Anja Mansrud, Ellen Mette Nielsen, Axel Mjærum & Elling Utvik Wammer

ENCIRCLING THE CRAFT TRADITIONS OF FRESHWATER FISHING: AN ARCHAEOLOGICAL AND EXPERIMENTAL STUDY OF WHEEL-SHAPED NET SINKERS IN THE SCANDINAVIAN INTERIOR (AD 800–1300)

Abstract

This paper investigates wheel-shaped net sinkers, that is hoops made of rods and with plaited birch bark fibres, clasping a sinker stone in the centre. Recently recovered from forest and mountain lakes of central Scandinavia, and dated to AD 800–1300, these sinkers offer a glimpse into the use of birch bark during the Viking Age and the medieval period. By combining archaeological analysis and experimental replication, this paper firstly aims to explore the knowledge and skills involved in the making. Secondly, we investigate the relationship between the specific crafting process and the broader craft traditions and technologies of which the sinkers were a part, and we suggest that birch bark plaiting represents a technological and aesthetic craft tradition originating in Karelia and Estonia. The sinkers were utilised in freshwater fishing and attached to the bottom line of gill or seine nets. We propose that this specific net fishing technology was introduced to central Scandinavia as a result of agricultural expansion from east to west around AD 800.

Keywords: Fishing gear, sinkers, birch bark plaiting, experiments, chaîne opératoire, Viking Age, Middle Ages

Anja Mansrud (Corresponding author), Museum of Archaeology, University of Stavanger, 4036 Stavanger, Norway: anja.mansrud@uis.no

Ellen Mette Nielsen, Kurudvegen 23, N - 2208 Kongsvinger, Norway: ellen.mette.nielsen.kongsvinger@gmail.com

Axel Mjærum, Museum of Cultural History, University of Oslo, Postboks 6762 St. Olavs plass, N - 0130 Oslo, Norway: a.j.mjarum@khm.uio.no

Elling Utvik Wammer, Norwegian Maritime Museum, Bygdøynesveien 37, N - 0286 Oslo, Norway: elling.utvik.wammer@marmuseum.no

Received: 8 April 2022; Revised: 6 October 2022; Accepted: 7 November 2022

Mansrud, A., Nielsen, E. M., Mjærum, A. & Wammer, E. U. 2022. Encircling the craft traditions of freshwater fishing: an archaeological and experimental study of wheel-shaped net sinkers in the Scandinavian interior (AD 800–1300). *Fennoscandia archaeologica* XXXIX: 76–95.

INTRODUCTION

Archaeological surveys in the interior regions of South Norway unearthed a rare collection of composite organic artefacts: wheel-shaped net sinkers with preserved birch bark fibres. Such sinkers were initially discovered by local fishermen in the 1940s and 1950s, when the mountain lakes were established as dammed basins for hydroelectric power production. Every spring, the

water was lowered, exposing large lacustrine areas, and the sinkers would appear on the dredged lake floor. In 2014, a systematic survey revealed several wheel-shaped net sinkers *in situ* on the silty bottom of Lake Tesse, a lake located 850 m.a.sl. (Wammer 2015; Bjørkli et al. 2016) (Fig. 1d). The organic components of wood and bark permit a direct dating, and ten sinkers have so far been C14-dated to c. 800–1300 BC. These finds thus make up a unique corpus of organic material culture, which provides novel insight into the utilisation of birch bark fibres during the Viking period and medieval times.

A wheel-shaped sinker consists of a hoop made of rods. In the centre, a pebble stone wrapped in birch bark is attached, and carefully fastened. The wheel-shaped net sinkers found in South Norway are of a similar basic form and composition. Weaving with narrow bands or strips of birch bark is essential to the technique (Fig. 1). However, the material shows a significant variety. On some of the net sinkers, the stone is tied unsystematically with bark strips to be fastened in the centre of the net (Fig. 1a), while on others, the stone is nicely woven into the bark strips, in a plaiting-like technique, giving these sinkers a more decorative appearance (Fig. 1b & 1c). The hoop is often partly or completely lashed with bark strips. The outer diameter of the hoops varies somewhat, between approx. 9–16 cm (commonly around 11–12 cm), and the weight of the sinkers is between approx. 90 and 170 g when dry (the majority being approx. 150 g).

The crafting technique, in particular the weaving and plaiting of birch bark strips to fasten the sinker stone, stands out as remarkable in central Scandinavia. Similar artefacts are, however, documented ethnographically in Finland, Karelia and the Baltic states (Valonen 1953) (Fig. 2, 3). This situation has raised a long-standing debate about the invention, origin, distribution and chronology of the wheel-shaped sinkers (e.g., Hagen 1959; Wammer 2016). The plaiting technique used in the production of shoes, baskets and other items is

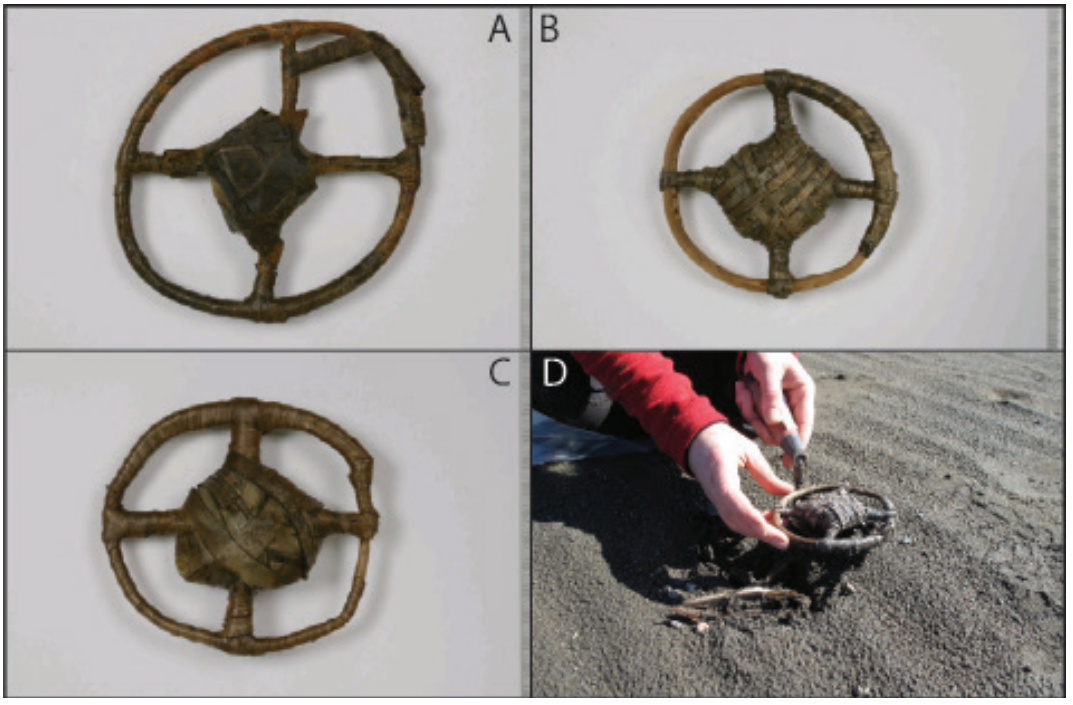

Figure 1. A selection of wheel shaped net sinkers discovered at the dredged lake floor of Lake Tesse, Norway. Some sinkers are made with simple, random plaiting (A and C), while others are regular and symmetrically woven (B). Sinkers found in situ during surveys in 2014 (D). (Pictures A–C: Vegard Vike, Museum of Cultural History.Picture D: Elling Utvik Wammer, Norwegian Maritime Museum.)

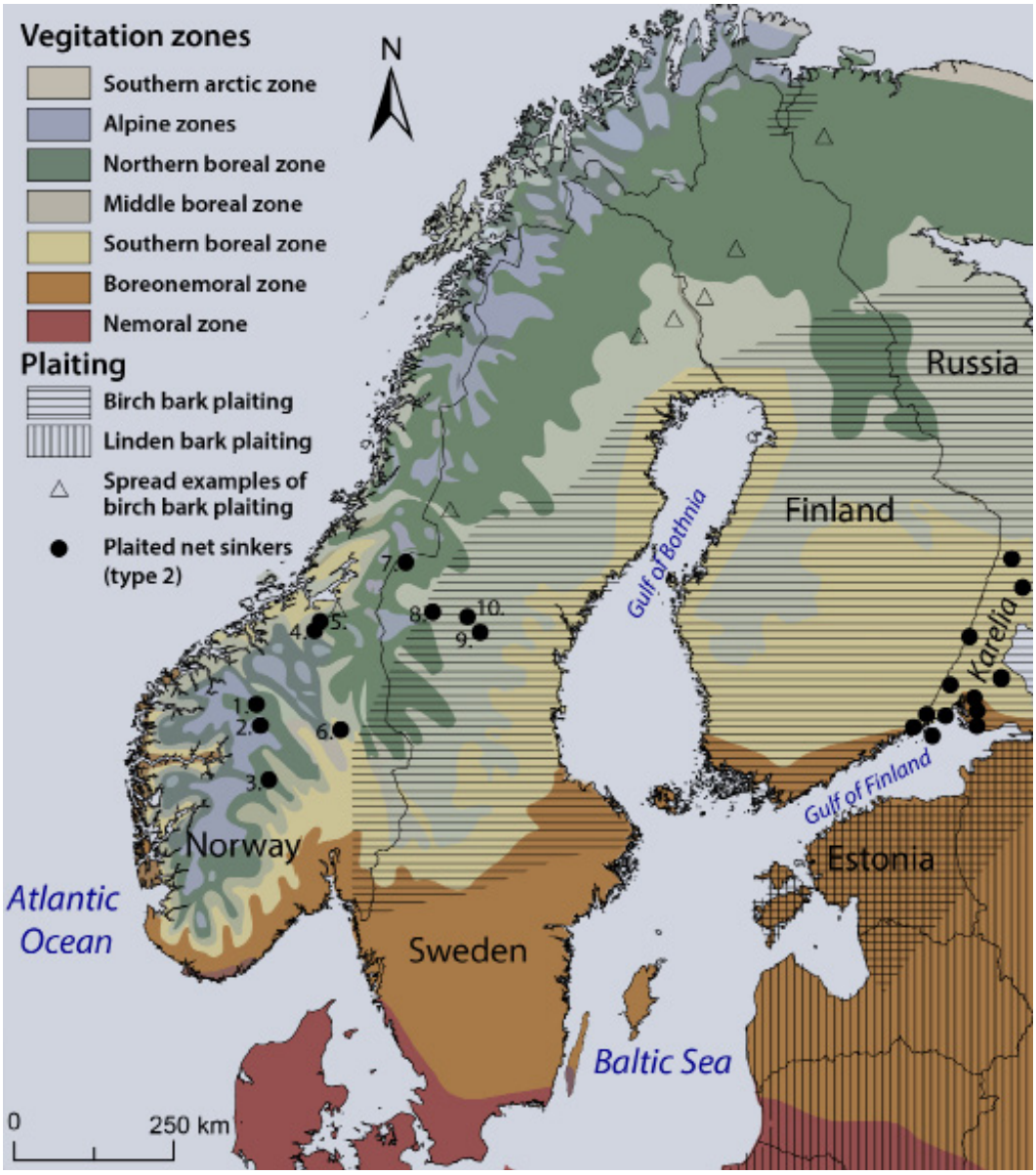

Figure 2. Lakes with wheel shaped net sinkers of Valonen's Type 2 in Central Scandinavia (1. Strandfjorden, 2. Tesse, 3. Lesjavannet, 4. Samsjøen, 5. Selbuvatnet, 6. Storsjøen, 7. Edeviken ved Torrön, 8. «a small lake» in Mattmar sokn, 9. Mellansvartsjön, 10. Locknesjön, cf, Tab.1) and in Karelia (based on Valonen 1952: abb. 219). The map also displays the distribution area for linden and birch bark plaiting in recent times (cf. Valonen 1953: 4). Vegetation zones are drawn in accordance with A. Moen (1999).

widespread in north-eastern Europe (cf. Fig. 2; Valonen 1953; Ågren & Lundholm 1970; Yarish et al. 2009; Dahlqvist 2019), and the presence of this form of craft in the interior of Sweden and Norway has commonly been associated with a westward migration of people from the interior areas of Southern Finland between the late 16th to the middle 17th century (Bjørshol 1979:

26–7; Welinder 2002). This migration wave is often referred to as the "Forest Finn" migration (Brochmann & Kjeldstadli 2008: 77–8; Valonen 1952: 258) and Lennart Björkquist (1938: 30) was among the first to maintain that the wheel-shaped sinkers are a material legacy of these Finnish settlers.

The recent radiocarbon dating to AD 800–1300 contests the link between the wheel-shaped sinkers and the later Finnish settlers, as is predates this migration wave by approximately 800 years (Fig. 4). By focusing on how the wheel-shaped sinkers were made, this paper asks: can a broader understanding of the plaiting techniques provide insight into the makers of the wheel-shaped sinkers? Since substantial parts of the original items are preserved, raw material utilisation and technological details can be examined and reconstructed. This paper takes advantage of this and moves beyond a typological approach to explore the origin of the sinkers and the question of who made them.

The aim of the present paper is twofold. Our first objective is to investigate the making of the wheel-shaped sinkers, by combining archaeological analysis and experimental replication, in collaboration with present-day birch bark crafters. Wood and plant material rarely survive in the archaeological record, and our knowledge of how plant fibres were gathered, treated, and utilised during these periods is limited and largely unexplored (Hurcombe 2014). By undertaking actualistic experiments, employing the *chaîne opératoire* (CO) approach (Lemonnier 1986) and focusing systematically on the initial steps involved in making a sinker, in particular the use of weaving and plaiting techniques for birch bark, we aim to provide hands-on acquaintance of the knowledge and skills involved in making a wheel-shaped sinker.

Secondly, we aim to encircle the relationship between the individual crafting process and the broader craft traditions of which they were a part (cf. Klepp 1980; Wollan 2006). Notably, cultural traditions and identity are most often expressed in the *non-functional* aspects of craft, such as decorative elements. Ethnographic craft studies suggest that devotion to tradition constitutes a stabilising element of cultural transmission, while individual creativity and diffusion are processes contributing to cultural and technological change (Klepp 1980: 199–210; Lemonnier 1986: 159–64). Therefore, studies of crafting techniques and processes are useful approaches for archaeologists to situate craft traditions in wider cultural-historical contexts. We use such a framework to attempt to encircle the origins of the central Scandinavian wheel-shaped sinker tradition. Other extraordinary finds of well-preserved wooden artefacts from these periods, found in snow patches on melting glaciers, are primarily related to hunting and transport (Pilø et al. 2022). The wheel-shaped sinkers give unique evidence of everyday subsistence practices and technologies related to freshwater fishing and indicate that a novel fishing technique – involving a particular type of gill or seine net – was introduced at the beginning of the Viking Age.

DEFINITION, GEOGRAPHICAL DISTRIBUTION, AND RADIOCARBON DATING OF THE WHEEL-SHAPED SINKERS

Net fishing is an ancient technique, and sinkers, utilised for both net and line fishing, are fundamental components of composite fishing gear with a wide geographic and temporal distribution. In Europe, the oldest gillnet so far discovered is from Antrea in Karelia and radiocarbon dated to before 8000 BC (Carpelan 2008; Miettinen et al. 2008). Sinkers are known from the Mesolithic and Neolithic up to recent times and occur in various archaeological contexts, such as dwellings and harbours, in the coastal as well as the interior regions of Scandinavia and the Baltics (Indreko 1956; Bergsvik 2002: 290–1; 2017; Bērziņš 2008; Piličiauskas et al. 2019; 2020). They are often discovered in the sea and on lake floors, where they were accidentally lost during fishing.

From archaeological contexts, the most common type is a simple stone sinker, made by creating one or two pierced holes or engraved lines/notches for fastening the net. Functional sinkers vary in size and weight from small pebbles used for fishing with hook and line (Bergsvik 2017), to medium-sized cobbles used for weighing down the net and holding it taut, to large rocks or assemblages functioning as anchors. As stray finds, sinkers are usually made of heavy, inorganic materials (stone, metals, or clay) and are generally difficult to date when found outside a stratigraphic

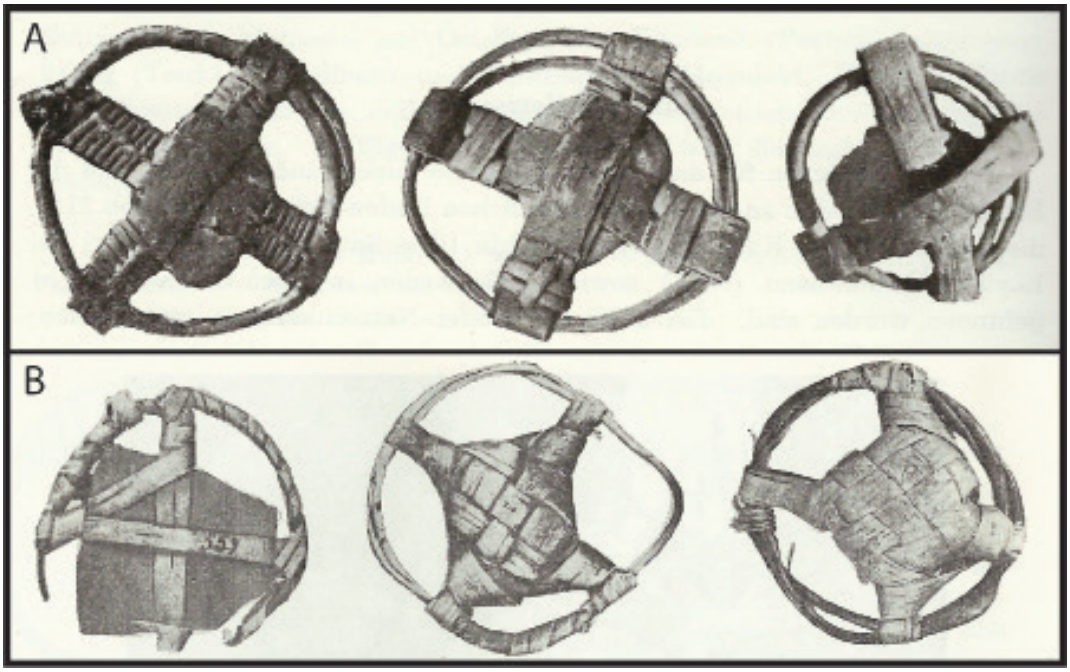

Figure 3. Sompa sinkers of Valonen`s Type 1 (top) and type 2 at bottom. Type 2 closely resembles the sinkers found in the Central Scandinavian interior. Ill. Valonen 1952: Abb. 215 and 217.

context, marine or lacustrine (Indreko 1956; Broadbent 1979: 127–8; Lannerbro 1997: 25–6; Bang-Andersen 2009; Stene et al. 2010: 516). In some cases, the stone sinkers are made in combination with organic materials, such as skin, wood, or bark, and can be directly dated. For example, pebbles placed in a bark container were in use in South Norway from the Late Middle Ages until recently, and in historical times, various materials were used as weights on fishing nets (Sirelius 1908: 147, 155; 1919: 171; Hesthagen & Kleiven 2016: 98–101; Severinsen 2016: 171). However, the wheel-shaped net sinkers stand out in a central Scandinavian context.

Definitions

Niilo Valonen (1952: 257–60) was the first to study the wheel-shaped sinkers with centre stones in detail (see however also Sirelius 1908: 147, 155). He denoted them *sompa-sinkers*[1] and divides them in two main types (Fig. 3). The two types have 1) a stone in the centre, 2) a wooden hoop of pliable twigs surrounding the stone, and 3) crossing strips made of bark fibres that fix the sinker.

Type 1 (Fig. 3) has a stone inserted in a hoop made of twigs held in place by a cross made of broad strips of birch bark. Valonen knew this type from the north-eastern part of the Bothnian Bay, where they were utilised as sinkers on seine nets and salmon gillnets until relatively recently (e.g., Finna.fi 2022a). Later, similar finds have been discovered in archaeological context across Scandinavia and the Baltics, such as Hedeby, Novgorod and Vefsen in Northern Norway (Rybina 2007: 126, 130; Schietzel 2014: 314–5; Wammer 2016: 97–8).

Valonen's Type 2 (Fig. 3) have a centre stone fastened to the hoop of twigs with thinner, plaited birch bark strips. They are somewhat smaller than Type 1, commonly with a diameter of 11–14 cm. Two of the sinkers depicted by Valonen (see Fig. 3) are made with a double hoop of twigs. This is also known from central Scandinavia but seems to be uncommon. One of the archaeological finds from Lake Tesse has a double hoop. In every other aspect, Valonen's Type 2 are morphologically identical to the sinkers found in Central Norway.

Geographical distribution and find contexts in interior Scandinavia

Valonen (1952: 259) describes Type 2 based on archaeological finds from Karelia, Finland and Estonia (cf. Sirelius 1908: 147; Björkquist 1938: 30; see also e.g., Finna.fi 2022b). Piličiauskas et al. (2020: 297) recently published a similar wheel-shaped sinker from the Žeimena River in East Lithuania and dated it to c. 1500 AD. However, in central Scandinavia, the distribution of wheel-shaped sinkers is geographically restricted, and they occur only as archaeological finds from lake beds. The sinkers are found at sites situated approx. 160–860 m above present sea level, and distributed within the southern, middle and northern boreal forest zones (Fig. 2). This is a region which is relatively flat on the Swedish side, with partly navigable watercourses that flow eastward from the Swedish-Norwegian border to the Gulf of Bothnia. The Norwegian side is characterised by a hillier landscape with watercourses draining towards the Skagerrak Sea. The northernmost sinkers are found in lakes with an outflow towards the Atlantic coast.

At present, wheel shaped net sinkers of Valonen`s Type 2 are documented from five different lakes in South Norway (n=61). The sinkers have been discovered on the dredged floor of these lakes, which are all regulated due to hydroelectric power production. Most sinkers have been found accidentally by non-archaeologists and delivered to museums since the hydropower production commenced in the early 20th century (Hagen 1959; Eknæs 1975; Wammer 2016).

Parallel finds in Scandinavia have been described briefly in the literature (Björkquist 1932), but not studied in detail. As far as possible, we have included the information of Valonen`s Type 2 finds from Sweden (n=4, Fig. 2, Table 1). All specimens have been reported from the mid-Swedish county of Jämtland, in lakes lying in, or in the vicinity of, the mountainous and forested region along the national border. Valonen's type 1 sinkers, however, have been found further south, in the county of Dalarna. Hence, the distribution of type 2 is similar on the Swedish and Norwegian side of the border. The only known specimen from Northern Norway, mentioned earlier, is of Valonens type 1.

Radiocarbon dating

The outer bark (phellem layer) of birch (likely *Betula pubescens*) from 10 out of 62 (16 per cent) wheel-shaped net sinkers has been radiocarbon dated. The dated material comprises thin layers of dead cork tissue, formed during the trees' lifetime (Evert 2006: 534; Klügl & Di Pietro 2021). Consequently, the dates represent the tree's lifespan, not necessarily the moment the sinker was crafted. However, since the fibres are normally used shortly after harvesting, the problem of "old wood" is presumably relatively limited, and it is unlikely that the C14 results predate the production of the sinkers by more than a few decades. Birch is short-lived, and most trees of *Betula pubescens* grow less than 100 years (Wehberg et al. 2005). When the trees grow old, the bark becomes deeply furrowed and cracks irregularly when harvested. This makes it less suitable for craftwork and weaving. The bark used for the net sinkers is most likely from relatively young trees.

The ten radiocarbon-dated items of Valonens type 2 are distributed evenly between c. 800 and 1330 calAD (Fig. 4). Several sinkers from the lakes Tesse and Selbusjøen, respectively, have been dated. In both cases, there is a significant time span between sinkers from the same lake. This suggests that the making and use of wheel-shaped sinkers *represent a continuous tradition.* These dates, with a low inherent age offset, are well suited for statistical modelling by using the *Boundary* function in the radiocarbon calibration program OxCal (Bayliss et al. 2011: 41; cf. Bronk Ramsey 2009; Reimer et al. 2020), based on the assumption that we have succeeded to randomly analyse samples from a uniform tradition (cf. Buck et al. 1992). Such a model points towards a start of this tradition around the onset of the Viking Age (712–847 calAD), while it is likely that the production of wheel-shaped sinkers ended in the middle of the Swedish and Norwegian Middle Ages (AD 1251–1331, Fig. 4).

METHOD: EXPERIMENTAL REPLICATION AND THE CHAÎNE OPÉRATOIRE

We have shown that the wheel-shaped sinkers from the interior of Central Norway are morphologically similar to the sinkers from Eastern

Table 1. Finds of wheel-shaped net sinkers of Valonen`s Type 2 from Norway and Sweden. All with context information are reported to have been found on lake beds.

Lake	County	Country	No. of finds	Context	Museum No	Reference
Tesse	Innlandet	Norway	57	Open forest/ mountain, c. 850 m.a.s.l.	C59636, C29405, C29406, C29614, C58794–6, C56056, C32763, C60749, C61146, C61147, C61148, C61149, C58948, C60750, SJF.05297–9, SJF.02099–100, SJF.03834, and three unmarked specimens on exhibition at Norwegian mountain museum	Unimus 2022; Wammer 2016
Storsjøen	Innlandet	Norway	1	Forest and farmland,	–	0.27
Strondafjorden	Innlandet	Norway	1	Forest and farmland,	0.11	4.23
Selbusjøen	Trøndelag	Norway	2	Forest and farmland, c. 160 m.a.s.l.	T28050	Unimus 2022
Samsjøen	Trøndelag	Norway	1	Open forest/mountain, c. 480 m.a.s.l.	T17199	Unimus 2022; Wammer 2017
Locknesjöen	Jämtland	Sweden	1	Farmland area, 328 m.a.s.l.	JLM13306	Björkquist 1932: 96; Wammer 2016
Torrön	Jämtland	Sweden	1	Forest, 417 m.a.s.l.	JLM22370	Wammer 2016
Mellan-svartsjön	Jämtland	Sweden	1	Forest, 443 m.a.s.l.	JLM29767	Wammer 2016
Lake (unknown)	Jämtland	Sweden	1	Not known	Unmarked specimen	Wammer 2016
Total			66			

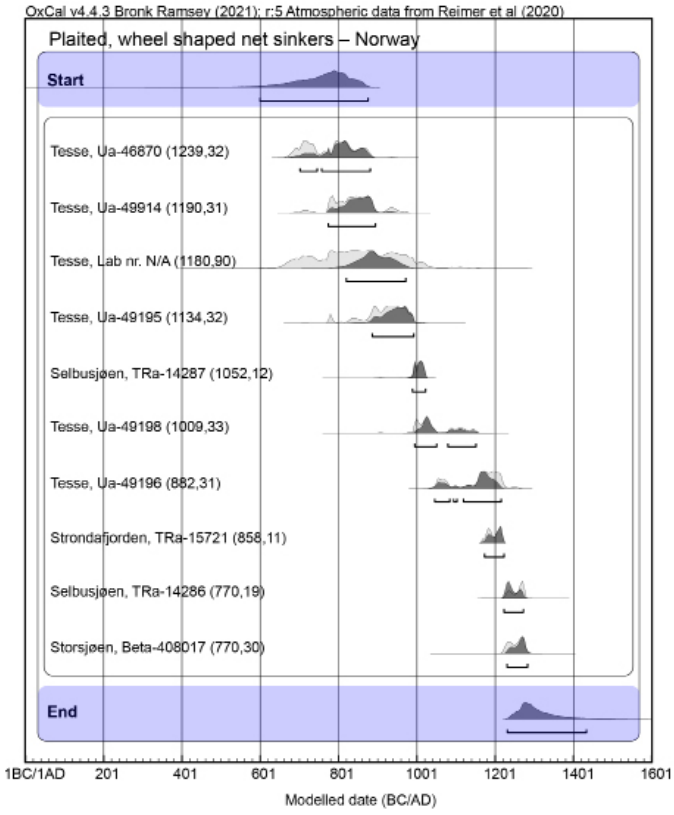

Figure 4. Calibration model of dated wheel shaped net sinkers from interior regions of Central Scandinavia. Light grey curves display unmodelled calibration curves, while modelled curves are displayed in grey curves. The start of the production is dated to AD 712–847 (1σ)/AD 600–876 (2σ) while the production most likely ended AD 1251–1331 (1σ)/AD 1232–1434 cal. (2σ).

Europe, and in the following, we examine the technological details and how they were crafted. We have investigated the crafting of wheel-shaped net sinkers through experimental replication, in collaboration with a local farmer/fisherman from Lom municipality, Torstein Bjørgen, and basket-maker Ellen Mette Nielsen (Nielsen & Wammer 2018). Following O'Neil & O'Sullivan (2019: 26), experimental archaeology is here understood as the reconstruction of technologies based on archaeological evidence, which subsequently can provide useful analogies for interpreting the archaeological record. An archaeological investigation of technical choices often relies on production debris among archaeological remains to identify technique (for example Harris 2014: 15), but in the case of the wheel-shaped sinkers, we only have the finished items available for study.

Since we as archaeologists lack experience and hands-on knowledge of the use of plant fibres (cf. Hurcombe 2007; 2008), and there is no direct connection with craft traditions that exist in Norway today, experimental replication in collaboration with present-day crafters may provide useful practical parameters and insights, enabling us make interpretations based directly on the archaeological remains. The role of specialised crafters is underestimated in archaeological research and experimental archaeology (Kristoffersen & Stoltz, forthcoming; see also Guldberg 2014; Molander 2018). Experienced crafters possess the skills and know-how involved in crafting techniques, and modern "multi-makers" like Bjørgen afford a valuable contribution to a more profound understanding of the craft involved in the making of the sinkers and the weaving/plaiting techniques. We use the term craft to avoid the economic, ahistorical implications of the word industry and to emphasise the skilled, small-scale and socially embedded character of making wheel-shaped sinkers. Personal observation of the particular and the distillation of these experiences into generalised observations both have their place in the concept of *actualistic* experimentation, i.e., experimental approaches aiming to identify and test techniques and materials which would have been available to the past crafters (Outram 2008). As noted by Outram (2008: 5), such attempts are "*best addressed through good collaborations between craftspeople and academics. Perhaps the most effective experiments are those that are totally integrated into a larger scheme of academic research with the experimentation being just one of the methods being employed in pursuit of a research goal. Where possible, there should be close collaboration between different specialists and those with academic and practical skills*". This study represents such an attempt.

Furthermore, following Sofaer (2006: 128) we regard this alliance between archaeologists and crafters as a productive form of cross-crafting, where different types of knowledge – embodied, practical and academic – are explored and fused to complement each other. In archaeological technological studies, materiality and human behaviour are commonly linked using the CO approach, a method for investigating the operational sequences underpinning tool production, which provides insight into the prehistoric practice and the interrelated tasks involved in artefact crafting. The steps involved in making a sinker – finding and harvesting raw material and the waving/plaiting techniques – also elucidate the knowledge underlying technical choices (Lemonnier 1986; 2012; Leroi-Gourhan 1993; Ingold 2010). Understanding the complexity of knowledge involved is key to unravelling each particular step of the sequence of making, enabling an appreciation of the knowledge and skill embedded in the steps that the crafter would have to master and identifying where individual choices can be made with regard to raw materials. While practical attempts can illuminate the various possibilities inherent in crafting material culture, the CO approach – defined as "the overall process that leads from a given state of matter to its transformed state" (Lemonnier 2012: 300) – is productively employed as an academic analytical device to grasp the sequenced operations of the crafting processes underlying the making of the wheel-shaped sinkers.

Furthermore, the CO approach as currently used in archaeology is not merely a method for investigating the crafting, use and discarding of tools, it also comprises a theoretical framework emphasising the link between material culture, technology and society. Techniques are part of socialisation processes, acquired in practical settings, learned through imitation and/or improvisation, and thus over time become embodied and

automatised. Through these actions, communal values and traditions are also sustained and transferred between community members.[2] In this perspective, technologies can be considered as culturally transmitted, historically formed systems of knowledge, and the execution of a certain technique is related to a set of culturally shared ideas and norms (Klepp 1980: 199–210; Wollan 2006; Lemonnier 2012; 2013). Thus, focusing on the of birch bark weaving and plaiting techniques involved in making the sinkers enables us to approach the skill of the individual crafter as well as the broader tradition of which the crafter was a part. In the following, we outline and discuss the operational sequence for the crafting of wheel-shaped sinkers with birch bark plaiting.

CRAFTING THE WHEEL-SHAPED SINKERS

Based on the fragmented sinkers and Bjørgen's extensive knowledge of, and experience with, older crafting techniques and natural materials, the wheel-shaped sinkers were recreated, resembling as closely as possible the form, techniques and materials observed on the archaeological specimens (cf. Outram 2008). Bjørgen, born in 1939, acquired substantial know-how of harvesting and crafting with birch bark during childhood, when he assisted his grandfather in collecting bark sheets for sealing the roofs of farm buildings. His traditional crafting skills also include cutting strips from the birch bark sheets for weaving small, plaited baskets. Bjørgen has been fishing in Lake Tesse since the age of 10. During this activity, he discovered several net sinkers in the lake and became interested in exploring how they were made. Since the birch wrapping and plaiting was fragmented on some of the sinkers, he was able to observe how they were constructed. He had no prior experience with making a hoop from one rod or stick and made his first sinker through trial and error. All the raw materials used in the experimental replication (Nielsen & Wammer 2018) and Bjørgen's previous reconstructions – water-rolled stones, birch bark (*Betula*) and rods or sticks of willow (*Salix*) or birch – were collected in the vicinity of Lake Tesse. Some of the investigated hoops from Lake Tesse have been identified as juniper (*Juniperus communis*), a common species in Ottadalen.

1: Gathering and preparing the birch bark for wrapping and weaving

According to Bjørgen, the best time for collecting birch bark in this particular area is mid-June. Around this time, the sap content is high, and the bark can be easily removed from the trunk (see also Valonen 1953: 101; Lindholm 2017). Bjørgen harvests his bark from birch trees growing just below the forest boundary (Fig. 5). The bark should be taken from flawless trunks on tall, straight trees. Such trees do not grow in places where the forest is too dense; they grow best in more open forest. The tree trunk should be about 15–20 cm in diameter and without branches. The quality of bark can vary, and on some trunks, the bark is too coarse to be useful.

Bark can be gathered in sheets, which are later cut into strips, and can be harvested in all kinds of weather, as long as it is not too dry. Bark sheets are best removed using a knife and later cut into strips with the preferred widths. Another

Figure 5. Torstein Bjørgen gathering birch bark from plain trunk of Betula (A and B). Preparing a sheet of bark and cutting strips (C). (Photos: Ellen Mette Nielsen and Elling Utvik Wammer.)

way to harvest bark is to remove strips or bands directly from the tree. To prevent flakes of bark from curling, they must be stored horizontally, sap-side against sap-side, with a weight on top, preferably outside and in a shady place, protected from rain. However, strips of birch bark dry quickly after being cut. They must be used immediately or kept moist and stored in a cool, dark place. Present day crafters keep them a plastic bag. Dry strips of bark can be made usable again if they are soaked in water, but the strips will not have the same degree of flexibility as fresh birch bark.

Birch bark consists of layers, which can be split to obtain thin strips for tying, wrapping and weaving/plaiting. The inner layers are the strongest, and when fresh, the bark is very flexible. The strips had a width of about 10–12 mm, similar to the strips of bark found on the old sinkers. If the strips of bark felt too thick, they were split, and layers of the bark were removed from the outside until the thickness felt suitable for weaving and wrapping.

For our experimental replications, Bjørgen used a knife and his fingers to remove the bark from the tree in sheets. After harvesting, the outer, white side of the sheets was lightly brushed by hand and cut into strips with scissors.

The diameter of a wheel-shaped sinker is 10–12 cm. When harvesting birch bark sheets, the length of each strip will equal the width of the trunk of the birch trees. A birch with a diameter of 16 cm produces strips of approx. 50 cm in length. With regard to the archaeological specimen, it is difficult to identify whether the bark was removed directly from the tree trunks or gathered as strips, because we cannot unwrap the strips to measure their length without destroying the artefacts.

2: Making the hoop

Slender rods or sticks from willow (Salix) or/and birch (Betula) were used for making the hoop (Fig. 6). Bjørgen aimed for rods with the same thickness as observed in the old wheel-shaped

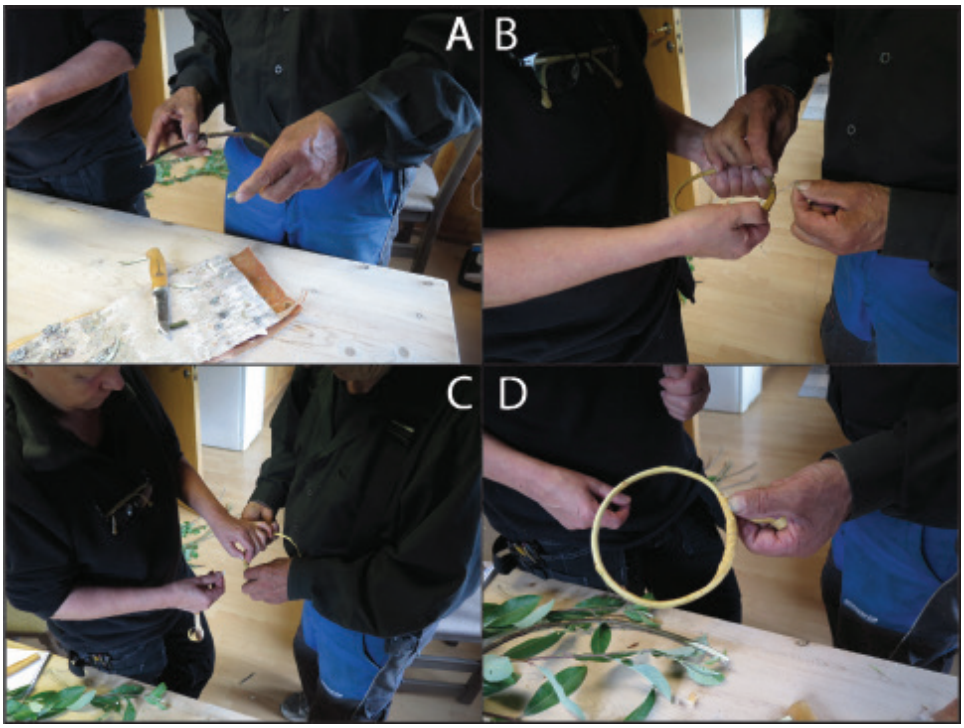

Figure 6. Bending the rod (A). Tying the ends of the rod together (B) and tying the strips on the overlapping ends (C and D). (Photos: Ellen Mette Nielsen and Elling Utvik Wammer.)

sinkers and made the hoop with the same diameter, about 11 cm. The rods need to be thin and flexible, preferably without branches. Bjørgen stripped the bark off the rods when they were fresh, using the back of his knife. This step was performed after forming the hoop but before the two ends were joined together. The rod was bent into the preferred circular shape when the wood was fresh but mellowed to dry a little before shaping (too fresh or too dry, it would most likely break). The ends were tied together with a wool string or metal wire. On a majority of the archaeological sinkers, the two ends of the rod are shaped at both ends to make the ring smooth in the overlapping part, as done in Bjørgen's reconstruction. Another locking technique has also been observed, reminiscent of the technique used on wooden hoops keeping barrels made of wood fixed together. On most of the finds, a strip of bark is tied around the overlapping ends to fasten the hoop properly. Bark strips and bands are solid and durable and could probably have been used by the past crafters for tying the ends.

On some net sinkers, this strip is continued around the whole ring. This practice does not have an obvious functional explanation and seems to represent a decorative element. However, as noted by the basket-maker (Nielsen), on some of the archaeologically retrieved sinkers, the hoop was broken, or split longitudinally. If this occurred during the crafting process, the winding around the hoop could strengthen and stabilise the rods to make a ring which is not perfect but fully functional. Another explanation could be practical; if the strips are long, you can wrap the left-over strip as far as it goes, then cut it off and fasten it around the spokes. The hoops were left to dry indoors overnight. After approximately one night, the material had lost its natural tautness. The dry hoop then retained its shape and size when continuing with the lashing and weaving.

3: Attaching the stone and making the spokes by wrapping and weaving birch bark strips

The sinker stone was attached to the hoop by taking a piece of birch bark strip, with the length approximately three times the diameter of the ring (Fig. 7a). The end of the strip was locked by turning the strip two times around the ring, so that the tension of this twist keeps the birch bark strips in place on the hoop. Then, the strip was transferred across the ring, to the other side, turned around the ring and back to the starting place.

Bjørgen locked the strip with a loop-like cross-knot around the ring and the first spoke. A second strip was placed at a 90-degree angle, perpendicular to the first strip, and the locking procedure was repeated. This stage was repeated four times, creating a cross of four birch bark strips. The sinker stone was placed in the centre, and Bjørgen went on to attach and lock a new strip around the hoop and the first spoke (Fig. 7b). He wrapped a birch bark strip round and round (several times) until it covered the stone. The end of the strip was locked by threading it under and over a birch bark strip already covering the stone. This process was repeated four times, one for each spoke, starting at each of the points where the birch bark strips cross or fasten to the ring. The tip of each birch bark strip from the wrapping procedure ends near the stone. These ends were wrapped and plaited around the stone and secured by weaving under and over the birch bark strips already in place. All four strips were woven one at a time. This process locks the stone tightly in the middle of the hoop.

Torstein Bjørgen observed differences in the final stage of making between the wheel-shaped sinkers found in Lake Tesse. Some were wrapped with birch bark strips all around the hoop, while others were just wrapped around the splice. Most of the sinkers had birch bark strips lashed randomly around the centre stone, as showed in Fig. 7c, while others had a symmetrical plaiting around the centre stone. According to Bjørgen, the last group of artefacts have a second layer of strips, woven regularly over and under, all around the stone in the centre. The birch bark strips used for this second layer were narrower than the strips in the first layer.

ENCIRCLING THE NETMAKERS: DISCUSSION

Learning from experiments: the individual crafter and the tradition

The experimental approach has provided novel information on the properties of birch plant fibres, crafting techniques and practical and aesthetic aspects of the wheel-shaped sinkers. In terms of knowledge and skill, making a wheel-shaped sinker requires:

1) Knowledge of the optimal raw materials: e.g., juniper for the hoop is better than birch and *Salix*.

2) Knowledge and skill of harvesting birch bark: time of the year, which trees have the best bark quality, and how to remove the bark without damaging the tree. In present-day society, this is not general knowledge.

3) Knowledge of the use, harvesting and handling of birch bark, and the use of bark strips for fastening and plaiting.

4) Knowledge and skill of how to make an even hoop, without cracks, and attach it in a way so it does not split open.

The experimental reconstruction demonstrates that the sinkers can be made from materials easily available in the region's local boreal forests. Making a wheel-shaped sinker involved a prolonged process, from harvesting bark to a finished product. It is labour intensive, requires large amounts of bark, and needs careful planning. This drawn-out crafting sequence, involves a spectrum of local knowledge, ranging from harvesting plant fibres and twigs at certain times of the year, to storing material in correct ways to maintain the flexibility (if the bark is not used immediately) and techniques for lashing, weaving, plaiting, and wrapping. Raw materials were probably gathered in the early summer but, considering that dozens of sinkers were required for a net, it must have been time-consuming to make them, and the use of plaiting must have added time to the process. To make a good hoop takes some attempts to master and attaching the bark to the hoop requires skill and experience. However, the crafting process is not difficult as such; it can be learned through imitation and making a wheel-shaped sinker could presumably have been mastered by anyone with some practice.

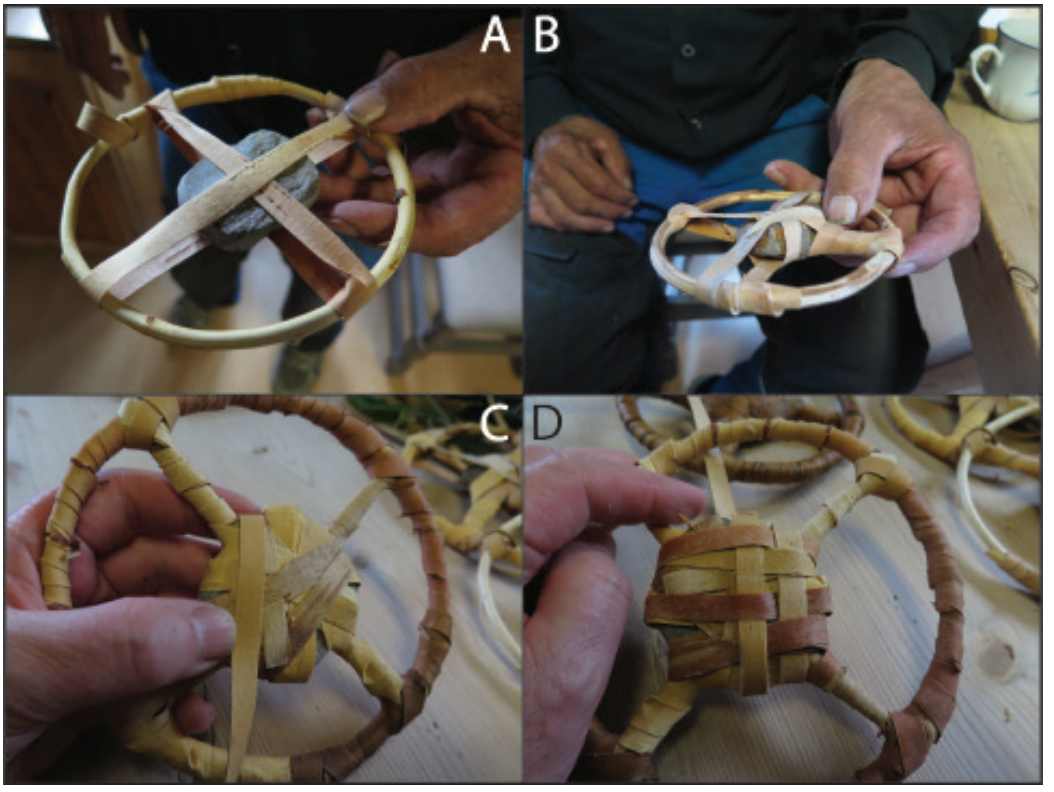

Figure 7. Fastening the stone by two crossing two birch bark strips (A). Wrapping strips around the spokes (B). Adding additional strips around th e stone (C). 4) Example of final plaiting (D). (Photos: Ellen Mette Nielsen and Elling Utvik Wammer.)

Through examination of the archaeological sinkers with fragmented birch bark strips, in combination with experimental replication, several different crafting techniques have been identified. Making strips of bark fibres and the weaving technique are two separate and independent processes of the craft. Birch bark strips were used in various ways for fastening the stone inside the hoop, locking the hoop-ends and wrapping it. Our observations of the whole corpus of wheel-shaped sinkers from South Norway support Bjørgen's suggested method. The basic production steps are the same for net sinkers with or without bark strip plaiting. Many of the archaeological specimens do not have "perfect" hoops, suggesting that most of the sinkers were made by non-specialists. From an experimental perspective, the variation in the sinkers from Lake Tesse may not represent particular groups or chronological developments. Rather, the differences may mirror individual artisans and result from adaptations to raw material constraints, length of the birch bands/strips, aesthetic standards and time invested in the crafting process, and the observed variation in wheel-shaped sinkers from Lake Tesse may be due to the production of sinkers over time. Based on a limited number of dated sinkers, we must also consider that the use of weaving and plaiting might reflect personal preferences or family traditions within the same craft.

Yet, some wheel-shaped sinkers stand out as exceptionally well-made. Arguably, the time invested in making a sinker enables a wider discussion of the relationship between functionality and the importance of aesthetics in everyday craft and subsistence technologies. Some sinkers are made with simple, random plaiting, while others are very regular and symmetrical. Bark strip plaiting probably made the net sinkers more robust, which can indicate a technical improvement, as previously suggested (Wammer 2016). However, aesthetics is not crucial for functionality, and the elaborate style of some of the wheel-shaped sinkers surpasses what is required for a sinker to work. The time invested in making a particularly aesthetic artefact may point to the presence of an overarching cultural tradition because tradition and identity are most often expressed in the non-functional aspects of craft, such as decorative elements (Klepp 1980: 199–210; Lemonnier 1986: 159–64). This interpretation is supported by the C14-datings, which suggest that the making and use of wheel-shaped sinkers persisted over a period of 500 years, from AD 800–1300. Such a recurring craft practice can be defined as a technological tradition, a specific way of creating material culture, maintained over prolonged periods of time, which becomes embedded in concepts of group identity (van Gijn 2010).

In Iron Age Norway and Sweden, the most common way of making items of bark was to harvest whole flakes of birch bark, divide them and sew them together (Valonen 1953; Granlund 1940: 33–6; Nordby 2012). Although vessels and mats of woven birch bark are known (Welinder 2002: 29), the technique of plaiting bark fibres seems uncommon in the region. Such a view is supported by the results of 15 years of archaeological surveys at glacial sites in the mountain areas of South Norway, some of them in the mountain areas around Lake Tesse. Altogether, there are 3500 finds from these sites, most of them comprising organic materials such as wood and bone. This record does not include any plaited items made from bark (cf. Pilø et al. 2018; 2021; 2022), hence pointing towards an external origin of the plaited sinker tradition recently discovered in central Scandinavia. Arguably, the birch bark plaiting technique is connected to the same overarching tradition as the finds from Karelia and Estonia (Sirelius 1908: 147; Valonen 1952: 259; Finna.fi 2022b).

Based on the geographical distribution of finds, we have shown in this paper that wheel-shaped net sinkers make up a technological, cultural, and aesthetic tradition constrained to the interior regions of central Scandinavia. The use of such sinkers is so far not documented in the southern or western coastal regions of Norway but have close morphological parallels to finds in Karelia and Estonia/Lithuania (Valonen's Type 2, cf. Figs. 2–3). Additionally, the technique of plaiting/weaving birch bark strips is primarily related to traditions in regions further east (Valonen 1952; 1953; Yarish et al. 2009).

The use of the wheel-shaped sinkers

The making of sinkers must be considered in relation to the remaining components of

composite fishing equipment. The wheel-shaped sinkers are defined in time and space, and it is therefore reasonable to assume that they were also connected to *one* specific fishing tradition. The fishing gear utilised in interior lake and river fishing in Norway remains rather understudied compared to coastal and pelagic fisheries (but see Eknæs 1975; Hesthagen & Kleiven 2016). We lack ethnographic evidence for fishing with wheel-shaped net sinkers in South Norway. But, based on their non-aquadynamic shape and weight, we believe that the wheel-shaped sinkers were made for net fishing, not line fishing. The wheel-shaped sinkers were presumably fastened on a type of gillnet or seine net (Ropeid 1958; Stewart 1977).

In Scandinavia, several forms of fishing nets have been used historically. One common type is *garn* (gillnet), characterised by relatively large mesh, meant to entangle fish. Another type is the seine net (Fig. 8). These nets are made of smaller mesh compared to gillnets and function as a trapping bag (Hermundstad 1964; Eknæs 1975; Hesthagen & Kleiven 2016). We find the linguistic distinction between throttling/standing nets (No. *Garn*) and seine nets (No. *Not*) in all the Nordic languages, though in slightly different forms,[3] and the two main types of equipment for net fishing both appear in medieval texts (Stoklund et al. 1960; Granlund et al. 1967: 194–206). Earlier Norwegian researchers tends to name the wheel-shaped net sinkers garnsenker (gillnet sinkers) (Hagen 1959; Eknæs 1975; Hesthagen & Kleiven 2016: 99). Both gillnets and hauling nets need weights fastened to the bottom line (No. *Telne*) to hold the net down (Ropeid 1958). Bjørgen, who is an experienced fisherman, assumes that the wheel-shaped sinkers were attached to the bottom line of the net through two points at the hoop. This is because fastening at one point easily leads to a tangle when the net is carried or moved. When the sinker is attached in two places, it will not spin around.

In the inland and mountain lakes of South Norway, trout (*Salmo trutta*) and char (*Salvelinus alpinus*) are the two fish species that have traditionally had the greatest economic importance. Other species, like perch (*Perca fluviatilis*), appear in southern and lower parts of the region but never reached the mountains. West of the Østerdalen valley, char is practically non-apparent and trout dominate (Huitfeldt-Kaas 1918). It is reasonable to believe that, in the westernmost lakes with finds of wheel-shaped net sinkers, these two species were the main targets for the fisheries. However, the fisheries could have been more varied in the lakes at lower altitudes further east.

It is not possible to determine the type of net fishing for which the wheel-shaped net sinkers were intended. They were probably well suited for both forms of net, and it is not possible to argue for a functional definition. The Finnish sompa sinkers were used for gillnets as well as seine and hauling nets (Sirelius 1908: 147, 155; Valonen 1952, see also Fig. 3). The traditional fishing gear used by indigenous groups on the northwest-coast of North America includes similar wood-hoop sinkers used for gillnet fishing (Stewart 1977: 86). The necessary number of sinkers per net depended on the length of the net, but 30–40 sinkers per net is not unthinkable (Ropeid 1958; see Stewart 1977: 86, for an ethnographic example).

The way from Karelia to central Scandinavia

Finally, we further suggest that these fishing nets with wheel shaped sinkers were introduced to the region as part of an agricultural expansion in the Viking Age. The farming communities in the interior areas of central Scandinavia have always relied on various outfield resources in addition to crops and husbandry (Holm et al. 2005). In the interior regions, farming was established late compared to the rest of Europe, in some areas as late as AD 400–800 (Hougen 1947: 122; Bergstøl 2008; Pedersen & Widgren 2011: 322–3; Stene 2014). The outfield resources, including elk and reindeer hunting/trapping and iron production were important supplements to farming during the Viking period and Middle Ages, and a considerable means of income and prosperity (Loftsgarden 2020). The role of fishing is generally difficult to study due to the availability of source material; fishing leaves few material traces and sites compared to iron production and trapping. However, the written sources of early modern times tell of repeated conflicts in relation to fishing-rights. There are also early written sources, like the "Tesse

Figure 8. Seine net fishing in lake Sølensjøen, Rendalen municipality, Innlandet County, Norway, c. 1965. Seven people and three boats seem to be involved. Two men, who had probably gotten to this place with the help of the empty rowing boat at the far right of the picture, stand on a small rock ledge and pull the net towards them. (Photo: Tore Fossum, Anno Norsk skogmuseum (CC BY-NC-ND 4.0).)

Document", a charter made sometime between AD 1202–1220 (Ugulen 2016), which indicates that fish were an important outfield/mountain resource – so important, that even medieval kings were involved in assigning fishing rights.

The archaeological record, in particular grave inventories from burials, suggests contact between farming societies in Central Norway and the Gulf of Bothnia during the Late Iron Age, probably made possible by transport via Swedish river systems (e.g., Martens 1969: 70–2; Røstad 2020). There was also lively communication across the Baltic Sea (e.g., Mägi 2018), and thereby multiple ways for the tradition of fishing with plaited wheel-shaped sinkers to find their way from Karelia to central Scandinavia. There is no evidence of a large-scale migration westwards in the Late Iron Age resembling the one that took place by Finnish settlers around AD 1600. Hence, we consider it as more likely that the sinkers followed the east-westwards networks as a part of an idea, technique, and a particular practice of lake fishing. When the farming societies expanded during the Late Iron Age to areas where resources from the outfields had to play a significant role in the subsistence,

people also needed to employ a viable form of lake fishing in the boreal forests. We believe this situation facilitated the adaptation of one specific eastern fishing tradition, which was already well adapted to a boreal environment and included plaited wheel-shaped net sinkers.

CONCLUSION

The experimental approach has provided novel information on the properties of birch plant fibres, crafting techniques and practical and aesthetic aspects of the plaited wheel-shaped sinkers. Based on the geographical distribution and the distinctive technique of plaiting strips of birch bark, we conclude that wheel-shaped net sinkers make up a particular technological and aesthetic craft tradition originating further east, in Karelia and Estonia. The wheel-shaped sinkers were presumably fastened on a type of gillnet or seine net (Ropeid 1958), and the practice of making wheel-shaped sinkers is therefore also entangled with a particular fishing tradition (cf. Hodder 2012). The fact that the wheel principle, the birch bark crafting technique as well as the aesthetics were embraced, strengthen such a perspective. Therefore, we propose that the net sinkers occurring in the region c. 800 BC also involved a novel method of net fishing. This novel package of fishing technology was introduced to the region as part of an agricultural expansion from east to west at the onset of the Viking Age.

CONTRIBUTIONS

E. W. proposed the idea for the study. E. M. N. and E.W. interviewed Torstein Bjørgen. E. M. N. performed the technological studies. A. Ma., A. Mj., E. M. N. and E. W. wrote the paper. A. Mj. and A. Ma. coordinated the work.

ACKNOWLEDGMENTS

This work was supported by the Norwegian Crafts Institute, Centre for Intangible Cultural Heritage, and is the result of a research collaboration carried out as part of the Research Network for Archaeological Studies of Inland Fishing (SINFISH). We would like to thank Torstein Bjørgen for his willingness to share his insight and knowledge about the wheel-shaped sinkers and his immense insight about Lake Tesse and local fishing traditions. Further, we are grateful to everyone who has provided information for this study. We also wish to thank the two anonymous reviewers for providing constructive critique and helpful comments.

REFERENCES

Bang-Andersen, S. 2009. Evig eies kun det tapte – med alle sine hemmeligheter. Refleksjoner rundt en gjenstand av kleberstein funnet ved Håelva på Jæren. In M. Nitter & E. S. Pedersen (eds.) *Tverrfaglige perspektiver*: 75–86. Stavanger: Arkeologisk museum.

Bayliss, A., Plicht, J., Ramsey, C., et al. 2011. Towards generational time-scales: The quantitative interpretation of archaeological chronologies. In A. Whittle, F. Healy & A. Bayliss (eds) *Gathering Time: Dating the Early Neolithic Enclosures of Southern Britain and Ireland* 1: 17–59. Oxbow Books.

Bergstøl, J. 2008. Samer i Østerdalen? En studie av etnisitet i jernalderen og middelalderen i det nordøstre Hedmark. Unpublished dissertation, Kulturhistorisk museum. Oslo: Universitetet i Oslo. < https://www.duo.uio.no/handle/10852/33240?locale-attribute=en>

Bergsvik, K. A. 2002. *Arkeologiske undersøkelser ved Skatestraumen,* B. 1, Bergen: Universitetet i Bergen.

Bergsvik, K. A. 2017. Mesolithic soapstone line-sinkers in Western Norway. Chronology, acquisition, distribution, function and decoration. In G. Hansen & P. Storemyr (eds.) *Soapstone in the North. Quarries, Products and People 7000 BC–AD 1700*: 73–92. Bergen: Universitetet i Bergen.

Bērziņš, V. 2008. *Sārnate: Living by a Coastal Lake during the East Baltic Neolithic*. Oulu: Faculty of Humanities, University of Oulu.

Bjørkli, B., Friis, E. K., Wammer, E. U., et al. 2016. Tesse – et arkeologisk eldorado og en innfallsport til fjellfisket som et tverrfaglig tema. In A. Mjærum & E. U. Wammer (eds.) *Fjellfiske i fortiden*: 15–35. Kristiansand: Portal forlag.

Björkquist, L. 1932. Ur accessionskatalogen 1932. *Jämten* 1932: 93–8.

Björkquist, L. 1938. Trä-och näverskor i Jämtland. *RIG* 21: 15–36.

Bjørshol, N. A. S. 1979. *Finnekulturen i Sør Norge – karakteristiske trekk. Instituttet for folkelivsgranskning*. Oslo: Universitetet i Oslo.

Bourdieu, P. 1977. *Outline of a Theory of Practice.* Cambridge: Cambridge University Press.

Broadbent, N. D. 1979. *Coastal Resources and Settlement Stability. A Critical Study of a Mesolithic Site Complex in Northern Sweden*. Uppsala: The Institute.

Brochmann, G. & Kjeldstadli, K. 2008. *A History of Immigration: The Case of Norway 900–2000*. Oslo: Universitetsforlaget.

Bronk Ramsey, C. 2009. Bayesian analysis of radiocarbon dates. *Radiocarbon* 51: 337–60.

Buck, C. E., Litton, C. D. & Smith, A. F. M. 1992. Calibration of radiocarbon results pertaining to related archaeological events. *Journal of Archaeological Science* 19: 497–512.

Carpelan, C. 2008. On the history and recent studies of the 'Antrea Net Find'. In M. Lavento (ed.) *Karelian Isthmus. Stone Age Studies in 1998s–2003*: 88–127. Helsinki: Finnish Antiquarian Society.

Dahlqvist, E. 2019. *Näver: fläta, tampa, vik*a. Stockholm: Natur & Kultur.

Eknæs, Å. 1975. Trinseformede garnsøkker og deres alder. *Årbok for Norsk skogbruksmuseum* 1973–1975: 172–7.

Evert, R. F. 2006. *Periderm. Esau's Plant Anatomy*: 427–45. John Wiley & Sons, Inc.

Finna.fi., 2022a. Cultural and scientific treasures from one address. <https://www.finna.fi/Record/museovirasto.4ED0F8B554EE31456B814709C7AD86C0?lng=en-gb> Read 11 September 2022. Finna.fi.

Finna.fi, 2022b. Cultural and scientific treasures from one address. <https://www.finna.fi/Record/museovirasto.C0D1EA79C8CF262F028B45C04DCAECFA> Read 11 September 2022.

Granlund, J. 1940. *Träkärl i svepteknik*. Stockholm: Museet.

Granlund, J, Luukko, A., Rasmussen, H., et al. 1967. Notfiske. In F. Hødnebø (ed.) *Kulturhistorisk leksikon for nordisk middelalder fra vikingtid til reformasjonstid*: 367–72. Oslo: Gyldendal Norsk Forlag.

Guldberg, S. S. 2014. The Smith on the Edge of Worlds. New perspectives on technology and ideology in the Late Norwegian Iron Age. Unpublished dissertation, Department of Archaeology, Conservation and History. Oslo: University of Oslo.

Hagen, A. 1959. Funn fra fjellvann. *Viking Tidsskrift for norrøn arkeologi Bind* XXIII: 35–41.

Hermundstad, K. 1964. Fisket. In K. Hermundstad (ed.) *Valdres Bygdebok V. Fyrste Del. Villdyr og veiding, fiske, turistferdsel, handverk og handverkarar*: 147–225. Leira: Valdres Bygdeboks Forlag.

Harris, S. 2014. Introduction. Leather in archaeology: between material properties, materiality and technological choices. In S. Harris & A. J. Veldmeije (eds.) *Why Leather? The Material and Cultural Dimensions of Leather*: 9–21. Leiden: Sidestone Press.

Hesthagen, T. & Kleiven, E. 2016. Fiskemåtar i fjellet i eldre tid. In A. Mjærum & E. U. Wammer (eds.) *Fjellfiske i fortiden*: 93–109. Kristiansand: Portal forlag.

Hodder, I. 2012. *Entangled. An Archaeology of the Relationships Between Humans andThings*. Chichester: Wiley-Blackwell.

Holm, I., Innselset, S. M., & Øye, I. (eds.) 2005. *'Utmark': The Outfield as Industry and Ideology in the Iron Age and the Middle Ages.* Bergen: University of Bergen.

Hougen, B. 1947. *Fra seter til gård. Studier i norsk bosetningshistorie.* Oslo: Norsk arkeologisk selskap.

Huitfeldt-Kaas, H. 1918. *Ferskvandsfiskenes utbredelse og indvandring i Norge. Med et tillæg om krebsen.* Kristiania: Centraltrykkeriet.

Hurcombe, L. 2007. A sense of materials and sensory perception in concepts of materiality. *World Archaeology* 39: 532–45.

Hurcombe, L. 2008. Organics from inorganics: using experimental archaeology as a research tool for studying perishable material culture. *World Archaeology* 40: 83–115.

Hurcombe, L. 2014. *Perishable Material Culture in Prehistory. Investigating the Missing Majority.* London: Routledge.

Indreko, R. 1956. *Steingeräte mit Rille*, Stockholm: Almqvist & Wiksell International.

Ingold, T. 2010. The textility of making. *Cambridge Journal of Economics* 34: 91–102.

Itkonen, T. 1957. *Suomen kielen suksisanastoa*. Helsinki: Suomalaisen kirjallisuuden seura.

Klepp, A. 1980. Tradisjon og kultur. Norveg. *Tidsskrift for etnologi og folkloristikk* 23: 195–224.

Klügl, J. & Di Pietro, G. 2021. The interaction of water with archaeological and ethnographic birch bark and its effects on swelling, shrinkage and deformations. *Heritage Science* 9: 3. https://doi.org/10.1186/s40494-020-00476-y.

Kristoffersen, E. S. & Stoltz, R. forthcoming. Textile and metal. A case of cross-crafting. In F.-A. Stylegar (ed.) *Snartemodugnaðr*.

Lannerbro, R. 1997. *Det södra fångstlandet. Katalog, Del 3,* Övre Österdalälven, Stockholm: Institutionen.

Lemonnier, P. 1986. The study of material culture today. Toward an anthropology of technical systems. *Journal of Anthropological Archaeology* 5: 147–86.

Lemonnier, P. 2012. *Mundane Objects, Materiality and Non-verbal Communication.* Walnut Creek: Left Coast Press.

Lemonnier, P. 2013. *Technological Choices: Transformation in Material Cultures since the Neolithic*. London and New York: Routledge.

Leroi-Gourhan, A. 1993. *Gesture and Speech.* Massachusetts: October.

Lindholm, K. 2017. Nävertäkt [Harvesting birch bark]. Regiongavleborg.se. <https://vimeo.com/248433906?embedded=true&source=video_title&owner=20905940> Visited 6 October 2022.

Loftsgarden, K. 2020. Mass production and mountain marketplaces in Norway in the Viking and Middle Ages. *Medieval Archaeology* 64(1): 94–115.

Martens, I. 1969. *Gravfeltet på By i Løten, Hedmark.* Universitetets Oldsaksamling Årbok 1965–66.

Mauss, M. 1979. Technique of the body. *Sociology and Psychology: Essays by Marcel Mauss*: 97–123. London: Routledge & Kegan Paul.

Miettinen, A., Sarmaja-Korjonen, K., Sonninen, E., et al. 2008. The palaeoenvironment of the 'Antrea Net Find'. In M. Lavento (ed.) *Karelian Isthmus – Stone Age Studies in 1998–2003*, 71–87. Helsinki: Finnish Antiquarian Society.

Moen, A. 1999. *National Atlas of Norway: Vegetation*. Hønefoss: Norwegian Mapping Authority.

Molander, B. 2018. Creativity and knowledge. In J. Sofaer (ed.) *Considering Creativity: Creativity, Knowledge and Practice in Bronze Age Europe*: 5–18. Oxford: Archaeopress.

Mägi, M. 2018. *In Austrvegr. The Role of the Eastern Baltic in Viking Age Communication across the Baltic Sea.* Leiden: Brill.

Nielsen. E. M. & Wammer, E. U. 2018. Trinsesøkker. Garnsøkker med trinseform. På besøk hos Torstein Bjørgen, juni 2018. Unpublished report.

Nordby. C. C. 2012. Gjemt og glemt? Harpikstetninger fra eldre jernalder – en forskningshistorisk gjennomgang i lys av tingenes hierarki. *Viking* LXXV: 75–92.

O'Neill, B. & O'Sullivan, A. 2019. Experimental archaeology and (re)-experiencing the senses of the medieval world. In R. Skeates & J. Day (eds.) *The Routledge Handbook of Sensory Archaeology.* Routledge.

Outram, A. K. 2008. Introduction to experimental archaeology. *World Archaeology* 40(1): 1–6.

Pedersen, A. & Widgren, M. 2011. Agriculture in Sweden. 800 BC–AD 1000. In J. Myrdal & M. Morell (eds.) *The Agrarian History of Sweden. 4000 BC to AD 2000*: 46–71. Lund: Nordic Academic Press.

Piličiauskas, G., Matiukas A., Peseckas. K, et al. 2020. Fishing history of the East Baltic during the Holocene according to underwater multiperiod riverine site Kaltanėnai, northeastern Lithuania. *Archaeological and Anthropological Sciences* 12: 1–26.

Piličiauskas, G., Vaikutiene, G., Kisieliene, D., et al. 2019. A closer look at Šventoji 2/4 – a stratified Stone Age fishing site in coastal Lithuania, 3200–2600 cal BC. *Lietuvos archeologija* 45: 105–43.

Pilø, L., Barrett, J., Eiken, T., et al. 2021. Interpreting archaeological site-formation processes at a mountain ice patch: A case study from Langfonne, Norway. *Holocene* 31(3): 469–82.

Pilø, L., Finstad, E., Ramsey. C. B., et al. 2018. The chronology of reindeer hunting on Norway`s highest ice patches. R*oyal Society Open Science* 5 171738171738. http://doi.org/10.1098/rsos.171738.

Pilø, L., Finstad, E., Wammer, E. U., et al. 2022. On a mountain high: Finding and documenting glacial archaeological sites during the

Anthropocene. *Journal of Field Archaeology* 47: 149–63.
Reimer, P. J., Austin W. E. N., Bard E., et al. 2020. The IntCal20 Northern Hemisphere Radiocarbon Age Calibration Curve (0–55 cal kBP). *Radiocarbon* 62: 725–57.
Ropeid, A. 1958. Nett- og notfiske i Trysilelva. *By og Bygd. Norsk Folkemuseums årbok* 1956–57: 113–20.
Rybina, E. A. 2007. Fishing and hunting. In M. Brisbane & J. Hather (eds.) *Wood Use in Medieval Novgrod,* 124–35. Oxford: Oxbow books.
Røstad, I. M. 2020. The Åker assemblage – Fit for a king? A new account and discussion of a collection of treasure of the Norwegian Merovingian Period. *Medieval Archaeology* 64: 1–30.
Schietzel, K. 2014. *Spurensuche Haithabu. Archäologische Spurensuche in der frühmittelalterlichen Ansiedlung Haithabu. Dokumentation und Chronik* 1963–2013. Neumünster: Wachholtz Verlag.
Severinsen, A. 2016. Sørsamenes fjellfiske. Ørret, sik og røye – svømmende matforråd. In A. Mjærum & E. U. Wammer (eds.) *Fjellfiske i fortiden*, 159–81. Kristiansand: Portal forlag.
Sirelius, U. T. 1908. *Suomalaisten kalastus, vol.* 3. Helsinki: Suomalaisen Kirjallisuuden Seura.
Sirelius, U. T. 1919. *Suomen kansanomaista kulttuuria*. Esineellisen kansatieteen tuloksia, vol. 1. Helsinki: Otava.
Sofaer, J. 2006. Pots, houses and metal: Technological relations at the Bronze Age Bronze Age tell of Százhalombatta, Hungary. *Oxford Journal of Archaeology* 25: 127–47.
Stene, K. 2014. *I randsonen av taigaen – bosetning og ressursutnyttelse i jernalder og middelalder i Østerdalen.* Kristiansand: Portal Forlag.
Stene, K., Persson, P., Damlien, H., et al. 2010. Lokaliteter fra steinbrukende tid ved Rena elv. In K. Stene (ed.) *Steinalderundersøkelser ved Rena elv. Gråfjellprosjektet. bind III*, 459–520. Oslo: Kulturhistorisk museum, Fornminneseksjonen.
Stewart, H. 1977. *Indian Fishing. Early Methods on the Nortwest Coast.* Vancouver: J. J. Douglas.
Stoklund, B., Hasslöf O., Virlonen E. A., et al. 1960. Garn og garnfiskeri. In F. Hødnebø (ed.) *Kulturhistorisk leksikon for nordisk middelalder fra vikingtid til reformasjonstid,* 195–206. Oslo: Gyldendal Norsk Forlag.
Ugulen, J. R. 2016. Tesse-dokumentet og fjellfisket i mellomalderen. In A. Mjærum & E. U. Wammer (eds.) *Fjellfiske i fortiden*, 127–35. Kristiansand: Portal forlag.
Valonen, N. 1952. *Geflechte und andere Arbeiten aus Birkenrindenstreifen unter besonderer Berücksichtigung finnischer Tradition.* Helsinki: Suomen muinaismuistoyhdistys.
Valonen, N. 1953. Om näverarbeten i Fenno-Skandien. In S. Erixon (ed.) *Från trä till stål.* Stockholm: Albert Bonniers forlag.
van Gijn, A. 2010. *Flint in Focus: Lithic Biographies in the Neolithic and Bronze Age*. Leiden.
Wammer, E. U. 2015. Maritimarkeologisk undersøkelse i forbindelse med fornyelse og revisjon av konsesjon (sektoravgift) i Tesse 2014. Saksnummer 2012363. Norsk Maritimt Museum. Oslo.
Wammer, E. U. 2016. Fjellfiske i grenselandet mellom fangstmark og jordbruksbygd i yngre jernalder og middelalder. In A. Mjærum & E. U. Wammer (eds.) *Fjellfiske i fortiden*: 183–205. Kristiansand: Portal forlag.
Wehberg, J., Thannheiser, D. & Meier, K.-D. 2005. Vegetation of the mountain birch forest in Northern Fennoscandia. In F. E. Wielgolaski (ed.) *Plant Ecology, Herbivory, and Human Impact in Nordic Mountain Birch Forests*, 34–52. Berlin - Heidelberg: Springer.
Welinder, S. 2002. *Skogsfinnarnas näverflätning*. Bingsjö.
Wollan, G. 2006. Håndverk som gestaltforståelse og skaperglede. En fenomenologisk studie. *Norsk antropologisk tidsskrift* 17: 63–76.
Yarish, V., Hoppe, F., & Widess, J. 2009. *Plaited Basketry with Birch Bark.* New York: Sterling Publishing Company.
Ågren, K., & Lundholm, K. 1970. *Näverslöjd*. Stockholm: ICA-Bokförlag.

NOTES

[1] The name *sompa* for the Finnish wheel-shaped net sinkers is a Sami loan word for the traditional ring - shaped device at the bottom end of a skiing pole (Itkonen 1957 : 157 – 9). In Norwegian, the same analogy is being used for the wheel-shaped sinkers: *trinse*-søkke.

[2] The idea of embodied, non-verbal body practices outlined by Marcel Mauss (1979) underlies Bourdieu's theory of practice (Bourdieu 1977).

[3] F.ex. Danish: Garn vs. Not. Swedish: garn/nät vs. Vad/not. (Stoklund et al. 1960: 193–206).