Röekillorna unsealed

– an osteological analysis of the seal remains at Röekillorna Spring

Tea Jahrehorn Önnerfors (BA)

BA-thesis in osteology

Term: Autumn 2022
Supervisor: Adam Boethius
Examiner: Torbjörn Ahlström

LUND UNIVERSITY

Abstract

Zooarchaeological studies have played a crucial role in understanding the pre-historic societies of Scania. The analysis of animal remains from archaeological sites has provided insights into the subsistence strategies, economic practices, and cultural beliefs of the people who lived in the region.

Remains from horse, dog, wild boar, and man are commonly observed in offering and burial contexts. Despite, wild animals contributing to these contexts interpretations of these have been trivial at most. Understandably, the presence of wild animal is less, and most are inhabitants of the natural landscape further complicating their relevance. Nevertheless, marine species are not inhabitants of the immediate settlements and their prevalence in other context than waste deposits could bring light to wild animals symbolic or individual value for pre-historic societies along the coastal areas of Scania.

This Bachelor thesis examines five so called offering-and/or burial contexts where remains from seal is present, as well as conducting a detailed osteological profile of 23 seal bones from one of these contexts: the wetland cult place at Röekillorna Spring in southeast Scania. No prior studies have compiled osteological data over the distribution and frequency of seal remains at offering-burial sites in the southeast region of Scania before.

The results indicate – in line with Müller-Wille (1992) who included Röekillorna in his sample of cult places in Northern Europe – a small yet notable continuity from Stone to Iron age of seal bones at offering-burial coastal sites in Scania, with a complete lack thereof during the larger part of the Bronze Age. All skeletal elements from these sites belong to the *Phocidae* sub-species of grey seals. A detailed presentation and condition of each bone from Röekillorna will be presented in this thesis, as well as a discussion of their relevance to the deposit and a general interpretation.

Keywords: *zooarchaeology, osteological research, offerings-and burial, pinnipedia, grey seals, Neolithic, Iron Age, wetlands, pre-historical Scania, Baltic Sea, Röekillorna Spring*

Acknowledgements

During spring of 2022 I was able to carry out research at the Museum of Vertebrae Zoology at the University of California, Berkeley. It was here, my interest for the osteology of pinnipedia was developed, for which I am grateful. Thanks also to my supervisor Adam Boethius for his patience and support, to Pier 39 in San Francisco as well as the Scanian coastline for creative encounters with marine mammals. Finally, a special thanks to Paul Eklöv Pettersson at LUHM for his kind support.

Table of Content

1. Introduction

Grey seals *(Halichoerus grypus)* are a species of pinniped that are found along the coasts of the North Atlantic Ocean and in the Baltic Sea. They are a vital component of marine ecosystems and have played a significant role in human history. Most research regarding ancient seals have been conducted in the mid-to northeastern part of the Baltic Sea, where at times, evidence suggests that grey seals only occurred sporadically with most of the seal remains identified as harp- and ringed seal. Nevertheless, zooarchaeological material from several coastal dwelling sites in Scania, southernmost area of the Baltic Sea, have also presented larger quantities of seal remains.

One of those sites is Röekillorna Spring, a cult site located a few miles east of Ystad in southern Sweden, in Löderup parish, more specifically Hagestad No. 41. After having been discovered in 1951, Röekillorna Spring was excavated thoroughly sixty years ago (1961-62) by Berta Stjernquist. Yet the documentation of the excavation and (osteological) analyses related to this pioneering work were only published as late as 1997. Historians of religion have directed their interest towards Röekillorna and discussed its relevance as a sanctuary among many other sites in Northern Europe (Müller-Wille 1992: 40–41, for a map, see p. 33 and below). The site "constitutes a spring sanctuary that has been repeatedly frequented over a long period of time in a densely populated landscape and in which animal and human sacrifices as well traces of meals can be established" (Müller-Wille 1992: 41). Therefore, it appears to be relevant to investigate what exactly the seal remains signify in this context. While a clear conclusion cannot be drawn, this thesis provides with osteological insights into a fascinating cult site used by many prehistoric generations in the South-East of Scania.

Below, I have inserted a map from Müller-Wille's work since it clearly indicates that Röekillorna has been interpreted by internationally acknowledged scholarship as a relevant cult place in continuous use in Northern Europe. Since this directly affects the interpretation of my work, this map has relevance for my interpretation.

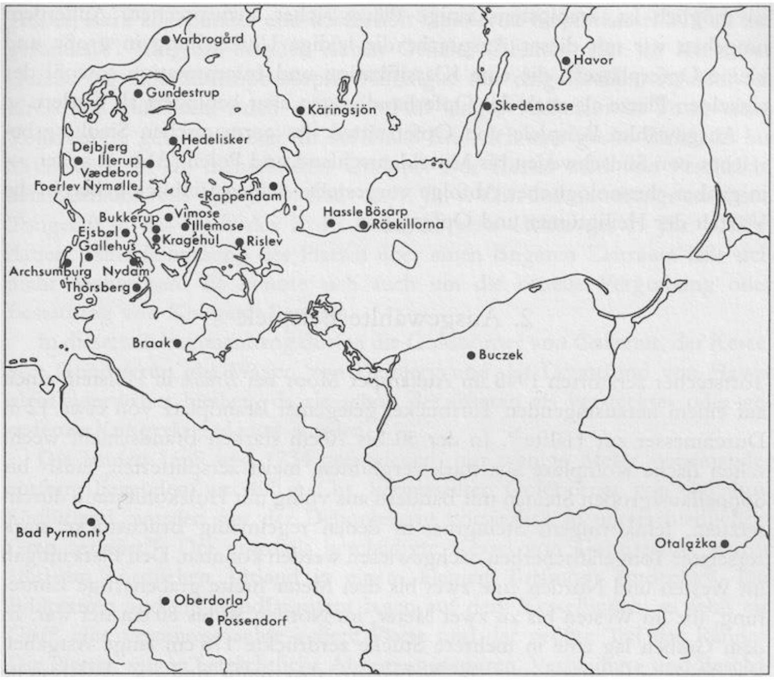


Fig 1: Older iron age sanctuaries in northern central Europe and southern Scandinavia (Müller-Wille 1992: 33)

1.1 Aims and research questions

This thesis aims to explore the relevance of grey seals in settlements part of the Baltic Sea, offering and burial contexts at dwelling sites in Scania, southern Sweden. Through the examination of skeletal elements from seal in the wetland deposit at Röekillorna Spring in southeast Scania, we will examine in how far grey seals have been utilized by human societies in other domains than as prey. The presence of seal bones in human graves or as offerings may indicate an individual's/or cultures connection to the sea or marine life. Additionally, by conducting osteological studies of seal bones at different archaeological sites a larger understanding of the prevalence of grey seal remains and their significance can be obtained. However, this objective of my thesis could not be considered for the time being.

Overall, this thesis aims to highlight the crucial role that grey seals play in the understanding of human-animal relationships and the importance of including marine species in future zooarchaeological research.

This study contains two objectives; one osteological case study assessing the zooarchaeological questions of the seal remains at Röekillorna Spring, and the other broader objective that derived from the results of the case study, namely the interpretation of seal remains in ritual contexts

The RQ1 is primarily concerned with osteological classification – the core of this discipline – but has of course also to be placed into a larger theoretical perspective related to the prevalence of seal in a cultural context decidedly identified as used as relevant for sacrificial purposes (Stjernquist 1997; Müller-Wille 1992). While issues of dating will be addressed later, it is important to point out that continuous use (also across time periods) of a cult place and significant topographical qualities by Müller-Wille (1992) are defined as an inclusion-criteria for cult places, which we will return to. Therefore RQ 2 will also specifically address issues of human-animal interactions in a cultural. The following research questions that will be addressed are as below:

RQ1: What specie of *Phocidae* are represented in the skeletal material from Röekillorna? Is it possible to extract data on their age, sex, health, and other relevant markers?

RQ2: What conclusions can be drawn regarding seal remains and human-animal interactions in wetland deposits, specifically cult sites?

As I will argue later, in this thesis I have taken a cautious and inductive approach towards clearly identifying the seal remains as human offerings at a cult place due to the messiness of the wetland/well context and related problems of dating and chronology. However, it is still plausible to assume that the osteological deposits are placed in an interpretable context of sacrifice and offerings at a cult site. We will return to this assumption later.

I recognize the limitations and further studies on the subject need to be conducted on an advanced level. The thesis should be regarded as an initiation as well as a basis for future investigations.

2. Background

2.1 Zooarchaeological Background

2.1.1 A brief overview of modern and ancient seals of the Baltic Sea

Today there are three species of true-or earless seals in the Baltic Sea: The grey seal (*Halichoerus grypus)*, the harbor seal *(Phoca vitulina)* and the ringed Seal *(Pusa hispida).* The current population of grey seal is estimated to be between 40.000-50.000 individuals, the grey seal is also the largest. The harbor seal is most common on the west-coast, and the western part of the Baltic Sea around Kattegat with a small population of 1.300 individuals located in Kalmarsund. The ringed seal today is primary located in the Northeast of Sweden, in Bothnia (Havs- och vattenmyndigheten 2019; HELCOM, 2018).

The harp seal *(Pagophilus groenlandicus)* was once a part of the Baltic Sea marine fauna, evidence suggest that they even occurred sporadically until the Middle-Ages and at times were the most hunted species of seal (Storå, 2001). This is especially true for Pitted Ware sites at Ajvide, Gotland and Stora Förvar located on Fårö. The earliest remains of harp seal in the Baltic major have recently been dated to c. 4800-4450 cal. BC (Glykou et al., 2021).

The grey seal measures between 1.60-2.30m, weighing about 100-310 kg in the Baltic population, with the Atlantic grey seal reaching up to 3 meters, reaching a weight of 400kg. Grey seals display sexual-dysmorphism with males greater than females (Hall et al. 2009; SLU Artdatabanken 2020). Males have a prominent snout which gave the species its name *grypus* meaning "hooked-nose", while the word *Halichoerus* stems from Greek translating to "Sea pig" (Hall et al 2009, Jefferson et al 2008).

The ancient grey seal *(Halichoerus grypus)* is believed to have roamed the northwest- and northeastern parts on the North Atlantic Sea. According to Fietz et al (2016) the Baltic grey seal *(Halichoerus grypus grypus)* derived from the others around 4200 BP. Recent results using mitochondrial aDNA as in the works of Bro-Jørgensen has established that the grey seal of the Baltic Sea belongs to a distinct phenotype. Consequently, due to the brackish waters of the Baltic, resulting in morphological, behavioral and genetical differences (Bro-Jørgensen 2021; Fietz et al, 2016), seals have adapted.

In accordance with current discourse regarding the grey seal, the earliest radiocarbon-dating of fossilized remains suggest immigration of the grey seal in the Baltic Sea at the beginning of the Littorina stage around 8000-7500 BP. Together with ringed seal they were the firsts species of seals to inhabit the Baltic Sea (Bro-Jørgensen 2001; Lepiksaar 1989; Ukkonen 2002). Establishing when the grey seal started to inhabit the southeastern part of the Baltic Sea, the earliest records are from the west coast, has proven to be more difficult. According to Apel & Storå (2017) the first evidence of grey seal at Åland dates to 6000BP (Apel & Storå, 2017; Ukkonen, 2002).

2.1.2 Previous research of ancient seals in Sweden

The zooarchaeological research history regarding seal remains in Sweden is rather extensive and has been thoroughly examined through the works of Jan Storå in recent decades. In several publications, Storå has implemented large comparative skeletal-phocaid data often with a combination of osteometric and morphological methods. His most acclaimed papers have been complied and titled "Reading the bones – *Stone Age Hunters and Seals in the Baltic"*, published in 2001. Here are covered diverse research areas in relation to seal bones; epiphyseal ageing-methods, taphonomy, hunting and foraging, seasonality, neolithic settlements and cultures, such as the Pitted Ware Culture, and in-depth identification and categorization of especially ringed and harp seal (Storå 2001).

Additionally, Jan Storå has together with P.G Ericson actualized a guide of standard measurements of phocaid skeletal elements in 1999 and as recently as 2020 updated the manual (Ericson & Storå 2020), all of which lay the foundation for the interpretation of the seal bones at Röekillorna in this thesis. Other prominent research made just in the last few years can be attributed to the works of Maiken Bro-Jørgensen in her doctoral thesis *"Ancient genomics of Baltic seals"*, and other interdisciplinary studies by; A. Glykou, L. Lõgas, G. Piliciauskiene et al, compiled and published *titled "Reconstructing the ecological history of the extinct harp seal population of the Baltic Sea"*, 2021. Earlier important works are Pikko Ukkonnen's (2002) *"The early history of seals in the northern Baltic"* and Johannes Lepiksaar's (1990) manual "Osteologica III – Phocaidae" which have been implemented in this study.

2.2 Archaeological context of this study

Fig 2: Showing Röekillorna in Scania.

Röekillorna Spring is situated a few kilometers from Hagestad, Löderup parish in southeast Scania close to the Baltic Sea. The area has a rich pre-historic landscape in proximity of several Megalithic monuments such as the stone-ship *Ale Stones*. Another Megalithic structure, a Neolithic grave, *Carlhögen* is located only a couple of hundred meters away from the spring.

As mentioned in the introduction, archeologist Berta Stjernquist in 1997 published *The Röekillorna Spring. Spring Cults in Scandinavian Prehistory*. Based upon a handful of other previous publications and original documentation, Stjernquist offers the most comprehensive description of the archaeological context so far, albeit strongly influenced by the idea of Röekillorna as a cult place with ritual offerings. Apart from her own writings, the book also features results of a geographical survey (and pollen dating) by Tage Nilsson and an osteological study by Ulrik Møhl. Møhl's study is relevant in its own right and was consulted extensively in this thesis.

In 1961, Berta Stjernquist initiated the excavation of Röekillorna as part of the Hagestad-project. Assisting her with the identification of the osteological material was Danish zoologist Møhl. The site was interpreted as a cult place where canine, horse and human bones had been ritually deposited. The complexity of the disturbed stratigraphical layers, prior presence of water and agricultural damage led to great difficulty in establishing chronozones. The dating was primarily based on material evidence and comparison with other finds in the areas as well as similar sites. This resulted in a relative dating from Neolithic to Iron Age, with a probable continuation of use (Strömberg 1995).

Location of the seal remains

The excavation 1961-1962 was conducted according to a grid made up of x and y coordinates. Interpreting this grid was difficult due to the original +, - axis of X having been switched, resulting in all finds being placed on opposite sides. This was not noted in the excavation report either, however, North was placed in the correct orientation making the plan readable if one mirrors it. Supposedly, to make up for this, Møhl the zoologist of the project created his own additional system marking the skeletal finds with an identifiable to numbers, labeling the bones accordingly.

In reference to Møhls system most seal bones are located at the southwestern sector around the spring with a few fragments located northwest. Evidence suggests eight deposits of bones belonging to seals, for simplification I assigned each deposit a letter A-G where both A and G represent the highest amount (Møhl, 1997; Stjernquist, 1997).

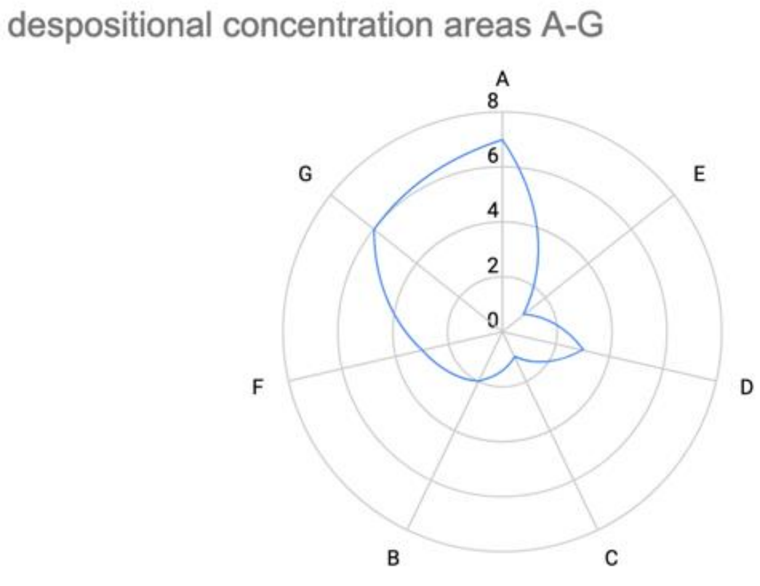


Fig. 3: Deposit A and G showed the highest amount of seal remains

2.3 Osteological context

The total osteological material from Röekillorna Spring consists of 6,161 pieces. Determined to be "in very good condition", some "bones and a few skulls are intact" (Møhl 1997:133). The concentration of certain bones allows the conclusion that whole animals or parts thereof were deposited. Møhl also states that many pieces have signs of redisposition, second movement (impacted by water-rolling) and other disturbances. According to his list, 4000 pieces could be identified, among the most frequent domesticated animals: *Equus caballus* (1280), *Canis familiaris* (1223), *Bos taurus* (770) and *Ovis aries* (600) which follows a pattern compared to other cult sites. The wild animal assemblage was expectedly low, except for 23 bones from grey seal (*Halichoerus grypus*) and 13 bones belonging to other wild species. Human remains were also present, 44 fragments thought to belong to at least 3 individuals; two adults and one child.

Møhl states that "we are obliged to conclude that the material from Röekillorna is not rubbish from settlements, but that the bones derive essentially from ritually disposed animals", why the discovery has been described as a "ritual find" or "holy well" (Møhl 1997: 134). Møhl discusses the prevalence of the various domesticized animal bones extensively but is short of providing clear explanations of wild species, which he says "presumably had less to do with" the rituals. As to the 23 seal remains Møhl speculates that they are "probably all from a single individual".

It is also evident that the water flow from the well has impacted the "chronological attribution of individual pieces of bone" so that "reliable dating of the layers in which the bones were found" is complicated. A "good deal of mixing has taken place" and "clear sequence" could not be established (Møhl 1997: 134 and 124). Based upon the entirety of the composition of osteological material, Møhl supports however the general conclusion that Röekillorna indeed is a sacrificial cult site comparable to others. Concerning wild animals breaking the conventional pattern he states that they "were in exceptional cases treated as objects of sacrifice earlier, when subsistence was based on hunting" (Møhl 1997: 125). When it comes to the 23 seal remains treated in this thesis, Møhl thus offers little clues about, yet still some hints as to their significance. This is a research gap I aim to address.

3. Material and method

3.1 Material

The skeletal material for this study originates from Hagestad 41, *Röekillorna Spring*, in Löderup Parish situated in southeast Scania. 23 bones from *Phocidae* have been selected according to the following criteria: *1)* the scarcity of seal remains in wetland deposits in Scania, *2)* the material constitutes almost half of wild fauna represented and the largest quantity of the same species, *3)* the exceptional state of preservation enabling detailed analysis. Comparative data has been gathered through the study of 14 seal fragments from St:

Hammar 15:1 in Vellinge parish, Scania, and 10 seal skeletal fragments from Nymölla/Möllehusen I-III situated in Gualöv parish, Scania.

Secondary osteological material used for the study includes modern seal skeletons obtained from the Zoological department at LUHM, the reference collection at LUX *(Lund's University)* and the author's private collection. The Phocidae represented in these collections are the following: grey seal *(Halichoerus grypus)*, ringed seal *(pusa hispida)*, harbor seal *(Phoca vitulina)*, Harp seal *(Pagophilus groenlandicus)* and bearded seal *(Erignathus barbatus*.

3.2 Method

For the examination of the 23 seal bones at Röekillorna, as well as for the observations made when studying the secondary material at St: Hammar and Nymölla I-II, classic laboratory zooarchaeological methods where implemented:

1) Taxonomic identification of specimen
2) Skeletal element frequency
3) Side and portion
4) Degree of fragmentation
5) Sex, based on morphological landmarks and diagnostic features 6). Age, status of epiphyseal fusion and size (Ericson & Storå, 2020; Gifford-Gonzales, 2018; Hesse & Wapnish, 1985; Reitz & Wing, 2008).

Application of inductive approach (reasoning), in which the analysis of the remains after examination derives results for interpretation, was implemented (Bernard, 2011). To simplify, when all data was collected and analyzed as individual elements and as a whole, the process of interpretation the seal bones in its context begun.

The data was then compiled in Excel, compared, and analyzed. A squared deviation score was applied in relation to five of the lumbar vertebrae at Röekillorna in a trial calculation for the measure of size-variability and standard deviation in relation to the reference collection.

Formula of*:*

$$s = \sqrt{\frac{SS_x}{n-1}} \text{ where } SS_x = \Sigma x^2 - \frac{(\Sigma x)^2}{n}$$

The mean of the sum of squares (SS) is the variance of a set of scores, and the square root of the variance is its standard deviation. Simplified as SS = ΣX2 – ((ΣX)2 / N) when using a calculator. The set of scores being the mean of all scores of the height mesurements taken of the seal vertebrae. It is a measurement variation or the deviation of data points from the mean value. A high variability equals higher numbers and vice versa. This will be presented in the result section.

Identification of specimen and differencing between species of *Phocidae* was conducted based on morphology, osteometry and comparison with reference material of modern seals. Several illustrated manuals and publications, both in the field of osteology and zoology were of great assistance. All publications will be listed in the list of references.
Due to great preservational status, measurements were taken on some of the bones. All osteometric measurements were taken with calipers and taken in accordance with Storå's manual, mentioned prior.

According to Storå (2001), seal bones are relatively easy to identify in relation to other fauna in the assemblage, yet the identification to specific species of seal proves more difficult due to fragmentation and morphological similarities between species (Storå, 2001). Intact bones or bones with unfragmented landmarks were osteometrically measured using P.G Ericson's & Jan Storå's (2020) manual of measuring seal bones. Sex and age estimation were implemented using Storå's publication on aging seal bones (2001), Gliford & Gonzales, (2018): "An introduction to Zooarchaeology" chapter six and seven, and Reiz & Wing's Manual to Zooarchaeology (Gifford-Gonzales, 2018; Reitz & Wing, 2008; Storå, 2001).

In the assessment of taphonomic markers, Behrensmeyer, A, K. 1978, "*Taphonomic and ecologic information from bone weathering"* has been used in the field to assess the taphonomic status of the bone material: weathering, gnawing, pathologies, cut and butcher marks, burned/unburned as well as environmental impact and disarticulation of bones.

As will be elaborated under results, trauma was presence in one bone, *right tibia,* and pathology observed in one of the lumbar vertebrates. These observations were noticed in the visual examination of the bones and based on criteria adapted by Baker and Brothwel (1980) as well as several paleopathological publications which will be listed in reference.

NISP (number of identified specimen) and MNI (minimum number of individuals) was established using Gifford-Gonzales, (2018). Quantification of the bone material has been relevant in the study of seal bones from Röekillorna where it has been interesting to determine how many individual seals there are. To find out, an MNI (minimum number of individuals) has been carried out, and a NISP (number of identified specimen) has been carried out (O'Connor 2008: 67), (Hesse & Wapnish 2007:114).

Three weeks were spent at LUHM with the materials, and one day at the laboratory of the Zoological department in Lund. During this time qualitative reading was conducted on all archived and unpublished material from Röekillorna. Microscope and magnifier were used at the Zoological department.

For additional reference in the field, I have used Johannes Lepiksaar’s seal manual from 1991 "Osteologica III, Phochidae", Ericsson’s & Storå’s osteometric manual *"A manual to the skeletal measurements of the seal genera Halichoerus and Phoca (Mammalia: Pinnipedia. (2020)’"* both of which focus on earless seals, as well as the California Academy of Science*”Identification of pinniped skulls of the Farallones National Marine Sanctuary”* (2017) which contains modern and high resolution photographs of both eared and earless seals as well as images of the most common pathologies.

The measurement of the skeletal elements was utilized by both analog and digital calipers and weighted in grams. Several photographs were taken using Canon EOS 1300D.

4. Theoretical framework

4.1 Taphonomy

In comparison with other sites, taphonomy could be used to establish comparative frequencies and thus create empirical evidence related to taphonomic processes. While such an approach certainly would be productive towards issues of dating and interpretation, it has been difficult to establish in this thesis due to the scarcity of seal remains in available samples.

When working with ancient skeletal remains one perspective that is of at most importance, is the knowledge and understanding of taphonomy. A body is not still post-mortem, it goes through several transitional stages until what remain is bones. When skeletonized, the bones continue to change depending on several thanatic factors. Exposure to the elements, soil ph-level and trampling all effect the status of the bones. (Clark et al. 1967).

Bones that have been deposited in water or wetlands usually either completely wear away and disappear or stay in almost pristine condition due to among other factors PH-level. Hence, the taphonomic process needs to be understood in the light of each specific context. Since the 1970s, archaeologist and osteologists have increasingly focused on taphonomy and how these processes impact the "life history" of faunal remains. As discussed by Behrensmeyer (1980) there are risks associated with faunal fragmentation, as some skeletal elements generally survive better than others, as well as some animals therefore often are over-represented in the assemblage (Behrensmeyer et al. 1980). The degree of fragmentation also affects the degree of identifiability. Farm animals such as cattle and pig are often over-estimated since their bones are easy to identify, and they generally survive well in the ground because of size and thickness. Smaller animals on the other hand such as rabbits or felines can have their skeletal remains destroyed over time (Lyman and O'Brian, 1987). This concept as well as identification bias need to be regarded prior to making great assumptions of human activity in relationship to animal remains (Gifford, 1981; Lyman, 1994). This thesis operates with taphonomical theories in order to explain the prevalence and preservation of seal remains in the Röekillorna wetland context.

More specifically, the taphonomy of seal bones is interesting for the interpretation of findings. In accordance with Binford's (1978) rankings of fragmentation degree, pinniped bones survive generally well. His results show that the femur of seals, in 4 out of 10, show 40% of the bone remaining. Metapodial/tarsus 13/30 and about 40%. The ulna 2/6 at 33.3% and so on (Binford, 1978).

Degree of fragmentation is based on Johannes Lepiksaar's "Fragmentation scheme" (1988) where he presents a selected number of skeletal elements and their most common degree of fragmentation (Lepiksaar, 1988).

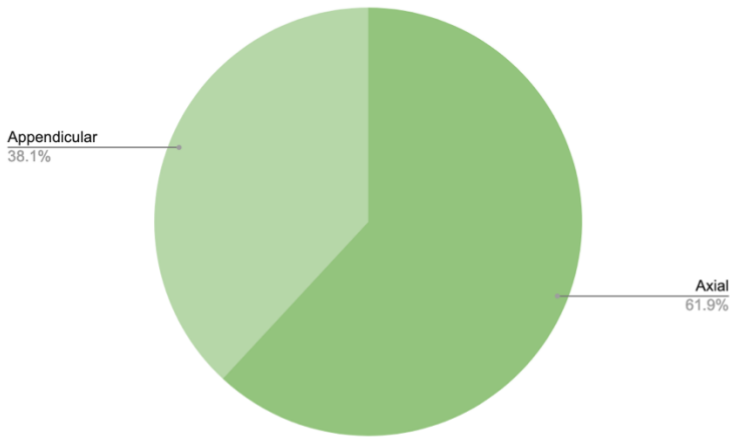
4.2 Bones and ritual offerings: social practices

Even if the social practices related to bones and ritual offerings do not constitute the main trajectory of this thesis, they are relevant for the interpretation of my results, as I already outlined in the background section. As stated previously, both Stjernquist and Møhl (1997) strongly argued for Röekillorna spring as a cult place, the relevance of which has been located in a far larger context across North-European space (Müller-Wille 1992 and map above). Provided the overwhelming evidence of sacrifice and offerings (of domesticized animals) at Röekillorna spring, it is possible to theorize that even the exceptions (wild animals) can be placed within the context of the cult place in question – anything else would be counterintuitive to assume. It is the primary task of science to establish truth values based on evidence and not to engage in burden of proof fallacies, i e prove claims made by others wrong. In our case, the 23 seal remains are prima facie evidence of osteological deposits and the starting point of an inductive investigation placing them within the evident socio-cultural context of an offering site/cult place.

In 1997, Stjernquist presented one theoretical classification of a cult place as “objects or structures in or at a spring” as “qualified circumstances of finds” (1997: 13). According to other research in the area, “two or more objects can be defined as an offering, that is a result of religious activity, if the find spot is wet land or marked by large stone etc.” (Stjernquist 1997: 13). Müller-Wille (1992: 31-32) points out that sanctuaries are characterized by factors like continuous use and “symbolism of the extraordinary” such like topographic peculiarities. If we apply these theoretical markers to our case: when it comes to Röekillorna Spring, the site was used for a very long time period and the spring as such known for its strong flow and peculiar ocher color (which has dyed the bones in a reddish tone to this day). In this vein, Müller-Wille included Röekillorna in his comprehensive overview of prehistoric sanctuaries (see map above), which is why this constitutes a relevant framework of interpretation.

5. Osteological Results

The 23 seal bones studied at Röekillorna are all determined to belong to the pinniped class of Phocidae. The majority of the 23 bones stemmed from the axial skeleton *61,9%*; all five lumbar vertebrae represented. The appendicular part made up 38,1% resulting in representation of bone from all over the body except from the distal extremities, no



carpal/tarsal bones or phalanges were present in the material. Adding to absent elements from the axial skeleton includes teeth.

dex	4
sin	5
axl	11

Bones from the left (sinister) side numbered: 5. 4 bones from the right (dexter) side and most bones, 11, located in the axial-midline of the body.

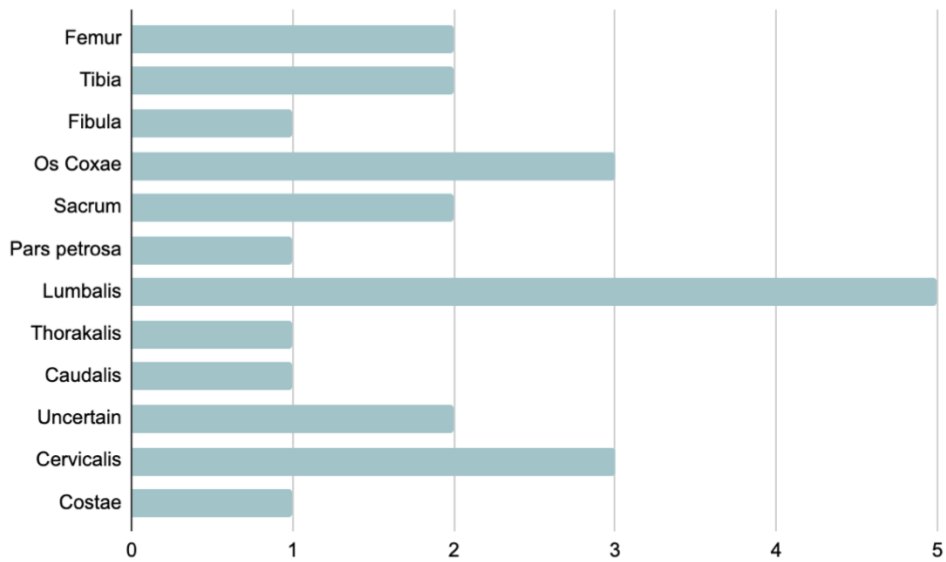


Table 1: Number of skeletal elements of Phocidae at Röekillorna

The seal bones make up about 1% of the animal remains recovered at Röekillorna Spring making 23 bones out of 4 070 identified fragments. Out of these 4 070 fragments around 2000

remains unidentified. 31% of the fragments are from horse, 30% from dog, cattle 19%, sheep/goat 15%, pig/swine 1,8% and human remains at 1%.
Only 1-4 smaller fragments from wild animals are present except from the seal bones closing in at 1%, 0,8% less than that of pig.
Discounting the seal bones, the wild fauna presents terrestrial animals local to the area such as: fox, red deer and hare, as well as a few bones from wild avian species. All of which exists naturally in the surrounding habitat (Møhl 1997).

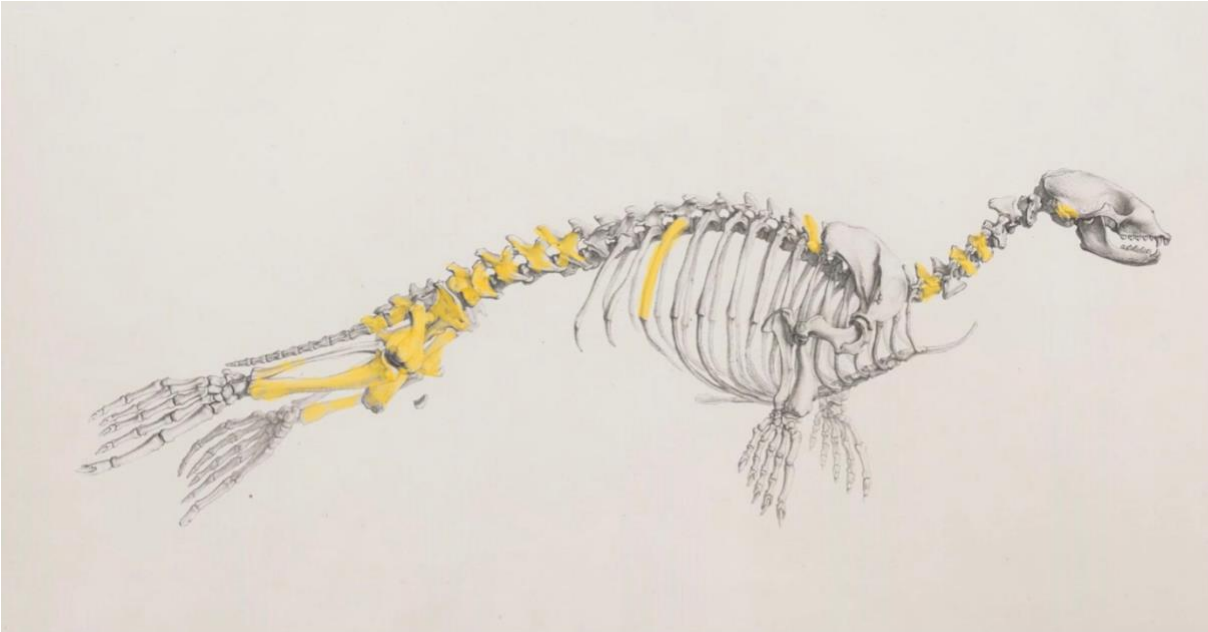


Fig 4: Overview of the skeletal elements analyzed (image: Smithsonian library open access). Drawing of Phoca Vitulina; harbour seal skeleton. To give an idea of the bones examined at Röekillorna and their location in the body.

Due to great preservational status, measurements were taken on some of the bones. All osteometric measurements were taken with calipers and taken in accordance with Storå's manual, mentioned prior. The measurements by Ericson and Storå has been abbreviated from standard mammalian measurements by Von der Driesch (1976) with changes to fit the pinniped morphology and in relation to archaeozoological findings. According to Storå, seals have a slow grow rate and the epiphyseal fusing occur later in life. In the archaeological assemblage unfused bones dominates (Storå, 2001).

(Fig 5) Pictured (left) shows the right femur from grey seal recovered at Röekillorna. The degree of fragmentation was low, around 5%. While the right side has been affected by taphonomy, the left side is nearly intact leaving several landmarks for measurement. In accordance with Storå's manual, minimum Length (9) was taken measuring the corpus from *Incisura trochanterica* to the distal outermost edge of *throchlea patellaris*. It measured 10,6 cm. The second measurement was the breadth of corpus (12) taken diagonally at the middle of the diaphysis. It measured 3,33 cm.

Fig 4: Femur, dext. n. caudalis

Using Storå's chapter on ageing seal bones (2001), this femur is estimated to belong to a seal that is a minimum of 3-5 years based of the epiphyseal fusion of the femoral head, which still has a slightly visible line, yet considered FUC, fully fused. Hence, the bone belongs to an adult seal. The species of seal determined as grey seal was based on morphological features and reference measurements. In Halichoerus grypus the femoral corpus is flatter than in the other species and has a stockier appearance according to Lepiksaar (1990). There was no evidence of gnawing nor any signs of human handling, such as cut marks.

The left femur (left Fig. 6) was slightly smaller than the right and the min length was measured to 10,1 cm. Hence, a 5mm difference. The degree of fragmentation about 10%. The bone was intact distally but showed several signs of gnawing proximally: as seen in the photo. Toothmarks from canines covered the femoral head, and pieces of *trochanter major* had been gnawed off. The placement of gnawing and toothing as well as the size of the puncture holes is consistent with having been made by a larger carnivora such as a dog. Dogs are especially interested in the surrounding epiphysial cartilage as well as bone marrow when the bone is fresh. Therefore, strongly indicating the bone lay visible for a time before it was deposited in the spring.

Fig 7: n. lateralis, dext. and sin Os Coxae.

In determining the number of individuals at Röekillorna, each bone that has a matching side (sin/dext.) were particularly studied in comparing differences and similarities. Due to the level of fragmentation is most cases absolute mesurements were not possible to take. Nevertheless, the landmarks that were intact were also measured. Furthest to the left in the picture is a right *Os coxae*, to the right is a left.

Halichoerus *fossa glutaea* is less pronounced than in other species, and when viewed *n. dorsalis* the *corpus iliaca* is less bent diagonally than in other species. Additionally, in grey seal, this skeletal element is particularly thick.

According to Ulrik Møhl the right *os coxae* had an imprint on the medial side of the bone thought to have been made by a hammer or axe.

The last “pair” of the 23 seal bones (Fig. 8) are two tibias, both missing the distal epiphysis. The two tibias were found in proximity to each other and as shown on the left, are morphologically highly similar. The proximal condyles of both tibias are completely fused to the diaphysis resulting in an age range of 5.25-14 years. The distal epiphysis fuses at earliest at 11 and latest at 14 years, since this part is missing in both tibias a maximal age limit is not possible to determine. It is, nevertheless, suggestive of the epiphysis not being completely fused. In seals the tibial and fibular epiphysis are fused together to create one bone: the crural bone. A complete fusion proximally happens as early as 17 months. The median observed fusion of both bones noted by Storå (2001) was at 8-9 years. A complete fusion between the tibia and fibula distally was between 11-16 years. The fibula in this case is not present most likely due to taphonomic reasons. It is observable however a prominent proximal *Crista later. Plantaris* in both specimens.

A small fragment determined to be of the fibula was noted by Møhl when studying the remains. Distally there are marks from roots and possible water-rolling. Neither tibia showed any signs of gnawing or human activity.

Fig. 9. Left tibia with healed fractured

Interestingly, the left tibia presented a pitted mark with rounded edges laterally on the bone, suggestive of a healed fracture (White, 2000).

Among the 23 bones were nine vertebrates from all regions of the spine: cervical, thoracal, lumbar, and coccygeal. A total height (TL) measurement was taken of the corpus in all nine vertebrae and later compared to mesurements taken in the same regions of the vertebrae belonging to a complete grey seal skeleton from a single individual.

Fig. 10: Lumbar vertebrae with pathology

The mesurements were repeated 3 times. Later, all five of the lumbar vertebraes where re-measured once again to lessen the margin of error while taken the measurement. The five lumbar vertebraes were visually different upon examination and varied up to 0.5 cm in height. In two of the lumbar vertebrae the spinal foramen was significantly wide and *" squared"* compared with all reference material. Image above shows one of the lumbar vertebraes, and the only one with visible pathology. The transverse process here shows both ossification and resorption. This could indicate external trauma with a secondary local infection (White, 2000).

All bones where weighted, but due to different levels of fragmentation this was not a useful method, and the results could not be used. Trying to answer the question of one or more individuals of seal in the material all bones were compared with each other, and a trial test of potential size-variability was performed.

Test trial of size-variability

Due to the noted size-variability and morphological differences of the lumbar vertebraes observed in the field, a standard-deviation scheme was preformed to assess statistical ground for the difference in size of the vertebrae in the same individual.

For this test two seal lumbar vertebraes, from two individuals of five (all) lumbar vertebraes from the reference collection was used in comparison with the Röekillorna lumbar vertebraes. A squared deviation was also conducted of seal 1 and 2 compared to each. All test subjects had the size-variability test applied against their own so detect potential size-variability in the same individual.

Due to limitations of reference material the interpretation of these results should be viewed only as a test trial. The squared deviation formula $SS = \Sigma X^2 - ((\Sigma X)^2 / N)$ was used and resulted in greater size variability in the Röekillorna seal compared to the other test subjects of seal 1 and 2, despite this, not statistically relevant. The sum of squares of the Röekillorna resulted in 0.4. Interestingly, however the size variability in seals 1 and 2 was even less; 0.032 in ref seal 1 and 0.132 in ref seal 2. Adding all lumbar vertebrae together the result showed 0.29 with a mean of 4.4, meaning this test did not show a significant size-variability which can be observed in the tables below:

Table 2: Röekillorna seal

IDnr	Vertebrae	Height mesurment
H 65: 2	Lumbalis	5,3
H 65: 3	Lumbalis	4,9
H 65: 4	Lumbalis	5,1
H 65: 5	Lumbalis	5,5
H 11:15	Lumbalis	4,7
Mean	-	5,1

Table 3: Reference seal 1

IDnr	Vertebrae	Height measurement
TJ93	Lumbalis	4,4
TJ94	Lumbalis	4,6
TJ95	Lumbalis	4,4
TJ96	Lumbalis	4,4
TJ97	Lumbalis	4,5
Mean	-	4,4

Table 4: Reference seal 2

IDnr	Vertebrae	Height measurement
D4	Lumbalis	4,5
E5	Lumbalis	4,7
F6	Lumbalis	4,4
G7	Lumbalis	4,2
G8	Lumbalis	4,5
Mean	-	4,4

The mean for the Röekillorna seal by itself was 5.1, and ref seal one and two; 4.4 and 4.4 respectively. Size variability from the mean for Röekillorna seal is observably larger than would be expected in comparison of the reference seals.

Seal spinal morphology is complex and the lack of osteological research of the seal vertebrae is a challenge when differencing seal species from each other. According to Storå (2001), it is not possible to determine the species of seal based on the vertebrae. This trial test was conducted based on my hypothesis that perhaps size-variability of skeletal elements within the same individual is lesser than between individuals of the same species, or even other species.

The last skeletal element of interest for the results are the *pars petrosa*, part of *os temporale*. According to Storå et al (2001) this part of the skull is one of the bones of seal easiest to determine to species. The pars petrosa was compared to 10 complete skulls from the Zoological department and the private collection as well as with partial skulls from LUX. All five relevant species of seal, both juvenile and adult was present in the reference material.

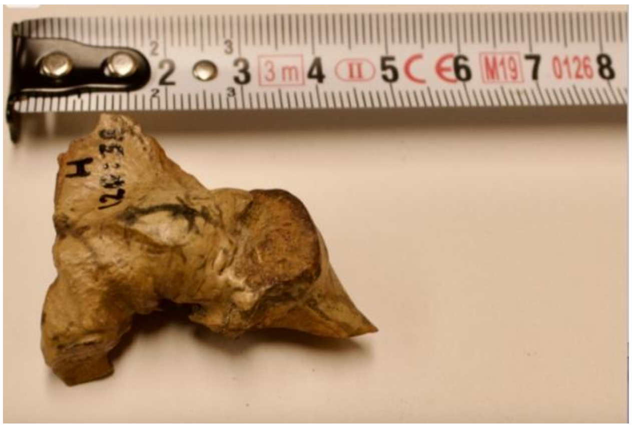


Fig 11 and 12:: Lateral view. Medial view of the pars petrosa

Measuring 3.2 cm in length it was on the smaller side, about 1cm smaller than what would be expected from an adult male grey seal. Indicating either a female or a younger male. Morphologically the pars petrosa was most similar to a sub-adult grey seal. The sex was not possible to determine with any certainty.

The results from mesurements and morphological studies of the 23 bones of seal from Röekillorna indicate one adult, possibly male grey seal and one smaller, younger, or female grey seal. The results of an MNI calculation shows a minimum number of 1 individual due to the left and right set of several bones. In contrast, when taking measurements into consideration there is a possibility of two seals in the material.

Table 5 of the skeletal elements showing length or height mesurements (depending in which bone was measured) in accordance with the Ericson & Storå manual:

No	IDnr:	Skeletal element	Side	Length/height/ cm	Weight/ g	Context group
1	**H 11:7**	Femur	Dex	12,3	98	A
2	**H 395:2**	Femur	Sin	11,2	82	E
3	**H 330:13**	Tibia	Dex	Broken distal	144	D:1
4	**H 325:4**	Tibia	Sin	Broken distal	136	D:2
5	**H 325:2**	Fibula	Sin	Midshaft	28	D:2
6	**H 11:9**	Os Coxae	Sin	no measurement	94	A
7	**H 11:8**	Os Coxae	Dex	no measurement	111	A
8	**H 11:9,12**	Sacrum	-	14,8	136	A
9	**H 120:38**	Pars petrosa	Sin	3L, 1,3H	10	C
10	**H 19:41**	Os Coxae	Dex	Small fragment	7	B
11	**H 11:15**	Lumbalis	-	4,7	78	A
12	**H 11:16**	Thorakalis	-	4,5	65	A
13	**H 11:13**	Caudalis	-	3,5	30	A
14	**H 19:53**	uncertain	-	tiny fragment	1	B
15	**H 335: 9**	Cervicalis	-	4,4	50	F
16	**H 335: 10**	Cervicalis	-	4,9	73	F
17	**H 335: 10**	Cervicalis	-	4,5	75	F
18	**H 65: 2**	Lumbalis	-	5,3	57	G
19	**H 65: 3**	Lumbalis	-	4,9	70	G
20	**H 65: 4**	Lumbalis	-	5,1	68	G
21	**H 65: 5**	Lumbalis	-	5,5	54	G
22	**H 65: 6**	Costae	-	16	21	G
23	**H 65: 10**	uncertain	-	2	1	G

Table 5 above shows all skeletal elements of seal present in the material at Röekillorna. 9 out of 23 fragments were positively identified as Halichoerus grypus, grey seal. 13 fragments determined to be seal otherwise specified, and 3 fragments had no clear markers of belonging to seal at all. According to Ulrik Møhl (1997) all 23 fragments belonged to grey seal, possibly to the same individual.

The seals are the only aquatic species, and only aquatic mammal present in the assemblage. No bones from fish were noted. The complete lack of fish fragments in a water source is surprising, yet explainable by their small and fragile size, as well as the archaeologists not water sieving the material. Smaller bones are commonly overlooked by this method. One can theorize that other smaller fragments or bones have been undiscovered due to it. Surprisingly, a few bones from smaller birds were accounted for as well as one small piece of mandible from a vole.

Results from comparative material

Below shows the table of relevant sites in Scania where seal bones have been retrieved from ritual contexts.

Table 6: Locations of seal remains

site	time period	grave	dry votive	wet votive	grey seal	element	quantity	other wild	human remains
Tågerup	Ertebøle	yes	yes	no	yes	tooth beads	1	wild boar	yes
Röekillorna	NK-EIA	no	no	yes	yes	all parts of body	23	few other	yes
Nymölla	NK	yes	yes	no	yes	claw-bone	1	unknown	yes
Nymölla	NK	yes	yes	no	yes	temporal bone	1	yes	yes
Mossby 10:27	VL-VI	no, in pit	yes, ritual meal	no	yes	2 cervicalis	2	bos taurus	no
Mossby 10:27	VL-VI	no, in pit	yes, ritual meal	no	yes	os temporale	1	felis, sus, bos	no
Gårdlösa	Iron Age	yes	yes	no	yes	?	?	felis, wolf, dog	yes
Gårdlösa	Iron Age	no, hearth	yes, ritual meal	no	yes	l&r humerus, rib	3	varied species	no
Gårdlösa	BA-MIA	yes	yes	no	phoca indet.	humerus	1	unknown	yes

From the LUHM material guide by Rosengren (2018), 19 sites which were mostly settlements presented seal remains, 4 of these had seal bones in burial-or offering contexts.

Table 7: Seal bones deposited in sacrificial context in Scania

site	element	quantity
Tågerup	tooth beads	1
Röekillorna	all parts of body	23
Nymölla	claw-bone	1
Nymölla	temporal bone	1

Mossby 10:27	2 cervicalis	2
Mossby 10:27	os temporale	1
Gårdlösa	-	1
Gårdlösa	l&r humerus, rib	3
Gårdlösa	humerus	1

The table above presents chronozone and the number of ritual context where seal remains have been located. It includes both areas with several ritual contexts such as graves as well as other forms of votive offerings. With or without the presence of human remains.

Seal bones occur in four graves, three dry votive deposits and one wet votive deposit. The latter being Röekillorna. One of the graves (Tågerup) has been dated to Late Mesolithic, the individual buried is a man interpreted to have worn clothing decorated with teeth from grey seal and wild boar. Two other graves (Nymölla/Möllehusen) are dated to the Neolithic. Grave I is that of a young male interpreted as having been wrapped in sealskin due to a claw-bone from grey seal being found. In Grave 2 belonging to individual III a temporal bone from grey seal was retrieved together with bones from wild boar, Individual III was also that of a man. Although, this was a double grave and a skeleton believed to be female, individual II was found next to the man.

The last two graves were excavated at Gårdlösa. The first was that of a man buried together with bones of cat, wolf, dog, and grey seal, dated to Iron age. The second is undated but believed to be Bronze-to Iron age. This grave contained remains of human and a humerus from undetermined seal. It is not specified if other animals were present in the grave. At Gårdlösa several hearths also excavated, in one of these several bones from grey seal were retrieved together with remains from various other species. The hearth was interpreted in relation with ritual meals.

At Mossby 10:27 several bones from seal were excavated from pits that were interpreted as offerings in accordance with ritual meals. Among the bones were 2 cervical vertebrae with signs of butchery deposited in a pit also containing bones from cattle. The other pit included a temporal bone from grey seal as well as bones from cattle, cat, and pig. In almost all these deposits other animal remains was present, both wild and domesticated. Interestingly, these were all dry deposits. The only wet offering-context is that of Röekillorna (Bolander, 2017; Stjernquist, 1981)

Table x: example of normal variation of seal remains, not in a ritual context. From Lilla Hammar.

Number	Quantity	Element	Species	Notes
LUHM: 30145	1	Humerus	Phoca int.	Weatering 3-4
LUHM: 30145	4	Cranium	Phoca int.	Weatering 4
LUHM: 30145	-	Atlas	Phoca int.	Man made marks
LUHM: 30145	3	Phalanges	Phoca int.	Weatering 3-4
LUHM: 30145	1	Cervical	Phoca int.	Weatering 3-4
LUHM: 30145	1	Femur	Phoca int.	Weatering 4, gnawing
LUHM: 30145	1	Scapula	Phoca int.	Weatering 4
LUHM: 30145	2	Costae	Phoca int.	Weatering 3
LUHM: 30145	1	Astragalus	Phoca int.	Weatering 3-4
LUHM: 30145	1	Ulna	Phoca int.	Weatering 3-4
LUHM: 30145	4	Cranium	Phoca int.	Weatering 3-4

The complete absence of phalanges or dentals in the seal material at Röekillorna is surprising. Yet, possible due to not water siwing the material. As shown in the table above, and in several of the other contexts presented; phalanges are relatively common.

6. Discussion

6.1 Responding to the research questions

a) Concerning RQ1: What specie of *Phocidae* are represented in the skeletal material from Röekillorna? Is it possible to extract data on their age, sex, health, and other relevant markers?

Confidently, there are nine bones that can be attributed to grey seal: two tibias, two femurs, one pars petrosa, two Os coxae and two pieces from the same sacrum. According to Ericsson and Storå (2020) in archaeological contexts it is mainly cranial elements that with a great degree of certainty along with the humerus, that can be adequately used to separate species. Despite this, the grey seal is the largest and therefor near to complete bones can separate them from the smaller species of seal, such as ringed and harbor seal. Considering the presence of different seal species during a certain timeframe and location, the grey seal is one of the most common in the area (still is today). Compared with the reference material and literature the skeletal elements mentioned derives from grey seal (Lepiksaar, 1990; Ericson & Storå, 2020; Almkvist, 1980).

13 of the bones were identified as Phoca intendent due to two factors: 1). Morphological deviations 2). Small fragments with markers belonging to seal, yet specie wasn’t determinable.

3 bone fragments were of such small size with no evident markers that they were classified as “uncertain”. Considering this, the probability of other species of seal can’t be disregarded.

Analyzing the remains for sex markers proved unsuccessful due to no reference material having been consequently marked male/female. In addition, hardly any literature obtained appear to have made skeletal sex profiles of grey seals.

Furthermore, sex identification of seals is preferably based on cranial, not post-cranial elements, especially the temporal bone and canine size. One part of a temporal bone; *pars petrosa*, was examined and is possibly that of a female or juvenile, in relation to size and shape. Adult male grey seal generally has thicker, larger, and rugged areas on their *pars petrosa.* Since no sexed female skulls were present in the reference material available, one should not ignore the possibility of the bone belonging to a female. Then again, the *pars petrosa* was almost identical to two juvenile seal skulls.

An estimate of age was done on all vertebraes, both in relation to each other (as in belonging to the same individual) and alone. This was conducted using Storå’s chart of epiphyseal ageing of seal bones.

All observed vertebrae are fused with no apparent ongoing fusing. Cervical, thoracic, and lumbar = FUC+. No sign of epiphyseal loosening which might occur in senior seals.
In reference of Jan Storå’s (2001:11) ”Stages of fusion” for grey seal suggesting an estimated age of: 15 years, that is if all five lumbar vertebrae belong to the same individual.
If not, since all are fused this would indicate the earliest age of 9.5+.

For the thoracic vertebrae, the earliest age of fusing is 7.5 years. If all are fused it would indicate an age of 17, if not it could indicate an age as great as 33 years. There is only one thoracic vertebra in the material.

For the cervical vertebrae: All three are fused indicating 7.5 if some are fused (5 are missing from the material if we assume it’s the same individual). It puts the individual seal’s age at around 8-9 years. On the contrary, the two femurs and two tibias still show an epiphyseal ring which in older adult seals isn’t noticeable or has been affected by osteoporosis. Seals are prone to osteoporosis, especially in their lumbar vertebraes and sacral area. This is absent in the material. The proximal area of the crural bone fuses at two years (juvenile), in this case it seems to have been present but missing due to taphonomic reasons, based on the rather large area of attachment along the bone. The femurs proximal epiphysis fuses at two, and the distal at 3 years, hence these bones are not likely to belong to a yearling yet may derive from a younger adult. At 4 years, the distal epiphysis of the tibia is fused. In the material these epiphyses are missing, seemingly as a result of them not being completely fused to begin with. In conclusion, the complete fusion, yet no traces of loosening or pathology of the lumbar vertebrae would suggest an age of 7-9 years. The femur would suggest around 5 years of age due the proximal end visible fusing line (although completely attached). The tibias distal areas fusing status is uncertain, yet probably not completely fused, making these bones belong to a seal under 11 years of age. Adding this together indicated one or several seals skeletal age between 5-9 years (Storå 2001: 7-12).

The bones are overall in good health, without any signs of osteoporosis. Nonetheless, as mentioned above, one vertebra shows significant ossification-processes on the transverse process. Investigating this, no skeletal abnormality or pathology obtained was usable for a diagnosis. Tuberculosis, which is a common illness among pinnipedia, was considered due to its ability to manifest periods of both bone resorption and bone ossification. In these cases, however, the body or corpus of the vertebrae seem to always be affected by the illness in some way (Ozakaki et al, 2019). Few diseases seem to affect only the transverse process. Osteomyelitis is possible, such as a local infection due to for instance an infected bite, or a spear penetrating the side of the seal and the wound later becomes infected.
The only other bone that presented pathology was one of the tibias, showing a possible healed fracture, that most likely occurred early in the seals life due to the great status of the fracture. Perhaps, at the time when this seal was a pup, in a sedentary state? (White, 2000).

b) Concerning RQ2: What conclusions can be drawn regarding seal remains and human-animal interactions in wetland deposits?

When noting other pre-historic contexts both Neolithic and from the Iron age in Scania, the presence of seal remains are few. Nevertheless, they are often the most represented wild fauna in the assemblages. This is in regard to both the bone survival rate and the fact that seal bones are relatively easy to identify. This study has had an inductive approach, starting with a material prior unknown to the author. 23 selected bones have been studied osteologically and then compared with earlier results of the skeletal remains at Röekillorna. The seal which has been an important animal in pre-historical times and within different cultures served as a starting point for a better understanding of human ritual activities. During the investigation of the remains, it became clear that the presence of seal in the material was more complex. Were the seal remains actually a part of the offering context? And was it more than only one individual?

In viewing comparative data, it became clear that seals do occur in ritual and offering contexts in Scania, be it few. The importance of seals in these contexts is not clear. The seal bones did not have any clear markers of human activity such as scraping, cut marks or signs of boiling or consumption. Although, this was noted by Møhl (1997) in his archived documents he identified several impact marks from blows and cutting. The bones were studied substantially in my thesis, yet no such marks where clearly indisputable. Nevertheless, one femur presented extensive marks for gnawing, canine imprints, and tonging, as defined by Behrensmeyer (1978). Manifestations of such marks are clear indicators for canine activity, and in relation to site and exposure of the bone, most likely from dogs. Dogs especially enjoy the epiphysial area of fresh bone. Domesticated dogs are indirect evidence of near human activity. A wild dog or wolf would have had transported the bone away, not consumed it at site of human held dogs.

In Ulrik Møhl analysis of the wild faunal remains at Röekillorna (1997), he makes the claim that they are not offerings based upon their low frequency. It is compatible in the case of wild animals that occur naturally around the contexts, such as birds, rabbits, deer etc. Seals, however, do not occur in the immediate surrounding and would have had to be transported by man. Turning Møhl's argument around: prevalence of seal bones indicates sacrificial relevance *not* the opposite, considering the number of bones and their concentrated deposition. As mentioned earlier, seal bones are sturdy and have a good survival rate which creates a possible bias if one mainly focuses on number of fragments. Møhl goes on to argue that wild animals have no sacrificial value. This can be debated as the results from this thesis shows that seal bones do occur in other ritual contexts.

Møhl theorizes that the seal bones all originate from the same individual. I would argue that this claim is unlikely, yet plausible. To illustrate; 1) the majority of (almost intact) bones are left/right pairs and with near to identical morphology, from size, shape to degree of fusing. 2) the bones all seemingly belongs to grey seal, 3) all except two bones were found in the south-western part of the trench. To contrast Møhl, there are at least two lumbar vertebrae that are not confidently placeable as grey seal. The spinal foramen in grey seals is normally small, flattened, and triangular. Two lumbar vertebrae in the material have in contrast large, squared, and open spinal foramen. Even when taking individual differences into account, none of the reference materials show this morphological trait. The *pars petrosa*: it's general morphology and mesurements did not match what would be expected belonging to the individual of the other bones. It was smaller, and flatter than that of an adult grey seal when compared with reference material.

At this point in the thesis, it is important to flag for a conservative position in relation to the interpretation of seal remains. Whereas previous literature (Møhl 1997) had much to say about the prevalence of "typical" osteological findings (of horse, dog and sheep) and their ritual significance, it was at loss concerning the interpretation of wild animal deposits. It has therefore been a point of departure in this thesis not to make any exaggerated claims related to the seal finds, but also not to dismiss them just because they fall out of the pattern. The big issue is rather to explain what they do in the context altogether in the first place, not to explain their prevalence *away* as a random occurrence, which would be speculative at best and unscientific at worst.

6.2 Suggestions for further research

As this thesis has demonstrated, osteological research into seal remains in wetland deposits (in connection with sacrificial practices) has the potential to be developed into several trajectories.

First of all, in order to establish clear chronologies it would be valuable to use mitochondrial DNA-analysis and to carry out radiocarbon dating (if collagen can be extracted) on all prevailing seal remains in relevant deposits. Such additional information would also support the interpretation of other findings at sites as Röekillorna. During the final phase of my study, zooarchaeologist Aiktaerini Glykou from Stockholm university visited LUHM in order to subject two bones in my sample (os coxae and pars petrosa) to further analysis. The results are still pending but will throw further light on the value of the selected sample in my thesis. Glykou’s research is among other field concerned with reconstructing ecological histories of pinnipedia in the Baltic Sea Area, which merits further exploration, for instance concerning grey seal. One area of interest could for instance be to study skeletal differences between contemporary and prehistoric seal populations by looking at ancient genomics (Bro-Jørgensen, 2021).

Secondly, Storå (2020) and Ukkonen (2002) have demonstrated the prevalence of seal remains in other ritual contexts around the central Baltic Sea (Gotland, Åland, Finland), for instance necklaces with seal teeth and seal figurines, predominantly during mesolithic and neolithic times. This points at cultural and ritual practices where the position of seals has been more pronounced. Taking these two avenues of future multidisciplinary studies together, research into osteological seal remains with new technologies and a broader mapping of the position of seals in a prehistoric cultural context, promises deeper understanding of the seal as one of the largest and most prevalent marine mammals in the Baltic Sea Area and its interplay with the development of human civilization.

7. References

Material in LUHM (see appendix 1)

References

Almkvist, L. (1980). *Sälar i Sverige*, Stockholm: Svenska Naturskyddsföreningen.

Apel, J., & Storå, J. (2017). ”Ett återbesök i Stora Förvar och en ny bild av mesolitikum på Gotland” in P. Wallin, & H. Martinsson-Wallin (Ed.), Arkeologi på Gotland 2: Tillbakablickar och nya forskningsrön (p. 9–18). Uppsala University.

Baker J. and Brothwell, D. (1980) *Animal diseases in Archeology*, London; New York : Academic Press, 1980.

Behrensmeyer A.K. (1978). “Taphonomic and ecologic information from bone weathering”, *Paleobiology*, 4 pp. 150-162.

Behrensmeyer, A, K., Gordon, K, D., Yanagi, G, T (1986) “Trampling as a cause of bone surface damage and pseudo-cutmarks”, Nature 319, 768-771.

Binford, L.R. (1978) *Nunamiut Ethnoarchaeology* Academic Press, New York.

Bolander, A. (2017) ”Östra Grevie 9:30 och 12:14: där backe möter slätt – mellan mosse och lund.” Rapport 2017:18. Lund: Arkeologerna, 69–85.

Bro-Jørgensen, M. H. (2021) *Ancient genomics of Baltic Seals. Insights on the past Baltic grey seal and harp seal population*, Theses and Papers in Scientific Archaeology 19, Stockholm: Stockholm University.

CLARK, J.; BEERBOWER, J.R. & KRETZKE, K.K. (1967) “Oligocene sedimentation, stratigraphy, paleoecology and paleo-climatology.” FIELD/ANA: Geol. Mem. 5, 1-158.

Clark, J. G. D. (1946). “Seal-Hunting in the Stone Age of North-Western Europe: A Study in Economic Prehistory”, *Proceedings of the Prehistoric Society*, 12, 12–48.

Ericson P.G.P. & Storå J. (2020) “A manual to the skeletal measurements of the seal genera Halichoerus and Phoca (Mammalia: Pinnipedia)” Report from the Swedish Museum of Natural History. 2020:4. Naturhistoriska riksmuseets småskriftserie.

Fietz, K. et al. (2016) “Shift of grey seal subspecies boundaries in response to climate, culling and conservation”, *Mol. Ecol.* 25: 4097– 4112.

Gifford-Gonzales, D. (2018) *An introduction to Zooarchaeology*, Springer.

Gifford D.P. (1981) Taphonomy and Paleoecology: A Critical Review of Archaeology's Sister Disciplines, Advances in Archaeological Method and Theory, 4 (1981), 365-438.

Glykou, L. Lõgas, G. Piliciauskiene et al. (2021) "Reconstructing the ecological history of the extinct harp seal population of the Baltic Sea", *Quaternary Science Reviews*, 1–15.

Hall, A. & Russell, D. J. F. (2018) "Gray Seal (Halichoerus grypus)". In *Encyclopedia of Marine Mammals* (eds. Würsig, B., Thewissen, J. G. M. & Kovacs, K.) 420–422 (Academic Press).

Havs-och vattenmyndigheten (2019) "Nationell förvaltningsplan förgråsäl (Halichoerus grypus) i Östersjön"

HELCOM (2018) "Population trends and abundance of seals", Helsinki Commission, URL: https://helcom.fi/baltic-sea-trends/holistic-assessments/state-of-the-baltic-sea-2018/ (accessed 12 January 2023).

Hesse B. and Wapnish P. (1985) *Animal Bone Archeology: From Objectives to Analysis*, University of Minnesota: Taraxacum.

Jefferson, T.A., Webber, M.A., Pitman, R.L. (2015) *Marine Mammals of the World - A comprehensive guide to their identification*. Chapter 6- Pinnipeds 358-522.

Lepiksaar, J. (1989) "Om den tafonomiska förlustens betydelse vid kvantitativ analys av antropogena thanatocoenoses", i *Faunahistoriska studier tillägnade Johannes Lepiksaar*, University of Lund, Archaeological Report Series No. 33, Lund: Lund University, 21–35.

Lepiksaar, J. (1990) unpublished manual "Osteologica III – Phocidae".

Lyman, R,L and O'Brian M. J (1987) *Special Study: Plow-zone zooarchaeology: fragmentation and idenxwtifiability.* 493-498. University of Missouri-Colombia: Columbia, Missouri.

Lyman, R.L. (1994) *Vertebrate Taphonomy*. Cambridge Manuals in Archaeology: Cambridge.

Møhl, Ulrik (1997) "The Human and Animal Bones from Röekillorna in Hagestad – zoological light on sacrificial practices" in *The Röekillorna Spring. Spring-cults in Scandinavian Prehistory* (ed. Berta Stjernquist), Acta Regiae Societatis Humanorum Litterarium Lundensis LXXXII, Stockholm: Almqvist & Wiksell, 117–122.

Müller-Wille, Michael (1992). "Ältereisenzeitliche Heiligtümer im nördlichen Europa nach den archäeologischen Quellen", in *Germanische Religionsgeschichte: Quellen und Quellenprobleme* (eds. Heinrich Beck, Detlev Ellmers and Kurt Schier), Berlin, New York: de Gruyter), 29–94.

Ozakaki et al, (2019) *A paleopathological approach to early human adaptation for wet-rice agriculture: The first case of Neolithic spinal tuberculosis at the Yangtze River Delta of China.* International Journal of Paleopathology.

Reitz, E. J. (2008) "Archaeozoology" in *Encyclopedia of Archaeology*, University of Georgia, Athens, GA.

Reitz, E.J. and Wing, E. S. (2008) *Manual to Zooarchaeology*.

Rosengren, E. (2018) "A Partial Catalogue of the Mammalian Archaeofaunal Material in the Collection at Lund University Historical Museum (LUHM)", Historiska Muséet: Lunds universitet, URL: https://www.historiskamuseet.lu.se/erika-rosengren/publication/95548efc-8a0e-4dba-a38f-18c9d3b81ec6 (accessed 30 November 2022).
SLU (2020) "Sälar", Artdatabanken, URL: https://www.artdatabanken.se/publikationer/bestall-rodlista-2020/ (accessed 30 November 2022).

Stjernquist, B. (1981) "The Gårdslösa project", in Gårdslösa. An iron age community in its natural and social setting (ed. Berta Stjernquist), Acta Regiae Societatis Humanorum Litterarium Lundensis LXXV, Lund: Gleerup, 9–23.

Stjernquist, B. (1997). *The Röekillorna Spring. Spring-cults in Scandinavian Prehistory*, Acta Regiae Societatis Humanorum Litterarium Lundensis LXXXII, Stockholm: Almqvist & Wiksell.

Storå, J. (2001) *Reading the bones – Stone Age Hunters and Seals in the Baltic*, Stockholm Studies in Archaeology 21, Stockholm: University of Stockholm.

Strömberg, M. (1995) Från bågskytt till medeltidsbonde. Bosättningshistoria i och kring Hagestad, Ystad: Kulturnämnden.

Ukkonen, P. (2002) "The early history of seals in the northern Baltic", *Ann. Zool. Fennica* 39: 187–207.

Von den Driesch, A (1976) A Guide to the Measurement of Animal Bones from Archaeological Sites: As Developed by the Institut Für Palaeoanatomie. Peabody Museum of Archaeology. Harvard

White, T. (2000) *Human osteology*. San Diego: Academic Press.

Würsig, B. and Thewissen, J.G.M. (2009) *Encyclopedia of Marine Mammals* (Second Edition), Academic Press, 2009, 500-503

Appendix 1 Overview over material in LUHM

No	IDnr:	Skeletal element	Side	Length/height/ cm	Weight/ g	Context group
1	H 11:7	Femur	Dex	12,3	98	A
2	H 395:2	Femur	Sin	11,2	82	E
3	H 330:13	Tibia	Dex	Broken distal	144	D:1
4	H 325:4	Tibia	Sin	Broken distal	136	D:2
5	H 325:2	Fibula	Sin	Midshaft	28	D:2
6	H 11:9	Os Coxae	Sin	no measurement	94	A
7	H 11:8	Os Coxae	Dex	no measurement	111	A
8	H 11:9,12	Sacrum	-	14,8	136	A
9	H 120:38	Pars petrosa	Sin	3L, 1,3H	10	C
10	H 19:41	Os Coxae	Dex	Small fragment	7	B
11	H 11:15	Lumbalis	-	4,7	78	A
12	H 11:16	Thorakalis	-	4,5	65	A
13	H 11:13	Caudalis	-	3,5	30	A
14	H 19:53	uncertain	-	tiny fragment	1	B
15	H 335: 9	Cervicalis	-	4,4	50	F
16	H 335: 10	Cervicalis	-	4,9	73	F
17	H 335: 10	Cervicalis	-	4,5	75	F
18	H 65: 2	Lumbalis	-	5,3	57	G
19	H 65: 3	Lumbalis	-	4,9	70	G
20	H 65: 4	Lumbalis	-	5,1	68	G
21	H 65: 5	Lumbalis	-	5,5	54	G
22	H 65: 6	Costae	-	16	21	G
23	H 65: 10	uncertain	-	2	1	G

Appendix 2 Chronozones and findings at other sites in Scania

Chronozone	location	h.g	ph.g	ph.hisp	ph.vit	ph.indet	Total Phocidae
EM	Ageröd	2	1	-	-	5	8
MM	Arlöv I	7	-	1	-	1	9
MM	Tågerup 1:1	28	-	-	-	21	49
M/LM	Tågerup 1:1					4	4
MM	Barsebäck 38:3	2	-	-	-	3	5

LM	Skateholm I	131		5		41	177
LM	Tågerup 1:1 FIII	5					4
LM	Stora Herrestad 59:3	4		4	1	31	40
LM	Skateholm II	102		1		4	107
LM-EN	Löddesborg	5	2			26	33
LM-EN	Nymölla 12:35	4				12	21
LM-EN	Sjöholmen	11				5	16
EN	Nymölla 12:35	2					2
EN	Hunneberget	1	2			4	7
EN	Västra Torp 9:2		1				1
N	Nymöllahusen II	5	59	9	1	95	169
MN	Hunnaberget	2	3			4	9
SA	Jonstorp M2		1			8	9
SA	Jonstorp M3+M4	1	5	4		98	108
BA	Hötofta					1	1
BA-EIA	Önsvala	1					1
BA-MIA	Gårdlösa	3				1	4
EIA-PRIA	Stora Hammar	2					2
EIA	Lilla Hammar	14					14
IA-PRIA-VA	Löddeköpinge 90:1	1					1
MLIA	Vallenberga 49:2	4					6
LIA/VP	Järrestad	1					1
LIA/VP-VA	Lahebiagrottan					15	15
LIA/VA	Håslöv 5:3					1	1
LIA/VA	Östra Torp	2					2
SA-IA	Stävie	1					1
SA-IA	Röekillorna	23					23
TOTAL	ALL	364	74	24	2	380	844

all seal remains from the published LUHM catalogue