TEXTILE PRODUCTION TOOLS FROM VIKING AGE GRAVES IN GOTLAND, SWEDEN

By

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ABSTRACT

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Over the past several decades, the research and analysis of archaeological textiles has become of ever increasing importance in gender, trade and production studies. When analyzing archaeological textiles, researchers must take into consideration the tools that were required to create textiles and how those tools influenced the quality and quantity of fiber that was needed to create multiple forms of textiles used to clothe a population. In past publications, researchers have focused on the analysis and interpretation of the remains of textiles found on the island of Gotland, but have not included in their studies the tools for the production of these textiles. Some of the tools that will be examined in this thesis include spindle whorls, weaving tablets, needles and needle cases. By examining the tools, found in the Viking Age grave sites excavated on Gotland and collecting data in the form of dimensions, weights and quantity of tools found, an interpretation can be made as to what type of textiles could have been created with these tools. By conducting analysis on the textiles and mineralized impressions, we can compare these to data from the tools and extrapolate whether the tools present could have created the fibers found alongside them in the burials. The analysis of this data can give insight into the various types and quality of textiles produced by the tools from the grave sites and to determine whether textiles could have been produced locally or were traded in. In this thesis, I will examine and analyze the textile tools found in approximately 200 Viking age graves located throughout Gotland in an effort to determine whether the production of textiles is feasible with the tools assembled and the types of textiles that could be produced. Not only can this give us insight into the production and trade of textiles during the Viking age on Gotland, but also how the production and/or trade of textiles influenced the daily lives of the inhabitants and how they affected trade and gender in an ever expanding economy.

Key words: textiles, textile tools, Gotland, gender, trade, production, archaeology, fiber, Viking age.

To my husband, Jim for his support

– Emotionally, mentally, financially –

I couldn’t have done this without you, dear

And

To all women, throughout time,

Who have only ever done just “Women’s Work”

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1. INTRODUCTION

Textiles in the Archaeological Record

The production of textiles has been a part of human daily activities for tens of thousands of years and one of the most important industries in pre-historic societies (Barber, 1991; Bender-Jorgensen, 1986). Textiles clothe our bodies, add luxury to our households, and are used as status items throughout the world. Since perishable textiles rarely are preserved in the archaeological record, the tools and processes used to produce them must be studied to better understand how textiles evolved over the centuries.

Those that do survive are found in very specific climates and regions and are usually small scraps of fabric found in trash middens and/or burials. Textiles that are found represent cultures, individuals, and time periods. They provide insight into the weaving techniques, spinning, and structures that went into their creation. Textiles are used for clothing, created for household and ritual purposes, are important in seafaring societies for use in sails and caulking, and are an important commodity in trade (Andersson et al., 2010; Gleba and Mannering, 2012; Barber, 1991).

Due to a variety of taphonomic factors that have helped preserve textiles in a relatively large number of archaeological deposits, numerous finds of textiles have been made from excavations in Northern Europe (Gleba and Mannering et al, 2012). Archaeologists have studied the structures and materials that make up these textiles and contributed important insights into how cultures produced textiles and the costumes worn

(Bender Jorgensen, 1992). From these artifactual textiles, researchers have been able to determine whether textiles imparted a certain social status to the owners or signaled membership into a social group (Andersson, 2003).

In particular, textiles from Viking period archaeological sites in Northern Europe have long been a fruitful area of archaeological inquiry. Several papers have been written about the textiles found in Gotland, Sweden that were produced during the Viking Period. Gotland is an island that modernly belongs to the country of Sweden and is located in the center of the Baltic Sea (see figure 2.1). It is and has been an integral part of trade routes and exchange for centuries (Carlsson, 2003).

In the past, archaeological studies of Gotland textiles were focused on the textiles themselves. The tools, in many cases, have been much less intensively studied than the textiles themselves. This thesis fills this intellectual gap, collects and analyzes textile production tools from graves dating to the Viking Age (750/800 – 1050 Current Era [CE]) in Gotland, maps the geographic distribution of these tools, and contextualizes the data using experimental archaeology by comparing to tools found in graves from other sites known from the Viking Age. The data can give us better insight into the textiles being produced on Gotland and the level of textile production during this period.

With only a few of the possible Viking settlement areas excavated on Gotland, the choice to study the tools found in the graves documented in Lena Thunmark-Nylén's (1995 - 2006) *Die Wikingerzeit Gotlands Vols. I-VI* is an attempt to fill a gap in the research of textiles and textile production in Gotland. Thunmark-Nylén's volumes include two of photographic documentation of the artifacts found in over four hundred of the eleven hundred graves excavated. A catalog of artifacts found in all eleven hundred graves by artifact type is handled separately and includes sections on the textile tools present, including spindle whorls, weaving tablets, needles, and needle cases.

The tools used in the production of textiles do survive in the archaeological record, giving archaeologists and historians a chance to interpret the how, where, and when of textile manufacture. When analyzing the craft of textile production, the tools used are an essential component to the creation of textiles and should be included in the study and analysis of the textiles themselves. As tools of different weights and dimensions produce different varieties of textiles, analyzing both the textiles and textile tools found, an interpretation can be made as to the whether the tools found could have been used to produce the textiles found within the same context.

By looking at the tool types and the distribution of the tools throughout the graves documented by Thunmark-Nylén, this thesis endeavors to gain better insight into the production of textiles on Gotland during the Viking period and to what extent the inhabitants of Gotland were producing textiles. By investigating the distribution of tools through the use of Geographical Information Systems (GIS), a postulation can be made as to the locations of textile production in the parishes of Gotland. By examining and analyzing the tools from the graves, looking at the distribution of the tools, and comparing them to tools from tools found in graves in the contemporary sites of Birka, Kaupang and Hedeby, a hypothesis can be formulated providing a potential answers to the research questions presented.

Earliest evidence of textiles

Artifactual textiles, the tools used to produce them and images of textile production have been documented from archaeological sites throughout the world. In the past, the literature and discussion of textiles and their production and importance has been slow to come to the forefront. Reference(s) to the earliest textile developments are few, with most discussing and documenting individual finds, such as Kvavadze, et.al. (2009) documented their find of a 30,000 year old linen fiber. E.J.W. Barber's *Prehistoric Textiles* (1991) is a timeline of textile development in the mid-east and Europe that discusses the evidence of textile production in prehistory dating to almost 25,000 years ago and is used and cited by most textile archaeologists today.

Some of the earliest and most reliable evidence of the creation of textiles comes from the "Venus figurines" (Barber, 1991). Venus figurines are small statues of women found associated with Anatomically Modern Humans during the Pleistocene. Some of the female representations look to be wearing string "skirts" around their waists and have been found in areas around the Mid-East and Mediterranean Sea dating as early at 25,000 Before Current Era (BCE).

In 1959, the Abbot A. Glory, while excavating in the Lascaux Caves in France, found a small piece of cordage fossilized in a chunk of clay (Glory, 1959; Barber, 1994). When the clay was broken apart a carbonized impression of a twisted cord was visible, allowing the remains to be dated to approximately 15,000 BCE. Until recently, this was the oldest known piece of textile production known (Barber, 1994).

During the Neolithic period (6,000 to 3,000 BCE), when humans were domesticating plants, animals and establishing permanent settlements, there was an increase of clay figurines showing representations of string skirts and other pieces of textiles that adorned the body (Wayland Barber, 1994). The development of agriculture and the domestication of animals allowed humans to produce textiles from those plants and animals that, in the past, were used as food sources. Barber (1991:295) suggests that it is no coincidence that the first direct proof of weaving comes within the area and time of the first domesticates.

There are only two solid sources of data that provide evidence of weaving: the textiles themselves and the impressions left in clay or metal. The earliest direct proof of weaving is found in Jarmo, northeastern Iraq, where archaeologists have found two small pieces of clay with the impression of woven textiles pressed into the clay, dating to ca. 7,000 BCE. Actual woven cloth pieces of textiles have been found in Nahal Hemar, Judean Desert, dating to ca. 6,500 BCE and at Çatalhöyük, Anatolian plateau, at about 6,000 BCE in a variety of bindings and weaves (Barber, 1991).

In Northern Europe, the earliest direct proof of fiber crafts are from the Mesolithic (7,500 – 4,000 BCE) with the recovery of spun fiber nets from Finland and Lithuania. The earliest weaving found so far dates to the late 4th century BCE, consisting of linen textiles from Switzerland (Barber, 1991).

While the textiles themselves do not survive the archaeological record on a large scale, the tools used in their production, funerary artifacts, and images on pottery portraying women weaving on pottery, illustrate the process of creating textiles. Evidence of weaving technologies in the forms of loom weights, spindle whorls, needles, and weaving tablets give archaeologists, researchers, and historians tangible evidence of how textiles were created and the processes, from the gathering of fiber to the finished product. Artifacts such as ceramic pots and urns, with depictions of women weaving, spinning and preparing textiles for use or transport and showing the tools used in the production of textiles, illustrate the importance of manufacturing textiles and how those tools were used to create them.

Table 1.1. A list of the cultural time periods discussed in the text and their approximate associated calendar age ranges for Northern Europe/Scandinavia. After Bender-Jorgensen, 1984.

Years of Period/Age	Period/Age Name
7,500 – 4,000 BCE	Mesolithic Period
4,000 – 1,800 BCE	Neolithic Period
1,800 – 500 BCE	Bronze Age
500 – 0 BCE	Pre- Roman Iron Age
0 – 300/400 CE	Roman Iron Age
300/400 – 550/600 CE	Early Germanic Iron Age/ Migration Period
550/600 – 750/800 CE	Late Germanic Iron Age/ Merovingian/Vendel Period
750/800 – 1050 CE	Viking Age

Early textiles in Scandinavia

The earliest evidence of textile production in Scandinavia comes from the Mesolithic period dating to approximately 4,200 BCE (table 1.1). An example of a technique called needle looping or nålebinding from Demark provides evidence of the spread of textile technology to the Scandinavian Peninsula (Bender Jørgensen, 1990). Prior to the arrival of the warp weighted loom in the Mesolithic period, there was a tradition of fine netting and needlework while weaving skills on a large piece scale developed. This can be seen during the 2nd millennium, in the burials of mound building people of Denmark, in examples of careful band weaving and elegant stitchery, but the weaving of major fabrics were not as developed as these other techniques (Barber, 1991; Gleba and Mannering, 2012). These well-developed thread crafts can be seen in the bands that were known for some time prior to textiles that were produced on the larger looms and transferred into these new structures of large loom textiles. It is not until the end of the Mesolithic, at the beginning of the Bronze Age, that the warp weighted loom made its way up into Scandinavia.

The first direct proof of large loom weaving technology in this area comes from northern Jutland, Denmark, during the beginning of the Bronze Age (ca. 1,800 BCE) in the form of a small fragment of woolen cloth in plain weave that was adhered to a bronze spear head. Over the decades, there have been other ancient textiles found in the bogs of Denmark, dating to the Bronze Age at approximately 1,500 BCE (Hald, 1980). One of these finds was the Egtved burial, containing the body of a young woman dressed in several garments thought to have been for ritual purposes. The skirt worn by the young woman showed similar techniques in the process of creating the heading band for a warp weighted loom (Barber, 1994). The shirt found in the burial was woven in a simple plain weave with sleeves attached at the shoulders. These garments provide insight into textile technology during the Bronze Age in Scandinavia and burial practices that included possible ritual clothing (Bender-Jørgensen, 2003).

From a limited number of finds from the pre-Roman Iron Age in Scandinavia, weaving technology was seen in the borders of a type called a “warp-lock,” indicating the use of the two beam loom (see figure 4.5). This type of loom allowed the weaver to create finished borders or “selvages” on all four sides of the fabric. This warp-lock structure can be seen in the remains of a woman found in a bog in Jutland, Demark, in 1879 wearing garments of wool and a sheep skin cloak dating to approximately 1,800 years ago and the Late Roman Iron Age. In the same area, a Roman Peplos style-gown of wool was found, a garment that was constructed in a tube with the top folded down on itself to create an overhang of cloth. These garments were exceptionally well preserved and found almost completely intact (Hald, 1980). This level of preservation is the result of acidic ground waters and a lack of oxygen that helps preserve wool, hair, and skin but destroys bone and vegetable matter (Barber, 1991).

The Roman Iron Age saw a continuation of the textile traditions from the pre-Roman Iron Age, but with a change in technologies including the warp-weighted loom replacing the tubular loom towards the end of this period. Proof of this change can be seen in the remains of textiles with starting borders, indicative of warp-weighted loom techniques, along with loom weights and spindle whorls being found in settlement areas and grave fields. With the warp-weighted loom came the capability of weaving a finer quality of fabric and the ability to produce more complex weaving structures and patterns (Bender Jørgensen, 1992).

The post-Roman period, referred to as the Migration Period (300/400 – 550/600 CE) in Scandinavia, saw an increase in the production of textiles, but also an increase in trade, with possible traded textiles coming from mainland Europe and the Mediterranean

(Bender Jørgensen, 1984). The innovations of the Roman Iron Age (such as warp-weighted looms and spindle whorls) continued along with patterned/brocaded tablet-woven bands, found in Norwegian Migration Period graves (Ræder Knudsen, 2009). Evidence of textile production can be found in the Migration Period site of Vallhagar, Gotland, where numerous loom weights and spindle whorls were excavated from the remains of several buildings (Stenberger, 1955).

During the Vendel Period (550/600 – 750/800 CE) a change occurs in the level of textiles produced in Scandinavia. This period saw a decline in textile production with the possible importation of textiles as the Scandinavian nobility was embracing the fashions of the Franks in Germany, which included the importation of textiles that were of a quality to those of the Frankish nobility (Bender Jørgensen, 1992).

Viking Age Textiles and Structures

The Viking Age (750/800 – 1050 CE) was a time of trade expansion and the establishment of trade networks, providing greater access to the importation and exportation of textiles (Graham-Campbell, 1980). This period saw the further stratification of society and the specialization of handcrafts. With the expansion of trade came a greater demand for more diverse types of cloth and great amounts including those textiles and fibers used in maritime activities (Andersson, 2003).

During this period, there was a great deal of production and trade of textiles as the population expanded and the need for clothing, cloth for sails and household needs increased over time. The variety of fibers and structures seen in surviving textiles are a testament to the skills and productivity of textile producers. Evidence of varieties of wool from the British Islands and Europe, seen in the Frisian textiles and silks imported as luxury items from the East and Byzantium, attest to the wide spread travels of the Vikings (Graham-Campbell, 1980).

Among the variety of textiles found throughout Northern Europe and Scandinavia, a broader diversity can be seen in the numerous techniques and structures in the remnants of textiles from the period (Hayeur Smith, 2014). The textiles woven for items such as clothing, household items and sail cloth were created in a range of structures and quality of tabbies and twills. Included in the tabbies are basic tabby, basket weaves and ribbed tabbies (weft faced tabbies). The twills are quite varied and include 2/1 twills, 2/2 twills. 3/1 twills, diagonal, diamond and broken diamond, rose path (see fig. 4.0). These weaves included fine woven textiles with thread count of 20-30 thread per centimeter and courser woven with 8-20 threads per centimeter (Andersson Strand, 2009). The finer clothes could have been used in clothing and as the time involved in creating the finer textiles is greater, these textiles could have been used in garments for higher status individuals. The courser textiles could have been used for household times, sails and possible as outerwear used for harsher times of the year.

Another form of weaving seen during this period is tablet woven bands. These bands would have been produced with the use of small “tablets” made of antler, wood or metal and used as decoration on garments and could possibly have been considered status items, as the expertise and time put into creating them was substantial.

Textiles documented on Gotland from the Viking Age appear to have been as varied as those found elsewhere in the Viking world, with examples of twill and tabby weaves, tubular bands and tablet woven bands (Bender Jørgensen, 1986; Nockert, 1970). Textile remnants document by Bender Jørgensen include weaving structures such as 2/2 twills, diamond twills and broken twills with tabby found rarely. Of those textile remnants found, a Z/Z twist in the yarn/threads is seen in almost all fabric structures. This Z/Z twist forms a cloth type different from mainland Sweden textiles during the period (Bender Jørgensen, 1986). These structures, possibly used in the construction of clothing articles, can also be seen in the mineralized impressions of textiles left on the metal artifacts collected from the grave sites (see Appendix B). These impressions, along with the textiles themselves, provide evidence of the quality and diversity of textiles on Gotland.

Evidence of tablet weaving comes from several sources and includes both tablet woven bands and weaving tablets. Both the bands and tablets have been found in the graves on Gotland. A piece of tablet woven band was found in a grave in the parish of Tingstäde that displays an intricate design (see Appendix B) (Bender Jørgensen, 1986; Thunmark-Nylén, 1996).

Tools

In the production of textiles, the tools used are as important as the textiles themselves. As textiles do not survive as well as the tools, the tools comprise the single most important and plentiful type of proof of textile production and technology at a given site (Andersson, et al. 2010). Some of the oldest tools found for textile production include spindle whorls, loom weights, and needles.

One of the most common textile tools found in archaeological sites is the spindle whorl. A whorl, which can be made of ceramic or stone, but have also been found in amber, bone, ivory and bronze, is the weight at the end of the spindle that provide the inertia to spin fiber into yarn/thread (see figure 4.2). It is thought that the use of a whorl dates back to the Neolithic age, with possible examples found in Anatolia and Iraq, making the use of the whorl for spinning approximately eight to ten thousand years ago. Among those artifacts found with the spindle whorls, were bone needles and possibly loom weights (Barber, 1991).

The earliest examples of loom weights come from Hungary, dating to the 6th to 7th century BCE. Found in an ancient house site, a collection of loom weights were found next to what is thought to be post holes that were used for the uprights for a warp weighted loom (see figure 4.0)(Barber, 1991).

It is around the 1st century BCE that evidence of tablet weaving makes an appearance, with weaving tablets found in Denmark and Spain, providing the clearest proof of tablet weaving. These tablets displayed the basic form needed to produce woven bands, including the holes needed to insert the warp thread through (see figure 4.6).

During the Viking period, we see examples of all these tools in settlement and grave sites. In the Gotland graves, examples of spindle whorls, weaving tablets, needles and needle cases have been documented. Although considered ancient technologies, the skill and knowledge needed to use these “ancient” tools would have been considerable.

Thesis Overview

In Chapter 2, I examine the pre-history of Gotland, including the geomorphological, geographical, environmental, and cultural landscapes of the island. As Gotland has never been attached to the mainland, it has provided a chance to study an environment that had developed independently from mainland environments and cultures (Martinsson-Wallin, et al., 2011). Located in the middle of the Baltic Sea, the inhabitants developed a trade based economy that allowed for contact with many cultures outside the sphere of Scandinavian countries (Carlsson, 1999, 1991; Kosiba, et al., 2007).

Chapter 3 is dedicated to the theoretical frameworks and methodological approaches used in this thesis. The theoretical concepts I rely most heavily on are cognitive archaeology, material culture theory, and archaeology of gender. Cognitive archaeology examines the thought processes behind the symbolic meaning of material culture left behind. The archaeology of gender explores the role of gender in culture(s) and how those roles are created. Material culture looks at the relationship of people and things, the material objects that have been created and left behind by humans over the centuries. The methodologies include researching and translating information gathered from publications, the collection of data from the tools in the form of measurements: diameter, height, weight, and material type, and the distribution of the artifacts based on the documentation from publications using ArcGIS. By translating publications by Lena Thunmark-Nylén and collating the counts and types of textile production artifacts, a database was created to be used in the data collection and analysis of the tools. The creation of scatter grams and bar charts illustrate the distribution of weight and size, providing a visual reference to the possible types of yarns and textiles produced on Gotland during the Viking Period. The use of a Geographical Information Systems (ArcGIS) allows me to create maps showing the spatial distribution of the tools and graves in the parishes of Gotland. A statistical comparison of the Gotlandic tools is presented with tools and data found in the graves from documented production sites of Birka, Sweden; Hedeby, Germany; and Kaupang, Norway.

Chapter 4 is a primer on the craft of textiles and textile production. This chapter focuses on the raw materials used during the Viking Age, including wool and flax, and the tools used in the production of textiles. It outlines the procedures for gathering and processing the fiber, preparing it to be made into yarn/thread. The next step in the process is to take the fiber and spin it into a yarn or thread. At this point, the yarn/thread can be woven into cloth or used in the creation of numerous cloth goods including clothing, household items, ship sails, and as a commodity for trade.

In Chapter 5, I present the literary analysis and translation from Thunmark-Nylén's *Der Wikingerzeit Gotlands* (1996-2006), the analysis of the textile tools from the graves of Viking Age Gotland, along with information on the distribution of the tools. The analysis consists of discussion about measurements, tool shape, and the interpretation of charts and scatter grams. I compare these data to similar tools found in the graves from contemporary sites in Northern Europe, including sites in Birka, Sweden, Kaupang, Norway, and Hedeby, Germany. Distributions are illustrated with maps generated with ArcMap, a Geographical Information System that helps analyze spatial distributions.

Chapter 6 is devoted to the discussion of the analysis and distribution of textile production tools. Included in this discussion is my interpretation of the data assembled and how this data can support the hypothesis of imported textiles goods, what textile were being produced on Gotland, how textile production affected the everyday lives of the inhabitants, and the reasoning of Gotland as a whole as a nodal point. I return to the central question of my thesis and interpret whether or not textiles were being produced on Gotland to the extent that would clothe a population. Conversely, the possibility of textiles being traded in, possibly for goods being produced on the island. I conclude by proposing questions and recommendations for future research and additional analysis that may further our understanding of textile production on Gotland and the importance of textiles throughout Scandinavia and Europe prior to the middle Ages.

CHAPTER 2. GOTLAND: AN ISLAND APART

Gotland is an island located in the middle of the Baltic Sea and includes several smaller islands including Fårö, Gotska Sandon and the Karlsö Islands (Lilla and Stora) (figure 2.1). Today, it is a province of Sweden and is divided into ninety-two parishes (figure 2.2) covering a total area of approximately 3,200 square kilometers. It is Sweden's largest island and the largest in the Baltic. Today's population is approximately 57,000 with the main sources of income being tourism, agriculture, and concrete production (www.gotland.se/english, 13 March, 2014). Gotland differs from the rest of Sweden in its maritime situation and geological make-up. As Gotland emerged from the Baltic Ice Lake, having never been attached to mainland Scandinavia, it presents the opportunity to study the impact of human behavior on the environment and lifestyles and the strategies used within limestone formations (Martinsson-Wallin, et al., 2011). The shallow but fertile soils and temperate climate have created the potential for pastoral farming and agriculture that the ancient inhabitants recognized and extends into today's economy (Graham-Campbell, 2000).

Geology and Geography of Gotland

The geological history of Gotland begins in the Cambrian Period over 543 million years ago as areas of Northern and Central Europe formed a continental mass known as Baltica. During the Cambrian up to the end of the Silurian (approx. 416 million years ago), the Baltica began to flood, creating a shallow sea whose depth and land borders changed through time (Eliason, et al., 2010). It was during the Silurian period (444-416 million years ago) that reef formations became common in the shallow waters of the coastlines, suggesting a more tropical climate and Baltica's location just south of the equator (Laufeld and Bassett, 1981). During this time, large amounts of shell fragments accumulated around the reefs, creating a stratified limestone deposit. At other times, large amounts of clay sediment combined with calcareous material were deposited, producing thick, fossil-rich, marlstone layers that were reddish in appearance and possibly made into artifacts. It has a very distinct look with a combination of fine reddish sand and coral striations mixed together. At the beginning of the Silurian period (approx. 444 million years ago), Gotland had little in the way of land life, however the sea contained extensive vegetation and animals (Eliason, et al., 2010: 10-11).

During the Caledonian orogeny (490-390 million years ago), which was a mountain building era that included parts of Northern Europe and Greenland, the Baltic basin would rise above sea level, eliminating the deposit of sediments on Gotland for millions of years (McKerrow, et al., 2000). It is not until the late Quarternary period at about two million years ago to the present that additional sediments were deposited, with inland ice ages typical of the northern latitudes dominating the period. Shorter periods of warmer climate occurred, known as interstadial periods, allowing vegetation to colonize (Eliason, et al., 2010).

Figure 2.1. The island of Gotland in relation to Sweden. (Frohne, 2009)

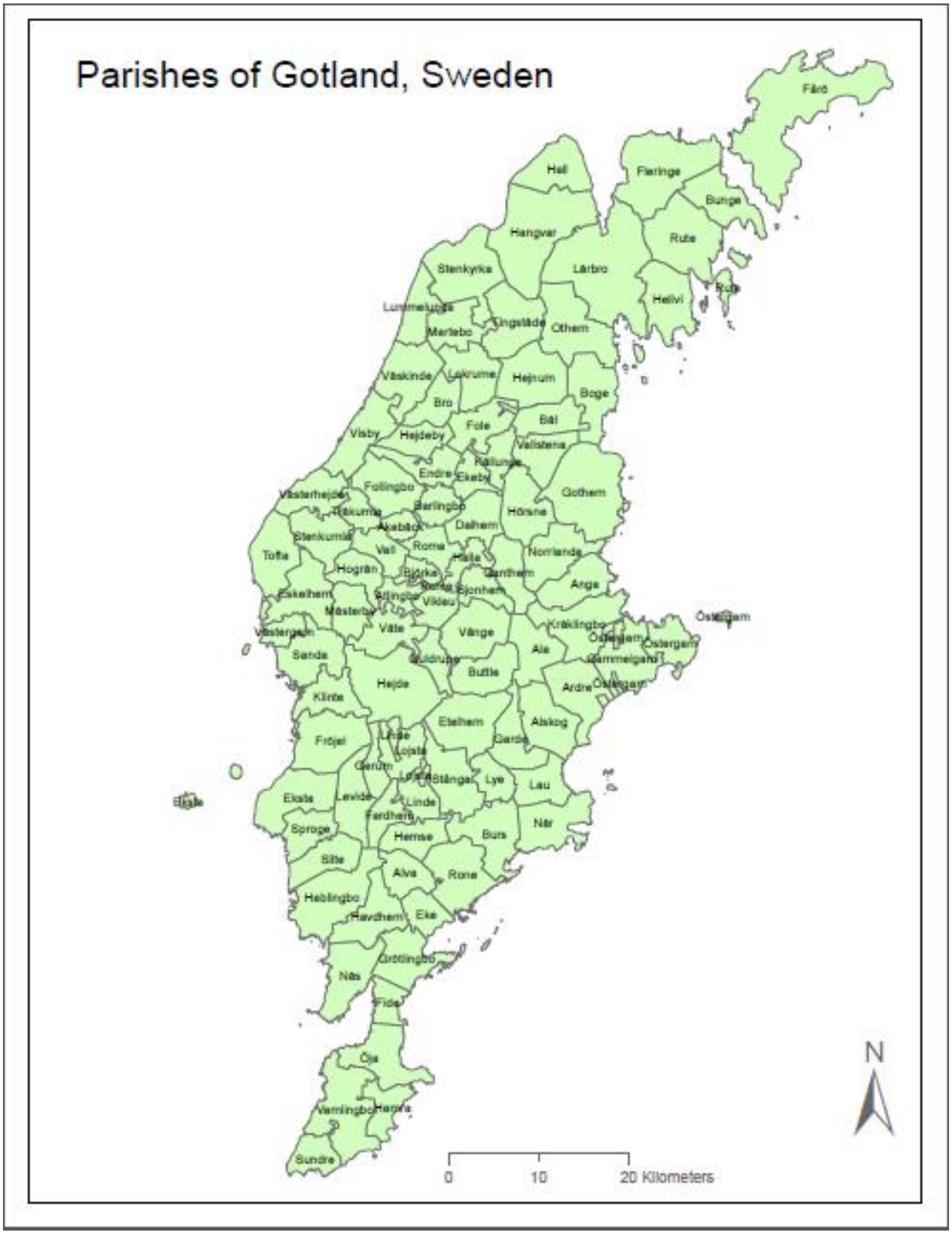

Figure 2.2 Map showing the 92 parishes of Gotland (Klessig, 2011)

The latest glaciation period, which extended from about 22,000 to 10,000 years ago, created large chunks of inland ice, lowering the sea water level to over 100 meters lower than present, which created land masses to the south, closing off the Baltic from the Atlantic. With a post-glacial warming period occurring at about 10,000 years ago, contact with the sea was made via the Danish Sound. It was at this time that hunter-gatherers spread into the Scandinavian mainland and Gotland (Eliason, et al., 2010).

Geography and landscape

Gotland's modern landscape was created during the time when the bedrock was a soft bottom sediment in a tropical near-shore sea 420-430 million years ago. Geologists have roughly divided Gotland into three limestone areas in the north, middle, and far south of the island, which are divided by two large low-lying areas of marlstone (Eliason, et al., 2010). The limestone had been used for centuries for use in creating the large pictures stones, found exclusively in Gotland (figure 2.3). The marlstone is distinctive in its make-up and can be seen in stone artifacts found in sites such as Ajvide, dating to the Mesolithic and Grötlingbo during the Viking Age. Like all islands, Gotland is heavily influenced by the surrounding seawater temperature, which creates a barrier to migrating species, giving Gotland a rather poor but interesting faunal population (Laufeld and Bassett, 1981).

With a coastline that is over 550 kilometers (770 if the larger islands are included) a diverse coastal environment accentuates the island's evolution and geology. Much of the island is fairly low and flat, with an average elevation of about 25 meters (Laufeld and Bassett, 1981). Nearly half of the island is covered with forest, which grows on areas of harder limestone (Eliason, et al., 2010).

Figure 2.3 Picture Stone from Gotland, Viking Age (Berig, 2008)

The Habitation of Gotland

Gotland has had a long habitation history, dating from the pre-historic periods of the late Paleolithic and on through the Mesolithic, Neolithic, Bronze and Iron Ages, to the present. This deep human history has resulted in the largest amount of graves and cemeteries found anywhere in Scandinavia. Time periods, normally recognized by

Europe, were delayed as compared to the rest of Europe and the Mediterranean as technologies moved north at a slower pace. The extended occupation of Gotland, along with the graves and cemeteries that have been located, provide archaeologists and researchers with a large collection of material remains suited for analysis and research that extend by millennia (Jørgensen, 2009). From an early date, Gotland had its own distinctive identity represented by minor variations in dominant forms of dress and clothing, burial ritual, and material culture (Fitzhugh and Ward, 2000). This can be seen in artifactual finds, such as women's brooches in the grave goods, settlement areas that have been excavated, and the picture stones (figure 2.3) found exclusively on Gotland.

Pre-Viking occupation

Archaeological evidence indicates that the first people arrived on Gotland approximately 9,400 years ago during the early Mesolithic Period (7,500-4,000 BCE). Evidence for this early migration comes in the form of skeletal remains in a cave site on the island of Stora Karlsö (Eliason, et al., 2010). Grave sites dating to this period possibly predate the settling of mainland Sweden by almost 3,000 years with the oldest evidence found on the mainland to date dating to approximately 6,000 years ago. The survival of early humans was based on subsistence during this period and was centered primarily on seal hunting and fishing (Martinsson -Wallin, et al., 2011).

Occupation of the island continued through the Mesolithic with sites such as Ajvide, located near the western coast of the island in the parish of Eksta. Ajvide was occupied from the late Mesolithic through to the mid Bronze Age (1,800 – 500 BCE) where a cemetery of approximately 80 graves were found. Burial practices during this period included both inhumations and cremations with evidence of dolmen style graves being erected and included artifacts in burials such as stone axes, ceramics and adornments (Martinsson-Wallin, et al., 2011).

The Neolithic Age (4,000-1,800 BCE) saw the introduction of agriculture and domesticates, such as sheep, goats and cattle, to the island and became the main source of income for the people of Gotland (Eliason, et al., 2011). To date, there are no clear settlement patterns as no communities, house foundations, or culture layers have been found. Evidence of terrestrial food intake has been found in burials dating to 3,400-300 BCE with radiocarbon dating supporting the theory that subsistence was based on farming and domestication of animals (Oden, 1980). Midway through the Neolithic the populace transition back to a hunter-gatherer lifestyle favoring seal hunting and fishing (Martinsson-Wallin, et al., 2011). Indicators of why this transition was made have not been explored in detail. Burials during this time are mostly inhumation, with practices changing in the late Neolithic to cist graves. These cist graves are concentrated in coastal areas and contained both inhumation and cremation burials and could consist of more than one person (Wallin, 2010). It is also about this time that copper begins to appear in the graves. Studies of bronze artifacts indicate that the copper was brought in from southwestern Europe possibly through barter or trade (Eliason, et al., 2010).

The Bronze Age (1,800-500 BCE) witnessed an increase in material culture that included the use of bronze in weaponry, adornment, and agriculture implements (Martinsson-Wallin, et al., 2011). As Gotland was and still is a metal poor area, bronze was introduced from Central Europe in the form of weapons and other manufactured articles including farming tools (Eliason, et al., 2010). Evidence of field systems around the island indicate that Bronze Age peoples of the island were organizing in units that went beyond the extended family into a community structure (Martinsson, et al., 2011). There is also evidence for the possible division of labor into specialized industries: farmers, herdsmen, craftsmen, and so forth (Lindquist, 1974; Martinsson, et al., 2011). It is during this time that the creation of large burial cairns, stone ship burials, and rock carvings became more widespread throughout the island, along with the inclusion of personal items of bronze in the burial ritual (Wallin, 2010). Towards the end of the Bronze Age and beginning of the Iron Age (550 BCE), there was a change in burial practices, with the population progressing towards the stone ship setting of burial (figure 2.4). Large rocks would be set on end to outline the inhumation graves in the shape of a ship

Figure 2.4 Garnarve stone ship burial, Gotland, Bronze Age photo:
http://www.spottinghistory.com/view/994/gannarve-ship-grave/

The Iron Age prior to the Viking Age consists of four defined sequences: Pre-Roman Iron Age (500-0 BCE), Roman Iron Age (0-300/400 CE), Migration Period (300/400 – 550/600 CE), and the Vendel Period (550/600-750/800 CE). The Pre-Roman and Roman Iron Ages (500 BCE – 300/400 CE) witnessed a growth of agricultural pursuits with arable meadows and smaller privatized areas for grazing (Martinsson-Wallin, et al., 2011). This can be seen in large complexes of "block-shaped" plots, suggesting a more organized community beyond the extended family and the dependence on cultivation of grains and domesticated livestock (Widgren, 1997). The Migration Period (300/400 – 550/600 CE) site of Vallhagar, excavated in the 1950's by a team of archaeologists lead by Marten Stenberger, was a settlement site in the south of Gotland that included numerous living structures, craft buildings and pen sites made of stone walls for livestock, including cattle, sheep, goats and pigs (Stenberger, 1955).

From the Vendel Period to the Middle Ages, Gotland was an important trading center and has provided high concentrations of artifactual finds that attest to the importance of Gotland as a trading point and possible nodal point. With approximately 45 coastal parishes and nearly 800 kilometers of coastline, nearly all the coastal parishes have the possibility of natural harbors (Carlsson, 2003). Gotland's strategic location allowed it to acquire control of trade routes over the centuries from east/west and north/south, and an accumulation of wealth that can be seen in the hundreds of hoards found throughout the island. Although Gotland was self-sufficient to a great extent, the inhabitants had to import raw materials like iron ore, glass cullet, and silver for the creation of goods needed both at home and for trade (Graham-Campbell, J., ed., 2000).

Picture stones

During the pre-historic periods Gotland had a very extensive and wide contact network. It was based on its presence in the Baltic and the distribution and substance of the rune stones and picture stone depicting the ships used during this time (Jorgensen, 2009). Hundreds of these picture stones were produced on Gotland from the local limestone from the 5th century onward and especially in the 8th and 11th centuries. These stones are richly informative with representations of ships, religion and dress of the period (Jones, 1984) and stress the importance of sailing ships during the Viking Age as many include ships under sail (Graham-Campbell, 1980).

Viking Age Gotland

More than any other period the Viking Age was a time when Gotland established itself as a major trading entity and ship building and repair location, providing examples of high quality indigenous handcrafts that included bronze jewelry work, glass bead making, and comb production. Picture stones were created that represented beliefs, social aspects and the formidable ships. Large hordes of silver and bronze were buried and represented the wealth and far reaching influence of the Gotland Vikings. Although the majority of modern literature places the beginning of the Viking Age with the raid on Lindisfarne, in 793 CE, it has been purposed by archaeologists and historians in more recent publications an earlier start to the Viking Age (Bender Jørgensen, 1992). They purpose that the period runs from the middle of the 8^{th} century to mid-11^{th} century (750-1050 CE), is a more accurate interpretation.

Gotland, along with several other islands, was considered an integral part of the Viking homelands, with its own distinctive character. Gotland held a prominent role dictated by its strategic location, and, while other islands were subsumed by the larger political groups, Gotland maintained its independence and culture alongside those Scandinavian societies (Graham-Campbell, J., 1980). Gotland's position in the middle of the Baltic was a natural point of contact and conflict for peoples living around the Baltic littoral (Fitzhugh, War, ed. 2000) and contributed to the socio-economic development of the island. It provided a midpoint for trading between mainland Scandinavia and the Baltic Coast (Carlsson, 1991, 1999), and regular contact with eastern centers such as Novgorod (Kosiba, et.al, 2007).

Gotland was also of particular importance in regards to its geological and geographical location, with limestone rich soil that was important for farming and shelter bays for trading and ship-building and repair. Approximately 400 farms have been documented from the Viking Age, isolated from each other, with no actual village structures known (Carlsson, 2004).

With little in the way of natural resources for the production of craft goods, such as jewelry, beads, weaponry, and combs, the need for a constant supply of materials was imperative to the production of these items and could only have been secured at *nodal points* of trade and commerce (Sinbæk, 2009). A nodal point in terms of archaeological context refers to a human occupied center of activity that acts as a central point of interaction and trade for the hinterlands and smaller farms. The systematic survey of the

Gotlandic coastline, in the 1980s, revealed the possibility of scores of Viking Age harbor sites (Carlsson, 1991), with nearly all of the 45 coastal parishes incorporating natural harbors used during the Viking Age. Considered one of the more important and best researched of these harbor sites is Paviken in Västergarn parish on the west coast of Gotland near the river Id (Idå). Paviken was excavated from 1967-73, with a large number of finds consisting of trade and ship yard goods. Paviken was predominately active during the 9th and 10th centuries and traces of iron and jewelry work, bead and bead manufacturing with glass from Italy, and Arabic coins and weights. These traces attest to its importance as a trading center and the distance traveled to obtain the raw goods (Graham-Campbell, ed., 2000). With the finding of household structures and items, Paviken was a permanent settlement and not just a seasonal trading center (Jørgensen, 2009). Paviken had considerable evidence of trade and manufacturing. Arabic coins and weights indicated contact with the East, along with glass tesserae from Italy for bead making. Along with the manufacturing, evidence of ship-building and repair and fishing were found at Paviken (Graham-Campbell, 2000).

Gotland has come to be known for the large amount and size of hoards found on the island from the Viking Age, with over 700 registered currently (Carlsson, 1999). Most of these hoards are associated with houses. The grave goods found demonstrate a connection to most of Europe, consisting of up-to-date equipment (Jørgensen, 2009). It was necessary to import raw materials for manufacture; the most important export was that of domestic animals, including cattle and sheep. The island became very wealthy due to its location in the Baltic, as a midway point or trading stations for ships on long voyages (Jørgensen, 2009). With its size, many harbors, and strategic location on the east/west axis on one of the period's most important trade routes, Gotland secured a place for itself in the texts from the early middle Ages (Jørgensen, 2009).

A number of small ports and trading centers flourished during the 8th to 11th centuries, ranging from small farm-related fishing villages to bigger, more central inhabited sites that could be more or less permanent. During this period, a strong network of contacts develops between the Baltic region countries and beyond (Carlsson, 2013). This can be seen in the large number of hordes found on Gotland and include large concentrations of Kufic coins, indicative of the trade role in Russia and Caliphate (Jones, 1984). Pendants from Gotland represent a tradition of Scandinavian goldsmiths working back to the 5th century (Graham-Campbell, 1980)

Gotland is seen as one of the period's most important trade routes and helped to secure its mention in Viking Age and early medieval period texts. One of these is the diaries of Wulfstan, a cleric from the British Islands, who traveled throughout Scandinavia with Viking marauders (Jørgensen, 2009).

Ships and shipbuilding in the Viking Age

The importance of the ships used during this period is a major factor in the wide ranging influence that the Vikings had on other societies and the influence those societies had on the Vikings. The opening up of Scandinavia to the rest of Europe and the establishment of trade routes and regular commercial networks throughout Europe, the Mediterranean, and the North Atlantic, was a direct result of the long ships used by the Vikings (Sawyer, 2001).

Summary

The geological, geographical and pre-historic information presented in this chapter is intended as an introduction to the island of Gotland. Its unique geological formation has allowed researchers to study the geological process on an international level. With the habitation of Gotland pre-dating the Swedish mainland, it offers the chance to study the social, religious, and economic structures of a population isolated from the mainland, but at the same time was a key player on the trade routes throughout the Baltic. Gotland’s strategic location has benefited the inhabitants over the centuries through trade with its connections to Scandinavia and Europe, south to the Mediterranean, and east as far as China as evidenced in the artifactual remains throughout the island.

CHAPTER 3. THEORETICAL AND METHODOLOGICAL

Theory is an important aspect of archaeological investigation, providing a perspective that helps us to frame the questions for our research, gain insight into past cultures and technologies, and how humans interacted with each other and their environments. Theory assists in the development of the questions and ideas we have in regards to our past. Although numerous perspectives are used in the course of researching and writing this thesis, I find myself predominantly looking through the theoretical lenses of cognitive archaeology, the archaeology of gender, and material culture theory. Cognitive archaeology focuses on past ways of thought and the symbolic arrangement of material remains. The archaeology of gender examines the gender roles in past societies, how gender identities and cultural identities were established, and how those roles affected the division of labor in a given society. Material culture explores the material record of the past and how those artifacts, tools and structures created by humans affected their daily lives, economies and the thought processes behind the production of those material remains.

Cognitive Approach to Archaeology

The field of archaeology has gone through numerous changes of theoretical thought over the last century, with many “new” approaches to how we, as archaeologists, view the archaeological record. In the past, artifacts were regarded as curiosities to be collected and displayed. With the introduction of cultural history, archaeologist became aware of how these artifacts could tell us about cultures of the past and how those cultures changed over time. This approach was limited in its scope, addressing cultural change but not how that culture developed over time (Johnson, 2010). The “new” archaeology, or processual archaeology, which emerged in the 1950s, embraced a more scientific methodology incorporating an interdisciplinary approach to cultural change and development. It stresses the dynamic relationship between social and economic aspects of culture and the environment as a way of understanding the processes of cultural change (Renfrew and Bahn, 2012). In the 1980s and 1990s, dissatisfied with the approaches of processual archaeology, archaeologists from Britain developed approaches that they felt overcame the shortcomings of functional-processual archaeology, including the need to address cognitive factors and . Post-processual archaeology was an attempt to focus on the role of the individual in history, and how material culture and actual objects are what makes society work (Hodder 2010). In the past couple of decades, archaeologists have moved away from post-processual as a whole and have come to incorporate a more cognitive-processual approach to the archaeological record. This approach is one of the newer branches of archaeology that works within the general assumptions and framework of processualism (Johnson, 2010).

Cognitive archaeology is the study of past ways of thought as inferred from the surviving material remains. It focuses on two areas; the evolutionary development of cognition in early hominids and subsequent cultural development of cognitive capacities, for example, the development of writing (Johnson, 2010; Renfrew, 2005). It aims to develop a methodology in the hope of learning how the minds of ancient communities worked and how that working shaped their actions (Johnson 2010; Renfrew 2005).

The cognitive approach to studying the material remains of the past can give insight to the customs of a past culture and how those customs were an integral part of the daily lives of the individuals. By investigating burial goods, an interpretation can be made as to what was valued in a past culture, the importance of an individual by the amount of artifacts buried with them, and what roles the individual could have had in their community. Burials customs of the Vikings, prior to Christianization, are of great value to archaeologists as the dead were buried with personal adornments and implements and utensils of everyday life, preparing the dead for the next world (Jesch, 2001). This can be seen in the Oseberg ship burial that included carts, food, animals, textiles and textile tools, and a servant (Stine Ingstad, 2002). In the burials from Viking age Gotland, many artifacts were buried with the deceased, leading one to speculate as to their belief in an afterlife. The artifacts included jewelry, weapons, and utensils used in everyday life, including the tools used in textile work. The textile tools found in the burials could lead to a belief that the deceased did some form of textile work while alive. The location of the artifacts could also give clues into how a tool was used. As almost all of the spindle whorls were found at the feet of the deceased, this could represent where the spindle would hang while a spinner created yarn/thread (Thunmark-Nylén, 1996). Spindles during this period of time were usually used while standing with the fiber being drawn out and the spindle increasingly working its way toward the ground as the spinner spun the yarn/thread longer and longer.

Archaeology of Gender and Identity

The archaeology of gender had its beginnings in the same movement that gave us "post-processual", feminist and cognitive archaeology. Like cognitive archaeology, it was meant to fill a void in how archaeologists interpreted the material record. The assumption that specialized craft activity was done by men and was considered more important than the activities of women was a fallacy that feminist archaeology hoped to remedy (Johnson, 2010). It was from this movement that interest in gender issues arose in the 1960s. Today, instead of simply representing an alternative focus of research, it has established itself as a necessary and vital part of all other archaeologies (Trigger, 2006).

Gender can vary from culture to culture and cannot be assumed that women and men behaved in the same way in all societies; it suggests that the division of labor can be related to biological sex, but not determined by it (Johnson, 2010; Renfrew, 2012). Some feminists argue such "facts as men's upper body strength or women's role in child birth and infant care socially constructed" (Johnson, 2010: 234). Men cannot have babies and women cannot lift the weight that men can. Those jobs/tasks that can be done in conjunction with the rearing of children can determine the degree women can contribute to the subsistence of a particular society (Brown, 1970). Those jobs/tasks are ones that allow them to oversee the rearing of the children within the structure of the community, including food cultivation and preparation, textile production and other domestic chores.

The archaeology of gender is a theoretical method of investigation that studies ancient societies through the close examination of the roles played by women and men as demonstrated in the archaeological record of the past (Jesch, 2002). For this thesis, it is regarded as the study of activities/chores related to specific gender identities and artifacts, to wit, textile tools. With the majority of textile tools found in graves designated as female, an assumption can be made that the women were the main producers/craftspeople of textiles. Not only were textiles an important part of the domestic economy, but women of all social classes participated in the production of textiles. Textiles had economic value, were symbols of wealth, and were regularly used as gifts (Larsson Lovén, 2013).

Material Culture

Material culture looks at the relationship of people and things, the material objects that have been created and left behind by humans over the centuries, and the beliefs (values, ideas, attitudes, assumptions) of a particular community/society at a given time. The term "material culture" can also refer to the artifacts themselves or the body of material available for study (Prown, 1982). Material culture can be used with reasonable confidence to tell us about the technologies of the past. By examining those material objects left behind in settlements, graves and middens, archaeologists can make an interpretation of what a society/culture found valuable, what crafts were practiced in the society, and form opinions about trade through the statistical studies of artifacts (Johnson, 2010). By examining burial practices and the richness and/or poorness of a grave, material culture can indicate the status and/or ranking of an individual within their community.

The study of artifacts is only one way of understanding a culture, but in certain instances (pre-historic/non-literate) the objects a culture leaves behind is the only surviving evidence and can inform us about the cultural beliefs and structures of a given culture. Not only is this one of the fundamental purposes of material culture, but it also aspires to an objectivity that looks to overcome our own cultural biases (Prown, 1982).

With its richness of burial goods, monumental burial works, and extensive trade network(s), the Viking Age gives archaeologists the chance to study a society that has little in the way of contemporary written resources. The artifacts left behind by the Vikings allow us a look into their social structures, their beliefs and their craftsmanship that would otherwise have been lost.

By looking at the grave goods buried with individuals, researchers can develop a picture of who the person was during life, whether of high or low status, and possibly what livelihood they were involved in. In the graves from Gotland, we see a range of graves goods that were buried with the deceased, including possible indicators of craft production in the form of textile tools. Along with other indicators, such as jewelry specific to women of Gotland, we can postulate that during life that the woman was involved in some way in textile work.

Methodologies Used

The methodologies used in the process of writing this thesis were dependent on available resources, including the accessibility of the artifacts, the time consuming process of translation of literature, and the skills learned during the course of my masters' seminars that included a course in GIS.

Literature analysis and translation

The first methodology undertaken was the translation and collection of information and data from publications. Translations from specific sections of the literature provided information about the artifacts found in the excavation of the graves/sites discussed. This included the artifact counts, the material types of artifacts, and the location of the artifact in relation to the burial remains. Once that translation and counts were established, a list of artifacts was created and given to the museums where the artifacts are curated. The translation also provided context for the artifacts and counts established by the author. Once the list was given to the museum, it permitted the staff to pull the artifacts for data collection and analysis.

Collection of data of textile production tools

As part of my field research, two trips to Sweden were undertaken to gather data on the textile tools found in the graves/sites. The data includes statistics of artifacts – weight, diameter, height, material type and the location where the tool was found, photographic evidence, and comments on the physical status of the artifact. After the data was entered into an Excel spread sheet, numerous bar charts, scatter grams and pie charts were created using the data collected.

Spatial analysis of distribution of tools

A spatial analysis was undertaken with the use of ArcGIS to document the distribution of tools and graves/sites throughout the parishes of Gotland and generate maps that provide a visual context for interpretation. Information is downloaded into ArcMap that includes the counts of tools found in each parish (see figure 2.3) along with the graves counts, from which shapefiles can be created for each of the artifact types. Shapefiles spatially describe vector features: points, lines, and polygons, representing, for example, water wells, rivers, and lakes. A shapefile stores non-topological geometry and attribute information for the spatial features in a data set. The geometry for a feature is stored as a shape comprising a set of vector coordinates. The artifact attributes can then be geocoded and a map produced. Geocoding is the process of finding associated geographic coordinates from other geographic data, such as street addresses, or in this instance, graves and artifacts. With geographic coordinates the features can be mapped and entered into ArcMap. Maps can then be created, providing a visual representation of the distribution of the tools and graves. An interpretation can then be made from the maps as to the areas of potential craft production

Summary

The use of theory in understanding the past allows archaeologists to frame questions for their research and achieve a better understanding of past cultures and technologies. Numerous theoretical perspectives were used, but the main perspectives include cognitive archaeology, archaeology of gender and identity, and material culture. The methodologies used allow a detailed analysis of the information and tools available. The translation of literature provided the starting point for research, with data analysis and spatial analysis supplying methods for the interpretation of the data.

CHAPTER 4. THE TECHNOLOGY OF TEXTILES

Fiber, Tools, and Processes

This chapter is intended to be an introduction to the production of textiles and the tools and fibers used during the Viking period in Scandinavia. It outlines the collection and processing of the raw fibers, the process of generating yarn/thread, the production of textiles, and the tools and structures used in creating textiles.

Much of the information presented below has been accumulated over the decades as a weaver, spinner and fiber artist. I have included citations where I know precisely where the information came from but for much of this chapter, my skills and knowledge of the production of textiles has been amassed through the teachers and colleagues that have taught and passed on their knowledge of the textile arts to me and the hands-on skills I have developed over thirty years.

Raw Fiber

There are two types of natural fibers that were used during the Viking period in Scandinavia to make textiles: animal or protein fibers, which include wool from sheep and to a limited extent, silk, and plant or cellulose fibers and include flax (linen), hemp, and nettles. The majority of fibers collected and used were wool and flax. Although wool textiles have been found at numerous sites around Viking Age Scandinavia, linen does not survive the archaeological record in this area to the extent wool does. This can also be said for hemp and nettles (Andersson, 2003).

Collection and preparation of wool

The wool of a sheep comes in three different layers: the outer layer, which is the *kemp*, is very course, stiff and easily broken, a middle layer, the *hair*, which is long, course and stronger than the most inner layer, the *wool*, which is the finest and softest of the layers (Geiger, 1994). These layers would be separated and used for different types of textiles.

The collection of wool would be done by either gathering snagged bits from shrubbery or shearing the fleece from the animal directly. There is evidence from graves and settlement areas that shears were in use during this time and could have been used in this process (Carlsson, forth –coming; Thunmark-Nylén, 2006). Once the wool was collected it would first be washed to remove any debris that would collect on the animal and then be separated out into the distinctive types. The *hair* would be used where a strong thread was needed such as the warp of the textile, while the *wool* would be used where strength was not a primary factor, as in the weft. *Warp* is the term to describe the long threads in woven textiles, with *weft* referring to the cross way threads that are woven into the warp (figure 4.10). The *kemp* would be used for felting or other household items. A set of combs would be used to comb out the wool and separate the different types of wool (figure 4.1). The combs consist of long metal spikes set into a wooden board or cross piece and used together to comb out the fleece, causing the fibers to lie parallel. The longer *hairs* would be drawn out from the comb, leaving the shorter *wool* fibers. By combing out the fleece in this fashion, a *worsted* yarn could be spun, creating a very strong thread. The term *worsted* is used to describe a yarn that has the fibers going in the same direction or parallel. The hairs and wool would then be taken and spun into yarn that could be used

Flax collection and preparation

Flax (*Linum usitatissimum*) is the plant that the textile linen is created from. Flax has been cultivated for approximately eight to ten thousand years. Flax is thought to have been developed in the Mid-East (Barber, 1991) and was used for other domestic staples including seeds that could be ground for flour and oil, distilled for cooking, and used in lamps. Flax requires a good source of water but does not need nutrient rich soil to be sustained (Andersson, 2003). The plant grows to a two to three foot height and then can be harvested by pulling it from the ground by the roots.

Once the flax has been harvested, the seeds are removed by a process called rippling. The stalks are pulled through a comb like device that pulls the seed heads off the stalk. The flax stalks are then left to “ret” or rot. This process can be done either by placing the stalks in water and soaking until they begin to break down or spreading them out over the ground where they can absorb the natural moisture from the ground and dew that settles on them. After the stalks have been retted, the next step is to “break” the stalks with a wooden club which breaks the stem and bark that are separated from the fibers (Andersson, 2003). Once the stem and bark are removed from the fibers, these fibers are then “hackled” or combed using a tool that looks similar to wool combs (figure 4.1) with their long metal teeth. The hackling combs the fibers and helps to break them apart into strands that can be spun into yarn/thread.

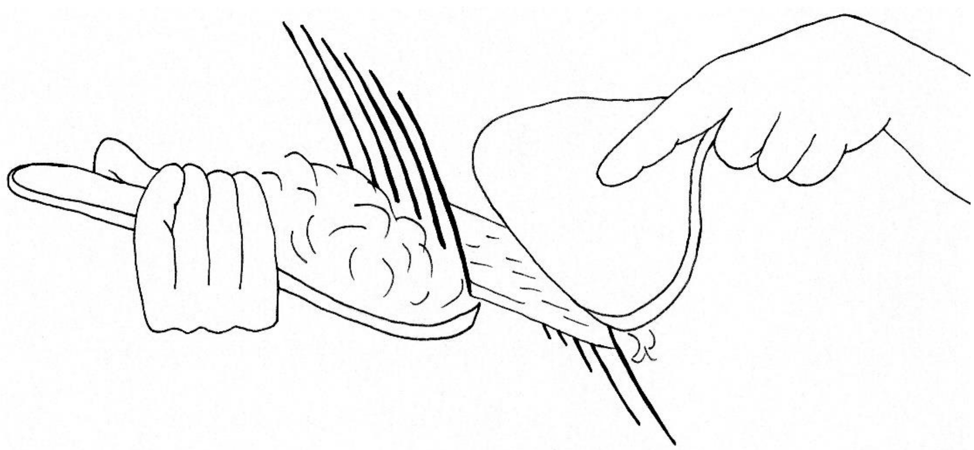

Figure 4.1 Wool being combed in preparation for spinning (after Andersson, 2003)

Hemp and nettles

Hemp (*Cannabis sativa*) and nettles (*Urtica dioica*), like flax, do not survive the archaeological record well in Northern Europe. It has been suggested that, unlike the flax plant, nettles and hemp were gathered wild and were not domesticated. There have been finds of hemp seeds from the Oseberg grave and Birka (Geijer, 1938). Both species were gathered and processed in similar ways to flax. Whether hemp and nettles were used in clothing or used just to make rope and other possible household items is not apparent in the archaeological record.

Silk

Although numerous pieces of silk cloth and thread have been found in the archaeological record in Scandinavia, silk would have been imported and used as luxury textiles (Andersson, 2003). Embroideries from the Oseberg burial and other small finds show that silk was used to denote status and wealth (Stine Ingstad, 1992).

Tools used in Textile production

The tools used in the production of textiles are as important as the textiles themselves. They allow humans to take fiber from an animal or plant and create clothing, household items, exchange/trade goods, and textiles used in the performance of social and religious ritual. Many of the tools uncovered in excavations were found in the graves of women, attesting to the importance of textile production and the skills needed to create them (Andersson, 2003; Barber, 1998). Some of the most common artifacts found include the spindle whorls, needles and looms weights, again stressing the constant and daily need to produce textiles for an ever growing global population.

Drop spindles and spindle whorls

The spindle whorl is only one part of the spindle or drop spindle, which is made up of the spindle whorl and a spindle. The spindle was the long, often wooden “stick” that was placed in the hole of the spindle whorl and was where the spun fiber was stored during the process of spinning it into yarn/thread (figure 4.2). Spindle whorls were usually made of stone, ceramic or bone but other less common materials used during the Viking period including glass, amber and bronze (Andersson, 2003). The spindle whorl acts as a weight on the spindle and helps to generate the inertia that allows the spinner to twist the fibers into a thread or yarn. A tool that was used along with the drop spindle was the distaff (figure 4.2). The distaff was used to hold the raw fiber in quantity which the spinner could draw from as she spun. It was usually made of wood and although we find examples of distaffs being used in scenes on pottery and in woodcuts, the artifact itself does not survive time.

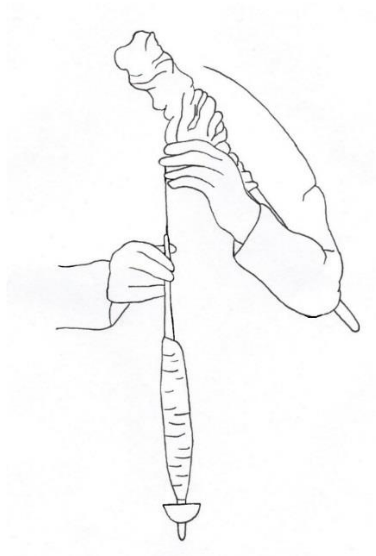

Figure 4.2 Illustration showing the use of spindle with whorl for spinning yarn/thread and distaff for storage of fiber.

Loom weights, looms and weaving battens or swords

Another common tool found in the archaeological record is the loom weight. These weights were used in conjunction with the warp weighted loom (figure 4.3) which, as with other wooden artifacts, are susceptible to the environment and do not survive. Loom weights have been found in sites throughout Scandinavia with examples found on Gotland dating to the Migration period (Stenberger, 1955) and are generally made of stone or clay. Loom weights can vary in size, weight and shape, depending on the textile being woven. The most common shapes found are the “doughnut” and pyramidical. The doughnut shaped ones, as the name infers, are round in shape with a large hole through the center that could be used to tie the excess warp to. The pyramidical weights have a flat bottom with the four sides coming up to a point at the top with a hole that would have a string threaded through where the warp could be tied off to. The warp weighted loom is used in a vertical position that allows the warp threads to hang down with the warp weights attached at the bottom. The weights keep tension on the warp which allows the weaver to raise and lower the threads, creating the structure of the textile. Depictions of the warp-weighted loom have been seen in Late Bronze Age Italy, dating to 14^{th} century BCE. The structure of the warp weighted loom is of a basic rectangle with two side supports and the cloth beam across the top that the woven textile could be wound on to and a lower beam that would support the weights. A warp-weighted loom in the Oseberg burial is thought to have been approximately one and a half meters tall (Stine Ingstad, 1992). Any excess warp would be suspended from the weights and as the textile was woven could be extended to allow the weaver to continue weaving. Heddle bars were used to create the structure of the textile and when threading several of these with warp could be used to create patterns in the textile. The heddle bars would have loops of string tied to them that would have the warp inserted through in different sequences permitting the weaver to create different patterns by the lowering and raising the heddle bar(s).

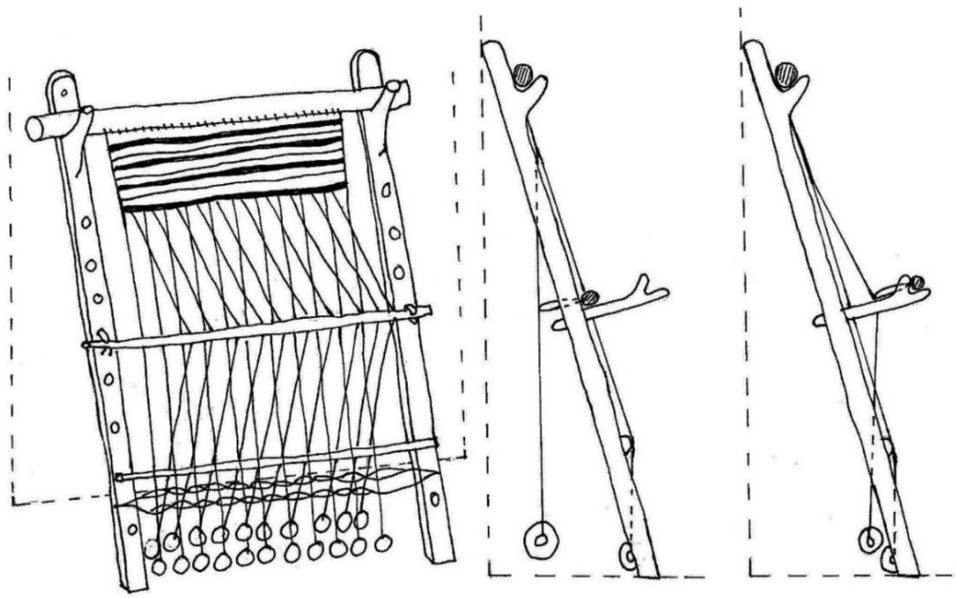

Figure 4.3 Warp weighted loom, show the natural shed (left side view) and alternating shed raised (right side view) (after Andersson, 2003)

A tool used in conjunction with the warp weighted loom is the weaving batten or "sword". This tool was a long sword shaped piece that helped the weaver "beat" the weft up into place. Examples from the late Iron Age suggest that weaving battens could have been made from wood, bone or iron (Andersson, 2003) and have been found in women's graves in Norway (Petersen, 1951). The batten would be inserted into the warp after the weft had been passed through and the weaver would "beat" the weft up into place.

The tube loom or vertical tube loom was an upright loom that, instead of having weights at the bottom, had a beam that allowed the warp to be stretched between the two beams in a "C" shape that created a textile with four finished edges or selvages. The earliest representation of the tube loom is found in Egypt dating to the New Kingdom (sixteenth through eleventh centuries, BCE) (Barber, 1998). Examples have also been found in Viking Age burials including the Oseberg burial (Stine Ingstad, 1992). For

Viking Age Scandinavia the warping process of the tube loom started with the passing of the warp around a rod that marks the end of the warp from one side, passing around first one beam then over the second beam and looping around a second end warp rod. The warp would then be taken back in the reverse direction, continuing the sequence until the warp was the width the weaver desired (figure 4.4).

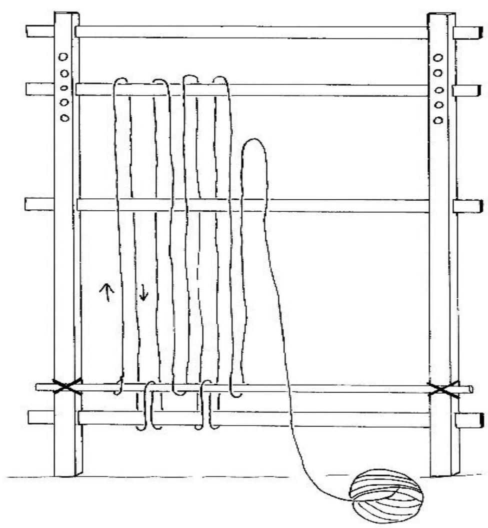

Figure 4.4 Illustration of vertical or "tube” loom. (After Crowfoot, 1979)

Weaving tablets

Weaving tablets are square, flat pieces of bone, wood or antler and were used to create a small band of textile that could be used for trim, belting or other decoration on clothing or household textiles. The average size of the tablet is approximately 2.5 centimeters square and would have small holes drilled into each of the corners (figure 4.4). Examples found in the Oseberg burial included tablets that had eight holes (Stine Ingstad, 1992). Surviving bands dating to 6,000 BCE are direct evidence that people have been using this technology for thousands of years. The tablet band could have been woven on a small loom as seen in the Oseberg burial (Stine Ingstad, 1992) or suspended from a hook with weights to control the tension (figure 4.6) (Andersson, 2003).

Each of the holes would have a thread passed through that would allow the weaver to create patterns in the band. The yarn would be suspended from a protrusion on the wall or upright beam with small clay or stone weights at the bottom to create tension. The weaver would rotate the cards to change the threads, creating different pattern design in the woven band.

Weaving tablets would have also been used in the creation of a “header” band for the warp-weighted loom. Examples of this header band can be found in extant textiles from Denmark dating to the mid Iron Age (Hald, 1980). Other tools used in textile production

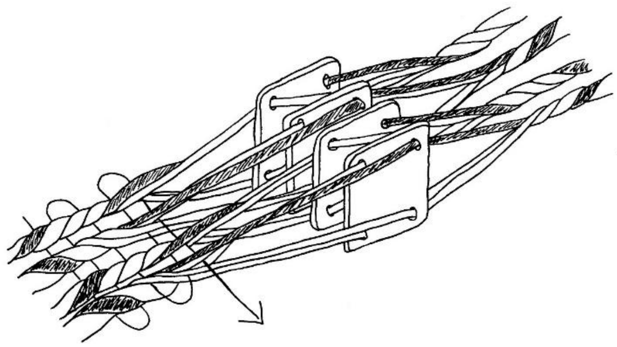

Figure 4.5. Illustration of weaving tablets showing warping, weft and structure created. (after Ræder Knudsen, 2000)

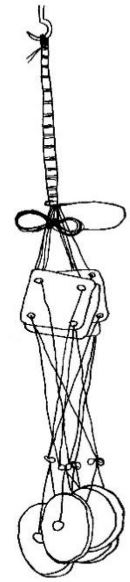

Figure 4.6 Illustration of use of weights for tablet weaving (after Andersson, 2003)

Other tools found in settlement and graves sites include wool combs, flax clubs, flax hackles, and reel winder or modernly “kniddy-knoddys”. Wool combs are used in a set of two and would be made from wood and iron. The upright iron tines would be set into a piece of wood, usually with one or two rows of the iron tines, with a handle off one side for the comber to hold (figure 4.2).

A flax club is a tool made from wood and was used to break down the stem and bark, separating it from the fiber core of the flax stalk (Stine Ingstad, 1992). The hackle was used to “comb” the inner fibers in preparation for spinning. Similar to the wool combs the hackle was a brush-like tool that the harvested flax would be pulled through to break the two inner layers apart. This would produce the courser “tow” linen and could be used for cordage and other utilitarian purposes and the finer inner layer that would be used for clothing and bed linens.

The reel winder or “kniddy-knoddy” was used to unwind the spun yarn/thread and create a skein that could be stored or dampened and suspended to set the spin in the fiber. Kniddy-knoddy is the modern term used by textile artists and consists of a center arm with two pieces attached at either end perpendicular to the center piece (figure 4.6). Examples of this tool were included in the textiles tools found the Oseberg burial (Stine Ingstad, 1992).

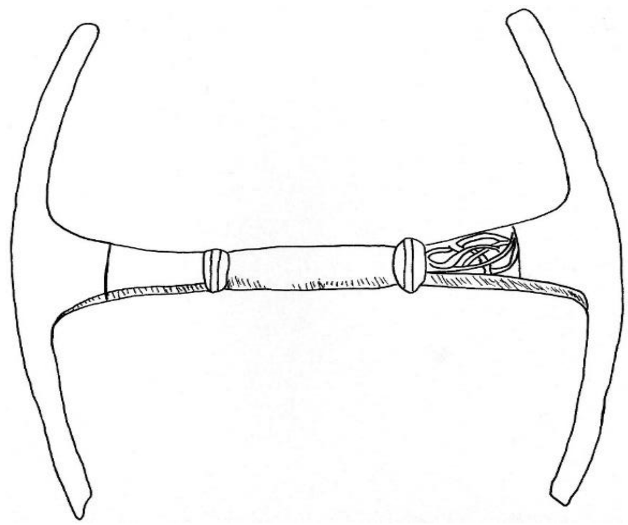

Figure 4.7 A reel winder or kniddy-knoddy. Finished yarn would be wound around the cross pieces to create a skein for later use. (after Stine Ingstad, 1992)

Needles and needle cases

Although needles and needle cases are not used in the process of spinning and weaving textiles, many textile archaeologists include them in their analysis and discussion. Needles were used in the construction and finishing of textile goods when sewing the fabric to make clothing, sails and household items. The needle cases kept the needles in close proximity to the owner and allowed her to have needle and thread at hand for the construction or repair of clothing and other household items. Needles and needle cases found in Viking Age graves on Gotland were made out of bone and bronze. Needles would vary in size according to what being sewn and the structure and weight of the textile was being used to create the item. The needle cases found in the gravesites would often have needles stored inside along with a small piece of mineralized textile that would have been used to keep the needle from falling out of the case.

Figure 4.8 Examples of bronze and bone needle cases from graves. (Klessig, 2011; Fuller, 2013)

Figure 4.9 Examples bronze and bone needles from graves (Klessig, 2011)

The Processes of Textile Production

The process of creating textiles, whether to clothe a body, make a sail, or for use in the household was a time consuming endeavor. The steps needed to create textiles include the raising and collection of the raw fibers, the processing of the raw fibers for spinning, spinning the fibers into a thread or yarn, and weaving the thread/yarn into cloth.

Preparing the Raw Fiber

In preparing the raw fiber for spinning, numerous steps are taken and the process can take considerable time and effort. Wool and flax require different procedures and time allotment to prepare them for spinning.

Once the wool has been collected from the animal, whether plucked or sheared, the process of cleaning, sorting and combing or carding starts with what spinners refer to as “skirting”. The fleece is laid out and the larger debris is removed by hand. The fleece can then be washed, sorted and combed into roving. During the combing process, the fleece can be sorted into the different weights of wool and be spun for the different purposes best suited for the weight. The roving is wool that has been formed into a roll or coil that can be spun directly from. This process can be done two to three times a year, depending on the breed of sheep. Although, there is discussion about the evidence of whether sheep were being used on Gotland for wool, today's Gotland sheep produce a wool that is more suited to the creation of heavier outerwear or possibly sails rather than finer woven cloth seen in the remnants of mineralized textiles found in the grave sites of Viking age women and men.

The preparation of flax for textile production is a lengthy process that starts with the planting and harvesting of the plant. Once the plant has matured, it is pulled by the roots from the ground and the seeds are harvested from the stalks. The stalks are set to "ret" or rot, breaking down the outer bark and inner strands. This allows moisture to be introduced into the plant, dissolving the pectin between the fiber bunches within the bark and stem (Andersson, 2003). Once the retting process is complete, the stalks are then broken down with a flax club and raked through flax hackles, producing fine strands of fiber that will be spun into thread or yarn.

Spinning, Plying and Dyeing

During the Viking Period, the spindle or drop spindle was the most common tool used in the process of spinning. The spindle could be used either with or without a spindle whorl. Depending on the type of yarn a spinner wanted to create, the spindle whorl could be placed at either the top of the spindle or at the bottom (figure 4.2). A drop spindle with the whorl at the top would usually be supported on the leg or thigh and rolled downwards with the palm of the hand. Once in motion, the spindle can be released and allowed to spin freely or supported. As the spindle is rotating, the spinner would draw out the fibers or “draft” while controlling the spin and thickness of the yarn being created. Drafting is the term used to draw the fibers out and twist them into a single strand of thread or yarn (Østergård, 2004). With the whorl at the bottom of the spindle, the spinner would grasp the spindle by the bottom and with a quick snap would set the spindle into motion, drafting out the fiber as the spindle was suspended.

When the fiber has been spun, it is described as either having a “Z” twist or “S” twist to the yarn. A “Z” twist is spun clockwise with an “S” twist being spun counter-clockwise (figure 4.9). When the spindle is full, the yarn is removed by winding onto a tool used to make a skein of yarn known as a reel or “kniddy-knoddy”. This tool would allow the spinner to remove the yarn from the spindle while creating a long circular skein that would be dampened and hung to dry, allowing the spin to be set into the fiber. The yarn could also be “plied” together to create a thicker stronger yarn. “Plying” was done by taking two threads and twisting them together, usually in the opposite direction than the original spinning (Gleba, Mannering, 2012).

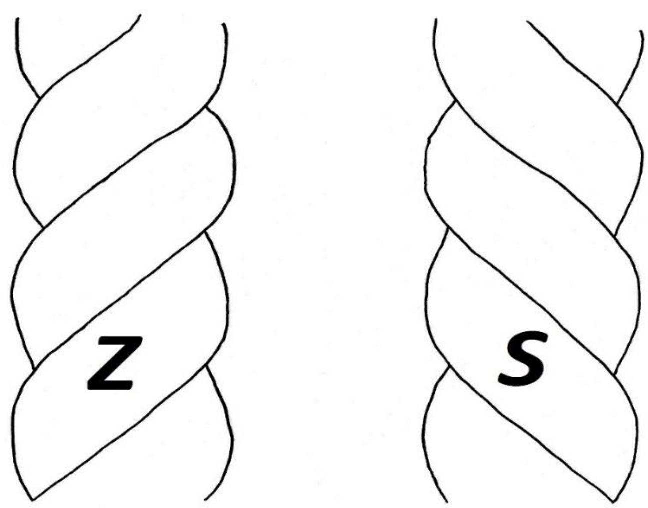

Figure 4.10 Z twist (clockwise) and S twist (counter clockwise) (Klessig, 2014)

The size and weight of the yarn being spun depended on the weight and diameter of the drop spindle. Heavier whorls would be used to create thicker yarns that could have been used in the creation of sails, blankets and other household items.

Weaving and Structures

Once the yarn/thread was spun, the process of weaving the yarn/thread into cloth could begin. The process of weaving includes measuring the warp, threading the warp to the loom and weaving with the weft to complete the cloth.

Measuring the warp

To measure a warp, some form of peg system would be set up that would allow the weaver to measure the warp with accuracy and keep the thread at a uniform length. The weaver would determine how wide and how long she wanted the woven piece to be and would set the pegs at the length she desired. Archaeological evidence showing a funerary model of textile workers standing at pegs in the wall measuring a warp that dates to the 11th Dynasty in Egypt (Barber, 1991). The weaver would need to determine how many threads needed to be set per centimeter by the size of the yarn/tread she was using, the larger the yarn the less threads per centimeter.

Measuring the warp could also include weaving a tablet “header” band that included the warp as the weft. The weaver would set up several weaving tablets with warp the approximate width of the top beam of the warp weighted loom and by passing a long loop through the turning tablets, pulling the loop through to the desired length. Once completed, the “header” band could be attached to the top beam of the warp-weighted loom. The warp could then be threaded through the string heddles and then weighted with loom weights for tension (figure 4.3). Evidence of this type of warp header was found in the Oseberg burial showing the tablet woven band with bundles of the warp hanging from it (Stine Ingstad, 1992).

The warping of the vertical tube loom has a process that differs from the warp-weighted loom in that the weaver was able to measure the warp directly onto the loom. The warp was passed around rods that marked the beginning and end of the woven piece. By passing the warp over a beginning rod, around the top and bottom beams and then around the second end rod, the weaver would then reverse the process, continuing until the warp was at the width and thread count desired. This created a continuous warp that permitted the weaver to produce a woven cloth with finished (selvages) edges on all four sides of the completed piece.

Weaving – over, under, over, under

Once the warp was measured, placed on the loom and the heddles threaded the actual weaving process could begin. The basic process of weaving takes flexible fibers and creates textiles that can be manufactured into numerous products. Weaving is defined here as two thread systems crossing each other at right angles (Andersson, 2003). The terms used to describe the two thread systems are warp and weft. The warp is the longer threads of a textile and is placed parallel to the side of the loom and kept taut during the weaving. The weft is the shorter threads that crosses the warp and runs alternately over and under through the warp threads (Andersson, 2003) for producing different grades of textiles.

To weave on the warp weighted loom, the loom must be placed against a vertical surface in an upright position, usually at a slight angle, allowing the warp weights to hang at the bottom. Weaving would start at the top of the loom with the weaver standing in front of the loom, passing a shuttle under a set of raised threads that created what is called the “shed” in modern weaving terms. In ethnographic accounts, weavers are shown, when first starting a project on the warp-weighted loom, as standing on a stool to be able to reach the top of the warp (Hoffman, 1964). The shed is created by raising and lowering of the heddle bars and is how the pattern work in a structure is created (see figure 4.3). The shuttle is a long piece of wood or bone that the weft yarn/thread can be wrapped around, giving the weaver a solid object to pass through the shed, making the task easier that working the loose weft through the shed. Numerous depictions of warp-weighted looms show the set-up and actions of the weaver passing the weft back and forth, sometimes with two or more weavers working on a loom.

Once the weft has been passed through the shed, the heddle bar(s) can be lowered and the weaver can then “beat” the weft into place with a weaving batten. At this time, different heddle bars can be raised or lowered creating a new shed that would produce a patterned structure to the textile. As the weaver progressed down the warp, the cloth is rolled up on the cloth (top) beam. This process is repeated, sometimes in different sequences depending on the pattern, until the warp has been completely woven.

Structures and patterns found in Viking Age textiles

The structures and patterns found in surviving textiles and the mineralized impressions of textiles from the Viking period show a broad range of skill sets and techniques. These small pieces of the past allow us to analyze a particular structure and pattern created, not only gaining a better insight into the abilities of the craft person creating the textiles, but also the importance of the craft of producing textiles for different uses in a given society.

The structure of a textile is determined in several ways including how fine or course the yarn/thread is, whether the yarn/thread is tightly spun, whether the thread has an S-twist or Z-twist, and the weaving technique and pattern used.

The fineness or coarseness of a thread can determine what the thread will be used for. Finer thread would most likely be used for clothing whereas the courser thread could have been used for household items such as blankets, wall hangings and possibly used for the construction of sails. The thickness of a yarn/thread can also determine how many threads per centimeter the textile would be woven at. The thread per centimeter looks at how many threads are woven into a textile by counting them both vertically and horizontally. A balanced weave will have the same count in both the warp and the weft (i.e. 12 threads vertically and 12 threads horizontally). In an unbalanced weave, these thread counts will be unequal, such as 10 threads vertically with 20 thread horizontally. An unbalanced weave can also change the structure of a weave by allowing either the warp thread or the weft thread to become more predominate, creating a “warp-faced” or “weft-faced” weave.

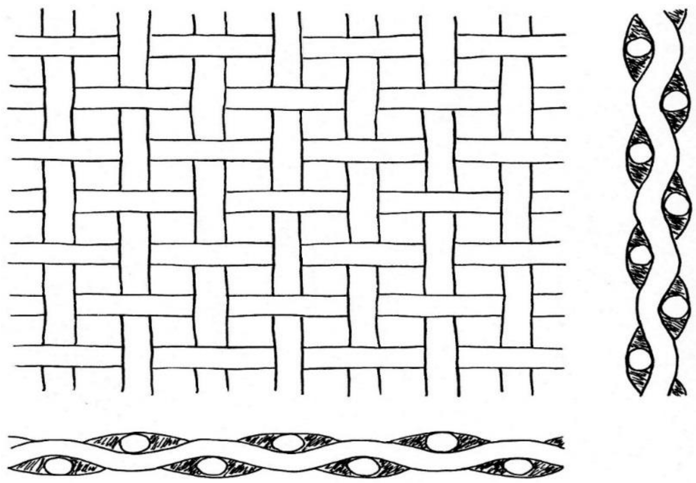

Figure 4.11 Structure of basic tabby weave.

The spin of a yarn/thread, whether spun tightly or loosely, will determine how the yarn will be used. If spun too loosely, the yarn would not be suitable for the warp, which has to support the weights at the bottom of the loom. If spun to tightly, the yarn can cause the finished textile to pucker, creating a bump effect similar to “seersucker”.

Weaving Patterns

Although much of the techniques and tools used to produce textiles during the Viking period are considered primitive to many, the patterns created were varied and well-constructed. Many of the extant textiles and mineralized impressions left in settlement sites and burials show a diverse range of patterns that include tabby, basket-weaves, twills, and brocades (figure 4.11) (Bender Jørgensen, 1986).

The simplest of these patterns is the tabby weave, creating a basic over-under-over-under structure. The tabby is the basic for all other patterns and was probably the first to be produced. Similar to the tabby are the basket and half-basket weaves. The half basket creates a pattern of two threads over and two threads under with one weft thread going back and forth. The basket weave is a balance weave with two weft threads being passed over two and under two warp threads.

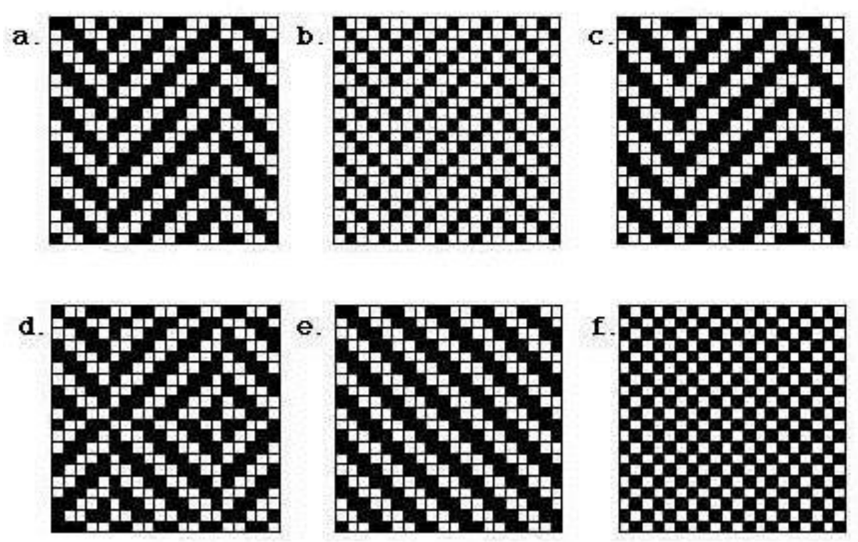

Figure 4.12 Some of the different structures of weave found in Viking Age Textiles – a) broken 2/2 twill, b) 2/1 chevron twill c)2/2 chevron twill, d) 2/2 diamond twill, e) 2/2 twill , f) tabby (after Bender Jorgensen, 1988)

Twills and brocades are achieved by threading the yarn in different sequences through the heddle strings. Two of the basic twill patterns found in textiles from the Viking period are the 2/1 and 2/2 twills. Both these twills have similar threading sequences but differ in how many heddle rods need to be used. The 2/1 twill is created by passing the weft thread over 2 threads and under one. Each subsequent change of the warp threads and pass of the weft thread creates a diagonal pattern that resembles stairs when examined closely. The 2/2 twill is created by passing the weft thread over two threads and under two threads, with each following change of warp and pass of weft creating a diagonal pattern similar to the 2/1 twill. The difference is how the yarn is threaded, as the 2/2 twill would require the use of one more heddle rod.

Other, more complex, twills that have been found are the broken and chevron twills, diamond and broken diamond twills, satin weaves, and brocades. These patterns are accomplished by a more intricate threading and shed process and, when found in archaeological context, considered more elite as they took more time to produce (Bender Jørgensen, 1992).

Tablet-weaving

The process of band weaving, or tablet weaving, produced smaller width pieces of textiles that could have been used for belts, leg wrappings and adornment for garments (Bender Jørgensen, 1992). Tablet weaving allows the weaver to create intricate patterns by turning the weaving tablets in different sequences (figures 4.4-4.5). The weaver could also include different colors of yarns that would produce complex designs.

Summary

The process of creating textiles is a time and energy consuming task that has numerous stages. The growing and gathering of the fiber could take several seasons and was labor intensive, with the pulling of the plant or the shearing/gathering of the wool. Once the fiber was gathered, the process of cleaning and separating the usable parts from the unusable would take place. With the task of cleaning and separating completed, the fiber was ready to be combed and spun into thread/yarn. The thread/yarn would then be measured to create the warp and placed on the loom. The process of weaving could finally begin. Weaving involves the placing of the weft through and around the warp in a structure of over, under, over, under. This structure can also be manipulated to create pattern in the weaving such as twills, brocades, and tapestries. The tools used in textile production are critical in understanding how textiles were created. By collecting data from the surviving tools, an interpretation can be made on the types of yarn/threads produced and the weaving structures.

CHAPTER 5. INVESTIGATION, ANALYSIS, AND DISTRIBUTION

The documentation and analysis of textile production tools is a growing factor in understanding the manufacturing of textiles. By collecting and analyzing data from tools found in settlement and grave sites, researchers gain insight into the quantity and quality of textiles produced (Andersson, 2003). This chapter looks at the tools found in the Viking Age graves of Gotland and presents the methodologies used in three sections. The first section documents the process of literary analysis and investigation of the tools documented in Lena Thunmark-Nylén's volumes *Der Wikingerzeit Gotlands* published from 1995 to 2006. The next section discusses the collection and analysis of data from the tools themselves. The third part of the analysis examines the spatial distribution of the tools using ArcMap by creating maps that illustrate the spatial distribution throughout the parishes of Gotland of tools and graves.

Literary Analysis and Translation

Lena Thunmark-Nylén's *Der Wikingerzeit Gotlands* (1996-2006) is a four volume publication that documents graves from the Viking Age on Gotland that were excavated from the 1930s to the 1960s. These are organized into two text volumes, two photographic volumes and one catalog volume. As there was little in the way of publications documenting excavated settlement areas on Gotland, I choose to begin with

Thunmark-Nylén's publications as these were organized in a manner that allowed me to segregate the textile tools from the rest of the artifacts documented.

In the catalog volume, Thunmark-Nylén provides type-find lists of the artifacts from all 1100 graves/sites with counts of each of the artifacts types organized by parish and site/grave number. A translation of Thunmark-Nylén's chapter 31, *Textilhandwerk*, in Volume III was undertaken. She discusses the tools found along with context information, categorization of tools, shape and material, and the number of each tool found (Klessig and Gabriel, 2012). The tools documented in the graves include spindle whorls, weaving tablets, needles and needle cases. Also included are shears, two smoothing stones, and one loom weight, but with their small numbers, they are not included in the current study.

Table 5.1 – Breakdown of spindle whorl material type per Thunmark-Nylén, 1996. Numbers are approximate.

Whorl type	Count	Stone	Bone	Amber	Bronze	other
Type 1	50		50			
Type 2	100	80	2	14	1	1
Type 3	6	1		1	3	1 (antler)

Approximately 199 spindle whorls were documented by Thunmark-Nylén. Of these about 156 were categorized into three types with the remainder listed as undetermined (table 5.1). Type 1 is dome shaped made from the sawed off joint head of animal bone, usually from cow or pig. Approximately 50 whorls are included in this category. Type 2 is also domed shaped and include approximately 100 whorls made of various materials, the most common material stone. Approximately 14 whorls were made of amber, with a few made from bone/antler and one of bronze. Type 3 are disc shaped with approximately six specimens documented with three made of bronze, and one each of antler, stone and amber. Thunmark-Nylén mentions that occasionally the dating of the spindle whorls to the Viking Age is in doubt as context is missing from the documentation.

There were 15-20 weaving tablets documented, found in both the graves and cultural deposits. All but one are made of antler with the single specimen being made from bronze sheet. One has runes carved into it and several show wear marks at the hole where the yarn/thread would have been fed through when getting ready to weave.

There were approximately 80 needle cases recorded with most coming from the graves. Thunmark-Nylén breaks down the cases into three types. Type 1 cases are made of bone, with approximately 20 of this type recorded. Type 2 consists of bronze cases, with approximately 20 of this type, have been created by rolling a sheet of bronze into a tube and then attaching a band around the tube with a ring to attach to a chain or string that can be suspended. Roughly 40 of type 3 were documented and are similar to type 2 but instead of a ring for suspension, the attached band is formed with a “bulge” to pass a chain or string through. Fifty to 60 loose needles were also documented with most of them coming from cultural deposits from archaeological sites. The needle cases and needles are discussed only briefly as they are not usually part of the textile production process. Other tools included include shears, a loom weight and glass smoothing stones.

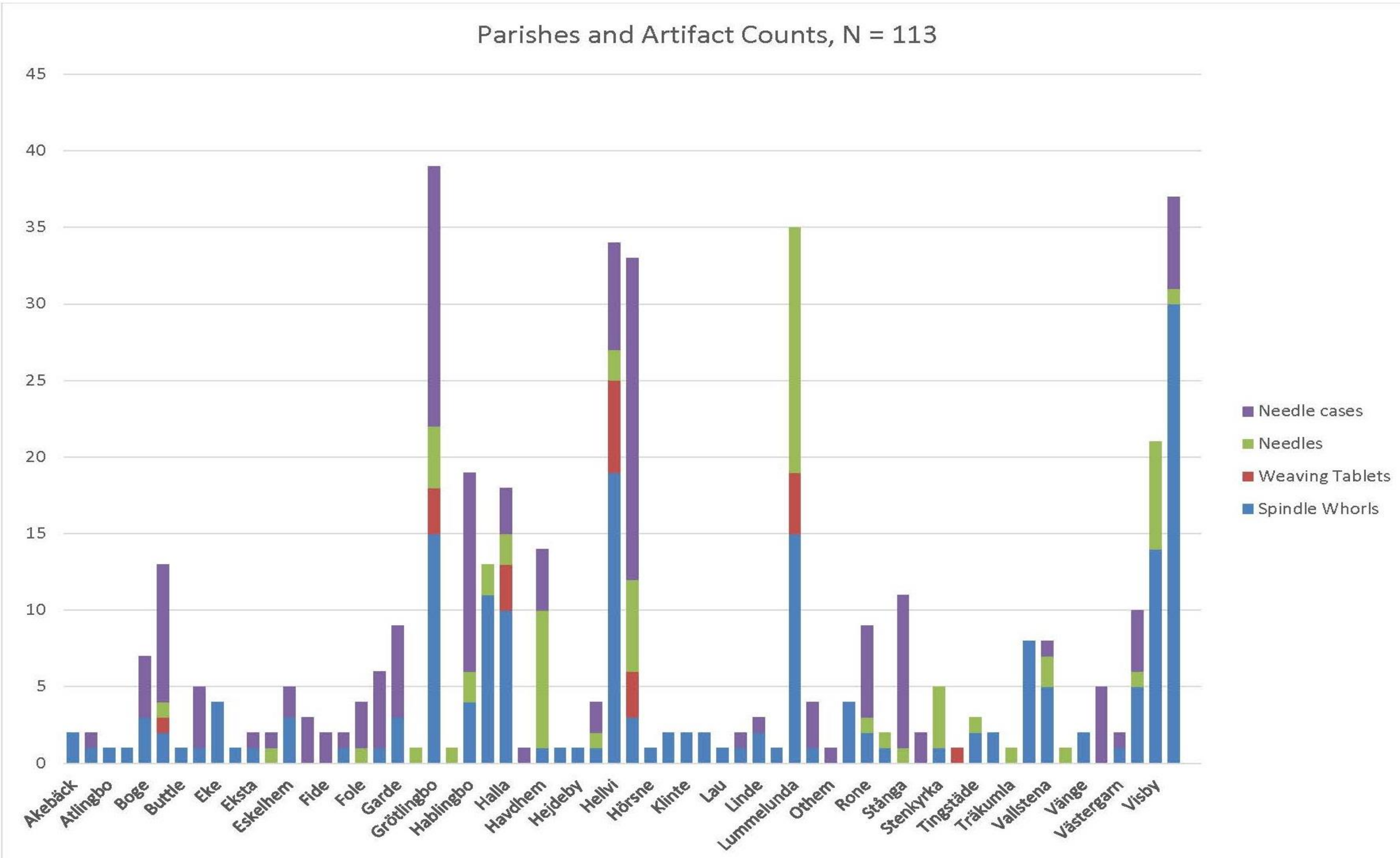

Figure 5.1. Chart showing distribution of textile tools in 61 parishes, and the general category of Gotland. (After Thunmark-Nylén, 2006)

Due to their low numbers shears, loom weight and glass smoothing stone will not be discussed here.

Collection of Data

The collection of data took place on two trips to Sweden in 2011 and 2013. Working with the State Historical Museum in Stockholm and the Gotland Fornsal Museum in Visby, data was collected using the template from the Center for Textile Research, University of Copenhagen registration system and will be added to the data bank of textile tools. Data was collected on spindle whorls, weaving tablets, and to a limited extent, needles and needle cases. Data was also collected on the one partial loom weight and a glass smoothing stone. These artifacts will be discussed briefly towards the end.

Spindle whorls

The collection of data from textile tool artifacts can help to determine the type of textile being produced. The diameter, shape, weight, height and material of a spindle whorl affect the type of textile being spun (Verhecken, 2009). The heavier and larger the spindle whorl the heavier the yarn/thread produced. The diameter and height influences the degree of the spin or twist of the yarn/thread. A higher twist yarn/thread would be used for the warp of a textile, as it would be able to sustain the weights the kept the tension on the warp. A lower twist yarn would be used for the weft of the textile as it would be unable to support the loom weights. The data can also be used to compare the different tools which would help in the determination of what type of yarn/threads/textiles were being produced. Spindle whorls on the lighter and smaller side would be used in finer textiles including those for richer clothing and for the production of tablet-woven bands that would be added to garments and might have been considered luxury goods.

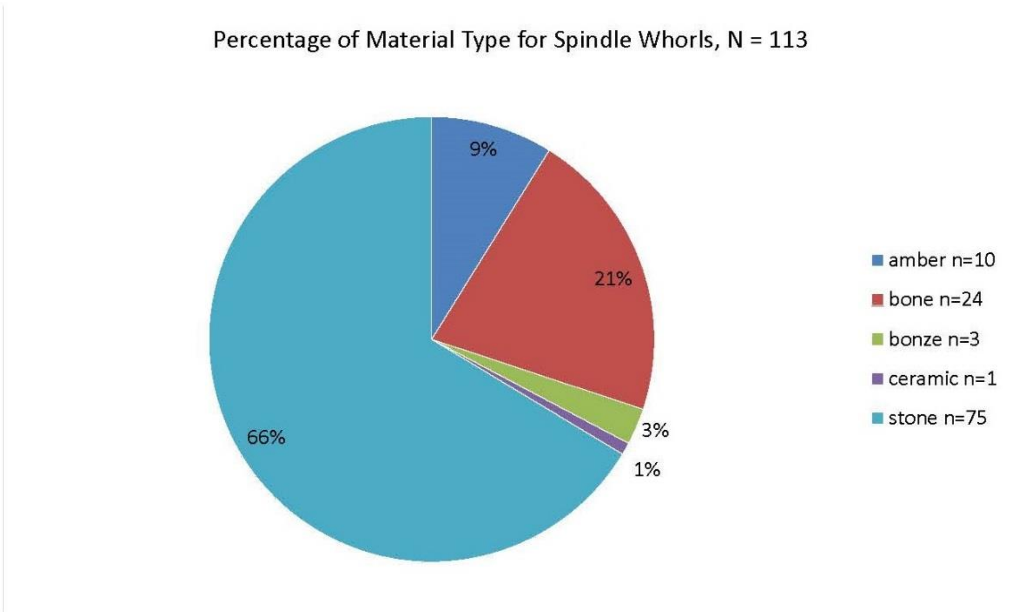

Figure 5.2. Chart showing percentage of material types for spindle whorls.

Out of the approximately 199 spindle whorls documented by Thunmark-Nylén data was collected on 110 spindle whorls from the graves/sites and 3 from the settlement area of Paviken for comparison. Whorls not documented in this thesis were either in conservation or the staff of the museums was unable to find the artifacts. The whorls were from 37 parishes, the city of Visby, and the general category of Gotland. Most of the whorls are regarded as from women's graves, but details were not given by Thunmark-Nylén. The whorls are broken down into material type with 67% (n= 75) created from stone, 23% (n=22) of bone, 10% of amber (n=11), 4% (n=3) bronze and less than 1% (n=1) of ceramic (fig. 5.2). The stone whorls are of indigenous stone and are made of a large variety of rock types (Thunmark-Nylén, 1996).

Data from three whorls not documented by Thunmark-Nylén are from the recent excavations of the settlement at Paviken by Gotland University and located south of the modern city of Visby. The data was collected as they represent settlement area and date to approximately the Late Viking Age / Early Middle Ages (personal communication, Christoph Kilger, 2013). These are included to provide a comparison that illustrates how the settlement and grave whorls are of common size, structure and material, and the possibility of the grave whorls having been used and were not just ritual grave goods.

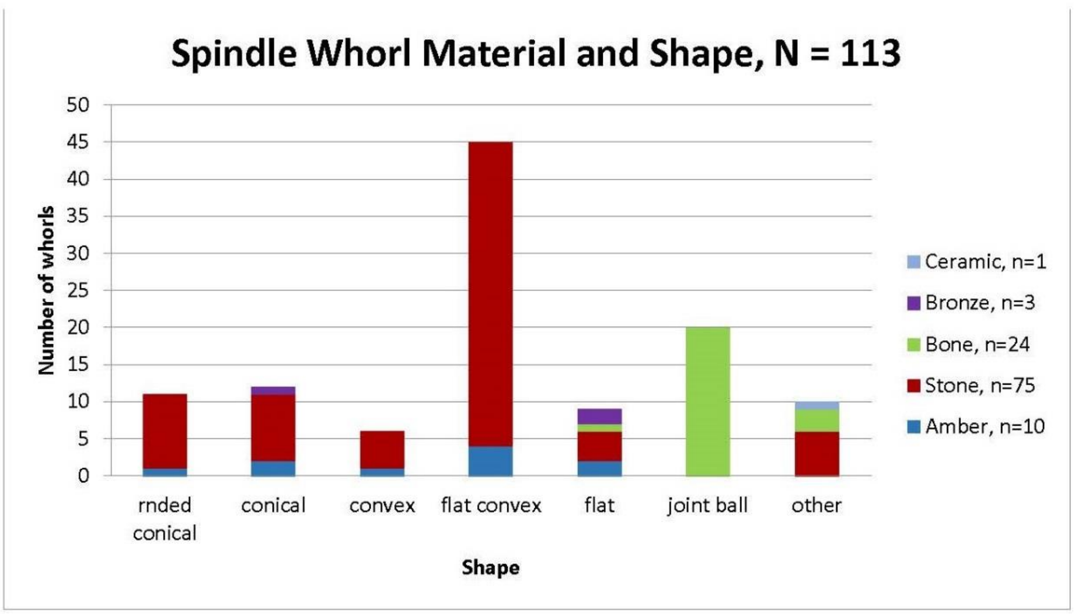

Figure 5.3. Bar chart showing breakdown of whorl types used in CTR registration data base, with added categories of other and joint ball. (Andersson, et al., 2011)

Two categories were added to the classification process – other and joint ball. The other category includes whorls that are either too degraded to make an assumption about or are of a shape that did not truly fit into any of the other categories. Joint ball whorls were categorized separately as they are fairly uniform and made from a single material type. The shape was determined on the 113 whorls, with the breakdown of whorl types showing 42% (N=47) were conical, convex and cylindrical each made up 11% (N=13, N=12, respectfully), 5% (N=6) were spherical, and three categories – lenticular, discoid and other (N=4, N=5, N=4) – each made up 4% of the types recorded (Figure 5.4). No whorls were recorded in the two categories of biconical and concave conical. Joint ball whorls make up 19% (N = 22) of the total whorl types.

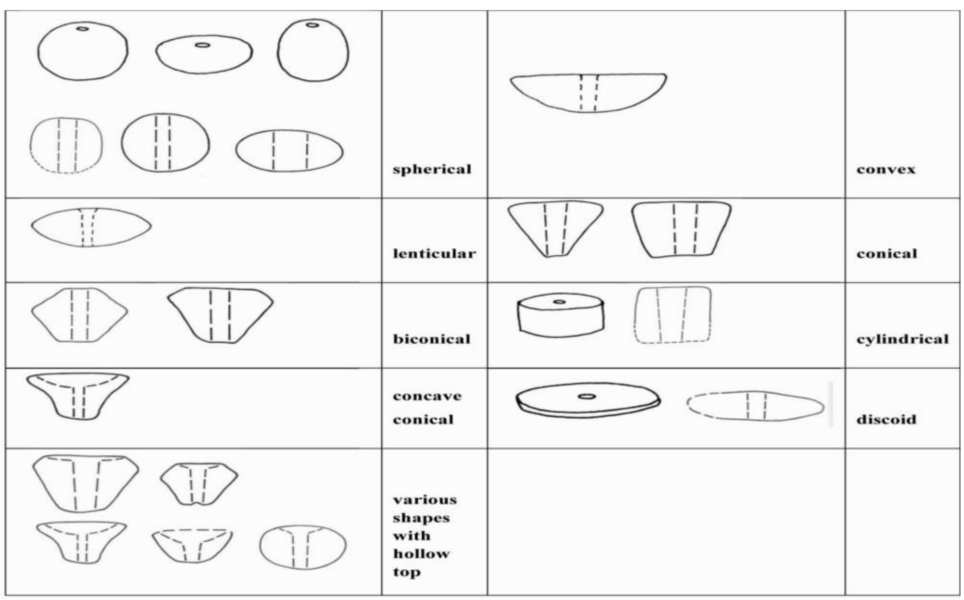

Figure 5.4 Illustration showing the categories of spindle whorl types used in recording tools, excluding 2 categories of other and joint ball for the Center for Textile Research, University of Copenhagen, Denmark. Used with permission (Andersson, et al., 2011)

In certain material types the shape of the whorl could be considered pre-determined (Andersson, 2003). Those whorls made from the joint balls of animals are limited to shape, size and weight. Whorls made of stone have a wide variance, depending on the type of stone used.

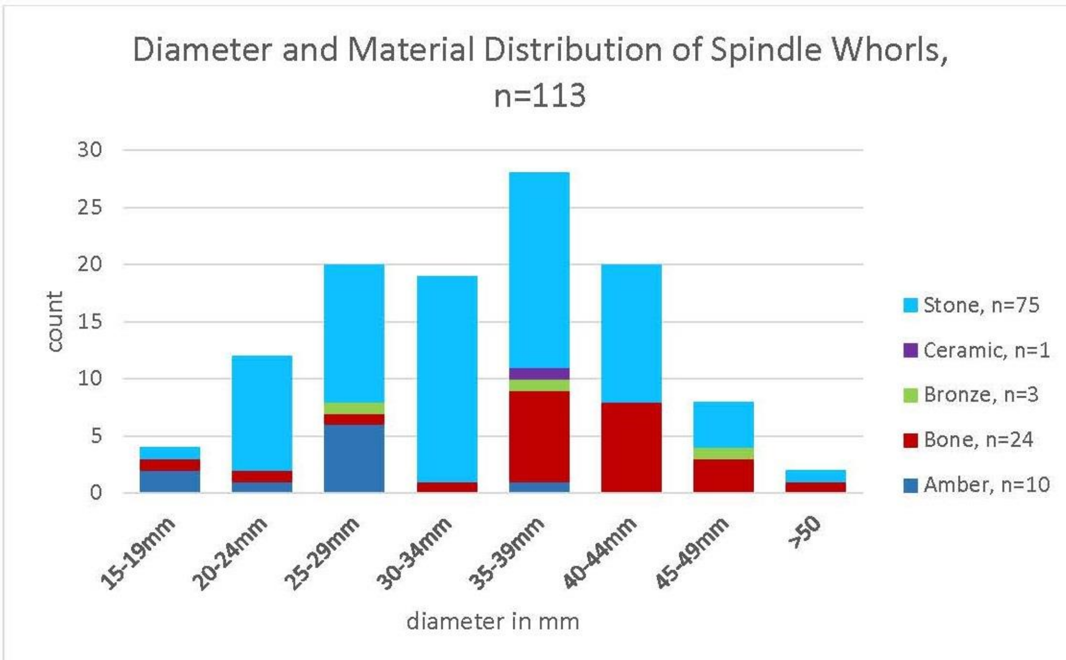

Figure 5.5. Distribution of whorl diameter to material.

Weight and diameter data

The weight was collected on the whole and partial whorls. Estimates were made on those whorls that were classified as just having small fragments missing and are included in the chart below. Those classified as partial (n=10) are not included as it would be difficult to estimate the weight with such a small percentage of the whorl. Of the 103 whorls represented in the chart below, the most common weights are between 10 and 54 grams representing 69% (n= 71) of the data collected. Of the whorls in this range, 49% (n=50) of them are of stone. Out of the 75 stone whorls 71% are in this weight range. The thirteen stone spindle whorls that are less than 10 grams look as though they have deteriorated over time and could have weighed more when originally created. All amber whorls that weight less than 20 grams were possibly used for lighter, finer, worsted weight spinning. All amber whorls can be considered complete, with at least 80% of the whorl in tact, and have a few nicks and abrasions that could indicate use wear.

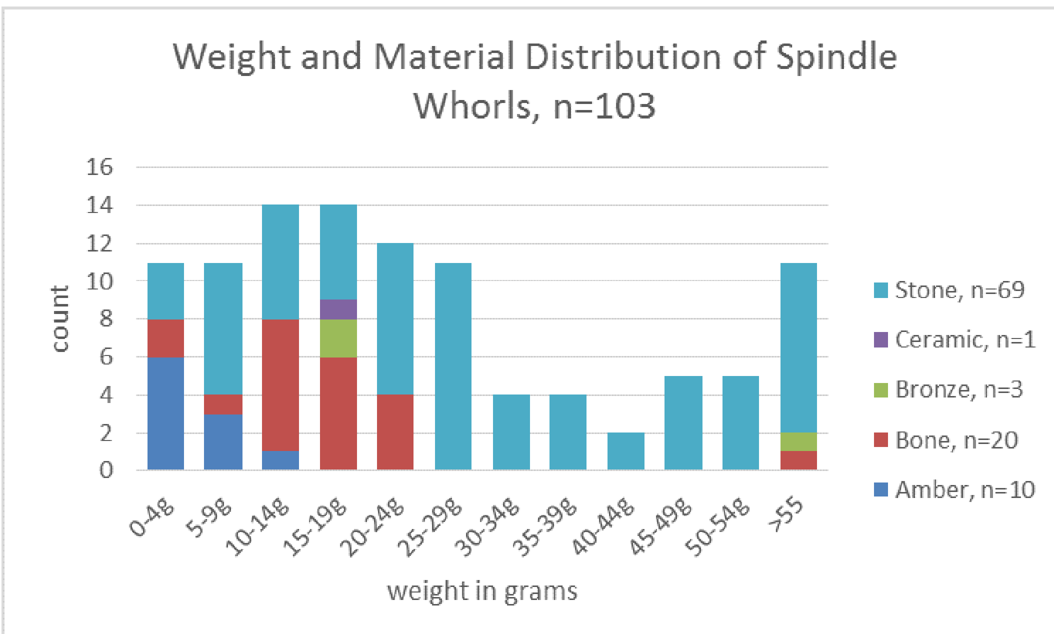

Figure 5.6. Distribution of whorl weight to material type.

The distribution of the weight of the whorls indicate the possibility of a large variety of yarn thicknesses that were being spun. With the different shapes, it is possible to have taken 2 whorls and place them on a spindle rod, adding extra weight to the lighter whorl and allowing the spinner options where she could have owned a smaller number whorls to create variable thicknesses of yarn (see figure 6.6).

Andersson indicates in *Tools for Textile Production from Birka and Hedeby* that spindle whorls under 10 grams were used to produce lighter weight yarn/thread that compares to modern worsted weight wool. The relationship between the weight and diameter can determine the size and spin created in the yarn/thread; the lower the weight and smaller the diameter, the finer the thread. Higher weight and larger diameter, with the exceptions of the bronze whorl(s), produce a heavier twist and thicker yarn. There are groupings of whorls by diameter in the 25-43 mm range of 2-3 whorls in each diameter, with the exception of 5 measured at 35 mm. The bronze disc whorls have a raised collar, which for the purposes of maximum height is not included in the calculations as it would be integrated with the spindle and lend little to the inertia of the whorl.

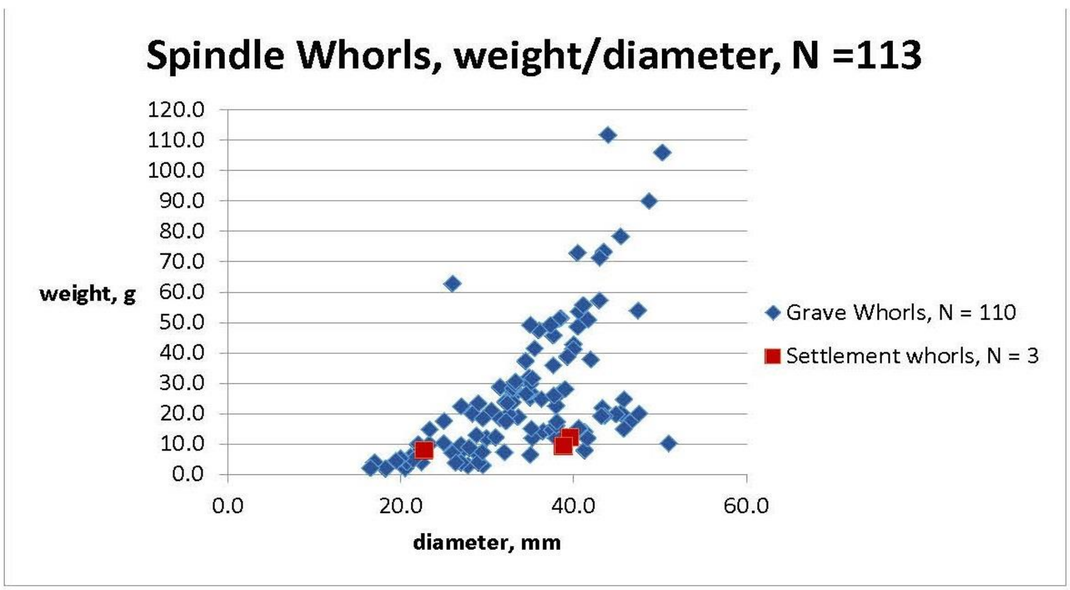

Figure 5.7. Scatter gram showing the distribution of weight and diameter for both grave and settlement spindle whorls.

Weaving tablets

Data was collect on 16 whole and partial weaving tablets. Nine are classified as whole with at least 80% of the tablet intact, with all tablets being made of antler. Two partial tablets with at least 50% intact and 5 partials with less than 50% were also recorded. The two tablets with more than 50% allowed me to calculate the dimensions for the full tablet. Several tablets and partials had wear marks at the holes where the warp thread was passed through. As the tablet band was woven tension would have been put on the tablets, creating the small linear mark. One of the less than 50% partials had what looked like the start of a hole that was not finished. This unfinished hole also had what looks like a decorative ring around the started hole. In the collection, there is one that has had runes carved into one side. At the time of data collection, there had been no identification of the runes or translation.

Of the nine whole tablets, data was collected on one from the settlement excavation of Västergarn for comparison. This tablet was comparable with ones from the graves/sites. The weight fell within the range of those whole tablets that had been excavated. The weight on the nine whole tablets and two partial tablets range from 2 and 8 grams, with all but two weighing between 2 and 5 grams. The dimensions of the whole and partial tablets range from 18 mm and 44.64 mm, with the majority falling between 32.4 and 37.76 mm. Compared to tablets found in the Oseberg burial and ones document from Lund, the Gotland tablets on average are smaller.

Comparison Birka, Hedeby, and Kaupang

In comparing the tools found in the Gotland graves with those graves discussed by Andersson (2003) in Birka and Hedeby, and Øye (2012) in Kaupang, similar materials are used in creating the whorls, needles and needle cases. There is no documentation of weaving tablets for any of the three sites used for comparison, either in the graves or the settlement areas.

Øye documented 27 datable finds of spindle whorls to 18 burials out of 116 from Kaupang (Øye, 2012). The whorls are mostly made from stone with seven examples of clay whorls. She notes that the whorls from the graves are more carefully made than those from the settlement area, with three of them having decorations. The graves whorls for Kaupang are of similar weight and diameter as the Gotland whorls, with the most common weights between five and 39 grams and the diameter between 20-44 mm. Øye (2012) reports that needles found in the graves are few, with their actual function uncertain. One of the possible needles had a wooden case attached to it that could have been protecting the point of the needle and a bronze needle case found in a grave measures 62 mm in length and 8-11 mm in diameter. This case fall into the parameters of those documented from the Gotland graves.

Andersson (2003) examines spindle whorls from Birka with only five being registered from graves, with two of them uncertain. Two of the three whorls documented from graves were made from amber, with the third being made of ceramic. The five whorls do not differ in size from those found in the settlement area of Birka. Of needles and needle cases, seven bone needles and 69 needle cases were excavated from graves. The bone needles were of the same form as those found in the Birka settlement. Of the 69 needle cases found in graves, two were found in men's graves. The materials used to create the needle cases include 49 of bronze, two of silver, six of iron and 12 of bone. Metal needles were found in 38 of the cases, with four small individual needles found separately (Andersson, 2003).

Table 5.2. Counts of tools from graves documented at sites. Numbers are approximate

Settlement	Spindle whorls	Weaving tablets	Needles	Needle Case
Gotland	199	15-20		80
Birka	5		49	69
Kaupang	27		1-3	1

Distribution of Tools and Graves

The use of GIS has allowed researchers to create maps that provide a visual documentation of the distribution of their research. I organized the information from Thunmark-Nylén's volume and used it to create maps of the distribution of the tools recorded. Analysis can be made and hypotheses created as to the level of textile production on Gotland during the Viking period.

I began with the data acquisition of textile tool artifacts found in Viking Age Graves in Gotland by establishing counts from the catalog volume of Thunmark-Nylén's series *Die Wikingerzeit Gotlands*. The catalog was broken down into artifact type finds and included over 40 categories. For the purpose of distribution analysis, the counts included the number of graves/sites per parish that included textile tools and the count of the tools themselves. The textiles tools included spindle whorls, weaving cards, needles, and needle cases. Of the 1100 graves/sites discussed by Thunmark-Nylén, 125 contain 167 spindle whorls, 10 contain 21 weaving tablets, 44 contain 69 needles, and 75 contain 146 needle cases. Of the 61 parishes with textile tools only 14 contain 3 or more textile tool types. These types include spindle whorls, weaving tablets, needles and needle cases. Other tools (loom weights, shears, and glass smoothing stone) were not included due to their small numbers.

ArcMap shape files were received from Professor Gustaf Svedjemo, with Gotland Campus, Upsala Universitet. After the counts were established, the data was transferred into a Microsoft excel spreadsheet, which was geocoded and transferred into ArcMap by joining the excel spreadsheet to the attribute table in the parish shapefile. Geocoding is the process of transforming a description of a location – such as a pair of coordinates, an address or name of a place – to a location on the earth's surface. Shapefiles were created from the original attribute table for of each of the artifact counts. A shapefile stores the geometric location and attribute information of geographic features that include points, lines or polygons (areas). These shapefiles were then used to create maps representing the distribution of graves and textile tool artifacts including needles and needle cases, spindle whorls, and weaving cards and the amount of each artifact per parish.

Distribution of spindle whorls

Figure 5.9 represents the distribution of spindle whorls to grave/sites with 46 of the 92 parishes containing spindle whorls. Of the 46 parishes, 23 contain only one grave and have only one to two spindle whorls. The highest count of spindle whorls is in the northeast parish of Hellvi (see figure 2.2) and contains 19 spindle whorls, but contains 14 grave/sites, which is only about 1.3 spindle whorls per grave. This can also been seen in parishes with thirteen and twelve graves, having similar percentage of spindle whorls to graves. This could indicate the production of yarn/thread for everyday use, such as the sewing and mending of clothes, household goods and possibly repairs on ship sails. In those parishes that contain five and six graves we see a large count of whorls, almost two per grave, suggesting that the women could have been spinning thread or yarn for more than just repairs or sewing. It is interesting to note that the parish of Lummelunda on the northwest coast of Gotland (see figure 2.2) had a very high ratio of spindle whorls to graves/sites with 15 spindle whorls and 3 graves/sites recorded. Also when looking at the catalog data, it can be seen that actually only 2 of the graves/sites contained the whorls.

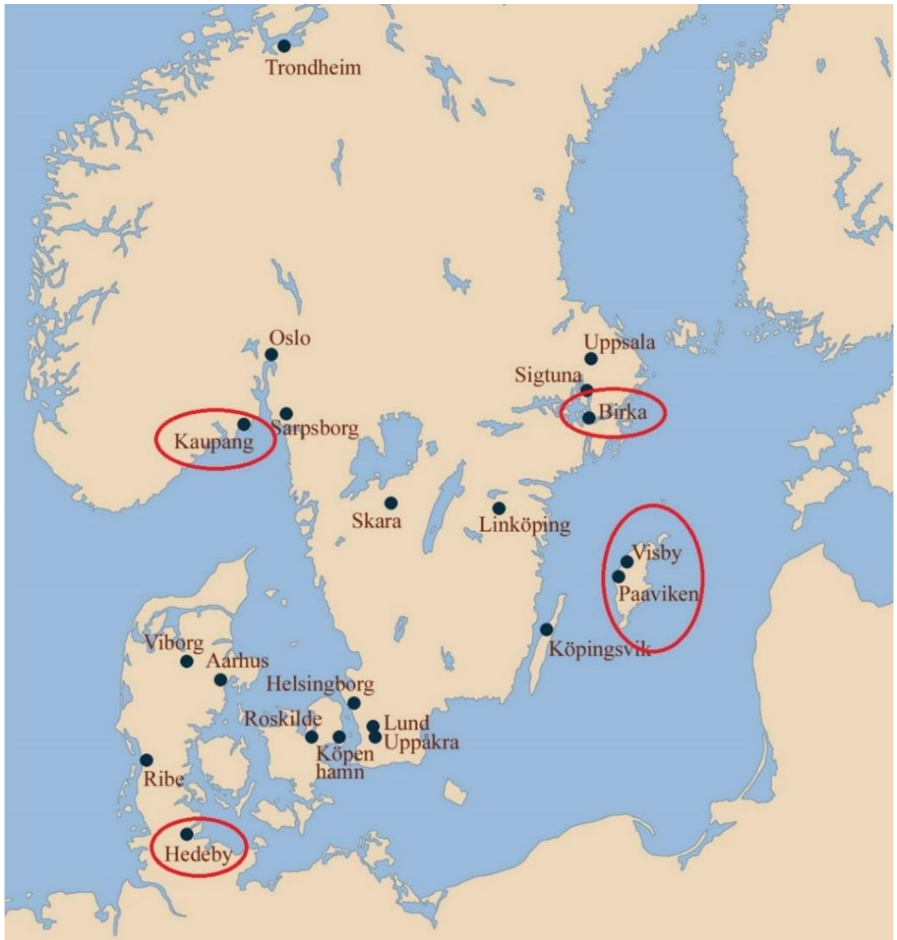

Figure 5.8 Map showing Viking Age settlement sites of Kaupang, Birka, and Hedeby in relation to Gotland and used for comparison. (Rosborn, 2006)

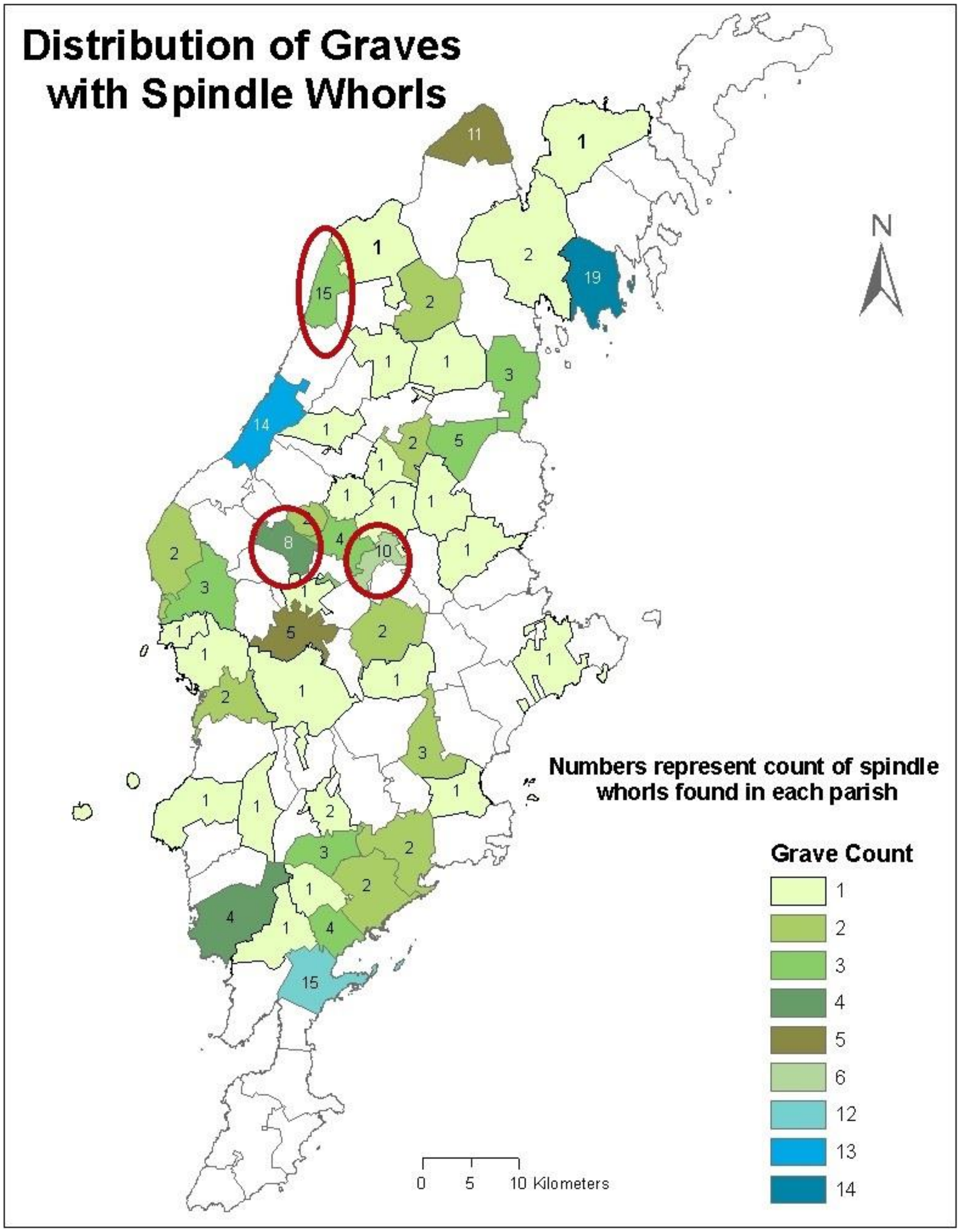

Figure 5.9 Map showing distribution of spindle whorls to graves. Parishes with read circles represent high whorl count to grave count ratio.

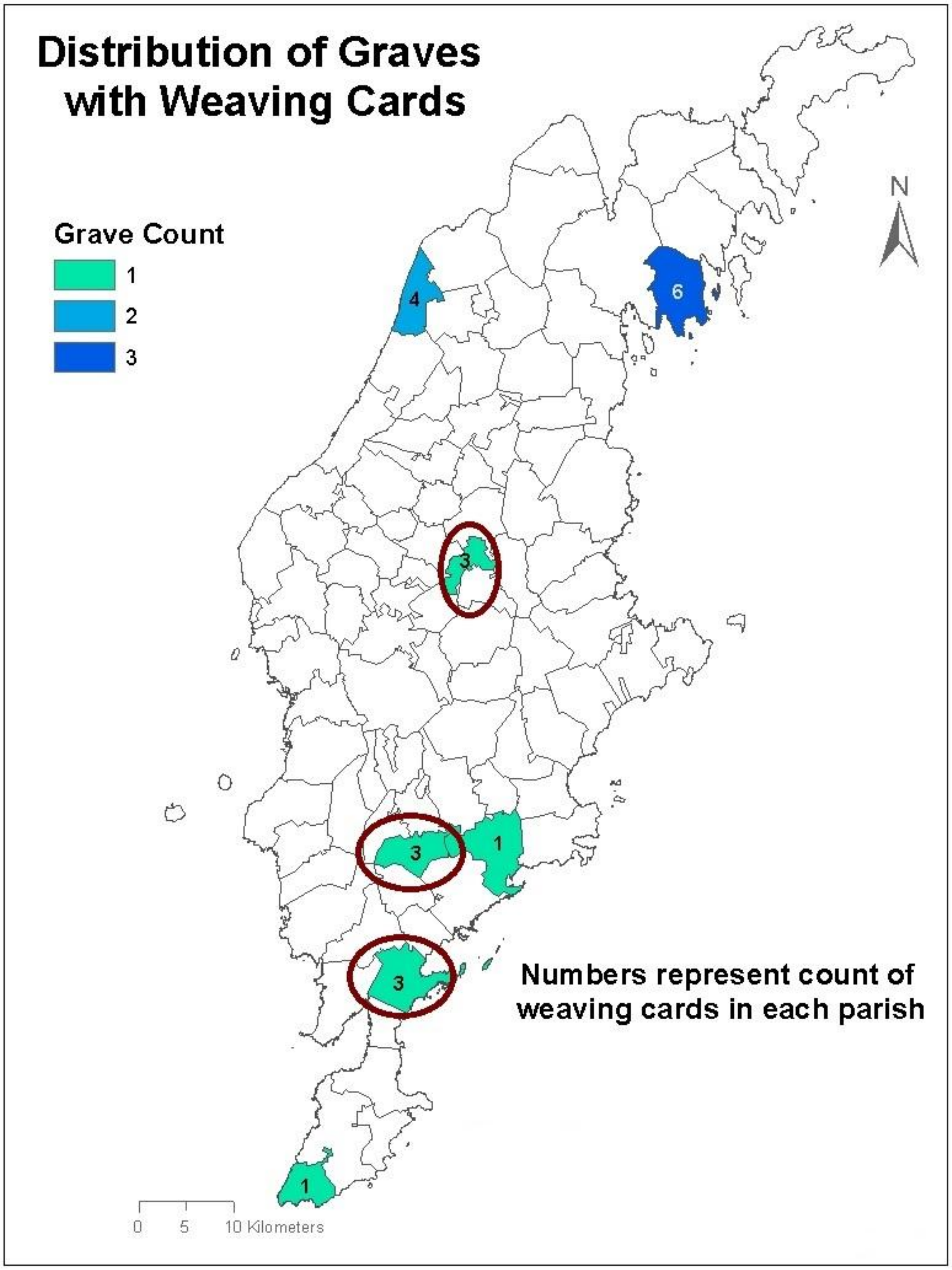

Figure 5.10 Map showing distribution of weaving tablets to graves. Parishes circled in red represent graves with higher tablet to grave count ratio.

Distribution of weaving tablets

With only 21 weaving tablets found in ten graves out of a total of 1,100 graves in seven parishes, figure 5.10 shows a distribution that is sparse, with less than 1% of all graves that contain weaving cards. Out of the 92 parishes listed only seven contained whole or partial weaving cards, approximately 8%. Three parishes that contained only one grave/site, Grötlingbo, Hemse, and Halla have three whole or partial weaving tables per grave with the remaining four with one to two weaving tablets per grave.

Distribution of needles and needle cases

Figures 5.11 and 5.12 are maps that represent parishes that have needle and needle cases. Approximately 15% (n=14) of the 92 parishes have both needle cases and needles with many of these parishes only a few having coastal access. It appears that, in the northern area, there is a larger distribution of needles than in the southern parishes, while needle cases appear to be more numerous in the south. The distribution of needles and needle cases appears to be arbitrary as no clear pattern can be seen.

Needle cases have been found in 36% (n=33) of the 92 parishes of Gotland. There are parishes that have up to 21 needles cases. Those parishes with which more than ten needle cases are located in the southern area of Gotland. It is interesting to note that the distribution of the needles and the needle cases do not always overlap.

Approximately 50-60 needles were documented in the graves/sites. Of the 92 parishes, 27% (n=24) of them contained needles. There is a parish on the northwest coast that have a relative high count of 16 needles found in two graves. Another parish in the south also contains a higher count compared to the counts in the majority of the parishes.

Overall Distributions and Analysis

When reviewing the distribution of all artifacts, there are five parishes that contain all four artifacts and seven that contain three artifacts. The five that include all artifacts are Burs, Grötlingbo, Halla, Hellvi, and Hemse. Of the five that contain all artifacts documented, Halla and Hemse are not coastal. All five contain either whole or partial weaving tablets. The seven that have 3 artifact types include Hablingbo, Havdhem, Hejnum, Lummelunda, Rone, Vate, and Vallstena. Three of the seven are coastal – Hablingbo, Lummelunda, and Rone. One, Havdhem, has a small area of access to the sea, with the remainder being landlocked. When looking at all four maps, we can see a fairly wide dispersal of artifacts with only a few (n=4) that contain relatively high counts of artifacts per parish. One that stands out is the parish of Lummelunda, where there are two graves that contain 14 spindle whorls, four weaving tablets and 16 needles.

Summary

The collection and analysis of data from textile tools found in graves sites and settlements provides insight into the quality and quantity of textiles produced in the past. Through the methodologies used in this chapter, a more in-depth interpretation can be made concerning textiles and their production from the tools found in the graves of Viking Age Gotland. These methods include literary translation, analysis of data collected from the tools found in the graves/sites, and spatial analysis of the tools and graves. Through these methods, an interpretation is made as to whether the tools represent a level of textile production that provides for the populace of Viking Age Gotland and possibly the types of textiles being produced.

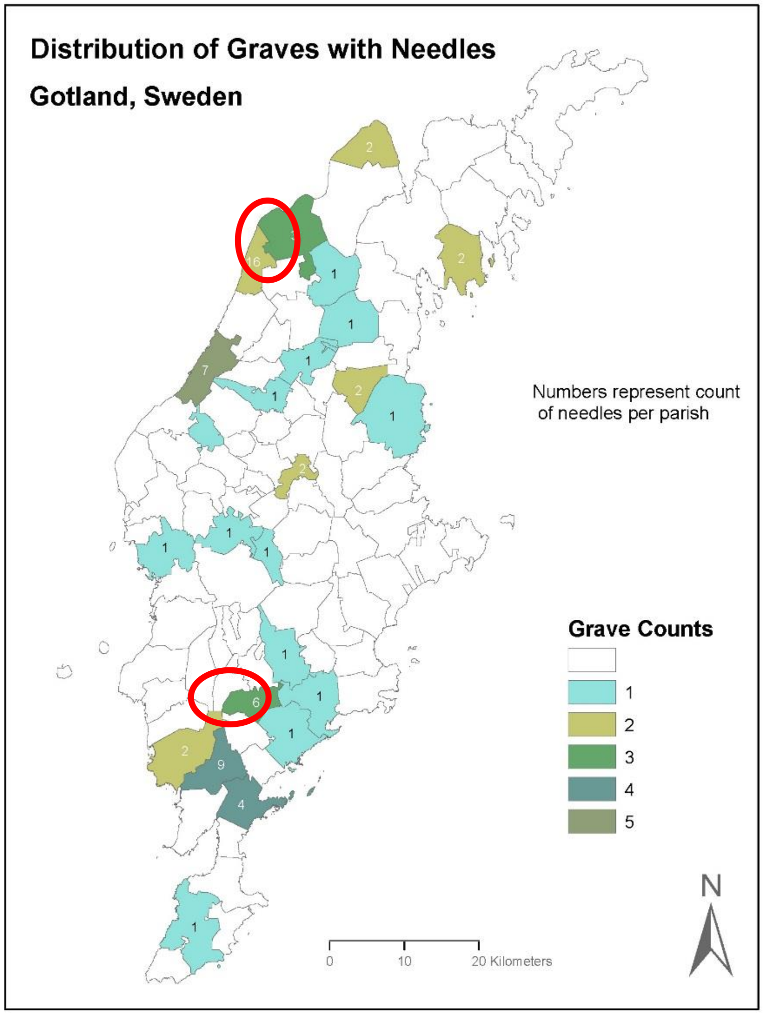

Figure 5.11. Map showing the distribution of needles to graves.

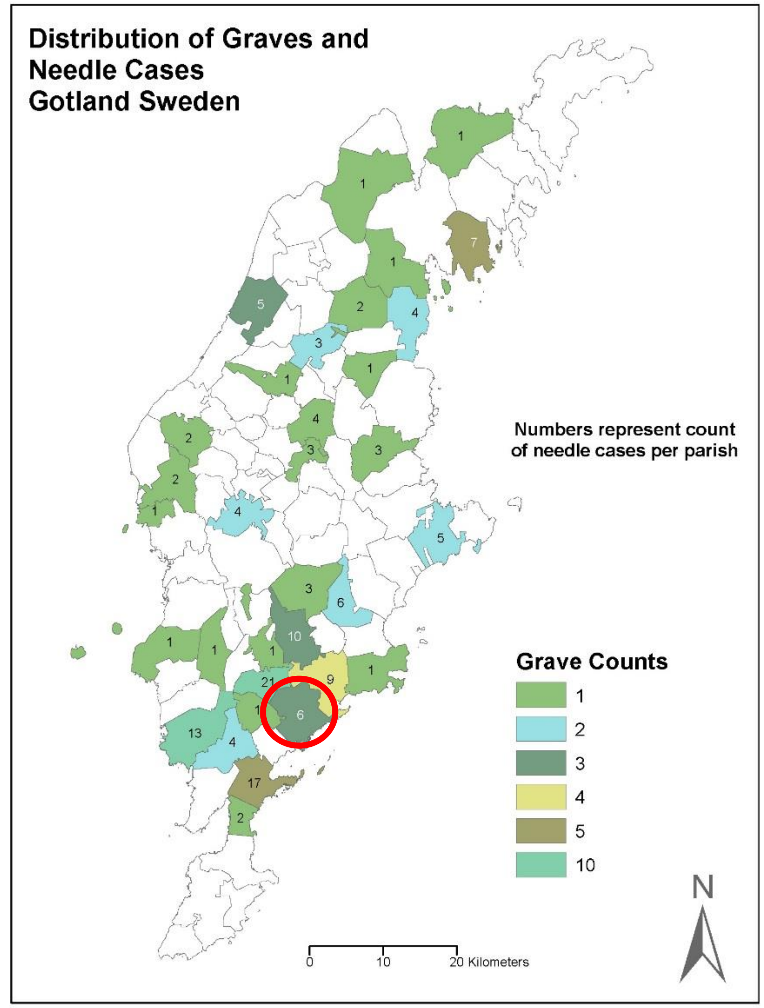

Figure 5.12. Map showing the distribution of needle cases to graves.

CHAPTER 6. DISCUSSION, SUMMARY, CONCLUSION AND RECOMMENDATIONS

Tools, Graves, Gender and Trade

The production of textiles is an industry that has been part of people's daily routine for thousands of years. Textiles clothe us, protect us from the elements and can indicate social status and group association. They are an integral part of our households as bed coverings, curtains, and more. Textiles have been used for trade and transportation in the forms of cloth, sails, rope and packaging, and for wrapping the dead.

This chapter discusses the tools found on Gotland during the Viking age, the implications of the quantities found, location of tools, comparative analysis to other research and data from those burials documented from contemporary sites of Birka in Sweden, Kaupang in Norway, and the Danish site of Hedeby now in Germany (Andersson, 2003; Øye, 2012). When looking at the development of textiles, we need to look at the difference between what could be considered textile work and production. Textile production is the creation of the textiles themselves from the processing of raw materials, through to the weaving of the final piece of textile. In the process of textiles production, the tools used include those tools used in the preparation of the fibers for spinning, spindles used in the spinning of the fiber and reel winders for the creation of skeins and storage of the finish yarn/thread, and looms, weaving battens, shuttles, and weaving tablets that are used to weave the textile into a finished piece of fabric. Textile work includes production, but goes beyond that to include the construction of garments and other finished textile products including household goods, sailcloth, packaging for transport, and burial goods. Textiles work would also include tools such as needles, pressing boards, glass smoothing stones, and shears.

Spindle whorls

Through experimental archaeology, archaeologists investigate the technologies used in the past to recreate items that people produced and used in their daily lives. Experiments in textile production explore the form and function of tools including spindle whorls, looms and loom weights, weaving tablets, and other tools and the time dedicated to the creation of textiles from raw fiber to finished cloth (Andersson, 2003). Researchers at the Center for Textile Research at University of Copenhagen and Lejre Center for Historical-Archaeolgical Research, Denmark have done extensive experimental archaeology into the functionality of different textile tools, including how the weight, diameter, thickness and material of the spindle whorl can affect the yarn/thread and textiles produced. In *Tools for Textile Production from Birka and Hededy* Andersson (2003) documented and discussed how the difference in shape, weight and diameter of spindle whorls influenced the yarn/thread produced. Andersson (2003) documented and analysed data on approximately 429 spindle whorls from Birka and 912 from Hedeby and looks at the weight of whorl as this can determine the fineness or courseness of the yarn and how the diameter of whorl affected how tightly spun the yarn was. Lighter weight whorls (less that 10 grams) would have been used to spin finer yarn/thread, whereas heavier whorls (15 grams and above) would have been used to spin much heavier, courser yarn/thread. Heavier whorls in the 10-20 grams range can be used to create finer threads, depending on the expertise of the spinner and quality of fiber being used (Andersson, 2003).

The analysis of the 103 whorls from the Gotland burials and the three from Paviken indicate that the range show weights between 2 and 111 grams (figure 5.6). The lighter weight whorls, weighing between 2 and 10 grams would have been used to spin finer, lighter weight yarn/threads. A number of the whorls in the heavier range are either partial or have eroded over the centuries and would have less weight than in their orginal form.

Data collected shows that 22 of the whorls (21%) were in the 2-9 grams range and included amber, stone and bone. All but one of the ten amber whorls are in this range. With the small diameter and low weight, these whorls would have been used with finer fibers and created lighter, finer yarns/thread that could have been used in what would be considered higher status clothing/textiles. These types of yarns/threads could also have been used in the production of tablet woven bands that were possibly used to decorate clothing, ritual item or traded for other raw materials or finished goods.

The whorls with a weight concentration between 20 and 55 grams (65%), would have been used to spin medium and courser weight yarns/threads. This yarn could have been used for outer garments that would have been worn over garments woven from finer threads, possibly made from linen. These over garments would not need to be as fine as those worn next to the skin. This yarn could also be used for household goods such as blankets, curtains, and table and bath linens, that again did not need to be the finest of materials. The heavier whorls at the top of the range could also have been used in producing heavy yarns that could have been used in the making of sailcoth and for the plying of finer yarns.

The combination of diameter, height and weight of a whorl determines how tightly spun the yarn/thread can be produced. The larger the diameter the more spin can be put on the yarn as the moment of inertia is greater than one that has a smaller diameter (Verhecken, 2009). It is also possible that some whorls could have been used in concert with each other, adding extra weight to a spindle which would allow the spinner to create heavier, thicker yarns (figure 6.6).

The heavier whorls (greater that 55 grams) could have been used in other context. Illustrations and experimental work show tablet woven bands hung on the wall with a weight tied to the bottom acting as the tension for the woven band (figures 4.5 and 4.6). Several of the whorls stand out as the shape and weight are similar to other documented loom weights in shape and size. The shape, size and diameter of the hole, is close to the same size on both sides, indicating that they could have been used as tension weights on smaller projects such at the tablet weaving mention above.

Two of the whorls that data was collected on, are what could be considered ”pre-forms” (fig 6.5). These pre-forms look as if they had been worked into the shape desired with one having a small indented area on the top. It is interesting to note that of those spindle whorls in the burials, these are the only ones that were not finished. The question arises as to why these pre-forms were buried with the deceased.

Of the 92 parishes, 47 contained spindle whorls, with 21 having a single whorl. This could indicate that as the need to create or repair items of clothing and household goods, a person would keep a spindle handy to spin yarn/thread to take care of the demands of the household.

Some of the questions that can be asked of the data are how many spindles did a spinner need to create yarn/thread? Did she create multiple sizes and types of yarn/thread? Were the tools found in the graves sites suitable for creating textiles or were they just grave items?

Figure 6.1 Joint ball spindle whorl and pre-form whorl. (Klessig, 2011)

Figure 6.2 Spindle using two whorls to add weight for spinning of heavier yarns.

Figure 6.3 Weaving tablet with wear marks and runes carved into face of tablet. (Klessig, 2011)

Figure 6.4 weaving tablet and base of elk antler showing possible preparation for tablet creation.

Weaving tablets

Weaving tablets are not usually found in settlement or grave context (Andersson, 2003). The exceptions are weaving tablets found in the Oseberg burial made of wood dating to the 9th/10th centuries (Morrison, 2002; Stine Ingstad, 1993) and limited amounts throughout Scandinavian mainland dating to the Early Roman Iron Age, also made out of wood (Raeder Knudsen, 2009). The weaving tablets from Gotland seem to have survived at a better rate, having been made from antler. Twenty-one tablets were documented by Thunmark-Nylén (1996) and data was collected on 10 whole tablets and five pieces. Data was also collected on two weaving tablets from the Västergarn settlement site. The tablets were cataloged as horn but are made from elk antler, probably from the base of the antler (figure 6.8). The base, as seen in figure 6.8 has a solid structure and could be worked into a reasonable square that could then be sliced into thin sheets.

With no information currently available to compare the weaving tablets from Gotland to the few found at Birka and Hedeby, I examined research on the Oseberg tablets and of the whole tablets from Gotland found the dimensions to be smaller than those from the Oseberg burial (Morrison, 2002). The Oseberg tablets were approximately 43 mm square with a thickness of 1-2 mm. The width and length dimensions of the Gotland tablets are somewhat comparable to the Oseberg tablets with the Gotland tablets dimensions ranging between 32 and 44 mm, with approximately five of the tablets as much as 10 mm smaller that the Oseberg tablets. The thickness on the Gotland tablets, with the exception of one, is between 1-3 mm and fall in the range of the Oseberg burial.

Figure 6.5 Detail of weaving tablet with scratch marks and possible wear marks at thread hole. (Klessig, 2011)

Among the data collected, I found that possibly five tablets have what appear to be wear marks in the form of small indentations radiating out from the holes. These indentations would be where the yarn/thread would rub against the tablet as it was turned in the process of weaving the band (figure 6.7 and 6.9). One of the cards has scratch marks and another has runic marks carved into it. At this time, there is no translation of the runes (figure 6.9). These factors could attest to the fact that these were not just graves goods, but were used in the creation of tablet weaving and possibly had significance to the deceased.

Needles and needle cases

The needles and needle cases documented by Thunmark-Nylén show a wide range of sizes ranging from small hand needles, to larger coarser needles. The smaller needles were possibly used in the construction of clothing and household goods such as table linens and blankets. The larger needles could have been used in pattern weaving, sewing or darning looser thicker fabric that was used for packaging to transport goods, and for repairs on sails. The needles are made up of two material types: bone and bronze. The needle cases are made of three material types; bone, iron, and bronze, and vary somewhat in diameter and length (Thunmark-Nylén, 2006).

Figure 6.6 Example of bronze needle case containing needle. (Fuller, 2013)

Figure 6.7 Examples of bronze needles in range of sizes. (Klessig, 2011)

Figure 6.8 Example of bone needle case containing needle. (Fuller, 2013)

Figure 6.9 Example of bone needle. (Klessig, 2011)

Analysis of textiles from Gotland

In *Prehistoric Scandinavian Textiles (Forhistoriske textile I Skandinavien)*, L. Bender Jørgensen (1986) documented 35 fragments of textile from Viking Age Gotland from approximately 20 graves. She comments on the fact that the Gotland textiles differ greatly from other Swedish textiles in their spin and structure. The Gotlandic fragments show a high proportion of 2/2 twills with Z/Z spinning, which appears to form a different type of cloth from the Swedish mainland during this period. With evidence of numerous elements that differ from the mainland, including jewelry, the cloth used for their costumes is different from those found in Scandinavia during this time (Bender Jørgensen, 1986).

Among the fragments, there were two pieces of textiles identified as tablet weaving. These would have been woven with weaving tablets like those documented by Thunmark-Nylén. With the tablets associated with some of the graves, this could indicate the importance of tablet weaving and suggests that the women they were buried with had an expertise in this form of weaving.

With such a difference, it would be reasonable to argue that the Gotlanders, were indeed, creating their own textiles. With little in the way of evidence of other tools used in the production of textiles, such as loom weights, it is hard to determine an accurate hypothesis of the level of textile production.

Interpretations of Grave Goods

When looking at the wealth of artifacts found in the graves documented by Thunmark-Nylén (1996-2006), there are indicators that provide insight to the status and gender of the graves. Many of the female graves have artifacts in common, including the animal head brooches worn by most women of Gotland during this period, whether of high or low status. In the higher status graves, there is a much broader and larger collection of artifacts that suggested a higher status, including multiple chains attached to brooches, “fish tail” (as described by the Gotland Fornsal Museum) pendant necklaces, and armbands/bracelets of both bronze and). There does not appear to be a difference in the type of tools found in either high status or low status graves, just the quantity found. In both graves types, there are spindle whorls of various sizes and material type, possibly indicating that the production of textiles was not a craft of status but a necessity in all status levels of daily life. Of the tools found in the graves several show possible use wear.

Approximately four to six of the spindle whorls from Broa, Eke, Vate, and Horsne and four weaving tablets from Hellvi in the north and Grötlingbo in the south show possible wear marks. These can be seen on the spindle whorls at the center hole where the spindle would be inserted (see appendix B) and especially on the weaving tablets at the thread holes in form of small linear indentations where the thread would rub against the hole (figure 6.9). The same wear marks can be seen on the tablet from the settlement site at Paviken (figure 6.8). These factors indicate that the tools from the graves/sites were not just burial goods, but had been used in the daily life of the women they were buried with.

When looking at other artifacts found in the graves/sites, the tools for textile production seem to be the only trade/craft tools buried with individuals. Many forms of jewelry, horse tack, weaponry, scales, and household items such as combs, keys, and knives can be seen, but do not include other craft tools, such as those used in carpentry, bead making and comb making. The questions that arise are: were these women's skill so prized that their tools represented who they were in life? Or were the tools just part of the basic ritual practices of the time? If so, then why are there no other craft tools buried with other members of the community?

In those Viking Age settlement sites that have been excavated on Gotland very few textile tools have been found in settlement context (Carlsson, 2011; Kilger, 2013;

personal communication). Those that have been located, mostly spindle whorls and a few weaving tablets, are comparable with those found in the burials (figure 6.7 and 6.8).

The Distribution of Tools, Graves, and Counts

The distribution of the tools throughout the island indicates that there is no particular concentration in specific areas (see figures 5.9-5.12). What we do see is graves in a few parishes that have high concentrations of individual tool types and some graves that have numerous tools types. Of the over 1,100 graves documented, only 192 (approximately 17%) of these contained textile tools and include excavations in all ninety-two parishes (Thunmark-Nylén, 2006).

In the northwestern coastal parish of Lummelunda, there are three graves documented with textile tools. Of these three, two contain 14 spindle whorls, approximately three weaving tablets and fifteen needles. Along with Lummelunda, the parishes of Hellvi and Grötlingbo, show large numbers of whorls, weaving tablets, needles and cases. The numbers differ in that for most of the artifact categories, these two parishes average one to two whorls per grave (see figures 5.9-5.12).

As Thunmark-Nylén states in her chapter on textile work, all but a few of the spindle whorls were found in women's graves, giving us an indication of the importance of textiles to the individual and to the gender. She also mentions that almost all of the spindle whorls were found at the feet or lower leg of the burial. The question arises as to why the whorls would be placed at the lower part of the body. As spinning with a drop spindle is usually done while standing with the spindle suspended from the hand, and as the spinner draws out the fiber, the yarn/thread gets longer. It is my interpretation that finding the whorls at the lower part of the body could symbolize how the whorls were used in daily life as the spinner created her yarn/thread (Thunmark-Nylén, 2006).

Trade, transportation and regional economy

Trade during the Viking Age was not limited to just Scandinavia or the British Islands. Evidence in the form of coins, glass, and bronze statuary from Asia have been found in the hoards scattered throughout the Viking homeland (Carlsson, 2003). At the center of this rather vast network is Gotland, situated almost directly in the center of the Baltic Sea, giving the island an advantageous position for trading of raw material and finished products from east to west and back. This can be seen in the many hoards found on Gotland, approximately 750 to date (Carlsson, 2003). These hoards have included silver jewelry and ingots, coins from the mid-east, and the bronze statue of a Buddha that give us a view of the expansive network of the Vikings. Also included in the evidence of large scale trade is glass used in bead making that has been sourced to Italy (Carlsson, 2013).

With evidence of trade that started in the earliest times of the Viking Age, Gotland had trading sites dating to 700-750 CE, and with approximately 800 kilometers of shoreline, there is a high probability of other harbors and trading places than have been documented thus far (Carlsson, 1991). What Gotland lacked in raw materials, the populace was able to trade in and create products for trade, possibly establishing a craft network that included comb making, bronze casting, and bead making. The evidence of these crafts can been seen in excavations at Fröjel and Paviken in the antler debris used in comb making, millefiori glass, and jewelry and weaponry found in the gravesites situated throughout the island (Carlsson, 2013; Kilger, personal communication, 2013). But when looking at the number of textile production tools found in the graves throughout the island, the question arises to the level of textile production on Gotland.

With a large trading network coming from around the Baltic and farther, the trading in of textiles from regions reputed to produce textiles, such as Iceland and Frisia, would have been a great possibility (Hayeur Smith, 2012). With evidence of trade textiles in other parts of Scandinavia coming from Frisia and silk from Asia, the need for producing textiles on a large scale was not imperative. This is not to say that there was not some textile production happening on Gotland. The need to create yarn/thread for repairs and producing household goods that might not have been available on a wide scale would be needed. With evidence in the graves that contained weaving tablets and tablet woven bands, Gotland women could have been producing woven bands as luxury items to be traded for other goods such as finished yardage for the use in clothing. The possibility of trading out raw fiber, such as wool and flax, also exists, as the agrarian societies, including Gotland, had a high productivity of crops. Exchange of agrarian products and items of local specialized craft production was possible for other finished product not available on Gotland (Callmer, 1994).

Conclusion(s)

When first starting the research for this thesis, I was of the opinion that the textiles needed to support the population of Gotland during the Viking Age were not being produced on the island. As the research progressed, I realized that, no matter the level of trade or production, people during the Viking Age would have to produce a certain amount of their own textiles. There would be a need to create thread for the sewing and repair of garments, household items, and for maritime activities such as sail construction and repair.

Spindle whorls and weaving tablets attest to the production of textiles, possibly of tablet woven trims for trade. With the possibility of harbor sites throughout the island, there is also the need for sailcloth for the ships that are built or those coming through that would need replacements.

With access to a trading network that extended to the Mid-East and Asia, Gotland was in a prime position for the import of textiles needed to cloth its population. But those textiles recorded by different researchers over the years tell me that the level of production was at a higher level that I had previously expected. Bender Jørgensen, in *Prehistoric Scandinavian Textiles* (1986), examines textile remnants from Gotland. After completing the analysis of some 35 fragments from the island, she discusses how different these textiles are from mainland Sweden and the rest of Scandinavia in their weaving and spinning structures. This has led me to rethink the level of textile production on Gotland and allow for a broader interpretation of the data. Without more evidence of production, such as loom weights, it is hard to determine the level of production.

As a necessity for daily life, there would always be the need for some textile production, whether for clothing, maritime activities (sails, ropes, etc.), or repairs to textiles. As Gotland has a rich history of trade and craftsmanship, textiles traded in from other textile producing communities is possible. It is also possible for the inhabitants to have traded fiber from the Gotland sheep for finished lengths of cloth.

Recommendations for Future Research

As there have been no other studies of the tools used in textile production in on Gotland, a broader study of the textile fragments and tools used in production prior to the Middle ages could be undertaken with the cooperation of the museum and researchers mentioned in this thesis. This should include the Neolithic, pre-Roman, Roman, Migration and Vendel periods, and would add to the knowledge that has been accumulated. This should include as much as possible the recording, analyzing, and documenting of tools, textile pieces, structures, fibers and possible dyes used.

An in-depth survey of those textile tools and fragments from settlement sites that have been excavated would add to the data available. Some of the settlement sites include Fröjel, Paviken, Boge, and Hemse. Though few, these sites could help in the understanding of the level of textile production.

Another consideration for future research could be revisiting those sites and parishes with high tool counts, in an attempt to survey the surrounding areas for a better perspective of the livelihoods and craft production. This could be done through noninvasive means such as ground penetrating radar (GPR), phosphate mapping, and small test excavations. With the possibility of many other harbor and trading sites, I believe the possibilities are numerous in discovering more about the level of textile production on Gotland.

Summary

In the past, the study of archaeological textiles and the tools used to create them has been a marginalized topic of research and discussion. This could be due to being seen as the work of women and therefore not as important as the work of men. By collecting and analyzing data on textile production, tools and the textile fragments themselves, an interpretation can be made on the level and types of textiles being produced on Gotland during the Viking Age.

This thesis is an attempt to gain a better perspective on the level of production on Gotland during the Viking Age. With the data collected, both physical and in literature, a broader interpretation has been realized by understanding how the production of textiles affect the daily lives of people during this period, how textiles and tools differ from locale to locale, and the implications of the types and numbers of tools found. With further investigation, a more concise and extensive picture can be presented, providing a more comprehensive analysis of textile production on Gotland.

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APPENDIX A

	GRAVESITE #	CATALOG #	Status	CATEGORY	MATERIAL	TYPE	DIAM/m	HGT/mm	WGT/g	TOP	BOTTOM	REGION	SITE	SITE TYPE	SURFACE	COMMENTS
										HOLE DIAM/mm						
1	SHM 23160	447012	1	SpWh	stone	6	50	39.4	106.	14.5	15.8	Lau	Liffride	grave	smooth	chips
2	SHM 32457	454935	1	SpWh	bone	10	22	9.8	4.0	7.0	8.5	Vate	Molna	grave	porous	great wear
3	SHM 27779:2/63	454947	1	SpWh	stone	6	34	18.5	32.	10.5	11.9	Grötlingbo	Udduide	grave	smooth	light damage
4	SHM 8064:127	454930	2	SpWh	bone	10	41	22.8	14.	13.7	16.4	Hablingbo	Havor	grave	porous	large piece missing use wear
5	SHM 7582:21Ag	477723	1	SpWh	amber	1	35	17.6	12.	7.1	5.4	Hablingbo	Havor	grave	smooth	use wear, includes 2 amber beads
6	SHM 8064:192	448168	3	SpWh-partial	bone	10	41	18.1	8.0	14.9	6.24 (approx)	Hablingbo	Havor	grave	porous	use wear, partial deteriation of spindle hole
7	SHM 7582:21Af	454950	1	SpWh	bone	10	43	29.8	22.	14.7	15.6	Hablingbo	Havor	grave	smooth	bottom porous with chip
8	SHM 27739:1d/61	454926	1	SpWh	bronze	8	46	1.5	18.	9.5	10.0	Grötlingbo	Norrkvie	grave	smooth	patina
9	SHM 27739:1d/61 - 1/3	454927	1	SpWh	stone	4	21	10.6	6.0	8.4	9.0	Grötlingbo	Norrkvie	grave	worn	use wear
10	SHM 27739: 1d/61 - 2/3	454927	2	SpWh	stone	4	21	11.4	6.0	11.1	12.3	Grötlingbo	Norrkvie	grave	worn	use wear
11	SHM 27739: 1d/61 - 3/3	454927	2	SpWh	stone	4	27	11.9	8.0	10.6	10.3	Grötlingbo	Norrkvie	grave	worn	use wear
12	SHM 7582:12h	477010	2	SpWh	bone	10	47	23.2	20.	14.3	15.8	Hablingbo	Havor	grave	smooth	bottom eroded
13	SHM 27739:11/61	454944	1	SpWh	stone	6	47	16.4	54.	13.4	13.6	Grötlingbo	Norrkvi	grave	smooth	inclusions, possible use marks
14	SHM 27778:13/61:2	454948	1	SpWh	stone	4	32	17.7	24.	10.6	12.0	Grötlingbo	Norrkvi	grave	semi-smooth	marlstone - reddish/pinkish w/CaCO
15	SHM 21540:20:7	454949	1	SpWh	stone	4	37	20.6	36.	12.8	14.4	Grötlingbo	Barshalder	grave	rough	inclusions and chip, possible use marks
16	SHM 11939:a	107619	1	SpWh	stone	4	33	19.2	26.	10.6	11.6	Halla	Broa	grave	smooth	
17	SHM 19734:25:2 - 1/4	107600/601	1	SpWh	amber	4	20	8.2	2.0	6.7	6.7	Halla	Broa	grave	smooth	possible use wear
18	SHM 19734:25:2 - 2/4	107600/601	1	SpWh	stone	2	20	8.6	4.0	6.9	7.1	Halla	Broa	grave	smooth	
19	SHM 19734:25:2 - 3/4	107600/601	1	SpWh	amber	4	18	10.8	2.0	6.2	6.5	Halla	Broa	grave	smooth	
20	SHM 19734:25:2 - 4/4	107600/601	1	SpWh	stone	4	17	8.6	4.0	6.2	7.2	Halla	Broa	grave	smooth	
21	GFC 9322: 173 Gr.218A		1	SpWh	amber	2	27	12.9	3.0	7.8	8.9	Hellvi	Ire	grave	smooth	
22	GFC C8654 Gr. 8		1	SpWh	stone	6	29	17.8	12.	13.1	13.7	Grötlingbo	Barshalder	grave	rough	eroded
23	GFC C9285: 102 Gr.242			SpWh	stone	4	28	16.1	13.	11.2	12.2	Hellvi	Ire	grave	semi-smooth	same material as cool one from SHM
24	GFC C9285: 106 Gr. 502			SpWh	stone	6	41	17.6	51.	13.1	13.4	Hellvi	Ire	grave	rough	eroded, same material as cool one from SHM
25	GFC C9322: 169-173 Gr.218A			SpWh	stone	4	23	13.1	10.	7.8	9.9	Hellvi	Ire	grave	smooth	possible signs of wear/use
26	GFC C10221: 101 Gr. 239			SpWh	stone	2	33	14.0	19.	11.9	12.3	Hellvi	Ire	grave	smooth	looks like someone took a wire brush to clean it
27	GFC C10221: 100 Gr. 239			SpWh	stone	6	48	23.7	90.	13.0	13.4	Hellvi	Ire	grave	smooth	
28	SHM 29560	1091259		SpWh	bone	1	38	21.0	22.	9.0	10.0	Lummelunda	Burge	grave		
29	SHM 21394:14 - 1/2	274133		SpWh	amber	2	26	11.0	7.2	5.0	6.0	Eke	Hallveda	grave	smooth	possible signs of wear/use
30	SHM 21394:14 - 2/2	274133		SpWh	amber	9	29	11.5	6.5	7.5	8.0	Eke	Hallveda	grave	smooth	possible signs of wear/use at lower edge
31	32181;7	23597		SpWh	stone	2	40	27.0	73.	9.0	11.5	Grotlingbo	dvide Nor Bar.	grave	rough	eroded, partial flaking
32	32181:27	24019		SpWh	stone	4	27	16.5	22.	7.0	9.0	Grotlingbo	Barshalder	grave	smooth	sandstone
33	32342	38251		SpWh	stone	2	23.5x30	16.0	21.	5.0	5.0	Grotlingbo	0 Fyndomrade	grave	rough	eroded, (Foremal Fossil) oval shape - possibly bead
34	27778:13	454948		SpWh	stone	9	29	15.0	23.	7.5	9.0	Grotlingbo	Norrkvie	grave	semi-smooth	limestone
35	9566	109102		SpWh	bronze	9	26	9.5	62.	6.5	8.0	Sanda		grave	smooth	bottom has circle decorations
36	7582:12h	477010		SpWh	bone	1	45	21.0	20.	12.5	11.0	Hablingbo	Havor	grave	smooth	bottom degraded
37	20550:160	473600		SpWh	bone	1	29	7.0	3.0	4.5	7.0	Hellvi	Stora Ire	grave	smooth	
38	20550:170	454940		SpWh	stone	6	21	4.5	4.9	5.0	5.5	Hellvi	Stora Ire	grave	smooth	fire affected?
39	20826:348	474320		SpWh	bone	1	32	11.0	7.4	7.5	7.0	Hellvi	Lilla Ire	grave	smooth	burnt
40	12592:23, 23b -1/2	1089288		SpWh	bone	1	36	18.0	14.	9.0	12.0	Vall	Levide	grave	smooth	burnished surface - question SpWh - see basket weaver pic
41	12592:23,23b - 2/2	1089288		SpWh	bone	1	37	18.0	14.	9.5	11.0	Vall	Levide	grave	smooth	see above line 42
42	8412	107615		SpWh	bone	1	35	10.5	6.5	9.0	9.5	Klinte	Klintebys	grave	smooth	see above line 42
43	13329:20	1091099		SpWh	stone	2	33	11.5	27.	7.0	8.0	Vall	Levide	grave	smooth	possible wear marks
44	15616:16	109110		SpWh	stone	9	44	28.5	111.	8.0	10.0	Vall	Levide	grave	smooth	rough shape
45	15616:12	454945		SpWh	bone	6(disc)	51	2./7.5	10.	9.5	10.5	Vall	Levide	grave	smooth	disc with collar for spindle
46	9121:10c	450382		SpWh	stone	9	36	20.5	47.	10.0	11.0	Alva	Rangsarve	grave	rough	
47	11561	107614		SpWh	bone	1	38	14.5	12.	8.0	8.0	Dalhem	Halfoser	grave	smooth	burnished surface - question SpWh - see basket weaver pic
48	7839	107617		SpWh	bone	1	38	18.0	16.	8.0	11.0	Garde	Halvands	grave	smooth	possible burnt bone - cracks on top
49	31964	27412		SpWh	stone	2	20	8.5	5.4	8.5	12.5	Akebäck	Glammunds	grave	smooth	very little left of whorl - looks like worn down

50	32457	1091098		SpWh	amber	9	16.5	7.5	2.1	4.0	4.0	Väte	Mölner	grave	smooth	fire affected?
51	32457	1091097		SpWh	stone	(partial)	31.0	12.0	12.3	13. (aprx)	10. (aprx)	Väte	Mölner	grave	smooth	
52	32457	1091096		SpWh?	stone	6	38.5	9.0	27.1	12.5	13.0	Väte	Mölner	grave	smooth	possible drill marks inside
53	6194	1091095		SpWh	stone	2	35.0	11.0	25.4	7.5	8.0	Vänge	Högvalds	grave	smooth	possible wear marks on top
54	24101:3A	1091094		SpWh	stone	2	28.3	14.1	20.0	6.0	7.5	Tofta	Krokstäde	grave	smooth	
55	14851.3	1091093		SpWh	stone	2	43.0	16.0	57.3	11.5	11.5	Tingstäde	Rosarve	grave	smooth	
56	25694	1091091		SpWh	stone	2	40.0	18.5	42.8	12.5	14.0	Rone	Stale	grave	rough	granite - corroded
57	25694	1091090		SpWh	stone	2	38.5	19.0	51.5	9.0	11.0	Rone	Stale	grave	semi-smooth	granite - rust corrosion from ???
58	11987:25	1091081		SpWh	stone	9	22.5	11.0	8.5	6.0	7.0	Halla	Broa	grave	smooth	
59	11987:26	1091082	2 pc.	SpWh?	bone	7	17./19.5	10.0	4.5	6.0	7.0	Halla	Broa	grave	semi-smooth	fire hardened - don't think spwh - need pics 2 pcs whole
60	14744:4	1091084		flat weight	stone	6	43.5	16.5	73.4	10.0	9.0	Havdhem	Kvinnegårda	grave	smooth	limestone (looks very much marble/limestone)
61	10563	1091074		SpWh	stone	2	22.0	8.5	10.1	5.5	5.0	Buttle	Butlegårda	grave	smooth	
62	13555:21	1091085		SpWh	stone	2	35.0	21.0	49.3	10.0	11.0	Hejde	Forsa	grave	semi-smooth	limestone
63	14287	1091076		SpWh	stone	2	31.5	18.0	28.9	8.0	10.5	Eke	Smiss	grave	semi-smooth	limestone
64	20517:7a	1091083		SpWh	stone	2	25.0	19.5	17.6	7.0	8.0	Halla	Okänd Fyndort	grave	smooth	limestone
65	18763:7	1091075		SpWh	stone	7	43.0	19.0	71.4	14.0	15.5	Eke	Petsarve	grave	smooth	sandstone shaping/cutting marks
66	99165:7	1091072		SpWh	stone	7	29.5	17.0	18.5	12.0	10.0	Boge	Lexarve	grave	smooth	possibly not spwh - whole seems naturally occurring
67	17039	1091073		SpWh	amber	6	29.0	8.0	4.0	10.0	10.5	Burs	Bandlunde	grave	smooth	
68	4689	1091086		SpWh	stone	2?	25.0	15.0	10.4	10.0	11.0	Hemse	nexhemmanet	grave	rough	2 pcs. Dimensions approx.
69	8919:02:00	1091077		SpWh	stone	6	27.0	10.0	9.8	9.5	11.0	Ekeby	Osterby	grave	smooth	poss. Burnt limestone
73	5035:a	1091088		SpWh	stone	2	35.0	19.5	27.2	12.0	12.5	Hemse	nexhemmanet	grave	semi-smooth	limestone possible rust deposit
74	3100	1091087		SpWh	amber	6	27.0	10.5	4.0	6.5	7.0	Horsne	Buters	grave	semi-smooth	shaped at top - possibly bead also?
75	19561:1	10901089		SpWh	stone	2	40.0	23.0	41.3	14.5	13.5	Klinte	Hunnige	grave	semi-rough	limestone possibly granite
76	12012	10901078		SpWh	stone	2	39.0	13.0	28.1	10.0	11.5	Eskelhem	Rovide	grave	smooth	
77	28043	1091079		SpWh	stone	2	32.5	16.5	19.9	11.5	13.0	Grotlingbo	Uddvide	grave	rough	broken - glued together
78	23438	1091080		SpWh	stone	2	33.0	19.5	23.8	11.0	11.5	Halle	Gannarve	grave	rough	fire affected - inside of hole burnt
79	19734:21	107620		SpWh	stone	2	35.0	18.5	30.0	13.5	14.0	Halle	Broa	grave	smooth	possible quartzite? Michael says limestone/sandstone
80	7839	107618		SpWh	stone	2	33.0	17.5	28.4	11.5	12.5	Garde	Halvands	grave	smooth	limestone?
81	5733	107622		SpWh	stone	2	31.5	15.0	18.4	9.5	13.0	Hemse	nexhemmanet	grave	semi-rough	
82	7643:01:00	107621		SpWh	stone	9	35.5	24.5	41.5	10.5	11.5	Hejdeby	Norrbys	grave	semi-smooth	
83	6698	107623		SpWh	stone	9	40.5	24.0	48.6	18.5	19.5	Norrlanda	Bjorke	grave	semi-smooth	coral?? Possible basketweaving tool?
84	4647	107627		SpWh	stone	2	42.0	22.0	37.9	13.0	13.0	Vänge	Nygards	grave		possible wear marks on "bottom"
85	DNR 431-764-11	2728		SpWh	stone	7	22.71	11.32	8.00	6.07	5.97	Vastergarn		sttlmt	smooth	indigenous??
86	431-764-11	2121		SpWh	bone	1	39.58	17.96	12.20	11.46	11.76	Vastergarn		sttlmt	semi-smooth	possible wear - use patina
87	431-2277-08	1931		SpWh	bone	1	38.83	15.38	9.50	9.22	11.52	Vastergarn		sttlmt	semi-smooth	visual of spindle hole size showing difference
88	GF C 8906		1	SpWh	stone	2	36.27	11.95	24.90	10.29	10.75	Akeback	Suderbys	grave	smooth	
89	C 71		1	SpWh	amber	4	29.45	15.80	7.40	8.58	10.11	Atlingbo	Atlings	grave	smooth	marks
90	C 6835		1	SpWh	stone	9	23.36	17.24	14.90	6.02	6.32	Barlingbo	Enlojane	grave	smooth	incised ring decorate around perimeter
91	C 10038:24-25	grave 4	2	SpWh	stone	7	26.36	6.06	3.90	8.26	9.58	Boge	Laxarve	grave	smooth	very worn - used constantly
92	C 10038:122	grave 15	2	SpWh	bone	1	41.60	19.23	11.90	14.74	12.36	Boge	Laxarve	grave	semi-smooth	underside missing - bottom of hole measurement approx.
93	C 8936:1		1	SpWh	stone	4	40.60	24.22	53.70	13.33	14.56	Eskelhem	Bringsarve	grave	smooth	difference top/bottom hole
94	A 2945		1	SpWh	stone	4	37.70	22.93	45.80	12.05	12.70	Eskelhem	Bringsarve	grave	smooth	use wear on top & bottom
95	C 8654	grave 13	2	SpWh	stone	4	33.28	22.83	29.70	11.64	15.38	Grotlingbo	Barshalder	grave	semi-smooth	basket tool??
96	C 5331		1	SpWh	stone	2	41.11	21.84	55.80	11.15	11.69	Hall	Gannarve	grave	smooth	
97	C 5339		2	SpWh	bone	1	45.82	24.12	15.10	preform?		Hall	Gannarve	grave	semi-smooth	preform whorl - no hole drilled
98	C 5537 1/2		2	SpWh	bone	1	40.64	24.99	15.40	11.24	11.63	Hall	Gannarve	grave	semi-smooth	
99	C 5337 2/2		2	SpWh	bone	1	44.89	26.00	19.80	preform?		Hall	Gannarve	grave	semi-smooth	preform whorl - no hole drilled
100	C 2101		1	SpWh	stone	2	34.49	15.14	26.60	8.43	9.16	Hellvi	Norrgarde	grave	smooth	
101	C 2103		1	SpWh	stone	4	38.31	24.13	51.20	12.16	13.50	Linde	Linde	grave	smooth	granite - hole tapered
102	C 2104		1	SpWh	stone	4	33.26	20.84	30.70	10.77	11.50	Linde	Linde	grave	smooth	granite
103	C 9458: 1-7, 9-10		2	SpWh	stone	6	45.81	11.14	24.80	9.52	9.71	Roma	Busarve	grave	smooth	whorl has shaped "crown"

104	C 9458: 1-7, 9-10		2	SpWh	bone	1	43.62	25.00	19.30	10.84	12.18	Roma	Busarve	grave	semi-smooth	
105	C 5526		2	SpWh	ceramic?	7	38.07	4.63/15.84	17.40	7.91	8.51	Visby	Altstad	grave	smooth	shaped clay?
106	C 10587:6		1	SpWh	stone	4	35.22	18.89	31.70	13.28	14.11	Visby	Str. Stadel	grave	smooth	excavated Stenberger - 1934
107	A 3142		1	SpWh	stone	5	37.35	24.52	49.20	11.38	12.90	Gotland		grave	smooth	
108	C 2873		1	SpWh	stone	3	32.18	12.15	17.50	9.76	10.33	Larbro	Pavalds	grave	smooth	
109	C 2874		1	SpWh	stone	2	37.72	16.84	26.00	14.82	15.52	Larbro	Pavalds	grave	semi-smooth	
110	C 10651:1		1	SpWh	bronze	6	35.11	1.80/9.81	15.20	7.38	8.30	Gotland		grave	smooth	design embossed on top of flat and collar
111	C 4014		1	SpWh	stone	4	45.45	27.74	78.40	12.42	13.51	Larbro	Pavalds	grave	semi-smooth	
112	C 4015		1	SpWh	stone	4	32.34	18.89	23.50	10.50	11.96	Larbro	Pavalds	grave	semi-smooth	
113	C 8936:1		2	SpWh	stone	4	34.47	22.69	37.40	9.98	11.52	Gotland		grave	smooth	
114	C 841		1	SpWh	stone	3	27.93	9.03	8.90	9.62	9.81	Gotland		grave	smooth	
115	C 837		2	SpWh	stone	2	39.29	21.10	38.80	13.52	14.23	Gotland		grave	semi-smooth	
116	C 831		2	SpWh	bone	1	43.22	24.25	19.30	14.66	15.61	Gotland		grave	semi-smooth	

STATUS classifications

1- complete object
2-small fragments missing
3- partial object
4- fragment

Category

SpWh - Spindle Whorl

WHORL TYPES

1 - spherical
2 - convex
3 - lenticular
4 - conical
5 - biconical
6 - cylindrical
7 - concave conical
8 - discoid
9 - other
10 - other

flat weight - looks like loom weight

	GRAVESITE #	CATALOG #	Status	CATEGORY	MATERIAL	TYPE	WIDTH/mm	ENGTH/m	EPTH/m	HOLE	WEIGHT/g	SITE	REGION	SITE TYPE	SURFACE	COMMENTS
1	SHM 11987 1/3	107573	2	WVCR	antler	flat	32.4	28	2.15	2.30	2	Broa	Halla	grave	smooth-partial	hole: 2.30; 2 comp/1 part hole
2	SHM 11987 2/3	107573	2	WVCR	antler	flat	32.22	29.93	2.02	1.80	2	Broa	Halla	grave	smooth-partial	hole: 1.80; 2 comp hole
3	SHM 11987 3/3	107573	1	WVCR	antler	flat	33.42	33.67	2.04	1.92	4	Broa	Halla	grave	smooth-partial	hole: 1.92; 4 comp hole
4	SHM 4683 1/2	107572	1	WVCR	antler	flat	34.65	35.3	2.92	2.80	6	Hemse	Hemse	grave	slightly porous	hole: 2.80; 4 comp hole-slight chip surface w/ use wear
5	SHM 4683 2/2	107572	1	WVCR	antler	flat	42.29	40.66	1.89	2.42	4	Hemse	Hemse	grave	slightly porous	hole: 2.42; 3 comp hole surface w/ use wear
6	SHM 5208:1644		1	WVCR	antler	flat	41.89	37.76	4.34	2.48	8	?	?	grave	slightly porous	hole: 2.48; 4 comp holes surface w/ use wear
7	SHM 32181:27E	24020	2	WVCR	antler	flat	36.03	35.49	2.91	3.41	4	Barshalder	Grötlingbo	grave	rough porous	hole: 3.41; 2 comp/ 2 part holes
8	SHM 32181:27E	24021	3	WVCR (3 pcs)	antler	flat	all partial p	all partial p	all partial pcs		2	Barshalder	Grötlingbo	grave	rough porous	c piece shows either drilling or decoration
9	SHM 22917:232 1/2	108040	1	WVCR	antler	flat	36.54	35.35	1.95	2.46	2	Stora Ire	Hellvi	grave	rough	#1 shows definite wear/use marks w/ runes carved into on 1 side, use patina
10	SHM 22917:232 2/2	108040	1	WVCR	antler	flat	40.05	39.06	1.59	2.18		Stora Ire	Hellvi	grave	rough	use patina
11	GFC C 9332: 224 Gr.230B		1 & 3	WVCR (1 whol	antler	flat	35.67	36.15	1.38	2.44	2	Ire	Hellvi	grave	smooth	pcs - not sure if cards, some decoration, some wear
12	431-764-11	2480	1	WVCR	antler	flat	44.64	44	1.49	2.37	4.9	Vastergarn		sttlmt	semi-smooth	possibly wear marks on holes - 2.12, 2.53, 3.07
13	431-764-11	202	1	WVCR	antler	flat	37.5	18.02	2.06	1.92	2.4	Vastergarn		sttlmt	semi-smooth	2 partial holes
14																

almost all weaving cards are described as being made from horn, but actually antler as they are all very flat and do not show growth lines as horn does, most likely elk antler.

SHM - Staten Historiska Museet, Stockholm
GFC - Gotland Fornsal Museum

Knudsen, NESAT X - tablet from Trondheim 62 mm - Oseberg 47squared - Lund 48squared
wear marks on tablets from Paris showing diagonal lines - wear marks on Gotland at holes show use - not just for burial

1- whole - greater that 80%   **2- partial greater that 50% can get all dimensions**   **3- partial with less than 50% dimensions not diagnostic**

APPENDIX B

1. Grave SHM 21394 Eke Parish - Amber

1. Grave C 71 Atlingbo Parish - Amber

2. Grave SHM 19734:25:2 Halla Parish - Amber and Stone

3. SHM 3100 Horsne Parish - Amber

4. Grave 10651:1 Gotland - Bronze

5. Grave 10651:1 Gotland – Bronze

6. Grave 27739:1d/61Grötlingbo
Parish - Bronze

b

7. Grave SHM 9566 Sanda Parish - Bronze

8. Grave SHM 9566 Sanda Parish – Bronze

9. GFM C 6835 Barlingbo Parish – Stone

11. Grave GFM 5526 Visby – Ceramic

10. Grave SHM 14287 Eke Parish -
Stone

11.Grave SHM 27778:13Grötlingbo
Parish - Stone

12. Grave SHM 6194 Vänge
Parish - Stone

13. Grave SHM 13329:20 Vall Parish - Stone

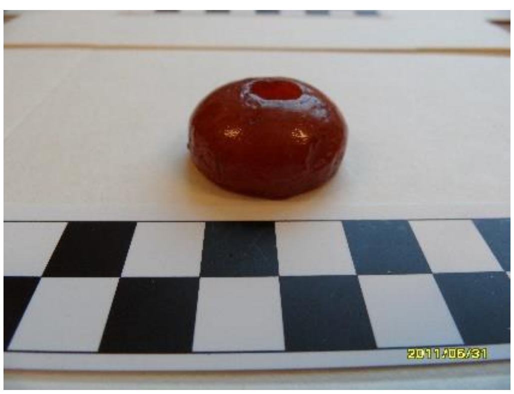
14. Grave SHM15616:12 Vall Parish - Bone

15. Grave SHM 14744:4 Havdhem Parish -
Stone

16. Grave GFM C 10221:100 Gr. 239 Hellvi
Parish - Stone

17. Grave GFM C 9458:1-7, 9-10 Roma Parish – Stone

18. Grave SHM 27739:11/61 Grötlingbo Parish – Stone



19. Grave GFM 9322:173 Gr. 218A Hellvi Parish – Amber

20. Grave GFM C 2873 Larbro Parish – Stone

21. Grave GFM C 9332:224 Fr. 230B Hellvi Parish – Antler

22. Grave SHM 22917:232 Hellvi Parish - Antler

23. Grave SHM 32181:27E Grötlingbo Parish – Antler

26. Grave/site SHM 25113 Fole Parish - Bone needle case with needle

27. Grave/site SHM12335 Dalhem Parish – Bronze needle case

28. Grave/site SHM 32458:1 Hemse Parish – bronze needles

29. Grave/site SHM 10736:1 Grötlingbo Parish – bronze needle case with textile

30. Grave/site SHM 12335 Dalhem Parish – Bronze needle case with needle

31. Grave/site SHM 4939 Havdhem Parish – Bronze needle

32. Grave/site SHM 29561 F83 Lummelunda Parish – Bronze needle

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