

ALL IS FISH THAT COMES TO HIS NET

*contextualising subsistence strategy, animal economy and mobility in coastal
Sweden's Mesolithic past*

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ABSTRACT

In an extensive analysis of seven coastal sites that are spread across the East and West coast of southern Sweden, animal economy and specialised hunting is at the forefront of interpreting the subsistence strategy and mobility in Mesolithic hunter-gatherer societies. Through comparative data, the following thesis will observe the differences and similarities between the aforementioned coastal regions of southern Sweden in an attempt to study the possible seasonality and sedentism of residential locations. In order to express a more nuanced variation between mobile and sedentary sites, the island of Blå Jungfrun, located on the East coast of southern Sweden, will be presented as the primary outlier when contrasting the utility and function of the various sites between one another. With an osteological assemblage that has never officially been analysed before, Blå Jungfrun offers a unique opportunity to discuss the definition of sedentary and mobile foragers, as well as provide arguments for a diverse Mesolithic past in southern Sweden – a past that is interpreted as complex with opportunistic and specialised subsistence strategies.

Keywords

Blå Jungfrun; coastal landscapes; mesolithic; osteology; zooarchaeology; mobility; diet; sedentism; subsistence strategy; hunter-gatherer

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1. INTRODUCTION

“Consider the subtleness of the sea; how its most dreaded creatures glide under water, unapparent for the most part, and treacherously hidden beneath the loveliest tints of azure..... Consider all this; and then turn to this green, gentle, and most docile earth; consider them both, the sea and the land; and do you not find a strange analogy to something in yourself?” - Moby Dick, Herman Melville.

Coastal environments and waterways have always been integrated in the life and world of the Mesolithic. More than just geographical points of interests, seascapes would have provided an amplitude of resources and means for transportation; essentially representing a vital basis of life to the people and animals that inhabited them (Mansrud, 2017; Fossum, 2020). Climatic and environmental shifts could consequently have led to dramatic events that changed the history of the landscape, causing a domino effect that would have changed the mobility and behaviour of animals and humans alike. It would have changed the way humans perceived their milieu and worldview, affecting not only their survival but also their relation to water (Mansrud, 2017).

Optimal foraging theory and ethnographic data is repeatedly used when interpreting the mobility and prey selection of hunter-gatherer societies, in order to study the movement between resources and shifts in subsistence strategy (Boethius *et al.*, 2020). Animals would have been extensively used and viewed as valuable resources for more than just consumption (David, 2017: 166). The ways of exploiting a certain bone for the same purpose can be diametrically different from one group to another, and from one species to another (David, 2017: 167). In the way that faunal resources are killed, acquired, transformed, exchanged and represented, the species and products related to them are applied a certain social value, such as taboos, beliefs and symbolism. In tangent with these social values, the consumption, acquisition, manufacture and use of animal products are what subsequently lead to practices that affect Mesolithic communities and their subsistence strategies.

Many factors are at play when estimating the accessibility to prey and the mobility of peoples, such as the seasonal migrations of game, stationary methods of capture and the quantity to quality ratios of an animal. Consequently, it creates a controversy about the opportunistic, specialised and selective choices that is assumed to affect foraging behaviour (Rivals *et al.*, 2004). Moreover, it questions the traditional view of Mesolithic communities that has otherwise been labelled as highly mobile and nomadic. Whilst some hunter-gatherers likely practised a higher mobility rate than others, this study will look deeper into what defines a mobile behaviour versus a stationary behaviour based on subsistence strategy and animal economy.

1.1 STUDY AREA

The primary material of this thesis has been analysed from the site of Blå Jungfrun, a small island situated in the Kalmar Strait. The site itself has been registered since 2001, but the official excavation was conducted thirteen years later, in 2014. During this test excavation, a preliminary osteological analysis was made. At the time, it was determined that the majority of the bone assemblage consisted of fragmented parts of the seal body, mainly from the skull, phalanges and teeth (Alexandersson *et al.*, 2015). In this thesis, an official osteological analysis was carried out on the Blå Jungfrun assemblage, and a database was created. This database subsequently became the primary source when comparing the subsistence strategy and animal economy of the East and West coast of southern Sweden.

Parallel to the main analysis of Blå Jungfrun, reports and articles from previous excavations from sites on the East and West coast have also been studied: Balltorp, in Västergötland; Huseby Klev, on the island of Orust; Gisslause, on the island of Gotland; Norje Sunnansund, in Scania; Köpingsvik, on the island of Öland; Tågerup, in Scania. The comparative difference in determined species per site has been an important point of the study, as the frequency of species and distributed elements can be indicative of specialised subsistence strategies. Additionally, the quantitative ratios of species will also play a major part in interpreting the mobility of Blå Jungfrun, as well as the respective regions of the West and East coast. The comparative study wishes to highlight not only the dilemmas of preservation of Mesolithic assemblages and the interpretation that affect them, but also past assumptions regarding the mobility of hunter-gatherers in a prehistoric context.

1.1.1 SITE SELECTION

Since the thesis has relied on contrasting the animal economy between Blå Jungfrun and other coastal sites, it was essential to find osteological reports that fit the relevant requirements of a comparative study. The requirements included the presence of seal bones and a determined quantity of animal bones that allowed the sites' animal economy to be interpreted. The sites also had to be defined as 'coastal' during its time of occupation. In the end, the sites of Balltorp, Huseby Klev and Tågerup were picked as part of the West coast assemblage, whilst the sites of Norje Sunnansund, Köpingsvik and Gisslause were picked as part of the East coast assemblage (Figure 1). The western sites were primarily picked because they had large faunal assemblages and separate phases of occupation that allowed a chronological analysis, which was valuable in order to interpret the differences in subsistence strategy. Meanwhile, on the East coast, the traces of sedentism and fermentation facilities on Norje Sunnansund was the main reason why it was an attractive site to include in this study, and the large quantity of seal bones on Gisslause was considered relevant when compared to the assemblage on Blå Jungfrun. The site of Köpingsvik was included as it was in close vicinity to Blå Jungfrun, and the lack of multiple phases per site on the East coast made Köpingsvik relevant as it could exemplify a late-period site.

The main dilemma of the various sites has been the difference in chronology and assemblage size, but the site selection was also limited by the availability of osteology reports.

Without quantitative data that visibly presented indeterminate versus determinate species and elements, a potential site with otherwise similar parameters was not possible to analyse further. The written thesis does not claim that this comparative study can be used as a way to trace animal economy over time, but rather as a way to interpret the site of Blå Jungfrun.

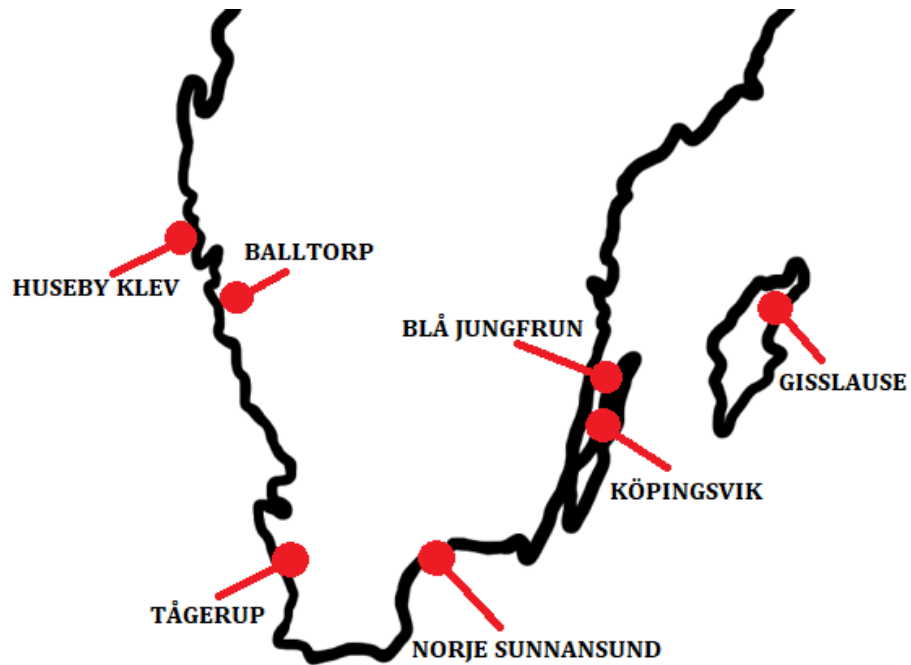


Figure 1: *Illustration of a geographical map of southern Sweden, with each site marked in red dots. Figure drawn by Hanna Rosenborg.*

1.2 PURPOSE & AIMS

No official osteological analysis has been done on the bone assemblage from the test excavation on Blå Jungfrun – until now. It presented an opportune time to dwell further in the Mesolithic research of coastal landscapes, and the animal economy of such sites. Mesolithic sites from the East and West coast of southern Sweden will be compared to one another and studied chronologically, with Blå Jungfrun as the primary osteological material. In doing so, contrasting the coastal landscapes of southern Sweden to one another in order to contextualise the traces of mobility, seasonality and animal economy is the main aim of this thesis.

The purpose of analysing the coastal landscapes of southern Sweden is to present the traces of mobility and animal economy in the Mesolithic past. Thereby, this thesis seeks to understand the subsistence strategy and distribution of animal remains that affect a settlement, by analysing the relevant parameters and contrasting the coastal landscapes to one another.

1.2.1 RESEARCH QUESTIONS

On account of the purpose and aim of the work, the following questions will be discussed:

- What defines Blå Jungfrun in contrast to the other Mesolithic sites on the East and West coast of southern Sweden?
- What visible differences are there between the identified pinniped material from Blå Jungfrun and the pinnipeds from the East and West coast?
- How does the distribution of animal remains and the organisation of animal economy differ between the East and West coast of southern Sweden?
- How does the animal economy at Blå Jungfrun reflect the functionality of the site, in relation to the distribution and organisation of animal remains at the East and West coast sites?

1.2.2 HYPOTHESIS

The hypothesis of this study is that there is a difference between the West and East coast of southern Sweden in terms of animal economy, and possibly in seasonal utilisation too. Additionally, there is an assumption that Blå Jungfrun will present a different frequency of animal remains than that of the other East coast sites, due to the island's size and limited assemblage. By comparing and discussing these differences, there is an expectation that traces of sedentism and specialised subsistence strategies will become visible and possible to draw conclusions from.

2. BACKGROUND

In order to understand the Mesolithic past, we need to familiarise ourselves with the landscape that subsequently affected the way people and animals moved around in it. Various methods can be conducted in order to understand the prehistoric landscape, such as tracing climatic changes and the migration of new fauna. The hunt and deposit of animal remains throughout millennia can also demonstrate the continuous change of seasonal diet and time period subsistence.

There is, however, a certain difficulty in interpreting the Mesolithic past. Especially when we are faced with sites that once occupied coastal zones, as they are sometimes described as being liminal places that separate land and sea, and are thereby perceived as ambiguous spots of activity (Mansrud, 2017; Schülke, 2020: 12). Regardless, studying coastal sites is the primary way of interpreting how prehistoric peoples might have interacted with, and perceived, coastal areas, especially when sites show signs of being repeatedly used (Schülke, 2020: 3, 384).

2.1 THE MESOLITHIC CHRONOLOGY

The chronology of the study is predominantly analysed according to the three main cultures of the South Scandinavian Mesolithic: the Maglemose, Kongemose and Ertebølle Cultures. The Mesolithic chronology begins with the Maglemose Culture, dated roughly between 9 800 - 6 400 BC; followed by the Kongemose Culture, dated circa 6 400 - 5 400 BC; and lastly, the Ertebølle Culture, dated roughly between 5 400 - 4 000 BC. However, the West coast sites of Huseby Klev and Balltorp are dated according to the two West-Swedish cultures of Sandarna, circa 8 400 - 6 000 BC, and Lihult, circa 6 000 - 4 000 BC. The site of Tågerup is located in Scania, and is therefore dated in accordance with Kongemose and Ertebølle. For the sake of simplicity in this study, these cultures will be referred to as the Early, Middle and Late Mesolithic stages henceforth, primarily due to the fact that multiple of the various sites used in this study overlap between cultures.

Additionally, the various sites in this study have been dated according to different dating methods, such as isotope analysis and typology. Sites dated with C¹⁴ analysis, or with archaeological typology, of BP/cal BP have been calculated to BC/cal BC. Additionally, some of these sites also have multiple phases. The East coast sites have respectively one phase each, but the West coast sites have been divided into two to three phases. Each phase indicates separate occupations. However, the site of Balltorp is divided between two phases as they represent separate excavations, with the first phase representing the excavation during 1996 and the second phase representing the excavation during 2011 (see 2.5.3 *The West Coast Sites*). The phases will simply be referred to in numerical order from this point onwards. The sites will be listed in chronological order, as shown below (Table 1).

Table 1: Chronological order of each site and their corresponding phases, in cal BC. NISP (Number of Identified Specimens) is listed for each site, as well as culture, coastal zone and dated period.

SITE	NISP	calBC	CULTURE	COASTAL AREA	PERIOD	ANALYSED BY
<i>Huseby Klev Phase I</i>	1,157	8300	Sandarna	West	Early Mesolithic	V. Christensson, F. Hellgren, L. Jonsson, M. Nemecek & G. Widmark
		7600				
<i>Balltorp Phase I*</i>	175	8300	Sandarna	West	Early - Middle Mesolithic	L. Jonsson
		6100				
<i>Norje Sunnansund</i>	18,240	7650	Maglemose	East	Early Mesolithic	A. Boethius
		6650				
<i>Huseby Klev Phase II</i>	1,812	7600	Sandarna	West	Early Mesolithic	V. Christensson, F. Hellgren, L. Jonsson, M. Nemecek & G. Widmark
		6700				
<i>Balltorp Phase II*</i>	222	7230	Sandarna	West	Early Mesolithic	L. Jonsson
		6886				
<i>Blå Jungfrun</i>	219	7040	Maglemose	East	Early - Middle Mesolithic	H. Rosenborg
		6695				
<i>Gisslause</i>	1,119	6050	Maglemose - Kongemose	East	Middle Mesolithic	J. Storå
		5650				
<i>Huseby Klev Phase III</i>	1,382	6000	Lihult	West	Middle Mesolithic	V. Christensson, F. Hellgren, L. Jonsson, M. Nemecek & G. Widmark
		5700				
<i>Tågerup Phase I**</i>	3,656		Kongemose	West	Middle Mesolithic	M. Eriksson & O. Magnell
<i>Tågerup Phase II**</i>	263		Kongemose - Ertebølle	West	Middle - Late Mesolithic	M. Eriksson & O. Magnell
<i>Tågerup Phase III**</i>	1,051		Ertebølle	West	Late Mesolithic	M. Eriksson & O. Magnell
<i>Köpingsvik</i>	333	4350	Ertebølle	East	Late Mesolithic	E. Sjöling
		4000				

* The overlap in calBC is because the two phases of Balltorp represent separate excavations, and were dated separately.

** Tågerup was dated by ¹⁴C and typology, but each phase was referred to by culture and does therefore not have calBC listed.

2.2 THE MESOLITHIC LANDSCAPE

Coastal landscapes have, throughout the prehistoric times, been essential areas for transport, hunting and communication (Larsson, 2017: 4) not only in Scandinavia, but all over the world. These seafront places have yielded food resources, and presented ways to gather materials such as driftwood, shells and bones. Intelligibly, it would have attracted settlement, hunting and gathering (Schülke, 2020: 1). Settling in the vicinity of the sea or lakes and other watercourses would thereby have affected the location of bases for communication and food (Ameziane, 2009: 9). With this in mind, we need to look at the landscape and shorelines that created these coastal environments that the Mesolithic peoples decided to utilise - or abandon, for that matter.

To begin with, the Baltic Sea Basin underwent several stages that would have affected the landscape and subsistence surrounding the Mesolithic peoples. Roughly around 9 600 BC, the Baltic Ice Lake began its deglaciation, and resulted in a dramatic drop in water level that would subsequently expose large areas of coastal land that had formerly been submerged (Larsson, 2017: 1; Hansson *et al.*, 2018; Nilsson *et al.*, 2020). This triggered the development of the Yoldia Sea stage, which connected the Baltic with the ocean through an outlet in south-central Sweden and allowed saltwater to enter the basin (Larsson, 2017: 1; Hansson *et al.*, 2018). The meltwater from the retreating ice sheets and the saline inflow of seawater created brackish conditions in the Yoldia Sea, which consequently introduced various species of plants and animals to reside within the Baltic. The ringed seal (*Pusa hispida*) and grey seal (*Halichoerus grypus*) arrived by sea; whilst wisents (*Bison bonasus*), aurochs (*Bos primigenius*), reindeer (*Rangifer rangifer*) and moose (*Alces alces*) travelled by land (Ameziane, 2009: 9; Larsson, 2017: 1). As the climate rose to warmer temperatures and the ice melted away, the Scandinavian landscape shifted dramatically from that of arctic steppes to temperate forests. Gradually, pine and birch began to dominate the growing forests, and the modern bogs of today would back then have been shallow lakes and ponds, with water banks that would have created opportunities for Mesolithic groups to fish, hunt and gather (Ameziane, 2009: 9).

Whilst the ice sheets continued to melt, the warming episode as well as the high rates of glacio-isostatic uplift would eventually lead to the Baltic Basin tipping over in southern Sweden. Consequently, this caused the outlets that otherwise drained the outflowing water from the Baltic Sea Basin to become too shallow for water to pass through (Berzins, 2006; Ivanova *et al.*, 2016). Around 8 700 BC, the Yoldia Sea was consequently replaced by the up-dammed Ancylus Lake (Andrén, 2003; Berzins, 2006; Ivanova *et al.*, 2016; Larsson, 2017: 1). During this stage, the Baltic basin became a freshwater lake, and its water level rose above that of the global sea level as a result of the rapid land uplift. Marine species that had previously migrated into the basin, like the ringed seal and grey seal, were subsequently trapped (Andrén, 2003; Ivanova *et al.*, 2016; Larsson, 2017: 1). The climate also began to shift around 8 500 BC, with an average temperature that would have been a couple of degrees warmer than current time, which impacted the development of vegetation. The forests became more densely populated by broad-leaved species like lime, elm, hazel and oak instead of pine and birch. This change of vegetation supported the migration of wild boar (*Sus scrofa*), red deer (*Cervus elaphus*) and roe deer

(*Capreolus capreolus*), whilst also pushing large herbivores like moose and aurochs away (Ameziane, 2009: 9; Larsson, 2017: 93).

Around 8 000 BC, the activity of rivers had eroded the thresholds that separated the lake from the sea and intrusions of saline water began to influence the southernmost area of the Baltic. By the end of the Ancylus stage, the salinity in the lake had once again turned the water into a brackish basin. This was triggered by the subsequent drainage of the Ancylus lake as the global sea level rose above its southern thresholds, which flooded the lake with marine waters via the Danish Strait around 7 000 BC (Andrén, 2003; Ameziane, 2009: 9; Ivanova *et al.*, 2016; Larsson, 2017: 1, 93). This marked the beginning of the Littorina Sea stage, which was characterised by its rise and fluctuation in sea level that submerged large areas of land and rapid increase in levels of salinity that affected the growth of bioproductivity in the Baltic basin. Shallow lakes began to drain and grow into bogs, and the climate would turn into the warmest period after the Ice Age, with warmer and moister conditions than previous periods. These climatic conditions replaced forests formerly dominated by pine and hazel with broad-leaved species like lime, and species like oak, linden and elm would reach the southern part of Norrland, Sweden, during this period (Andrén, 2004; Ameziane, 2009: 9; Ivanova *et al.*, 2016; Larsson, 2017: 1 - 2, 93; Hansson *et al.*, 2018). Sometime between 6 500 and 6 000 BC, signs of gradual transition to brackish or marine conditions began to surface as the global sea level once again rose and resulted in an influx of saline water in the Baltic Sea basin (Berzins, 2006; Nilsson *et al.*, 2020). Roughly around 6 000 and 4 000 BC, the Littorina transgression would have reached 5 - 10 metres above present sea level in southernmost Sweden, in response to the global sea level rise and the decreased rate of isostatic uplift (Nilsson *et al.*, 2020).

2.3 THE MOBILITY IN THE MESOLITHIC

To begin with, the term ‘mobility’ itself implies a regular change of residence (Price *et al.*, 2021). The traditional view of hunter-gatherers has dominated archaeological perspectives as being that of mobile societies that annually or seasonally moved between temporary or locationally constrained resources, very much in contrast to the sedentary lifestyle of farmers that would remain in one place. This interpretation has led sedentary communities to appear as a late phenomenon, with the introduction of agriculture as its beginning and the consequent end of hunter-gatherer mobility (Price *et al.*, 2021). However, this in turn causes a paradoxical misinterpretation of how the practice of agriculture spread across the continent, as it implies that farmers expressed *some* kind of mobility – as well as hunter-gatherers being more sedentary than previously imagined (Price *et al.*, 2021). Furthermore, subsistence strategies and mobility could be tied together when we discuss hunter-gatherer societies. In turn, we would be able to define the possible differences between a sedentary and mobile hunter-gatherer community.

The late glacial populations are oftentimes perceived as having been small and mobile social units (Meiklejohn, 2017: 89). The term ‘band societies’ refer to loose societal organisations, which is also often associated with hunter-gatherer groups. However, the results of several archaeological excavations and research through recent decades have led to a growing

knowledge about settlements and social organisation during the Mesolithic (Larsson, 2017: 113). Repeatedly used sites, determined by radiocarbon dates from material found on the site, can help us discuss the different human relations that might have occurred on a location. First of all, revisited sites imply that people were acquainted with it, probably revisiting it deliberately rather than accidentally. Targeted returns to earlier used camps and settlements indicate that it might have been part of an overall social and cosmological way of being; perhaps the site symbolised more than a seasonal occupation, but also as an ancestral place that the group shared as a collective memory through generations. Second of all, returned visits mean that at least one member of the group knew of its location. Perhaps it was all the more important to return to already-known places of economic, resource or cosmological significance in areas where dramatic changes to shorelines and coastal landscapes happened (Schülke, 2020: 385).

However, there is also a chance that a secondary group of people simply ‘stumbled upon’ a previously used site. The place could have been frequented by others who used the same types of artefacts, whilst the next group had never been there before or had any historic connection to it. Perhaps different groups of people revisited sites separately between one another because they followed the same idea of what a ‘right’ place is; a coincidental reoccupation based on location and resource importance (Schülke, 2020: 385). If one decided to set up camp in a place one had never been before, and stumbled upon a site in an attractive spot with bountiful resources - or maybe a well-hidden shelter, or a clear view of one’s surroundings - it would have been a convenient ‘recycling’ of settlement. Perhaps it would have made a place feel ‘secure’ if there were traces of previous occupation, on the notion that there would be any traces left from a former group.

In accordance with the previous paragraph, people might have recognised remains of old activity at former sites, such as fireplaces, abandoned tools or vegetation that had intentionally or unintentionally been altered by humans. Structures made by human hands could have been recognised, and might have served as ‘space attractors’ to new visitors. Non-man made things, such as animals and trees, that frequented special places could likewise have been recognised as possible ancestral or spiritual beings that made those places especially attractive to settle by (Schülke, 2020: 385).

Thus, the abandonment of a site showcases the changes in the site’s surroundings. Coastal sites whose beaches dried out would have resulted in new types of vegetation and animals occupying the area, which had once been an ideal place for human habitation instead. This might have led to the place feeling ‘wrong’ as its original purpose was no longer suitable, and would have required new daily routines (Schülke, 2020: 385). The strategic and convenient importance of the site might have been lost to newer generations, and abandoned against better options. Perhaps the continuous ebb and flow of sea level rise also played a part in the abandonment of sites, as the settlements simply became submerged over time and were no longer inhabitable.

2.3.1 STATIONARY STRATEGIES OF THE MESOLITHIC

The development of stationary societies and territoriality implies that specific areas could have been viewed as more advantageous than others (Boethius *et al.*, 2020). Settling close to shorelines indicates that marine adaptation has been an important factor in locating accessible resources (Solheim, 2020: 47). The specialised activity of fishing and the exploitation of marine resources has often been viewed as very costly and dependent on technological adaptation, and would have made the forager group very vulnerable to climatic changes in resources and prey selection (Fossum, 2020: 180). Hunter-gatherer communities have instead traditionally been assumed to have relied more on terrestrial resources, and it has been suggested that humans would only turn to aquatic resources when terrestrial foods were otherwise inaccessible or lacked qualitative proportions to sustain a large population (Lewis *et al.*, 2020). In ethnographic records, aquatic resources seem to have had a larger frequency on the human diet in regions with low effective temperatures, than in warmer regions (Solheim, 2020: 58). Additionally, it has been shown that hunter-gatherer populations might increase rapidly when resources are abundant, and environmental conditions are favourable (Lewis *et al.*, 2020).

One might argue that a maritime subsistence strategy would not have been sustainable, yet the socio-economic consequences could rather have been strategically appropriate (Mjærum & Mansrud, 2020: 289; Boethius *et al.*, 2020). Marine environments might, in fact, have been more ecologically stable than inland regions, as they might have allowed a wider range of different ecological niches within short distances. Some aquatic species could also have received high return rates, in accordance with the geographical location, season and hunting technique necessary to find and capture them (Solheim, 2020: 58). By relying on temporary and spatially predictable marine resources, it would have resulted in population pressure with reduced mobility, delayed return systems, population growth and increased economic and social differentiation, possibly leading to a larger diversity to ritual activities (Mjærum & Mansrud, 2020: 289; Boethius *et al.*, 2020). In other words, the increased dependency on aquatic resources could result in the reduced dependency of residential mobility (Solheim, 2020: 58).

Decreased mobility can also be linked to territoriality, indicated by an increased dependency of resources that require stationary methods in order to have a steady supply of them, such as fish (Boethius, 2017; Boethius *et al.*, 2017; Boethius *et al.*, 2020). The practice of conservation and the occurrence of large food storages can also imply that a social unit will be bound to the safe-keeping of said storages, and thereby function as a societal anchor (Boethius *et al.*, 2020). However, the increased dependency on resources like fish is not in and of itself a direct indication of decreased mobility, as there are multiple factors that affect the transition to sedentism. If there is a diminishing isotopic niche width combined with limited residential mobility between coast and inland, mass catching technologies and year-round seasonality indicators as well as having a selective hunting strategy and the capacity to store large resource abundances by fermentation or drying, then it is likely that the site was a sedentary community (Boethius & Ahlström, 2018). Delayed-return subsistence strategies such as fermentation and drying, together with the use of stationary food procurement technologies such as nets and traps,

would have enabled foraging groups to settle on specific areas that allowed the capture and storage of large quantities of food over long periods of time (Boethius *et al.*, 2020).

By understanding the motivation behind the act of hunting and fishing, we would understand the importance of so-called specialised subsistence strategies. According to Harrod (2000: 6), hunting can be described as something more than an “economic activity” as we might otherwise describe it. Rather, it was a necessity to hunt animals not only because they brought the prehistoric peoples a source of food but also provided skins for clothing and lodges (Harrod, 2000: 6), as well as bones for tools and teeth for decorative trinkets. The reliance on animals was therefore not strictly dependent on meat, and might not even have been the main cause for why some animals were hunted in the first place.

The demography of the prey population and foraging time (Magnell *et al.*, 2020) can be indicative of conscious prey choice. When investigating hunting and prey choice through the application of optimal foraging theory, models show that foragers will focus on maximising the return rate in relation to foraging time. Consequently, animals that provided a large supply of meat and fat from each kill would be preferable if the purpose of a hunt was to optimise the short-term return. Similarly to prestigious hunts, prey selection from an optimal foraging perspective interprets age and sex structures to play an important part in targeting animals based on large body size and nutritional value, where adult males tend to be the preferred prey (Magnell, 2005; Magnell *et al.*, 2020).

Moreover, factors such as accessibility, seasonal migrations and quality/quantity ratios can serve as indicators of specialised hunting (Rivals *et al.*, 2004). However, specialisation has several definitions. One might define specialised hunting as the focused hunt for one species, but it could imply that the animals were not selectively targeted based on morphological factors such as age or sex. The distinction between opportunism and selection, in contrast to specialisation, is therefore not conclusive (Rivals *et al.*, 2004). Seasonality can further complicate the matter. The opportunistic hunt for an animal could be dependent on season and location, but if a faunal assemblage were to only have one species identified, that might imply that it was part of a specialised hunt. In a scenario like this, we have to rely on the context of a faunal assemblage and interpret its distribution versus other sites.

2.3.2 THE RESIDENTIAL STRUCTURES OF THE MESOLITHIC

When combining optimal foraging theory with ethnographic data, hunter-gatherer societies can be described as either mobile or stationary. A high mobility rate of a forager group would mean that the group is moving between different resource patches, and will move from one area to another when the resources decline (Boethius *et al.*, 2020). Additionally, foraging groups can be structured by residential and logistical mobility. The logistical mobility system refers to a group of ‘collectors’ that is part of a social unit that rarely move their stationary homes for long periods of time, but will move logistically through the landscape in smaller task groups in order to gather and hunt for specific resources and bring them back to the site (Binford, 1978; Binford, 1980;

Boethius *et al.*, 2020; Breivik, 2021: 123). Comparatively, residential mobility is characterised by social units that physically move their residential bases from one location to another when it becomes difficult to gather or hunt resources in the area, consequently resulting in short-term occupation and smaller bases. Residential mobility is therefore less sedentary than those that practice logistical mobility (Boethius *et al.*, 2020; Breivik, 2021: 123).

Notwithstanding, mobility would not necessarily be limited to residential sites and homes, as described by Breivik (2021: 123, 125). Field camps, stations and caches are also specific places that likely were produced and utilised, and had their respective purposes (Table 2). A residential ‘base’ could be likened to that of the ‘main site’ of subsistence activities, manufacturing and maintenance. The residential base can therefore be described as having ‘general’ activities that structure their location and range of tasks, likely working as the main social hub of a forager group. The material culture would be diverse with both discarded and manufactured objects, as well as raw material procurement. In contrast, field camps would function as temporary operational centres where task groups sleep, eat and maintain themselves while away from the residential base, presumably as part of a specialised activity. Stations could be described as localised spots where task groups could have engaged in information gathering, whilst caches would contain temporary storages. These special purpose sites would have a narrower range of objects and activities present (Binford, 1978).

Another site structure is suggested by Larsson (1990), where three different regions could have been utilised throughout the year. The summer seasons would have been characterised by residential bases in coastal regions, whereas autumn would consist of small units split between freshwater basins or upper reaches of rivers inland. During the winter seasons, the communities would move further down the rivers with closer proximity to the coast, but extensive winter occupations near lakeshores are thought to have been few and far between during the Early Mesolithic periods (Astrup, 2019: 37 - 38).

In the end, there is no definite answer to know which mobility was more or less common amongst the Mesolithic peoples. It would rather seem that the diversity of sites and bases is too great. However, there was likely a larger complexity to Mesolithic settlements than we simply give the hunter-gatherers credit for. Whilst some social groups might have concentrated solely on coastal resources and occupied the coastal sites while others relied on inland areas, some might instead have been more mobile and utilised both areas depending on availability and season (Astrup, 2019: 37). Similarly, some sites could have adopted the model of logistical mobility, with one sedentary residential base that stayed all-year round and several smaller camps or stations where task groups would travel more or less regularly to.

Table 2: *Listed types of residential structures, with a short description (Binford, 1978) respectively.*

RESIDENTIAL STRUCTURE	DESCRIPTION
<i>Residential base</i>	The centre of activities surrounding subsistence, manufacture and maintenance. It is where foraging parties originate from, and has a foraging radius to various resources. It might express stationary or situational mobility; affected by seasonality or year-round activity.
<i>Location site</i>	A site where extractive tasks are exclusively carried out. They tend to be short-term and scattered in the landscape, as they generally gather limited quantities of resources during only one period at a time.
<i>Field camp</i>	A temporary centre of activity for a task group. The task group will maintain itself here while away from its residential base. It can express specialised or intensified prey choice.
<i>Station</i>	A special-purpose site where task groups gather to gain information, such as the observation of other humans or the movement of game. A station can act as an in-between location where strategies and logistical activities are observed or planned, such as hunting strategies, but is not necessarily executed in the same spot but planned elsewhere.
<i>Cache</i>	Temporary storages, oftentimes out in the field. They function as a short-term solution when task groups transport resources to consumers, as large bulks of resources might be left at a cache until it is time to re-stock, or until a task group is able to carry back what was left behind.

Finally, it is important to remember that while Mesolithic groups oftentimes are characterised by mobility and short term subsistence, settlements in coastal landscapes do not equal passivity to the surrounding environment. As this study has focused on animal economy and mobility, it is essential to discuss the normative bias that otherwise affects the interpretation of coastal settlements.

Coastal groups have visibly used the surrounding landscape and other ecological niches that are not coastal or marine when utilising resources. Demonstrated by terrestrial resources found in Mesolithic coastal contexts, it has been suggested that coastal groups have, on multiple occasions, been able to use the forested areas and manipulated the woodlands both intentionally and unintentionally (Solheim, 2020: 60; Fossum, 2020: 180). Moreover, transportation and communication between waterways would have allowed travel through great distances, which in turn would have led to farther foraging ranges and longer logistical moves. Boats could have allowed dispersed resources to be harvested and be brought back to the site, which could also explain the large species diversity that coastal sites tend to exhibit (Fossum, 2020: 180). Coastal groups did therefore not refuse terrestrial resources or isolated themselves to the coastal or marine landscape, but not all coastal regions were necessarily suitable for settlement or resource exploitation, which adds to the argument that Mesolithic coastal groups were more diverse than past research would otherwise suggest; different coastal regions offered different kinds of productivity, with separate social and practical advantages to other sites (Solheim, 2020: 60 - 61).

2.4 PREVIOUS RESEARCH

With the discovery of kitchenmiddens, *kökkenmöddinger*, archaeologists have investigated the usage of coastal landscapes during the Stone Age as early as the middle part of the 19th century. The research that was conducted from the *Kökkenmöddinge Kommissionen* in Denmark was highly influential, setting the standard for years to come for archaeological excavations with the combination of stratigraphic analysis and science (Larsson, 2017: 2; Schülke, 2020: 6). Disciplines like botany, geology, zoology and archaeology worked together interdisciplinary whilst investigating these human-made shell heaps. During the second half of the 19th century, the first anthropological research on maritime hunter-gatherers would also begin. In parallel, extensive landscape inventories were conducted in West Sweden, followed by decades of systematizing the excavated material of shorebound sites from the region (Larsson, 2017: 3 - 4; Schülke, 2020: 6). Studying the traces and remains that Mesolithic groups left behind on coastal sites became the main gateway to understand and interpret how these areas and landscapes were used, perceived and interacted with (Schülke, 2020: 3).

However, the significance and use of coastal areas by prehistoric peoples in the Mesolithic is largely dependent on what is archaeologically visible. Environmental processes such as local isostatic development and global eustatic sea level rise, as well as climatic changes, affected the Mesolithic landscape, resulting in regional and local differences to coastal areas (Schülke, 2020: 4, 7). The continuous change of coastlines due to regressions, transgressions and

land upheaval causes a certain dilemma when investigating the representativeness of coastal areas, as the development of land-sea relations differ significantly between regions and time periods. Since northern Europe experienced faster land rise than sea level rise compared to the rest of the continent since the last deglaciation, the tilted shorelines and water level changes has caused many of the Mesolithic coastal sites in the southern Baltic to now be submerged or overlaid, making it difficult to access or even investigate them (Hansson *et al.*, 2018; Schülke, 2020: 4, 7; Bergsvik & Ritchie, 2021: 229). Coupled with geomorphological processes, such as erosion, the preservation and taphonomy of coastal sites is also negatively affected (Solheim, 2020: 45). Furthermore, the loss of uninvestigated or ‘missing’ coastal sites confronts the problem of interpreting the distribution of inland sites as representative to a region’s original spatial distribution, since the inland distribution could instead be biased from the lack of sites located along former marine shorelines, and brings up the question whether Early Mesolithic coastal zones have been underestimated (Astrup, 2019: 13 - 14; Schülke, 2020: 7; Solheim, 2020: 45).

In recent years, however, there has been an increased interest in studying submerged landscapes and the potential that it yields. One of the pending trends in archaeological literature is the continuous comparison of the Early and Late Mesolithic cultures of southern Scandinavia in terms of their varying reliance on marine resources (Astrup, 2019: 12 - 13). Previous research would oftentimes focus on the objects and material culture of Mesolithic societies, where dating and cultural concepts acted as primary components. Ecological conditions had a major part in interpreting how the environment affected the settlements, as Mesolithic groups were mainly portrayed as mobile nomadic hunting communities (Larsson, 2017: 4 - 5). When *New Archaeology* was introduced, the focus shifted to that of the economy and settlement structure of Mesolithic sites. Inspired by social anthropology, the traditional mobility of Mesolithic groups was confronted by studying food procurement strategies and material culture. In doing so, it was believed that social identities and territoriality could be investigated, and show the extent of mobility for different social groups and societies (Larsson, 2017: 4 - 5). Following this methodology, the research of Mesolithic sites during the last decade has moved from focusing on individual sites and their function, to go back to the study of the landscape that affects said settlements. However, as the landscape was formerly studied primarily by ecological niches, it now contains a multiplicity of approaches such as burial sites, symbolism and votive offerings, which assists in interpreting Mesolithic sites. The social groups and human beings behind the traces and remains of the Mesolithic past have become the primary aspect, whereas chronology, procurement strategies and implements were largely dominated by previous research (Larsson, 2017: 5).

Furthermore, researching marine adaptation has in recent years become a significant part in understanding the different stages of human development in prehistory (Solheim, 2020: 45). Traditionally, terrestrial resources were assumed to have had the most important economic and symbolic factors in human history, with resources like big game and the development of agriculture being viewed as the primary cause of structural and social advancement in Europe

(Solheim, 2020: 44). The difficulty in interpreting the exploitation of coastal and hinterland resources have consequently led marine adaptation and coastal settlement to be assumed as a marginal and late phenomenon, but the archaeological record now shows that marine resources have been utilised earlier than previously thought (Solheim, 2020: 44 - 45; Price *et al.*, 2021). Maritime adaptation is continuously being interpreted as possibly having been more cost-effective in some areas, and the technological innovation of switching between resource availability might have supported the pre-agricultural population rise across Southern Scandinavia (Lewis *et al.*, 2020).

2.4.1 BLÅ JUNGFRUN

Blå Jungfrun is a small island, located in the northern region of the Kalmar Strait and with a close proximity to Öland (Figure 2). The landscape consists of bare granite cliffs, mixed forests and rocky terrain, with little faunal activity aside from mountain hares and bats. The island itself can be described as having the shape of a dome, approximately 86 metres at its highest point (Blå Jungfrun n.d.).

The archaeological site on Blå Jungfrun has been registered since 2001, but worked stone material has been found in the area as far back as the 1970s. During the test excavation in 2014, only a preliminary osteological analysis was possible because of the economical limits of the initial budget. At the time, it was determined that the majority of the bone assemblage was from fragmented parts of the seal body, mainly from the skull, phalanges and teeth (Alexandersson *et al.*, 2015). The bone assemblage at Blå Jungfrun was found in three out of four square units beneath the area dubbed ‘the Cliff Overhang’ during the test excavation. Each square unit was 50x50 cm in size and had a deep cultural layer - more than 70 cm at its deepest spot. The three square units with bone material were excavated inside the central area of the Cliff Overhang about a metre apart from one another, and the total weight of the assemblage became 101,7 g. Despite the acidic soil, the bone material was fairly well preserved and displayed burnt or sooty surfaces (Alexandersson *et al.*, 2015).



Figure 2: *Picture of Blå Jungfrun. Picture taken by Torbjörn Ahlström.*

Alexandersson further explained (pers. comm., Apr. 2021) that during the initial excavation of the ‘Cliff Overhang’ on Blå Jungfrun, a layer as hard as ‘concrete’ was discovered below the excavated contexts. At the time, it was assumed that it was a natural layer, prior to the site being utilised, close to the bedrock. Consequently, it was covered when the excavation was over. However, what actually contained in that layer could have been the result of extracting blubber, which could also have explained the concrete-like texture (K. Alexandersson, pers. comm., Apr. 2021). When blubber is extracted for oil, what is later left deposited in the ground will eventually harden and become thick and hard like concrete (Pettersson & Wikell, 2013).

When another site located on Blå Jungfrun was excavated a couple of years later, a settlement was analysed but no sign of deposited bone material was found. The lack of bone material was noted as strange, unless food waste was deposited somewhere else or had been completely lost to taphonomic processes (K. Alexandersson, pers. comm., Apr. 2021).

2.4.2 THE EAST COAST SITES

The site of Norje Sunnansund is located a kilometre southwest of Norje in the municipality of Sölvesborg, Scania. When the site was inhabited, it would have been located close to a lake, Vesan, which today is drained. During its occupation, the settlement would likely have been part of a peninsula with close proximity to the waterline. With the Baltic Sea basin only 2 kilometres away, and a forested landscape of hazel and pine trees in its vicinity, the site would have had an

array of resources at its disposal (Kjällquist *et al.*, 2014; Boethius, 2017). Additionally, the temperature would have been roughly warmer than it is today, with a climate more akin to modern Central Europe, and would have resulted in higher humidity and milder winters (Kjällquist *et al.*, 2014). As the sea levels rose around the end of the settlement's occupation, around 6 700 - 6 600 BC, it would have been significantly closer to the waterline, up until the site was abandoned and later flooded by the Littorina Sea transgression (Kjällquist *et al.*, 2014).

During 2010, a preliminary investigation was performed in collaboration with the Blekinge museum, until it was eventually excavated in 2012. Based on the topography and the finds excavated from the site, it has been assumed that only 30% of its total size has been preserved and only 10% has so far been excavated, with traces that show that the settlement could have been repeatedly visited and used for approximately a 1 000 year long period (Kjällquist *et al.*, 2014; Boethius, 2017). Several hundred square metres were excavated, which generated around 200 000 fish fragments and exposed a facility for fermenting fish, resulting in Norje Sunnansund being the earliest evidence of Mesolithic fermentation in the world (Boethius, 2016; Boethius, 2017). In addition to the fish bones, 1 940 mammalian bones and 106 bird bones were also recovered and identified to species level or to family level (Boethius, 2017).

Further northeast, the island of Gotland is located approximately 8 miles away from the mainland. Some of the oldest sites on the island can be dated to roughly the late stages of the Ancylus Lake (Larsson, 2017: 55), at a time when the climate had undergone significant temperature changes. The landscape that had once been affected by an arctic climate, became subarctic and Gotland expressed a temperature change from roughly 10 degrees to 17 degrees during mid-summer. The temperature would continuously rise as the Littorina Lake transgression eventually replaced the Ancylus Lake (Ekman, 1922: 276 - 277; Ivanova *et al.*, 2016).

Discovered in 1928, the site of Gisslause on Gotland had its first excavation during the summer of 1929 and was revisited again in 1982 (Boethius *et al.*, 2017). During Gisslause's occupation, the island of Gotland would have been smaller than it is today and would have contained several, small lakes and a limited food supply due to a lack of larger mammals (Larsson, 2017: 55). Another excavation was carried out by Gotland University (now Uppsala University Campus Gotland) in 2010, with the primary aim to find more fish bones from the cultural layer. Due to this, it was necessary to change the way the soil samples were analysed. By using 4-mm and 2-mm meshes, samples from the cultural layer were systematically water sieved in order to have the chance to recover as many fish bones as possible (Boethius *et al.*, 2017).

Also located on an island, the site of Köpingsvik is situated on the northeast of Borgholm, on the western side of Öland. The island of Öland is characterised by its beach embankments, shaped during the Ancylus and Littorina Lake transgressions respectively (Öland n.d.). The landscape also possesses a unique type of soil, *alvar*, which is rich in limestone and can only be found on Öland, Gotland and parts of Västergötland (Alvar n.d.).

Öland underwent various surveys during the 1990s, which resulted in several Stone Age sites, votive offerings and stray finds being recorded. Until recently, however, not many sites on Öland have since been excavated (Larsson, 2017: 53). The site of Köpingsvik has primarily been an archaeological area known for its rich material from the Viking Age and early Middle Age. The archaeological area is one of Öland's most archaeological extensive spots and covers a total area of about 540 000 m² but with only 22 000 m² investigated so far. Karl-Alfred Gustawsson was the one that first discovered the prehistoric sites in Köpingsvik during the mid-1920s, and there has since been several archaeological excavations in the area, with at least 20 graves dated to the Stone Age (Alexandersson, 2004).

During the excavation of Köpingsvik, a total of 583 fragments were found and analysed, weighing 239,7 grams altogether. More than half of the total weight was identified, and about three quarters of the total bone material was possible to determine species or element (Sjöling, 2004).

2.4.3 THE WEST COAST SITES

The site of Balltorp is located on the eastern side of Deleberget in the municipality of Mölndal, Västergötland. In modern day, the site is roughly 5 kilometres away from the sea, but during its occupation the sea levels would have been right next to it and the settlement itself would have been located on a beach in connection to the coastal archipelago. The site of Balltorp would have had a rather secure position on the beach, with a rich and diverse maritime environment in its vicinity. During its settlement, it would have had forested surroundings containing pine, hazel and birch trees. Around this time, the coastal area of Mölndal would also have acted as the estuary of the largest river in the Nordic region, creating a bay that would have been wider than a mile and much further inland than it is today (Johansson *et al.*, 2014).

Balltorp had its first excavation between 1987 and 1988 (Jonsson, 1996; Johansson *et al.*, 2014). During the spring of 2008, a preliminary investigation took place in Mölndal, which would lead to the discovery of three different settlements. The excavation of the Mesolithic context would be discovered after the initial excavation of previous settlement layers, and took place between May and July 2011. It was only within an area of approximately 100 m² that bone material was found, in a submarine layer outside of the actual settlement. Water screening had been necessary to find and save the quantity of bones present in the muddy soil, and the eroded surface on some of the bones testified that they had been in water for prolonged periods of time (Johansson *et al.*, 2014).

Almost 90 kilometres north of Balltorp, the site of Huseby Klev is located on the island of Orust. The fourth biggest island by landmass in Sweden, Orust has a characteristic bedrock of gneiss, with plinth-shaped heights and elevations that has resulted in steep seashores, mountain slopes and rift valleys (Orust n.d.; Nordqvist, 2005: 7). Huseby Klev is situated on the edge of the Morlanda valley, with mountains and steep slopes on both sides (Nordqvist, 2005: 7).

Excavated between 1992 and 1994, Huseby Klev has become known as the earliest known coastal settlement on the Atlantic coast with organic remains. The osteological material is present throughout each occupational phase and consists of 11.9 kg of fragmented remains, excluding the amount of indeterminate bone artefacts, or bones removed prior to the osteological analysis (Boethius, 2018b).

Much further south, the site of Tågerup is located in the municipality of Landskrona, Scania. The topography of the site speaks of an environment that was in the vicinity of a deep-water bay with a close proximity to both the sea and several freshwater basins, with the site itself being located near an estuary. Pine, hazel and alder trees would have dominated the forested environment in and around the settlement, likely mixed with lime and oak trees as well. When investigating soil samples, the low degrees of herbal pollen seems to indicate that the forested area was rather dense. The pine tree population would eventually decrease in size, whilst alder, birch and willow trees became more frequent in wetter soils. Ash and oak trees would also grow to become more common during the later phases of the settlement (Karsten & Knarrström, 2000: 256 - 257, 265).

The excavation of Tågerup became part of a major project in building the West coast railroad between Helsingborg and Kävlinge, which became one of the largest archaeological investigations in the country at the time. Along the 40 kilometres long route, 37 spots of interest were investigated between the years of 1997 and 1998. The pollen analysis of Tågerup shows that several square kilometres would have been actively used or inhabited (Karsten & Knarrström, 2000). The osteological material found on the site was gathered from the final and preliminary investigation, divided between five different categories according to the context of which they were found or dated from (Eriksson & Magnell, 2000: 160).

3. THEORETICAL FRAMEWORK

This thesis has taken the interpretation and analysis of previously researched sites into account when studying each respective coastal zone, in the form of reports and articles. The usage of optimal foraging theory, contextualised mobility and ethnoarchaeological data have been prominent parts. As a result, it was necessary to delve into these topics in order to get an idea of how the site of Blå Jungfrun should be interpreted.

Since the osteological material from the excavation on Blå Jungfrun had not previously been analysed, the *functionality* of the site became the leading question. By comparing its function and structure with the other coastal sites, the mobility of Blå Jungfrun would possibly be glimpsed through from the comparative frequencies of animal economy and subsistence strategy.

3.1 FUNCTIONALISM

Trying to understand the function of an object from the past became one of the primary focuses of processual archaeology, where more or less everything has a role to play in order to keep the system going, much like organs are necessary to keep a body alive. Essentially, the adaptive function of something is what drives its creation and usefulness (Harris & Cipolla, 2017: 21). *Functionalism*, in this sense, is the theory of how things work, why they exist and what part they play in a system or society.

Different functions might be considered relative to one another, and understanding the importance of said functions and their relation to each other is what can also be described as *structural functionalism* (Harris & Cipolla, 2017: 22). New Archaeology used this framework to draw analogies between social groups and organic life, which Lewis Binford would come to be at the forefront of, by applying heavy emphasis on adaptation and universalised laws that affected cultural processes. However, the primary argument against this type of structural-functionalism was that it assumed that change only occurred from outside the cultural system, which left no explanation for how or why social groups or individuals might have changed their ways of doing things other than for the purpose of adapting to a new environmental stimulus (Harris & Cipolla, 2017: 44 - 45).

The purpose of this thesis is not so much to prove what might have led one Mesolithic society to act differently than another, but rather to study the function of Blå Jungfrun in comparison to the other coastal sites and by doing so, also understand the criteria that makes Mesolithic settlements characteristically different from each other.

3.2 SOURCE CRITICISM

One of the main dilemmas that this thesis faces is the interpretation of the osteological material and the analysis of the coastal sites, as the sample sizes, chronology and geographical location greatly differ between one another. Whilst the difference in sample sizes can be explained by the selection of methods and change of technology in more recent excavations, the sites do not otherwise share the same location or chronology. It can be said that the thesis never intended to

compare them as though they had equal attributes, but rather as comparative data that can be contrasted to that of Blå Jungfrun. The analysis of Blå Jungfrun might not have been the same if it had been compared to that of similarly sized sites, with small bone assemblages and single-species remains. If the functionality of Blå Jungfrun was to be discussed, it was necessary to compare it to a more diverse selection of sites in order to not only discover the variety of utilisation and sizes of Mesolithic settlements, but also to understand what would set Blå Jungfrun apart from other residential sites other than the obvious differences in sample size.

Taphonomic processes and ecological factors also sets the sites apart, as one location risks greater loss of skeletal remains than another, and the faunal frequencies are sometimes dependent on the local environment. A higher frequency of identified specimens in one place is therefore not necessarily synonymous with greater dependency or bigger importance compared to another, but the *relative* abundance might instead show differences that sets two places apart. Overrepresentation of certain elements can also be interpreted as either being selectively carried from the kill-site to deposition, or as a matter of taphonomic loss.

Additionally, not all bone fragments found on old sea floors outside of coastal settlements are necessarily traces of human activity, as cadavers and skeletal remains from dead animals could be carried to shore by currents and waves (Johansson *et al.*, 2014). However, the assemblages in this comparative study have been conducted in accordance with the context in which they were found, which sets the osteological material at the time and place of occupation.

4. MATERIAL

The primary material has been analysed from the site of Blå Jungfrun, specifically from the test excavation that took place in 2014 (Alexandersson *et al.*, 2015). A total of 219 bone fragments from Blå Jungfrun have been analysed at Kalmar Läns Museum, resulting in a total of 35 identified specimens (Table 3). Initially, 226 fragments were examined, but six proved to be charcoal instead of bone material. In addition to this, two fragments proved to be from the same piece - a canine tooth from a grey seal.

A total of 8 datasets have been collected and examined, with a total of 29 448 specimens. Osteology reports and articles from previous excavations from the East and West coast sites have been used when quantifying the databases. Altogether, the study encompasses a total of 50 504 bone fragments, including indeterminate species of birds and fish.

However, the site of Köpingsvik did not provide full data on the abundance of elements based on NISP (*Number of Identified Specimens*) from the indeterminate fragments (seals, rodents, and fish) and the identified fragments of Atlantic cod (*Gadus morhua*). MNI (*Minimum Number of Individuals*) was not possible to ascertain from this dataset, due to no stated side determination of the identified elements. Similarly, MNI was not stated in the datasets of Gisslause, Huseby Klev and the first phase of Balltorp.

Furthermore, only an approximated 13% of the total fish assemblage from Norje Sunnansund has been analysed so far (Boethius, 2017), and it is this frequency that this study has adjusted itself to.

Table 3: A table showcasing the three basic parameters of bone fragments from the East and West coast. NSP = number of species, excluding indeterminate species of mammals, fish or birds. NISP = number of identified specimens. MNI = minimum number of individuals.

THE EAST COAST			
SITE	TOTAL NSP	TOTAL NISP	TOTAL MNI
<i>Blå Jungfrun</i>	2	35	3
<i>Gisslause</i>	11	1 119	N/A
<i>Köpingsvik</i>	6	333	N/A
<i>Norje Sunnansund</i>	73	18 240	123
THE WEST COAST			
SITE	TOTAL NSP	TOTAL NISP	TOTAL MNI
<i>Balltorp Phase I</i>	22	175	N/A
<i>Balltorp Phase II</i>	25	222	32
<i>Huseby Klev Phase I</i>	42	1 157	N/A
<i>Huseby Klev Phase II</i>	37	1 812	N/A
<i>Huseby Klev Phase III</i>	31	1 382	N/A
<i>Tågerup Phase I</i>	39	3 657	62
<i>Tågerup Phase II</i>	12	263	19
<i>Tågerup Phase III</i>	30	1 053	23

4.1 MATERIAL SELECTION

Since the study would rely extensively on comparing data, certain criteria were necessary to apply in order to follow the aims and research questions. With Blå Jungfrun as the main outlier, sites chosen for the study would need to be classified as coastal with at least one definite species identified. Additionally, the identified material of the various sites would need, at minimum, roughly the same amount of fragments as Blå Jungfrun respectively. Because of the duration of the study, sites that already had a database visualising the total quantity of identified material were prioritised. Sites that did not have a clear chronological dating of the osteological material and the Mesolithic contexts of which they were found in, were excluded.

Furthermore, only fragments that were identified to definite species, family or element level were included in the analysis. Fragments marked as ‘indeterminate mammalia’ or similar were excluded from statistical diagrams and figures because it would not be possible to categorise them as either terrestrial or marine, which this study relies on in order to analyse the animal economy of each site. Fragments that either had question marks or were impossible to determine as either avian, pescetarian or mammalian were also excluded. Fragments that were determined to species with a question mark were simply included in the database as ‘indeterminate’ on family level. Indeterminate fish and birds are, however, included in the statistical analysis of the animal economy, because their presence allowed the study of subsistence strategies and diet.

5. METHODOLOGY

The identification of the bone material from Blå Jungfrun has been performed in accordance with the reference collection available at Lund University, as well as the image compendium published by the Department of Archaeology and Ancient History. The analysis was done according to zooarchaeological methods, focusing on the determination of species and elements, and taphonomic processes. Age determination was also implemented, and was initially meant to act as a seasonality or age selection indicator but since only one fragment was possible to age estimate it was not possible to investigate further.

Due to the fragmentation and the sooty surface of the bone material, few gnaw- and cut marks were visible ocularly. Digital photos and microscopic pictures were therefore taken in order to find and study gnaw- and cut marks closer, and to determine the existence of trampling. A portable DinoLite Digital Microscope was used for the microscopic imaging, and made it possible to study and compare various marks to one another digitally when the reference material was not otherwise available.

Side determination and the recording of zones has been registered on a certain few fragments from the total amount of bone material. The side determination of fragments was made possible with reference material. However, many teeth were excluded from side determination, either due to the fragmented state or the lack of relevant reference material. The criteria for recording the zones of fragmented bones has been based on the system from Needham and Spence (1996).

Apart from reference material, an image compendium by Lepiksaar (1991) was also used when determining each pinniped species. Attempts at measuring relevant elements were conducted in accordance with the manual by Ericson and Storå (1999).

5.1 QUANTIFICATION

In order to sufficiently analyse the material, it has been necessary to apply certain quantifications to it. It is done in addition to the side determination and taphonomic processes, and serves as an important factor when investigating subsistence strategies and statistical quantities. In addition to this, NSP (*Number of Species*), NISP and MNI is applied when analysing the material and presenting the results, as a way to quantify the identified fragments.

5.2 CATEGORISATION

The large diversity of the osteological material in this study has made it necessary to categorise the species, elements and definition of the analysed fauna (Table 4, Table 5). Detailed information about the various species and elements will be included in the official appendix instead.

Mammals are naturally separated between terrestrial and marine, as their ecology and physiology is substantially different when analysing the subsistence and hunting strategy related to them. Thereafter, the mammalian assemblage has been categorised into five classes: ungulates, cetaceans, pinnipeds, fur game and rodents. Whilst seals and other pinnipeds might have been hunted as a means for fur, they are not defined as fur game per se in this study due to the aforementioned division of marine and terrestrial species. Fur game will also be referred to as either 'big fur game' or 'small fur game' as the size differences might have played a role in the hunt, and possible consumption of meat, of fur game species.

Subsequently, the avian assemblage of this study is categorised into six classes: waterbirds, seabirds, gamefowls, corvids, songbirds and birds of prey. Corvids refer to species that are part of the *Corvidae* family, such as crows and rooks. Songbirds generally refer to perching, small birds with melodious calls, and is an umbrella term for a group of families rather than a single family of birds. Birds of prey, similarly, refer to a clade of predatory birds that share the characteristics of talons and curve-tipped beaks. The definition that separates the waterbirds, seabirds and gamefowls from one another is primarily ecological preference. In this study, seabirds is used as an umbrella term for the avian species that primarily flock and hunt in coastal and deep-sea environments; waterbirds on the other hand refer to avian species that primarily flock and hunt around inland lakes, wetland areas and shallow coastal environments.

Fish has been categorised into three classes: freshwater, coastal and diadromous. Freshwater refers to species that strictly live in either freshwater or brackish water, depending on the chronological development of the Baltic Sea Basin. Comparatively, coastal refers to species that strictly live in saltwater and deep-sea environments. Diadromous refers to species that travel between freshwater and saltwater environments as part of their ecological behaviour.

The analysis of the bone elements made it necessary to separate various anatomical parts into categories, primarily the extremities and cranium. The bone elements of the mammalian and avian species have been categorised in similar terms of anatomy, with cranium, front, rear and distal extremities separated from one another. The only exception to the categories is that of the fish species. Due to the widely different anatomy of fish, the bone elements had to be categorised differently, with the shoulder belt and pelvis replacing front and rear extremities.

Table 4: Categories of mammalian, avian and pescetarian species and families. Left table: category of amphibians, terrestrial and marine mammalian species. Middle table: category of bird species and families. Right table: category of fish species and families.

CATEGORY	SPECIES
Amphibians	frogs toads
Ungulates	auroch bison elk red deer roe deer wild reindeer wild boar
Cetaceans	dolphins porpoise
Pinnipeds	grey seal harbour seal harp seal ringed seal
Big fur game	bears canines felines
Small fur game	badger beaver mountain hare hedgehog otter pine marten polecats squirrel
Rodents	mice rats voles

CATEGORY	SPECIES
Waterbirds	ducks geese grey heron swans
Seabirds	auks/alcids cormorants gannets grebes gulls loons pelican shearwaters
Gamefowls	western capercaillie
Corvids	crows nutcrackers
Songbirds	nuthatches
Birds of prey	eagles falcons kites

CATEGORY	SPECIES
Freshwater	burbot cyprinids percinids pike smelt
Coastal	ballan wrasse common dab dogfish european flounder european plaice gadids grey gurnard hake herring ling mackerel thornback ray tuna
Diadromous	eel salmonids

Table 5: Categories of mammalian, avian and pescetarian bone elements. Left table: category of amphibian and mammalian bone elements in anatomical order. Middle table: category of avian bone elements in anatomical order. Right table: category of pescetarian bone elements in anatomical order.

CATEGORY	BONE ELEMENTS	CATEGORY	BONE ELEMENTS	CATEGORY	BONE ELEMENTS
Cranium	calvarium dentes mandibula	Cranium	calvarium mandibula		parasphenoidale vomer frontale basioccipitale premaxillare maxillare dentale dentes articulare quadratum palatinum ectoterygoideum preoperculare operculare hyomandibulare keratohyale epihyale hypohyale urohyale branchiale pharyngea interparietale parietale
Antler	cornu				
Front Extremities	scapula humerus radius ulna sternum clavicula	Front Extremities	sternum furcula coracoid scapula humerus radius ulna	Cranium	
Spine	vertebrae	Spine	vertebrae		
Rib bones	costae	Rib bones	costae	Shoulder belt	posttemporale supracleitrare cleitrum scapula coracoid
Rear Extremities	coxae sacrum femur tibia fibula	Rear Extremities	coxae femur tibiotarsus fibula		
Distal Extremities	carpalia metacarpalia tarsalia metatarsalia phalanges metapodials	Distal Extremities	carpalia carpometacarpalia tarsometatarsus phalanges	Pelvis	basipterygium
Other	sesamoids patella indeterminate	Other	indeterminate	Spine	vertebrae
				Other	spinale squama costae weberian bones anale

5.3 AGE DETERMINATION

This study performed an age estimation of its primary osteological material from Blå Jungfrun, in the hopes that it could investigate the age structure of the killed seals. Furthermore, animals and their corresponding elements age at different stages, and can be affected by their anatomy, species and ecology. It is therefore important to determine the various ages of a bone assemblage in order to understand the hunting strategy, specialisation and seasonality of the prehistoric peoples.

Age estimation at the time of death was obtained by using epiphyseal fusion data. In accordance with Storå's method of epiphyseal fusion (2001a; 2001b), the stage of fusion of the epiphyses was divided into three categories; unfused, fusing and fused. A completely fused skeleton (skeletal age 8) is reached earliest in ringed seal (7.25 years), then harbour seal (8 years) and last in grey seal (11 years) (Storå, 2001a; Storå, 2001b). Yearlings are seals in their first year of life; juveniles are seals which have not reached full body size or sexual maturity; adult and old adult seals have reached full body size and are sexually mature (Storå, 2001a; Storå, 2001b).

Grey seal, ringed seal, harbour seal (*Phoca vitulina*) and harp seal (*Pagophilus groenlandicus*) share the same sequence of epiphyseal fusion, but there is considerable variation in the observed ages of fusion of the epiphyses which is most marked in epiphyses fusing late in life and complicates the use of chronological ages when estimating age (Storå, 2001a; Storå, 2001b). For instance, the end of February tends to be the earliest time for ringed seal, grey seal and harp seal to give birth (Table 6), and they continue to brood during March (Ekman, 1922: 253, 267 - 268; Storå, 2001a; Storå, 2001b). Harbour seal, on the other hand, gives birth much later and on land, roughly around midsummer, during June (Ekman, 1922: 267 - 268; Storå, 2001a; Storå, 2001b).

Table 6: Illustrative table showcasing the range of birth between the various seal species. Dark cells refer to the earliest and latest birthing period.

SPECIES	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
Grey seal (<i>Halichoerus grypus</i>)												
Harbour seal (<i>Phoca vitulina</i>)												
Harp seal (<i>Pagophilus groenlandicus</i>)												
Ringed seal (<i>Pusa hispida</i>)												

5.4 TAPHONOMY

Cut marks and butcher marks have been studied on the various bones from Blå Jungfrun, with the purpose of determining whether the animal remains has been cut, marrow-split, skinned or filleted. Trampling and gnaw marks have also been a necessary part of the study, since it can function as a good indicator of whether or not the excavated remains have been visible above ground and available for animals to walk on, or for scavengers to eat. These taphonomic processes have played a part in comparing the pinniped material between Blå Jungfrun and the other sites, in an attempt to understand the different treatments of seal bones. However, due to the sooty surface of the analysed bones from Blå Jungfrun, and the presence of varying degrees of burnt material, weathering has been excluded from the analysis.

6. RESULTS

The study begins by showcasing the total representation of identified animal categories, as shown in Figure 3. Fish dominate the total NISP, followed by ungulates, birds and pinnipeds. The total NISP has also been comparatively divided between the West and East coast (Figure 6), in order to illustrate the difference in assemblage abundance between the two regions.

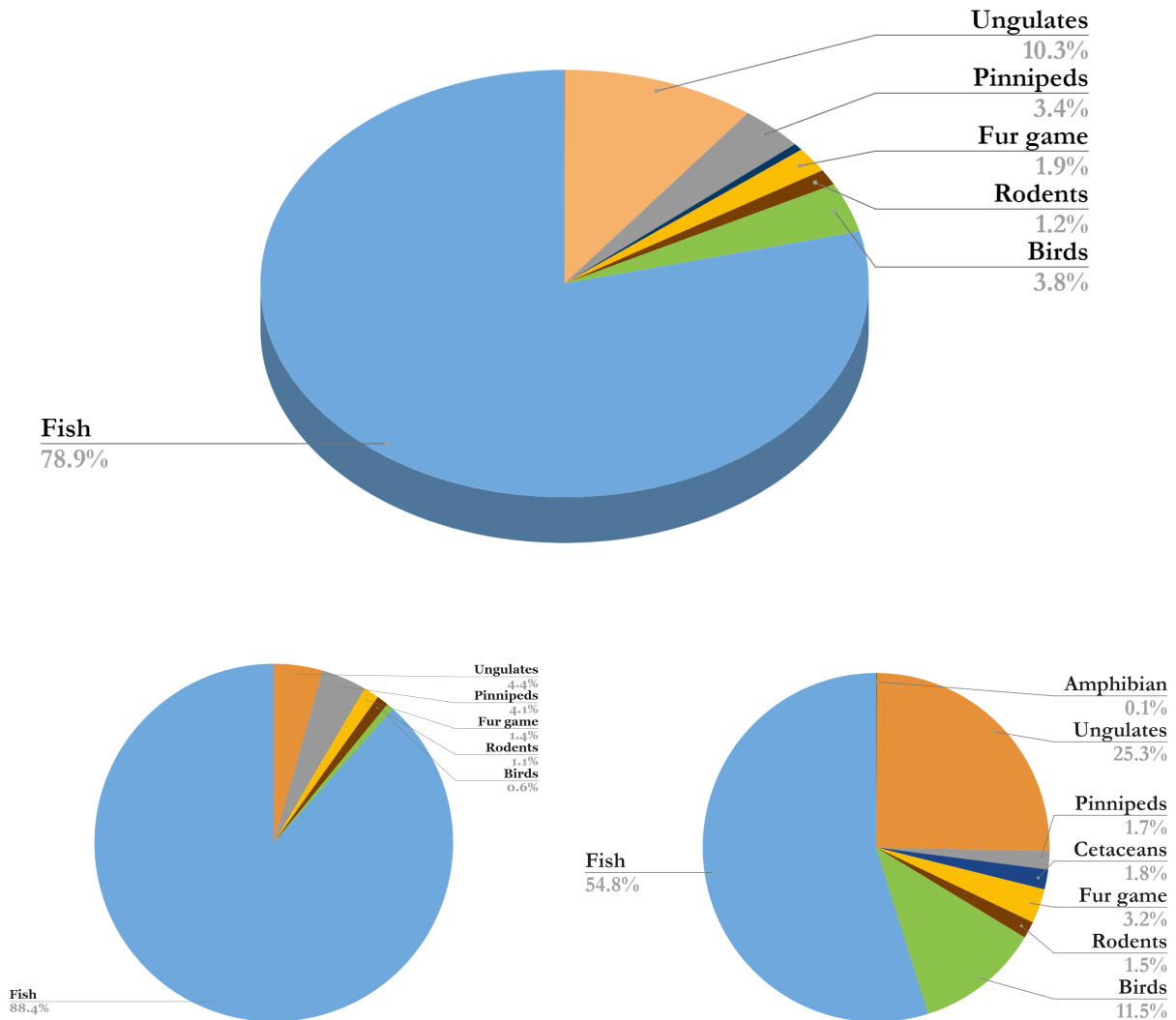


Figure 3: Pie chart bar featuring the total abundance of faunal remains from all sites, and the relative abundance of fauna per coastal region of West and East based on NISP. Upper pie chart: total abundance of faunal remains from all sites combined. Lower left pie chart: relative abundance of fauna from the East coast. Lower right pie chart: relative abundance of fauna from the West coast.

6.1 BLÅ JUNGFRUN

Blå Jungfrun has the smallest assemblage of bone material analysed in this study, with a total of 219 fragments. A total of 35 fragments were possible to identify to species or family category (see Appendix A: Table A1), and the remaining 184 fragments found on the site were categorised as indeterminate. In contrast to the other sites presented in this study, Blå Jungfrun only exhibits identifiable remains from pinnipeds, resulting in Blå Jungfrun being the only site in this study to feature a single-genus category. Considering the isolated geography of the island, it was assumed that ungulates and other terrestrial mammals would likely not represent the majority of the total material. However, birds and fish would otherwise have been expected to be present.

The main portion of the analysis took place in Kalmar Läns Museum, using borrowed reference material and a microscope from the zooarchaeological collection at Lund University, LUX. When the initial analysis was done, a selected few fragments were transported to the laboratory at LUX in order to ensure the estimation of species and element identification. With better access to the zooarchaeological collection, it was possible to differentiate the pinniped species between one another and exclude other mammals from further study.

6.1.1 REPRESENTED SPECIES

As shown in Figure 4, half of the identifiable material, 18 fragments, was simply stated to belong to a seal of indeterminate species, either due to the fragmentation of the material or due to the lack of sufficient reference material. The remainder of the identifiable material, however, was possible to determine as grey seal and ringed seal respectively, with a slightly bigger frequency of grey seal.

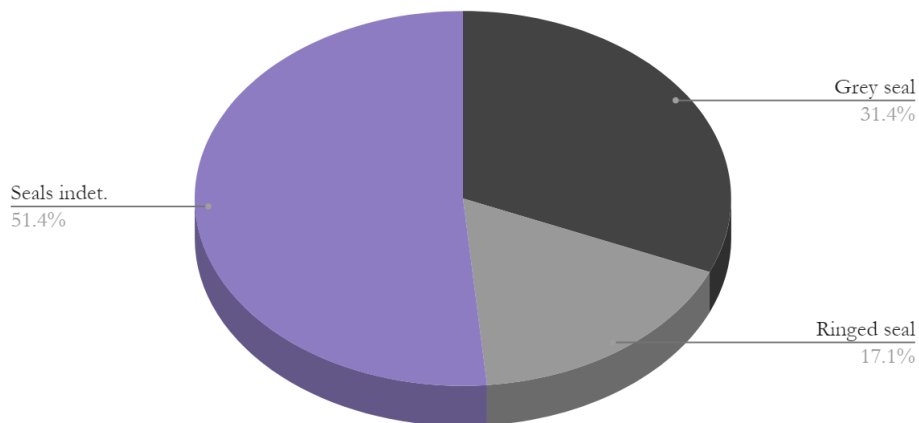


Figure 4: Circle diagram featuring the relative abundance of pinnipeds from Blå Jungfrun based on NISP.

6.1.2 ELEMENT DISTRIBUTION

Each indeterminate and determinate fragments of seals, a total of 35 fragments, were possible to identify to specific elements, as shown in Figure 5. The element distribution at Blå Jungfrun consists of small limb bones, vertebrae, cranial bones and teeth.

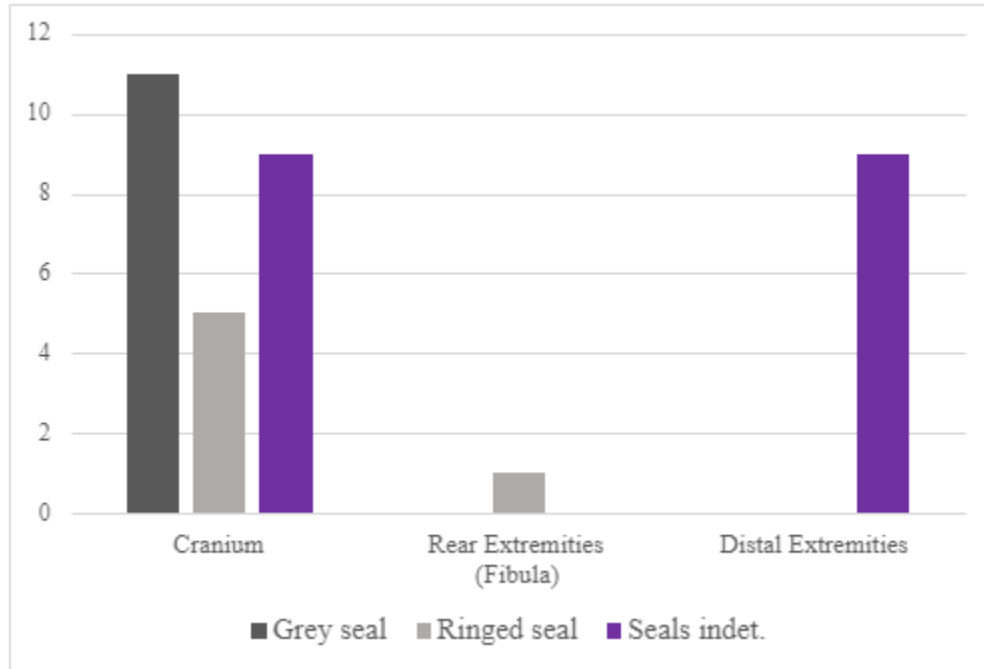


Figure 5: Column chart featuring the element distribution of pinnipeds from Blå Jungfrun based on NISP.

The large majority of the identified material was determined to be fragmented parts of the calvarium, which also dominated each species' category. Amongst these cranial fragments, almost all were determined as being part of the temporal bone, specifically the mastoid part of the temporal bone (see Appendix A: Table A2).

9 fragments, half of the indeterminate seal material, were identified as phalanges. An attempt was made to try and measure these phalanges using osteometrics by Ericson & Storå (1999) in order to determine the correct species, but this was later abandoned as the lack of sufficient reference material prevented the analysis to determine whether the fragments were anterior or posterior, or in which anatomical order they were.

6.1.3 AGE DISTRIBUTION

The age distribution at Blå Jungfrun is a difficult matter due to the fragmented state of the bone material. In accordance with Storå's age determination of seal bones using epiphyseal fusion data (2001), cranial bones were not included in determining the age of the material since they were not part of the criteria for age estimation. With that said, each cranial fragment that was identified was noted as fused.

Following the directive of Storå (2001), the analysis focused on determining the limb bone fragments and teeth. Each identified phalanges were determined as fused. However, the teeth were not possible to determine to a certain age, other than that they were not deciduous teeth. Since it was not possible to determine the phalanges in anatomical order either, the fragmented fibula of a ringed seal was the only bone fragment possible to pinpoint an estimated age to.

The distal epiphysis of the fibula bone was determined as fused and sets the individual to age group 4. This means that the individual was categorised as 'old adult' and would have been sexually mature before death. By being set to age group 4, i.e. the final age group before all limb bones would have fused, this also means that at least one individual of the bone material is possible to estimate as an adult with anatomical parts of the body from prior age groups being completely fused.

One age-determined fragment is, however, the bare minimum worth discussing when analysing age differences in an assemblage. It is far from ideal and tells little to nothing about the identified individuals. It should therefore be assumed that the material could still have inhibited juvenile seals, and that a further analysis of the phalanges and teeth would have been preferable to determine the estimated range of ages in the assemblage.

6.1.4 MANIPULATION AND MODIFICATION

The material of Blå Jungfrun showcased little signs of gnaw marks and trampling. The majority of the bones from Blå Jungfrun were, however, charred or slightly burnt. At least two fragments had the characteristic 'porcelain' sound from being burnt.

In addition to this, a large portion of the fragments had traces of butchery. Whilst there were no visible cut marks on the fragments, a lot of fragments belonging to small limb bones exhibited traces of having been cleaved or split.

The single fragment of a fibula bone did not belong to the assemblage with visible butchery marks, but it is assumed that its deposit together with several fragments of phalanges indicate that flippers were cut off from the carcasses and discarded. By cutting the flippers a bit too far up, it might have resulted in a piece of fibula being discarded with the flippers.

Similarly, the identified fragments of cranial bones have no definitive traces of butchery, but the amount of small pieces could suggest that the animals were clubbed to death or had their skulls crushed post-mortem. The skull itself does not have much meat to offer, but the brain is fatty and nutritious. After removing the brain, the broken left-overs of the skull could have been deposited with the other small limb bones.

6.2 THE EAST AND WEST COAST

A total of 24 130 fragments had been possible to identify in accordance with the original reports from each East coast site (Figure 6). 19 386 fragments were possible to identify to species; 19 275 fragments were possible to determine to specific elements. In addition to this, a total of 9 721 fragments were collected and categorised in accordance with the original reports from the West coast sites. 9 028 fragments were possible to determine to species; 8 764 fragments were possible to identify to bone elements.

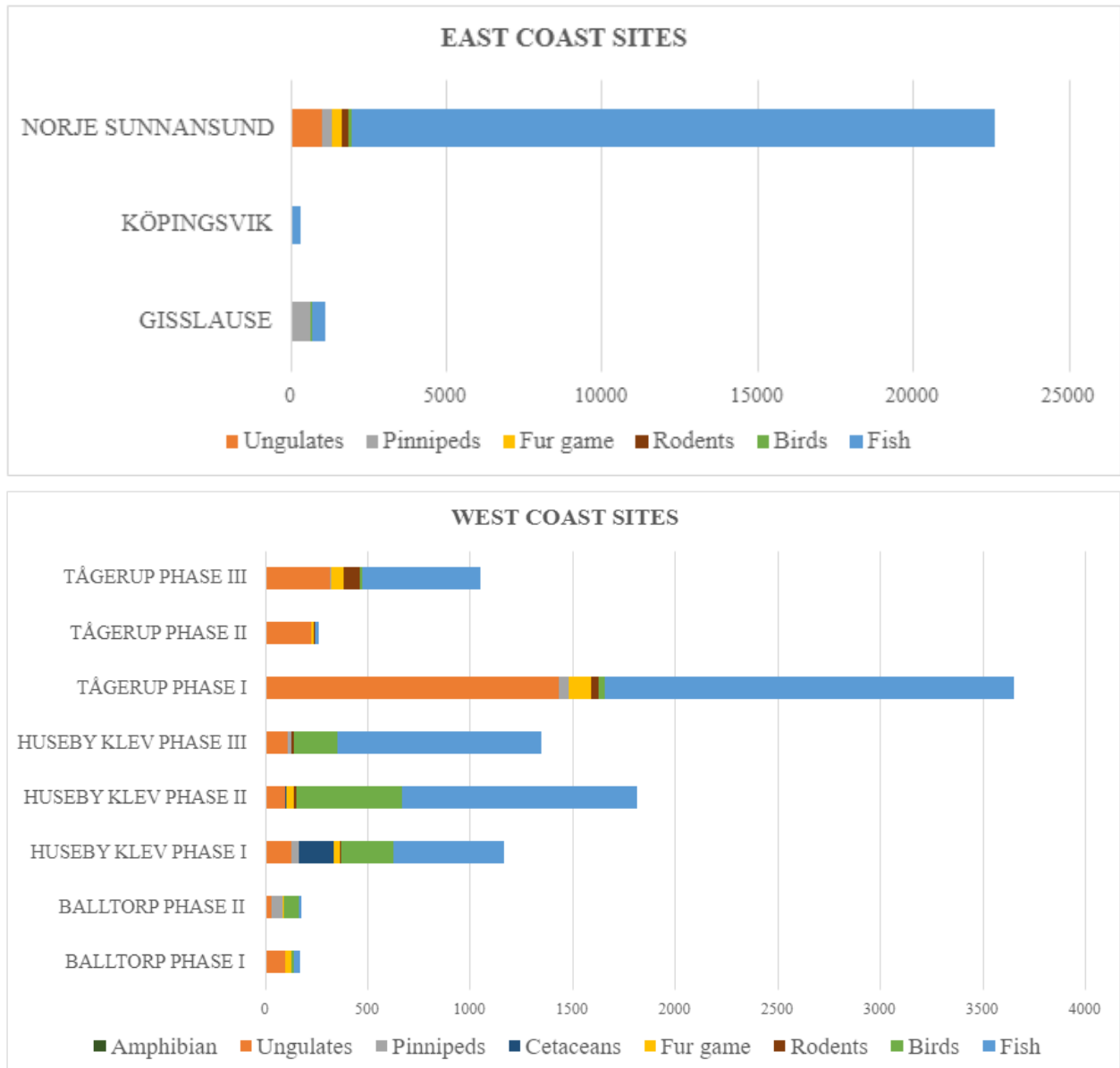


Figure 6: Staple diagram featuring the total relative abundance of fauna from the East and West coast sites respectively, based on NISP. Upper staple diagram: relative abundance from each East coast site, excluding Blå Jungfrun. Lower staple diagram: relative abundance from each West coast site.

With the sites combined, the East coast provided the largest bone assemblage in this study, as well as the largest assemblage of fish and seal bones. The fish assemblage dominates more than two thirds of the total NISP, followed by the ungulate and pinniped assemblages. In contrast to the West coast, birds and fur game had significantly lower frequency on the East coast. Comparatively, the West coast had a high frequency of ungulates and fur game, and an almost even distribution of fish and pinnipeds.

The vast majority of the East coast material is identified from the Early Mesolithic site of Norje Sunnansund; Huseby Klev and Tågerup had the largest assemblages on the West coast. However, the site of Gisslaue provided the largest frequency of pinnipeds out of all sites.

6.2.1 REPRESENTED SPECIES

As seen in Figure 7, ungulates and pinnipeds were almost equally abundant in the East coast material. 1 061 fragments of ungulates and 923 fragments of pinnipeds were identified, as well as 337 fragments of fur game and 258 fragments of rodents (see Appendix B: Table B1). An additional 16 428 indeterminate mammalian fragments were also identified according to the original osteological reports, but were excluded from this analysis due to their ambiguous identification.

Excluding the indeterminate mammalian assemblage, the West coast analysis consists of a total of 9 678 fragments. In addition to the sub-recent mammal bones, the frog bones (see Appendix C: Table C1) found during the excavation have been suggested to have been locally present in the area and died close to the deposited bones, hence becoming mixed with the rest of the assemblage. They were, in the end, included in the official database, but according to the report it is uncertain whether they were contemporaneous with the settlement or not (Eriksson & Magnell, 2000: 189). Ungulates otherwise dominated the mammalian assemblage on the West coast, followed by fur game. The sites had a much larger quantity of cervids and suids compared to the East coast, but a comparatively smaller assemblage of bovids (see Appendix C: Table C2, Table C3, Table C4). The cetacean and pinniped assemblages are similar in frequency, but combined they would just about surpass the fur game assemblage. This might indicate that the hunter-gatherers on the West coast chose terrestrial and mammalian resources as their preferred subsistence strategy, rather than fish.

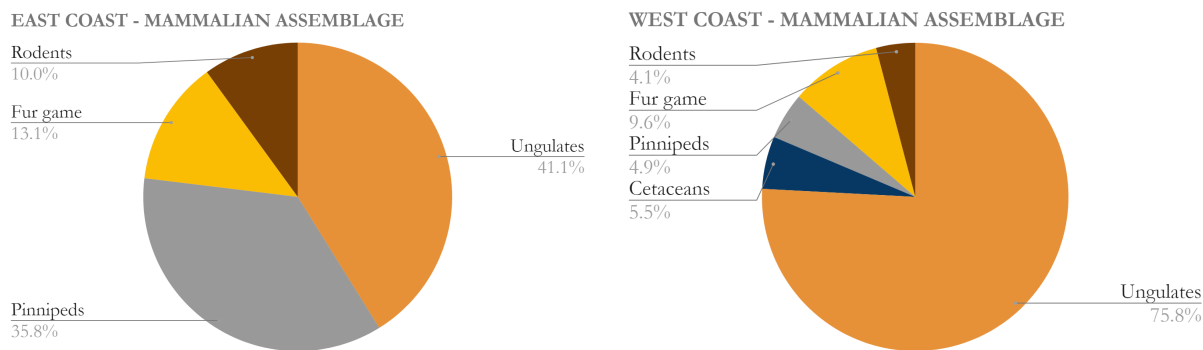


Figure 7: Circle diagram featuring the total relative abundance of mammalian fauna from the East and West coast sites combined, based on NISP. Left pie chart: total relative abundance of mammalian fauna from the East coast. Right pie chart: total relative abundance of mammalian fauna from the West coast.



Figure 8: Circle diagram featuring the total relative abundance of pinnipeds from the East and West coast sites combined, based on NISP. Left pie chart: the relative abundance of pinnipeds from the East coast sites. Right pie chart: the relative abundance of pinnipeds from the West coast sites.

Out of the 923 fragments of pinnipeds on the East coast, more than half of the total NISP were indeterminate fragments of seals (Figure 8). Aside from that, grey seals dominated more than half of the identified seal fragments, closely followed by the ringed seal. The frequency of seals on the East coast is almost six times larger than that of the West coast, possibly indicating a bigger dependence on marine mammals. On the LM site of Köpingsvik, however, harp seal fragments were identified. It is the only site on both the East and West coast sites that have identified harp seal fragments. As the youngest site on the East coast, the fragments represent the occurrence of possible harp seal hunting as the Baltic basin entered its Littorina Sea phase.

Grey seals dominated the majority of pinniped assemblages on the West coast. All three sites had grey seal finds in their respective assemblages, and grey seals were present at these sites throughout each Mesolithic phase. The West coast was the only region to exhibit harbour seal fragments, albeit in small quantities and only on the Huseby Klev site between its early and late phase (see Appendix C: Table C3). The pinniped assemblage on the West coast was also noted to have had its largest frequency during the same period as when the cetaceans were most prominent, during the EM and MM phase of occupation.

Half of the bird assemblage from the East coast is made up of waterbirds (Figure 9). The East coast had arguably a larger variety of bird species (see Appendix B: Table B2) than that of the West coast, but a considerably smaller quantity of avian remains. The combined distribution of birds on the West coast sites is more than seven times larger than that of the East coast's. However, the majority of the bird assemblage is made up of indeterminate species. Out of the identified species, seabirds dominate the assemblage, followed by waterbird species (see Appendix C: Table C5, Table C6, Table C7). The West coast sites also had a slightly larger assemblage of birds of prey than that of the East coast, primarily dominated by eagle species. When comparing the East and West coast bird assemblages, the percentage difference between waterbirds and seabirds are similarly parallel to one another. By roughly ten percent, the East coast has more waterbirds and the West coast more seabirds.

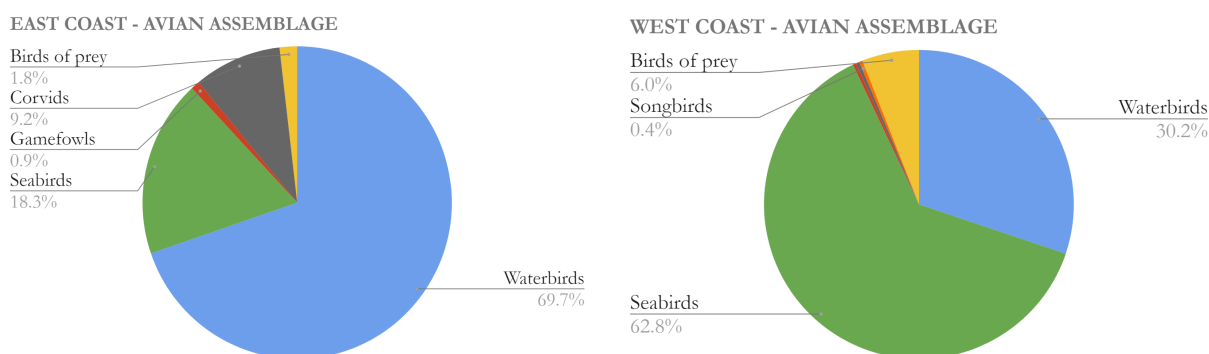


Figure 9: Pie chart featuring the total relative abundance of birds from the East and West coast sites combined, based on NISP. Left pie chart: the total relative abundance of birds from the East coast sites. Right pie chart: the total relative abundance of birds from the West coast sites.

The large fish assemblage on the East coast is almost entirely made out of freshwater fish, mainly by cyprinids, perciniids and pike (*Esox lucius*) (Figure 10). There are few remains of diadromous salmon and trout species present on the East coast. In contrast to the total NISP of identified fish specimens, the salmon and trout species are percentually miniscule. Comparatively, there are large quantities of burbot (*Lota lota*) and cyprinids (see Appendix B: Table B3). Whilst both Norje Sunnansund and Gisslause solely exhibit freshwater and diadromous species, a small quantity of Atlantic cod (*Gadus morhua*) were identified on the site of Köpingsvik. Similarly to the site's finds of harp seal, this influx of coastal fish could be explained by the opening of the Baltic basin and Littorina transgression at the time, allowing coastal fish to migrate and adapt to the brackish waters.

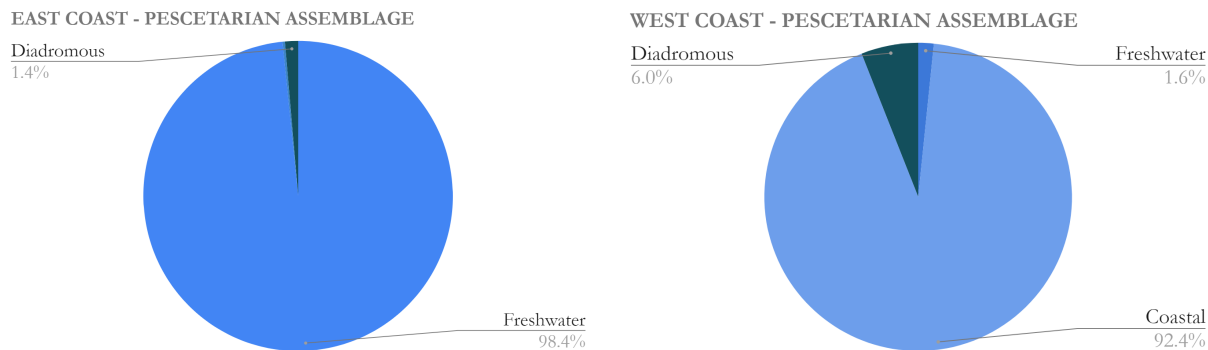


Figure 10: Pie chart featuring the total relative abundance of fish from the East and West coast sites combined, based on NISP. Left pie chart: total relative abundance of fish from the East coast sites. Right pie chart: total relative abundance of fish from the West coast sites.

The fish assemblage of the West coast was comparatively the largest of all other categories based on NISP, but in contrast to the East coast it is more than four times smaller. Out of the 3 814 fragments that were possible to identify to species, 3 523 fragments belonged to coastal fish species (see Appendix C: Table C8, Table C9, Table C10). Very few finds of freshwater and diadromous species are identified on the West coast sites, and are only found on the site of Tågerup.

6.2.2 ELEMENT DISTRIBUTION

Out of the 19 275 fragments that were possible to determine to specific elements from the East coast sites, 3 740 fragments were determined to be cranial elements. For the mammalian assemblage, the cranium proved to have the highest frequency (Figure 11). The mammalian assemblage is also dominated by limb bone fragments. The ungulates represent the larger quantities for most of the distribution, except for the cranium, vertebrae, ribs and to some extent the smaller limb bones. Pinnipeds follow soon thereafter with large quantities of identified elements, mainly from the cranium and limb bones belonging to flippers and extremities.

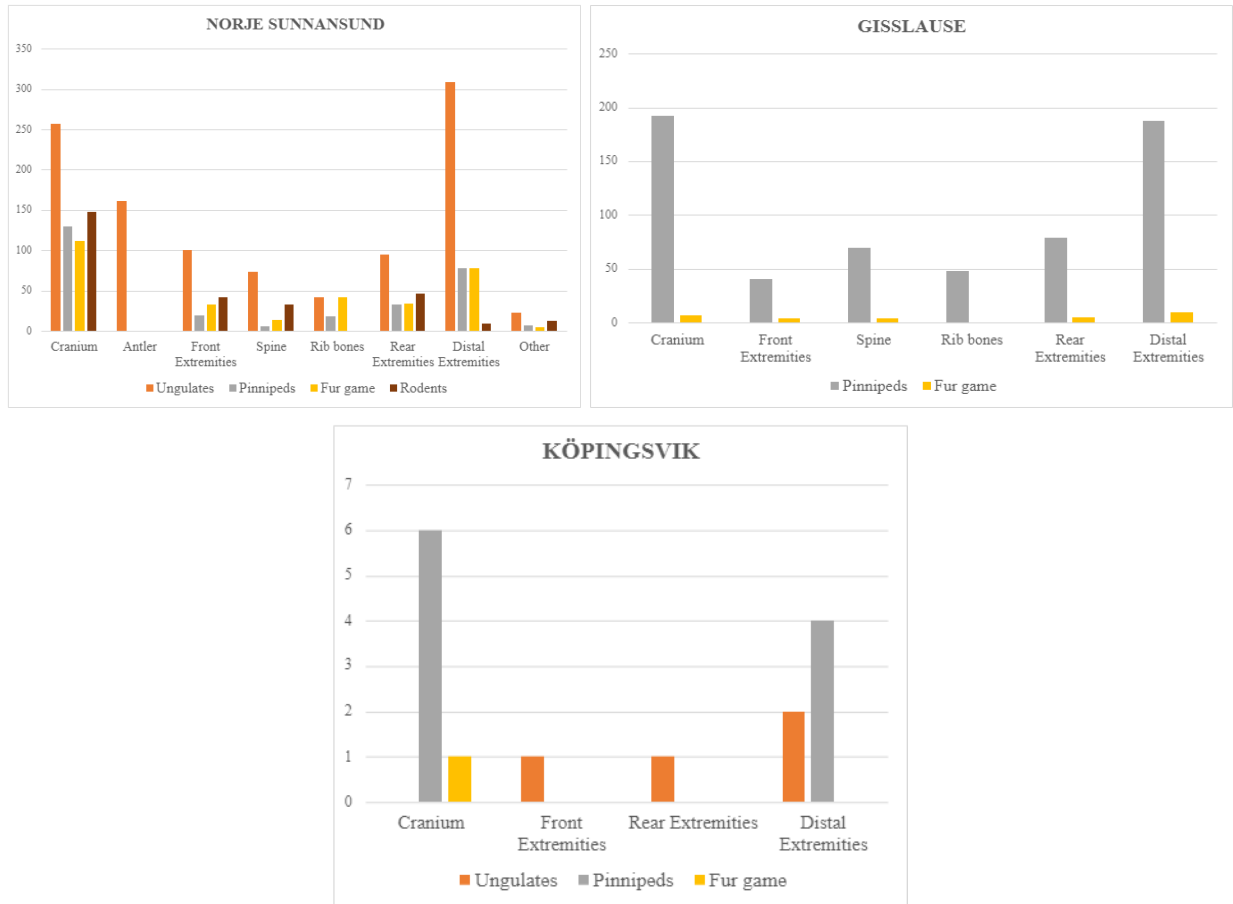


Figure 11: Column charts showing the relative element distribution of the East coast sites respectively.

The West coast's mammalian element distribution is also dominated by cranial fragments, followed by front and rear extremities (Figure 12). With a total of 1 069 fragments, the cranium represents approximately half of the identified elements and primarily belongs to the ungulates. In fact, ungulates dominated every category except for vertebrae and indeterminate elements, in terms of quantity. The fur game assemblage had the second largest element distribution, but had less diverse distribution than that of the ungulates as it was primarily dominated by teeth, frontal extremities and phalanges.

Looking at the chronological distribution on the West coast, the EM period seems arguably more diverse in terms of both elemental and species distribution. It shows elements from almost all parts of the body, but is primarily dominated by body core and limb bone extremities. This suggests that the subsistence strategy at the time might have been that most parts of the body were transported back to the sites (Boethius, 2018b). Coupled with the diversity and quantity of species, it might indicate that the EM occupied sites had close proximity to its resources and utilised large portions of the bodies.

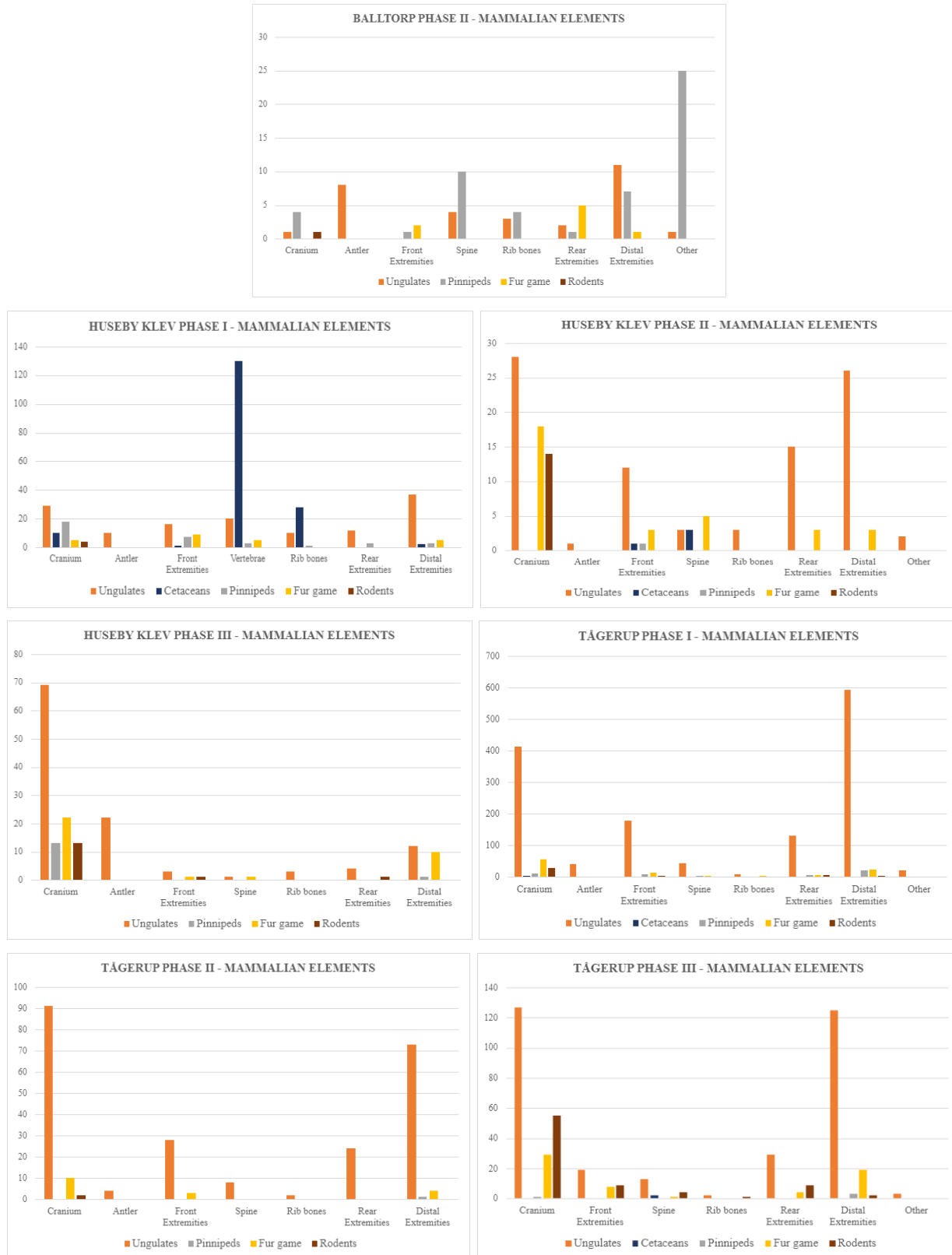


Figure 12: Column charts showing the relative element distribution of the West coast sites respectively, per phase. Phase I of Balltorp has been excluded, as no element distribution was recorded.

The element distribution of pinniped remains from the coastal zones are fairly similar, with high frequency of cranial fragments, rear and distal extremities (Figure 13). Comparatively with Blå Jungfrun, all sites share a large quantity of cranial and extremity fragments, implying that skulls and flippers were deposited after the animal had been clubbed and the carcass had been butchered. However, unlike Blå Jungfrun, the East and West coast also show frequencies of rib bones and vertebrates, as well as core body elements belonging to the front and rear extremities. This could either indicate that seals were likely hunted locally, close to the occupied site, or that the hunter-gatherers carried killed seals back to the site for consumption, implying that the kill-site might not have been too far off.

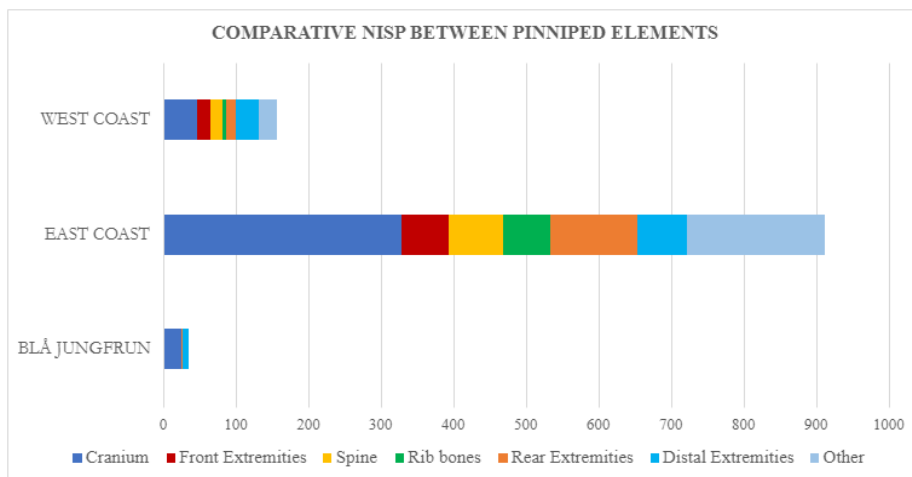


Figure 13: Staple diagram featuring the element distribution of pinniped species from the East and West coast sites combined, comparatively with the element distribution from Blå Jungfrun.

The bird assemblage has the smallest quantity of identified elements from the East coast but was largely dominated by elements from the front extremities (Figure 14), mainly by front extremity elements like the ulna and humerus. The front extremities also had some of the best preserved elements from each species, as the rest of the distribution is almost solely based between the waterbird and seabird species.

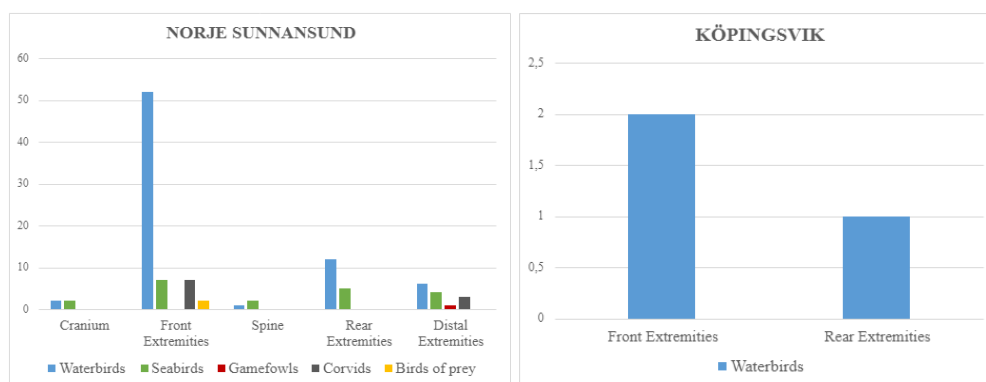


Figure 14: Column charts featuring the relative element distribution of avian remains between the East coast sites of Norje Sunnansund and Köpingsvik. Gisslause not included due to having no identified element distribution of birds.

Similarly to the East coast, the bird assemblage of the West coast has a very small frequency of cranial fragments but a substantially larger distribution of front extremities (Figure 15). The coracoid bone and humerus dominated the front extremity distribution, and was almost present during every phase throughout each site occupation. The auks (*Alcidae*) had the most diverse element distribution, followed by various waterbird species. Birds of prey were almost exclusively distributed by front and distal extremities.



Figure 15: Column chart featuring the element distribution of avian remains between the West coast sites respectively, based on NISP. Balltorp Phase I is not included due to having no recorded element distribution of its bird assemblage. Tågerup Phase II is not included due to only having one identified element of a red-throated loon, a humerus.

The element distribution of fish from the East coast is primarily dominated by vertebrae, by a total of 13 394 fragments (Figure 16). For many of the various species, vertebrae was the only identifiable element. After vertebrae, the distribution of cranial fragments was also large, with roughly 2 884 fragments in total.

The site of Köpingsvik only had a definite element distribution of the two identified fragments of perch (*Perca fluviatilis*), whilst the Atlantic cod and the indeterminate fish fragments have an unknown quantity of cranial and vertebrae distribution as they were never properly recorded.

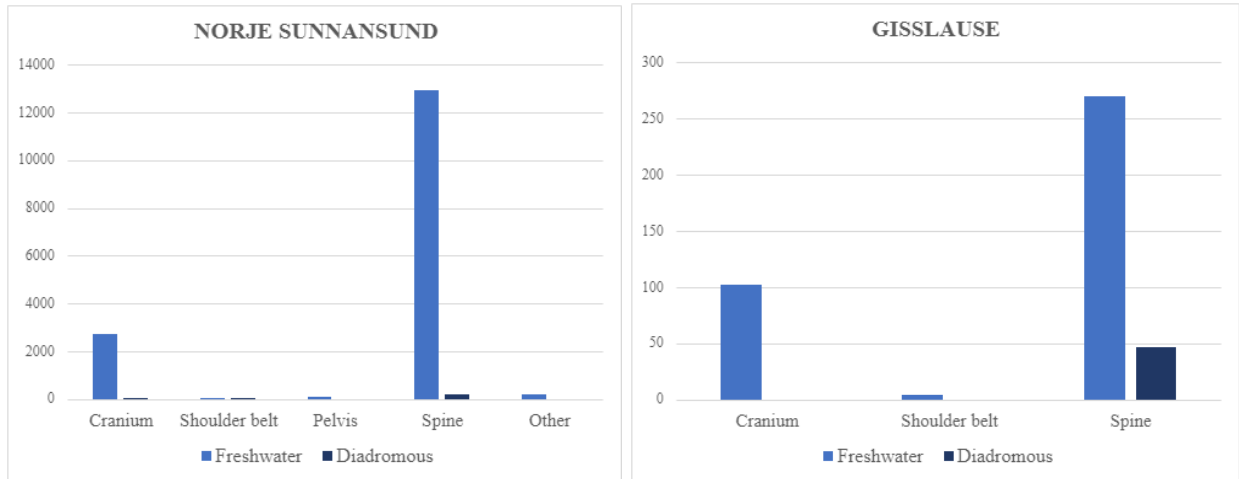


Figure 16: Column charts featuring the element distribution of fish from each East coast site respectively, based on NISP. Köpingsvik is not included due to only having two identified elements of perch, from the cranium. The indeterminate fish species and cod from Köpingsvik had no determinate elements.

The element distribution of the fish assemblage from the West coast sites is not unlike that of the East coast, as it is vertebrates and cranial fragments that dominates it (Figure 17). The West coast also had almost twice the amount of fish scales than that of the East coast, but had otherwise a less diverse frequency of elements.

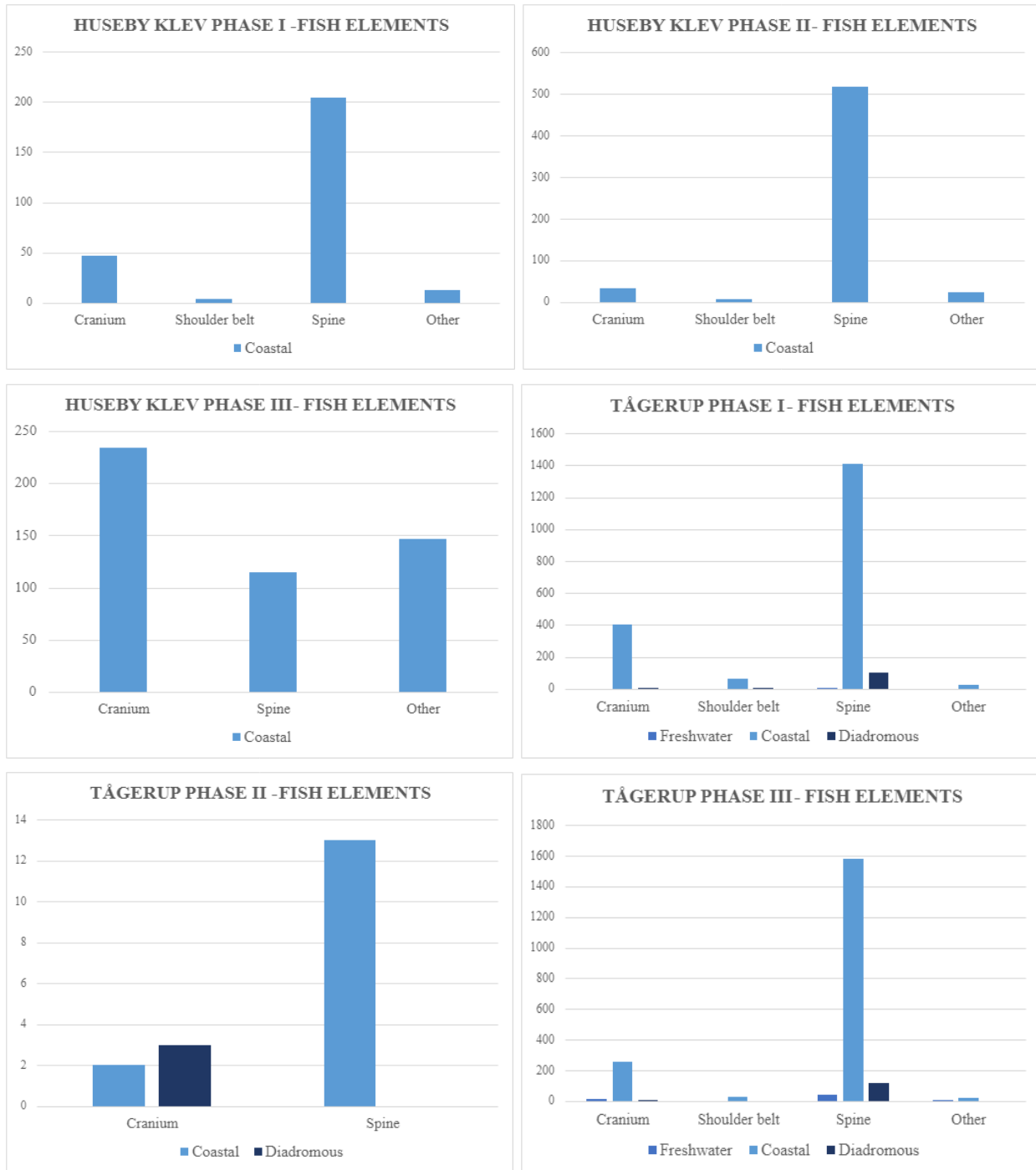


Figure 17: Column charts featuring the element distribution of fish from each West coast site respectively, based on NISP. Balltorp is not included due to having no determinate elements from its fish assemblage.

6.2.3 AGE DISTRIBUTION

The age distribution between the western and eastern assemblages was only reported for a few species or animal categories, primarily by terrestrial mammals. In some cases, small sample sizes reportedly complicated the interpretation of age distribution. Needless to say, some patterns of age selection were possible to ascertain.

On the West coast, the site of Huseby Klev presents a varied age distribution between the various species. Between the ages of 1 and 3.5 years, wild boar seems to have been hunted from a young age but does otherwise have a low outtake of juveniles and suggests that they were hunted between all ages instead (Boethius, 2018b). Similarly, roe deer had a visible distribution of primarily older individuals and a low outtake of juveniles during the site's middle phase. By analysing tooth wear, roe deer seems to have experienced an intensified hunting pressure between the ages of 2 and 4 years, followed by a lesser outtake between the ages of 4 and 7 years. The oldest roe deer was estimated to be about 10 years of age before death. This suggests that roe deer was flexibly hunted but with a focus on older individuals, whereas the wild boar was hunted between all ages (Boethius, 2018b). Comparatively, red deer completely lack juvenile individuals in its assemblage; the age distribution is between 3 and 6 years (Boethius, 2018b).

The site of Tågerup exhibits a large assemblage of primarily young adult or adult individuals. Elk provided one juvenile around the age of 1 year, as well as one adult individual. The age distribution of red deer showed only one juvenile younger than two years, whereas the remaining age estimation showed two intervals: the first interval being between the years of 2 and 5 years, and the second being around 10 years. Comparatively, roe deer had a larger assemblage of juveniles, but showed a similar distribution to that of Huseby Klev due to the fact that most of the roe deer was estimated between the ages of 1 and 5 years. Only a few individuals were estimated to have been older than three months and younger than 1 year before death (Eriksson & Magnell, 2000: 197 - 198). Unlike the other ungulate species, wild boar seems to primarily have had young individuals targeted, as only a few tusks and teeth have been possible to estimate over the age of 3 (Eriksson & Magnell, 2000: 200). In addition to ungulates, five species of fur game were possible to estimate age on, but no detailed distribution was possible to ascertain. The calvarial fragments and extremities of at least four individuals of red fox (*Vulpes vulpes*) indicate that they belonged to grown adults; three heavily worn down teeth of brown bear (*Ursus arctos*) is presumably from an old animal; three individuals of wild cat (*Felis silvestris*) is estimated as adults; an unfused epiphysis of a marten implies that at least one individual was juvenile, whilst the remaining fragments are estimated as adults. Finally, one beaver was estimated to be an adult (Eriksson & Magnell, 2000: 182 - 183, 185).

In contrast to the other West coast sites, the age distribution from the site of Balltorp is limited to a handful of fur game species from its second phase, and is not very representative of the average age distribution as a whole. The identified fragments of fox and the identified calcaneus of a squirrel (*Sciurus vulgaris*) were determined to belong to adult individuals (Johansson *et al.*, 2014).

On the East coast, Norje Sunnansund was the only site that was able to conduct an age estimation on its ungulate and fur game assemblage. Red deer reportedly had a high kill-off rate between the ages of 2,5 and 4 years, and fur game showed no sign of juvenile individuals. Out of the 303 fragments from fur game, 72 bone elements had fused epiphyses and none of the remainder fragments showed signs of any unfused epiphyses, even though different species with varied reproductive strategies were all represented in the assemblage (Boethius, 2017).

The age distribution of the marine mammals varied between the coastal zones, but the West coast sites of Balltorp and Tågerup had no reported age estimation of their respective seal and cetacean remains, and can therefore not be included. Whilst the site of Huseby Klev did conduct age distribution between the pinniped and cetacean species, no clear age selection was discovered (Boethius, 2018a; Boethius, 2018b) as both juveniles and older individuals were present, and it is thereby indicated that no age was particularly targeted when hunting for them.

On the East coast, however, Gisslause was represented primarily by juvenile seals, with a higher frequency of young individuals represented amongst the ringed seal remains. Four radial bones and three femurs of ringed seal had been measured, and exhibited a size variation that meant they would have been roughly around 2 - 3 months old at death (Boethius *et al.*, 2017). The age for a large majority of the assemblage had otherwise been estimated using epiphyseal fusion data, which showed that adult seals had been an uncommon occurrence at Gisslause (Boethius *et al.*, 2017).

In contrast, the site of Norje Sunnansund had an almost even distribution between the estimated ages of the seals at the site. The epiphyseal fusion data shows how roughly 60% of the seal bones had fused epiphyses, whilst the last 40% were unfused (Boethius, 2017). Yearlings and old adults of seal species seem to have been primarily targeted, but foetal bones and newborn seal pups from both grey and ringed seals have also been identified on the site, which indicates that seals in-calf were also specifically hunted (Boethius, 2017).

Köpingsvik only had a selected few fragments that were possible to determine age on, and were all from the indeterminate pinniped assemblage (Sjöling, 2004). Age estimation was conducted in accordance with age division and epiphyseal fusion data, and determined six pinniped fragments - phalanges, rib bones, a temporal bone and an incisor - as juvenile (Sjöling, 2004).

The age distribution between the avian and fish assemblages were largely limited, as only the site of Balltorp reportedly stated that all of its identified bird bones from its second phase had been estimated to be from adult individuals. In addition to this, two fish vertebrates from the second phase had been possible to estimate relative growth on, and were estimated to have been at the end of their growth by the time they died, which would roughly have been around autumn or late autumn (Johansson *et al.*, 2014).

7. DISCUSSION

The initial query of this thesis was; what defines Blå Jungfrun in contrast to the other Mesolithic sites on the East and West coast of southern Sweden, and what visible differences in the osteological material are there? The results presented in this thesis demonstrated that the majority of the osteological remains from Blå Jungfrun's assemblage belonged to pinniped species. This indicates that the primary difference between Blå Jungfrun and the East and West coast sites is the frequency of pinnipeds, but also the element distribution of the pinniped remains. Comparatively to the East and West coast sites, Blå Jungfrun had no other identified mammalian species in its assemblage and almost solely had cranial or distal extremities in its element distribution. The rather small quantity of pinniped remains on Blå Jungfrun implies that it had not been a long-term base, but possibly a short-term camp with high prey specialisation. The underrepresentation of certain elements could be explained by the possibility that the osteological material from Blå Jungfrun is primarily butchered waste, and does not represent the kind of distribution otherwise seen on residential settlements. In contrast, the East and West coast sites displayed a more varied element distribution, which indicates that some sites might have hunted seals close to the occupied base or had the means to transport the carcasses. However, the frequency of other faunal species indicate that the East and West coast sites did not specialise solely on seal hunting, but rather sustained themselves on multiple subsistence strategies.

In addition to the initial research questions, the study also inquired on how the distribution of animal remains and the organisation of animal economy would differ between the East and West coast of southern Sweden. This led to a comparative analysis of the various assemblages, which in turn resulted in a relative difference of mammalian, avian and pescetarian remains. The East coast sites displayed a higher frequency of marine resources and arguably a larger diversity of species, implying that the eastern coastal zone had better potential for marine dependency, or was at least primarily exploited for fishing and seal hunting. The West coast sites, however, had a higher frequency of ungulates and fur game, with a steady decline of marine mammals throughout the occupational phases. This could imply a possible shift in subsistence strategy, which resulted in a lower dependency on marine resources. The West coast sites also exhibited a much larger frequency of seabird and deep-sea fish species, indicating that the western sites relied less on inland lakes and streams but more on coastal shores.

This thesis finalised its research questions by asking how the animal economy at Blå Jungfrun would have reflected the functionality of the site, when put in relation to the distribution and organisation of animal remains at the East and West coast sites. Demonstrated by its frequency of pinniped remains, lack of other identified species and overrepresentation of cranial and distal extremities, the functionality of Blå Jungfrun is implied to have been a temporary base that specialised in hunting seals and leaving butchered waste behind while the rest of the carcasses were transported elsewhere. Comparatively, the other sites on the East and West coast exhibit multiple identified species of both mammalian, avian and pescetarian remains. Despite the diverse characteristics of mobility that indicate some sites being more seasonally

dependent than others, Blå Jungfrun has visibly stood out with a different functionality than that of the other sites.

Looking back at the aims and questions of this study, the diverse distribution of species and elements has been of utmost interest as it has allowed an extensive analysis of the subsistence strategies between the coastal sites of southern Sweden, and whether the frequency of certain species and elements were descriptive of sedentary or temporary bases. To put it simply, the quantity, or lack thereof, of faunal remains in tandem with other factors could indirectly illustrate the definition of a temporary hunting camp and a sedentary settlement.

Based on the results, we see an almost immediate difference in the animal economy between the western and eastern coastal sites. The distribution of mammalian species differed primarily between terrestrial and marine species, with the West coast sites sharing a larger quantity of ungulate and fur game species than the East coast sites. Additionally, the West coast displayed a significant distribution of avian remains, as well as deep-sea fish. In parallel, the East coast had arguably a larger *diversity* of various species, primarily the species that belonged to the waterbird, freshwater fish and pinniped assemblages.

However, the prevalence and distribution of certain assemblages can partly be explained by the ecological differences and chronology of each respective site, and the Baltic basin's geological development throughout the Mesolithic period. In other words, it is ecologically explanatory that the West coast sites displayed coastal fish species and cetacean species due to having access to the marine waters of the sea. Comparatively, three out of the four East coast sites were not occupied at a time when the Baltic basin was connected to the sea and would therefore not display saltwater species. The sole exception of this ecological analysis is that of the LM site of Köpingsvik, as the remains of harp seal and cod were identified - species that otherwise did not exist in the Baltic basin during its Ancylus Lake stage. Similarly, the islands of Blå Jungfrun and Gisslause were less likely to display large ungulate or fur game species, either due to their small size in landmass or isolation from the mainland. Needless to say, this would explain why Blå Jungfrun and Gisslause do not contribute to the ungulate assemblage from the East coast sites.

Interestingly, the site of Huseby Klev on the island of Orust *does* present a distribution of large ungulates and large fur game species. This might be explained by the fact that Orust would have been a large island that also was close to the mainland, possibly meaning that large species were able to swim across and sustain themselves on the island. Regular availability of ungulates might still have been limited, though, and could indicate that hunters had to hunt on the mainland before transporting the butchered remains back to the island (Boethius, 2018b).

Furthermore, climatic changes and increased temperatures could also have affected the abundance and body size of various species, even though it might not have affected every faunal group (Magnell, 2017). There is a reported decrease in the elk population roughly around 7 550 - 7 000 BC and a steady decline from that point on. The auroch also experienced a decreased population, followed by its eventual extinction. Coincidentally, the red deer population began to

increase around that same time. Roe deer and wild boar does, however, not experience any major shifts in frequency throughout the Mesolithic (Magnell, 2017). This could imply that the environmental changes that negatively affected the elk and auroch populations did not affect the smaller ungulate species. In turn, this indicates that roe deer and wild boar were less reliant on the environmental spaces and temperatures that otherwise drove the larger ungulates away. Alternatively, it could also mean that the human foragers experienced a more dramatic shift in subsistence strategy than the ungulates during climatic changes, as both roe deer and wild boar seemed to have had a rather equal prey selection whilst the elk and auroch population was still frequently present. When the elks and aurochs became more scarce, it seems there was an intensification of hunting red deer as the “new” large ungulate instead.

Despite the various factors that ecologically explain the contrast in species and environment between each coastal zone, the assessment of the animal economy shows notable differences that sets the two regions apart in terms of subsistence strategy. To begin with, the East coast displays a specialised focus on marine resources that is centred around freshwater fishing and hunting. The diverse distribution of waterbird species on the East coast implies that they were likely targeted around inland lakes and shallow water bodies, possibly as a result of being an opportunistic and “secondary” catch to freshwater fish (Kjällquist *et al.*, 2014). This can be further substantiated by the diversity of cyprinid species and burbot, whose frequency and large quantity indicates intensified fishing (Boethius *et al.*, 2017). Burbot, which is normally a nocturnal species that resides in deep waters during summer, would have been easier to catch during winter when they gather in shallow waters at daytime to spawn - implying that the Mesolithic peoples on the East coast were less likely to fish out on open water, and were more dependent on shallow waters such as lakes and streams connected to them (Boethius, 2017; Boethius *et al.*, 2017). In other words, the diversity of freshwater fish and waterbird species on the East coast could indicate that the coastal sites in this region relied more on moving between the coast and the inland lakes, possibly motivated by specialisation.

Additionally, the East coast sites share the frequency of pinniped assemblages. Whilst the distribution of seal species greatly differ in quantity between each site, the presence of pinniped remains from both Early and Late Mesolithic occupation phases strengthens the notion that marine resources were primarily utilised on the East coast. Arguably, the large quantity of pinniped remains on Blå Jungfrun and Gisslause might imply that the East coast was more likely to conduct specialised hunting of seals.

In parallel, the West coast sites displayed a larger assemblage of avian remains, primarily from seabird species, and deep-sea fish. Species like the European hake (*Merluccius merluccius*) and common ling (*Molva molva*) usually reside in deep water and makes them rather difficult to catch, which implies that the hunter groups would have needed fish lines and seine nets to catch them (Boethius, 2018b). Similarly, the quantity of Atlantic herring (*Clupea harengus*) could also indicate that the hunters would have used boats and nets off-shore, but they could also have

caught herring during spawn when the fish would gather in large schools closer to shore (Boethius, 2018b) and therefore catch them seasonally by intensified fishing.

The hunt and trapping of birds was likely carried out as a means of an additional source of meat and material (Eriksson & Magnell, 2000: 208, 216), similarly to the opportunistic hunt on the East coast. However, the frequency of seabird species might indicate that hunters partook in opportunistic catches locally, close to the occupied coast, rather than from inland lakes. Auks were some of the most prevalent avian species on the West coast sites, and were featured during almost every phase of each respective site. On the site of Huseby Klev, auks displayed the largest assemblage of bird bones throughout each occupation phase, possibly meaning that the site targeted those species more intensively than other seabird species, and implies that it performed specialised hunting (Boethius, 2018b). If we combine the frequency of seabird species and deep-sea fish, it suggests a parallel dependency on deep water rather than shallow water, in contrast to the East coast. This would further explain why there is such a gap between waterbird species and freshwater fish on the West coast, in case they relied less on inland water bodies.

Interestingly, the earlier phases of the West coast sites had a larger prevalence of marine mammals, before dramatically decreasing between the middle and late phases. Roughly parallel with this process, fish was less prevalent during the earlier phases but had a gradual increase during the middle, followed by a slight decrease in the late phase again. Between the middle and late phase, freshwater and diadromous fish begin to increase in frequency. This indicates that the distribution of marine mammals and fish are closely correlated to one another throughout each phase. The abundance of cetacean and pinniped remains from the earlier phases could signify that the marine waters at the time were nutrient-rich, so when the marine mammalian population subsequently decreased in frequency, the hunter-gatherers that had previously targeted those resources had to shift their subsistence strategy (Boethius, 2018a) and thereby urging them to rely more on fish.

7.1 CONCEPTUALISING A HUNTING CAMP ON BLÅ JUNGFRUN

Where does the analysis of the animal economy from each coastal zone lead us in regards to the functionality and structure of Blå Jungfrun? The comparative analysis of the coastal zones was conducted in order to understand the utilisation of South Scandinavian Mesolithic sites based on animal economy, and in turn interpret the activity at Blå Jungfrun. The site of Blå Jungfrun would act as the primary outline of this study, and repeatedly stood out as having a single-species assemblage and limited diversity of identified elements. When contrasted to the other sites, Blå Jungfrun exhibits a completely different frequency of occupational activity, which subsequently sets the sites apart when investigating mobility and subsistence strategy.

Size, artefacts and organisation can define the structure of a site in relation to the environmental factors of its location. Meaning, that the availability of food resources in tandem with the climate affect the mobility and subsistence strategy that is visible on a site, and that different site types are dictated by different strategies (Breivik, 2021; Binford, 1980). With this in mind, the diverse frequency of multiple species from the eastern and western sites indicate that

different choices of prey selection and methods of hunting or fishing have been utilised when exploiting resources, as both opportunistic and specialised capture can be observed from each respective site. Furthermore, the diversity of species and usage of systematic hunting strategies could imply that stationary methods have been utilised, which in turn could lead to the interpretation of sedentism. Comparatively, the lack of diversity could instead depict the opposite of a sedentary site, such as a cache or field camp. Consequently, the single-species assemblage of Blå Jungfrun seems to indicate that the site has primarily been a hunting camp, with high prey specialisation but low residential activity.

In order to conceptualise Blå Jungfrun as a hunting camp, we must first conceptualise a sedentary settlement. By recognising a sedentary base, we will understand what separates them from temporary and highly mobile stations. To begin with, the relationship between hunting and fishing would arguably be more intertwined on a sedentary settlement, as the diversity of resources would attract long-term utilisation. The frequency of fish in parallel with terrestrial fauna could thereby act as a paradox, since the reliance on marine specialisation would be dependent on the hunting of ungulates (Mansrud, 2017), considering that the resources obtained from ungulates plays an important part in obtaining aquatic staple foods. If we consider the possibility that the Mesolithic peoples used boats for both daily transport as well as fishing, there is a special entanglement involved between boats and ungulates as hides could have been used to manufacture boats (Mansrud, 2017). This strengthens the notion that hunting and fishing played major roles in building a sedentary subsistence strategy, as they are both needed in order to provide for a stationary lifestyle.

However, the Early Mesolithic is argued to have had few fisheries and not depended much on fish as a subsistence strategy (Mansrud, 2017), partly because it would have been incompatible with the residential mobility that kept the groups from staying at one site for too long, and also because fishing has been viewed as labour intensive. It is important, though, to point out that sedentism can be interpreted as having a highly specialised subsistence strategy. Fish that spawn in large numbers during a limited time of the year could have been caught with nets and stationary tools and have had easily accessible, high-return catches (Mansrud, 2017; Mjærum & Mansrud, 2020: 290), as well as functioned as a delayed-return subsistence strategy without necessarily being sedentary. Even as a type of low-scale food production, fish maintenance can be considered a type of resource management (Mjærum & Mansrud, 2020: 290) and a major dietary source to the Mesolithic hunter-gatherers (Boethius *et al.*, 2020). Furthermore, a stationary dependency of fish and expansion of sedentism could be related to the emergence of territoriality among foragers (Boethius *et al.*, 2020), which might otherwise be considered a phenomenon that is designated to sedentary farmers.

The site of Tågerup on the West coast and the site of Norje Sunnansund on the East coast can be used as examples of both sedentism and territoriality, primarily by the subsistence strategy and age distribution represented by them. Tying these processes together, Norje Sunnansund and Tågerup share similar hunting strategies that in turn could explain how they have practised a sedentary lifestyle.

The age distribution (see 6.2.3 *Age Distribution*) between the two sites indicates that ungulates were systematically hunted. The relative low frequency of red deer being killed during their prime could indicate that antlers were not the sole reason as to why red deer were hunted at this life stage. It is difficult to quantify the ratio of which antlers were collected from hunted animals, as opposed to shed antlers gathered from the wild, and therefore it is not certain that the few stags that have been hunted in their prime necessarily were killed when they still had their antlers attached (Magnell *et al.*, 2020). It might rather look like red deer were targeted when their maximal body size and condition provided the best chances of large fat and meat resources, as well as best supply of raw material for bone crafts.

The exclusion of juveniles in favour of young adult animals poses an interesting hunting strategy. By systematically hunting for animals that have grown to full body size but are not actively breeding yet implies that juveniles and prime animals were selectively spared, presumably in order to keep the population in balance (Boethius *et al.*, 2020). Even when comparing this prehistoric system to modern cullings of ungulate populations and vice versa, juveniles and prime animals are seldom targeted due to their impact on the population growth (Magnell *et al.*, 2020). Age, sex and reproductive capacity can therefore count as indicators for selective hunting in Mesolithic contexts, but it could also strengthen the notion of territoriality. Since territoriality is implied by stationary technologies, it would be reasonable that systematic and selective hunting of animals would indicate a sedentary lifestyle as opposed to moving to another location when the population size at the current site would decline. By ensuring a continued growth of population size, the hunter-gatherers would ensure a long-term gain of secondary products whilst relying on other food sources for sustenance, such as marine resources (Boethius *et al.*, 2020; Magnell 2005; Magnell *et al.*, 2020).

Seasonality also plays a part in interpreting a sedentary lifestyle on the respective sites. Both sites have identified species that are either easier to hunt or fish during certain seasons, or would have been residential all-year round. This could indicate that the sites were not entirely dependent on migration or seasonal occurrences, but rather relied on systemic and opportunistic hunting or fishing during both summer and winter seasons (Eriksson & Magnell, 2000: 211 - 214; Kjällquist *et al.*, 2014; Boethius, 2017). Tågerup displays how the seasonality indicators (based on the seasonal occurrence of migratory species and birthing seasons) would have been low during May, before picking back up during summer and hit a peak between October and November (Eriksson & Magnell, 2000: 211). Winter would thereafter have had low activity, until the seasonal frequency reaches the lowest values during spring in May again. Even though the site has lower frequency between winter and spring, the osteological material indicates that Tågerup was seasonally active all-year round (Eriksson & Magnell, 2000: 212 - 213).

Similarly, Norje Sunnansund has been presented as being inhabited throughout the year from late summer to late spring, with seasonality indicators such as the presence of migratory bird species from all seasons, pinniped and roe deer fetuses, young seal calves and intensified roach fishing (Boethius, 2016). The site of Norje Sunnansund is also unique due to the traces of acidic manipulation on its fish assemblage, which has proved that prehistoric peoples conserved fish by fermentation. The practice of fermentation does not only show that fish were consciously stored long-term and through a large-scale production, but also that the inability to move the facility would have resulted in a type of necessary territoriality in order to make sure that nobody else would take advantage of the food supply (Boethius, 2016; Boethius *et al.*, 2020). This implies that Norje Sunnansund not only actively utilised fishing as a form of subsistence strategy, but also were heavily dependent on the capture and conservation of fish, like a circle that both began and ended with sedentism.

Combined with the diversity and quantity of species as well as signs of specialised age selection, it is implied that both Tågerup and Norje Sunnansund practised a stationary lifestyle with long-term methods of acquiring resources, where they were able to shift between subsistence strategies, if necessary, when the seasons changed.

Comparable to Tågerup and Norje Sunnansund, Blå Jungfrun neither has the quantity nor diversity of species to qualify as a large, residential site. Moreover, if we consider the sea level at the time of occupation, Blå Jungfrun would not only have been further isolated from the inland than it is today, but would also have been much smaller in landmass. Long-term occupation might therefore have been inconvenient, and would not have attracted a human settlement if it already had a limited supply of food. Even if we entertain the idea that Blå Jungfrun had been a residential settlement, it would have been expected that a more diverse element distribution would have been present, as it might have indicated that killed seals would have been consumed on-site. The element distribution would, in other words, have demonstrated how a human population would have been able to sustain themselves on the island – while hunting seals. As it stands, Blå Jungfrun only displays cranial and distal extremities, which further strengthen the notion that the occupants of the site only left butchered waste on the island.

If the hunters on Blå Jungfrun did not stay on-site to eat the seals they killed, and the only species found on the site are from pinniped species, where does that lead us in terms of functionality? Since seasonality has not been possible to interpret in greater detail due to the fact that only a single fragment of a fibula was estimated by age, the limited frequency of species and element distribution can instead be tied to the distance from the mainland. To begin with, we might take the method of hunting seals into account. Seals apply a certain subsistence strategy to the groups that hunt them. It can be argued that the grey seal and harp seal are ‘easier’ to hunt than their close relatives, the harbour seal and ringed seal. The grey seal is not as proficient as the ringed seal at keeping its holes in the ice open during the winter season, causing them to become easy prey to hunters (Ekman, 1922: 444). In addition to this, both the grey seal and harp seal tend to stay huddled together in large groups (Ekman, 1922: 444) instead of being solitary

and on the move. This probably offered hunters a better chance at a high-rate return of food and blubber, and corresponds to behavioural differences between the seal species that were probably exploited by the Mesolithic hunter-gatherers. However, the various seal species share the trait of being migratory and dependent on ice during the birthing season (Edlund, 2000: 56) – excluding the harbour seal, which births during mid-summer. In addition to birthing their young, the seals would also be dependent on ice during shedding. The ringed seal, for instance, has reportedly been observed in modern time to suffer from illness and open wounds during warmer winter months, when the ice has melted sooner in April and prevented healthy shedding on-ice (Edlund, 2000: 62 - 63). Ethnographic records from the Bothnian Bay show how modern seal hunters are continuously affected by the migration and behaviour of seals, which subsequently alter the hunting season (Edlund, 2000: 56). By residing on ice for long periods of time, the predictable behaviour of seals might have provided an opportune time for prehistoric hunter-gatherers to exploit their seasonal migration to ice-covered waters. This in contrast to when seals would reside in water and swim far away from land, hunting seals during winter would have allowed hunters to stalk them on solid terrain.

Furthermore, the young pups of the grey seal and harp seal are extremely vulnerable during its first three weeks. They are very dependent on their mothers and need to stay hidden in their birth place. The harp seal pups in particular are ill fit to be left alone, because they will quickly drown if they fall into water without the help of their mother to get back on land. This makes the pups an easy prey for the hunters. In contrast to the grey seal and harp seal, the ringed seal and harbour seals' pups are independent shortly after birth: the ringed seal pup is able to swim while still covered in its soft baby fur, and the harbour seal pup sheds its baby fur even before its birth (Ekman, 1922: 444).

By applying the factors of seal hunting as a specialised subsistence strategy, the site of Blå Jungfrun might have functioned as a hunting camp when seals resided in or around its area, possibly during winter when it would have been easier to stalk them. The underrepresentation of certain elements can attest that animal products were extracted on-site from the killed seals, but not necessarily consumed immediately. If the seals were clubbed to death, or perhaps if their skulls were crushed post-mortem to extract the brain, little to no fragments of the skull might be preserved due to the amount of bones being splintered, and would explain why there are so few preserved cranial fragments other than parts of the temporal bone and loose teeth. The reason why parts of the temporal bone has been preserved might be because one would more likely crush the skull either from above or from behind, causing the skull to implode or split whilst the temporal bone would avoid the brunt of the impact and probably separate from respective sides of the skull. Additionally, the reason why the mastoid part of the temporal bone belongs to the majority of the preserved skull bones, could partly be because that anatomical part of the skull is more robust, and partly because they are better 'protected' from violent impact.

The assumed traces of blubber concrete on Blå Jungfrun might also imply that the site had intensified hunting of seals in order to extract blubber. By starting a fire, strips of blubber

would have been applied and resulted in melted fat, which would have flowed onto the charcoal and functioned as a wick (Pettersson & Wikell, 2013). By boiling the blubber, the melted fat could similarly have been fabricated as train oil (Edlund, 2000: 65) and might have been gathered from the fire. When the hunters consequently left the island, they might have covered the pits where the left-over butchered waste and extracted oil were.

However, the limited quantity of remains indicate that the site did not necessarily practise intensified hunting to the point that it was regularly used for a long period of time. Comparatively, the island site of Gisslause is structurally different from Blå Jungfrun in terms of subsistence strategy and short-term occupation. The site of Gisslause, situated far from the mainland, has a large quantity of seal remains in its total faunal assemblage, and shows a similar frequency of specialised seal hunting like that on Blå Jungfrun, but at a much bigger scale. The lack of body elements that belonged to the cranial, frontal and rear extremities indicate a selective transport of carcass parts (Boethius *et al.*, 2017), much like the element distribution on Blå Jungfrun. However, Gisslause also contains assemblages of mountain hare (*Lepus timidus*), fish and bird. The high frequency of burbot implies that the site might have been used during the winter season, of which the people could have used land-based methods to catch the fish while it spawned in shallow waters (Boethius *et al.*, 2017). This implies that the site of Gisslause could have been a seasonal *field camp* used during winter to perform intensified hunting and fishing of seals and burbot. In contrast to Blå Jungfrun, the people on Gisslause seem to have relied on the local fauna to sustain themselves for the *entirety* of winter. This is probably due to the fact that it would have been difficult and inconvenient to travel back-and-forth between the island of Gotland and the mainland, because of the nautical distance between the two.

The island site of Huseby Klev is also fundamentally different, as the large size of Orust and closer proximity to the mainland seems to have allowed a wider variety of faunal resources. This would have offered better chances to travel between the island and mainland in order to acquire multiple sources of food. This, in turn, could indicate that Blå Jungfrun's small size prevented it from being an attractive spot of long-term food procurement, but the distance to the island of Öland and the mainland might still have allowed short transportation time. The underrepresentation of elements could thereby imply that Blå Jungfrun was a temporary hunting camp that conducted specialised hunting of seals during a short period of time, without the continuous need to sustain themselves on other local food sources. The seals would be killed and butchered on-site, with blubber being extracted and flippers discarded while the remaining parts of the carcasses and pelts were transported back to the main site from whence the hunters came.

Arguably, the bone assemblage at Blå Jungfrun could have been deposited as part of a ritualised activity. Blå Jungfrun could have been a centre for not only seal hunting, but also a place of sacrifice. This is a possibility based on ethnographic studies that describe how some modern hunter-gatherer societies have rituals that are aimed to 'transform back' the original forms of the slain prey so they can be hunted again. In Alaska, Inuit groups will throw the intestines of fish back to the sea so they can be reborn as fish again (Edsman, 1994: 36). Similarly, the Swedish Sami will deposit the cooked, gnawed bones of seals back to the

breathing holes on the ice so it may resurrect as the same seal again. Various ceremonies of killed and eaten game involve the burial of their bones and skulls in order to resurrect them (Edsman, 1994: 50). However, the idea that Blå Jungfrun would primarily have been used in a ritualised context is not agreed upon, primarily because of the limited assemblage and the fragmented state of the bones. The fragments have been charred as part of some kind of production process or cooking, however, I find this more indicative of oil extraction rather than a ritualised feast. It would rather seem that the systematic hunt for seals and the consequent deposit of butchered waste is what likely resulted in burying the skeletal remains, but a ritualised aspect of this activity could have been secondary. This study maintains that Blå Jungfrun can be interpreted as an Early Mesolithic hunting camp, indicated by its specialised assemblage of pinniped remains and the overrepresentation of cranial and extremity elements.

8. CONCLUSION

The coastal environments of South Scandinavian Mesolithic sites have been difficult to interpret in the archaeological record, primarily because of their elusive preservation and the climatic conditions that have rendered many sites inaccessible underwater. Past research has claimed that inland settlements have been dominated by terrestrial resources, whilst coastal sites have predominantly captured marine mammals (Kjällquist *et al.*, 2014; Boethius & Ahlström, 2018; Mjærøum & Mansrud, 2020). The biased interpretation put mammalian hunts before fisheries, and caused an overrepresentation of terrestrial resources in Mesolithic contexts (Lewis *et al.*, 2020; Price *et al.*, 2021). Inland sites came to represent the hunter-gatherer societies as more dependent on ungulates than fish or marine mammals, and created a normative interpretation that the foraging groups were highly mobile and reliant on the change of seasons and the abundance of resources per location (Price *et al.*, 2021). Not only has this claim been challenged by recent studies, but it has also resulted in an amplitude of evidence that points to the opposite of previous research (Boethius, 2016; Boethius, 2017; Boethius & Ahlström, 2018; Boethius *et al.*, 2020; Magnell *et al.*, 2020; Mjærøum & Mansrud, 2020).

The purpose of this thesis was to analyse the coastal landscapes of southern Sweden, with the unique material from Blå Jungfrun as the main outlier for a specialised hunting strategy in a forager community. In accordance with the research questions and the comparative study of the East and West coast of southern Sweden, it has been possible to assess a large variation in animal economy and subsistence strategy between the regions. The East coast sites represented a larger frequency of marine resources such as seals and fish, regardless of occupational phase. The sites of Gisslause and Blå Jungfrun were interpreted as temporal bases that functioned as hunting camps that targeted seals, as indicated by their specialised capture of pinniped species. In contrast, the West coast sites had a larger variety of ungulate and avian species, as well as a higher frequency of shifting prey selection and hunting strategies throughout the Mesolithic phases. In some cases, the West coast sites were also indicative of year-round long occupations. The conclusive interpretation of this is that both the East and West coast sites had the opportunity and appropriate requirements to be stationary long-term, but not all sites or locations were necessarily utilised as permanent residences.

The assemblage of Blå Jungfrun has provided an interesting point of reference to the comparative study of the coastal sites of southern Sweden, as it has been interpreted as primarily a hunting camp. Whilst deposits of animal remains away from residential bases can be viewed as a ritualised place of worship, the seal bones from Blå Jungfrun have instead indicated being deposited as butchered waste. The lack of other faunal remains and long-term activity implies that Blå Jungfrun was mainly a temporary location for seal hunting, with a possible dependency on seasonal activity.

The results of this study showed that the frequency and diversity of species and age distribution between faunal individuals can be indicative of subsistence activities in a Mesolithic settlement. Moreover, the animal economy and visible specialisation of certain species can

function as indicators for both a mobile and stationary lifestyle, but with completely different requirements. Once considered a late phenomenon with the occurrence of farmers and agriculture, sedentism seems to have been possible as early as the Early Mesolithic period. Evidence such as the fermentation facilities at Norje Sunnansund and the specialised hunting patterns at Tågerup, shows how the Mesolithic peoples could have adapted to a sedentary subsistence strategy. In comparison, the site of Blå Jungfrun can explain how the specialised hunt of seasonal species would have allowed a high mobility between residential bases and temporary camps. The multitude of strategies and prey selection choices interpreted from prehistoric hunter-gatherers present a largely unexplored Mesolithic past, but offer tremendous potential.

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PERSONAL COMMUNICATION

Alexandersson, K. PhD student at Göteborg University and archaeologist at Kalmar Läns Museum. Conversation regarding the archaeological activity at Blå Jungfrun. 2021-04-21.

APPENDIX A

Table A1: Table featuring the relative abundance of pinniped species from Blå Jungfrun based on NISP and MNI.

BLÅ JUNGFRUN			
FAMILY	SPECIES	NISP	MNI
Phocidae	Grey seal (<i>Halichoerus grypus</i>)	11	2
	Ringed seal (<i>Pusa hispida</i>)	6	1
	Seals indet. (<i>Phocidae indet.</i>)	22	N/A

Table A2: Table featuring the element distribution of pinniped species from Blå Jungfrun based on NISP.

BLÅ JUNGFRUN								TOTAL
	SPECIES	OSSIUM CRANII	OS TEMPORALE	PROCESSUS MASTOIDEUM	DENTES	FIBULA	PHALANGES	SUM
Phocidae	Grey seal (<i>Halichoerus grypus</i>)	0	2	4	5	0	0	11
	Ringed seal (<i>Pusa hispida</i>)	0	1	2	2	1	0	6
	Seals indet. (<i>Phocidae indet.</i>)	4	3	3	2	0	8	20

APPENDIX B

Table B1: Table featuring the relative abundance of mammalian species from the East coast sites of Gisslause, Köpingsvik and Norje Sunnansund, based on NISP and MNI. Data collected from osteological reports and articles (Sjöling, 2004; Boethius, 2016; Boethius et al., 2017; Boethius, 2017; Boethius, 2018a).

FAMILY	SPECIES	GISSLAUSE		KÖPINGSVIK		NORJE SUNNANSUND	
		NISP	MNI	NISP	MNI	NISP	MNI
Bovidae	Auroch (<i>Bos primigenius</i>)					32	2
Cervidae	Elk (<i>Alces alces</i>)			4	N/A	19	2
	Red deer (<i>Cervus elaphus</i>)					373	5
	Roe deer (<i>Capreolus capreolus</i>)					271	4
	Cervids indet. (<i>Cervidae indet.</i>)					31	
Suidae	Wild boar (<i>Sus scrofa</i>)					331	4
Phocidae	Grey seal (<i>Halichoerus grypus</i>)	64	N/A	2	N/A	77	9
	Harp seal (<i>Pagophilus groenlandicus</i>)			4	N/A		
	Ringed seal (<i>Pusa hispida</i>)	85	N/A			42	3
	Seals indet. (<i>Phocidae indet.</i>)	466	N/A	11	N/A	172	5
Canidae	Dog (<i>Canis familiaris</i>)					32	2
	Red fox (<i>Vulpes vulpes</i>)					22	2
	Wolf (<i>Canis lupus</i>)					14	2
	Canids indet. (<i>Canidae indet.</i>)					11	
Felidae	Wild cat (<i>Felis silvestris</i>)					9	1
Carnivora	Carnivores indet. (<i>Carnivora indet.</i>)					6	
Ursidae	Brown bear (<i>Ursus arctos</i>)			1	N/A	19	2
Mustelidae	Badger (<i>Meles meles</i>)					29	2
	Otter (<i>Lutra lutra</i>)					36	2
	Pine marten (<i>Martes martes</i>)					42	3
	European polecat (<i>Mustela putorius</i>)					1	1
Castoridae	Beaver (<i>Castor fiber</i>)					17	2

Leporidae	Mountain hare (<i>Lepus timidus</i>)	33	N/A			1	1
Erinaceidae	European hedgehog (<i>Erinaceus europaeus</i>)					7	3
Sciuridae	Red squirrel (<i>Scurius vulgaris</i>)					57	8
Cricetidae	Water vole (<i>Arvicola amphibius</i>)					72	12
	Field vole (<i>Microtus agrestis</i>)					14	5
Muridae	Yellow-necked mouse (<i>Apodemus flavicollis</i>)					9	4
Rodentia	Rodents indet. (<i>Rodentia indet.</i>)			5		158	
Mammalia	Mammals indet. (<i>Mammalia indet.</i>)					16 428	

Table B2: Table featuring the relative abundance of avian species from the East coast sites of Gisslausa, Köpingsvik and Norje Sunnansund, based on NISP and MNI. Data collected from osteological reports and articles (Sjöling, 2004; Boethius, 2016; Boethius et al., 2017; Boethius, 2017; Boethius, 2018a).

FAMILY	SPECIES	GISSLAUSE		KÖPINGSVIK		NORJE SUNNANSUND	
		NISP	MNI	NISP	MNI	NISP	MNI
Anatidae	Northern shoveler (<i>Anas clypeata</i>)					4	2
	Eurasian wigeon (<i>Anas penelope</i>)					2	1
	Mallard (<i>Anas platyrhynchos</i>)					13	2
	Garganey (<i>Anas querquedula</i>)					1	1
	Northern pintail (<i>Anas acuta</i>)					1	1
	Common pochard (<i>Aythya ferina</i>)					1	1
	Tufted duck (<i>Aythya fuligula</i>)					4	2
	Greater scaup (<i>Aythya marila</i>)					2	1
	Common goldeneye (<i>Bucephala clangula</i>)					4	1
	Long-tailed duck (<i>Clangula hyemalis</i>)					1	1
	Common eider (<i>Somateria mollissima</i>)					1	1
	Velvet scoter (<i>Melanitta fusca</i>)					7	2
	Common scoter (<i>Melanitta nigra</i>)					1	1
	Common merganser (<i>Mergus merganser</i>)					7	1
	Red-breasted merganser (<i>Mergus serrator</i>)					2	1
	Greylag goose (<i>Anser anser</i>)					8	1
	Bean goose (<i>Anser fabalis</i>)					2	1
	Geese indet. (<i>Anserini indet.</i>)					2	1
	Waterbirds indet. (<i>Anatidae indet.</i>)					8	1
	Diving ducks indet. (<i>Aythiinae indet.</i>)				3	N/A	
Podicipedidae	Great crested grebe (<i>Podiceps cristatus</i>)					3	1
	Red-necked grebe (<i>Podiceps grisegena</i>)					1	1
Gaviidae	Black-throated loon (<i>Gavia arctica</i>)					3	1
	Red-throated loon (<i>Gavia stellata</i>)					3	1

Phalacrocoracidae	Great cormorant (<i>Phalacrocorax carbo</i>)					10	1
Ardeidae	Grey heron (<i>Ardea cinerea</i>)					2	1
Corvidae	Carrion crow (<i>Corvus corone</i>)					5	1
	Spotted nutcracker (<i>Nucifraga caryocatactes</i>)					1	1
	Corvids indet. (<i>Corvidae indet.</i>)					4	3
Phasianidae	Western capercaillie (<i>Tetrao urogallus</i>)					1	1
Accipitridae	Red kite (<i>Milvus milvus</i>)					1	1
	White-tailed eagle (<i>Haliaeetus albicilla</i>)					1	1
Aves	Birds indet. (<i>Aves indet.</i>)	47	N/A				

Table B3: Table featuring the relative abundance of fish species from the East coast sites of Gisslaue, Köpingsvik and Norje Sunnansund, based on NISP and MNI. Data collected from osteological reports and articles (Sjöling, 2004; Boethius, 2016; Boethius et al., 2017; Boethius, 2017; Boethius, 2018a).

FAMILY	SPECIES	GISSLAUE		KÖPINGSVIK		NORJE SUNNANSUND	
		NISP	MNI	NISP	MNI	NISP	MNI
Cyprinidae	Roach (<i>Rutilus rutilus</i>)	1	N/A			1016	N/A
	Bream (<i>Abramis brama</i>)					20	N/A
	Silver bream (<i>Blicca bjoerkna</i>)					3	N/A
	European chub (<i>Squalius cephalus</i>)					6	N/A
	Crucian carp (<i>Carassius carassius</i>)					8	N/A
	Rudd (<i>Scardinius erythrophthalmus</i>)					13	N/A
	Dace (<i>Leuciscus leuciscus</i>)					11	N/A
	Tench (<i>Tinca tinca</i>)					19	N/A
	Bleak (<i>Alburnus alburnus</i>)					6	N/A
	Idé (<i>Leuciscus idus</i>)					7	N/A
	Cyprinids indet. (<i>Rutilus / Leuciscus</i>)					161	N/A
	Cyprinids indet. (<i>Cyprinidae indet.</i>)	132	N/A			10 708	N/A
	Percidae	Perch (<i>Perca fluviatilis</i>)	45	N/A	2	N/A	2 778
Pike-perch (<i>Sander lucioperca</i>)		4	N/A			53	N/A
Ruffe (<i>Gymnocephalus cernua</i>)						35	N/A
Percinids indet. (<i>Percidae indet.</i>)						13	N/A
Esocidae	Pike (<i>Esox lucius</i>)	67	N/A			1098	N/A
Gadidae	Atlantic cod (<i>Gadus morhua</i>)			42	N/A		
Lotidae	Burbot (<i>Lota lota</i>)	128	N/A			83	N/A
Salmonidae	Arctic char (<i>Salvelinus alpinus</i>)	2	N/A			3	N/A
	Whitefish indet. (<i>Coregonus indet.</i>)	41	N/A			32	N/A
	Trout (<i>Salmo trutta</i>)					1	N/A
	Salmon (<i>Salmo salar</i>)					1	N/A
	Salmon indet. (<i>Salmonidae indet.</i>)	1	N/A			7	N/A

Anguillidae	Eel (<i>Anguilla anguilla</i>)	3	N/A			138	N/A
Osmeridae	Smelt (<i>Osmerus eperlanus</i>)					10	N/A
Pisces	Fish indet. (<i>Pisces indet.</i>)			259	N/A	4414	N/A

APPENDIX C

Table C1: Table featuring the relative abundance of amphibian species from the West coast sites of Balltorp (phase I) and Tågerup (phase I & II), based on NISP and MNI. Data collected from osteological reports (Eriksson & Magnell, 2000; Johansson et al., 2014).

FAMILY	SPECIES	BALLTORP PHASE II		TÅGERUP PHASE I		TÅGERUP PHASE III	
		NISP	MNI	NISP	MNI	NISP	MNI
Bufonidae	Common toad (<i>Bufo bufo</i>)	3	1				
	Toad indet. (<i>Bufo indet.</i>)			1	N/A		
Ranidae	Frog indet. (<i>Rana indet.</i>)					2	N/A

Table C2: Table featuring the relative abundance of mammalian species from the West coast site of Balltorp (phase I & II) based on NISP and MNI. Data collected from osteological reports (Jonsson, 1996; Johansson et al., 2014).

FAMILY	SPECIES	BALLTORP PHASE I		BALLTORP PHASE II	
		NISP	MNI	NISP	MNI
Bovidae	Auroch (<i>Bos primigenius</i>)	8	N/A		
Cervidae	Red deer (<i>Cervus elaphus</i>)	61	N/A	17	1
	Roe deer (<i>Capreolus capreolus</i>)	8	N/A	3	1
Suidae	Wild boar (<i>Sus scrofa</i>)	21	N/A	10	1
Phocidae	Grey seal (<i>Halichoerus grypus</i>)			14	2
	Seals indet. (<i>Phocidae indet.</i>)	3	N/A	38	1
Canidae	Dog (<i>Canis familiaris</i>)	2	N/A		
	Red fox (<i>Vulpes vulpes</i>)	1	N/A	3	1
Felidae	Wild cat (<i>Felis silvestris</i>)	8	N/A		
Mustelidae	Otter (<i>Lutra lutra</i>)	6	N/A		
	Pine marten (<i>Martes martes</i>)	3	N/A		
Castoridae	Beaver (<i>Castor fiber</i>)	2	N/A		
Leporidae	Mountain hare (<i>Lepus timidus</i>)	1	N/A	3	1
Sciuridae	Red squirrel (<i>Sciurus vulgaris</i>)	4	N/A	2	1
Cricetidae	Water vole (<i>Arvicola amphibius</i>)			1	1
Mammalia	Mammals indet. (<i>Mammalia indet.</i>)			43	N/A

Table C3: Table featuring the relative abundance of mammalian species from the West coast site of Huseby Klev (phase I, II & III) based on NISP and MNI. Data collected from osteological reports and articles (Boethius, 2018a; Boethius, 2018b).

FAMILY	SPECIES	HUSEBY KLEV PHASE I		HUSEBY KLEV PHASE II		HUSEBY KLEV PHASE III	
		NISP	MNI	NISP	MNI	NISP	MNI
Cervidae	Elk (<i>Alces alces</i>)	4	N/A			3	N/A
	Red deer (<i>Cervus elaphus</i>)	31	N/A	16	N/A	33	N/A
	Roe deer (<i>Capreolus capreolus</i>)	11	N/A	44	N/A	54	N/A
	Reindeer (<i>Rangifer rangifer</i>)	3	N/A				
Suidae	Wild boar (<i>Sus scrofa</i>)	81	N/A	40	N/A	24	N/A
Phocidae	Grey seal (<i>Halichoerus grypus</i>)	28	N/A	1	N/A	9	N/A
	Harbour seal (<i>Phoca vitulina</i>)	4	N/A			5	N/A
	Seals indet. (<i>Phocidae indet.</i>)	3	N/A				
Phocoenidae	Harbour porpoise (<i>Phocoena phocoena</i>)	27	N/A	1	N/A		
Delphinidae	White-beaked dolphin (<i>Lagenorhynchus albirostris</i>)	140	N/A	3	N/A		
	Dolphins indet. (<i>Delphinidae indet.</i>)	4	N/A				
Canidae	Dog (<i>Canis familiaris</i>)	3	N/A			14	N/A
	Red fox (<i>Vulpes vulpes</i>)	8	N/A	12	N/A	9	N/A
	Wolf (<i>Canis lupus</i>)			6	N/A		
Felidae	Wild cat (<i>Felis silvestris</i>)			10	N/A	1	N/A
Ursidae	Brown bear (<i>Ursus arctos</i>)	3	N/A	1	N/A		
Mustelidae	Badger (<i>Meles meles</i>)	1	N/A				
	Otter (<i>Lutra lutra</i>)	5	N/A	1	N/A	3	N/A
	Pine marten (<i>Martes martes</i>)	1	N/A				

Castoridae	Beaver (<i>Castor fiber</i>)	2	N/A			1	N/A
Erinaceidae	European hedgehog (<i>Erinaceus europaeus</i>)	1	N/A			1	N/A
Sciuridae	Red squirrel (<i>Scurius vulgaris</i>)			2	N/A	5	N/A
Cricetidae	Water vole (<i>Arvicola amphibius</i>)	4	N/A	12	N/A	7	N/A
Rodentia	Rodents indet. (<i>Rodentia indet.</i>)			2	N/A	8	N/A

Table C4: Table featuring the relative abundance of mammalian species from the West coast site of Tågerup (phase I, II & III) based on NISP and MNI. Data collected from an osteological report (Eriksson & Magnell, 2000).

FAMILY	SPECIES	TÅGERUP PHASE I		TÅGERUP PHASE II		TÅGERUP PHASE III	
		NISP	MNI	NISP	MNI	NISP	MNI
Bovidae	Auroch / Bison (<i>Bos primigenius</i> / <i>Bison bonasus</i>)	1	N/A				
Cervidae	Elk (<i>Alces alces</i>)	41	3				
	Red deer (<i>Cervus elaphus</i>)	518	15	84	3	129	3
	Roe deer (<i>Capreolus capreolus</i>)	384	13	82	4	108	4
Suidae	Wild boar (<i>Sus scrofa</i>)	490	15	58	4	81	4
Phocidae	Grey seal (<i>Halichoerus grypus</i>)	28	2			4	1
	Seals indet. (<i>Phocidae indet.</i>)	21	N/A	1	N/A		
Phocoenidae	Harbour porpoise (<i>Phocoena phocoena</i>)	1	N/A			2	N/A
Canidae	Dog (<i>Canis familiaris</i>)	39	4	1	1	17	2
	Red fox (<i>Vulpes vulpes</i>)	2	1	1	1	8	2
	Wolf (<i>Canis lupus</i>)	6	1	1	1	2	1
Felidae	Wild cat (<i>Felis silvestris</i>)	1	1	3	1	8	1
Ursidae	Brown bear (<i>Ursus arctos</i>)	23	2	8	2	2	1
Mustelidae	Badger (<i>Meles meles</i>)	7	3	1	1	1	1
	Otter (<i>Lutra lutra</i>)	3	1			5	1
	Pine marten (<i>Martes martes</i>)	7	1	2	1	10	2
Castoridae	Beaver (<i>Castor fiber</i>)	12	N/A			1	N/A
Erinaceidae	European hedgehog (<i>Erinaceus europaeus</i>)	4	N/A			4	N/A
Sciuridae	Red squirrel (<i>Scurius vulgaris</i>)	3	N/A			3	N/A
Cricetidae	Water vole (<i>Arvicola amphibius</i>)	12	N/A			40	N/A
	Field vole (<i>Microtus agrestis</i>)	3	N/A			2	N/A
Rodentia	Rodents indet. (<i>Rodentia indet.</i>)	21	N/A	2	N/A	36	N/A

Table C5: Table featuring the relative abundance of avian species from the West coast site of Balltorp (phase I & II) based on NISP and MNI. Data collected from osteological reports (Jonsson, 1996; Johansson et al., 2014).

FAMILY	SPECIES	BALLTORP PHASE I		BALLTORP PHASE II	
		NISP	MNI	NISP	MNI
Anatidae	Eurasian wigeon (<i>Anas penelope</i>)			5	3
	Common eider (<i>Somateria mollissima</i>)			2	1
	Velvet scoter (<i>Melanitta fusca</i>)			5	1
	Common scoter (<i>Melanitta nigra</i>)			1	1
	Red-breasted merganser (<i>Mergus serrator</i>)			1	1
	Greylag goose (<i>Anser anser</i>)			1	N/A
	Mute swan (<i>Cygnus olor</i>)			1	1
	Whooper swan / Mute swan (<i>Cygnus cygnus</i> / <i>Cygnus olor</i>)			1	1
	Geese indet. (<i>Anserini indet.</i>)			3	1
	Waterbirds indet. (<i>Anatidae indet.</i>)	2	N/A		
	Ducks indet. (<i>Anas indet.</i>)			1	N/A
	Dabbling ducks indet. (<i>Anatinae indet.</i>)			10	2
Laridae	Great black-backed gull / Glaucous gull (<i>Larus marinus</i> / <i>Larus hyperboreus</i>)	2	N/A		
	Common gull / Black-legged kittiwake (<i>Larus canus</i> / <i>Rissa tridactyla</i>)	1	N/A	1	1
	European herring gull / Lesser black-backed gull (<i>Larus argentatus</i> / <i>Larus fuscus</i>)	1	N/A	3	1
Gaviidae	Red-throated loon (<i>Gavia stellata</i>)			9	1
	Yellow-billed loon / Common loon (<i>Gavia adamsii</i> / <i>Gavia immer</i>)	1	N/A		
Phalacrocoracidae	Great cormorant (<i>Phalacrocorax carbo</i>)	2	N/A	4	1
Accipitridae	White-tailed eagle (<i>Haliaeetus albicilla</i>)			1	1
	White-tailed eagle / Golden eagle (<i>Haliaeetus albicilla</i> / <i>Aquila chrysaetos</i>)	1	N/A	2	1
Pelecanidae	Pelicans indet. (<i>Pelecanus indet.</i>)			5	1
Alcidae	Razorbill (<i>Alca torda</i>)			2	1
	Black guillemot (<i>Cepphus grylle</i>)			1	1

	Razorbill / Common murre (<i>Alca torda</i> / <i>Uria aalge</i>)	3	N/A		
Aves	Birds indet. (<i>Aves indet.</i>)			16	N/A

Table C6: Table featuring the relative abundance of avian species from the West coast site of Huseby Klev (phase I, II & III) based on NISP and MNI. Data collected from osteological reports and articles (Boethius, 2018a; Boethius, 2018b).

FAMILY	SPECIES	HUSEBY KLEV PBO-EBO		HUSEBY KLEV MBO		HUSEBY KLEV MAT	
		NISP	MNI	NISP	MNI	NISP	MNI
Anatidae	Common goldeneye (<i>Bucephala clangula</i>)	1	N/A				
	Long-tailed duck (<i>Clangula hyemalis</i>)	1	N/A			1	N/A
	Common eider (<i>Somateria mollissima</i>)	7	N/A	3	N/A		
	Velvet scoter (<i>Melanitta fusca</i>)	8	N/A	4	N/A	1	N/A
	Common scoter (<i>Melanitta nigra</i>)	2	N/A				
	Red-breasted merganser (<i>Mergus serrator</i>)					1	N/A
	Whooper swan (<i>Cygnus cygnus</i>)	1	N/A				
	Waterbirds indet. (<i>Anatidae indet.</i>)	3	N/A				
Laridae	Great black-backed gull (<i>Larus marinus</i>)	3	N/A				
	Common gull (<i>Larus canus</i>)					2	N/A
	European herring gull (<i>Larus argentatus</i>)	3	N/A	4	N/A		
Procellariidae	Manx shearwater (<i>Puffinus puffinus</i>)			1	N/A		
Podicipedidae	Great crested grebe (<i>Podiceps cristatus</i>)	3	N/A	1	N/A		
Gaviidae	Black-throated loon (<i>Gavia arctica</i>)	3	N/A			1	N/A
	Red-throated loon (<i>Gavia stellata</i>)	3	N/A			2	N/A
Phalacrocoracidae	Great cormorant (<i>Phalacrocorax carbo</i>)	4	N/A	4	N/A		
Sittidae	Eurasian nuthatch (<i>Sitta europaea</i>)			1	N/A		
Accipitridae	White-tailed eagle (<i>Haliaeetus albicilla</i>)			3	N/A		
Alcidae	Razorbill (<i>Alca torda</i>)	1	N/A	2	N/A	1	N/A
	Black guillemot (<i>Cepphus grylle</i>)	1	N/A				
	Great auk (<i>Pinguinus impennis</i>)	18	N/A	21	N/A	5	N/A
	Common murre (<i>Uria aalge</i>)	14	N/A	6	N/A	1	N/A
	Thick-billed murre (<i>Uria lomvia</i>)	1	N/A				

Aves	Birds indet. (<i>Aves indet.</i>)	180	N/A	467	N/A	198	N/A
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Table C7: Table featuring the relative abundance of avian species from the West coast site of Tågerup (phase I, II & III) based on NISP and MNI. Data collected from an osteological report (Eriksson & Magnell, 2000).

FAMILY	SPECIES	TÅGERUP PHASE I		TÅGERUP PHASE II		TÅGERUP PHASE III	
		NISP	MNI	NISP	MNI	NISP	MNI
Anatidae	Mallard (<i>Anas platyrhynchos</i>)	2	N/A				
	Common goldeneye (<i>Bucephala clangula</i>)	1	N/A				
	Red-breasted merganser (<i>Mergus serrator</i>)	1	N/A				
	Tundra swan (<i>Cygnus colombianus</i>)	1	N/A				
	Swans indet. (<i>Cygnidae indet.</i>)	2	N/A				
	Waterbirds indet. (<i>Anatidae indet.</i>)	4	N/A			4	N/A
	Diving ducks indet. (<i>Aythiinae indet.</i>)	4	N/A			1	N/A
Laridae	Seabirds indet. (<i>Laridae indet.</i>)	4	N/A				
Sulidae	Northern gannet (<i>Sula bassana</i>)	1	N/A				
Gaviidae	Red-throated loon (<i>Gavia stellata</i>)			1	N/A		
Corvidae	Corvids indet. (<i>Corvidae indet.</i>)					1	N/A
Phasianidae	Western capercaillie (<i>Tetrao urogallus</i>)	1	N/A				
Accipitridae	White-tailed eagle (<i>Haliaeetus albicilla</i>)	4	N/A			2	N/A
	White-tailed eagle / Golden eagle (<i>Haliaeetus albicilla / Aquilla chrysaetos</i>)	2	N/A			1	N/A
Falconidae	Falcons indet. (<i>Falconiformes indet.</i>)	1					
Alcidae	Great auk (<i>Pinguinus impennis</i>)	2	N/A				
	Razorbill / Common murre (<i>Alca torda / Uria aalge</i>)	1	N/A				

Table C8: Table featuring the relative abundance of fish species from the West coast site of Balltorp (phase I & II) based on NISP and MNI. Data collected from osteological reports (Jonsson, 1996; Johansson et al., 2014).

FAMILY	SPECIES	BALLTORP PHASE I		BALLTORP PHASE II	
		NISP	MNI	NISP	MNI
Clupeidae	Atlantic herring (<i>Clupea harengus</i>)	1	N/A		
Scombridae	Atlantic mackerel (<i>Scomber scombrus</i>)			8	N/A
Esocidae	Pike (<i>Esox lucius</i>)	2	N/A		
Gadidae	Atlantic cod (<i>Gadus morhua</i>)	13	N/A		
	Codfish indet. (<i>Gadidae indet.</i>)	18	N/A		
Osteichthyes	Bony fish indet. (<i>Osteichthyes indet.</i>)			2	N/A
Pisces	Fish indet. (<i>Pisces indet.</i>)	N/A	N/A		

Table C9: Table featuring the relative abundance of fish species from the West coast site of Huseby Klev (phase I, II & III) based on NISP and MNI. Data collected from osteological reports and articles (Boethius, 2018a; Boethius, 2018b).

FAMILY	SPECIES	HUSEBY KLEV PHASE I		HUSEBY KLEV PHASE II		HUSEBY KLEV PHASE III	
		NISP	MNI	NISP	MNI	NISP	MNI
Clupeidae	Atlantic herring (<i>Clupea harengus</i>)			157	N/A		
Scombridae	Atlantic mackerel (<i>Scomber scombrus</i>)	7	N/A	1	N/A		
Gadidae	Atlantic cod (<i>Gadus morhua</i>)	210	N/A	110	N/A	266	N/A
	Haddock (<i>Melanogrammus aeglefinus</i>)			1	N/A	31	N/A
	Whiting (<i>Merlangius merlangus</i>)	1	N/A	3	N/A	7	N/A
	Saithe / Atlantic pollock (<i>Pollachius virens</i> / <i>Pollachius pollachius</i>)	5	N/A	49	N/A	163	N/A
	Codfish indet. (<i>Gadidae indet.</i>)					3	N/A
Lotidae	Common ling (<i>Molva molva</i>)			95	N/A	2	N/A
Triglidae	Grey gurnard (<i>Eutriglia gurnardus</i>)			2	N/A	2	N/A
Pleuronectidae	European plaice (<i>Pleuronectes platessa</i>)	11	N/A	31	N/A	17	N/A
	Flatfish indet. (<i>Pleuronectidae indet.</i>)			1	N/A	3	N/A
Merlucciidae	European hake (<i>Merluccius merluccius</i>)	5	N/A				
Squalidae	Spiny dogfish (<i>Squalus acanthias</i>)	29	N/A	113	N/A	2	N/A
Labridae	Ballan wrasse (<i>Labrus bergylta</i>)			1	N/A		
Rajidae	Thornback ray (<i>Raja clavata</i>)			8	N/A		
Pisces	Fish indet. (<i>Pisces indet.</i>)	268	N/A	572	N/A	496	N/A

Table C10: Table featuring the relative abundance of fish species from the West coast site of Tågerup (phase I, II & III) based on NISP and MNI. Data collected from an osteological report (Eriksson & Magnell, 2000).

FAMILY	SPECIES	TÅGERUP PHASE I		TÅGERUP PHASE II		TÅGERUP PHASE III	
		NISP	MNI	NISP	MNI	NISP	MNI
Cyprinidae	Roach (<i>Rutilus rutilus</i>)					1	N/A
	Tench (<i>Tinca tinca</i>)					1	N/A
	Cyprinids indet. (<i>Cyprinidae indet.</i>)	2	N/A			18	N/A
Clupeidae	Atlantic herring (<i>Clupea harengus</i>)	1 269	N/A			103	N/A
Percidae	Perch (<i>Perca fluviatilis</i>)	1	N/A			24	N/A
Scombridae	Atlantic mackerel (<i>Scomber scombrus</i>)					11	N/A
	Atlantic bluefin tuna (<i>Thunnus thynnus</i>)	2	N/A				
Esocidae	Pike (<i>Esox lucius</i>)					13	N/A
Gadidae	Atlantic cod (<i>Gadus morhua</i>)	4	N/A			27	N/A
	Saithe / Atlantic pollock (<i>Pollachius virens</i> / <i>Pollachius pollachius</i>)					6	N/A
	Codfish indet. (<i>Gadidae indet.</i>)	14	N/A	7	N/A	164	N/A
Salmonidae	Salmon indet. (<i>Salmonidae indet.</i>)	42	N/A			14	N/A
Anguillidae	Eel (<i>Anguilla anguilla</i>)	62	N/A	3	N/A	108	N/A
Triglidae	Grey gurnard (<i>Eutriglia gurnardus</i>)	1	N/A				
Pleuronectidae	European flounder (<i>Platichthys flesus</i>)	8	N/A				
	Flatfish indet. (<i>Pleuronectidae indet.</i>)	593	N/A	8	N/A	80	N/A
Squalidae	Spiny dogfish (<i>Squalus acanthias</i>)					9	N/A