Artifactual Evidence for the Role of the Warp-Weighted Loom: The Transformation of Textile Production in the Iron Age Levant

A Dissertation Presented

by

Thaddeus Jacob Nelson

to

The Graduate School

in Partial Fulfillment of the

Requirements

for the Degree of

Doctor of Philosophy

in

Anthropology

Stony Brook University

May 2016

Stony Brook University

The Graduate School

Thaddeus Jacob Nelson

We, the dissertation committee for the above candidate for the

Doctor of Philosophy degree, hereby recommend

acceptance of this dissertation.

Dr. Paul Zimansky – Dissertation Advisor
Professor, Interdepartmental Program in Anthropological Sciences

Dr. John Shea - Chairperson of Defense
Professor, Interdepartmental Program in Anthropological Sciences

Dr. Katheryn Twiss
Associate Professor, Interdepartmental Program in Anthropological Sciences

Dr. Elisabeth Hildebrand
Associate Professor, Interdepartmental Program in Anthropological Sciences

Dr. Laura Mazow
Assistant Professor, Department of Anthropology, East Carolina University

This dissertation is accepted by the Graduate School

Charles Taber
Dean of the Graduate School

Abstract of the Dissertation

Artifactual Evidence for the Role of the Warp-Weighted Loom: The Transformation of Textile Production in the Iron Age Levant

by

Thaddeus Jacob Nelson

Doctor of Philosophy

in

Anthropology

Stony Brook University

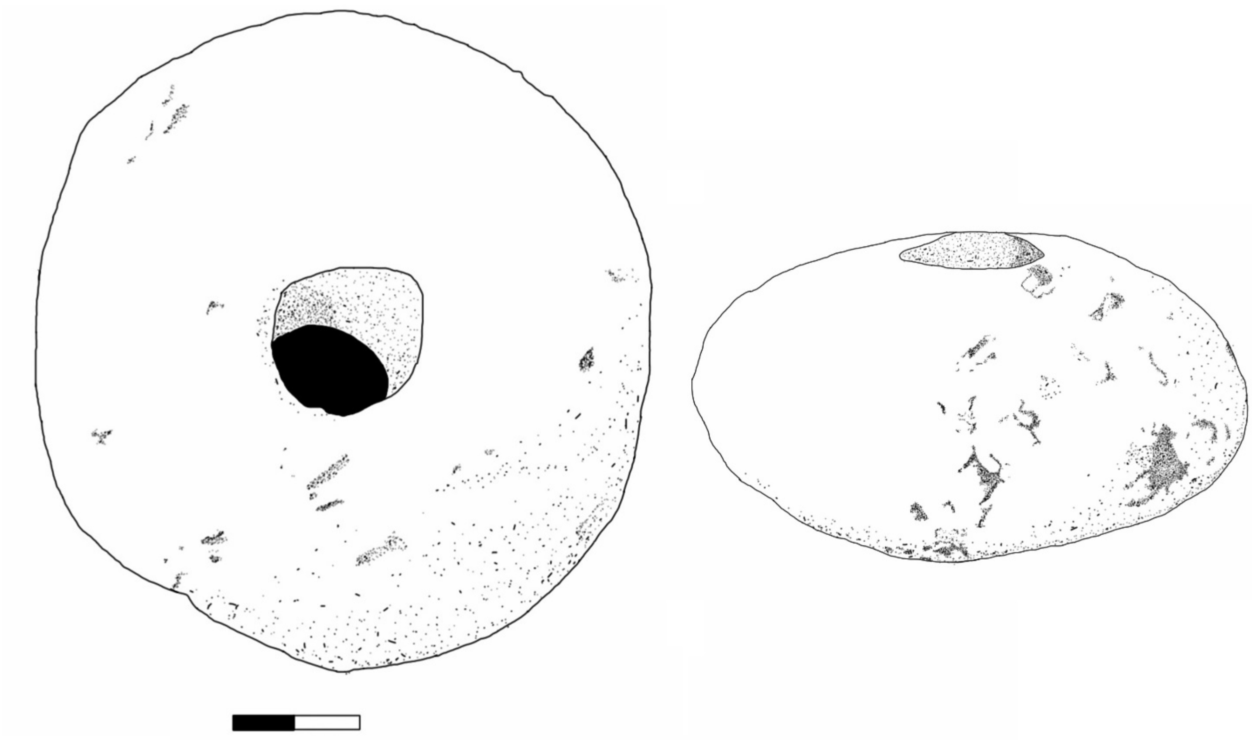
2016

This thesis presents a comparative study of textile tools and textile remains from the Iron Age II (c. 1000 – 500 BCE) Levant as a means to investigate textile production and procurement in international economies. Earlier studies interpret the increase in loom weights (components of warp-weighted looms) during the Iron Age II as evidence that weavers working with these looms were the predominant source of textiles in the Levant. Yet there is no consensus on the nature of the textiles woven on warp-weighted looms, which authors independently describe as fine trade commodities, tapestries for tribute payments, and coarse fabrics for households and agricultural industries. This study builds on results of Martensson et al.'s (2009) experimental weaving to describe a new approach for reconstructing the textiles woven with Iron Age II warp-weighted looms from loom weights. These reconstructions are compared to textile remains and textile impressions in order to describe the variation in fabrics that could have been woven with warp-weighted looms. Applied to loom weights from twelve Iron Age II sites, this method shows that Levantine warp-weighted looms were best suited for weaving multiple types of animal fiber (i.e. wool and goat hair) textiles rather than fine bast fiber (i.e. linen and hemp) fabrics. This demonstrates that Iron Age II society had multiple strategies to produce and procure textiles, some of which may have been overlooked due to ubiquitous evidence for warp-weighted looms.

Dedication Page

For my parents, John R. Nelson and Anne Y. Nelson, who instilled in me an understanding of the importance of the endeavor of crafting.

Frontispiece



Vertically pierced (donut) weight from Beth-Shean - Artifact 29-103-706 at the University of Pennsylvania Museum of Archaeology and Anthropology and Anthropology

Table of Contents

List of Figures

List of Tables

Acknowledgments

I would like to take this opportunity to thank the people who helped me during by time at Stony Brook University. It is hard to explain or even count the contributions of other people to my work on this project, but I will try to thank them for their assistance.

First, I would like to thank my advisor Professor Paul Zimansky. Years ago while discussing my course schedule for a new semester; Paul was the first to suggest that I adopt textile production as a dissertation topic. Without this suggestion, you would be reading an entirely different project. I must also thank Paul, along with Professor Elizabeth Stone, for the opportunity to work at Ayanis during my first year at Stony Brook.

I would also like extend my gratitude to my internal committee members, Professor John Shea, Professor Katheryn Twiss, and Professor Elisabeth Hildebrand. I thank John for advice both on the study of ancient tools and on professional skills. I thank Kathy for stepping in and countless points to guide me with regard to departmental guidelines and help develop my understanding of the animals and plants used in textile production. I thank Lisa for helping develop my theoretical background through multiple courses and for advice on navigating real life in graduate school. I would also like to thank the many other IDPAS faculty and staff members who supported my studies.

I am thankful for the help of my external committee member Professor Laura Mazow of East Carolina University. Laura stepped in toward the end of this project and ended up with more work than I think she expected. Her guidance helped develop and clarify the product of this research project. I would also like to acknowledge the role of Irene Good, whose early work on my committee provided direction for my research.

I would also like to express my appreciation for the many colleagues whom I have worked with during my time in graduate school. I thank Dr. Oded Borowski, and Dr. James W. Hardin whose work at the Lahav Research Project served as my introduction to excavation in the Levant, and who have both consistently encouraged my work. I also thank the numerous people studying textiles and textile production in Southwest Asia who have provided guidance or clarification during my research. This list of such individuals includes Dr. Agnete Wisti Lassen, Dr. Caroline Sauvage, Dr. Orit Shamir, Deborah Cassuto, and Dr. Eva Andersson Strand.

I would also like to express my appreciation to Katherine Blanchard and the staff of the Near Eastern Section of the University of Pennsylvania Museum of Archaeology and Anthropology. Katherine and her staff at the university provided invaluable access to the museum's collection of textile related artifacts.

My experience in graduate school has included many people who I think of as both friends and colleagues. I met Stephanie Rost, Helen Malko, Arzu Demirergi, and Jennifer Henecke in a class before I even enrolled at Stony Brook, and they have each been part of my experience of graduate school: conferences, excavation, as well as less academic settings of Long Island's beaches and restuarants. I have also had the chance to call many other students in the department friends; Jen Everhart, Jesse Wolfhagen, Justin Pargeter, Hilary Duke, Matthew Sisk, and Sarah Pilliard are all important figures in my life, without whom I cannot imagine Stony Brook. Of course, I must also extend my gratitude to the other IDPAS students who have helped proof conference presentations or shared a beer. I would also like to thank the staff of Stony Brook University with whom I worked as a student employee over the last three years: Donna Malloy, Kathleen Paterno, Wendi Mathews, Glenn Dausch, Christopher Morris, Christopher Heedles, and the many student employees.

I cannot finish without thanking my family. I was fortunate enough to grow up surrounded by a family of crafters whose skill included everything from fine woodworking to knitting, and who provide inspiration for my interest in ancient weavers. I could not choose anyone better than my father, John R. Nelson, with whom to launch a boat at dawn or with whom to share a beer at midnight. My mother, Anne Y. Nelson, is a voice of constant inspiration and strength, whose skill with yarn drew me to start working with fibers and textiles myself. I would also like to thank my brother, Zack Nelson, who followed our parents' inspiration to become a metal smith and works to be an independent artist.

Finally, I would like to thank my girlfriend, Suzanne Burkett. She has put up with all the stress and long nights of my work on this project. While I worked to reconstruct the story of ancient weavers, she constructed a business that caters to today's weavers and knitters. She listened when I needed to talk and left me along when I needed peace. I would never have gotten through this project without her.

Chapter 1: Changing Textile Practices in the Changing World of the Iron Age II Levant

Spinning fibers into yarn (i.e. a continuous strand made by spinning fibers together. See Glossary in Appendix P) is inferred from Upper Paleolithic threads and iconography to be one of the earliest human technologies (Kvavadze et al. 2009; Nadel et al. 1994; Soffer et al. 2000). Barber (1994: 42-70) describes the Upper Paleolithic invention of yarn as a *String Revolution*: a gateway to new composite tools (e.g. fishing nets), containers, household furnishings, clothing, and structures (e.g. tents). Soffer and colleagues (2000) identify the invention of yarn as a key component in symbolic communication through garments. Transforming yarn into the items that people use is a time consuming endeavor; even a single garment can require the hands of multiple workers spinning and weaving for days or weeks (Lipkin and Jarva 2014). Barber argues (1991: 4-5) that the sum of human labor spent in textile production may be greater than that of any other technology. Technological developments in textile production have led to other "revolutions" since the Upper Paleolithic *String Revolution*. For example, McCorriston (1997) identifies the development of wool textile production in 3rd Millennium Mesopotamia as a *Fiber Revolution.* Instead of countless workers growing flax on the best agricultural land, the development of wooly sheep permitted a small number of shepherds produced a greater amount of wool herding sheep in low quality land. McCorriston (1997) argues that these changes in labor and agricultural organization contributed to the development of urban centers, workshops, and state and temple elites.

A further example of social changes associated with a transition in textile production technology is the Iron Age II Levant (c. 1,000 – 500 BCE). Social changes in this period include growth of urban centers, transition from household to royal industries, and reorganization of agricultural trade (Eitam 1990a; Faust 2013: 211; Hopkins 1996; Master 2014). A dramatic increase in the number of loom weights (components of warp-weighted looms. See Glossary in Appendix P) recovered in Iron Age II Levantine sites is evidence of a change in textile production (Cecchini 2000: 212-216; Shamir 1996: 140). Multiple authors argue that this technological transition was driven by new demands for textiles created by changes in Iron Age II society (e.g. Boertien 2013; Browning 1988; Browning 2001; Cecchini 2000; Friend 1998). Yet these authors do not describe a textile revolution, but instead they theorize that weavers used warp-weighted looms to fulfill a single distinct market demand (e.g. fine trade textiles, fine cultic textiles, fine fabrics used for tribute payment, or coarse utilitarian fabrics). The present study describes a new analysis of Iron Age II loom weights that concludes that warp-weighted looms from this period were versatile tools used to weave multiple types of fabric, and therefore the large number of weights from this period was not the result of a single new demand, but a component of a suite of social transitions.

Textile Production in the Iron Age II Levant

Loom weights occur in only a small number of Levantine Iron Age I (1200 – 1000 BCE) and Bronze Age (3300 – 2000 BCE) sites (Cecchini 2000: 219-220; Shamir 1996: 140-142), but loom weights are found in nearly every Iron Age II site (Boertien 2013: 24-26, 251; Shamir 1996: 140-142). Multiple authors write that loom weights occur in greater numbers in Iron Age II sites than in sites from earlier periods (e.g. Boertien 2004; Cassuto 2012; Shamir 2007b: 47). Explanations for the higher number of loom weights in the Iron Age II include a technical shift away from the use of other types of looms (Cassuto 2012: 473) or an increase in weaving activity (i.e. more looms used by more weavers to make more fabric) (Boertien 2013: 251-252).

Multiple studies note that Iron Age II loom weights were larger than Bronze Age or Iron Age I loom weights (e.g. Boertien 2013: 114; Browning 2001: 252; Cassuto 2012: 471; Cecchini 2000: 230-231). A change in the size of loom weights is further evidence that weaving practices changed during the Iron Age II (e.g. the production of a new type of fabric) (Martensson et al. 2009).

Although authors generally agree that Iron Age II weights are more numerous and larger than weights from earlier periods, they do not agree on how these changes related to the social changes in Levantine society (e.g. Boertien 2013; Browning 1988, 2001; Cassuto 2012; Shamir 2007b).

Textiles in the Changing Iron Age II Society

The Levantine Iron Age II (c. 1000-539 BCE) was a period of social and economic centralization (Faust 2013; Harrison 2001: 128-129; Master 2014: 128-129). Many Iron Age II sites were walled urban centers (Faust 2013: 211; Master 2014: 85-86). Royalty and priests controlled the urban centers and their economies (Faust 2013: 211; Hopkins 1996; Master 2014), The elites' power extended through smaller outposts to rural populations (Hardin et al. 2014). They used their control of local agricultural industries and trade routes to amass wealth that permitted them to maintain their power (Eitam 1990a; Holladay 2006).

Boertien (2013: 283-312; 2014) writes that loom weights from Iron Age II cultic contexts at Deir 'Alla and Kuntillet 'Ajrud show that weavers used warp-weighted looms to produce textiles for powerful religious officials. She argues that heavy Iron Age II weights were suited to weaving fine textiles from special fibers: linen, hemp, and *sha'atnez* (i.e. textiles with mixed wool and linen threads).

Levantine Agricultural Industries

During Iron Age II, large industrial olive and grape press buildings replaced small lineage or family operated presses (Faust 2013: 68-71). Multiple authors interpret the new presses as evidence that olive oil and wine production were the primary industries controlled by Iron Age II royalty and temples (Eitam 1990a; Faust 2008: 267).

Like olive oil and wine production, weaving transformed agrarian (e.g. flax and hemp) and pastoral (e.g. wool and goat hair) raw materials into a commodity. Some authors argue that loom weights found in Iron Age II olive oil and wine press buildings show that textile production occurred in these buildings when grapes and olives were not being pressed (Gitin 1997: 90; Shamir 2007b: 45). These authors conclude that the heavy loom weights found in olive oil and wine press buildings were parts of warp-weighted looms used to weave coarse animal fiber (e.g. goat hair or wool) textiles (Gitin 1997: 90; Shamir 2007b: 46). Eitam (1990b) suggests that these coarse fabrics were tools used in the production of olive oil and wine.

Long Distance Trade

The Iron Age II Levant was a crossroads of long distance trade routes. By the Ninth Century, Philistine and Phoenician cities on the Levantine coast were trading with Egypt, Anatolia, Greece, and Cyprus (Brugge and Kleber in press; Faust 2011: 74; Master 2003; 2014: 89). The Phoenicians trade from Tyre and other Northern Levantine cities is of interest, because these cities were known for the production of purple shellfish-dyed textiles (Astour 1965; Holladay 2006: n.9).

As early as the Tenth Century, trade routes connecting the Arabian Peninsula and Mesopotamia traversed the Levant (Bulliet 1990: 65-68). These caravans carried incense, textiles, and precious stones. Byrne argues (2003: 14-15) that the blue-purple textiles that Neo-Assyrian texts describe in one caravan were Phoenician shellfish-dyed textiles. Thus, the Arabian caravans not only provided new commodities to the Levant, but they also created a new market for Levantine textiles.

Boertien (2013: 25-26, 269-271) argues that Iron Age II weavers who produced fine textiles for trade used warp-weighted looms. She concludes that the large number of loom weights in Iron Age II contexts as evidence of village level industries that produced surplus textiles for exchange.

Neo-Assyrian Imperial Impact on Textile Production

Beginning in the Eighth Century, the Neo-Assyrian Empire expanded into the Levant by conquering Levantine kingdoms (Faust 2011: 63; Holladay 2006). The Neo-Assyrian Empire extracted wealth from the Levantine states by collecting annual tribute. When Levantine rulers refused to pay the required tribute, the Neo-Assyrians army marched on the Levantine cities and took their valuables (e.g. ivory, gold, and furniture) (Faust 2011: 71-74; 2013; Grayson and Novotny 2012: 65-66; Jankowska 1969; Leichty 2011: 16). Neo-Assyrian kings frequently recorded fine textiles in the lists of valuables taken as tribute and as military prizes (See Table 1.1).

Browning (1988) argues that the large number of loom weights in Iron Age II contexts reflects an increased demand for Levantine textiles used to fulfill tribute obligations. He theorizes that heavy Iron Age II loom weights permitted Iron Age II weavers to produce the fine tapestries described in Neo-Assyrian tribute lists (Browning 2001: 252-253).

Table 1.1: List of Neo-Assyrian kings who took textile tribute from the Levant (Grayson and Novotny 2012: 65-66; Leichty 2011: 16, 55-56, 304-305; Lie 1929: 27-29; Oates and Oates 2004: 226-227; Page 1968: 143-145; Roaf 1990: 132-197; Tadmor et al. 2011: 37-131; Yamada 2000: 243-247)

	Reign (date BCE)
Ashurnasirpal II	883-859
Shalmaneser III	858-824
Adad-Nirari III	810-783
Tiglath-Pileser III	744-727
Sargon II	721-705
Sennacherib	704-681
Esarhaddon	680-669
Ashurbanipal	668-627

Explanations for Changes in Iron Age II Weaving Practices

As described above, multiple authors suggest that Iron Age II weavers used warp-weighted looms to meet new demands created by changes in Levantine society. These authors agree that Iron Age II loom weights are heavier and more numerous than weights from earlier periods. Yet, they conclude that the high mass permitted weavers to produce different styles of textiles (e.g. fine cultic textiles, fine trade goods, fine tapestries, or coarse utilitarian fabrics), and that different social changes lead to increased demand (e.g. development of cultic elites, growth of long distance trade, new imperial tribute demands, or formation of royal wine and olive oil industries) (Boertien 2013: 25-26, 269-271; Browning 1988, 2001; Eitam 1990b; Gitin 1997: 89-90). Either one can conclude that some of these reconstructions are not valid and that Iron Age II warp-weighted looms had only a single function, or one can conclude that Iron Age II warp-weighted looms were versatile tools used to weave multiple types of textiles.

This study will evaluate each reconstruction of Iron Age II textile production as a hypothesis of the type of fabric made with warp-weighted looms. In order to test these hypotheses, this study returns to the Iron Age II loom weights with a new method developed by Martensson and colleagues (2007a, 2007b) to reconstruct the fabrics woven with Iron Age II loom weight. The results will demonstrate that Iron Age II warp-weighted looms were versatile tools used to weave multiple types of fabric and thus changes in how weavers used warp-weighed looms may have been part of a suite of changes in Iron Age II society.

How to Reconstruct Fabric from Loom Weights

Unlike other forms of material culture, such as ceramics, metals, or lithics, textiles rarely survive in the archaeological record. Therefore, the tools used to produce textiles (e.g. spindle whorls and loom weights) are often the only archaeological evidence of textile production (Barber 1994: 24-25; Olofsson et al. 2015: 75-76). Studies of Mesoamerican spindle whorls show that analyses of measurable characteristics (i.e. diameter, mass, thickness) can be used to reconstruct variation in finished textiles (e.g. fiber type) from non-perishable artifacts (e.g. Brumfiel 1991; Parsons and Parsons 1990: 314-316). In order to reconstruct textiles from tools, one must understand how variation in the tools creates variation in finished textiles.

Recent experimental work by Martensson and colleagues (2007a, 2007b; 2009) demonstrates a method to reconstruct the fabric woven with a given loom weight. By weaving with different sets of loom weights, Martesson et al. show that a loom weight's mass and thickness constrain the quality of fabric which it can be used to weave. These results demonstrates that earlier reconstructions of Iron Age II textiles disagree on the fabrics woven with warp-weighted looms: they overlook the importance of loom weight thickness (Martensson et al. 2009: 382-386).

This study builds on Martensson et al.'s methods to analyze Iron Age II loom weights. The approach described in Chapter 4 reconstructs textiles' warp arraignments from loom weights using a set of four inequalities. However, these results provide only a partial reconstruction of the variation of textiles woven with Iron Age II loom weights: the thickness of warp threads and the warp count. These reconstructions are compared to the warp thread arrangements of Iron Age II textile remains and impressions in order to reconstruct additional characteristics of the textiles woven with warp-weighted looms: fiber type and weft thread count. This approach requires two samples of artifacts: loom weights and textile remains and impressions.

Artifacts that Provide Evidence of Iron Age II Weaving Practices

Evidence of weaving is common in the Iron Age II material record and includes loom weights, textiles, and textile impressions. Thousands of loom weights have been excavated from Iron Age II sites, which suggests that the warp-weighted looms of which they were a nearly ubiquitous tool in Levantine villages and cities.

This study analyzes 1,865 loom weights from 12 sites, of which measurements are available for 1,170 of the weights (See Figure 1.1). Measurements of the weights are from published site reports and the collection of the Pennsylvania University Museum of Anthropology and Archaeology (See Chapter 3). The sample is geographically, materially, and formally diverse (See Chapter 3). Thus, this sample reflects the potential variation in Iron Age II warp-weighted looms.

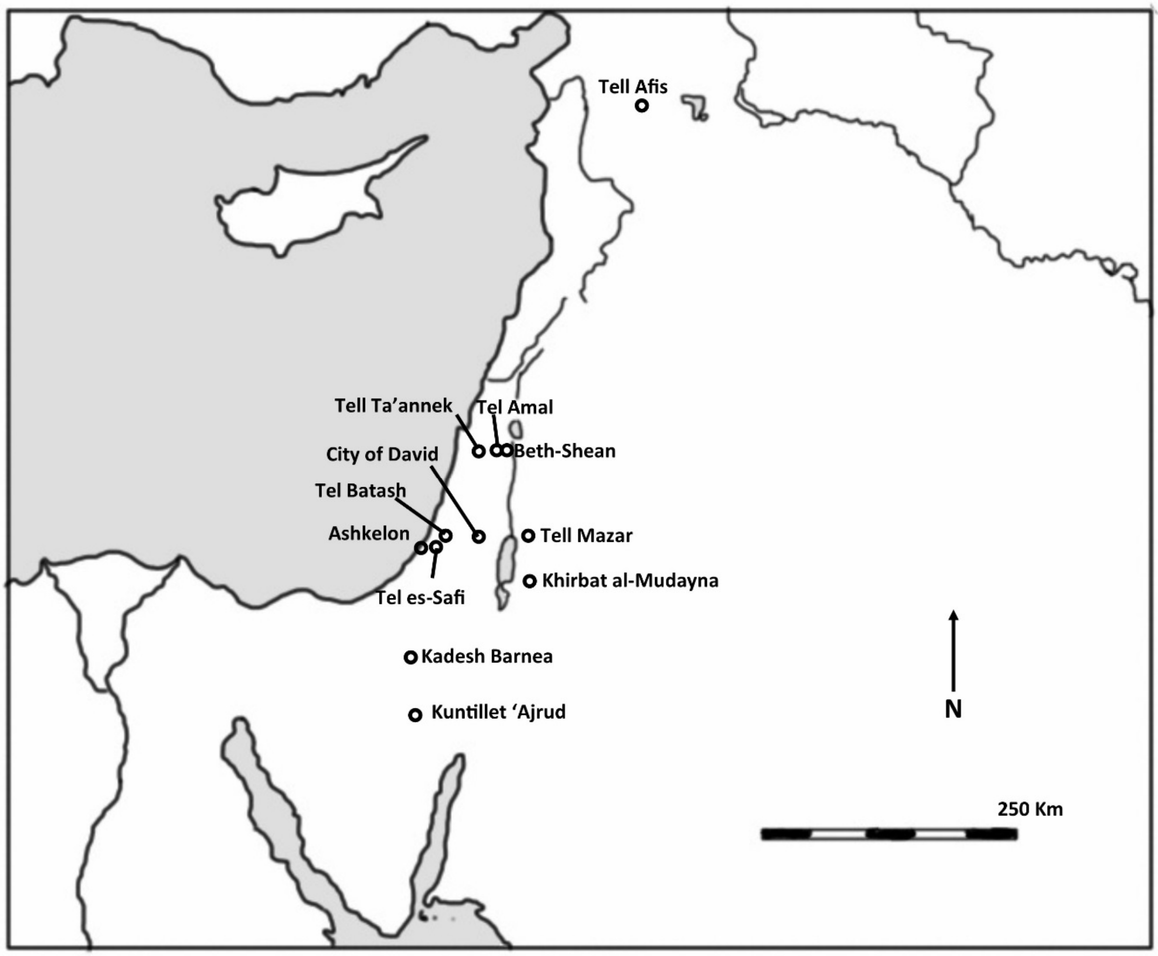


Figure 1.1: Map of sites with loom weights analyzed in this study (Background map from Killebrew and Steiner 2014)

The number of textile remains and impressions recovered from Iron Age II sites is relatively large, even though these materials preserve poorly in the archaeological record. This study collects data from published descriptions of 227 textile fragments and 16 textile impressions from Iron Age II sites (See Figure 1.2). This sample includes all textiles remains and impressions identified by a literature survey. Therefore, these remains and impressions demonstrate the known range of variation in finished textiles: fiber types (i.e. linen, wool, goat hair, hemp, or mixed fabrics), thread count (i.e. the number of warp and weft threads in one centimeter of fabric), and thread thickness (i.e. the diameter of threads).

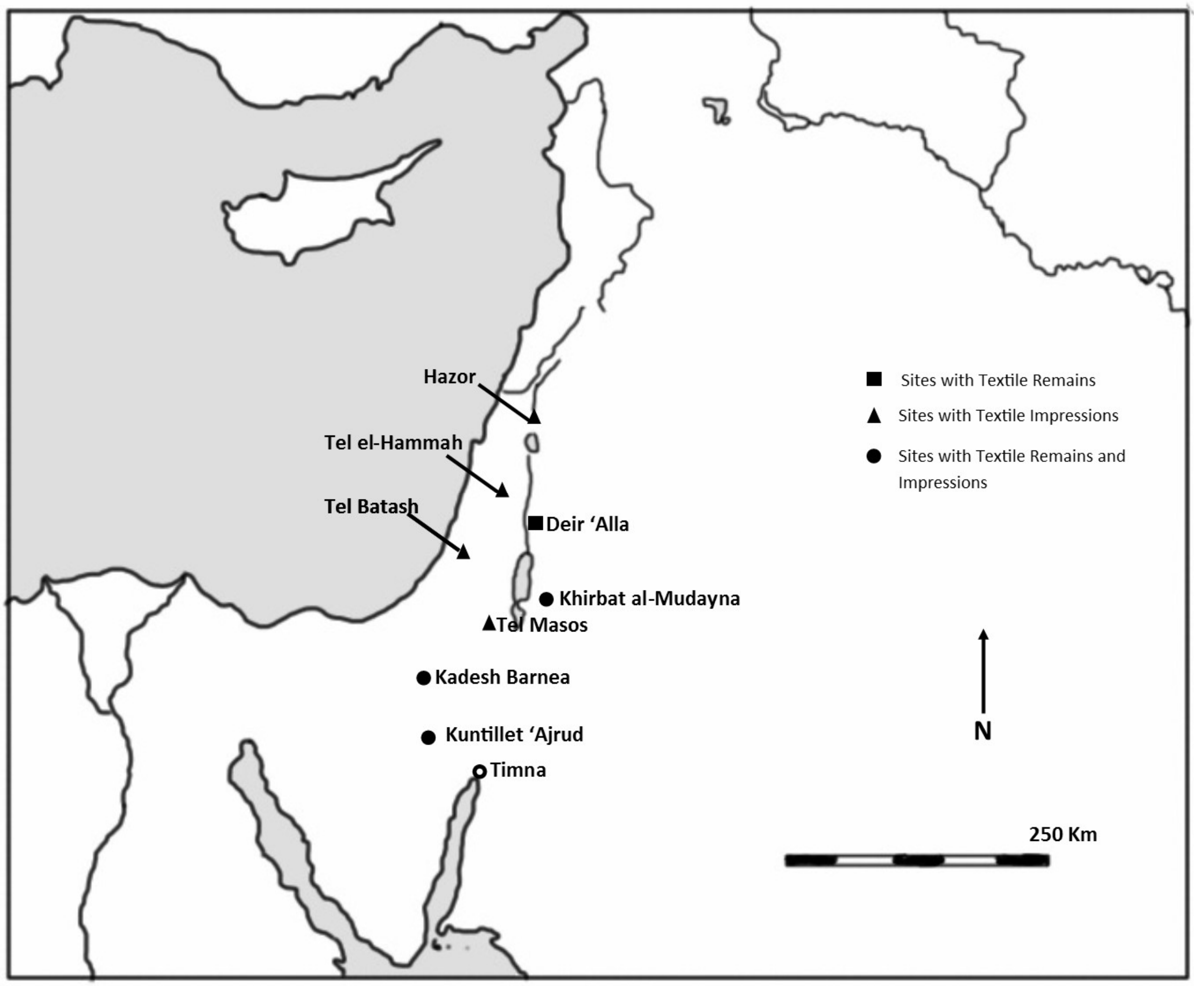


Figure 1.2: Map of sites with textile remains and fabric impressions analyzed in this study (Background map from Killebrew and Steiner 2014).

A New Reconstruction of Iron Age II Textile Production

The increase in Iron Age II loom weights suggests that there was a change in textile production. The following chapters develop a new reconstruction of the fabrics woven with Iron Age II warp-weighted looms (See Chapters 4 and 5). The results described in Chapter 6 show that warp-weighted looms were used to weave multiple types of animal fiber textiles. Thus, weavers did not use these looms to meet a single market's demand, but to fulfill multiple demands for textiles associated with different aspects of Iron Age II society: trade, industry, and domestic activities.

Chapter 2: The Place of the Warp-weighted loom in Iron Age II Levantine Society

Iron Age II weavers made extensive use of the warp-weighted loom. This is evident from the thousands of loom weights recovered in excavations. However, few weavers outside of historic reenactments use warp-weighted looms today, and therefore they are unfamiliar to most people (Barber 1991: 4-5). This chapter provides a review of background information on warp-weighted looms necessary to investigate their use in the Iron Age II Levant.

The modern understanding of warp-weighted looms comes primarily from Hoffman's (1974) ethnographic observation of Finnish and Norwegian weavers and from interpretations of Greek images of warp-weighted looms (e.g. Carroll 1983; Crowfoot 1936: 40-42; McLaughlin 1981). A warp-weighted looms is a rectangular frame which is positioned at a slight angle to the ground (Britnell 1977). The frame is usually taller than the weaver and slightly wider than the textiles woven on the loom. Vertically oriented warp threads are tied to a bar (called the beam) placed across the top of the loom. A loom weight is tied to each group of warp threads. Weights made of stone and clay occur in the archaeological record (Andersson Strand 2015: 52-53). The weight hangs below the threads to create tension (See Figure 2.1). Maintaining appropriate tension on the warp threads keeps the threads parallel down the length of the fabric as a second horizontal set of threads (i.e. the weft threads) is added to the fabric. Loom weights of different sizes, shapes, and materials create appropriate tensions for the material (bast fiber warp threads require more tension than do animal warp threads) and thickness of warp threads used (thick warp threads require more tension than do thin warp threads) (Hoffmann 1974: 23-92; Martensson et al. 2009).

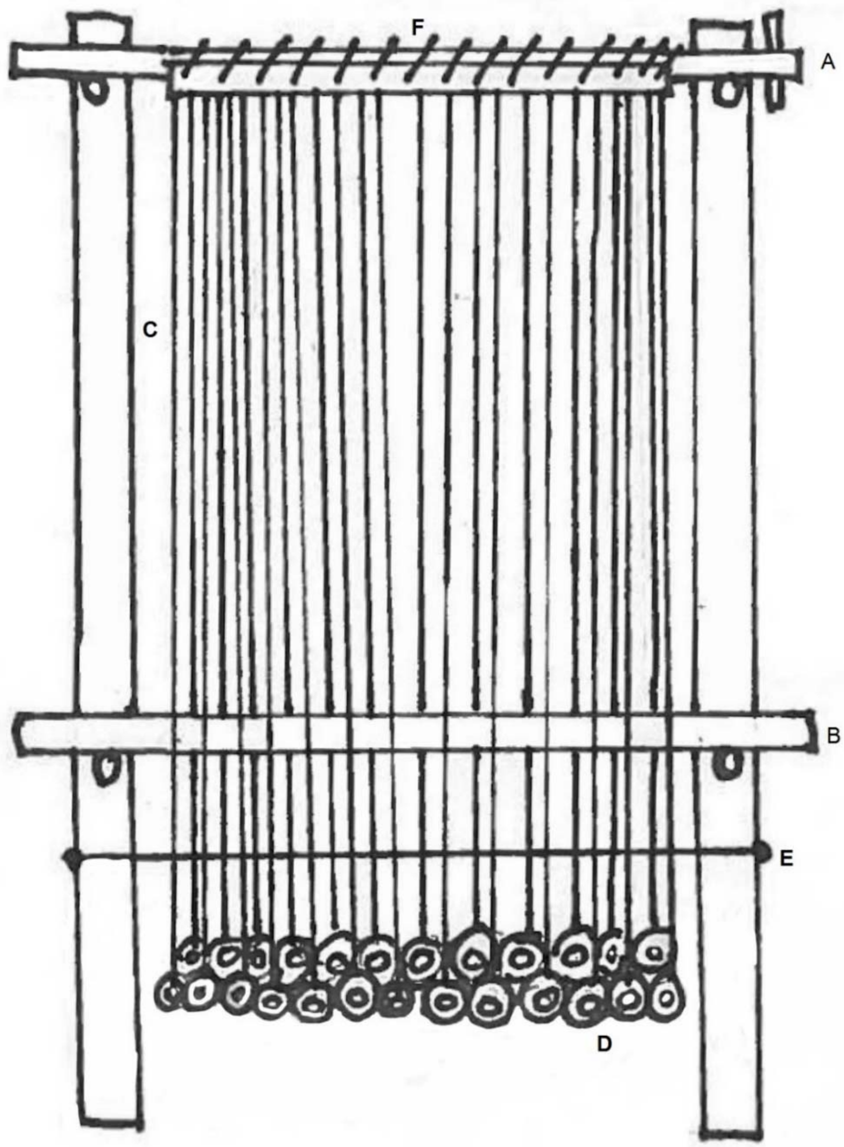


Figure 2.1: Front view of warp-weighted loom (A Beam, B Heddle Rod, C warp threads, D loom weights, E spacing cord, F starting border) (After Hoffmann 1974: 24)

History of Identification of Levantine Loom Weights

Cassuto (2012: 468) cites Bliss and Mcalister's excavations in the late Nineteenth Century as the first publications of Levantine data to describe these artifacts as loom weights, but the function of "loom weights" has not always been certain. Multiple authors suggest other uses for this type of artifact. A review of the arguments for other identifications demonstrates that these other uses are implausible (Cassuto 2012: 468-469; Shamir 1996: 142-145; Sheffer 1981, 1988). Alternative interpretations of these artifacts, first suggested in the Mid-Twentieth Century, include sinkers for fishing nets and heat storage devices for ritual sacrifices (e.g. Lapp 1969: 47; Maisler 1950: 197; B. Mazar et al. 1964: 25). Iron Age II loom weights could not have functioned as fishing sinkers, because they are made from unbaked clay which crumbles when wet (Shamir 1996: 142). Friend (1998: 5) examined the clay balls from Ta'annek that Lapp (1969: 47) identifies as heat storage tools, but she found no evidence that the artifacts had been exposed to heat.

Because a small number of these artifacts were found sitting in jar mouths, Gal (1989) argues that they are stoppers used in the fermentation of wine and beer. He suggests that the hole in the center of each clay ball allowed gasses to escape during fermentation. This interpretation is used by multiple other authors who interpret these artifacts as evidence of ancient brewing and wine making (Ebeling and Homan 2008: 58-90; Homan 2004: 89-91; Stager 1996). However, Master (2011) writes that many of the clay balls found in the Ashkelon winery, a context in which fermentation stoppers are expected, are too small to have sat in jar mouths. Further, many of these balls were found in lines, as one would expect if the weights fell from abandoned looms (Barber 1991: 93; Cassuto 2012: 467). This leads Master to conclude that the clay balls may have sometimes been used as stoppers, but that they were primarily loom weights (Master 2011).

Castro Cural (1988) argues that the perforated clay balls found in Iron Age II sites could not have been loom weights, because they lack string marks that would result from suspending weights from the warp threads and because they are too fragile to have been used on a loom. Sheffer (1981, 1988) and Shamir (1996: 141-142) refute these arguments with independent success weaving with replica loom weights, that demonstrate that the clay balls were not too fragile for this function. In a separate experiment, Shamir (1996: 143) tied warp threads to clay loom weights and then moved the weights to simulate weaving, showing this activity did not create string marks on the loom weights. She argues that this demonstrates that warp threads do not always leave visible marks on loom weights.

History of Warp-weighted looms in the Levant

Bronze Age Loom Weights

The warp-weighted loom is thought to have been developed in Northern Anatolia during the Neolithic (c. 9,700 – 5,300 BCE) (Barber 1991: 113, 301). The earliest Levantine loom weights are from only three Early Bronze Age sites (See Table 2.1) (Fischer 2008: 201; Friend 1996: 55-56; 1998: 12-14). Shamir (1996: 139-140) identifies fifteen Middle Bronze Age sites with loom weights and 5 Late Bronze Age sites with loom weights.

Iron Age I Loom Weights

Loom weights have been reported from nine Iron Age I sites (Lehmann et al. 2010: 149-151; Rahmstorf 2005: Appendix 2). The earliest loom weights found in the Northern Levant come from this period (Cecchini 2000).

Iron Age II Loom Weights

Loom weights are nearly ubiquitous in the Iron Age II. They are reported from sixty-two sites (Boertien 2012; Cecchini 2000; Dagan and Cassuto 2013; P. M. M. l. Daviau 2002; P. M. M. Daviau and Dion 2002; Hardin and Blakely 2014; Peyronel 2007; Shamir 1996; Stone and Zimansky 1999). This number is greater than the sites in all earlier periods combined. Several authors argue that there are large numbers of loom weights from this period (e.g. Boertien 2004; 2013: 13; Browning 1988: 157; Cassuto 2012; Shamir 2007b: 47). The larger number of Iron Age II sites with weights and the larger quantity of weights overall suggests that there were more warp-weighted looms in use during this period than during the Bronze Age Periods or Iron Age I Period.

Table 2.1: Levantine sites at which loom weights have been recovered (Boertien 2012; Cecchini 2000: 219-220; Dagan and Cassuto 2013; P. M. M. l. Daviau 2002: 191-198; P. M. M. Daviau and Dion 2002; Fischer 2008: 201; Friend 1996: 55-56; 1998: 12-14; Hardin and Blakely 2014; Lehmann et al. 2010: 149-151; Peyronel 2007; Rahmstorf 2005; Shamir 1996: 140-141; Stone and Zimansky 1999)

Period	Dates	Sites with Loom Weights
Early Bronze Age	3300-2000 BCE	Tell Halif, Tell Ta'annek, and Tell Abu al-Kharaz (3 sites)
Middle Bronze Age	2000-1550 BCE	Tell el-Ajjul, Bethel, Tell Beit Mirsim, Beth-Shean, Gibeon, Gezer, Jericho, Kabri, Megiddo, Tel Megadim, Tel Mevorakh, Tel Qashish, Sheckem, Tel Ta'annak, H. Nahal Te'enim, and Tel Yoqne'am (15 sites)
Late Bronze Age	1550-1200 BCE	Tell Abu Hawam, Gezer, Hazor, Megiddo, Tell Ta'annek (5 sites)
Iron Age I	1200-1000 BCE	Ashdod, Ashkelon, Tel Miqne Megiddo, Tell Qasile, Beth-Shean, Qubur al Walayidah, Tabara el Akra, Tell Afis (9 sites)
Iron Age II	1000-539 BCE	Tell Abu Hawam, Afeq, Tel Amal, Ashdod, Tel Batash/Timnah, Tel beer Sheba, Tell Beit Mirsim, Bethel, Beth-Shean, Deir 'Alla, Erani, En Gedi, Tel En Gev, Tel Gamma, Gezer, Gibeon, H. Hadash, Tell Halif, Tell el-Hammah, Tel Haror, Hazor, Tell el-Hesi, Tell Ira, Tell Judeideh, Kadesh Barnea, Tell Keisan, Kuntillet 'Ajrud, Lachish, Tel Maresha, Tel Miqne-Ekron, Motza, Tell en-Nasbeh, Pella, Tell Qasile, H. Rosh Zayit, Tell es-Safi/Gath, Tell es-Sa'idiyeh, Samaria, Tel Sera', Shiqmona, Tel Ta'annek, H. Uzza, Vered Jericho, Tell Yin'am, Tell Zakariya, Tell Afis, Tell Mastuma, Hama, Tell Masin, Tell Nebi Mend, Tabara el Akrad, Tell Ahmar, Malatya, Tall Jawa, Ein Dara, Khirbat al-Mudayna, Tell Mazar, Tell Mardiq/Ebla, Khorvat Shimon, Khirbet Summeily, and Tell el-Oreme (62 sites)

Multiple authors argue that loom weights from the Iron Age II are generally heavier than loom weights from the Iron Age I or Bronze Age periods (e.g. Boertien 2013: 114; Browning 2001: 252; Cassuto 2012: 471; Cecchini 2000: 230-231). This generalization should be taken with a grain of salt, because it is based on loom weights from a small number of Iron Age I and

Bronze Age sites. Additionally, Loom weights from many early excavations are left out of this comparison, because the loom weights' masses are not published (e.g. Albright 1943: 57). The available data suggests that loom weights from Iron Age I and Bronze Age sites are smaller than some weights from the Iron Age II, but that there are also relatively light Iron Age II loom weights (See Table 2.2 and Figure 2.2). So, it may be more accurate to describe Iron Age II loom weights as more variable than weights from earlier periods. If this interpretation is accurate, then Iron Age II loom weights would have been components of more versatile looms than weights from earlier periods, because the diversity in mass would have permitted weavers to make a greater variety of fabrics (Martensson et al. 2009).

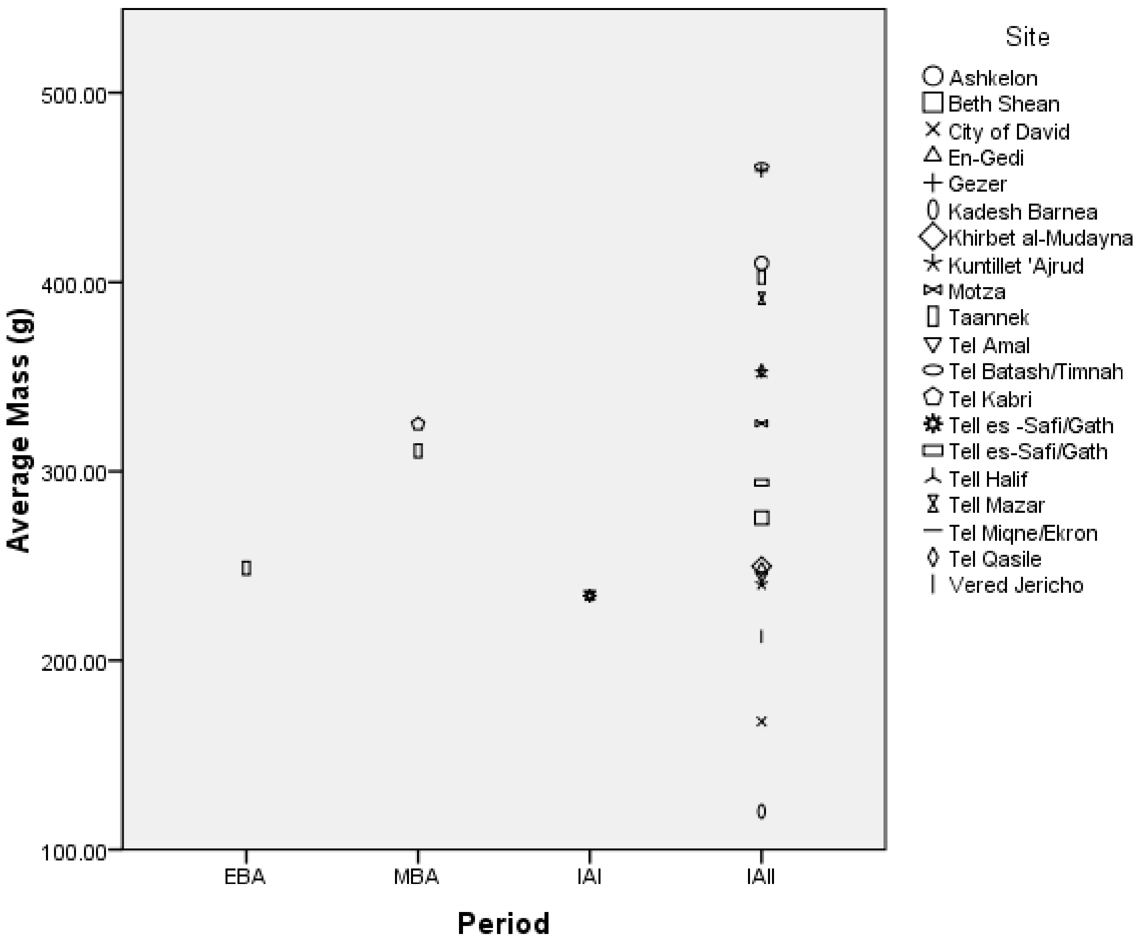


Figure 2.2: Average mass of loom weights from Levantine sites (See Table 2.2)

Table 2.2: Average mass of loom weights from Levantine sites (if the number of weights is not included, the number was unpublished or unclear)

Site	Period	Number of Weights	Average Mass (g)	Source
Taannek	EBA	3	248.67	See Chapter 3
Tell Abu al-Kharaz	EBA		Up to 90	Fischer 2009
Taannek	MBA	48	310.83	See Chapter 3
Tel Kabri	MBA	24	325.02	Oren 2002
Tell Abu al-Kharaz	MBA		Above 100	Fischer 2009
Ashkelon	IAI		Three types 60-70 g, 140-150 g, and >500 g	Lass 1994
Tel Miqne-Ekron	IAI	53	236.6	Shamir 2007b
Tell es -Safi/Gath	IAI	22	234.14	Cassuto 2012
Ashkelon	IAII	42	410.07	See Chapter 3
Beth-Shean	IAII	200	275.22	See Chapter 3
City of David	IAII	43	167.58	See Chapter 3
En-Gedi	IAII	19	248.18	Shamir 2007a
Gezer	IAII	29	458.7	Friend 1996
Kadesh Barnea	IAII	12	120.16	See Chapter 3
Khirbat al-Mudayna	IAII	134	249.68	See Chapter 3
Kuntillet 'Ajrud	IAII	19	240.36	See Chapter 3
Tel Amal	IAII	135	244.69	See Chapter 3
Tel Batash/Timnah	IAII		461.1	Shamir 1996, Table 3
Tel Miqne-Ekron	IAII		353.2	Shamir 1996, Table 3
Tel Qasile	IAII		353	Shamir 1996, Table 3
Tell Abu al-Kharaz	IAII		275-470	Fischer 2009
Tell es-Safi/Gath	IAII	57	293.95	See Chapter 3
Tell Halif	IAII	25	351.4	Friend 1996
Tell Mazar	IAII	184	391.24	See Chapter 3
Tell Moza	IAII	9	415.66	Shamir 2009
Tell Ta'annek	IAII	67	402.53	See Chapter 3
Vered Jericho	IAII		212.7	Shamir 1996, Table 3

Explaining Changes in Loom Weights in the Iron Age II

As discussed in Chapter 1, earlier studies of Iron Age II textile production present contradictory interpretations of the larger number and size of loom weights. Each reconstruction concludes that Iron Age II weavers used warp-weighted looms to weave a distinct type of textiles that fulfilled demands related to specific changes in Iron Age II society.

Reconstruction 1: Warp-weighted looms were used for sha'atnez *tapestries for Neo-Assyrian tribute payments*

Browning's reconstruction of Iron Age II textile production (1988, 2001) is based on his observations that the loom weights dating to this period are more numerous and that they are larger than loom weights dating to earlier periods. He suggests that the number of loom weights increased so that weavers could meet new demand for textiles created from tribute obligations imposed by the conquering Neo-Assyrian kings. Neo-Assyrian inscriptions describe Levantine textiles in tribute payments as colorful garments (e.g. Tadmor et al. 2011: 37-40), which Browning interprets as tapestries with patterns created from different colored weft threads. Tapestries are fabrics in which weft threads are tightly packed so that only the colored design is visible and the small number of warp threads are hidden (i.e. a type of weft faced fabric). The pattern may require points at which colored weft threads double back in the middle of a pass to create the design (Barber 1992: 111; Browning 2001: 250-252). Browning writes that the Iron Age II tapestries were woven with wool weft threads and linen warp threads (making them *sha'atnez* or fabrics that contain wool and linen). At Tell Afis, Cecchini (Cecchini 2000: 229-231) interprets the transition from unpierced loom weights to pierced loom weights in the Iron Age II Period as evidence that Neo-Assyrian tribute demand also caused changes in textile production at northern sites. If Cecchini's conclusion is valid, then Browning's model explains changes in Iron Age II textile production across the Levant.

Browning's model has two testable implications. If Browning's argument that warp-weighted looms permitted weavers to meet demand created by Neo-Assyrians is correct, then one would expect the number of Iron Age II loom weights should increase during the period of the Neo-Assyrian conquest. Further, if Browning's reconstruction is accurate, one would expect Iron Age II loom weights to be suitable to weave *sha'atnez* tapestries.

Boertien (2013: 25-26) refutes the first of these expectations with the increase in numbers of loom weights seen in the Ninth to Eighth Centuries at sites like Deir 'Alla, Beth Shemesh, Gezer, and Tell Beit Mirsim that predate Neo-Assyrian tribute demands. However, Gitin (1997: 89-92) argues that the more than 600 loom weights found at Seventh Century Ekron show the result of Neo-Assyrian economic policy, which he suggests shifted labor from sites such as Beth Shemesh, Gezer, and Tell Beit Mirsim to Ekron. Yet, Faust and Weiss (Faust 2011; Faust and Weiss 2005) conclude that Neo-Assyrian's did not control Ekron's economy, because Ekron was outside the imperial borders. These conflicting reconstructions leave the relationship between Neo-Assyrian authority and Iron Age II textile production ambiguous, although the technological developments in weaving began prior to the Neo-Assyrian conquests.

In regards to Browning's second expectation, that Iron Age II loom weights were suitable for weaving tapestries with linen warps and wool wefts, tapestry weaving requires high tension on the warp threads for the weaver to be able to tightly pack the weft threads (Barber 1992: 111). Linen warp threads, like those Browning suggest were used in these tapestries, require a higher tension than wool warp threads (Andersson 1999: 20). Thus, if Browning's reconstruction of Iron Age II weaving is accurate, loom weights from this period should be suitable for weaving fabrics with low warp count (i.e. weft faced tapestries) and for keeping the warp threads under very high tensions (See Table 2.3).

Reconstruction 2: Regional Variation in Textile Production for Trade and Cult

In a recent study of Transjordanian loom weights, Boertien (2013) argues that the increase in loom weights during the Iron Age II is attributable to weavers transitioning from domestic weaving to the production of surplus textiles used for trade. Her reconstruction divides textile production into two regional industries based on variation in the mass of Iron Age II loom weight. Boertien interprets light loom weights (c. < 350 g) from the Shephelah, Moab, Gilead, and the region around Jerusalem as evidence of a focus on the manufacture of wool fabrics and heavier loom weights (c. > 350 g) from the Jordan Valley and Beth-Shean Valley as evidence of weaving fabric from linen and hemp (Boertien 2013: 259). Boertien also interprets loom weights and uncommon fabrics (i.e. hemp, linen, and *sha'atnez*) from ritual contexts at Kuntillet 'Ajrud and Deir 'Alla as evidence that some textiles woven on warp-weighted looms were used in ritual activities (Boertien 2013: 310; 2014).

Boertien's reconstruction of Iron Age II textile production requires three separate hypotheses of what types of fabrics weavers produced with warp-weighted looms based on her suggested uses for Iron Age II loom weights (See Table 2.3).

<u>Bast Textiles Made in the Valleys:</u> Boertien (Boertien 2013: 231, 251, 280) argues that heavy loom weights were used to weave fine bast fiber textiles that were used as trade commodities. Weaving bast fiber textiles requires loom weights capable of creating high tensions on the warp

threads (Andersson 1999: 20). Therefore, if Iron Age II weavers produced fine bast fiber textiles with warp-weighted looms, one would expect that the loom weights were suitable for warp arrangements with high tensions.

Woolen Textiles Made in the Uplands: Boertien interprets light loom weights as evidence of wool fabrics woven with fine threads (Boertien 2013: 231, 251, 280). She does not describe the number of threads/cm expected for wool textiles. However, she identifies one warp-dominant textile from Khirbat al-Mudayna as an example of the fine wool textiles woven with Iron Age II loom weights. This textile has 16 warp threads/cm and 12 weft threads/cm (Boertien 2013: 192). Warp-weighted looms used to weave similar textiles would have required loom weights suitable for weaving warp-dominant textiles with fine warp threads.

Textiles for Ritual Use: Boertien writes that some of the Iron Age II loom weights were used to weave ritual garments from special fibers (e.g. *sha'atnez* and linen fabrics found at Kuntillet 'Ajrud and hemp fabric from Deir 'Alla) (Boertien 2007; 2013: 311-313). She identifies a fragment of warp-dominant hemp cloth with 24 warp threads/cm from Deir 'Alla as a ritual textile (Boertien 2013: 121). If warp-weighted looms were used to weave similar warp-dominant textiles, then the loom weights would have created high tensions on the bast fiber warp threads.

Reconstruction 3: Utilitarian Fabric Production

Finally, multiple authors infer that Iron Age II heavy loom weights (> 300 g or > 400 g) were used to produce utilitarian fabrics, such as carpets, wall hangings, blankets, and storage containers, suitable for domestic and industrial functions (e.g. furnishing a house or transporting agricultural products). These textiles would have had low thread counts and thick threads (Fischer 2009: 115; Friend 1998: 10; Gitin 1997: 89-90). Shamir and Eitam argue that coarse utilitarian fabrics were woven from animal fiber yarns. Shamir (2009: 160) writes that the large loom weights from Tel Moza were used in domestic weaving of woolen textiles. Eitam (1990b) is more descriptive and he compares this category of textiles to goat hair containers used to transport olives in the 1940s. Although animal fiber warp threads require less tension to weave than do bast warp threads, the thick warp threads used in rough utilitarian textiles require relatively high tensions (See Table 2.3) (Martensson et al. 2009: 278).

Table 2.3: Expectations for the three reconstructions of Iron Age II warp-weighted loom products (Boertien 2013; Browning 1988, 2001; Friend 1998)

Textile Description	Author's Evidence	Expected Characteristics	Tension Required
1) Neo-Assyrian Tribute			
Sha'atnez Tapestries	Heavy loom weights	Low warp count (tapestries) *sha'atnez*	High tension
2) Regional Specialization for Trade and Ritual			
Bast Textiles	Heavy loom weights	High warp count hemp and linen	High tension
Animal Fiber Textiles	Light loom weights	Fine wool fabrics	Low tension
Ritual Fabrics	Heavy loom weights	High warp count *sha'atnez*, linen, and hemp	High tension
3) Domestic and Utilitarian Fabrics			
Rugs, Wall Hangings, Storage Containers, Blankets	Heavy loom weights	Low warp count, animal fiber	High tension

Changes in Iron Age II Society and Textile Production

During the Iron Age II, Levantine society became more urbanized. Activities that were once organized by households were controlled by urban elites (e.g. agricultural production and trade) (Hopkins 1996; Master 2014). Boertien and Browning's models suggest that the increase in loom weights during this period is evidence that textile production changed to meet new needs created by the social and economic changes. However, they disagree as to the cause of this change: increased trade, demand for ritual fabrics, or imperial taxation.

The different reconstructions of Iron Age II weaving reflect the fact that although the authors who interpret these artifacts agree on a definition of heavy weights as those which are more than 300 or 400 g (Boertien 2013: 259; Fischer 2009: 115; Friend 1996: 9-10), they disagree on what quality of fabric was produced with these weights and thus how the fabrics were used.

A hypothesis-driven approach to identifying a relationship between known changes in Iron Age II society and changes in weaving practices requires a method to compare the available data to expectations (i.e. the textiles loom weights were used to weave). The following chapter describes the available material evidence for Iron Age II weaving: loom weights, textile remains, and textile impressions, which are the available data with which it is possible to test the hypotheses described in Table 2.3.

Chapter 3: Archaeological Evidence of Iron Age II Textile Weaving

This chapter describes the data collection processes and the information available from each site. Three types of data are presented: loom weights, textile remains, and fabric impressions from Iron Age II Levantine sites The data use here are collected from published excavation reports augmented with measurements I collected from the University of Pennsylvania Museum of Archaeology and Anthropology. The data comprise 1,865 loom weights from twelve sites (See Table 3.1). These sites were selected based on a literature survey for records that include loom weight mass, width, and recovery contexts the characteristics on which my analyses are based. I increased the sample of weights from Beth-Shean by measuring unpublished artifacts at the University of Pennsylvania Museum of Archaeology and Anthropology.

Table 3.1: Number of loom weights studied from Iron Age II sites

	Loom Weights	Measured Loom Weights
Kadesh Barnea	13	11
Kuntillet 'Ajrud	19	19
City of David Excavation	142	52
Beth-Shean	231	219
Ashkelon	63	47
Tel es-Safi	130	82
Tel Amal	171	145
Tel Batash	298	101
Tell Ta'annek	88	58
Khirbats al-Mudayna	278	138
Tell Mazar	202	184
Tell Afis	230	114
Total	1865	1170

Textile remains and impressions are available from nine Iron Age II sites. From their published descriptions, I collected data on warp thread count, weft thread count, and material (e.g. flax, wool, goat hair, or hemp fiber) (See Table 3.2).

Table 3.2: Sources of Iron Age II textile remains and textile impressions analyzed in this study

	Textile Remains	Impressions
Kadesh Barnea	56	7
Kuntillet 'Ajrud	93	1
Tell el-Hammah	0	1
Timna Mining Camp	76	0
Hazor	0	2
Tel Masos	0	1
Tel Batash	0	1
Khirbat al-Mudayna	1	3
Deir ‘Alla	1	0
Total	227	16

Typologies Used to Classify Loom Weights

Three typologies are widely used to describe loom weights from the Iron Age II Levant, each focuses on a distinct set of characteristics to define types of weights.

Shamir developed the most commonly used typology by building on upon Beck’s typology of beads (Beck 1928; Shamir 1991; 2007b: 44-45). Shamir’s system defines types on material, shape, ratio of height to width, and piercing location (i.e. horizontally or vertically pierced) (See Table 3.3 and Figures 3.1-3.4). In some cases, the process of classifying loom weights under Shamir’s typology requires subjective judgments (e.g. the overlapping definitions of the spherical and donut-shaped types) which can create contradictory identifications.

Table 3.3 Description of types in Shamir’s typology of Levantine loom weights (Shamir 1991: 135-136)

Type	Description	Perforation
Spherical/Near-spherical	1:1 ratio of diameter to height (within 1 cm)	Vertical
Donut-shaped	Diameter is larger than height	Vertical
Biconical/Near-biconical	Biconical	Vertical
Ovoid	Oval with perforation in top third of the weight	Horizontal
Pyramidal	Flat square or elliptical base with perforation in top third of weight	Horizontal
Amorphic	Unshaped masses of mud. Possibly unfinished weights	None
Undefined	Weights too damaged to identify	Either
Cylindrical	Unpierced cylinder weights	None

Boertien also published a typology for Iron Age II loom weights. She developed the typology through experimental archaeology to reconstruct clay weights using only tools and materials that were available in the Iron Age II. Using this approach Boertien tried to link the creative acts and thoughts of the past with the material remains recovered by archaeologists (Boertien 2013: 93). Based on her replication of past production sequences, she argues that each type of weight identified is the result of a distinct sequence of choices made during its production (Boertien 2013: 93-95). Her resulting typology has two levels: The first is defined by the orientation (horizontal or vertical) of the perforation through each weight (See Figures 3.1-3.4). The second defines subtypes based on different techniques for molding the shape of the loom weight (e.g. shaping in the hands vs. rolling on a table top) (See Table 3.4).

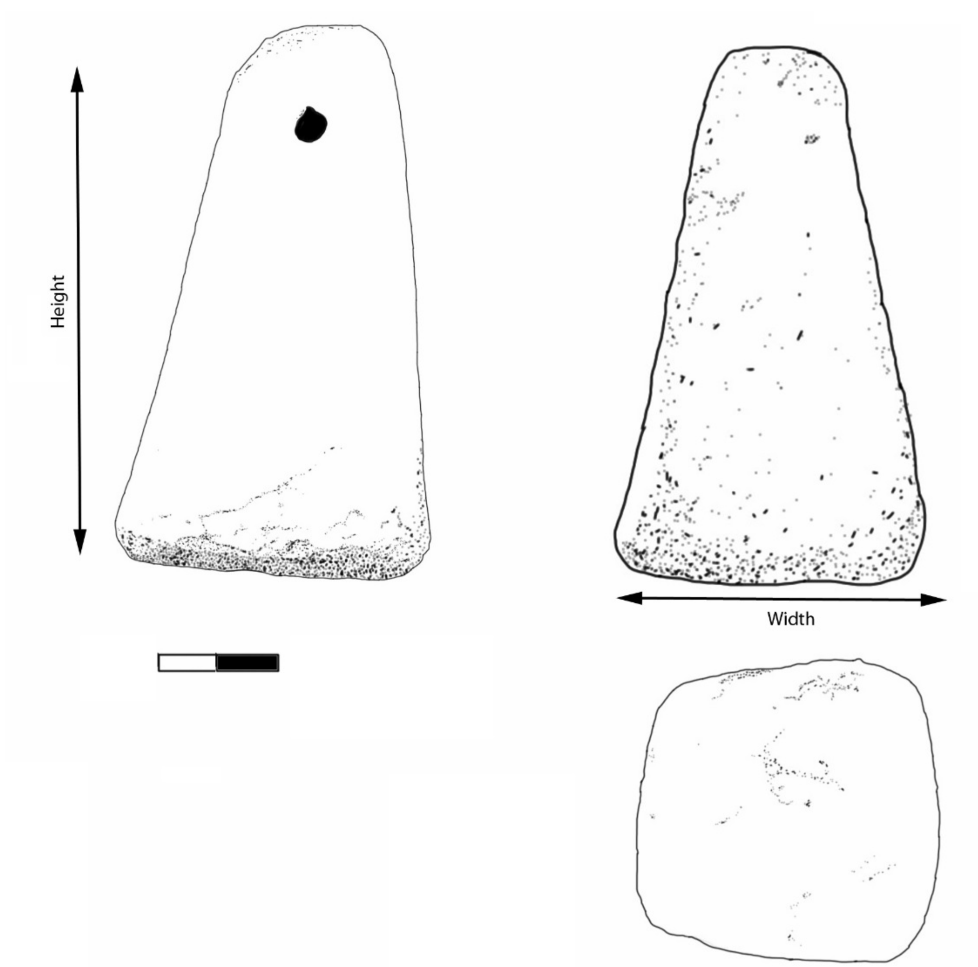


Figure 3.1: Illustration of horizontally pierced loom weight - Clay weight from Beth-Shean Artifact 29-103-707 at the University of Pennsylvania Museum

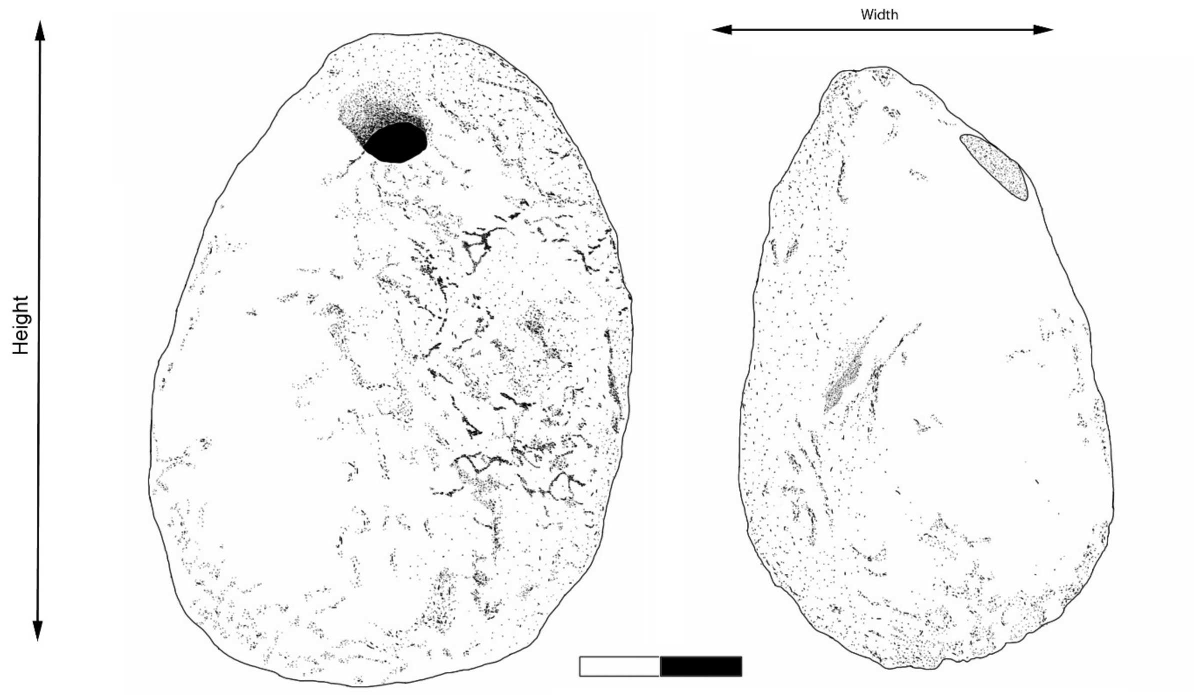


Figure 3.2: Illustration of horizontally pierced loom weights - Gypsum weight from Beth-Shean Artifact 29-107-615 at the University of Pennsylvania Museum

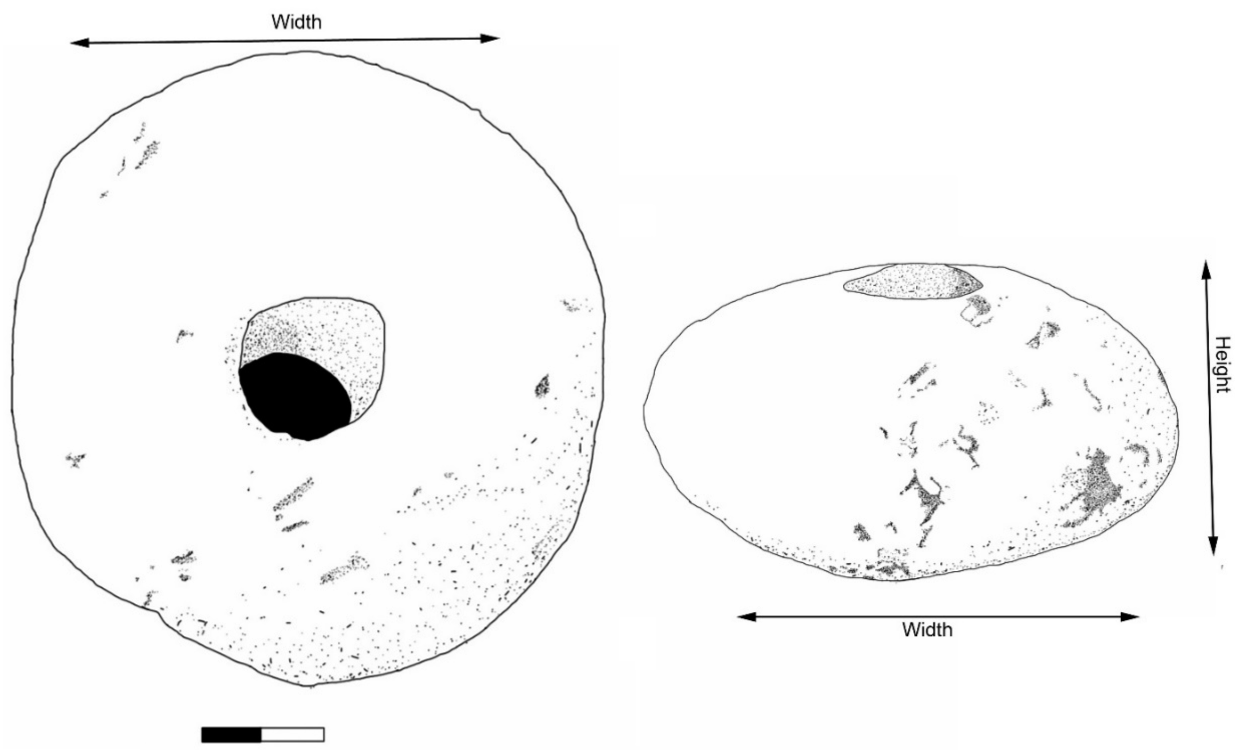


Figure 3.3: Illustration of vertically pierced (donut) weight from Beth-Shean - Artifact 29-103-706 at the University of Pennsylvania Museum of Archaeology and Anthropology and Anthropology

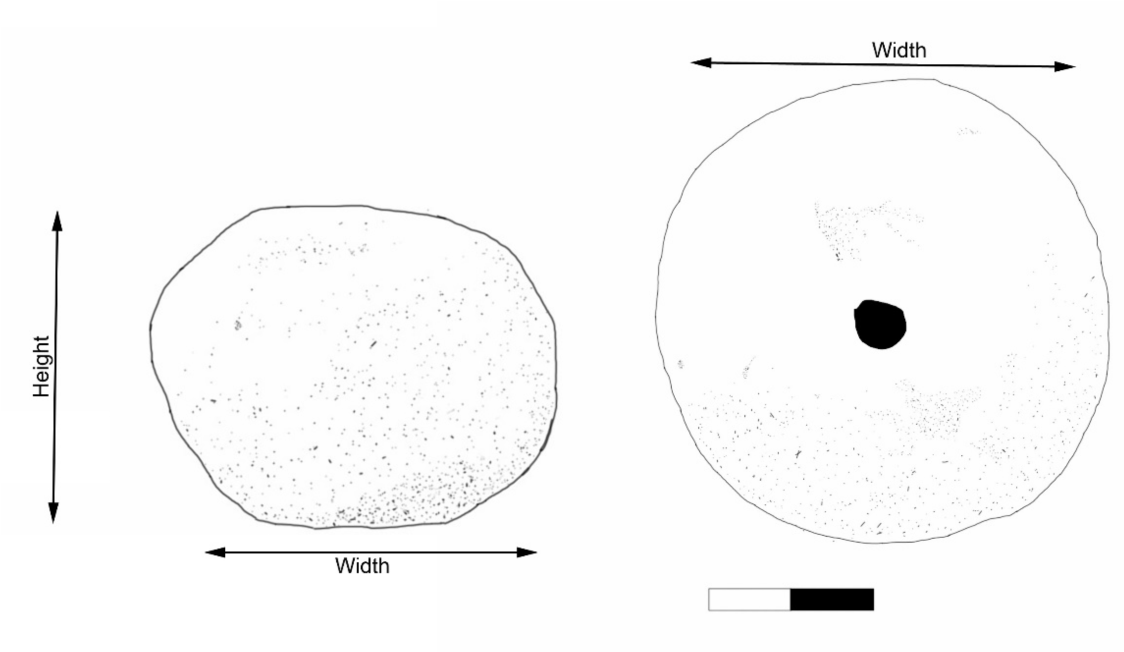


Figure 3.3: Illustration of vertically pierced (spherical) weight from Beth-Shean - Artifact 29.103.748 at the University of Pennsylvania Museum of Archaeology and Anthropology

Table 3.4: Descriptions of types used in Boertien's typology of loom weights (Boertien 2013: 93-95)

Type	Description	Perforation Orientation	Perforation Diameter
Conical	Conical body with circular or elliptical base	Horizontal	.5-2 cm
Behive-shaped	Conical body with flattened top with a perforation in the middle of the weight	Horizontal	1-1.4 cm
Donut-shaped	Weight made from a coiled piece of clay, either rounded or biconical Width is 1 cm wider than height, but less than 9 cm	Vertical	1-2 cm
Large Donut-shaped	Donut shaped weight larger than 9 cm with a flattened side	Vertical	1-2 cm
Spherical	Width and height vary by no more than 1 cm Diameter is greater than 5 cm	Vertical	>1 cm
Wheel Shaped	Width is 1 cm more than height with flat ends Usually more than 9 cm in diameter	Vertical	>1 cm
Cylinder (Pierced)	Width and height vary by no more than 1 cm with flat ends	Vertical	>1 cm
Spool/Reel	Unpierced cylinder	None	
Anchor Shaped	Height is greater than diameter. Body and based are elliptical or flattened rectangular with rounded top	Horizontal	>1 cm
Square	Small with flattened top and square base	Horizontal	<1 cm
Pyramidal (circular base)	Pyramid-shaped with circular based	Horizontal	>1 cm
Pyramidal (Square base)	Pyramidal square body with square base	Horizontal	<1 cm

Cassuto describes loom weights from Tell es-Safi using a third typology that identifies three groups of loom weights based on orientation of piercing: horizontal pierced with an off-center piercing (See Figures 3.1 and 3.2); vertical pierced with a central piercing (See Figures 3.3 and 3.4); and unpierced spools (See Table 3.5). The first group includes Shamir's pyramidal, trapezoidal, disc, and conical types (See Table 3.3). The second includes Shamir's donut and spherical weights (See Table 3.3). The third includes all weights classified as cylinders, cigar-shaped, or spools (See Figure 3.5)(Cassuto 2012: 469).

Table 3.5: Description of types used in Cassuto's typology of loom weights (Cassuto 2012: 469)

Type	Example Types
Horizontally Perforated	Trapezoidal, Pyramidal, Disc, and Conical
Vertically Perforated	Spherical and Donut
Cylinder	Unpierced reel and spool

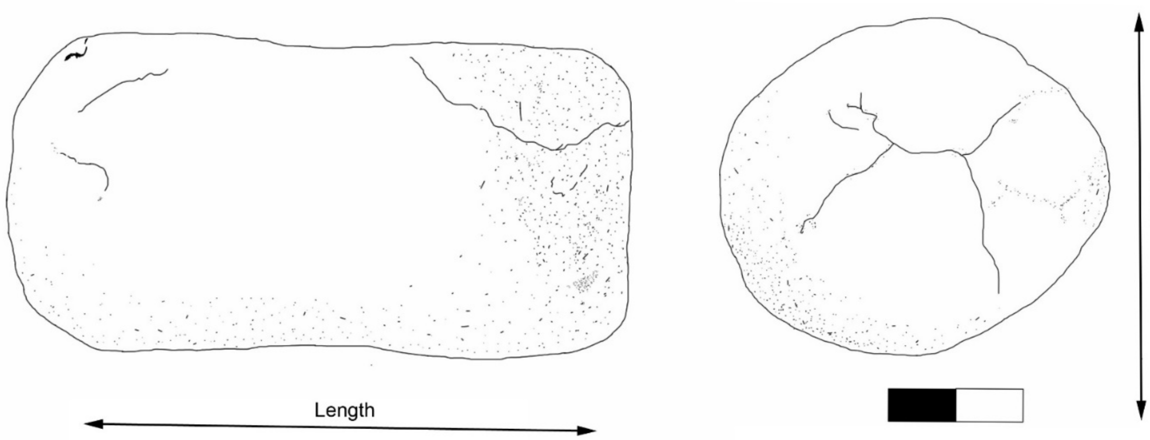


Figure 3.5: Illustration of an unpierced cylindrical weight from 'Ain Dara housed at Stony Brook University

This analysis reclassifies all loom weights using a single typology to permit comparisons between sites published using different typologies. Boertien's and Shamir's typologies are not suitable, because each requires measurements that are not included in all published descriptions of loom weights. Instead, Cassuto's typology is used, because it relies only on the orientation of the loom weight's piercing and can easily be used to reclassify data published using Boertien or Shamir's typologies, because both incorporate piercing orientation into their definitions of different types.

Post-depositional Changes to Loom Weight Frequency

Some researchers (e.g. Boertien 2013: 270-271; Cassuto 2012: 473; Shamir 1996: 152-153) have interpreted the number of weights recovered at a site as directly reflecting the scale of weaving at that site (i.e. more loom weights means more weaving). Yet variation in the number of loom weights may result from other factors. Some excavations recover a small number of weights spread throughout contexts and strata (e.g. ‘Ain Dara), others recover dozens of loom weights in groups (e.g. Deir ‘Alla, Tell Mastuma).

Excavating sites at different scales can cause variation in the numbers of loom weights recovered at the sites. Excavations with small exposures are relatively likely to recover few loom weights. A comparison of excavations at the two northern Levantine sites of ‘Ain Dara and Tell Mastuma shows the impact that excavation size can have on the number of loom weights recovered by archaeologists. Stone and Zimansky (1999: 5-7) excavated ‘Ain Dara for three seasons, digging three slit trenches (2 m by 9 m) and two 10 m by 10 m squares (i.e. a total exposure of 254 m^2). This small exposure recovered eleven cylindrical clay weights from securely dated contexts (Stone and Zimansky 1999: 76-77). At Tell Mastuma, excavators opened more than 2,600 m^2 over most of the tell. They recovered more than 2,000 whole and fragmentary cylindrical clay loom weights in three seasons of excavation (Nishiyama 1998: 92). Although both excavations focused on domestic contexts that contained similar types of loom weights, unsurprisingly they recovered different numbers of weights.

Cultural and natural processes that damage loom weights may also cause variations in loom weight totals. Most Iron Age II loom weights are made of fragile unbaked clay so they "melt" in the rain, break, and crack during weaving (Shamir 1991: 135-136). More robust weights made of fired clay or stone are often found chipped and broken (i.e. Master 2011; Shamir 2006: 482, photo 413.421). This type of damage can occur accidently during weaving or after deposition. It is therefore expected that the loom weights archaeologists recover constitute only a portion of the total used (Cassuto 2012: 470; Shamir 1991: 136). Our inability to estimate the percent of loom weights lost through attrition, limits the analytical value of direct comparisons of loom weight counts.

Post-depositional Changes to Loom Weight Measurements

Many loom weights have visible damage. Weavers may have overlooked blemishes and continued to use weights when damage did not significantly alter mass or width (two important criteria for weavers, as will be demonstrated below). Thus, damaged weights may be representative of Iron Age II weavers' tools, and should be included in analyses focused on variation in these tools. Analysis of damaged weights is complicated because researchers use different strategies to describe damaged weights, and not all reports describe the amount of damage or missing material.

For cases in which a percent or estimate of the amount missing from a weight is available (e.g. Master 2011), I included those weights that were reported as 80% or more complete. Most reports, however, only state that a weight may be broken in half (e.g. Tell Afis). I did not include these weights in my samples.

Collecting Data from Textile Remains and Impressions

Textile remains and impressions are direct evidence of fabrics made by Iron Age II weavers. Although the sample of 227 remains and 16 impressions from Iron Age II sites is relatively large, it has limitations (See Table 3.2, Figure 2.2). Although texts and iconography clearly demonstrate that textiles were used at all Iron Age II sites, issues of preservation bias the sample: textiles have been recovered from only a small number of sites. The preserved artifacts are only a small percentage of the total textiles that were in use in the Iron Age II, and each is only a small part of the fabric of which it was originally a part. Additionally, the textiles and impressions show only some of the diagnostic characteristics in which archaeologists are interested. For example, it may be possible to identify fiber type, but few artifacts include textile edges; the difference between warp and weft threads is clearest along a textile's edge (Sheffer and Tidhar 2012: 291)

Fabric remains preserve well in dry, frozen, or waterlogged environments, and in association with certain metals (Barber 1991: 3, 132-133). Even where the natural environment favored preservation, Iron Age II urban centers were inherently hostile environments for textile preservation. Long-term habitation at these sites would have included fires, disturbed soils, and other anthropogenic factors that contribute to the destruction of organic remains (Davidson et al. 2010; Stager et al. 2011c: 13-14). The majority of the fabric remains analyzed for this study were found at sites in the southern Levant that are located in dry environments. This introduces a potential bias in that the sample may reflect types of textiles used in desert environments but not in other locales.

Clay fabric impressions should preserve more easily than textile remains, but only sixteen Iron Age II impressions have been published (See Table 3.2). The majority of clay impressions come from vessels identified as Negebite ware, a Southern Levantine pottery tradition (Sheffer 1976). It is not clear why this is so, but ceramic impressions may disproportionately represent fabrics from the Southern Levant where vessels from this tradition were common.

Most of the Iron Age II textile remains and impressions are only a few centimeters in size. Thus it is not possible to reconstruct the textiles' original sizes. However, they provide sufficient data for the analyses in the present study (See Figure 3.6, Table A.1)(Shamir 2007c: 255; Sheffer and Tidhar 2012: 289). For example, it is usually possible from the textile remains and impressions to count the warp and weft threads/cm and assess the type of fiber used. Although many of the fabric remains and impressions lack selvedges (i.e. the edges of woven cloth), Sheffer and Tidhar (2012: 291) show that it is possible to infer the orientation of weave from such small remains.

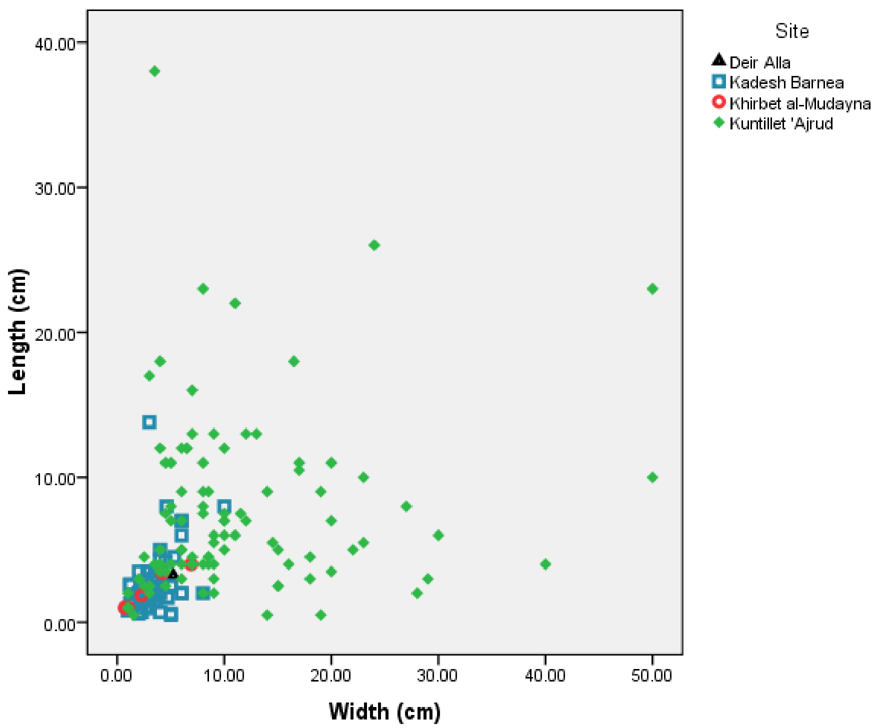


Figure 3.6: Dimensions of Iron Age II textile remains and impressions – data includes only those examples for which measurements were provided in published descriptions (See Table A.1)

Contextual Information on Loom Weights, Textile Remains, and Impressions

1) Tell Afis

Sources: (Cecchini 2000, 2014; Cecchini and Mazzoni 1998; Mazzoni 1998, 2013, 2014)

Tell Afis is a tell site located in Northern Syria. The mound is divided into an acropolis to the north and an outer town to the south. Partial excavation of both areas identified Iron Age II occupations. Although only preliminary results have been published, available data includes the recovery context and types of 230 loom weights, of which measurements are provided for 114 (See Figure 3.7 and Table B.1).

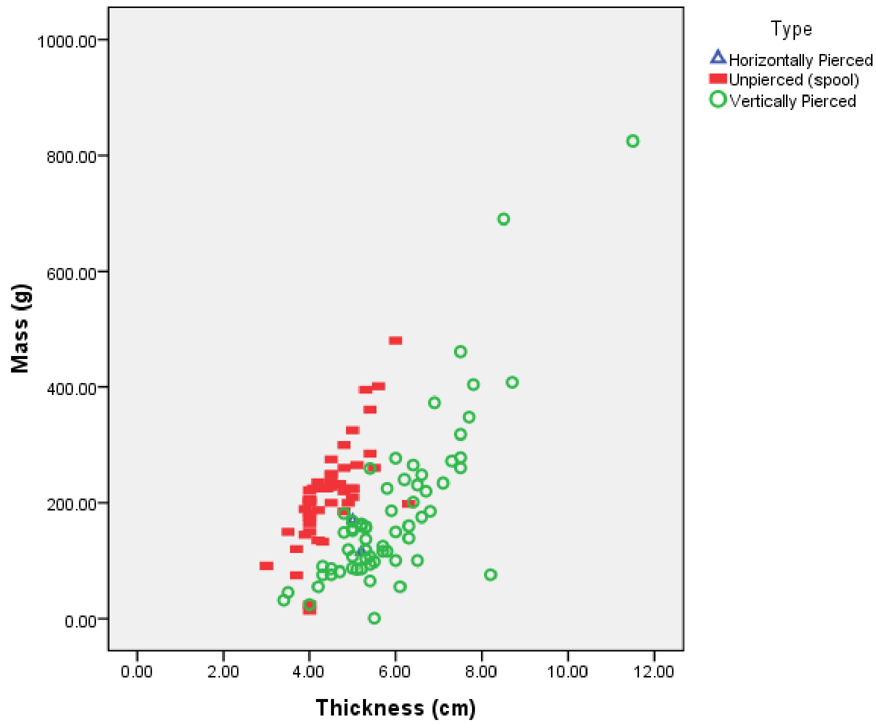


Figure 3.7: Loom weights from Tell Afis (See Table B.1)

<u>The Acropolis</u>

The acropolis is the elite section of the site. It contains primarily public and ritual structures, although some structures also contain evidence of domestic activities. Of the 187 weights published from this area, 80 have been measured and published. The weights are a mixture of unpierced (spool), horizontally pierced, and vertically pierced types. There are 186 clay weights, although they are not differentiated as baked or unbaked clay and one vertically pierced stone weight. The weights were not recovered in groups: small numbers were reported from throughout the site (See Table 3.6).

Table 3.6: Spatial distribution of loom weights from Tell Afis (Total number of weights/Number of weights measured)

		Area A	Area G	Area L	Area O	Acropolis Total (Areas A, G, L, O)	Outer Town (Area D)
Iron I	Spool Pierced	21/6 2/1	31/8			52/14 2/1	
Iron II	Spool Pierced	15/7 8/3	20/7 4/2	6/3 3/0		41/17 15/5	1/1 3/3
Iron II/III	Spool Pierced					1/1	
Iron III	Spool Pierced	 2/2	23/9 44/21	4/1 9/7	 1/1	27/10 56/31	3/3 30/30

The Outer Town

The outer town is the domestic area. Although published in less detail than weights from the acropolis, thirty-three loom weights are described with measurements. The assemblage consists of four unpierced (spool) and twenty-seven vertically pierced loom weights (See Table 3.6). All of the weights are clay; they are not described as baked or unbaked.

2) Kuntillet 'Ajrud

Sources: (Meshel 1978, 2012a, 2012b; Shamir 2012a; Sheffer and Tidhar 1991, 2012)

Kuntillet ‘Ajrud is located in the Northern Sinai Desert. This Eighth Century site contains evidence of religious and domestic activities. Nineteen unbaked clay loom weights are described, including one cluster of eleven, one cluster of five, and three weights that were later recovered from illegal excavations without known findspots. Average measurements for the sixteen legally excavated weights are published (See Table C.1, Figure 3.8). Measurements for the three looted weights are published separately. Based on photographs of six of the loom weights, all the weights seem to be vertically pierced. Measurements of ninety-five textile remains and one textile impression have also been published (See Table C.2, Figure 3.9).

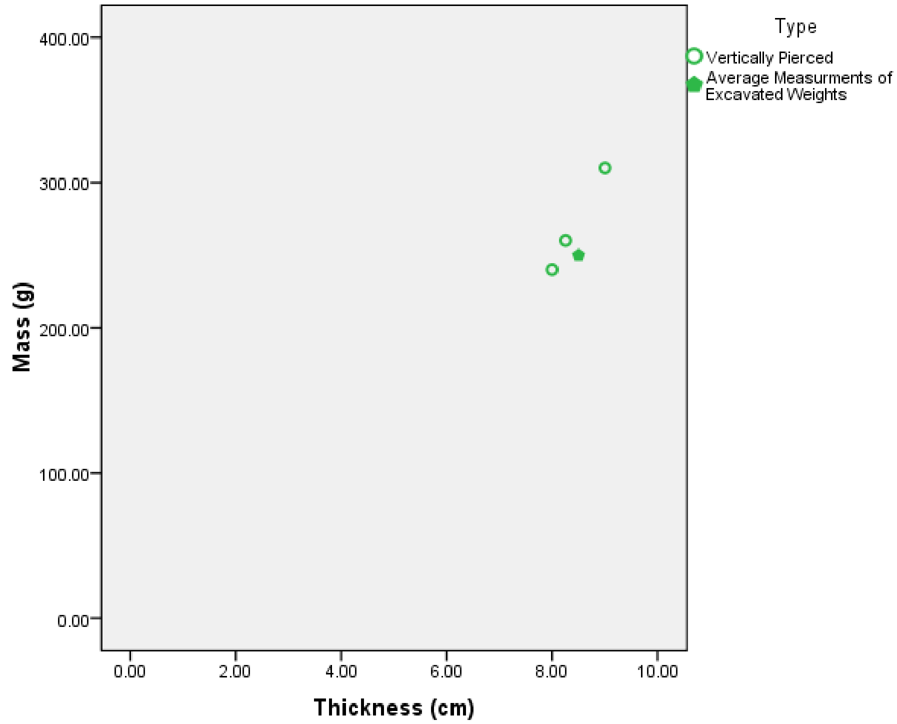


Figure 3.8: Loom weights from Kuntillet ‘Ajrud (See Table C.1)

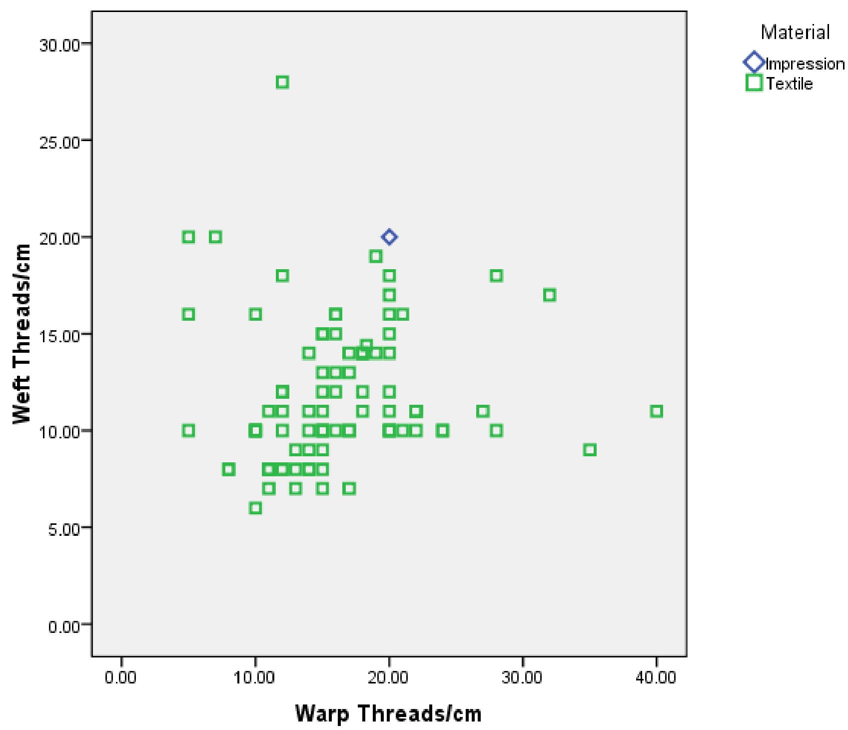


Figure 3.9: Textile remains and impressions from Kuntillet ‘Ajrud (See Table C.2)

3) Kadesh Barnea (Tell el-Qudeirat)

Sources: (Cohen and Bernick-Greenberg 2007; Shamir 2007c)

Kadesh Barnea is located in the Northeastern Sinai Desert. During the Iron Age it was a fortress and caravan stop. Nine loom weights are published from Iron Age II contexts, of which measurements are available for eight weights. Four additional loom weights, of which measurements are provided for three, are described from contexts that include Iron Age II and Persian materials (See Figure 3.10, Table D.1). All of the weights are vertically pierced. One weight is clay, and the remaining are poorly fired or unbaked clay. Fifty-six linen textile remains and seven textile impressions were also recorded. All of the textile remains derive from a single Iron Age II locus (See Figure 3.11, Table D.2).

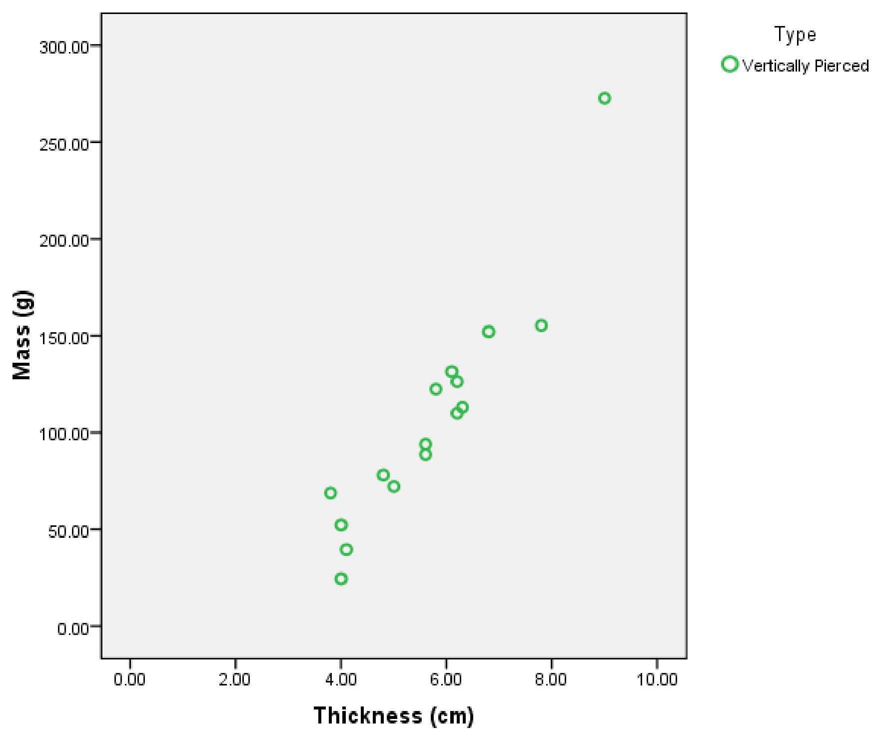


Figure 3.10: Loom weights from Kadesh Barnea (See Table D.1)

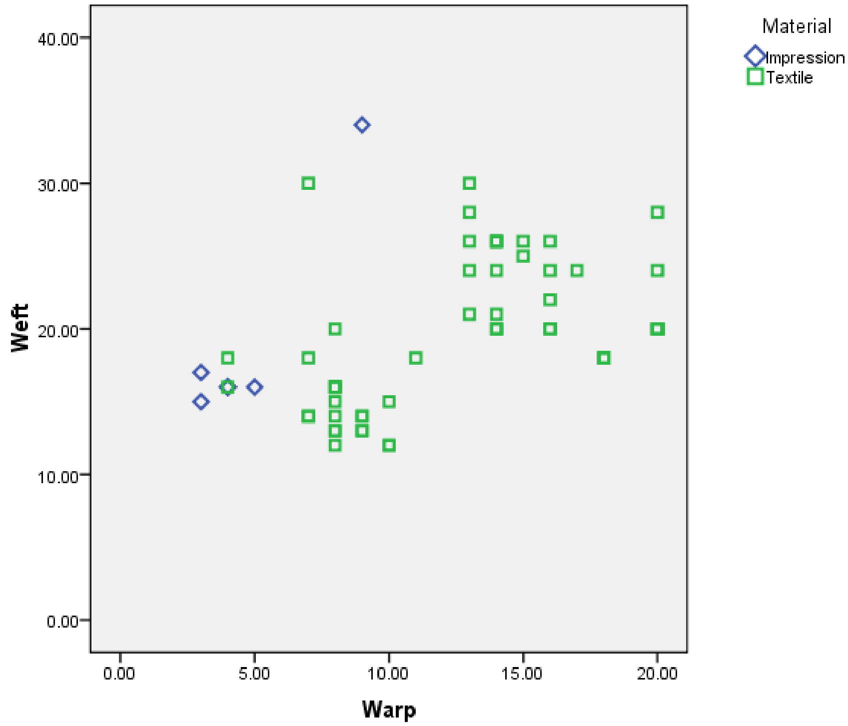


Figure 3.11: Textile remains and impressions from Kadesh Barnea (See Table D.2)

4) City of David (Jerusalem)

Sources: (Ariel and Shiloh 1996; Shamir 1996; Shiloh 1984)

The City of David site is an area of six hectares bordering the Temple Mount in Jerusalem. One hundred forty-two loom weights are described from this site, but measurements are provided only for fifty-two (See Figure 3.12, Table E.1). Most of the loom weights are vertically pierced, but a small number are horizontally pierced and a few are too incomplete to classify. There is 1 chalk weight and 141 clay weights (fired, poorly fired, or unfired clay). Most of the weights come from three clusters in domestic contexts (See Table 3.7).

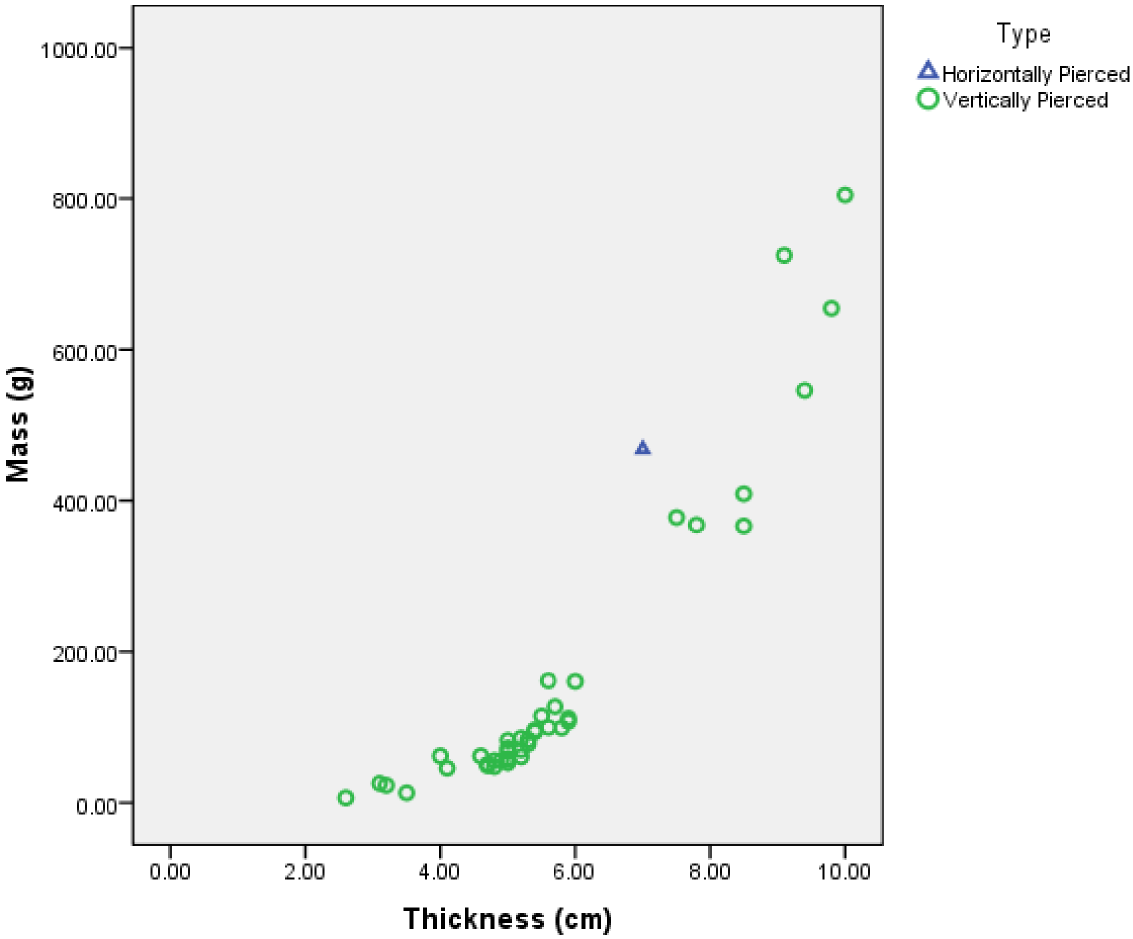


Figure 3.12: Loom weights from the City of David Excavation (See Table E.1)

Table 3.7: Loom weight clusters from City of David Excavation (Shamir 1996)

	Number of Weights	Number of Weights Measured	Context Description
Group 1: D1.456	10	2	Debris
Group 2: G.1108	73	25	Fill
Group 3: G.1110	24	16	Fill
Other Weights	32	9	Various

5) Tel Beth-Shean

Sources: (James 1966; A. Mazar et al. 2006; Ousterhout 2013; Shamir 2006)

Tel Beth-Shean is located at the corners of the Beth-Shean, Jezreel, and Jordan Valleys. Two hundred thirty-one Iron Age II loom weights were recovered in two separate excavations. In 1921, Fischer, Rowe, and Fitzgerald excavated a public structure in what is now called Area S. I measured 108 loom weights from this 1921 excavation in the collection of the University of Pennsylvania Museum of Archaeology and Anthropology (See Table F.1, Figure 3.13). Alegre Savariego sent photographs of two additional weights in the Mandate Collection in the Rockefeller Museum in Jerusalem (Savariego, Personal Communication, 2015). These photographs show one clay vertically pierced weight and one stone horizontally pierced weight.

Between 1989 and 1996, Mazar renewed excavations in Area S and expanded excavation into a four roomed house in Area P. Mazar recovered 121 loom weights: 110 weights from the Area P and 11 weights from Area S. Measurements are available for 90 of the weights (Appendix F, Figure 3.13).

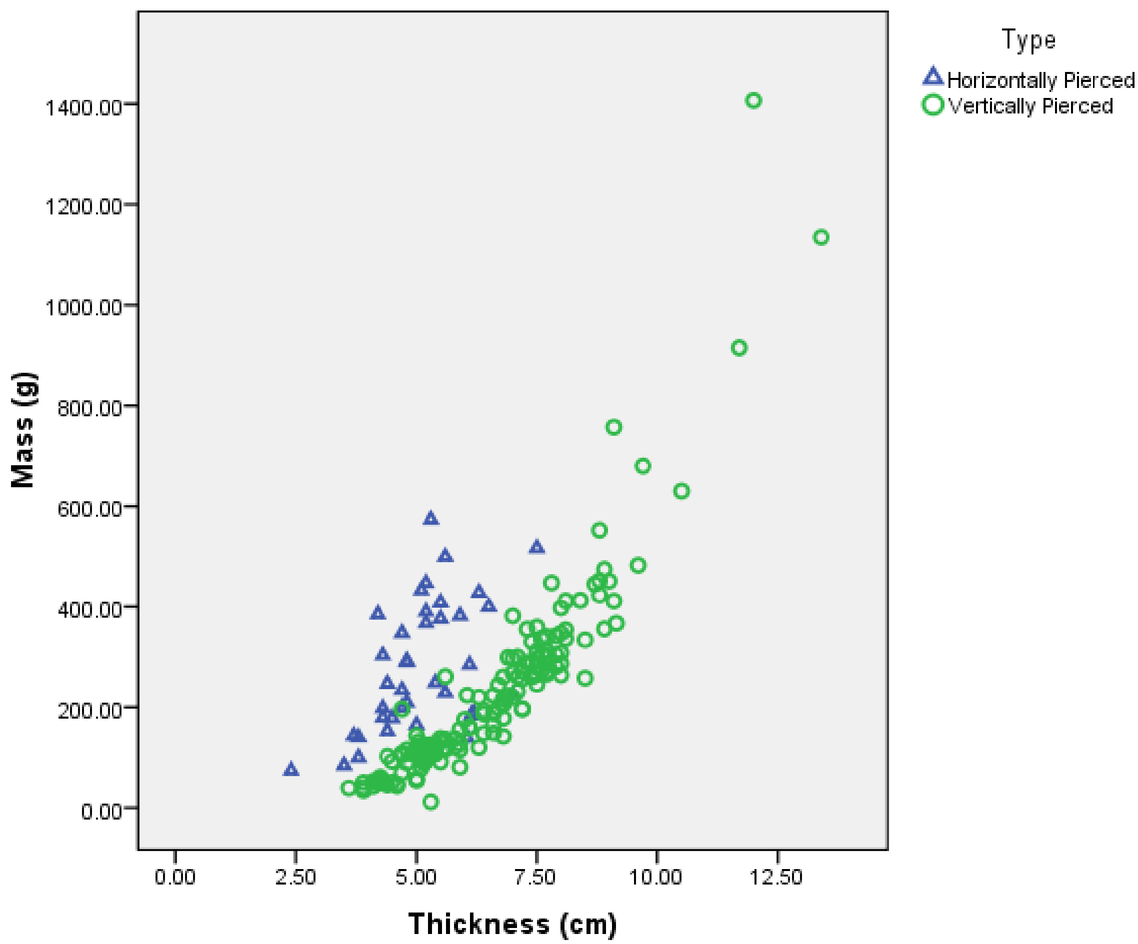


Figure 3.13 Loom weights from Beth-Shean (See Table F.1)

Area P/The Four Roomed House

One hundred nine unbaked clay donut weights come from two clusters found in the hallway of a large four roomed house in stratum P-7 of Area P. Measurements are available for seventy-six of these weights. Additionally, descriptions and measurements are available for one isolated weight in stratum P-7, two weights from stratum P-8a (a short lived stratum below P-7), and one weight from stratum P-6 (a short lived stratum above P-7). All of the weights from Area P are vertically pierced clay weights.

Area S/Public Structure

One hundred twenty-two weights are from a public structure in Area S. Mazar's excavation reported eleven weights from Area S, of which measurements are available for nine. The others are from the 1921 excavation. I measured 108 weights from the University of Pennsylvania and obtained images of 2 from the Rockefeller Museum in Jerusalem. Weights from Area S include vertically pierced baked clay and stone weights and horizontally pierced gypsum weights (See Table F.1, Figure 3.13).

6) Ashkelon

Sources: (Master 2011; Master and Stager 2011; Stager et al. 2011a, 2011b, 2011c)

Ashkelon is located on the southern Levantine coast. Sixty-three loom weights that Master describes as clay (2011) come from two areas of the site: a winery and a marketplace. From the winery, measurements are available for 41 of the 51 weights, but 6 of them are less than 80% complete and so were omitted from my analysis (See Figure 3.14, Table G.1). Six loom weights are from a single locus in a building in the marketplace. Measurements are available for all six of these weights.

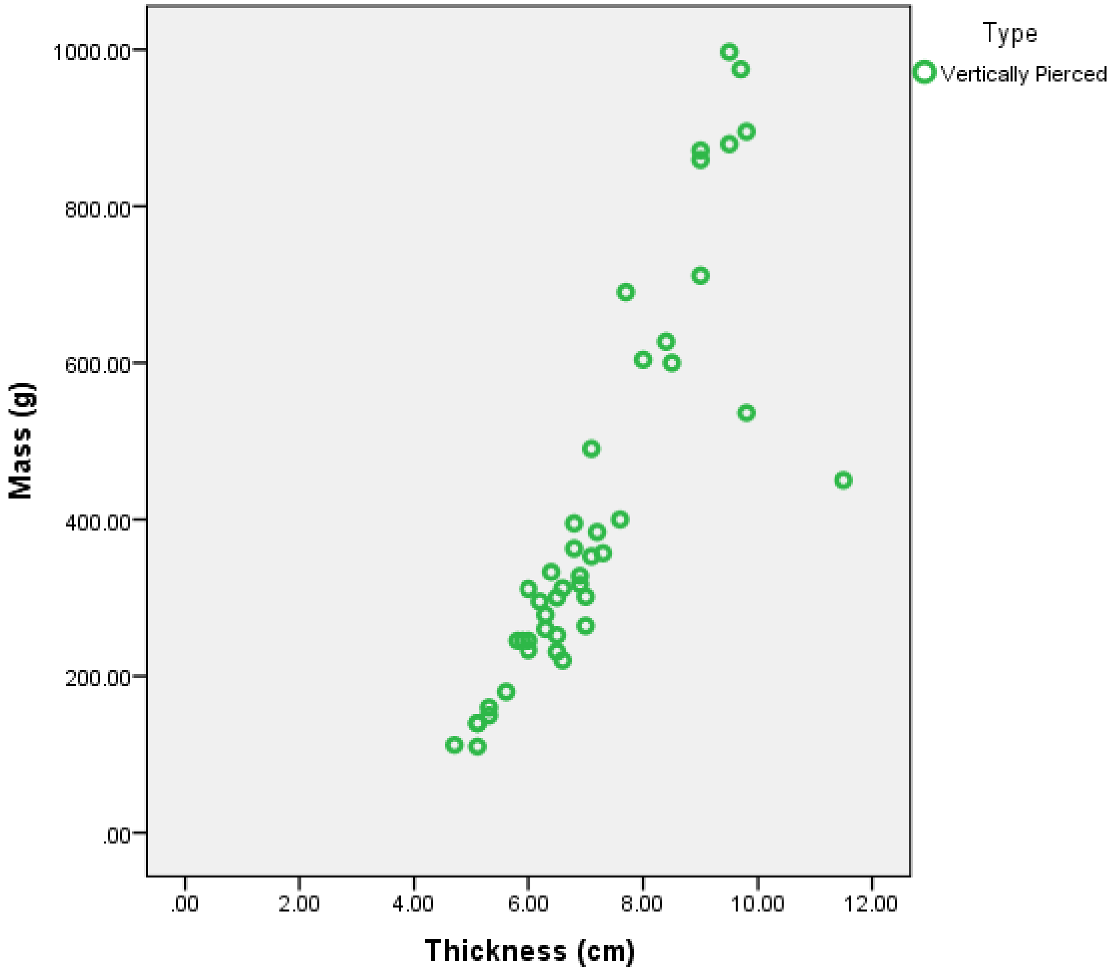


Figure 3.14: Loom weights from Ashkelon (See Table G.1)

7) Tell es-Safi (Identified as Gath)

Sources: (Cassuto 2012; Maeir 2012; Zuckerman and Maeir 2012)

Tell es-Safi is located between Ashkelon and Jerusalem. One hundred thirty loom weights are published from the site. Measurements are available for eighty-two of them. They are all vertically pierced baked clay weights (See Figure 3.15, Table G.1).

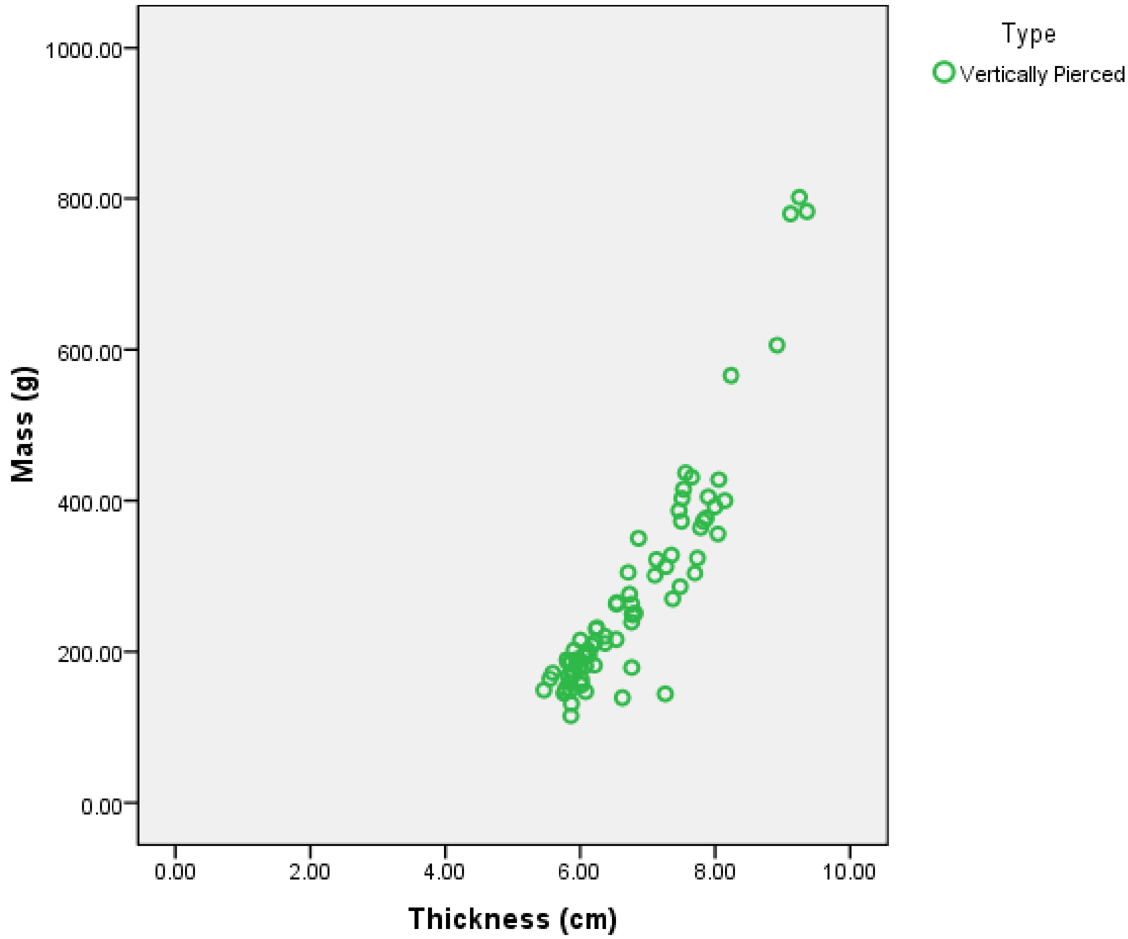


Figure 3.15: Loom weights from Tell es-Safi (See Appendix H)

8) Tel Batash (Identified as Timnah)

Sources: (Browning 1988, 2001; A. Mazar et al. 2001; A. Mazar et al. 1997; Sheffer 2001)

Tel Batash is located in the Soreq Valley, between the southern Levantine coast and the Shephelah. Two hundred ninety-eight loom weights, 288 clay and 4 stone, are published from four Seventh Century domestic buildings. Measurements are available for 101 of them. Each of the four buildings contained a separate cluster of weights (See Figure 3.16, Table I.1). The four clusters include weights of multiple types: both horizontally and vertically pierced.

An impression on the body sherd of a ceramic vessel is of balanced linen fabric with twelve threads in both warp and weft.

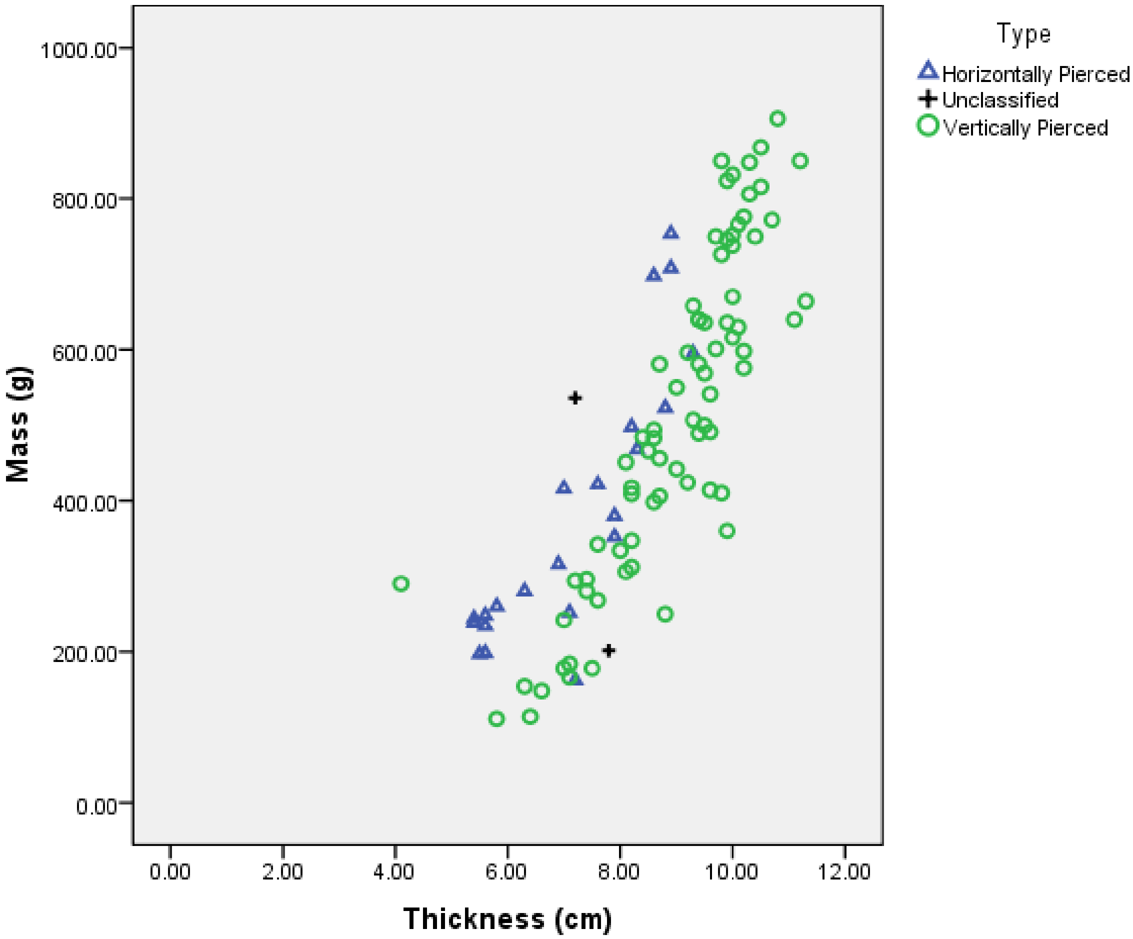


Figure 3.16: Loom weights from Tel Batash (weights identified as Unclassified were described as “Odd” or “PNP” by Browning (2001); types that he does not describe) (See Table I.1)

9) Khirbat al-Mudayna

Sources: (Boertien 2013, 2014; P. M. M. Daviau 1997; P. M. M. l. Daviau 2009; P. M. M. Daviau and Chadwick 2007; P. M. M. Daviau and Dion 2002)

Khirbat al-Mudayna is a walled fortress on the Wadi ath-Thamad. Textile-related finds from Khirbat al-Mudayna include 278 unbaked clay loom weights, 3 textile impressions, and 1 piece of woven cloth. These finds are from public, ritual, and industrial contexts. The loom weights include both vertically and horizontally pierced weights. One hundred sixty-three of the loom weights are from six clusters of weights (See Figure 3.17, Table J.1). Individual descriptions of the loom weights are not available, but averages are published for the mass and width of the weights in each cluster. Some clusters were subdivided based on differences between the loom weight size and shapes of loom weights. I analyzed each group of weights using the published averages.

The thread counts and materials of the fabric remains and two of the impressions are described individually. I included these in my analyses of textile remains and impressions (See Figure 3.18, Table J.2).

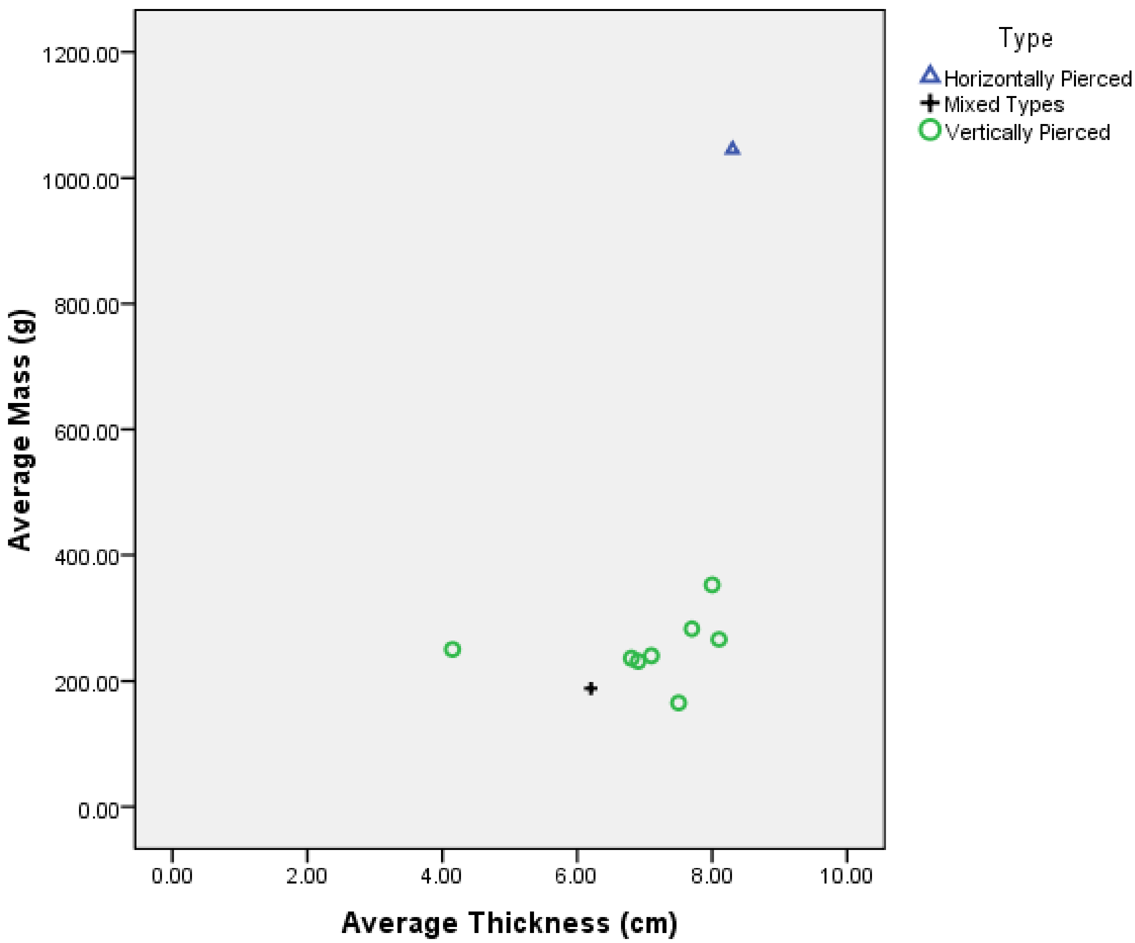


Figure 3.17: Loom weight clusters from Khirbat al-Mudayna (See Table J.1)

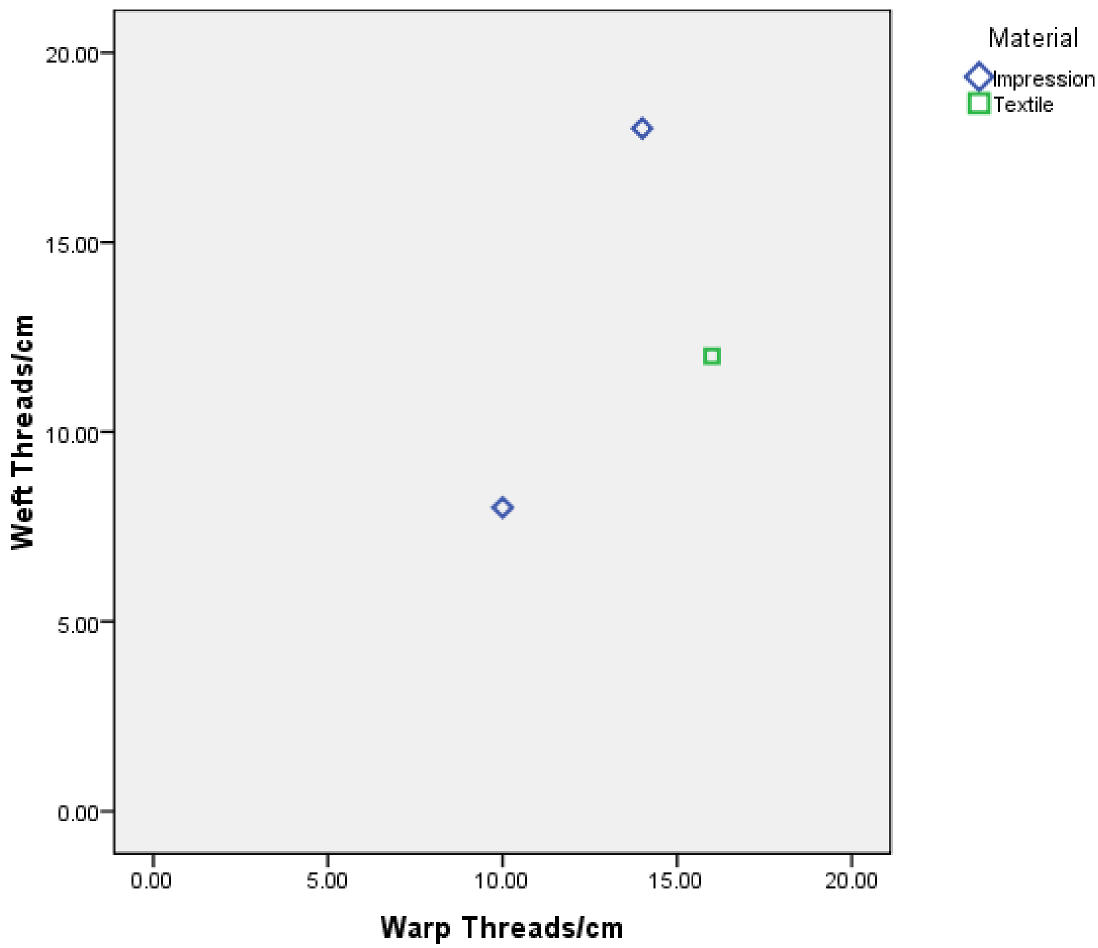


Figure 3.18: Textile remains and impressions from Khirbat al-Mudayna (See Table J.2)

10) Tell Mazar

Sources: (Boertien 2012, 2013; Yassine and Steen 2012)

Tell Mazar is a small fortress/palace located in the central Jordan Valley. During the Iron Age II, the entire site was a large courtyard building with evidence of domestic activities. Two hundred two Iron Age II loom weights made of unfired clay are published from the site. They include horizontally and vertically pierced examples and were found in eight distinct clusters (See Figure 3.19, Table K.1). Average measurements are available for seven of these clusters. I analyzed each cluster of weights using the published average measurements.

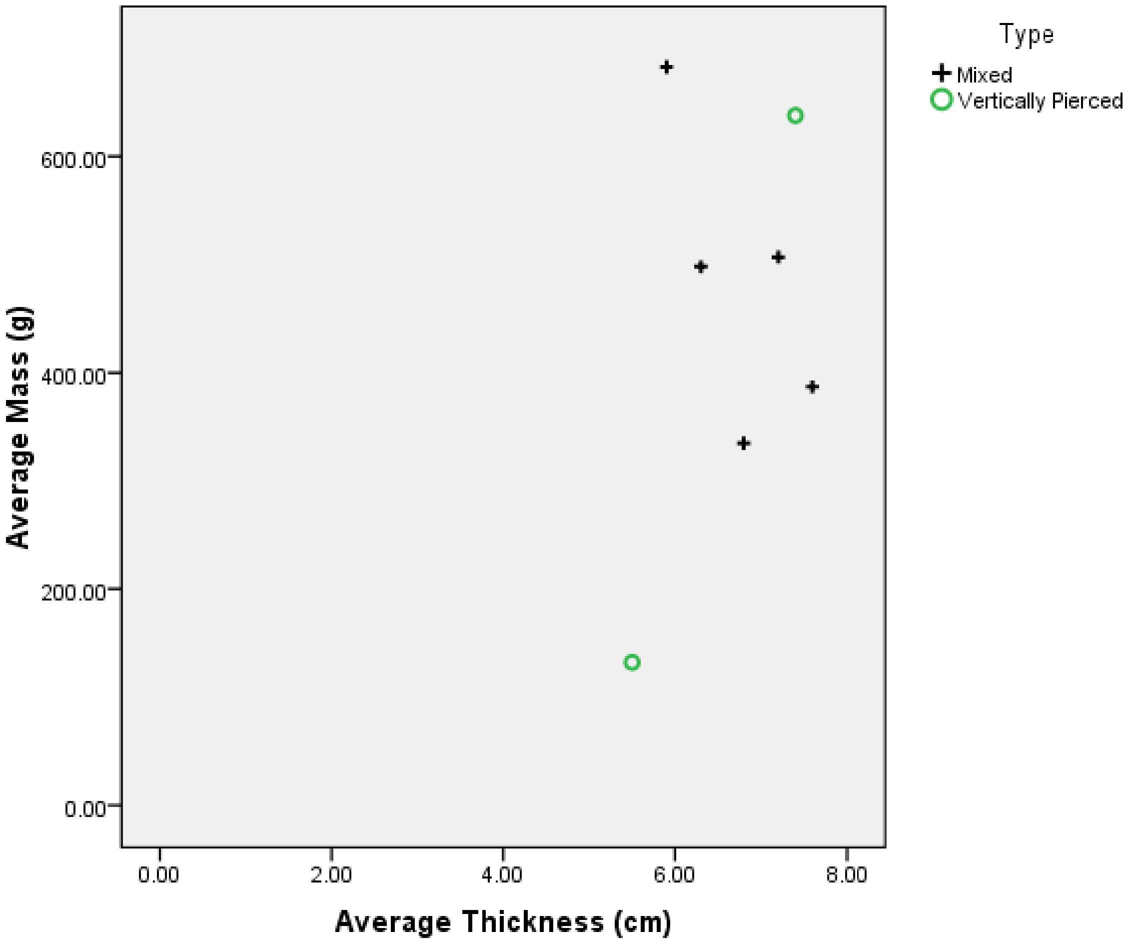


Figure 3.19: Loom weight clusters from Tell Mazar (See Table K.1)

11) Tel Ta'annek

Sources: (Fowler 1984; Friend 1998; Lapp 1964, 1969; Meehl 1995)

Tel Ta'annek is located in the hills between Megiddo and Beth-Shean. Most contexts at the site are domestic, but evidence of ritual activity was found in Locus 61. This context also included the largest cluster of loom weights. Lapp interpreted Locus 61 as part of a late tenth century cultic building (Lapp 1964: 26-28). Alternatively Fowler argued that it was a domestic building with evidence of household cult (Fowler 1984).

Eight-eight fired clay loom weights are reported from the site for which measurements are available for fifty-eight. They loom weights include both horizontally and vertically pierced types (See Figure 3.20, Table L.1).

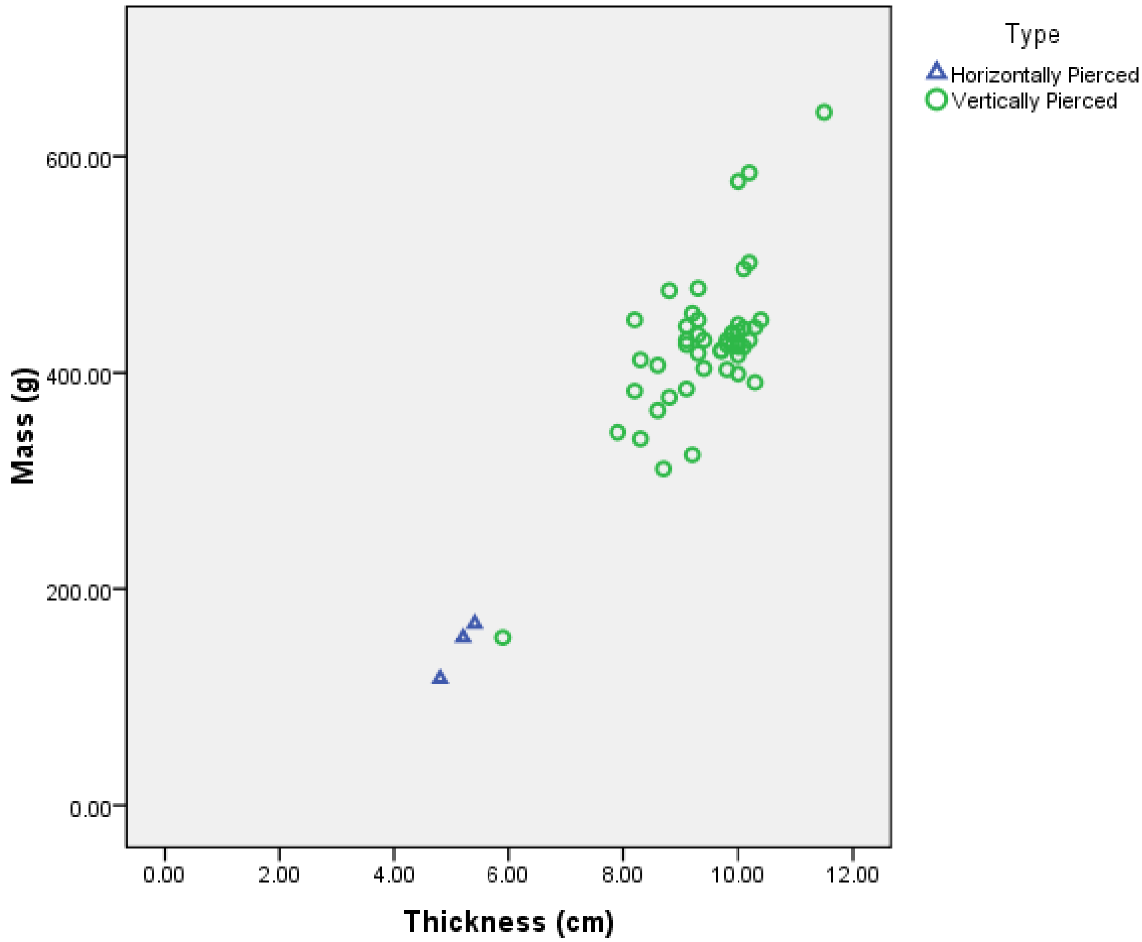


Figure 3.20: Loom weight clusters from Tel Ta'annek (See Table L.1)

12) Tel Amal

Sources: (Edelstein 1969; Feig 2013; Shamir 2012b)

Tel Amal is in the Beth-Shean Valley. Structures at the site contain evidence of domestic activity. One hundred seventy one loom weights are described from the site, of which measurements are available for 145 of them. The weights include 169 horizontally pierced gypsum weights, 1 horizontally pierced basalt weight, and 1 vertically pierced unbaked clay weight (See Figure 3.21, Table M.1).

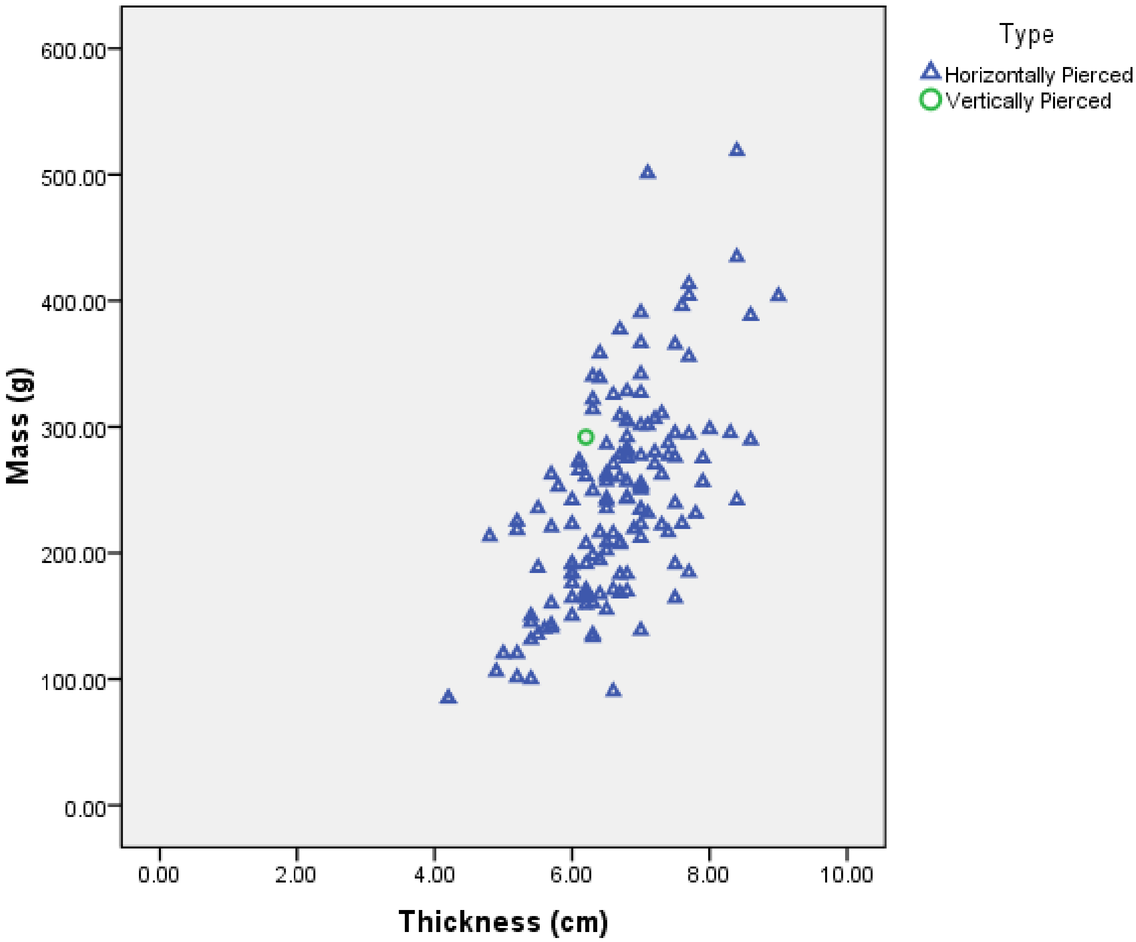


Figure 3.21: Loom weights from Tel Amal (Table M.1)

13) Deir ʻAlla

Sources: (Boertien 2004, 2007, 2013, 2014; van der Kooij and Ibrahim 1989)

Deir ʻAlla is located in the central Jordan Valley. Buildings at the site contain the remains of domestic activities. The remains of an inscription suggest that one building was used for ritual. Six hundred seventy-fine loom weights and one piece of fabric are published from the Iron Age II levels. Individual measurements are not published for the loom weights, so they are not analyzed in the present study. The textile fragment from Deir ʻAlla is a piece of hemp cloth. It has 24 warp threads/cm and 20 weft threads/cm.

14) Timna Mining Camp

Sources: (Ben-Yosef et al. 2012; Shamir and Baginski 1993; Shamir et al. 2014)

Timna is located in the southwestern Arabah. The site was a center for copper mining and smelting. Seventy-six textile fragments are published from the site. They include wool, goat hair, and linen cloth. The fabrics made with each fiber type are published as separate groups. Individual measurements are available for only one linen textile. For the remaining 75 textile fragments, the highest and lowest warp and weft thread counts are published in three groups by fabric type (wool, goat hair, and linen fabrics) (See Table 3.8).

Table 3.8: Textile remains from Timna (Shamir and Baginski 1993)

	Number of Remains	Warp Thread Count	Weft Thread Count	Type of Fabric
Grouped Wool	63	3-12	11-40	62 weft faced, 1 balanced
Grouped Goat Hair	9	3-5	8-20	weft faced
Balanced Linen	3	9-12	9-12	balanced
Warp Faced Linen	1	18	9	warp faced

15) Tell el-Hammah

Sources: (Cahill 2006; Cahill et al. 1987; Shamir 2012a)

Tell el-Hammah is located at the southern entrance to the Beth-Shean Valley. Textile related materials from Tell el-Hammah include loom weights, burnt fabric, and impressions of cloth on clay. Limited information is available for most of these artifacts. Only one textile impression from a clay jar stopper is published with warp and weft thread counts is analyzed in the present study. It is balanced linen fabric with fifteen treads per centimeter in both warp and weft.

16) Hazor

Source: (Shamir 2012a; Sheffer 1976)

Hazor is located north of the Sea of Galilee. Two clay stoppers from the site have fabric impressions (See Table 3.9). Descriptions of the impressions include the warp and weft thread counts and that both were woven from linen.

Table 3.9: Textile impressions from Hazor

	Material	Warp Count	Weft Count
Stopper #12	Linen	4-5	4-5
Stopper #14	Linen	10-12	10-12

17) Tel Masos

Sources: (Sheffer 1976)

Tel Masos is located on the Wadi Beer-Sheva in the Northern Negev. One textile impression on the bottom sherd of a vessel is described. It is of a wool fabric with four warp threads/cm and twenty to twenty-two weft threads/cm.

Large assemblages of artifacts from the Iron Age II Levant permit comparisons of fabrics reconstructed from loom weight characteristics with actual textile remains and impressions. The following chapter describes the methods used in this study to reconstruct the types of fabric that could be woven using Iron Age II loom weights and the results of this comparison.

Chapter 4: Reconstructing the Production Goals of Iron Age II Weavers

This chapter reconstructs the textiles that were woven using the Iron Age II loom weights described in Chapter 3 using a two-step method: first, it demonstrates a method to reconstruct, for the warp-weighted loom, the tension and number of warp threads/cm based on the thickness and mass of a loom weight. This process permits one to move from what is generally preserved - loom weights - to reconstruct what is not preserved - textiles. These reconstructions are compared to Iron Age textiles and fabric impressions to identify which textiles could have been woven using these loom weights and thus identify characteristics of Iron Age II fabrics missing from the reconstructions: fiber type and weft thread count.

From Loom Weights to Warps

Textile remains and textile impressions from Iron Age II sites vary in warp thread count, weft thread count, and warp thread thickness. Warp and weft thread counts are measured in threads/cm. Warp thread count (warp threads/cm or warp count) describes the number of warp threads in one centimeter of cloth measured perpendicularly to the warp threads. Weft thread count (weft threads/cm or weft count) describes the number of weft threads in one centimeter of cloth measured perpendicularly to the weft threads. Textiles with low warp and/or weft thread counts have gaps between the intersecting threads and are described as "open". Textiles with high warp and/or weft thread counts have no spaces between the threads and are described as "closed". Warp and weft threads vary in thickness. Thick threads in either warp or weft create a more closed fabric than do thin threads (See Figures 4.1, 4.2, and 4.3).

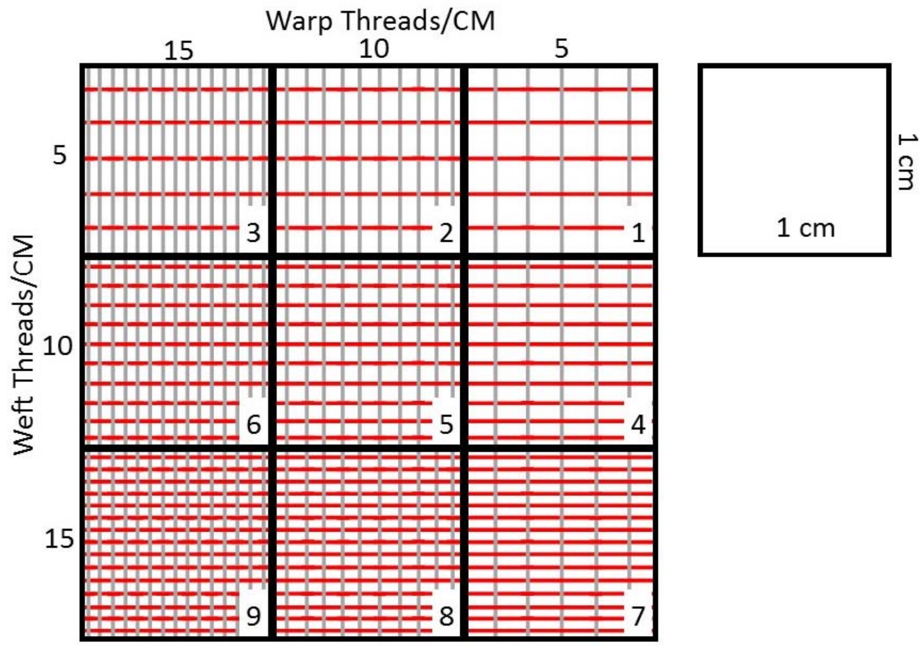


Figure 4.1: Schematic of different types of fabric with *fine* threads. Warp counts increase from right to left and weft counts increase from top to bottom. Boxes 1, 5 and 9 are balanced fabrics, Boxes 2, 3, and 6 have a higher warp count than weft count, and Boxes 4, 7, and 8 have a higher weft count than warp count (Adapted From Andersson Strand et al. 2015: Figure 6.1.3).

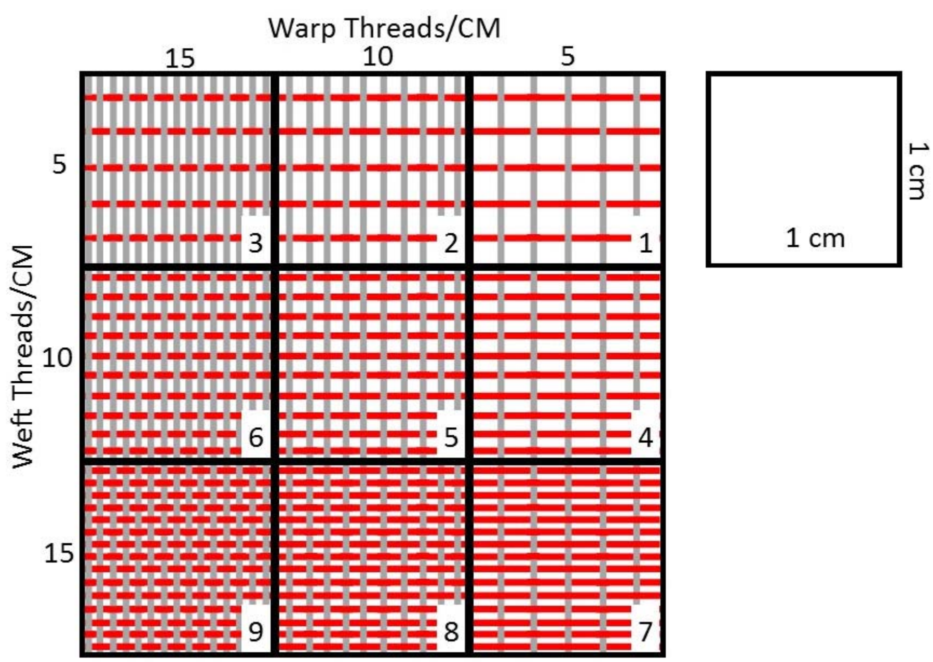


Figure 4.2: Schematic of different types of fabric with *medium* threads. Warp counts increase from right to left and weft counts increase from top to bottom. Boxes 1, 5 and 9 are balanced fabrics, Boxes 2, 3, and 6 have a higher warp count than weft count, and Boxes 4, 7, and 8 have a higher weft count than warp count (Adapted From Andersson Strand et al. 2015: Figure 6.1.3).

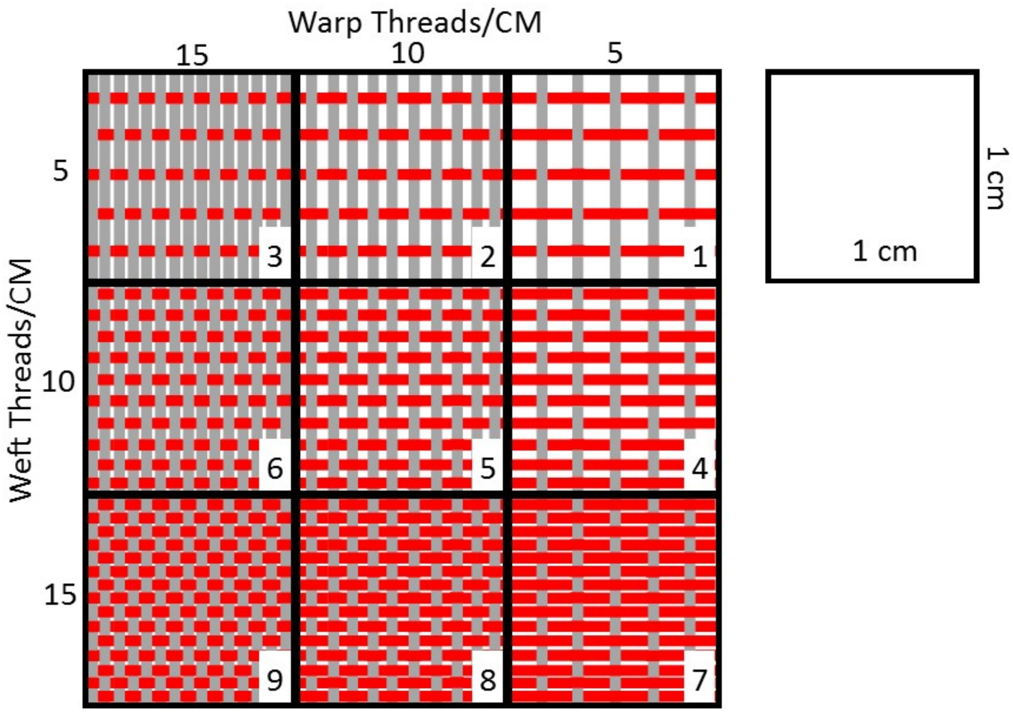


Figure 4.3: Schematic of different types of fabric with *thick* threads. Warp counts increase from right to left and weft counts increase from top to bottom. Boxes 1, 5 and 9 are balanced fabrics, Boxes 2, 3, and 6 have a higher warp count than weft count, and Boxes 4, 7, and 8 have a higher weft count than warp count (Adapted From Andersson Strand et al. 2015: Figure 6.1.3).

Weaving creates fabric by interlocking two perpendicular sets of threads. The weaver decides key characteristics of the finished fabric (i.e. warp count, weft count, thread thickness, and type of fiber) before setting up the loom. Weaving fabric based on these choices requires the use of loom weights of the correct size (mass and thickness) for the desired fabric.

The initial step in weaving, "warping" or "dressing" the loom, is the process of setting up the warp threads on the loom. There are multiple ways to warp a loom, but all methods fulfill two actions: measuring to the warp threads to the correct length (slightly longer than the finished textile will be, so that there is sufficient length to tie the threads to the loom and loom weights) and attaching the warp threads to the loom. On a warp-weighted loom, the warp threads are suspended from a horizontal beam, and spaced to match the finished fabric's warp thread count (i.e. for a fabric with 10 warp threads/cm, warp threads are attached to the beam 1 mm apart) (Hoffmann 1974: 82-84).

Once the warp threads are attached to the loom, they are tied to the loom weights or a loop of thread that is itself tied to the loom weight. Multiple warp threads are attached to each loom weight. There are two factors that constrain the choice of loom weights: their mass and thickness. The mass of the loom weight provides equal tension to each warp thread to which it is tied. If the weight is too light and does not create sufficient tension, it is difficult for the weaver to manage the warp threads during weaving. Thick warp threads require more tension than thin warp threads (Martensson et al. 2009: 378). Additionally, linen warp threads require higher tension than wool warp threads (Andersson 1999: 20).

In addition to creating tension on the warp threads, loom weights serve to organize the warp threads during weaving. For tabby weave (the pattern of weaving used in all Iron Age II textile remains and fabric impressions), two rows of loom weights both equal in length to the width of the finished fabric are used. The warp threads are tied to the weights alternating between rows (i.e. the first warp thread is tied to the front row of loom weights and the second warp thread is tied to the back row of loom weights). This maintains the order of the warp threads and constrains the textile's width to that of the rows of loom weights (See Figure 4.4). If the rows of loom weights that are thinner than the width of the fabric, the fabric contracts during weaving. Alternatively, if the rows of loom weights are wider than the fabric, the fabric expands during weaving (Martensson et al. 2009).

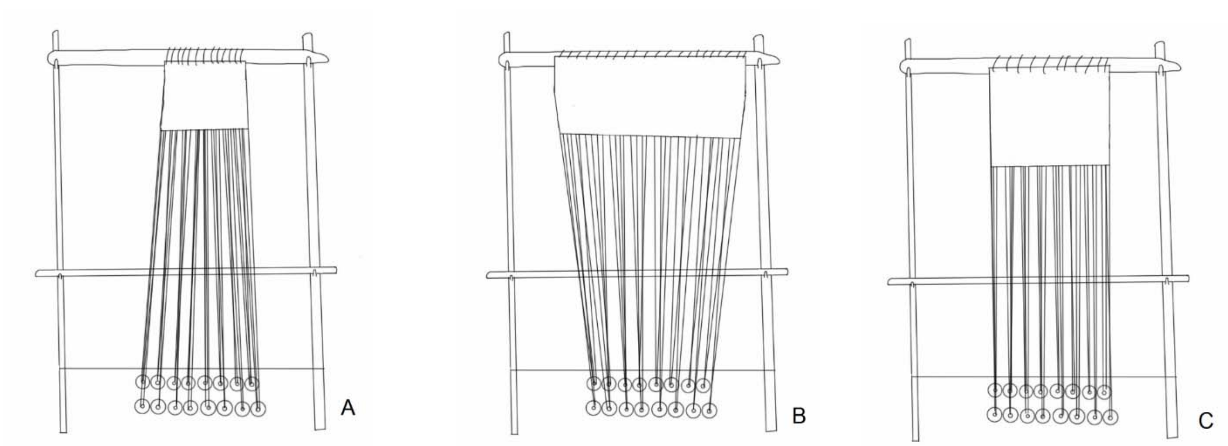


Figure 4.4: Impact of loom weight thickness on textile width. A) Textile woven with loom weights that are too thick. The textile widens during weaving. B) Textile woven with loom weights that are too thin. The textile contracts during weaving. C) Textile woven with loom weights of optimal thickness. The Textile remains the same width as the rows of loom weights for the entire weaving process.

Once the loom weights are tied to the warp threads, weaving begins. Weaving is a repetitive process that interlocks warp and weft threads. The “shed bar” is placed horizontally in the middle of the weaving and tied to alternating warp threads (See Figure 4.5). When the weaver pulls the shed bar forward, half of the warp threads are lifted creating a passage with one half the warp threads in front and the other half of the warp threads in back. The weaver passes the weft thread through this passage. The shed bar is then released, creating the counter-shed (the warp threads that were in front move to the back), and locking the weft thread in place (Hoffmann 1974: 45). This process continues with weft threads added one at a time until the textile reaches the desired length.

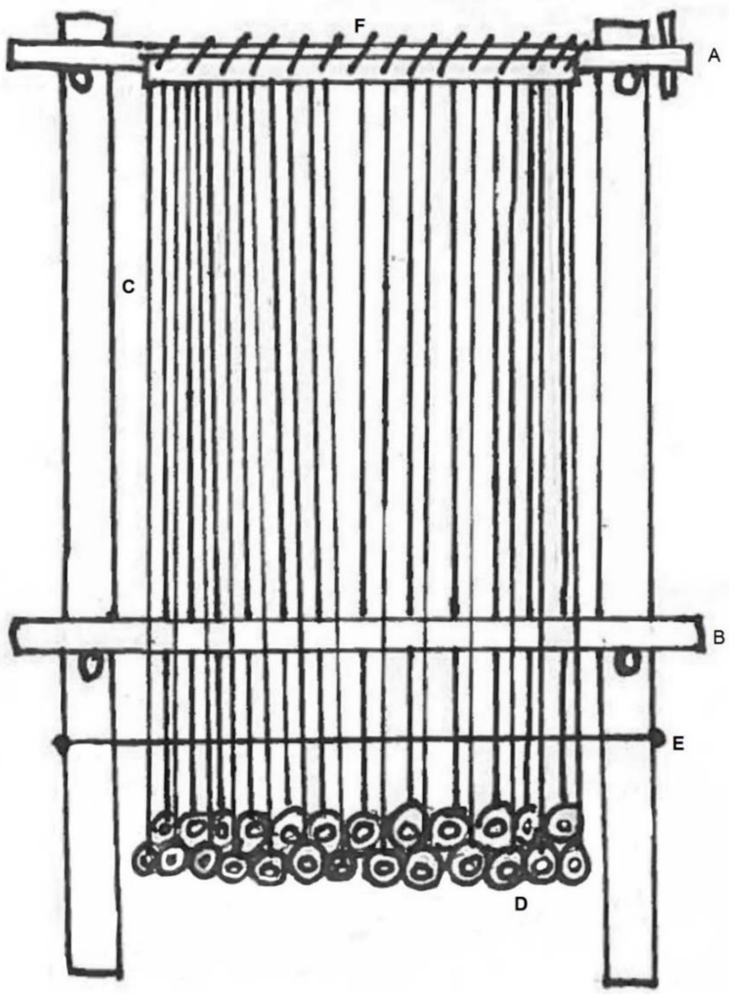


Figure 4.5: Front view of warp-weighted loom (A Beam, B Heddle Rod, C warp threads, D loom weights, E spacing cord, F starting border) (After Hoffmann 1974: 24)

For a warp-weighted loom to work effectively, the warp threads must be under optimal tensions. This allows the weaver to switch between shed and counter-shed arrangements easily and to quickly add weft threads. If the loom weights are too light they cannot provide sufficient tension resulting in friction that sticks the warp threads together. This can prevent the smooth transition from shed to counter shed and back again, slowing the weaving process as the weaver must separate individual warp threads by hand. On the other hand, one cannot simply continue to add tension, because if the loom weights are too heavy, the warp threads will break (Martensson et al. 2009). For each type of warp thread (i.e. thickness and material) there is an ideal range of tension which enables easy transition between shed and counter shed and without breaking the warp threads.

Recent work by Martensson et al. (2007a, 2007b; 2009) provides a means to interpret variation among loom weights. Martensson and colleagues used experimental weaving to identify how physical variation in the mass and shape of loom weights enables weavers to create fabrics with different warp threads counts and different warp thread thicknesses. Working with experienced weavers who used different warp thread thicknesses, warp thread counts, loom weight shapes, and loom weight sizes, these experiments demonstrated the importance of loom weight thickness in constraining the finished size of textiles and supported the relationship between warp thread thickness and loom weight mass (described above).

Based on their observations, Martensson et al. suggest conditions on the ways weavers can arrange warp threads. First, each loom weight should be tied to between five and thirty warp threads: fewer than five warp threads per loom weight is inefficient as it requires too many loom weights for weavers to organize, and more than thirty warp threads per loom weight leads to an uneven weave (Martensson et al. 2009: 392). Second, warp-weighted looms are best suited for weaving fabrics with at least 5 warp threads/cm. Too many warp threads per centimeter creates fabric that is difficult to weave, because friction from the warp threads rubbing together makes it difficult to change sheds. Martensson et al. suggest a maximum of 30 thin warp threads/cm (10 g-20 g tension required per thread), 20 medium warp threads/cm (20 g-30 g tension required per thread), and 10 thick warp threads/cm (more than 30 g of tension required per thread) (See Table 4.1) (Martensson et al. 2009: 392-393).

Table 4.1: Limitations on warp threads per centimeter (Martensson et al. 2009: 392-393)

	Minimum	Maximum
Threads/cm		
Very Thin Thread (10-20g tension)	5	30
Thin Thread (20-30g tension)	5	20
Thick Threads (>30g tension)	5	10

The results of Martensson et al.'s experiments can be summed up as follows: heavy, thick loom weights are best suited for weaving low-warp-thread-count fabrics with thick warp threads; light, thin loom weights are best suited for weaving high-warp-thread-count fabrics with thin warp threads. The fact that evenly woven textiles are recovered from multiple Iron Age II sites suggests that Iron Age II weavers followed these guidelines (Martensson et al. 2009: 396-397).

Martensson et al. use these observations to reconstruct the fabrics that could be woven with different loom weights. They provide a set of equations that which use a loom weight's mass and width and a set of possible tensions (e.g. 10 g, 20 g, 30 g, and 40 g) to calculate characteristics of fabric that could be woven with the loom weight (i.e. warp thread count and warp thread thickness) (Martensson et al. 2009: 393).

Their first equation determines the number of warp threads that should be attached to a loom weight for efficient weaving. Because the tension is evenly distributed across all attached warp threads, the number of warp threads is equal to a loom weight's mass divided by the tensions selected by the analyst (See Figure 4.6) (Martensson et al. 2009: 393).

$$\textbf{Warp Threads per Loom Weight} = \frac{\textbf{Mass}}{\textbf{Tension}}$$

Figure 4.6: Equation to calculate the number of warp attached to one loom weight (Martensson et al. 2009: 393)

As each warp-weighted loom is set up with two rows of loom weights (see above), calculating the number of warp threads for each pair of loom weights is a necessary intermediate step before determining the number of warp threads per centimeter. The warp threads for a pair of loom weights are thus equal to twice the number of warp threads attached to a single loom weight (See Figure 4.7) (Martensson et al. 2009: 393).

$$\textit{Warp Threads per Two Loom Weights} = 2 * \textit{Warp Threads per Loom Weight}$$

Figure 4.7: Equation to calculate the number of warp threads attached to two loom weights (Martensson et al. 2009: 393)

Finally, warp threads are distributed over the width of the fabric. As discussed above, to create an even fabric, the total width of the row of loom weights must be equal to the width of the fabric. Therefore each centimeter of fabric corresponds to a centimeter of each row of loom weights. The number of warp threads/cm can then be calculated by dividing the number of warp threads attached to two loom weights by the thickness of the loom weights (See Figure 4.8) (Martensson et al. 2009: 393).

$$\textit{Warp Threads per CM} = \frac{\textit{Warp Threads per Two Loom Weights}}{\textit{Thickness}}$$

Figure 4.8: Equation to calculate the number of warp threads/cm (Martensson et al. 2009: 393)

Martensson et al. use this approach to compare the results for different tensions selected by the authors (See Table 4.2). Their approach results in a mathematical reconstruction of textiles that could be woven at each specific tension value. Arrangements of warp threads with too many or too few warp threads/cm or per loom weight are rejected, because they would be too difficult or inefficient to weave (Martensson et al. 2007a; Martensson et al. 2009).

Table 4.2: Example table using Martensson et al.'s approach to analyze a loom weight from Ashkelon (Master 2011)

	A	B	C	D
Warp threads requiring	10g warp tension	20g warp tension	30g warp tension	40g warp tension
Number of threads per loom weight	32	16	11	8
Number of threads per two loom weights	64	32	22	16
Warp threads/cm	9	4	3	2
Evaluation of stability	Possible, Too many threads per weight	Possible, too few threads/cm	Unlikely, too few threads/cm	Unlikely, too few threads/cm
Ashkelon Loom Weight 44452: Mass 328g, Thickness 6.9cm				

Although Martensson et al.'s approach is a good starting point in determining the types of fabric woven using a given loom weight, their approach underestimates the full variation of fabrics, as their reconstructions only tested a set number of specific tensions. Their approach does not address textiles that required tensions that fall between those they tested, which could lead to reconstructions that do not identify any arrangement of warp threads for a loom weight. Such an outcome is shown in the loom weight evaluated in Table 4.2.

Building on Martensson et al.'s observations, I developed a method that accounts for the full range of fabrics that can be woven with a loom weight. From the equations and limits Martensson et al. describe, I derived a set of four inequalities. Each inequality can be used to identify a tension based on the known mass and width of a loom weight. The first set of inequalities identifies the tensions for looms set up with the highest and lowest threads *per loom weight* (5-30 threads per loom weight) (see above). The second set of inequalities identifies the tensions for looms set up with the highest and lowest threads per centimeter (5-30 threads/cm) (see above). These ranges are based on Martensson et al.'s limits of warp threads per centimeter and warp threads per loom weight and describe the optimum loom set-ups (the optimum warp thread arrangement enables weavers to efficiently switch sheds and results in a uniform fabric with even distribution of warp and weft threads). Although weavers can use loom weights in suboptimal arrangements (e.g. too many or too few threads/cm or too high or too low tension), such an arrangement is difficult and the operation may fail if the warp thread counts or tensions are too high or too low. Iron Age II textile remains and impressions show even weaves that suggest the use of optimal arrangements. Therefore, I calculated only the optimal arrangements of warp threads. I discuss the possible use of loom weights in suboptimal arrangements in my results, but do not include them in my calculations.

Each inequality I developed is described below, followed by a figure that shows the step-by-step derivation. A loom weight from Beth-Shean with a mass of 117 g and thickness of 4.8 cm is used to demonstrate the calculations.

Inequality 1:

Figure 4.9 shows the derivation of Inequality 1 from the lower limit of at least five threads attached to each loom weight. From Martensson et al.'s original equation (See Figure 4.6), I substituted mass/tension for the number of threads per loom weight. I then isolated the tension for the final inequality. For a loom weight with mass 117 g, this results in a tension less than or equal to 23.4 g per warp thread.

$$\boldsymbol{Warp\ Threads\ per\ Loom\ Weight \geq 5}$$

$$\boldsymbol{\frac{Mass}{Tension} \geq 5}$$

$$\boldsymbol{\frac{Tension}{Mass} \leq \frac{1}{5}}$$

$$\boldsymbol{Tension \leq \frac{Mass}{5}}$$

Figure 4.9: Derivation of inequality to calculate the maximum tension for a loom weight based on five threads per loom weight

Inequality 2:

Figure 4.10 shows the derivation of Inequality 2, which is based on the maximum number of thirty warp threads attached to each loom weight. Again, I substituted mass/tension for the number of threads per loom weight (See Figure 4.6). I then isolated the tension variable. For a loom weight with mass 117 g, this results in a tension greater than or equal to 3.9 g.

$$Warp\ Threads\ per\ Loom\ Weight \leq 30$$

$$\frac{Mass}{Tension} \leq 30$$

$$\frac{Tension}{Mass} \geq \frac{1}{30}$$

$$Tension \geq \frac{Mass}{30}$$

Figure 4.10: Derivation of inequality to calculate the minimum tension for a loom weight based on thirty threads warp per loom weight

Inequality 3:

Inequality 3 is based on the minimum number of 5 warp threads/cm. The derivation of Inequality 3 is shown in figure 4.11. I substituted the number of warp threads per two loom weight/loom weight thickness for the number of warp threads/cm (See Figure 4.8). I then substituted 2 **X** the number of warp threads per loom weight for the number of warp threads per two loom weights (See Figure 4.7). Next, as before, I substituted loom weight mass/tension (See Figure 4.6). Finally, I isolated the tension. The loom weight with mass 117 g and thickness 4.8 cm, results in a tension less than or equal to 9.75 g.

$$Warp\ Threads\ per\ CM \geq 5$$

$$\frac{Warp\ Threads\ per\ Two\ Loom\ Weights}{Thickness} \geq 5$$

$$Warp\ Threads\ per\ Two\ Loom\ Weights \geq 5 * Thickness$$

$$2 * Warp\ Threads\ per\ Loom\ Weight \geq 5 * Thickness$$

$$2 * \frac{Mass}{Tension} \geq 5 * Thickness$$

$$\frac{Tension}{2 * Mass} \leq \frac{1}{5 * Thickness}$$

$$Tension \leq \frac{2 * Mass}{5 * Thickness}$$

Figure 4.11: Derivation of inequality to calculate the maximum tension for a loom weight based on five threads/cm

Inequality 4:

Figure 4.12 shows the derivation of Inequality 4. The fourth inequality is based on the maximum number of warp threads per centimeter. This is a conditional inequality, because the maximum number of warp threads per centimeter varies in relation to the thickness of warp threads. I substituted the number of warp threads per two loom weights/loom weight thickness in place of the number of warp threads per centimeter (See Figure 4.8). I then substituted two **X** the number of warp threads per loom weight for the number of threads per two loom weights (See Figure 4.7). Next, I substituted loom weight mass/tension (See Figure 4.6). Finally, I isolated the tension. The loom weight with mass 117 g and thickness 4.8 cm, results in a tension of 1.635 g.

This inequality must be evaluated for each potential range of tension, because of the conditional relationship between tension and the maximum number of warp threads/cm.

$$\textit{Warp Threads per CM} \leq \{10, 20, 30\}$$

$$\frac{\textit{Warp Threads per Two Loom Weights}}{\textit{Thickness}} \leq \{10, 20, 30\}$$

$$\textit{Warp Threads per Two Loom Weights} \leq \{10, 20, 30\} * \textit{Thickness}$$

$$2 * (\textit{Warp Threads per Loom Weight}) \leq \{10, 20, 30\} * \textit{Thickness}$$

$$2 * \frac{\textit{Mass}}{\textit{Tension}} \leq \{10, 20, 30\} * \textit{Thickness}$$

$$\frac{\textit{Tension}}{2 * \textit{Mass}} \geq \frac{1}{\{10, 20, 30\} * \textit{Thickness}}$$

$$\textit{Tension} \geq \frac{2 * \textit{Mass}}{\{10, 20, 30\} * \textit{Thickness}}$$

Figure 4.12: Derivation of inequality to calculate the minimum tension for a loom weight based on ten, twenty, or thirty threads/cm

These four inequalities identify four limiting values. The first upper bound and lower bound are based on the number of threads per loom weight. The second upper bound and lower bound are based on the number of threads per centimeter. A range of tensions between the lowest upper bound and highest lower bound makes all four inequalities true mathematical statements. A tensions between those values is within the optimal ranges of warp threads per centimeter and warp threads per loom weight. For the example of the loom weight with mass 117 g and thickness 4.8 cm, the range is between 9.75 g and 3.9 g of tension.

Equation 1:

Figure 4.13 shows the derivation of an equation to calculate the warp threads per centimeter of textile using the optimal range of tensions derived using the inequalities. I started from Martensson et al.'s observation that the possible number of warp threads per centimeter is equal to the warp threads attached to two loom weights/loom weight's thickness (See Figure 4.8). I then substituted two **X** warp threads per loom weight in place of the number of warp threads attached to two loom weights (See Equation 4.7). Next, I substituted mass/tension for the number of warp threads attached to a loom weight (See Figure 4.6), and simplified to reach the final equation.

$$\textit{Warp Threads per CM} = \frac{\textit{Warp Threads per Two Loom Weights}}{\textit{Thickness}}$$

$$\textit{Warp Threads per CM} = \frac{2 * \textit{Warp Threads per Loom Weight}}{\textit{Thickness}}$$

$$\textit{Warp Threads per CM} = \frac{2 * \textit{Mass/Tension}}{\textit{Thickness}}$$

$$\textit{Warp Threads per CM} = \frac{2 * \textit{Mass}}{\textit{Tension} * \textit{Thickness}}$$

Figure 4.13: Derivation of equation to calculate the number of warp threads/cm

Thus to calculate the optimum number of warp threads per centimeter for each loom weight, I used the mass and thickness of each loom weight, substituting the highest and lowest tension identified for each into separate instances of the equation. The results are the highest and lowest warp thread count possible for each loom weight. For example, for the loom weight with mass 117 g and thickness 4.8 cm, the optimal range is between 5 and 12.5 warp threads/cm.

Using these inequalities and equations provides the full range of variation possible using what Martensson et al. identify as optimal loom set ups. These tension ranges can be used to reconstruct the thickness of the non-preserved warp threads based on the recovered loom weights. High tensions suggest thick warp threads. Low tensions suggest thin warp threads. The range of warp threads/cm can be used further to reconstruct if the fabric woven with the particular loom weights would have been open or closed. In the example from Beth-Shean, tensions between 3.9 g and 9.75 g and warp thread counts between 5 and 12.5 warp threads/cm, as calculated above, suggest an open textile woven with thin warp threads.

Iron Age II Textile Reconstructions from Loom Weights

The results of my calculations are presented in Figures 4.14 – 4.23 for individual loom weights and Figure 4.24 for groups of loom weights (See Table N.1, N.2). These demonstrate that the majority of Iron Age II loom weights are best suited for weaving textiles with low warp thread counts. 95.7% of the individual loom weights were too wide to be used on looms with fifteen or more warp threads/cm (See Table 4.3). When used to weave fabric with the highest optimal warp thread counts, these weights were suited for weaving thin warp threads that required low tensions (See Table 4.4). At the other extreme, the results showed that five warp threads/cm was the minimum for every loom weight (based on Martensson et al.'s suggestion that five warp threads/cm is the lowest optimal warp thread count). If used to weave fabrics with five warp threads/cm, most Iron Age II loom weights would still provide low tensions, although increased from the arrangements with higher warp counts (See Table 4.4). Figure 4.24 and Table 4.5 show the same result for loom weights for which measurements were published as group averages (i.e. weights from Khirbat al-Mudayna, Tell Mazar, and Kuntillet 'Ajrud). These results demonstrate that these weights were also best suited for weaving textiles with low warp thread counts and low tensions.

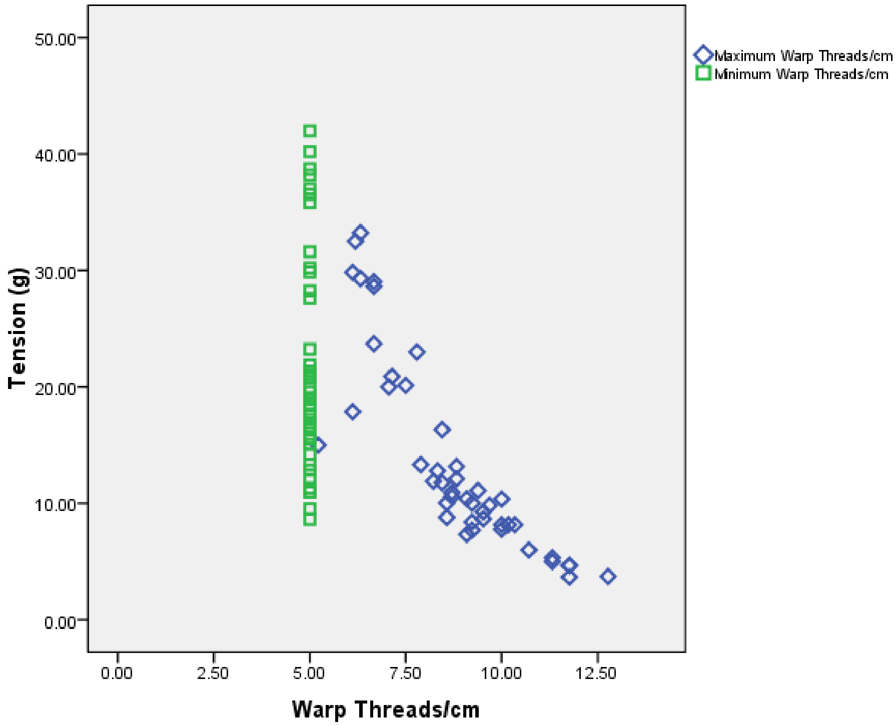


Figure 4.14: Calculated warp thread count and tensions for individual loom weights from Ashkelon (See Table N.1)

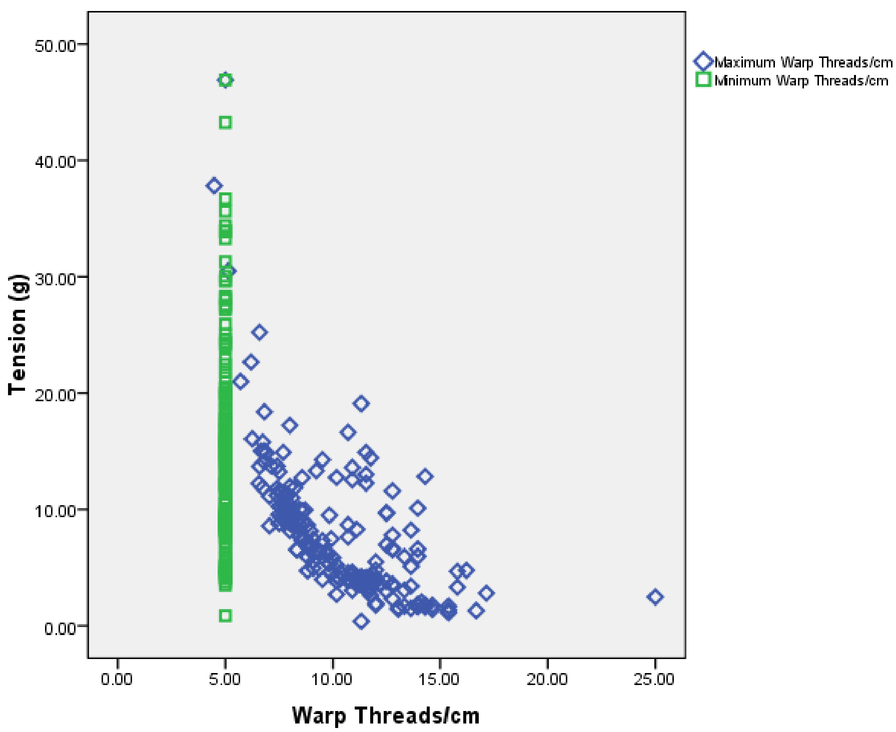


Figure 4.15: Calculated warp thread count and tensions for individual loom weights from Beth-Shean (See Table N.1)

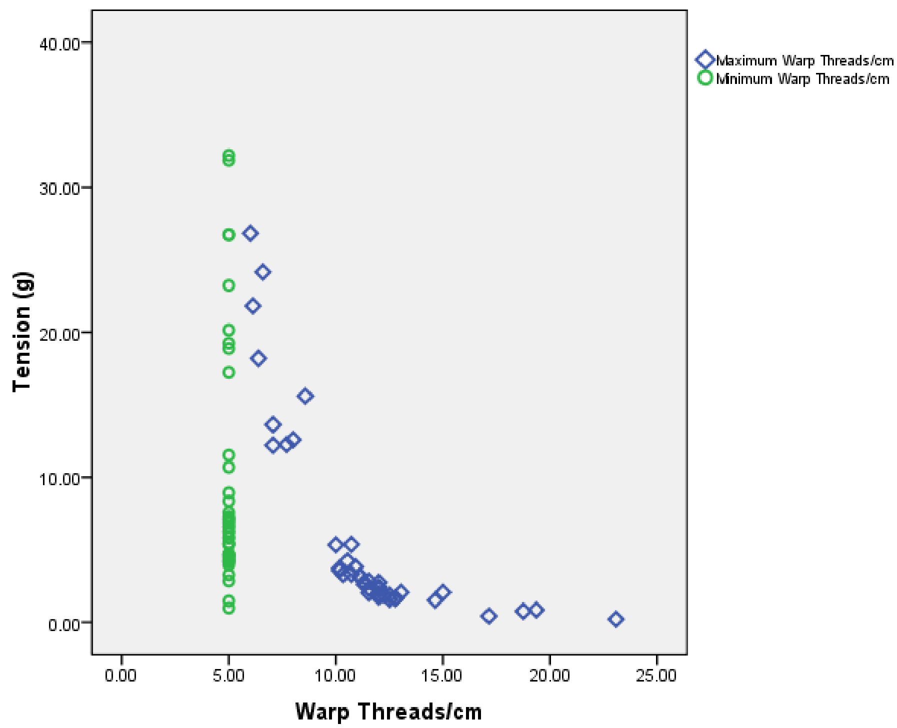


Figure 4.16: Calculated warp thread count and tensions for individual loom weights from the City of David Excavation (See Table N.1)

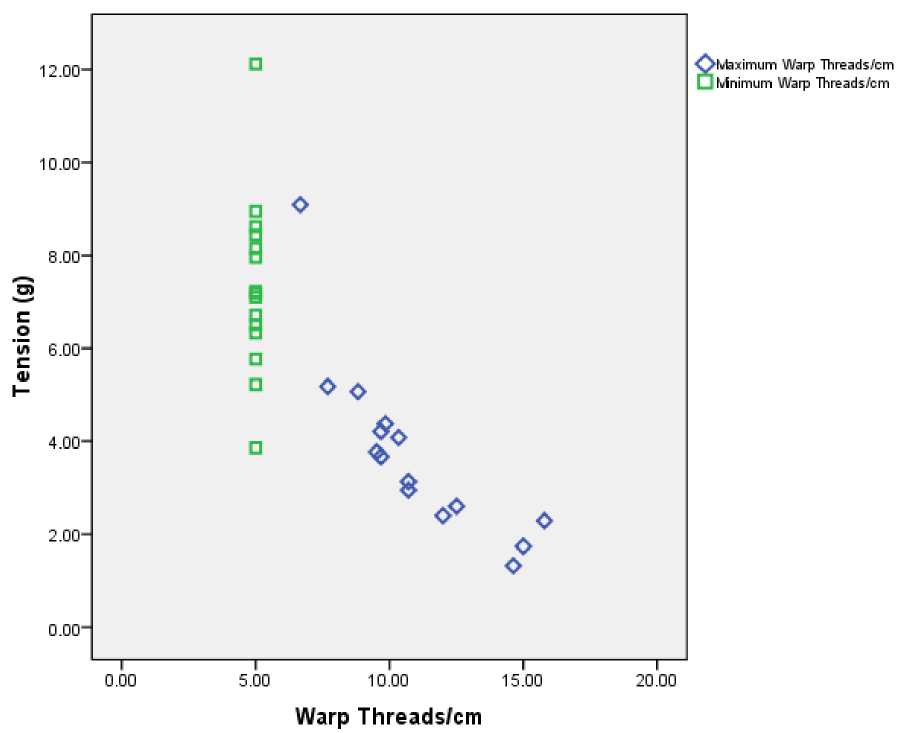


Figure 4.17: Calculated warp thread count and tensions for individual loom weights from Kadesh Barnea (See Table N.1)

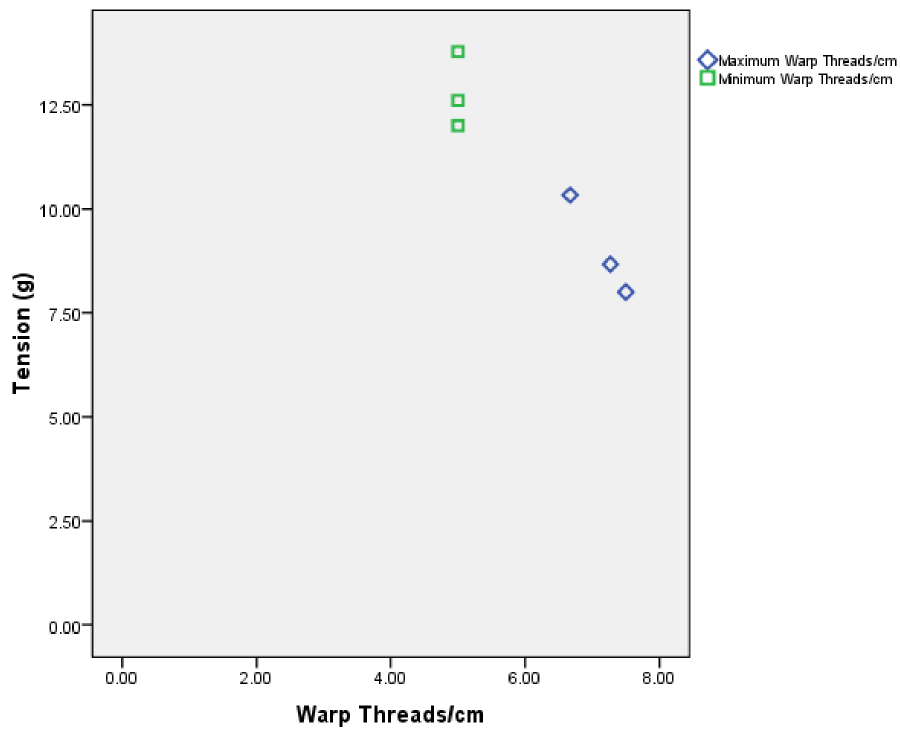


Figure 4.18: Calculated warp thread count and tensions for individual loom weights from Kuntillet ‘Ajrud (See Table N.1)

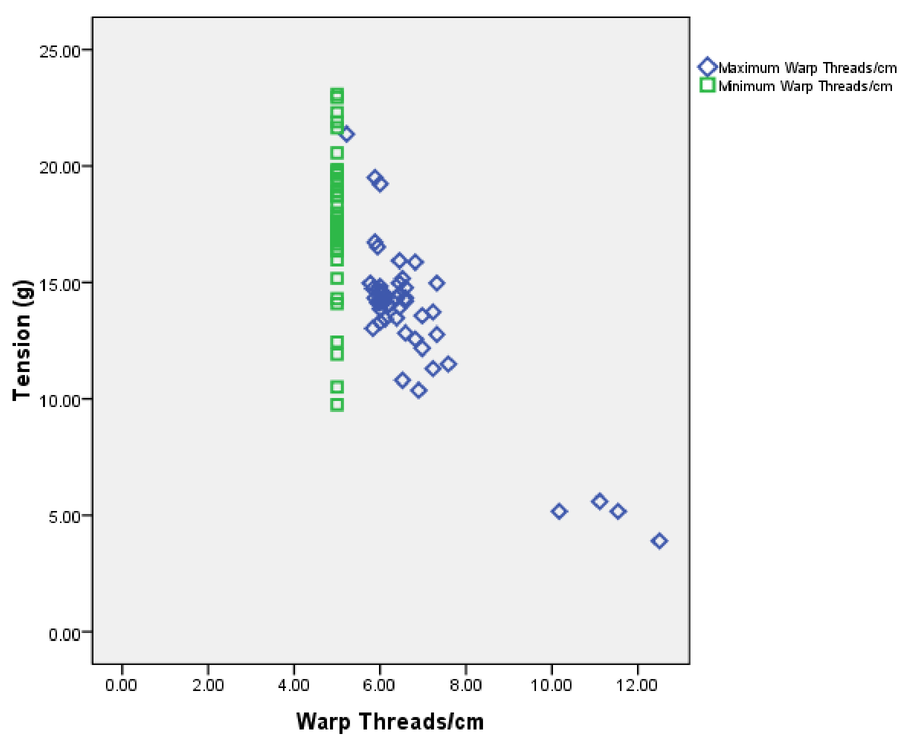


Figure 4.19: Calculated warp thread count and tensions for individual loom weights from Tell Ta’annek (See Table N.1)

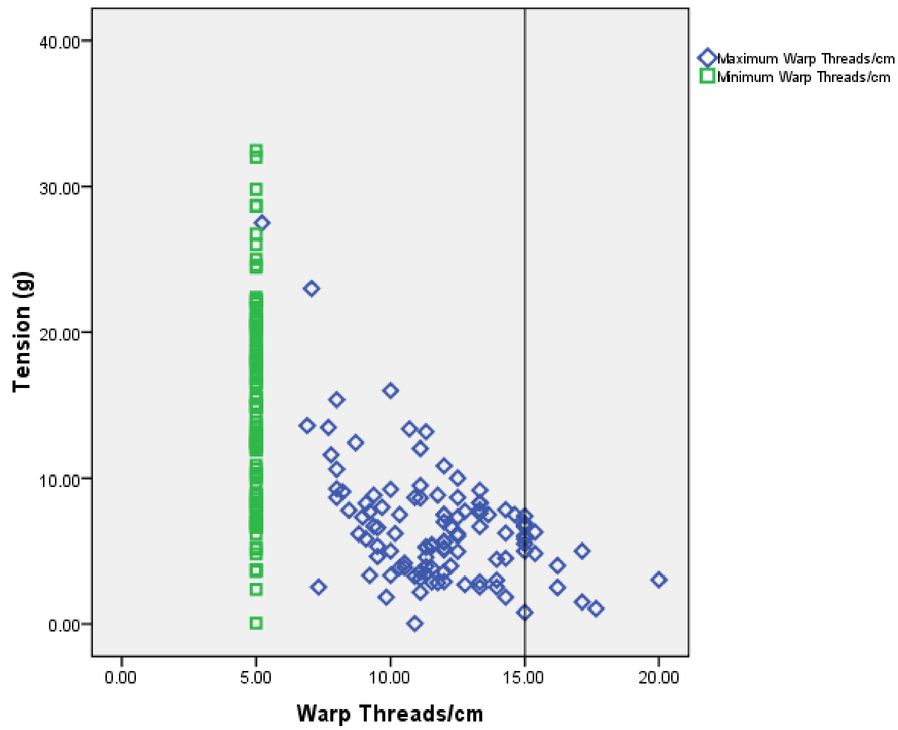


Figure 4.20: Calculated warp thread count and tensions for individual loom weights from Tell Afis (reference line placed at x = 15) (See Table N.1)

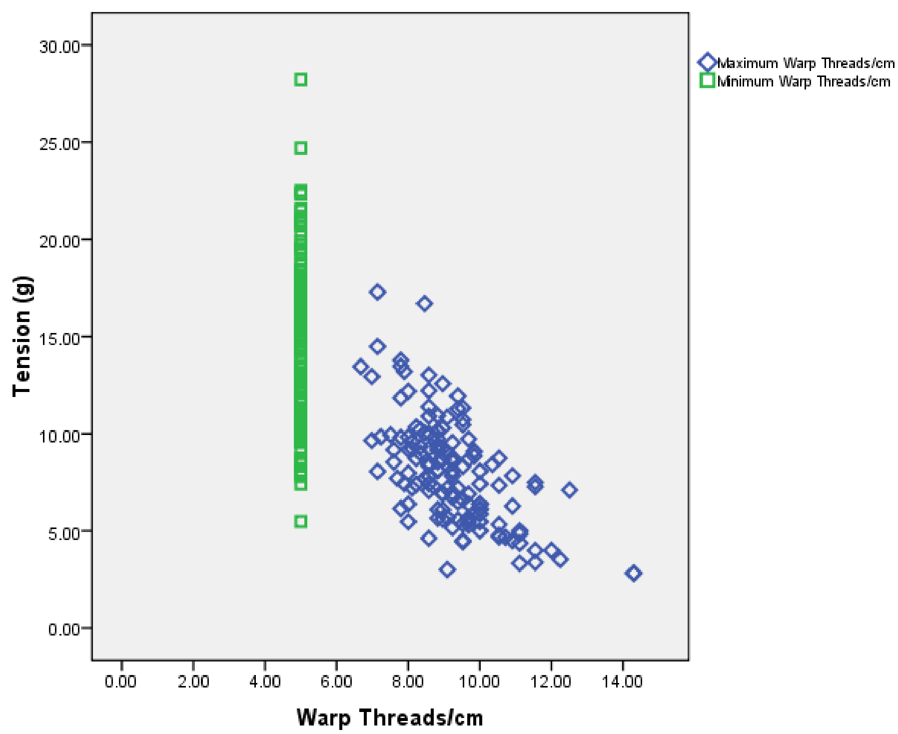


Figure 4.21: Calculated warp thread count and tensions for individual loom weights from Tel Amal (See Table N.1)

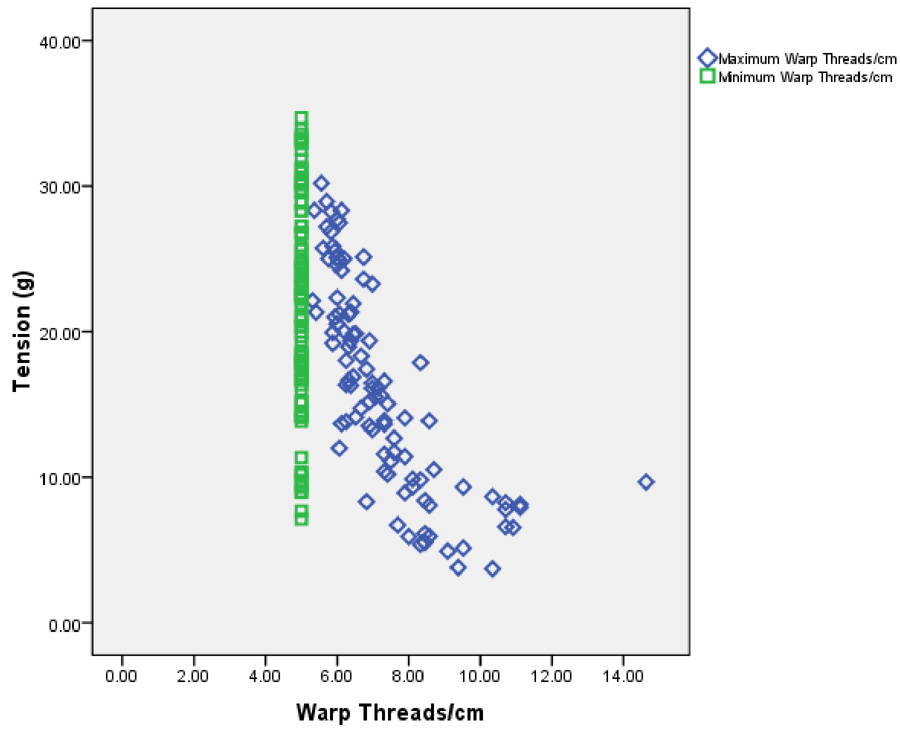


Figure 4.22: Calculated warp thread count and tensions for individual loom weights from Tel Batash (See Table N.1)

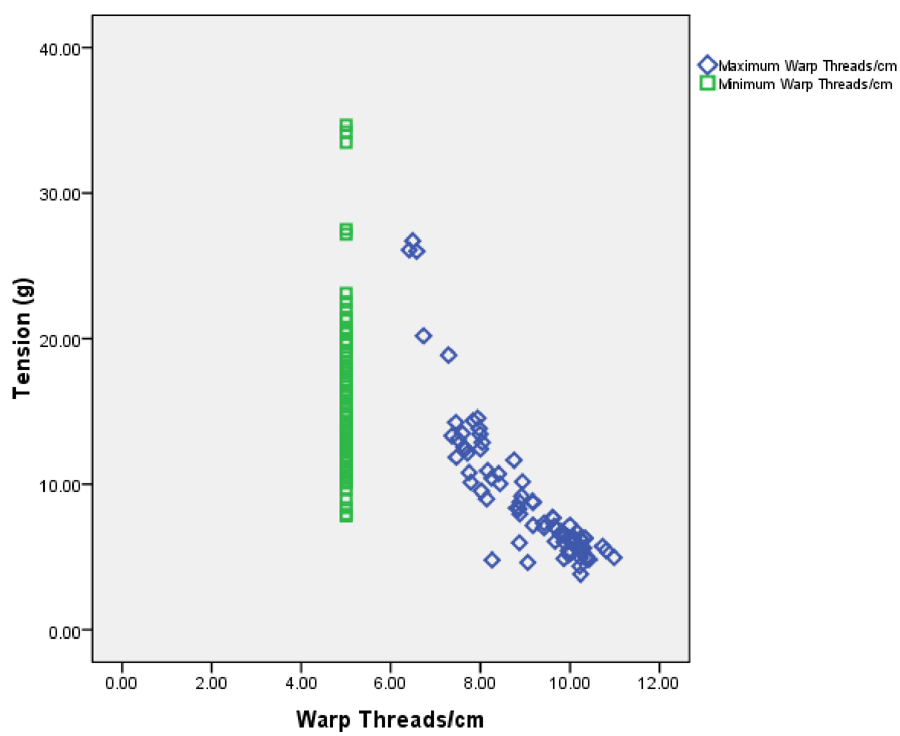


Figure 4.23: Calculated warp thread count and tensions for individual loom weights from Tell es-Safi (See Table N.1)

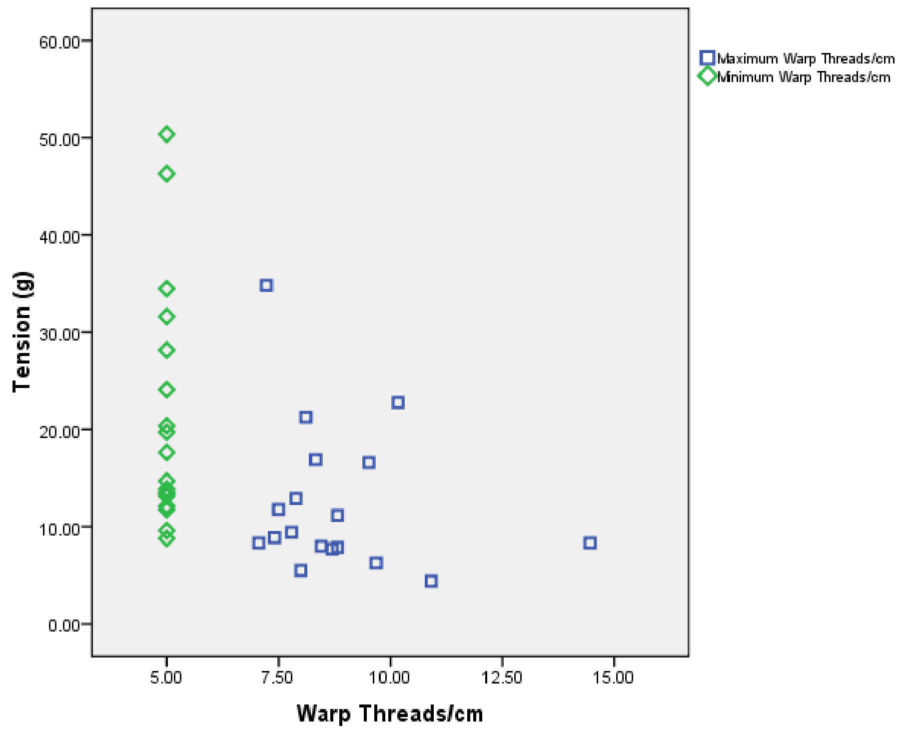


Figure 4.24: Calculated warp thread count and tensions for groups of Iron Age II loom weights (See Table N.2)

Table 4.3: Cumulative percentiles of loom weights suited for weaving arrangements with different warp thread counts

Maximum Warp Thread/CM	Individual Loom Weights	Groups of Loom Weights
<10	60.40%	83.3% of Groups
<15	95.70%	100.00% of Groups
<20	99.60%	
<25	99.90%	
<30	100.00%	
Maximum	25.00 Threads/cm	14.46 Threads/cm

Table 4.4: Cumulative percentiles of individual loom weights suited for weaving arrangements with different tensions

Tension (g)	Tension with Highest Warp Thread Count	Tension with Lowest Warp Thread Count
<5g	25.10%	5.00%
<10g	64.40%	23.40%
<15g	86.60%	49.90%
<20g	92.60%	77.90%
<25g	96.10%	89.70%
<30g	99.20%	94.60%
<35g	99.70%	98.60%
<40g	99.90%	99.50%
<45g	99.90%	99.90%
<50g	100.00%	100.00%
Maximum	46.90g	46.90g

Table 4.5: Cumulative percentiles of groups of loom weights suited for weaving arrangements with different tensions

Tension (g)	Tension with Highest Warp Thread Count	Tension with Lowest Warp Thread Count
<5g	5.60% Groups	0.00% Groups
<10g	55.60% Groups	11.1% Groups
<15g	72.20% Groups	50.00% Groups
<20g	83.30% Groups	61.10% Groups
<25g	94.40% Groups	72.20% Groups
<30g	94.40% Groups	77.80% Groups
<35g	100.00% Groups	88.90% Groups
<40g		88.90% Groups
<45g		88.90% Groups
<50g		94.40% Groups
<55g		100.00% Groups
Maximum	34.83g	50.36g

Comparison of Loom Weights with Preserved Textile Remains and Impressions

Iron Age II textiles would have varied with respect to the number of weft threads per centimeter. If these fabrics had low warp counts, like those woven with the loom weights in this sample, weft-dominant fabrics would have been closed fabrics, with only the weft threads visible on the finished fabric (i.e. weft faced) and balanced or warp-dominant fabrics would have been open weaves with spaces between the threads (See Figure 4.1, 4.2, and 4.3). If textiles had low warp counts and thin warp threads, weavers could not have made textiles with higher warp counts than weft counts using Iron Age II loom weights.

Although weft thread count is an important part of variation in textiles, it cannot be reconstructed from loom weights alone. A comparison of the warp thread counts calculated from Iron Age II loom weights to the warp thread counts of preserved textiles and impressions shows the range of potential weft counts and the fiber types of textiles that could have been woven with the loom weights.

Figure 4.25 is a scatter plot of preserved Iron Age II textile remains and impressions (warp threads per centimeter on the x-axis and weft threads per centimeter on the y-axis) with the shape of each point corresponding to the fiber used to produce the textiles it represents (e.g. wool, linen, goat hair, hemp, *sha'atnez,* or unidentified). The diagonal line (y = x) on Figure 4.25 indicates the boundary between warp-dominant textiles and weft-dominant textiles. Textile remains and impressions close to this line are balanced**.**

.

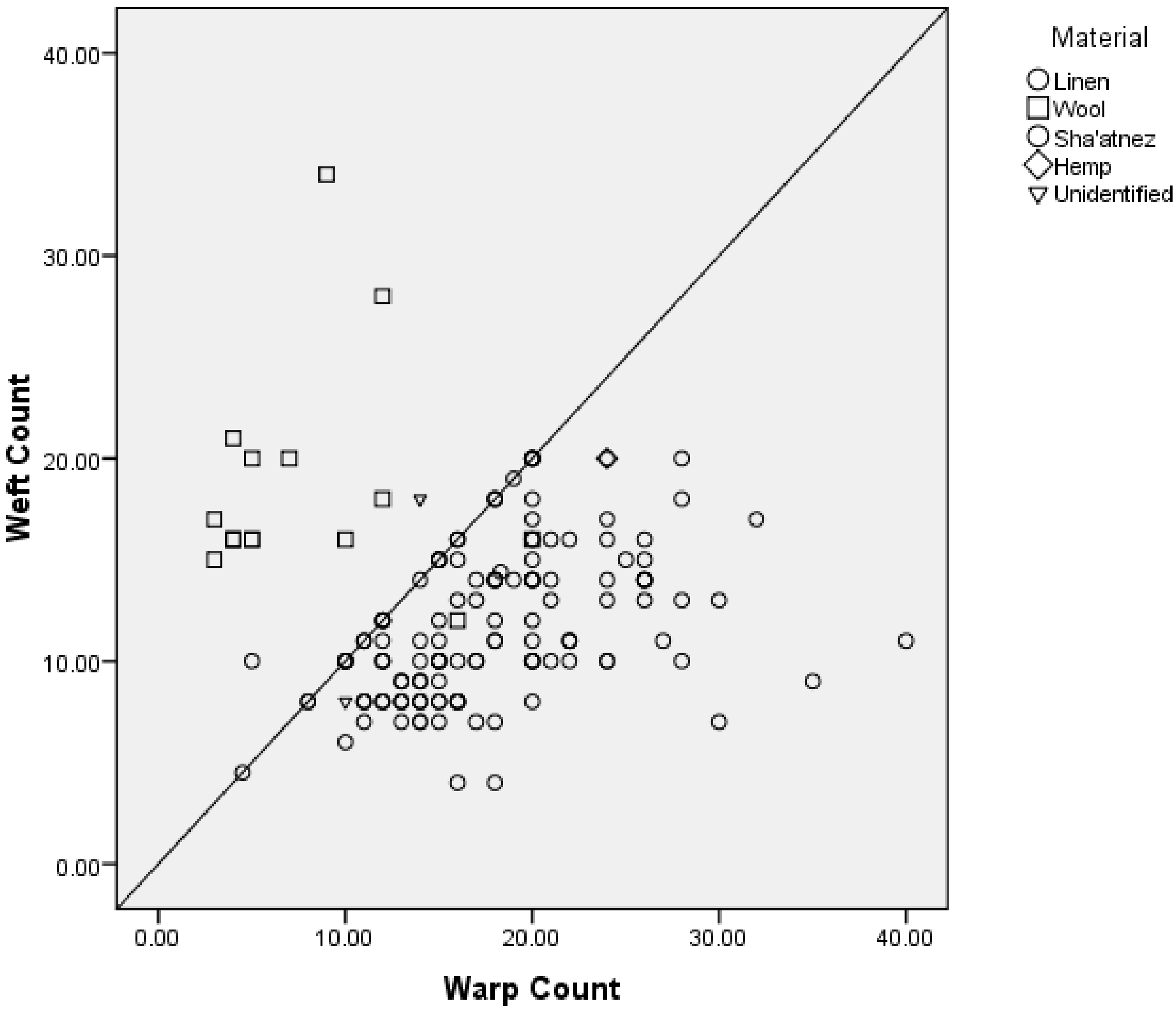


Figure 4.25: Textile remains and impressions from Kuntillet ‘Ajrud, Kadesh Barnea, Deir ‘Alla, Khirbat al-Mudayna, Tel Masos, Tell el-Hammah, Tel Batash, and Hazor. The diagonal line is set at x = y (Boertien 2013; Shamir 2007c, 2012a; Sheffer 1976, 2001; Sheffer and Tidhar 2012)

For the textiles from Timna, only one, a linen fragment, was published with individual warp and weft thread counts. The remaining textiles were published in three groups (e.g. wool, linen, and goat hair textiles). Figure 4.26 therefore shows the ranges of warp and weft counts for each group of textiles. As both the wool and goat hair textiles are primarily weft-dominant fabrics, both groups are plotted as rectangles, falling mostly above the y = x function (See Figure 4.25). The corner of each rectangle corresponds to the minimum and maximum thread count. One balanced wool textile fragment is represented by the intersection of the rectangle containing all wool textiles and the x = y function. Three of the linen textiles are balanced fabrics and are plotted as a line segment on the y = x function. The final linen textiles is plotted according to the published individual values.

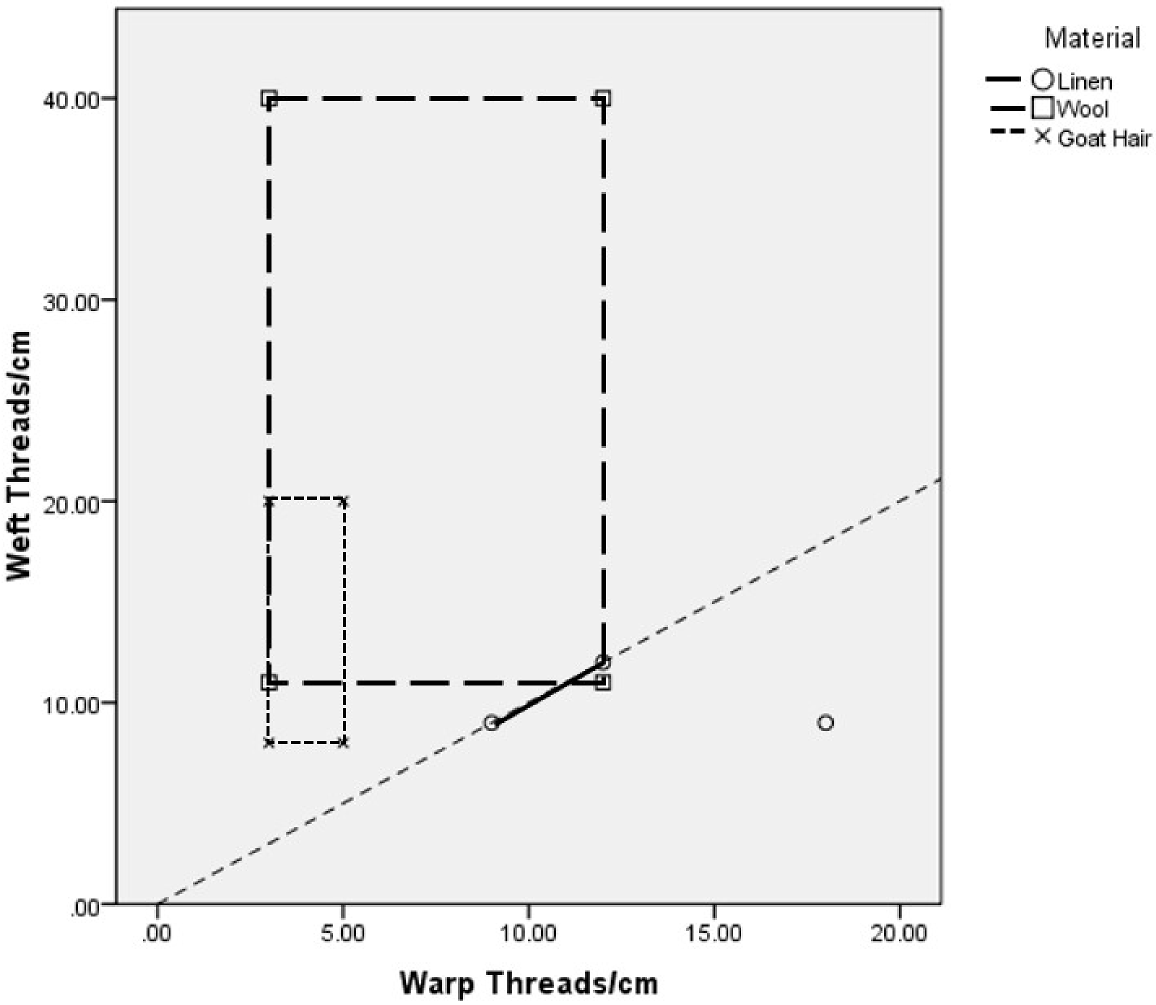


Figure 4.26: Textile remains from Timna. Rectangles are the ranges of wool and goat hair textiles (Shamir and Baginski 1993)

Figure 4.25 and Figure 4.26 demonstrate that the sample of preserved Iron Age II textile remains and impressions contains two distinct types of textiles. The general pattern can be described as weft-dominant fabrics made of animal fibers and balanced and warp-dominant fabrics made of plant fibers. Weft-dominant textile remains are made from animal fiber yarns (wool, goat hair, one *sha'atnez,* and one unidentified). Shamir (2007c: 262; 2012a) and Sheffer (1976, 2001) also interpreted the textile impressions from vessel bases as reflecting animal fiber textiles. Balanced and warp-dominant textiles are primarily linen, but this group also includes one hemp, three wool, one unidentified, and two *sha'atnez*.

The scatterplot of Iron Age II textile remains and impression permitted a comparison between the warp counts of textiles remains and impressions and the warp counts reconstructed from Iron Age II loom weights. Two parallel lines perpendicular to the x-axis at the highest and lowest warp thread counts calculated from loom weights show the range of preserved textile remains and impressions that could have been woven with the sample of Iron Age II loom weights (i.e. those textiles and impressions with warp thread counts between the two lines) (See Figure 4.27).

Based solely on a comparison of warp thread, the weft-dominant fabrics could have been woven using Iron Age II loom weights. The weft-dominant, animal fiber textiles all had warp thread counts lower than fifteen warp threads/cm. Textiles, like these, with fifteen or fewer warp threads/cm could have been woven using Iron Age II loom weights (The examples of weft-dominant fabrics with fewer than 5 warp thread/cm are discussed in Chapter 5) (See Table 4.3).

The warp-dominant and balanced fabrics have a wide range of warp counts (4.5-40 warp threads/cm). 33.7% of the warp-dominant and balanced textile remains and impressions (excluding the remains from Timna) have warp thread counts lower than fifteen threads/cm. Based solely on comparison of loom warp weight warp thread counts, these textiles could have been woven using Iron Age II loom weights. The remaining 66.3% of balanced and warp-dominant textiles have warp thread counts too high to have been woven on the warp-weighted loom. Therefore, in terms of production techniques, warp-dominant and balanced textiles should be analyzed as two separate groups: those that could have been woven using the warp-weighted loom, and those that were woven on a different loom type, such as the ground or upright loom (See Figure 4.27).

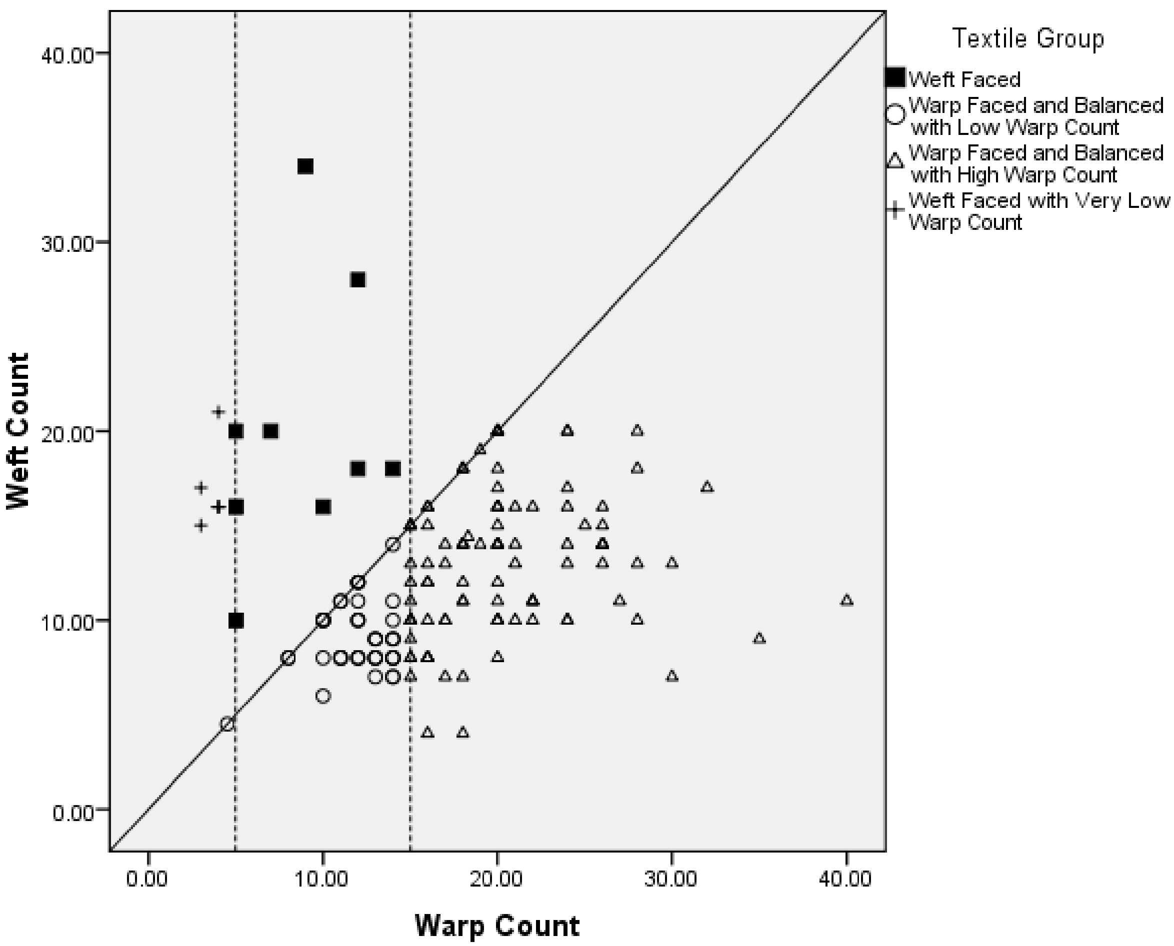


Figure 4.27: Textile Remains and impressions identifying potential production method. The diagonal solid line is set at y = x, to assist in differentiating weft-dominant (above the line), balanced (on the line), and warp-dominant (below the line) textiles. The vertical dashed lines are set at y = 5 and y = 15, showing the optimal range of warp counts identified for Iron Age II loom weights.

Results of Primary Analyses

The results of these analyses provide the first evidence that Iron Age II weavers used one or more types of loom in addition to the warp-weighted loom. The next chapter will address two additional questions to clarify the relationship between Iron Age II weavers' use of warp-weighted looms and the types of textiles that they wove: what range of warp thread thickness could Iron Age II loom weights have been used to weave and could Iron Age II loom weights have been used to weave fabrics with fewer than five warp threads/cm.

Chapter 5: Identifying the Fabrics Made with Warp-weighted looms

The analysis in Chapter 4 show that the warp thread counts of some Iron Age II fabrics are too high to have been woven using warp-weighted looms. Weaving these high warp count textiles would have required weavers to use other loom types in addition to the warp-weighted loom. The analyses from Chapter 4, however, do not provide sufficient information to determine which fabrics were made using warp-weighted looms and which were made with other types of looms.

Results of two additional lines of investigation demonstrate that Iron Age II loom weights were used to weave weft-dominant animal fiber textiles. Comparing the fabrics' warp thread thicknesses to the tensions calculated for the loom weights demonstrates that loom weights provide sufficient tension to weave the weft-dominant fabrics in my sample but not enough tension to weave the warp-dominant and balanced fabrics. Weft-dominant textiles with fewer than five warp threads/cm suggest a problem with the conclusion that all weft-dominant textiles were woven with warp-weighted looms, because five warp threads/cm is the theoretical minimum warp count identified for warp-weighted looms (Martensson et al. 2009). Adjusting the initial assumptions used in the analyses from Chapter 4 to permit textiles with fewer than 5 warp threads/cm shows that these textiles could in fact have been woven using warp-weighted looms.

Comparing Warp Thread Thickness and Loom Weight Tension

Iron Age II weavers had to arrange warp threads so that each warp thread was at the appropriate tension for it its material and thickness. If the loom weight is too heavy, the tension can cause the warp threads to break; too light, the shed cannot easily change. On a warp-weighted loom, the tension is set by tying a specific number of warp threads to each loom weight to equally distribute the weight's mass. For example, if a set of warp threads each require 10 g of tension, a weaver can tie ten warp threads each to a set of weights that each weight 100 g.

According to Martensson et al.'s (2009) study, thick warp threads require more tension than thin warp threads (See Table 5.1). Figure 5.1 shows the relationship between tension and warp thread count for four loom weights. The relationships shown in the graph are transformations of the function $f(x) = 1/x$ (See Figure 4.2). A loom weight creates the lowest possible tension when tied to the maximum number of warp threads: conversely, it creates the highest possible tension when tied to the minimum number of warp threads.

Table 5.1: Warp tensions needed to weave with warp threads of different thicknesses (Martensson et al. 2009: 378).

Thread Diameter (mm)	Tension Needed to Weave (g)
≤0.3	c. 10
0.3-0.4	c. 15-20
0.4-0.6	c. 25-30
0.8-1.0	c. 40

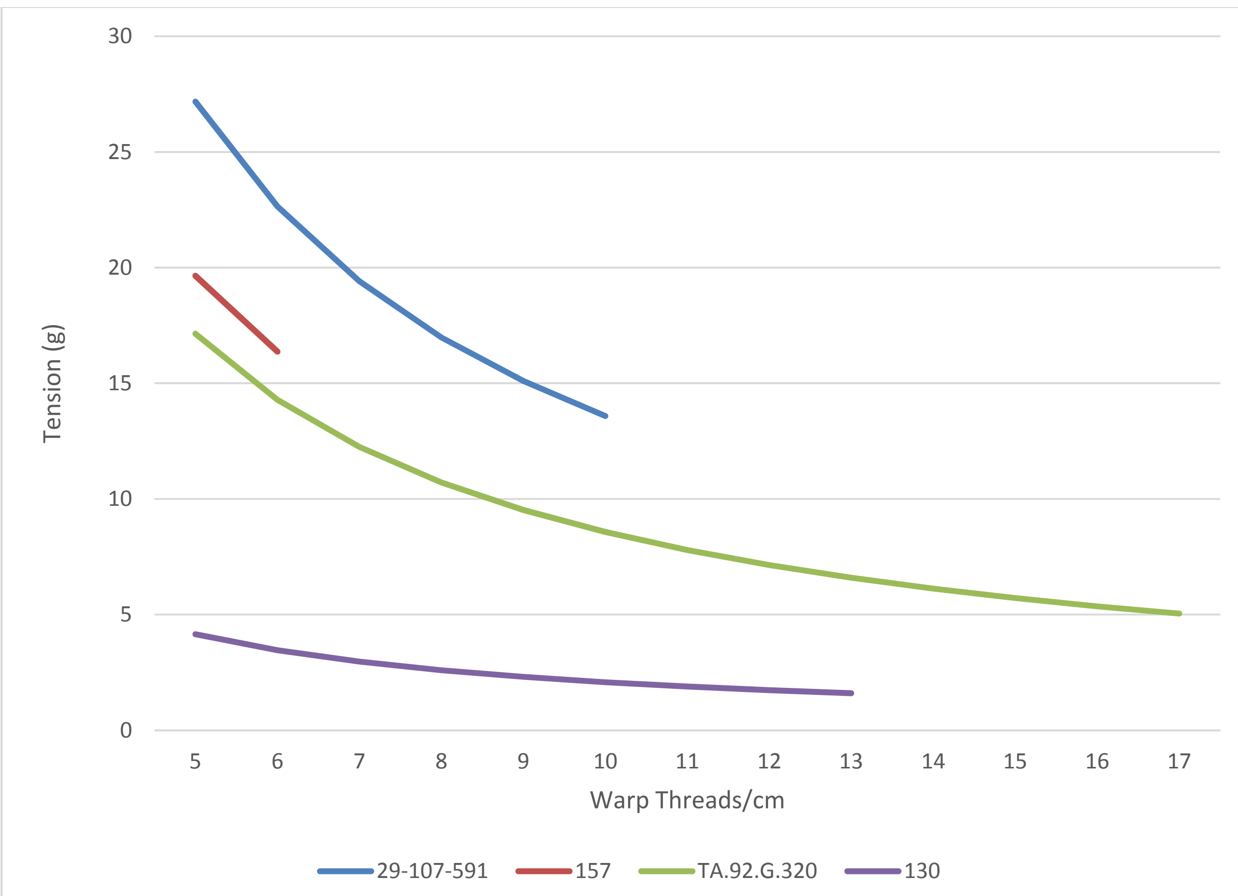


Figure 5.1: Relationship between warp thread count and tension for four loom weights: 29-107-591 from Beth-Shean (6.3cm thick and 428g), 157 from Ta'annek (10.1cm thick and 496g, TA.92.G.320 from Tell Afis (3.5cm thick and 150g), and 130 from the City of David (4.7cm thick and 48.8g).

The textile remains and impressions in my sample show that Iron Age II textiles were made with warp threads of varied thicknesses that would have required weavers to use loom weights which provided appropriate tensions or use a different type of loom if appropriate loom weights were not available. Warp thread thicknesses from textile remains and impressions can thus be compared to the tensions calculated for loom weights to test if a given fabric could have been woven with loom weights or a different type of loom.

Warp thread thicknesses are only published for textile remains and impressions from Kuntillet ‘Ajrud and Khirbat al-Mudayna. The thread thicknesses of textiles remains from Kuntillet ‘Ajrud are described in relative terms as “fine”, “medium”, and “coarse” (Sheffer and Tidhar 2012: 292-297). Although these descriptions cannot be matched to exact tensions, “fine” warp threads would have required less tension than “medium” warp threads and “medium” warp threads would have required less tension than “coarse” warp threads. Exact measurements are published for the textile remains and impressions from Khirbat al-Mudayna, which permits the tensions required to weave these textiles to be reconstructed from Table 5.1 (Boertien 2013: 192, 226-229).

Tension Requirements of Weft-dominant Fabrics

Seven weft-dominant textiles were recovered from Kuntillet ‘Ajrud: three are made with fine threads and four are made with medium threads (See Table 5.2). The three textiles made with fine threads each have between 10 and 12 warp threads/cm. Figure 5.2 shows the tensions calculated for arrangements of loom weights with 10 to 12 warp threads/cm (See Table O.1). For loom weights with a calculated maximum warp thread count of between 10 and 12 threads/cm, the tension calculation is based on the highest possible warp count. For loom weights with a calculated maximum warp thread count greater than 12 warp threads/cm, the tension calculation is based on a warp thread count of 12 warp threads/cm, because these loom weights could still be used to weave textiles with twelve threads/cm. 92.7% of the tensions calculated in Table 5.3 are less than 10 g per thread. Tensions below 10 g per warp thread could only be used to weave fabrics made with fine threads, like the three from Kuntillet ‘Ajrud (See Table 5.1).

Table 5.2: Descriptions of weft-dominant fabrics from Kuntillet ‘Ajrud (Sheffer and Tidhar 2012)

Artifact Number	Material	Thickness	Warp Count	Weft Count
35	Wool	Medium	5	20
91	Wool	Medium	5	16
98a	*Sha'atnez*	Medium	5	10
95a	Wool	Medium	7	20
36	Wool	Fine	10	16
105	Wool	Fine	12	18
107	Wool	Fine	12	28

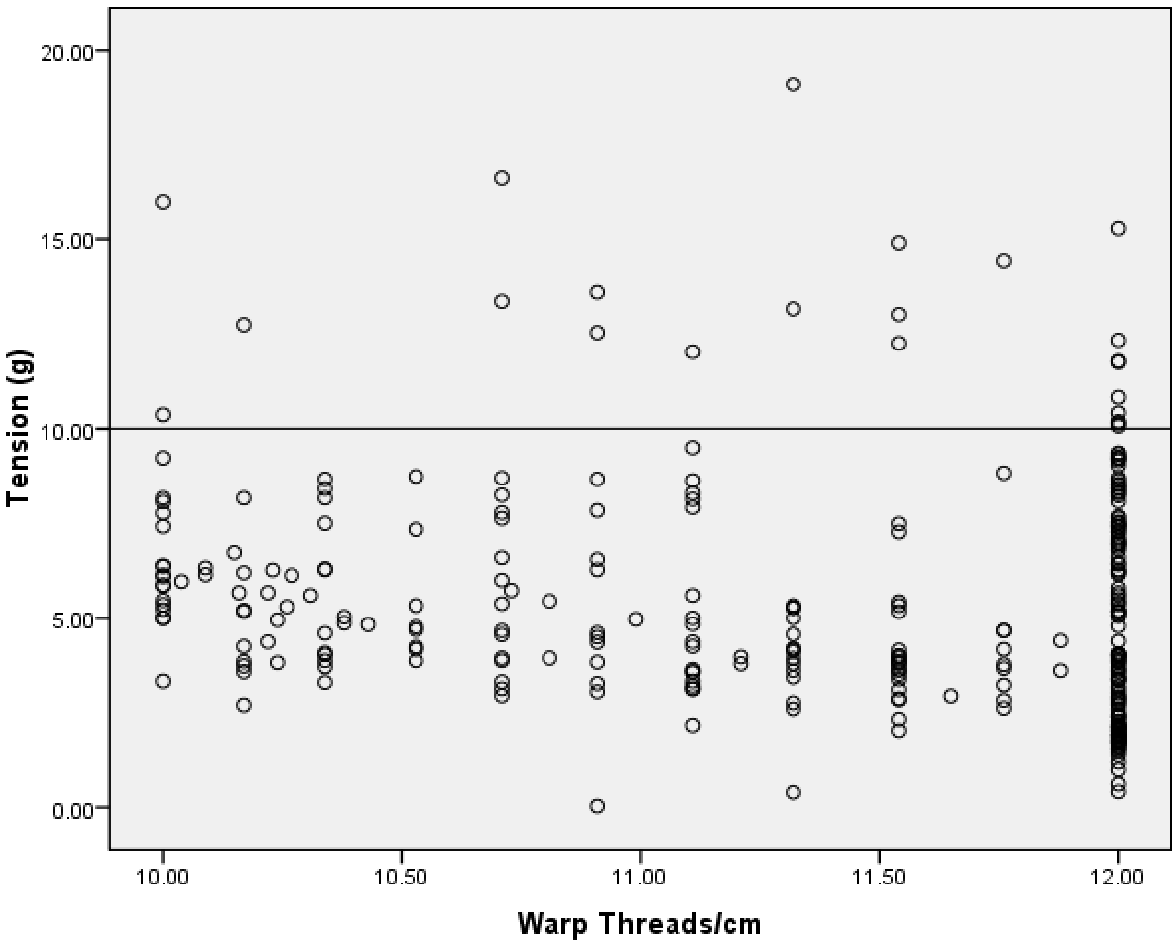


Figure 5.2: Tension calculations for warp arrangements between ten and twelve warp threads/cm – the line is placed at Tension = 10 g for reference (See Appendix O.1).

The four textiles from Kuntillet 'Ajrud made using medium-thickness threads would have required higher tensions to weave than those made with fine warp threads, but they still could have been woven using warp-weighted looms. The four textiles made with medium warp threads have warp counts of between 5 and 7 threads/cm. Figure 5.3 shows the tensions calculated for loom weights when used to weave fabrics with 5 warp threads/cm. 76.3% of these arrangements would have created more than 10 g of tension per warp thread, enabling weavers to work with thicker warp threads, such as those used to produce these four textiles (See Table 5.3).

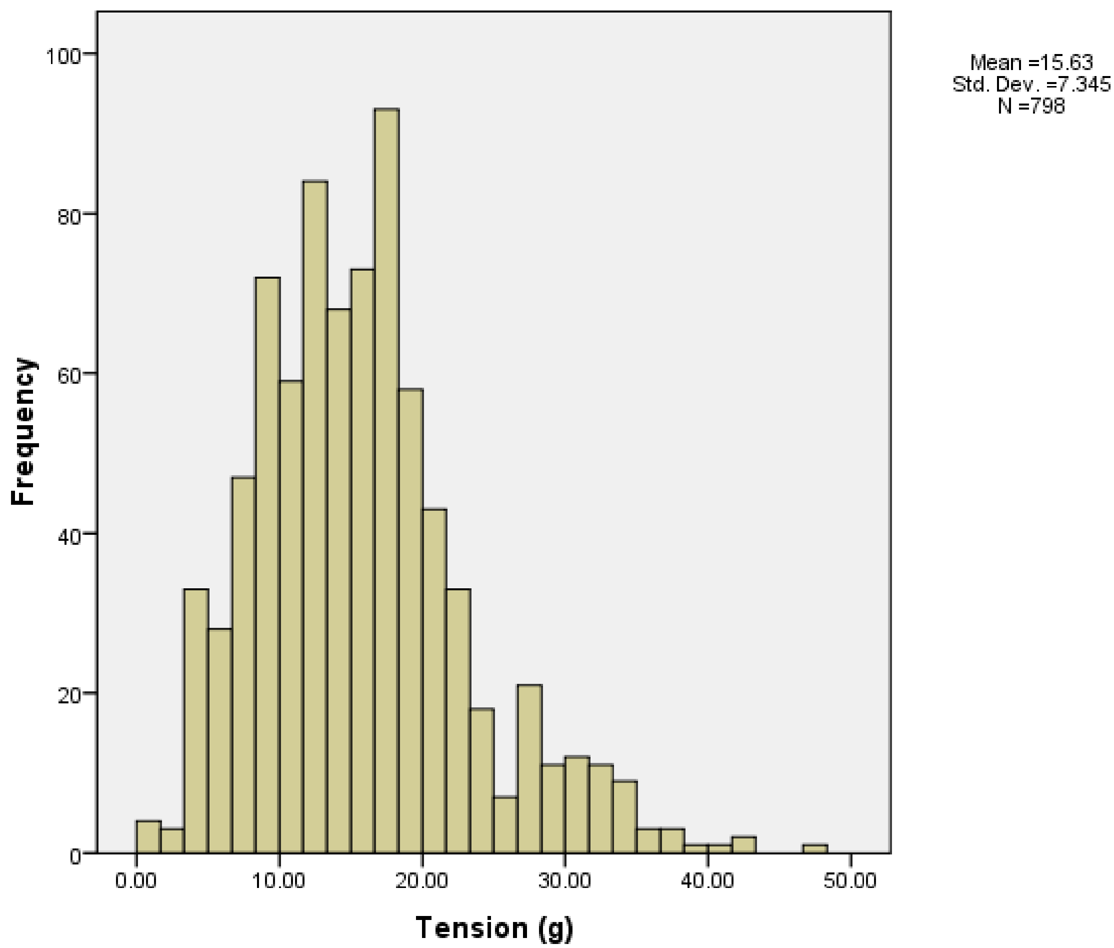


Figure 5.3: Frequency of different tensions for loom weights when used to weave fabric with 5 warp threads/cm

Table 5.3: Percent of loom weights capable of weaving different tensions with warp arrangements of 5 warp threads/cm

Tension (g)	Loom Weights
≤ 10 g	23.40%
10 g – 20 g	54.70%
20 g – 30 g	16.50%
30 g - 40 g	4.90%
40 g – 50 g	0.50%

Impression MT 937 from Khirbat al-Mudayna is of a fabric made from 0.25 mm-thick threads with 14 warp threads/cm and 18 weft threads/cm (Boertien 2013: 228). It could have been woven using an Iron Age II warp weighed loom. Figure 5.4 shows tensions calculated loom weights used to weave fabric with 14 warp threads/cm (twelve loom weights with a calculated maximum of 13.95 warp threads/cm are included as well) (See Table O.2). All of the tensions are suitable for weaving fabrics with very thin warp threads less than 0.3 mm-thick, such as those apparent on MT937 (See Table 5.1).

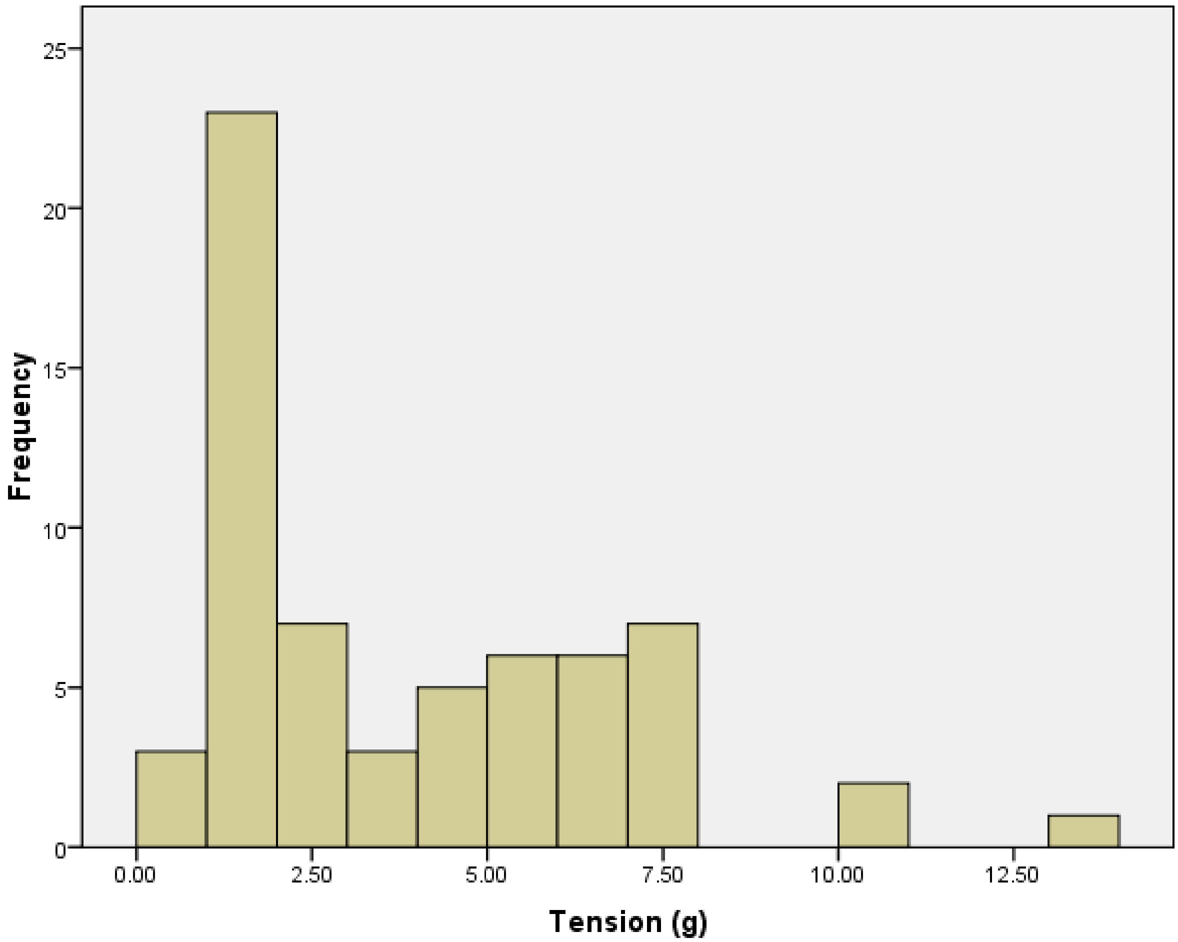


Figure 5.4: Tensions calculated for loom weights with 14 warp threads/cm

Iron Age II weft-dominant fabrics show a relationship between warp thread count and thread thickness in which low warp count fabrics would have required high tensions and high warp count textiles would have required low tensions. The loom weights in this study's sample were designed to weave textiles with this relationship between warp counts and warp thread thickness, as shown in Figure 5.1. This suggests that the Iron Age II weft-dominant textiles could have been woven using these loom weights.

Tension Requirements for Warp-dominant and Balanced Fabrics

33.7% of warp-dominant and balanced textiles and impressions have fewer than 15 warp treads/cm, and thus, in theory, could have been woven on the warp-weighted loom. However, the thickness of warp threads used to make these fabrics indicates that these fabrics could not have been woven using the Iron Age II warp-weighted looms currently reconstructed, because the preserved loom weights could not have provided enough tension to weave these threads. As with weft-dominant fabrics, this analysis must be focused on fabrics from Kuntillet ‘Ajrud and Khirbat al-Mudayna, which are the only two sites with published warp thread thicknesses for textile remains and impressions.

The relationship between warp count and warp thread thickness in fabrics from Kuntillet ‘Ajrud is different from the pattern observed in Iron Age II loom weights (i.e. thick warp threads require low warp counts and high warp counts require thin warp threads) (See Figure 5.1). The warp-dominant and balanced textiles from Kuntillet ‘Ajurd include fabrics with high warp counts and medium or coarse threads. Thus, one can conclude that these could not have been woven with warp-weighted looms (See Figure 5.5).

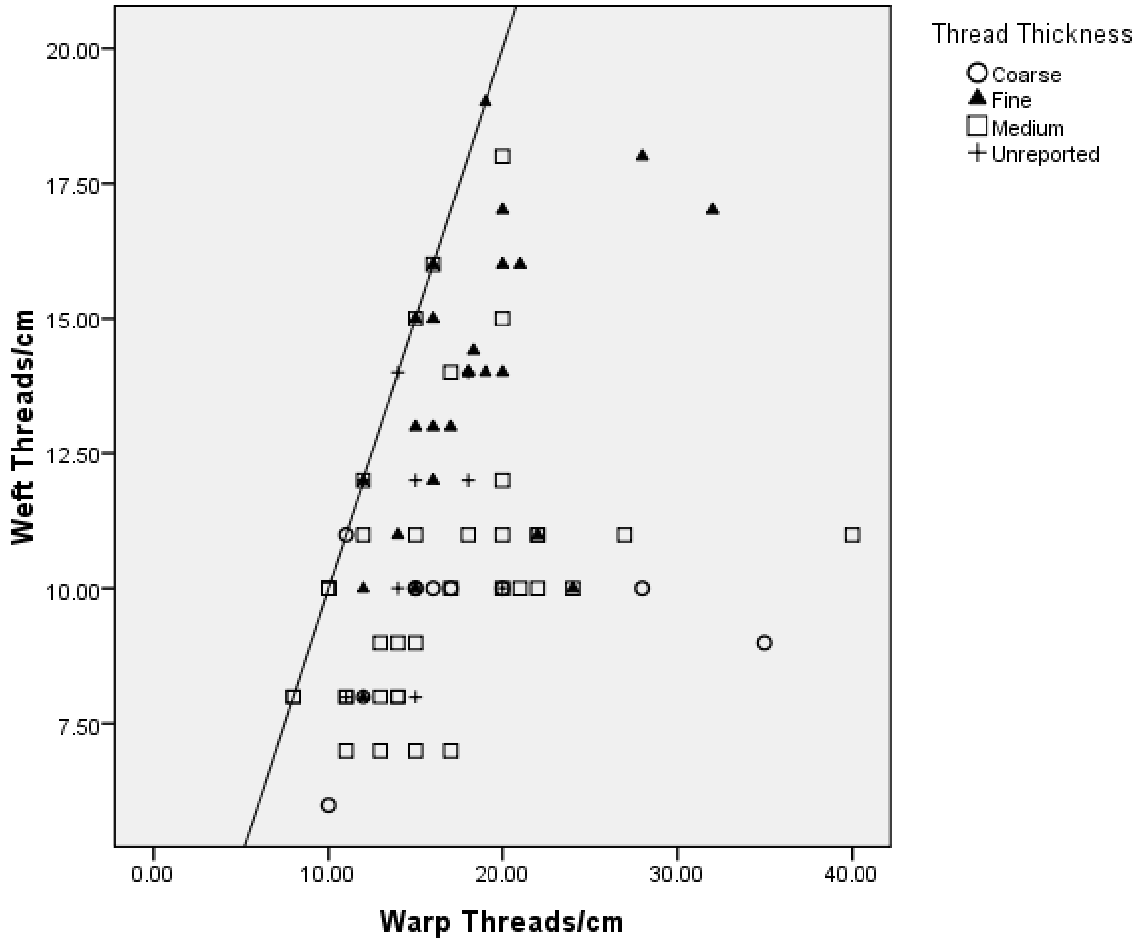


Figure 5.5: Thread thickness of warp-dominant and balanced textiles from Kuntillet ʻAjrud (Diagonal black line is y=x, indicating balanced textiles).

Only eight weft-dominant or balanced textiles from Kuntillet ʻAjrud accord with the required relationship between warp thread count and warp thread thickness suggested by tensions calculated from loom weights (Figure 5.1): two with low warp thread counts (8 threads/cm) and medium threads, and six with higher warp thread counts (10-12 threads/cm) and fine threads. However, even these eight textiles may have required too much tension to weave using known loom weights, as they were woven from linen warp threads. Linen warp threads require more tension to weave with than animal fiber warp threads of the same thickness (Andersson 1999: 20). This difference in thread material may have made it impossible to weave the Kuntillet ʻAjrud fabrics with warp-weighted looms using the loom weights in this study.

Analysis of two warp-dominant fabrics from Khirbat al-Mudayna shows that they could not have been woven with Iron Age II loom weights. One of these fabrics is represented by an impression on a clay stopper: it had 10 warp threads/cm that were 0.5 mm-thick. The other fabric is a wool textile with 16 warp threads/cm that are 0.41 – 0.52 mm-thick (Boertien 2013: 193-194, 226). Weaving fabrics such as these that have warp threads 0.41 - 0.52 mm-thick requires 25-30 g of tension (See Table 5.1). Iron Age II loom weights would not provide tensions of 25-30 g when used to weave fabrics with ten or sixteen warp threads/cm. Thus these fabrics must have been woven on a different type of loom (See Table O.1, Figure 5.2).

How Tension Indicates the Purpose of Warp-weighted looms

Comparing tensions calculated from Iron Age II loom weights to the warp thread thicknesses of recovered fabrics and impressions shows that Iron Age II weft-dominant fabrics could been produced using warp-weighted looms, but warp-dominant and balanced textiles could not have. Among Iron Age II fabrics, weft-dominant textiles were primarily made from animal fiber yarns (See Chapter 4). These results indicate that Iron Age II loom weights were designed so that weavers could produce weft-dominant animal fiber fabrics using warp-weighted looms.

Weaving Fabrics with Low Warp Counts

Iron Age II warp-weighted looms could only be used to weave fabrics with low warp counts (fewer than 15 warp threads/cm), but a subset of weft-dominant fabrics with fewer than 5 warp threads/cm require additional discussion. Martensson et al. (2009: 393) observe that, although warp-weighted looms are best suited for weaving textiles with five or more warp threads/cm, they could be used to weave textiles with lower warp counts, albeit with reduced efficiency. Current knowledge of warp-weighted looms does not enable quantification of this loss of efficiency. Nor is it certain that this limit only occurs when weaving with warp-weighted looms: it may also be difficult to weave textiles with fewer than five warp threads/cm on ground or upright looms. In order to evaluate the possibility that Iron Age II fabrics with fewer than 5 warp threads/cm were woven using warp-weighted looms, the initial analyses of Iron Age II loom weights were rerun without the lower limit of 5 warp threads/cm to recalculate warp thread counts and tensions (See Chapter 4). Figure 5.5 shows that weavers could have used Iron Age II warp-weighted looms to weave fabrics with fewer than 5 warp threads/cm, although the tensions reconstructed for the lowest calculated warp counts may have been impractical, as they would have broken the warp threads (this reflects a limit where the number of warp threads per centimeter is zero).

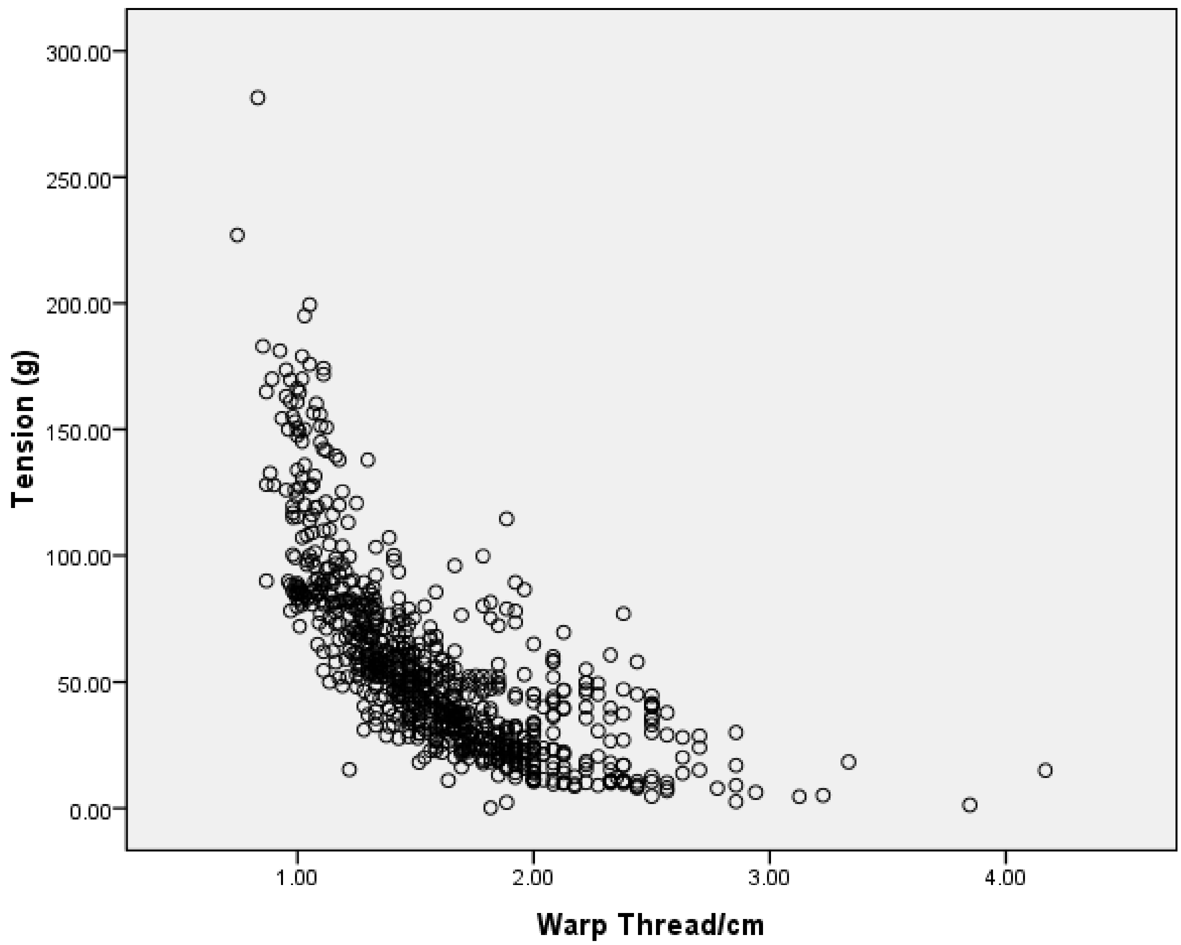


Figure 5.4: Recalculated tensions for Iron Age II loom weights without the minimum of 5 warp threads/cm

Warp-weighted looms Were Tools for Weft-dominant Fabrics

Analyses of remains, textile impressions, and loom weights shows that Iron Age II textile production was more complex than previously thought; there must have been multiple types of looms in use contemporaneously, and that the type of loom used was, in large part, dictated by the type of fabric woven. The warp counts and warp thread thicknesses of most weft-dominant fabrics fall within the limits calculated for Iron Age II loom weights, and additional calculations in this chapter show that even those weft-dominant fabrics with fewer than five warp threads/cm could have been woven using warp-weighted looms. However, warp-dominant and balanced fabrics have warp thread counts that are too high and warp threads that are too thick to have been woven with Iron Age II loom weights.

Use of loom weights in the Iron Age II was thus related to the production of weft-dominant animal fiber fabrics. Identifying the relationships between warp-weighted looms and a particular fabric type, however, does not fully explain why large numbers of weavers over a wide geographic region adopted this new type of loom. The following chapter suggests that use of warp-weighted looms was related to existing differences in the production of animal fiber and plant fiber fabrics and the uses to which these fabrics were put.

Chapter 6: Two Strategies of Textile Procurement in the Iron Age II

The archaeological record of Iron Age II Levantine weaving is unusually rich, because of the widespread use of warp-weighted looms and the good preservation of clay and stone loom weights. The ubiquity of loom weights in sites from this period may be the reason that reconstructions of Iron Age II textile production identify warp-weighted looms as the tools used to weave multiple distinct types of fabric (e.g. fine wool, fine linen, coarse linen, and *sha'atnez*) (e.g. Boertien 2013; Browning 1988, 2001; Shamir 2007c; Sheffer and Tidhar 2012). The analyses in Chapters 4 and 5 provide new insights into the fabrics that could have been woven with Iron Age II warp-weighted looms. The weights analyzed in this study are best suited for looms used to weave textiles with low warp counts, similar to the weft-dominant animal fiber fabrics in the sample of textile remains and textile impressions. A comparison of this conclusion to the expectations of hypotheses described in Chapter 2 suggests weaving with warp-weighted looms was only one of multiple distinct methods that Iron Age II people used to obtain textiles.

Sha'atnez Tapestries used for Neo-Assyrian Tribute

Browning (1988, 2001) interprets Iron Age II warp-weighted looms as tools to weave fabrics for tribute to the Neo-Assyrian Empire. He describes these textiles as *sha'atnez* tapestries (Browning 2001: 253-254). Three examples of *sha'atnez* fabric with wool wefts and linen warps come from Kuntillet 'Ajrud: one weft-dominant textile made with medium threads, one balanced textile made with medium threads, and one warp-dominant textile without a description of thread diameter. The warp thread counts of the weft-dominant (5 warp threads/cm) and balanced (8 warp threads/cm) textiles are within the range calculated for Iron Age II loom weights (See Tables N.1 and N.2), but the loom weights may not have provided sufficient tension to weave the medium linen warp threads (See Chapter 5). The warp-dominant example has 18 warp threads/cm, which is too high to have been woven with Iron Age II loom weights.

Although two of the *sha'atnez* textiles from Kuntillet 'Ajrud have warp counts that could have been made with Iron Age II warp-weighted looms, these textiles are not tapestries like the *sha'atnez* textiles Browning describes. Weaving tapestries with linen warp threads requires looms able to provide high tensions (Andersson 1999: 20; Barber 1992: 111). The loom weights analyzed in this study are suitable for warp arrangements with relatively low tensions (e.g. 78.1% are suitable for arrangements with tensions of 20 g or less), and thus could not have been used to weave tapestries with linen warp threads (See Table 5.1). In fact, Barber writes that the high tensions needed for tapestry weaving would have been impossible with warp-weighted looms (Barber 1992: 111). Although Iron Age II loom weights may have been suitable for weaving some *sha'atnez* fabrics, Browning's interpretation of Iron Age II loom weights as tools for *sha'atnez* tapestries can be rejected (See Table 6.1).

Table 6.1: Evaluation of hypothesized products of Iron Age II loom weights

Textile Description	Conclusion
1) Neo-Assyrian Tribute	
Sha'atnez Tapestries	Rejected: Tapestries with linen warp threads would require too much tension for Iron Age II loom weights
2) Regional Specialization for Trade and Ritual	
Bast Textiles	Rejected: Iron Age II bast textiles have warp thread counts too high and would require too much tension for Iron Age II loom weights
Animal Fiber Textiles	Tentatively Retained: Only for low warp count textiles
Ritual Fabrics	Rejected: Iron Age II bast textiles have warp thread counts too high and would require too much tension for Iron Age II loom weights
3) Domestic and Utilitarian Fabrics	
Rugs, Wall Hangings, Storage Containers, Blankets	Retained

Fine Textiles for Trade and Ritual

Boertien (2013) argues that Iron Age II warp-weighted looms were used to weave two types of textiles: fine bast fiber textiles woven with heavy loom weights and fine wool textiles woven with light loom weights (See Table 6.1). Chapter 4's analysis of Iron Age II textile remains and impressions demonstrates a difference between weft-dominant animal fiber textiles and balanced and warp-dominant bast fiber textiles. However, the loom weights analyzed in Chapters 4 and 5 are not suitable for weaving the bast textiles in this sample of textile remains. Thus, one can reject the hypotheses that Iron Age II loom weights were used to weave fine bast textiles used as trade goods or used as ritual garments.

Boertien interprets light loom weights as evidence that Iron Age II weavers used warp-weighted looms to produce fine wool fabrics (Boertien 2013: 231, 251, 280, 285). Chapter 5 shows that 23.4% of loom weights are suitable for weaving textiles requiring 10 g or less of tension. Tensions of 10 g or less are sufficient to weave fine animal fiber warp threads (See Table 5.1). However, the warp-dominant wool textile that Boertien identifies as an example of fine wool fabric has 16 warp threads/cm. Chapter 4 shows 16 warp threads/cm is too high for this textile to have been woven with the analyzed loom weights (See Table 4.5). Thus, the hypotheses that Iron Age II loom weights were used to weave fine wool textiles should be retained, albeit with the understanding that some fine wool textiles could not have been made with these weights (See Table 6.1).

Coarse Textiles Used in Home and Industry

The third interpretation of Iron Age II loom weights is that warp-weighted looms were used to weave "heavy" or "coarse" fabrics such as rugs, wall hangings, bags, and blankets (Fischer 2009: 115; Friend 1998: 10; Gitin 1997: 89-90). The sample of textile impressions in this study includes eight examples of weft-dominant wool fabrics impressed on the bottoms of ceramic vessels (See Table 6.2). Sheffer (1976) argues that the textiles preserved in these impressions were carpets, and thus they are an example of utilitarian textiles. The range of warp thread counts of these impressions (3-9 warp threads/cm) is within the variation of warp thread counts reconstructed for Iron Age II loom weights, and thus may have been made using warp-weighted looms. Rough textiles would have been woven with animal fiber textiles with medium or thick warp threads and thus required a loom that can provide high tensions. The results of analyses (Chapter 4) show that 22.1% of individually measured loom weights (38.9% of loom weights analyzed as groups) were suitable for warp arrangements with more than 20 g of tension, which could have been used to weave textiles with thicker (i.e. > .4 mm) warp threads (See Tables 4.5, 4.6, and 5.1). Thus, the hypothesis that Iron Age II loom weights were used to weave heavy utilitarian textiles should be retained (See Table 6.1).

Table 6.2: Textile impressions found on the bottoms of ceramic vessels (Cohen and Bernick-Greenberg 2007; Shamir 2007c; Sheffer 1976)

Impression Description	Type of Impression	Warp Threads/cm	Weft Threads/cm
Tel Masos Negev Ware	Vessel Bottom	4	21
Kadesh Barnea Reg. 1721	Vessel Bottom	9	34
Kadesh Barnea Negev Ware	Vessel Bottom	4	16
Kadesh Barnea Negev Ware	Vessel Bottom	4	16
Kadesh Barnea Negev Ware	Vessel Bottom	3	17
Kadesh Barnea Negev Ware	Vessel Bottom	3	15
Kadesh Barnea Negev Ware	Vessel Bottom	5	16
Kadesh Barnea Negev Ware	Vessel Bottom	4	16

The Versatile Iron Age II Warp-Weighted Loom

Table 6.1 shows that two hypotheses about the use of Iron Age II warp-weighted looms can be retained: *Iron Age II warp-weighted looms were used to weave fine animal fiber textiles* and *Iron Age II warp-weighted looms were used to weave coarse animal fiber textiles*. Retaining both hypotheses suggests that Iron Age II warp-weighted looms were versatile tools used to weave a variety of animal fiber textiles. Tables 6.3 and 6.4 and Figure 6.1 show variation in the average mass and average thickness of loom weights from Iron Age II sites. The variation in Iron Age II loom weights would have permitted weavers to use warp-weighted looms to weave a variety of textiles, and not only a single type of fabric as Friend (1998: 10) and Browning (1988: 250-252) suggest.

Table 6.3: Average mass of loom weights from Levantine sites (if the number of weights is not included, the number was unpublished or unclear)

Site	Period	Number of Weights	Average Mass (g)	Source
Taannek	EBA	3	248.67	See Chapter 3
Tell Abu al-Kharaz	EBA		Up to 90	Fischer 2009
Taannek	MBA	48	310.83	See Chapter 3
Tel Kabri	MBA	24	325.02	Oren 2002
Tell Abu al-Kharaz	MBA		Above 100	Fischer 2009
Ashkelon	IAI		Three types 60-70 g, 140-150 g, and >500 g	Lass 1994
Tel Miqne-Ekron	IAI	53	236.6	Shamir 2007b
Tell es -Safi/Gath	IAI	22	234.14	Cassuto 2012
Ashkelon	IAII	42	410.07	See Chapter 3
Beth-Shean	IAII	200	275.22	See Chapter 3
City of David	IAII	43	167.58	See Chapter 3
En-Gedi	IAII	19	248.18	Shamir 2007a
Gezer	IAII	29	458.7	Friend 1996
Kadesh Barnea	IAII	12	120.16	See Chapter 3
Khirbat al-Mudayna	IAII	134	249.68	See Chapter 3
Kuntillet 'Ajrud	IAII	19	240.36	See Chapter 3
Tel Amal	IAII	135	244.69	See Chapter 3
Tel Batash/Timnah	IAII		461.1	Shamir 1996, Table 3
Tel Miqne-Ekron	IAII		353.2	Shamir 1996, Table 3
Tel Qasile	IAII		353	Shamir 1996, Table 3
Tell Abu al-Kharaz	IAII		275-470	Fischer 2009
Tell es-Safi/Gath	IAII	57	293.95	See Chapter 3
Tell Halif	IAII	25	351.4	Friend 1996
Tell Mazar	IAII	184	391.24	See Chapter 3
Tell Moza	IAII	9	415.66	Shamir 2009
Tell Ta'annek	IAII	67	402.53	See Chapter 3
Vered Jericho	IAII		212.7	Shamir 1996, Table 3

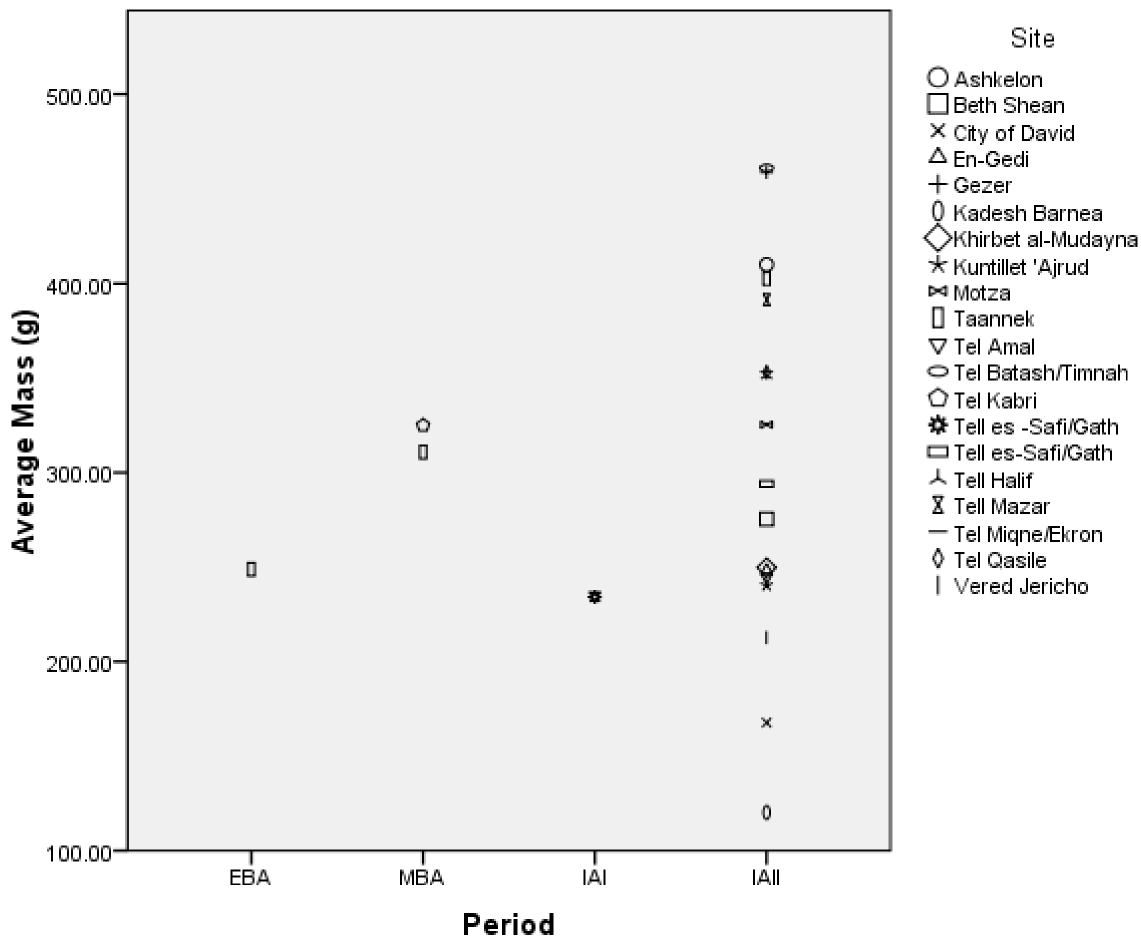


Figure 6.1: Average mass of loom weights from Levantine sites (See Table 6.3)

	Thickness (cm)
Tel Afis	5.04
Ashkelon	5.44
Kadesh Barnea	5.70
City of David	5.89
Beth-Shean	6.18
Tel Amal	6.65
Tell es-Safi	6.76
Tel Batash	8.30
Kuntillet 'Ajrud	8.49
Tel Ta'annek	8.96

Table 6.4: Average thickness of loom weights from sites analyzed in this study (See Tables B.1, C.1, D.1, E.1, F.1, G.1, H.1, I.1, L.1, and M.1)

Iron Age II Bast Fiber Textiles

The hypotheses evaluated in Table 6.1 show that Iron Age II warp weighted looms were not suitable for weaving bast fiber fabrics. Yet, the occurrence of fabrics with bast fiber warp threads (i.e. linen textiles, hemp textiles, and *sha'atnez* textiles*)* in texts and in the archaeological record demonstrates that these fabrics were part of Levantine material culture (e.g. Boertien 2007; Browning 1988: 74-76; Sheffer and Tidhar 2012). If Iron Age II weavers did not use warp-weighted looms to weave these textiles, then Levantine people must have had an alternative source: either a different means of local production or long distance trade.

Local Production of Bast Fiber Textiles

Linen production has a long history in the Levant. Linen was the only textile fiber used in the Levant from at least c. 12,000 BC Calibrated until the Middle Bronze Age (2,000 - 1,500) (Abbo et al. 2015). Wool textiles first occur in the Levant in the Middle Bronze Age (Shamir 2015), but flax seeds show that use of this new fiber did not lead to the abandonment of flax (e.g. van Zeist and Heeres 1973). Flax production was important enough to be included in the Tenth Century Gezer Calendar's schedule of agricultural activities (Wright 1955: 50-55). It is not possible to determine if the flax seeds or the flax mentioned in the Gezer calendar were used for fiber or for food, but Shamir (1996: 142; 2007c: 263) describes a linen thread found on an Iron Age spindle from el-Hammah. This piece of linen thread is direct evidence of linen production in the Iron Age, because it shows that spinning occurred at the site. Thus, one can conclude that linen fiber and yarn were produced in the Iron Age II Levant.

This study shows Iron Age II weavers could not have used the analyzed loom weights on looms set up to weave linen textiles (See Chapter 5). Thus, one can conclude that Iron Age II weavers may have used other types of looms to weave bast fiber and *sha'atnez* textiles. Multiple authors agree that Levantine weavers were familiar with either the upright loom or the ground loom (e.g. Boertien 2013: 60-70; Cassuto 2012; Cecchini 2000). Barber (1991: 80-84, 113-114) argues that these two styles of loom were used in the Levant before the Iron Age (i.e. the ground loom in the Neolithic and the upright loom in the Bronze Age). These two types of looms are primarily made of organic material and therefore they do not preserve in the archaeological record. Thus, an absence of evidence of these two types of looms cannot be interpreted as evidence of their absence in the Iron Age II (Barber 1991: 92). Future reconstructions of Iron

Age II textile production must consider that weavers would have needed one of these looms in order to produce bast fiber textiles.

Long Distance Trade for Bast Fiber Textiles

Trade is a second possible source for Iron Age II textiles. Long distance trade was an important component of the Iron Age II economy. Philistine and Phoenician traders who operated along the Mediterranean coast exchanged goods with Egypt, Anatolia, Greece, and Cyprus (Brugge and Kleber in press; Master 2003; 2014: 89). Beginning in the First Millennium, inland traders crossed the Levant as they traveled between the Arabian Peninsula and Mesopotamia (Byrne 2003; Finkelstein 1988). These trade routes may have made textiles from a wide geographic area available to Levantine people.

1. Egypt as a Source of Linen Textiles

Egypt is so strongly associated with the production of linen fabrics that Barber calls Egypt the "Land of Linen" (1994: 185). Elat (1978: 34) argues that Egyptian linen was transported through the Levant to Mesopotamia by Arab and Philistine traders, and thus would have been available to Levantine people. Shamir and Baginski (1993) write that the linen textiles from Timna are similar to linen textiles from Amarna, and thus may be Egyptian imports. However, Shamir (2007c: 262) argues that the threads in linen textiles found at Kadesh Barnea were not spun using Egyptian methods (i.e. making long threads from single fibers and then plying these threads). She concludes the textiles from Kadesh Barnea are not from Egypt. These observations suggest that Egypt may have supplied a portion of the linen textiles used in the Iron Age II Levant.

2. Arab Caravans as a Source for Linens

Iron Age II Arab caravans carried incense, textiles, and other commodities over Levantine routes to Mesopotamia (Bulliet 1990: 65-68). Byrne (2003: 14-15) describes an Iron Age II Mesopotamian record of an Arab caravan that had blue-purple textiles, iron, and precious stones. However, Byrne suggests that the caravan carried shellfish-dyed wool textiles, which the caravan procured in the Levant. Further, several authors note that the Iron Age II Arabian Peninsula had little if any linen production. These authors conclude that most linen textiles in the

Arabian Peninsula originated in Egypt, Mesopotamia, or some other region (Boivin and Fuller 2009: 162; Reade and Potts 1993: 102-104). Thus, it is unlikely that Iron Age II Levantine linen textiles originated in the Arabian Peninsula.

3. The Northern Mediterranean as a Source for Linens

Iron Age II traders in the Northern Levant (e.g. Phoenicia) exchanged goods with people from the Northern Mediterranean (e.g. Anatolia, Greece, and Cyprus), who cultivated flax (Barber 1991: 194-195, 197; Skals et al. 2015: 64-68). Thus, the Iron Age II Levantine traders had access to linen from the Northern Mediterranean. Yet, the Phoenician traders are better known for the exchange of murex-dyed wool textiles than for trade in linen textiles (Astour 1965; Holladay 2006: n.9). This suggests that if linen textiles were a commodity on these trade routes, they were of secondary importance.

4. Eastern Sources of Bast Fibers

Neo-Assyrian texts indicate that Mesopotamian weavers produced linen textiles (Gaspa 2013), which suggests that Levantine contact with Mesopotamia permitted the exchange of these linen textiles. However, Oppenheim (1967: 244-246) argues that First Millennium Mesopotamia produced only a small amount of linen. Further, he writes that Neo-Assyrians relied on Egypt as a source of linen fabrics and the Levant as a sources of colored wool fabrics. Neo-Assyrian royal texts support this argument, because they list textiles among the booty taken from the Levant and Egypt (e.g. Grayson and Novotny 2012: 65-66; Leichty 2011: 16, 55-56, 304-305; Lie 1929: 27-29; Oates and Oates 2004: 226-227; Page 1968: 143-145; Roaf 1990: 132-197; Tadmor et al. 2011: 37-131; Yamada 2000: 243-247).

5. Sources of Hemp Textiles

The hemp fabric and threads from Deir ‘Alla are the only hemp known from the Iron Age II Levant. Zohary and colleagues (2012: 132-133) write that hemp was domesticated in China and that hemp occurred in the Levant only after the Iron Age. Boertien (2014: 152, 261) argues that hemp remains from Deir ‘Alla show that the Jordan Valley was an Iron Age II center of hemp production. Yet, no other hemp occurs among the thousands of identified botanical remains described from Deir ‘Alla (van Zeist and Heeres 1973). This observation suggests that the hemp may not have been grown locally and that traders may have brought the hemp to Deir ‘Alla from a different region. The current state of research suggests that hemp was grown to the east of Deir ‘Alla (e.g. Mesopotamia or Iran) (Zohary et al. 2012: 132-133), but too little is known about hemp in the Iron Age II to develop a more exact reconstruction.

Levantine or Foreign Production of Bast Fiber Textiles

There were two potential sources of bast fiber textiles in the Iron Age II Levant. The linen thread from Tell el-Hammah demonstrates that some linen production occurred in the Levant. It is also possible that some bast fiber textiles came from foreign traders. However, a review of possible trading sources for linen textiles does not permit one to identify a specific source (See Above).

Further research into Iron Age II textile production could clarify the scale of Levantine bast textile production. This study demonstrates that textile production tools can be analyzed to reconstruct past textile production (e.g. Iron Age II loom weights as evidence of the production of animal fiber textiles). Spindle whorls, parts of the tools used to produce yarn, are found in most Iron Age II sites (Shamir 1996: 151-153). Studies of spindle whorls from other regions show that whorls can be used to reconstruct the types of yarn which they were used to spin (e.g. Andersson 1999: 19; Brumfiel 1991), and recent experimental studies improve our understanding of how variation in spindle whorls effects spinning (e.g. Andersson Strand 2012; Martensson et al. 2006a; Martensson et al. 2006b; Verhecken 2010). Thus, there are both a data set (i.e. spindle whorls) and improved methods to analyze Iron Age II whorls with the purpose of reconstructing variation in spinning. A regional analyses of Iron Age II spindle whorls could help reconstruct the types of fiber spun at different sites (i.e. animal or bast fibers), and thus determine the scale of Levantine production of bast fiber textiles.

Two Sources of Iron age II Textiles

Studies of Iron Age II textile production focus on warp-weighted looms. This may be because loom weights occur in most sites and other types of looms are invisible to archaeologist. Earlier studies of Iron Age II textile production identify loom weights as components of looms used to weave: *sha’atnez* tapestries, fine linen, hemp, and wool fabrics, and coarse textiles (e.g. Boertien 2013; Browning 1988; Friend 1998). This study presents a new reconstruction of Iron

Age II textile warp-weighted looms as specialized tools for the production of animal fiber textiles. Thus, this study concludes that Iron Age II people had different ways of obtaining animal fiber textiles (i.e. weaving with warp-weighted looms) and bast fiber textiles (i.e. use of a different type of loom or trade).

One can differentiate the two groups of Iron Age II textiles not only by the types of fiber use to weave them (i.e. animal fibers or plant fibers) but also by their function. Iron Age II animal fiber textiles were suitable as coarse household and industrial tools as well as fine trade goods (See Table 6.1). The analyses in Chapters 4 and 5 show that the sample of animal fiber textiles could have been woven with warp-weighted looms. Thus, warp-weighted tools were versatile tools on which weavers were able to weave weft-dominant animal fiber textiles for many different functions.

The second group of Iron Age II textiles contains of textiles with bast fiber warp threads (i.e. linen textiles, hemp textiles, and *sha'atnez* textiles). Multiple authors argue that in First Millennium Southwest Asia, including the Levant, these textiles were valuable fabrics used as trade commodities and as symbols of political or religious authority (Boertien 2007; 2013: 270, 283-294; Browning 1988; Oppenheim 1967; Sheffer and Tidhar 2012: 307). Although it is not possible to rule out other uses for Iron Age II bast fiber textiles, the occurrence of linen textiles in Neo-Assyrian kings' tribute lists shows that there was a common recognition of bast textiles as valuable (e.g. Grayson and Novotny 2012: 65-66; Leichty 2011: 16, 55-56, 304-305; Lie 1929: 27-29; Oates and Oates 2004: 226-227; Page 1968: 143-145; Roaf 1990: 132-197; Tadmor et al. 2011: 37-131; Yamada 2000: 243-247).

Theoretically, Iron Age II weavers could have manufactured loom weights of the appropriate shape, thickness, mass, and material to weave bast fiber textiles (Martensson et al. 2009). Yet, the results of this study suggest that Iron Age II weavers used older types of looms (i.e. ground looms or upright looms) to weave these valuable fabrics. Future research into this issue may consider that there was "meaning in the making" of Iron Age II textiles that lead Levantine people to choose different methods for the production of valuable and symbolic bast fiber textiles than they used to weave versatile animal fiber textiles (Berg 2006).

Conclusion

Different authors suggest that the ubiquity of loom weights in the Iron Age II Period was the result of distinct developments in Levantine society: Neo-Assyrian tribute demands (Browning 1988; 2001: 252; Cecchini and Mazzoni 1998), development of textile industries for trade (Boertien 2013: 313-314), growth of agricultural industry (Eitam 1990b; Gitin 1997: 89-90), or household production (Friend 1998: 10). However, this study demonstrates that Iron Age II weavers used warp-weighted looms to weave many types of animal fiber textiles. Thus future research must consider loom weights as a factor in a suite of changes in Iron Age II society that related to animal fiber textiles (e.g. trade, agricultural industry, and domestic life), and therefore another example of a textile revolution.

ABBO, SHAHAL, ZEZAK, INBAR, LEV-YADUN, SIMCHA, SHAMIR, ORIT, FRIEDMAN, TONI and GOPHER, AVI 2015: Harvesting wild flax in the Galilee, Israel and extracting fibers – bearing on Near Eastern plant domestication. *Israel Journal of Plant Sciences,* 62**,** 52-64.

ALBRIGHT, WILLIAM FOXWELL 1943: *The excavation of Tell Beit Mirsim : Iron Age, v.3* New Haven, American Schools of Oriental Research.

ANDERSSON, EVA 1999: *The common thread : textile production during the Late Iron Age-Viking Age* Lund, Sweden, University of Lund, Institute of Archaeology.

ANDERSSON STRAND, EVA 2012: From spindle whorls and loom weights to fabrics in the Bronze Age Aegean. In Nosch, M.-L. & Laffineur, R. (eds.), *Kosmos: jewellery, adornment and textiles in the Aegean Bronze Age.* Leuven, Peeters.

ANDERSSON STRAND, EVA 2015: The basics of textile tools and textile technology - from fibre to fabric. In Strand, E.A. & Nosch, M.-L. (eds.), *Tools, textiles and contexts: investigating textile production int he Aegean and Eastern Mediterranean Bronze Age.* Oxford, Oxbow Books.

ANDERSSON STRAND, EVA, MOSCH, MARIE-LOUISE and CUTLER, JOANNE 2015: Textile tools and textile production - studies of selected Bronze Age sites: introduction. In Strand, E.A. & Nosch, M.-L. (eds.), *Tools, textiles and contexts: investigating textile production in the Aegean and eastern Mediterranean Bronze Age.* Oxford, Oxbow Books.

ARIEL, DONALD T. and SHILOH, YIGAL 1996: *Excavations at the City of David Vol. 4* Jerusalem, Inst. of Archaeology, Hebrew Univ. of Jerusalem.

ASTOUR, MICHAEL C. 1965: The Origin of the terms 'Canaan,' 'Phoenician,' and 'Purple'". *Journal of Near Eastern Studies,* 24**,** 346-350.

BARBER, ELIZABETH J. W. 1991: *Prehistoric textiles: the development of cloth in the Neolithic and Bronze Ages with special reference to the Aegean* Princeton, Princeton University Press.

BARBER, ELIZABETH J. W. 1992: The Peplos of Athena. In Neils, J. (ed.), *Goddess and polis: the panathenaic festival in ancient Athens.* Princeton, Princeton University Press.

BARBER, ELIZABETH J. W. 1994: *Women's work the first 20,000 years: women, cloth, and society in early times* New York, Norton.

BECK, HORACE C. 1928: I. - Classification and nomenclature of beads and pendants. *Arcaeologia,* 77**,** 1-76.

BEN-YOSEF, EREZ, TAUXE, LISA, SHAAR, RON and RON, HAGAI 2012: A new chronological framework for Iron Age copper production at Timna (Israel). *Bulletin of the American Schools of Oriental Research,* 367**,** 31-71.

BERG, INA 2006: Meaning in the making: The potter's wheel at Phylakopi, Melos (Greece). *Journal of Anthropological Archaeology,* 26**,** 234-252.

BOERTIEN, JEANNETTE 2004: Iron Age loom weights from Tall Dayr Alla in Jordan. *The Annual of the Department of Antiquities,* 48**,** 305-332.

BOERTIEN, JEANNETTE 2007: Asherah and textiles. *Biblische Notizen,* 134**,** 63-77.

BOERTIEN, JEANNETTE 2012: Weaving at Tell Mazar: the loomweights. In Yassine, K. & Steen, E.v.d. (eds.), *Tell el-Mazar II excavations on the mound 1977-1981: field I* Oxford, Archaeopress.

BOERTIEN, JEANNETTE 2013. Unravelling the fabric: textile production in Iron Age Transjordan. PHD Dissertation, Rijksuniveriteit Gröningen, Netherlands.

BOERTIEN, JEANNETTE 2014: Public or domestic? Temple, text and textile production at Khirbet el-Mudayna in Moab. In Steen, E.V.D., Boertien, J. & Mulder-Hymans, N. (eds.), *Exploring the narrative: Jerusalem and Jordan in the Bronze and Iron Ages.* London, Bloomsbury T&T Clark.

BOIVIN, NICOLE and FULLER, DORIAN Q. 2009: Shell middens, ships and seeds: exploring coastal subsistence, maritime trade and the dispersal of domesticates in and around the ancient Arabian Peninsula. *Journal of World Prehistory,* 22**,** 113-180.

BRITNELL, WILLIAM J. 1977: How upright was the warp-weighted loom? *Antiquity,* 51**,** 238-239.

BROWNING, DANIEL C. 1988. The textile industry of Iron Age Timnah and its regional and socioeconomic contexts : a literary and artifactual analysis. PHD Dissertation, Southwestern Baptist Theological Seminary,

BROWNING, DANIEL C. 2001: A. loomweights. In Mazar, A., Kelm, G.L. & Panitz-Cohen, N. (eds.), *Timnah (Tel Batash) II.* Jerusalem, Institute of Archaeology, Hebrew University of Jerusalem.

BRUGGE, CAROLINE VAN DER and KLEBER, KRISTIN in press: The empire of trade and the empires of force. Tyre in the Neo-Assyrian and Neo-Babylonian Periods. In Garcia, J.C.M. (ed.), *Dynamics of Production and Economic Interaction in the Near East in the first half of the first millenium BCE. Proceedings of a colloquium of the European Science Foundation June 28-30 in Lille.*

BRUMFIEL, ELISABETH M. 1991: Weaving and cooking: women's production in Aztec Mexico. In Gero, J.M. & Conkey, M.W. (eds.), *Engendering Archaeology.* Cambridge, Blackwell.

BULLIET, RICHARD W 1990: *The camel and the wheel*, Columbia University Press.

BYRNE, RYAN 2003: Early Assyrian contacts with Arabs and the impact on Levantine vassal tribute. *Bulletin of the American Schools of Oriental Research,* 331**,** 11-25.

CAHILL, JANE M. 2006: The excavations at Tell el-Hammah: a prelude to Amihai Mazar's Beth-Shean Valley regional project. In Maeir, A.M. & Miroschedji, P.d. (eds.), *I will speak the riddles of ancient times: archaeological and historical essays in honor of Amihai Mazar on the occasion of his sixtieth birthday.* Winona Lake, Eisenbrauns.

CAHILL, JANE M., LIPTON, G. and TARLER, D. 1987: Tell el-Hammah, 1985-1987. *Israel Exploration Journal,* 37**,** 280-283.

CARROLL, DIANE LEE 1983: Warping the Greek loom: a second method. *American Journal of Archaeology,* 87**,** 96-98.

CASSUTO, DEBORAH 2012: Weaving implements. In Maeir, A.M. (ed.), *Tell es-Safi/Gath I: the 1996-2005 seasons.* Wiesbaden, Germany, Harrassowitz.

CECCHINI, SERENA MARIA 2000: The textile industry in Norther Syria during the Iron Age according to the evidence of the Tell Afis excavations. In Bunnens, G. (ed.), *Essays on syria in the Iron Age.* Sterling, Virgina, Louvain.

CECCHINI, SERENA MARIA 2014: Tell Afis in the Iron Age: the official buildings of the eastern acropolis. *Near Eastern Archaeology,* 77**,** 58-63.

CECCHINI, SERENA MARIA and MAZZONI, STEFANIA 1998: *Tell Afis (Siria): scavi sull'acropoli 1988-1992* Pisa, Edizioni ETS.

COHEN, RUDOLPH and BERNICK-GREENBERG, HANNAH 2007: *Excavations at Kadesh Barnea (Tell el-Qudeirat) 1976-1982* Jerusalem, Israel Antiquities Authority.

CROWFOOT, GRACE M. 1936: Of the warp-weighted loom. *The Annual of the British School at Athens,* 37**,** 36-47.

CURAL, Z. CASTRO 1988: Response to Sheffer. *Archaeological Textiles Newsletter,* 7.

DAGAN, AMIT and CASSUTO, DEBI. 2013. Khorvat Shimon: an Iron Age IIB industrial site near Tell es-Safi/Gath. Paper presented at the 2013 ASOR Annual Meeting, Baltimore,

DAVIAU, P. M. MICHELE 1997: Moab's northern border: Khirbet al-Mudayna on the Wadi ath-Thamad. *Biblical Archaeologist,* 60**,** 222-228.

DAVIAU, P. M. MICHÈLE 2002: *Excavations at Tall Jawa, Jordan: Volume II The Iron Age Artefacts* Leiden, Brill.

DAVIAU, P. M. MICHÈLE. 2009. Industrial furnishings from Khirbat al-Mudayna ath-Thamad: lues from Egyptian iconography. Paper presented at the ASOR Annual Meeting, New Orleans,

DAVIAU, P. M. MICHELE and CHADWICK, ROBERT 2007: Shepherds and weavers in a "global economy". In Levy, T.E., Daviau, P.M.M., Younker, R.W. & Shaer, M. (eds.), *Crossing Jordan: North American contributions to the archaeology of Jordan.* London, Equinox Publishing.

DAVIAU, P. M. MICHELE and DION, PAUL-EUGENE 2002: Economy-related finds from Khirbat al-Mudayna (Wadi ath-Thamad, Jordan). *Bulletin of the American Schools of Oriental Research,* 328**,** 31-48.

DAVIDSON, DONALD A., WILSON, CLARE A., LEMOS, IRENE S. and THEOCHAROPOULOS, S.P. 2010: Tell formation processes as indicated from geoarchaeological and geochemical investigations at Xeropolis, Euboea, Greece. *Journal of Archaeological Science,* 37**,** 1564-1571.

EBELING, JENNIE and HOMAN, MICHAEL 2008: Baking and brewing beer in the Israelite household: a study of women's cooking technology. In Nakhai, B.A. (ed.), *The world of women in the ancient and classical Near East.* Newcastle upon Tyne, Cambridge Scholars Pub.

EDELSTEIN, GERSHON 1969: *The weavers' quarters at Tel-Amal in the period of the united monarchy: five seasons of excavations at Tel Amal* Nir David, Israel, Museum of Mediterranean Archeology.

EITAM, DAVID 1990a: Royal industry in ancient Israel during the Iron Age Period. In Aerts, E. & Klengel, H. (eds.), *The town as regional economic center in the ancient Near East.* Leuven, Leuven University Press.

EITAM, DAVID 1990b: Textile and olive oil production in ancient Israel during the Iron Age Period. In Guineau, B. (ed.), *Pigments et colorants de l'antiquité et du moyen age : teinture, peinture, enluminure; études historiques et physico-chimiques; colloque international.* Paris, Éd. du Centre National de la Recherche Scientifique.

ELAT, MOSHE 1978: The economic relations of the Neo-Assyrian Empire with Egypt. *Journal of the American Oriental Society,* 98**,** 20-34.

EMERY, IRENE 1966: *The primary structures of fabrics: an illustrated classification* New York, The Spiral Press.

FAUST, AVRAHAM 2008: Household economies in the kingdoms of Israel and Judah In Yasur-Landau, A., Ebeling, J.R. & Mazow, L.B. (eds.), *Household archaeology in ancient Israel and beyond.* Leiden, Brill.

FAUST, AVRAHAM 2011: The interests of the Assyrian Empire in the west: olive oil production as a test-case. *Journal of the Economic and Social History of the Orient,* 54**,** 62-86.
FAUST, AVRAHAM 2013: The Shephelah in the Iron Age: a new look on the settlement of Judah. *Palestine Exploitation Quarterly,* 145**,** 203-219.
FAUST, AVRAHAM and WEISS, EHUD 2005: Judah, Philistia, and the Mediterranean world: reconstructing the economic system of the Seventh Century B.C.E. *Bulletin of the American Schools of Oriental Research,* 338**,** 71-92.
FEIG, NURIT 2013: Tel 'Amal: an Iron Age IIA settlement and remains from the Bronze Age and the Ottomon Empire. *Hadashot Arkeologiyot—Excavations and Surveys in Israel***,** 39-41.
FINKELSTEIN, ISRAEL 1988: Arabian trade and socio-political conditions in the Negev in the Twelfth-Eleventh Centuries B. C. E. *Journal of Near Eastern Studies,* 47**,** 241-252.
FISCHER, PETER M. 2008: Tell Abu al-Kharaz: a bead in the Jordan Valley. *Near Eastern Archaeology,* 71**,** 196-213.
FISCHER, PETER M. 2009: Textile production at Tall Abu al-Kharaz, Jordan Valley. In Kaptijn, E. & Petit, L.P. (eds.), *A timeless vale: festschrift in honour of Gerrit van der Kooij.* Leiden, Leiden University.
FOWLER, MERVYN D. 1984: Concerning the 'cultic" structure at Taanach. *Zeitschrift des Deutschen Palastina-Wereins (1953-),* 100**,** 30-34.
FRIEND, GLENDA 1996. Textile production at tell Gezer and Tell Halif: the development of Iron Age II cottage industries. MA Thesis, Baltimore Hebrew University, Baltimore.
FRIEND, GLENDA 1998: *Tell Taannek 1963 - 1968 2, The Artifacts: The Loom Weights* Birzeit, Palestine Inst. of Archaeology, Birzeit Univ.
GAL, ZVI 1989: Loom weights or jar stoppers? *Israel Exploration Journal,* 39**,** 281-283.
GASPA, SALVATORE 2013: Textile production and comsumption in the Neo-Assyrian Empire. In Nosch, M.-L., Koefoed, H. & Strand, E.A. (eds.), *Textile Production and Consumption in the Ancient Near East: Archaeology, Epigraphy, Iconography.* Oxford, Oxbow Wooks.
GITIN, SEYMOUR 1997: The Neo-Asyria Empire and its western periphery: the Levant, with a focus on Philistine Ekron. In Parpola, S. & Whiting, R.M. (eds.), *Assyria 1995.* Heksinki, Vammalan Kirjapaino Oy.
GRAYSON, ALBERT KIRK and NOVOTNY, JAMIE R. 2012: *The royal inscriptions of Sennacherib, king of Assyria* Winona Lake, Ind., Eisenbrauns.
HARDIN, JAMES and BLAKELY, JEFFREY. 2014. The Iron Age IIA materials from Khirbet Summeily. Paper presented at the 2014 ASOR Annual Conference, San Diego,
HARDIN, JAMES, ROLLSTON, CHRISTOPHER A. and BLAKELY, JEFFERY A. 2014: Iron Age Bullae from Officialdom's Periphery: Khirbet Summeily in Broader Context. *Near Eastern Archaeology,* 77**,** 299-301.
HARRISON, T.P 2001: Tell Ta'yinat and the Kingdom of Unqi. In Daviau, P.M.M., Wevers, J.W., Weigl, M. & Dion, P.-E. (eds.), *The World of the Aramaeans.* Sheffield, Sheffield Academic Press.
HOFFMANN, MARTA 1974: *The warp-weighted loom: studies in the history and technology of an ancient implement* Oslo, The Norwegian Research Council for Science and the Humanities.

HOLLADAY, JOHN S. 2006: Hezekiah's tribute, long-distance trade, and the wealth of nations ca. 1000-600 BC: a new perspective. In Gitin, S., Wright, J.E. & Dessel, J.P. (eds.), *Confronting the past: archaeological and historical essays on ancient Israel in honor of William G. Dever.* Winona Lakes, Eisenbrauns.

HOMAN, MICHAEL M. 2004: Beer and its drinkers: an ancient Near Eastern love story. *Near Eastern Archaeology,* 67**,** 88-95.

HOPKINS, DAVID 1996: Bare bones: putting flesh on the economics of ancient Israel. *Journal for the Study of the Old Testament Supplement Series***,** 121-141.

JAMES, FRANCES W. 1966: *The Iron Age at Beth Shan : a study of levels VI-IV* Philadelphia, University Museum, University of Pennsylvania.

JANKOWSKA, N. B. 1969: Some problems of the economy of the Assyrian Empire. In Diakonoff, I.M. (ed.), *Ancient Mesopotamia: socio-economic history.* Moskow, Nauka.

KILLEBREW, ANN E. and STEINER, MARGREET 2014: Map of the Levant. In Killebrew, A.E. & Steiner, M. (eds.), *The Oxford handbook of the archaeology of the Levant: C.8000-332 BCE.* Oxford, Oxford University Press.

KVAVADZE, ELISO, BAR-YOSEF, OFER, BELFER-COHEN, ANNA, BOARETTO, ELISABETTA, JAKELI, NINO, MATSKEVICH, ZINOVI and MESHVELIANI, TENGIZ 2009: 30,000-year-old wild flax fibers. *Science,* 325**,** 1359.

LAPP, PAUL W. 1964: The 1963 Excavation at Ta'annek. *Bulletin of the American Schools of Oriental Research***,** 4-44.

LAPP, PAUL W. 1969: The 1968 Excavations at Tell Ta'annek. *Bulletin of the American Schools of Oriental Research,* 195**,** 2-49.

LASS, EGON H. E. 1994: Quantitative studies in flotation at Ashkelon, 1986 to 1988. *Bulletin of the American Schools of Oriental Research,* 294**,** 23-38

LEHMANN, GUNNAR, ROSEN, STEVEN A., BERLEJUNG, ANGELIKA, NEUMEIER, BAT-AMI and NIEMANN, HERMANN MICHAEL 2010: Excavations at Qubur al-Walaydah, 2007-2009. *Die Welt des Orients,* 40**,** 137-159.

LEICHTY, ERLE 2011: *The royal inscriptions of Esarhaddon, king of Assyria (680-669 BC)* Winona Lake, Ind., Eisenbrauns.

LIE, A. G. 1929: *The inscriptions of Sargon II, king of Assyria* Paris, Paul Geuthner.

LIPKIN, SANNA and JARVA, EERO 2014: Ancient textiles were expensive. How do you know that? *Faravid,* 38**,** 28-38.

MAEIR, AREN M. 2012: The Tell es-Safi/Gath Archaeological Project 1996-2010: introduction, overview and synopsis of results. In Maeir, A.M. (ed.), *Tell es-Safi/Gath I: the 1996-2005 seasons.* Germany, Manfred Gorg.

MAISLER, BENJAMIN 1950: The excavations at Tell Qasîle: peliminary rport. *Israel Exploration Journal,* 1**,** 194-218.

MARTENSSON, LINDA, ANDERSSON, EVA, NOSCH, MARIA-LOUISE and BATZER, ANNE. 2006a. *Technical report: experimental archaeology part 2:1 flax.* Tools and Textiles - Texts and Contexts Research Programme CTR, http://ctr.hum.ku.dk/tools/Technical_report_2-1_experimental_archaeology.pdf.

MARTENSSON, LINDA, ANDERSSON, EVA, NOSCH, MARIA-LOUISE and BATZER, ANNE. 2006b. *Technical report: experimental archaeology part 2:2 whorl of bead?* Tools and Textiles - Texts and Contexts Research Programme CTR, http://ctr.hum.ku.dk/tools/Technical_report_2-2__experimental_arcaheology.PDF.

MARTENSSON, LINDA, ANDERSSON, EVA, NOSCH, MARIA-LOUISE and BATZER, ANNE. 2007a. *Technical report: experimental archaelogy part 3 loom weights.* Tools and Textiles - Texts and Contexts Research Programme CTR, http://ctr.hum.ku.dk/tools/Technical_report_3__experimental_archaeology.PDF.

MARTENSSON, LINDA, ANDERSSON, EVA, NOSCH, MARIA-LOUISE and BATZER, ANNE. 2007b. *Technical report: experimental archaeology part 4 spools.* Tools and Textiles - Texts and Contexts Research Programme CTR, http://ctr.hum.ku.dk/tools/Technical_report_4__experimental_arcaheology.PDF.

MARTENSSON, LINDA, NOSCH, MARIA-LOUISE and STRAND, EVA ANDERSSON 2009: Shape of things: understanding a loom weight. *Oxford Journal of Archaeology,* 28**,** 373-398.

MASTER, DANIEL M. 2003: Trade and politics: Ashkelon's balancing act in the Seventh Century BCE. *Bulletin of the American Schools of Oriental Research,* 330**,** 47-64.

MASTER, DANIEL M. 2011: Loom weights and jar stoppers. In Stager, L.E., Master, D.M. & Schloen, J.D. (eds.), *Ashkelon 3: the Seventh Century B.C.* Winona Lake, Eisenbraun.

MASTER, DANIEL M. 2014: Economy and exchange in the Iron Age kingdoms of the southern Levant. *Bulletin of the American Schools of Oriental Research,* 372**,** 81-97.

MASTER, DANIEL M. and STAGER, LAWRENCE E. 2011: Conclusion. In Stager, L.E., Master, D.M. & Schloen, J.D. (eds.), *Ashkeelon 3: the Seventh Century B.C.* Winona Lake, Eisenbraun.

MAZAR, AMIHAY , KELM, GEORGE L. and PANITZ-COHEN, NAVA 2001: *Timnah (Tel Batash) II* Jerusalem, Institute of Archaeology, Hebrew University of Jerusalem.

MAZAR, AMIHAY , MULLINS, ROBERT A. and PANITZ-COHEN, NAVA 2006: *Excavations at Tel Beth-Shean, 1989-1996* Jerusalem, Israel Exploration Society : Institute of Archaeology, the Hebrew University of Jerusalem.

MAZAR, AMIHAY , PANITZ-COHEN, NAVA and KELM, GEORGE L. 1997: *Timnah (Tel Batash) I* Jerusalem, Hebrew University, Institute of Archaeology.

MAZAR, B., BIRAN, A., DOTHAN, M. and DUNAYEVSKY, I. 1964: 'Ein Gev: excavations in 1961. *Israel Exploration Journal,* 14**,** 1-49.

MAZZONI, STEFANIA 1998: *The Italian excavations of Tell Afis (Syria): from chiefdom to an Aramaean state* Pisa, Edizioni ETS.

MAZZONI, STEFANIA 2013: Tell Afis: history and excavations. *Near Eastern Archaeology,* 76**,** 204-212.

MAZZONI, STEFANIA 2014: Tell Afis in the Iron Age: the temple on the acropolis. *Near Eastern Archaeology,* 77**,** 44-52.

MCCORRISTON, JOY 1997: The fiber revolution: textile extensification, alienation, and social stratification in ancient Mesopotamia. *Current Anthropology,* 38**,** 517-549.

MCLAUGHLIN, BARBARA K. 1981: New evidence on the mechanics of loom weights. *AJA,* 85**,** 79-91.

MEEHL, MARK WILLIAM 1995. A strategraphic analysis of the unpublished Early Iron Age materials from Tell Ta'annek in light of recent Jezreel Valley excavations. The Johns Hopkins University, Baltimore, Maryland.

MESHEL, ZE'EV 1978: *Kuntillet `Ajrud : a religious centre from the time of the Judaean monarchy on the border of Sinai* Jerusalem, Israel Museum.

MESHEL, ZE'EV 2012a: The nature of the site and its Biblical background. In Meshel, Z.e. (ed.), *Kuntillet 'Ajrud (Horvat Teman) an Iron Age II religious site on the Judah-Sinai border.* Jerusalem, Israel Antiquity Authority.

MESHEL, ZE'EV 2012b: The site: location, environment and exploration. In Meshel, Z.e. (ed.), *Kuntillet 'Ajrud (Horvat Temain): an Iron Age II religious site in the Judah-Sinai border.* Jerusalem, Israel Exploration Society.

NADEL, D., DANIN, A., WERKER, E., SCHICK, T., KISLEV, M. E. and STEWART, K. 1994: 19,000-year-old twisted fiber from Ohalo II. *Current Anthropology,* 35**,** 451-458.

NISHIYAMA, SHIN'ICHI 1998: Reusing the object: rim sherd loomweights in the early First Millenium BC from Tell Mastuma, north-west Syria. *Orient,* 33**,** 88-102.

OATES, JOAN and OATES, DAVID 2004: *Nimrud: an Assyrian imperial city revealed* Norfolk, Biddles Limited.

OLOFSSON, LINDA, ANDERSSON STRAND, EVA and NOSCH, MARIE-LOUISE 2015: Experimental testing of Bronze Age textile tools. In Strand, E.A. & Nosch, M.-L. (eds.), *Tools, textiles and contexts: investigating textile production in the Aegean and Eastern Mediterranean Bronze Age.* Oxford, Oxbow Books.

OPPENHEIM, A. LEO 1967: Essay on overland trade in the First Millenniu B.C. *Journal of Cuneiform Studies,* 21**,** 236-254.

OREN, RONIT 2002: Loom weights and spindle worls. In Scheftelowitz, N.a. & Oren, R. (eds.), *Tel Kabri: the 1986-1993 excavation seasons.* Tel Aviv, Emery and Claire Yass Publications in Archaeology.

OUSTERHOUT, ROBERT 2013: Beth Shean revisited: reexamining at Late Antiquity site in transition. *Expedition,* 55**,** 8-11.

PAGE, STEPHANIE 1968: A stela of Adad-nirari III and Nergal-eres from Tell al Rimah. *Iraq,* 30**,** 139-153.

PARSONS, JEFFREY R. and PARSONS, MARY HRONES 1990: *Maguey utilization in highland central Mexico : an archaeological ethnography* Ann Arbor, Museum of Anthropology, University of Michigan.

PEYRONEL, LUCA 2007: Spinning and weaving at Tell Mardikh-Ebla (Syria): some observations on spindle-whorls and loom-weights from the Bronze and Iron Ages. In Gillis, C. & Nosch, M.-L.B. (eds.), *Ancient textiles : production, craft and society.* Oxford, Oxbow.

RAHMSTORF, LORENZ 2005: Ethnicity and changes in weaving technology in Cyprus and the eastern Mediterranean in the 12th Century BC. In Karageorghis, V., Matthaus, H. & Rogge, S. (eds.), *Cyprus: religion and society from the Late Bronze Age to the end of the Archaic Period.*

READE, WENDY J. and POTTS, DANIEL T. 1993: New evidence for late Third Millennium linen from Tell Abraq , Umm Al-Qaiwan, UAE. *Paléorient,* 19**,** 99-106.

ROAF, MICHAEL 1990: *Cultural atlas of Mesopotamia and the ancient Near East* New York, Facts on File.

SAVARIEGO, ALEGRE 2015 Personal Communication.

SHAMIR, ORIT 1991: Loomweights and whorls from the City of David. *Archaeological Textiles Newsletter,* 12**,** 135-170.

SHAMIR, ORIT 1996: Loomweights and whorls. In Silo, Y.a., Ariel, D. & Groot, A.D. (eds.), *Excavations at the City of David: Vol IV. various reports.* Jerusalem, The Hebrew University.

SHAMIR, ORIT 2006: Objects associated with the weaving indusrty (Beth Shean, Area P). In Mazar, A. (ed.), *Excavations at Tel Beth-Shean 1989-1996 1: from the Late Bronze Age IIB to the Medieval Period.* Jerusalem, Israel Exploration Society : Institute of Archaeology, the Hebrew University of Jerusalem.
SHAMIR, ORIT 2007a: Loom weights from En-Gedi. In Stern, E. (ed.), *En-Gedi excavations I, final report (1991-1965).* Jerusalem, Israel Exploration Society.
SHAMIR, ORIT 2007b: Loomweights and textile production at Tel Miqne-Ekron: a preliminary report. In Gitin, S., Crawford, S.W. & Ben-Tor, A. (eds.), *Up to the gates of Ekron.* Jerusalem, W.F. Albright Institute of Archaeological Research.
SHAMIR, ORIT 2007c: Textiles, loom weights, and spindle whorls. In Cohen, R., Bernick-Greenberg, H. & Bar-Yosef Meyer, D. (eds.), *Excavations at Kadesh Barnea (Tell el-Qudeirat) 1976-1982.* Jerusalem, Israel Antiquity Authority.
SHAMIR, ORIT 2009: The loom weights. In Greenhut, Z. & Groot, A.D. (eds.), *Salvage excavations at Tel Moza: the Bronze and Iron Age settlements and later occupations.* Jerusalem, Israel Antiquities Authority.
SHAMIR, ORIT 2012a: Remains of cords and textile impressions on a clay stopper. In Meshel, Z.e. (ed.), *Kuntillet 'Ajrud: an Iron Age II religious site on the Judean-Sinai border.* Jerusalem, Israel Antiquities Authority.
SHAMIR, ORIT 2012b: Tel 'Amal: loomweights. *Hadashot Arkeologiyot—Excavations and Surveys in Israel,* 125**,** 1-11.
SHAMIR, ORIT 2015: Textiles from the Chalcolithic Period, Early and Middle Bronze Age in the Southern Levant – the continuation of splicing. *Archaeological Textiles Review,* 57**,** 12-25.
SHAMIR, ORIT and BAGINSKI, A. 1993: Textiles from the mining camps at Timna. *Archaeological Textiles Newsletter,* 15**,** 9.
SHAMIR, ORIT, WORKMAN, VANESSA and BEN-YOSEF, EREZ. 2014. Textiles and textile impressions on pottery from the Hathor temple and Iron Age smelting sites at Timna. Paper presented at the American Schools of Oriental Science Annual Meeting, San Diego, November 19, 2014.
SHEFFER, AVIGAIL 1976: Comparative analysis of a 'Negev Ware' impression from Tel Masos. *Tel Aviv,* 1976**,** 81-88.
SHEFFER, AVIGAIL 1981: The use of perforated clay balls on the warp-weighted loom. *Tel Aviv,* 8**,** 81-83.
SHEFFER, AVIGAIL 1988: Response to Curel. *Archaeological Textiles Newsletter,* 7**,** 5.
SHEFFER, AVIGAIL 2001: Appendix: a textile impression from Tel Batash. In Mazar, A., Kelm, G.L. & Panitz-Cohen, N. (eds.), *Timnah (Tel Batash) II.* Jerusalem, Institute of Arcchaeology, Hebrew University of Jerusalem.
SHEFFER, AVIGAIL and TIDHAR, AMALIA 1991: Textiles and basketry at Kuntillat 'Ajrud. *'Atiqot,* 20**,** 1-26.
SHEFFER, AVIGAIL and TIDHAR, AMALIA 2012: Textiles and Basketry. In Meshel, Z.e. (ed.), *Kuntillet ʻAjrud (Ḥorvat Teman) : an Iron Age II religious site on the Judah-Sinai border.* Jerusalem, Israel Exploration Society.
SHILOH, YIGAL 1984: *Excavations at the city of David, I, 1978-1982 : interim report of the first five seasons* Jerusalem, Institute of Archaeology, Hebrew University of Jerusalem.
SKALS, IRENE, MOLLER-WIERING, SUSAN and NOSCH, MARIE-LOUISE 2015: Survey of archaeological textile remains from Aegean and eastern Mediterranean area. In Strand,

E.A. & Nosch, M.-L. (eds.), *Tools, textiles and contexts: investigating textile production in the Aegean and eastern Mediterranean Bronze Age.* Oxford, Oxbow Books.
SMITH, MICHELE HAYEUR 2014: Dress, cloth, and the farmer's wife: Textiles from Ø 172 Tatsipataa, Greenland, with comaprative data from Iceland. *Journal of the North Atlantic,* 6**,** 64-81.
SOFFER, O., ADOVASIO, J.M. and HYLAND, D.C. 2000: The "Venus" figurines: textiles, basketry, gender, and status in the Upper Paleolithic. *Current Anthropology,* 41**,** 511-537.
STAGER, LAWRENCE E. 1996: The fury of Babylon: Ashkelon and the archaeology of destruction. *Biblical Archaeology Review,* 22**,** 56-77.
STAGER, LAWRENCE E., MASTER, DANIEL M. and SCHLOEN, J. DAVID 2011a: The Marketplace and Quarry in Grid 50. In Stager, L.E., Master, D.M. & Schloen, J.D. (eds.), *Ashkelon 3: The Seventh Century B.C.* Winona Lakes, Eisenbrauns.
STAGER, LAWRENCE E., MASTER, DANIEL M. and SCHLOEN, J. DAVID 2011b: Quantative and spatial analysis of pottery and other artifacts. In Stager, L.E., Master, D.M. & Schloen, J.D. (eds.), *Ashkelon 3: the Seventh Century B.C.* Winona Lake, EIsenbraun.
STAGER, LAWRENCE E., MASTER, DANIEL M. and SCHLOEN, J. DAVID 2011c: The winery in grid 38. In Stager, L.E., Master, D.M. & Schloen, J.D. (eds.), *Ashkelon 3: the Seventh Century B.C.* Winona Lakes, Eisenbrauns.
STONE, ELIZABETH C. and ZIMANSKY, PAUL E. 1999: *The Iron Age settlement at `Ain Dara, Syria : survey and soundings* Oxford, England, J. and E. Hedges : Archaeopress.
TADMOR, HAYIM , YAMADA, SHIGEO and NOVOTNY, JAMIE R. 2011: *The royal inscriptions of Tiglath-pileser III (744-727 BC) and Shalmaneser V (726-722 BC), kings of Assyria* Winona Lake, Ind., Eisenbrauns.
VAN DER KOOIJ, GERRIT and IBRAHIM, MOAWIYAH 1989: *Picking up the threads: a continuing review of excavations at Deir Alla, Jordan* Leiden, University of Leiden, Archaeological Centre.
VAN ZEIST, W. and HEERES, J. A. H. 1973: Paleobotanical Studies of Deir 'Alla, Jordan. *Paléorient***,** 21-37.
VERHECKEN, ANDRE 2010: The moment of inertia: a parameter for the functional classification of worldwide spindle-whorls from all periods. In Strand, E.A. (ed.), *North Europoean Symposium for Archaeological Textiles X.* Oxford, Oxbow.
WRIGHT, G. ERNEST 1955: Israelite daily life. *The Biblical Archaeologist,* 18**,** 50-79.
YAMADA, SHIGEO 2000: *The construction of the Assyrian empire: a historical study of the inscriptions of Shalmanesar III (859-824 B.C.) relating to his campaigns in the West* Leiden, Brill.
YASSINE, KHAIR and STEEN, E. J. VAN DER 2012: *Tell el-Mazar II: excavations on the mound 1977-1981: field I* Oxford, Archaeopress.
ZOHARY, DANIEL, HOPF, MARIA and WEISS, EHUD 2012: *Domestication of plants in the Old World : the origin and spread of domesticated plants in Southwest Asia, Europe, and the Mediterranean Basin* Oxford, Oxford University Press.
ZUCKERMAN, ALEXANDER and MAEIR, AREN M. 2012: The stratigraphy and architecture of Area A: Strata A1-A5. In Maeir, A.M. (ed.), *Tell es-Safi/Gath I: the 1996-2005 seasons.* Germany, Manfred Gorg.

Appendix A: Sizes of Textile Remains and Impressions
Sources: (Boertien 2013; Shamir 2007c, 2012a; Sheffer and Tidhar 2012)

Table A.1: Sizes of Textile Remains and Impressions

Site	Artifact Number	Width (cm)	Length (cm)
Kuntillet 'Ajrud	2	11.5	7.5
Kuntillet 'Ajrud	3	17	10.5
Kuntillet 'Ajrud	4	15	2.5
Kuntillet 'Ajrud	5	10	7
Kuntillet 'Ajrud	6	7	13
Kuntillet 'Ajrud	7	6	4
Kuntillet 'Ajrud	8	8	7.5
Kuntillet 'Ajrud	9	15	5
Kuntillet 'Ajrud	10	11	22
Kuntillet 'Ajrud	11	10	6
Kuntillet 'Ajrud	12	50	23
Kuntillet 'Ajrud	13	20	11
Kuntillet 'Ajrud	14	4	5
Kuntillet 'Ajrud	15	13	13
Kuntillet 'Ajrud	16	16.5	18
Kuntillet 'Ajrud	17	50	10
Kuntillet 'Ajrud	18	27	8
Kuntillet 'Ajrud	19	25+34	10.5
Kuntillet 'Ajrud	30	29	3
Kuntillet 'Ajrud	31	10	7
Kuntillet 'Ajrud	32	9	6
Kuntillet 'Ajrud	33	6	5
Kuntillet 'Ajrud	34	9	13
Kuntillet 'Ajrud	35	6.5	12
Kuntillet 'Ajrud	36	5	7
Kuntillet 'Ajrud	37	10	7.5
Kuntillet 'Ajrud	38	12	7
Kuntillet 'Ajrud	39	10	5
Kuntillet 'Ajrud	41	5	11
Kuntillet 'Ajrud	42	4.5	7.5
Kuntillet 'Ajrud	43	19	9
Kuntillet 'Ajrud	44	5	8
Kuntillet 'Ajrud	45	30	6
Kuntillet 'Ajrud	46	3	2
Kuntillet 'Ajrud	47	8	2
Kuntillet 'Ajrud	48	16	

Kuntillet 'Ajrud	49	16	4
Kuntillet 'Ajrud	50	2.5	4.5
Kuntillet 'Ajrud	51		
Kuntillet 'Ajrud	51a	9	
Kuntillet 'Ajrud	52	8	8
Kuntillet 'Ajrud	53	4.5	11
Kuntillet 'Ajrud	60		
Kuntillet 'Ajrud	61	10	12
Kuntillet 'Ajrud	62	8	23
Kuntillet 'Ajrud	63	14	9
Kuntillet 'Ajrud	64	6.5	12
Kuntillet 'Ajrud	65	6	12
Kuntillet 'Ajrud	66	8	11
Kuntillet 'Ajrud	67	20	3.5
Kuntillet 'Ajrud	68	8	4
Kuntillet 'Ajrud	69	18	3
Kuntillet 'Ajrud	70	8.5	4.5
Kuntillet 'Ajrud	71	4	12
Kuntillet 'Ajrud	72	8.5	9
Kuntillet 'Ajrud	73	1.5	.5.5
Kuntillet 'Ajrud	74	3	17
Kuntillet 'Ajrud	75	8.5	4.5
Kuntillet 'Ajrud	76	17	11
Kuntillet 'Ajrud	77	23	10
Kuntillet 'Ajrud	78		
Kuntillet 'Ajrud	80	7	4
Kuntillet 'Ajrud	82	5	4
Kuntillet 'Ajrud	83	40	4
Kuntillet 'Ajrud	84	8	9
Kuntillet 'Ajrud	85	1	1
Kuntillet 'Ajrud	86	4	4
Kuntillet 'Ajrud	87	3	2.5
Kuntillet 'Ajrud	88	1	1
Kuntillet 'Ajrud	89	9	4
Kuntillet 'Ajrud	90	9	2
Kuntillet 'Ajrud	91	6	9
Kuntillet 'Ajrud	92		
Kuntillet 'Ajrud	93	8.5	4
Kuntillet 'Ajrud	94	9	5.5
Kuntillet 'Ajrud	95a	12	13
Kuntillet 'Ajrud	95b	3	2.5

Kuntillet 'Ajrud	96	7	4
Kuntillet 'Ajrud	97		
Kuntillet 'Ajrud	98a	3.5	4
Kuntillet 'Ajrud	98b	4	4
Kuntillet 'Ajrud	99	2.5	2.5
Kuntillet 'Ajrud	100	4	3.5
Kuntillet 'Ajrud	101	23	5.5
Kuntillet 'Ajrud	102	4	18
Kuntillet 'Ajrud	103	20	7
Kuntillet 'Ajrud	104	28	2
Kuntillet 'Ajrud	105	1	2
Kuntillet 'Ajrud	106	22	5
Kuntillet 'Ajrud	107	6	5
Kuntillet 'Ajrud	108	15	2.5
Kuntillet 'Ajrud	109	11	6
Kuntillet 'Ajrud	110	19	0.5
Kuntillet 'Ajrud	111	14	0.5
Kuntillet 'Ajrud	112	3.5	38
Kuntillet 'Ajrud	15Frag	7	4.5
Kuntillet 'Ajrud	62Frag	14.5	5.5
Kuntillet 'Ajrud	67Frag	24	26
Kuntillet 'Ajrud	68Frag	18	4.5
Kuntillet 'Ajrud	70Frag	6	3
Kuntillet 'Ajrud	86Frag	2	3
Kadesh Barnea	1	5	0.6
Kadesh Barnea	2	1.2	2.6
Kadesh Barnea	3	3.5	3.5
Kadesh Barnea	4	3	13.8
Kadesh Barnea	5	3	2
Kadesh Barnea	6	2.5	2
Kadesh Barnea	7	5.3	4.5
Kadesh Barnea	8	5	0.5
Kadesh Barnea	9	6	2
Kadesh Barnea	10	6	7
Kadesh Barnea	11	4	5
Kadesh Barnea	12	4.6	8
Kadesh Barnea	13	1.5	1.3
Kadesh Barnea	14	10	8
Kadesh Barnea	15	2.8	3.5
Kadesh Barnea	16	4.5	4.2
Kadesh Barnea	17	2.4	2.5

Kadesh Barnea	18	1.2	2.6
Kadesh Barnea	19	2.5	2.5
Kadesh Barnea	20	3.8	1.8
Kadesh Barnea	21	2.4	2.3
Kadesh Barnea	22	3.3	3
Kadesh Barnea	23	4	2
Kadesh Barnea	24	1.2	1.3
Kadesh Barnea	25	3.7	2.9
Kadesh Barnea	26	4.7	1.7
Kadesh Barnea	27	2	3.5
Kadesh Barnea	28	2	0.6
Kadesh Barnea	29	3.6	1.5
Kadesh Barnea	30	3	1.6
Kadesh Barnea	31	4	4.3
Kadesh Barnea	32	6	2
Kadesh Barnea	33	2.7	1
Kadesh Barnea	34	3.5	2.5
Kadesh Barnea	35	1.5	1.5
Kadesh Barnea	36	4	0.7
Kadesh Barnea	37	2.3	0.7
Kadesh Barnea	38	1	0.8
Kadesh Barnea	39	2.7	2
Kadesh Barnea	40	2.2	2.2
Kadesh Barnea	41	2.2	1.7
Kadesh Barnea	42	2	2
Kadesh Barnea	43	8	2
Kadesh Barnea	44	4.2	2.5
Kadesh Barnea	45	5	2.5
Kadesh Barnea	46	3	1
Kadesh Barnea	47	3	1
Kadesh Barnea	48	2	2
Kadesh Barnea	49	3	3.5
Kadesh Barnea	50	2	1.5
Kadesh Barnea	51	2.5	1.7
Kadesh Barnea	52	2	2
Kadesh Barnea	53	3.5	1.5
Kadesh Barnea	54	1.5	1.5
Kadesh Barnea	55	6	6
Kadesh Barnea	56	5	2.5
Kadesh Barnea	Sherd 1721	6	7
Khirbat al-Mudayna	MT1265	2.259	1.839

Khirbat al-Mudayna	MT1265	0.987	0.99
Khirbat al-Mudayna	MT1085	6.9	4
Khirbat al-Mudayna	MT2490	0.7	1
Khirbat al-Mudayna	MT 937	4.2	3.4
Deir ‘Alla	Cloth Fragment	5.2	3.2
Kuntillet 'Ajrud	1342/30	6	7
Average Size		8.188625767	5.694590062

Appendix B: Loom weights from Tell Afis
Sources: (Cecchini 2000, 2014; Cecchini and Mazzoni 1998; Mazzoni 1998, 2013, 2014)
Table B.1: Loom weights from Tell Afis

Artifact Number	Area	Period	Mass (g)	Thickness (cm)	Type	Material
TA.88.D.97	D	IAII	158	5.3	VP	Clay
TA.89.D.28	D	IAII	225	5.8	VP	Clay
TA.88.D.99	D	IAII	404	7.8	VP	Clay
TA.89.D.16	D	IAII	185	4.8	Unpierced	Clay
TA.86.D.49	D	IAIII	76	4.5	VP	Clay
TA.89.D.97	D	IAIII	76	8.2	VP	Clay
TA.88.D.109	D	IAIII	86	4.5	VP	Clay
TA.86.D.63	D	IAIII	116	5.8	VP	Clay
TA.87.D.13	D	IAIII	118	5.3	VP	Clay
TA.86.D.51	D	IAIII	119	4.9	VP	Clay
TA.87.D.alfa	D	IAIII	156	5	VP	Clay
TA.88.D.168	D	IAIII	158	5.3	VP	Clay
TA.86.D.55	D	IAIII	160	6.3	VP	Clay
TA.87.D.217y	D	IAIII	160	5.2	VP	Clay
TA.87.D.100z	D	IAIII	163	5.2	VP	Clay
TA.87.D.217D	D	IAIII	181	4.8	VP	Clay
TA.88.D.62	D	IAIII	185	6.8	VP	Clay
TA.87.D.12	D	IAIII	186	5.9	VP	Clay
TA.89.D.169	D	IAIII	201	6.4	VP	Clay
TA.89.D.66	D	IAIII	231	6.5	VP	Clay
TA.86.D.63	D	IAIII	234	7.1	VP	Clay
TA.87.D?173/6	D	IAIII	259	5.4	VP	Clay
TA.86.D.70	D	IAIII	265	6.4	VP	Clay
TA.86.D.2	D	IAIII	272	7.3	VP	Clay
TA.88.D.87	D	IAIII	277	6	VP	Clay
TA.89.D.64	D	IAIII	318	7.5	VP	Clay
TA.88.D.83	D	IAIII	348	7.7	VP	Clay
TA.87.D.75	D	IAIII	373	6.9	VP	Clay
TA.87.D.beta	D	IAIII	408	8.7	VP	Clay
TA.86.D.6	D	IAIII	461	7.5	VP	Clay
TA.89.D.370	D	IAIII	690	8.5	VP	Clay
TA.89.D.263	D	IAIII	75	3.7	Unpierced	Clay
TA.88.D.8	D	IAIII	222	4	Unpierced	Clay
TA.88.D.27	D	IAIII	228	4.5	Unpierced	Clay
TA.89.E.162	E	IAI	825	11.5	VP	Clay
TA.92.E.14	E	IAI		6.5	HP	Clay

TA.91.E.65	E	IAI	165	4	Unpierced	Clay
TA.92.E.175	E	IAI	200	4.9	Unpierced	Clay
TA.97.E.24	E	IAI	260	4.8	Unpierced	Clay
TA.92.E.117	E	IAI	325	5	Unpierced	Clay
TA.97.E.215	E	IAI	361	5.4	Unpierced	Clay
TA.92.E.160	E	IAI	401	5.6	Unpierced	Clay
TA.92.E.31	E	IAI		1.4	Unpierced	Clay
TA.89.E.322	E	IAI		4.5	Unpierced	Clay
TA.89.E.323	E	IAI		4.3	Unpierced	Clay
TA.92.E.184	E	IAI		4	Unpierced	Clay
TA.92.E.195	E	IAI		5	Unpierced	Clay
TA.92.E.290bis	E	IAI		4.2	Unpierced	Clay
TA.89.E.216	E	IAI		4	Unpierced	Clay
TA.89.E.198	E	IAI		3.5	Unpierced	Clay
TA.88.E.182	E	IAI		4	Unpierced	Clay
TA.88.E.162	E	IAI		4.5	Unpierced	Clay
TA.88.E.191	E	IAI		3.5	Unpierced	Clay
TA.88.E.124	E	IAI		4	Unpierced	Clay
TA.91.E.61	E	IAI		4.9	Unpierced	Clay
TA.91.E.73	E	IAI		5.6	Unpierced	Clay
TA.91.E.170	E	IAI		3.8	Unpierced	Clay
TA.91.E.71	E	IAII		5	HP	Clay
TA.91.E.80	E	IAII		4.8	HP	Clay
TA.88.E.173	E	IAII	139	6.3	VP	Clay
TA.91.E.46	E	IAII		6.3	VP	Clay
TA.88.E.205	E	IAII	175	6.6	VP	Clay
TA.88.E.204	E	IAII	220	6.7	VP	Clay
TA.88.E.184	E	IAII		6.3	VP	Clay
TA.91.E.63	E	IAII		6.8	VP	Clay
TA.91.E.64	E	IAII		5.3	VP	Clay
TA.91.E.113a	E	IAII		4.4	VP	Clay
TA.91.E.72	E	IAII	91	3	Unpierced	Clay
TA.88.E.207	E	IAII	181	4	Unpierced	Clay
TA.88.E.142	E	IAII	189	3.9	Unpierced	Clay
TA.91.E.59	E	IAII	198	6.3	Unpierced	Clay
TA.88.E.140	E	IAII	202	4	Unpierced	Clay
TA.88.E.129	E	IAII	235	4.5	Unpierced	Clay
TA.91.E.62	E	IAII	265	5.1	Unpierced	Clay
TA.88.E.91	E	IAII		4.5	Unpierced	Clay
TA.88.E.133	E	IAII		5	Unpierced	Clay
TA.88.E.197	E	IAII		5	Unpierced	Clay

TA.88.E.198	E	IAII		4.8	Unpierced	Clay
TA.91.E.12	E	IAII		4	Unpierced	Clay
TA.92.E.14	E	IAII		4.4	Unpierced	Clay
TA.91.E.36	E	IAII		3.8	Unpierced	Clay
TA.91.E.101	E	IAII		3.7	Unpierced	Clay
TA.91.E.80	E	IAIII	137	5.3	VP	Clay
TA.91.E.41	E	IAIII	240	6.2	VP	Clay
TA.92.G.438	G	IAI	120	3.7	Unpierced	Clay
TA.92.G.433a	G	IAI	220	4.8	Unpierced	Clay
TA.92.G.419	G	IAI	225	4.4	Unpierced	Clay
TA.97.G.315	G	IAI	232	4.7	Unpierced	Clay
TA.92.G.429	G	IAI	249	4.5	Unpierced	Clay
TA.94.G.342	G	IAI	249	4.5	Unpierced	Clay
TA.94.g.369d	G	IAI	285	5.4	Unpierced	Clay
TA.92.G.224b	G	IAI	300	4.8	Unpierced	Clay
TA.92.G.429	G	IAI	480	6	Unpierced	Clay
TA.92.E.492	G	IAI		4.2	Unpierced	Clay
TA.92.G.490	G	IAI			Unpierced	Clay
TA.92.G.491	G	IAI		3.9	Unpierced	Clay
TA.92.G.431	G	IAI		4.9	Unpierced	Clay
TA.92.G.426	G	IAI		5.8	Unpierced	Clay
TA.92.G.433b	G	IAI			Unpierced	Clay
TA.92.G.433C	G	IAI			Unpierced	Clay
TA.92.G.433d	G	IAI			Unpierced	Clay
TA.92.G.433e	G	IAI			Unpierced	Clay
TA.92.G.433f	G	IAI			Unpierced	Clay
TA.92.G.435	G	IAI		4.3	Unpierced	Clay
TA.92.G.436	G	IAI		5.8	Unpierced	Clay
TA.92.G.437	G	IAI		4.8	Unpierced	Clay
TA.92.G.389	G	IAI		4.5	Unpierced	Clay
TA.92.G.198	G	IAI		4.5	Unpierced	Clay
TA.92.G.224a	G	IAI		4.5	Unpierced	Clay
TA.92.G.224c	G	IAI		4.7	Unpierced	Clay
TA.92.G.311	G	IAI		4.5	Unpierced	Clay
TA.92.G.333	G	IAI		4.5	Unpierced	Clay
TA.92.G.337	G	IAI		4	Unpierced	Clay
TA.92.G.347	G	IAI		5.2	Unpierced	Clay
TA.92.G.439	G	IAI			Unpierced	Clay
TA.89.G.327	G	IAII	115	5.2	HP	Clay
TA.89.G.315	G	IAII	170	5	HP	Clay
TA.92.G.508c	G	IAII		4.3	VP	Clay

TA.92.G.239	G	IAII		4.5	VP	Clay
TA.92.G.309	G	IAII	135	4.2	Unpierced	Clay
TA.92.G.320	G	IAII	150	3.5	Unpierced	Clay
TA.92.G.401	G	IAII	200	4	Unpierced	Clay
TA.96.G.94	G	IAII	207	4	Unpierced	Clay
TA.92.G.308	G	IAII	225	4.1	Unpierced	Clay
TA.92.G.305	G	IAII	235	4.2	Unpierced	Clay
TA.92.G.324	G	IAII	395	5.3	Unpierced	Clay
TA.92.G.268	G	IAII		4.3	Unpierced	Clay
TA.92.G.304a	G	IAII		4.3	Unpierced	Clay
TA.92.G.304b	G	IAII		4.2	Unpierced	Clay
TA.92.G.306	G	IAII		4.2	Unpierced	Clay
TA.92.G.314	G	IAII		4.4	Unpierced	Clay
TA.92.G.315	G	IAII		4.5	Unpierced	Clay
TA.92.G.317	G	IAII		4	Unpierced	Clay
TA.92.G.318	G	IAII			Unpierced	Clay
TA.92.G.321	G	IAII		5.2	Unpierced	Clay
TA.92.G.322	G	IAII		4.7	Unpierced	Clay
TA.92.G.323	G	IAII		4.8	Unpierced	Clay
TA.92.G.328	G	IAII		4.1	Unpierced	Clay
TA.92.G.162	G	IAII		4.3	Unpierced	Clay
TA.97.G.66	G	IAII/III	187	4.2	Unpierced	Clay
TA.92.G.470	G	IAIII	45	3.5	VP	Clay
TA.89.G.122	G	IAIII	100	6.5	VP	Clay
TA.89.G.306	G	IAIII		5.5	VP	Clay
TA.89.G.190	G	IAIII	0.8	5.5	VP	Clay
TA.92.G.463	G	IAIII	55	6.1	VP	Clay
TA.89.G.310	G	IAIII	100	6	VP	Clay
TA.89.G.337	G	IAIII	150	6	VP	Clay
TA.89.G.210	G	IAIII	260	7.5	VP	Clay
TA.89.G.293	G	IAIII		5.9	VP	Clay
TA.89.G.304	G	IAIII		4.5	VP	Clay
TA.89.G.305	G	IAIII		5.8	VP	Clay
TA.89.G.307	G	IAIII		7.2	VP	Clay
TA.89.G.317	G	IAIII		5	VP	Clay
TA.89.G.328	G	IAIII		5.4	VP	Clay
TA.89.G.330	G	IAIII		7	VP	Clay
TA.89.G.331	G	IAIII		5	VP	Clay
TA.89.G.332	G	IAIII		5.6	VP	Clay
TA.89.G.268	G	IAIII		6.9	VP	Clay
TA.92.G.474a	G	IAIII		6.1	VP	Clay

TA.92.G.456	G	IAIII		5.9	VP	Clay
TA.92.G.22	G	IAIII		6.1	VP	Clay
TA.92.G.36	G	IAIII		6	VP	Clay
TA.92.G.8	G	IAIII		5.6	VP	Clay
TA.89.G.248	G	IAIII		6.5	VP	Clay
TA.89.G.249	G	IAIII		6.5	VP	Clay
TA.96.G.479	G	IAIII	23.7	4	VP	Clay
TA.96.G.22	G	IAIII	31.4	3.4	VP	Clay
TA.92.G.463	G	IAIII	55	4.2	VP	Clay
TA.96.G.126	G	IAIII	75.6	4.3	VP	Clay
TA.97.G.82	G	IAIII	81	4.7	VP	Clay
TA.96.G.44	G	IAIII	89.9	4.3	VP	Clay
TA.96.G.125	G	IAIII	94	5.4	VP	Clay
TA.94.G.261	G	IAIII	116	5.7	VP	Clay
TA.96.G.72	G	IAIII	149	4.8	VP	Clay
TA.96.G.94	G	IAIII	168	5	VP	Clay
TA.89.G.210	G	IAIII	278	7.5	VP	Clay
TA.92.G.84	G	IAIII	65	5.4	VP	Clay
TA.92.G.70	G	IAIII	85	5.1	VP	Clay
TA.92.G.69	G	IAIII	125	5.7	VP	Clay
TA.89.G.329	G	IAIII		4.7	VP	Clay
TA.92.G.82	G	IAIII		5.9	VP	Clay
TA.92.G.105	G	IAIII		6.8	VP	Clay
TA.92.G.474b	G	IAIII		4.8	VP	Clay
TA.92.G.549	G	IAIII		5.4	VP	Clay
TA.96.G.263	G	IAIII	133	4.3	Unpierced	Clay
TA.92.G.456	G	IAIII	145	3.9	Unpierced	Clay
TA.89.G.218	G	IAIII	150	4	Unpierced	Clay
TA.89.G.284	G	IAIII	175	4	Unpierced	Clay
TA.89.G.202	G	IAIII	200	4.5	Unpierced	Clay
TA.89.G.209	G	IAIII	210	5	Unpierced	Clay
TA.89.G.224	G	IAIII	225	5	Unpierced	Clay
TA.92.G.480	G	IAIII	275	4.5	Unpierced	Clay
TA.92.G.479	G	IAIII	23.7	4	Unpierced	Clay
TA.89.G.285	G	IAIII		3.5	Unpierced	Clay
TA.89.G.303	G	IAIII		3.5	Unpierced	Clay
TA.92.G.481a	G	IAIII		5.5	Unpierced	Clay
TA.92.G.481b	G	IAIII		5	Unpierced	Clay
TA,92.G.481c	G	IAIII		4	Unpierced	Clay
TA.92.G.481d	G	IAIII		3.7	Unpierced	Clay
TA.89.G.219	G	IAIII		4.4	Unpierced	Clay

TA.92.G.307	G	IAIII		4.3	Unpierced	Clay
TA.92.G.105	G	IAIII		4.2	Unpierced	Clay
TA.89.G.203	G	IAIII		4.7	Unpierced	Clay
TA.89.G.204	G	IAIII		4.1	Unpierced	Clay
TA.G.89.363	G	IAIII		5.5	Unpierced	Clay
TA.89.G.364	G	IAIII		4.6	Unpierced	Clay
TA.89.G.365	G	IAIII		4.3	Unpierced	Clay
TA.92.L.215	L	IAII		4.6	VP	Clay
TA.92.L.187	L	IAII		3.1	VP	Clay
TA.92.L.161	L	IAII		4.5	VP	Clay
TA.92.L.214	L	IAII	205	4	Unpierced	Clay
TA.82.L.119	L	IAII	225	5	Unpierced	Clay
TA.92.L.139	L	IAII	260	5.5	Unpierced	Clay
T.92.L.116	L	IAII		3.6	Unpierced	Clay
TA.92.L.213	L	IAII		4.5	Unpierced	Clay
TA.92.L.310	L	IAII		4	Unpierced	Clay
TA.92.L.255	L	IAIII	86	5.2	VP	Clay
TA.92.L.140	L	IAIII	87	5	VP	Clay
TA.92.L.253	L	IAIII	107	5	VP	Clay
TA.92.L.254	L	IAIII	107	5.4	VP	Clay
TA.92.L.455	L	IAIII	248	6.6	VP	Clay
TA.92.L.54	L	IAIII	98	5.5	VP	Clay
TA.92.L.97	L	IAIII	152	5	VP	Clay
TA.92.L.102	L	IAIII		2.6	VP	Clay
TA.92.L.78	L	IAIII	13.9	4	Unpierced	Clay
TA.92.L.88	L	IAIII		5.5	Unpierced	Clay
TA.92.L.106	L	IAIII			Unpierced	Clay
TA.92.L.125	L	IAIII		4	Unpierced	Clay
TA.92.L.87	L	IAIII		3	VP	Stone
TA.96.O.79	O	IAIII	103	5.3	VP	Clay

Abbreviations: VP – "Vertically Pierced", HP – "Horizontally Pierced"

Appendix C: Textile related artifacts from Kuntillet ‘Ajrud
Sources: (Shamir 2012a; Sheffer and Tidhar 2012)

Table C.1: Loom weights from Kuntillet ‘Ajrud

Artifact Description	Mass (g)	Thickness (cm)	Material
Average of Excavated Weights (16)	250	8.5	Unbaked Clay
Illegally Excavated Weight 1	310	9	Unbaked Clay
Illegally Excavated Weight 2	260	8.25	Unbaked Clay
Illegally Excavated Weight 3	240	8	Unbaked Clay

Table C.2: Textile remains and impressions from Kuntillet ‘Ajrud

Number	Material	Thread Thickness	Warp Count	Weft Count
2	Linen	Coarse	28	10
3	Linen	Fine	21	16
4	Linen	Fine	15	10
5	Linen	Medium	8	8
6	Linen	Medium	13	7
7	Linen	Medium	40	11
8	Linen	Fine	19	19
9	Linen	Medium	22	10
10	Linen	Coarse	15	10
11	Linen	Fine	16	16
12	Linen	Medium	10	10
13	Linen	Coarse	11	11
14	Linen	Medium	10	10
15	Linen	Medium	16	16
16	Linen	Medium	10	10
17	Linen	Medium	20	12
18	Linen	Medium	17	7
19	Linen	Medium	18	11
30	Linen	Medium	15	7
31	Linen	Fine	12	12
32	Wool	Coarse	3	
33	Linen	Coarse	17	10
34	Linen	Fine	24	10
35	Wool	Medium	5	20
36	Wool	Fine	10	16
37	Linen	Fine	17	13
38	Linen	Fine	12	8
39	Linen	Fine	18	14

41	Wool	Fine	20	16
42	Linen	Medium	20	18
43	Linen	Medium	13	8
44	Linen	Medium	17	10
45	Linen	Coarse	16	10
46	Linen	Coarse	35	9
47	Linen	Fine	12	10
49	Linen	Medium	27	11
50	Linen	Medium	20	15
52	Linen	Coarse	20	10
53	Linen	Medium	15	9
61	Linen	Medium	11	8
62	Linen	Fine	16	13
63	Linen	Fine	20	17
64	Linen		11	8
65	Linen	Fine	14	11
66	Linen		12	12
67	Linen	Fine	20	14
68	Linen	Medium	22	11
69	Linen	Medium	14	9
70	Linen	Fine	22	11
71	Linen	Medium	20	11
72	Linen	Medium	11	8
73	Linen	Medium	20	10
74	Linen	Fine	32	17
75	Linen	Medium	22	11
76	Linen	Medium	12	11
77	Linen	Medium	11	7
80	Linen	Medium	24	10
82	Linen	Fine	18	14
83	Linen	Coarse	12	8
84	Linen	Medium	10	10
85	Linen	Coarse	10	6
86	Wool	Medium		
87	Linen	Fine	19	14
88	Linen	Fine		
89	Linen		15	8
90	Linen	Fine	18	14
91	Wool	Medium	5	16
93	Linen	Medium	12	12
94	Linen	Medium	15	11

96	Linen	Fine	15	13
99	Linen	Fine	15	15
100	Linen	Fine	28	18
101	Linen	Fine	18.3	14.4
102	Sha'atnez		18	12
103	Linen	Medium	15	15
104	Linen	Medium	21	10
105	Wool	Fine	12	18
106	Linen	Medium	13	9
107	Wool	Fine	12	28
108	Linen	Fine	16	15
109	Linen	Medium	14	8
110	Linen	Medium	14	8
111	Linen	Fine	14	
112	Linen	Medium	17	14
15 Second Fragment	Linen	Coarse	15	10
51a	Linen			
62 Second Fragment	Linen		20	10
67 Second Fragment	Linen		14	14
68 Second Fragment	Linen		14	10
70 Second Fragment	Linen		15	12
86 Second Fragment	Linen		18	14
95a	Wool	Medium	7	20
95b	Linen	Fine	16	12
98a	Sha'atnez	Medium	5	10
98b	Sha'atnez	Medium	8	8
Impression	Linen		20	20

Appendix D: Textile Related Artifacts from Kadesh Barnea
Sources: (Shamir 2007c)

Table D.1: Loom weights from Kadesh Barnea

Catalog Number	Registration Number	Stratum	Mass (g)	Thickness (cm)	Type	Material
1	1825	4b	24.5	4	VP	Unbaked Clay
2	1018	3c	68.7	3.8	VP	Unbaked Clay
3	8021/1	3,2	113.1	6.3	VP	Poorly Fired Clay
4	8021/2	3,2	110	6.2	VP	Poorly Fired Clay
5	8494	3,2	122.4	5.8	VP	Poorly Fired Clay
6	8494	3,2			VP	Poorly Fired Clay
7	38	3a	78.1	4.8	VP	Unbaked Clay
8	39	3a	72.1	5	VP	Unbaked Clay
9	754	2	39.6	4.1	VP	Poorly Fired Clay
16	9061	2, 1	52.2	4	VP	Chalk
17	2300/1	3,1			VP	Poorly Fired Clay
18	2300/2	3,1	94	5.6	VP	Unbaked Clay
19	2300/3	3,1	88.6	5.6	VP	Unbaked Clay
20	2285		131.5	6.1	VP	Unbaked Clay
21	1		272.7	9	VP	Unbaked Clay
22	2		152.1	6.8	VP	Unbaked Clay
23	3		155.3	7.8	VP	Unbaked Clay
24			126.3	6.2	VP	Poorly Fired Clay

Abbreviations: VP – "Vertically Pierced", HP – "Horizontally Pierced"

Table D.2: Textile remains and impressions from Kadesh Barnea

Artifact Number	Material	Weft Count	Warp Count
1	Linen	8	16
2	Linen	14	20
3	Linen	10	12
4	Linen	8	12
5	Linen	20	20
6	Linen	20	20
7	Linen	8	15
8	Linen		
9	Linen	16	24
10	Linen	8	13
11	Linen	13	21
12	Linen	9	13
13	Linen	20	24
14	Linen	9	14
15	Linen	14	20
16	Linen	17	24
17	Linen	7	14
18	Linen	11	18
19	Linen	16	20
20	Linen	8	16
21	Linen	9	13
22	Linen	7	18
23	Linen	7	14
24	Linen	16	22
25	Linen	14	24
26	Linen	8	16
27	Linen	13	28
28	Linen	8	20
29	Linen	13	24
30	Linen	14	26
31	Linen	20	20
32	Linen	7	30
33	Linen	10	15
34	Linen	18	18
35	Linen	9	14
36	Linen	4	18
37	Linen	13	30
38	Linen	16	26
39	Linen	14	21

40	Linen	18	18
41	Linen	15	26
42	Linen	8	13
43	Linen	14	26
44	Linen	15	25
45	Linen	13	26
46	Linen	14	26
47	Linen	16	20
48	Linen	14	20
49	Linen	18	18
50	Linen	20	28
51	Linen	10	12
52	Linen	4	16
53	Linen	8	14
54	Linen	20	20
55	Linen	8	16
56	Linen	14	26
Impression 1721	Wool	34	9
Negebite Ware	Wool	16	4
Negebite Ware	Wool	17	3
Negebite Ware	Wool	15	3
Negebite Ware	Wool	16	5
Negebite Ware	Wool	16	4
Negebite Ware	Wool	16	4

Appendix E: Loom Weights from the City of David Excavation
Source: (Shamir 1996)
Table E.1: Loom Weights from the City of David Excavation

Study ID	Area	Locus	Strata	Mass (g)	Thickness (cm)	Type	Material
1	D1	316	12	25.4	3.1	VP	Well Fired Clay
2	D1	395	12			VP	Unfired Clay
3	D1	453	12			Poor Preservation	Unfired Clay
4	D1	456	12		7.3	VP	Unfired Clay
5	D1	456	12		7.5	VP	Unfired Clay
6	D1	456	12			HP	Unfired Clay
7	D1	456	12		6.6	VP	Unfired Clay
8	D1	456	12	160.5	6	VP	Unfired Clay
9	D1	456	12	468	7	HP	Unfired Clay
10	D1	456	12			Poor Preservation	Unfired Clay
11	D1	456	12			Poor Preservation	Unfired Clay
12	D1	456	12			Poor Preservation	Unfired Clay
13	D1	456	12			Poor Preservation	Unfired Clay
14	D1	469	12			VP	Unfired Clay
15	D1	469	12	111.8	5.9	VP	Unfired Clay
16	D1	469	12		6.1	VP	Unfired Clay
17	D1	469	12		6.9	VP	Unfired Clay
18	D1	469	12	98.9	5.8	VP	Unfired Clay
19	D2	2309	12	115	5.5	VP	Unfired Clay
20	D2	2309	12	82		VP	Unfired Clay
21	D2	2337	12	6.4	2.6	VP	Chalk
22	E1	1249	11		4.6	VP	Unfired Clay
23	E1	1303	12		8.5	VP	Unfired Clay
24	E1	1322	12		5.1	VP	Unfired Clay
25	E1	1394	11			VP	Unfired Clay
26	E1	1621	10	127.3	5.7	VP	Poorly Fired Clay
27	E1	2015	12		7.6	VP	Well Fired Clay
28	E2	544	11			VP	Well Fired Clay
29	E3	1930A	10	12.9	3.5	VP	Well Fired Clay
30	E3	1944	10			Poor Preservation	Unfired Clay
31	G	784	10c-10b		5.7	VP	Unfired Clay
32	G	791	10b		6.3	VP	Well Fired Clay
33	G	792	10c-10b	161.4	5.6	VP	Unfired Clay
34	G	986	10c		5.5	VP	Unfired Clay

35	G	997	10B		4.5	VP	Unfired Clay
36	G	997	10b	93.7	5.4	VP	Unfired Clay
37	G	997	10B		7.3	VP	Unfired Clay
38	G	997	10B			Poor Preservation	Unfired Clay
39	G	997	10B		5.8	Unfinished	Unfired Clay
40	G	997	10B		6.4	VP	Unfired Clay
41	G	1108	10C	85.2	5.2	VP	Unfired Clay
42	G	1108	10C		4.9	VP	Unfired Clay
43	G	1108	10C			Poor Preservation	Unfired Clay
44	G	1108	10C		5	VP	Unfired Clay
45	G	1108	10C			Poor Preservation	Unfired Clay
46	G	1108	10C	62	4	VP	Unfired Clay
47	G	1108	10C		4.3	VP	Unfired Clay
48	G	1108	10C			Poor Preservation	Unfired Clay
49	G	1108	10C			VP	Unfired Clay
50	G	1108	10C			Poor Preservation	Unfired Clay
51	G	1108	10C			VP	Unfired Clay
52	G	1108	10C	82.5	5	VP	Unfired Clay
53	G	1108	10C			VP	Unfired Clay
54	G	1108	10C	58.9	5	VP	Unfired Clay
55	G	1108	10C			Poor Preservation	Unfired Clay
56	G	1108	10C	366.4	8.5	VP	Unfired Clay
57	G	1108	10C			VP	Unfired Clay
58	G	1108	10C			VP	Unfired Clay
59	G	1108	10C		9.3	VP	Unfired Clay
60	G	1108	10C			Poor Preservation	Unfired Clay
61	G	1108	10C			Poor Preservation	Unfired Clay
62	G	1108	10C			Poor Preservation	Unfired Clay
63	G	1108	10C			Poor Preservation	Unfired Clay
64	G	1108	10C	22.8	3.2	VP	Unfired Clay
65	G	1108	10C			Poor Preservation	Unfired Clay
66	G	1108	10C	724.9	9.1	VP	Unfired Clay
67	G	1108	10C			Poor Preservation	Unfired Clay
68	G	1108	10C	49.9	4.7	VP	Unfired Clay
69	G	1108	10C			Poor Preservation	Unfired Clay
70	G	1108	10C	56.8	5	VP	Unfired Clay
71	G	1108	10C		5.1	VP	Unfired Clay
72	G	1108	10C			VP	Unfired Clay
73	G	1108	10C	805	10	VP	Unfired Clay
74	G	1108	10C			Poor Preservation	Unfired Clay
75	G	1108	10C	408.8	8.5	VP	Unfired Clay

76	G	1108	10C		8.6	VP	Unfired Clay
77	G	1108	10C			VP	Unfired Clay
78	G	1108	10C			Poor Preservation	Unfired Clay
79	G	1108	10C			Poor Preservation	Unfired Clay
80	G	1108	10C			VP	Unfired Clay
81	G	1108	10C	82.9	5.3	VP	Unfired Clay
82	G	1108	10C			VP	Unfired Clay
83	G	1108	10C	50.8	4.7	VP	Unfired Clay
84	G	1108	10C	45.6	4.1	VP	Unfired Clay
85	G	1108	10C	96.2	5.4	VP	Unfired Clay
86	G	1108	10C	62	4.6	VP	Unfired Clay
87	G	1108	10C	367.9	7.8	VP	Unfired Clay
88	G	1108	10C	654.7	9.8	VP	Unfired Clay
89	G	1108	10C	546	9.4	VP	Unfired Clay
90	G	1108	10C			Poor Preservation	Unfired Clay
91	G	1108	10C		4.3	VP	Unfired Clay
92	G	1108	10C			Poor Preservation	Unfired Clay
93	G	1108	10C	77.9	5.3	VP	Unfired Clay
94	G	1108	10C			Poor Preservation	Unfired Clay
95	G	1108	10C			Poor Preservation	Unfired Clay
96	G	1108	10C			Poor Preservation	Unfired Clay
97	G	1108	10C			Poor Preservation	Unfired Clay
98	G	1108	10C		8	VP	Unfired Clay
99	G	1108	10C			VP	Unfired Clay
100	G	1108	10C	52.4	5	VP	Unfired Clay
101	G	1108	10C			Poor Preservation	Unfired Clay
102	G	1108	10C	47.5	4.8	VP	Unfired Clay
103	G	1108	10C		4.8	VP	Unfired Clay
104	G	1108	10C	72.6	5	VP	Unfired Clay
105	G	1108	10C	99.4	5.6	VP	Unfired Clay
106	G	1108	10C			VP	Unfired Clay
107	G	1108	10C			VP	Unfired Clay
108	G	1108	10C			VP	Unfired Clay
109	G	1108	10C			VP	Unfired Clay
110	G	1108	10C			VP	Unfired Clay
111	G	1108	10C		4.6	VP	Unfired Clay
112	G	1108	10C	68.4	5	VP	Unfired Clay
113	G	1108	10C		7.4	VP	Unfired Clay
114	G	1110	10C	70	5.2	VP	Unfired Clay
115	G	1110	10C	109		Unfinished	Unfired Clay
116	G	1110	10C	64.3		Unfinished	Unfired Clay

117	G	1110	10C	56	4.8	VP	Unfired Clay
118	G	1110	10C			VP	Unfired Clay
119	G	1110	10C	53		Unfinished	Unfired Clay
120	G	1110	10C	65.8		Unfinished	Unfired Clay
121	G	1110	10C	90.3		Unfinished	Unfired Clay
122	G	1110	10C	86.8		Unfinished	Unfired Clay
123	G	1110	10C	115		Unfinished	Unfired Clay
124	G	1110	10C		4.8	VP	Unfired Clay
125	G	1110	10C	107.5	5.9	VP	Unfired Clay
126	G	1110	10C	96		Unfinished	Unfired Clay
127	G	1110	10C	77.2		Unfinished	Unfired Clay
128	G	1110	10C	56	4.9	VP	Unfired Clay
129	G	1110	10C	61	5.2	VP	Unfired Clay
130	G	1110	10C	48.8	4.7	VP	Unfired Clay
131	G	1110	10C			Poor Preservation	Unfired Clay
132	G	1110	10C			Poor Preservation	Unfired Clay
133	G	1110	10C			Poor Preservation	Unfired Clay
134	G	1110	10C	377.8	7.5	VP	Unfired Clay
135	G	1110	10C			Poor Preservation	Unfired Clay
136	G	1110	10C			Poor Preservation	Unfired Clay
137	G	1110	10C		7.2	VP	Unfired Clay
138	G	1122B	12B		4.9	VP	Unfired Clay
139	G	1132	10C			VP	Unfired Clay
140	G	1132	10C			VP	Unfired Clay
141	G	1132	10C		7	VP	Unfired Clay
142	G	1132	10C			VP	Unfired Clay

Abbreviations: VP – "Vertically Pierced", HP – "Horizontally Pierced"

Appendix F: Loom Weights from Beth-Shean
Sources: (Shamir 2006)

Table F.1: Loom Weights from Beth-Shean

Artifact Number	Context	Mass (g)	Thickness (cm)	Material	Shape
106016	p-6	196.86	7.2	clay	VP
384140	s-1a		7.5	gypsum	HP
384192	s-1	196.24	4.7	gypsum	VP
384254	s-1	376.23	5.5	gypsum	HP
386050	P-7	447.23	7.8	clay	VP
386128	p-8A	257.86	8.5	clay	VP
386414	p-8A	115.49	5.9	clay	VP
887239	S-1	11.7	5.3	clay	VP
887355	S-1		5.3X6.4	clay	HP
888107	topsoil	303.41	4.3	gypsum	HP
987036	s-1a	390.63	5.2	gypsum	HP
988011	s-1b	248.93	5.4	gypsum	HP
228678/51	P-7 - Clustered Weights	304.07	7.9	clay	VP
286278/52	P-7 - Clustered Weights	148.9	6.6	clay	VP
286278/53	P-7 - Clustered Weights	56.66	5	clay	VP
286292/1	P-7 - Clustered Weights	134.91		clay	VP
286292/10	P-7 - Clustered Weights	142.46		clay	VP
286292/11	P-7 - Clustered Weights	311.67	7.7	clay	VP
286292/12	P-7 - Clustered Weights	268.3	7	clay	VP
286292/13	P-7 - Clustered Weights	349.77		clay	VP
286292/14	P-7 - Clustered Weights	303.8	7.6	clay	VP
286292/15	P-7 - Clustered Weights	451.35	8.8	clay	VP
286292/16	P-7 - Clustered Weights	285.42	7.7	clay	VP
286292/17	P-7 - Clustered Weights	280	7.5	clay	VP
286292/18	P-7 - Clustered Weights	237.75		clay	VP
286292/19	P-7 - Clustered Weights	255		clay	VP
286292/1a	P-7 - Clustered Weights	320.5		clay	VP
286292/1b	P-7 - Clustered Weights	381.8	7	clay	VP
286292/2	P-7 - Clustered Weights	375		clay	VP
286292/20	P-7 - Clustered Weights	141.96	6.8	clay	VP
286292/21	P-7 - Clustered Weights	510.7		clay	VP
286292/22	P-7 - Clustered Weights	280.86	7.9	clay	VP
286292/23	P-7 - Clustered Weights	366.86		clay	VP
286292/24	P-7 - Clustered Weights	355.55	7.3	clay	VP
286292/25	P-7 - Clustered Weights	336.76	7.6	clay	VP

286292/26	P-7 - Clustered Weights	302.63	7.7	clay	VP
286292/27	P-7 - Clustered Weights	260.41	6.8	clay	VP
286292/28	P-7 - Clustered Weights	397.54	8	clay	VP
286292/29	P-7 - Clustered Weights	271.24	7.7	clay	VP
286292/3	P-7 - Clustered Weights	195.85	7.2	clay	VP
286292/30	P-7 - Clustered Weights	263.97	8	clay	VP
286292/31	P-7 - Clustered Weights	330.4	7.4	clay	VP
286292/33	P-7 - Clustered Weights	153.74		clay	VP
286292/34	P-7 - Clustered Weights	156.23		clay	VP
286292/35	P-7 - Clustered Weights	178.1	6.8	clay	VP
286292/36	P-7 - Clustered Weights	200.47		clay	VP
286292/37	P-7 - Clustered Weights	378.92		clay	VP
286292/38	P-7 - Clustered Weights	380.3		clay	VP
286292/39	P-7 - Clustered Weights	359.41	7.5	clay	VP
286292/4	P-7 - Clustered Weights	295.85	7.5	clay	VP
286292/40	P-7 - Clustered Weights	347.21	8	clay	VP
286292/41	P-7 - Clustered Weights	215.05		clay	VP
286292/42	P-7 - Clustered Weights	265.96	7.7	clay	VP
286292/43	P-7 - Clustered Weights	260.39	7.4	clay	VP
286292/44	P-7 - Clustered Weights	170.25		clay	VP
286292/45	P-7 - Clustered Weights	552	8.8	clay	VP
286292/46	P-7 - Clustered Weights	260.67	7.1	clay	VP
286292/47	P-7 - Clustered Weights	412.48	8.4	clay	VP
286292/48	P-7 - Clustered Weights	296.71	7	clay	VP
286292/49	P-7 - Clustered Weights	342.66	7.9	clay	VP
286292/5	P-7 - Clustered Weights	423.14	8.8	clay	VP
286292/50	P-7 - Clustered Weights	411.58	8.1	clay	VP
286292/51	P-7 - Clustered Weights	154.59		clay	VP
286292/52	P-7 - Clustered Weights	244.19	6.7	clay	VP
286292/53	P-7 - Clustered Weights	281.65	7.5	clay	VP
286292/54	P-7 - Clustered Weights	256.56	7.2	clay	VP
286292/55	P-7 - Clustered Weights	355.95	8.9	clay	VP
286292/56	P-7 - Clustered Weights	341.07	7.7	clay	VP
286292/57	P-7 - Clustered Weights	444.85	8.7	clay	VP
286292/58	P-7 - Clustered Weights	336.81	8.1	clay	VP
286292/59	P-7 - Clustered Weights	223.07	6.9	clay	VP
286292/6	P-7 - Clustered Weights	264.85	7.5	clay	VP
286292/60	P-7 - Clustered Weights	173.63		clay	VP
286292/61	P-7 - Clustered Weights	206.18	6.8	clay	VP
286292/62	P-7 - Clustered Weights	185.19		clay	VP
286292/63	P-7 - Clustered Weights	285.08		clay	VP

286292/64	P-7 - Clustered Weights	187.27	6.6	clay	VP
286292/65	P-7 - Clustered Weights	147.73	6.4	clay	VP
286292/66	P-7 - Clustered Weights	240.27		clay	VP
286292/67	P-7 - Clustered Weights	165.84	6.6	clay	VP
286292/68	P-7 - Clustered Weights	80.44		clay	VP
286292/69	P-7 - Clustered Weights	175.88	6	clay	VP
286292/7	P-7 - Clustered Weights	215.99	6.8	clay	VP
286292/70	P-7 - Clustered Weights	286.86	8	clay	VP
286292/71	P-7 - Clustered Weights	336.62	7.6	clay	VP
286292/72	P-7 - Clustered Weights	300.15	7.1	clay	VP
286292/73	P-7 - Clustered Weights	60.6		clay	VP
286292/74	P-7 - Clustered Weights	201.13		clay	VP
286292/75	P-7 - Clustered Weights	288.65	7.3	clay	VP
286292/76	P-7 - Clustered Weights	156.61		clay	VP
286292/77	P-7 - Clustered Weights	219.73	6.3	clay	VP
286292/78	P-7 - Clustered Weights	208.02	6.8	clay	VP
286292/79	P-7 - Clustered Weights	143.73		clay	VP
286292/8	P-7 - Clustered Weights	411.29	9.1	clay	VP
286292/80	P-7 - Clustered Weights	273.55	7.6	clay	VP
286292/81	P-7 - Clustered Weights	245.65	7.5	clay	VP
286292/82	P-7 - Clustered Weights	271.81	7.2	clay	VP
286292/83	P-7 - Clustered Weights	131.42		clay	VP
286292/84	P-7 - Clustered Weights	199.38	6.7	clay	VP
286292/85	P-7 - Clustered Weights	57.93	5	clay	VP
286292/86	P-7 - Clustered Weights	334.13	8.5	clay	VP
286292/87	P-7 - Clustered Weights	308.47	8	clay	VP
286292/88	P-7 - Clustered Weights	231.24	7.1	clay	VP
286292/89	P-7 - Clustered Weights	219.79	7	clay	VP
286292/9	P-7 - Clustered Weights	229.5		clay	VP
286292/90	P-7 - Clustered Weights	223.46	6.6	clay	VP
286292/91	P-7 - Clustered Weights	482.15	9.6	clay	VP
286292/92	P-7 - Clustered Weights	159.17	6.1	clay	VP
286292/93	P-7 - Clustered Weights	43.28	4.6	clay	VP
286292/94	P-7 - Clustered Weights	312.32	7.7	clay	VP
286292/95	P-7 - Clustered Weights	298.89	6.9	clay	VP
286292/96	P-7 - Clustered Weights	450.75	9	clay	VP
286292/97	P-7 - Clustered Weights	358.69		clay	VP
286292/98	P-7 - Clustered Weights	354.33	8.1	clay	VP
286292/99	P-7 - Clustered Weights	311.92	7.5	clay	VP
28692/32	P-7 - Clustered Weights	287.54	7.4	clay	VP
2886278/50	P-7 - Clustered Weights	630.11	10.5	clay	VP

687006/1	s-1	382.35	5.9	gypsum	HP
687006/2	s-1	408.15	5.5	gypsum	HP
687006/3	s-1	385.11	4.2	gypsum	HP
687006/4	s-1	367.94	5.2	gypsum	HP
29-103-1071	s (UPenn)	44.9	4.4	Clay	VP
29-103-1067	s (UPenn)	81.1	5.9	Clay	VP
29-107-660	s (UPenn)	53.7	5	Basalt	VP
33-9-251	s (UPenn)	34.2	3.9	Basalt	VP
29-107-681	s (UPenn)	40.4	3.9	Basalt	VP
29-103-705	s (UPenn)	127.5	5.9	clay	VP
29-103-732	s (UPenn)	119.9	6.3	clay	VP
29-107-685	s (UPenn)	78.6	5.1	Basalt	VP
29-107-679	s (UPenn)	39.2	3.6	Basalt	VP
29-103-748	s (UPenn)	88.2	5.15	clay	VP
29-103-721	s (UPenn)	138	5.8	clay	VP
29-103-729	s (UPenn)	102.5	4.4	clay	VP
29-107-610	s (UPenn)	209	4.8	gypsum	HP
29-107-61	s (UPenn)	247	4.4	gypsum	HP
29-107-613	s (UPenn)	433	5.1	gypsum	HP
29-107-606	s (UPenn)	292	4.8	gypsum	HP
29-103-747A	s (UPenn)	161	6.1	Clay	VP
29-103-747B	s (UPenn)	156.2	5.9	Clay	VP
29-107-612	s (UPenn)	261	5.6	Clay	VP
29-107-672	s (UPenn)	1135	13.4	Basalt	VP
29-107-871	s (UPenn)	757	9.1	Basalt	VP
29-107-617	s (UPenn)	143.2	3.7	gypsum	HP
29-107-616	s (UPenn)	199.2	4.7	gypsum	HP
29-107-601	s (UPenn)	84.2	3.5	gypsum	HP
29-107-615	s (UPenn)	198.1	4.3	gypsum	HP
29-107-602	s (UPenn)	140.5	3.8	gypsum	HP
29-107-598	s (UPenn)	499	5.6	gypsum	HP
29-107-588	s (UPenn)	400	6.5	gypsum	HP
29-103-706	s (UPenn)	367	9.15	Clay	VP
29-103-315	s (UPenn)	108.3	5.3	Clay	VP
29-103-725	s (UPenn)	186.7	6.4	Clay	VP
29-103-718A	s (UPenn)	188.6	6.2	clay	HP
29-103-718b	s (UPenn)	186.5	6.15	clay	HP
29-103-742	s (UPenn)	52.7	4.3	clay	VP
29-103-744	s (UPenn)	138.4	5.5	clay	VP
29-103-738	s (UPenn)	92.1	4.5	clay	VP
29-107-662	s (UPenn)	474	8.9	Basalt	VP

29-103-736	s (UPenn)	143.6	5	clay	VP
29-103-74	s (UPenn)	91.4	5.5	clay	VP
29-103-743	s (UPenn)	108.3	5.05	clay	VP
29-107-608	s (UPenn)	139.2	6.05	gypsum	HP
29-103-711A	s (UPenn)	184	6.15	clay	HP
29-103-711B	s (UPenn)	225	7	Clay	HP
29-107-665	s (UPenn)	680	9.7	Basalt	VP
29-103-739	s (UPenn)	89.5	4.8	Clay	VP
29-103-750	s (UPenn)	105.2	5.2	clay	VP
29-103-710	s (UPenn)	285	6.1	gypsum	HP
29-103-722a	s (UPenn)	125	5.1	clay	VP
29-103-722b	s (UPenn)	53.9	4.2	clay	VP
29-103-722c	s (UPenn)	113.7	5.3	clay	VP
29-103-722d	s (UPenn)	118.2	5.6	clay	VP
29-103-722e	s (UPenn)	52.3	4.3	clay	VP
29-103-722f	s (UPenn)	136.7	5.6	clay	VP
29-103-722g	s (UPenn)	120.9	5.8	clay	VP
29-103-722h	s (UPenn)	109.2	5.4	clay	VP
29-107-674	s (UPenn)	1407	12	Basalt	VP
29-107-675	s (UPenn)	915	11.7	Basalt	VP
29-103-714	s (UPenn)	165	5	clay	HP
29-107-623	s (UPenn)	119.2	5.35	gypsum	HP
29-107-609	s (UPenn)	573	5.3	gypsum	HP
29-103-728	s (UPenn)	517	7.5	gypsum	HP
29-107-593	s (UPenn)	447	5.2	gypsum	HP
29-107-590	s (UPenn)	74.4	2.4	gypsum	HP
29-107-386	s (UPenn)	234	4.7	gypsum	HP
29-107-622	s (UPenn)	153	4.4	gypsum	HP
29-107-597	s (UPenn)	179.5	4.3	gypsum	HP
29-107-611	s (UPenn)	100	3.8	gypsum	HP
29-107-572	s (UPenn)	348	4.7	gypsum	HP
29-107-594	s (UPenn)	229	5.6	gypsum	HP
29-107-575	s (UPenn)	290	4.8	gypsum	HP
29-107-591	s (UPenn)	428	6.3	gypsum	HP
29-103-707	s (UPenn)	178.4	4.5	gypsum	HP
29-103-724A	s (UPenn)	123.3	5.3	clay	VP
29-103-724b	s (UPenn)	116	5.6	clay	VP
29-103-724c	s (UPenn)	117	5	clay	VP
29-103-724d	s (UPenn)	109.1	5.2	clay	VP
29-103-753a	s (UPenn)	54.4	4.3	clay	VP
29-103-753b	s (UPenn)	193.3	6.4	clay	VP

29-103-753c	s (UPenn)	131.9	5.05	clay	VP
29-103-753d	s (UPenn)	125	5.3	clay	VP
29-103-753e	s (UPenn)	61.2	4.25	clay	VP
29-103-753f	s (UPenn)	115.2	5.2	clay	VP
29-103-753g	s (UPenn)	50.5	3.9	clay	VP
29-103-753h	s (UPenn)	52.4	4.3	clay	VP
29-103-753i	s (UPenn)	49.7	4.3	clay	VP
29-103-753j	s (UPenn)	48.7	4.2	clay	VP
29-103-753k	s (UPenn)	115.3	4.8	clay	VP
29-103-753l	s (UPenn)	107.6	4.9	clay	VP
29-103-753m	s (UPenn)	113.7	5.35	clay	VP
29-103-753n	s (UPenn)	108.1	4.7	clay	VP
29-103-753o	s (UPenn)	52.7	4.1	clay	VP
29-103-753p	s (UPenn)	113.4	5.2	clay	VP
29-103-753q	s (UPenn)	108.5	5.2	clay	VP
29-103-753r	s (UPenn)	113.2	5.1	clay	VP
29-103-753s	s (UPenn)	224	6.05	clay	VP
29-103-753t	s (UPenn)	118.3	5.2	clay	VP
29-103-753u	s (UPenn)	93.3	5.2	clay	VP
29-103-753v	s (UPenn)	118.3	5.55	clay	VP
29-103-753w	s (UPenn)	130.8	5.5	clay	VP
29-103-753u1	s (UPenn)	42.6	4.1	clay	VP
29-103-753x	s (UPenn)	52.1	4.2	clay	VP
29-103-753y	s (UPenn)	69.5	4.7	clay	VP
29-103-753z	s (UPenn)	127.6	5.4	clay	VP
29-103-753a1	s (UPenn)	126.1	5.3	clay	VP
29-103-753b1	s (UPenn)	54.3	4.3	clay	VP
29-103-753c1	s (UPenn)	124.5	5.2	clay	VP
29-103-753d1	s (UPenn)	47.2	4.6	clay	VP
29-103-753e1	s (UPenn)	114.8	5	clay	VP
29-103-753f1	s (UPenn)	97	5.1	clay	VP
29-103-753g1	s (UPenn)	104.8	4.7	clay	VP
29-103-753h1	s (UPenn)	50.6	4.5	clay	VP
29-103-753i1	s (UPenn)	107	5.4	clay	VP
29-103-753j1	s (UPenn)	120.1	5.2	clay	VP
29-103-753k1	s (UPenn)	120.9	5	clay	VP
30-11-51	s (Rockefeller Museum)			Clay	VP
30-12-101a	s (Rockefeller Museum)			Stone	HP

Abbreviations: VP – "Vertically Pierced", HP – "Horizontally Pierced"

Appendix G: Loom Weights from Ashkelon
Source: (Master 2011)

Table G.1: Loom weights from Ashkelon

Find Number	Room	Mass (g)	Thickness (cm)	Percent Complete	Type	Material
39061	221	160	5.3	95	VP	Clay
39062	221	180	5.6	100	VP	Clay
39063	221	395	6.8	100	VP	Clay
39064	221	400	7.6	100	VP	Clay
39065	221	490	7.1	100	VP	Clay
39066	221	450	11.5	95	VP	Clay
32926	312	231	6.5	100	VP	Clay
41046	312	245	5.8	100	VP	Clay
43911	312	997	9.5	100	VP	Clay
43912	312	253		35	VP	Clay
43913	312	690	7.7	100	VP	Clay
43914	312	252	6.5	85	VP	Clay
43915	312	316		35	VP	Clay
43916	312	871	9	100	VP	Clay
43917	312	112	4.7	100	VP	Clay
43918	312	311	6	100	VP	Clay
43919	312	264	7	25	VP	Clay
43920	312	711	9	90	VP	Clay
43921	312	145		30	VP	Clay
44219	312	182		7 Fragments	VP	Clay
44266	312	975	9.7	100	VP	Clay
44339	312	295	6.2	100	VP	Clay
44452	312	328	6.9	95	VP	Clay
44453	312	233	6	85	VP	Clay
44454	312	879	9.5	100	VP	Clay
44455	312	245	5.9	100	VP	Clay
44456	312	245	6	100	VP	Clay
44457	312	272		Fragmentary	VP	Clay
44458	312	340		85	VP	Clay
44459	312	353	7.1	100	VP	Clay
44460	312	193		35	VP	Clay
44461	312	278	6.3	100	VP	Clay
44462	312	435		Fragmentary	VP	Clay
44596	312	301	7	95	VP	Clay
44597	312	312	6.6	100	VP	Clay
44598	312	363	6.8	100	VP	Clay
44599	312	384	7.2	100	VP	Clay

44600	312	536	9.8	60	VP	Clay
44601	312	627	8.4	90	VP	Clay
44602	312	357	7.3	90	VP	Clay
44603	312	859	9	100	VP	Clay
44604	312	317	6.9	100	VP	Clay
44605	312	333	6.4	100	VP	Clay
44606	312	604	8	100	VP	Clay
45457	312	895	9.8	100	VP	Clay
38423	342	100		Fragmentary	VP	Clay
42770	342			Fragmentary	VP	Clay
43173	342			Fragmentary	VP	Clay
43617	342	140	5.1	100	VP	Clay
43714	342	140	5.1	100	VP	Clay
43720	342	150	5.3	90	VP	Clay
43724	342			Fragmentary	VP	Clay
43725	342			Fragmentary	VP	Clay
43735	342			Fragmentary	VP	Clay
43736	342	110	5.1	100	VP	Clay
41027	460	600	8.5	60	VP	Clay
41028	460	220	6.6	80	VP	Clay
41029	460	300	6.5	100	VP	Clay
42638	460	260	6.3	100	VP	Clay

Abbreviations: VP – "Vertically Pierced", HP – "Horizontally Pierced"

Appendix H: Loom Weights from Tell es-Safi/Gath
Source: (Cassuto 2012)
Table H.1: Loom weights from Tell es-Safi

Study Number	Locus	Mass (g)	Thickness (cm)	Shape	Material	Condition
1	74715>74706	566	8.234	VP	Clay	whole
2	11010			VP	Clay	frag
3	22001		6.045	VP	Clay	frag
4	22004			VP	Clay	frag
5	22007			VP	Clay	frag
6	23023			VP	Clay	crumbly burnt frag
7	23027		8.208	VP	Clay	Partial
8	23027			VP	Clay	frag
9	22043			VP	Clay	small frag
10	22028			VP	Clay	burnt frag
11	33023			VP	Clay	frag
12	42028	364	7.7855	VP	Clay	large frag
13	43013	373	7.827	VP	Clay	whole
14	33030	149	5.46	VP	Clay	whole
15	33033	179	6.762	VP	Clay	partial
16	33030	373	7.498	VP	Clay	almost whole
17	44021	324	7.7378	VP	Clay	almost whole
18	44033	170	5.87	VP	Clay	almost whole
19	33030	163	6.016	VP	Clay	two pieces-partial
20	45019			VP	Clay	Frag
21	45027	151	5.781	VP	Clay	almost whole
22	45026	350	6.861	VP	Clay	frag
23	22042>22036	340		VP	Clay	frag
24	62017			VP	Clay	frag
25	72032	606	8.917	VP	Clay	whole
26	74715>74706			VP	Clay	Partial
27	74715>74706			VP	Clay	Fragments
28	74715>74706	405	7.898	VP	Clay	whole
29	44021	208	6.177	VP	Clay	whole
30	33030	181	6.077	VP	Clay	almost whole
31	33030	159	5.848	VP	Clay	whole
32	33030	197	6.068	VP	Clay	whole
33	33030	178		VP	Clay	5 broken frag
34	33030	131	5.869	VP	Clay	frag
35	33030	146	5.78	VP	Clay	frag

36	33030	182	6.207	VP	Clay	two frag
37	33030	202	6.111	VP	Clay	almost whole
38	33030	168	5.819	VP	Clay	whole
39	44021	304	7.699	VP	Clay	partial
40	44021	431	7.655	VP	Clay	whole
41	44021	130		VP	Clay	frag
42	44021	220	6.368	VP	Clay	whole
43	44021	232	6.246	VP	Clay	whole
44	44021	190	5.946	VP	Clay	Whole
45	44021	169		VP	Clay	frags
46	44021	230	6.232	VP	Clay	whole
47	44021	213	6.219	VP	Clay	whole
48	44021	185	5.9445	VP	Clay	whole
49	44021	188	5.8635	VP	Clay	whole
50	44021	189	5.804	VP	Clay	whole
51	44021	184	5.844	VP	Clay	whole
52	44021	149	5.857	VP	Clay	partial
53	44021	100		VP	Clay	frag
54	44020	202	5.911	VP	Clay	intact
55	44020			VP	Clay	frag
56	44020	196	6.131	VP	Clay	Intact
57	44020	263	6.76	VP	Clay	intact
58	44020	194	6.062	VP	Clay	intact
59	44020	170	5.906	VP	Clay	intact
60	44020	211	6.369	VP	Clay	complete
61	44020	147	6.079	VP	Clay	partial
62	44020	115	5.862	VP	Clay	half
63	44020	119		VP	Clay	partial
64	44021	156	6.02	VP	Clay	partial
65	44027	392	7.995	VP	Clay	whole
66	44027	377	7.867	VP	Clay	partial
67	44027	195	6.065	VP	Clay	whole
68	44027	179	5.9765	VP	Clay	whole
69	44027	157	6	VP	Clay	whole
70	44027	216	6.533	VP	Clay	whole
71	44027	189	5.8	VP	Clay	partial
72	44027	145	5.752	VP	Clay	partial
73	44027			VP	Clay	frag
74	44027			VP	Clay	frag
75	44027			VP	Clay	frag
76	44027	164	5.548	VP	Clay	Whole

77	44027	215	6.001	VP	Clay	Whole
78	44027	172	5.5895	VP	Clay	Whole
79	45030			VP	Clay	frag
80	45030	144	7.261	VP	Clay	half
81	45030	251	6.813	VP	Clay	almost whole
82	45030	322	7.133	VP	Clay	whole
83	45030			VP	Clay	frag
84	22042>22036	529		VP	Clay	very frag
85	22042>22036	432		VP	Clay	frags
86	22042>22036	506?		VP	Clay	frag
87	22042>22036	557		VP	Clay	frag
88	22042>22036	249		VP	Clay	frag
89	22042>22036	162		VP	Clay	frags
90	74715>74706	802	9.25	VP	Clay	complete, perfectly round
91	74715>74706			VP	Clay	crumbly frag
92	74715>74706	267		VP	Clay	Partial
93	74715>74706	265	6.545	VP	Clay	almost whole
94	74715>74706	250	6.77	VP	Clay	partial
95	74715>74706			VP	Clay	frag
96	74715>74706	356	8.04	VP	Clay	almost whole
97	74715>74706	780	9.12	VP	Clay	complete, perfectly round
98	74715>74706	270	7.37	VP	Clay	almost whole
99	74715>74706	286	7.48	VP	Clay	partial
100	74715>74706	276	6.73	VP	Clay	partial
101	74715>74706	400	8.14	VP	Clay	intact
102	74715>74706	428	8.0523	VP	Clay	intact
103	74715>74706	313	7.27	VP	Clay	partial
104	74715>74706	239	6.76	VP	Clay	partial
105	74715>74706	437	7.56	VP	Clay	almost whole
106	74715>74706	139	6.625	VP	Clay	frag
107	74715>74706	415	7.5285	VP	Clay	intact
108	74715>74706	249	6.78	VP	Clay	intact
109	74715>74706	783	9.36	VP	Clay	intact
110	74715>74706	328	7.35	VP	Clay	intact
111	74715>74706	305	6.71	VP	Clay	intact
112	74715>74706	387	7.462	VP	Clay	almost whole
113	74715>74706	403	7.507	VP	Clay	almost whole
114	74715>74706			VP	Clay	frag
115	74715>74706	263	6.539	VP	Clay	almost whole
116	74715>74706	301	7.107	VP	Clay	Partial

Abbreviations: VP – "Vertically Pierced", HP – "Horizontally Pierced"

Appendix I: Loom Weights from Tel Batash/Timnah
Sources: (Browning 1988, 2001)
Table I.1: Loom weights from Tel Batash

Registration Number	Locus	Building	Strata	Mass (g)	Thickness (cm)	Type	Material
D7053	D708		IV			Unidentified	Clay
D7063	D708		IV			Unidentified	Clay
D7072	D708		IV			Unidentified	Clay
D8106	D812		IVA			Unidentified	Clay
D8152	D819		IVB			Unidentified	Clay
D8163	D821		IVB			Unidentified	Clay
7385	768		IV		7.6	VP	Clay
D10207	D1048		III			Unidentified	Clay
D8024	D802		III			Unidentified	Clay
D8034	D802		III			Unidentified	Clay
D8052	D802		III			Unidentified	Clay
7084/1	731		III-II		6.3	VP	Clay
7084/2	731		III-II		12	VP	Clay
7332	750	737	III			Unidentified	Clay
7519	743	743	II			VP	Clay
7520	743	743	II			HP	Clay
7133/3	743	743	II		8	VP	Clay
7133/2	743	743	II		6.3	VP	Clay
7162	743	743	II		6.6	VP	Clay
7162/2	743	743	II			VP	Clay
7514/1	743	743	II		8.2	VP	Clay
7514/2	743	743	II		7.6	HP	Clay
7514/3	743	743	II		8.6	VP	Clay
7514/4	743	743	II		8.2	VP	Clay
7514/5	743	743	II		8.2	VP	Clay
7514/6	743	743	II		8	VP	Clay
7514/7	743	743	II		8	VP	Clay
7514/8	743	743	II		9.4	VP	Clay
7514/9	743	743	II		8.5	Unclassified	Stone
7514/10	743	743	II			VP	Clay
7514/11	743	743	II			VP	Clay
7514/12	743	743	II			VP	Clay
7514/13	743	743	II			VP	Clay
7514/14	743	743	II		7.5	VP	Clay
7514/15	743	743	II		7	VP	Clay
7514/16	743	743	II		7.5	VP	Clay

7514/17	743	743	II		7.2	VP	Clay
7514/18	743	743	II		8	HP	Clay
7514/19	743	743	II		5.4	VP	Clay
7514/20	743	743	II		9.2	VP	Clay
7514/21	743	743	II		7.6	VP	Clay
7514/22	743	743	II		7.5	VP	Clay
7535	743	743	II			VP	Clay
7535/1	743	743	II			VP	Clay
7535/2	743	743	II		7.3	VP	Clay
7535/3	743	743	II			VP	Clay
7535/4	743	743	II			VP	Clay
7535/5	743	743	II		7.4	VP	Clay
7535/6	743	743	II		7.4	VP	Clay
7622	743	743	II		5.9	VP	Clay
7507	743	743	II		7.7	VP	Clay
7512	743	743	II			Unidentified	Clay
7501	743	743	II			Unidentified	Clay
7504	743	743	II		5.5	VP	Clay
7590/1	778	743	II			VP	Clay
7590/2	778	743	II			VP	Clay
7590/3	778	743	II			Unidentified	Clay
7556/1	779	743	II			Unidentified	Clay
7556/2	779	743	II			Unidentified	Clay
7556	779	743	II		9.4	VP	Clay
F6088	F604	F607	II		8.7	VP	Clay
F6074	F605	F607	II		9.7	VP	Clay
F6012	F607	F607	II	342.4	7.6	VP	Clay
F6025	F607	F607	II	268	7.6	VP	Clay
F6043	F607	F607	II	333.5	8	VP	Clay
F6045	F607	F607	II	451.4	8.1	VP	Clay
F6049	F607	F607	II	306	8.1	VP	Clay
F6060	F607	F607	II	409.2	8.2	VP	Clay
F6070	F607	F607	II	848	10.3	VP	Clay
F6071	F607	F607	II	824	9.9	VP	Clay
F6078	F607	F607	II	772	10.7	VP	Clay
F6080	F607	F607	II	906	10.8	VP	Clay
F6081/1	F607	F607	II		7.2	VP	Clay
F6081/2	F607	F607	II	296	7.4	VP	Clay
F6086	F607	F607	II	494	8.6	VP	Clay
F6095	F607	F607	II	832	10	VP	Clay
F6096	F607	F607	II	850	9.8	VP	Clay

F6097	F607	F607	II	776	10.2	VP	Clay
F6098	F607	F607	II	806	10.3	VP	Clay
F6104	F607	F607	II	422	7.6	HP	Clay
F6105	F607	F607	II	359.7	9.9	VP	Clay
F6131	F607	F607	II	347.4	8.2	VP	Clay
F6131/2	F607	F607	II	252	7.1	HP	Clay
F6144/1	F607	F607	II	766	10.1	VP	Clay
F6144/2	F607	F607	II	658	9.3	VP	Clay
F6144/3	F607	F607	II			VP	Clay
F6144/4	F607	F607	II	726	9.8	VP	Clay
F6161	F607	F607	II		6.4	HP	Clay
F6172	F607	F607	II	483.6	8.6	VP	Clay
F6187	F607	F607	II	816	10.5	VP	Clay
F6187/1	F607	F607	II		8.9	VP	Clay
F6194/1	F607	F607	II	468	8.3	HP	Clay
F6194/2	F607	F607	II	465.7	8.5	VP	Clay
F6207	F607	F607	II	640	11.1	VP	Clay
F6223	F607	F607	II	868	10.5	VP	Clay
F9009	F607	F607	II	456	8.7	VP	Clay
F9017	F607	F607	II	342		HP	Clay
F9024	F607	F607	II	154	6.3	VP	Clay
F9025	F607	F607	II	406	8.7	VP	Clay
F6047	F607	F607	II			Unidentified	Clay
F6048	F607	F607	II			Unidentified	Clay
F6904	F607	F607	II			Unidentified	Clay
F6044	F612	F607	II	750	9.7	VP	Clay
F6157	F621	F607	II	280	6.3	HP	Clay
F9019/1	F904	F607	II	232		HP	Clay
F9019/2	F904	F607	II			HP	Clay
F9023/1	F904	F607	II	484	8.4	VP	Clay
F9078	F915	F607	II	290	4.1	VP	Clay
F9057	F916	F607	II	312	8.2	VP	Clay
F9067	F916	F607	II		9.8	VP	Clay
F9082/1	F916	F607	II		8.2	VP	Clay
F9082/2	F916	F607	II		10	Unclassified	Clay
F9088	F916	F607	II			Unidentified	Clay
F6103	F603	F608	II	536	7.2	Unclassified	Clay
F6127	F603	F608	II	184	7.1	VP	Clay
F6220	F603	F608	II	416.8	8.2	VP	Clay
F6211	F603	F608	II			Unidentified	Clay
F6055	F606	F608	II	291.3	7.2	VP	Clay

F6138	F606	F608	II			VP	Clay
F6014	F608	F608	II	498	8.2	HP	Clay
F6033	F608	F608	II	442.1	9	VP	Clay
F6034	F608	F608	II	414.4	9.6	VP	Clay
F6035	F608	F608	II		6.8	VP	Clay
F6148	F608	F608	II	424	9.2	VP	Clay
F6322	F608	F608	II	598	10.2	VP	Clay
F6327	F608	F608	II	114	6.4	VP	Clay
F6416	F608	F608	II	280	7.4	VP	Clay
F6054	F608	F608	II			Unidentified	Clay
F7011	F608	F608	II			Unidentified	Clay
F7016	F608	F608	II			Unidentified	Clay
F6261/1	F632	F608	II	489	9.4	VP	Clay
F6261/2	F632	F608	II	640	9.4	VP	Clay
F6261/3	F632	F608	II	636	9.9	VP	Clay
F6261/4	F632	F608	II	601	9.7	VP	Clay
F6261/5	F632	F608	II	750	10.4	VP	Clay
F6261/6	F632	F608	II	576	10.2	VP	Clay
F6261/7	F632	F608	II	752	10	VP	Clay
F6261/8	F632	F608	II	500	9.5	VP	Clay
F6270/1	F632	F608	II	640	9.4	VP	Clay
F6270/2	F632	F608	II	569	9.5	VP	Clay
F6270/3	F632	F608	II	670	10	VP	Clay
F6270/4	F632	F608	II	636	9.5	VP	Clay
F6270/5	F632	F608	II	850	11.2	VP	Clay
F6270/6	F632	F608	II	738	10	VP	Clay
F6270/7	F632	F608	II	664	11.3	VP	Clay
F6270/8	F632	F608	II	540.7	9.6	VP	Clay
F6270/9	F632	F608	II	410.3	9.8	VP	Clay
F6270/10	F632	F608	II	698	8.6	HP	Clay
F6270/11	F632	F608	II	380.3	7.9	HP	Clay
F6270/12	F632	F608	II		10.4	VP	Clay
F6272/1	F632	F608	II		8.1	HP	Clay
F6272/2	F632	F608	II		9.7	VP	Clay
F6272/3	F632	F608	II	507	9.3	VP	Clay
F6272/4	F632	F608	II	581.1	8.7	VP	Clay
F6272/5	F632	F608	II	630	10.1	VP	Clay
F6272/6	F632	F608	II	580.8	9.4	VP	Clay
F6272/7	F632	F608	II	490.6	9.6	VP	Clay
F6272/8	F632	F608	II			VP	Clay
F6272/1	F632	F608	II		10.5	VP	Clay

F6272/2	F632	F608	II		10.1	VP	Clay
F6288	F632	F608	II		10.6	VP	Clay
F6289	F632	F608	II			Unidentified	Clay
F6393	F632	F608	II	550	9	VP	Clay
F6298/1	F632	F608	II		8.7	HP	Clay
F6298/2	F632	F608	II	398	8.6	VP	Clay
F6298/3	F632	F608	II	616	10	VP	Clay
F6298	F632	F608	II	316	6.9	HP	Clay
F6310/1	F632	F608	II	595	9.3	HP	Clay
F6310/2	F632	F608	II		8.7	VP	Clay
F6310/3	F632	F608	II		9.5	VP	Clay
F6310/4	F632	F608	II		9.1	VP	Clay
F6370	F632	F608	II		7.1	VP	Clay
F6372/1	F632	F608	II		9.6	VP	Clay
F6372/2	F632	F608	II			VP	Clay
F6372/3	F632	F608	II			VP	Clay
F6387	F632	F608	II	746	9.9	VP	Clay
F6392	F632	F608	II	111.4	5.8	VP	Clay
F6390	F632	F608	II			Unidentified	Clay
F6404	F632	F608	II	522.5	8.8	HP	Stone
F9059/1	F917		II		7.1	VP	Clay
F9059/2	F917		II		6.7	VP	Clay
F6059/3	F917		II		8.4	HP	Clay
F6312	F630		I		8.1	VP	Clay
F6203	F620		I			VP	Clay
9772	E619		IIIB			Unidentified	Clay
E7063	E619		IIIB			Unidentified	Clay
9579	987		III		10.5	VP	Clay
9590	987		III			Unidentified	Clay
9133/11	915	915	II		7.5	VP	Clay
9179/1	915	915	II		9.5	VP	Clay
9156/1	920	950	II			HP	Clay
9118/1	920	950	II			VP	Clay
9118/3	920	950	II			VP	Clay
9118/5	920	950	II		9.2	HP	Clay
9118/6	920	950	II		9.1	VP	Clay
9118/7	920	950	II			HP	Clay
9118/9	920	950	II			Unidentified	Clay
9118/10	920	950	II			VP	Clay
9118/11	920	950	II		10.1	VP	Clay
9118/12	920	950	II		7.9	VP	Clay

9118/13	920	950	II		9.1	VP	Clay
9118/15	920	950	II			Unidentified	Clay
9121/1	920	950	II		7	HP	Clay
9121/2	920	950	II		6.8	VP	Clay
9130	920	950	II			HP	Clay
9137/1	920	950	II		9.6	VP	Clay
9137/2	920	950	II		9.5	VP	Clay
9137/3	920	950	II		7.8	HP	Clay
9137/4	920	950	II			VP	Clay
9137/5	920	950	II		7.5	HP	Clay
9137/6	920	950	II		10.7	VP	Clay
9137/7	920	950	II		6.9	HP	Clay
9137/8	920	950	II		10.3	VP	Clay
9137/11	920	950	II		7.5	VP	Clay
9137/12	920	950	II			VP	Clay
9138/6	920	950	II		9.4	VP	Clay
9138/11	920	950	II		7.7	Unclassified	Clay
9175/2	920	950	II		10.5	VP	Clay
9181/1	920	950	II		7.2	HP	Clay
9181/2	920	950	II			HP	Clay
9181/3	920	950	II		7	HP	Clay
9294	946	950	II	595.8	9.2	VP	Clay
9249/1	947	950	II	708	8.9	HP	Clay
9249/2	947	950	II		6	HP	Clay
9249/3	947	950	II		8.7	HP	Clay
9249/4	947	950	II		5.9	HP	Clay
9249/5	947	950	II		5.5	HP	Clay
9429/6	947	950	II		4.9	HP	Clay
9249/7	947	950	II		5.4	HP	Clay
9249/8	947	950	II		5.7	HP	Clay
9249/9	947	950	II		5.6	HP	Clay
9249/10	947	950	II	147.7	6.6	VP	Clay
9249/11	947	950	II	177.6	7.5	VP	Clay
9249/12	947	950	II	162	7.2	HP	Clay
9249/13	947	950	II	201.5	7.8	Unidentified	Clay
9249/14	947	950	II	754	8.9	HP	Clay
9249/15	947	950	II	237.6	5.4	HP	Clay
9249/16	947	950	II	198.1	5.6	HP	Clay
9290/1	947	950	II	416.1	7	HP	Clay
9290/2	947	950	II	260.1	5.8	HP	Clay
9290/3	947	950	II	244.1	5.4	HP	Clay

9290/4	947	950	II	196.6	5.5	HP	Clay
9290/5	947	950	II	247.5	5.6	HP	Clay
9290/6	947	950	II	165.5	7.1	VP	Clay
9305/1	947	950	II	233.5	5.6	HP	Clay
9305/2	947	950	II	242	7	VP	Clay
9305/3	947	950	II	178.3	7	VP	Clay
9305/4	947	950	II			Unidentified	Clay
9363	957	950	II	351.6	7.9	HP	Clay
9370	960	950	II	249.6	8.8	VP	Clay
9577/2	958	950	II			HP	Clay
9104/1	916		I-II		6.8	HP	Clay
9104/3	916		I-II		6.5	HP	Clay
9104/4	916		I-II		7.3	HP	Clay
9104/5	916		I-II		7.9	HP	Clay
9104/6	916		I-II			HP	Clay
9085	916		I-II			Unidentified	Clay
9086	916		I-II			Unidentified	Clay
9227	944		I-II			Unidentified	Clay
9029	903		I			VP	Clay
9554/1					8.3	Unclassified	Stone
9554/2						Unclassified	Stone
H9025	H905		III?			Unidentified	Clay
H9110	H922		IIIA		6	VP	Clay
H8524	H850		II			Unidentified	Clay
H9202	H961		II			Unidentified	Clay
H10225	H1007	H959	II			Unidentified	Clay
H10407	H1065		II			Unidentified	Clay
H9024	H907		I			Unidentified	Clay
H9154	H942		I			Unclassified	Stone
H10287	H901		I			Unidentified	Clay
G6020	G606		II			Unidentified	Clay

Abbreviations: VP – “Vertically Pierced”, HP – “Horizontally Pierced”

Appendix J: Textile-related Artifacts from Khirbat al-Mudayna
Source: (Boertien 2013)

Table J.1: Loom weight clusters from Khirbat al-Mudayna

Cluster	Context	Average Thickness (cm)	Average Mass (g)	Number of Weights	Shapes	Material
Group 1	A30:67	6.9	231	33	VP	Unbaked Clay
Group 1	A30:67	7.1	240	14	VP	Unbaked Clay
Group 1	A30:65	7.7	283	4	VP	Unbaked Clay
Group 1	A20:3	7	Unpublished	4	VP	Unbaked Clay
Group 2	Room 206	8.1	266	22	VP	Unbaked Clay
Group 3	Room 206	8	353	17	VP	Unbaked Clay
Group 3	Room 206	8.3	1045	1	HP	Unbaked Clay
Group 4	Room 211	7.5	165	30	VP	Unbaked Clay
Group 4	Room 211	6.8	236	2	VP	Unbaked Clay
Group 4	Room 211	6.2	188	3	Mixed	Unbaked Clay
Group 4	Room 211	Unpublished		4	Unidentified	Unbaked Clay
Group 5	Building 210	Unpublished		22	VP	Unbaked Clay
Gate Area		4.15	250	7	VP	Unbaked Clay

Abbreviations: VP – "Vertically Pierced", HP – "Horizontally Pierced"

Table J.2: Textile remains from Khirbat al-Mudayna

Find Number	Description	Material	Warp Thread Count	Weft Thread Count	Thread Thickness
MT1265	Two fragments of carbonized cloth	Wool	16	12	.41-.52mm
MT1085	Jar stopper with cloth impression	Unidentified	10	8	.5mm
MT2490	Jar stopper with cloth impression	Unidentified			1.0mm
MT937	Impression of fabric on organic material	Unidentified	14	18	.25mm

Appendix K: Loom Weights from Tell Mazar
Sources: (Boertien 2012, 2013)

Table K.1: Loom weights from Tell Mazar

Group	Context	Stratum	Average Thickness (cm)	Average Mass (g)	Number of Weights	Shapes	Material
Group 1	Room 503	V	5.5	132	56	VP	Unbaked Clay
Group 2	Room 318	III	7.4	638	26	VP	Unbaked Clay
Group 3	GE8:14	III	6.8	335	21	3 HP 18 VP	Unbaked Clay
Group 4	GE8:14	III	7.6	387	27	1 HP 26 VP	Unbaked Clay
Group 5	Room 312	III	5.9	683	19	14 HP 5 VP	Unbaked Clay
Group 6	Room 312	III	6.3	498	22	13 HP 9 VP	Unbaked Clay
Group 7	GH8:11	III	7.2	507	13	3 HP 10 VP	Unbaked Clay
Group 8	Room 313	III	No Measurements		18	13 HP 5 VP	Unbaked Clay

Abbreviations: VP – “Vertically Pierced”, HP – “Horizontally Pierced”

Appendix L: Loom Weights from Tel Ta'annek

Source: (Friend 1998)

Table L.1: Loom weights from Tel Ta'annek

Artifact Number	Locus	Mass (g)	Thickness (cm)	Shape	Material
87	65	403	9.8	VP	Poorly Fired Clay
88	93	585	10.2	VP	Poorly Fired Clay
89	93		10.1	VP	Poorly Fired Clay
90	93			VP	Poorly Fired Clay
91	93			VP	Poorly Fired Clay
92	93		10.7	VP	Poorly Fired Clay
93	52	478	9.3	VP	Poorly Fired Clay
94	27	449	8.2	VP	Poorly Fired Clay
95	35			HP	Fired Clay
96	30	155	5.9	VP	Fired Clay
97	53	117	4.8	HP	Poorly Fired Clay
98	53			HP	Poorly Fired Clay
99	53	168	5.4	HP	Poorly Fired Clay
100	53		4.4	HP	Poorly Fired Clay
101	53			HP	Poorly Fired Clay
102	53	155	5.2	HP	Fired Clay
103	53		7.4	HP	Poorly Fired Clay
104	53		5.4	HP	Poorly Fired Clay
105	53			HP	Poorly Fired Clay
106	53		3.8	HP	Poorly Fired Clay
107	53			HP	Poorly Fired Clay
108	53			Unidentified	Poorly Fired Clay
109	53			Unidentified	Poorly Fired Clay
110	53			Unidentified	Poorly Fired Clay
111	59	508		VP	Poorly Fired Clay
112	60		10	VP	Poorly Fired Clay
113	61			VP	Poorly Fired Clay
114	61	455	9.2	VP	Poorly Fired Clay
115	61		7.5	VP	Poorly Fired Clay
116	61	399	10	VP	Poorly Fired Clay
117	61	416	10	VP	Poorly Fired Clay
118	61	426	9.8	VP	Poorly Fired Clay
119	61		9.6	VP	Poorly Fired Clay
120	61	424	10	VP	Poorly Fired Clay
121	61	407	8.6	VP	Poorly Fired Clay
122	61		8.1	VP	Poorly Fired Clay

123	61			9.7	VP	Poorly Fired Clay
124	61		404	9.4	VP	Poorly Fired Clay
125	61		441	10.1	VP	Poorly Fired Clay
126	61		437	9.9	VP	Poorly Fired Clay
127	61			8.9	VP	Poorly Fired Clay
128	61			8.3	VP	Poorly Fired Clay
129	61		502	10.2	VP	Poorly Fired Clay
130	61		430	9.8	VP	Poorly Fired Clay
131	61		430	9.1	VP	Poorly Fired Clay
132	61				VP	Poorly Fired Clay
133	61				VP	Poorly Fired Clay
134	61				VP	Poorly Fired Clay
135	61				VP	Poorly Fired Clay
136	61		377	8.8	VP	Poorly Fired Clay
137	61				VP	Poorly Fired Clay
138	61				VP	Poorly Fired Clay
139	61		391	10.3	VP	Poorly Fired Clay
140	61		430	10.2	VP	Poorly Fired Clay
141	61		438	10	VP	Poorly Fired Clay
142	61		449	10.4	VP	Poorly Fired Clay
143	61		427	10	VP	Poorly Fired Clay
144	61		412	8.3	VP	Poorly Fired Clay
145	61		436	9.9	VP	Poorly Fired Clay
146	61		425	9.9	VP	Poorly Fired Clay
147	61		424	10.1	VP	Poorly Fired Clay
148	61		385	9.1	VP	Poorly Fired Clay
149	61		339	8.3	VP	Poorly Fired Clay
150	61		383	8.2	VP	Poorly Fired Clay
151	61			8.2	VP	Poorly Fired Clay
152	61		421	9.7	VP	Poorly Fired Clay
153	61		311	8.7	VP	Poorly Fired Clay
154	61		442	10.3	VP	Poorly Fired Clay
155	61		449	9.3	VP	Poorly Fired Clay
156	61				VP	Poorly Fired Clay
157	61		496	10.1	VP	Poorly Fired Clay
158	61		324	9.2	VP	Poorly Fired Clay
159	61		443	9.1	VP	Poorly Fired Clay
160	61		418	9.3	VP	Poorly Fired Clay
161	61		476	8.8	VP	Poorly Fired Clay
162	61		345	7.9	VP	Poorly Fired Clay
163	61		641	11.5	VP	Poorly Fired Clay

164	61	430	9.4	VP	Poorly Fired Clay
165	61	420	9.7	VP	Poorly Fired Clay
166	61			VP	Poorly Fired Clay
167	61			VP	Poorly Fired Clay
168	61	365	8.6	VP	Poorly Fired Clay
169	61	577	10	VP	Poorly Fired Clay
170	61	429	10	VP	Poorly Fired Clay
171	61	445	10	VP	Poorly Fired Clay
172	61	426	9.1	VP	Poorly Fired Clay
173	61	435	9.3	VP	Poorly Fired Clay
174	61		10.1	VP	Poorly Fired Clay

Abbreviations: VP – "Vertically Pierced", HP – "Horizontally Pierced"

Appendix M: Loom Weights from Tel Amal
Source: (Shamir 2012b)
Table M.1: Loom weights from Tel Amal

Study Number	Registration Number	Locus	Basket	Mass (g)	Thickness (cm)	Shape	Material
1	1964-2055			101.4	5.2	HP	Basalt
2	1964-2056			340	6.3	HP	Gypsum
3	1964-2058			388.2	8.6	HP	Gypsum
4	1964-2059			390.6	7	HP	Gypsum
5	1964-2060			355.6	7.7	HP	Gypsum
6	1964-2062			518.7	8.4	HP	Gypsum
7	1964-2080			167	6.4	HP	Gypsum
8	1964-2083			90.4	6.6	HP	Gypsum
9	1964-2084			321.5	6.3	HP	Gypsum
10	1964-2130/1			223	7.6	HP	Gypsum
11	1964-2130/2			222.6	7	HP	Gypsum
12	1964-2130/3					HP	Gypsum
13	1964-2130/4			289.6	8.6	HP	Gypsum
14	1964-2130/5			231.2	7.8	HP	Gypsum
15	1964-2130/6			169.4	6.8	HP	Gypsum
16	1964-2131/1			403.5	9	HP	Gypsum
17	1964-2131/2			235	7	HP	Gypsum
18	1964-2131/3			183.1	6.8	HP	Gypsum
19	1964-2131			182.4		HP	Gypsum
20	1964-2131/5			138.7	7	HP	Gypsum
21	1964-2131/6			191.5	6.2	HP	Gypsum
22	1964-2133			105.8	4.9	HP	Gypsum
23	1964-2134/14			213	4.8	HP	Gypsum
24	1964-2135/1			328	6.8	HP	Gypsum
25	1964-2135/			198	6.3	HP	Gypsum
26	1964-2235/4				7.2	HP	Gypsum
27	1964-2135/5			301.2	7	HP	Gypsum
28	1964-2137/7			338.8	6.4	HP	Gypsum
29	1964-2135/8			310.3	7.3	HP	Gypsum
30	1964-2135/11			294.3	7.7	HP	Gypsum
31	1964-2135/15					HP	Gypsum
32	1964-2136/3			301.1	7.1	HP	Gypsum
33	1964-2136/5			305	6.8	HP	Gypsum
34	1964/2136/6			140.7	5.7	HP	Gypsum

35	1964-2136/7			413.3	7.7	HP	Gypsum
36	1964-2136/8				6.5	HP	Gypsum
37	1964-2136/9			165.3		HP	Gypsum
38	1964-2136/10			133.1	6.3	HP	Gypsum
39	1964-2136/11			249.3	6.3	HP	Gypsum
40	1964-2136/12			215.4	6.6	HP	Gypsum
41	1964-2136/14			308.6	6.7	HP	Gypsum
42	1964-2136/15			216.3	7.4	HP	Gypsum
43	1964-2137/2			377	6.7	HP	Gypsum
44	1964-2137/3			325.4	6.6	HP	Gypsum
45	1964-2137/4			277	7.4	HP	Gypsum
46	1964-2137/6			304.3		HP	Gypsum
47	1964-2137/17			160	5.7	HP	Gypsum
48	1964-2138/1			306.3	7.2	HP	Gypsum
49	1964-2138/1			140	5.6	HP	Gypsum
50	1964-2138/2			263	6.5	HP	Gypsum
51	1964-2138/3			239.4	7.5	HP	Gypsum
52	1964-2138/3			188.5	5.5	HP	Gypsum
53	1964-2138/5			313.8	6.3	HP	Gypsum
54	1964-2138/6			207	6.7	HP	Gypsum
55	1964-2138/6			270	7.2	HP	Gypsum
56	1964-2138/6			252.6	5.8	HP	Gypsum
57	1964-2138/8			135.3	6.3	HP	Gypsum
58	1964-2138/9			224.8	5.2	HP	Gypsum
59	1964-2138/9			191.3	7.5	HP	Gypsum
60	1964-2138/10			256.8	6.5	HP	Gypsum
61	1964-2138/12			365.3	7.5	HP	Gypsum
62	1964-2138/13			208.3	6.7	HP	Gypsum
63	1964-2138/15			84.9	4.2	HP	Gypsum
64	A7/1			220.3	5.7	HP	Gypsum
65	1			164.3	6.2	HP	Gypsum
66	2			298.1	8	HP	Gypsum
67	3			277.7	6.7	HP	Gypsum
68	4			404	7.7	HP	Gypsum
69	5			295.3	8.3	HP	Gypsum
70	6			294.8	7.5	HP	Gypsum
71	7				7.7	HP	Gypsum
72	8			216	6.4	HP	Gypsum
73	9			280	7.2	HP	Gypsum

74	10			253.8	7	HP	Gypsum
75	11			241.9	8.4	HP	Gypsum
76	13				7	HP	Gypsum
77	14			243.3	6.5	HP	Gypsum
78	15			250.3	7	HP	Gypsum
79	16			275.6	7.5	HP	Gypsum
80	17			184.5	7.7	HP	Gypsum
81	18			272	6.1	HP	Gypsum
82	19					HP	Gypsum
83	20					HP	Gypsum
84	21					HP	Gypsum
85	22					HP	Gypsum
86	23					HP	Gypsum
87	24					HP	Gypsum
88	25			286.3	6.5	HP	Gypsum
89	26			274.9	6.8	HP	Gypsum
90	27			277	7	HP	Gypsum
91	28			170.6	6.2	HP	Gypsum
92	29			221.9	7.3	HP	Gypsum
93	30			256.5	6.8	HP	Gypsum
94	31			218	5.2	HP	Gypsum
95	33			282.8	6.8	HP	Gypsum
96	35			341.8	7	HP	Gypsum
97	11		172	143	5.7	HP	Gypsum
98	1		288	265.5	6.1	HP	Gypsum
99	2		288	207.1	6.2	HP	Gypsum
100	3		288	280	6.8	HP	Gypsum
101			309	241	6.5	HP	Gypsum
102	6		336	396	7.6	HP	Gypsum
103			11/21	275	7.9	HP	Gypsum
104	2129/1		45	222.6	6	HP	Gypsum
105	2129/2		45	235.2	6.5	HP	Gypsum
106	2129/3		45	191.1	6	HP	Gypsum
107	2129/4		45	155	6.5	HP	Gypsum
108	2129/5		45	191.6	6	HP	Gypsum
109	2129/6		45	84.4	4.2	HP	Gypsum
110	107	102?	1177	145.2	5.4	HP	Gypsum
111	22A	103?	1177	366.4	7	HP	Gypsum
112		56?	168	434.7	8.4	HP	Gypsum

113	1	NL		292	6.2	VP	Unfired Clay
114	2	NL		150.1	6	HP	Gypsum
115	3	NL		100	5.4	HP	Gypsum
116	4	NL		168	6.2	HP	Gypsum
117	5	NL		184.3	6	HP	Gypsum
118	8	11	192	260.6	6.2	HP	Gypsum
119		13	138	235.2	5.5	HP	Gypsum
120	14	13	138	159	6.2	HP	Gypsum
121	1	16		234	7	HP	Gypsum
122	2	16		164.2	6	HP	Gypsum
123	3	16		131	5.4	HP	Gypsum
124	4	16		164	7.5	HP	Gypsum
125	4	16		243	6.8	HP	Gypsum
126	5	16		120	5	HP	Gypsum
127	5	16		262	7.3	HP	Gypsum
128	6	16		208.4	6.5	HP	Gypsum
129	6	16		150	5.4	HP	Gypsum
130	7	16		262.3	5.7	HP	Gypsum
131	7	16		252.1	7	HP	Gypsum
132	8	16		170.5	6.6	HP	Gypsum
133	8	16		231.4	7.1	HP	Gypsum
134	9	16		256.3	7.9	HP	Gypsum
135	9	16		212	7	HP	Gypsum
136	10	16		183.1	6	HP	Gypsum
137	1	16	179	194.3	6.4	HP	Gypsum
138	2	16	179	242	6	HP	Gypsum
139	3	16	179	182.7	6.7	HP	Gypsum
140	4	16	179	168	6.7	HP	Gypsum
141	6	16	179	282	6.8	HP	Gypsum
142	7	16	179	292	6.8	HP	Gypsum
143	12	16	179	304	6.8	HP	Gypsum
144	13	16	179	270	6.6	HP	Gypsum
145	38	16	179	287.2	7.4	HP	Gypsum
146	3	21	140	135.1	5.5	HP	Gypsum
147	10	22	199	501	7.1	HP	Gypsum
148	1	22	209	260	6.7	HP	Gypsum
149	16	22	209	219	6.9	HP	Gypsum
150	32	22	209	160.4	6.3	HP	Gypsum

151	34	22	209	358.1	6.4	HP	Gypsum
152	37	24	209	244	6.8	HP	Gypsum
153	5	24	226	176	6	HP	Gypsum
154	9	24	226	260.3	6.5	HP	Gypsum
155	12	24	226	255	7	HP	Gypsum
156	19	24	226			HP	Gypsum
157	36	24	226	273	6.1	HP	Gypsum
158	15	25	175	326.9	7	HP	Gypsum
159	2	34	194	120.1	5.2	HP	Gypsum
160	18	42	331	202	6.5	HP	Gypsum

Abbreviations: VP – "Vertically Pierced", HP – "Horizontally Pierced"

Appendix N: Calculated warp thread counts and tensions for Iron Age II loom weights

Table N.1: Calculated warp thread counts and tensions for individual Iron Age II loom weights

		Warp Threads/CM		Tension (g)	
Artifact ID	Group	Maximum	Minimum	Minimum	Maximum
Ashkelon					
39061	221	11.32	5.00	5.33	12.08
39062	221	10.71	5.00	6.00	12.86
39063	221	8.82	5.00	13.17	23.24
39064	221	7.89	5.00	13.33	21.05
39065	221	8.45	5.00	16.33	27.61
39066	221	5.22	5.00	15.00	15.65
32926	312	9.23	5.00	7.70	14.22
41046	312	10.34	5.00	8.17	16.90
43911	312	6.32	5.00	33.23	41.98
43913	312	7.79	5.00	23.00	35.84
43914	312	9.23	5.00	8.40	15.51
43916	312	6.67	5.00	29.03	38.71
43917	312	12.77	5.00	3.73	9.53
43918	312	10.00	5.00	10.37	20.73
43919	312	8.57	5.00	8.80	15.09
43920	312	6.67	5.00	23.70	31.60
44266	312	6.19	5.00	32.50	40.21
44339	312	9.68	5.00	9.83	19.03
44452	312	8.70	5.00	10.93	19.01
44453	312	10.00	5.00	7.77	15.53
44454	312	6.32	5.00	29.30	37.01
44455	312	10.17	5.00	8.17	16.61
44456	312	10.00	5.00	8.17	16.33
44459	312	8.45	5.00	11.77	19.89
44461	312	9.52	5.00	9.27	17.65
44596	312	8.57	5.00	10.03	17.20
44597	312	9.09	5.00	10.40	18.91
44598	312	8.82	5.00	12.10	21.35
44599	312	8.33	5.00	12.80	21.33
44600	312	6.12	5.00	17.87	21.88
44601	312	7.14	5.00	20.90	29.86
44602	312	8.22	5.00	11.90	19.56
44603	312	6.67	5.00	28.63	38.18
44604	312	8.70	5.00	10.57	18.38
44605	312	9.38	5.00	11.10	20.81
44606	312	7.50	5.00	20.13	30.20

45457	312	6.12	5.00	29.83	36.53
43617	342	11.76	5.00	4.67	10.98
43714	342	11.76	5.00	4.67	10.98
43720	342	11.32	5.00	5.00	11.32
43736	342	11.76	5.00	3.67	8.63
41027	460	7.06	5.00	20.00	28.24
41028	460	9.09	5.00	7.33	13.33
41029	460	9.23	5.00	10.00	18.46
42638	460	9.52	5.00	8.67	16.51
Beth-Shean					
106016	p-6	8.33	5.00	6.56	10.94
386050	P-7	7.69	5.00	14.91	22.93
228678/51	P-7	7.59	5.00	10.14	15.40
286278/52	P-7	9.09	5.00	4.96	9.02
286278/53	P-7	12.00	5.00	1.89	4.53
286292/11	P-7	7.79	5.00	10.39	16.19
286292/12	P-7	8.57	5.00	8.94	15.33
286292/14	P-7	7.89	5.00	10.13	15.99
286292/15	P-7	6.82	5.00	15.05	20.52
286292/16	P-7	7.79	5.00	9.51	14.83
286292/17	P-7	8.00	5.00	9.33	14.93
286292/1b	P-7	8.57	5.00	12.73	21.82
286292/20	P-7	8.82	5.00	4.73	8.35
286292/22	P-7	7.59	5.00	9.36	14.22
286292/24	P-7	8.22	5.00	11.85	19.48
286292/25	P-7	7.89	5.00	11.23	17.72
286292/26	P-7	7.79	5.00	10.09	15.72
286292/27	P-7	8.82	5.00	8.68	15.32
286292/28	P-7	7.50	5.00	13.25	19.88
286292/29	P-7	7.79	5.00	9.04	14.09
286292/3	P-7	8.33	5.00	6.53	10.88
286292/30	P-7	7.50	5.00	8.80	13.20
286292/31	P-7	8.11	5.00	11.01	17.86
286292/35	P-7	8.82	5.00	5.94	10.48
286292/39	P-7	8.00	5.00	11.98	19.17
286292/4	P-7	8.00	5.00	9.86	15.78
286292/40	P-7	7.50	5.00	11.57	17.36
286292/42	P-7	7.79	5.00	8.87	13.82
286292/43	P-7	8.11	5.00	8.68	14.08
286292/45	P-7	6.82	5.00	18.40	25.09
286292/46	P-7	8.45	5.00	8.69	14.69

286292/47	P-7	7.14	5.00	13.75	19.64
286292/48	P-7	8.57	5.00	9.89	16.95
286292/49	P-7	7.59	5.00	11.42	17.35
286292/5	P-7	6.82	5.00	14.10	19.23
286292/50	P-7	7.41	5.00	13.72	20.32
286292/52	P-7	8.96	5.00	8.14	14.58
286292/53	P-7	8.00	5.00	9.39	15.02
286292/54	P-7	8.33	5.00	8.55	14.25
286292/55	P-7	6.74	5.00	11.87	16.00
286292/56	P-7	7.79	5.00	11.37	17.72
286292/57	P-7	6.90	5.00	14.83	20.45
286292/58	P-7	7.41	5.00	11.23	16.63
286292/59	P-7	8.70	5.00	7.44	12.93
286292/6	P-7	8.00	5.00	8.83	14.13
286292/61	P-7	8.82	5.00	6.87	12.13
286292/64	P-7	9.09	5.00	6.24	11.35
286292/65	P-7	9.38	5.00	4.92	9.23
286292/67	P-7	9.09	5.00	5.53	10.05
286292/69	P-7	10.00	5.00	5.86	11.73
286292/7	P-7	8.82	5.00	7.20	12.71
286292/70	P-7	7.50	5.00	9.56	14.34
286292/71	P-7	7.89	5.00	11.22	17.72
286292/72	P-7	8.45	5.00	10.01	16.91
286292/75	P-7	8.22	5.00	9.62	15.82
286292/77	P-7	9.52	5.00	7.32	13.95
286292/78	P-7	8.82	5.00	6.93	12.24
286292/8	P-7	6.59	5.00	13.71	18.08
286292/80	P-7	7.89	5.00	9.12	14.40
286292/81	P-7	8.00	5.00	8.19	13.10
286292/82	P-7	8.33	5.00	9.06	15.10
286292/84	P-7	8.96	5.00	6.65	11.90
286292/85	P-7	12.00	5.00	1.93	4.63
286292/86	P-7	7.06	5.00	11.14	15.72
286292/87	P-7	7.50	5.00	10.28	15.42
286292/88	P-7	8.45	5.00	7.71	13.03
286292/89	P-7	8.57	5.00	7.33	12.56
286292/90	P-7	9.09	5.00	7.45	13.54
286292/91	P-7	6.25	5.00	16.07	20.09
286292/92	P-7	9.84	5.00	5.31	10.44
286292/93	P-7	13.04	5.00	1.44	3.76
286292/94	P-7	7.79	5.00	10.41	16.22

286292/95	P-7	8.70	5.00	9.96	17.33
286292/96	P-7	6.67	5.00	15.03	20.03
286292/98	P-7	7.41	5.00	11.81	17.50
286292/99	P-7	8.00	5.00	10.40	16.64
28692/32	P-7	8.11	5.00	9.58	15.54
2886278/50	P-7	5.71	5.00	21.00	24.00
386128	p-8A	7.06	5.00	8.60	12.13
386414	p-8A	10.17	5.00	3.85	7.83
384192	s-1	12.77	5.00	6.54	16.70
384254	s-1	10.91	5.00	12.54	27.36
887239	S-1	11.32	5.00	0.39	0.88
687006/1	s-1	10.17	5.00	12.75	25.92
687006/2	s-1	10.91	5.00	13.61	29.68
687006/3	s-1	14.29	5.00	12.84	36.68
687006/4	s-1	11.54	5.00	12.26	28.30
987036	s-1a	11.54	5.00	13.02	30.05
988011	s-1b	11.11	5.00	8.30	18.44
888107	topsoil	13.95	5.00	10.11	28.22
29-107-679	Area S (UPenn)	16.67	5.00	1.31	4.36
29-103-1067	Area S (UPenn)	10.17	5.00	2.70	5.50
29-103-1071	Area S (UPenn)	13.64	5.00	1.50	4.08
29-103-315	Area S (UPenn)	11.32	5.00	3.61	8.17
29-103-705	Area S (UPenn)	10.17	5.00	4.25	8.64
29-103-706	Area S (UPenn)	6.56	5.00	12.23	16.04
29-103-707	Area S (UPenn)	13.33	5.00	5.95	15.86
29-103-710	Area S (UPenn)	9.84	5.00	9.50	18.69
29-103-711A	Area S (UPenn)	9.76	5.00	6.13	11.97
29-103-711B	Area S (UPenn)	8.57	5.00	7.50	12.86
29-103-714	Area S (UPenn)	12.00	5.00	5.50	13.20
29-103-718A	Area S (UPenn)	9.68	5.00	6.29	12.17
29-103-718b	Area S (UPenn)	9.76	5.00	6.22	12.13

29-103-721	Area S (UPenn)	10.34	5.00	4.60	9.52
29-103-722a	Area S (UPenn)	11.76	5.00	4.17	9.80
29-103-722b	Area S (UPenn)	14.29	5.00	1.80	5.13
29-103-722c	Area S (UPenn)	11.32	5.00	3.79	8.58
29-103-722d	Area S (UPenn)	10.71	5.00	3.94	8.44
29-103-722e	Area S (UPenn)	13.95	5.00	1.74	4.87
29-103-722f	Area S (UPenn)	10.71	5.00	4.56	9.76
29-103-722g	Area S (UPenn)	10.34	5.00	4.03	8.34
29-103-722h	Area S (UPenn)	11.11	5.00	3.64	8.09
29-103-724A	Area S (UPenn)	11.32	5.00	4.11	9.31
29-103-724b	Area S (UPenn)	10.71	5.00	3.87	8.29
29-103-724c	Area S (UPenn)	12.00	5.00	3.90	9.36
29-103-724d	Area S (UPenn)	11.54	5.00	3.64	8.39
29-103-725	Area S (UPenn)	9.38	5.00	6.22	11.67
29-103-728	Area S (UPenn)	8.00	5.00	17.23	27.57
29-103-729	Area S (UPenn)	13.64	5.00	3.42	9.32
29-103-732	Area S (UPenn)	9.52	5.00	4.00	7.61
29-103-736	Area S (UPenn)	12.00	5.00	4.79	11.49
29-103-738	Area S (UPenn)	13.33	5.00	3.07	8.19
29-103-739	Area S (UPenn)	12.50	5.00	2.98	7.46
29-103-74	Area S (UPenn)	10.91	5.00	3.05	6.65
29-103-742	Area S (UPenn)	13.95	5.00	1.76	4.90
29-103-743	Area S (UPenn)	11.88	5.00	3.61	8.58

29-103-744	Area S (UPenn)	10.91	5.00	4.61	10.07
29-103-747A	Area S (UPenn)	9.84	5.00	5.37	10.56
29-103-747B	Area S (UPenn)	10.17	5.00	5.21	10.59
29-103-748	Area S (UPenn)	11.65	5.00	2.94	6.85
29-103-750	Area S (UPenn)	11.54	5.00	3.51	8.09
29-103-753a	Area S (UPenn)	13.95	5.00	1.81	5.06
29-103-753a1	Area S (UPenn)	11.32	5.00	4.20	9.52
29-103-753b	Area S (UPenn)	9.38	5.00	6.44	12.08
29-103-753b1	Area S (UPenn)	13.95	5.00	1.81	5.05
29-103-753c	Area S (UPenn)	11.88	5.00	4.40	10.45
29-103-753c1	Area S (UPenn)	11.54	5.00	4.15	9.58
29-103-753d	Area S (UPenn)	11.32	5.00	4.17	9.43
29-103-753d1	Area S (UPenn)	13.04	5.00	1.57	4.10
29-103-753e	Area S (UPenn)	14.12	5.00	2.04	5.76
29-103-753e1	Area S (UPenn)	12.00	5.00	3.83	9.18
29-103-753f	Area S (UPenn)	11.54	5.00	3.84	8.86
29-103-753f1	Area S (UPenn)	11.76	5.00	3.23	7.61
29-103-753g	Area S (UPenn)	15.38	5.00	1.68	5.18
29-103-753g1	Area S (UPenn)	12.77	5.00	3.49	8.92
29-103-753h	Area S (UPenn)	13.95	5.00	1.75	4.87
29-103-753h1	Area S (UPenn)	13.33	5.00	1.69	4.50
29-103-753i	Area S (UPenn)	13.95	5.00	1.66	4.62
29-103-753i1	Area S (UPenn)	11.11	5.00	3.57	7.93

29-103-753j	Area S (UPenn)	14.29	5.00	1.62	4.64
29-103-753j1	Area S (UPenn)	11.54	5.00	4.00	9.24
29-103-753k	Area S (UPenn)	12.50	5.00	3.84	9.61
29-103-753k1	Area S (UPenn)	12.00	5.00	4.03	9.67
29-103-753l	Area S (UPenn)	12.24	5.00	3.59	8.78
29-103-753m	Area S (UPenn)	11.21	5.00	3.79	8.50
29-103-753n	Area S (UPenn)	12.77	5.00	3.60	9.20
29-103-753o	Area S (UPenn)	14.63	5.00	1.76	5.14
29-103-753p	Area S (UPenn)	11.54	5.00	3.78	8.72
29-103-753q	Area S (UPenn)	11.54	5.00	3.62	8.35
29-103-753r	Area S (UPenn)	11.76	5.00	3.77	8.88
29-103-753s	Area S (UPenn)	9.92	5.00	7.47	14.81
29-103-753t	Area S (UPenn)	11.54	5.00	3.94	9.10
29-103-753u	Area S (UPenn)	11.54	5.00	3.11	7.18
29-103-753u1	Area S (UPenn)	14.63	5.00	1.42	4.16
29-103-753v	Area S (UPenn)	10.81	5.00	3.94	8.53
29-103-753w	Area S (UPenn)	10.91	5.00	4.36	9.51
29-103-753x	Area S (UPenn)	14.29	5.00	1.74	4.96
29-103-753y	Area S (UPenn)	12.77	5.00	2.32	5.91
29-103-753z	Area S (UPenn)	11.11	5.00	4.25	9.45
29-107-386	Area S (UPenn)	12.77	5.00	7.80	19.91
29-107-572	Area S (UPenn)	12.77	5.00	11.60	29.62
29-107-575	Area S (UPenn)	12.50	5.00	9.67	24.17

29-107-588	Area S (UPenn)	9.23	5.00	13.33	24.62
29-107-590	Area S (UPenn)	25.00	5.00	2.48	12.40
29-107-591	Area S (UPenn)	9.52	5.00	14.27	27.17
29-107-593	Area S (UPenn)	11.54	5.00	14.90	34.38
29-107-594	Area S (UPenn)	10.71	5.00	7.63	16.36
29-107-597	Area S (UPenn)	13.95	5.00	5.98	16.70
29-107-598	Area S (UPenn)	10.71	5.00	16.63	35.64
29-107-601	Area S (UPenn)	17.14	5.00	2.81	9.62
29-107-602	Area S (UPenn)	15.79	5.00	4.68	14.79
29-107-606	Area S (UPenn)	12.50	5.00	9.73	24.33
29-107-608	Area S (UPenn)	9.92	5.00	4.64	9.20
29-107-609	Area S (UPenn)	11.32	5.00	19.10	43.25
29-107-61	Area S (UPenn)	13.64	5.00	8.23	22.45
29-107-610	Area S (UPenn)	12.50	5.00	6.97	17.42
29-107-611	Area S (UPenn)	15.79	5.00	3.33	10.53
29-107-612	Area S (UPenn)	10.71	5.00	8.70	18.64
29-107-613	Area S (UPenn)	11.76	5.00	14.43	33.96
29-107-615	Area S (UPenn)	13.95	5.00	6.60	18.43
29-107-616	Area S (UPenn)	12.77	5.00	6.64	16.95
29-107-617	Area S (UPenn)	16.22	5.00	4.77	15.48
29-107-622	Area S (UPenn)	13.64	5.00	5.10	13.91
29-107-623	Area S (UPenn)	11.21	5.00	3.97	8.91
29-107-660	Area S (UPenn)	12.00	5.00	1.79	4.30

29-107-662	Area S (UPenn)	6.74	5.00	15.80	21.30
29-107-665	Area S (UPenn)	6.19	5.00	22.67	28.04
29-107-672	Area S (UPenn)	4.48	5.00	37.83	33.88
29-107-674	Area S (UPenn)	5.00	5.00	46.90	46.90
29-107-675	Area S (UPenn)	5.13	5.00	30.50	31.28
29-107-681	Area S (UPenn)	15.38	5.00	1.35	4.14
29-107-685	Area S (UPenn)	11.76	5.00	2.62	6.16
29-107-871	Area S (UPenn)	6.59	5.00	25.23	33.27
33-9-251	Area S (UPenn)	15.38	5.00	1.14	3.51
City of David					
41	1108	11.54	5.00	2.84	6.55
46	1108	15.00	5.00	2.07	6.20
52	1108	12.00	5.00	2.75	6.60
54	1108	12.00	5.00	1.96	4.71
56	1108	7.06	5.00	12.21	17.24
64	1108	18.75	5.00	0.76	2.85
66	1108	6.59	5.00	24.16	31.86
68	1108	12.77	5.00	1.66	4.25
70	1108	12.00	5.00	1.89	4.54
73	1108	6.00	5.00	26.83	32.20
75	1108	7.06	5.00	13.63	19.24
81	1108	11.32	5.00	2.76	6.26
83	1108	12.77	5.00	1.69	4.32
84	1108	14.63	5.00	1.52	4.45
85	1108	11.11	5.00	3.21	7.13
86	1108	13.04	5.00	2.07	5.39
87	1108	7.69	5.00	12.26	18.87
88	1108	6.12	5.00	21.82	26.72
89	1108	6.38	5.00	18.20	23.23
93	1108	11.32	5.00	2.60	5.88
100	1108	12.00	5.00	1.75	4.19
102	1108	12.50	5.00	1.58	3.96
104	1108	12.00	5.00	2.42	5.81
105	1108	10.71	5.00	3.31	7.10

112	1108	12.00	5.00	2.28	5.47
114	1110	11.54	5.00	2.33	5.38
117	1110	12.50	5.00	1.87	4.67
125	1110	10.17	5.00	3.58	7.29
128	1110	12.24	5.00	1.87	4.57
129	1110	11.54	5.00	2.03	4.69
130	1110	12.77	5.00	1.63	4.15
134	1110	8.00	5.00	12.59	20.15
1	Isolated	19.35	5.00	0.85	3.28
8	Isolated	10.00	5.00	5.35	10.70
9	Isolated	8.57	5.00	15.60	26.74
15	Isolated	10.17	5.00	3.73	7.58
18	Isolated	10.34	5.00	3.30	6.82
19	Isolated	10.91	5.00	3.83	8.36
21	Isolated	23.08	5.00	0.21	0.98
26	Isolated	10.53	5.00	4.24	8.93
29	Isolated	17.14	5.00	0.43	1.47
33	Isolated	10.71	5.00	5.38	11.53
36	Isolated	11.11	5.00	3.12	6.94
Kadesh Barnea					
2	Ungrouped	15.79	5.00	2.29	7.23
3	Ungrouped	9.52	5.00	3.77	7.18
4	Ungrouped	9.68	5.00	3.67	7.10
5	Ungrouped	10.34	5.00	4.08	8.44
7	Ungrouped	12.50	5.00	2.60	6.51
8	Ungrouped	12.00	5.00	2.40	5.77
9	Ungrouped	14.63	5.00	1.32	3.86
16	Ungrouped	15.00	5.00	1.74	5.22
18	Ungrouped	10.71	5.00	3.13	6.71
19	Ungrouped	10.71	5.00	2.95	6.33
20	Ungrouped	9.84	5.00	4.38	8.62
21	Ungrouped	6.67	5.00	9.09	12.12
22	Ungrouped	8.82	5.00	5.07	8.95
23	Ungrouped	7.69	5.00	5.18	7.96
24	Ungrouped	9.68	5.00	4.21	8.15
Kuntillet 'Ajrud					
Individual Weight 1		6.67	5.00	10.33	13.78
Individual Weight 2		7.27	5.00	8.67	12.61
Individual		7.50	5.00	8.00	12.00

Weight 3					
Ta'annek					
97	53	12.50	5.00	3.90	9.75
99	53	11.11	5.00	5.60	12.44
102	53	11.54	5.00	5.17	11.92
114	61	6.52	5.00	15.17	19.78
116	61	6.00	5.00	13.30	15.96
117	61	6.00	5.00	13.87	16.64
118	61	6.12	5.00	14.20	17.39
120	61	6.00	5.00	14.13	16.96
121	61	6.98	5.00	13.57	18.93
124	61	6.38	5.00	13.47	17.19
125	61	5.94	5.00	14.70	17.47
126	61	6.06	5.00	14.57	17.66
129	61	5.88	5.00	16.73	19.69
130	61	6.12	5.00	14.33	17.55
131	61	6.59	5.00	14.33	18.90
136	61	6.82	5.00	12.57	17.14
139	61	5.83	5.00	13.03	15.18
140	61	5.88	5.00	14.33	16.86
141	61	6.00	5.00	14.60	17.52
142	61	5.77	5.00	14.97	17.27
143	61	6.00	5.00	14.23	17.08
144	61	7.23	5.00	13.73	19.86
145	61	6.06	5.00	14.53	17.62
146	61	6.06	5.00	14.17	17.17
147	61	5.94	5.00	14.13	16.79
148	61	6.59	5.00	12.83	16.92
149	61	7.23	5.00	11.30	16.34
150	61	7.32	5.00	12.77	18.68
152	61	6.19	5.00	14.03	17.36
153	61	6.90	5.00	10.37	14.30
154	61	5.83	5.00	14.73	17.17
155	61	6.45	5.00	14.97	19.31
157	61	5.94	5.00	16.53	19.64
158	61	6.52	5.00	10.80	14.09
159	61	6.59	5.00	14.77	19.47
160	61	6.45	5.00	13.93	17.98
161	61	6.82	5.00	15.87	21.64
162	61	7.59	5.00	11.50	17.47
163	61	5.22	5.00	21.37	22.30

164	61	6.38	5.00	14.33	18.30
165	61	6.19	5.00	14.00	17.32
168	61	6.98	5.00	12.17	16.98
169	61	6.00	5.00	19.23	23.08
170	61	6.00	5.00	14.30	17.16
171	61	6.00	5.00	14.83	17.80
172	61	6.59	5.00	14.20	18.73
173	61	6.45	5.00	14.50	18.71
88	93	5.88	5.00	19.50	22.94
87	Ungrouped	6.12	5.00	13.43	16.45
93	Ungrouped	6.45	5.00	15.93	20.56
94	Ungrouped	7.32	5.00	14.97	21.90
96	Ungrouped	10.17	5.00	5.17	10.51
Tell Afis					
TA.86.D.2	D	8.22	5.00	9.07	14.90
TA.86.D.49	D	13.33	5.00	2.53	6.76
TA.86.D.51	D	12.24	5.00	3.97	9.71
TA.86.D.55	D	9.52	5.00	5.33	10.16
TA.86.D.6	D	8.00	5.00	15.37	24.59
TA.86.D.63	D	8.45	5.00	7.80	13.18
TA.86.D.63	D	10.34	5.00	3.87	8.00
TA.86.D.70	D	9.38	5.00	8.83	16.56
TA.87.D.100z	D	11.54	5.00	5.43	12.54
TA.87.D.12	D	10.17	5.00	6.20	12.61
TA.87.D.13	D	11.32	5.00	3.93	8.91
TA.87.D.217D	D	12.50	5.00	6.03	15.08
TA.87.D.217y	D	11.54	5.00	5.33	12.31
TA.87.D.75	D	8.70	5.00	12.43	21.62
TA.87.D.alfa	D	12.00	5.00	5.20	12.48
TA.87.D.beta	D	6.90	5.00	13.60	18.76
TA.87.D?173/6	D	11.11	5.00	8.63	19.19
TA.88.D.109	D	13.33	5.00	2.87	7.64
TA.88.D.168	D	11.32	5.00	5.27	11.92
TA.88.D.27	D	13.33	5.00	7.60	20.27
TA.88.D.62	D	8.82	5.00	6.17	10.88
TA.88.D.8	D	15.00	5.00	7.40	22.20
TA.88.D.83	D	7.79	5.00	11.60	18.08
TA.88.D.87	D	10.00	5.00	9.23	18.47
TA.88.D.97	D	11.32	5.00	5.27	11.92
TA.88.D.99	D	7.69	5.00	13.47	20.72
TA.89.D.16	D	12.50	5.00	6.17	15.42

TA.89.D.169	D	9.38	5.00	6.70	12.56
TA.89.D.263	D	16.22	5.00	2.50	8.11
TA.89.D.28	D	10.34	5.00	7.50	15.52
TA.89.D.370	D	7.06	5.00	23.00	32.47
TA.89.D.64	D	8.00	5.00	10.60	16.96
TA.89.D.66	D	9.23	5.00	7.70	14.22
TA.89.D.97	D	7.32	5.00	2.53	3.71
TA.88.E.129	E	13.33	5.00	7.83	20.89
TA.88.E.140	E	15.00	5.00	6.73	20.20
TA.88.E.142	E	15.38	5.00	6.30	19.38
TA.88.E.173	E	9.52	5.00	4.63	8.83
TA.88.E.204	E	8.96	5.00	7.33	13.13
TA.88.E.205	E	9.09	5.00	5.83	10.61
TA.88.E.207	E	15.00	5.00	6.03	18.10
TA.89.E.162	E	5.22	5.00	27.50	28.70
TA.91.E.41	E	9.68	5.00	8.00	15.48
TA.91.E.59	E	9.52	5.00	6.60	12.57
TA.91.E.62	E	11.76	5.00	8.83	20.78
TA.91.E.65	E	15.00	5.00	5.50	16.50
TA.91.E.72	E	20.00	5.00	3.03	12.13
TA.91.E.80	E	11.32	5.00	4.57	10.34
TA.92.E.117	E	12.00	5.00	10.83	26.00
TA.92.E.160	E	10.71	5.00	13.37	28.64
TA.92.E.175	E	12.24	5.00	6.67	16.33
TA.97.E.215	E	11.11	5.00	12.03	26.74
TA.97.E.24	E	12.50	5.00	8.67	21.67
TA.89.G.122	G	9.23	5.00	3.33	6.15
TA.89.G.190	G	10.91	5.00	0.03	0.06
TA.89.G.202	G	13.33	5.00	6.67	17.78
TA.89.G.209	G	12.00	5.00	7.00	16.80
TA.89.G.210	G	8.00	5.00	9.27	14.83
TA.89.G.210	G	8.00	5.00	8.67	13.87
TA.89.G.218	G	15.00	5.00	5.00	15.00
TA.89.G.224	G	12.00	5.00	7.50	18.00
TA.89.G.284	G	15.00	5.00	5.83	17.50
TA.89.G.310	G	10.00	5.00	3.33	6.67
TA.89.G.315	G	12.00	5.00	5.67	13.60
TA.89.G.327	G	11.54	5.00	3.83	8.85
TA.89.G.337	G	10.00	5.00	5.00	10.00
TA.92.G.224b	G	12.50	5.00	10.00	25.00
TA.92.G.305	G	14.29	5.00	7.83	22.38

TA.92.G.308	G	14.63	5.00	7.50	21.95
TA.92.G.309	G	14.29	5.00	4.50	12.86
TA.92.G.320	G	17.14	5.00	5.00	17.14
TA.92.G.324	G	11.32	5.00	13.17	29.81
TA.92.G.401	G	15.00	5.00	6.67	20.00
TA.92.G.419	G	13.64	5.00	7.50	20.45
TA.92.G.429	G	10.00	5.00	16.00	32.00
TA.92.G.429	G	13.33	5.00	8.30	22.13
TA.92.G.433a	G	12.50	5.00	7.33	18.33
TA.92.G.438	G	16.22	5.00	4.00	12.97
TA.92.G.456	G	15.38	5.00	4.83	14.87
TA.92.G.463	G	9.84	5.00	1.83	3.61
TA.92.G.463	G	14.29	5.00	1.83	5.24
TA.92.G.470	G	17.14	5.00	1.50	5.14
TA.92.G.480	G	13.33	5.00	9.17	24.44
TA.92.G.69	G	10.53	5.00	4.17	8.77
TA.92.G.70	G	11.76	5.00	2.83	6.67
TA.92.G.84	G	11.11	5.00	2.17	4.81
TA.94.G.261	G	10.53	5.00	3.87	8.14
TA.94.G.342	G	13.33	5.00	8.30	22.13
TA.94.g.369d	G	11.11	5.00	9.50	21.11
TA.96.G.125	G	11.11	5.00	3.13	6.96
TA.96.G.126	G	13.95	5.00	2.52	7.03
TA.96.G.22	G	17.65	5.00	1.05	3.69
TA.96.G.263	G	13.95	5.00	4.43	12.37
TA.96.G.44	G	13.95	5.00	3.00	8.36
TA.96.G.479	G	15.00	5.00	0.79	2.37
TA.96.G.72	G	12.50	5.00	4.97	12.42
TA.96.G.94	G	12.00	5.00	5.60	13.44
TA.96.G.94	G	15.00	5.00	6.90	20.70
TA.97.G.315	G	12.77	5.00	7.73	19.74
TA.97.G.66	G	14.29	5.00	6.23	17.81
TA.97.G.82	G	12.77	5.00	2.70	6.89
TA.82.L.119	L	12.00	5.00	7.50	18.00
TA.92.L.139	L	10.91	5.00	8.67	18.91
TA.92.L.140	L	12.00	5.00	2.90	6.96
TA.92.L.214	L	15.00	5.00	6.83	20.50
TA.92.L.253	L	12.00	5.00	3.57	8.56
TA.92.L.254	L	11.11	5.00	3.57	7.93
TA.92.L.255	L	11.54	5.00	2.87	6.62
TA.92.L.455	L	9.09	5.00	8.27	15.03

TA.92.L.54	L	10.91	5.00	3.27	7.13
TA.92.L.97	L	12.00	5.00	5.07	12.16
TA.96.O.79	O	11.32	5.00	3.43	7.77
Tel Amal					
121	16	8.57	5.00	7.80	13.37
122	16	10.00	5.00	5.47	10.95
123	16	11.11	5.00	4.37	9.70
124	16	8.00	5.00	5.47	8.75
125	16	8.82	5.00	8.10	14.29
126	16	12.00	5.00	4.00	9.60
127	16	8.22	5.00	8.73	14.36
128	16	9.23	5.00	6.95	12.82
129	16	11.11	5.00	5.00	11.11
130	16	10.53	5.00	8.74	18.41
131	16	8.57	5.00	8.40	14.41
132	16	9.09	5.00	5.68	10.33
133	16	8.45	5.00	7.71	13.04
134	16	7.59	5.00	8.54	12.98
135	16	8.57	5.00	7.07	12.11
136	16	10.00	5.00	6.10	12.21
137	16	9.38	5.00	6.48	12.14
138	16	10.00	5.00	8.07	16.13
139	16	8.96	5.00	6.09	10.91
140	16	8.96	5.00	5.60	10.03
141	16	8.82	5.00	9.40	16.59
142	16	8.82	5.00	9.73	17.18
143	16	8.82	5.00	10.13	17.88
144	16	9.09	5.00	9.00	16.36
145	16	8.11	5.00	9.57	15.52
1	Ungrouped	11.54	5.00	3.38	7.80
2	Ungrouped	9.52	5.00	11.33	21.59
3	Ungrouped	6.98	5.00	12.94	18.06
4	Ungrouped	8.57	5.00	13.02	22.32
5	Ungrouped	7.79	5.00	11.85	18.47
6	Ungrouped	7.14	5.00	17.29	24.70
7	Ungrouped	9.38	5.00	5.57	10.44
8	Ungrouped	9.09	5.00	3.01	5.48
9	Ungrouped	9.52	5.00	10.72	20.41
10	Ungrouped	7.89	5.00	7.43	11.74
11	Ungrouped	8.57	5.00	7.42	12.72
13	Ungrouped	6.98	5.00	9.65	13.47

14	Ungrouped	7.69	5.00	7.71	11.86
15	Ungrouped	8.82	5.00	5.65	9.96
16	Ungrouped	6.67	5.00	13.45	17.93
17	Ungrouped	8.57	5.00	7.83	13.43
18	Ungrouped	8.82	5.00	6.10	10.77
20	Ungrouped	8.57	5.00	4.62	7.93
21	Ungrouped	9.68	5.00	6.38	12.35
22	Ungrouped	12.24	5.00	3.53	8.64
23	Ungrouped	12.50	5.00	7.10	17.75
24	Ungrouped	8.82	5.00	10.93	19.29
25	Ungrouped	9.52	5.00	6.60	12.57
27	Ungrouped	8.57	5.00	10.04	17.21
28	Ungrouped	9.38	5.00	11.29	21.18
29	Ungrouped	8.22	5.00	10.34	17.00
30	Ungrouped	7.79	5.00	9.81	15.29
32	Ungrouped	8.45	5.00	10.04	16.96
33	Ungrouped	8.82	5.00	10.17	17.94
34	Ungrouped	10.53	5.00	4.69	9.87
35	Ungrouped	7.79	5.00	13.78	21.47
38	Ungrouped	9.52	5.00	4.44	8.45
39	Ungrouped	9.52	5.00	8.31	15.83
40	Ungrouped	9.09	5.00	7.18	13.05
41	Ungrouped	8.96	5.00	10.29	18.42
42	Ungrouped	8.11	5.00	7.21	11.69
43	Ungrouped	8.96	5.00	12.57	22.51
44	Ungrouped	9.09	5.00	10.85	19.72
45	Ungrouped	8.11	5.00	9.23	14.97
47	Ungrouped	10.53	5.00	5.33	11.23
48	Ungrouped	8.33	5.00	10.21	17.02
49	Ungrouped	10.71	5.00	4.67	10.00
50	Ungrouped	9.23	5.00	8.77	16.18
51	Ungrouped	8.00	5.00	7.98	12.77
52	Ungrouped	10.91	5.00	6.28	13.71
53	Ungrouped	9.52	5.00	10.46	19.92
54	Ungrouped	8.96	5.00	6.90	12.36
55	Ungrouped	8.33	5.00	9.00	15.00
56	Ungrouped	10.34	5.00	8.42	17.42
57	Ungrouped	9.52	5.00	4.51	8.59
58	Ungrouped	11.54	5.00	7.49	17.29
59	Ungrouped	8.00	5.00	6.38	10.20
60	Ungrouped	9.23	5.00	8.56	15.80

61	Ungrouped	8.00	5.00	12.18	19.48
62	Ungrouped	8.96	5.00	6.94	12.44
63	Ungrouped	14.29	5.00	2.83	8.09
64	Ungrouped	10.53	5.00	7.34	15.46
65	Ungrouped	9.68	5.00	5.48	10.60
66	Ungrouped	7.50	5.00	9.94	14.91
67	Ungrouped	8.96	5.00	9.26	16.58
68	Ungrouped	7.79	5.00	13.47	20.99
69	Ungrouped	7.23	5.00	9.84	14.23
70	Ungrouped	8.00	5.00	9.83	15.72
72	Ungrouped	9.38	5.00	7.20	13.50
73	Ungrouped	8.33	5.00	9.33	15.56
74	Ungrouped	8.57	5.00	8.46	14.50
75	Ungrouped	7.14	5.00	8.06	11.52
77	Ungrouped	9.23	5.00	8.11	14.97
78	Ungrouped	8.57	5.00	8.34	14.30
79	Ungrouped	8.00	5.00	9.19	14.70
80	Ungrouped	7.79	5.00	6.15	9.58
81	Ungrouped	9.84	5.00	9.07	17.84
88	Ungrouped	9.23	5.00	9.54	17.62
89	Ungrouped	8.82	5.00	9.16	16.17
90	Ungrouped	8.57	5.00	9.23	15.83
91	Ungrouped	9.68	5.00	5.69	11.01
92	Ungrouped	8.22	5.00	7.40	12.16
93	Ungrouped	8.82	5.00	8.55	15.09
94	Ungrouped	11.54	5.00	7.27	16.77
95	Ungr ouped	8.82	5.00	9.43	16.64
96	Ungrouped	8.57	5.00	11.39	19.53
97	Ungrouped	10.53	5.00	4.77	10.04
98	Ungrouped	9.84	5.00	8.85	17.41
99	Ungrouped	9.68	5.00	6.90	13.36
100	Ungrouped	8.82	5.00	9.33	16.47
101	Ungrouped	9.23	5.00	8.03	14.83
102	Ungrouped	7.89	5.00	13.20	20.84
103	Ungrouped	7.59	5.00	9.17	13.92
104	Ungrouped	10.00	5.00	7.42	14.84
105	Ungrouped	9.23	5.00	7.84	14.47
106	Ungrouped	10.00	5.00	6.37	12.74
107	Ungrouped	9.23	5.00	5.17	9.54
108	Ungrouped	10.00	5.00	6.39	12.77
109	Ungrouped	14.29	5.00	2.81	8.04

110	Ungrouped	11.11	5.00	4.84	10.76
111	Ungrouped	8.57	5.00	12.21	20.94
112	Ungrouped	7.14	5.00	14.49	20.70
113	Ungrouped	9.68	5.00	9.73	18.84
114	Ungrouped	10.00	5.00	5.00	10.01
115	Ungrouped	11.11	5.00	3.33	7.41
116	Ungrouped	9.68	5.00	5.60	10.84
117	Ungrouped	10.00	5.00	6.14	12.29
118	Ungrouped	9.68	5.00	8.69	16.81
119	Ungrouped	10.91	5.00	7.84	17.11
120	Ungrouped	9.68	5.00	5.30	10.26
146	Ungrouped	10.91	5.00	4.50	9.83
147	Ungrouped	8.45	5.00	16.70	28.23
148	Ungrouped	8.96	5.00	8.67	15.52
149	Ungrouped	8.70	5.00	7.30	12.70
150	Ungrouped	9.52	5.00	5.35	10.18
151	Ungrouped	9.38	5.00	11.94	22.38
152	Ungrouped	8.82	5.00	8.13	14.35
153	Ungrouped	10.00	5.00	5.87	11.73
154	Ungrouped	9.23	5.00	8.68	16.02
155	Ungrouped	8.57	5.00	8.50	14.57
157	Ungrouped	9.84	5.00	9.10	17.90
158	Ungrouped	8.57	5.00	10.90	18.68
159	Ungrouped	11.54	5.00	4.00	9.24
160	Ungrouped	9.23	5.00	6.73	12.43
Tel Batash/Timnah					
9294	950	6.52	5.00	19.86	25.90
9363	950	7.59	5.00	11.72	17.80
9370	950	6.82	5.00	8.32	11.35
9249/1	950	6.74	5.00	23.60	31.82
9249/10	950	9.09	5.00	4.92	8.95
9249/11	950	8.00	5.00	5.92	9.47
9249/12	950	8.33	5.00	5.40	9.00
9249/13	950	7.69	5.00	6.72	10.33
9249/14	950	6.74	5.00	25.13	33.89
9249/15	950	11.11	5.00	7.92	17.60
9249/16	950	10.71	5.00	6.60	14.15
9290/1	950	8.57	5.00	13.87	23.78
9290/2	950	10.34	5.00	8.67	17.94
9290/3	950	11.11	5.00	8.14	18.08
9290/4	950	10.91	5.00	6.55	14.30

9290/5	950	10.71	5.00	8.25	17.68
9290/6	950	8.45	5.00	5.52	9.32
9305/1	950	10.71	5.00	7.78	16.68
9305/2	950	8.57	5.00	8.07	13.83
9305/3	950	8.57	5.00	5.94	10.19
F6012	F607	7.89	5.00	11.41	18.02
F6025	F607	7.89	5.00	8.93	14.11
F6043	F607	7.50	5.00	11.12	16.68
F6044	F607	6.19	5.00	25.00	30.93
F6045	F607	7.41	5.00	15.05	22.29
F6049	F607	7.41	5.00	10.20	15.11
F6060	F607	7.32	5.00	13.64	19.96
F6070	F607	5.83	5.00	28.27	32.93
F6071	F607	6.06	5.00	27.47	33.29
F6078	F607	5.61	5.00	25.73	28.86
F6080	F607	5.56	5.00	30.20	33.56
F6081/2	F607	8.11	5.00	9.87	16.00
F6086	F607	6.98	5.00	16.47	22.98
F6095	F607	6.00	5.00	27.73	33.28
F6096	F607	6.12	5.00	28.33	34.69
F6097	F607	5.88	5.00	25.87	30.43
F6098	F607	5.83	5.00	26.87	31.30
F6104	F607	7.89	5.00	14.07	22.21
F6105	F607	6.06	5.00	11.99	14.53
F6131	F607	7.32	5.00	11.58	16.95
F6131/2	F607	8.45	5.00	8.40	14.20
F6144/1	F607	5.94	5.00	25.53	30.34
F6144/2	F607	6.45	5.00	21.93	28.30
F6144/4	F607	6.12	5.00	24.20	29.63
F6157	F607	9.52	5.00	9.33	17.78
F6172	F607	6.98	5.00	16.11	22.48
F6187	F607	5.71	5.00	27.20	31.09
F6194/1	F607	7.23	5.00	15.60	22.55
F6194/2	F607	7.06	5.00	15.52	21.92
F6207	F607	5.41	5.00	21.33	23.06
F6223	F607	5.71	5.00	28.93	33.07
F9009	F607	6.90	5.00	15.20	20.97
F9023/1	F607	7.14	5.00	16.13	23.05
F9024	F607	9.52	5.00	5.13	9.78
F9025	F607	6.90	5.00	13.53	18.67
F9057	F607	7.32	5.00	10.40	15.22

F9078	F607	14.63	5.00	9.67	28.29
F6014	F608	7.32	5.00	16.60	24.29
F6033	F608	6.67	5.00	14.74	19.65
F6034	F608	6.25	5.00	13.81	17.27
F6055	F608	8.33	5.00	9.81	16.35
F6103	F608	8.33	5.00	17.87	29.78
F6127	F608	8.45	5.00	6.13	10.37
F6148	F608	6.52	5.00	14.13	18.43
F6220	F608	7.32	5.00	13.89	20.33
F6261/1	F608	6.38	5.00	16.30	20.81
F6261/2	F608	6.38	5.00	21.33	27.23
F6261/3	F608	6.06	5.00	21.20	25.70
F6261/4	F608	6.19	5.00	20.03	24.78
F6261/5	F608	5.77	5.00	25.00	28.85
F6261/6	F608	5.88	5.00	19.20	22.59
F6261/7	F608	6.00	5.00	25.07	30.08
F6261/8	F608	6.32	5.00	16.67	21.05
F6270/1	F608	6.38	5.00	21.33	27.23
F6270/10	F608	6.98	5.00	23.27	32.47
F6270/11	F608	7.59	5.00	12.68	19.26
F6270/2	F608	6.32	5.00	18.97	23.96
F6270/3	F608	6.00	5.00	22.33	26.80
F6270/4	F608	6.32	5.00	21.20	26.78
F6270/5	F608	5.36	5.00	28.33	30.36
F6270/6	F608	6.00	5.00	24.60	29.52
F6270/7	F608	5.31	5.00	22.13	23.50
F6270/8	F608	6.25	5.00	18.02	22.53
F6270/9	F608	6.12	5.00	13.68	16.75
F6272/3	F608	6.45	5.00	16.90	21.81
F6272/4	F608	6.90	5.00	19.37	26.72
F6272/5	F608	5.94	5.00	21.00	24.95
F6272/6	F608	6.38	5.00	19.36	24.71
F6272/7	F608	6.25	5.00	16.35	20.44
F6298	F608	8.70	5.00	10.53	18.32
F6298/2	F608	6.98	5.00	13.27	18.51
F6298/3	F608	6.00	5.00	20.53	24.64
F6310/1	F608	6.45	5.00	19.83	25.59
F6322	F608	5.88	5.00	19.93	23.45
F6327	F608	9.38	5.00	3.80	7.13
F6387	F608	6.06	5.00	24.87	30.14
F6392	F608	10.34	5.00	3.71	7.68

F6393	F608	6.67	5.00	18.33	24.44
F6404	F608	6.82	5.00	17.42	23.75
F6416	F608	8.11	5.00	9.33	15.14
Tel es-Safi/Gath					
14	Group 1	10.99	5.00	4.97	10.92
16	Group 1	8.00	5.00	12.43	19.90
17	Group 1	7.75	5.00	10.80	16.75
29	Group 1	9.71	5.00	6.93	13.47
30	Group 1	9.87	5.00	6.03	11.91
31	Group 1	10.26	5.00	5.30	10.88
32	Group 1	9.89	5.00	6.57	12.99
34	Group 1	10.22	5.00	4.37	8.93
35	Group 1	10.38	5.00	4.87	10.10
36	Group 1	9.67	5.00	6.07	11.73
37	Group 1	9.82	5.00	6.73	13.22
38	Group 1	10.31	5.00	5.60	11.55
39	Group 1	7.79	5.00	10.13	15.79
40	Group 1	7.84	5.00	14.37	22.52
42	Group 1	9.42	5.00	7.32	13.79
43	Group 1	9.61	5.00	7.72	14.83
44	Group 1	10.09	5.00	6.33	12.78
46	Group 1	9.63	5.00	7.67	14.76
47	Group 1	9.65	5.00	7.10	13.70
48	Group 1	10.09	5.00	6.15	12.41
49	Group 1	10.23	5.00	6.27	12.83
50	Group 1	10.34	5.00	6.28	12.99
51	Group 1	10.27	5.00	6.13	12.59
52	Group 1	10.24	5.00	4.95	10.14
54	Group 1	10.15	5.00	6.73	13.67
56	Group 1	9.79	5.00	6.53	12.79
57	Group 1	8.88	5.00	8.77	15.56
58	Group 1	9.90	5.00	6.47	12.80
59	Group 1	10.16	5.00	5.67	11.51
60	Group 1	9.42	5.00	7.02	13.22
61	Group 1	9.87	5.00	4.90	9.67
62	Group 1	10.24	5.00	3.82	7.81
64	Group 1	9.97	5.00	5.20	10.37
65	Group 1	7.50	5.00	13.07	19.61
66	Group 1	7.63	5.00	12.55	19.14
67	Group 1	9.89	5.00	6.48	12.83
68	Group 1	10.04	5.00	5.97	11.98

69	Group 1	10.00	5.00	5.22	10.43
70	Group 1	9.18	5.00	7.18	13.19
71	Group 1	10.34	5.00	6.30	13.03
72	Group 1	10.43	5.00	4.83	10.08
76	Group 1	10.81	5.00	5.45	11.79
77	Group 1	10.00	5.00	7.17	14.33
78	Group 1	10.73	5.00	5.73	12.31
1	Group 2	7.29	5.00	18.87	27.50
28	Group 2	7.60	5.00	13.48	20.49
90	Group 2	6.49	5.00	26.72	34.66
93	Group 2	9.17	5.00	8.83	16.20
94	Group 2	8.86	5.00	8.33	14.77
96	Group 2	7.46	5.00	11.85	17.69
97	Group 2	6.58	5.00	26.00	34.21
98	Group 2	8.14	5.00	9.00	14.66
99	Group 2	8.02	5.00	9.53	15.29
100	Group 2	8.92	5.00	9.18	16.37
101	Group 2	7.37	5.00	13.32	19.63
102	Group 2	7.45	5.00	14.25	21.24
103	Group 2	8.25	5.00	10.42	17.19
104	Group 2	8.88	5.00	7.95	14.11
105	Group 2	7.94	5.00	14.55	23.10
106	Group 2	9.06	5.00	4.63	8.39
107	Group 2	7.97	5.00	13.82	22.02
108	Group 2	8.85	5.00	8.28	14.66
109	Group 2	6.41	5.00	26.10	33.46
110	Group 2	8.16	5.00	10.93	17.85
111	Group 2	8.94	5.00	10.17	18.18
112	Group 2	8.04	5.00	12.88	20.72
113	Group 2	7.99	5.00	13.43	21.47
115	Group 2	9.18	5.00	8.75	16.06
116	Group 2	8.44	5.00	10.03	16.94
80	Group 4	8.26	5.00	4.80	7.93
81	Group 4	8.81	5.00	8.37	14.74
82	Group 4	8.41	5.00	10.72	18.03
12	Ungrouped	7.71	5.00	12.13	18.70
13	Ungrouped	7.67	5.00	12.43	19.06
15	Ungrouped	8.87	5.00	5.97	10.59
18	Ungrouped	10.22	5.00	5.67	11.58
19	Ungrouped	9.97	5.00	5.43	10.84
21	Ungrouped	10.38	5.00	5.03	10.45

22	Ungrouped	8.75	5.00	11.65	20.38
25	Ungrouped	6.73	5.00	20.20	27.18

Table N.2: Warp thread counts and tensions calculated for groups of loom weights

			Warp Threads/CM		Tension (g)	
Context	Group	Number of Weights	Maximum	Minimum	Minimum	Maximum
Khirbat al-Mudayna						
Gate Area		1.00	14.46	5.00	8.33	24.10
A30:65	1	4.00	7.79	5.00	9.43	14.70
A30:67	1	14.00	8.45	5.00	8.00	13.52
A30:67	1	33.00	8.70	5.00	7.70	13.39
Room 206	2	22.00	7.41	5.00	8.87	13.14
Room 206	3	1.00	7.23	5.00	34.83	50.36
Room 206	3	17.00	7.50	5.00	11.77	17.65
Room 211	4	30.00	8.00	5.00	5.50	8.80
Room 211	4	2.00	8.82	5.00	7.87	13.88
Room 211	4	3.00	9.68	5.00	6.27	12.13
Kuntillet 'Ajrud						
Excavated Weights		16.00	7.06	5.00	8.33	11.76
Tell Mazar						
Room 503	Group 1	56.00	10.91	5.00	4.40	9.60
Room 318	Group 2	26.00	8.11	5.00	21.27	34.49
GE8:14	Group 3	21.00	8.82	5.00	11.17	19.71
GE8:14	Group 4	27.00	7.89	5.00	12.90	20.37
Room 312	Group 5	19.00	10.17	5.00	22.77	46.31
Room 312	Group 6	22.00	9.52	5.00	16.60	31.62
GH8:11	Group 7	13.00	8.33	5.00	16.90	28.17

Appendix O: Tensions Calculated for Warp Arrangments with Subsets of Loom Weights Discussed in Chapter 5

Table O.1: Tensions for warp arrangments between ten and twelve warp threads/cm

Site	Artifact Number	Warp Thread Count (Threads/cm)	Tension (g)
Tell Afis	TA.89.G.310	10.00	3.33
Tell Afis	TA.89.G.337	10.00	5.00
Tel Amal	114	10.00	5.00
Tel es-Safi/Gath	69	10.00	5.22
Tel Amal	122	10.00	5.47
Beth-Shean	286292/69	10.00	5.86
Tel Amal	136	10.00	6.10
Tel Amal	117	10.00	6.14
Tel Amal	106	10.00	6.37
Tel Amal	108	10.00	6.39
Tel Amal	104	10.00	7.42
Ashkelon	44453	10.00	7.77
Tel Amal	138	10.00	8.07
Ashkelon	43918	10.00	10.37
Tell Afis	TA.92.G.429	10.00	16.00
City of David	8	10.00	5.35
Tel Amal	153	10.00	5.87
Ashkelon	44456	10.00	8.17
Tell Afis	TA.88.D.87	10.00	9.23
Tel es-Safi/Gath	68	10.04	5.97
Tel es-Safi/Gath	44	10.09	6.33
Tel es-Safi/Gath	48	10.09	6.15
Tel es-Safi/Gath	54	10.15	6.73
Tel es-Safi/Gath	59	10.16	5.67
Beth-Shean	29-103-1067	10.17	2.70
City of David	125	10.17	3.58
City of David	15	10.17	3.73
Beth-Shean	386414	10.17	3.85
Beth-Shean	29-103-705	10.17	4.25
Ta’annek	96	10.17	5.17
Beth-Shean	29-103-747B	10.17	5.21
Tell Afis	TA.87.D.12	10.17	6.20
Beth-Shean	687006/1	10.17	12.75
Ashkelon	44455	10.17	8.17
Tel es-Safi/Gath	18	10.22	5.67
Tel es-Safi/Gath	34	10.22	4.37

Tel es-Safi/Gath	49	10.23	6.27
Tel es-Safi/Gath	62	10.24	3.82
Tel es-Safi/Gath	52	10.24	4.95
Tel es-Safi/Gath	31	10.26	5.30
Tel es-Safi/Gath	51	10.27	6.13
Tel es-Safi/Gath	38	10.31	5.60
Tel es-Safi/Gath	50	10.34	6.28
City of David	18	10.34	3.30
Tel Batash/Timnah	F6392	10.34	3.71
Tell Afis	TA.86.D.63	10.34	3.87
Beth-Shean	29-103-722g	10.34	4.03
Kadesh Barnea	5	10.34	4.08
Tel es-Safi/Gath	71	10.34	6.30
Tell Afis	TA.89.D.28	10.34	7.50
Tel Amal	56	10.34	8.42
Beth-Shean	29-103-721	10.34	4.60
Ashkelon	41046	10.34	8.17
Tel Batash/Timnah	9290/2	10.34	8.67
Tel es-Safi/Gath	21	10.38	5.03
Tel es-Safi/Gath	35	10.38	4.87
Tel es-Safi/Gath	72	10.43	4.83
Tell Afis	TA.94.G.261	10.53	3.87
Tell Afis	TA.92.G.69	10.53	4.17
City of David	26	10.53	4.24
Tel Amal	34	10.53	4.69
Tel Amal	97	10.53	4.77
Tel Amal	47	10.53	5.33
Tel Amal	64	10.53	7.34
Tel Amal	130	10.53	8.74
Beth-Shean	29-103-722f	10.71	4.56
Tel Amal	49	10.71	4.67
Kadesh Barnea	19	10.71	2.95
Kadesh Barnea	18	10.71	3.13
City of David	105	10.71	3.31
Beth-Shean	29-103-724b	10.71	3.87
Beth-Shean	29-103-722d	10.71	3.94
City of David	33	10.71	5.38
Ashkelon	39062	10.71	6.00
Tel Batash/Timnah	9249/16	10.71	6.60
Beth-Shean	29-107-594	10.71	7.63
Tel Batash/Timnah	9305/1	10.71	7.78

Tel Batash/Timnah	9290/5	10.71	8.25
Tell Afis	TA.92.E.160	10.71	13.37
Beth-Shean	29-107-598	10.71	16.63
Beth-Shean	29-107-612	10.71	8.70
Tel es-Safi/Gath	78	10.73	5.73
Beth-Shean	29-103-753v	10.81	3.94
Tel es-Safi/Gath	76	10.81	5.45
Tell Afis	TA.89.G.190	10.91	0.03
Beth-Shean	29-103-74	10.91	3.05
Tell Afis	TA.92.L.54	10.91	3.27
City of David	19	10.91	3.83
Beth-Shean	29-103-753w	10.91	4.36
Tel Amal	146	10.91	4.50
Beth-Shean	29-103-744	10.91	4.61
Tel Amal	52	10.91	6.28
Tel Batash/Timnah	9290/4	10.91	6.55
Tel Amal	119	10.91	7.84
Beth-Shean	384254	10.91	12.54
Beth-Shean	687006/2	10.91	13.61
Tell Afis	TA.92.L.139	10.91	8.67
Tel es-Safi/Gath	14	10.99	4.97
City of David	36	11.11	3.12
Tell Afis	TA.96.G.125	11.11	3.13
Tel Amal	115	11.11	3.33
Beth-Shean	29-103-753i1	11.11	3.57
Tell Afis	TA.92.L.254	11.11	3.57
Beth-Shean	29-103-722h	11.11	3.64
Beth-Shean	29-103-753z	11.11	4.25
Tel Amal	110	11.11	4.84
Tel Amal	129	11.11	5.00
Tel Batash/Timnah	9249/15	11.11	7.92
Tel Batash/Timnah	9290/3	11.11	8.14
Tell Afis	TA.87.D?173/6	11.11	8.63
Tell Afis	TA.94.g.369d	11.11	9.50
Tell Afis	TA.97.E.215	11.11	12.03
Tell Afis	TA.92.G.84	11.11	2.17
City of David	85	11.11	3.21
Tel Amal	123	11.11	4.37
Ta’annek	99	11.11	5.60
Beth-Shean	988011	11.11	8.30
Beth-Shean	29-103-753m	11.21	3.79

Beth-Shean	29-107-623	11.21	3.97
Beth-Shean	29-103-724A	11.32	4.11
Beth-Shean	29-103-753d	11.32	4.17
Beth-Shean	29-107-609	11.32	19.10
Beth-Shean	887239	11.32	0.39
City of David	93	11.32	2.60
City of David	81	11.32	2.76
Tell Afis	TA.96.O.79	11.32	3.43
Beth-Shean	29-103-315	11.32	3.61
Beth-Shean	29-103-722c	11.32	3.79
Tell Afis	TA.87.D.13	11.32	3.93
Beth-Shean	29-103-753a1	11.32	4.20
Tell Afis	TA.91.E.80	11.32	4.57
Ashkelon	43720	11.32	5.00
Tell Afis	TA.88.D.168	11.32	5.27
Tell Afis	TA.88.D.97	11.32	5.27
Ashkelon	39061	11.32	5.33
Tell Afis	TA.92.G.324	11.32	13.17
City of David	114	11.54	2.33
City of David	41	11.54	2.84
Beth-Shean	29-103-753c1	11.54	4.15
City of David	129	11.54	2.03
Tell Afis	TA.92.L.255	11.54	2.87
Beth-Shean	29-103-753u	11.54	3.11
Tel Amal	1	11.54	3.38
Beth-Shean	29-103-750	11.54	3.51
Beth-Shean	29-103-753q	11.54	3.62
Beth-Shean	29-103-724d	11.54	3.64
Beth-Shean	29-103-753p	11.54	3.78
Tell Afis	TA.89.G.327	11.54	3.83
Beth-Shean	29-103-753f	11.54	3.84
Beth-Shean	29-103-753t	11.54	3.94
Beth-Shean	29-103-753j1	11.54	4.00
Tel Amal	159	11.54	4.00
Ta’annek	102	11.54	5.17
Tell Afis	TA.87.D.217y	11.54	5.33
Tell Afis	TA.87.D.100z	11.54	5.43
Tel Amal	94	11.54	7.27
Tel Amal	58	11.54	7.49
Beth-Shean	687006/4	11.54	12.26
Beth-Shean	29-107-593	11.54	14.90

Beth-Shean	987036	11.54	13.02
Beth-Shean	29-103-748	11.65	2.94
Beth-Shean	29-103-722a	11.76	4.17
Ashkelon	43617	11.76	4.67
Ashkelon	43714	11.76	4.67
Tell Afis	TA.91.E.62	11.76	8.83
Beth-Shean	29-107-685	11.76	2.62
Tell Afis	TA.92.G.70	11.76	2.83
Beth-Shean	29-103-753f1	11.76	3.23
Ashkelon	43736	11.76	3.67
Beth-Shean	29-103-753r	11.76	3.77
Beth-Shean	29-107-613	11.76	14.43
Beth-Shean	29-103-743	11.88	3.61
Beth-Shean	29-103-753c	11.88	4.40
Kadesh Barnea	8	12.00	2.40
City of David	21	12.00	0.41
City of David	29	12.00	0.61
Tell Afis	TA.96.G.479	12.00	0.99
City of David	64	12.00	1.19
City of David	1	12.00	1.37
Beth-Shean	33-9-251	12.00	1.46
Tell Afis	TA.96.G.22	12.00	1.54
Beth-Shean	286292/93	12.00	1.57
Kadesh Barnea	9	12.00	1.61
City of David	102	12.00	1.65
Beth-Shean	29-103-1071	12.00	1.70
Beth-Shean	29-103-753d1	12.00	1.71
Beth-Shean	29-107-681	12.00	1.73
City of David	130	12.00	1.73
Beth-Shean	29-103-753u1	12.00	1.73
City of David	100	12.00	1.75
City of David	68	12.00	1.77
Beth-Shean	29-107-660	12.00	1.79
City of David	83	12.00	1.80
Beth-Shean	29-107-679	12.00	1.81
City of David	84	12.00	1.85
Beth-Shean	29-103-753h1	12.00	1.87
Beth-Shean	286278/53	12.00	1.89
City of David	70	12.00	1.89
City of David	128	12.00	1.90
Beth-Shean	29-103-753i	12.00	1.93

Beth-Shean	286292/85	12.00	1.93
Beth-Shean	29-103-753j	12.00	1.93
City of David	117	12.00	1.94
City of David	54	12.00	1.96
Beth-Shean	29-103-722e	12.00	2.03
Beth-Shean	29-103-753h	12.00	2.03
Beth-Shean	29-103-742	12.00	2.04
Beth-Shean	29-103-753x	12.00	2.07
Beth-Shean	29-103-753b1	12.00	2.10
Beth-Shean	29-103-753a	12.00	2.11
Beth-Shean	29-103-722b	12.00	2.14
Beth-Shean	29-103-753o	12.00	2.14
Tell Afis	TA.92.G.470	12.00	2.14
Beth-Shean	29-103-753g	12.00	2.16
Kadesh Barnea	16	12.00	2.18
Tell Afis	TA.92.G.463	12.00	2.18
City of David	86	12.00	2.25
City of David	112	12.00	2.28
Beth-Shean	29-103-753e	12.00	2.40
City of David	104	12.00	2.42
Beth-Shean	29-103-753y	12.00	2.46
City of David	46	12.00	2.58
Kadesh Barnea	7	12.00	2.71
City of David	52	12.00	2.75
Tell Afis	TA.86.D.49	12.00	2.81
Tell Afis	TA.97.G.82	12.00	2.87
Tell Afis	TA.92.L.140	12.00	2.90
Tell Afis	TA.96.G.126	12.00	2.93
Kadesh Barnea	2	12.00	3.01
Beth-Shean	29-103-739	12.00	3.11
Tell Afis	TA.88.D.109	12.00	3.19
Tel Amal	109	12.00	3.35
Tel Amal	63	12.00	3.37
Tell Afis	TA.89.D.263	12.00	3.38
Beth-Shean	29-103-738	12.00	3.41
Tell Afis	TA.96.G.44	12.00	3.48
Tell Afis	TA.92.L.253	12.00	3.57
Tel Amal	22	12.00	3.60
Beth-Shean	29-103-753l	12.00	3.66
Beth-Shean	29-103-753g1	12.00	3.72
Beth-Shean	29-103-753e1	12.00	3.83

Beth-Shean	29-103-753n	12.00	3.83
Beth-Shean	29-103-729	12.00	3.88
Beth-Shean	29-103-724c	12.00	3.90
Ashkelon	43917	12.00	3.97
Tel Amal	126	12.00	4.00
Beth-Shean	29-103-753k	12.00	4.00
Beth-Shean	29-107-601	12.00	4.01
Beth-Shean	29-103-753k1	12.00	4.03
Tell Afis	TA.86.D.51	12.00	4.05
Ta'annek	97	12.00	4.06
Beth-Shean	29-107-611	12.00	4.39
Tell Afis	TA.91.E.72	12.00	5.06
Tell Afis	TA.92.L.97	12.00	5.07
Tell Afis	TA.96.G.263	12.00	5.16
Beth-Shean	29-107-590	12.00	5.17
Tell Afis	TA.96.G.72	12.00	5.17
Tell Afis	TA.87.D.alfa	12.00	5.20
Tell Afis	TA.92.G.309	12.00	5.36
Tell Afis	TA.92.G.438	12.00	5.41
Beth-Shean	29-103-714	12.00	5.50
Tell Afis	TA.89.G.315	12.00	5.67
Beth-Shean	29-107-622	12.00	5.80
Beth-Shean	29-107-602	12.00	6.16
Tell Afis	TA.92.G.456	12.00	6.20
Tell Afis	TA.89.G.218	12.00	6.25
Tell Afis	TA.87.D.217D	12.00	6.28
Tell Afis	TA.89.D.16	12.00	6.42
Beth-Shean	29-107-617	12.00	6.45
Beth-Shean	29-103-707	12.00	6.61
Tell Afis	TA.92.E.175	12.00	6.80
Tell Afis	TA.91.E.65	12.00	6.88
Beth-Shean	29-107-597	12.00	6.96
Beth-Shean	384192	12.00	6.96
Tell Afis	TA.89.G.209	12.00	7.00
Beth-Shean	29-107-616	12.00	7.06
Tell Afis	TA.92.G.320	12.00	7.14
Beth-Shean	29-107-610	12.00	7.26
Tell Afis	TA.89.G.284	12.00	7.29
Tel Amal	23	12.00	7.40
Tell Afis	TA.89.G.202	12.00	7.41
Tell Afis	TA.97.G.66	12.00	7.42

Tell Afis	TA.89.G.224	12.00	7.50
Tell Afis	TA.82.L.119	12.00	7.50
Tell Afis	TA.88.E.207	12.00	7.54
Tell Afis	TA.92.G.433a	12.00	7.64
Beth-Shean	29-107-615	12.00	7.68
Tell Afis	TA.88.E.142	12.00	8.08
Tell Afis	TA.97.G.315	12.00	8.23
Beth-Shean	29-107-386	12.00	8.30
Tell Afis	TA.92.G.401	12.00	8.33
Tell Afis	TA.88.E.140	12.00	8.42
Tell Afis	TA.88.D.27	12.00	8.44
Tell Afis	TA.92.G.419	12.00	8.52
Tell Afis	TA.92.L.214	12.00	8.54
Tell Afis	TA.96.G.94	12.00	8.63
Tell Afis	TA.88.E.129	12.00	8.70
Tell Afis	TA.97.E.24	12.00	9.03
Tell Afis	TA.92.G.308	12.00	9.15
Tell Afis	TA.92.G.429	12.00	9.22
Tell Afis	TA.94.G.342	12.00	9.22
Tell Afis	TA.88.D.8	12.00	9.25
Tell Afis	TA.92.G.305	12.00	9.33
Beth-Shean	29-107-61	12.00	9.36
Beth-Shean	29-107-575	12.00	10.07
Beth-Shean	29-107-606	12.00	10.14
Tell Afis	TA.92.G.480	12.00	10.19
Tell Afis	TA.92.G.224b	12.00	10.42
Tell Afis	TA.92.E.117	12.00	10.83
Beth-Shean	888107	12.00	11.76
Tel Batash/Timnah	F9078	12.00	11.79
Beth-Shean	29-107-572	12.00	12.34
Beth-Shean	687006/3	12.00	15.28
Beth-Shean	29-103-736	12.00	4.79
Tell Afis	TA.96.G.94	12.00	5.60

Table O.2: Tensions for warp arrangments with fourteen warp threads/cm

Site	Artifact Number	Warp Thread Count (Threads/cm)	Tension (g)
Tell Afis	TA.96.G.126	13.95	2.52
Tell Afis	TA.96.G.44	13.95	3.00
Beth-Shean	29-103-753i	13.95	1.66
Beth-Shean	29-103-722e	13.95	1.74
Beth-Shean	29-103-753h	13.95	1.75
Beth-Shean	29-103-742	13.95	1.76
Beth-Shean	29-103-753b1	13.95	1.81
Beth-Shean	29-103-753a	13.95	1.81
Tell Afis	TA.96.G.263	13.95	4.43
Beth-Shean	29-107-597	13.95	5.98
Beth-Shean	29-107-615	13.95	6.60
Beth-Shean	888107	13.95	10.11
City of David	21	14.00	0.35
City of David	29	14.00	0.53
Tell Afis	TA.96.G.479	14.00	0.85
City of David	64	14.00	1.02
City of David	1	14.00	1.17
Beth-Shean	33-9-251	14.00	1.25
Tell Afis	TA.96.G.22	14.00	1.32
Kadesh Barnea	9	14.00	1.38
Beth-Shean	29-107-681	14.00	1.48
Beth-Shean	29-103-753u1	14.00	1.48
Beth-Shean	29-107-679	14.00	1.56
City of David	84	14.00	1.59
Beth-Shean	29-103-753j	14.00	1.66
Beth-Shean	29-103-753x	14.00	1.77
Beth-Shean	29-103-722b	14.00	1.83
Beth-Shean	29-103-753o	14.00	1.84
Tell Afis	TA.92.G.470	14.00	1.84
Beth-Shean	29-103-753g	14.00	1.85
Kadesh Barnea	16	14.00	1.86
Tell Afis	TA.92.G.463	14.00	1.87
Beth-Shean	29-103-753e	14.00	2.06
City of David	46	14.00	2.21
Kadesh Barnea	2	14.00	2.58
Tel Amal	109	14.00	2.87
Tel Amal	63	14.00	2.89
Tell Afis	TA.89.D.263	14.00	2.90

Beth-Shean	29-107-601	14.00	3.44
Beth-Shean	29-107-611	14.00	3.76
Tell Afis	TA.91.E.72	14.00	4.33
Beth-Shean	29-107-590	14.00	4.43
Tell Afis	TA.92.G.309	14.00	4.59
Tell Afis	TA.92.G.438	14.00	4.63
Beth-Shean	29-107-602	14.00	5.28
Tell Afis	TA.92.G.456	14.00	5.31
Tell Afis	TA.89.G.218	14.00	5.36
Beth-Shean	29-107-617	14.00	5.53
Tell Afis	TA.91.E.65	14.00	5.89
Tell Afis	TA.92.G.320	14.00	6.12
Tell Afis	TA.89.G.284	14.00	6.25
Tell Afis	TA.97.G.66	14.00	6.36
Tell Afis	TA.88.E.207	14.00	6.46
Tell Afis	TA.88.E.142	14.00	6.92
Tell Afis	TA.92.G.401	14.00	7.14
Tell Afis	TA.88.E.140	14.00	7.21
Tell Afis	TA.92.L.214	14.00	7.32
Tell Afis	TA.96.G.94	14.00	7.39
Tell Afis	TA.92.G.308	14.00	7.84
Tell Afis	TA.88.D.8	14.00	7.93
Tell Afis	TA.92.G.305	14.00	7.99
Tel Batash/Timnah	F9078	14.00	10.10
Beth-Shean	687006/3	14.00	13.10

Appendix P: Glossary of Textile Related Terms

Balanced Textile: Fabric with equal warp counts and weft counts (Barber 1991: 127).
Bast Fibers: Fiber taken from the woody stem of a plant (e.g. hemp or linen) (Barber 1991: 11).
Beam: A rod to which the warp threads are attached (Barber 1991: 80).
Fabric: Any material constructed from fibers (e.g. textiles, paper, felt) (Emery 1966: XVI).
Fibers: A component of any animal or plant tissue used to make fabrics (Emery 1966: 9).
Heddle Rod: A rod attached to one half of the warp threads which allows the weaver to manipulate one half of the warp threads at a time (Barber 1991: 81-82).
Hemp: Fiber from the stem of the hemp plant (*Cannabis sativa*) (Barber 1991: 15).
Linen: Fiber from the stem of the flax plant (*Linum usitatissimum* or related wild species) (Abbo et al. 2015).
Loom: A frame used to weave fabric from two sets of perpendicular threads (i.e. the warp and weft). A loom's primary function is to create tension on the warp threads (Barber 1991: 80).
Loom Weight: A weight suspended from a group of warp threads to create tension on a warp-weighted loom (Hoffmann 1974).
Selvedge: The edge of a woven fabric (Barber 1991: 9).
***Sha'atnez* Fabric:** Fabric woven with wool yarn and linen yarn (Sheffer and Tidhar 2012: 307).
Shed: A passageway in the warp threads created from alternating which warp threads are in front and are in back (**countershed** is the passage with the warp threads reversed from the shed) (Barber 1991: 82).
Spinning: The processes of twisting short fibers into a long continuous yarn (Emery 1966: 9).
Tabby Fabric: Woven fabric in which each weft thread passes over and then under alternating warp threads, and in which the pattern of which warp threads are in front or in back alternates in each row (also called plain weave) (Emery 1966: 76).
Tapestry: Weft faced fabric in which additional warp threads are added to create a design. The weft threads do not always traverse the entire fabric (Barber 1992: 11).
Textile: Fabric woven from two intersecting sets of threads (Emery 1966: 74).
Thread Count: The number of warp and weft threads in one centimeter of fabric (Emery 1966: 76).
Warp Threads: One set of threads used to weave fabric. The warp threads are set up on the loom at the start of weaving (Barber 1991: 80).
Warp Threads/cm: The number of warp threads in one centimeter of fabric measured at a right angle to the warp threads (also Warp Thread Count or Warp Count).
Warp Faced Fabric: Fabric with a higher warp count than weft count, in which the warp threads hide the weft threads (Barber 1991: 107).
Warp-Dominant Fabric: Fabric with more warp threads per centimeter than weft threads per centimeter (Smith 2014: 70).
Warp-Weighted Loom: A type of loom on which the warp threads are stretched between the beam and a set of weights (Hoffmann 1974).
Weaving: The process of creating fabric from two perpendicular sets of threads (i.e. the warp and the weft) (Barber 1991: 5).
Weft Threads: One set of threads used to weave fabric. Weft threads are added one at a time at a right angle to the warp threads (also called *woof*) (Barber 1991: 80).
Weft Threads/cm: The number of weft threads in one centimeter of fabric measured at a right angle to the weft threads (also Weft Thread Count or Weft Count).

Weft Faced Fabric: Fabric with a higher weft count than warp count, in which the weft threads hide the warp threads (Barber 1991: 127).
Weft-Dominant Fabric: Fabric with more weft threads per centimeter than warp thread per centimeter (Smith 2014: 70).
Wool: Fiber taken from the undercoat of a sheep (Barber 1991: 20-21).
Yarn: A continuous strand created from fibers for use in weaving (Emery 1966: 10).