Much of our knowledge about North American Paleoindian lifeways derives from sites where large mammals (bison, mammoth) were exploited. These sites sometimes represent loci where animals were killed and butchered (e.g., Haury et al. 1959) and in other cases represent loci where animal carcasses were scavenged and butchered (e.g., Saunders and Daeschler 1994). Several Paleoindian deposits represent residential loci (e.g., Frison 1982a; Hill et al. 2011; Larson et al. 2009; Sellet et al. 2009; Wilmsen and Roberts 1978). Artifacts representing activities other than killing and butchering of large game are occasionally recovered from Paleoindian residential deposits. One category of artifact that has been recovered from Paleoindian sites in western North America is an eyed needle made of osseous (bone, antler, ivory) material (Figure 1). For convenience, I refer to the needles as “bone” needles despite the fact that some specimens may have been made of other osseous tissue such as cervid antler, a material that has greater elasticity and resistance to bending fracture than...
bone (Jin and Shipman 2010; MacGregor and Currey 1983).

First recovered from the Folsom-era Lindenmeier site in northern Colorado, eyed bone needles in terminal Pleistocene-early Holocene archaeological sediments of North America were immediately recognized as revealing Paleoindian lifeways, yet most needle specimens have been only briefly mentioned (e.g., Roberts 1941; Schultz and Frankforter 1948). The needle from the Hell Gap site in eastern Wyoming is, for example, not mentioned in four annual progress reports (Irwin 1969, 1970, 1973; Irwin and Brew 1968) and mentioned in one sentence in a summary report (Irwin-Williams et al. 1973). A photograph of the needle from Hell Gap has now been published (Kornfeld and Larson 2009:6, Figure 1.4d), but the needle’s length and diameter are not reported. It is likely because of the few published descriptions of eyed needles that in 1994 it was reported that the bone needle recovered from the Broken Mammoth site in Alaska was “one of the few known from Paleoindian contexts in North America” (Yesner 1994:155; see also Amato 2010). At that time, more than 75 Paleoindian needles had been mentioned in the literature (Table 1).

In this paper I summarize the metrics of all Paleoindian osseous needles known to me from locations west of the south-flowing stretch of the Mississippi River. Published experimental replications of needles are described as are expectations based on a model of needle use and experimentally generated use damage. Ethnographic and experimental data suggest small-diameter needles are good for sewing thin hides together and attaching ornaments such as beads to clothing. Breakage patterns suggest Paleoindian needles were used to sew. The distributions of Paleoindian needles and the types of artifacts with which they are associated indicate that at domestic sites Paleoindians, likely women, had specific areas in which sewing and related activities took place.

### Background and Issues

Ethnographically, women are the seamstresses in residential loci (Issenman 1997a, 1997b) but when on hunting forays men might carry needles and sinew thread as part of a repair kit (Hoffman 2002; Issenman 1985). Assuming that North American Paleoindian women were usually the seamstresses when a band was residing in a domestic site, the distribution and artifacts associated with eyed bone needles—site structure—could reveal the spatial organization of domestic activities undertaken by women.

Many items have been labeled “Paleoindian eyed bone needles.” However, those specimens vary sufficiently in size and shape to suggest that more than one function is represented (Amato 2010). Further, some specimens said to represent Paleoindian eyed bone needles are of unclear...
Paleoindian cultures vary in age and archaeological manifestation, but overall they include those materials that are at least 10,000 years old; some materials may be a bit younger (Haynes 2002; Meltzer 2009). For purposes here, the ≥ 10,000 calendar year age is a convenient if permeable chronometric boundary. The usual argument is that because Paleoindians entered North America near the end of the final Pleistocene glacial (Wisconsin) stage, climates would have been colder than at present in high altitudes and high latitudes (e.g., Hoffecker 2005; Osborn 2004, 2014). Tailored, that is, individually fit, skin clothing would have been required for those early immigrants to survive; production of tailored clothing would have in turn required needles for stitching (e.g., Dixon 2001; Goebel 2004; Guthrie 1991; Meltzer 2009). The oldest eyed bone needles known are from eastern Europe and Siberia and date to about 38,000 calendar years before present (cal B.P.) (Derevianko and Shunkov 2004; Golovanova et al. 2010; Kuzim 2008; Vasil’ev et al. 2002). North American Paleoindian eyed bone needles are considerably younger given that the earliest well-documented human occupation of the continent dates to about 13,500 cal. B.P. (Meltzer 2009).

Not all of the ~90 Paleoindian eyed bone needles known (Table 1) have been described and information on the archaeological context of some specimens is unpublished. Uniformity both in morphometry (shape and size) and contexts for well-published specimens suggests functional constraints on mechanical design and patterned behaviors, respectively. In the following, proximal denotes the eyed end and distal denotes the pointed end of a needle. I have only examined

Table 1. Inventory of Paleoindian Sites with Eyed Bone Needles.

<table>
<thead>
<tr>
<th>Site</th>
<th>Location</th>
<th>Age (cal B.P.)</th>
<th>n of Specimens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lindenmeierb, c</td>
<td>Colorado</td>
<td>12,700</td>
<td>25</td>
</tr>
<tr>
<td>Allen Sitee</td>
<td>Nebraska</td>
<td>12,250–11,980</td>
<td>5</td>
</tr>
<tr>
<td>Hell Gapc, e</td>
<td>Wyoming</td>
<td>13,100f</td>
<td>1</td>
</tr>
<tr>
<td>Marnes, Harrison horizonc, g</td>
<td>Washington</td>
<td>11,500</td>
<td>10</td>
</tr>
<tr>
<td>Winkler-1c</td>
<td>Texas</td>
<td>11,000</td>
<td>1</td>
</tr>
<tr>
<td>Lind Coulee, c, b</td>
<td>Washington</td>
<td>11,750</td>
<td>18–20</td>
</tr>
<tr>
<td>Hanco, t</td>
<td>Wyoming</td>
<td>11,700</td>
<td>1</td>
</tr>
<tr>
<td>Agate Basin</td>
<td>Wyoming</td>
<td>12,750</td>
<td>16</td>
</tr>
<tr>
<td>Horn Shelterc, e</td>
<td>Texas</td>
<td>11,150</td>
<td>&gt;1</td>
</tr>
<tr>
<td>Barton Gulch</td>
<td>Montana</td>
<td>10,650</td>
<td>&gt;1</td>
</tr>
<tr>
<td>Broken Mammothb</td>
<td>Alaska</td>
<td>11,800–11,000</td>
<td>1</td>
</tr>
<tr>
<td>Buhl Burialc</td>
<td>Idaho</td>
<td>12,660</td>
<td>1</td>
</tr>
<tr>
<td>Sentinel Gapc, e</td>
<td>Washington</td>
<td>11,700</td>
<td>1</td>
</tr>
<tr>
<td>Medicine Lodge Creekd, e</td>
<td>Wyoming</td>
<td>10,700</td>
<td>1</td>
</tr>
<tr>
<td>O. V. Claryc, e</td>
<td>Nebraska</td>
<td>10,100</td>
<td>2</td>
</tr>
<tr>
<td>Bonneville Estatesd, e</td>
<td>Nevada</td>
<td>12,200</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: Sites are listed in chronological order of publication which approximates chronological order of discovery.

aThis is the number of needle or needle fragments reported; the number of complete specimens is typically unclear, sometimes discrete fragments of a needle are each tallied independently but these is not always clear. If values are given as >1 then the published literature only indicates that “bone needles” were found.

bSee Supplemental Table 3 for details.

cBeads or other ornaments were recovered.

dPossible bead preforms were recovered.

eSee Supplemental Table 5 for details.

fAge is based on one of two radiocarbon assays (the one with the small standard deviation; the other is older and has a SD of 830 years).

gSee Supplemental Table 1 for details.

hSee Supplemental Table 2 for details.

iSee Supplemental Table 4 for details.
Needles suggested elsewhere to be Paleoindian specimens (Osborn 2014) include those from Graham Cave (Chapman 1952; Logan 1952) and Arnold Research Cave (Shippee 1966), both in Missouri. These specimens are not included in analyses here because they are from unclear stratigraphic proveniences and of unclear age (e.g., Wolverton 2001). 

Other specimens are too young to be included (Table 2). Specimens described as possible needles (Davis et al. 1997; Goebel et al. 2011; Gough and Galm 2002) or needle performs (Kornfeld and Larson 2009) have been recovered from several sites but some are not included in the discussion that follows for want of morphometric data.

### Needle Production, Morphometry, and Identification

Identification of North American specimens as bone needles has typically been founded on the presence of an “eye” and when evidence of an eye is absent, on the basis of an oval cross-section of 2–5 mm diameter, similar to criteria used to identify upper Paleolithic specimens in Europe (Stone 2011). Often said to be finely made, delicate, and approximately the size of modern steel darning needles, morphometric attributes typically recorded are length, width (maximum diameter), thickness (minimum diameter), and cross-sectional shape. The diameter of the eye is rarely reported, and sometimes the means of manufacturing the eye is inferred based on the morphology of the eye. Prehistorically, eyes were either drilled on both sides of the proximal end (Flenniken 1978), or a slit was gouged on both sides of the proximal end with burins (Osborn 2014). The first step may have involved gouging to create a dimple for placement of a drill, but this has not been documented among Paleoindian needles.

The needle from the Hell Gap site was replicated in about 45 minutes (Kirk 1973). Later investigators illustrated both the replicate needle and a “grooved Bos rib” representing the “experiment in bone needle production from the 1960s Hell Gap lab” (Kornfeld and Larson 2009:6, Figures 1.4a and 1.4c). Subsequent replications have utilized bones of birds or small mammals (Hoffman 2002) such as jack rabbits (*Lepus californicus*; Flenniken 1978). This saves time when producing a preform or blank, usually accomplished by the “groove and snap” technique such as is illustrated by the grooved *Bos* rib in the Hell Gap replication. Ethnographically there is some preference for bones of species whose behaviors result in strong, dense bones (Hoffman 2002). Production of needle blanks takes about 25–30 minutes (range = 10 to 45 minutes) (Hoffman 2002).

### Table 2. Inventory of Specimens Elsewhere Referred to as Paleoindian “Needles” that may not be Paleoindian in Age and Morphometrically do not Match Specimens from Lindenmeier, Marmes, Lind Coulee, and Agate Basin.

<table>
<thead>
<tr>
<th>Site</th>
<th>Description</th>
<th>Length</th>
<th>Width</th>
<th>Thickness</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graham Cave, MO</td>
<td>Eye; age unknown</td>
<td></td>
<td></td>
<td></td>
<td>Chapman 1952; Logan 1952</td>
</tr>
<tr>
<td>Arnold Research Cave, MO</td>
<td>Eye, two specimens; strata disturbed, age unknown</td>
<td></td>
<td></td>
<td></td>
<td>Shippee 1966</td>
</tr>
<tr>
<td>Medicine Lodge Creek, WY</td>
<td>Distal fragment; &lt; 9000 cal B.P.</td>
<td>25</td>
<td>1.6</td>
<td>1.6</td>
<td>Frison and Walker 2007</td>
</tr>
<tr>
<td>Shoup, Beta Rockshelter, ID</td>
<td>Eye, one specimen; &lt; 6600–6300 cal B.P.</td>
<td>77</td>
<td>3</td>
<td>2</td>
<td>Swanson and Sneed 1966</td>
</tr>
<tr>
<td>Shoup, Alpha Rockshelter, ID</td>
<td>Midsection; 8000–5600 cal B.P.</td>
<td>4</td>
<td>3</td>
<td></td>
<td>Swanson and Sneed 1966</td>
</tr>
<tr>
<td>Marmes Rockshelter, WA</td>
<td>13,300–10,400 cal B.P.</td>
<td>26</td>
<td>4</td>
<td></td>
<td>Rice 1972</td>
</tr>
<tr>
<td>Marmes Rockshelter, WA</td>
<td>13,300–10,400 cal B.P.</td>
<td>65</td>
<td>9</td>
<td>2</td>
<td>Rice 1972</td>
</tr>
<tr>
<td>Bernard Creek Rockshelter, ID</td>
<td>Two proximal, one distal fragment; 7900–8200 cal B.P.</td>
<td>18–34</td>
<td>2–3</td>
<td>2–3</td>
<td>Randolph and Dahlstrom 1977</td>
</tr>
</tbody>
</table>

**Note:** All dimensions are in millimeters; blanks indicate no metric data are available.
Blanks are shaped by carving, abrasion, polishing, or some combination thereof (Flenniken 1978; Hoffman 2002). Final shaping takes about 20 minutes (range = 10 to 25 minutes) (Flenniken 1978; Hoffman 2002). Some replicators suggest needle eyes were made after final shaping and sharpening (Hoffman 2002), and others found that final shaping prior to making the eye often results in fracture of the needle because of a too-small cross-section of the needle shaft (Flenniken 1978; McComb 1989). Whether gouged or drilled, eye production takes 10 to 15 minutes (Flenniken 1978; Hoffman 2002). Total production time per experimentally replicated bone needle is 60–90 minutes for those ~2 mm in diameter.

What have been labeled Paleoindian needle “blanks” or “preforms” sometimes have flattened but unperforated proximal ends and cross sections of larger size than finished needles (Irwin and Moody 1978; Root and Gustafson 2004; Stone 2011). Average length of finished Paleoindian needles is difficult to determine given that many specimens are broken, and dimensions for some complete specimens have been not been published. Length is unlikely to provide a definitive criterion of a Paleoindian needle because broken specimens may have been re-sharpened (McComb 1989) and length is less functionally constrained than diameter. The uniformity in cross-sectional diameter of many specimens identified as Paleoindian needles and recovered from different sites (Figure 2) suggests diameter is functionally constrained, a point I return to below.

Specimens believed to represent broken needles are common, although many of these retain no evidence of an eye. To facilitate identification of fragmentary specimens without evidence of eyes as Paleoindian eyed bone needles, I compiled cross-sectional size data for needles and needle fragments recovered from undisputed Paleoindian contexts, and that retained evidence of an eye (Table 3). I assume that eyed needle specimens represent completely manufactured specimens as opposed to preforms. The observed range of diameters spans .8 to 6 mm with the majority falling below 3 mm diameter (Figure 2). Some specimens are said to be needle “blanks” or “preforms” (Supplemental Tables 1–5) but the bases for such assignment are seldom explicit.

The four eyed specimens from the Allen site are larger on average (4.25 ± 1.5 mm) than all
other eyed specimens (1.81 ± .58 mm; Student’s $t = 5.18, p < .0001$). (The eyed bone needle from the Paleoindian Norden site in northern Florida is about 5 mm in diameter [Dunbar and Vojnovski 2007].) I distinguish small-diameter eyed needles ($\leq 2.9$ mm in diameter) from large-diameter needles ($\geq 3.0$ mm in diameter) because ethnoarchaeological evidence suggests needles of different diameter served different functions (Hoffman 2002). The sample of small-diameter Paleoindian needles with evidence of eyes ($n = 14$) displays a range of 2.44–8.8 mm maximum diameter and an average diameter of $1.81 \pm .58$ mm (Table 3). Twenty-six eyed needle specimens recovered from Amchitka Island and dating between 2,500 and 1,000 years ago averaged 1.67 mm in diameter (Hoffman 2002).

### Mechanics of Needles and Use Damage

A major modern concern in the mass production of sewn textiles concerns needle penetration force, a variable significantly influenced by needle diameter, needle surface finish, and fabric mass measured as thickness and density (e.g., Carvalho et al. 2009; El Gholmy and Elhawary 2013; Gotlih 1997; Lomov 1998). Modern steel needles of small diameter and smooth surface finish require less penetration force than needles of large diameter and rough surface finish. Greater requisite penetration force resulting from greater resistance (large needle diameter, rough needle surface, high fabric mass) can result in mid-length bending and fracture of a needle (Figure 3). As Semenov [1964:100] noted:

There are some grounds for supposing that only thin skins, taken off small animals, could be pierced with a bone needle, and even in this case it would have been necessary to broaden the hole with a bone awl, so that the needle could pass freely through with a thread of sinew. Thus the skin would be pierced preparatorily, then the hole widened with a bone point, so that finally the needle and thread themselves could go through.

Several long worked bone specimens with diameters $\geq 3$ mm have been recovered from the sites listed in Table 1. Terminal Pleistocene deposits at the Marmes site, for example, produced 10 needle specimens and seven “pin” specimens; the latter average 4.14 ± .87 mm in diameter (range 2.7–5.3 mm), suggesting a different function than the needles recovered from the site. Similarly, several elongate narrow and pointed bone specimens were recovered from Lindenmeier; these could be needle preforms but they may be functionally distinct tools (Wilmsen and

---

Table 3. Metric Data (mm) for Paleoindian Bone Needles with Evidence of an Eye.

<table>
<thead>
<tr>
<th>Site name</th>
<th>Catalog number</th>
<th>Length</th>
<th>Width</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lindenmeier</td>
<td>G579</td>
<td>17.9</td>
<td>.8</td>
<td></td>
</tr>
<tr>
<td>Lindenmeier</td>
<td>G120</td>
<td>~29.0</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>Lindenmeier</td>
<td>G278a</td>
<td>26.3</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>Lindenmeier</td>
<td>USNM 443719a</td>
<td>35.3</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>Marmes</td>
<td>3454</td>
<td>51.9</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Marmes</td>
<td>3451</td>
<td>29.0</td>
<td>1.5</td>
<td>1.0</td>
</tr>
<tr>
<td>Winkler-I</td>
<td></td>
<td>13.34</td>
<td>1.72</td>
<td>1.07</td>
</tr>
<tr>
<td>Lind Coulee</td>
<td>15 (4E/14N)</td>
<td>15.9</td>
<td>2.9</td>
<td></td>
</tr>
<tr>
<td>Lind Coulee</td>
<td>59a (4E/12N)</td>
<td>13.2</td>
<td>2.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Lind Coulee</td>
<td>109a (10E/14N)</td>
<td>15.0</td>
<td>2.2</td>
<td>1.5</td>
</tr>
<tr>
<td>Agate Basin</td>
<td>OA004</td>
<td>~70.0</td>
<td>2.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Agate Basin</td>
<td>C3478</td>
<td>~30.0</td>
<td>1.7</td>
<td>1.3</td>
</tr>
<tr>
<td>Horn Shelter</td>
<td>717</td>
<td>43.0</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Medicine Lodge Creek</td>
<td>32126</td>
<td>6</td>
<td>1.6</td>
<td>.9</td>
</tr>
<tr>
<td>Allen</td>
<td></td>
<td>3.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allen</td>
<td></td>
<td>3.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allen</td>
<td></td>
<td>5.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allen</td>
<td></td>
<td>6.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Blanks indicate no metric data is available; “~” indicates the dimension was estimated from photographs.
Roberts 1978:131, Figure 125). The same can be said for two needle preforms (~3.7 mm diameter) recovered from the Hell Gap site (Kornfeld and Larson 2009), and two distal needle or awl fragments (~2.5 mm diameter) recovered from Bonneville Estates Rockshelter (Goebel et al. 2011). These tools may have been used to initially pierce and generate holes in (thick?) hides; eyed needles would then have been less likely to fracture as they passed through and drew thread through the previously produced holes.

The hole created by the needle or perforator must accommodate the thread diameter but not be so large as to result in loose seams. Sinew swells when wet (Amato 2010; Issenman 1985) and thus stitch tightness is maintained, but the type of stitch also plays a critical role (Hatt 1969; Issenman 1997a). Sinew thread can be extremely small in diameter and not cut or tear hide (Issenman 1985); hair and vegetal fiber thread tears hide and stitches loosen (Amato 2010). Once the needle has passed through the fabric, drawing the thread through subjects the proximal end of the eye to pulling forces and also bending forces if the needle’s long axis is not parallel with the thread. Either force can result in a broken eye (Stone 2011).

Bone has a coarser texture or grain than steel, thus friction generated by pushing a needle through tissue may be greater and resistance to penetration greater than with a steel needle (Amato 2010). Experiments indicate that elastic strength or resistance to bending fracture is greatest parallel to the grain of a bone (the direction of osteons). Thus pushing forces transmitted through a bone needle meeting a resistance (hides) should be parallel to the long axis of the needle (Rosell et al. 2011; Scheinsohn and Ferretti 1995).

Needles have two functions: to pierce tissue and to draw thread through (Amato 2010; Mc-

![Figure 3. Needle mechanics and model of forces during sewing.](image-url)
Prehistoric eyed bone needles will thus likely be subjected to three kinds of use damage. Experimentally replicated and used bone needles are highly polished and may display very fine striations (Gates St-Pierre 2007; Griffitts 2006); distal tips are rounded and sometimes crushed (Bouchud 1977; LeMoine 1989, 1997). If the final stages of shaping involved abrasion, needles that have been minimally used may display micro-striae from the abrasion stone; striae created by manufacturing abrasion may be worn away by the polishing action of the needle passing through a hide. Experimental data indicate, however, use of needles may create striae. Semenov [1964:18] noted (see also Buc 2011), for example:

in practice piercing is not done by straight pressure but is accompanied by turns of the hand to right and left in a quarter or half circle. In this case the point’s wear is influenced by two movements, a straight and a rotary one; traces on the point will reflect these two forms of movement.

Use-wear microstriations will both parallel the needle’s long axis and encircle the long axis.

Many Paleoindian specimens are broken transversely into two or more pieces near the mid-section. A number of them retain only the distal portion of the eye, the proximal portion having been broken off. As noted above, these kinds of fracture can result from use (Amato 2010; Griffitts 2007; Hoffman 2002). It is unclear if Paleoindian needles had a new eye drilled if the first one broke, but experimental replication (Flenniken 1978) suggests drilling a replacement eye would have a high probability of breaking the small cross-section of a completely formed needle. Some Old World Upper Paleolithic specimens have been redrilled after the first eye broke (Stone 2011), but on average Upper Paleolithic specimens are of larger diameter than Paleoindian needles (e.g., Borziyak 1993; Stone 2011). Not only are Upper Paleolithic eyed bone needles of larger mean diameter than Paleoindian needles, so too are chronologically more recent specimens from both the Old World and the New World (e.g., Deschler-Erb 2001; Gates St-Pierre 2010; Gostencnik 2001; Hoffman 2002; Legrand 2008; Legrand-Pineau 2010; Provenzano 2001; Tamla and Maldre 2001; Wheeler 1978).

Needles with large diameters are more durable but small diameters permit finer stitching and likely were used on thin hides (Amato 2010; Griffitts 2007; Hoffman 2002; McComb 1989). The smaller the needle diameter, the smaller the stitches possible. Hoffman (2002) proposed that, in the Aleutians, ca. 1,000 year old small-diameter (~1 mm) needles were used for sewing embroidery or decorative appliqué along clothing seams or when sewing thin or fragile skins. These small-diameter needles have a small groove encircling their proximal end; sinew thread was tied to this groove. Larger diameter (~1.7 mm or larger) needles in the area had eyes. Hoffman’s (2002) experimental work showed needle diameters could not be much less than 1.0 mm and have an eye. If Paleoindians were limited to eyed needles (for whatever reason), they were constrained to eyed needle diameters > 1.0 mm (Figure 2). Thus “small diameter” is relative. Paleoindian small-diameter eyed needles may have been used to stitch applique on clothing. Indirect evidence for this is found in the fact that a number of the sites listed in Table 1 also produced bone, shell, or stone beads or pendants (see also Holliday and Killick 2013). Some of these ornaments are quite small and have very small holes.

Why Paleoindians might have decorated their clothing is unclear. But consider this. No known Paleoindian needles have been recovered from early Paleoindian contexts, that is, ≥ 13,100 cal B.P. (Table 1). The age of known Paleoindian needles (13,100–10,000 cal B.P.) corresponds with the time when people were settling down and establishing a home territory (Meltzer 2009). The human population was becoming more dense, so the chances of encountering hostile strangers or otherwise unknown kin was greater. As well, or perhaps alternatively, ornaments were stitched on seams to strengthen them (Issenman 1997a). Inspection of Paleoindian beads and ornaments for use-wear traces may suggest if and how they were attached to clothing (Amato 2010).

Large-diameter needles were likely used for a different sewing function than small-diameter needles. They may have been used to stitch thicker hides than small-diameter needles (McComb 1989), or to manufacture basketry (e.g., Legrand 2008; Stone 2011). Or, large-diameter specimens without eyes may be needle preforms,
awls, or other functionally distinct implements. Inspection of use wear may help resolve questions of needle function (e.g., Buc 2011; LeMoine 1989, 1994, 1997).

Site Structure

On one hand, assuming that the eyed bone needles were used to sew tailored clothing from animal hides, needles might be associated with remains of the animals that provided the hides. This is not to suggest that an animal was procured, skinned, and its fresh hide immediately stitched into a pair of pants. Rather, it is to say that the related activities of skinning and sewing might result in approximate association of remains of the two activities in a residential camp. Tanning of hides might also spatially overlap with the other two activities; scrapers, fleshers, hide beamers, and awls would be found with needles (Issenman 1997a, 1997b; Klokkernes 2007; Osborn 2004, 2014; Rasková Zelinková 2010). Tools for needle manufacture and maintenance and repair such as burins or spurs (Eren et al. 2013) and grooved abrading stones may also be associated. On the other hand, if the small-diameter needles were used to stitch beads and other ornaments onto clothing, associations with the same set of tools plus ornaments are expected. Five residential sites have been described in ways that allow examination of the distributions of Paleoindian needles and the artifacts with which they were spatially associated when recovered.

Evidence of the predicted associations has been reported for the ~11,000 cal B.P. O. V. Clary site in Nebraska (Hill et al. 2011). There, two bone needles are associated with scrapers, gravers, lithic perforators, a bone awl, and numerous bifaces, expedient stone tools, and faunal remains. These materials are distributed in a dense cluster around a hearth interpreted to represent a multifunctional activity area of a residential occupation. The majority of activities in this location were likely undertaken by women (Hill et al. 2011).

Two radiocarbon assays indicate artifacts from the Harrison Horizon at the Marmes site in southeastern Washington were deposited about 11,500 cal B.P. (Lyman 2012). Seven of the 10 needle specimens from this site occur in the same general area as skeletal remains of three individual red fox (Vulpes vulpes) (Figure 4). Some of the fox remains display evidence of having been butchered by humans (Lyman 2012). Eight of the nine recovered stone tools also occur in the eastern area of the excavation (east of the W15 line) (Ozbun et al. 2004).
The Marmes site needles seem to be part of an animal and hide processing and sewing activity area likely used by women.

Ethnographic descriptions of sewing of tailored clothing in arctic areas indicate that seamstresses sometimes had “sewing camps” (Osborn 2014:49). Even though they are associated with the industrial age, many individuals today keep their sewing paraphernalia together in a distinct area of the home. If Paleoindian seamstresses behaved similarly, eyed bone needle specimens and associated artifacts (for fabricating needles, preparing hides, and the like) will be clustered in space. On the one hand, this seems to not be the case at the Marmes site (Figure 4). The 19 needle specimens recovered from the ~11,750 cal B.P. Lind Coulee site (Craven 2004), on the other hand, cluster in one area (Figure 5), suggesting a location devoted to sewing and sewing-related tasks. Other artifacts in the area include 20 scrapers, two gravers, and two bone awls (Irwin and Moody 1978).

The 25 needle specimens from the Lindenmeier Folsom site (~12,700 cal B.P. [Haynes 2003; Haynes and Agogino 1960]) also appear somewhat clustered rather than scattered (Figure 6). Gravers (n = 39) and grooved abrading stones (n = 2) are not tightly associated with the needles, suggesting sewing activities were more limited in areal extent than activities resulting in the deposition of the other two artifact types. Scrapers were not identified as a distinct artifact category among the Lindenmeier lithic artifacts (Wilmsen and Roberts 1978), so it is unknown if such artifacts occur in the collection. Finally, at least six of the 16 needle specimens recovered from the Folsom level of the Agate Basin site (~12,750 cal B.P. [Frison 1982b]) are clustered within a 6 x 6 ft (1.8 x 1.8 m) area within what is thought to represent the floor of a “suspected habitation structure” (Frison 1982a:42); locations of the other ten specimens are unclear. Also on the floor of the structure were 1 scraper, 7 “flake tools,” 4 gravers, 2 “bone projectile points,” and other tools. Most of the tools, including the needles, were in the northwestern quarter of the structure’s oval floor, about a meter from a fire hearth near the center of the floor (Frison 1982a:42). A domestic sewing area is suggested.

**Discussion and Conclusion**

North American Paleoindian eyed bone needles have seldom been described in detail let alone examined with an eye (no pun intended) to inferring human behavior, other than repetition of the
notion that specimens indicate tailored clothing was made. Given the relative uniformity of needle morphology and diameter across the western United States, differences in how eyes were made—bifacially drilled versus gouged with a burin—might warrant study as to spatio-temporal distribution. Needles of large diameter (≥ 3 mm) may have had different functions than small-diameter (≤ 2.9 mm) needles. The two specimens from Bernard Creek Rockshelter, although not of Paleoindian affiliation (Table 2), have eyes that are located 7–15 mm distal to the proximal end rather than immediately at the proximal end (Randolph and Dahlstrom 1977). These morphometric variants may represent spatially, temporally, and/or functionally distinct kinds of implements. Use wear may reveal functional differences that covary with needle diameter and eye location.

As of early 2014, at least 85 eyed bone needles and fragments thereof have been found in North American Paleoindian contexts; that number is conservative because additional specimens that may date to the Paleoindian era are not included in the total and not all specimens recovered have been described in the literature (Table 1, Supplemental Tables 1–5). In many cases only one or two specimens have been recovered from a site. Those sites that have produced more than five specimens for which contextual data are available suggest prehistoric sewing activity loci in what seem on other bases to be residential camps. The frequency distribution of needle diameters indicates many needles were of small diameter (≤ 2.9 mm) whereas some others were larger (≥ 3.0 mm). Ethnoarchaeological data suggest these two size classes of needles likely served different purposes. Evidence suggests that small diameter (≤ 2.9 mm) needles were used for appliqué and to stitch thin hides; large diameter (≥ 3 mm) needles were used to stitch thick hides. As more data on individual needles become avail-

Figure 6. Distribution of needles, gravers, and grooved abraders on the Lindenmeier Area II occupation surface (redrawn after Wilmsen and Roberts 1978: Figures 162, 163, 165).
able, and as more Paleoindian deposits are excavated, close attention to needle morphometry and needle context may reveal additional details of terminal Pleistocene lifeways in North America.

Acknowledgments. Study of the Marmes needles was courtesy of the U.S. Army Corps of Engineers, Walla Walla District, and Washington State University, Museum of Anthropology. Research on the Marmes Site faunal collection, which resulted in the recognition of three specimens reported here for the first time, was funded by NSF grant BCS-0912851. Thanks to Stan Gough and Ken Ames for providing information on needles from Sentinel Gap and Hatwai, respectively. Comments on an early draft were provided by M.T. Boulanger and M.I. Eren; discussions with M.G. Hill, B. Hockett, S.R. Holen, D.J. Meltzer, and D.N. Schmitt were valuable. Two anonymous reviewers and J.M. Adovasio identified weaknesses in a later draft.

Supplemental Materials. Supplemental materials are linked to the online version of the paper, which is accessible via the SAA member login at www.saa.org/members-login.

Supplemental Table 1. Inventory of Marmes Site, Harrison Horizon Bone Needle Specimens.

Supplemental Table 2. Inventory of Lind Coulee Bone Needle Specimens.

Supplemental Table 3. Inventory of Lindenmeier Bone Needle Specimens.

Supplemental Table 4. Inventory of Agate Basin Site, Folsom Bone Needle Specimens.

Supplemental Table 5. Inventory of Other Paleoindian Bone Needle Specimens.

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