though smoothing is most likely. The shoulder region on the interior has horizontal striations from a brushed or wiped surface treatment. This vessel is very similar in morphology and tool use to 78-26 p26c and 78-90 V21. Someone numbered these three vessels the same; however, each vessel is decorated slightly different, suggesting the potter adhered to morphology and tool type more than overall motif. Wright also described these tool impressions as "dentate"; however, it is evident from the interior decoration that these are CWS impressions. This vessel reflects attributes that characterize the Point Peninsula Corded, Rocker Stamp type, Princess Point, and Sandbanks types.

Figure 7.12: Vessel BdGa-12-76-19

Vessel 19 of the Charleston Lake assemblage is a grit tempered pot with an outflaring rim and constricted neck. The lip is "stepped" due to a medial groove running the length of the lip. There are coil breaks visible on the breaks at the shoulder region. From the rim to the shoulder has horizontal CWS impressions with roughly 3-7mm plain spaces between each impression. On the neck some of these plain spaces are used to put additional CWS impressions that appear to either be criss-crossing, or variously left and right oblique. Some of these impressions are single weak punctates made with a stylus-like tool with a tip roughly 2mm wide. The lip shows signs of CWS impressions suggesting that the medial groove was made on the lip after having been decorated. The interior of this vessel is undecorated. The interior also has a thick layer of carbonized residue from cooking. Despite this residue layer, horizontal striations from a brushed or wiped surface treatment are present. Further, anvil marks suggest the paddle and anvil method of vessel construction. The rim section appears to have been made separately from the vessel body and base. The exterior shoulder of this vessel has fabric or net impressions that have been partially smoothed over. The clay fabric colour is very light and yellowish suggesting a poor firing temperature creating the crumbly feel of fired paste. This vessel is used to define the middle phase of the Sandbanks Tradition by Wright and Daechsel (1988).

Figure 7.13: Vessel BdGa-12-76-22

Vessel 22 of the Charleston Lake assemblage is a large grit-tempered globular vessel with round castellations and a well-developed angular collar. The collar width ranges between 25 and 40 mm due to the castellations. The rim is very slightly out-flaring—almost vertical. The lip is flat and out-sloping with angular edges. The rim is zonally decorated with 10 cm wide panes made up of horizontal and vertical CWS impressions. It should be noted that Wright's (1980) initial observations identified these tool impressions as CWS; however, they look like they may be a type of dentate tool that has to be pressed further into the clay than traditional dentate tools. That aside, short vertical CWS impressions are banded underneath the collar. The upper and middle neck region are decorated with horizontal CWS impressions—these impressions are applied in 10 cm sections suggesting that the tool itself measures close to 10c m not including where the potter would have gripped the tool. On the lower neck, above the shoulder, are criss-crossing CWS impressions. From the shoulder to the base are fabric or net impressions likely from the manufacture process.

The lip is decorated with right oblique CWS impressions. The interior rim is also decorated with right oblique CWS impressions. The interior has anvil marks leftover from the paddle and anvil method of vessel shaping. There is a drill hole present on the right side of the vessel from a repair effort. Wright (1980) believes that this is an Owasco Corded Collar type similar to pottery found on the Lite site. The fact that these impressions seem more dentate than CWS may be a significant clue as to what exactly this vessel is.

Figure 7.14: Vessel BdGa-12-76-1

Vessel 1 of the Charleston Lake assemblage is a complete (with some reconstruction) small pot with a conical base, straight rim, and neck that blends into the rim shape from a highly defined shoulder. The lip is flat in some places, more rounded in others, with an angular edge on the interior and a rounded edge on the exterior. This vessel has a complex design that is difficult to interpret. The exterior of the lip has circular tool impressions running horizontally around the top of the rim. The neck is decorated with horizontal incised lines made with a stylus-like tool with a 2.5mm tip. On one side there is only horizontal incised lines, though later in the band the potter made horizontal circular-tool stamp impressions roughly 1.5 cm apart with horizontal incising in the intermediate space. The shoulder region and down is zonally decorated with both vertical and horizontal panes. There are vertical circular-tool stamping impressions that run down the vessel and all intersect at the pointed base. At mid-vessel, these vertical designs are 7.5 cm wide. Within the panes created by the vertical designs are horizontal circular-tool impressions, some of with turn into a push-pull technique creating a more oval-like impression. In some places there is a 1.5 cm plain space between the horizontal designs. The pointed vessel base is pitted, likely from having been set down in soil depressions during its use-life. The lip is decorated with medially running circular-tool impressions. Due to reconstruction efforts, it is difficult to interpret any interior decoration; however, some oblique striations on the interior indicate a wiped or brushed surface treatment before firing. Anvil impressions are present on the interior surface. Most of the fracture lines on this vessel are horizontal, suggesting that this vessel was coiled. Carbonized food residue can be seen on the interior. Wright (1980) believes that this vessel belongs to the Late Point Peninsula phase with no certain type assigned. The basal morphology of this vessel does suggest a Middle Woodland origin.

Figure 7.15: Vessel BdGa-12-76-3

Vessel 3 of the 1976 field season Charleston Lake assemblage is a small, nearly complete, grit-tempered pot with a straight rim and an irregular lip shape. In some places it seems stepped, but it is mostly rounded. The neck is not constricted. The exterior rim has right oblique CWS impressions near the lip. Below is a 3 cm wide band of horizontal CWS impressions with bands of horizontally placed weak punctates superimposed over the CWS impressions at 1.5 cm and 3 cm down from the lip. These impressions were likely made with the same CWS tool. On the neck there is a band of opposed oblique CWS motif—right oblique CWS impressions meet with left oblique CWS impressions creating a zig-zag or triangular design. The intermediate spaces in this band are plain. Below the lower neck, just above the shoulder, is another band of horizontal CWS impressions superimposed with weak punctates. On the shoulder is right oblique CWS impressions spaced 1 cm apart with the intermediate space filled in by the initial horizontal CWS design. The lip has oval-tool impressions running medially, which was likely made with the end of the CWS tool. The interior is decorated with vertical CWS impressions. Some of these impressions begin just below the lip, while on the other side of the vessel the vertical CWS impressions begin 2.5 cm below the lip. The interior of this vessel is very uneven and chunky. One can clearly see where the rim section was attached obliquely to a thick, chunky, conical base. It does not appear that the interior was either smoothed or paddled. The exterior surface is rough and likely did not receive a surface treatment. Wright (1980) places this vessel in the Late Point Peninsula sequence and the Early Owasco sequence. This vessel does not fit neatly into a type, and it is apparent from the shape of the base that a lump of clay was simply modelled into a base, and the rest of the vessel was a single slab smoothed onto it. This may be a cup, a "juvenile" or medicinal vessel, or an expedient vessel.

Figure 7.16: Vessel BdGa-12-76-2

Vessel 2 of the Charleston Lake assemblage is a small, nearly complete, grit-tempered pot with an insloping rim with a conical base and a flat, insloping lip that is also everted on the exterior of the vessel. The lip was shaped by folding clay from the interior to the exterior—an action that can be easily distinguished due to the unsmoothed nature of the fold. On the rim is a 3 cm thick band of horizontal CWS impressions with right-oblique-to-vertical scarification treatments superimposed on the design about 2 cm apart. Just above the shoulder on the lower rim are right oblique CWS impressions. From the shoulder to base are net or fabric impressions likely from the vessel shaping process. The twist of the cord material used in the fabric or net can be distinguished in the clay. The lip is decorated with CWS impressions across the lip. The interior is left plain, though some striations from wiping can be seen. The interior of the conical base was created by pressing the end of a stick down into the base. The tip of this tool is 7mm wide and rounded. This vessel was made by smoothing fillets of clay together by hand. The interior is left rough and uneven, and it is evident that the rim section was made separately from the base. The unrefined nature of this vessel suggests that it may be a child's practice vessel, or an expedient vessel. Wright (1980) places this vessel in the Late Point Peninsula phase and notes its similarity to the Owasco Cord-on-Cord type.

Figure 7.17: Vessel BdGa-12-76-8

Vessel 8 of the Charleston Lake assemblage is a grit-tempered vessel with an out-flaring rim, slightly constricted neck, and rounded lip that is slightly everted. Half of the vessel, plus the base, is missing; however, the shape of the shoulder suggests that this vessel was globular. The upper rim and lip area was shaped by folding clay from the interior to the exterior and can be seen where the folded clay was not quite smoothed fully. The upper rim, below the lip, is decorated with right oblique CWS impressions. The upper neck is decorated with nearly vertical CWS impressions which have punctates through them, creating bossing on the interior. The stylus-like tool used to create the punctates measures 7 mm wide and appears to be rounded. Each punctate is placed between 1.5-2 cm apart. Below the punctates is a band of right oblique CWS impressions. On the lower neck is two horizontal bands of tool stamp impressions likely made with the tip of the CWS tool—in some places the cording can be seen to have marred the surface of what might be considered a weak puncates. The neck to shoulder region has six horizontal CWS impressions with right oblique CWS impressions superimposed over them. The final band, on the shoulder, is made up of right oblique CWS impressions. From the shoulder, and presumably to the base, the vessel exhibits fabric or net impressions likely from the manufacture process, or as a surface treatment. The lip of this vessel has oval-tool stamping placed medially on the lip. The interior rim has vertical, sometimes oblique, CWS impressions, while the rest remains plain. The interior of the vessel was given a wiped surface treatment. There are three unique scarification patterns on the interior of the vessel made up of a fine line with a criss-cross over it on one end. These may be use-wear marks or a conscious choice of the potter during production. There is a heavy amount of carbonized food residue present on the interior of this vessel from cooking. The vessel breaks on the lower portion of this vessel appear to show signs of the coiling method of vessel manufacture. The rim section of this vessel was created separately from the body and base, and the oblique attachment point where the vessel was smoothed together is visible in the clay cross-section on breaks, as well as a visible suture on the interior of the vessel. The base of this vessel exhibits anvil marks from the paddle and anvil method of vessel shaping and finishing. This vessel is used by Wright and Daeschel to define the Middle phase of the Sandbanks Tradition style ceramics (A.D 700). This vessel has an AMS date of AD 926 (on carbonized food residue).

Figure 7.18: Vessel BdGa-12-76-4

Vessel 4 of the Charleston Lake assemblage is a grit-tempered vessel with a very slightly everted rim, straight neck, and a thin lip with angular edges. The rim is decorated with a band of criss-crossing pseudoscallop shell tool impressions. The entire body of the vessel is decorated using a pseudoscallop shell stamping tool. For the most part, this consists of horizontal drag-stamping that is partially smoothed every 2cm to create a plaited appearance. In some places, however, the PSS tool may have been used to make vertical rocker stamping, though this may be an effect of the close-impressed drag-stamping. The lip is thin and flat with angular edges and is decorated with right oblique PSS stamping placed 5 mm apart. The interior of the rim is decorated with left oblique PSS stamping. The exterior of this vessel was given a smoothed surface treatment prior to decoration and firing. The interior is combed with a tined tool. Anvil marks present on the interior of the vessel indicates the paddle and anvil method of vessel shaping was used during manufacture. Highly distinguishable coil breaks can be seen by eye. The vessel reflects the characteristics of the early Point Peninsula St. Lawrence Pseudoscallop type. This vessel has been AMS dated to 395 cal BC.

Figure 7.19: Vessel BdGa-12-76-9

Vessel 9 of the Charleston Lake assemblage is a large grit-tempered vessel with a thin applique incipient collar, a slightly outflared rim, slightly constricted neck, and a pinched or bevelled lip. The rim is decorated above and below the collar with short, vertical CWS impressions. There is a 1 cm wide plain space followed by a band of vertical CWS impressions, another horizontal plain band 2.5 cm wide, and another band of vertical CWS impressions. The shoulder appears undecorated. This vessel has suffered exfoliation and the surface treatment is difficult to distinguish. The interior of the vessel is undecorated and similarly lacks an identifiable surface treatment. The rim section is attached obliquely to the vessel body and base. The lip is pinched to a point and left undecorated. A coil break can be seen on the vessel body indicating that the body and base were made using the coiling method of vessel construction, whereas the rim section consists of a single clay fillet. There are thick carbonized food encrustations on the rim interior of this vessel. Wright (1980) associates this vessel with the Point Peninsula Corded type, sharing similarities to the Jack's Reef Corded Collar type.

Figure 7.20: Vessel BdGa-12-76-6

Vessel 6 of the Charleston Lake assemblage is a CWS decorated vessel, grit-tempered, with an elongated, slightly constricted neck, out-flaring rim, and an everted lip that is flat in some places while round in others. Below the lip on the upper rim on the exterior there is vertical CWS impressions. These appear to have been made by rolling the tool across the surface explaining why the tool used on the upper rim looks much thinner than the tool used on the rest of the vessel. Below, there are three bands of short vertical CWS impressions. The mid-neck region has two rows of square weak punctates made with a stylus-like tool that measures 5 mm by 6mm. The two rows of weak punctates are delimited by a plain intermediate space. The lower neck, above the shoulder, is decorated with short vertical CWS impressions followed by the CWS rolling technique near the shoulder. The body and base of this vessel is missing, though there appear to be net or fabric impressions on what is left of the shoulder. The lip is decorated with oblique CWS impressions and there may be a medial line running down the lip, but it is obscured by tool impressions. The rim interior is decorated with vertical CWS drag-stamp impressions, though these too may have been rolled. There is a brushed or wiped surface treatment on the interior rim while the rest was smoothed prior to firing. The exterior rim of the vessel was also given a smoothed surface treatment. The body of this vessel may have been coil constructed, but it appears the rim section was made separately and attached obliquely to the body and base. There are pock marks that cover the exterior and interior of this vessel. Wright (1980) explains these as a calcium temper type used by either a single potter or by a specific group within the Gananoque drainage system and can be seen on other vessels in this collection. Wright and Daechsel use this vessel to define the Early Sandbanks phase (A.D. 700).

Figure 7.21: Vessel BdGa-12-76-17

Vessel 17 of the Charleston Lake assemblage is a rim and neck fragment. This vessel is grit-tempered with incipient pointed castellations, a slightly constricted neck, and an "oblique" lip. The lip is moulded to a point and out-slopes to a point on the exterior of the rim. This point may have been made by laying an applique across the exterior. The rim is decorated with left oblique dentate-like tool impressions. The tool is very fine and has sesame seed shaped tines. A line of horizontal dentate-like tool impressions acts as a delimiter for a band of zonal decoration made up of oblique pillars of horizontal and vertical dentate-like tool impressions. This band is 5 cm wide while each pillar is about 3 cm wide. Below is another horizontal dentate-like tool impression acting as a delimiter. On the lower neck is a zig-zagging horizontal dentate-like too impression. The lip on this vessel can either be defined as the top portion of what may be an applique (ie. The "oblique" lip) or the uppermost portion of the vessel wall. I have defined it here as the uppermost portion of the vessel. That said, the lip is undecorated, and the "oblique lip" or upper rim is decorated with right oblique dentate-like tool impressions. The interior is undecorated and was smoothed before decoration and firing. The exterior was given a smoothed surface treatment. The break on this vessel looks like a coil break; however, I believe this is where the rim section was attached to the body and base. It has considerable similarities to the Black Necked type, but the use of dentate stamping is noteworthy.

Figure 7.22: Vessel BdGa-12-76-5

Vessel 5 of the Charleston Lake assemblage is a coil constructed, grit-tempered vessel with a thin, flat lip, and a straight, though slightly everted, rim profile. The neck is straight as well. The entire vessel is decorated with horizontal PSS rocker stamping. The PSS tool used on this vessel is 3.2 cm long. In some places—mostly near the shoulder—the impressions are very closely placed and appear to be drag-stamped. On the lower half of the vessel the impressions are spaced more widely apart. There is a 1 cm wide plain intermediate space between each application of horizontal PSS rocker stamping. The lip is thin, flat, and undecorated. The interior rim is decorated with left oblique PSS stamping that appears to be drag-stamped. The rest of the interior is left plain, though there are striations from a combed surface treatment. The exterior of the vessel was given a smoothed surface treatment prior to decoration and firing. Anvil impressions on the interior indicate a paddle and anvil method of vessel shaping was used. There is carbonized food residue encrusted to the interior of the pot from cooking. The paste colour suggests a low firing temperature. This vessel is a Middle Woodland pot that Wright (1980) places into the Point Peninsula Rocker type ware, though its possession of PSS stamping puts it into the St. Lawrence Pseudoscallop type. This vessel is AMS dated to 639 cal BC.

Figure 7.23: Vessel BdGa-12-76-14

Vessel 17 of the Charleston Lake assemblage is a grit-tempered pot with a slightly out-flaring rim, a stepped lip with medial groove, and a well-defined shoulder. The mostly straight nature of the rim profile does not present with a constricted neck. There are two horizontal CWS impressed lines under the lip on the rim. The rim is also decorated with a band of right oblique CWS impressions with left oblique CWS impressions superimposed every 5-6 cm. On the lower rim/neck are weak punctates that do not create bossing on the interior. The stylus-like tool that made the weak punctates is 3 mm wide and are impressed every 1 cm. Below the weak punctates are three horizontal CWS impressed lines. The horizontal impressions turn into horizontal lines made with a stylus-like too using a push-pull action. Similar to the rim section, the horizontally impressed lines are interrupted by a superimposed right oblique design made with the stylus push-pull action. The superimposed designs are spaced every 7 cm. The shoulder is undecorated and displays fabric or net impressions from the vessel shaping process. The stepped lip and medial groove may have had CWS impressions but they have since exfoliated. The interior is left plain while the rim section was given a brushed surface treatment. The rest of the interior was given a smoothed surface treatment. Exfoliation on the exterior makes surface treatment difficult to distinguish, though it appears to have been smoothed. Wright (1980) originally identifies this vessel as related to Owasco, Pickering, and Glen-Meyer vessels; however, it fits the definition of the Middle Sandbanks phase style ceramics (A.D. 800).

Figure 7.24: Vessel BdGa-12-76-18

Vessel 18 of the Charleston Lake assemblage is a grit-tempered pot with an out-flaring rim, constricted neck, and an angular incipient collar. The lip is slightly concave with angular edges. The rim/collar is decorated with criss-crossed dentate stamping. Below the collar is a band of right oblique dentate stamping. The rest of the vessel is left plain other than a ribbed-paddle surface treatment that Wright (1980) refers to as check-stamped. This vessel has a sherd missing from the rim that appears to have been a single incipient castellation—possibly a nubbin castellation, incipient rounded castellation, or incipient pointed castellation. The collar is 1 cm wide and gradually increases to 3 cm wide near where the castellation should be. The lip is decorated with right oblique dentate stamping. The interior of the vessel is left plain. The interior rim profile is slight concave while the exterior is slightly convex. The exterior rim section was given a smoothed surface treatment prior to decoration and firing. The interior surface is quite exfoliated; however, it appears that interior was given a smoothed surface treatment. The method of vessel construction is difficult to distinguish, though the fractures appear primarily horizontal, suggesting that the coiling method was used. There is some carbonized food residue encrusted on the rim interior. This vessel is indicative of early Pickering ware—it is highly conservative, restricting decoration to the collar and rim area, using dentate tools, with a paddled exterior. Wright (1980) suggests that the criss-cross design on the rim may be related to Middleport wares.

Figure 7.25: Vessel BdGa-12-76-11

Vessel 11 of the Charleston Lake assemblage is a globular, grit-tempered pot with a constricted neck, outflaring rim, angular collar, and a flat, out-sloping lip with angular edges. The collar width ranges from 2-3 cm, suggesting that the rim may have been rising to a castellation. The rim/collar is decorated with alternating left and right oblique incised lines made with a linear tool 5 mm wide. Wright called these linear stamp impressions; however, striations within the impressions suggest that the stylus was dragged to create the line. The opposed oblique incised lines create triangular panes of decoration. Below the collar on the upper neck are tool notching likely made with the same stylus-like tool. Below the notch marks are three horizontal incised lines. The neck is decorated the same as the collar/rim with triangular panes of oppose left and right oblique incised lines. The vessel, from the shoulder down, is undecorated; however, it displays surface marks from a textured paddle surface treatment. The lip is decorated with closely placed left oblique linear tool stamping. The interior of the lip is notched, likely with the same stylus-like tool that made the incised lines. The rest of the interior is left plain. The interior is heavily exfoliated and the surface treatment is difficult to interpret. There is carbonized food encrusted on the interior rim. The rim and neck section of this vessel were created separately from the body and base, smoothed together prior to decoration and firing. Wright (1980) identifies this vessel as a Roebuck Low Collar type. It also shares similarities to the Black Necked and Sidey Notched types.

Figure 7.26: Vessel BdGa-12-76-10

Vessel 10 of the Charleston Lake assemblage is a large grit-tempered pot with an outflaring rim, constricted neck, and a flat, extremely evert lip with angular to round edges. The entire exterior of the vessel is decorated with plaits of linear tool rocker stamping—a pillar of vertical rocker stamping next to a pillar of horizontal rocker stamping. The section of the linear tool used for impression is 3cm long on average which correlates to the spacing between each section of plaits. The lip is decorated with vertical CWS impressions. Every 2-4cm the CWS tool was impressed deeply into the lip creating notches. Splayed clay is still present from this action. The interior rim is decorated with a criss-crossing design of linear tool stamping creating a diamond-plate appearance. On the interior neck there is horizontal CWS rocker stamping. The rest of the interior is left plain. The interior may have been smoothed prior to firing. The exterior surface treatment is difficult to interpret due to thorough decoration and exfoliation. Coil breaks suggest this vessel was coil constructed. Wright places this vessel in the late Point Peninsula sequence. The shape of this vessel is similar to the Owasco Platted type; however, the use of cord-wrapped stick and rocker stamping suggests Wright was correct in assigning this vessel to the Point Peninsula Complex.

Figure 7.27: Vessel BdGa-12-76-21

Vessel 21 of the Charleston Lake assemblage is a grit-tempered pot with a slightly constricted neck, a nearly straight rim profile, and a flat lip that is concave in some places. The vessel is globular in shape. The rim is “wavy”, indicative of incipient round castellations. The decorative tool on this vessel looks like either a corded-paddle edged tool or a cord-wrapped stick. On the rim are criss-crossed CWS impressions as well as bossing from interior punctates. Below the bossing is a band of right oblique CWS impressions. The upper to middle neck region is decorated with right oblique CWS impressions with left oblique superimposed CWS impressions that may have originally been a criss-cross motif. They superficially create a herringbone pattern. On the lower neck and shoulder area are bands of right oblique CWS impressions. The decoration on the exterior of the vessel has been partially smoothed over. From the shoulder to the base are net or fabric impressions, likely from the process of vessel shaping and wall thinning. The lip is decorated with near vertical CWS impressions. The interior has near vertical CWS drag-stamping. Below that are punctates that create the bossing on the exterior of the vessel. The tip of the stylus like tool used to create the punctates was 4 mm wide. The interior of the vessel was smoothed prior to firing, there are anvil impressions from the paddle and anvil technique of wall thinning and shaping, as well as long, thin striations that are likely use-wear from cooking. The use of CWS (or corded-paddle), subtle neck constriction, and the presence of interior punctates and exterior bossing suggests it is an early Pickering vessel. Though, the criss-cross motif is more typically seen in Glen-Meyer vessels.

Figure 7.28: Vessel BdGa-12-77-1

Vessel 77-1 of the Charleston Lake assemblage is a grit-tempered pot. The rim has incipient rounded castellations 16-20 cm apart from each other. The neck is slightly constricted, and the lip is nearly flat with rounded edges. The rim profile is out-flared. The exterior and interior of this vessel is extravagantly decorated with dentate stamping applied in a variety of techniques. The dentate tool used on this vessel has rounded teeth. The longest impression left on the vessel is 6 cm long giving an indication of the size of the functional portion of the decorative tool. The exterior rim is decorated with a band of vertical dentate stamping. The neck has a band of horizontal dentate stamping applied in both firm and soft gestures and smoothed in the middle of the band. Below the neck down are plaits of horizontal and vertical plaits. The horizontal plaits were applied in two gestures to create the whole motif, and each line is separated by a 5 mm wide plain space. The vertical plaits appear to be much more neatly applied in a drag-stamp gesture. The vertical plaits are slightly smoothed over. The lip is decorated with right oblique dentate stamping. The interior rim is decorated with dentate drag-stamping and appears to have been slightly smoothed over. The entirety of the interior below the rim is decorated with vertical and horizontal plaits of linear trailing or channeling creating a ladder motif. The stylus-like tool used to create the channeled attribute has a tip that is 4 mm wide. There is carbonized food encrusted to the interior rim of this vessel. Wright places this vessel in the Late Point

Peninsula sequence, though this vessel may reflect the Rice Lake Banded type (Johnston 1968).

Figure 7.29: BdGa-12-76-7

Vessel 7 of the Charleston Lake excavation is a grit-tempered vessel with high quantities of feldspar and crushed quartz. This vessel has a very slightly constricted neck and a slightly out-flaring rim. The lip is flat with nearly angular edges and is outsloping. The lip of this vessel is pressed down in some places. The rim has “wavy”, incipient round castellations. The exterior rim has left oblique dentate stamping that changes to left oblique dentate stamping. A horizontal line of dentate stamping acts as a delimiter between the rim and a band of right oblique dentate stamping on the neck. Below that is another line of horizontal dentate stamping acting as a delimited between the neck decoration and the band of right oblique dentate stamping on the lower neck/shoulder region. From the shoulder down this vessel was left plain and given a smoothed surface treatment. The lip of this vessel is decorated with right oblique dentate stamping and the interior is left undecorated. The interior surface displays striations from a wiped surface treatment on the rim while the neck down was given a smoothed surface treatment. There is carbonized food residue encrusted to the rim. The rim section of this vessel was made separately from the body and attached obliquely to a coil constructed body, evinced by distinguishable coil breaks. Anvil marks present on the interior indicate a paddle and anvil method of vessel construction and shaping. Wright classifies this vessel as an early Pickering ware; however, this vessel also reflects the early Sandbanks Tradition.

7.5 South Lake Vessels

Figure 7.30: Vessel BcGb-6-20

Vessel 20 of the South Lake assemblage is a grit-tempered pot with a very slightly constricted neck, a slightly out-flaring rim, and a lip that is flat, out-sloping, and slightly thickened. The rim was formed by folding clay from the interior to the exterior of the vessel which gives the lip a thickened appearance. The exterior rim is decorated with right oblique dentate stamping that changes to left oblique dentate stamping. From below the rim to the lower neck is a 6.5 cm thick band of horizontal dentate stamping. On the lower neck/shoulder region is a band of vertical dentate stamping. The lip is decorated with right oblique dentate stamping. The interior of the vessel is left plain with horizontal striations from a wiped surface treatment prior to firing. The exterior surface is exfoliated, obscuring any interpretation of the exterior surface treatment type used. The clay matrix of this vessel is laminated in nature, and with a lack of any visible coil breaks, it is parsimonious to say that this vessel was constructed using fillets and slabs and fit together using a paddle and anvil technique. There is a repair hole just below the rim—the drill tip used measures 5 mm wide. This vessel is used by Wright and Daeschel to define the Early Sandbanks Tradition (A.D. 600).

Figure 7.31: Vessel BcGb-6-10

Vessel 10 of the South Lake assemblage is a grit tempered vessel with cord-wrapped stick impressed decoration. The rim of this vessel is slightly out-flaring, the neck is not quite constricted, and the lip is out-sloping. The rim has right oblique CWS impressions delimited by a horizontal CWS impression below, another series of right oblique CWS impressions, and a second horizontal CWS impression delimiter. The lip is decorated with right oblique CWS impressions. The neck has two bands of right oblique CWS impressions followed by three horizontal CWS impressions on the lower neck and shoulder area. This vessel has partially smoothed over net or fabric impressions from the shoulder to the base indicating this vessel was likely shaped in a net or bag made of natural materials. The interior has the remnants of anvil marks suggesting the vessel walls were thinned using the paddle and anvil technique. The interior neck and shoulder areas have carbonized food residues. The interior rim has striations from wiping while the remainder of the interior vessel is smoothed. This vessel is an example of the Early Sandbanks Tradition ceramic style (A.D 700). The base of this vessel is likely globular or subconical. This vessel has an AMS date of A.D. 727.

Figure 7.32: Vessel BcGb-6-14

Vessel 14 of the South Lake assemblage is a grit tempered vessel with a slightly constricted neck and an out-flaring rim. The lip is flat and out-sloping. The rim has vertical linear tool stamping. The lower rim and upper neck area have left oblique linear tool stamping above right oblique linear tool stamping creating a chevron pattern. A 4 cm long section has slight stylus point impressions dotted through the chevron pattern and are not found elsewhere on the vessel. A thin vertical plain space is below the chevron pattern acting as a delimiter. Below that, on the neck, is another linear tool stamp chevron pattern. On the lower neck is left oblique linear tool stamping above right oblique linear tool stamping with left oblique linear tool stamping superimposed over every two right oblique linear tool stamp impressions. The vessel is smoothed from rim to shoulder. From the shoulder to the base the vessel was treated with rib-paddle malleation. The interior of the rim is decorated with left oblique linear tool stamping. The interior surface is completely smoothed. Some carbonized food residue can be seen on the interior shoulder. The body has anvil marks from the paddle and anvil technique of vessel wall thinning. At the shoulder it is evident that the rim section of this vessel was made and attached separately from the body and base of the vessel. This vessel resembles the Pickering pattern of motif employment, tool use, tool manipulation, and vessel morphology, reflecting the Ontario Oblique type in the Pickering Branch. The base of this vessel is likely globular or subconical.

Figure 7.33: Vessel BcGb-6-18

Vessel 18 of the South Lake assemblage is a grit tempered vessel. The rim is very slightly out-flaring and the lip is rounded and was formed by folding the clay rim from interior to exterior.. The rim is decorated with right oblique CWS impressions. On the neck there are deep circular punctates made with a broad stylus-like tool creating a bossed interior. The punctates appear to have been made after decoration as they interrupt the horizontal CWS impressions decorating the neck. The CWS impressions look like plaits, but they were applied in an overlapping fashion. The interior rim is decorated with vertical CWS impressions while the remainder is plain and smoothed. The lip of this vessel is decorated with right oblique CWS impressions. The break on this vessel exhibits the appearance of a coil constructed pot. The tool type, tool manipulation, general motif and morphology exemplify the mid to Late Sandbanks Tradition style of pottery (AD 800-900).

Figure 7.34: Vessel BcGb-6-13

Vessel 13 of the South Lake assemblage is a grit tempered globular vessel with a constricted neck and out-flaring rim. The lip is flat and out-sloping. This vessel has a poorly developed collar that extends from the lip down 1 cm. The collar/rim is decorated with left oblique linear tool stamping above vertical linear tool stamping on the upper neck. The neck has left and right oblique linear tool stamping making a chevron pattern. Below, on the lower neck, is a band of left oblique linear tool stamping. From the lower neck to the base the vessel exhibits a surface treatment that appears to be a net impression from the vessel wall thinning process. The interior rim is decorated with left oblique linear tool stamping while the rest of the vessel interior is smoothed. The exterior was smoothed from the rim to the neck. Anvil marks indicate the paddle and anvil method of vessel construction. This vessel was made by using slabs and fillets. The rim and neck section of this vessel were attached to the vessel body and base separately. From the shoulder to the lip there is carbonized food residue from cooking. Vessel morphology and design suggests that this vessel reflects the Ontario Oblique type of the Pickering Branch.

Figure 7.35: Vessel BcGb-6-8

Vessel 8 of the South Lake assemblage is grit tempered and has a slightly out-flaring rim, slightly constricted neck, and an angular, grooved lip. It has a well-developed angular collar and a large, pointed castellation. It is decorated zonally with linear incised lines made with a stylus-like tool with a tip roughly 3 mm wide. The collar/rim has triangular zones with left and right oblique incised lines. The neck is decorated with a similar zonal pattern of triangular sections made up of horizontal, right oblique, and left oblique incised lines. On the lower neck are eight oval-like impressions on the plain area between two incised lines which does not appear on the rest of the preserved rim section. Beneath the castellation is smooth and undecorated. The lip of this vessel has an incised line running medially. The interior of the vessel is smooth and undecorated. The rim section of this pot was attached obliquely to a base and body that was made separately. The interior does not have anvil marks and it is difficult to tell which method of vessel wall thinning was used in its production. The decoration and morphology of this vessel suggests it is related to the Huron Black Necked pottery type.

Figure 7.36: Vessel BcGb-6-2

Vessel 2 of the South Lake assemblage is a small grit-tempered globular pot with a constricted neck and slightly out-flaring rim. The rim is pinched into a point that could serve as a well-developed pointed collar. The lip is pointed if this rim is interpreted as collared. The lip is plain. The top of the collar is decorated with right oblique linear tool stamping; the bottom is decorated with oval-like tool stamping that was likely made with the point of the linear tool or stylus-like object. From the rim to the base the vessel is plain, the surface of which was smoothed prior to firing. The rim of this vessel was shaped by folding clay over from the interior to the exterior. The rim section was shaped and attached to the vessel body and base separately. Where the rim section was attached to the rest of the vessel the potter created an angular corner that sweeps into the concavity of neck constriction rather than smoothing the rim and body together to appear seamless. The interior body of this vessel has anvil marks from the paddle and anvil method of vessel wall thinning. This vessel does not fit neatly into a type but does reflect similarities to the Ontario Oblique type or a Sidey Notched variant.

Figure 7.37: Vessel BcGb-6-21

Vessel 21 of the South Lake assemblage is a globular vessel with a slightly constricted neck and slightly out-flaring rim. The lip is flat and out-sloping. The lip is decorated with right oblique CWS impressions. The exterior rim has a band of vertical CWS impressions over left oblique CWS impressions. The neck is decorated with 8 descending lines of horizontal CWS impressions which were applied in an overlapping fashion. The lower neck/shoulder region is decorated with a band of right oblique CWS impressions. The interior rim is decorated with vertical CWS impressions. From the rim to the shoulder the vessel was smoothed before decorating, while the area from the shoulder to the base has impressions from a net or fabric as a result of vessel wall thinning and shaping processes. The interior of the vessel has horizontal striations from wiping or brushing prior to firing. This vessel appears to be temperless; however, the interior and exterior surfaces are pocked. This phenomenon is also seen in the Charleston Lake collection—Wright (1980) believes that a calcium mineral was used as a temper that degraded over time or during firing (a feature seemingly unique to the Gananoque drainage). On the exterior body there are what appear to be CWS impressions that have been smoothed over and then had the fabric or net impressed on it. The rim and neck section of this vessel was made and attached separately from the vessel body and base. This vessel looks to have used a combination of coiling and modelling for its construction. The design, vessel morphology, tool type, and tool manipulation are representative of the Early Sandbanks Tradition ceramic style of eastern Ontario (A.D 700).

Figure 7.38: Vessel BcGb-6-5

Vessel 5 of the South Lake assemblage is a collared and castellated pot with a constricted neck. The collar is well-developed and angular, the exterior of which is slightly convex. The lip is flat with an incised line running medially across the surface. The exterior rim is zonally decorated. There are triangular panes that consists of left oblique incised lines, a horizontally incised line, right oblique incised lines, and horizontally incised lines. On the underside of the collar are oval-like impressions likely from the tip of the stylus-like tool used to create the incised decoration. The neck consists of nine horizontal incised lines—the intermediate clay channels are left plain. On the lower neck above the shoulder are left oblique incised lines. The interior of the rim is concave and left plain. The rest of the interior is left plain as well. From the rim to the shoulder the vessel was smoothed before decoration and firing. The section of shoulder that is preserved exhibits signs of malleation. The impressions are long and wide suggesting that this vessel may have been thinned and shaped using a ribbed-paddle. The rim section of this vessel was created separately and attached to a modelled body and base—the oblique attachment technique can be seen in the clay fabric in the cross-section of the vessel break. This vessel is a rare variant of the Huron Black Necked type (a small percentage of Black Necked vessels have only horizontal incising on the neck).

Figure 7.39: Vessel BcGb-6-19

Vessel 19 of the South Lake assemblage is a grit-tempered, collared, and out-flaring pot. The collar is roughly 1 cm wide extending down from the lip and is angular with rounded corners. The vessels only decoration is a band of right oblique linear tool stamping on the collar. The entirety of the vessel is plain otherwise. The lip of this vessel is flat and right-angled. The interior surface of this vessel has striations from wiping or smoothing but does not appear brushed. The interior rim has carbonized food residue from cooking. The rim has very slight, rounded “bumps” roughly 5-6 cm in length. These may be weak or incipient forms of castellation. This vessel is similar to Huron-Incised types.

Figure 7.40: Vessel BcGb-6-3

Vessel 3 of the South Lake assemblage is a grit-tempered pot with a slightly constricted neck and a well-developed angular collar. From left to the right the collar thickness increases steadily from 2 cm to 2.7 cm wide—this may be a stylistic choice, or it is an indication that this vessel had a castellation when it was complete. The rim is straight, and the lip is flat with rounded edges, decorated with linear tool stamping. There is a low curvature to the shoulder of this vessel making it difficult to infer basal shape. The collar is decorated with right oblique linear stamping—in some places it is clear that the tool was re-applied multiple times to make the impressions deeper and that these lines were made by pressing the tip of a stylus-like tool (roughly 3 mm wide) into the clay multiple times until a line is achieved. Under the collar are impressions made with the tip of a stylus-like tool in a right to left orientation making them look like they are oblique—these may be better described as vertical punctates under the collar. From the neck to the base this vessel is plain. The interior rim has oval-like notches made with the tip of a stylus-like tool applied in a right to left orientation. The rest of the interior of the vessel is similarly plain. A laminated fracture on the rim profile shows that the rim and collar were created by either folding a slab of clay over the rim and shaped into a collar, or the collar was created separately and smoothed onto the front of the rim section. There is carbonized food residue adhering to the interior neck section of this vessel. Horizontal striations left over from the wiping and smoothing process are present on the interior, as well as anvil marks from the paddle and anvil method of vessel wall thinning and shaping. There are surface scratches found on the interior rim that appear to be evidence of use-wear. This vessel reflects a mixture of the Lawson Incised and Pound Necked types. It is highly similar to vessel BcGb-6-2, but there are obvious differences in the morphology of the neck and rim sections.

Figure 7.41: Vessel BcGb-6-23

Vessel 23 of the South Lake assemblage is a grit-tempered pot, likely globular, with a slightly constricted neck and slightly out-flaring rim. This vessel has a poorly developed square collar with round edges. The lip is flat and out-sloping. The tool type used on this vessel is difficult to see due to surface exfoliation; however, the morphology of the impressions suggests it is a linear tool stamp. They may be CWS impressions, though they are very narrow and implies a thin linear tool. That said, the rim is decorated with right oblique linear tool stamping above left oblique linear tool stamping. Under the collar there is right oblique linear tool stamping. These three bands create a herring-bone pattern. From the neck to the base is undecorated. The lip has right oblique linear stamping while the interior is plain. The vessel was smoothed from the rim to the shoulder. From the shoulder to the base the surface indicates a net or fabric impression was applied, likely from the vessel shaping processe. The interior is smoothed. Anvil marks are present on the interior suggesting the paddle and anvil method of vessel wall shaping and thinning. The rim and neck section of this vessel were created and attached separately before firing, and this process can be seen in the uneven surface of the clay near the neck to shoulder transition. The clay fabric is crumbly with a grey interior suggesting a low firing temperature. The herring-bone motif restricted to the collar area, plain interior, fabric/net impression, and general vessel morphology suggests that this is a Pickering vessel.

Figure 7.42: Vessel BcGb-6-4

Vessel 4 of the South Lake assemblage is grit-tempered with an out-flaring rim and slightly constricted neck. The lip is flat with squared edges and is out-sloping. The vessel rim is decorated with right oblique CWS impressions. Below are three horizontal bands of CWS impressions, each delimited by a horizontal plain space. The small portion of shoulder left on this vessel has a complex pattern that may be more CWS impressions; however, it appears to be net or fabric impressions from the manufacture process. The lip of this vessel is decorated with right oblique CWS impressions and the interior of the rim has right oblique CWS impressions. The exterior surface from rim to shoulder was smoothed prior to decoration and firing. The shoulder to the base has net or fabric impressions. The interior surface has horizontal striations from wiping or brushing as a surface treatment. The lip of this vessel is thickened, achieved by folding the clay rim over from the interior to the exterior. The paste is crumbly and grey from low firing temperatures. The rim section of this vessel was created separately from the body and base and attached prior to firing. Anvil impressions from the paddle and anvil technique of vessel shaping and thinning are present on the interior. The vessel design and morphology are indicative of the Early Sandbanks Tradition, or a CWS variant of the Boys Oblique Dentate type of the Pickering Branch. Below is a photo of the body and basal portion.

Figure 7.43: Vessel Body BcGb-6-4

Figure 7.44: Vessel BcGb-3-2

Vessel 2 of the secondary South Lake assemblage (BcGb-3) is a grit-tempered pot with a constricted neck and out-flaring rim. The lip is flat with angular edges and is everted. The body appears to be globular judging by the shape of the shoulder. The lip is decorated with vertical linear tool stamping about 5 mm wide with 5 mm of space in between each stamp. The exterior rim/lip has short tool impressions staggered in between the lip impressions creating a "frilled" look. There is a space on the rim that appears to be plain, though it is quite exfoliated, and the creation of the tool impressions on the rim also made some marks below from an unsteady hand during decoration. The exterior neck is bossed from large rectangular punctates on the interior. From the neck to the shoulder are alternating bands of left and right oblique linear tool stamp impressions creating a herringbone pattern. From the shoulder to the base the vessel has been malleated with some sort of paddle creating divets or craters on the vessel surface similar to check-stamping. The interior of the vessel has right oblique drag-stamped linear tool impressions. The walls are quite thin, and the lip is thickened. There are anvil marks on the interior indicating that the vessel was shaped and thinned using the paddle and anvil method of construction. Wright and Daechsel (1988) believe this vessel belongs to the Late Sandbanks Phase ceramic style, though it appears to have more Pickering traits than Sandbanks traits.

Figure 7.45: Vessel BcGb-3-2 (2)

Figure 7.46: Vessel BcGb-6-9

Vessel 9 of the South Lake assemblage is a small grit-tempered pot with a well-developed angular collar, pointed castellation, and a flat, slightly everted lip with rounded edges. The rim is not out-flaring and the neck is constricted. The collar on this vessel is 1.5 cm wide, rising to 2 cm at the castellation. The vessel rim is decorated zonally in triangular panes of horizontal, left oblique, and right oblique incised lines made with a stylus-like tool with a 1 mm wide tip. The bottom of the collar is notched with a stylus-like tool—the notches appear to have been made in two or more strokes or stamping actions. The neck is left plain and smoothed. The shoulder has stylus tool stamping that look more like weak punctates, each varying in shape. This changes on the other side of the vessel where the weak punctate impressions turn into linear tool stamp impressions roughly 1 cm long that have a wedge look to them as though the tool were sharpened to a convex edge like a knife. The body of this vessel is globular. It appears that the rim section was made separately from the body and attached before decoration and firing. The interior of this vessel has anvil marks from the paddle and anvil method of vessel construction. The interior and exterior surface treatment is smoothing. The design and morphology of this vessel suggests that it reflects the Huron Incised type of the Huron sequence.

Figure 7.47: Vessel BcGb-6-1

Vessel 1 of the South Lake assemblage consists of two rim sections that make up a complete rim, neck, and shoulder section. This vessel is grit tempered with an out-flaring rim and slightly constricted neck. The rim has a poorly developed collar that is smoothed onto the neck. The lip is flat with angular, though slightly rounded, edges. The shoulder curvature indicates this was likely a globular vessel. The exterior rim/collar is decorated with right oblique linear stamp impressions while the entirety of the vessel is plain. From the shoulder to the base are surface treatment impressions that appear to be check-stamping. The interior is smoothed, though there are scrape marks in the clay—these could be from use-wear, but they could also be incidents during vessel construction. Anvil marks present on the interior suggests the paddle and anvil method of vessel construction. Where the vessel is broken, sheets of clay are separating from each other in a laminated fashion. This suggests this vessel was created using slabs and fillets of clay that were subsequently smoothed together. The interior rim has carbonized food residue present. It is also evident that the rim section was made separately from the rest of the vessel and smoothed together with the body before decoration and firing. This vessel is difficult to place into a type, but it shares similarities to Middleport Oblique, Ontario Oblique, and Lawson Incised. The other half of this vessel can be seen in the photo below.

Figure 7.48: Vessel BcGb-6-1 (2)

Figure 7.49: Vessel BcGb-3-1

Vessel 1 of the South Lake assemblage (BcGb-3) is a grit-tempered pot with a round collar and a slightly out-flaring rim with incipient round castellations. The lip is flat with slightly rounded edges and a medial groove. The neck is constricted. The collar is 3.2 cm wide. The exterior rim has a convex profile while the interior has a concave profile. The upper rim of this vessel is decorated with horizontal dentate-like tool stamping. The tool impressions have a circular to diamond shape. The lower half of the rim has left oblique dentate-like tool impressions. The neck, from below the collar to the shoulder, is decorated with horizontal dentate-like tool impressions. There is very little spacing between each stamping action and the decoration appears to have been partially smoothed before firing. The motif may be a herringbone pattern, but it is difficult to be certain. The shoulder is plain, suggesting that this vessel had a smoothed surface treatment prior to decoration and firing. The lip is decorated with medial dentate-like tool impressions. The interior of the rim is decorated with right oblique dentate-like tool impressions. There is a double row of deep oval-rectangular punctates. The punctates are placed in a right oblique fashion on the interior, and the left oblique tool stamping on the exterior is placed in correlation to the punctates in such a way that they delineate each pair of punctates on the interior. The interior was given a smoothed surface treatment. The vessel was constructed using the slab and fillet method, though paddle and anvil marks are missing suggesting that the vessel was shaped by hand or anvil marks were carefully smoothed away before firing. There are carbonized food residue encrustations on the interior from cooking. This vessel represents the Boys Oblique Dentate type. Wright (1966) merged Ridley's (1958) Scugog Oblique Dentate Bossed type into Boys Oblique Dentate. This specimen is noteworthy for two reasons: 1) there is no bossing, but punctates are present, and 2) the "bossing" that should be present is delineated by oblique dentate stamping instead of punctates.