



# LUND UNIVERSITY

## Maritime exchange during the Middle Neolithic

### Evidence of trade in ceramic figurines at the Pitted Ware Culture site of Tråsättra

Fauvelle, Mikael; Brorsson, Torbjörn; Artursson, Magnus; Björck, Niclas; Horn, Christian

*Published in:*

Journal of Archaeological Science: Reports

*DOI:*

[10.1016/j.jasrep.2025.105342](https://doi.org/10.1016/j.jasrep.2025.105342)

2025

*Document Version:*

Publisher's PDF, also known as Version of record

[Link to publication](#)

*Citation for published version (APA):*

Fauvelle, M., Brorsson, T., Artursson, M., Björck, N., & Horn, C. (2025). Maritime exchange during the Middle Neolithic: Evidence of trade in ceramic figurines at the Pitted Ware Culture site of Tråsättra. *Journal of Archaeological Science: Reports*, 66, Article 105342. <https://doi.org/10.1016/j.jasrep.2025.105342>

*Total number of authors:*

5

*Creative Commons License:*

CC BY

#### General rights

Unless other specific re-use rights are stated the following general rights apply:

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

Read more about Creative commons licenses: <https://creativecommons.org/licenses/>

#### Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

LUND UNIVERSITY

PO Box 117  
221 00 Lund  
+46 46-222 00 00



# Maritime exchange during the Middle Neolithic: evidence of trade in ceramic figurines at the Pitted Ware Culture site of Tråsättra

Mikael Fauvelle<sup>a,\*</sup>, Torbjörn Brorsson<sup>b</sup>, Magnus Artursson<sup>c</sup>, Niclas Björck<sup>d</sup>, Christian Horn<sup>e</sup>

<sup>a</sup> Lund University, Department of Archaeology and Ancient History, Helgonavägen 3, Box 192, 221 00 Lund, Sweden

<sup>b</sup> Center for Ceramic Studies, Nyhamnsläge, Sweden

<sup>c</sup> Swedish National Historical Museums, Lund, Sweden

<sup>d</sup> Swedish National Historical Museums, Uppsala, Sweden

<sup>e</sup> University of Gothenburg, Department of Historical Studies, Gothenburg, Sweden

## ARTICLE INFO

### Keywords:

Neolithic Europe  
Pitted Ware Culture  
Hunter-gatherers  
Figurine studies  
Trade and exchange  
Maritime mobility  
ICP-MA/ES analysis

## ABSTRACT

This paper presents a snapshot of a neolithic maritime exchange network centred on the Pitted Ware Culture (PWC) site of Tråsättra (circa 2630 to 2470 BCE), located northeast of modern-day Stockholm, Sweden. We used a combination of Inductively Coupled Plasma Mass Atomic Emission Spectrometry (ICP-MA/ES) and thin section analysis to study and source the clays used to produce 19 potsherds and 39 ceramic figurines from the site. Our results showed that while all potsherds were made with local clays, 10 of the figurines were made with non-local clays sourced from across the Baltic Sea region, including the island of Gotland and the Åland archipelago. Furthermore, most of the non-local figurines were anthropomorphs, while all animal figurines were made with local clays. We suggest that this striking pattern indicates that the PWC people of Tråsättra were participating in a long-distance trading network comparable to the ritual and prestige focused exchange systems found in many anthropologically known maritime societies. Similar results were also received from the analysis of 14 potsherds and 3 figurines from the nearby Early Neolithic (circa 3620 to 3360 BCE) site of Lappdal, suggesting that the exchange of ceramics was a long-standing practice for fisher-forager cultures in the Baltic Sea region. Our cluster analysis of clay composition also indicates that some figurines may have been traded on the local level, pointing to multiple spheres of economic interaction. We argue that these results highlight the considerable economic complexity that was present in this neolithic fisher-forager society.

## 1. Introduction

Maritime hunter-gatherer societies have long attracted the attention of archaeologists due to their propensity towards sedentary lifeways and economic complexity (Ames, 1994; Arnold, 1995; Arnold et al., 2016; Hayden, 1994). Recent research has highlighted the variability of fisher-forager economic and political organization found in different parts of the world (Kidder, 2023; Sampson, 2023). While some fisher-foragers developed hierarchical chiefdoms based on the control of marine resources and transport (Arnold, 2001, 1995; Fauvelle, 2011; Fauvelle et al., 2024b; Fauvelle and Somerville, 2024), others maintained more anarchic or egalitarian political cultures (Angelbeck and Grier, 2012; García-Piquer et al., 2022). Studying maritime fisher-foragers can therefore provide a window into the great diversity of forms of social organization present in non-state societies (e.g. Graeber and Wengrow,

2021). In this paper we use ceramic sourcing data to explore economic networks in one of Europe's last fisher-forager societies, the Middle Neolithic Pitted Ware Culture (PWC). Our results indicate that the PWC inhabitants of the site of Tråsättra were engaged in the long-distance trade of figurines across the Baltic Sea, likely as part of a ritual economy or a prestige-focused exchange system.

The PWC thrived on the islands and coasts of southern Scandinavia and the Baltic Sea region during the Middle Neolithic (3500 and 2300 BCE) (Fig. 1). Throughout this time they maintained a hunter-gatherer lifestyle despite frequent interactions with the agricultural Funnel Beaker (FBC) and Battle Axe (BAC) cultures that occupied the terrestrial and interior parts of Scandinavia (Artursson et al., 2023; Iversen et al., 2021; Klassen, 2020). Recent archaeological investigations into the PWC have shown that they lived in sedentary or semi-sedentary communities with both domestic and ritual structures, had high levels of violence, and

\* Corresponding author.

E-mail address: [mikael.fauvelle@ark.lu.se](mailto:mikael.fauvelle@ark.lu.se) (M. Fauvelle).

<https://doi.org/10.1016/j.jasrep.2025.105342>

Received 18 March 2025; Received in revised form 28 July 2025; Accepted 30 July 2025

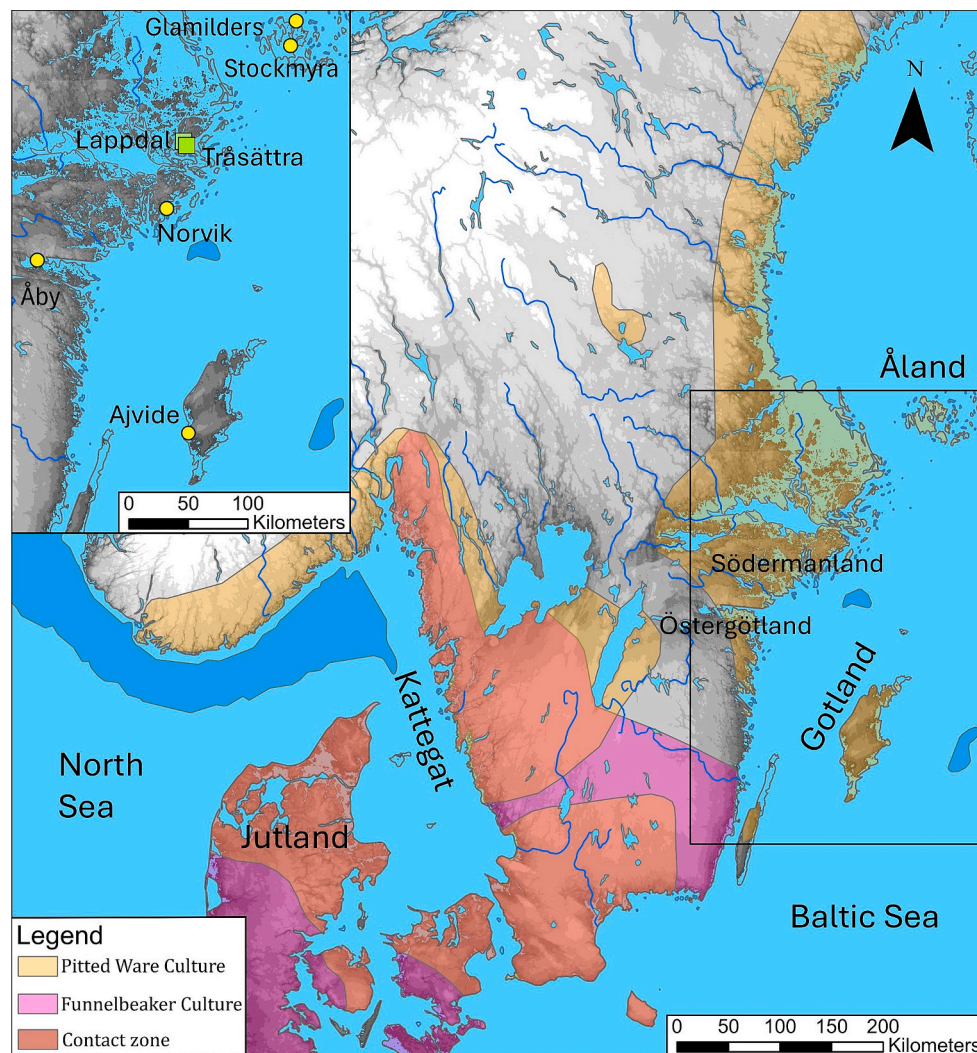
2352-409X/© 2025 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

consumed diets heavy in fish and seals (Artursson et al., 2023; Horn, 2021; Horn and Schultrich, 2025; Iversen, 2016; Klassen, 2020; Krooks and Boethius, 2024). The PWC were capable mariners, possibly using skin boats to travel across the sea (Fauvelle et al., 2024a). Genetic studies have also shown that the PWC formed a genetically distinct population most closely related to ancestral Mesolithic hunter-gatherers (Coutinho et al., 2020; Malmström et al., 2009; Mittnik et al., 2018; Skoglund et al., 2012). The PWC were the last hunters and gatherers to inhabit southern and middle Scandinavia and were eventually either absorbed or outcompeted by agricultural groups during the Late Neolithic.

Previous studies have found abundant evidence for long-distance interaction between PWC communities. Flint from Denmark and southern Sweden was traded widely between PWC communities and it has been proposed that the seemingly rapid spread of the PWC might have been due to their participation in flint exchange networks (Iversen et al., 2021). Analyses of PWC pottery from the Kattegat area has shown that a ceramic vessel from southern Halland was manufactured in Djursland on Jutland, showing that there was maritime trade between modern-day Denmark and Sweden (Brorsson et al., 2018). Finds of non-local goods on Gotland including beaver incisors, elk bone, flint, dentalium shell, and amber beads also indicates maritime exchange took place in the Baltic Sea region (Andersson, 2016; Janzon, 1974;

Martinsson-Wallin, 2008; Taffinder, 2000). Seal oil has also been proposed as a possible PWC trade good (Svizzero, 2015). Strontium isotope studies have shown that bear skulls and other animal bones were traded across the Kattegat between Denmark and Sweden, possibly as part of ritual activity (Price et al., 2021). A similar study using laser ablation strontium analysis on both human and canine teeth from the PWC site of Jettböle in Åland showed that a dog had been transported all the way from Gotland to Åland (Boethius et al., 2024). Both of these examples of the movement of animals would have required voyages over large distances of open sea. Humans have also been shown to have moved between communities, with approximately 9 % of individuals analysed for strontium isotopes from a PWC cemetery Västerbjers on Gotland shown to be non-local (Ahlström and Price, 2021).

Despite evidence of regional interaction, the economic and political organization of the PWC is poorly understood. Studies during the 20th century often assumed that the PWC had an egalitarian or “band-like” organization owing to evolutionary comparisons with contemporary agricultural groups such as the Funnel Beaker Culture (FBC) or Battle Axe Culture (BAC) that were seen as more politically complex. Such preconceptions regarding PWC social organization stand in contrast to evidence for classic hallmarks of emergent social complexity including sedentism (Ahlström and Price, 2021; Artursson et al., 2023), warfare (Horn, 2021; Horn and Schultrich, 2025; Iversen, 2016), seafaring



**Fig. 1.** Map of southern and middle Scandinavia and the Baltic Sea region showing important sites and regions named in text. Major culture areas for the PWC and FBC are overlaid on top of the Middle Neolithic coastline. The Battle Axe Culture (BAC) replaced first the FBC and eventually the PWC in the southern and middle regions of mainland Scandinavia towards the end of the Neolithic period.



(Boethius et al., 2024; Fauvelle et al., 2024a), and long-distance exchange (Boethius et al., 2024; Iversen et al., 2021; Price et al., 2021). In this paper we present a snapshot of economic interaction within the PWC world focused on the site of Tråsättra. By sourcing the clays used to produce ceramic potsherds and figurines we expand our understanding of the local and long-distance exchanges that underwrote part of the PWC political-economic system.

## 2. Methods: materials and sample selection

This study is based on the analysis of 39 figurines and 19 potsherds from the site of Tråsättra, located just north of modern-day Stockholm (Fig. 1). Recent excavations of Tråsättra have shown that it was a permanent settlement inhabited between 2630 and 2470 BCE. A full discussion of the Tråsättra excavations and an analysis of the material finds

can be found in a recent paper by Artursson et al. (2023), as well as the Tråsättra excavation publication by Björck and colleagues (Björck et al., 2020). The settlement consisted of 9 circular huts occupied in two phases with up to 6 structures in use during the later phase. The huts surrounded a central activity and cooking area, and one was separated by the others by a L-shaped fence, possibly indicating that it had a ritual or secretive function. The site was located on a beach and had a likely population of between 30 and 40 individuals. Our study of the Tråsättra ceramics is complemented by the analysis of an additional 19 potsherds and 3 figurines from the site of Lappdal, an Early Neolithic fisher-forager site with similar material culture to the slightly late PWC complex. The site of Lappdal is C14 dated to 3620–3360 BCE, and is located around 4 km northwest of Tråsättra (Björck, 2021).

Tråsättra is notable for having one of the largest assemblages of figurines ever found at a PWC site, with a total of 215 figurine fragments



**Fig. 2.** Selection of figurines from Tråsättra. Anthropomorphic figurines on top and zoomorphic figurines on the bottom. Figurines sampled for this study are shown with their artifact numbers (Photo: Niclas Björck, Arkeologerna).



having been recovered during excavations (Artursson et al., 2023; Björck et al., 2020, p. 120; Lindström, 2024). Figurines are common at PWC sites in the Baltic Sea Region, but are rare at PWC sites in Denmark and the Kattegat, making figurines one of the aspects of material culture that separates eastern and western manifestations of the PWC (Iversen et al., 2024; Lindström, 2024). Most PWC figurines are either zoomorphic or anthropomorphic, although some represent inanimate objects (Fig. 2) (Björck et al., 2020, p. 144). Across the Baltic Sea Region PWC figurines share many similarities in stylistic representation, form, and size. These similarities suggest shared cultural traditions and the possibility of exchange between different PWC communities.

The clays used to produce figurines and other ceramic objects from Tråsättra and Lappdal were sourced using Inductively Coupled Plasma Mass Atomic Emission Spectrometry (ICP-MS/ES) at the OMAC laboratories in Galway, Ireland. A total of 39 figurines, 19 potsherds, and 1 clay sample from Tråsättra, and 3 figurines and 14 potsherds from Lappdal were selected for analysis. Of the ceramics from Tråsättra, sampled ceramics represent 18 % of the total figurine assemblage (39 out of 215), while the 19 potsherds represent only a small fraction of the 104,106 total recovered sherds. We prioritized selecting sample potsherds that were typologically identified and represented a range of different types. Samples of 0.25 g were taken from each of these objects for ICP-MS/ES. Our analysis measured 44 different elements, of which 12 form the basis for our interpretations of the provenance of the ceramic objects. These elements are aluminium (Al), chromium (Cr), gallium (Ga), manganese (Mn), vanadium (V), calcium (Ca), magnesium (Mg), strontium (Sr), cerium (Ce), lanthanum (La), sodium (Na), and cobalt (Co) (See [Supplementary Data: Table 1](#)). The selection of trace elements is based on previous analysis that demonstrated reliable discriminating processing (Thompson and Walsh, 1989; Speakman and Neff 2005). These elements are geochemically stable, which means that their concentrations are not significantly affected by ceramic production processes such as firing or the addition of temper (Glascok et al., 1992). They also have low mobility in the environment, which ensures that their relative abundances remain intact from the clay source to the finished product (Neff, 2000). Another important factor is their ability to distinguish between different geological sources; the trace elements exhibit significant variation among clay deposits, which makes it possible to identify the origin of ceramic vessels (Arnold et al., 1991). The selection of these elements is consistent with previous studies of ceramic provenance using ICP-MS/ES (Brorsson et al., 2018, 2019; Eriksson et al., 2024; Von Arbin et al., 2022).

## 2.1. Methods: cluster analysis and provenance determination

The central goal of our analysis was to determine the provenance of the ceramic vessels and figurines from Tråsättra and Lappdal. Our analysis is based on the understanding that ceramics of a similar geographical origin should have similar chemical compositions. In order to make these determinations, we subjected the elemental chemical fingerprints for each object obtained through ICP-MS/ES to an agglomerative cluster analysis. This is a bottom-up statistical processes which identifies like-clusters within the sample dataset and arranges them in order of distance from each other. Clusters are then separated based on the Euclidean distance between them using the software SPSS PASW Statistics 17. The clusters were subsequently compared to a comprehensive reference database comprising approximately 15,000 ceramic sherds and clay samples. This database, maintained by Ceramic Studies in Sweden, includes material from a wide range of archaeological sites across Northern Europe. Among the reference materials are ceramics from several Neolithic sites located in mainland Sweden, as well as in Finland, the Åland Islands, and Gotland. The comparative analysis enabled a contextualization of the identified clusters within established typological and compositional frameworks. The provenance of ceramic clusters was determined by matching them to the elemental fingerprint of previously studied ceramics within the database. The use

of ICP-MS analysis coupled to dendrochronological cluster analysis is a common method for ceramic source provenance determination that has been used in case studies throughout the world (Brorsson et al., 2018, 2019; Eriksson et al., 2024; Little et al., 2004; Von Arbin et al., 2022).

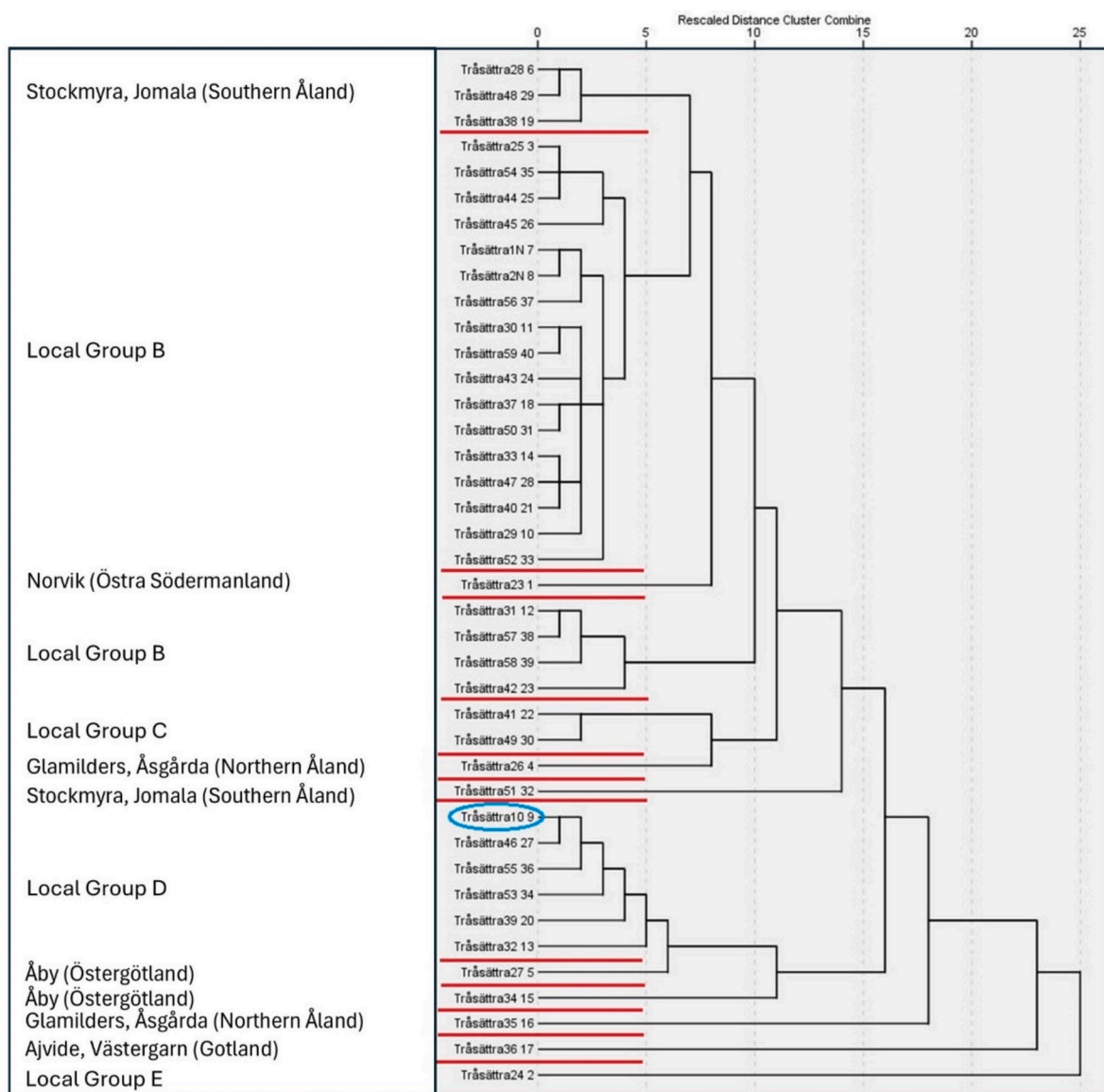
The first stage of the cluster analysis compared ceramics internally within the Tråsättra sample group. This analysis showed that most of the ceramics from Tråsättra cluster relatively closely together with our local clay sample (collected directly from the site) suggesting that they were of local manufacture. Some differences within this group, however, indicate that local clays were sourced from different locations. Within the local assemblage we could identify 5 distinct clusters that likely indicate different local clay sources (A through E, Fig. 3, [Supplementary Table 1](#) ICP data). These clusters stayed relatively consistent across multiple dendrograms and while remaining distinct from comparative materials in nearby regions such as Östergötland and Uppland. This makes it very likely that they represent clays from different local sources.

Our cluster analysis also identified numerous figurines from Tråsättra (samples Tråsättra 23, 24, 26, 34, 35, 36, 38, 48, 51) that were chemically distinct from these larger local groups. In the second stage of our analysis we compared these outlier figurines with comparative material from known sources from sites in Uppland, Södermanland, Östergötland, Åland, Gotland, Estonia, Latvia, Lithuania, and the Finnish mainland. These comparisons were done using the same agglomerative cluster analysis described above. Ceramics from the Finnish settlements of Nuiskala, Jäkärä and Kokemäki near Turku all differ from and do not cluster with the figurines in Tråsättra. So do ceramics from Estonia, Latvia and Lithuania, and it is clear that none of the analyzed figurines from Tråsättra originate from the eastern Baltic Sea area.

Closer matches were identified between the Tråsättra material and sites in Södermanland, Östergötland, Gotland, and Åland (Fig. 4). Further cluster analysis therefore focused on these regions. Comparisons with ceramics from Södermanland and Östergötland reveal that the figurines Tråsättra27 and Tråsättra34 are clustered together with ceramics from the pit ceramic settlement in Åby in Norrköping. These two figurines thus have more similarities with Åby's ceramics than, for example, with materials from Tråsättra or Norvik. The elements that distinguish these two samples from the majority of Tråsättra's figurines are the low levels of chromium (Cr) and vanadium (V) ([Supplementary Table 1](#)). Likewise, figurine Tråsättra23 is placed in a cluster together with three shards from Norvik, and its provenance should have been eastern Södermanland.

Our cluster analysis places figurine Tråsättra36 together with ceramics from Gotland, specifically Ajvide and Västergarn on western Gotland. While the ceramics are chemically similar, this result is intriguing as figurines are rare on Gotland. It should be noted, however, that the highest proportion of calcium (Ca) was found in the figurine Tråsättra36 ([Supplementary Table 1](#)). In the majority of the figurines, the calcium levels were between 1 and 3.5 %, while there was 4.7 % calcium in this figurine. The bedrock and soils of Gotland are known for their high limestone content, which lends support to this identification.

The remaining figurines all have the closest matches with ceramics from Åland. Four of the shards; Tråsättra28, Tråsättra38, Tråsättra48 and Tråsättra51 were placed in a cluster with ceramics from the settlement in Stockmyra in Jomala on the southern part of mainland Åland. A shard from Otterböte at Kökar in southern Åland also has similarities with the figurines from Tråsättra. The distance between Tråsättra and Stockmyra is about 120 km by water, and between Tråsättra and Kökar it is about 150 km. It is noteworthy that the figurines have the most similarities with comparison material from southern and not northern Åland. In the figurines Tråsättra28, Tråsättra38 and Tråsättra48, the concentrations of cobalt (Co), chromium (Cr), gallium (Ga) and manganese (Mn) are higher than in most of the material from Tråsättra. In the figurine Tråsättra51, only chromium (Cr) and manganese (Mn) are elevated, which shows that this figurine has not been made from the



**Fig. 3.** Initial cluster analysis for all figurines from Tråsättra in order to identify local ceramic groups. Shown with eventual provenance determinations of each cluster based on later comparison with known sources. Local clay source is circled in blue. Note that while the Åland figurines form several small clusters on this chart they become more clearly grouped together when compared with more chemically similar comparative sources (Fig. 4 below). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

same type of raw material that was used for the other three of possible Åland provenance (see [Supplementary Table 1](#)).

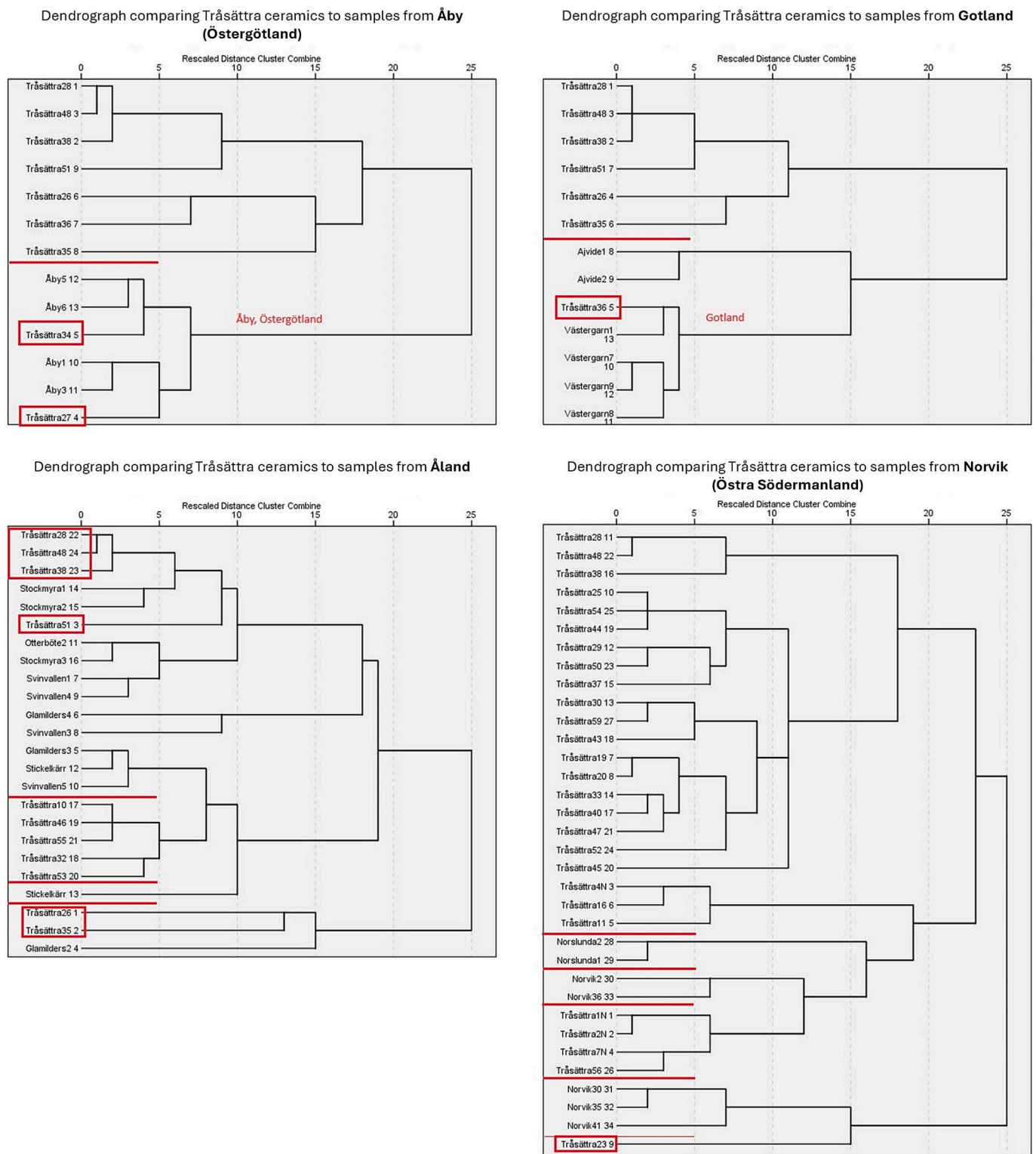
The two figurines Tråsättra26 and Tråsättra35 were placed in a heterogeneous group together with a figurine from Glamilders in Långbergsöda on the northern parts of mainland Åland. It is likely that the provenance is Åland, but based on how the samples are grouped, it is not clear. It can be stated that the two figurines Tråsättra26 and Tråsättra35 are made of similar raw materials, which were probably sourced in the same area.

Cluster analysis was also performed on the ceramics and figurines from Lappdal, following the same procedure outlined above. This analysis showed that most ceramics from Lappdal cluster together with the Tråsättra ceramics from local group D (Fig. 5). We compared outliers to reference material from Estonia, Latvia, Lithuania, mainland Finland, Uppland, Södermanland, Västmanland, Gästrikland, Närke, Östergötland and Gotland, but found little chemical similarity with the ceramics from those regions. The outliers clustered nicely, however, with known sources from Åland (Fig. 6). The samples Lappdal 1,

Lappdal 10, and Lappdal 17 the same chemical composition as pottery and figurines from Stockmyra in Jomala in southern Åland, while samples Lappdal 4 and Lappdal 9 cluster together with ceramics from Åsgårda and Svinvallen in Saltvik in northern Åland.

## 2.2. Methods: thin section analysis

Thin section was also used on a selection of 6 figurines from Tråsättra in order to study the clay composition and tempers used in the production of the figurines. For this analysis we used 0.03 mm slices from the artifacts which were studied under a polarization microscope at magnifications between 25x and 1000 x in crossed and parallel light. For each sample we noted characteristics including the coarseness of the clay, the type of temper used, the grain size and sorting, the mineralogical composition of the clay, the presence of diatoms, and the presence of organic materials. All of these characteristics allowed us to compare the ceramic production and composition between figurines in order to further refine our understanding of the object histories of PWC ceramics.



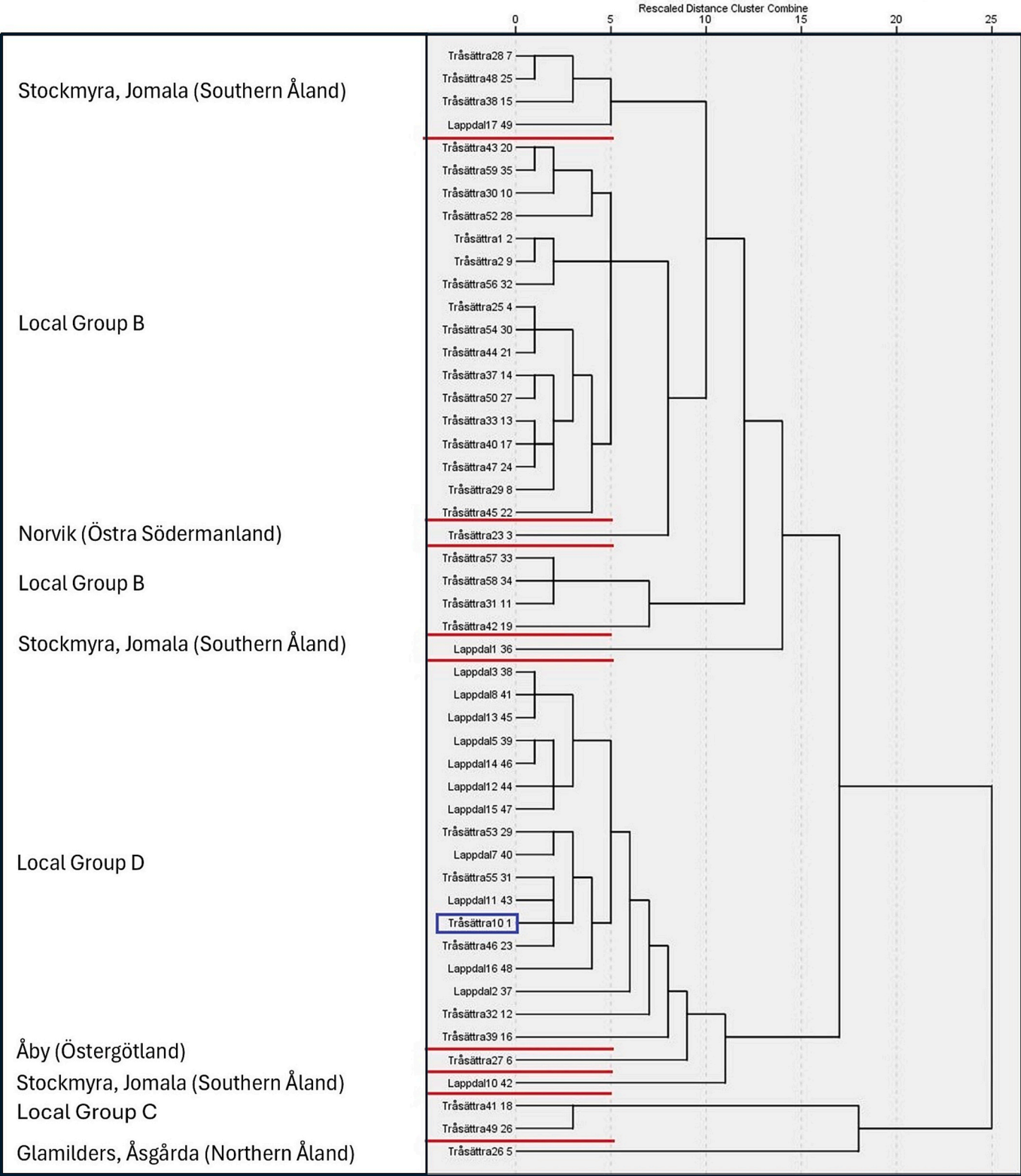
**Fig. 4.** Cluster analysis performed on Tråsättra outliers together with known samples from Åby, Norvik, Gotland, and Åland. Selected non-local figurines highlighted in red boxes. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

### 3. Results

Our analysis of the Tråsättra figurines identified 10 figurines that were of non-local origin. Of these figurines, 6 most closely matched clay profiles from Åland, including 4 that likely come from southern Åland (Samples 28, 38, 48, and 51, closest match from Stockmyra) and two that likely come from northern Åland (samples 26 and 35, closest match

from Glamilders). Of the four remaining figurines, two were clustered with ceramics from Åby in Norrköping (Samples 27 and 34), one with Norvik in eastern Södermanland (Sample 23), and one with Ajvide on Gotland (sample 36) (See Table 1). A map of the identified source locations of the Tråsättra figurines can be found on Fig. 7 All 19 of the analysed potsherds from Tråsättra were made with local clays. While the sampled potsherds represent a relatively small component of the overall





**Fig. 5.** Dendrogram showing average linkage between groups using selected samples from both Tråsättra and Lappdal. Note that many samples from both Tråsättra and Lappdal cluster into local Group D. Sample in blue rectangle is raw clay from Tråsättra. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

ceramic assemblage at the site, the fact that all were made with local clays suggests that the trade in ceramics was restricted to figurines. Nine out of the ten non-local figurines from Tråsättra are anthropomorphic, including one (sample 23) that is interpreted as a bear-

human hybrid. The one remaining non-local figurine, sample 51, is interpreted as representing a drum. This means that all zoomorphic figurines from Tråsättra analysed for this study were made with local clays. Of the figurines made with local clays, 22 are assessed as human, 2

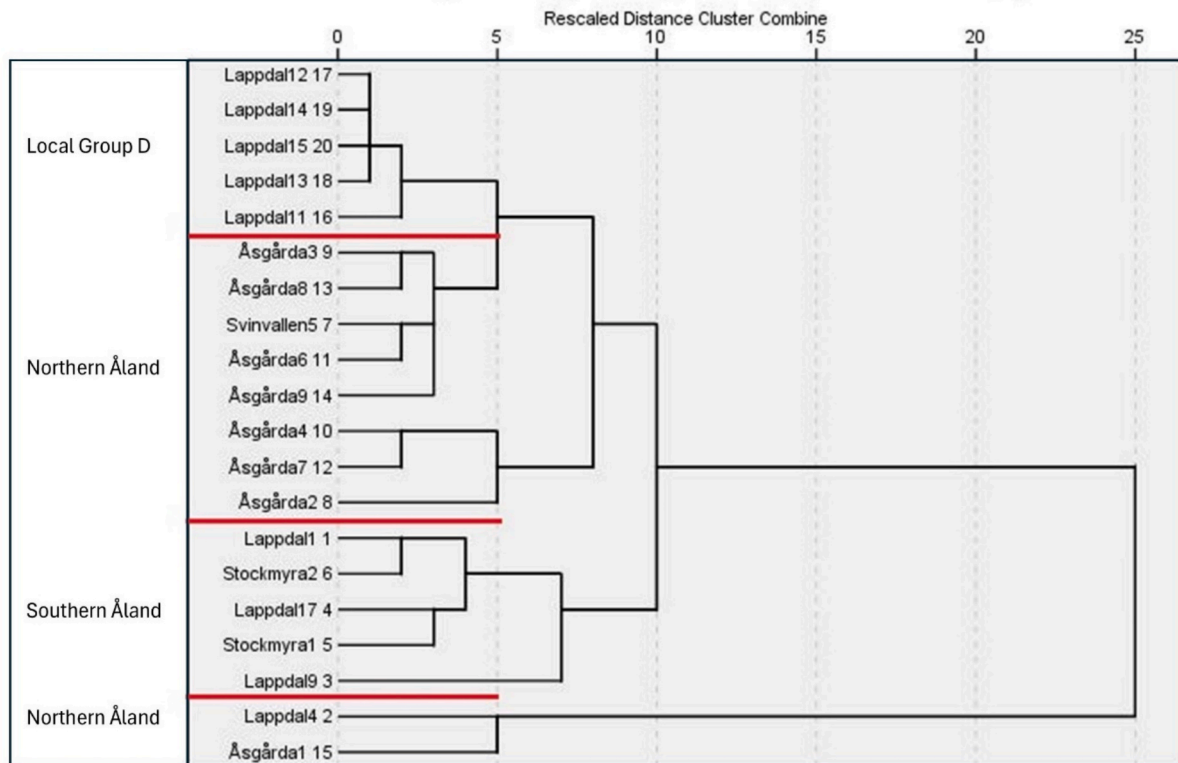


Fig. 6. Dendrogram showing selected ceramics from Lappdal and their association with ceramic samples from Åland.

as human-animal hybrids, 2 as seals, 1 bird, 1 bear, and 1 boar. Our cluster analysis placed the artifacts deemed to have been made with local clays into 5 different sub-groups (A through E) based on similarities in clay profiles. The three largest sub-groups (A, B, and D) consist of around 75 % anthropomorphic figurines while the two smallest groups (C and E) are entirely anthropomorphs. Group E consists of a single striking figurine (Tråsättra 24), interpreted as a human female and stylistically similar to figurines from Åland, that has a local chemical character, but it deviates very clearly with regard to magnesium (Björck et al 2020:130). One possibility is that it is a locally made figurine that was mixed with magnesium high fishbone during manufacture, possibly indicating ritual practice. While the sample sizes for groups C and E are too small to draw definitive conclusions, it is possible that some of these subgroups represent local trade partners with similar clays to Tråsättra, and that the pattern of trading in anthropomorphic figurines that we see for long-distance exchange holds up even on the local and regional level.

The thin section analysis of the Tråsättra figurines confirmed the results of the ICP-MS/ES analysis while also adding additional insights. Figurine 36 was shown to have been made with a medium coarse clay that had a very high lime content similar to clays from Gotland, confirming the sample's provenance (Fig. 8). Figurine 27 was shown to have had organic plant material mixed into its clay, a choice that had no clear functional role and thus likely had a symbolic or ritual function. Four of the figurines (26, 49, 50, 58) were also shown to have had crushed shell added to their clay as a temper. Comparisons between figurine 26, matched to northern Åland, and local ceramics from Tråsättra show a strong degree of similarity in paste and composition, suggesting that there may have been shared traditions of ceramic production in these two areas.

The analysis of ceramics from the Early Neolithic site of Lappdal sheds light on long term trends in the movement of ceramics in the Baltic Sea region and is informative for understanding the Tråsättra assemblage. A total of 14 potsherds and 3 figurines from Lappdal were analyzed using ICP-MS/ES. The majority of these (11 of the potsherds

and 2 of the figurines) matched the composition of Tråsättra group D, showing that there was overlap in the clay sources used by the residents of both sites. One non-local figurine was matched to southern Åland, but unfortunately the figurines from Lappdal were too fragmented and small to conclusively determine if they were anthropomorphs or zoomorphs. Three potsherds also were matched to northern Åland and one potsherd was matched to southern Åland. The fact that potsherds were imported to Lappdal from Åland is a major deviation from the pattern at Tråsättra where all potsherds were made with local clays. This could suggest that long-distance trade was less restricted by artifact type during the Early Neolithic, implying that trade may have become more patterned by the time Tråsättra was inhabited around a millennia later.

#### 4. Discussion

Our analysis of the Tråsättra ceramics show that the PWC inhabitants of Tråsättra maintained trade connections with locations throughout the Baltic Sea region. Six out of ten non-local figurines were provenanced to the Åland archipelago, indicating the importance of this region for PWC economic networks. Other figurines were provenanced to sources in coastal Östergötland, Södermanland, and the island of Gotland, indicating that the PWC participated in a maritime exchange system that was some 400 km wide. The fact that 4 out of 17 samples from the Early Neolithic Lappdal assemblage also showed a non-local provenance show that the phenomena of long-distance trade over maritime networks had a deep antiquity in the middle Baltic Sea region.

The non-local ceramic assemblage at Tråsättra is highly patterned across artifact types. All of the sampled potsherds were made with local clays, while nearly 25 % of the figurines were non-local imports. This strongly suggests that the trade of ceramic objects was focused on ritual items rather than utilitarian goods. Out of the 10 non-local figurines 8 represented humans, 1 is interpreted as a human-bear hybrid, and 1 is interpreted as a drum. This means that up to 90 % of non-local figurines were anthropomorphs while all zoomorphic figurines were made with

**Table 1**

Provenance of Tråsättra figurines.

Artifact Number	Laboratory #	Type	Status	Location	Provenance
SU. F49	Tråsättra36	Human	fragment	Central area	Ajvide, Västergarn (Gotland)
SU. F33	Tråsättra35	Human	half	A6339	Glamilders, Långbergsöda (Northern Åland)
SU. F103	Tråsättra26	Human	half	Hut 3	Glamilders, Långbergsöda (Northern Åland)
SU. F3	Tråsättra47	Human	hel	A6339	Local Group A
SU. F13	Tråsättra33	Human	fragment	Hut 4	Local Group A
SU. F17.	Tråsättra59	Human	half	Hut 3	Local Group A
SU. F37	Tråsättra43	Human	half	Hut 6	Local Group A
SU. F57	Tråsättra37	Human	half	Central area	Local Group A
SU. F77	Tråsättra29	Human	intact	Hut 5	Local Group A
SU. F89	Tråsättra56	Human	half	Central area	Local Group A
SU. F92	Tråsättra40	Human	fragment	Central area	Local Group A
SU. F95	Tråsättra25	Human	half	Hut 4	Local Group A
SU. F96	Tråsättra54	Human	half	Central area	Local Group A
SU. F107	Tråsättra52	Human	half	Hut 1	Local Group A
SU. F144	Tråsättra50	Human	half	Central area	Local Group A
SU. F69.	Tråsättra44	Bear	damaged	Hut 2	Local Group A
SU. F4	Tråsättra30	Seal	half	Hut 3	Local Group A
SU. F112	Tråsättra45	Seal	fragment	Hut 6	Local Group A
FU. F2	Tråsättra1	Human	fragment	Central area	Local Group A
FU. F567	Tråsättra2	Human	fragment	Central area	Local Group A
SU. F142	Tråsättra57	Bird	intact	Central area	Local Group B
SU. F70.	Tråsättra31	Human	half	Hut 3	Local Group B
SU. F81	Tråsättra42	Human	half	Central area	Local Group B
SU. F145	Tråsättra58	Human	half	Central area	Local Group B
SU. F93	Tråsättra41	Human	damaged	Hut 3	Local Group C
SU. F126	Tråsättra49	Human	half	Central area	Local Group C
SU. F8	Tråsättra32	Bear	fragment	Hut 6	Local Group D (Lappdal grupp)
SU. F56	Tråsättra55	Human	half	Central area	Local Group D (Lappdal grupp)
SU. F91	Tråsättra39	Human	half	Hut 3	Local Group D (Lappdal grupp)
SU. F133	Tråsättra53	Human	half	A12043	Local Group D (Lappdal grupp)
SU. F121	Tråsättra46	Pig/Boar	half	Central area	Local Group D (Lappdal grupp)
SU. F62	Tråsättra24	Human	hel	Hut 5	Local Group E
SU. F11	Tråsättra23	Bear	half	Central area	Norvik (Östra Södermanland)
SU. F90.	Tråsättra38	Human	half	Central area	Stockmyra, Jomala (Southern Åland)
SU. F130	Tråsättra28	Human	half	Central area	Stockmyra, Jomala (Southern Åland)
SU. F136	Tråsättra48	Human	half	Hut 3	Stockmyra, Jomala (Southern Åland)
SU. F6299	Tråsättra51	Trumma	intact	Hut 3	Stockmyra, Jomala (Southern Åland)
SU. F33	Tråsättra34	Human	half	A6339	Åby (Östergötland)
SU. F105	Tråsättra27	Human	half	Hut 4	Åby (Östergötland)

local clays. Previous studies have identified stylistic differences between anthropomorphic and zoomorphic PWC figurines, including a lack of eyes on zoomorphic figurines and a tendency for anthropomorphic figurines to have more decorations (Lindström, 2024). Our results confirm that there was a distinction between anthropomorphic and zoomorphic figurines and suggest that this difference could be based on a connection between anthropomorphic figurines and regional exchange. As zoomorphic figurines were produced locally it is more likely that they were used for daily ritual activities. Non-local anthropomorphic figurines, on the other hand, are more likely to have been connected to activities related to out-group interactions.

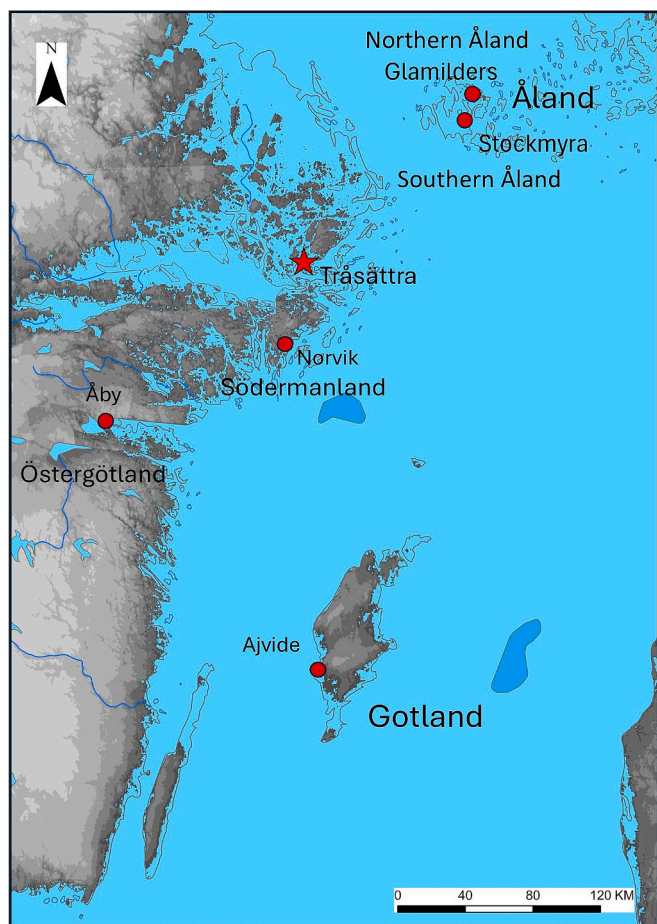
The fact that only figurines were being imported to Tråsättra and that nearly all of these figurines represented anthropomorphs strongly suggests that PWC exchange was not based on resource scarcity alone. Instead, a different logic must be proposed to explain the highly patterned nature of the non-local ceramic assemblage at the site. One possibility is that the Tråsättra figurines were being traded as part of a ritual economy similar to that found in many other traditional and transegalitarian societies around the world (Fauvelle and Perry, 2023; Lesure and Blake, 2002; Spielmann, 2002; Wells and McAnany, 2008). In such systems, the need to provision feasts and obtain ritual items is a primary driving factor for regional and interregional exchange. In ancient California, for example, steatite animal effigies, charm stones, bone whistles, and food for feasts were important trade goods that were exchanged in order to supply shamanic and chiefly activities (Fauvelle and Perry, 2023). In ancient Mesoamerica, the concept of a ritual economy has also been used to explain how economies can be structured around a need to procure non-utilitarian items associated with elite

adornment, performance, and other ritual functions (Wells and McAnany, 2008; Wells, 2006). A ritual economy approach might explain why figurines seem to have been regularly imported to Tråsättra but ceramic pots were entirely locally produced.

Another possible explanation for the exchange pattern we have identified at Tråsättra would be that anthropomorphic figurines were traded as part of a prestige exchange network. Under such a model, figurines would have been obtained through exchange with distant trading partners and their ownership would have increased the social prestige of the skilled voyagers who had travelled across the Baltic Sea to procure them. Like with ritual economies, prestige exchange systems are well documented in many traditional and small-scale societies around the world (Arnold, 2012; Clark and Blake, 1994; Malinowski, 1922; Munn, 1992). The fact that most traded figurines are anthropomorphs might indicate that they represent exchange partners or perhaps even individuals with whom the owner has conducted trade. The prestige of such figurines could also have been connected to their display of the owners knowledge of distant places and groups (Helms, 1993, 1979). The importance of acquiring items over great distances to signal prestige could explain why figurines from Tråsättra were sourced to an area stretching over 400 km of the Baltic Sea.

Related to both models presented above is the possibility that PWC anthropomorphic figurines were connected to the functioning of secret societies. Secret societies are exclusive social groups that are central to the political and economic organization of many traditional societies around the world (Chacon et al., 2025; Fauvelle and Ling, 2025; Hayden, 2018; Ling et al., 2022). Secret societies are so-named after the esoteric knowledge that they held secret from non-group members; the existence



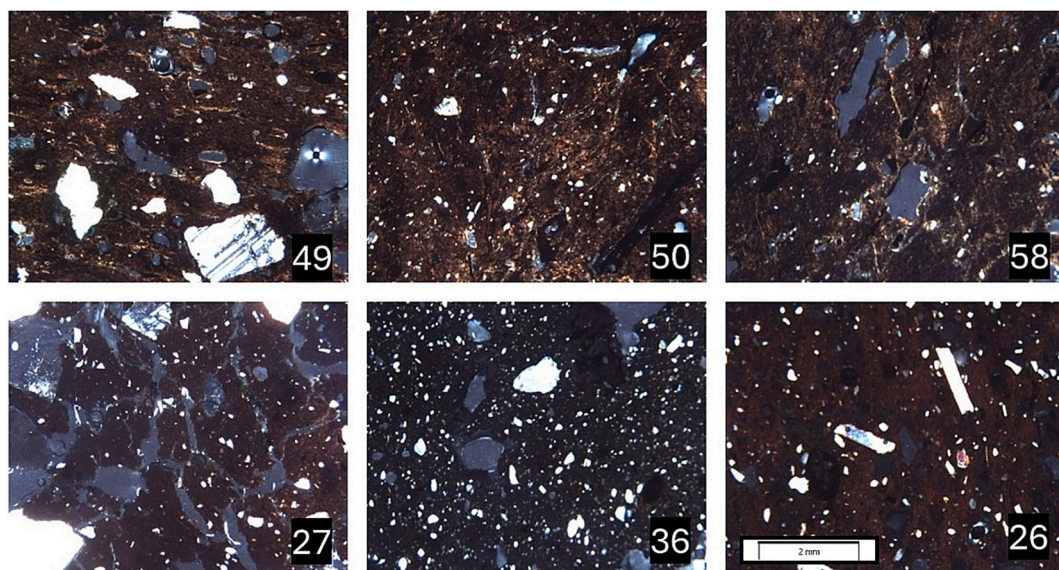


**Fig. 7.** Map of ceramic exchange network represented in the Tråsättra figurine assemblage. Red dots represent locations where figurines at Tråsättra were sourced from. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

of the society itself was usually well known (Hayden, 2018). In this way secret societies can be compared to the trade guilds, fraternities, or political clubs of modern society (Fauvelle and Ling, 2025). One common characteristic of secret societies is the existence of specialized gathering places that are separated from the rest of the group (Hayden, 2018). Such structures have parallels at many PWC settlements including at Tråsättra where a fenced off structure identified as a secluded ritual area with a specialized building was found during excavations (Artursson et al., 2023). A major function of secret societies is to connect members in disparate places through shared membership in the society and knowledge of esoteric rites and secrets (Hayden, 2018; Ling et al., 2022). Through membership in secret societies ancient traders would have been able to access ready-made connections and political ties in the places they travelled through (Chacon et al., 2025; Fauvelle and Ling, 2025). In many anthropologically known examples of secret societies, statues and effigies of founding members, deities, or other supernatural beings play important roles in the ritual activities of group members (Hayden, 2018). It is possible that the anthropomorphic figurines from Tråsättra played a similar role and that the non-local figurines could represent connections to secret societies in distant places.

Other possible explanations for the presence of non-local anthropomorphic figurines at Tråsättra include their seizure during raiding and out-group mobility connected to marriage practices. It is well documented that high levels of violence and warfare within PWC society (Horn, 2021; Horn and Schultrich, 2025; Iversen, 2016). Patron deity capture is a common goal of warfare and raiding practiced by groups around the world and throughout history (Palka, 2023). If anthropomorphic figurines were high status items connected to ritual practice they might have been attractive targets to seize and take home during successful maritime raids. Anthropomorphic figurines representing lineage or clan groups may also have accompanied people traveling between different settlements for the purposes of out-group marriage. Connections through marriage could have helped maintain political and economic ties between groups and could have been an important way to organize the dispersed settlements of different PWC groups in the Baltic Sea region.

Our results also have implications for understanding the broader political and economic organization of the PWC. Evidence for



**Fig. 8.** Thin section photos of Tråsättra figurines. Photos taken under a polarization microscope in crossed light. The digits indicate the sample number. Shell temper was added to clay matrix in Figurines 26, 49, 50, and 58, while figurine 27 has organic material mixed into its clay. Figurine 36 has a high lime content which is consistent with our identification of Gotland for the figurine's provenance. Magnification 40x.

substantial exchange in figurines across the Baltic Sea region suggests that there were sustained connections between different PWC groups. The results of our cluster analysis indicates that such connections may have existed on both the regional and local levels. Ties between elites, secret societies, or shamanic practitioners at different settlements could have been key to the formation and maintenance of a pan-regional system of alliances, similar to what is seen in many other low-density transegalitarian hunter-gatherer groups around the world (Angelbeck and Grier, 2012; Sanger, 2017; Smith and Fauvelle, 2022). While individual PWC settlements were generally rather small, they could have utilized regional networks to organize collective action to meet any potential threats posed by external actors (e.g. Lund et al., 2022). Such regional collective organization could explain the long-term resilience of PWC society in the face of encroachment by agricultural groups such as the FBC and BAC. The maintenance of such political and economic networks would also have been facilitated by the fact that most PWC settlements were located on the sea and would have been connected through maritime routes as evidenced by the cross-Baltic trade ties discussed in this paper.

Long-distance maritime exchange, seaborne raiding, secret societies, and dispersed populations participating in regional alliance networks are all characteristics that may have been shared between the PWC and the later maritime societies of the Late Neolithic and the Nordic Bronze Age (Horn et al., 2024). While the fisher-foragers of the PWC were absorbed by agricultural groups at the end of the Neolithic, it is therefore likely that many of their traditions lived on in the subsequent maritime cultures that developed in the Baltic Sea region. Indeed, it would have been strange if the mariners of the Nordic Bronze Age did not derive at least some inspiration from what had been one of the region's longest lasting and most resilient maritime societies. Far from representing an evolutionary dead end, the fisher-foragers of the PWC may thus have directly influenced the formation of Scandinavian Bronze Age society. The maritime exchanges of the PWC can therefore be seen as the first manifestation of the seafaring societies that would come to characterize Scandinavia for much of its history.

## 5. Conclusion

Our analysis of the ceramics from Tråsättra has shown that the ancient inhabitants of the site traded with other PWC groups across the Baltic Sea region during the Middle Neolithic. Around a quarter of the figurine samples from Tråsättra were made with non-local clays, indicating a substantial degree of out-group exchange. Non-local figurines at Tråsättra were imported from locations on the Åland archipelago, the island of Gotland, and coastal regions of Östergötland and Södermanland. Figurines identified as being made with local clays also showed considerable chemical clustering, likely indicating that they were made from multiple nearby sources and possibly indicating trade with adjacent groups. Together, the economic exchange network that Tråsättra was a part of covered an area over 400 km wide. This area includes substantial stretches of open water and trade with Åland and Gotland would have required long-distance maritime trips. Our complementary study of ceramics from the Early Neolithic site of Lappdal also identified non-local imports from Åland, suggesting that long-distance trade in ceramics across the Baltic Sea was a practice with considerable time depth among Neolithic Scandinavian fisher-foragers.

The exchange of ceramics at Tråsättra was highly patterned, with a focus on the trade of anthropomorphic figurines. While almost all imported figurines were anthropomorphic, no zoomorphic figurines were shown to be made with non-local clays. Furthermore, all analysed potsherds were made with local clays. These results indicate that the trade of ceramics at Tråsättra was focused on non-utilitarian items and was guided by a clear internal logic. We have suggested that this pattern could be explained either by a ritual economy focused on acquiring goods for shamanic practice or by a prestige exchange network driven by the desire of seafaring traders to expand their fame and social standing

through the acquisition of exotic goods and knowledge. Other possibilities that could explain the presence of non-local figurines at Tråsättra include their capture during raiding or mobility connected to out-group marriage practices. Anthropological and archaeological case studies exist for all of these possibilities and can provide comparative material with which to build testable hypotheses for future research.

The fact that the people of Tråsättra were engaged in long-distance maritime exchange provides further evidence of the considerable economic complexity of the PWC. Once described as the “strange people” of the Middle Neolithic (Larsson, 2006), recent research including the results presented here has shown that the PWC were sedentary or semi-sedentary fisher-foragers who participated in high levels of violence and travelled long distances across the Baltic Sea (Ahlström and Price, 2021; Artursson et al., 2023; Boethius et al., 2024; Fauvelle et al., 2024a; Horn, 2021; Horn and Schultrich, 2025; Iversen, 2016; Iversen et al., 2021; Price et al., 2021). These characteristics make the PWC comparable to many other complex hunter-gatherers from maritime regions around the world (Ames, 1994; Arnold et al., 2016; Sampson, 2023). Evidence of long-distance exchange such as those presented here show that PWC fisher-foragers did not only take to the ocean for subsistence activities such as fishing and seal hunting but also engaged in maritime trade similar to that of the seafaring cultures that inhabited the area during later periods. We hope that future research will continue to shed light on the contributions of Europe's neolithic hunters and gatherers to the unique history of the Baltic Sea Region.

## CRedit authorship contribution statement

**Mikael Fauvelle:** Writing – review & editing, Writing – original draft, Visualization, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Torbjörn Brorsson:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Magnus Artursson:** Writing – review & editing, Methodology, Investigation, Formal analysis, Conceptualization. **Niclas Björck:** Writing – review & editing, Methodology, Investigation, Formal analysis, Conceptualization. **Christian Horn:** Writing – review & editing, Visualization, Funding acquisition, Conceptualization.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Acknowledgements

Funding for this research was provided by a grant from Riksbankens Jubileumsfond to the Maritime Encounters project (M21-0018). We are grateful to two anonymous reviewers for their helpful comments and suggestions for improving the manuscript.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jasrep.2025.105342>.

## Data availability

Data can be found in [supplemental table](#).

## References

- Ahlström, T., Price, T.D., 2021. Mobile or stationary? An analysis of strontium and carbon isotopes from Västerbjers, Gotland Sweden. *J. Archaeol. Sci.: Reports* 36, 102902.



- Ames, K.M., 1994. The Northwest Coast: complex hunter-gatherers, ecology, and social evolution. *Ann. Rev. Anthropol.* 209–229.
- Arnold, D.E., Neff, H., Bishop, R.L., 1991. Compositional analysis and “sources” of pottery: an ethnoarchaeological approach. *Am. Anthropol.* 93 (1), 70–90.
- Andersson, H., 2016. *Gotländska stenåldersstudier: människor och djur, platser och landskap*. Stockholm University, Institutionen för arkeologi och antikens kultur. PhD Thesis.
- Angelbeck, B., Grier, C., 2012. Anarchism and the archaeology of anarchic societies. *Curr. Anthropol.* 53, 547–587.
- Arnold, J.E., 2012. Prestige trade in the santa barbara channel region. *Calif. Archaeol.* 4, 145–148.
- Arnold, J.E., 2001. The Origins of a Pacific Coast chiefdom: the Chumash of the Channel Islands. University of Utah Press, Salt Lake City.
- Arnold, J.E., 1995. Transportation innovation and social complexity among maritime hunter gatherer societies. *Am. Anthropol.* 97, 733–747.
- Arnold, J.E., Sunell, S., Nigra, B.T., Bishop, K.J., Jones, T., Bongers, J., 2016. Entrenched disbelief: complex hunter-gatherers and the case for inclusive cultural evolutionary thinking. *J. Archaeol. Method Theory* 23, 448–499.
- Artursson, M., Björck, N., Lindberg, K.-F., 2023. Seal hunters, fishermen and sea-voyagers: late middle neolithic (2600–2400 cal BC) maritime hunter-gatherers in the Baltic Sea Archipelago at Träsättra Sweden. *J. Neolithic Archaeol.* 89–147.
- Björck, N., 2021. Lappdal – Den långa historien kring Österåkers förstoneolitiska boplatser. (No. 44). *Arkeologerna: Statens historiska museer*.
- Björck, N., Artursson, M., Lindberg, K.F., 2020. Träsättra – aspekter på säljägarnas vardag och symbolism (No. 2019:40). *Arkeologerna rapport*. Arkeologerna, Uppsala.
- Boethius, A., Storå, J., Gustavsson, R., Kielman-Schmitt, M., 2024. Mobility among the stone age island foragers of Jettböle, Åland, investigated through high-resolution strontium isotope ratio analysis. *Quat. Sci. Rev.* 328, 108548.
- Brorsson, T., Blank, M., Fridén, I.B., 2018. Mobility and exchange in the Middle Neolithic: provenance studies of Pitted Ware and Funnel Beaker pottery from Jutland, Denmark and the west coast of Sweden. *J. Archaeol. Sci. Rep.* 20, 662–674. <https://doi.org/10.1016/j.jasrep.2018.06.004>.
- Brorsson, T., Jucenius, J., Stenbäck, N., 2019. Thin section and ICP analysis of Neolithic pottery from the Åland Islands. In: Mannerman, K., Manninen, M.A., Personen, P., Seppänen, L. (Eds.), *Helsinki Harvest. Proceedings of the 11th Nordic Conference on the Application of Scientific Methods in Archaeology*. Archaeological Society of Finland, Helsinki, pp. 48–71.
- Chacon, R., Dye, D., Hayden, B., Ling, J., Chacon, Y., 2025. The origins of secret societies and their contribution to the rise of social complexity. *Presenting Counterpoints to the Dominant Terrestrial Narrative of European Prehistory*. Oxbow Books, Oxford.
- Clark, J.E., Blake, M., 1994. The Power of Prestige: Competitive Generosity and the Emergence of Rank Societies in Lowland Mesoamerica. In: Brumfiel, E.M., Fox, J.W. (Eds.), *Factional Competition and Political Development in the New World*. Cambridge University Press, Cambridge, pp. 17–30.
- Coutinho, A., Günther, T., Munters, A.R., Svensson, E.M., Götherström, A., Storå, J., Malmström, H., Jakobsson, M., 2020. The Neolithic Pitted Ware culture foragers were culturally but not genetically influenced by the Battle Axe culture herders. *Am. J. Phys. Anthropol.* 172, 638–649. <https://doi.org/10.1002/ajpa.24079>.
- Eriksson, N., Brorsson, T., Daly, A., Hansson, J., Isaksson, S., 2024. The Maderö Wreck: A Ship Loaded with Bricks from Lübeck Sunk in the Stockholm Archipelago in the Late 15th Century. *Int. J. Nautical Archaeol.* 53, 348–366. <https://doi.org/10.1080/10572414.2023.2295452>.
- Fauvelle, M., 2011. Mobile mounds: asymmetrical exchange and the role of the toml in the development of chumash complexity. *Calif. Archaeol.* 3, 141–158.
- Fauvelle, M., Horn, C., Alvå, J., Artursson, M., 2024a. Skin boats in Scandinavia? Evaluating the maritime technologies of the neolithic pitted ware culture. *J. Marit. Archaeol.* <https://doi.org/10.1007/s11457-024-09408-4>.
- Fauvelle, M., Ling, J., 2025. Larger Boats, longer Voyages, and Powerful Leaders: Comparing Maritime Modes of production in Scandinavia and California. In: Cunliffe, B., Fauvelle, M., Kock, J., Ling, J. (Eds.), *Maritime Encounters I: Presenting Counterpoints to the Dominate Terrestrial Narrative of European Prehistory*. Oxbow Books.
- Fauvelle, M., Perry, J., 2023. Fisher-Hunter-Gatherer Complexity on California’s Channel Islands: Feasting, Ceremonialism, and the Ritual Economy. In: Sampson, C.P. (Ed.), *Fisher-Hunter-Gatherer Complexity in North America*. University Press of Florida, Gainesville, pp. 194–224.
- Fauvelle, M., Shiro, S., Peter, J., 2024b. Maritime technologies and coastal identities: seafaring and social complexity in indigenous California and Hokkaido. *Indigenous Studies and Cultural Diversity* 1, 30–52. <https://doi.org/10.57519/iscd.00008>.
- Fauvelle, M., Somerville, A., 2024. Diet, status, and incipient social inequality: stable isotope data from three complex fisher-hunter-gatherer sites in Southern California. *J. Anthropol. Archaeol.* 73, 101554. <https://doi.org/10.1016/j.jaa.2023.101554>.
- García-Piquer, A., Navarrete, V., Aguilera, N., Carracedo, R., Franch, A., P., C.G., Ros-Sabé, E., Zegers, G., Prieto, A., Piqué, R., 2022. En el mar interior de Última Esperanza: Dinámicas de ocupación y movilidad canoera en la isla Diego Portales (Magallanes, Chile). *Latin American Antiquity* 33, 838–856. [10.1017/laq.2021.85](https://doi.org/10.1017/laq.2021.85).
- Glascok, M.D., 1992. Characterization of archaeological ceramics at MURR by neutron activation analysis and multivariate statistics. In: El-Kady, Y.M. (Ed.), *Chemical Characterization of Ceramic Pastes in Archaeology*. Prehistory Press, pp. 11–26.
- Graeber, D., Wengrow, D., 2021. *The dawn of everything: a new history of humanity*. Penguin UK.
- Hayden, B., 2018. The power of ritual in prehistory: secret societies and origins of social complexity. Cambridge University Press.
- Hayden, B., 1994. Competition, labor, and complex hunter-gatherers. *Key Issues in Hunter-Gatherer Research* 56, 155–161.
- Helms, M.W., 1993. *Craft and the kingly ideal: art, trade, and power*. University of Texas Press, Austin.
- Helms, M.W., 1979. *Ancient Panama: Chiefs in Search of Power*. University of Texas Press, Austin.
- Horn, C., 2021. Trouble in paradise? Violent conflict in funnel-beaker societies. *Oxford J. Archaeol.* 40, 43–64. <https://doi.org/10.1111/ojoa.12212>.
- Horn, C., Austvoll, K.I., Artursson, M., Ling, J., 2024. Nordic Bronze Age Economies. Cambridge University Press, Cambridge.
- Horn, C., Schultrich, S., 2025. A millennium of war: Violent encounters during the 4th and 3rd millennia BC in the Western Baltic Sea. In: Koch, J., Fauvelle, M., Cunliffe, B., Johan, L. (Eds.), *Presenting Counterpoints to the Dominate Terrestrial Narrative of European Prehistory*. Maritime Encounters.
- Iversen, R., 2016. Arrowheads as indicators of interpersonal violence and group identity among the Neolithic Pitted Ware hunters of southwestern Scandinavia. *J. Anthropol. Archaeol.* 44, 69–86.
- Iversen, R., Becker, V., Bristow, R., 2024. Figurative Representations in the north European Neolithic—are they there? *Camb. Archaeol. J.* 34, 601–619.
- Iversen, R., Philippsen, B., Persson, P., 2021. Reconsidering the Pitted Ware chronology: a temporal fixation of the Scandinavian Neolithic hunters, fishers and gatherers. *Præhistorische Zeitschrift* 96, 44–88. <https://doi.org/10.1515/pz-2020-0033>.
- Janzon, G.O., 1974. *Gotlands mellanneolitiska gravar* (PhD Thesis). Almqvist & Wiksell.
- Kidder, T.R., 2023. Envisioning Variations in Complexity among complex Hunter-Gatherers. In: Sampson, C.P. (Ed.), *Fisher-Hunter-Gatherer Complexity in North America*. University Press of Florida, Gainesville, pp. 225–244.
- Klassen, L., 2020. The Pitted Ware Culture on Djursland: Supra-regional significance and contacts in the Middle Neolithic of southern Scandinavia. Aarhus Universitetsforlag.
- Krooks, B., Boethius, A., 2024. Freshwater exploitation at Ajvide - pitted ware culture fishing practises investigated through laser ablation facilitated strontium isotope analyses. *Quat. Sci. Rev.* 344, 108967. <https://doi.org/10.1016/j.quascirev.2024.108967>.
- Larsson, M., 2006. A tale of a strange people: The Pitted Ware Culture in southern Sweden. *Humanvetenskapliga institutionen*.
- Lesure, R.G., Blake, M., 2002. Interpretive challenges in the study of early complexity: economy, ritual, and architecture at Paso de la Amada, Mexico. *J. Anthropol. Archaeol.* 21, 1–24.
- Lindström, T., 2024. *Människor, djur och varelser i miniatyr: Flerartliga förbindelser i den gropkeramiska kulturen* (PhD Thesis). Stockholms Universitet, Institutionen för arkeologi och antikens kultur.
- Ling, J., Chacon, R.J., Chacon, Y., 2022. Bronze Age Long-Distance Exchange, Secret Societies, Rock Art, and the Supra Regional Interaction Hypothesis. *Bronze Age Long-Distance Exchange, Secret Societies, Rock Art, and the Supra Regional Interaction Hypothesis. Trade before Civilization: Long Distance Exchange and the Rise of Social Complexity* 53.
- Lund, J., Furholt, M., Austvoll, K.I., 2022. Reassessing power in the archaeological discourse. How collective, cooperative and affective perspectives may impact our understanding of social relations and organization in prehistory. *Archaeol. Dialogues* 29, 33–50. <https://doi.org/10.1017/S1380203822000162>.
- Malinowski, B., 1922. Argonauts of the western Pacific: An account of native enterprise and adventure in the archipelagoes of Melanesian New Guinea. Routledge.
- Malmström, H., Gilbert, M.T.P., Thomas, M.G., Brandström, M., Storå, J., Molnar, P., Andersen, P.K., Bendixen, C., Holmlund, G., Götherström, A., 2009. Ancient DNA reveals lack of continuity between neolithic hunter-gatherers and contemporary Scandinavians. *Curr. Biol.* 19, 1758–1762.
- Martinsson-Wallin, H., 2008. Land and sea animal remains from Middle Neolithic pitted ware sites on Gotland Island in the Baltic Sea, Sweden. *Isl. Inq. Colon. Seafar. Archaeol. Marit. Landsc.* 29, 171.
- Mittnik, A., Wang, C.-C., Pfengle, S., Daubaras, M., Zariņa, G., Hallgren, F., Allmæ, R., Khartanovich, V., Moiseyev, V., Törv, M., 2018. The genetic prehistory of the Baltic Sea region. *Nat. Commun.* 9, 442.
- Munn, N.D., 1992. The fame of Gawa: A symbolic study of value transformation in a Massim (Papua New Guinea) society. Duke University Press.
- Neff, H., 2000. Neutron activation analysis for provenance determination in archaeology. In: Renfrew, C., Bahn, P. (Eds.), *Archaeology: the Key Concepts*. Routledge, pp. 125–131.
- Palka, J.W., 2023. Mesoamerican warfare, protecting divinities, and fortified sanctuaries. *J. Anthropol. Res.* 79 (1), 51–101.
- Price, T.D., Klassen, L., Sjögren, K.-G., 2021. Pitted ware culture: Isotopic evidence for contact between Sweden and Denmark across the Kattegat in the Middle Neolithic, ca. 3000 BC. *J. Anthropol. Archaeol.* 61, 101254.
- Sampson, C.P., 2023. *Fisher-Hunter-Gatherer Complexity in North America*. University Press of Florida, Gainesville.
- Sanger, M.C., 2017. Anarchic theory and the study of hunter-gatherers. *The SAA Archaeological Record* 17, 39–44.
- Skoglund, P., Malmström, H., Raghavan, M., Storå, J., Hall, P., Willerslev, E., Gilbert, M.T.P., Götherström, A., Jakobsson, M., 2012. Origins and genetic legacy of neolithic farmers and hunter-gatherers in Europe. *Science* 336, 466–469. <https://doi.org/10.1126/science.1216304>.
- Smith, E.M., Fauvelle, M., 2022. Beyond the Periphery: Comparing Complexities in Southern California. In: Boswell, A., Knabb, K. (Eds.), *Life at the Margins of the State: Comparative Landscapes from the Old and New Worlds*. University Press of Colorado, pp. 140–162.
- Speakman, R.J., Neff, H., 2005. The application of laser ablation-ICP-MS to the study of archaeological materials – An introduction. In: Speakman, R.J., Neff, H. (Eds.), *Laser Ablation-ICP-MS in Archaeological Research*. University of New Mexico Press, pp. 1–14.



- Spielmann, K.A., 2002. Feasting, Craft Specialization, and the Ritual Mode of Production in Small-Scale Societies. *Am. Anthropol.* 104, 195–207.
- Svizzero, S., 2015. Trade, immiserising growth and the long-term neolithisation process of the Pitted Ware Culture. *J. Anthropol. Archaeol.* 40, 332–339.
- Taffinder, J., 2000. The allure of the exotic: The social use of non-local raw materials during the Stone Age in Sweden.
- Thompson, M., Walsh, J.N., 1989. A Handbook of Inductively Coupled Plasma Spectrometry. Chapman & Hall, London.
- Wells, C.E., McAnany, P.A., 2008. Dimensions of Ritual Economy. Emerald Group Publishing Limited.
- Von Arbin, S., Skowronek, T., Daly, A., Brorsson, T., Isaksson, S., Seir, T., 2022. Tracing Trade Routes: Examining the Cargo of the 15th-Century Skaftö Wreck. *Int. J. Nautical Archaeol.* 51, 112–144. <https://doi.org/10.1080/10572414.2022.2076518>.
- Wells, E.C., 2006. Recent trends in theorizing prehispanic Mesoamerican economies. *J. Archaeol. Res.* 14, 265–312.