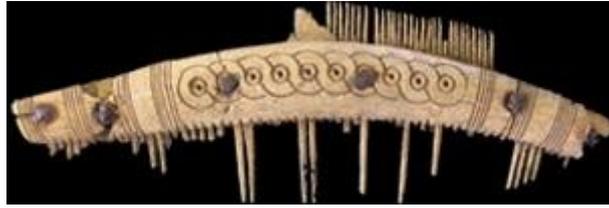


The Worked Bone and Antler from Burdale



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Introduction

39 objects of worked skeletal material were recovered during the excavation. Given the lack of direct evidence for industry (semi-manufactures, waste etc), these are best interpreted as objects used by the inhabitants of, and visitors to, the settlement at Burdale. The collection is small, but useful comparanda exist at sites within Yorkshire (*e.g.* Fishergate, Bluebridge Lane and Coppergate, York; Wharram; West Heslerton; Cottam) the British Isles (*e.g.* Flixborough; Lincoln; Southampton; London; Dublin; sites in northern and western Scotland), and overseas (*e.g.* Dorestad, Ribe, Haithabu, Birka, and Lund).

In the following, the objects are catalogued, and then discussed according to ascribed function where inference allows. Objects are described according to the following traits: form (referring to relevant typological systems); raw materials (using both macroscopy and biomolecular methods; see below); methods of manufacture, use wear and repair (where evident).

Raw materials are identified where possible. Enhanced macroscopic techniques allow qualified identification to species level in some cases, but where possible these techniques are supported and augmented by protein-based techniques (ZooMS). This is the first time this approach has been applied on artefactual material, and its low cost, small sample size, and high efficiency rate proved effective in this study.

Catalogue

COMBS

In the below catalogue entries, the following details are recorded, where known:

- **Form** (Composite/ One-Piece; Single-Sided/ Double-Sided)
- **Component/ Completeness** (estimated as <25%/25-50%/50-75%, or 75-100% of complete object)
- **Type** (after Ashby 2011)
- **Raw Materials** (by macroscopic and biomolecular techniques. In many cases, resolution is achieved through the application of these approaches in tandem; catalogue entries give a final identification, and Table 1 provides detail on the independent results of the two tests)
- **Ornament**
- **Rivet Materials**
- **Rivet Arrangement** (may be ‘central’, ‘alternating edge’, or ‘every edge’, or ‘decorative’, but only ascertainable when multiple rivets /perforations are preserved). See Ashby 2005.
- **Quality**. A subjective measure, based on an assessment of object aesthetics, evenness and symmetry of form and ornament, and quality of finish.
- **Use Wear**. Assigned subjectively, on the basis of tooth striations and beading. See Ashby 2005.
- **Tooth Density**. Number of teeth per cm.
- **Tooth Differentiation**. For double-sided (and semi-double) combs, this is the ratio of the tooth densities on each edge.

- **Tooth Graduation.** This is the shortening of teeth towards the terminals of a comb. It is recorded as either present or absent.
- **Dimensions.** L (Greatest Length); W (Greatest Width); Th (Greatest Thickness).

BUR06

Find No: BUR06, 1001, sf5

Object Type: Composite comb, type 2a fragments. <10% complete

Component: 10% complete.

Not measurable

Description: Bone (split rib) connecting plates, antler (red or roe deer) billets. Highly fragmented. Two toothplate fragments, shows tooth differentiation of 6 vs >7.

Undecorated. Wear unknown.

Find No: BUR06, 1008, sf11

Object Type: Composite comb, unknown single-sided type.

Component: <10% complete, single toothplate.

L: 12mm; **W:** 20mm (inc); **Th:** 2.5mm

Description: Indeterminate bone/antler. One narrow toothplate fragment, shows tooth density of 6. One iron rivet at one edge; perforation but lost rivet at other edge - suggests every edge arrangement. Undecorated. Quality unknown. Wear unknown.

Find No: BUR06, 1009, sf20

Object Type: Composite comb, Type 2b semi-double

Component: 90% complete connecting plate, in 2 fragments.

L: 171mm (inc); **W:** 18mm; **Th:** 5mm

Description: Antler (probably red deer). Concavo-convex profile, shallow plano-convex section. 7 iron rivets (total complement), evenly spread. Interlaced ring-and-dot-chain, forming a sort of running guilloche. Fine groups of 3 oblique fine line motifs. Close to the terminal, a field contains hatching/saltires, with margins composed of c.4 sawn lines. A round notch has been cut out of the basal edge at the terminal; given the form of the comb, this is most likely for suspension, rather than for securing within a case. There is a small area of finer (c.8 per cm) toothcuts, positioned centrally on the back of the connecting plate, indicating that originally there was a short array of fine teeth on one edge, opposed to a full set of coarser teeth on the other. Tooth differentiation: 8 / 5. Medium/ high quality. Wear unknown. Riveted together post-decoration; rivets cut unsympathetically through ornament.

Such combs are often referred to as 'semi-double' combs. They are not frequent finds, but examples are known, and they tend to be ornate, presumably 'high end' pieces (see for example those from York; Ashby 2006a fig. 7.14). They appear to date to around the 7th and 8th centuries, though a comprehensive chronological survey remains to be undertaken (see MacGregor 1985: 94; Roes 1963). The presence of two examples within the collection from this site is striking; it does suggest the presence of individuals of status.

The guilloche decoration of this particular example is broadly paralleled at Fishergate House, York (Ashby and Spall 2005: artefact 2777), and much more closely in a later

7th-/early 8th-century grave at Castledyke South, Barton-on-Humber (Grave 183; Drinkall and Foreman 1998:, Pl. 16). The comb is thus a high quality, though not unique, piece. Its quality of ornament does not quite match that seen on sf107 (below).

Find No: BUR06, 1083, sf107

Object Type: Composite comb, type 2b semi-double

Component: 80% complete. 5 coarse teeth remaining, several of which are broken (including one complete but loose), c27 fine teeth remaining.

L: 126mm; **W:** 40mm; **Th:** 11.4mm

Description: Antler. 6 iron rivets, alternating-edge arrangement. Connecting plates of Plano-convex section, and concavo-convex profile. Endplates are not preserved. The matching connecting plates are decorated with interconnected double ring-and-dot, enclosed within a central field. Either side of that field are 3-4 groups of 4-5 roughly incised vertical lines. Teeth graduated on top (fine), but not on base. Tooth differentiation 9 / 5. High quality. Minor wear striations on teeth.

Find No: BUR06, 1119, sf159

Object Type: Composite comb, probably type 2b.

Component: c.25% complete, 3 fragments of connecting plate, 3 toothplates.

L: 90mm (inc); **W:** 22mm; **Th:** 9.3mm

Description: Antler (probably red deer) connecting plate and billets. Expertly made, well-ornamented; overlapping double-ring and dot motifs; overall arrangement unclear. Terminals feature small zones of 4-5 vertical incised-line ornament. Quality high. Tooth density 6, regular, even toothcuts. Plano-/concavo-convex bowed profile, and plano-convex section. Wear unknown. 3 iron rivets, all at edges, *alternating edge arrangement*.

Find No: BUR06, 1119, sf290

Object Type: Composite comb, type 2b

Component: <10% complete, single endplate frag.

L: 14mm (incomplete); **W:** 33mm; **Th:** 3.4mm

Description: Indeterminate antler. One decorative endplate fragment, shows tooth graduation and a tooth density of 5. Staining from one central iron rivet perforation, suggests *central* or *mixed* overall arrangement unknown. Undecorated. Quality mixed- roughly cut teeth, ornately-carved, sharp 'horned' profile. Oblique striation from finishing. Wear unknown.

BUR07

Find No: BUR07, 1009, sf147

Object Type: Composite comb, type 12.

Component: 10% complete, single endplate.

L: 21mm; **W:** 37mm; **Th:** 3mm

Description: Antler; indeterminate species. One endplate, complete with all teeth, shows tooth differentiation of 4/6. Edge perforation, no staining. Undecorated. Raised rectangular area that would have underlain connecting plate. Quality unknown. Wear low.

Find No: BUR07, 1046, sf150

Object Type: Composite comb, Type 2a.

Component: <25% complete, short section of connecting plates.

L: 37mm (inc); **W:** 13.4mm (inc); **Th:** 2.5mm

Description: Bone; prob split rib Flat connecting plates, profile unknown. Decorated with roughly incised, knife-cut pairs of vertical lines. Toothcuts small and neat, 6 per cm; perhaps expertly made, but decorated with lesser skill. One iron-stained perforation. Quality low. Wear unknown.

Find No: BUR07, 1054, sf153

Object Type: Composite comb, unknown double-sided type.

Component: <10% complete, 1 toothplate frag.

L: 13mm; **W:** 31mm (inc); **Th:** 2.8mm

Description: Antler; probably red deer. One narrow toothplate fragment, shows coarse tooth density of 6; other edge unknown (8 vs 0 teeth remaining). One rivet perforation (iron staining) at centre – possibly suggests *central arrangement*, though too few rivets preserved to be confident. Undecorated. Quality medium. Wear low/medium; little striation.

Find No: BUR07, 1054, sf154

Object Type: Composite comb, unknown double-sided type, type 12.

Component: c.75% complete, 2 fragments of connecting plate, 1 endplate, and 4 toothplates.

L: 86mm (inc); **W:** 36mm; **Th:** 10.0mm

Description: Antler (probably red deer) connecting plate and billets. Teeth are graduated at end, where there is a rounded endplate profile. Comb shows tooth differentiation of 5/5, and teeth are very finely striated, Wear low. The whole is simply-made, with a central field bounded by 5 vertical lines, containing double-saltire-lozenges, Quality medium. Straight connecting plates of flattened plano-convex section. 3 iron rivets, all at edges, *alternating edge arrangement*.

Find No: BUR07, 1109, sf155

Object Type: Composite comb, Type 2a.

Component: <25% complete, short section of connecting plate.

L: 38mm (inc); **W:** 8.7mm (inc); **Th:** 2.7mm

Description: Bone; split rib. Flat, cigar-shaped connecting plates. Decorated with roughly incised, knife-cut vertical lines. 2 iron rivets, close together. Quality low. Wear unknown.

Find No: BUR07, 1158, sf156

Object Type: Composite comb, type 2b.

Component: c40% complete, 3 toothplate and 2 connecting plate fragments, all crossmend.

L: 98mm (inc); **W:** 21mm (inc); **Th:** 6.1mm

Description: Antler; probably red deer. Toothplates have toothcuts, which show tooth density of 4. No complete teeth remaining, bases are well worn. 3 rivets (iron) at alternating edges – *alternating edge arrangement*. Undecorated, surface of connecting plate is root-etched. Connecting plates are of plano-convex section, and concavo-convex profile. Quality Q3. Wear W/3/4, some beading even at bases.

Find No: BUR07, 1421, sf157

Find 157 consists of a large number of comb fragments excavated from an SFB. Herein they are divided into three groups, probably constituting three combs.

Find No: BUR07, 1421, sf157A

Object Type: Composite comb, type 2b.

Component: c.75% complete, 2 fragments of connecting plate, 1 endplate, and 4 toothplates.

L: 108mm (inc); **W:** 21mm; **Th:** 13.1mm

Description: Antler (red deer) connecting plate and billets. Many fragments of possible 2 combs. 6 fragments of connecting plate, 4 fragments of toothplate, one endplate. Good condition, well-made, High quality. Large empty central area, terminals decorated with crosshatch fields, bounded by vertical lines. Winged, sweeping horned endplate. Graduated teeth at terminals, density 6. Connecting plates have a concavo-convex, bowed profile, and plano-convex section. Teeth are striated, Wear medium. >3 iron rivets, all at edges, *alternating edge arrangement*.

Find No: BUR07, 1421, sf157B

Object Type: Composite comb, type 2a.

Component: c.50% complete, 2 fragments of connecting plate, 1 endplate, and 4 toothplates.

L: 81mm (inc); **W:** 30mm; **Th:** 8.6mm

Description: Postcranial bone probably used for both connecting plates and billets. Many fragments of comb. Expertly made, though poorly ornamented; decoration consists of a rough field of knife-cut single cross-hatch ornament, well-made, Quality medium/low. There is a large empty central area, and terminals are decorated with crosshatch fields, bounded by vertical lines. Winged, sweeping horned endplate. Teeth are graduated at terminals, with a density of v.5. The connecting plates are flat in section, and may be cut from split ribs. Wear unknown. 5 iron rivets, all at edges, *alternating edge arrangement*.

Find No: BUR07, 1421, sf157C

Object Type: Composite comb, type 2b.

Component: c.50% complete, 2 fragments of connecting plate, 1 toothplate.

L: 85mm (inc); **W:** 22mm; **Th:** 4.6mm

Description: Antler (probably red deer) 2 fragments of connecting plate, 6 toothplates, one endplate, intact. Well made, though unornamented. Quality medium/low. Toothcuts are coarse c.4 per cm. The connecting plates have a marked concavo-convex, bowed profile, and a deep plano-convex section. Wear low. One iron-stained rivet perforation at an edge; arrangement unknown.

Find No: BUR07 Test Pit J, Layer 2, sf158

Object Type: Composite comb, type 12.

Component: c50% complete, central area of both connecting plates, with 3 toothplate fragments.

L: 67mm (inc); **W:** 26mm (inc); **Th:** 10.6mm

Description: Antler; probably red deer (connecting plates). Tooth differentiation of 5/5. All teeth bases are preserved, though 3 teeth are lost, bases only remaining. The whole is well manufactured, but undecorated. Quality medium. Straight, cigar-shaped

connecting plates, of plano-convex section. Polished. Some beading on remaining teeth, Wear medium. 1 iron rivet at edge; *alternating edge arrangement*.

Find No: BUR07, 1203, sf196

Object Type: Composite comb, Type 2a.

Component: <10% complete, short terminal section of connecting plate.

L: 27mm (inc); **W:** 13.7mm (inc); **Th:** 2.2mm

Description: Bone; split rib. 1 iron rivet close to terminal, differentiation of 6/5. Toothcuts on one edge only, c5per 10mm. Undecorated. Narrow, with straight edges, and toothcuts on one edge only. Quality medium/low. Wear unknown.

Find No: BUR07, 1009, sf197

Object Type: Composite comb, unknown double-sided type.

Component: c25% complete, area of connecting plate only.

L: 44mm (inc); **W:** 13mm (inc); **Th:** 3.7mm

Description: Antler; probably red deer. Shows tooth differentiation of 6/6. All teeth lost. Irregular, poorly-cut toothcuts, undecorated, Quality low. Straight connecting plates of plano-convex section. Polished. Wear unknown. 2 large, round rivet perforations, no staining, unknown arrangement.

Find No: BUR07, 1054, sf198

Object Type: Composite comb, unknown double-sided type.

Component: <10% complete, single toothplate frag.

L: 10mm; **W:** 21mm (inc); **Th:** 2.2mm

Description: Antler; probably red deer. One narrow toothplate fragment, shows probable tooth differentiation of 6/6. 4 vs 2 teeth remaining. One rivet perforation (with iron staining) at centre – possibly suggests *central edge arrangement*. Undecorated. Quality unknown. Wear low to medium, some striation.

Find No: BUR07, 1471, sf242

Object Type: Composite comb, unknown double-sided type, probably type 12.

Component: <50% complete, area of conn and 5 toothplates.

L: 47mm (inc); **W:** 34mm (inc); **Th:** 9.1mm

Description: Indeterminate bone/antler connecting plate and billets. Tooth differentiation of 6/6. Teeth are striated, wear low/medium. Professionally-made, simple vertical line ornament at margins, Quality medium. Straight connecting plates, of flattened plano-convex section. 2 iron rivets, *alternating edge arrangement*.

Find No: BUR07, 1472, sf250

Object Type: Composite comb, unknown double-sided.

Component: 25% complete, short section of connecting plates with centres of billets intact.

L: 38mm (inc); **W:** 15mm (inc); **Th:** 8.9mm

Description: Antler; indeterminate species. 2 rivets, one perforation, all at edges, but overall arrangement unclear. Teeth differentiation of 6/5. Decorated with double-line cross-hatching within margins of paired vertical lines, expertly undertaken. Quality high/medium. Wear unknown.

Find No: BUR07, 1213, sf312

Object Type: Composite comb, unknown single-sided type.

Component: <10% complete, single toothplate.

L: 10mm; **W:** 21mm (inc); **Th:** 2.2mm

Description: Antler; probably red deer. One narrow toothplate fragment, shows tooth density of 6. One rivet perforation (no staining) at one edge - suggests alternating edge arrangement. Undecorated. Quality unknown. Wear unknown.

Find No: BUR07, 1213, sf313

Object Type: Composite comb, type 12.

Component: 10% complete, single endplate.

L: 24mm; **W:** 49mm; **Th:** 2.5mm

Description: Antler; probably red deer. One endplate, complete but missing all teeth, shows tooth differentiation of 6/6. One iron rivet perforation (no staining) close to, but not at edge. Undecorated. A rectangular raised area is preserved; this would have underlain the connecting plate (now lost). Quality unknown. Wear unknown.

Find No: BUR07, 1472, sf314

Object Type: Composite comb, type 12.

Component: 50% complete, very fragmented.

L: unknown; **W:** 42mm; **Th:** 3.5mm

Description: Antler; probably red deer. 3 fragments of connecting plate, with toothcuts on both sides, 4 iron rivets. Connecting plate of plano-convex section, and cigar-shaped profile. Vertical incised-line ornament features at the terminals. 3 fragments of toothplate, all with riveting on one edge only: *alternating edge arrangement*. Tooth differentiation 5/5. The endplate has marked decorative graduation on both edges, with teeth extending right to the comb end. Indeterminate bone/antler. Quality medium. Wear medium; some beading at ends.

Find No: BUR07, 1036, sf315

Object Type: Composite comb, type 8a.

Component: <10% complete, conn frag.

L: 22mm (inc); **W:** 11mm (inc); **Th:** 3.0mm

Description: Antler; probably red deer. One narrow connecting plate fragment, of sub-triangular section, decorated with c12 chevrons in field enclosed by paired vertical lines. Toothcuts on one edge show tooth density of 5. One rivet perforation (marked by slight iron staining) is preserved at one edge – overall arrangement unknown. Undecorated. Quality medium. Wear unknown.

Find No: BUR07, 1196, sf872, recovered during flotation.

Object Type: Composite comb, unknown double-sided type.

Component: Fragment of connecting plate and fragment of toothplate

L: 42mm; (inc); **W:** 11mm; **Th:** 2.8mm

Description: Bone connecting plate (flat, split rib). Antler (probably red deer) toothplate. Undecorated, but with even toothcuts along both edges. One iron rivet; one ironstained perforation on one edge of billet. Arrangement unclear. Tooth differentiation 5/5. Quality 3; wear 3 (some minor beading).

Other Object Types

In the following, the following details are recorded, where known:

- **Form**
- **Component/ Completeness** (estimated as <25%/25-50%/50-75%, or 75-100% of complete object)
- **Type** (after relevant classifications)
- **Raw Materials** (by macroscopic and, where undertaken, biomolecular techniques)
- **Ornament**
- **Dimensions.** L (Greatest Length); W (Greatest Width); Th (Greatest Thickness); D (Greatest diameter). Other measurements are specified in the catalogue entries.

BUR06

Find No: BUR06, 1015, sf40

Object Type: Pin / needle.

Component: Tip and fragment of shaft, c 50% complete

L: 52mm (inc); **W:** 4mm; **Th:** 3mm

Description: Bone/ antler. Faceted shank.

Find No: BUR06, 1042, sf61

Object Type: Pin / needle. Bone.

Component: Bone (bovid). Tip and most of shaft, c 75% complete

L: 72mm (inc); **W:** 7mm; **Th:** 3mm

Description: Flattened shank.

Find No: BUR06, 1097, sf134

Object Type: Pin / needle.

Component: Head and most of shaft, c 75% complete

L: 80mm (inc); **W:** 13mm; **Th:** 4mm

Description: Bone. Flattened shank. Polished. Flared, perforated head. Perforation is rough, and of rectangular shape, 5 x 3.5mm

Find No: BUR06, 1196, sf140

Object Type: Needle.

Component: Complete.

L: 105mm; **W:** 9mm; **Th:** 4mm

Description: Bone. Round shank. Very polished. Rounded, faceted, perforated head. Perforation round and smooth, diameter 3mm

BUR07

Find No: BUR07, 1019, sf148

Object Type: Pin /needle

Component: c50% complete

L: 37mm; **D:** 3.70mm

Description: Bone; natural channel visible in relief on reverse. No cancellous areas. Lower shank and tip only. Shank of circular section. No decoration. See MacGregor *et al.* 1999: 1950 for parallels. Probably dress or hair pin. Polish on tip.

Find No: BUR07, 1050, sf149

Object Type: Picker-cum-beater

Component: c10% complete, two pieces

L: 103mm; **W:** 13.1mm at head; **Th:** 6.4mm

Description: Bone. Gently flared head, flattened top, large areas of cancellous tissue in head, natural groove on lower shank. Bone. Perforated head, round, d 4.7mm. Shank flattened, kidney-shaped; no decoration. Polished at centre and tip. At Coppergate, this form is associated with Phase 4A and onwards into the 12th-century (MacGregor 1999: 1967, type 2).

Find No: BUR07, 1049, sf151

Object Type: Pin /Needle

Component: c50% complete, head and upper shank

L: 51mm (inc); **W:** 9.65mm at head; **Th:** 3.21mm

Description: Bone, with some areas of cancellous tissue exposed. Spatulate head, flat top with circular perforation, diameter 3mm. Shank of flattened ovoid section. No decoration. 'Pig fibula' type. Group 2 (see MacGregor *et al.* 1999: 1951). If a needle, the expanded head 9mm head could only have been passed through coarse textiles.

Find No: BUR07, 1054, sf152

Object Type: Pin

Component: c100% complete

L: 74mm; **W:** 7.35mm at head; **Th:** 2.50mm

Description: Probably bone. Spatulate head, flat top, unperforated. Shank of flattened ovoid section; probably bone. No cancellous areas. No decoration. Group 1 (see MacGregor *et al.* 1999: 1950). Probably dress or hair pin. Polish on tip.

Find No: BUR07 Test Pit G, 1496, sf243

Object Type: Socketed implement handle

Component: 50% complete

L: 86mm (inc); **D:** 22mm at head, 15mm at base

Description: Antler tine, red deer. Proximal end perforated; distal end contains iron tang, from knife or similar. Outer surface removed, proximal end features lines defining circumferential field of knife-cut ornament, containing crude 'chain' style motif, and bounded by paired chevrons (compare MacGregor *et al.* 1999: 1971-2).

Find No: BUR07, 1016, sf259

Object Type: Perforated longbone.

Component: c. 50% of longbone

L: 131mm (inc); **W:** 28mm; **Th:** 13mm

Description: Bone. Distal articulation and lower shaft of sheep tibia. Distal articulation intact, roughly perforated just below head. Shaft sliced through obliquely at mid-shaft, and rough oblique cut marks lie parallel with the break.

Find No: BUR07, 1016, sf260

Object Type: Perforated longbone.

Component: 25-50% of longbone.

L: 81mm (inc); **W:** 14mm; **Th:** 10mm

Description: Bone. Distal articulation and lower shaft of sheep tibia. Distal articulation intact, roughly perforated just below head. Shaft sliced through transversely at mid-shaft.

Find No: BUR07, 1050, sf311

Object Type: Pin / Needle

Component: c50% complete, head and upper shank

L: 53mm (inc); **W:** 8.27mm at head; **Th/D:** 3.61mm

Description: Bone (pig). Spatulate head, natural articular top with circular perforation, diameter 4mm. Shank of circular section, slightly faceted, groove just below top of head on one face. No decoration. Pig fibula type. Group 2 (MacGregor *et al.* 1999: 1951). If a needle, the expanded 8mm head could only have been passed through relatively coarse textiles.

Biomolecular Results

The Burdale worked bone collection provided the opportunity to trial a recently developed biomolecular form of species identification. ZooMS (Zooarchaeology by Mass Spectrometry) is a high throughput, rapid proteomic method for the identification of animal products to species. It works by fingerprinting the protein spectra preserved within bone collagen, and the fact that it operates on extremely small sample sizes means that it is minimally destructive, and thus well suited to application in the study of bone and antler artefacts. With this in mind, a large number of the objects from Burdale were subjected to analysis by ZooMS, and it was possible to test multiple samples from the same object. This is particularly important in the study of composite items, such as hair combs.

The results of ZooMS and macroscopic identifications are presented in Table 1. ZooMS identifications do not always provide us with a single species determination, but rather a selection of possible alternatives. These can often be filtered by reference to morphology (if it can be established on macroscopic grounds that an object is made of antler, then it is easy to interpret the ZooMS result that the object is 'reindeer/goat'. Similarly, historical biogeography allows us to rule out certain species: reindeer, elk, and fallow deer were not native to the British Isles during the early Middle Ages, so we would need to build a strong case if we were to interpret 'red/fallow/roe/elk' as anything other than red deer. Moreover, the antlers of the roe deer are small and we have little evidence for their being worked in the past (although see Riddler 2003), and of the two species native to the British Isles, red deer is the most likely source of material for the manufacture of items such as combs. Thus, identification proceeds via a process of logical elimination.

This study represents the first application of the method to an artefactual collection, and a subset of samples were also subjected to aDNA analysis, in order to test of the veracity of the technique (see von Holstein *et al.* in press). The study demonstrated that, when used in tandem with macroscopic techniques, ZooMS is a highly effective tool for artefactual work.

Table 1: Raw Material Identifications

SF Number	Object Type	Macroscopic Identification	Proteomic Identification
BUR06, sf5	Comb (toothplate)	Bone/Antler	Red/ Roe Deer
BUR06, sf11	Comb	Bone/Antler	Ruminant
BUR06, sf20	Comb	Antler (probably red deer)	Fallow/Red/Roe/Elk
BUR06, sf40	Pin / needle	Bone	Ruminant
BUR06, sf61	Pin / needle	Bone	Cow/ sheep
BUR06, sf134	Pin / needle	Bone	Mammal
BUR06, sf159	Comb	Prob. Red Deer	Fallow/Red/Roe/Elk
BUR06, sf290	Comb (toothplate)	Bone/Antler	Fallow/ Red/ Roe/ Elk
BUR07, sf147	Comb	Indeterminate Antler	Fallow/Red/Roe/Elk
BUR07, sf150	Comb	Bone: split Rib; small bovid.	Ruminant
BUR07, sf153	Comb	Bone/Antler	Fallow/Red/Roe/Elk
BUR07, sf154	Comb (conn)	Bone/Antler	Fallow/Red/Roe/Elk
BUR07, sf154	Comb (toothplate)	Antler (probably red deer)	Ruminant
BUR07, sf155	Comb	Bone: split rib; bovid.	Ruminant
BUR07, sf156	Comb (conn)	Antler (probably red deer)	Ruminant
BUR07, sf156	Comb (conn)	Bone/Antler	Ruminant
BUR07, sf156	Comb (toothplate)	Bone/Antler	Ruminant
BUR07, sf157A	Comb (conn)	Bone/Antler	Ruminant

BUR07, sf157A	Comb (conn)	Bone/Antler	Fallow/Red/Roe/Elk
BUR07, sf157B	Comb (conn)	Probably Bone	Cattle/sheep/goat/reindeer
BUR07, sf157C	Comb	Antler (probably red deer)	Fallow/Red/Roe/Elk
BUR07, sf157C	Comb (toothplate)	Antler (probably red deer)	Fallow/Red/Roe/Elk
BUR07, sf158	Comb (conn)	Antler (probably red deer)	Fallow/Red/Roe/Elk
BUR07, sf158	Comb (toothplate)	Bone/Antler	Fallow/Red/Roe/Elk
BUR07, sf196	Comb (conn)	Bone; small bovid.	Cattle/sheep/goat/reindeer
BUR07, sf197	Comb (conn)	Antler (probably red deer)	Fallow/Red/Roe/Elk
BUR07, sf198	Comb (toothplate)	Bone/Antler	Fallow/Red/Roe/Elk
BUR07, sf242	Comb (conn)	Bone/Antler	Cattle
BUR07, sf242	Comb (toothplate)	Bone/Antler	Red/ Fallow/ Elk
BUR07, sf250	Comb (conn)	Bone/Antler	Unidentified spectra
BUR07, sf250	Comb (toothplate)	Bone/Antler	Roe/ Fallow
BUR07, sf312	Comb (toothplate)	Indeterminate Antler	Fallow/ Red/ Roe/ Elk
BUR07, sf313	Comb (toothplate)	Indeterminate Antler	Fallow/ Red/ Roe/ Elk
BUR07, sf314	Comb	Indeterminate Antler	Fallow/ Red/ Roe/ Elk
BUR07, sf315	Comb	Indeterminate Antler	Fallow/ Red/ Roe/ Elk
BUR07, sf872	Comb (conn)	Bone/ split rib	Cattle
BUR07, sf872	Comb (toothplate)	Indeterminate Antler	Fallow/ Red/ Roe/ Elk
BUR07, sf259	Perforated longbone	Bone; sheep tibia	Cattle/ sheep/ goat/reindeer
BUR07, sf260	Perforated longbone	Bone; sheep tibia	Cattle/ sheep/ goat/

			reindeer
BUR07, sf148	Pin / needle	Indeterminate Antler	Pig
BUR07, sf149	Pin beater	Bone	Cattle/ sheep/ goat/ reindeer
BUR07, sf151	Pin / needle	Bone	Pig
BUR07, sf311	Pin / needle	Bone	Pig

Discussion

The Combs

There are twenty-six combs from Burdale, including single-sided and double-sided composite combs. There are no one-piece combs. Eleven examples are of double-sided types, while fifteen are single-sided (including two semi-double examples). Typologically, all identifiable examples of double-sided forms may be classed as type 12 (Ashby 2011), while the single-sided forms include type 2a (five examples), type 2b (seven examples), and type 8a (one example). Other examples could not be securely identified to type. This profile is typical of an 8th- or 9th-century settlement, while the absence of evidence for production is well paralleled at rural sites of Middle/Late Anglo-Saxon date. The site should thus be seen as a net consumer (rather than producer) of combs, and in general the evidence is in accordance with contemporary collections from the Middle-Anglian north.

It is germane to consider the collection more closely, in the context of other site assemblages from the region and beyond. The Middle/Late-Saxon collection from the South Manor at Wharram contains roughly equal numbers of double-sided and single-sided combs (MacGregor 2000), as does the material from Saxon Southampton (Riddler 2004: 147, though see Hinton 1980: 76). At 7th- to 10th-century Flixborough and the 6th- to 7th-century cemetery of Castledyke South, Barton-on-Humber, double-sided combs dominate (<2:1, and 3:1 respectively; Drinkall and Foreman 1998: 82). The dominance of double-sided combs is more marked in the material from London (e.g. Riddler 2004: 146), but at Fishergate, York, single-sided combs dominate (3:1; Rogers 1993: 1388-1402). Thus, together with the existence of close parallels in ornament in the region, it does seem that Anglian York and its environs provide the best context in which to consider the Burdale material, and further comparative research is recommended.

Raw materials are dominated by antler (probably red deer antler on the basis of macrostructure, and supported in a number of cases by ZooMS analysis). There are a small number of examples of the exploitation of postcranial bone, but this is not extensive (as, for example, has been observed at Southampton (Riddler 2011) This is as would be expected on bio-geographical grounds; there is no reason to suggest that any of these objects were not manufactured locally. Indeed, form and ornament are

typical of northern England in the middle/late Anglo-Saxon period, while the 'alternating-edge' riveting pattern is the most frequently identified arrangement across the British Isles throughout the early-medieval period.

One area in which the combs stand out is in their quality of production and ornament. There is no objective method for the study of object quality, but on the whole the combs are well made, with attention paid to symmetry, ornament, and finishing. They compare favourably, for instance, with the collections from sites such as Cottam, and perhaps have more in common with Anglian sites in York itself (such as Fishergate and Fishergate House/ Blue Bridge Lane). In particular, a small number of combs exhibit very high levels of craftsmanship, such as the 'semi-double' type 2b comb with running guilloche ornament (paralleled at Castledyke South; Drinkall and Foreman 1998). Of course, not all combs are of higher quality, and some of the bone double-sided examples are a little more rudimentary; it is unclear whether this distinction should be seen as the result of social differentiation, or if it is a function of chronology.

One comb that stands out is sf315: a tiny fragment of triangular-sectioned connecting plate from a type 8a comb. Such combs are characteristic of the 10th and 11th centuries. As such, this example postdates much of the other material in the Burdale collection, and its loss may have occurred during the final stages of early-medieval activity on the site.

The Pointed Objects

There are 9 pointed objects from Burdale, of which 8 may be classified as pins or needles, and one is a textile implement – a picker-cum-beater.

The pins/needles all have the spatulate heads characteristic of pig fibulae, and in some cases biomolecular analysis (ZooMS) bears out the species identification as *Sus scrofa*. These pins were made using the fibula from a pig: an element well-suited for such a use, and requiring minimal adaptation in order to do the job. The broad diaphysis of the bone works well as a shank without trimming, and the examples from Burdale have broad shanks typical of this material. Likewise, the expanded proximal end of the fibula recommends itself as a pinhead, requiring only trimming and perforation, depending upon function. The rudimentary design and minimal decoration of the Burdale examples are typical of the form, with comparable examples known from early medieval sites as disparate as Lagore and Haithabu (see MacGregor 1985: 120-121 for a survey)

The use of pig fibula pins is poorly understood. MacGregor (1985: 121) has suggested that only the examples with most closely-trimmed heads (MacGregor *et al.* 1999: 1951, Group 3) could have been used as needles, and that other perforated examples (Group 2) simply acted as paired dress fasteners or primitive safety pins. Wear studies could be carried out, and would have considerable interpretative potential if taken as part of a wider synthetic study, but close analysis was not possible as part of this evaluation.

Sf149 from Burdale is a typical picker-cum-beater, being rounded in cross-section, and featuring one pointed end and a flattened butt. It displays the cancellous tissue visible on many examples that allows confident identification of the material as the long bone of a medium-sized or large mammal, and ZooMS broadly confirms this. Pin beaters were used in the textile trade, being used to beat weft into place during the weaving process. The butt-ended 'picker-cum-beater' type (its butt being used to pick up the weft) seems particularly characteristic of the Viking Age, when they were associated with the use of the two-beam vertical loom, an innovation that seems to date back to the 10th century (MacGregor *et al.* 1999: 1968; Walton Rogers 1997: 1760). The Burdale example is typically highly polished through use, with particularly clear evidence of wear visible towards the distal end of the shaft. Evidence from urban excavations such as York seems to suggest that such tools were produced (probably by textile workers themselves) according to necessity, and did not travel far from their place of manufacture or use. The presence of an example at Burdale then, is perhaps significant.

Miscellaneous Other Objects

There is a single socketed implement-handle from Burdale (sf243); broad parallels are numerous (see MacGregor 1985: 168-70), but further research is needed. There are also two examples of what we have termed 'perforated longbones'. The Burdale finds are fairly typical of the type, being fashioned from the distal end of a sheep tibia (sheep and goat provide the most frequently utilised resource for these tools, and examples are also known on metapodia and femora as well as tibiae). The diaphysis is, as is common, crudely broken or cut to a point, while the size of the articular socket is within the diametrical range of those from York (*cf* MacGregor *et al.* 1999: 1990). Detailed studies of use wear (around perforations) and polish (on cut surfaces) will be required if the functions of these sorts of objects are to be ascertained.

Summary

The Burdale assemblage is an important one, comprising a large number of combs, and a small number of various other object forms. ZooMS biomolecular species identification was trialled on this collection, and the results confirm the considerable potential of the technique for application on worked-bone material. The Burdale collection itself offers significant potential for further analysis and interpretation, particularly in synthesis, and in comparison with broadly contemporary sites in Yorkshire (*e.g.* Cottam; Wharram) and beyond (Flixborough; London; Southampton).

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