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RESEARCH ARTICLE

Reconstructing Maglemose bone fishhooks – a craftsmanship from Zealand

Solveig Chaudesaigues-Clausen

MA, University of Copenhagen, København, Denmark

ABSTRACT

The first fishhooks that have been found on the Danish territory date back to the Maglemose period (c. 9600/9500–6700 B.C.), and they are made of bone and antler. Most of them were excavated at the start of the twentieth century in settlements next to inland bogs and lakes and have since then only been studied in a very few cases. The aim of this paper is to analyse the assemblage of at least 30 fishhooks and 23 manufacturing products from that period and produce new knowledge about the Maglemose culture through fishhook typology, technology and comparison with the North European bone production.

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Introduction

Line fishing is a commonly practiced activity today across the world, both for pleasure and economic purposes. It is highly specialised and requires a great variation of fishhook sizes and shapes (Chacón *et al.* 2015), as well as implements such as lures or spoons (Brinkhuizen 1983, Table 1 p. 14, Bergsvik and David 2015). Although they are today mainly made of metal, they can also be crafted in traditional materials such as wood, animal body parts, bone and many others (Gruvel 1928). This fishing implement, with the shape we know today – a shank, a curved bend and a point – has its European roots in Final Palaeolithic (Gramsch *et al.* 2013) and has been used ever since.

The Danish Mesolithic comprises numerous fishhooks, especially the Early Mesolithic culture of Maglemose (c. 9600/9500–6700 B.C.) and the Late Mesolithic culture of Ertebølle (5400–3950 B.C.). The study of fishing in these periods is of particular interest as this region, in Mesolithic times, was a changing 'waterworld' (Mansrud 2017, Mansrud and Persson 2017), comprising fresh, brackish and salt water, and was, therefore, rich in resources. This paper will focus on the fishhooks from the Maglemose period, where groups of people were living primarily in landscapes dominated by lakes, rivers and bogs, and were using inland fishing (Clark 1936, p. 89). The aim will be to analyse the typology and technology of bone fishhooks from the Danish Maglemose culture on Zealand. The study will comprise:

- The Åmose sites: Øgårde, Vinde-Helsinge, Mullerup I, Ulkestrup Lyng Øst I
- The Sværdborg sites: Sværdborg I, Lundby I

Problems and goals

Through this paper, we will try to analyse how an artefact or a combination of techniques can be representative of an archaeological culture. Defining archaeological cultures started at the end of the nineteenth century, when the English ethnologist E. B. Tylor defined culture as a set of behaviours and traditions comprising morals, art, law, beliefs, knowledge and habits (Tylor 1871, p. 1, Friman 1996, p. 143). This definition was given by ethnologists, who were looking at living societies and, therefore, were focussing on non-material aspects. When the archaeologists tried to define archaeological cultures at the start of the twentieth century, the focus was at first on material evidence only. For instance, Gordon Childe's definition in 1929 was that certain types of finished artefacts or *fossiles directeurs* that were constantly recurring together were corresponding to an archaeological culture (Friman 1996, p. 145,

CONTACT Solveig Chaudesaigues-Clausen solveig.chaudesaigues@gmail.com

Roberts and Vander Linden 2011, p. 2). This definition, which only considered the most prominent material evidence, has evolved since. Not only the final objects are representative, all the remnants of a culture – both material and non-material – play an active part in the tradition of a group and define an archaeological culture (Friman 1996, p. 150, Apel *et al.* 2018, p. 5ff). Then, studying the material evidence of an archaeological culture can lead to the identification of techno-complexes, social traditions and differences or similarities in practices, which is what this paper will intend to do.

In search of adding to the definition of the Maglemose culture, one of the goals is to establish a typology of the fishhooks, by answering these questions:

- Is it possible, when presented with a stray find, to be able to place the fishhook in its original chronological context, based on morphological criteria?
- Can a fishhook type be characteristic of a culture?
- How do we discern cultural traits? Is there a morphological evolution of the shapes?

The other goal will be to study the fishhook manufacture, with the purpose of characterising one – or several – production(s) and understand how it is integrated in the technology of the other bone and antler objects. The following problems will be tackled:

- How many manufacturing methods can be defined and what do they tell about the social group and its contacts?
- Can chronological differences be observed?
- Is technology shared on a wide area or on the contrary restrained?
- What level of freedom can a person making a hook have?

It will be possible to answer these questions with the study of the fishhooks, the products from manufacture, as well as with experimentation. Experiments have been carried out in order to reconstruct the operational scheme of Maglemose fishhooks and to understand what type of waste derived from it. It was done by following the observations and stigmas found on the archaeological material. The material chosen was a red deer metacarpus and the whole process followed the Maglemose method, from the *débitage* of the bone to the final fishhook.

Environmental and cultural context

During the Ancylus Lake stage (c. 9500–8000 BP), the South Scandinavian area was composed of inland lakes, bogs and coastal landscapes around Kattegat, creating favourable conditions that attracted people who settled on lake borders or on the coast (Clark 1936, p. 89, Rößler 2006, p. 15). It is in this context that the Maglemose culture developed as the first Mesolithic culture of the Danish territory (Figure 1). Its centre is considered to be the island of Zealand, where big inland sites have been found and contained a huge amount of archaeological material. Jutland and South Sweden are also traditionally integrated in this central Maglemose culture (David 1999a, p. 25). A greater Maglemose territory with differences and similarities in industries has also been recognised in northern Germany, East England and northern Poland (Figure 1).

Considering the bone industry, the island of Zealand is most representative of the Maglemose culture as bone artefacts are to be found contrary to Jutland, where the limestone sediments have not preserved the organic material (David 1999a, p. 23). As the archaic coastlines from the Maglemose period are today flooded due to eustatic sea-level changes (Rößler 2006), only the inland sites are left to study (Figure 1); therefore, the visible fishing economy is only based on freshwater fish (Ritchie 2010, p. 35). The equipment is represented by barbed bone points, which have been used as spears for fish, as on the Boreal site Kunda in Estonia where two spears were found in pike remains (Clark 1975, p. 144). On the pre-Boreal German site of Friesack, a probable fishnet was discovered (Johansson 2000, p. 110). A paddle from Ulkestrup suggests the use of log boats (Jensen 2001, p. 100). The fish that probably played the most important role in the economy was pike (Clark 1975, p. 142) and the fishhooks used were massive and made for carnivorous fish.

Maglemose fishhooks: characteristics

The Maglemose fishhooks are very varied in shapes and lengths. The shank is usually long and straight, and the bend is curved or has a rectangular outline

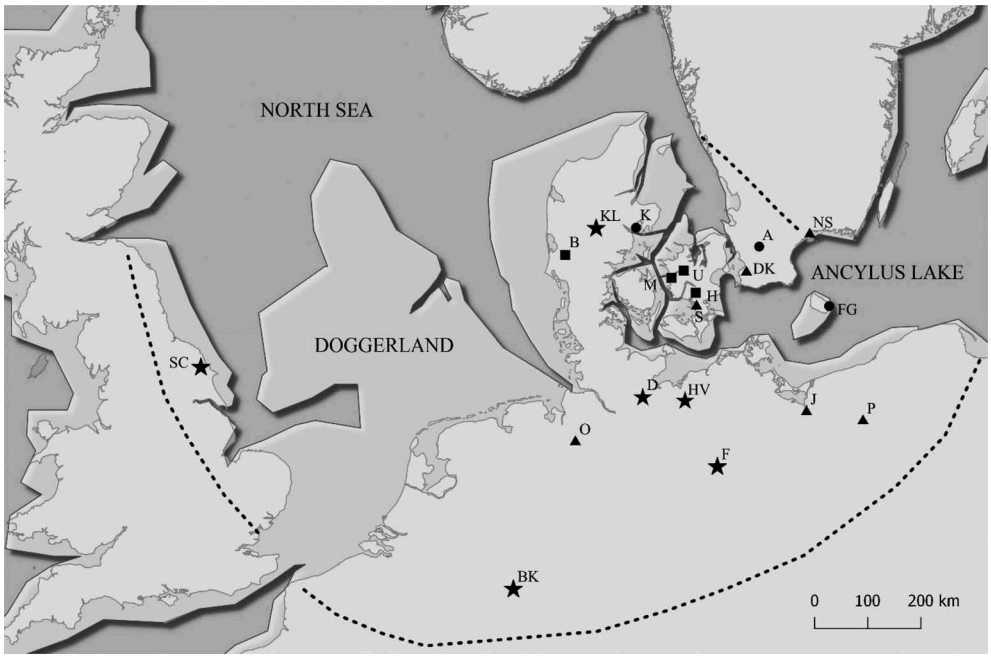


Figure 1. Map over the Maglemose culture and Maglemose-affiliated sites, with some of the sites mentioned in the text and the contemporary coastline. The stippled line represents the rough limits of the greater Maglemose area. Preboreal sites marked with a star: SC: Star Carr. BK: Bedburg-Königshoven. D: Duvensee. HV: Hohen Viecheln. F: Friesack. KL: Klosterlund. Phase 2 sites marked with a square: B: Bøllund. M: Mullerup I. U: Ulkestrup Lyng Øst I. H: Holmegård V. Phase 3 marked with a triangle: O: Oldendorf 69. J: Szczecin-Jezierzyce. P: Pomorski 3. S: Sværdborg I. DK: Draken MK 356. NS: Norje Sunnansund. Late Maglemose sites marked with a circle: K. Kalø Vig. A: Ageröd I:D. FG: Frennegård. After: Brinch Petersen (1973), p. 103, Fischer (1994), David (1999b), David (2006b), p. 96, Casati and Sørensen (2006), p. 36, Novak (2007), p. 90, Sørensen *et al*. (2013), p. 21, Sørensen *et al*. (2018a), p. 174, Sørensen *et al*. (2018b), p. 306. Map of the Doggerland area around 7000 B.C.: Solveig CC, after Gaffney and Thomson (2007), p. 3.

(Friis Johansen 1919, p. 207). The part for attaching the line can be individualised by a knob or a thickening of the shaft and, in some cases, there is no attachment modification. The internal bend is U-shaped and the point is barbless.

Based on data from four sites (Figure 2), 84% of the fishhooks are made from long bone (Mullerup I, Sværdborg I, Øgårde, Vinde-Helsinge) and 12.5% from flat bone (Mullerup I, Sværdborg I). The remaining 3.5 % represent roe deer antler (Mullerup I, Figure 2). On all sites, long bones are the predominant choice for making fishhooks. There can, however, be variation in the selection of the animal species, as some of the bones are very massive (10.8 mm thickness for X.7369 from Sværdborg I), and others are thinner, around 3.5–4 mm thickness. Long bones were probably preferred for their tubular properties, their sturdiness, and the fact that they do not need the scraping of the spongy tissue. The use of roe deer antler for one single fishhook from Mullerup I (Figure 2) may, on the other hand, constitute a special or opportunistic choice (David 1999a, p. 179).

Maglemose fishhooks are rather big, as seen by the size of the fishhooks from Øgårde and Sværdborg I (Figure 3). The longest in the assemblage is the one from Sværdborg I-1923 (Figure 3, drawing), which is 124.1 mm long. These massive fishhooks seem perfect to catch big carnivorous lake fish such as pike (*Esox lucius*) or wels catfish (*Silurus glanis*). On the other hand, smaller ones can also be found. They have especially been seen on Vinde-Helsinge, where all the small fishhooks are fragmented, so only their minimum size could be measured. Their mean full size would be estimated around 40 mm. They could be used for smaller lake fish such as perch (*Perca fluviatilis*) or tench (*Tinca tinca*).

From these observations, can a more precise typology of the Maglemose fishhooks be established?

Typology: a useful tool?

Typological classification is based on technological and morphological attributes and has a long

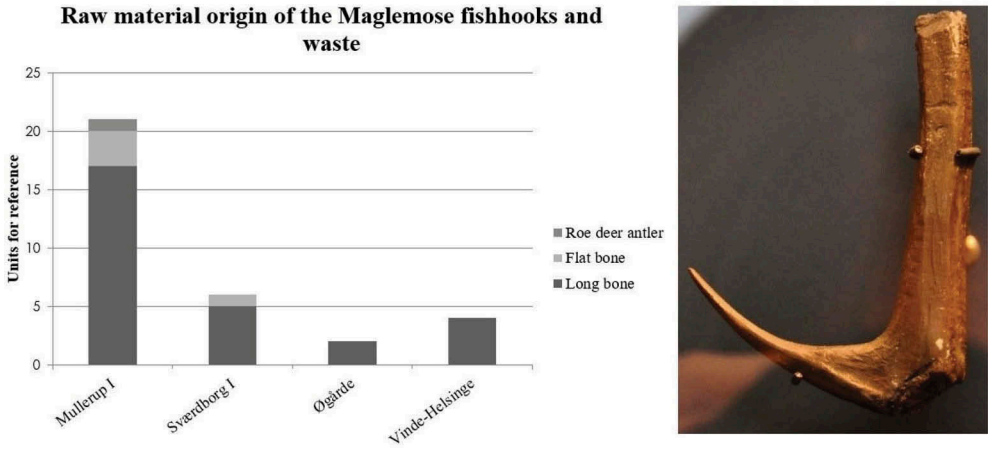


Figure 2. Identified raw material origin of the Maglemose fishhooks and waste. Material from Mullerup I: data from David (1999a). Picture taken by Solveig Chaudesaigues-Clausen: roe deer antler fishhook from Mullerup I (M497).

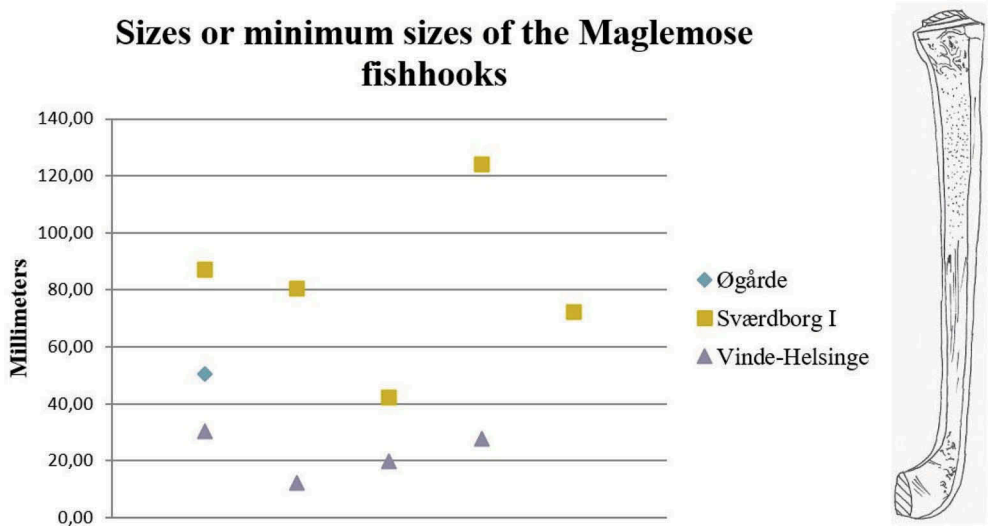


Figure 3. Sizes or minimum sizes of the Maglemose fishhooks. Fishhook: the longest one in the assemblage, Sværdborg I-1923 (X.5326). Drawing: Solveig CC.

tradition in archaeology (Bordes 1961, p. 11). It serves two purposes (Karsten and Knarrström 2003, p. 14, Clarkson *et al.* 2014, p. 168):

- Faced with a large number of archaeological objects, it objectively structures our observations into limited categories, where artefacts can be said to be alike in a defined way. Then, the objects can be studied, compared, contrasted and explained.
- It provides universal terminological conventions: thus, artefacts acquire a scientific status.

Typological classifications were extensively developed in the second half of the twentieth century in order to cope with the huge amount of archaeological material that was excavated. It can be used under various categories: morphological typology, functional typology, classificatory typology, *etc.* (Bordes 1967, p. 26ff, Clarkson and O'Connor 2014, p. 172). However, it has to be handled carefully, as it creates a level of abstraction (Clarkson and O'Connor 2014, p. 172, Karsten and Knarrström 2003, p. 14ff). An overreliance on typology only can for example be seen with the Early and Middle Palaeolithic biface classification

developed by François Bordes in the 1960s (Bordes 1961, Depaepe 2018, p. 127, Soressi and Geneste 2011, p. 335). According to him, typology was superior to technology: the techniques were only the means, while the artefacts were the final intention (Bordes 1961, p. 27). He classified each biface on a morphological basis and for him, the morphological differences were only cultural and not resulting from use or technology. But the emergence of the technological approach in the 1980s created a rejection of the Bordian typology (Soressi and Geneste 2011, p. 339). Even if some of the morphologies were culturally connoted, the shape of numerous bifaces was rather linked to their long use, resharpening and reshaping, than to their immutable type (Depaepe 2018, p. 217). Today, prehistorians still use Bordes' typology, as it is practical and is a part of the archaeological discourse (Pettitt 2009, p. 210), but it has to be remembered that it is a classificatory typology. Therefore, the purpose of each typology has to be expressed clearly.

As for the Maglemose fishhooks, their shape is mainly dependent on the prey to catch and the raw material used (Friman 1996, p. 161, Bergsvik and David 2015, p. 193, Chacón *et al.* 2015). From the observations noticed, there does not seem to be a definite Maglemose type, except from two fishhooks from Sværdborg I with a rectangular outline (Figure 4 n.5, Friis-Johansen 1919, p. 207). Their diversity is also seen *intra* sites, where the assemblages are not homogenous either, and represent probably different purposes. However, Eva David made a typology of fishhooks from Mullerup I, making a distinction between the fishhooks with a shaped bend and the fishhooks with an uneven base (David 1999a, p. 110). These uneven-based 'fishhooks' – the so-called *bentvejer* – are already present in the early literature (Sarauw 1904, Friis Johansen 1919). They are composed of an uneven or rough base, a defined point and another supposed point or shaft, which is broken at the base. Sarauw interpreted them as needles for binding fishnets (Sarauw 1904, p. 263). He thought that the objects were discarded when one of the points broke off during use (Sarauw 1904, p. 264). For Friis Johansen, they may have been small leister prongs (Friis Johansen 1919, p. 211). These *bentvejer* are for the moment only found on Zealand. Eva David integrated the manufacture of these uneven-based fishhooks in the production of the fishhooks with a shaped bend (David 1999a, p. 199). If they are considered fishhooks, the base should then have a function. On the Neolithic site of Vinča-Belo Brdo in Serbia, 41 hook-like objects made of flat bone have been found. They are quite unique because they have a big long rectangular base, a shank and a point, and could be lure hooks (Cristiani *et al.* 2016, p. 135). Lure hooks are sophisticated composite objects that are traditionally adorned

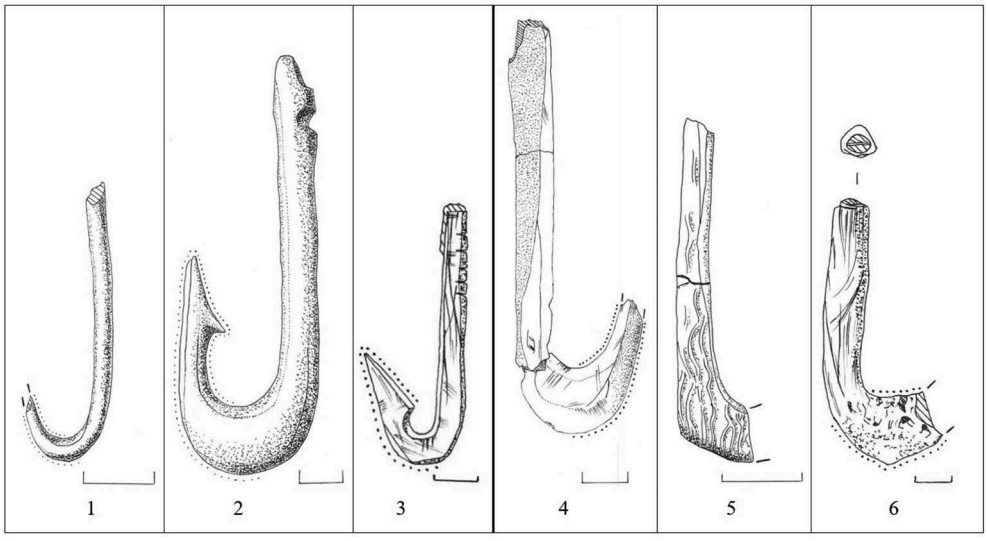


Figure 4. Left: stray finds interpreted as Maglemose: N.1: Grundmosegård (A42903). N.2: Unknown locality (22251). N.3: Søborg lake (A28539). Right: fishhooks from Maglemose contexts: N.4: Sværborg I (X.1448). N.5: Sværdborg I (X.5283). N.6: Sværdborg I (X.7369). Drawings: Solveig CC.

with feathers, leather, ropes, plant fibres or shells, and simulate a small fish to attract carnivorous fish when they vibrate in the water. They combine the properties of both fishhook and bait (Cristiani *et al*. 2016, p. 136). Coloured concretions were found on the base and top shank of nine of these Vinča-Belo Brdo artefacts, supporting the lure hook theory (Cristiani *et al*. 2016, p. 139). Could the Maglemose *bentvejer* then be lure hooks? If so, remains of organic material or modifications would also be found on the base of the uneven hooks, but it was not the case. Another interpretation of these artefacts will be presented later in this paper.

There is also a certain number of old stray finds of fishhooks that have been attributed to the Maglemose culture, based on morphological criteria. However, these criteria are rather vague. Very different morphologies are present in these stray finds, from a barb (Figure 4 n.2), to a visible bend perforation (n.3) or a very slim fishhook (n.1). The visible perforation has not yet been proved in a Danish Maglemose context, and barbs are considered a feature that mainly appears in the Neolithic (Clark 1936, p. 137). Metal hooks were first common in the late Bronze Age and early Iron Age (Clark 1952, p. 56), so bone hooks could belong to another period than the Mesolithic. These observations show that fishhook morphological typology must be taken carefully.

Technological study of the Åmosen and Sværdborg bog fishhooks

Table 1 sums up the techniques involved in the manufacturing of Maglemose fishhooks.

A list of the Zealand fishhooks studied is provided in Table 2.

The débitage to produce blanks

Based on David (1999a, 1999b) and the observation on rough-outs, fishhooks and *bentvejer*, two *débitage* methods can potentially be related to the creation of blanks for fishhook production (further descriptions in David 1999a, 1999b):

- The *débitage* of big game ribs or F-method (Figure 5, left): breaking off the proximal end of the rib, scraping and/or grooving the sides of the rib, using the shaft-wedge technique both laterally with a bone piece and longitudinally with a flint flake in order to separate the rib in two pieces (David 1999a, 1999b).
- The *débitage* of metapodials or D-method (Figure 5, right): vertical percussion on the edges of the proximal epiphysis of the bone metapodial to regularise the bone shaft, grooving longitudinally, sawing and breaking off the distal end and splintering the grooves with the shaft-wedge technique to detach long pieces of bone (David 1999a, 1999b).

The obtention of the blanks for fishhooks can also result from an opportunistic piece of bone that was fractured for marrow extraction, or from the recycling of a former bone tool.

The rough-outs

There are in the assemblage three rough-outs that can be assigned to fishhook production and one possible one. They are all broken longitudinally on the bend region so they could not be further shaped and have been discarded. The one from Vinde-Helsinge, the possible one (Figure 6), was probably discarded near a fireplace, as the surface is burnt.

These rough-outs are coming from both Åmosen and Sværdborg bog and are very similar. The raw material is in two cases (Mullerup I and Lundby I) long bone from big land game, and in one case (Ulkestrup I) rib from big land game. Different shapes of outer bend are chosen, curved and square. They can come from a *débitage*, a marrow-fractured bone or from recycling (the Ulkestrup I rough-out (Andersen *et al*. 1982, p. 74) seems to be recycled from the proximal end of a barbed point).

Regarding the techniques involved in the shaping of the rough-out, they are strictly similar. They consist of (Figure 7 left):

- Bifacial boring on the lower part of the rough-out. Boring easily permits the shaping of the bend. Experimentation has shown that the hole permits the elimination of the powder produced during grooving. The perforation could have a double purpose, both of shaping the

Table 1. The principal techniques visible on the Maglemose *débitage* and fishhook production (Averbouh *et al*. 1999, p. 304ff, David 1999a, 1999b, p. 648–701, 2007). Experiments: Solveig CC.

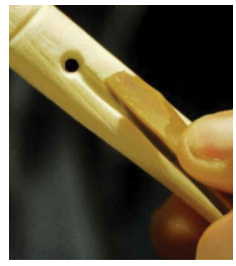
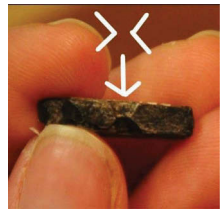
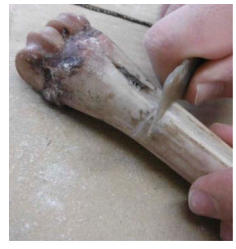
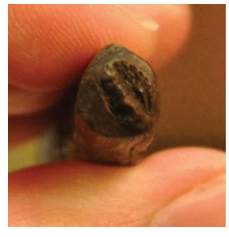
Working processes	Characteristics	Illustration
Grooving	Consists in incising an osseous material, then deepening the incision by abrasion. Repetitive linear movement towards oneself or the exterior to create a groove. Tool: burin or a thin flake. Thin sideslips from grooving can be noticed.	
Scraping	Technique used to scrape smooth a surface. Movement towards oneself or the exterior. The macroscopic traces are linear-undulated parallel striations, with perpendicular successive depressions that correspond to a different pressure created when the tool was applied.	
Boring	Continuous abrasion with a pointed flint tool with an alternate circular movement with the hand. It leaves parallel circular striations. The movement is applied on one face and then on the other face, creating a double cone profile.	
Sawing	Consists in digging a furrow with a sharp flint tool in a back and forth unidirectional movement. Sawing is usually better adapted to elements of little thickness. Sideslips with parallel more or less deep defined striations can be noticed. Sawing can locally be associated with other techniques, like deepening a groove or fracturing.	
Fracturing/ Prepared fracturing	Fracturing can be used alone on thin elements, but without any control of the fracture line. It is the reason why this technique is often combined with others. On the break, the sawing zone is completely flat, while the flexion zone is irregular and presents small indentations.	
Shaft-wedge	Used to divide a bone in its length. For ribs, an osseous wedge is placed transversally in the groove and permits the creation of a split along the bone. Then a flint wedge is placed in the split and is hit perpendicularly to the grooves. The blanks can then be separated. For long bones, only the flint wedge can be used.	

Table 2. The Zealand Maglemose fishhooks studied (Sarauw 1904, Friis Johansen 1919, Broholm 1924, Mathiassen 1943, Brinch Petersen 1973, Henriksen 1976, 1980, Andersen *et al.* 1982, David 1999a).

Site	Region	Maglemose culture phase	Date BP/Date cal. BP	Date B.C./Date cal. B.C.	Dated material	Fishhooks	Material of fishhooks	Museum	Museum number
Lundby I	South Zealand	Phase 1–2				1 *bentveje* during official excavation, 1 rough-out during private excavations	Bone		
Vinde-Helsinge	Northwest Zealand	Phase 2	8550–8350 BP			Min. 7 fishhooks + small fragments + min. 2 *bentvejer* + 1 rough-out	Bone	Nationalmuseet, Denmark	A36512: VI 57 VI 81 VI 132 VI 214 VI? VI 169 VI 133 VI 91 VI 30 VI 185
Mullerup I (*locus classicus*)	Northwest Zealand	Phase 2	8660 ± 120 and 8330 ± 110 BP	6700–6400 B.C.		7 fishhooks 14 *bentvejer* 1 rough-out	Flat and long bones and roe deer antler	Nationalmuseet, Denmark	A18269: M497 M866 M1081 M551 M566 M160 M524 M255 M256 M460 M1160 M1152 M1133 M788 M767 M1157 M245 M? M436 M257 M433 M892 M897
Ulkestrup Lyng Øst I, hut II	Northwest Zealand	Phase 2	8370 ± 130 and 8140 ± 100 BP	Hut II: 6230 B.C. (K-2176)[1], 6100 B.C (K-1509)[2]	[1] Birch from the floor [2] Tinder fungus from waste area	1 rough-out	Flat bone	Nationalmuseet, Denmark	UL17447 and 21,344

(*Continued*)

Table 2. (Continued).

Site	Region	Maglemose culture phase	Date BP/Date cal. BP	Date B.C./Date cal. B.C.	Dated material	Fishhooks	Material of fishhooks	Museum	Museum number
Sværdborg I-1917 & 1923	South Zealand	Phase 3	8350–7850 BP			3 + 8 fishhooks	Bone	Nationalmuseet, Denmark	A29293: X.1448 (Sværdborg-1917) X.? (Sværdborg-1917) X.5 (Sværdborg-1917) X.5283 X.5326 (Sværdborg-1923) X.7369
Øgårde	Northwest Zealand	Phase 2, 3 or 4				4 fishhooks + 1 *bentveje*	Bone	Nationalmuseet, Denmark	A38444: ØI 1453 ØI 1554

interior of the bend and the technical purpose of improving manufacture.

- Central longitudinal grooving, from the perforation towards the upper part of the rough-out, until the opening of a groove. It permits the placing of the shank. The next stage after this initial groove can be seen in Figure 7 left 13b, where the groove is widened by inner scraping.

Waste

Going back to the *bentvejer*, they could simply be waste from fishhook production rather than objects with a function. They are of various sizes, a small one is from Vinde-Helsinge (39.9 mm long, Figure 8 n.4) and among the biggest is another one from Vinde-Helsinge (84 mm, Figure 8 n.3). The fact that they are of various sizes matches well the size range of the fishhooks.

The *bentvejer* have some characteristics in common (Figure 8):

- A completely preserved or nearly complete defined point.
- A missing broken off opposite 'shank'. The breakage pattern is always the same: the object is broken at the 'shank', which seems to be the weakest point.
- A V-shaped internal bend. Bifacial traces of grooving to shape the bend and sideslips can be seen.
- There is no regularity in the shape of the base between the different *bentvejer*, the base can be either broken or worked. In terms of function, this part could probably have a less significant purpose if it was used as an active object.
- Like fishhooks, most of them are made out of long bone, and the others of rib. Like the rough-outs, recycling is also used (Figure 8 n.2).

The fact that the base does not have a defined shape could suggest that either it does not constitute the important part of the object or that these objects are in fact not tools but simply waste from fishhook production. When looking back at the operational scheme of Eva David (Figure 7, left), the only way the central grooving can be widened to make a fishhook is by scraping the inner sides of the rough-

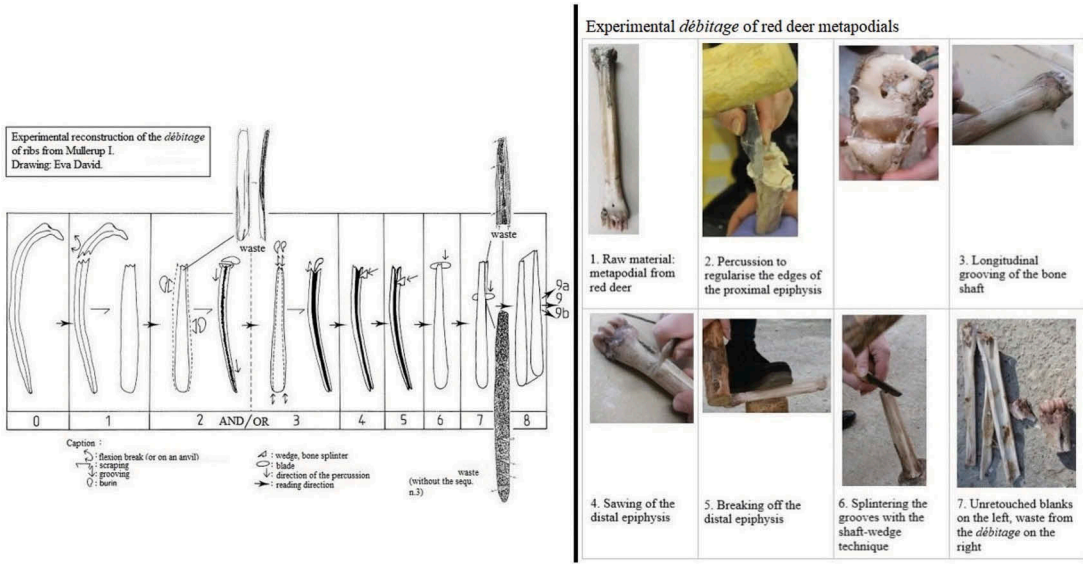


Figure 5. Left: *débitage* of ribs from big land game from Mullerup I (David 1999a: 212). With permission by E. David to use the drawing. Translation: SCC. Right: experimental *débitage* of metapodial. Experiments: SCC, under the direction of E. David.

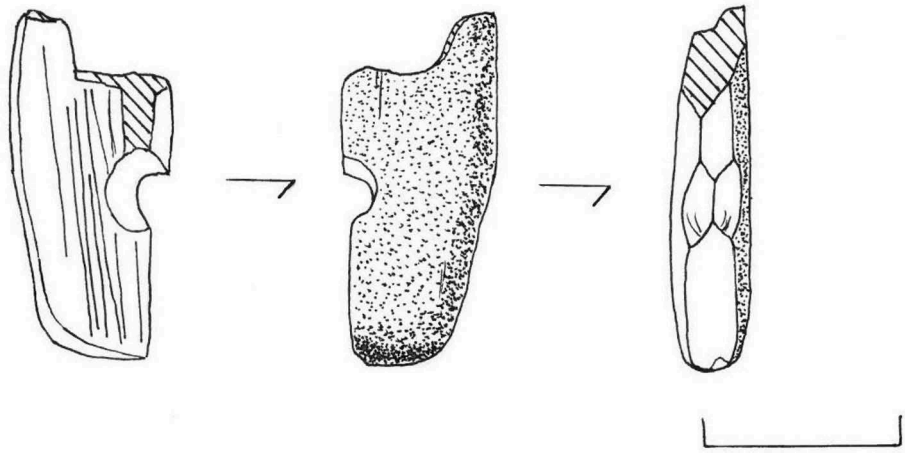


Figure 6. Probable rough-out from Vinde-Helsinge (VI 185). Drawing: Solveig CC.

out. It should automatically result in the shaping of the *bentveje*. Experimentation confirmed this result and showed that scraping the point of the hook naturally creates an hourglass shape, and with further circumferential scraping on the point area, it produces two individualised opposing points. Thus, the point of the supposed *bentveje* could be a result from the shaping of the point of the fishhook and ends up being as individualised as the fishhook point (Figure 9).

Then, if the *bentveje* is a waste product from fishhook manufacture, it has to be found out how it is separated from the top shank of the hook. The literature states that it is simply broken. Eva David notices that the shank bases have a burnt aspect (David 1999a, p. 110). Direct study of the *bentvejer* did not provide an answer. The fractures did not seem to have been through any preparation. Hand fracturing (flexion break) on rather thin pieces and on fresh bone could be undertaken. When examining the upper part of the shank of three fishhooks from Sværdborg I, a prepared sawing and then fracturing can be seen, permitting

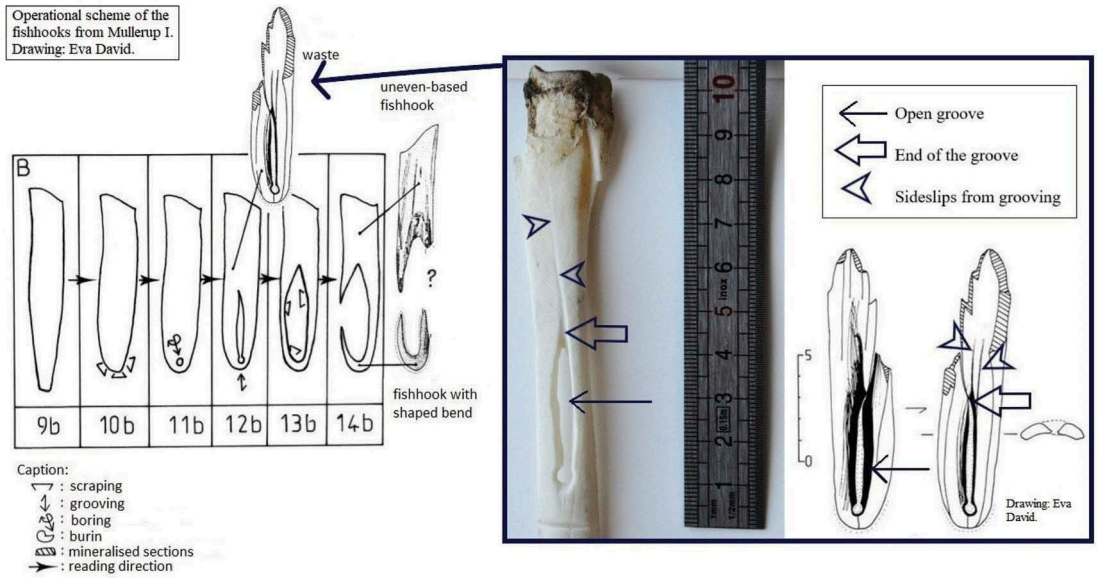


Figure 7. Left: the operational scheme of a fishhook with shaped and uneven base (*bentveje*) from Mullerup I (David 1999a: 199). Translation: SCC. Right: experimental rough-out showing the exact same stigmata as the Maglemose rough-outs (drawing: David 1999b: pl. 36). Photo and experiment: Solveig CC. Drawings: Eva David, with permission to use the drawings (1999a, 1999b).

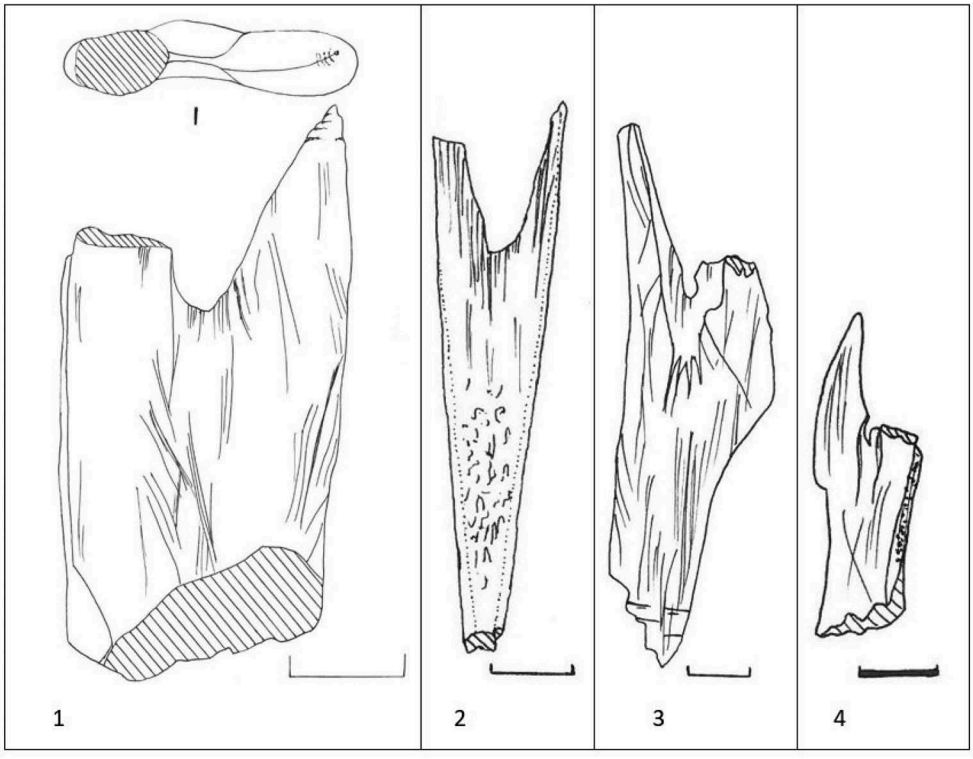


Figure 8. *Bentvejer*: N.1: Øgårde (ØI 1453). N.2: Sværdborg I-1919 (X.5). N.3: Vinde-Helsinge (VI 81). N.4: Vinde-Helsinge (VI 132). Drawings: Solveig CC.

a controlled fracture (Figure 10). It is possible that on massive fishhooks, a prepared sawing was undertaken to detach the fishhook more easily from its rough-out. This was also the solution that was chosen during the detachment of the experimental Maglemose fishhook.

Once the shank is taken off, it should be the last stage of manufacture, as the rest has already been

Figure 9. Experimental Maglemose fishhook under production.

shaped by scraping. Regarding other possible waste products, none have been noticed.

Discussions and perspectives

The technological analysis of the Maglemose fishhooks showed that if the choice of raw material does not seem to be normalised, the fishhook shaping techniques (boring-grooving-scraping) are in contrast identical on the six studied Zealand sites. Maglemose bone artefacts have not been preserved from Jutland; it is, therefore, impossible to tell whether this production method characterises the whole Danish territory. As for a chronological variation, it has not been noticed. From the observations on the rough-outs, there is continuity of this shaping method at least from phases 1–2 (Lundby I) to at least phase 3 (Sværdborg I). The fact that it is a time-consuming inner longitudinal grooving and scraping that was undertaken for the shaping shows that strict rules were followed, even for massive hooks. Therefore, Maglemose fishhook production is strongly culturally connoted and highly standardised. When looking at other objects such as the barbed bone points, a strict standardisation of the operational schemes is also followed and it is characteristic of the Zealand Maglemose bone industry (David 1999a, 1999b).

Comparing the Danish fishhooks and their manufacturing method with bone technology from northern Europe, some assumptions can be made. Eva David has identified several methods for making barbed bone points from England to the Russian plain (David 2006a, p. 138ff). The barbed points made from ungulate metapodials

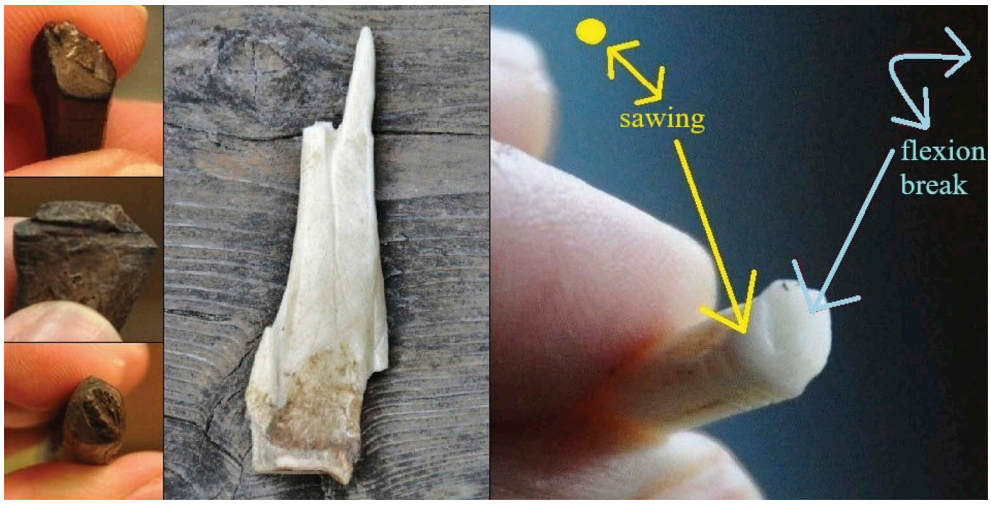


Figure 10. Left: the upper part of shanks of Maglemose fishhooks that present a prepared fracture (sawing + fracture): X.?, X.5326, X.7369 from Sværdborg I. Middle: experimental *bentveje* with sawn off and flexion-broken shank base. Right: upper part of the corresponding experimental fishhook, with sawn and broken off upper shank.

and flat bones are a common artefact in the whole area (Clark 1936, p. 87), but different *débitage* methods show that these weapons look alike but are not made the same way, and she demonstrated different technological traditions (David 2006a, p. 138ff). These traditions can for example be seen in the *débitage* of metapodials. David recognised a north-eastern techno-complex, represented by the Z-method, consisting of splitting the bone with a shaft-wedge-splinter technique (Bergsvik and David 2015, p. 214). It was first identified on the Russian site of Zamostje II but is also present on the western Norwegian coastal sites Viste and Sævarhelleren (David 1999a, p. 359ff, Bergsvik and David 2015, p. 213). There is another techno-complex: the northern techno-complex. It includes Star Carr, Hohen Viecheln, Duvensee, Friesack, and Zealand sites (David 2006a, p. 138–140). In this northern techno-complex, the D-method of *débitage* of bone shafts – the groove and splinter technique – is found in the Zealand Maglemose settlements and constitutes a special group in this northern techno-complex (David 2006a, p. 138ff).

There is one fishhook from Southern Sweden that could be affiliated to the Zealand production method, it is the Late Maglemose fishhook from Ageröd I:D (Figure 11). But no waste from the shaping process was recognised (Larsson 1978, p. 132). Even if Larsson suggests the possibility that it was shaped following the Maglemose method, it cannot be ascertained without waste material. Therefore, bone material from this layer should be studied in order to determine how the fishhook was manufactured. Looking at the older site of Ageröd I:A-H-C in the VL horizon, which is dated to the late Boreal chronozone (David 1999a, p. 31), it comprises both influences: the western Danish D-method and the eastern Z-method for the *débitage* of bone shafts (David 1999a, p. 353ff, 1999b pl. 104 & 105, Bergsvik and David 2015, p. 214). Ageröd I:A-H-C, along with the neighbouring site of Norje Sunnansund (pit area E2), mark the limits of the south Scandinavian eastern Z-method (David and Kjällquist 2018, p. 254). According to this, even if the Øresund did not exist in Maglemose times, there seems to be a *stricto sensu* Zealand Maglemose tradition (David 2006b, p. 96), different from the southern Swedish one that is subject to different influences. It seems again that the operational scheme of the Maglemose fishhooks is a part of the definition of the Zealand Maglemose group and adds to its characterisation as a singular techno-complex (Figure 11).

The Maglemose Zealand bone technology appears to be a long conservative tradition that does not allow innovation. Concerning the lithic industry, it also tends to be quite conservative.

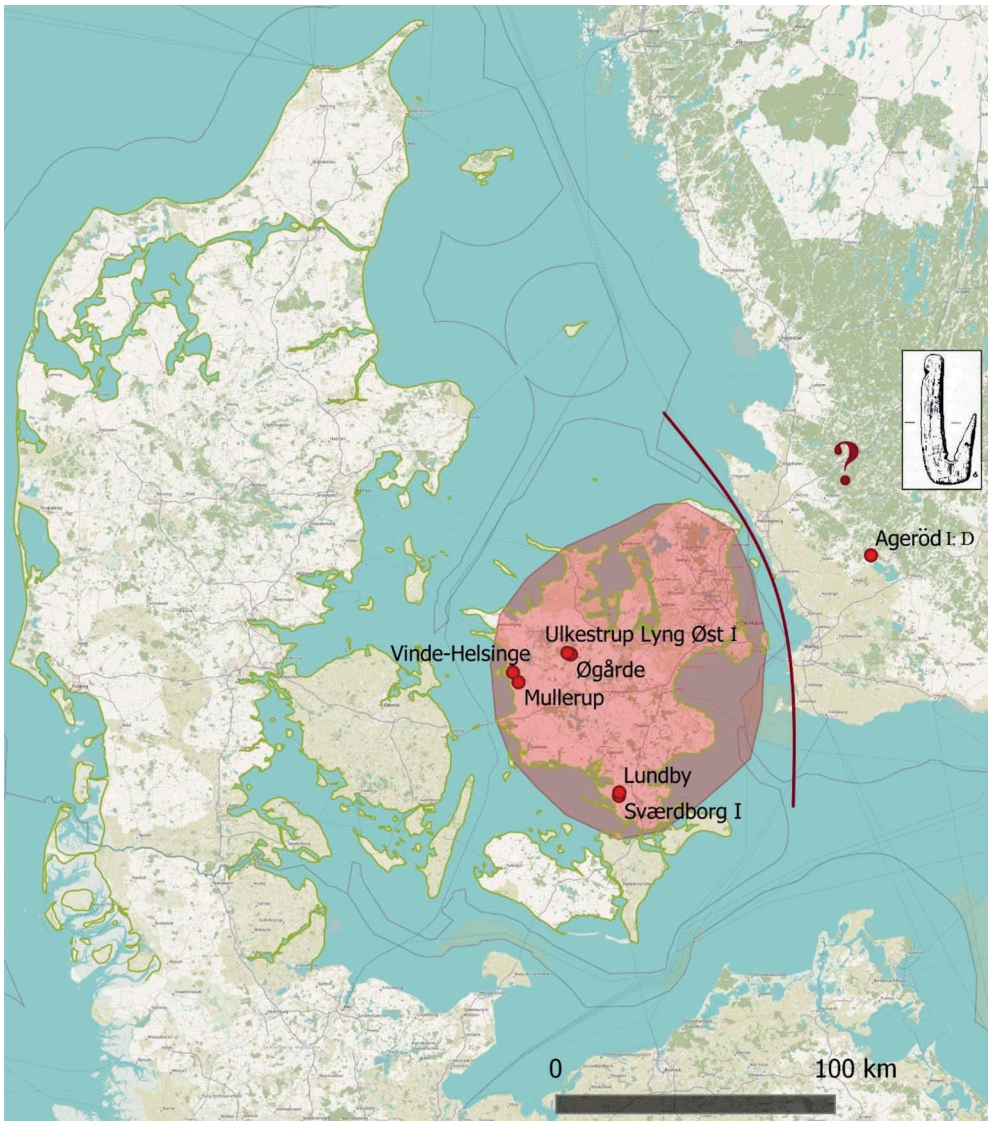


Figure 11. Map over the sites with Maglemose fishhooks, showing that the same technology is shared on all Zealand sites. The integration of Ageröd I:D in this techno-complex is not known. Fishhook: drawing by B. Centervall (Larsson 1978, p.132) with permission by L. Larsson to use the drawing. Map: Solveig CC.

However, during phase 3 of the Maglemose period, it is subject to change: a new flint knapping technology is introduced, called the conical core blade concept (Sørensen 2012, p. 241, Sørensen *et al.* 2013). It is a blade production method that consists of using the pressure technique to detach blades from regular conical cores. This technique permits the creation of very regular blades, and it requires a highly specialised knowledge (Sørensen 2012, p. 237ff, Sørensen *et al.* 2013, p. 23). This technology seems to originate from western Russia – the oldest date being from Stanovoye 4: 9375 ± 50 BP – and it spreads throughout Scandinavia. It arrives in Denmark through the Baltic countries and is present on Zealand around 8170 ± 120 BP on Ulkestrup II, during the phase 3 of the Maglemose culture (Sørensen *et al.* 2013, p. 25ff). The theory of an eastern contact is also confirmed by DNA analysis of individuals from Hummervikholmen in southern Norway (dated to 9452-9275 BP for Hum1 and Hum2) and Motala in southern Sweden (dated to 6977 ± 69 BP for Motala3) (Eriksson *et al.* 2018, p. 908, Günther *et al.* 2018, p. 3ff). DNA from two sites shows that the individuals' genetic affinities were from both western and eastern hunter-gatherers (Günther

et al. 2018, p. 3ff). It seems then that the exchange of knowledge also accompanied the exchange of DNA. However, even if the conical core blade concept is a new technology, it is only seen by the Maglemose people as an optimisation of the blade production and does not generate new artefact types or eastern-inspired artefacts. As for the bone industry, they did not consider the Z-method to be efficient or interesting enough to replace their own traditional method.

These observations show that some practices, whether they are symbolic or material – often combining both in hunter-gatherer societies (Mansrud 2017, p. 2) – create a sense of belonging to a certain group, to a community of practice that shares the same knowledge and skills (Wenger and Snyder 2000, p. 139ff). The restricted Maglemose Zealand fishhook production or the regional differences in blade technology in South Scandinavia during phase 3 are witnesses of the communities of practice that seemed to exist in the Maglemose culture (Sørensen *et al.* 2018a, p. 195).

Even if the fish species caught on the different Danish Maglemose settlements were approximately the same (Rosenlund 1976, p. 22), it did not seem to generate identical-looking fishhooks, except from the two ones from Sværdborg I. There does not seem to be a standardisation in their shape. But looking further north, on the Middle Mesolithic sites of the southern coast of Norway as well as the southwestern coast of Sweden (8300–6300 BC), it appears that there is a recurring style all along the settlements of these regions. From Viste in southwestern Norway, to Prestemoen in southeastern Norway and Dammen in southwestern Sweden, most of the fishhooks have the same shape, are made from metapodials, have an average size of c. 30 mm and notches on the shank (Persson 2014, Bergsvik and David 2015, Mansrud 2017, p. 5). All these coastal sites have fished the same fish species, especially codfish and deep-sea fish (Århberg 2007, p. 47, Persson 2014, p. 220), and the fishhooks have the same style, contrary to the Maglemose ones.

Conclusion

This paper has attempted to give a structured overview of a single group of artefacts from the Maglemose period. It tried to demonstrate that, considering the fact that fishhooks are weapons used to catch fish, the Maglemose fishhook typology is rather linked to their use, the raw material chosen and the person who made the hook. Considering how specialised the choice of a fishhook still is today, where fishermen have their own preferences depending on the intended fish and the period of the year (Chacón *et al.* 2015), it is highly likely that fishhooks from Mesolithic times were produced by the fishermen themselves.

It has been established that it was difficult to place a stray find with complete certainty back in its original chronological context, when no manufacturing products were present. The manufacturing products – rough-outs, *bentvejer* – and the technical actions are on the contrary the true cultural markers. It is by their study and identification that it was possible to recognise a community of practice on the Zealand area, which shares the same knowledge and techniques about fishhook production.

To go further, a study of fishhooks in the Mesolithic of Europe contemporary to Maglemose times – choosing both coastal and lacustrine/riverine communities, as well as the ones that do not use fishhooks – should be undertaken. It would then be possible to draw a map of the use of fishhooks, their context and manufacture, in order to understand how specialised line fishing was in other European regions. We know from Russian sites that are contemporary to the Maglemose culture, such as Zamostje II, Stanovoye and Ivanovskoye 7 layer IV (Zhilin and Matiskainen 2000, p. 699, Maigrot *et al.* 2014, p. 246ff, Zhilin 2014, p. 101ff), that the fishhooks are made by hole-drilling on the rough-out and by convergent grooving to detach a triangular offcut. This method is very similar to the one used on the Middle Mesolithic coastal sites of south Norway and southwestern Sweden (Mansrud and Persson 2017). Since the Zamostje II Z-method of *débitage* of bone metapodials is also present on the southwestern Norwegian Viste and Sævarhelleren sites (Bergsvik and David 2015, p. 209), there could be an eastern-related production method of fishhooks on those sites. However, the Russian fishhooks are not similar in style to the Swedish and Norwegian ones (Zhilin and

Matiskainen 2000, p. 699, Zhilin 2014, p. 101). It would be interesting to study how widely this manufacturing method is practiced in time and space, and see what the connections between the western Russian plain and the Scandinavian area are.

As for coastal fishing, an analysis of stable isotopes on a human humerus from Køge Sønakke dated to 8250+-25 BP showed that this coastal Late Maglemose human consumed sea fish (Fischer *et al*. 2007). Underwater investigations in the coming years will probably bring more information about the submerged coastal Maglemose settlements in Denmark and what fishing gear they used there (Fischer 2001, p. 5, Moe Astrup 2018).

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