Amongst Seals, Cattle, and Boars

- A Comparative Study of the Faunal Assemblages and Subsistence Strategies of the Scandinavian Pitted Ware Culture -

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Abstract

This study utilises Correspondence Analysis to investigate the subsistence strategies of Scandinavia's Middle Neolithic Culture of the Pitted Ware Culture (PWC). The aim is to understand subsistence strategies' regional and local expressions across larger geographic areas. The studied material is derived from PWC settlements in Gotland, Åland, Central-Eastern Sweden, and South Scandinavia.

The results confirmed previous findings that the Danish PWC settlements relied more on cattle than the Central-Eastern Swedish and the Baltic Sea Island sites. However, the latter two shared more similarities with minor regional differences. These findings suggest that local cultural identity and plausible hybridisation with contemporary farming groups occurred in regional areas within South Scandinavia.

This study highlights the importance of contextualising subsistence strategies within the cultural and geographic context of the Middle Neolithic period. Furthermore, the findings provide new insight into the local cultural aspects of the PWC in Scandinavia and offer valuable insights for future research.

Keywords: Osteology, Animal Osteology, Middle Neolithic, Pitted Ware Culture, Subsistence Strategies.

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1. Introduction

The Middle Neolithic was an exciting period where multiple material cultures and subsistence strategies like husbandry and foraging coexisted. The PWC is interpreted as hunter-gatherers amongst the farming communities of the Funnel Beaker Culture (FBC) and the later Battle Axe Culture (BAC) (Larsson, 2006, p. 15). Ancient DNA studies indicate that these three groups were genetically separated from each other (Coutinho et al., 2020, p. 646).

The PWC has often been defined by the material culture and by the maritime-oriented subsistence strategy (Larsson, 2006, p. 15). One intriguing aspect of the PWC subsistence strategies is the potential combination of Foraging and Neolithic strategies, resulting in a mixed economy. Numerous scientific studies have explored various aspects of subsistence strategies based on human and faunal remains. The isotopic analysis of PWC remains indicates, in general, a predominantly maritime-oriented subsistence strategy (Eriksson, 2004; Eriksson & Lidén, 2008; Fornander, 2011a). In recent decades, multiple studies have investigated farming and cereal intake amongst the PWC. For example, lipid analysis conducted by Dimick (2011) on ceramic sherds from the Korsnäs PWC sites indicates the presence of vegetables in their diet. Archaeobotanical remains have been studied by Vanhanen et al. (2019), and the presence of free-threshing barley, hulled and free-threshing wheat have been found on sites in Åland, Åby, and Tråsättra. Then there are interesting results from Kainsbakke and Kirial Bro, Denmark, where faunal remains are dominated by cattle bones (Makarewicz & Pleuger, 2020).

These studies indicate that the cultural concept of PWC is diverse and complex and is not solely categorised by archaeological material culture or DNA. The question is whether the PWC culture exhibited different regional cultural spheres. One possibility suggested by Iversen (2010, p. 27) is the potential creolisation between PWC and FBC in Zealand in Denmark. The question is whether or not the PWC cultures distinguish themselves in different regional culture spheres. One possible indication of cultural variation is based on diet and subsistence strategies, which also indicates adaptability to the environment and local resources among the PWC. The field of subsistence strategies of the PWC has been studied in multiple constellations, so why would it be interesting to perform a similar study? The difference lies in using Correspondence Analysis over a large amount of data covering vast geographic areas and multiple settlements.

This thesis serves as an initial investigation to analyse regional attributes and examine extensive data using correspondence analysis. In addition, it acts as a pilot study to evaluate the feasibility of broader regional comparative studies on faunal assemblages.

1.1. Aims and Research Questions

The primary research aim of this thesis is to conduct a comparative analysis of faunal assemblages from multiple PWC settlements and contexts. The collected data will be analysed using Correspondence Analysis to identify and assess differences in subsistence strategies. The investigative aim is to analyse the extent to which PWC groups had distinctive or uniform subsistence strategies, which could reflect local cultural variations within the broader PWC community.

This research focuses on the faunal assemblages of mammals, birds, and fish, with a particular emphasis on mammals. The presence of terrestrial, maritime, and domesticated mammals will be examined across different regions. Domesticated animals are of particular interest as they may indicate the practice of husbandry as a local subsistence strategy and, by extension, indicate local cultural distinctions within the PWC.

This study's selected settlement and contexts encompass larger geographic areas where PWC finds have been unearthed. These areas are divided between the regions of Scandinavia: South Scandinavia, Central-Eastern Sweden, and the Baltic Sea Islands of Åland and Gotland.

1.1.1. Research Questions

1. Are there apparent differences and similarities in the faunal assemblage on PWC settlement areas in larger geographic areas such as South Scandinavian sites compared with the Central-Eastern Swedish and the Baltic Sea Islands sites? Do differences occur within different regions as well?
2. If there are differences, could it indicate a cultural variation within the generalised PWC, or could it be explained by other factors such as environmental adaptation or trade?

2. Background

2.1. Research History

Table 1: Periods of the Neolithic. Source: Fornander, 2011a, p. 18.

Period	Abbreviation	Approximate date
Early Neolithic	**EN**	**4000–3300 BCE**
Early Neolithic I	*EN I*	*4000–3650 BCE*
Early Neolithic II	*EN II*	*3650–3300 BCE*
Middle Neolithic	**MN**	**3300–2300 BCE**
Middle Neolithic A	*MN A*	*3300–2800/2700 BCE*
Middle Neolithic B	*MN B*	*2800/2700–2300 BCE*
Late Neolithic	**LN**	**2300–1800 BCE**

The Middle Neolithic, approximately 3300-2300 BCE, are the main period of interest within the scope of this thesis. The Middle Neolithic is divided into two phases, MN A and MN B, see Table 1 (Fornander, 2011a, p. 18). The Funnel Beaker Culture (FBC) expanded its territorial expansion in Scandinavia during the EN. The FBC reached its peak during the transition stage between EN and MN A, and the regression of FBC occurred during MN A (Malmer, 2002, p. 45). The economy of the FBC is described as farming intermixed with wild game hunting and fishing (Malmer, 2002, p. 25). The PWC emerged in Central-Eastern Sweden during the end of the EN, and the PWC expanded to West- and South Scandinavia shortly after. The PWC are present in archaeological material throughout the whole phase of the Middle Neolithic, both during MN A and MN B (Fornander, 2011a, p. 19). Battle Axe Culture (BAC) appeared in central and southern Swedish archaeological material culture around 2800 BCE during the MN B. BAC is the regional variation of the northern and eastern European Corded Ware Culture (CWC). The Danish parallel group to the BAC is the Single Grave Culture (SGC) (Fornander, 2011a, p. 21).

2.1.1. Who or what is the Pitted Ware Culture?

The PWC is traditionally identified and characterised by the pottery decoration with pits, tanged arrowheads, and cylindrical cores (Fornander, 2011a, p. 19). Another defining attribute of the PWC culture is their foraging strategy of hunting and gathering (Larsson, 2006, p. 15). The latter interpretation is based on the evident coastal focus amongst the PWC and the abundance of seal bones (Fornander, 2011a, p. 20). The PWC has also been suggested to practice pig husbandry, especially in Gotland (Österholm, 1989, p. 28: Welinder, 1973, p. 54). Other older economic interpretations of the emergence of the PWC have been explained by the degeneration of the farming economy of the FBC and the forced return to the Mesolithic lifestyle (Welinder, 1973, p. 58). Other theories state that the PWC were a homogeneous group of eastern hunter-gatherers (Larsson, 2006, p. 15).

DNA have indicated genetic differences between FBC, BAC, and PWC groups (Coutinho et al., 2020, p. 646) and supports the idea of a homogenous PWC group. The genetic origin of the PWC has been traced to the earlier Mesolithic hunter-gatherer societies predating 5000 BCE (Coutinho et al., 2020, p. 639; Malmström et al., 2009, p. 1759; Mittnik et al., 2018, p. 2). One important aspect regarding the genetic similarities between the Mesolithic hunter-gatherers and the PWC foragers is that the resulting similarities do not make them the same people with similar cultural or social identities (Coutinho et al., 2020, p. 645; Malmström et al., 2019, p. 3). One significant difference between the FBC and the PWC was reduced genetic diversity among the PWC (Malmström et al., 2015, p. 8; Skoglund et al., 2014, p. 1). Skoglund et al. (2014, p. 1-2) proposed that the low genetic diversity could be because the foragers tend to live in communities with few inhabitants; they were restricted by fluctuating living conditions or by the carrying capacity. Another factor is that the PWC was partially incorporated into expanding farming groups, which is partly supported by indications of low-level admixture between FBC and PWC groups (Coutinho et al., 2020, p. 639; Malmström et al., 2019, p. 3; Mittnik et al. 2018, p. 8). A sampling of FBC individuals buried in Ansarve, Gotland, indicated limited western hunter-gatherer admixture rather than PWC or eastern hunter-gatherer. These results indicate on admixture amongst the FBC buried in Ansarve had admixture before settling in Gotland and had little contact with the local PWC (Fraser, 2018, p. 58: Fraser et al., 2018, pp. 330-331). Interestingly, FBC individuals from Gökhem, Gotland, had a significant admixture of PWC-related hunter-gatherer genes. The question is if the genetic data were from local PWC groups on the mainland because the arrival of PWC on Gotland was later than Central-Eastern Sweden, which could indicate genetic intermixing between FBC and PWC on the mainland before the FBC arrival to Gotland (Fraser, 2018, p. 59).

2.2. Diet through Faunal Assemblages, Isotopic-, and Lipid-Analysis

2.2.1. The Baltic Region

Jan Storå (2001) performed a substantial study about faunal remains in the Baltic area, which involved assemblages from 24 Stone Age sites dated between 3300-1800 cal. BCE. The general conclusion is that the PWC subsistence strategies heavily relied on seals. Especially the harp seal (*Pagophilus groenlandicus*), followed by the ringed seal (*Pusa hispida*) (Storå, 2001, p. 3; 53). The reliance on the seal is apparent in the Ålandic faunal assemblage (Storå, 2002, p. 57). Another important source of protein and substitute for seasonal seal hunting was fish. Studies of soil samples in Ajvide on Gotland and Jettböle on Åland indicate fishing during all seasons (Olson & Walther, 2007, p. 183). Fowling has also been practised at the site of Jettböle I. The majority of the 724 identified specimens to species were migratory birds, such as eider (*Somateria mollissima*), and other water birds of the *Anatidae* family were most prominent. The fowling was seasonally based, with intense hunting periods from early spring to early autumn. This further enhances the ability to support a year-round-based subsistence strategy (Mannermaa, 2002, pp. 88–94).

Over the years, a multitude of isotopic analyses have been conducted on human remains from PWC graves and settlements in the Baltic area. Eriksson (2004, p. 158) conducted $\delta^{13}C$- and $\delta^{15}N$-isotope sampling on remains from Västerbjers, Gotland, and the results indicate a predominant maritime protein intake from seals and fish. Howcroft et al. (2014, p. 45) conducted similar studies on human remains with similar results at the site of Ajvide, Gotland. Further studies on the Gotlandic sites of Ire, Västerbjers, Visby and Västerby indicate a heavy maritime diet amongst the PWC individuals. This is also evident from Köpingsvik on Öland and Korsnäs from the Central-Eastern Swedish mainland site. The seals are supported to be the dominant source of protein in the sampled materials (Eriksson & Lidén, 2013, p. 295). The locations of Västerbjers and Korsnäs had a rich amount of pig/boar, and Eriksson & Lidén (2013, p. 295) and Fornander (2011a, p. 76-77) argued that the pig/boar were more likely connected to ritual feasting rather than a staple nutritional intake. In the case of Västerbjers, this conclusion has been opposed by Ahlström and Price (2021). The main issue was previously studied in the sampling of bone collagen, which only generates data from dietary proteins and not the entire scope of the diet. The faunal assemblage of Västerbjers is dominated by pig/boar bones at 72,6% compared with seal bones at 10,9%. To find the whole spectrum of macronutrients like carbohydrates, fats, and protein, tooth enamel was sampled (Ahlström et al., 2021, pp. 1-2). The latter analysis revealed that 43% of the protein was derived from terrestrial sources, whereas 58% originated from maritime sources. Furthermore, it was found that 77% of carbohydrates and fat originated from terrestrial C3 sources. These outcomes indicate that the dominance of maritime protein intake among individuals from Västerbjers was not as significant as indicated in previous research (Ahlström & Price. 2021, p. 6–8).

2.2.2. Central-Eastern Sweden

Seals, especially harp seals, dominate the faunal assemblage of Korsnäs. The hunting strategy of the site combined sealing with fishing and wild boar hunting. In earlier studies, there were no traces of agriculture through pollen analysis (Fornander et al., 2008, pp. 283-284). This was further extended through δ^{13}C- and δ^{15}N-isotope values based on human remains. The diet was predominantly maritime (Fornander et al., 2008, pp. 287-289). Lipid residue analysis on ceramics indicates different spatial food storage in the settlement area of Korsnäs. The residue analysis found traces of vegetables and showed that the ceramics were not only used for storing maritime and terrestrial animals (Dimick, 2011, pp. 35-36). Similar evidence has been uncovered at the site of Tråsättra, where pottery was used for lipid analysis. They discovered the lipid derived from maritime and terrestrial mammals, fish, and vegetables (Björck et al., 2019, p. 13). Further faunal studies indicate fowling was practised at Tråsättra, but the dominant faunal remains were seals and ringed seals, followed by fish (Björck et al., 2019, pp. 18-19).

2.2.3. Djursland, Denmark

The faunal assemblage from the site of Kainsbakke showed a large abundance of *Bos spp.*, comprising 52% of the NISP (Number of Identified Specimens). The *Bos spp* category includes both domesticated cattle (*Bos taurus*) and wild aurochs (*Bos primigenius*). The abundance of cattle suggests interaction with contemporaneous FBC and SGC communities in Djursland and Jutland (Makarewicz & Pleuger, 2020, pp. 285-286). The bones categorised as *Bos spp.* were further analysed using the Logarithmic Size Index (LSI), which assesses the size of large and small-bodied animals. LSI was used to determine the presence of domesticated cattle and aurochs in the faunal assemblage. The majority of the bones exhibited lower LSI values than female aurochs, indicating that they belonged to domesticated cattle. However, male cattle, which have a similar size to female aurochs, could be either cattle or aurochs. The large-bodied animals were most likely aurochs (Makarewicz & Pleuger, 2020, pp. 285-286). Similarly, at the Kirial Bro settlement, cattle dominated the faunal assemblage, representing 40% of the NISP identified at the genus level. The cattle at this site also exhibited low LSI values, suggesting they were domesticated cattle rather than aurochs (Makarewicz & Pleuger, 2020, p. 317).

Kainsbakke and Kirial Bro's faunal assemblages yielded a vast number of fish bones. The fishing strategies of Kainsbakke and Kirial Bro were based predominantly on a near-shore environment based on a large number of specimens from the *Pleuronectidae* family and the greater weever (*Trachinus draco).* The greater weever represents 50% of fish identified at Kainsbakke (Pleuger & Makarewicz, 2020, pp. 345-346) and 88% of the identified fish assembly in Kirial Bro (Pleuger & Makarewicz, 2020, p. 348). In the Ginnerup faunal assemblages from 2020 years, excavation is the greater weever also the most abundant fish species (Klassen et al., 2023, pp. 50-51).

In the pit A47 at the Kainsbakke site, a small number of human remains were discovered, most likely bones from two individuals (Wincentz, 2020, p. 51). DNA analyses were conducted on one maxilla, revealing that the individual was a biological female (Allentoft, 2020, pp. 447-449). The female remains were further sampled for Strontium isotope (Sr-isotope) analysis. The Sr-isotope values indicated on a mixed diet consisting of both terrestrial and marine food (Price et al., 2021, p. 5). The ^{14}C-datings of the human remains provided a time range of 3100-2920 cal. BCE (Klassen et al., 2020b, p. 429). Additionally, the haplogroups identified in the female genome showed similarities to those found in individuals with FBC heritage rather than PWC heritage (Klassen et al., 2020b, p. 465).

2.3. Farming and the PWC

Agriculture arose in the Near East in approximately 8000 BCE, gradually spreading across Europe until it reached the south of Scandinavia around 4000 BCE. The continued expansion of farming took another 1000 years before reaching the Scandinavia peninsula (Malmer, 2002, p. 15). Agriculture, cattle rearing, and cereal cultivation were introduced in Scandinavia during the early Neolithic by the FBC. This happened around 3300 cal. BCE and farming spread through present-day Denmark to western and central Sweden. The culture of

FBC-erected megaliths continued to spread to Central-Eastern Sweden. The early pottery amongst the PWC resembled those of the FBC, although the pottery was introduced in Scandinavia in the late Mesolithic by the hunter-gatherer group of Ertebølle (Mittnik et al., 2018, p. 2).

Finds of carbonised cereals from barley, wheat, and glume, where found in the Danish PWC sites of Kainbakke and Kirial Bro. There is also a possible indication of local cultivation based on isotope analysis performed on cattle teeth from Kainsbakke. The animals seem to have been fed cereal stubble during the autumn (Andreasen, 2020, p. 383). Vanhanen et al. (2019, p. 8) ascribe cereals to local cultivation, which is evident based on the preference for barley, a more suitable crop for colder environments. Furthermore, the study discusses the possibility that cereals are essential to ritual behaviour like feasting. The main diet is still maritime based on lipid and faunal remains analysis (Vanhanen et al., 2019, p. 8). The archaeobotanical research is still in progress, and in the site of Ginnerup, Denmark, there are abundant finds of cereals in the youngest layers of the feature A4 during the excavation of 2020. The archaeobotanical study is ongoing, and future data will generate interesting results that may change the view of cereal cultivation amongst the PWC (Klassen et al., 2023, p. 57). Vanhanen et al. (2019, p. 8-9) conclude that the PWC did some part-time cereal cultivation, but they were nonetheless not farmers.

2.4 Rituals and Faunal Remains.

2.4.1 Pits & Ritual Deposition Kainsbakke and Ginnerup, Denmark

At the Kainsbakke site, archaeologists uncovered several smaller pits that were identified as ordinary settlement pits containing waste products. However, pit A64 stood out as potentially having ritualistic importance due to its stratigraphic layers and the larger assemblage of flint, pottery, and animal bones (Wincentz, 2020, p. 44). The most prominent feature of Kainsbakke was pit A47, which exhibited clearly defined stratigraphic layers. Pit A47 was constructed during the FBC phase of the Early Neolithic, although traces from the FBC were limited to a few objects. The most prominent PWC refuse material was found in Layers 1 and 3, which remained undisturbed and were dated between approximately 3050-2800 BCE. Further evidence suggests that layers 1 and 3 were deposited within a relatively short period of time (Wincentz, 2020, p. 110). According to the ^{14}C-datings of the pit, A47 took the ritualistic deposition place around 2800 BCE (Klassen et al., 2020b, p. 407). However, the material dated within the pit comprised of the redeposition of FBC materials and older PWC materials (Philippsen et al., 2020, pp. 270-271). This could possibly be explained by the redeposition tool being placed when pit A47 were repurposed as a pit for ritualistic deposition (Klassen et al., 2020b, p. 407).

The faunal assemblage found in pit A47 included skeletal elements from the Brown bear (*Ursus arctos*), Eurasian elk (*Alces alces*), red deer (*Cervus elaphus*), pig/boars, cattle, and aurochs (Klassen et al., 2020b, pp. 407-408; Makarewicz & Pleuger, 2020, pp. 277-279). The distribution of bear elements, which comprised cranial elements and phalanges but lacked axial skeletal elements, suggests that bears were treated differently from herbivores and marine mammals in the same context. Sr-isotope analysis of the bears' dental enamel revealed that at least two brown bears had higher Sr-isotope value compared to the baseline of the Djursland peninsula (Makarewicz & Pleuger, 2020, pp. 303-305). Among the sampled animals, at least one red deer, four cattle, and three Eurasian elk were not from the Djursland area (Klassen et al., 2020b, p. 432). The Eurasian elk found in pit A47 likely originated from Central-Northern Halland to North-Western Scania, Sweden (Klassen et al., 2020b, p. 436 & 441; Makarewicz & Pleuger, 2020, pp. 299-300).

Similar evidence of consciously placed animal bones was found within a layer of pit A4 at the site of Ginnerup. The bones consisted of horse mandibles, pig, and roe deer (Capreolus capreolus) scapulae, suggesting deliberate placements. The pit also contained refuse from cooking and flint knapping activities. (Klassen et al., 2023, p. 42). The material found in pit A4 included a mixture of pottery from FBC and PWC, with some shards exhibiting characteristics from both cultures. This can be attributed to similar decorative elements between FBC style MN-A II and early PWC pottery. The depositions in pit A4 could indirectly reflect the transition stage between FBC and PWC culture on the site of Ginnerup. The pit has clearly defined layers, with layers 5-7 predominantly represented by PWC elements, which increase abundance in the upper layers. The lower layers contain a higher proportion of FBC material culture (Klassen, 2023, p. 45). The deposition in pit A4 is estimated to have occurred between 3150 cal. BCE to 2950 cal. BCE, during a 200-year-long period. The ^{14}C-dating is performed on faunal remains in 6 different contexts from 4 different layers. (Klassen et al., 2023, p. 47).

2.4.2 Animal and Food Culture

Feasting and communal food consumption could have been essential in the PWC communities. For example, the consumption of cereals would potentially have played a significant role during feasts and fostered bonding, integration, and potentially even competition among individuals and groups within the PWC community. Moreover, this competition may extend beyond PWC groups to include FBC groups. Other significant evidence of ritualistic feasts is the presence of pig bones in burials (Vanhanen et al., 2019, pp. 8–9).

For example, at the settlement of Ire in Gotland, grave 7 contained 19 pig mandibles (Ekman, 1974, p. 214; Janzon, 1974, p. 40; Vanhanen et al., p. 8), while grave 60 at Ajvide, Gotland, contained 30 pig mandibles (Burenhult, 2002, pp. 114-115). The concept of burying animal teeth, such as those from seals, dogs, and foxes, is a common trait in PWC burials, suggesting a common practice amongst the PWC (Sjöstrand, 2022, p. 306). The deposition of boar tusks in the graves of Västerbjers might indicate a potential connection to feasting rituals (Eriksson, 2004, p. 156). Further discussion of pigs contributes an essential role in the cosmology of the PWC. This is due to the number of tusks and pendants made of pig bones found in the settlement of Korsnäs, and the pigs are also believed to play an essential part in rituals and special feasts. Even sacrifices have been suggested (Fornander et al., 2008, pp. 293-294). Detailed studies of boar tusks in the Ajvide burial context have been studied by Lumbye (2012, p. 49), indicating a larger number of tusks buried with men and children than women. The pigs would potentially play a part in societal or individual displays, and it could also be a practice associated with ceremonial acts like funerals or marriages. This could also play a political role as a show of status or strength to establish dominance in a hierarchical society (Sjöstrand, 2022, p. 308). Hedgehogs have also been suggested to have had a ritualistic value amongst the PWC on Gotland based on their presence as burial gifts in four graves at Ajvide. In grave 2, five hedgehog mandibles were found on the chest region of a young woman called the hedgehog girl (Lindqvist, 1997, pp. 72-73). The hedgehogs (*Erinaceus europaeus*) have been suggested to be imported from mainland Sweden to Gotland by the PWC (Lindqvist, 1997, p. 72). This is further supported by DNA studies by Fraser et al. (2012, pp. 232-233), indicating that the hedgehog had a Western origin.

Clay figurines display both animals (zoomorphic) and humans (anthropomorphic) and play a part in the material culture of the PWC. These figurines have been documented in various locations, including Finland and the Baltic states (Larsson, 2009, p. 243). For example, in Åland, a collection of clay figurines has been discovered, consisting of both zoomorphic and anthropomorphic clay figurines (Storå, 2001, pp. 49-50). In addition, anthropomorphic figures have been unearthed in Tråsättra, Sweden, with an assemblage of at least 100 figures has been identified out of 321 figurine fragments (Björck et al., 2019, p. 15).

3. Material and Methods

3.1. Material

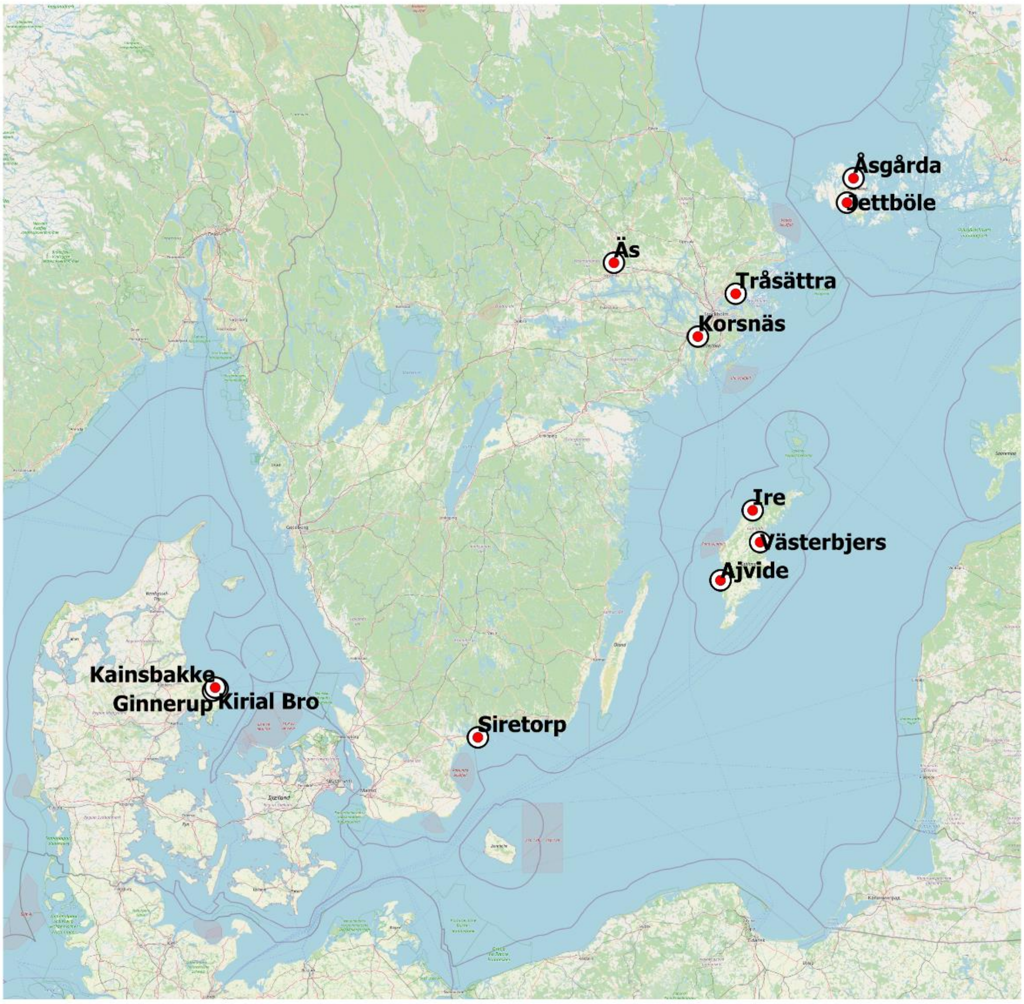


Figure 1: Distribution map of settlements and materials included in this study.

The study includes data from multiple faunal assemblages from various sites. The scope of this study covers an area from the East of the Baltic Sea Islands of Gotland and Åland to Central-Eastern Sweden to the West and Djursland in Denmark to the South, see Figure 1. For more details about the settlement areas, see Table 2 and Appendix 3. The faunal assemblage included in this thesis is presented in Table 3.

Table 2: Presentation of settlement, location, and source of the material used in this research.
**Settlement sites and materials without identified ^{14}C-dating.*
***Unknown Osteologist for excavation of 2020 of Ginnerup; source Klassen et al. 2023.*

Settlement Site	*Location*	*Geographic Area*	*Osteologist*	*Source materials*	*Approx. C-14-dating*
Ajvide "wide area"	Gotland, Sweden	The Baltic Sea Island	Alexander Sjöstrand	Sjöstrand, 2022, p. 92.	3100–2300 BCE
Ajvide Dark Area 1	Gotland, Sweden	The Baltic Sea Island	Alexander Sjöstrand	Sjöstrand, 2022, p. 123.	3000–2900 BCE
Ajvide Dark Area 2	Gotland, Sweden	The Baltic Sea Island	Alexander Sjöstrand	Sjöstrand, 2022, p. 146.	2600–2200 BCE
Åsgårda	Åland, Finland	The Baltic Sea Island	Jan Storå	Storå, 2002, p. 53. Storå, 2000, pp. 60–61.	2500–2000/1800 cal. BCE
Äs	Västmanland, Sweden	Central Eastern Sweden	Johannes Lepiksaar	Lepiksaar, 1974, pp. 141–142.	Unknown*
Ginnerup	Djursland, Denmark	South Scandinavia	Cheryl A. Makarewicz & Sarah Pleuger **Unknown	Makarewicz & Pleuger, 2020, p. 322. Klassen et al, 2023, p. 50.	3100-2920 cal. BCE
Ire	Gotland, Sweden	The Baltic Sea Island	Jan Ekman	Ekman, 1974, p. 225.	Unknown*
Jettböle I	Åland, Finland	The Baltic Sea Island	Jan Storå (Mam.), Kristiina Mannermaa (Birds), Olson & Walter (Fish)	Storå, 2002, p. 53. Storå, 2000, pp. 60–61. Mannermaa, 2002, p. 92. Olson & Walther, 2007, p. 179.	3370-2840 cal. BCE
Jettböle II	Åland, Finland	The Baltic Sea Island	Jan Storå	Storå, 2002, p. 53. Storå, 2000, pp. 60–61.	2500-2000/1800 cal. BCE
Kainsbakke	Djursland, Denmark	South Scandinavia	Cheryl A. Makarewicz & Sarah Pleuger	Makarewicz & Pleuger, 2020, pp. 286–287; 307. Pleuger & Makarewicz, 2020, p. 350.	2910–2450 BCE
Kirial Bro	Djursland, Denmark	South Scandinavia	Cheryl A. Makarewicz & Sarah Pleuger	Makarewicz & Pleuger, 2020, pp. 318–319. Pleuger & Makarewicz, 2020, p. 351.	2910–2450 BCE
Korsnäs	Södermanland, Sweden	Central Eastern Sweden	Kim Aaris-Sørensen & Maria Olander	Aaris-Sørensen, 1978 pp. 6–9;13. Olander, 2009, p. 4.	3350–2640 cal. BCE
Siretorp	Blekinge, Sweden	South Scandinavia	Elias Dahr	Dahr, 1939, pp. 242–243.	Unknown*
Tråsättra	Uppland, Sweden	Central Eastern Sweden	Ola Magnell	Björck et al., 2019, p. 169.	2890–2290 BCE
Västerbjers	Gotland, Sweden	The Baltic Sea Island	Elias Dahr	Dahr, 1943, p. 107.	2900-2500 cal. BCE

Table 3: Showing all animal remains documented in the source material, including the total amount of identified and unidentified mammals, birds, and fish. The unidentified mammals (red-coloured numbers) are excluded from the analysis.

Settlement/Site	***Mam. Tot.***	***Mam. Un-id.***	***Mam. Id.***	***Birds Tot.***	***Birds Un-id.***	***Birds Id.***	***Fish Tot.***	***Fish Un-id.***	***Fish Id.***
Kainsbakke	**5916**	1741	4175	**476**	347	129	**10539**	0	10539
Kirial Bro	**838**	509	329	**0**	0	0	**2508**	0	2508
Ginnerup	**11344**	10495	849	**23**	23	0	**1692**	0	13059
Tråsättra	**1046**	0	1046	**21**	0	21	**606**	0	606
Ajvide Dark area 1	**2994**	0	2994	**66**	66	0	**10314**	10314	0
Ajvide Dark area 2	**3955**	0	3955	**81**	81	0	**7398**	7398	0
Ajvide wide area	**12171**	0	12171	**282**	282	0	**32450**	32450	0
Korsnäs	**9932**	8230	1702	**63**	28	35	**25729**	2015	23714
Jettböle I	**2814**	8	2806	**1235**	302	933	**13093**	9774	3319
Jettböle II	**741**	20	721	**0**	0	0	**0**	0	0
Åsgårda	**1239**	26	1213	**0**	0	0	**0**	0	0
Västerbjers	**1707**	0	1707	**20**	20	0	**11**	11	0
Ire	**1476**	0	1476	**23**	0	23	**6778**	0	6778
Siretorp	**1392**	0	1392	**37**	0	37	**7**	7	0
Äs	**1149**	0	1149	**113**	0	113	**10038**	0	10038
Total	**58714**	**21029**	**37685**	**2440**	**1149**	**1291**	**121163**	**61969**	**70561**

The osteological data was collected in Excel spreadsheets, then analysed and organised to answer the research questions. The main interest within this study is a comparison of mammals and the subsistence strategies of the PWC. The study will also include fish and birds when the data is available. Unclear categories in the data, such as *Large Ruminants* or *medium-sized mammals*, were determined to be excluded from the comparative studies. Only mammals identified as species or genus were included. Every specimen identified as fish and bird is included in this study because these categories are not as vital for this thesis's comparative studies to be known on the genus level. Birds are almost non-existent in the material, and fish are categorised as maritime resources no matter the species. These identified species/genera were excluded: amphibians, dogs (*Canis familiaris*) and rodents. The rodents and amphibians were excluded based on the risk of bio-turbulence. The dog was excluded because it could be both fur animals and domesticated mammals or a category of its own. This research was mainly aimed at subsistence strategies and wild fur game animals, so the decision was made to exclude domesticated dogs entirely.

3.2. Method

The data used for CA was collected from multiple publications, gathered, and processed in the Office Excel software, see Chapter 3.2. Materials for further information. The animal assemblage was divided into categories based on species, genus or domesticated, terrestrial wild game, fur game, etc. The essential factor for the species was that they were at least identified to genus level, apart from birds and fish. The categories of animals and geographic location were then compared with the help of Correspondence Analysis (CA). The results from the CA will then be presented as a graph and compared with compiled data presented in tables. Then analysed and discussed with scientific studies. These results may lead to a possible hypothesis about the visible relationships illuminated through the analysis.

3.2.1 Correspondence Analysis

Correspondence Analysis (CA) is a statistical methodology based on a data sequence. The CA analyses the relationship between two variables (Greenacre, 2010, p. 111; Lundin, 2005, p. 7). The methodology allows transferring data from rows and columns to points/dots on a graph. The graph, in turn, represents a geometrical interpretation of the position of the points based on similarities and differences in-between the rows and columns (Greenacre, 2010, p. 111). The graph is based on a horizontal line, the x-axis, and a vertical line, the y-axis. The variables are then illustrated in the coordinate system, and the inertia for each axis is presented (Greenacre, 2007, pp. 65-66).

The distance in the graphs represents connections and conditions for the different variables. The closer the variables are to each other, the stronger connections there are between these variables, and the opposite for longer distances between the variables (Lundin, 2005, p. 7). The inertia value indicates the variables' deviations and a large value when far from the average value and the opposite for a value closer to the average (Greenacre, 2007, p. 29). The inertia provides an essential estimation of the degree of homogeneity within the analysed material, and the closer to the centroid, the more homogeneous or randomly dispersed. The variables further from the centroid indicate heterogeneous patterns (Macheridis, 2016, p. 480). The data presented in the graphs are multi-dimensional and turned into a two-dimensional image, which constitutes some data loss. The CA minimises that loss and maximises the amount of information preserved (Greenacre, 2007, p. 41).

CA is a compromise between exploration and confirmation, and the change occurs during the repeated corrections and adaptations of the data material. This effect has one negative effect: the results generate a different objectivity than when the more formal methods are used, giving room for subjectivity. On the other hand, it is also necessary to have an open process for science to generate necessary qualitative and quantitative results (Lundin, 2005, p. 9). The CA cannot be used as conclusive evidence for the divergence between different sites and be complimented by additional information before any conclusions are made (Sjöstrand, 2022, p. 267).

The software used for CA in this research was the R-studio, version 2022.12.0+353, and the package called “ ca “.

3.3. Evaluation of Sources

3.3.1. Taphonomy

The excavations on the site of Ginnerup can illustrate one interesting case study of excavation bias, see Figure 2. The faunal assemblage predating the excavation of 2020 was analysed by Makarewicz and Pleuger (2020, p. 321) and not a single fish specimen was found. The overall osteological description of the faunal assemblage from Ginnerup pointed out the small number of bones (Makarewicz & Pleuger, 2020, p. 320). The recovery methodology is the likely scenario behind the earlier low numbers of bone elements and fish. However, the 2020 years of excavation did yield a substantial number of specimens. Of 1692 identified fish specimens, the non-diagnostic fish bones are not even counted or included in the data in Klassen et al. (2023, p. 49). The new verdict about the soil was its excellent bone preservation conditions. The excavation methodology included sieves and water, which unearthed large bone fragments and specimens (Klassen et al., 2023, p. 47). The other Danish sites of Kirial Bro and Kainsbakke also yielded a large number of fish NISP. In both settlements, the excavation involved water sieving (Pleuger & Makarewicz, 2020, p. 344; Richter, 1986a, p. 117). This reflects on more than just the fish materials. It also affects the number of mammal and bird bones found, and multiple of the material is based on older excavations, which will most likely lead to a high loss of specimens, especially smaller species such as fish.

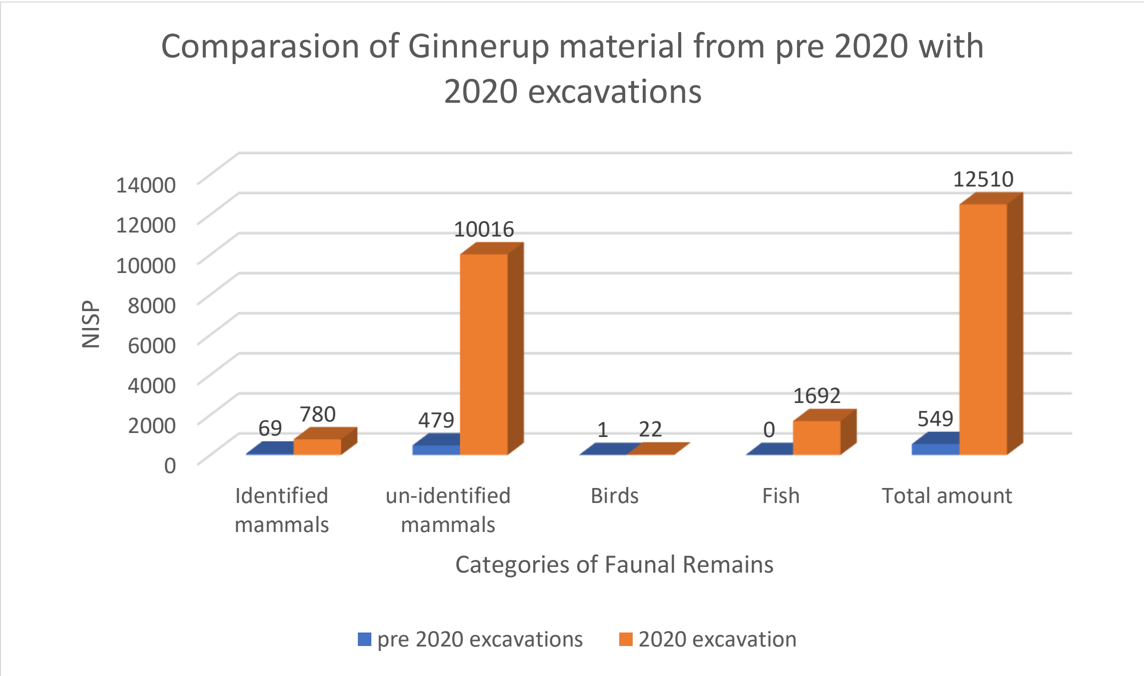
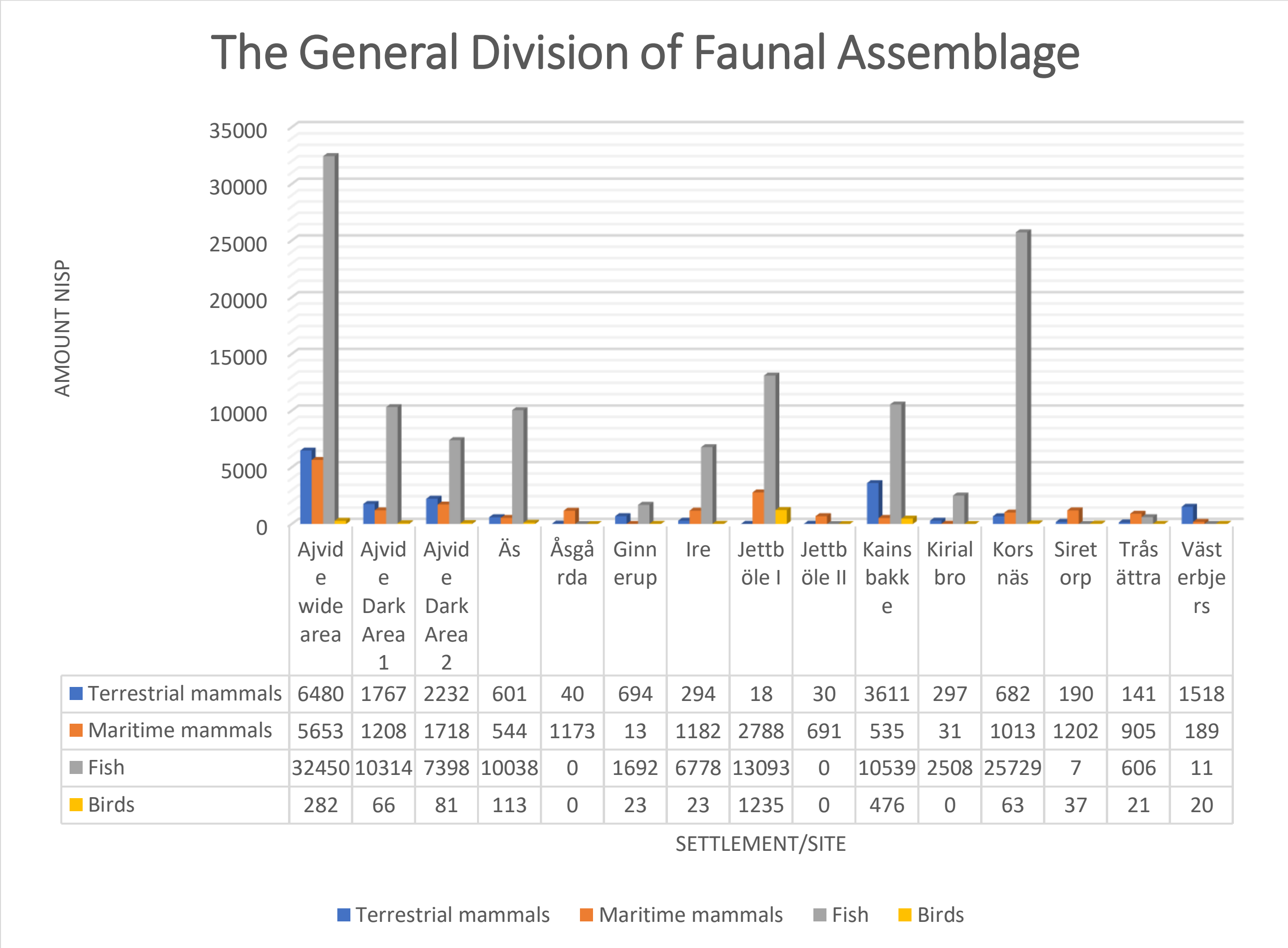


Figure 2: Comparative Analysis of Osteological Data in Ginnerup based on year.

4. Results

4.1. The Overall Differences between Settlement Areas

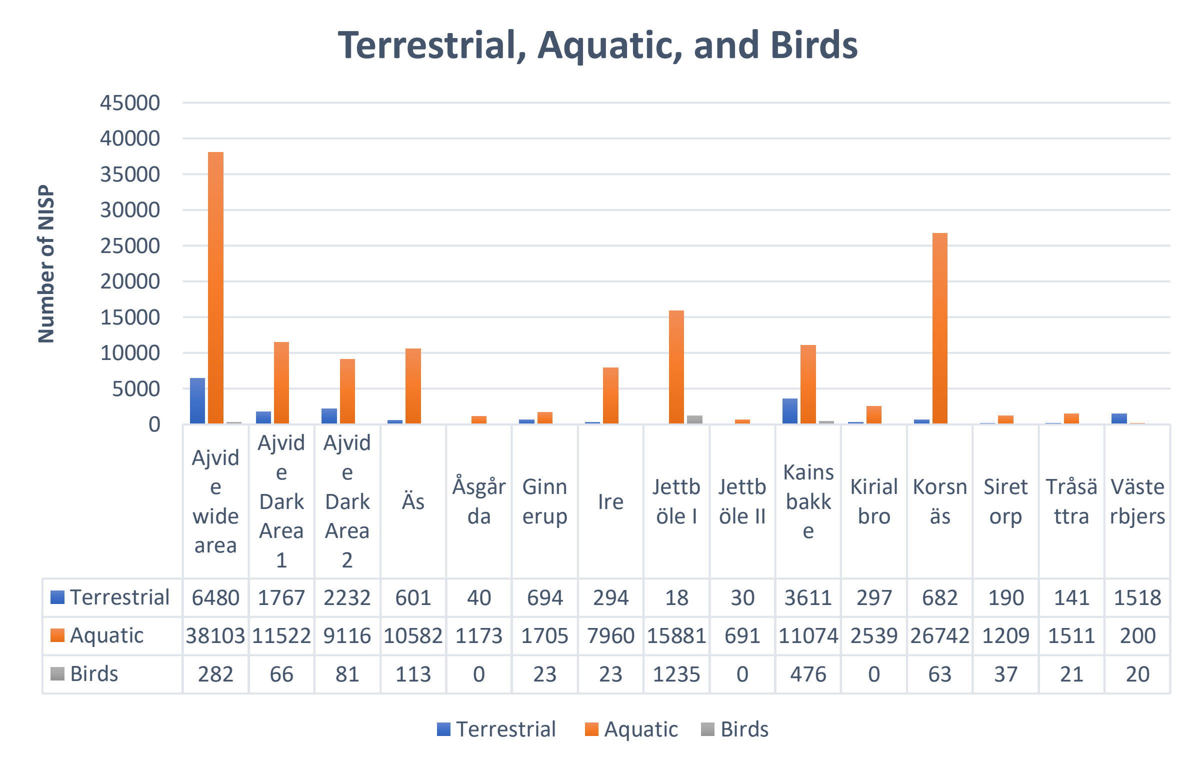


	Ajvide wide area	Ajvide Dark Area 1	Ajvide Dark Area 2	Äs	Åsgårda	Ginnerup	Ire	Jettböle I	Jettböle II	Kainsbakke	Kirial bro	Korsnäs	Siretorp	Tråsättra	Västerbjers
Terrestrial mammals	6480	1767	2232	601	40	694	294	18	30	3611	297	682	190	141	1518
Maritime mammals	5653	1208	1718	544	1173	13	1182	2788	691	535	31	1013	1202	905	189
Fish	32450	10314	7398	10038	0	1692	6778	13093	0	10539	2508	25729	7	606	11
Birds	282	66	81	113	0	23	23	1235	0	476	0	63	37	21	20

Figure 3: Division of terrestrial mammals, maritime mammals, fish, and birds. Terrestrial mammals include domesticated, terrestrial wild game, fur game, pig/boar, and dogs. Maritime mammals include seals and porpoises. Fish and birds include all NISP identified.

4.1.1. Maritime focus and the amount of Fish

The fish constitutes a predominant part of the faunal assemblage, see Figure 3. The following settlements/sites did not contain fish: Åsgårda and Jettböle II. The settlement areas of Siretorp, Tråsättra, and Västerbjers generated fish, albeit in lower numbers compared to mammals. All contexts from Ajvide, Äs, Ire, Jettböle I, Kainsbakke, Kirial Bro, and Korsnäs generated substantially higher numbers of fish bones compared to mammals, see Figure 3. Another category with low occurrence in the material is birds, predominantly identified on the site of Jettböle I. The essential factor in the categories in Figure 3 and Figure 4. is that the mammalians, both terrestrial and maritime, only include species identified to genus level. Fish and birds do have all NISP identified above the genus level. Therefore, the fish will affect the comparison between aquatic and terrestrial food sources in the faunal assemblage and indicate more extensive aquatic reliance compared with settlements containing no or a low number of fish.



	Ajvide wide area	Ajvide Dark Area 1	Ajvide Dark Area 2	Äs	Åsgårda	Ginnerup	Ire	Jettböle I	Jettböle II	Kainsbakke	Kirialbro	Korsnäs	Siretorp	Tråsättra	Västerbjers
Terrestrial	6480	1767	2232	601	40	694	294	18	30	3611	297	682	190	141	1518
Aquatic	38103	11522	9116	10582	1173	1705	7960	15881	691	11074	2539	26742	1209	1511	200
Birds	282	66	81	113	0	23	23	1235	0	476	0	63	37	21	20

Figure 4: Comparison of terrestrial (only mammals), marine/aquatic resources (marine mammals and fish), and birds as their category. Only identified mammals are used in this graph; all fish and birds NISP are included.

In Figure 4, the sites with a large number of fish strongly indicate aquatic reliance: e.g. all contexts from Ajvide, Äs, Ire, Jettböle I, Kainsbakke, and Korsnäs. In general, the site with smaller faunal assemblages like Åsgårda, Ginnerup, Jettböle II, Siretorp, Tråsättra, and Västerbjers disappear in comparison with the fish-rich materials of Korsnäs and Ajvide (wide area). A CA analysis also illustrates the division of aquatic and terrestrial resources, see Figure 5. The predominance of fish affects the CA plotting, and the only differentiated settlement areas are Västerbjers (VI) and Jettböle I (J1). The Västerbjers settlement indicates high reliance on terrestrial mammals. The Jettböle I site is affected by the large number of bird bones identified in the settlement area. Ginnerup (G1) and Kainsbakke (K1) were located closer to the terrestrial animals, only marginally.

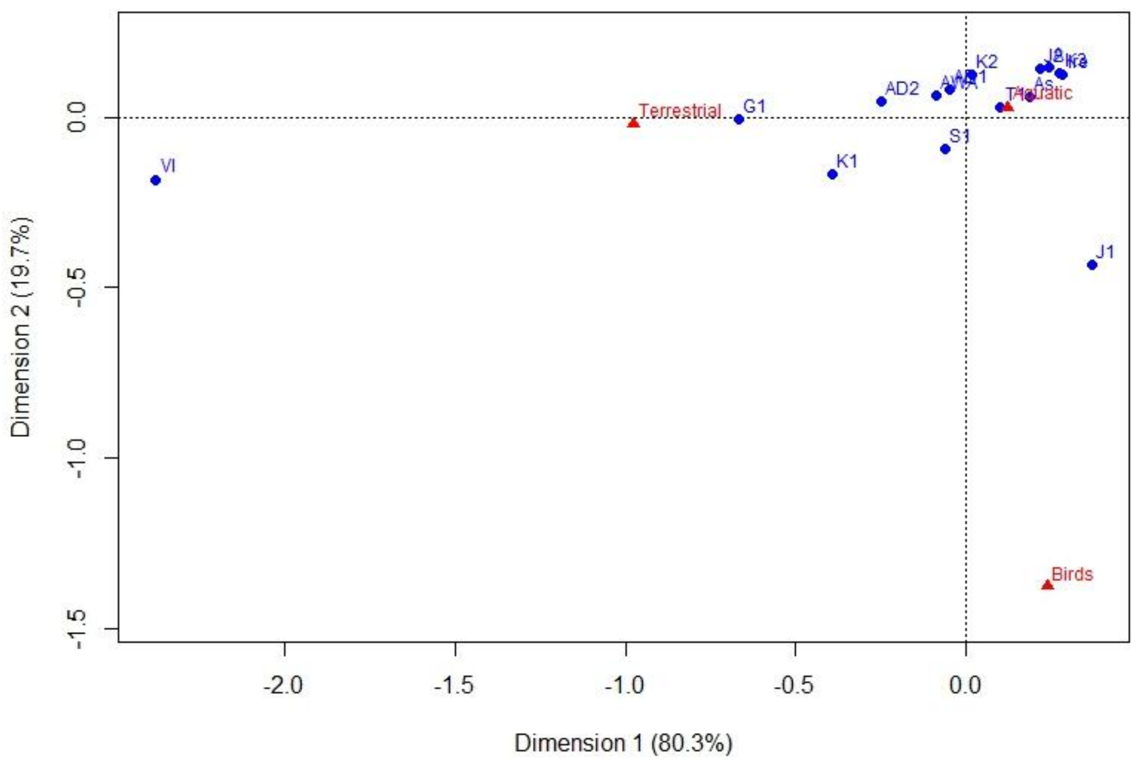


Figure 5: CA-analysis comparing terrestrial mammals with aquatic resources. This category includes fish and birds as a separate category. Ajvide Dark Area 1 (AD1), Ajvide Dark Area 2 (AD2), Åsgårda (A), Äs (As), Ginnerup (G1), Jettböle I (J1), Jettböle II (J2), Kainsbakke (K1), Kirial Bro (K2), Korsnäs (K3), Siretorp (S1), Tråsättra (T1), and Västerbjers (V1).

Another CA was performed, see Figure 6, including multiple variables. This resulted in an almost circular result evident in the low inertia values, see Appendix 2. The settlement area with the highest inertia value was that of Kainsbakke (K1). Ginnerup (G1) is located close to Kainsbakke toward the domesticated mammals (Dom_Mam) and terrestrial wild game (Terra_Game). The indications are that the marine mammals (Marine_mam) were more prominent in the settlement areas of Åsgårda (A), Siretorp (S1), and Jettböle 2 (J2). The issue with low differences in the inertia values demands the further exclusion of variables and another statistical method of comparison. The percentual division between maritime and terrestrial mammal species is presented in Figure 7. In Figure 8, fish and birds are excluded, generating a more evident division of the mammalian species in the faunal assemblages.

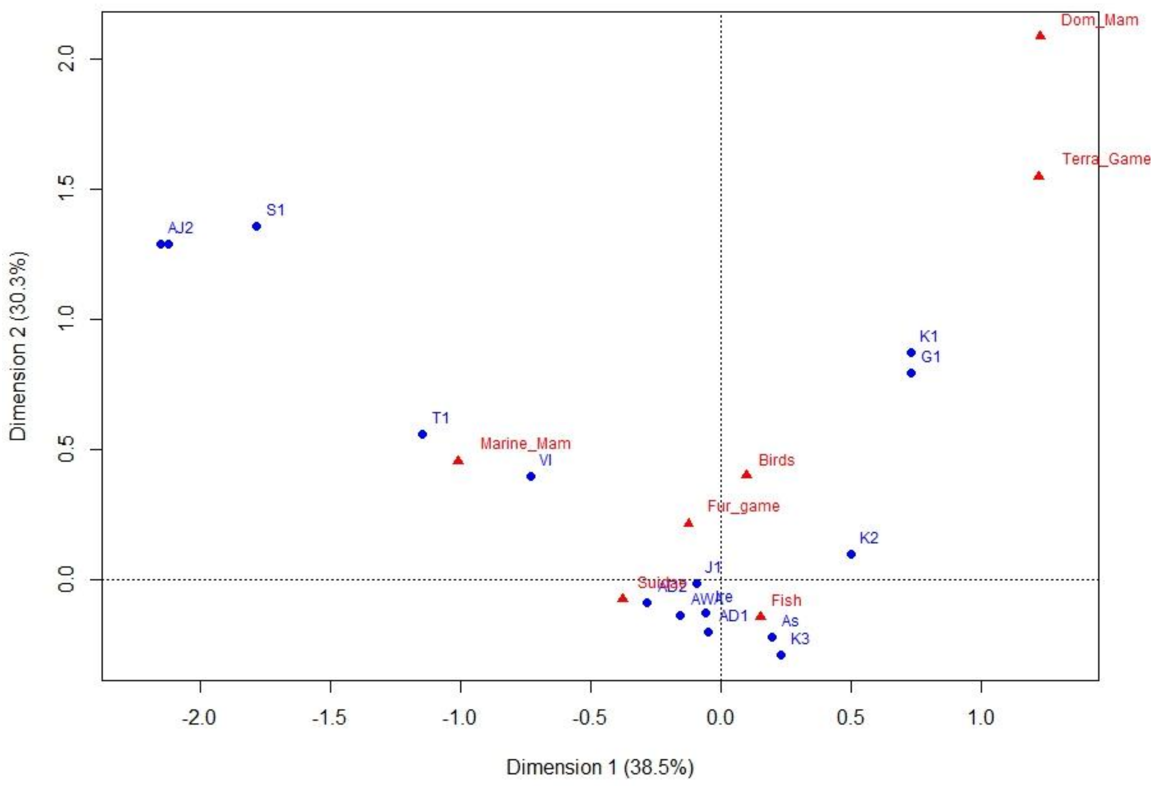


Figure 6: CA plotting based on marine mammals (Marine_Mam), Pig/boar, Fur wild game (Fur_Game), Terrestrial wild game (Terra_Game), Domesticated mammals (Dom_Mam), Fish, and Birds. Settlement areas included: Ajvide wide area (AWA), Ajvide Dark Area 1 (AD1), Ajvide Dark Area 2 (AD2), Åsgårda (A), Äs (As), Ginnerup (G1), Jettböle I (J1), Jettböle II (J2), Kainsbakke (K1), Kirial Bro (K2), Korsnäs (K3), Siretorp (S1), Tråsättra (T1), Västerbjers (V1).

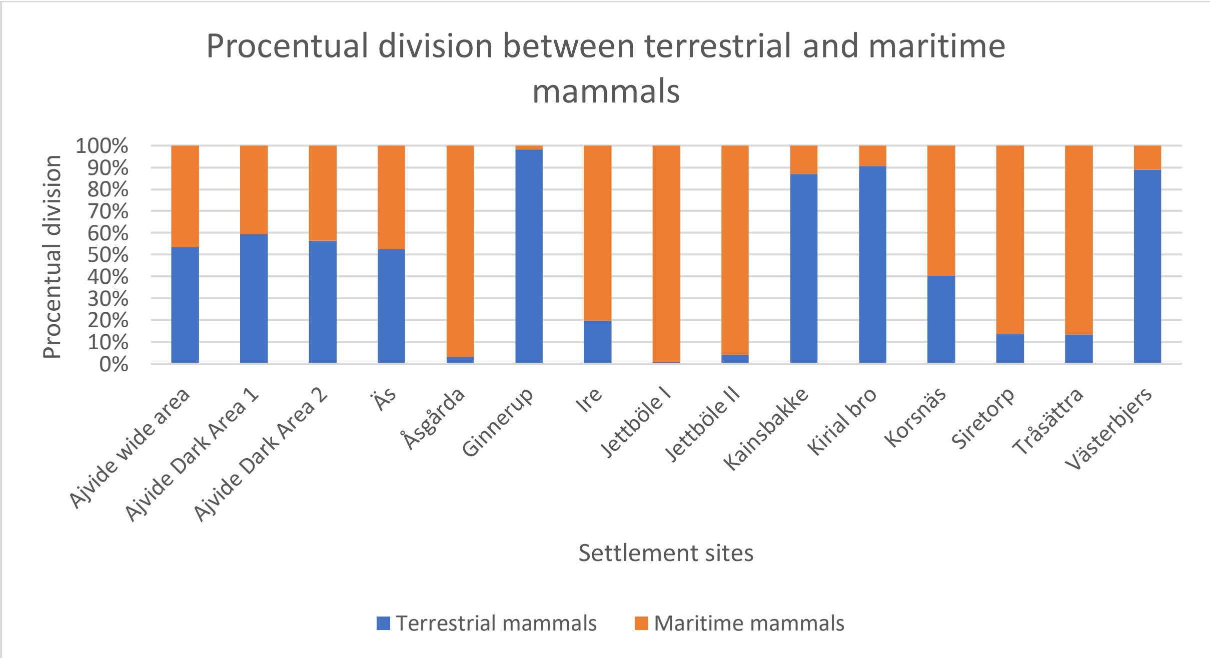


Figure 7: Percentual differences in the terrestrial vs maritime mammalian amount in all included context and settlement areas.

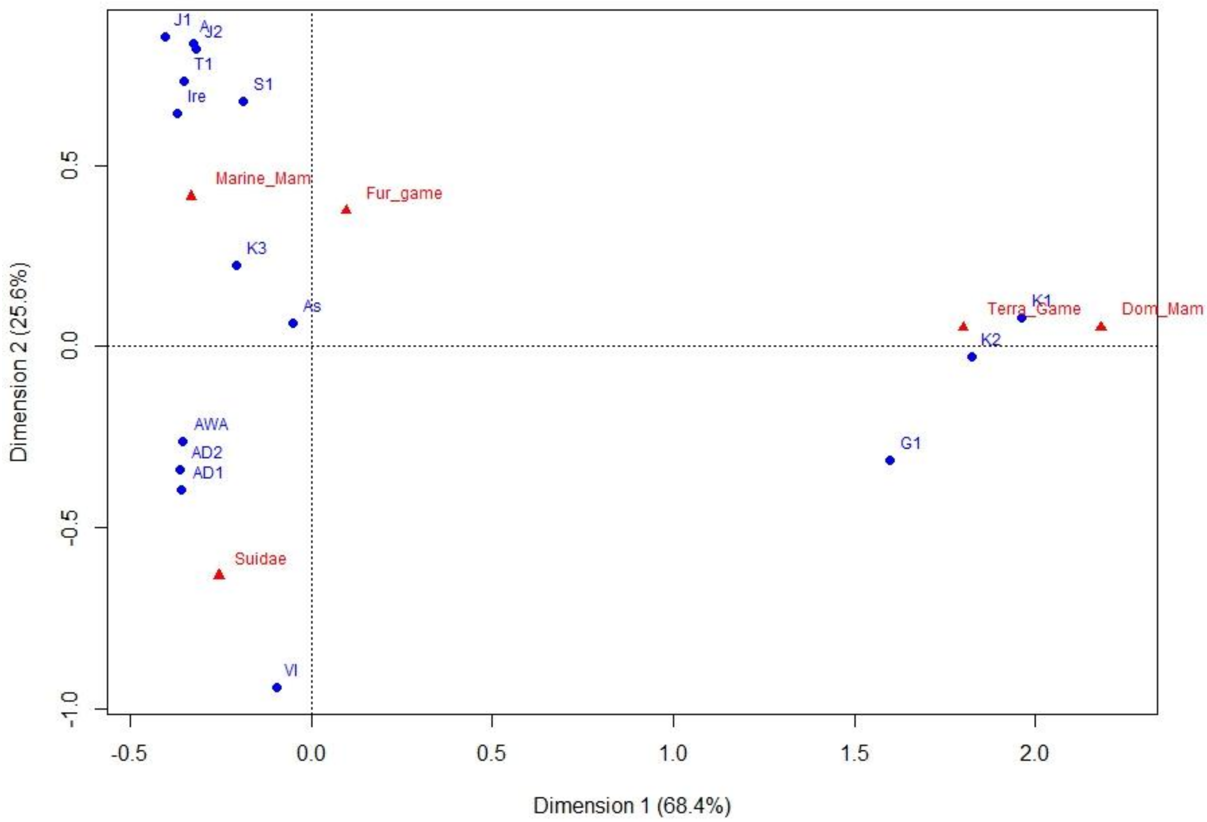


Figure 8: CA plotting only mammalian categories of marine mammals (Marine_Mam), Pig/boar, Fur wild game (Fur_Game), Terrestrial wild game (Terra_Game), and Domesticated mammals (Dom_Mam). Settlement areas included: Ajvide wide area (AWA), Ajvide Dark Area 1 (AD1), Ajvide Dark Area 2 (AD2), Åsgårda (A), Äs (As), Ginnerup (G1), Jettböle I (J1), Jettböle II (J2), Kainsbakke (K1), Kirial Bro (K2), Korsnäs (K3), Siretorp (S1), Tråsättra (T1), and Västerbjers (V1).

Figure 7 presents a clear division of maritime and terrestrial mammals in every site and context. The settlement areas with a clear terrestrial focus on mammals are the following: Ginnerup (G1), Kainsbakke (K1), Kirial Bro (K2), and Västerbjers (V1). The Settlement areas of Kainsbakke (K1), Kirial Bro (K2), and Ginnerup (G1) are indicated to have relied more on terrestrial wild game animals and domesticated mammals, and this is further implied by Figure 8. Interestingly, the Ajvide materials had slightly above 50 % terrestrial mammals, including Ajvide Wide Area, Dark Areas 1, and Dark Area 2, see Figure 7. The mainland site of Äs shared this number of terrestrial mammals as well. Maritime mammals, seals dominated the Åland sites of Åsgårda, Jettböle I and II faunal assemblage. The Blekinge site of Siretorp and the Gotland site of Ire and Tråsättra in Central-Eastern Sweden also contained a predominant maritime mammalian diet. Korsnäs site had around 40 % terrestrial mammals, still predominant maritime mammalian diet. This is further evident in Figure 8, with a clear maritime mammalian focus is presented in the following settlement areas: Jettböle I (J1) and

II (J2), Åsgårda (A), Tråsättra (T1), Ire, and Siretorp (S1). Pig/Boar are more prominent in settlement of Ajvide wide area (AWA) and its contexts Dark Area 1 (AD1) and Dark Area 2 (AD2). Västerbjers (V1) is the most prominent settlement relying on pigs. Korsnäs (K3) and Äs (As) are between maritime mammals and pigs. The wild fur game could affect their location. In the percentual division, see Figure 7, the site of Äs relied on maritime animals and terrestrial mammals. Korsnäs relied somewhat more on a maritime diet, as indicated in Figure 8.

4.2. Regional Differences and Similarities

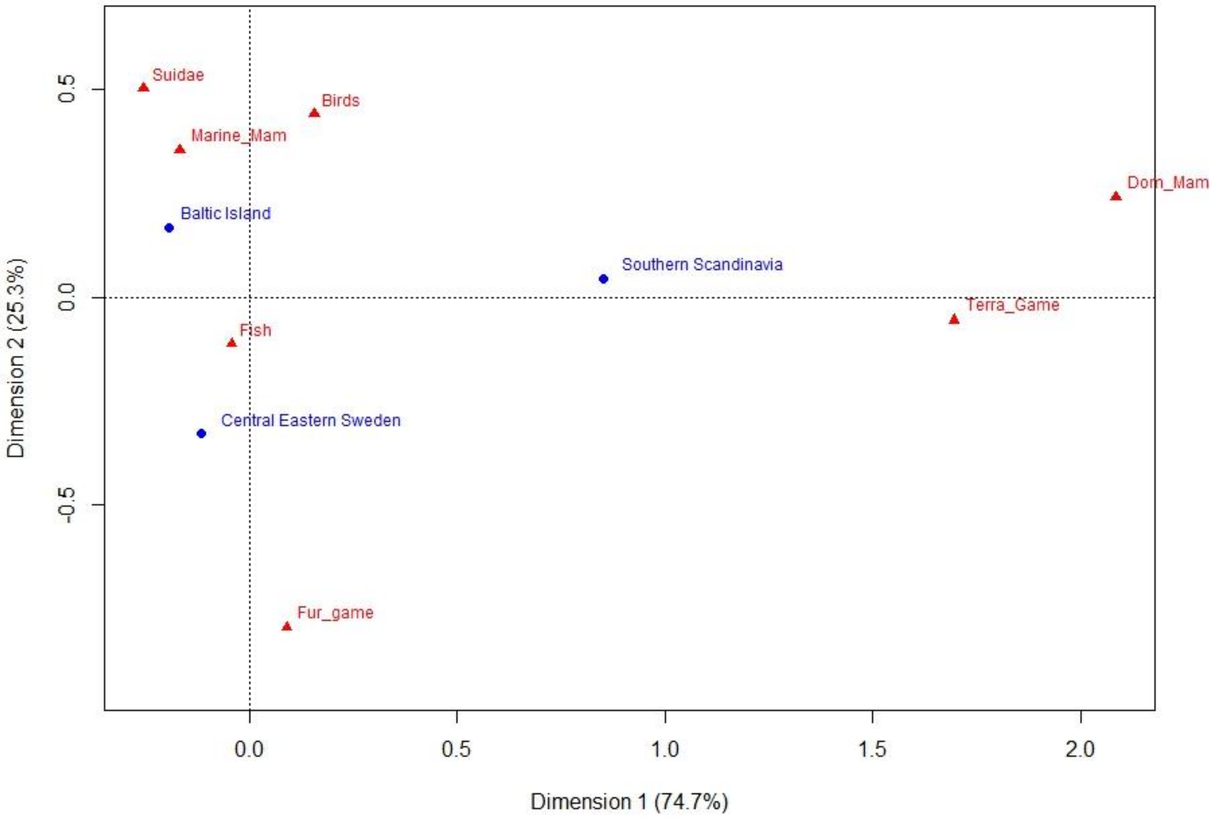


Figure 9: Comparative study of the regional differences between Southern Scandinavian sites, Baltic Sea Island sites (excluding Ajvide Dark Areas 1 and 2) and the Central-Eastern Swedish sites. The animal categories included here are Pig/boar (Pig), Marine mammals (Marine_Mam), terrestrial wild game (Terra_Game), fur wild game (Fur_game), domesticated mammals (Dom_Mam.), fish, and birds.

The initial regional comparison included all settlement areas without the context of Ajvide Dark Area 1 and Dark Area 2, and these contexts are already included in Ajvide's wide area. The initial comparison included birds, fish, and wild fur games; see Figure 9. The results indicate some regional differences, especially regarding South Scandinavia. The wild fur game mainly affects the Central-Eastern Swedish sites. The reliance on Pig/boar and marine mammals is higher in both Baltic Sea Islands and Central-Eastern Sweden. Figure 10, which excludes fish, birds, and fur wild game, further indicates a higher reliance on maritime and Pig/boar amongst Central-Eastern Swedish and the Baltic Sea Islands regions. The Baltic Sea Island sites seem to have a higher degree of wild boar/pigs in their faunal assemblage than the Central-Eastern Swedish sites. The South Scandinavian Sites generated the highest terrestrial wild game, as shown in Figure 9 and Figure 10.

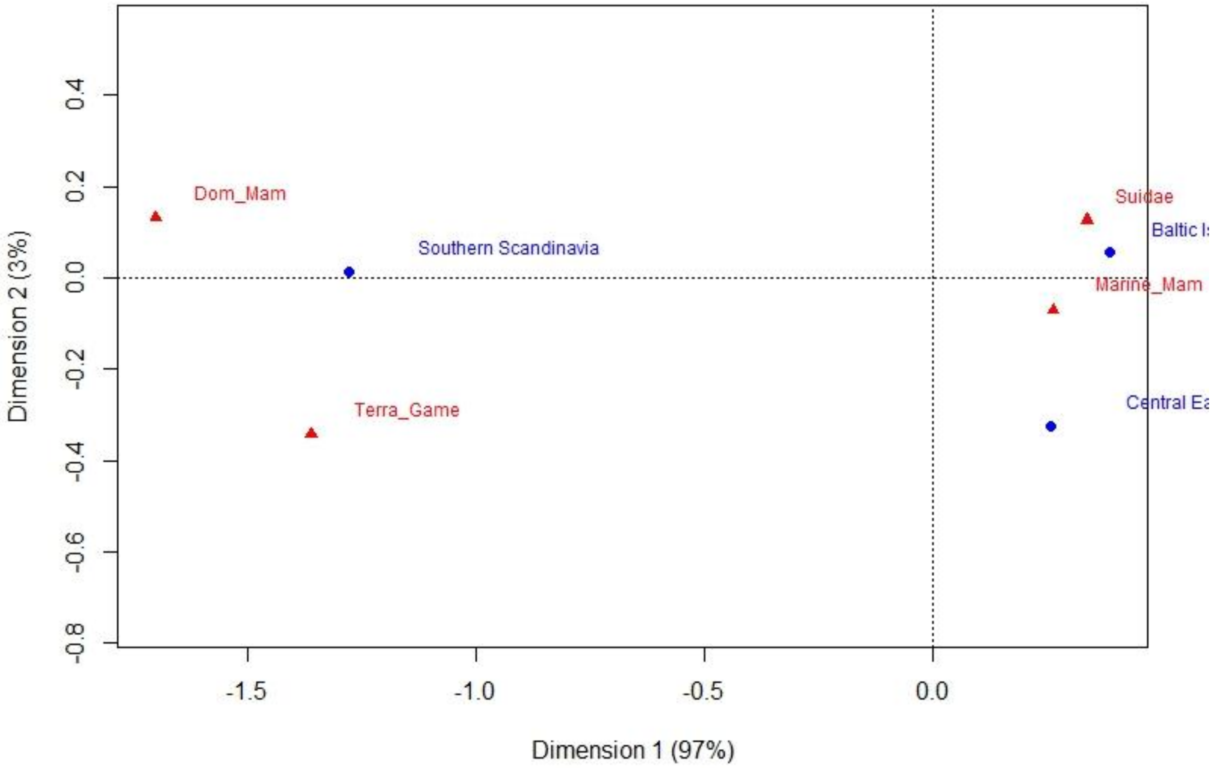
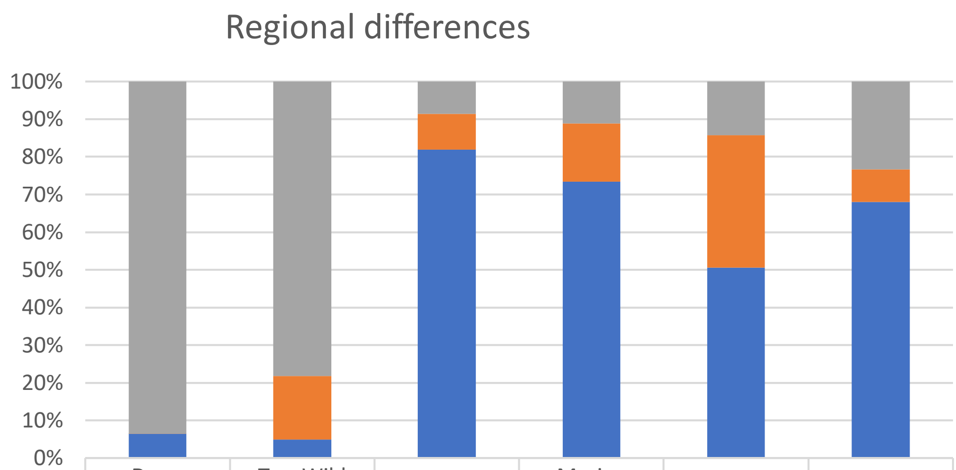


Figure 10: Comparative study of the regional differences between Southern Scandinavian sites, Baltic Sea Island sites (excluding Ajvide Dark Areas 1 and 2) and the Central-Eastern Swedish sites. The animal categories included here are pig/boar (Pig), Marine mammals (Marine_Mam), terrestrial wild game (Terra_Game), and domesticated mammals (Dom_Mam.).



	Dom. Mammals	Ter. Wild Game	Pig/Boar	Marine mammals	Fish	Birds
Southern Scandinavia	3023	1046	780	1781	14746	536
Central Eastern Sweden	4	226	868	2462	36373	197
Baltic Island	207	66	7486	11676	52332	1560

Baltic Island Central Eastern Sweden Southern Scandinavia

Figure 11: Regional percentual comparison of faunal assemblage.

4.3. Inter-regional Differences and Similarities

4.3.1. Comparison of the Settlement Areas in Central-Eastern Sweden

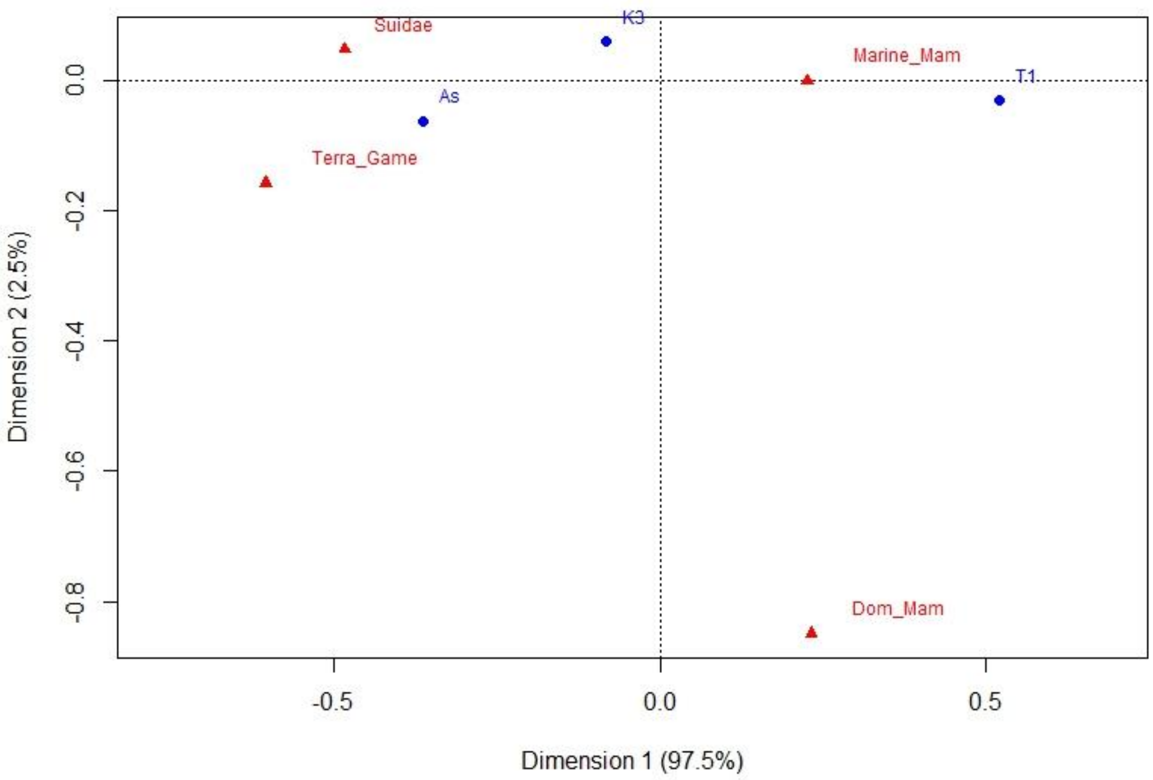
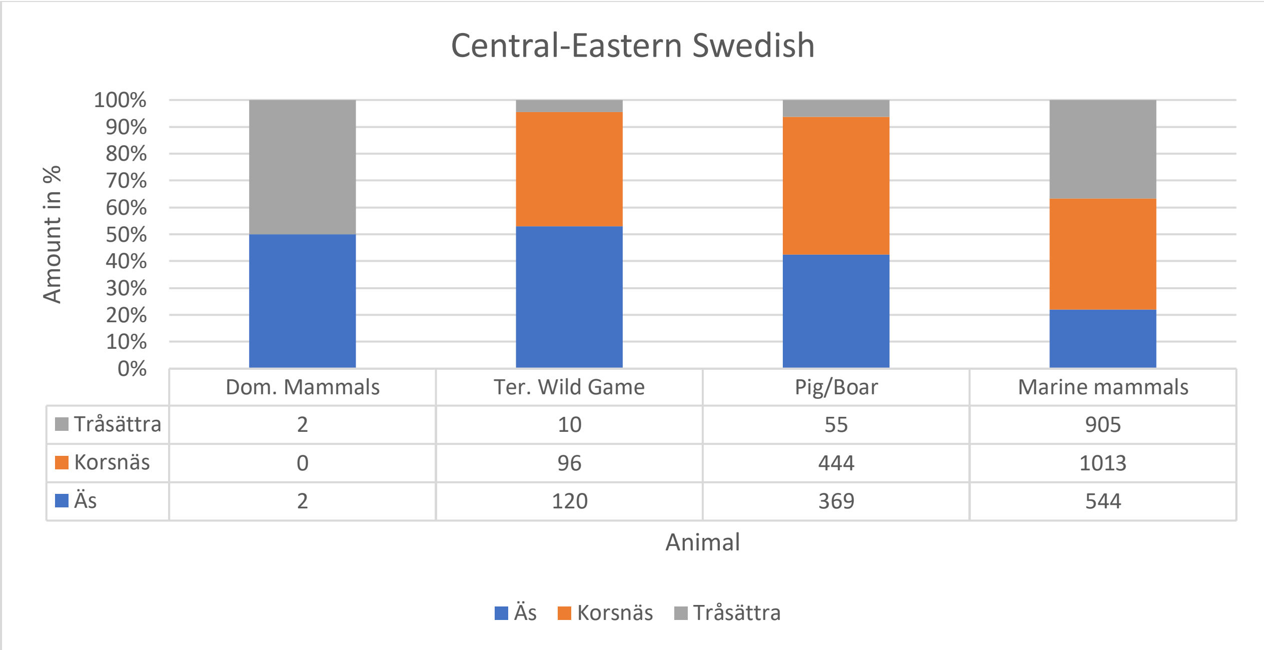


Figure 12: Inter-regional comparison of Central-Eastern Sweden. Includes pig/boar (Suidae), Terrestrial wild game (Terra_Game), Marine Mammals (Marine_Mam), and Domesticated Mammals (Dom_Mam. Settlement areas included: Äs (As), Korsnäs (K3), and Tråsättra (T1).

The main difference in the CA analysis is that the site of Tråsättra (T1) differentiates from the sites of Äs (As) and Korsnäs (K1). The marine mammals were the most sizable proportion of Tråsättra faunal assemblage in percentage. The interesting part is that the site of Korsnäs, see Figure 14, has a higher number of marine mammals and a notably higher amount of pig/boar (Suidae). This leads to the settlement of Korsnäs (K3) relying on both pig/boar and Marine mammals, evident in both Figure 12 and Figure 11. Äs (As) indicate a more terrestrial basis with terrestrial wild game and pig/boar than the other two sites. The presence of domesticated mammals is primarily non-existent and is divided into 4 NISP between Äs and Tråsättra, see Figure 13.



	Dom. Mammals	Ter. Wild Game	Pig/Boar	Marine mammals
Tråsättra	2	10	55	905
Korsnäs	0	96	444	1013
Äs	2	120	369	544

Figure 13: Percentual comparison of faunal assemblage in-between the Central-Eastern Swedish settlements.

4.3.2. Comparison of the Settlement areas amongst the Baltic Sea Islands

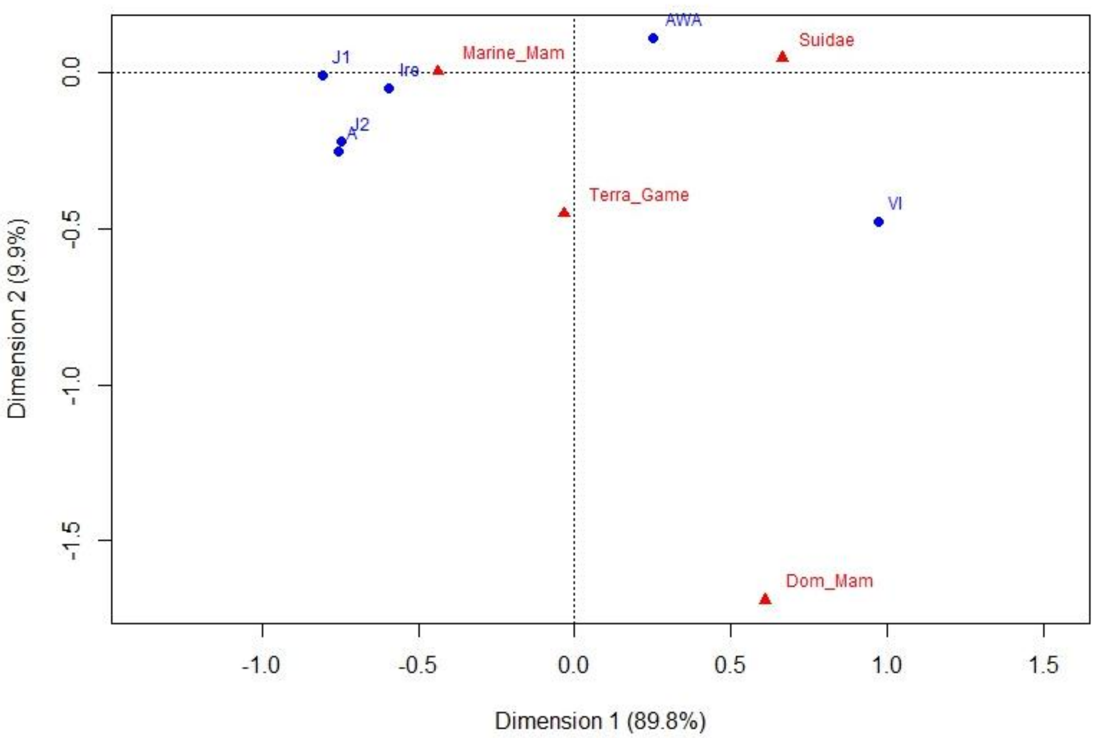
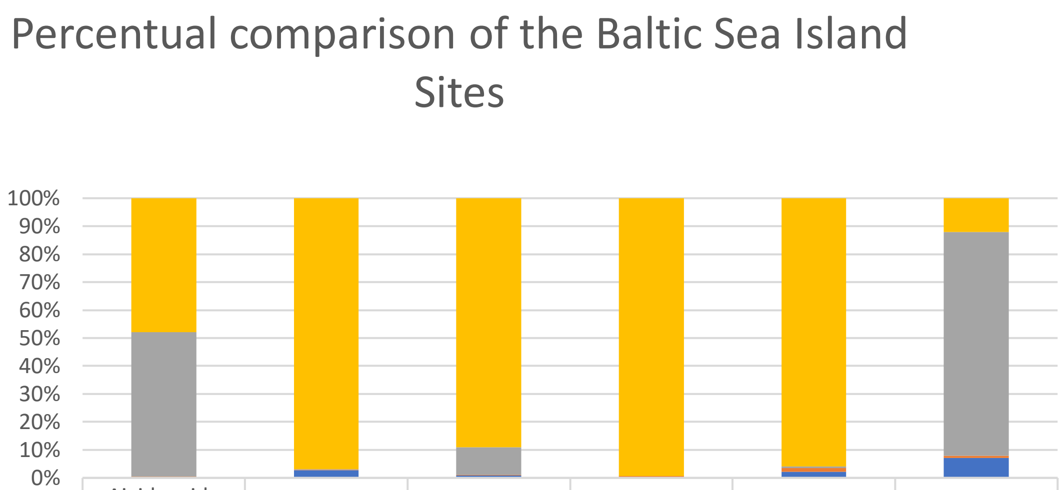


Figure 14: CA comparison of the Baltic Sea Islands settlements. Includes pig/boar (Suidae), Terrestrial wild game (Terra_Game), Marine Mammals (Marine_Mam), and Domesticated Mammals (Dom_Mam. Settlement areas included: Ajvide wide area (AWA), Åsgårda (A), Jettböle I (J1), Jettböle II (J2), Ire, and Västerbjers (V1).

The Baltic Sea Islands indicate two sustenance strategies: seal hunting or heavy dependence on pig/boar. Domesticated animals are not excluded from the Baltic Sea Islands' sites, but their presence is relatively low, see Figure 15. The leading site that showed a different sustenance strategy is Västerbjers (V1), with a heavy overrepresentation of pigs in the faunal assemblage. Figures 14 and 15 Ajvide wide area (AWA) has almost 50% each between pigs and marine mammals, which means seals. The marine mammal/seals dominate the faunal assemblage in all other sites. Domesticated mammals are present in all contexts, see Figure 15 on the page, but their numbers are low and only percentual visible in Jettböle II, Åsgårda, and Västerbjers. Domesticated animals seem only marginally present in the Baltic Sea Islands region's PWC sites. The terrestrial wild game category is almost non-existing in the Baltic Sea Islands region, which is most likely explained by the geographical location on an island setting with a high presence of pig/boar but no deer.



	Ajvide wide Area	Åsgårda	Ire	Jettböle I	Jettböle II	Västerbjers
Marine mammals	5653	1173	1182	2788	691	189
Pig/Boar	6086	2	130	1	5	1262
Ter. Wild Game	28	2	2	13	9	12
Dom. Mammals	30	34	12	4	16	111

Dom. Mammals Ter. Wild Game Pig/Boar Marine mammals

Figure 15: Percentual division of mammals between the Baltic Sea Island settlements.

4.3.3. South Scandinavian Comparison

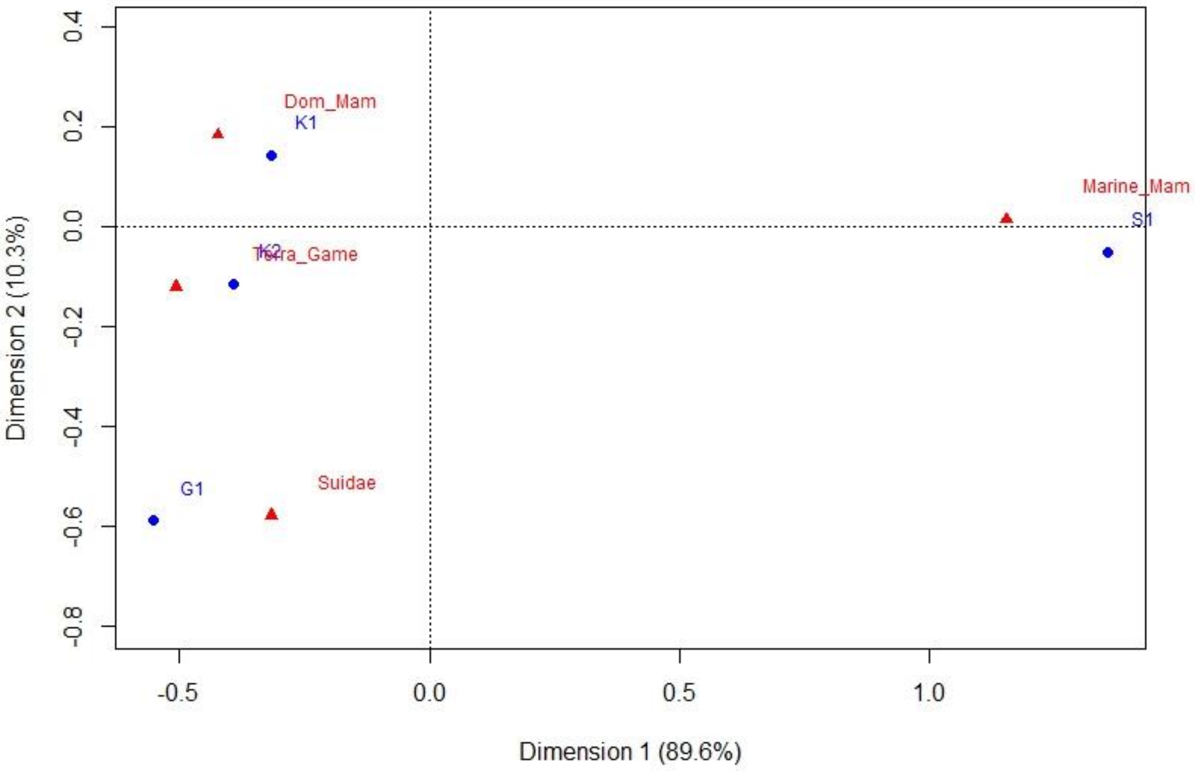


Figure 16: Correspondance analysis between the South Scandinavian sites of Ginnerup (G1), Kainsbakke (K1), Kirial Bro (K2), and Siretorp (S1). Includes main dietary categories of domesticated mammals (Dom_Mam), terrestrial wild game (Terra_Game), pig/Boar (Suidae), and marine mammals (Marine_Mam).

The Danish sites generally relied more on terrestrial resources than Siretorp in Blekinge, as illustrated in both Figure 16 and Figure 17. The main difference between the Danish sites is the number of pigs in Ginnerup in a percentual comparison with those of Kainsbakke and Kirial Bro. The number of domesticated mammals is highest in the settlement of Kainsbakke; see Figure 16 and Figure 17 on the next page. The Siretorp material includes 90 NISP of domesticated animals, but this amount is insignificant compared to the settlement of Djursland. The primary sustenance strategy at Siretorp is seals and maritime mammals. The primary sustenance strategy amongst the Djursland settlement is domesticated mammals and fish, as presented in Figure 3.

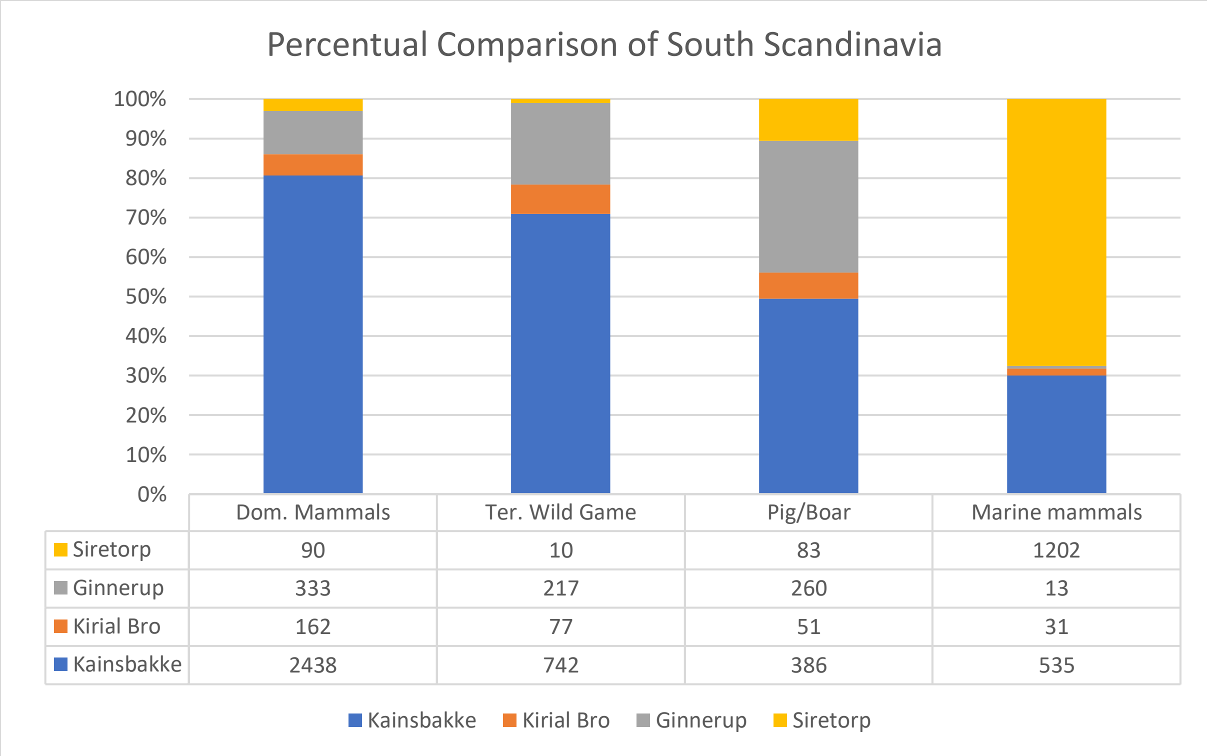


Figure 17: Percentual comparison of mammal division between the different settlements of South Scandinavia.

5. Discussion

5.1. The Initial Results of the Research

5.1.1. Question One: Inter- and Intraregional Differences and Similarities

The results of the comparative study of faunal assemblage indicate that there are both larger and smaller differences between geographic regions. The differences also occur within each geographic area as well. The south Scandinavian region had a considerably different composition of the faunal assemblage compared with Central-Eastern Sweden and the Baltic Sea Island sites. The main difference was the large number of domesticated mammals and terrestrial wild game animals in the South Scandinavian PWC settlement areas. Central-Eastern Sweden and the Baltic Sea Island sites shared a higher degree of similarities within the composition of their faunal assemblage with higher reliance on marine mammals and pig/boar. Fish were a common feature in all regional faunal assemblages and were found in most settlement areas. This is discussed in detail in chapter *5.2.5. The Abundance and Taphonomic Loss of Fish.*

The intraregional differences within the South Scandinavian PWC settlements are the Siretorp material, which did not display an abundance of domesticated cattle as the Danish settlements of Djursland, e.g., Ginnerup, Kainsbakke, and Kirial Bro. Instead, Siretorp displayed a marine-oriented subsistence strategy with high levels of seals in the faunal assemblage and resembled those of Tråsättra, Jettböle I and II, and Åsgårda, see Figure 8. Although minor differences occurred within Central-Eastern Sweden, see Figure 12, and the Baltic Sea Islands, see Figure 14. The main difference is that the Ålandic settlement differentiates itself from those from Gotland, primarily based on the number of pigs/boars in the faunal assemblages from Gotland compared with a high level of marine mammals in the PWC-settlements Åsgårda, Jettböle I, and Jettböle II.

5.1.2. Question Two: Environmental Adaptation or Cultural Diversities?

This question is more difficult to answer and includes multiple variables, all of which are not possible to fit in the scope of this thesis. Nonetheless, there are clear indications that the South Scandinavian settlement sites involve two subsistence strategies. Siretorp indicates a more marine-oriented subsistence strategy aligned with sealing and heavy reliance on maritime protein sources. The settlements on Djursland, on the other hand, include elements more typical for farming communities involving cattle and, potentially, cattle herding. This could indicate two different cultural spheres within the South Scandinavian region. The other geographic areas of Central-Eastern Sweden and the Baltic Sea Islands included in this study involved more maritime-focused hunting of mammals. But there are exceptions, such as Västerbjers with more pigs/boars. However, these regions seemed to have more in common than the Djursland settlements and could constitute one larger regional cultural identity. Local environmental adaptation is potentially indicated in the faunal assemblages of Jettböle I and Tråsättra. Both sites involved more fowling and a high focus on maritime protein resources. These islands were located far from the mainland during the Middle Neolithic, which could indicate a local adaptation of the hunting strategies. There is a potential indication of differences in cultural aspects regarding food and food consumption within the Scandinavian PWC complex.

5.2. Comparative Analysis within Each Region

5.2.1. South Scandinavia

The CA was a valuable tool for a comparative study of subsistence strategies between and in-between the theoretically constructed geographical regions. The results indicate minor geographic differences, including inter-regional differences. The large-scale regional comparison yielded exciting results, as seen in Figures 9, 10, and 11. The Southern Scandinavian areas differentiate from Central Eastern Sweden and the Baltic Sea Islands. The South Scandinavian sites dominate the number of domesticated animals, mainly cattle. Makarewicz and Pleuger (2020, p. 283-286) offer one potential explanation for the high amount of cattle in the Djursland area: the potential of interaction between contemporary farmers of FBC and SGC. Another interesting difference is the large number of terrestrial wild game animals in the assemblages from South Scandinavia compared with central-eastern Swedish sites, see Figure 8. The red deer was the second most common mammal species in the faunal assemblage of Kainsbakke (Makarewicz & Pleuger. 2020, p. 298) and Kirial Bro (Makarewicz & Pleuger. 2020, p. 318). Wild horse is an uncommon feature in faunal assemblages, except for Ginnerup, with an abundance of wild horses (Klassen et al., 2023, p. 51; Makarewicz & Pleuger, 2020, p. 321) and wild horse was categorised as terrestrial wild game. Regional differences were illustrated within this geographic area when the South Scandinavian sites/settlements were compared. The domesticated input in the Djursland faunal assemblage follows the lines of Makarewicz and Pleuger's (2020, p. 321) arguments for complex animal-based utilisation strategies involving livestock husbandry and marine-oriented sustenance strategies. The maritime protein sources were common in all three settlements on the Djursland peninsula, but fish rather than seals dominated this source. It is evident that the Siretorp faunal assemblage is considerably different from those of the Djursland materials, see Figure 16. The Siretorp assemblage shares more notable similarities with the Åland settlements of Jettböle I, Jettböle II, and Åsgårda and the Central-Eastern Swedish site of Tråsättra, see Figure 8. The primary subsistence at the site of Siretorp is maritime mammals followed by pigs/boars and could be described as the expected norm for the subsistence strategies of the PWC. Nevertheless, Siretorp faunal assemblage includes 90 NISP identified as domesticated mammals, see Figure 17. There are at least three issues with the faunal assemblage of Siretorp bovine material. The first one is the risk of intrusion of other cultural layers. The earlier excavations of Siretorp described difficulties separating the border between CWC and PWC cultural layers (Bagge & Kjellmark, 1939, p. 19). The domesticated species found in Siretorp could be intrusions from other cultures and periods. The second potential bias is the taphonomic loss of identifiable bone elements due to a large amount of burned bones. According to Dahr's (1939, p. 242) description, there was only a minority of unburned bones in the faunal assemblage. Then there is the issue with the NISP number because 65 of 75 cattle bone fragments are dental fragments (Bagge & Kjellmark, 1939, p. 243). The dental remains are easier to identify species, and the fragmentary nature of the dental remains could mean that the fragments came from the same tooth or animal.

The question of this regional evidence of domesticated mammals represents one unique strategy amongst the PWC from Djursland rather than a South Scandinavian phenomenon. One potential issue with husbandry interpretations of the Djursland settlement is the inclusion of FBC materials. The latest publication by Klassen et al. (2023) of the excavation of Ginnerup analysed a pit called A4 with clear stratigraphic layers. The layers were ^{14}C-dated, and the overall trend for the material was that the wild game animals increased to more than 60% of the faunal assemblage in the higher layers of 6-7 compared with 30-31% in the older layers of 4-5, the fish material increased as well in the layers of 6-7 (Klassen et al., 2023, p. 51). The main interesting thing is the dating of layers 4-5, which is contemporary with the first occupation phase of Ginnerup, is dated to approximately 3200-3100 cal. BCE. Layer 6 is dated to approximately 3020-2960 cal. BCE and represent the second occupation phase (Klassen et al., 2023, p. 48). This could indicate dietary and socioeconomic changes over time. One crucial note by Klassen et al. (2023, p. 51) is that this was observed in only one feature, and the number of identified bone elements is small. This remark is suitable to remember and might indicate that the subsistence strategies on Djursland could have been more dynamic, and cultural perceptions changed over time. However, the site of Ginnerup is part of an ongoing excavation. Therefore, future publications and data could tell a different story, and no conclusion should be drawn yet based on current assessments. Another small source of error is the presence of potential Aurochs among the domesticated cattle. They were noted by Richter (1989, p. 45-16) amongst the Kainsbakke materials and can be hard to distinguish. Aurochs were also present in Makarewicz and Pleuger's (2020, pp. 283, 289, 317) in Kainsbakke and Kirial Bro settlements. Aurochs were also found in small numbers at the site of Ginnerup during the 2020 field season (Klassen et al., 2023, p. 50). The aurochs were included in the *Bos spp* category in Makarewicz and Pleuger (2020), and I, therefore, included them among the domesticated mammal categories. The reasoning was based on the LSI value study by Makarewicz and Pleuger (2020, p. 283), which indicated a large number of cattle amongst the bovine bone elements. The inclusion of a few aurochs will not affect the overall large representation of domesticated cattle in the Djursland settlement material but still present some typological challenges in the comparative studies.

The settlements of Kainsbakke, Kirial Bro, and Ginnerup are located only a few kilometres from each other in the surrounding areas of the prehistoric fjord system Kolindsund (Makarewicz & Pleuger, 2020, p. 319; Klassen et al., 2023, p. 36). This affects the outcome of this comparative analysis. The result would have been more diverse and interesting if more Danish or South Swedish settlements had been included in this study. The main reason I chose these settlements for this study is based on the description of these sites as the only settlements securely connected to the PWC culture within present-day Denmark Makarewicz and Pleuger (2020, p. 279). Other reasons are a large amount of faunal bone available to analyse within these contexts and the inclusion of cattle, indicating a different subsistence strategy. Therefore, as mentioned earlier, the settlements were determined to be suitable for a comparative study of PWC sites.

5.2.2. Central-Eastern Sweden

This geographic area included only three settlement areas in the Mälaren Valley. The initial results of the central-eastern Swedish sites are the low number of domesticated mammals, Figures 12 and 13. Tråsättra faunal assemblage had notably less pig/boar compared to the settlements of Korsnäs and Äs, see Figure 13, and is visible in the CA in Figure 12. The Tråsättra settlement relied more on maritime mammals and shares similarities with the settlement of Jettböle I and II, Åsgårda, Ire, and Siretorp in Figure 8. The settlement of Korsnäs and Äs shows more mixed terrestrial and maritime mammal reliance, as evident in Figures 7, 8, and 13. The faunal assemblage of the Central-Eastern settlement included only four cattle fragments, two from Äs (Lepiksaar, 1974, pp. 141-142) and another two from Tråsättra (Björck et al., 2019, p. 169). In the latter, the two cattle NISP consisted of two tooth fragments. Therefore, it could only be seen as an indicator of potential contact networks with the inland farming communities rather than husbandry strategies (Björck et al., 2019, p. 171). The cattle of Äs are represented by one molar and one patella. These few remains from cattle were interpreted as potential temporary prey animals or stolen/traded from the inland farming neighbours (Lepiksaar, 1974, pp. 146-147). These low amounts do not indicate part-time herding within the included settlements from central-eastern Sweden. The large amount of pig/boar in the settlement of Korsnäs and Äs, see Figure 13, affect the CA in Figure 12, and indicate higher terrestrial reliance compared to that of Tråsättra. This could reflect ecological factors such as the availability of mainland hunting areas.

5.2.3. Gotland and Åland

The CA analyses' initial results indicate differences in the faunal assemblages between the two islands of Gotland and Åland. The Gotland settlement contained many pig/boars remains, compared with the maritime-orientated island of Åland, see Figure 15 and Figure 14. The focus on pig/boar is evident in the faunal assemblage of Västerbjers compared with the Ajvide assemblage, which contained around 50% pig/boar and almost 50% marine mammals. Västerbjers were the site of Gotland that yielded the largest number of domestic animals, see Figure 15, with 111 specimens divided between 57 Sheep/Goats and 54 Cattle bones, according to data from Stenberger et al. (1943, p. 107). One issue with the Västerbjers material is the results from Eriksson (2004, p. 149) ^{14}C-dating of two cattle bones and one sheep/goat bone, dated to the Bronze Age. This means that the domestic specimens found on Västerbjers include later intrusions and do not reflect the subsistence strategies of the previous PWC individuals. Similar issues were recorded in Åsgårda, and this material included 31 Cattle and three sheep (Storå, 2000, pp. 60-61). The issue with the Åsgårda material is that parts of the materials are derived from layers with stratigraphical uncertainties and coarse dating. For example, cattle teeth from layer four were dated to Bronze Age (Storå, 2000, pp. 68-69). The faunal assemblage of Jettböle II also contained faunal remains, such as one pig bone, which was dated to the Iron Age, indicating intrusions from younger materials (Storå, 2000, p. 67). In general, the traces of cattle or sheep/goats were not high in the Baltic Sea Islands settlements included in this thesis.

The predominance of seals in the materials from the settlements of Åland did not come as a surprise based on previous studies performed by Jan Storå (2000, 2001, 2002). The hunting strategies were seasonal and adapted to the seal's behavioural pattern, especially regarding their migratory or sedentary lifestyles and reproduction patterns (Storå, 2001, p. 52). Apart from composing the protein intake, the seals played a substantial role in the PWC. The evidence lies partly in the number of seal teeth found in burials, and there are graves containing hundreds of seal teeth at Ajvide (Sjöstrand, 2022, p. 305). Different parts of the seals have been deposited differently at Jettböle I and II sites, which is particularly noticeable for craniums. This practice was notable in the site of Jettböle II, where the skulls were deposited in distinct patterns (Storå, 2001, pp. 48-49).

The number of birds was generally low; the exception was the Jettböle I site, which yielded the largest amount of NISP from birds, see Figures 4 & 5. The bird remains were analysed by Mannermaa (2002), which might be why the presence of birds was high at Jattböle I. Mannermaa's (2002, p. 94) study indicates a widely practised fowling at the Jettböle I site. This sustenance strategy would have fitted well with the isolated location of the Ålandic Islands. Birds are present in multiple PWC settlements included in this study. The predominantly identified species are water birds, which is logical due to the coastal environment of all included settlements. The settlement of Jettböle had thick culture layers, and Mannermaa (2002, p. 85-86) described the sites as permanently inhabited settlements. Then the seasonality with sealing, fishing, and fowling makes perfect sense as ecological adaptability amongst the PWC to sustain themselves.

All settlements generally included some pig/boar in their faunal assemblage. The region with the lowest reliance on pigs seems to be the Ålandic sites of Åsgårda, Jettböle I, and Jettböle II, see Figure 15. The common ground for these sites is a predominant reliance on maritime mammals; see Figure 7. Other settlement areas with a low number of pigs are Tråsättra and Siretorp. Both these settlements relied heavily on maritime mammals. Finally, the Pig/boar is predominantly present in the Baltic Sea Islands, see Figure 11, and is especially evident at Västerbjers, followed by Ajvide, which is presented in Figures 14 and 15.

5.2.4. Similar traits in Central-Eastern Sweden and the Baltic Sea Islands

The regions of Central-Eastern Sweden and the Islands in the Baltic Sea region shared more similarities in their faunal assemblages. Storå (2001, p. 4) describe that the inland sites of Korsnäs, Äs, and Alvastra contained a large number of terrestrial species, especially compared to the island and archipelago sites. This statement holds and is further evident in Figure 11. The Central-Eastern Sweden faunal assemblages also comprised a larger number of fur game animals than the settlements of Gotland and Åland, see Figure 11. One potential explanation for this is that geographic location is in close proximity to the woodland of Sweden, which in turn would support a more diverse fauna compared to the islands of the Baltic Sea. Aaris-Sørensen (1978, p. 17) describes the possibility of hunting in woodland areas for larger species like the Eurasian elk at the site of Korsnäs. The ecological niches of Gotland and Åland are entirely different. The remains of red deer species found in Jettbölle have been attributed to imports from the mainland by Mannermaa (2001, p. 88). The few elements found on other settlement sites on Gotland and Åland could potentially also be imported bone elements imported from the mainland. All settlements of the Baltic Sea Island indicate reliance on maritime subsistence, Figures 4 and 5, apart from the Gotlandic site of Västerbjers. The differences between the Central-East Swedish area and the island of the Baltic Sea are minor. The islands of the Baltic Sea region indicate more reliance on a subsistence strategy based on pig/boar and a more terrestrial subsistence strategy compared to the Central-East Swedish sites. The main reason for this would be the chosen settlement areas. Figure 9, with more parameters, such as birds and fish, still indicates more similarities between the island of the Baltic Sea and Central-East Swedish sites. The difference is that the islands of Gotland and Åland indicate more vital marine mammals than Central Eastern Sweden due to the presence of fish and wild fur game.

The settlement of Tråsättra and Jettböle I and II yielded similar results, and this could be due to environmental adaptations. The settlement of Tråsättra was situated 80 km from the closest mainland (Björck et al., 2019, p. 7). The geographic isolation is similar to the island of Åland during the Middle Neolithic was situated over 100 km from the closest mainland (Mannermaa, 2001, p. 85). The settlement sites of Jettböle I, Jettböle II, and Åsgårda shows similar traits with heavy reliance on maritime mammals, see Figures 7 and 8. I would argue that the small island setting of Tråsättra made the inhabitants adapt to the local environment and ecological realities, which in turn is reflected in the heavy reliance on maritime mammals compared to that of Korsnäs and Äs. Another similarity, albeit small, is traces of fowling between Jettböle I (Mannermaa, 2001, p. 94) and the traces of limited fowling at the site of Tråsättra (Björck et al., 2019, p. 172).

5.2.5. The Abundance and Taphonomic Loss of Fish

The fish represents a large proportion of all NISP included in this thesis; see Figure 3. At the same time, the fish is also one of the more elusive categories. One example is the total exclusion of fish in the faunal assemblages of Åsgårda and Jettböle II. This poses the question of whether the fish was found and not included in the data or if the fish have not been analysed or not even found on these sites. Another interesting example is the settlement of Västerbjers, Gotland, which contained only 11 fish specimens (Stenberger et al., 1943, p. 107). Eriksson (2004, p. 137) mentions that the fish is lacking due to excavation techniques and later excavations in the latter half of the 20th century found a substantial number of fish. Another site with a low number of fish is the settlement site of Siretorp, and Dahr (1939, p. 245) commented that the amount should have been higher due to the coastal environment. One prospect for the low number of fish would be taphonomic loss due to the excavation technique, especially if the dirt was water sieved. The case study is presented in Chapter *3.6.1. Taphonomy* on pages 16-17.

Korsnäs yielded a large number of fish bones, but Aaris-Sørensen (1978, p. 11-12) argued that the total amount would have been higher if more dirt was water-sieved apart from the three sediment samples. This is further evident in Olson and Walther's (2007, p. 183) water-sieved older dirt samples through small, meshed sieves from Ajvide and Jettböle I and managed to retrieve small herringbones. Taphonomic issues and poor preserving conditions have also been discussed in Äs by Lepiksaar since the main finds are vertebrae from fish. This element withstands withering better and is particularly overrepresented amongst the perch, not for pikes. The pikes are softer and less sticking than the perch vertebrae and, therefore, more likely eaten by carrion birds, dogs, and invertebrates. Species of fish with high-fat content, like herrings and flatfish (*Pleuronectiformes*), have lower resistance against taphonomic processes (Lepiksaar, 1974, pp. 154-156). The few numbers of fish that remain in Stenberger et al. (1943, p. 107) are most likely different from the reality of the subsistence strategy of the PWC inhabitants. The general locations of all settlements also allow for fishing, and the resources are easy to acquire. Archaeological finds of a fishing weir system in the offshore area of the Kirial Bro settlement is further indications of the potential mass catch strategies amongst the Djursland settlements (Pleuger & Makarewicz, 2020, p. 364). The fishing strategies have been adapted based on regional parameters like the species living in the shore environment and the geographic location. Olson and Walther's (2007, p. 183) statement regarding the high importance of fish at the sites of Ajvide and Jettböle on a year-round basis is most likely similar for all included settlement areas in this thesis.

5.2.6. Wild boar or Domesticated pigs?

The debate around the domestication of wild/feral Pig/boar has been discussed for a long time, especially regarding the PWC settlements/sites of Gotland. The prospects of transferring pigs to Gotland from mainland Sweden were presented (Lepiksaar, 1974, p. 145). One perception of the pig/boars from Västerbjers, Gotland, is that they were not domesticated, but the question if they were feral pigs or wild boars is still open, according to Eriksson (2004, p. 155-156). Eriksson's (2004, p. 155-156) conclusion was based on an isotopic analysis of diet, which indicates on terrestrial diet amongst the pigs. The pigs' diet would have constituted a higher level of maritime diet if they lived among humans due to the presence of waste products within the settlement area (Eriksson, 2004, pp. 155-156). Other studies, such as Hägglund (2017, p. 29) on Ajvide, applied dental measurements of the third molars (M3) with Linear Enamel Hypoplasia (LEH) combined with an assessment of tooth wear to assess if pig/boar were domesticated or not. The following results and discussion were that the LEH indicates slightly larger M3 in the sampled material compared with domesticated pigs Hägglund (2017, p. 54-55). Hägglund (2017, p. 53) argues for a boar mixture with few signatures of domesticated pig. The LEH method has been criticised by Lumbye (2012, p. 15) because this method does not generate precise results. This study could not state if the pigs were domesticated, feral or wild boars. The issue is addressed in multiple studies and demands more profound attention to local environments, faunal remains and isotopic analysis. The pig/boar on Gotland must have been transported to the island by humans. One single tooth from pig/boar from Hemmor, Gotland, analysed by Fraser et al. (2018, p. 329), yielded Sr value in the upper vicinity of the local baseline. As stated by

Ahlström and Price (2021, p. 8), this could imply that the pig/boar were transported from Öland to Gotland as a living animal or as an imported tooth garment. As the continued reflection by Ahlström and Price (2021, p. 8) states that it would be hard to perceive these animals as wild regardless of their morphological affiliation with wild boar or domesticated animals if they were transported from neighbouring islands to Gotland.

Lepiksaar's (1974) morphological analysis of the pig/boar remains from Äs could not determine if they derived from wild boars or primitive domesticated pigs. They were smaller than the Mesolithic Scanian wild boar and more extensive than the contemporary pig/boar bones from Gotland but similar in size to modern wild boars in Germany (Lepiksaar, 1974, pp. 148-149). Olander (2010, p. 5) analysed the material from the 2009 excavation of Korsnäs and could not determine if the pig/boar represented wild boar or early forms of domesticated pigs. Measurements in the LSI have been used for studying the pig/boar from the Danish sites of Kainsbakke. The size of the pigs indicates a more diminutive stature compared to modern wild boars, based on Turkish boars. Therefore, the standing interpretation is that these remains are from husbanded pigs. Multiple factors have been combined for this conclusion, the small body size and moderate levels of slaughtered juvenile pigs. In addition, stable isotope analysis supports the notion of free-ranging animals (Makarewicz & Pleuger, 2020, pp. 292-295).

5.3. Does the Different Subsistence Strategies Reflect Cultural Variation in the PWC?

The aspect of dividing the Middle Neolithic cultures based on material culture and subsistence strategies have been critiqued by Jennbert (2007, p. 50; 2015, p. 68). Further discussions by Malmer (2002, p. 49: 122) and Jennbert (2015, p. 72) state that the boundary between the culture of FBC and PWC is far from sharp. The relationship between these cultures is also complex and uncertain, according to Larsson (2006, p. 279). Practising the mixed economy amongst PWC, especially in the Djursland material, confirms these statements of loose borders between cultural settings. The subsistence strategies do not, as previously stated by Jennbert (2007 & 2015), paint the whole picture of the PWC as a cultural entity. However, there are more remarkable similarities between the Central-Eastern Swedish settlements and Siretorp with the settlements of the Baltic Sea Islands. Therefore, the Djursland material could be another cultural setting of PWC. Malmer (2002, p. 126) discussed the possibility that the PWC inherited the tradition of FBC, especially in the mixed cult sites of Sarup and Alvastra. The exciting part in PWC sites on Djursland often is located on previous FBC settlements and re-purposed causewayed enclosure/ditch segments like the pit A47 in Kainsbakke (Wincentz, 2020, p. 56; Makarewicz & Pleuger, 2020, p. 279). The a-DNA studies have identified three genetically separated PWC, FBC, and BAC groups, but it does not always support different cultures. This is evident in the genetical study by Coutinho et al. (2020) on BAC-influenced PWC burials on Gotland that yielded PWC-DNA from the buried individuals. However, the individuals were buried in similar burial positions as the BAC and/or with BAC artefacts. The question is if these buried individuals identified themselves as BAC or PWC. Or perhaps even a local identity? The purpose of this thesis is to discover similarities and differences within the scope of subsistence strategies, and there is a prominent indication of cultural deviation amongst the PWC of Denmark.

5.3.1. The Potential of Local Cultural Hybridization in South Scandinavia

The number of cattle and sheep/goat in the Djursland faunal assemblage is unique for the PWC. The question is if the focus on cattle represents a local identity in Djursland or a more prominent Southwestern Scandinavian identity. Makarewicz and Pleuger (2020, p. 321) discuss the potential connections between the Djursland settlements with contemporary farming groups based on the mixed subsistence strategies and the limited importance of sealing. There have been discussions of a possible hybridisation of FBC and PWC in South Scandinavia. One reason behind this is the general mixed cultural expressions between PWC and FBC in the South Scandinavian PWC setting, according to Iversen (2010, p. 15). This mixed culture was then called creolisation by Iversen (2010, p. 27). I prefer to call the potentially mixed Neolithic culture “cultural hybridisation” instead of Creolization. The possibility of hybridisation is based on the finds of the possible incorporation of FBC traditions and mixed sustenance strategy of mixed animal husbandry and maritime hunting amongst the PWC in Kainsbakke and Kirial Bro. There are also possible burned cereals found at these settlement sites (Andreasen, 2020, p. 383; Makarewicz et al., 2020, p. 319; Price et al., 2021, p. 4-5) that indicate cultivations of cereals. Further evidence of mixed cultural identity is the mixed archaeological record in the area. Iversen (2010, p. 27) describes the Danish PWC material as mixed regional identities on the Jutland Peninsula, where the Djursland settlement is located, with little reuse of FBC megalithic tombs, compared with the Zealand area where the connections with the FBC were stronger. Iversen

(2010, p. 27) continues to find two possible clay figurines similar to those of the eastern Swedish areas and closer connections with the Jonstorp area.

The PWC settlements in Jonstorp, North-Western Scania, have a mixed archaeological material culture and, to some degree, the faunal assemblage. Seals dominate the faunal assemblage at Jonstorp, but bones from cattle, pigs, sheep/goats and fish are present (Jennbert, 2007, p. 53; Malmer, 2002, pp. 123-124). Malmer (2002, p. 123-124) describe that cattle remains are solely based on dental enamel and that the NISP is too small for determining the relative importance of animal husbandry and hunting. Makarewicz and Pleuger (2020, p. 287) argue that these faunal remains need further zooarchaeological information and ^{14}C-dating on the cattle bones to confirm these assessments. The latest statements are more reasonable before a suitable conclusion is drawn.

There have been connections between the Djursland settlements, especially Kainsbakke, with the PWC in Jonstorp and Southwestern Sweden. Another connectivity is the brown bear and Eurasian elk bone elements with clear Sr isotope values linked with mainland Sweden and support the idea of import from Swedish areas (Klassen et al., 2020b, p. 436 & 441; Makarewicz & Pleuger, 2020, pp. 299-300).

Another side of the identity debate is the presence of fish and seals in the Djursland faunal assemblages. According to Pleuger and Makarewicz (2020, p. 364-365), the presence of fish and sealing could be interpreted as a manifestation of their cultural identity as PWC. This includes terrestrial hunting. It would have set them apart from the contemporaneous farming groups in the area (Pleuger & Makarewicz, 2020, pp. 364-365). This relates to Iversen's (2010, p. 27) discussion of an ethnically distinct group of PWC in present-day Denmark. The influences are still relevant in the subsistence strategies of the Djursland settlement, which differentiates it from all other settlements included in this study. Some connections between farming groups and the PWC occurred.

Siretorp differentiated itself from the Djursland settlements, and according to Edenmo et al. (1997, p. 199), the PWC in South Sweden can be divided into two groups based on differences in the ceramic style. One was called the Siretorp group, and the other PWC group was identified in Jonstrop, North-Western Scania. The latter group had ceramics containing both FBC and PWC elements (Edenmo et al., 1997, p. 199). Further discussions by Mats Larsson in Edenmo et al. (1997, p. 201) is the concept of PWC is not relevant in the South Swedish region, and both groups were perceived as local groups with their own identity and could belong to later parts of FBC societies. These are interesting discussions and indications. There are clear signs of local entities within the PWC of South Scandinavia, both in present-day Sweden and Denmark. However, further studies are needed to be conducted with multiple variables.

5.3.2. The PWC of Central-Eastern Sweden and the Baltic Sea Islands

The concept of regional variation within the PWC has been suggested before. The coastal area of Central-Eastern Sweden and the islands of Gotland and Åland have been suggested to be one cultural centrum for the PWC in Edenmo et al. (1997, p. 202). The region differentiates itself through the material culture with a lower amount of tanged arrowhead and no presence of cylindrical blade core, both common in South and West Sweden. The ceramics also differentiates between Central-Eastern Sweden compared with South Sweden. They also include Megalith tombs in both South and West Sweden but not Central-Eastern Sweden, which indicates no social hierarchy in the East area (Edenmo et al., 1997, pp. 196-199). The subsistence strategies analysed within the scope of this thesis indicate that the similarities between the Central-Eastern region and the Baltic Sea regions are more extensive compared with South Scandinavia, apart from Siretorp. This could indicate a larger PWC geographic area with a strong identity associated with hunting and maybe pig herding. The latter is an intensely debated subject. However, it would indicate husbandry practice amongst the PWC if the pigs were domesticated. The connections between the Åland site of Jettböle and Tråsättra are suggested by the finds of clay figurines and similar maritime-focused subsistence strategies, which also can be linked to the island setting and isolation from mainland areas. No conclusions can be safely drawn because too few settlement sites are included in this pilot study. Areas in present-day central Sweden indicate possible husbandry practised amongst the PWC. Primarily the site of Alvastra was mentioned by Storå (2001, p. 4) as potential evidence for a flexible source of proteins amongst the PWC with the inclusion of domesticated mammals. The settlement of Alvastra has traces from both FBC and PWC and could be attributed to both cultures. The site's resemblance to the assemblage indicates cults of FBC but also contains large numbers of GRK pottery (Malmer, 2002, pp. 103-104). This begs the question of whether the cattle derived from a secure PWC context. If it does, then this would suggest that PWC groups in Central Sweden used cattle husbandry as a mode of subsistence (Makarewicz & Pleuger, 2020, p. 288). The settlement material would have been interesting to study in a future analysis of this topic. As with the South Scandinavian discussion, including and comparing FBC settlement from mainland Sweden would be interesting.

5.4 Conclusion and Future Studies

CA in comparative studies of faunal assemblages from multiple sites and geographic areas can be used to study subsistence strategies. The results have confirmed the unique setting of reliance on domesticated animals in the Djursland settlements of Ginnerup, Kainsbakke, and Kirial Bro. There is a local identity amongst the South Scandinavian PWC. The Central-Eastern Swedish sites and the settlements of Gotland and Åland indicate more extensive reliance on maritime mammals and pig/boar. Minor regional variations were detected. The question of hybridisation as an explanation for cattle herding amongst the Danish settlements is plausible. However, further studies should be conducted with multiple variables outside the faunal remains before safer conclusions can be drawn.

Future studies could narrow down the geographic area, focusing mainly on the South Scandinavian regions. The next step would be to include multiple variables in the CA, such as the settlement area's archaeological material and cultural mixture within the overall assemblage. It would also be interesting to compare FBC settlement's faunal remains with PWC in south Scandinavia to detect similarities and differences on a smaller regional level. Another focus could be a more extensive geographic study of Scandinavia, including more settlements and faunal remains. This type of study exceeds the scope/limit that a master's thesis allows. The question of farming is not geographically limited to southern Scandinavia. It would have been better if the study included more settlements from South Scandinavia to improve the statistical data. It would be interesting to compare FBC settlements to see similarities and differences.

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Appendix 1

Table 4: Declaration of Abbreviation in Appendix 1 and the Figures

Abbreviation	***Translation***
A	Åsgårda
AD1	Ajvide Dark Area 1
AD2	Ajvide Dark Area 2
As	Äs
AWA	Ajvide Wide Area
G1	Ginnerup
J1	Jettböle I
J2	Jettböle II
K1	Kainsbakke
K2	Kirial Bro
K3	Korsnäs
S1	Siretorp
T1	Tråsättra
Dom_Mam	Domesticated Mammals
Fur_Game	Fur Wild Game Animals
Marine_Mam	Marine Mammals
Pig/boar	Pig/Wild Boar
Terra_Game	Terrestrial Wild Game

Appendix 2: Principal Inertias

Figure 5:

Principal inertias (eigenvalues):

	1	2
Value	0.120286	0.029522
Percentage	80.29%	19.71%

Rows:

	AWA	AD1	AD2	As
Mass	0.277927	0.082666	0.070763	0.070370
ChiDist	0.110034	0.093249	0.252999	0.195368
Inertia	0.003365	0.000719	0.004529	0.002686
Dim. 1	-0.255505	-0.139259	-0.717979	0.537252
Dim. 2	0.379644	0.464247	0.260397	0.341825
	A	G1	Ire	J1
Mass	0.007563	0.015900	0.050829	0.106834
ChiDist	0.284480	0.668447	0.310724	0.570605
Inertia	0.000612	0.007104	0.004908	0.034784
Dim. 1	0.704269	-1.927245	0.818791	1.066882
Dim. 2	0.848764	-0.040083	0.734060	-2.528064
	J2	K1	K2	K3
Mass	0.004496	0.094513	0.017683	0.171094
ChiDist	0.260091	0.427711	0.127406	0.305133
Inertia	0.000304	0.017290	0.000287	0.015930
Dim. 1	0.625499	-1.135657	0.049592	0.796278
Dim. 2	0.835043	-0.970431	0.734726	0.755217
	S1	T1	VI	
Mass	0.008954	0.010382	0.010026	
ChiDist	0.110377	0.104541	2.385747	
Inertia	0.000109	0.000113	0.057067	
Dim. 1	-0.176638	0.288770	-6.858711	
Dim. 2	-0.534373	0.174447	-1.062230	

Columns:

	Terrestrial	Aquatic	Birds
Mass	0.111809	0.872977	0.015214
ChiDist	0.976860	0.123799	1.397983
Inertia	0.106695	0.013379	0.029733
Dim. 1	-2.815991	0.348613	0.691715
Dim. 2	-0.118251	0.154839	-8.015675

Figure 6:

Principal inertias (eigenvalues):

	1	2	3
Value	0.191465	0.150798	0.119621
Percentage	38.48%	30.31%	24.04%
	4	5	6
Value	0.026227	0.006582	0.002862
Percentage	5.27%	1.32%	0.58%

Rows:

	AWA	AD1	AD2	As
Mass	0.277927	0.082666	0.070763	0.070370
ChiDist	0.269824	0.260297	0.446790	0.360527
Inertia	0.020234	0.005601	0.014126	0.009147
Dim. 1	-0.358767	-0.115535	-0.653735	0.444248
Dim. 2	-0.348477	-0.514017	-0.233421	-0.571885
	A	G1	Ire	J1
Mass	0.007563	0.015900	0.050829	0.106834
ChiDist	2.645504	1.198517	0.318343	0.582944
Inertia	0.052933	0.022839	0.005151	0.036305
Dim. 1	-4.919441	1.671276	-0.136868	-0.218904
Dim. 2	3.317960	2.038213	-0.332520	-0.039741
	J2	K1	K2	K3
Mass	0.004496	0.094513	0.017683	0.171094
ChiDist	2.619276	1.136923	0.540551	0.430045
Inertia	0.030842	0.122167	0.005167	0.031642
Dim. 1	-4.851555	1.663464	1.135192	0.526989
Dim. 2	3.317407	2.240518	0.249000	-0.747578
	S1	T1	VI	
Mass	0.008954	0.010382	0.010026	
ChiDist	2.292821	1.520664	2.648376	
Inertia	0.047070	0.024007	0.070323	
Dim. 1	-4.073092	-2.623693	-1.665730	
Dim. 2	3.500379	1.439900	1.026439	

Columns:

	Dom_Mam	Terra_Game	Fur_game	Pig/boar
Mass	0.020221	0.008349	0.002644	0.080596
ChiDist	2.451017	2.065074	1.658710	1.181123
Inertia	0.121476	0.035604	0.007274	0.112436
Dim.	1 2.803486	2.788843	-0.285828	-0.861695
Dim.	2 5.368047	3.982112	0.550980	-0.191632
	Marine_Mam	Fish	Birds	
Mass	0.117502	0.755474	0.015214	
ChiDist	1.143907	0.222129	1.397983	
Inertia	0.153754	0.037276	0.029733	
Dim. 1	-2.310048	0.341849	0.224123	
Dim. 2	1.169391	-0.371754	1.028050	

Figure 8:

Principal inertias (eigenvalues):

	1	2	3	4
Value	0.61572	0.230058	0.046275	0.008074
Percentage	68.4%	25.56%	5.14%	0.9%

Rows:

	AWA	AD1	AD2	As
Mass	0.321995	0.078255	0.105229	0.030862
ChiDist	0.444629	0.538306	0.499910	0.854059
Inertia	0.063657	0.022676	0.026298	0.022511
Dim. 1	-0.452079	-0.458060	-0.460081	-0.062599
Dim. 2	-0.548817	-0.827204	-0.712706	0.133534
	A	G1	Ire	J1
Mass	0.032983	0.022704	0.036735	0.076298
ChiDist	0.913342	1.718388	0.742187	0.962916
Innertia	0.027514	0.067043	0.020235	0.070744
Dim. 1	-0.416119	2.036783	-0.471247	-0.515572
Dim. 2	1.741229	-0.658704	1.338805	1.784563
	J2	K1	K2	K3
Mass	0.019605	0.112652	0.008919	0.044811
ChiDist	0.895839	1.968300	1.845472	0.570372
Inertia	0.015733	0.436437	0.030375	0.014578
Dim. 1	-0.402918	2.500325	2.322949	-0.262179
Dim. 2	1.709628	0.162550	-0.061422	0.469424
	S1	T1	VI	
Mass	0.037850	0.028224	0.042880	
ChiDist	0.718535	0.919095	0.952995	
Inertia	0.019542	0.023842	0.038944	
Dim. 1	-0.238039	-0.445493	-0.122802	
Dim. 2	1.410750	1.525686	-1.965044	

Columns:

	Dom_Mam	Terra_Game	Fur_game	Pig/boar
Mass	0.088180	0.036409	0.011529	0.351470
ChiDist	2.194094	1.907552	1.756475	0.681728
Inertia	0.424503	0.132482	0.035569	0.163347
Dim. 1	2.777636	2.293628	0.123134	-0.323663
Dim. 2	0.106453	0.106630	0.778472	-1.318996
	Marine_Mam			
Mass	0.512413			
ChiDist	0.530532			
Inertia	0.144226			
Dim. 1	-0.421734			
Dim. 2	0.861304			

Figure 9:

Principal inertias (eigenvalues):

	1	2
Value	0.141348	0.047775
Percentage	74.74%	25.26%

Rows:

	Baltic Sea Island	Central Eastern Sweden	Southern Scandinavia
Mass	0.540623	0.297489	0.161888
ChiDist	0.255031	0.348541	0.853109
Inertia	0.035163	0.036139	0.117821
Dim. 1	-0.511121	-0.304242	2.265965
Dim. 2	0.767120	-1.506288	0.206202

Columns:

	Dom_Mam	Terra_Game	Fur_game	Pig/boar
Mass	0.023819	0.009855	0.002976	0.067274
ChiDist	2.098797	1.695753	0.801071	0.563794
Inertia	0.104922	0.028338	0.001909	0.021384
Dim. 1	5.545853	4.508027	0.239284	-0.676428
Dim. 2	1.097957	-0.253387	-3.641776	2.302084
	Marine_Mam	Fish	Birds	
Mass	0.117247	0.761941	0.016888	
ChiDist	0.390910	0.119950	0.467420	
Inertia	0.017917	0.010963	0.003690	
Dim. 1	-0.447992	-0.113135	0.414431	
Dim. 2	1.613925	-0.513121	2.016172	

Figure 10:

Principal inertias (eigenvalues):

	1	2
Value	0.473006	0.014671
Percentage	96.99%	3.01%

Rows:

	Baltic Sea Island	Central Eastern Sweden	Southern Scandinavia
Mass	0.656034	0.120169	0.223797
ChiDist	0.392652	0.414868	1.278567
Inertia	0.101145	0.020683	0.365849
Dim. 1	0.565332	0.375718	-1.858941
Dim. 2	0.452451	-2.679639	0.112539

Columns:

	Dom_Mam	Terra_Game	Pig/boar	Marine_Mam
Mass	0.109165	0.045165	0.308321	0.537350
ChiDist	1.706030	1.404267	0.362794	0.273873
Inertia	0.317728	0.089063	0.040581	0.040305
Dim. 1	-2.473276	-1.980220	0.494787	0.384995
Dim. 2	1.080237	-2.826186	1.038467	-0.577763

Figure 12:

Principal inertias (eigenvalues):

	1	2
Value	0.115473	0.00296
Percentage	97.5%	2.5%

Rows:

	As	K3	T1
Mass	0.290730	0.436236	0.273034
ChiDist	0.368587	0.103252	0.521607
Inertia	0.039497	0.004651	0.074285
Dim. 1	-1.069244	-0.246477	1.532352
Dim. 2	-1.138565	1.109769	-0.560757

Columns:

	Dom_Mam	Terra_Game	Pig/boar	Marine_Mam
Mass	0.001124	0.063483	0.243820	0.691573
ChiDist	0.880648	0.624927	0.485922	0.225603
Inertia	0.000871	0.024792	0.057571	0.035199
Dim. 1	0.681415	-1.779316	-1.422940	0.663896
Dim. 2	-15.616226	-2.903089	0.884352	-0.019925

Figure 14:

Principal inertias (eigenvalues):

	1	2	3
Value	0.288927	0.031958	0.001031
Percentage	89.75%	9.93%	0.32%

Rows:

	AWA	A	Ire	J1
Mass	0.606998	0.062310	0.068227	0.144379
ChiDist	0.274669	0.797823	0.596610	0.806071
Inertia	0.045794	0.039662	0.024285	0.093810
Dim. 1	0.467709	-1.401995	-1.103461	-1.499195
Dim. 2	0.618863	-1.410689	-0.271525	-0.042498

	J2	VI
Mass	0.037098	0.080988
ChiDist	0.788120	1.084895
Innertia	0.023043	0.095322
Dim. 1	-1.387988	1.811257
Dim. 2	-1.246543	-2.677467

Columns:

	Dom_Mam	Terra_Game	Pig/boar	Marine_Mam
Mass	0.010651	0.003396	0.385181	0.600772
ChiDist	1.797477	0.709118	0.666497	0.436929
Inertia	0.034412	0.001708	0.171105	0.114691
Dim. 1	1.132119	-0.060925	1.237016	-0.812833
Dim. 2	-9.457393	-2.537345	0.256335	0.017662

Figure 16:

Principal inertias (eigenvalues):

	1	2	3
Value	0.491973	0.056784	0.000375
Percentage	89.59%	10.34%	0.07%

Rows:

	K1	K2	G1	S1
Mass	0.618552	0.048416	0.124133	0.208899
ChiDist	0.348230	0.415435	0.805591	1.357938
Inertia	0.075008	0.008356	0.080559	0.385209
Dim. 1	-0.452191	-0.556655	-0.785484	1.934710
Dim. 2	0.603024	-0.477928	-2.465961	-0.209459

Columns:

	Dom_Mam	Terra_Game	Pig/boar	Marine_Mam
Mass	0.455958	0.157768	0.117647	0.268627
ChiDist	0.461328	0.522106	0.658426	1.154562
Inertia	0.097038	0.043007	0.051003	0.358084
Dim. 1	-0.603701	-0.721699	-0.450705	1.645950
Dim. 2	0.767296	-0.507771	-2.421817	0.056491

Appendix 2: Database

Locations/Species	Kainsbakke	Kirial bro	Ginnerup	Tråsättra	Ajvide dark area 1 (Inside)	Ajvide dark area 1	Ajvide dark area 2 (Inside)	Ajvide dark area 2 (Inside)	Ajvide wide area	Korsnäs	Jettböle I	Jettböle II	Åsgårda	Västerbjers	Ire	Siretorp (PWC contexts)	Äs	Total
Bos spp.	2165	128	149	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2442**
Aurochs	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**17**
Bos taurus	0	0	17	2	0	0	1	0	5	0	4	16	31	54	2	75	2	**209**
Ovis/Capra	228	20	147	0	4	0	4	0	25	0	0	0	0	57	10	15	0	**510**
Ovis aries	34	14	2	0	0	0	0	0	0	0	0	0	3	0	0	0	0	**53**
Capra hircus	11	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**12**
Cervidae sp.	0	0	7	5	0	0	1	0	28	0	0	0	0	0	0	10	39	**90**
Alces alces	28	1	6	5	0	0	0	0	0	88	13	2	2	0	0	0	58	**203**
Cervus elaphus	696	73	31	0	0	0	0	0	0	0	0	7	0	0	1	0	11	**819**
Capreolous capreolous	9	0	30	0	0	0	0	0	0	8	0	0	0	0	0	0	11	**58**
Equus sp	9	3	143	0	0	0	0	0	0	0	0	0	0	12	1	0	1	**169**
Sus scrofa	386	51	241	55	1591	68	2002	131	6086	444	1	5	2	1262	130	83	369	**12907**
Sus dom.	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**10**
Wild boar	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**9**
Canis sp.	29	1	2	0	10	5	2	2	31	0	0	0	0	0	0	0	0	**82**
Canis familiaris	0	0	0	7	59	1	36	0	164	47	0	0	0	117	121	0	9	**561**
Vulpes vulpes	3	0	0	1	37	0	40	4	127	0	0	0	0	13	4	0	1	**230**
Lynx lynx	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	**3**
Felis silvestris	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	3	3	**11**
Ursus arctos	31	1	2	2	0	0	0	0	0	3	0	0	0	0	0	0	12	**51**
Meles meles	3	0	1	0	0	0	0	0	0	8	0	0	0	0	0	0	3	**15**
Lutra lutra	0	0	0	14	0	0	0	0	0	17	0	0	0	0	0	0	11	**42**
Martes martes	0	0	1	15	0	0	0	0	0	5	0	0	0	0	0	2	27	**50**
Mustela putorius	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
Erinaceus europeus	0	0	0	0	1	0	8	0	13	0	0	0	0	0	8	0	0	**30**
Castor fiber	7	6	0	21	0	0	0	0	0	45	0	0	2	0	2	0	39	**122**

Sciurus vulgaris	0	0	2	2	0	0	0	0	0	5	0	0	0	0	0	0	0	**9**
Arvicola terrestris	0	0	10	0	0	0	0	0	0	3	0	0	0	0	0	0	4	**17**
Muridae	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	**4**
Talpa europaea	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Rodentia sp.	0	0	1	0	4	0	1	0	7	0	0	0	0	0	0	0	0	**13**
Lepus sp.	1	0	2	9	6	0	5	0	32	9	0	0	0	3	15	2	5	**89**
Phocoena phocoena	0	0	0	9	1	0	2	1	5	19	0	0	0	0	0	0	0	**37**
Pinnipedia sp.	399	22	12	744	1076	131	1603	112	5648	954	1007	327	528	189	1112	1202	0	**15066**
P. hispida	0	0	0	102	0	0	0	0	0	1	397	143	193	0	12	0	542	**1390**
Halichoerus gryphys	101	8	0	0	0	0	0	0	0	1	1	1	11	0	0	0	0	**123**
Pagophilus groenlandicus	10	1	1	50	0	0	0	0	0	38	1383	220	441	0	58	0	2	**2204**
Phoca vitulina	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**25**
Mammalia sp.	1741	509	10495	0	0	0	0	0	0	8230	8	20	26	0	0	0	0	**21029**
Aves sp.	347	0	23	0	57	9	79	2	282	28	302	0	0	20	0	0	0	**1149**
Alca torda	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	**2**
Anas platyrhynchos	0	0	0	0	0	0	0	0	0	1	4	0	0	0	0	0	8	**13**
Anas sp/Anatinae sp.	0	0	0	0	0	0	0	0	0	13	146	0	0	0	0	0	0	**159**
Anser sp.	12	0	0	0	0	0	0	0	0	0	3	0	0	0	3	0	0	**18**
Arenaria interpres	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	**1**
Accipiter gentilis	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
Bucephala clangula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53	**53**
Buteo buteo	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**3**
Cepphus sp.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	**1**
Cepphus grylle	0	0	0	0	0	0	0	0	0	0	12	0	0	0	2	0	0	**14**
Clargula hyemalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**1**
Columbidae	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Corvus sp.	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**5**
Corvus corone	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	**1**
Cygnus cygnus	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	3	**20**
Cygnus olor	5	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	**18**
Cygnus sp.	17	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	**19**
Gavia arctica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**1**
Gavia stellata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**
Grus grus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**1**

Haliaeetinae sp.	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	37	0	**39**
Haliaeetus albicilla	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	**3**
Hirundo rustica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**1**
Laridae sp.	0	0	0	0	0	0	0	0	0	1	6	0	0	0	2	0	0	**9**
Melanitta sp.	0	0	0	0	0	0	0	0	0	0	23	0	0	0	0	0	0	**23**
Melanitta nigra	0	0	0	1	0	0	0	0	0	0	2	0	0	0	1	0	0	**4**
Melanitta fusca	0	0	0	0	0	0	0	0	0	1	102	0	0	0	1	0	0	**104**
Mergus sp.	0	0	0	0	0	0	0	0	0	2	16	0	0	0	3	0	0	**21**
Mergus serrator	0	0	0	1	0	0	0	0	0	2	2	0	0	0	2	0	0	**7**
Mergus merganser	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	38	**46**
Numenius arquata	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	**2**
Phalacrocorax sp.	87	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**88**
Phalacrocorax carbo	0	0	0	0	0	0	0	0	0	0	7	0	0	0	1	0	0	**8**
Philomachus	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	**1**
Podiceps cristatus	0	0	0	1	0	0	0	0	0	4	0	0	0	0	0	0	0	**5**
Somateria mollissima	0	0	0	1	0	0	0	0	0	5	573	0	0	0	0	0	10	**589**
Scolopax rusticola	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
Sturnus vulgaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	**3**
Tetrao urgallus	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	**2**
Lyrurus tetrix	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
Spatula clypeata	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Aves sp.	0	0	0	0	7588	2726	7161	237	32450	2015	9774	0	0	11	0	7	0	**61969**
Acipenser sturio	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	**2**
Anguilla anguilla	959	51	183	1	0	0	0	0	0	13	0	0	0	0	0	0	0	**1207**
Abramis brama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	**2**
Leuciscus cephalus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	**4**
Leuciscus idus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	**12**
Scardinius erythr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	**2**
Blicca bjoerkna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**
Belone belone	1062	52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1114**
Clupea harengus	10	0	5	14	0	0	0	0	0	21746	538	0	0	0	2940	0	11	**25264**

Cyprinidae	0	0	1	36	0	0	0	0	0	13	0	0	0	0	0	0	506	**556**
Rutilus rutilus	0	0	0	2	0	0	0	0	0	24	0	0	0	0	0	0	202	**228**
Coregonus sp.	0	0	0	20	0	0	0	0	0	13	0	0	0	0	0	0	35	**68**
Esox lucius	0	0	0	278	0	0	0	0	0	394	24	0	0	0	55	0	987	**1738**
Gadidae sp.	1979	117	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2098**
Gadus morhua	0	0	0	14	0	0	0	0	0	8	2734	0	0	0	3584	0	0	**6340**
Pollachius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Dicentrarchus labrax	84	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**86**
D. labrax/Chelon sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Chelon sp.	383	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**383**
Cottidae sp.	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
myoxocephalus scorpius	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**8**
Percidae sp.	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	**3**
Perca fluviatilis	0	0	0	220	0	0	0	0	0	1463	7	0	0	0	25	0	8234	**9949**
Stizostedion lucioperca	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	34	**50**
Pleuronectidae sp.	459	45	246	0	0	0	0	0	0	0	9	0	0	0	154	0	0	**913**
Salmonidae sp.	244	8	20	0	0	0	0	0	0	0	0	0	0	0	10	0	0	**282**
Platicthys flesus	0	0	0	0	0	0	0	0	0	28	0	0	0	0	0	0	3	**31**
Scophthalmus maximus	0	0	0	0	0	0	0	0	0	12	7	0	0	0	0	0	0	**19**
Scomber scombrus	94	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**102**
Lota lota	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**
Tinca tinca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	4	**12**
Trachinus draco	5265	2228	1224	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**8717**
Total	**16931**	**3346**	**13059**	**1673**	**10434**	**2940**	**10945**	**489**	**44903**	**3572**	**17142**	**741**	**1239**	**1738**	**8277**	**1436**	**11300**	**182317**

Appendix 3: Presentation of Settlements

Ajvide, Gotland

The settlement area of Ajvide, Eksta parish, is situated on the west coast of Gotland, Sweden. Ajvide with all contexts is ^{14}C-dating to ca. 3100-2300 BCE and indicated on long PWC presence on the site (Sjöstrand, 2020, p. 79). The site has been highly investigated, and large-scale excavations were conducted on the site in the 1980s and 1990s (Storå, 2001, p. 15). The whole settlement area covers an area of 200 000 m^2 (Sjöstrand, 2022, p. 20; Storå, 2001, p. 15). The site of Ajvide is divided into three different categories for this study, and all osteological data is collected from Alexander Sjöstrand (2022). These three categories are called Ajvide, meaning "wide area", which represents all faunal remains presented in Sjöstrand (2022, p. 92), followed by two singular contexts called "Dark Area 1" (Sjöstrand, 2022, pp. 98-99) and "Dark Area 2" (Sjöstrand, 2022, pp. 128-130). Both Dark Areas have smaller contexts divided into an inside and outside, respectively. In this thesis, the areas inside and outside are multiplied as one unit for each dark area (Sjöstrand, 2020, p. 79).

Table 1: Overall presentation of all faunal assemblage collected about Ajvide from Sjöstrand (2022); Amphibians are included.

	Tot. NISP (incl. Unidentified)	Weight (g)	Identified NISP	Identified NISP Weight (g)
Ajvide Dark Area 1 Inside	37999	24160	10436	7856
Ajvide Dark Area 1 outside	5240	1726	2941	975
Dark area 2 Inside	35192	28187	10946	13562
Dark area 2 outside	3276	2545	489	888
Ajvide site wide	139096	99244	44916	44452

Ajvide Dark Area 1

Dark Area 1 is dated to ca. 3000-2900 BCE (Sjöstrand, 2022, p. 123). The feature was identified in 1992 and had clear demarcation. The feature size is 20x11 m and contains the largest concentration of ceramics and artefacts in the whole excavated site of Ajvide and the second-largest faunal assemblage. (Sjöstrand, 2022, p. 29).

Ajvide Dark Area 2

Dark Area 2 is dated to ca. 2600-2200 BCE (Sjöstrand, 2022, p. 146). The feature was subjected to a small number of test pits in 1983 and full excavation by 2006. The size of Dark Area 2 is ca. 11x16 m, and the surface contained the largest concentration of faunal assemblage and the second largest amount of ceramic and artefacts. This context did not have clear demarcation like Dark Area 1 (Sjöstrand, 2022, pp. 30-31).

Ire, Gotland

The PWC of Ire is located on the northwest coast of Gotland, Sweden (Storå, 2001. p. 15). The faunal remains from Ire are collected from an osteological analysis performed by Jan Ekman (1974).

Västerbjers, Gotland

The PWC site of Västerbjers is located on the east coast of Gotland, and the main pottery found on the site is typical PWC style (Storå, 2001, p. 16). The faunal remains presented in this study from Västerbjers derive from the osteological data analysed by Dahr (1943, p. 107). The human and faunal remains were radiocarbon-dated (Eriksson, 2004, pp. 149-153), and the final analysis presented the results of 2900-2500 cal. BCE was the cemetery used (Eriksson, 2004, p. 159). Signs of intrusion from Bronze Age material in Västerbjers (Eriksson, 2004, p. 149).

Jettböle I and Jettböle II, Åland

The PWC site of Jettböle is located on Åland and the Ålandic Islands, and there are at least 20 contemporary PWC sites. Jettböle PWC settlements are divided into two phases: Jettböle I and II. This division is based on the pottery material and based on the settlement area in relation to the sea level. They are physically separated by ca. 150 m (Götherström et al., 2002, p. 45).

The settlement area of Jettböle I have been ^{14}C-dated to ca. 3370-2840 cal. BCE (Storå, 2000, p. 63. Jettböle I is one of the largest PWC sites on the Ålandic islands, and during the middle Neolithic, the archipelago of Åland consisted of a bunch of smaller islands. The closest distance to the mainland was over 100 km (Mannermaa, 2002, pp. 85-86). The faunal remains from the site of Jettböle I originate from excavations in 1905, 1906, 1908 and 1911 by Björn Cederhvarf. The faunal material has been re-analysed by Storå, and the faunal remains originated from the main trench called A-180 m^2 (Storå, 2001, p. 13).

The osteological data for the Jettböle I site was collected from multiple studies. The data of Mammals derived from Storå 2000; 2001 & 2002. The seals were presented in Storå (2000, p. 60) and Storå (2002, p. 53). All other mammals were presented in Storå (2000, p. 61). The main issue was that the following species of hares, dogs and porpoises were identified without presenting the number of identified specimens (Storå, 2000, pp. 60-61). These species were subsequently dismissed from this study. The bird material was collected from Mannermaa's (2002) study. The fish material was collected from Olson and Walther (2007) and based on two soil samples: one from the 1911 excavation, the other contained a 0.5-litre soil sample from the 1999 excavation (Olson & Walther, 2007, pp. 177-178).

The Jettböle II settlement proved hard to ^{14}C-dated, the archaeological material resembles that of the Jettböle I phase, and one pig bone was dated to the Iron Age (Storå, 2000, p. 67). The osteological data were collected from Storå in 2000, 2001 & 2002 and included only mammalian species. Following species were left out because their presence was only marked with a cross and no number of identified specimens: hares, dogs and porpoises.

Åsgårda, Åland

The PWC site of Åsgårda in Saltvik, Åland. The settlement complex is divided into two separate phases the older phase includes pottery of Jettböle I type, and the younger phase includes Jettböle II pottery type. The settlement is probably contemporary with the settlements of Jettböle I and II. Åsgårda were excavated between 1991 and 1992, and the upper layers were disturbed by agricultural practices. The archaeological material is rich in lithics, pottery, both burned and unburned bones and 32 clay figurines, including intrusion from other archaeological material cultures and bronze-age pottery. The disturbance is also evident with the ^{14}C-datings dated to the Bronze Age in four cattle teeth. The lower layers were undisturbed and could be dated to the late Middle Neolithic. Two bones from sheep and cattle were dated to the early Neolithic. These dates from the lower layers indicate a long period of accumulation of material, and the late Middle Neolithic and early late Neolithic finds cannot be separated based on stratigraphy. Generally, the faunal remains were well preserved and dominated by the harp and ringed seals (Storå, 2000, pp. 68-69).

Korsnäs, Södermanland, Sweden

The settlement of Korsnäs, Södermanland in Sweden is ^{14}C-dated dated to around 3350-2640 cal. BCE was during the Middle Neolithic, situated on an isthmus in an inner archipelago environment. Approximately 30 known PWC sites are in the surrounding area of Korsnäs (Fornander, 2010, pp. 3-6; Fornander, 2011a, pp. 33-34; Fornander, 2011b, pp. 3-6). The osteological material from Korsnäs is based on two separate osteological analyses: Kim Aaris-Sørensen (1978) and Maria Olander (2010). Aaris-Sørensen (1978, p. 3) analysed the faunal assemblage from the excavation season of 1970, and Olander (2010) analysed the faunal assemblage from the seminar excavation 2009.

Tråsättra, Uppland Sweden

The settlement of Tråsättra is located in Österåkers parish, Uppland and is ^{14}C-dated to ca. 2630-2470 BCE. The location of Tråsättra was situated on an archipelago of present-day Mälardalen. The closest mainland site was 80 km in the northwest and southwest. The site contained over 300 clay figurines and traces of possible burials without human remains preserved (Björck et al., 2019, p. 7; 49). In addition, there are 38 known Neolithic locals within a radius of 15 km from Tråsättra (Björck et al., 2019, pp. 9-11; 49). The faunal assemblage of Tråsättra was investigated by the osteologist Ola Magnell (Björck et al., 2019, p. 49). The faunal assemblage was highly fragmented and burned. As a result, only 1673 fragments could be identified as species seal dominates the faunal assemblage, and Pig/boar dominates the terrestrial mammals, but only with a few per cent (Björck et al., 2019, p. 49, 167-169).

Äs, Västmanland Sweden

Äs was a PWC site in present-day Västmanland in Sweden on an esker. The site is located between Västerås and Sala, 10 km north of Västerås (Löfstrand, 1974, p. 34). One is ^{14}C-dated was taken on faunal remains during 1974 that yielded the result 3775± 105 BP, but the results could not be fitted in the archaeological chronology (Löfstrand, 1974, pp. 106-107). During the Neolithic, the area around Äs was an inner archipelago with brackish sea water levels 33-37 m higher than present sea levels (Löfstrand, 1974, p. 55; 134). The site was investigated in 1948 and 1970, and the remains of two settlement areas were discovered and named Äs 1 and Äs 2. The settlement of Äs 1 was determined to be the bigger one and lay 300 m south of the Eastern side of the esker (Löfstrand, 1974, p. 34). The osteological material from Äs used in this study was analysed by Lepiksaar in 1974 from faunal remains uncovered in the excavation of 1967. The general description of the faunal remains was that the material was fragile and fragmented. In turn, this made it highly possible that multiple fragments could belong to the same animal and bone element and one single specimen being identified multiple times (Lepiksaar, 1974, pp. 140-142).

Siretorp, Blekinge, Sweden

The Siretorp area is outside the present-day town of Sölvesborg in Blekinge, Sweden. The sites were first uncovered by Fritz Reventlow in 1902 (Bagge & Kjellmark, 1939, p. 17). The location of Siretorp has yielded more than 20 sites in an area of 5x5km. The PWC sites in the area have stratigraphic issues with Ertebölle layers intermixed with the PWC (Larsson, 2006, pp. 53-54). The faunal assemblage from Siretorp used in this thesis is based on Dahr (1939, p. 242). The site contained layers interpreted as late Mesolithic Ertebölle and the Neolithic CWC. This included bone material from three different layers named M, a, and ca. These bone materials were excluded from this study, in total, 37 NISP of 1469.

Ginnerup, Djursland, Denmark

The settlement site of Ginnerup is located on a hill on the north-western edge of the present-day village of Ginnerup. During the Stone Age, the site was on a plateau above the previous Kolindsund Fjord (Rasmussen, 2020, pp. 195-197; Makarewicz & Pleuger, 2020, p. 319). There were seven initial ^{14}C-datings performed at Ginnerup, and the results are difficult to interpret (Philippsen et al., 2020, pp. 259-260). After the excavations in 2020, a new ^{14}C-analysis generated the ca. 3100-2920 cal result. BCE indicates an older presence of PWC compared to Kirial Bro and Kainsbakke sites, with approximately 50-100 years (Klassen et al., 2023, p. 37). There is a small amount of FBC artefacts found at the site. Still, the primary find categories were categorised as PWC artefacts found in pit structures during the trial excavations of the field seasons of 2001 and 2003 (Rasmussen, 2020, p. 195). The excavations of Ginnerup are ongoing, and the latest published material is based on the 2020 field season. The excavation started in 2020 and is planned to be finished during the 2023 season (Klassen et al., 2023, p. 37). The osteological data from the pre-2020 years excavation of Ginnerup was analysed by Makarewicz and Pleuger (2020). The data about unearthed faunal remains for the 2020 excavation was collected from Klassen et al. (2023); see Figure 2.

Kainsbakke, Djursland, Denmark

The site of Kainsbakke is situated in north-eastern Djursland during the Middle Neolithic. The settlement was on a sizeable island separated from the peninsula by the Neolithic Kolindsund Fjord (Makarewicz & Pleuger, 2020, p. 279; Wincentz, 2020, p. 36). The dating of Kainsbakke has been problematic due to the admixture of FBC activity with the PWC. The earliest part of PWC at Kainsbakke is around 3000 BC to around 2700 BC, when both ^{14}C dating and archaeological material generate evidence for the further presence of PWC (Philippsen et al., 2020, pp. 270-271). Other dates presented for Kainsbakke are a PWC occupation between 3050-2800 BC (Makarewicz & Pleuger, 2020, p. 279). The settlements have been the subjects of multiple excavations between 1979, 1982, 2001-2003, and 2009. Approximately 2700 m^2 has been excavated, which is only 4% of the total core area of the settlement (Wincentz, 2020, pp. 38-39). Most of the cultural material and faunal assemblage from Kainsbakke was recovered from pit A47. This feature's dimensions were 5,7x4,5 m across and 1 m deep and were originally part of FBC causewayed enclosures. This construction was later reused by PWC group A47. There are some indications of the ritual function of pit A47, which is based on the careful deposition of specific animal skeletal parts within the generalised midden deposits (Makarewicz & Pleuger, 2020, pp. 279-280; Wincentz, 2020, pp. 44-56). The faunal remains from Kainsbakke included in this thesis are based on osteological works performed by Makarewicz and Pleuger (2020). The overall faunal assemblage of Kainsbakke included excavation in 1979-1982 and the excavation from 2002-2003. Therefore, the older material analysed by Jane Richter (1986a & 1989) was re-analysed with the new faunal assemblage (Makarewicz & Pleuger, 2020, p. 279; Pleuger & Makarewicz, 2020, p. 344).

Kirial Bro, Djursland, Denmark

The Kirial Bro settlement is 1 km east of Kainsbakke and 3,5 km west of present-day Grenaa, Djurland, Denmark. During the Neolithic, the settlement was located along the northward branch of a Kolindsund fjord system (Wincentz, 2020, p. 116, 137; Makarewicz & Pleuger, 2020, p. 317). The ^{14}C-dating generated different results, and cereal grains were dated to an actual age between 3011-2975 BCE with 12,6% probability and 2943-2895 BCE with 82,8% probability. Older AMS dates generated a result of 3016-2897 cal. BCE with a probability of 95,4% and 3016-2897 cal. BCE with a probability of 95,6%. The complexity in interpreting the ^{14}C-datings at Kirial Bro is due to the settlement site's shallow and ploughed-down kitchen middens and cultural layers. (Philippsen et al., 2020, p. 263). This confusing dating has been interpreted to be at least contemporary with the PWC site of Kainsbakke around 2900 BCE. It also concurs with the artefact assemblage between these two sites (Wincentz, 2020, p. 136). The settlement of Kirial Bro has been known for more than a century and is comprised of heavily plough-damaged shell deposits (Wincentz, 2020, p. 137). The site also contained material and artefacts attributed to both the Late Mesolithic culture of Ertbölle and the Neolithic farmers of FBC (Wincentz, 2020, p. 116, 137; Makarewicz & Pleuger, 2020, p. 317). The faunal assemblage of Kirial Bro is investigated by Makarewicz and Pleuger (2020). The cattle were the most prominent species in the faunal remains from Kirial Bro, followed by red deer and pigs. The diagrams did not include two kinds of bird bones (Makarewicz & Pleuger, 2020, pp. 318-319).