Dress, Cloth, and the Farmer's Wife: Textiles from Ø 172 Tatsipataa, Greenland, with Comparative Data from Iceland

Author(s): Michèle Hayeur Smith
Source: Journal of the North Atlantic, 6():64-81. 2014.
Published By: Eagle Hill Institute
URL: http://www.bioone.org/doi/full/10.3721/037.002.sp607

Dress, Cloth, and the Farmer's Wife: Textiles from Ø 172 Tatsipataa, Greenland, with Comparative Data from Iceland

Michèle Hayeur Smith*

Abstract - Midden excavations at Ø172 (Tatsipataa), on the eastern shore of the Igaliku fjord in southwestern Greenland, produced a significant textile collection consisting of 98 fragments. This collection is important as it stems from a well-contextualized and well-stratified sequence, allowing significant insights into the evolution and nature of cloth production in Greenland. Analysis of this collection showed that while the earliest fragments mirror Icelandic counterparts of comparable ages, the Ø172 collection changes considerably by the 14th century. From this point onward, Greenlandic women wove a weft-dominant cloth unique to Greenland. This cloth type has previously been noted in other, later, Greenlandic collections, but the Tatsipataa collection provides new evidence for the date of its first production. The sudden appearance of this distinctive weft-dominant Greenlandic homespun in the mid-14th century suggests that its production was a domestic adaptation to the initial climatic fluctuations of the Little Ice Age. Overall, the Tatsipataa collection suggests that Greenlandic textile production did not follow the evolutionary trajectory of Icelandic textiles, which became a form of currency from the early to the later Middle Ages. Instead, Greenlandic textiles appear to have been consistently produced for household consumption, without the intense standardization for trade observed in medieval Icelandic collections.

Introduction

Textile production was one of the more important household activities of Icelanders in the 10th century. Produced entirely by women, textiles rapidly gained importance, becoming a significant trade commodity exported to Norway in the early medieval period, with growing markets expanding first to the British Isles and then to Northern Europe (Gelsinger 1980:69–70; Hayeur Smith, in press). Within Iceland, cloth became the basis of the economic system, used as currency to pay taxes, tithes, debts, and fines. Medieval literary sources suggest strict legal guidelines that were implemented regulating the size, length, and quality of this currency (Dennis et al. 1980, 2002; Hayeur Smith 2014:732–733; Hoffman 1974:213; Þórláksson 1991).

All textile production in Iceland was done using the warp-weighted loom and drop or high-top whorl (see Fig.1; Andersson Strand 2011:5,6,8,9; Bender Jørgensen 1992:11; Hayeur Smith 2014a:732; Hoffman1974:226; Robertsdottir 2008:67). Basic weaves encountered varied through time, with most diversity in weaves found during Iceland's Viking Age (Hayeur Smith 2013b) and rapidly declining so that the main weave types which dominate the assemblage in the early medieval period are the 2/2 twill and the tabby[1] or plain weave (Fig. 2; Hayeur Smith 2014:738)

By the last decades of the 10th century, when the Icelanders sailed to Greenland to settle, they brought with them this important textile tradition and continued to produce cloth for household needs. Cloth had many utilitarian functions—as clothing, sails, tents, and household equipment—but cloth did not retain its value as a form of currency in Greenland as it had done in Iceland. Instead, Greenlandic cloth production evolved in a very different direction, one that was based more on local consumption.

Midden excavations were carried out in southwestern Greenland on the eastern shore of the Igaliku Fjord at Ø172 Tatsipataa between 2009 and 2010, and were part of the Vatnahverfi project focusing on understanding Norse farming and hunting strategies as well as local resource management (Smiarowksi 2012:3). The site of Ø172 was selected following coring and surveying of the area, though it was the midden, located in close proximity to a Norse farm, that was the focus of the project and from which a sizeable quantity of archaeofauna and textiles were found (Fig. 3). Organic remains such as these, well preserved in permafrost, are becoming increasingly rare due to climatic fluctuations and overall warming trends (Smiarowski 2012:4). Widespread degradation of the archaeological record seems inevitable, and the preservation of so many textiles is an important, if unexpected, contribution from this site. The textiles from Ø172 are also important as a result of having been excavated under controlled conditions from a well-stratified sequence. As information from a properly contextualized site, they offer a unique opportunity for contributing to understanding the evolution of textile production in Greenland as well as identifying important strategies that were adopted as climate changed in Greenland during the start of the Little Ice Age.

These textiles were sent to Brown University and were cleaned and curated by Alex Allardt, consulting

*Haffenreffer Museum,Brown University, 300 Tower Street, Bristol, RI, 02809, USA; Michele_Smith@brown.edu.

conservator for Brown University's Haffenreffer Museum of Anthropology and were analyzed by the author. This paper presents preliminary results of this analysis, placing this material into a larger context of cloth production in the North Atlantic during the medieval period.

The Data and its Analysis

Textiles from Ø172

Textiles from the North Atlantic and Scandinavia have been the topic of numerous scholarly works (e.g., Scandinavia: Andersson 2003; Andersson Strand 2011; Bender Jørgensen 1986, 1992; Christensen and Nockert 2006; Hagen 1994; Hägg 1974, 1984a, 1984b, 1986, 1991; Kjellberg 1982, Kjellberg and Hoffman 1991; Vedeler 2007. Icelandic textiles: Damsholt 1984; Guðjonsson 1962,1965,1970,1973, 1980, 1989, 1990, 1992, 1994, 1998a, 1998b; Hayeur Smith 2012, 2013a, 2013b, 2014, in press; Robertsdottir 2008, Walton Rogers 2012. Greenlandic material: Nørlund 1924, 1925; Østergård 1998,2004, 2005).

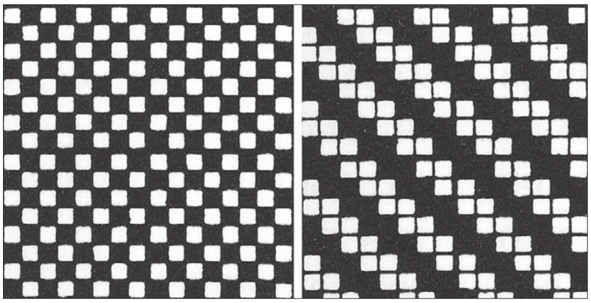

Figure 2. Weave types encountered in medieval Iceland: to the left a tabby or plain weave, and to the right a 2/2 diagonal twill (Bender Jørgensen 1992:12)

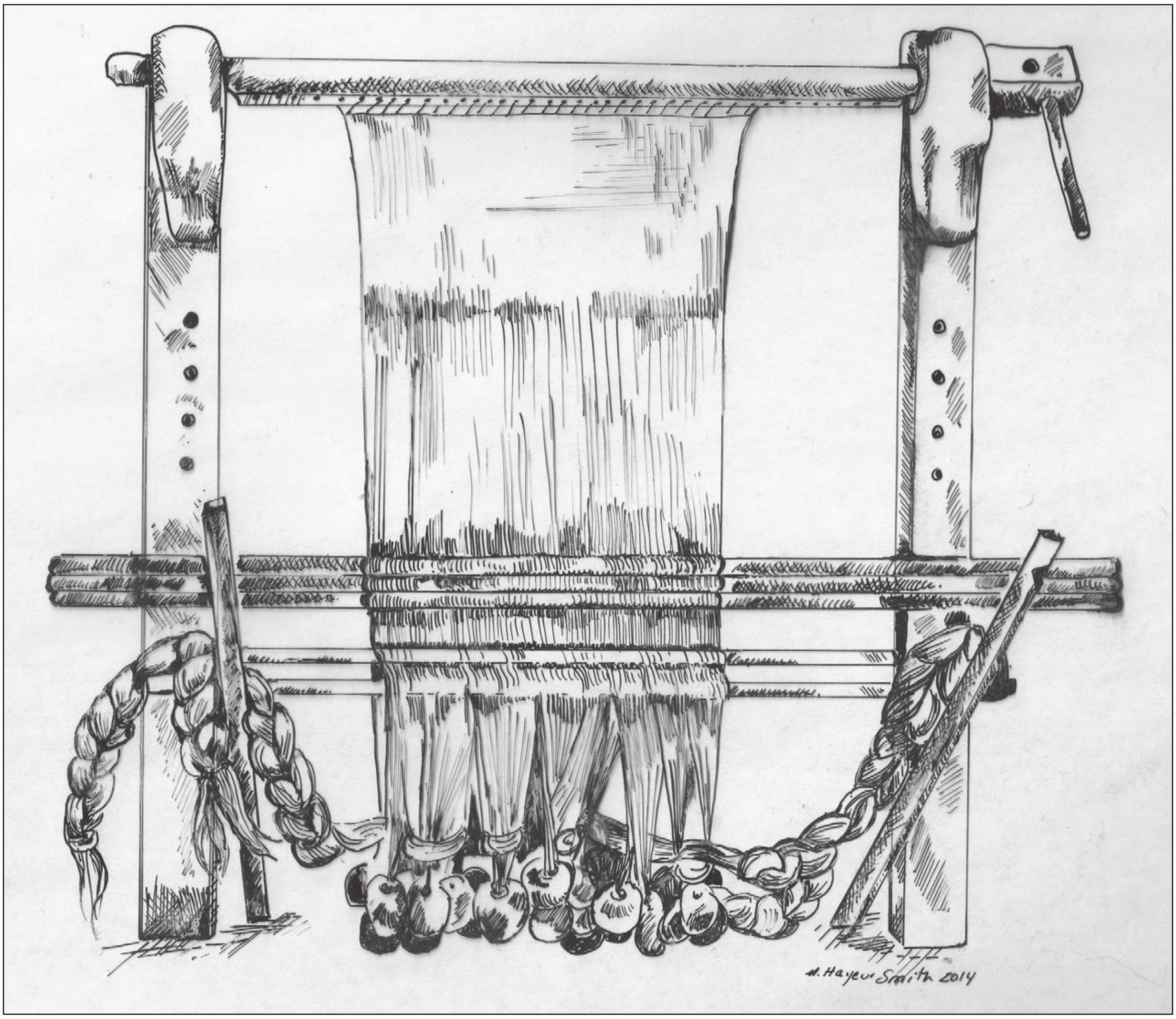

Figure 1. The warp-weight loom. The illustration was done based on a replica of a warp-weighted loom on display at the National Museum of Iceland. The extra warp yarns braided to the side may not always be displayed in this manner, and the set up may vary slightly from region to region. (Illustration © Hayeur Smith 2014).

The textile collection from Ø 172 was catalogued under 63 field numbers, although the actual number of fragments (98) associated with these field-assigned numbers was far larger after conservation and analysis. The majority of the textiles from Ø172 came from Area C (76), with fewer from Area B (22).

Preliminary dating of the midden phases by K. Smiarowksi (Hunter College, CUNY, NY, New York, USA) are shown in Table 1. Each piece was analyzed for fiber type, object dimensions, thread counts (warp and weft), warp and weft yarn dimensions, spin tension (when possible), construction details, color, weave pattern, evidence for incorporation within larger garments or objects, adhering or incorporated non-textile materials, and unique features. All objects were photographed using a digital DinoScope® microscope at magnifications of 70x– 200x and a Nikon digital camera. Samples have been taken from select pieces of cloth and await further analysis for fiber and dye identification, which will be carried out by McCrone Assocaites, Inc. (Chicago IL, USA).

The range of textile finds from the site is shown in Table 2. Most of the textiles analyzed are 2/2 twills, some warp-faced with dominant warp thread counts. An additional 12 items were very fragmented, although it is most likely that these were 2/2 twills, as well. There are two 2/1 twills, and 1 possible tabby, although the weave was too disarticulated to be certain of this identification. Additionally

Table 1. Midden phases from Ø 172, and their preliminary dating and number of textiles found.

Phase	Date	Number of textiles
Phase 1	AD1000–1100	59
Phase 2	AD1100–1200	34
Phase 3	AD1200–1300[4]	5

Table 2. Distribution of types of textiles found.

2/2 twills	Possible 2/2 twill	2/1 twill	Tabby	Cordage	Yarn	Clumps of raw wool	Vegetal
69	12	2	1	3	5	3	3

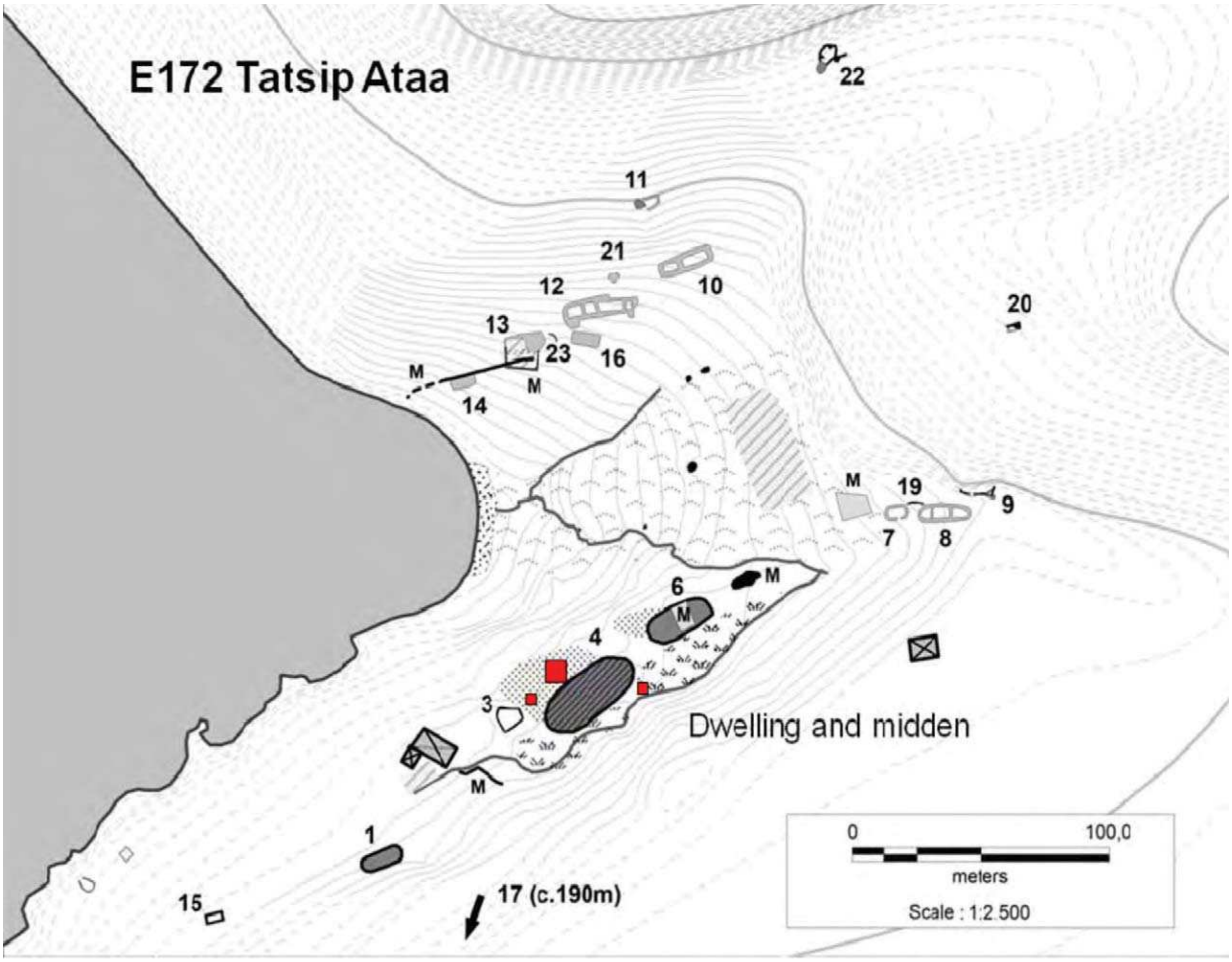

Figure 3. E172 Site plan with the excavation areas marked in red. Areas A–C are the largest red square NW of str. 4. Area D is the smaller square NW of Str. 4, and Area E is the small square SE of Str.4. Plan by C.K.Madsen. (in Smiarowski 2012:6).

there are cords of wool, raw wool, and three fragments of vegetal material, with preliminary visual identification as sphagnum moss by Heather Trigg (University of Massachusetts, Boston's Fiske Center for Archaeological Research, Boston, MA, USA).

The spinning pattern for all of these textiles follows a pattern previously noted on Icelandic cloth: warp yarns are single z-spun while weft yarns are s-spun. Visual identification indicates that the warp fibers tend to be noticeably more coarse that the weft fibers because the warp yarns are spun from the outer hairs—the *tog*—and the weft from the softer and fluffier inner coat—the *þel*—of the "northern short tail" sheep (Østergård 2005:81; Ryder 1982:224; Walton Rogers 1998, 2011). This feature is unique to the Norse textile tradition and is first noted in Viking Age Norway according to Bender Jørgensen (1986, 1992), and may be have been adapted to the structure of the warp-weighted loom and the need for strong and coarse fibers able to withstand being suspended from the loom, though this remains inconclusive and requires further investigation. The same pattern was noted in other Greenlandic textile collections by Walton Rogers, who pointed out that that Greenlandic fibers were of the hairy- and hairy-medium fleece type, with a mean of 33–56 microns for the warp and 21–38 for the weft fibers (Walton Rogers 1998:69; Walton Rogers in Østergård 2004:83). Icelandic textiles offer similar ratios, with large warp fibers often >100 μ displaying continuous medullas, medium fibers in the range ≈30–60 μ, and the undercoat fibers in some cases very fine with the smallest diameters ranging around 10 μ (Ordoñez 2011). Preliminary testing is also underway on the Ø172 textiles to determine whether other types of fiber such as goat hair and rabbit fur were incorporated into them, as noted by Østergård (2004) in other Greenlandic collections.

In other archaeological contexts, Spin direction[2] has often been linked to geographic regions (Bender Jørgensen 1986, Minar 2001:384). In Iceland, the choice to spin z/s textiles may have some association with foreign textile traditions that made their way into Iceland during the Landnám period, as more than half of Icelandic textiles from the Viking Age are spun like those most characteristically found in Norway during the Viking Age: z/z (Hayeur Smith, in press).[3] Yet a significant proportion of textiles, even in the Viking Age, were z/s, and by the 12th–13th century, this spin pattern became dominant in Iceland (ibid.) and in Norway as well (Vedeler 2007:285–384). In Iceland, this rapid shift in spin direction could be linked either to the ethnic origins of the women doing the spinning or by trade with the British Isles, Scandinavia, and Continental Europe where this spin tradition was widespread (ibid.).

The tension of the yarns used in weaving cloth is affected both by the technological structure and requirements of the warp-weighted loom and the needs of the weavers (Mårtensson, et al. 2009:396–397). Most of the warp yarns in the Ø172 collection are hard spun, between 30–45°, while wefts are fluffier, between 15–30°, which promotes more napping on the surface of the cloth.

Unique Aspects of the Ø172 Textiles and their Relationship to other Greenlandic Collections

Modifications, sewing, and weaving features

The transformation of textiles into dress items is usually visible by the presence of stitching, hems, embroidered eyelets, patching, or particularities in the cloth itself such as the presence of starting borders. Although none of the latter were noted in this assemblage, these borders are common features used to identify the use of the warp-weighted loom in textile production. Another commonly identified feature in North Atlantic assemblages are selvages—the borders or edges of the piece of cloth created during the weaving process. These features, when present, offer insights into the use of cloth in various areas of life, into dress practices, and into functional contexts of textile production for sails, tents, blankets, etc. Twenty-three of the ninety-eight textiles from Ø172 present some of these technical details, shedding light into their use as objects (Table 3).

Utilitarian items

No. 1363a from Area B, layer 195C, may have been a part of a sail or tent as it has a visible large, stitched eyelet with a diameter of 14.90 mm (Fig. 4) similar to a sail cloth eyelet (Trondenes 06) found in 1994 within the Trondenes Church by Jon Bojer Godal (Cooke et al. 2002:204) and radiocarbon dated to AD 1280–1420 (ibid). It is made using the eyelet stitch (similar to the button hole stitch; Fig. 5; Thursfield 2001:54–58). Eyelets which served to rig the ship with ropes were stitched or embroidered directly into the sail. Sail cloth is difficult to identify archaeologically, is uncommon, and it is generally thanks to eyelets such as these or the presence of surface treatment making the sails stiff that they can be identified (Cooke et al. 2002:204).

Table 3. Textile fragments from Areas B and C offering information on household items, dress, or weaving technology.

	Eyelet	Tablet woven piping	Patching	Hem/ seams	Selvage	Striped textiles
Area B	0	3	0	4	1	1
Area C	1	0	1	7	1	4

Typically, Scandinavian sail cloth was made of a 2/1 twill. This pattern is particularly characteristic of Danish and Swedish sails from the 11th–13th centuries, but in Iceland they were almost always 2/2 twills (Cooke et al. 2002:204) such as with the Greenlandic sample No. 1363a. The Oseberg ship sails were also made from a 2/2 twill (Christensen and Nockert 2006:20).

Experimental trials at Roskilde, Denmark, undertaken to reconstruct the Skuldelev ships, indicated that wool performed better than linen for making sails, providing more stretch and elasticity in strong winds (Cooke et al. 2002:207). Through experimental trials, it was also noted that different grades and weights of wool produced different results and that sails needed to be treated to reduce airflow (ibid). This surface treatment, or smörring, consisted of rubbing the cloth in animal fat, resin, and red ochre (Cooke et al. 2002:209). Although Ø172 1363a did not display such properties, further analysis is required to test for the presence of these materials. Undoubtedly, similar surface treatments would also be required for tents, particularly in the rainy and windy conditions of the North Atlantic.

Figure 4. No. 1363a—possible eyelet from a sail or tent (Photograph © M. Hayeur Smith 2012).

Figure 5. Close up of No. 1363a showing details of the eyelet stitch (Photograph © M. Hayeur Smith 2012).

Clothing fragments and sewing

Ø172 offered several examples of stitching, patching, discarded hems, or finishing touches done on garments. Of particular interest are the tablet-woven piping fragments found in Area B: 386a,b and 286 (Fig. 6). This decorative technique was used to edge garments and prevent the cloth from fraying. Tablet-woven piped edges use a combination of tablet weaving and stitching whereby the weft thread in the tablet weave also acts as the sewing thread that secures the edge of the cloth (Østergård 2004:104).

Selvages can also be used to edge garments. They are produced as the natural edges that form while weaving on the warp-weighted loom and are not decorative, as are the tablet-woven piped edges. Østergård (2004) noted two different types of selvage in Norse Greenlandic cloth. In one, the weft threads are crossed once at the end; in the other type, they are crossed over twice to create a cluster of threads grouped in fours (see Østergård, 2004:65, figs 33, 34). Selvages were noted on No. 1151a from Area C, and 343 from Area B (Fig. 7). One of these examples appears to be of the first type, while the other is inconclusive due the size of the piece and deterioration of the weave.

Patching was also identified at Ø172, and is very widespread in Icelandic collections, suggesting that cloth was commonly worn to the extreme and that no piece of cloth was wasted. As a result, clothing identified in the archaeological collections was frequently patched until the garments could no longer withstand being patched before they were discarded in the middens of Norse farms.

This level of cloth recycling cannot be overstated and is a significant characteristic of textiles and their use in the Norse colonies of the North Atlantic as well as in Scandinavia (Vedeler 2007). Despite the variability that might exist between skins, furs, and different grades of cloth, it is interesting to consider that parkas, for example, while made of skins and fur, lasted on average one year if worn daily and were recut and transformed into blankets, etc., thereafter (Kobayashi Issenman 2000:40). Once cloth began to fray and wear, it could be salvaged and reused to make other household items or used as patches on existing garments. A few noteworthy pieces, such as the shirt from Búaland, Iceland (H. Gestsdóttir, Fornleifastofnun Íslands, 2011 pers. comm.; Róbersdóttir 2008:vi), include 17–20 patches on a single shirt. This intense recycling of clothing is also apparent in the numerous discarded hems found in Icelandic middens, often interpreted as "cording". When the cloth is folded onto itself and stitched down to create a finished edge at the base of a garment it becomes permanently fixed, creased, and no longer flexible for reuse. It is easier to cut the hem off rather than work painstakingly at undoing the stitches and attempting to flatten the cloth for reintegration into a new garment or object. Several of these hems were noted at Ø172, including 1365b, 1129 (2), 1151e,h, and 1409 from Area C, and 600b and 444a,b,c from Area B.

Stitching is visible on these discarded hems—386a, noted for its tablet-woven piping, also shows evidence of having been patched and stitched. Stitching is often visible on both Icelandic and Greenlandic cloth due to the use of a plied thread, which is more solid and helps create

Figure 6. No. 386a with tablet-woven piped edging. (Photograph © M. Hayeur Smith 2012).

Figure 7. Selvage, type 2 identified on No. 343 from Area B. (Photograph © M. Hayeur Smith).

a more durable stitch. Typically, overcast or hemming stitches are used to keep garments together (Thursfield 2001:44). No. 1151g, while very small, may also have been an eyelet of some sort. As intense napping on the surface of the cloth obstructs visibility, it is only possible to see the outlines of some eyelet stitching on this piece.

Other interesting features at Ø172 include two sets of cloth from Area B (no. 708) and from Area C (no. 1179 a,b,c) with striping made from two colors of yarn: light and dark brown in color (initially probably white and tan). A similar piece was recorded from the Farm Beneath the Sand (GUS), (64V2-III-555), that originally combined black 2/2 twill of goat hair with narrow stripes of white fur from Arctic hare (Østergård 2004:71). A recent re-analysis of fibers from textiles from the Farm Beneath the Sand site using ancient DNA studies, has determined that several of the initial species identification were incorrect, though the arctic hare (64V2-III-555) remains inconclusive (G. Nyegaard, Greenland National Museum and Archives, Nuuk, Greenland, 2014 pers. comm.). The "hare" fur from the fragment found at the GUS was noticeably different from the rest of the fibers. This was not the case at Ø172, though further testing is required. Number 1179 a,b,c, along with others, await analysis for fiber content identification.

Two additional pieces, 1090 and 1370 (both from Area C), show a crease or anomaly in the weave that is difficult to discern visually. This may be due to idiosyncrasies of the weaver and therefore part of the cloth or the result of being folded and crushed in a midden for the last 700 years.

Weft-dominant cloth

One of the more unique features of Greenlandic cloth is the dominance of noticeably high weft thread counts in the archaeological textile collections. Arriving in Greenland, the Norse brought with them textile traditions from Iceland that, as a rule of thumb, incorporated more warp threads than weft threads in their weaves. This warp-dominant characteristic was noted in the earliest textiles found at Ø172. As elsewhere in Greenland, it is almost impossible to discern Icelandic from Greenlandic cloth in these earlier phases.

Østergård (2004) attributed the weft-dominant cloth, which appeared later in her sequence, to women looking to make warmer clothing in the face of increasingly harsh winters (Østergård 1998:62, 65; 2004:62–63; 2005:81), and this change clearly would be an effective adaptive strategy in garment construction (M.T. Ordoñez, University of Rhode Island, Kingston, RI, USA, 2012 pers. comm.). Østergård (2005:81) felt that the use of more underwool that was then beaten more closely on the loom created a more firm and warmer product. Alternative solutions might involve surface treatment of the textiles, which surprisingly none of the Ø172 textiles display. Østergård never identified a specific date when this transition took place, only stating that this was a characteristic that could be used to identify Greenlandic *vaðmál* in other archaeological settings and that it seemed to appear in later contexts (ibid.).

Ø172 is unique in this regard as it has the advantage of having a relatively well-controlled chronological sequence spanning several centuries that allows this behavioral feature to be tracked through time despite its relatively small sample size in comparison with other Greenlandic collections. In Area B, no textiles were noted with high weft-thread counts; all were like their Icelandic counterparts. However, Area B also had far fewer textiles than Area C and the absence of weft-dominant textiles there may simply reflect sample size. By contrast, textiles from Area C show this shift in weaving patterns occurring in the second and third phases of the site's sequence[4] (Fig. 8). It appears that weavers were experimenting with this technological anomaly before implementing it fully into their cloth tradition, as there is a clear chronologically sensitive sequence from warp-dominant textiles in Phase 1 to equally balanced and weft-dominant textiles in Phases 2 and 3, (as mentioned above, phase 2 and 3 date dated to later periods [1100–1300+]). In Area C, textiles from layer 114 (Phase 1) begin to show textiles with equal thread counts, as do textiles from layer 93 in Phase 2. By layer 86, in Phase 2, this trait is well established and weft threads start to outnumber warp threads significantly, with thread counts of 10/15 or 8/13 and with the numbers of weft-dominant textiles increasing through time. Figure 8 displays thread counts for the various phases at Ø172: Phase 1–2 textiles clearly mirror the Icelandic vaðmál, yet by late Phase 2 things begin to change, with an increasing amount of cloth produced using weft-dominant weaves. The only textile from Phase 3 has a weft-dominant weave, as was also the case at the later Norse site of Herjolfsnes, where this weft-dominance intensifies with extremely high weft-thread counts.

In order to establish an approximate date for this shift in weaving, two fragments of cloth from Area C were sampled and submitted for AMS dating at Beta Analytic Laboratories (Fig. 9): No. 1142b, from Context 93 (Beta-320126), produced a radiocarbon age of 600 ± 30 bp, calibrated at 1-sigma to calAD

1309–1398 and at 2-standard deviations to calAD 1297–1408. Internal probabilities suggest the most likely estimate for its actual age is calAD 1309–1361 under the 1-sigma curve ($P = 0.797$) with a far lower ($P = 0.202$) probability of falling within the secondary curve, calAD 1386–1398. At two standard deviations, there is an internal probability of 0.74 that the date for this sample falls in the interval calAD 1297–1373. With fair certainty, the best estimate for the age of this sample is ca. calAD 1300–1365.

No.1090, from Context 86 (Beta-320125), produced a radiocarbon date of 560 ± 30 bp, calibrated at 1-sigma to calAD 1323–1415 and at 2-standard deviations to calAD 1308–1428. Internal probabilities under the 1- and 2-sigma curves are almost exactly evenly split between the intervals calAD 1323–1347 and calAD 1392–1415 (under the 1-sigma curve) and 1308–1361 or calAD 1386–1428 (under the 2-sigma curve). Given the even internal probabilities under both curves, the best estimate for the age of E172-1090 is calAD 1323–1415 at 1-sigma and calAD 1308–1428 at 2 standard deviations.

These samples' ages are statistically identical at $P > 0.95$ (T = 0.8888889). Given their stratigraphic comparability (based on the excavators' Harris Matrix placement), their similarity as the earliest Greenlandic weft-dominant cloth samples in the site, and the probability that the garments they represent were in use for more than a single (or even a few) years and may have been recycled and reused for quite a few years, an average of the two dates is reasonable and may provide a closer approximation of the age of the later deposits from which both samples came. The pooled average of these two samples, 580 ± 21 bp, calibrates to calAD 1320–1405 at 1-sigma, with a 68.3% internal probability under the 1-sigma curve that the actual date for these deposits falls within the interval calAD 1320–1349. At two standard devia-

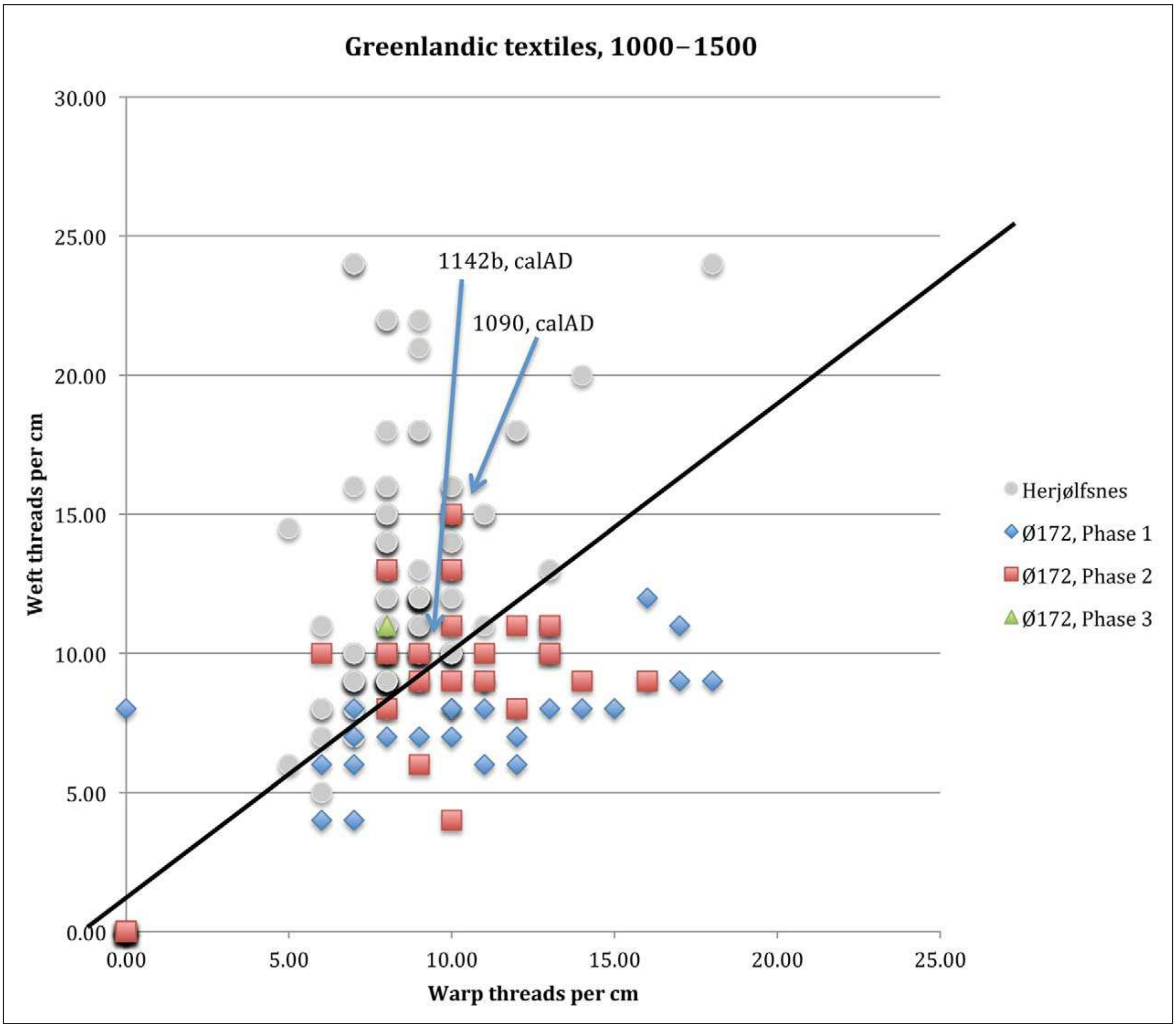

Figure 8. Thread counts recorded from Herjolfsnes (Østergård 2004) and Ø172 phases 1–3.

tions, the range for the age of these samples is calAD 1308–1413, with an internal probability of 67.5% under the 2-sigma curve that the most accurate age estimate for the initiation of the deposition of weft-dominant cloth at Ø172 commences somewhere around calAD 1308–1362 (Fig. 9).

While the data here is meager and only represents one site, the pattern suggested appears to follow other textile data from Greenland: the transition to weft-dominant cloth was a feature that appeared later rather than earlier on in the settlement. Furthermore, the results do confirm the suspicions voiced by Østergård (2004:63) that weft-dominant cloth was developed because "Greenlanders wanted clothes that were warmer."

Ø172 Textiles in Light of Comparative Material from Iceland

Contemporaneous Icelandic textiles

Icelandic textiles from the Viking Age share common features and form a distinct cluster of textiles within a chronology of North Atlantic cloth production (Hayeur Smith, in press). These early textiles tend to include more diversity in weaves, color, and spin direction and also share many features with Norse colonies in the British Isles. It was noted by Bender Jørgensen (1992) and Walton Rogers (1989) that textiles in Great Britain from the 9th and 10th centuries show differences between grave finds from Scotland, Ireland, the Isle of Man, and urban sites:

> "The textiles from urban sites are mainly z/s woolen twills, viz. both plain diagonal twills, broken twills, and diamond twills and sometimes 2/1 lozenge twills whereas tabby is relatively rare. Fabrics with z/z spin are rare too, whereas this spin combination is common in the graves both of Anglo-Saxon England and of Viking Scotland and Ireland. The Viking graves as just described exhibit a strong predominance of z/z tabby and a few z/z twills …" (Bender Jørgensen 1992:40).

The main distinction appears to be spin direction, which has close correlations with geographic distribution and cultural affiliation as mentioned earlier (Minar 2001:384). Viking Age burial sites from the British Isles and Iceland share similar textile traditions with Viking Norway, with z/z textiles as the preferred spin directions. Textiles from settlement sites from the same period in Iceland share textile traditions with British urban sites and continental Europe, with greater numbers of z/s cloth (Fig. 10; Hayeur Smith, in press).

Comparisons between Greenland and Iceland's Landnám period are impossible, and textiles from the earliest phases at Ø172 meet with more limited comparative datasets from early medieval Iceland due to a general paucity of archaeological material for the 11th–13th centuries in the Icelandic archaeological record. Despite this, it is possible to gain a sense about what textiles were like from the few specimens that do exist and from textiles dating to the early or mid-1200s.

Very early on in the Commonwealth period it appears that Iceland turned its cloth production strategies towards manufacturing very standardized cloth (Hayeur Smith 2014:733). Based on analyses carried out on Icelandic textiles by the author,[5] textiles are predominantly 2/2 twills, the majority of which have hard spun warp threads and fluffier wefts; all are z/s spun with a warp thread count range between 4–14 (ibid.) Certain sites such as Bergþórshvoll appear to have been engaged in producing this type of cloth in a quasi-industrial fashion. The data clusters in Figure 11 clearly illustrate the growing importance of vaðmál as a

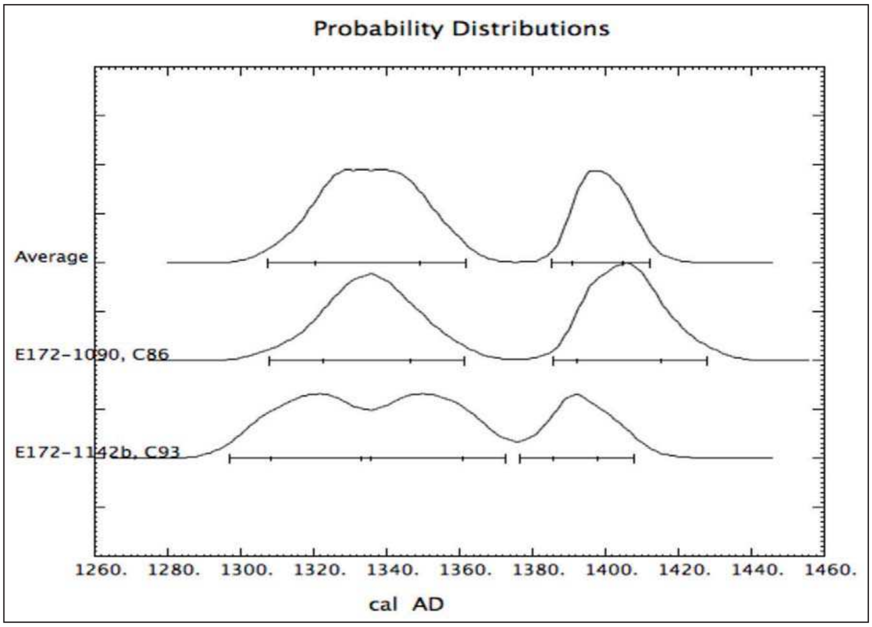

Figure 9. Probability Distributions for calibrated radiocarbon dates on textiles from Ø172.

legal currency and trade commodity (Hayeur Smith 2012, 2013a, 2014), while the thread counts resonate with records that exist on the topic of legal vaðmál studied by Helgi Þórláksson in his doctoral dissertation (Hayeur Smith 2014:733). Additionally, it is clear that cloth currency did not diminish in importance after the 13th century, as has generally been thought. Instead, a more complex and nuanced picture emerges, with a tapering off of cloth currency as a trade commodity in the 16th or 17th centuries. The continuing significance of vaðmál as a trade product into the late 16th century was observed in the English harbor records examined by Helgi þórlaksson (1991):

> "August 1596, for example, a 60 ton English ship engaged in Icelandic trade docked at Yarmouth, England carrying 640 yards of vaðmál, 240 vaðmál socks, 720 vaðmál mittens, and 18 vaðmál cassocks, which the harbormasters assessed as being worth more than all of the fish that filled its hold" (þórlaksson 1991:262; K.P. Smith, Haffenreffer Museum of Anthropology, Brown University, Providence, RI, USA, translation).

In Figure 11, this standardization is noted especially in data from the sites of Gásir, Möðruvellir, Kúabot, and Bessastðair, with thread counts centered around 8, 10, and 12 warp threads per centimeter. On average, weft thread counts almost never go beyond 10 weft threads per centimeter.

Looking at medieval records, the archaeological data resonates with the sources, and each cluster noted at 8, 10, or 12 warp threads per centimeter corresponds to a different quality of vaðmál (H. Þórlaksson, University of Iceland, Reykjavík, Iceland, 2012 pers. comm.). In fact, both Hoffman (1974)

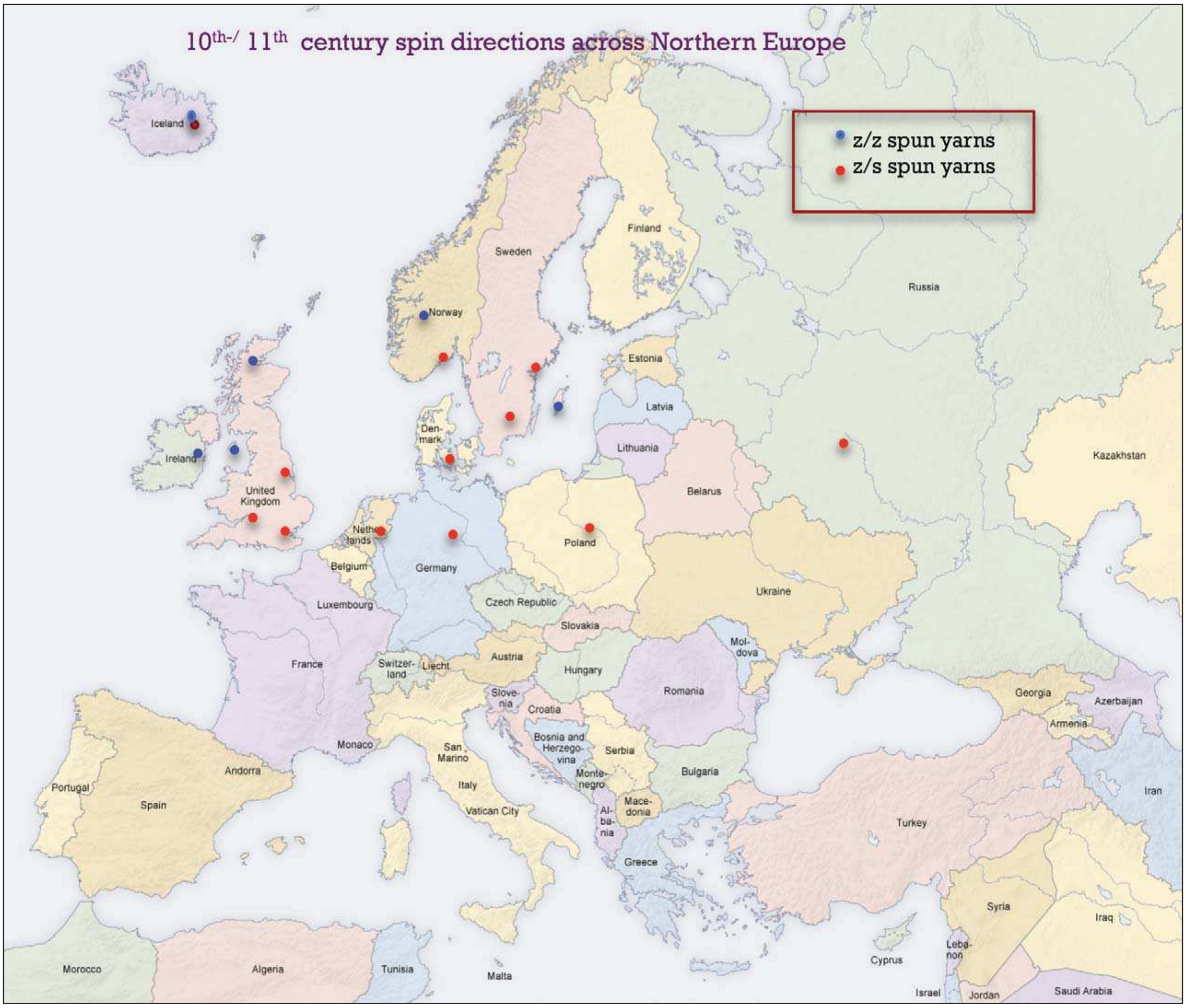

Figure 10. Distribution of spin direction for Iceland, Scandinavia, the British Isles, and continental Europe during the 10th and 11th century. Note the similarity in spin between the British Isles and Iceland, suggesting strong cultural ties between these two regions. (Hayeur Smith, in press).

and Þórláksson (1991) offer some ideas as to how cloth was intended to be woven based on medieval sources. Hoffman (1974:213) noted that in *Búalög*, the legal guidelines were frequently inconsistent, but she argued for a range between 4–14 warp threads per centimeter for legal cloth. Þórláksson (1991:252), on the other hand, identified legal guidelines enacted at various periods around AD 1300 and then again between AD 1613 and 1640 stating that *gjaldavoð* was to have 220 warp threads per 2.5 ells[6] (9–10 warp threads per cm), *klæðavoð* 260 warp threads per 3 ells of cloth (11 warp threads per cm), and *smávoð* 320 threads per 3.25–3.5 ells of cloth (11–14 warp threads per cm).

It is the author's opinion that this standardization reflects the growing importance of cloth as a form of legal currency and item of trade in Iceland, which may have been triggered by pressures from international trade markets in cloth (Hayeur Smith 2014:741). Dugmore et al. (2007:20) suggest that by AD 1200 Iceland had intensified its production of sheep for surplus wool as well, a pattern that fits nicely with the Icelandic textile data. This pattern differed in Greenland, where sheep appear to have been largely bred for milk and not surplus wool (ibid.).

Textiles from Ø172 and their Place in the North Atlantic during the Little Ice Age

The textiles from Ø172's earliest phase bear no distinct features to distinguish them from Icelandic cloth and present themselves in so similar a fashion that it is difficult to tell them apart. It is only in the later material, from late Phase 2 onwards, that distinctive traits emerge, with Greenlandic cloth developing its own idiosyncratic style within the North Atlantic continuum. Numbers of cloth from Phase 3 are not as abundant as they are on other Greenlandic sites because Ø172 is a site with few to no late-14th- and 15th-century deposits. The few items that do exist from Phase 3 are weft dominant—confirming patterns in textile production observed elsewhere in

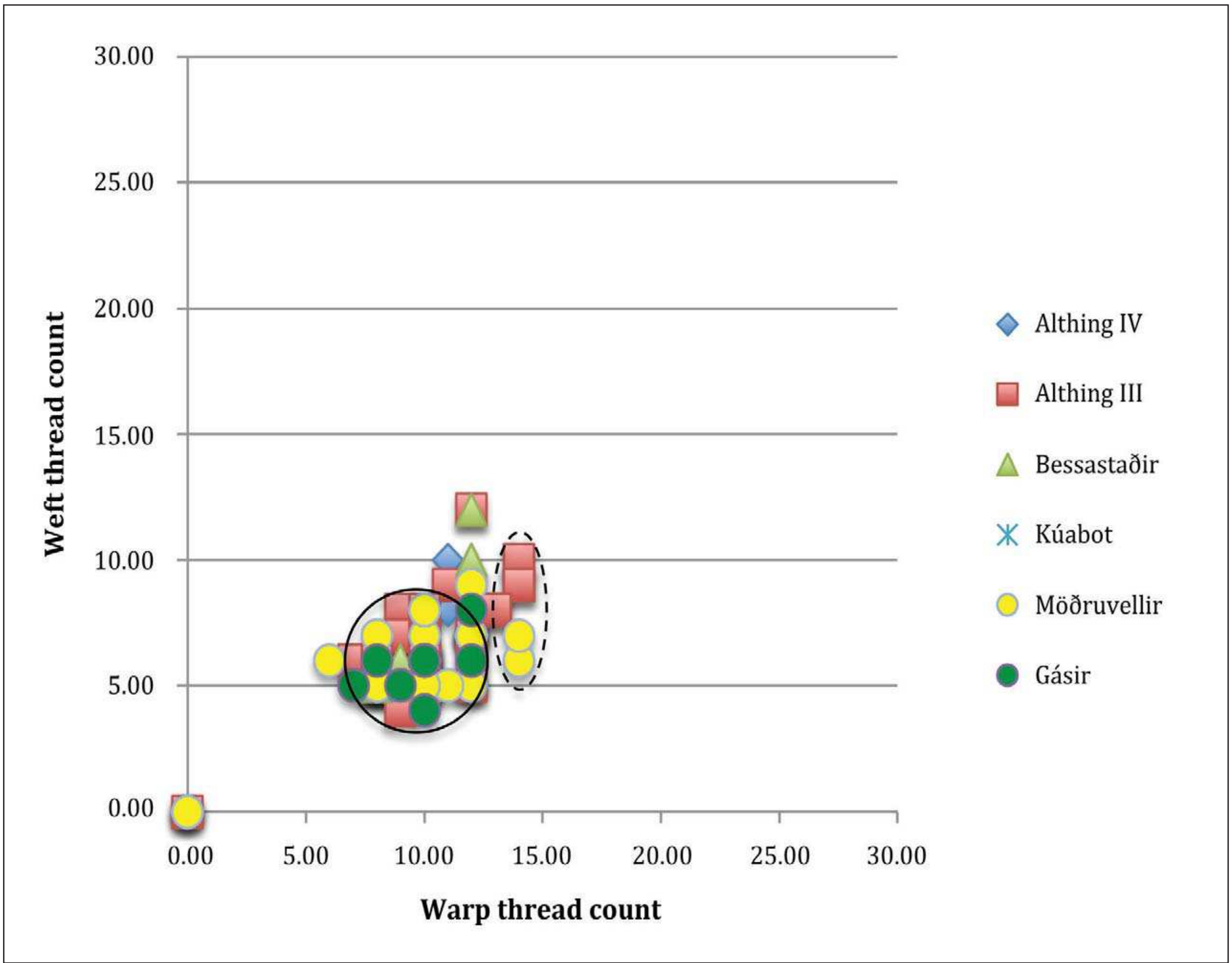

Figure 11. Thread counts for Iceland's medieval period showing intense standardization of cloth by 1200 and possibly earlier (Hayeur Smith 2014a, 2013a). Circle and dashed oval reflect standardization of thread counts at 7-12 warp threads per centimeter and 14 warp threads per centimeter.

Greenland that this feature developed in the early 14th century and expanded across Norse Greenland by the 15th century. Figure 12 illustrates the similarity of earlier textile traditions in Iceland and Greenland, while Figure13 illustrates the separation noted by Østergård (2004) and in this paper. While Iceland

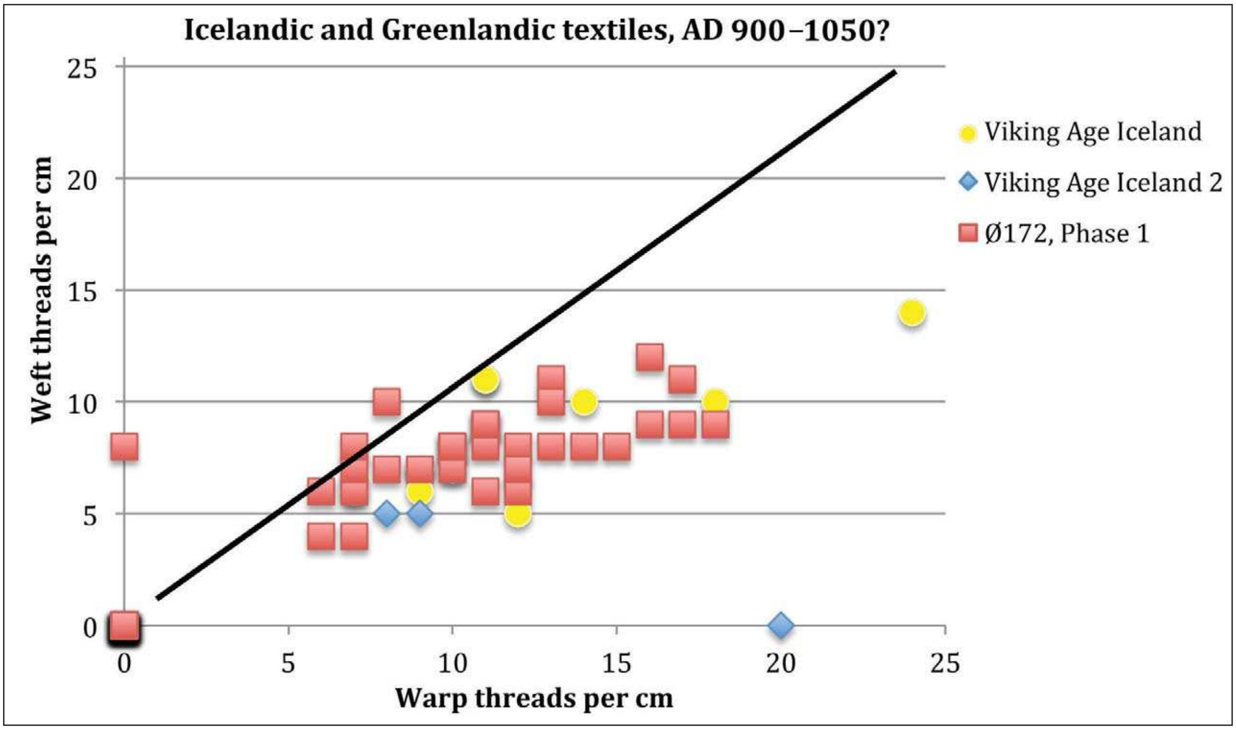

Figure 12. Textiles from Ø172 Phase 1 compared with early and late Viking Age Icelandic textiles (Hayeur Smith 2012, 2014a, 2013a).

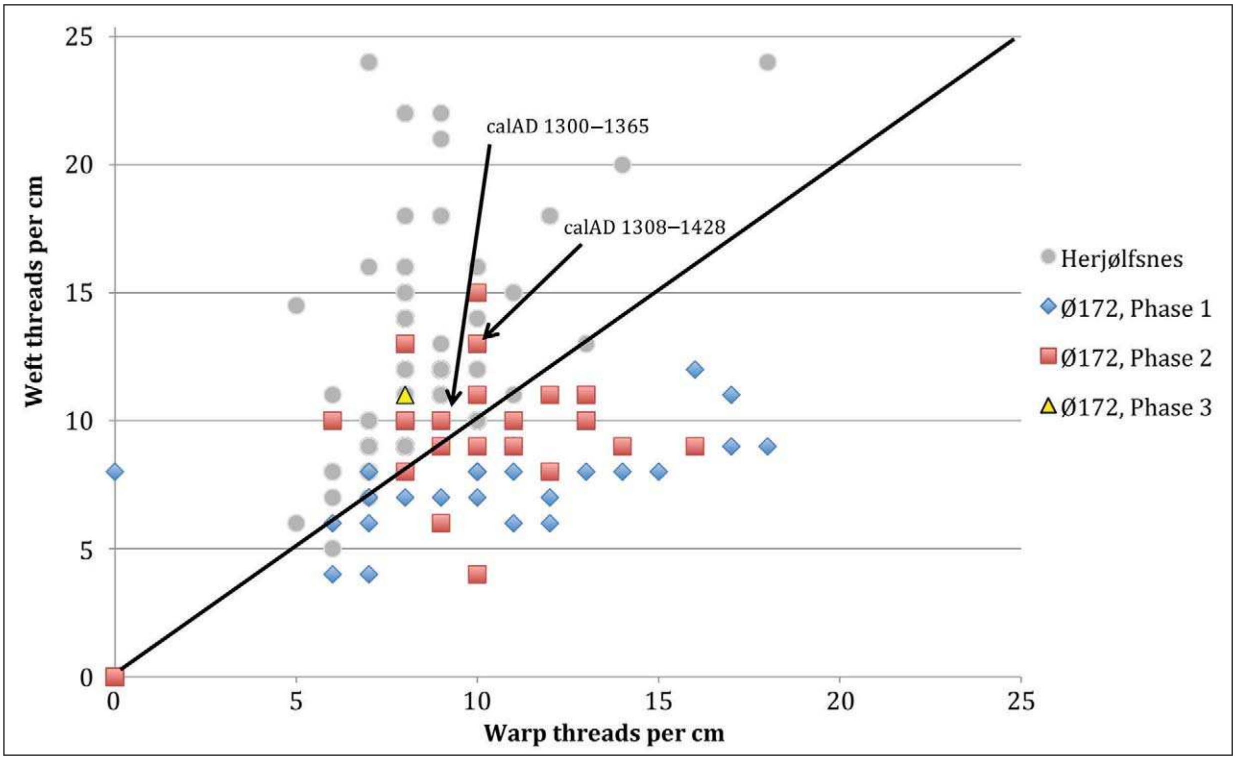

Figure 13. Textiles from Ø172 Phase 2 compared with high medieval textiles from Iceland (Hayeur Smith 2012) and Herjølfsnes (Østergård 2008).

appears to have focused its textile production on economic concerns, intensifying its wool and textiles for trade and currency, the Greenlanders appear to have been focused on staying warm.

The Little Ice Age affected Iceland and Greenland in different ways (Fig.14). While temperature drops observed in Greenland seem to commence around 1300, Iceland began experiencing sustained climatic deterioration between AD1475 and AD1520. The 16th, 17th, 18th, 19th centuries have generally been described as ones of extreme poverty and famine, not to mention the beginning of a cold spell that intensified, ruining crops and making subsistence generally difficult (Hayeur Smith 2012:14,15).

Correlating temperature fluctuations in the North Atlantic with textile production in Greenland may provide more definitive answers to the technological adaptations that Norse Greenlandic women chose to implement in their cloth production. According to McGovern (1980:246), Mann et al. (2009:1257), and Dugmore et al. (2007), the North Atlantic experienced cooling effects from the Little Ice Age before AD 1500, with a first cold spell occurring sometime between AD 1320–1350.

The shift in cloth technology to weft-dominant cloth occurs, according to the dates obtained from samples at Ø172, between AD 1308 and 1362—well within the range noted for this first cold transition (see Fig. 14). The textile data also seems to suggest that some kind of experimentation may have taken place before weft-dominant cloth became implemented on all cloth.

This type of behavior, so rarely visible in the archaeological record, brings to mind decisions that women—the sole weavers in Norse society—had to make regarding the way they produced cloth. Weaving, cordage and cloth technologies, overall, have been noted by textile analysts to be culturally conservative and to change very little over the course of time (Adovasio 1986, Carr and Maslowski 1995, Drooker 1992, Johnson and Speedy 1991, Kuttruff 1988, Minar 2001, Petersen and Wolford 2000). When the weather started getting cold, how would one make warmer garments?

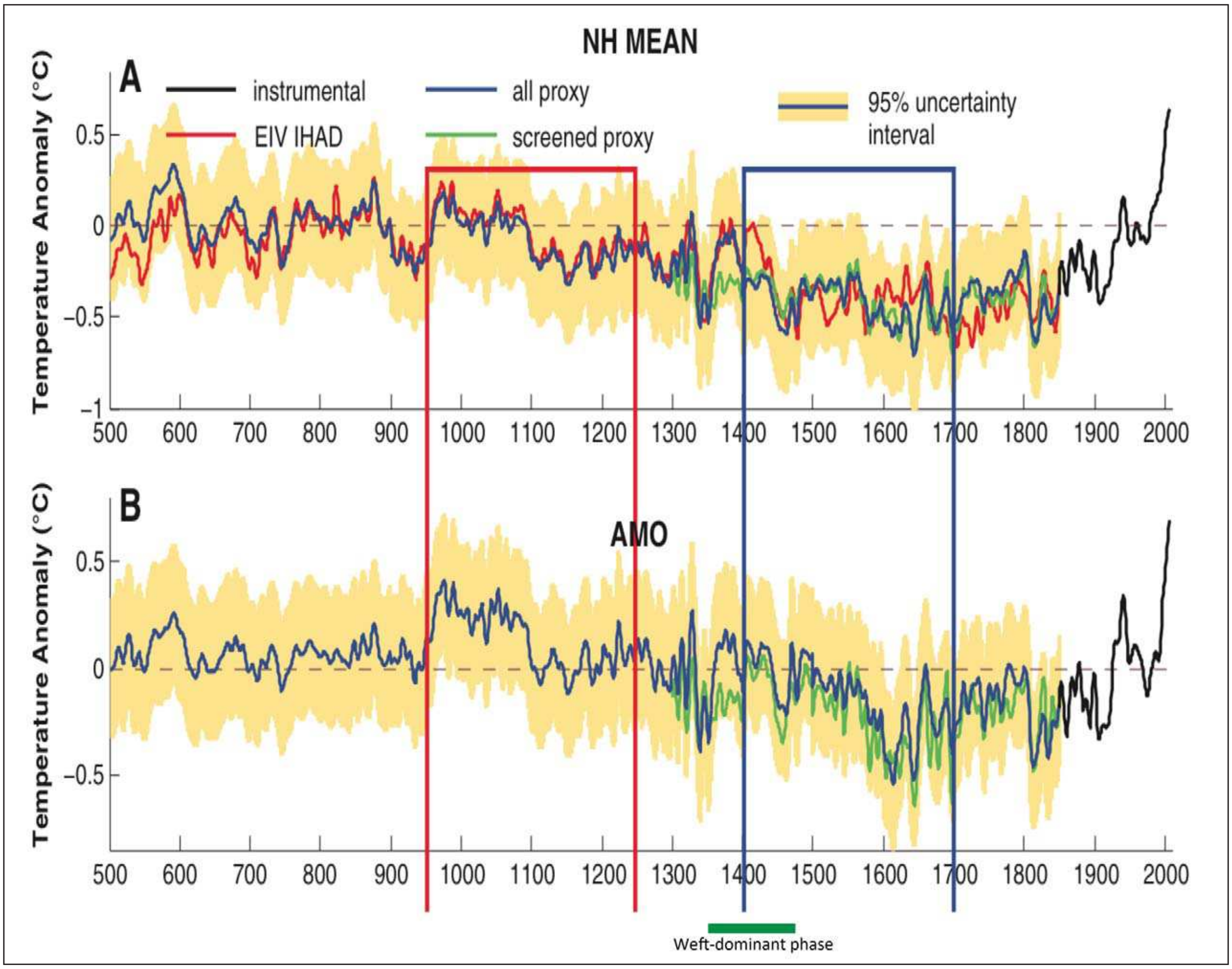

Figure 14. Climate deterioration in the North hemisphere and North Atlantic from multiple proxy records. Adapted from Mann et al. (2009).

One solution would be the inclusion of furs into clothing, which while not widespread, does occur. For example, from the GUS in Greenland a textile fragment was found to have rabbit fur incorporated into the weave. As pointed out by Walton Rogers, fur is notoriously difficult to use as the fibers are very slippery—in this case the rabbit hair was plied twofold to make it stronger, undoubtedly producing a warm and soft fabric but somewhat weak and fragile (Walton Rogers 1998:68). Many furs were probably too valuable for everyday use, and at least some were sent to Norway as tax payments to the Norwegian king (Dugmore et al. 2007:18, McGovern 1980:257–258). Creating greater numbers of *vararfeldir*—pile-woven cloaks (see Guðjónsson 1962:13)—was another option but would also have been labor intensive and costly, requiring greater quantities of wool.

Ideally, no new tools would be introduced, no extra labor or people required, and no extra material should be used or wasted without a correspondingly strong need or expectation of return. The latter may have been a concern in Norse Greenland, where the focus was not on producing surplus wool (Dugmore et al. 2007, Smiarowski 2012).

Another concern might be overall conservatism of the late Greenlandic Norse population. Looking at the social dynamics of Norse Greenland during the periods leading up to the end of the colony, many features suggest that things were out of balance socially, and that a powerful ecclesiastic elite may have been to blame for their demise. While this elite certainly looked towards Europe for cultural contact with Greenland, they also consumed a disproportionate amount of the country's foreign imported goods and were responsible for the building of large manors and churches, such as that at Gardar, which had room for as many as 150 cattle (McGovern 1980:266, 2000:338). Smaller farmers, on the other hand, did not fare as well, and the elite may have monopolized most of the colony's resources for themselves while imposing a cultural conservatism and their "carefully maintained cultural barriers" vis-a-vis the Inuit, who were moving into Norse settlement areas by the late 13th or early 14th centuries (McGovern 1980:266). This social situation may have impacted the clothing and weaving traditions in Greenland and resulted in the refusal to adopt the efficient skin clothing of the Inuit in favor of European woolen garments that were not well adapted to the cooling climatic conditions of the little Ice Age (McGovern 1980:265). As a marginalized community at the edge of the western world, they tried to adapt in a different manner, through their textile production, though without radically changing the overall appearance of the cloth.

With these ideas in mind, it is possible to draw up a list of priorities required for the transformation of cloth into something warmer by the women who produced it:

- The cloth should look nearly the same as the old cloth—dress styles in non-industrial contexts are notoriously conservative and change very slowly through time (Entwhistle 2000, Hayeur Smith 2004, Polhemus and Procter 1978, Sapir 1931). In this regard, weft-dominant cloth would have looked almost exactly like regular vaðmál from earlier periods and would have required no significant differences in the overall appearance of garments.
- Making it should have required as little extra effort as possible and should have been something that any farmer's wife might be able to do as a part of her regular weaving chores. This consideration would have been particularity important given the long list of tasks these women had to do around the farm in addition to textile work and clothing their household. Adding more weft yarns does not change the weaving process dramatically. Current research into Icelandic textiles is demonstrating that women were very accustomed to working with the wool from the northern short tail sheep and knew well that the inner fibers are soft and fluffy and bind easily. Just like Icelandic cloth, wool analyzed from the GUS textiles was treated, combed, or carded so that the two fiber types were separated and the coarse outer hairs used as warp yarns with the fine underwool used as the wefts (Walton Rogers 1998:66, 80). The shift to adding more weft yarns than warp yarns[7] (at Ø172, one finds 6/10, 8/13, 10/13, so a ratio of 3:1, 4:1, and even 5:1) only makes sense if by using more of the underwool it was beaten closer on the loom in order to obtain a more firm and warmer product (Østergård 2005:81).
- The final product could not be too different from the original vaðmál in terms of weight, thickness, etc., and not too thick to adversely affect sewing and any other work involved in garment construction. It had to carry the same properties as those to which they were accustomed.

Weft-dominant cloth appears to have been the Greenlandic answer to this conundrum.

Conclusion

In its earliest phases, the cloth produced and used at Ø172 easily fit within the production patterns identified for Icelandic cloth from similar periods. In both of these North Atlantic Norse colonies, the cloth produced during the 11th–13th centuries was warp-dominant, generally a 2/2 twill, and z/s spun with warp yarns made from the outer hairs of the northern short tail sheep, and the weft yarn made from the softer *þel.* It is only circa AD 1308–1360 that Greenlandic cloth changed, becoming unique to this specific cultural landscape with weft threads outnumbering warp threads significantly. As noted by Østergård (2004), it may be possible to use this unique weft-dominant feature to identify the movement and trade of Greenlandic cloth outside of Greenland, along with future isotope analyses testing the provenance of the wool. It does not appear that Greenlanders were as invested in the cloth trade as the Icelanders who traded homespun with Norway and the British Isles throughout the Medieval period and intensified their own production by increasing sheep farming and standardizing cloth production (Dugmore et al. 2007). Norse Greenlanders' farming strategies appear to have been designed largely for milk and not surplus wool (ibid.), and in their cloth incorporated goat hair and other fibers as Østergård (2004) has demonstrated at The Farm Beneath the Sand and at Herjolfsnes. The impression provided is that Greenlandic women were more introspective and inwardly focused, and by the early 14th century, were striving to create warmer cloth in response to colder winters rather than trading this much-needed commodity to the outside world.

Ø 172 has provided a glimpse into the past. It has provided information on the decisions that women, so frequently absent from the archaeological record, took as weavers deliberately trying to survive the harsh Greenlandic climate. Comparable reactions were not noted in Iceland during this period; although later in the 16th and 17th centuries, when temperatures plummeted again, Icelandic cloth production strategies changed as well, providing yet another solution to making cloth and staying warm during the little Ice Age (Hayeur Smith 2012). More detailed analysis on fibers and dyes will help expand the results from this preliminary analysis and expand our understanding of cloth production and its transformations in medieval Greenland.

Acknowledgments

This research was made possibly with funds from the National Science Foundation, Arctic Social Sciences, Polar Programs award numbers 1023167 and 1303898, and with the help from the following institutions and individuals: the Haffenreffer Museum of Anthropology, Brown University; the Greenlandic National Museum and Archives; the Danish National Museum; Hunter College/CUNY; the National Museum of Iceland; Fornleifastofnun Íslands; the University of Rhode Island's Department of Textiles, Design and Fashion Merchandising; and Konrad Smiarowksi, Georg Nygaard, Jette Arneborg, Thomas McGovern, Margaret Ordoñez, Ramona Harris, Howell Magnus, Lilja Árnadóttir, and Guðmundur Óláfsson. Special thanks to Konrad Smiarowski, for sharing with me his unpublished data, to Jette Arneborg and Thomas McGovern for getting the textiles to me and making it all happen, and to Kevin P. Smith, my husband, for his encouragement, help, and support while preparing this paper, and for his assistance editing it.

Literature Cited

Adovasio J.M., 1986. Artifacts and ethnicity: Basketry as indicator of territoriality and population movements in the prehistoric Great Basin. Pp. 43–88, *In* C.J. Condie and D.D. Fowler (Eds.). Anthropology of the Desert West: Essays in Honor of Jesse D. Jennings. University of Utah Press, Salt Lake City, UT, USA.

Andersson, E. 2003. Tools for textile production from Birka and Hedeby. Birka Studies Vol. 8. Stockholm, Sweden.

Andersson Strand, E. 2011. Tools and textile- production and organization in Birka and Hedeby. Pp.1–17, *In* A. Holt, G. Sigurðsson, G. Ólafsson, and O. Vesteinsson (Eds.). Viking Settlements and Viking Society, Papers from the Proceedings of the Sixteenth Viking Congress, Reykjavik and Reykholt, 16–23 August 2009. Hið Íslenzka Fornleifafélag, and the University of Iceland Press, Reykjavík, Iceland.

Bender Jørgensen, L. 1986. Fornhistoriske textile I Skandinavien, (Nordiske Fortidsminder Series B, vol. 9.) Det Kongelige Nordiske Oldskriftselskab, Copenhagen, Denmark.

Bender Jørgensen, L. 1992. North European Textiles until AD 100. Aarhus Universitetsforlag, Aahrus, Denmark.

Carr, C., and R.F. Maslowski, 1995. Cordage and fabrics: Relating form, technology, and social processes. pp. 298–343, *In* C. Carr and J.R. Neitzel (Eds.). Style, Society, and Person: Archaeological and Ethnological Perspectives. Plenum Press, New York, NY, USA.

Cooke, B, C. Christiansen, and L. Hammarlund, 2002. Viking woolen square sails and fabric cover factor. International Journal of Nautical Archaeology 31.2:202–210.

Christensen, A.M., and M. Nockert. 2006. Osebergfunnet bind IV, Tekstilene. Museum of Cultural History, University Of Oslo, Oslo, Norway.

Damsholt N. 1984. The role of the Icelandic women in the sagas and in the production of homespun cloth. Scandinavian Journal of History 9:75–90.

Dennis, A., P. Foote, and R. Perkins, 1980. Laws of Early Iceland, Grágás I. University of Manitoba Press, Winnipeg, MB, Canada.

Dennis, A., P. Foote, and R. Perkins, 2002. Laws of Early Iceland, Grágás II. University of Manitoba Press, Winnipeg, MB, Canada.

Drooker, P.B., 1992. Mississippian Village Textiles at Wickliffe, University of Alabama Press Tuscaloosa.

Dugmore, A.J., C. Keller, and T.H. McGovern. 2007. Norse Greenland settlement: Reflections on climate change, trade, and the contrasting fates of human settlements in the North Atlantic islands. Arctic Anthropology 44(1):12–36.

Emery, I. 2009. The Primary Structure of Fabrics. Thames and Hudson, London, UK.

Entwistle, J. 2000. The Fashion Body: Fashion, Dress, and Modern Social Theory. Polity Press, Cambridge, UK.

Gelsinger, B.E. 1980. Icelandic Enterprise: Commerce and Economy in the Middle Ages. University of South Carolina Press, Columbia, SC, USA.

Guðjónsson, E.E. 1962.Forn röggvarvefnaður. Árbók hins Íslenzka Fornleifafélags 1962:12–71.

Guðjónsson, E.E. 1965. Um skinnsaum. Árbók hins Íslenzka Fornleifafélags 1964:69–87.

Guðjónsson, E.E. 1970, The National Costume of Women in Iceland. Litbrá-offset, Reykjavik, Iceland.

Guðjónsson, E.E. 1973. Íslenzk útsaumsheiti og útsaumsgerdir á miðöldum. Árbók hins Íslenzka Fornleifafélags 1972:131–150

Guðjónsson, E.E. 1980. Note on medieval Icelandic shaggy pile weaving. Bulletin de liaison du centre international d'études des textiles anciens. CIETA, Lyon, France.

Guðjónsson, E.E. 1989. Jarnvarðr Yllir. Textile History 20:2.

Guðjónsson, E.E. 1990. Some aspects of the Icelandic warp-weighted loom, Vefstaður. Textile History 21:2.

Guðjónsson, E.E. 1992 Um rokka, einkum med tilliti til skotrokka. Árbók hins Íslenzka Fornleifafélags 1992:11–52.

Guðjónsson, E.E. 1994 Um vefstóla og vefara á Íslandi á 18. og 19. öld. Árbók hins Íslenzka Fornleifafélags 1993:5–50.

Guðjónsson, E.E. 1998a. Um vefstóla á Íslandi á 18. öld. Nokkrar athugasemdir, Árbók hins Íslenzka Fornleifafélags 1996–1997:129–140.

Guðjónsson, E.E. 1998b. Kljásteinavefstaðir á Íslandi og á Grænlandi. Árbók hins Íslenzka Fornleifafélags 1996–1997:95–120.

Hagen, K.G., 1994. Profesjonalisme og urbanisering, Universitetets Oldsakssamling Skrifter Ny rekke nr. 16. Oslo, , Norway.

Hägg, I., 1974. Kvinnodräkten i Birka. Diss. Aun 2. Uppsala, Sweden.

Hägg, I., 1984a. Birkas orientaliska praktplagg. Fornvännen 78:204–233.

Hägg, I., 1984b. Die Textilfunde aus dem Hafen von Haithabu, mit Beiträgen von G. Grenander Nyberg und H. Schweppe. Berichte über die Ausgrabungen in Haithabu 20, Neumünster, Germany.

Hägg, I., 1986. Die Tracht. Birka II:2. KVHAA, Stockholm, Sweden. Pp. 51–72.

Hägg, I., 1991. Textilfunde aus der Siedlung und aus den Gräbern von Haithabu. Beschreibung und Gliederung. Berichte über die Ausgrabungen in Haithabu, herausgegeben von K. Schietzel, 29 Neumünster, Germany.

Hayeur Smith, M., 2004. Draupnir Sweat and Mardöll Tears: An Archaeology of Jewellery, Gender, and Identity in Viking Age Iceland. BAR International Series 1276

Hayeur Smith, M., 2012 Some in rags, some in jags, and some in silken gowns: Textiles from Iceland's Early Modern period. International Journal of Historic Archaeology 16(3):509–528.

Hayeur Smith, M., 2013a. Textiles from the 1988 Bessastaðir Excavation. *In* Guðmundur Ólafsson (Ed.). Bessastaðarannsokn 1988. Skýrslur Þjóðminjasafn Íslands 2012. Reykjavik, Iceland.

Hayeur Smith, M., 2013b Viking Age textiles in Iceland. Unpublished paper presented on December 6th 2013 for Félag fornleifafræðinga, National Museum of Iceland, Reykjavik, Iceland.

Hayeur Smith, M., 2014. Thorir's bargain: Gender, vaðmál, and the law. Pp.730–746, *In* A. Reynolds, and K.P. Smith (Eds.). World Archaeology: Archaeology of Legal Culture 45(5).

Hayeur Smith, M. In press. Weaving wealth: Cloth and trade in Viking age and medieval Iceland. *In* A. Ling Huang, and C. Jahnke (Eds.). Textiles and Economy, Production, and Trade of Textiles: The Central and Northern Europe as Example, Oxbow Books, Oxford, UK.

Hoffman, M. 1974. The Warp-weighted Loom: Studies in the History and Technology of an Ancient Implement. The Norwegian Research Council for Science and the Humanities, Oslo, Norway.

Johnson, W.C., and D.S. Speedy, 1991. Cordage twist direction as a tool in delineating territorial boundaries and demonstrating population continuity during the Late prehistoric periods in the upper Ohio River Valley. Paper presented at the Annual Meeting of the Middle Atlantic Archaeological Conference, Ocean City, MD, USA.

Kjellberg A. 1979. Tekstilmaterialet I Oslogate 7 De arkeologiske utgravninger, in Gamlebyen, Oslo, bind 2. Feltene Oslogate 3 og 7. Bebyggelsesrester og funngrupper, Øvre Ervik. Pp.83–105.

Kjellberg A. 1982. Medieval textiles from the excavations in the old town of Oslo. Pp.136–150, *In* L. Bender Jørgensen and K. Tidow (Eds). Texilesymposium Neumünster, Archoaelogishe Textilien. Neumünster, Germany.

Kjellberg A., and M. Hoffmand. 1991. Tekstiler. Pp. 13–81, *In* E. Schia and P. Molaug (Eds.). De arkeologiske utgravninger i Gamlebyen, Oslo, bind 8, Dagliglivets gjenstander, Øvre Ervik. Alvheim G1 Eide, Oslo, Norway.

Kobayashi Issenman, B. 2000. Sinews of Survival: The Living Legacy of Inuit Clothing. UBC Press, Vancouver, BC, Canada.

Kuttruff, J.T., 1988. Textile attributes and production complexity as indicators of Caddoan status differentiation in the Arkansas Valley and southern Ozark Regions. Ph.D. Dissertation. Ohio State University, Columbus, OH, USA.

Mann, M.E., Z. Zhang, S. Rutherford, R.S. Bradley; M.K. Hughes, D. Shindell; C. Ammann, G. Faluvegi, and F. Ni, 2009. Global signature and dynamical origins of the Little Ice Age and medieval climate anomaly. Science 326:1256–1260.

McGovern, T. 1980. Cows, harp seals, and churchbells: Adaptation and extinction in Norse Greenland. Human Ecology 8(3):245–275.

McGovern, T. 2000 The demise of Norse Greenland. Pp.327–339, *In* W.W. Fitzhugh and E.I. Ward (Eds.). Vikings: The North Atlantic Saga. Smithsonian Institution Press, Washington, DC, USA.

Minar. J. 2001. Motor skills and the learning process: The conservation of cordage final twist direction in communities of practice. Journal of Anthropological Research 57(4):381–405.

Mårtensson, L., M.L Nosch, and E. Andersson Strand, 2009. Shape of things: Understanding a loom weight. Oxford Journal of Archaeology 28(4):373–398.

Nørlund, P. 1924. Buried Norsemen at Herjolfnes. *In* Meddelelser om Grønland Bd 67. Copenhagen, Denmark.

Nørlund, P. 1925 Herjolfnes Fundet og Sidste Nordboer paa Grønland. Nationalmuseets Bog om sjældne Fund fra de seneste Aar. Copenhagen, Denmark. Pp. 35–50.

Ordoñez, M.T. 2011. Icelandic Textile Report, University of Rhode Island, Department of Textiles, Design, and Fashion Merchandising, Kingston, RI, USA.

Østergård, E. 1998. The textiles: A preliminary report. Pp. 58–65, *In* J. Arneborg and H.C. Gulløv (Eds.). Man, Culture, and Environment in Ancient Greenland. Report on a Research Programme. Dansk Polar Center, Nuuk, Greenland.

Østergård, E. 2004. Woven into the Earth: Textiles from Norse Greenland. Aarhus University Press, Aarhus, Denmark.

Østergård, E. 2005. The Greenlandic Vaðmál in northern archaeological textiles. Pp. 80–83, *In* F. Pritchard and P. Wild (Eds.). Textile Symposium in Edinburgh 5th–7th of May 1999; NESAT VII (2005). Oxbow Books, Oxford, UK.

Petersen, J.B., and J.A. Wolford, 2000. Spin and twist as cultural markers: A New England perspective on native fiber industries. Pp. 101–117, *In* P.B. Drooker and L.D. Webster (Eds.). Beyond Cloth and Cordage: Archaeological Textile Research in the Americas. University of Utah Press, Salt Lake City, UT, USA.

Polhemus T., and L. Proctor, 1978. Fashion and Anti-Fashion: An Anthropology of Clothing and Adornment. Thames and Hudson, London, UK.

Róbertsdóttir, H. 2008. Wool and Society, Manufacturing Policy, Economic Thought, and Local Production in 18th-century Iceland. Makadam Publishers, Göteborg, Stockholm, Sweden.

Ryder, M.L. 1982, European wool types from the Iron Age to the Middle Ages. Pp. 224–238, *In* L. Bender Jørgensen and K. Tidow (Eds.). Archäologische Textilfunde May 6th to May 8th 1981. Textilsymposium Neumünster (NESAT 1.) Neumünster, Germany.

Sapir, E. 1931. Fashion. Pp. 139–144, *In* E.R. Seligman and A. Johnson (Eds.). Encyclopedia of the Social Sciences, Vol. VI. Macmillan, New York, NY, USA.

Smiarowski, K., 2012. E172 Tatsip Ataa midden excavation 2009 and 2010. Preliminary excavation report. Hunter College, CUNY, New York, NY, USA.

Thursfield, S., 2001. The Medieval Tailor's Assistant: Making Common Garments 1200–1500. Ruth Bean, Carlton, Bedford, UK.

Vedeler, M., 2007. Klær og Formspråk i Norsk Middelalder, Unpublished paper. Oslo, Norway. Provided by Dr. Christian Keller, University of Oslo, Oslo, Norway.

Vestergård Pedersen, K., and M.L. Nosch (Eds.) .The Medieval Broadcloth: Changing Trends in Fashions, Manufacturing, and Consumption. Ancient Textiles Series 6:99–108.

Walton Rogers, P. 1989. Textiles, cordage, and raw fiber from 16–22 Coppergate, Volume 15, Volume 17. Published for the York Archaeological Trust by the Council for British Archaeology, York, UK.

Walton Rogers, P. 1998. The raw materials of textiles from GUS, with a note on fragments of fleece and animal pelts from the same site. Pp. 66–73, *In* J. Arneborg and H.C. Gulløv (Eds.). Man Culture and Environment in Ancient Greenland. Report on a Research Programme, Dansk Polar Center, Nuuk, Greenland.

Walton Rogers, P. 2011. Fibres in a Textile from Tjornuvik Faroe Islands, Unpublished textile report. Provided by Simun Arge, National Museum of Faroe Islands, Tórshavn, Faroe Islands.

Walton Rogers, P. 2012, Textiles wool and hair. Pp. 196–217, *In* G. Sveinbjarnardottir (Ed.). Reykholt: Archaeological Investigation at a High Status Farm in Western Iceland, National Museum of Iceland, Reykjavik, Iceland.

Þórláksson, H. 1991. Vaðmál og Verðlag : Vaðmál í Utanlandsviðskiptum og Búskap Íslendinga á 13. og 14. öld. Háskóli Íslands, Reykjavík, Iceland.

Endnotes

[1]The tabby or plain weave is generally balanced with an equal number of warp and weft yarns, according to Bender Jørgensen (1992:13). In many cases, the ratio in one system can be higher than in the other. When the warp yarns outnumber the weft and obscure the weft elements almost completely one uses the term "warp-faced", while in the opposite situation one uses the term "weft faced" (Emery 2009:77).

[2]Natural fibers of any type have limited lengths and must be spun into yarn, thread, or the like in order to be extended enough and provide sufficient length to be used in weaving (Minar 2001:387). The fibers, through the process of spinning or twisting, are made to overlap each other and the addition of new fibers adds to the length (ibid.). In this process, the spinner has two options; either to turn the fibers clockwise or counter-clockwise. In textile terminology, this is referred to as z-spin (or twist) and s-spin (or twist), z being clockwise and s counter-clockwise.

[3]Z/z spun cloth appears to have been the norm in Scandinavia from AD 200 onwards and has been linked to the adoption of the warp-weighted loom along with the weaving of 2/2 twills (Bender Jørgensen 1992). By the Viking Age z/s spun fibers are noted on Scandinavian sites, though Norway and Gotland in the Baltic appear to remain more conservative in the persistence of older spinning traditions with z/z-spun twills (Bender Jorgensen 1992:38–39,138).

[4]Note that the phasing at Ø172 is still under analysis, and Phase 2 may prove to be part of an earlier Phase 3, with Phase 3 exapanding later into the 14th century. I am grateful to Konrad Smiarowski, Thomas McGovern, and Georg Nygaard for having shared this data at this early stage.

[5]2010–2103, NSF Award no. 1023167 "Rags to Riches, an Archaeological Study of Textiles and Gender in Iceland, AD874-1800"; 2013–2016 NSF Award no. 1303898 "Weaving Islands of Cloth, Gender, Textiles, and Trade across the North Atlantic from the Viking Age to the Early Modern Period".

[6]At this time, it is said the ell measured 55.6 cm (Hoffman 1974:213)

[7]In Icelandic medieval vaðmál, there are generally more warp yarns than wefts so that a ratio of 2:1 or 3:1 is common.