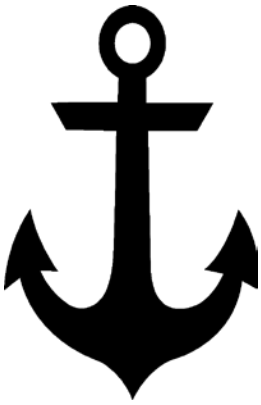
A Typological Assessment of Anchors used in Northern Europe During the Early and High Middle Ages, CE 750 - 1300



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Abstract

This thesis will present an overview of the current knowledge of the historical and chronological development of known anchors used in northern Europe between 750 and 1300 CE, representing the early and high middle ages in this region. It will detail the adoption, use, and evolution of iron anchor designs in the region. To achieve this, dated anchors will be identified and be ordered using typological assessment. This will enable the diagnostic forms and features anchors possess to be used for a system of classification based on these features.

In addition, this thesis will discuss the role of cultural and economic interactions between the cultures of northern Europe and the Mediterranean throughout classical antiquity and the early medieval period (8th century BCE – 8th century CE) in influencing anchor design in northern Europe. It will also discuss the influence of the seafaring and shipbuilding methods of Viking cultures between the 8th century CE and 14th century CE. All dates used in this thesis will use the Common Era year-numbering system, with all dates using CE, unless specifically noted as BCE.

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Declaration of Candidate

I certify that this thesis does not incorporate without my knowledge any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

Daniel Robert Claggett

2017

1. Introduction

Typological assessment, the classification of objects based on their physical characteristics, is one of the earliest techniques for dating archaeological material (Aldenderfer 1996:727-728; Spaulding 1953:305-314; Whallon and Brown 1982). The application of typological assessment divides a group of artefacts into types based on variables such as form, style, size and construction method. The reliability of this method of artefact assessment is improved when a chronological sequence of artefacts of a common style or form can also be accurately dated using absolute dating methods (e.g., proxy dating, stratigraphy, 14^c radiometric analysis). Although its reliability varies based on the amount of archaeological material available, using typological assessment allows for the dating of artefacts that would otherwise be non-dateable. Using this method of analysis also provides a far greater level of information to be inferred from objects, because analysis of an objects design and development can reflect economic and technological changes in the culture that produced them, as well as shed light on related cultural phenomena (Frost 1973).

This thesis will discuss the potential for typological assessment to be used in chronologically detailing the development of northern European anchors in the middle ages. Although no typology exists for anchors in northern Europe, the benefit of this type of assessment has been demonstrated in the Mediterranean for a variety of artefact types, including anchors, since the earliest archaeological work was carried out. Before methods of absolute dating were available, numerous contributors helped create one of the most successful typologies in the region to classify amphorae (Hruby 2010:195-216; Warden 2013: 81-84). Applying these typologies helped provide dates for the adoption, use and abandonment of certain amphorae designs. In addition, typological analysis provided information on the economic development of the Mediterranean by examining the dispersion and frequency of a given amphorae type, reflecting the level of economic activity and trade in the region during the period that design was used in (Evans 2013:98). The Mediterranean is also the first region where historical literary and archaeological evidence was used to create a typology for anchors. Based on archaeological, ethnographic and primary literary evidence ranging from the Bronze Age to the medieval period, this typology has been useful in establishing the date of certain anchor types and the cultural origin of their design. This thesis intends to create a typology for anchors used in medieval northern Europe, similar to the anchor typology developed in the Mediterranean.

How can typological assessment of existing medieval anchors provide a framework for investigating and understanding the development of anchor technology in the North Sea cultures? This research question will be answered by identifying and recording a combination of primary literary and archaeological examples of medieval iron anchors in northern Europe. Developing this typology will detail the use and development of iron anchors in the region, and help to better interpret the chronological development and abandonment of anchor designs used throughout the period. Answering this research question will be achieved in conjunction with the primary aim of the project, which is to explain the influences behind the forms and features iron anchors possessed, and how these developed during the middle ages.

1.1 Aims

The primary aim of this study is to explain the cultural and technological influences behind anchor design and development in medieval northern Europe. This aim will provide context to the central research question, because it will detail the importance of cultural and economic contact to the adoption of iron anchor technology in northern Europe, and the reasons why anchor design changed over the study period. Achieving this aim will create a typology that takes into account the influences and events that altered the methods in which anchors were made.

This study will focus primarily on three cultural group's active in the region. This discussion will focus on the ancient and medieval seafaring cultures of the Mediterranean, the emergent Viking cultures of Scandinavia and the vernacular cultures of northern Europe. The term 'vernacular' will be used to describe northern European cultures that are not defined as part of the Viking culture that emerged in the 8th – 9th centuries CE. Both Viking and Mediterranean cultures played a large role in the development of maritime technologies in northern Europe. The Viking expansion, beginning in the late 8th century CE, was a significant moment in European history (Magnusson 1973; Bill 2011; Winroth 2014). It dramatically altered the cultural and political landscape of northern Europe, particularly in Britain, Ireland, and the northwest coast of Europe (Smyth 1977; McGovern 1990; Brink 2011:4-10). Viking cultural and technological practices changed shipbuilding and seafaring methods in northern Europe (Woodman 2002:24). In addition, the Mediterranean traditions of shipbuilding also had a significant impact on maritime development of northern Europe. This influence began as early as the 5th century BCE, when Mediterranean trading ships visited the British Isles and other parts of northern Europe (Boon 1977:240; Ruiz 2014:413). Economic contact between northern Europe and Phoenician, Greek, and Carthaginian cultures existed indirectly, by connecting existing Atlantic and western Mediterranean trading networks together (Figure 1.1). This maritime contact is reflected through extensive archaeological material originating from the Mediterranean found throughout northern Europe (Boon 1976:195-199; Holman 2005; McGrail 1998:253-254). This study will determine the extent that ancient Mediterranean, primarily Graeco-Roman, shipbuilding practices influenced contemporary development in northern Europe, and the extent which this influence continued in the medieval period.

Figure 1.1: Greek and Phoenician towns and colonies, highlighting the trade routes between the Mediterranean and Britain (Cartwright 2016; removed due to copyright restrictions).

1.2 Project Rationale and Significance

There is a significant gap in the understanding of the anchor and its development in northern Europe. This is because of the limited evidence of archaeological and primary literary source data, but also because of a limited effort prior to this study to compile and analyse dated anchors in the region in order to create an anchor typology. Only a limited number of authors attempting to provide in-depth analysis of anchor types in the region (Moll 1927; Ellmers 1988). The information that dated anchors can provide is enhanced when it is incorporated into a typology, as features shared between dated and undated anchors can be used to infer a similar date and cultural origin for non-contextual anchor finds. The creation of a chronological anchor typology allows for these implements to become a means of dating in and of themselves. In addition, the anchor is an integral part of any sea-going vessel and should be included in discussions related to seafaring technologies. Discussion of its use and development in northern Europe is overlooked in a number of texts aiming to discuss the seafaring history of the region (Van de Noort 2011; Hutchinson 1994; Unger 1980).

A case study of an iron anchor found outside of a dateable context in the township of Camuscross, on the Isle of Skye in Scotland, served as an inspiration for this project (Figure 1.2). In part, problems faced interpreting the Camuscross anchor highlight the benefit an anchor typology for northern Europe would provide for dating anchors. Limitations experienced in interpreting the anchor emphasise the lack of resources available to determine the anchors date and origin. The lack of understanding about the anchors development in northern Europe made further interpretation of the Camuscross anchor difficult, and highlighted this project's necessity (Roberts et al 2013:38). A detailed history of the anchor's use and development will fill an important gap that exists in our understanding of the economic and technological development of shipbuilding in northern Europe; two factors that can be better understood through analysis of an object like the anchor (see Section 3.1). This understanding will complement related studies in Viking/medieval seafaring, allowing for a more accurate interpretation of new anchors finds in the region.

Figure 1.2: The Camuscross anchor, found in 2009 on the Isle of Skye (Photo by author, with permission of the Museum of the Isles, Armadale, Isle of Skye).

In addition to the lack of a relative dating system in the region, there is a knowledge gap in what influenced the development of anchors in northern Europe, including the role of cultures external to the region in this development. This gap exists for much of the medieval period, and there is little information about these external influences in the period between the adoption of the sail in Scandinavia in the 7th century CE and the introduction of carvel-based planking to the northern Europe at the turn of the 15th century CE (Van de Noort 2011:174; McGrail 2014). The proximity of the Mediterranean to northern Europe has made exchange of culture and technology between the two regions significant and continuous (Ugner 1980:34), and it is the region that arguably has had the most influence on northern European shipbuilding. The correlation between this exchange and the development of iron anchors in northern Europe will be discussed.

1.3 Study Area

The geographical focus for this study will be the areas encompassing the modern-day countries of the United Kingdom, Ireland, Norway, Sweden, Denmark, and northern Germany (Figure 1.3). The study will focus primarily on the activities and interactions of cultures that lived along the coastlines that border the North Sea basin, as defined by Van de Noort (2011). The study area also encompasses waterways that were key to the economic development and contact between cultures in this region; along with the North Sea basin, this includes the Baltic Sea, Irish Sea, North Atlantic Ocean and English Channel.

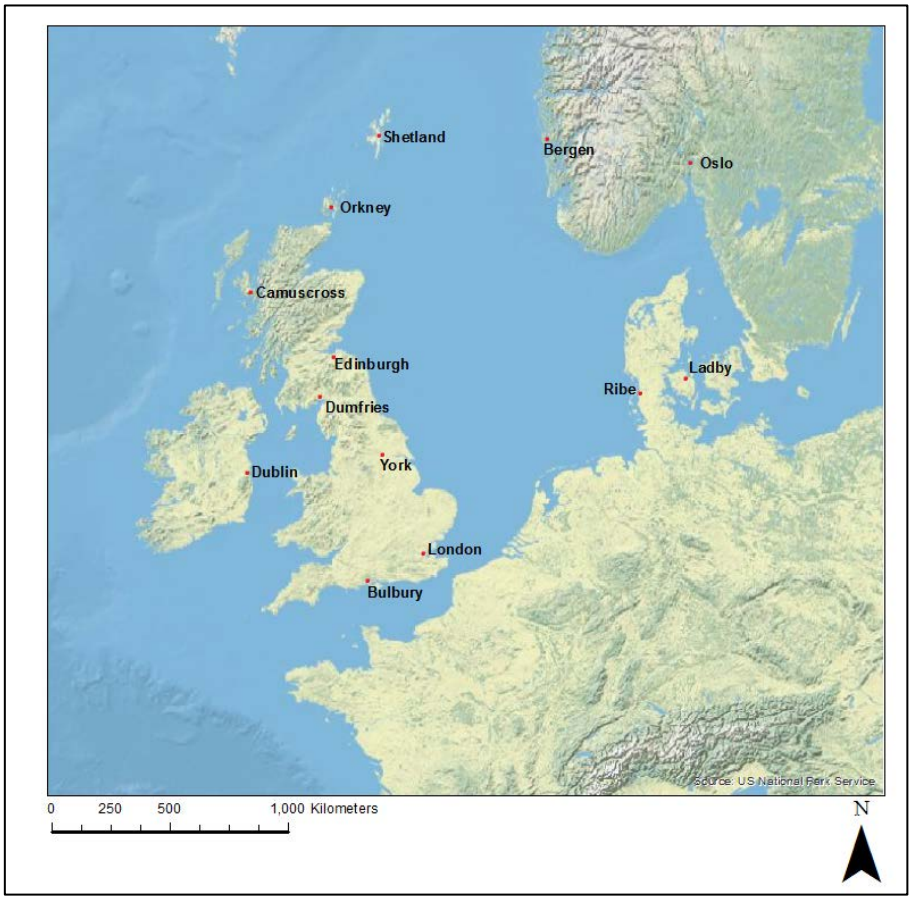


Figure 2.3: The study area, with boundaries surrounding the areas limit (Image by Author, ESRI).

Northern Europe, and in particular Scandinavia, will be the primary focal point of this study because of the large number of Viking anchors found in the region. Discussing the origins of iron anchor technology in Europe will include discussion of the ancient Mediterranean, because of the regions influence on the initial development of this technology.

1.4 Methods

The methodology of this research project will consist of three stages. Firstly, a literature review of primary and secondary literary sources and imagery related to anchor development will be presented, along with any general histories that provide information on the topic of anchor development in Europe. The literature review is designed to provide context to the archaeological material that will be recorded in northern Europe, which forms the second stage of research. Anchors in the area dated within the study period will be recorded to identify forms and features that are both common and distinct, and how these features change throughout the period. The third stage of this project will be to analyse the archaeological and literary information gained from the previous two stages and to develop a typology based on the forms and features identified in the previous to stages of research. Lastly, an assessment of the role external cultures had on anchor development will be discussed. The desired outcome here will be to provide an explanation for the chronological development of forms and styles anchors took between the 8th and 13th centuries CE, using comparative analysis with dated anchors from external cultures known to have had a significant impact on the development of seafaring in the region. The next chapter will discuss the historical background of anchor use and development in Europe, as well as the history of cultural contact between northern Europe and the Mediterranean.

2. Background

This chapter will discuss the knowledge that currently exists about the history of the anchor's development and use. An overview will be presented of the history of cultural contact in northern Europe and the Mediterranean relevant to the propagation of maritime technology transfer between the two regions. In addition, primary literary source depiction of anchors in northern Europe, as well as the Mediterranean, from the Bronze Age to the middle ages will be discussed.

2.1 Anchor Etymology and Depiction in Primary Literary Sources

The origin of modern English 'anchor' comes from the Greek *ἄγκυρα* (*ankyra),* meaning 'hook' or 'crooked' (Moll 1927:293). The Proto-Indo-European (PIE) base of this word is *ank- 'to bend'. The modern word for anchor also likely derives from the ancient Latin word for anchor, *ancora.* The Latin *ancora* was adopted into old Norse around the 8th century CE as *akkeri*, and the old English word for anchor, *ancor,* also developed from the Latin *ancora* in the 9th century CE. Similarly, the word anchor developed into Germanic languages as *anker* or *ankar,* adapted from the Latin *ancora*. As a nautical loanword, *anker* is unique because it is the only nautical term in any Germanic language that does not have an indigenous origin (Talbut 1979:35; Frank 2001:7-8). Understanding the adoption of these words into a particular language group is important, as it suggests the adoption of the technology by the cultural group who speaks that language.

The extent which anchors are discussed and depicted in primary literary sources varies depending on time and place. Artistic imagery can provide basic morphological information, but not necessarily detailed diagnostic evidence about an anchor (Rackham 1945:410; Moll 1927:295), since the features represented are based on the author's/artist's knowledge of seafaring and what they want to depict. This means that literary source imagery is neither comprehensive nor necessarily accurate. Nonetheless, literary sources can provide morphological information about an anchor, and dated sources allow for anchors depicted in them to be assigned a period of creation and use based on the literary source's date.

The Mediterranean possesses a large amount of primary literary source imagery for anchors, dating back as early as the 3rd millennium BCE. The most abundant source of this imagery is from coinage, monuments and symbols of state. One of the earliest depictions of an anchor is found in an Egyptian burial temple, which has been dated by hieroglyph examination to the reign of King Sahure in the 25th century BCE. The temple, known as the Sahure temple complex, contains a relief depicting sea-going Egyptian vessels. At the bow of one of these vessels is a figure standing next to a pyramid-shaped/trapezoidal object with a hole at the top, believed to be a stone weight-anchor (Figure 2.1, Wachsmann 1998:13; Curryer 1999:20). A similar scene appears in the Unas pyramid complex, dated to the 24th century BCE. One relief from the complex depicts a similar object at a ship's bow (Figure 2.2). The shape and design of these objects are identical to archaeological examples of anchors used during the mid-3rd millennium BCE in ancient Egypt (Frost 1979:141; Wachsmann 1998:257-258).

Figure 2.1: One of the earliest depictions of a likely stone weight-anchor from the Sahure burial temple relief, 25th century BCE (from Wachsmann 1998:14, removed due to copyright restrictions).

Figure 2.2: The relief from the Unas Pyramid, depicting a likely stone weight-anchor at the vessel's bow, 24th century BCE (from Wachsmann 1998:15, removed due to copyright restrictions).

In the classical world, anchors appear in primary literary source imagery on coinage or as symbols of state from the 5th century BCE onwards (Moll 1927:300-301). Most of this imagery comes from Hellenistic coins. The morphology of the anchors depicted in these images, when compared to archaeological evidence, most resembles that of either wooden anchors or early examples of iron anchors (Curryer 1999:21). The Seleucid Empire in particular used anchors as symbols of authority and as official emblems of state (Bernárdez 2009). Seleucid coinage (Figure 2.4) from the late 4th century BCE onwards contains a wide variety of anchor types and motifs on its coinage. Despite the limitations of primary literary source images, these coins still provide valuable information, because they depict the basic morphology of an anchor and can be dated to the reign of the monarch who commissioned them (Bernandez 2009:605-610; Pfrommer 1993:24).

Figure 2.3: Roman currency depicting most likely a wooden anchor, 3rd century BCE (British Museum, R1867, 0101.1, removed due to copyright restrictions).

Figure 2.4: Coin minted by Seleucos I depicting a wooden anchor, 3rd century BCE (Wildwinds Coin Database 2017, removed due to copyright restrictions).

Ancient texts that discuss anchors in a Mediterranean context date back even further. The earliest known use of the Greek word *ἄγκυρα* dates to a 6th-century BCE poem by Theognis of Megara (Moll 1927:294). Greek and Roman authors that describe the history of the anchor mostly discuss the anchor's original inventors. Most primary literary sources refer to wooden and iron anchor types that were contemporary at the time the literature was produced. Authors often present conflicting reports of the anchor being invented by different people. Herodotus (9.74), in the 5th century BCE, provides the earliest recorded reference to anchors being made out of iron. Strabo (7.3.9), writing in the 1st century CE, credits the invention of the double-fluked (or armed) anchor to the 6th-century BCE Anacharsis, while in the following century Pausanias (1.1.16) claims that King Midas invented the device in the 8th century BCE, and that he founded the city Ancyra and named it after this invention.

Primary literary sources discussing anchors in northern Europe are also plentiful, but they do not discuss the origin of iron anchors, nor do they discuss in detail the technical specifications or diagnostic features of anchors. Most literature is metaphorical, with the anchor a symbol for stability or safety (Frank 2001:8). Some literature discusses the names that anchors were given and information about how they were moored (Jesch 2001:166-168), but otherwise the usefulness of these sources in describing anchors is limited.

The most informative northern European iconographic sources are images that depict anchors. Such imagery occurs largely in tapestries, illuminated manuscripts, graffiti, and town seals. These images are made using artistic license and are not entirely accurate, but they provide valuable information as to the general shape and larger diagnostic features of anchors, as well how they were carried aboard ship and their size relative to the vessels that carried them (Figure 2.5 and 2.6). Most of this imagery in northern Europe dates to the late 13th or early 14th century CE. By the 14th century CE there is a significant increase in ship and anchor depictions. Prior to the 13th century CE, such imagery is incredibly scarce, but a unique example containing multiple anchors depictions is the 11th-century CE Bayeux Tapestry.

Figure 2.5: Drawing of a detail of the Tunis Tapestry showing an anchor stowed at a ship's bow, 16th century CE (from Friel 1995:123, removed due to copyright restrictions).

Figure 2.6: The seal of Winchelsea, depicting a large anchor with a prominent stock on the ship's stern, 14th century CE (National Maritime Museum, SEC0489, removed due to copyright restrictions).

The Bayeux Tapestry is one of the most revealing artistic sources for ships and maritime technology in medieval northern Europe. It was made in England in 1070 CE, only a short time after the Norman invasion that it depicts (Saul 1982:138-139), meaning the ships and anchors shown are a rare and reliable source of information about 11th-century CE ships and their equipment. The tapestry contains many scenes of vessels of the era, but most pertinent to this discussion are four scenes, depicting anchors either stowed on a ship or being deployed, wherein the shape of the anchors and their rope hawsers are clearly visible (Figure 2.7). Diagnostic features such as curved arms, flukes and a pronounced anchor crown are visible. This rare example of ships and anchors being depicted prior to the 13th century CE is useful for interpreting the design of anchors and ships in the earlier periods of the middle ages.

Figure 2.7: Detail of the Bayeux Tapestry showing a ship and its anchor, 11th century CE (Scene 1G, Bayeux Museum, Bayeux, removed due to copyright restrictions).

2.2 Cultural Contact and Seafaring in Northern Europe: CE 400 – 800

Contact and exchange between northern European societies in Britain, Scandinavia and northwestern Europe was extensive prior to the Viking age. In particular there was a high level of cultural contact and migration between these societies from the 5th - 8th centuries CE. Although these cultures shared an overarching tradition of shipbuilding, culturally unique types of ships and boats have been found in each region (Crumlin-Pedersen 1988:98). Migration from northern Germany and Jutland into the British Isles began in the 5th century CE (Binns 1980), and further waves of migration took place during the 6th and 7th centuries CE from southwest Norway (Hines 1984). The extent the maritime activity between continental Europe and Britain continues to be debated (Davies 1977:20-24; Wood 1988; Van de Noort 2011:171).

The debate behind the nature of this contact relates to the importance of this interaction in influencing cultural change in Britain from the 5th century CE onwards (Härke 2011). However, there is genetic (Schiffels et al 2016) and archaeological (Carver 1988:119) evidence to suggest that significant contact took place between both regions from the 5th to the 7th centuries CE. By the 7th century CE, the influence of migration affected shipbuilding in Britain, as construction methods used in Scandinavia are visible in the archaeological record of Anglo-Saxon Britain (Casson 1996:147). The end of the 8th century CE saw further waves of migration into Britain from Scandinavia by Viking raiders and settlers, eventually leading to the establishment of the Danelaw in the 9th century CE (McGovern 1990).

There are a handful of archaeological and historical examples of vessels and shipbuilding technologies used in Scandinavia between the 5th and 8th centuries CE (Crumlin-Pedersen 1988; Carver 1988). The Gotland stones are a valuable source of pre-Viking ship imagery. Several of the stones depict rowed and sailed vessels dating from between the 7th and 9th centuries CE (Figure 2.8). This makes the stones useful in dating the adoption of different propulsion and navigation technologies in the Pre-Viking era (Crumlin-Pedersen 1988:112). The Gotland stones are the first definitive evidence from Scandinavia for sailed vessels. Additional evidence for earlier sailed vessels in Scandinavia comes from the chance find at Karlby, on the east coast of Jutland of a small, engraved stone inscribed on one side with the image of a sailing ship (Figure 2.9). The stone is without archaeological context and dated on stylistic grounds, most likely to the 7th century CE (Rieck and Crumlin-Pedersen 1988:129-133). It is likely that this technology came to Scandinavia from northern continental Europe. The Frisians were familiar with the technology from contact with Gallic and Roman cultures, and are the most likely culture to have spread sailing technology to Scandinavia (Mattingly 1948:345; Sawyer 2003:75-76).

Figure 2.8: Boats with sails depicted on the Gotland stones, 8th century CE (Crumlin-Pedersen 1988:112, removed due to copyright restrictions).

Figure 2.9: The Karlby stone depicting a pre-Viking sailing vessel
(from Rieck and Crumlin-Pedersen 1988, removed due to copyright restrictions)

There are several surviving archaeological remains of pre-Viking ships in Scandinavia. The most detailed and archetypal examples are the Nydam boats, found in southern Denmark in the 19th century. The Nydam finds comprise three vessels dated to between the 4th and 5th centuries CE (Engelhardt 1865; Gebühr 2001:6). Nydam 2 (Figure 2.10) is the most intact of the boats and dated through dendrochronology to the 4th century CE (Gebühr 2001:35).

Figure 2.10: Reconstruction drawings of the Nydam 2 boat (from Shetelig 1930,
removed due to copyright restrictions).

Nydam 2 has been particularly valuable because of its well-preserved condition. It is representative of the construction techniques used by shipwrights of the time (Crumlin-Pedersen 1988:105). Analysis of the boatbuilding methods used in Nydam 2 shows that it was a clinker-built vessel comprising oak timbers fastened with iron bolts/rivets (Shetelig 1930). The vessel was propelled by oars and likely employed a side rudder, or steering oar, for navigation. The vessel had a keel, and many of its design features are similar to later Viking ships of the 8th and 9th centuries CE (Johnstone 1988:115-116).

Contemporary evidence for shipbuilding in Anglo-Saxon Britain suggests Scandinavian shipbuilding and cultural traditions had begun to influence shipwrights in the British Isles by at least the 7th century CE (Casson 1996:147). The best example of a pre-Viking vessel in the British Isles is the Sutton Hoo ship (Figure 2.11). The Sutton Hoo ship is dated to the 7th century CE, at least two centuries later than Nydam 2. Nevertheless, Sutton Hoo exhibits many similar constructions methods as Nydam 2; it is clinker-built, has iron rivets, was oar propelled, and was fitted with a side-mounted steering oar.

The low, slender profile of Sutton Hoo resembles that of the Nydam vessel, as well as later Viking-period vessels (Evans 1994:24-25). Commonalities in construction methods seen in vessels from Scandinavia and the British Isles, as well as the similar cultural tradition of ship burial seen in Sutton Hoo, indicate significant cultural and technological influence from Scandinavian societies on the British Isles (Carver 1988:117).

2.3 Cultural Contact and Seafaring in the Mediterranean: 400 BCE – CE 600

An extensive history of economic contact between northern European cultures and those of the Mediterranean exists (Ruiz 2014; Penhallurick 2010; Holman 2005; Van de Noort 2011:146-177). This contact ranges from indirect trade routes established between Phoenician and Greek traders with the British Isles by at least the 7th century BCE, to the direct cultural contact and assimilation of Britain into the Roman Empire in the 1st century CE (Ruiz 2014:413). The influence that the Mediterranean has had on northern Europe is significant, and the earliest evidence of Mediterranean-British maritime contact comes from a mixture of primary, archaeological and etymological sources.

Figure 2.11: The Sutton Hoo ship burial (7th century CE, left; Khan Academy 2017) and Ladby ship burial in Denmark (10th century CE, right; author, with permission of the Viking Museum, Ladby, removed due to copyright restrictions).

Prior to the Roman period, the influence of Mediterranean cultures on northern Europe is limited, and restricted primarily to interaction through trade. Primary source evidence of Phoenician and Greek trade with the British Isles is discussed in Strabo's *Geography.* Strabo (3.5.11) mentions the Phoenician colony of Gades (modern-day Cadiz, Spain) in the past conducting trade with "tin-mining Cassiterides". Cassiterides was a word used to refer to natives in the area where tin mining was most active in Britain, most likely Cornwall (Vennemann 2013:400).

Etymological evidence also reflects interaction between the Mediterranean and northern Europe. One theory behind the origins of the name 'Thanet', an isle formerly separated from the southeast English mainland, is that it derives from the name for the Carthaginian god Tanit, highlighting a connection to Carthaginian trade and colonisation of the area. As Thanet served as a trading centre for Carthaginian merchants, it is possible that this is where the name of the isle originates from (Vennemann 2013:401). This further supports the evidence suggesting long, sustained contact between Mediterranean and British cultures during the pre-Roman period existed.

Archaeologically, economic activity between the Mediterranean and northern Europe can be seen on a large scale. There are large hoards of Greek and Carthaginian coins, dating back to the 4th-2nd centuries BCE (Holman 2005:40) found across Britain, but mostly along on the south coast of England. Cornwall and the Scilly Isles in particular contain large hoards of coins from a number of Mediterranean cultures, indicating a high level of exchange with Mediterranean merchants seeking tin from this region (Laing and Laing 1983:7-9; Penhallurick 2010). Evidence of Mediterranean merchants operating in the region in include a lead stock found off the coast of Porth Felen, in Wales, and another found in Plymouth, both of Greco-Roman style (Cunliffe 2005:480; Green 2015). Both anchor stocks have been dated to between the 5th - 1st century BCE, and further reinforce the evidence of Mediterranean vessels operating in the English Channel and Irish Sea. The Roman Empire's successful invasion and occupation of England in 43 CE further integrated the northern European world into the Mediterranean trade network. Roman occupation had direct cultural, economic and technological consequences on the island and its inhabitants (Allason-Jones 2011; Fulford 1992:294-305). Archaeological evidence from the ancient Roman harbour of Londinium has uncovered goods and materials from across the empire that found their way into the British Isles, displaying large-scale trade of goods and technology with the Mediterranean in this period (Milne 1988:82).

In addition, the Roman occupation of Britain, Gaul and north-west Germany also saw the beginning of indirect contact between the Mediterranean and Scandinavia. This contact was limited, and is reflected primarily in trade goods from the empire found in Scandinavia during dating to the Roman Imperial period (Price 2015:283-289), as well as evidence for the use of Germanic soldiers by the empire beginning in the 2nd century CE (Jørgensen 2001). Conflict between Roman navies and Saxon pirates would have acquainted many northern European cultures with vernacular seafaring methods of the Mediterranean (Crumlin-Pedersen 1988; Pearson 2006). The adoption of techniques such as rowing, and technologies such as the sail in the late Roman, early Saxon period likely indicates an indirect influence of Mediterranean shipbuilding methods through the medium of trade between the cultures of northern Europe and Rome (Sawyer 2003:75-76). It is evident through archaeological and primary literary source evidence that the Mediterranean and northern Europe had a long-standing connection with one another, with varying levels of intensity.

Although all of northern Europe experienced some form of contact with Mediterranean cultures in the ancient world, Britain has been a focal point for Mediterranean contact throughout history. This contact has varied from indirect economic activity by Greek and Carthaginian merchants (Vennemann 2013) to the long-term, direct occupation of the island by the Roman Empire (Shotter 2004:66-79; Allanson-Jones 2011). The Mediterranean played a large role influencing the seafaring technologies that would be used in northern Europe during the medieval period. Mediterranean contact with Scandinavia was far more limited than with Britain, but economic contact between the two regions is reflected in archaeological finds of Roman goods in Scandinavia (Møller-Jensen 2006; Green 2009). Both regions discussed had an influence on the shipbuilding in northern Europe to some extent, but how this is reflected in a maritime technology such as the anchor has yet to be explored.

The next chapter will present an archaeological history of anchor finds in each region, and present debates related to the development of an anchor typology as a means of dating anchors, and the extent by which anchors reflect influences of Mediterranean and pre-Viking cultures on shipbuilding methods in northern Europe.

3. Literature Review

This chapter will discuss the importance of the anchor in understanding the maritime activities of past societies and what work has been done on both understanding the development of anchors and understanding the ways in which they can be interpreted. This discussion will include the archaeological history of important anchor finds in both the Mediterranean and northern Europe, the establishment of an anchor typology in the Mediterranean, and the limited attempts to create a similar typology for northern Europe.

3.1 Anchors as an archaeological resource

Anchors are an important archaeological resource, as they can be an indicator of economic activity and the developing seafaring practices of the society which produced them (Edberg 2013:203). Anchors can reflect the level of sophistication with which a society can manufacture maritime equipment, based on their size and design. Economically, anchors can provide some indication of the number of vessels that a culture produced through the size and quantity of a certain anchor type (Haldane 1998:19). In addition, an anchor find on the seabed implies the passing of a ship, and knowing the cultural attribution of the anchor type can provide information about vessels belonging to that culture that did not sink, but instead jettisoned or lost their anchor without the vessel sharing the same fate (Wachsmann 1998:255). This can serve as an identifier of past trade routes and shipping lanes (Frost 1966:56; McCaslin 1980). Interpretation of an anchor's design can provide information about all of these broader topics in seafaring, and can be beneficial for dating anchors without context, and which are unable to be reliably dated (Frost 1973:75).

3.2 Development of the anchor in the Europe

Anchors and other devices for mooring a vessel have been used in Europe since at least the Early Bronze Age (McGrail 2002:38). The earliest forms of mooring a vessel were posts or spikes that would be struck into a riverbed or seabed to hold a vessel still (van der Heide 1974; Ruldolph 1974). The design of some logboats in northern Europe, dating from the Bronze Age (Olsson and Sjoberg 1971) to the Roman Imperial period (de Weerd 1978; de Weerd and Haalebos 1973) suggest that they used mooring posts as a means of anchoring. Another early mooring device, and a forbearer to the first true anchors, were stone sinkers, simple objects that relied on weight alone to hold a vessel. Stone sinkers have been found in many parts of the world, and examples in the Mediterranean date from at least the 3rd millennium BC, and continue in use on a local level up to the present day (Frost 1963, 1973, 1979, 1982; Galili 1985; Pulak 2008:289-311; van Nouhoys 1951:21; Wachsmann 1998:31).

The Mediterranean

Many early developments in modern maritime archaeology originate in the Mediterranean (Green 2010:1599). As a result, there has been extensive research into the development of seafaring and shipbuilding in the region. Evidence for seafaring in the region dates back over at least 15,000 years (Laskaris et al 2011). The earliest archaeological evidence for an anchor in the Mediterranean dates to the Early Bronze Age, around 2300 BCE (Nibbi 1979). These anchors were basic stone sinkers, and have been found predominantly in the eastern Mediterranean, making them the earliest known stone weight-anchors (Nibbi 1984). Stone anchors continued to be used into the late Roman period, with both multiple-holed and single-holed anchors from this time found off the coast of Alexandria (Nibbi 1991). Evidence of Mediterranean-style stone anchors have been dated as late as the medieval era in the Red Sea, and continue to be used at a local level to the present day (Raban 1990:299).

Stone sinkers gradually developed into increasingly complex designs, leading to the development of composite stone anchors. The first composite anchor emerged around 1,600 BCE, which gave an anchor the ability to grip to the seabed (McCaslin 1980). These anchors were an improvement upon stone sinkers, due to the multiple-hole design allowing for both an anchor rope and for wooden spikes, or 'flukes', which could hold in the seabed (Figure 3.1, 5). Composite anchors continued to develop, with wood making up increasingly more of the anchor's structure as designs became more complex (Figure 3.1, 10-11, 7-9). The limitations of stone as a malleable material meant that it was eventually abandoned as the primary material in an anchor. Wood became the principal material for anchors around the 7th century BCE (Kapitän 1984:35; Haldane 1985:417). Stone continued to be used in anchors, but was relegated to use as the first anchor stocks. The earliest wooden, stone-stocked anchors had a single arm, or 'hook', to grip to the floor of the sea or river. This developed into anchors with two hooks, increasing the capability of an anchor to grip to the seafloor.

Lead and iron began replacing stone in anchor construction, although the latter continued to be used as stocks for wooden anchors until the 4th century BCE (Haldane 1985; Frost 1982). Metal, especially lead, anchor stock designs were diverse, and included lead-sheathed wooden stocks, lead-cased wooden stocks, and solid lead stocks (Haldane 1990:21). The use of wooden anchors continued into the 1st century CE (Speziale 1929) alongside all metal (typically iron) anchors, which are first documented in the early 5th century BCE by Herodotus (*History* 9.74). Improvements in iron-working, along with an increased supply of lead, brought about the decline of wooden anchors beginning in the 3rd century BCE (Haldane 1990). Iron anchors were an improvement upon the wooden anchor, because they allowed for removable stock and for anchor rings to be placed both the crown and top of the shank. A greater variation in anchor design was possible using metal, ranging from early Roman Republican-era 'V'-shaped anchors found off the coast of Italy (Foerster 1969) to medieval period, 'Y'-shaped anchors found in the eastern Mediterranean (Van Doorninck 2004).

Figure 3.1: The development of stone anchors, from early stone sinkers to stone-stocked wooden anchors (from Kapitän 1984:34, removed due to copyright restrictions).

Northern Europe

In contrast to the Mediterranean, dated anchor finds are far less common in northern Europe. There is still incomplete understanding of anchors in this region, as well as of the origins of iron anchor technology. Nevertheless, archaeological finds of anchors in northern Europe date back to the 19th century. The earliest types of anchors used in northern Europe were like the stone sinker and composite anchors of the Mediterranean. Stone anchor finds in northern Europe are not as numerous as the Mediterranean, but there are examples from across the British Isles of stone artefacts that have been interpreted as anchors (Goudie 2005; Farrar 1970). These stone anchors have generally conformed to the same design as many stone anchor types found in the Mediterranean, possessing features such as a hole in the upper portion to fasten it to the stone (Figure 3.2). In Scotland, there are examples of composite anchors containing fluke holes, another similar development to the Mediterranean (McCarthy 2012:9-10). A lack of contextual material associated with stone anchor finds has made dating them more difficult than in the Mediterranean, but stone anchors from dateable sites do exist.

Stone anchors from a dateable context in northern Europe have been found predominantly in the British Isles. Six stone weight-anchors, found at Sicar Rock, Scotland (Figure 3.2) have been interpreted as composite stone anchors based on Kapitän's stone anchor typology (McCarthy 2012:10; Kapitän 1984:34). Although found in an undateable context, the Sicar Rock anchors were compared to a similar stone anchor find from Lulworth Cave in Dorset. This stone anchor was dated by associated pottery, which provided a deposition date of between 100 BCE and 100 CE (Farrar 1970). A Romano-British site in North Killingholme, England, contained a large sandstone object resembling an anchor (Jordan 2006), and several anchor stones have been found at a medieval site in Leicestershire (Salisbury 1992). These dateable finds reveal two things about stone anchor use in the region. Firstly, stone anchors saw extensive use at a much later date in northern Europe than in the Mediterranean. Secondly, stone weight-anchors found in Leicestershire show that this anchor type continued to be used in the British Isles into the 14th century CE, making the date range for stone anchors in northern Europe broad and this technology long lasting.

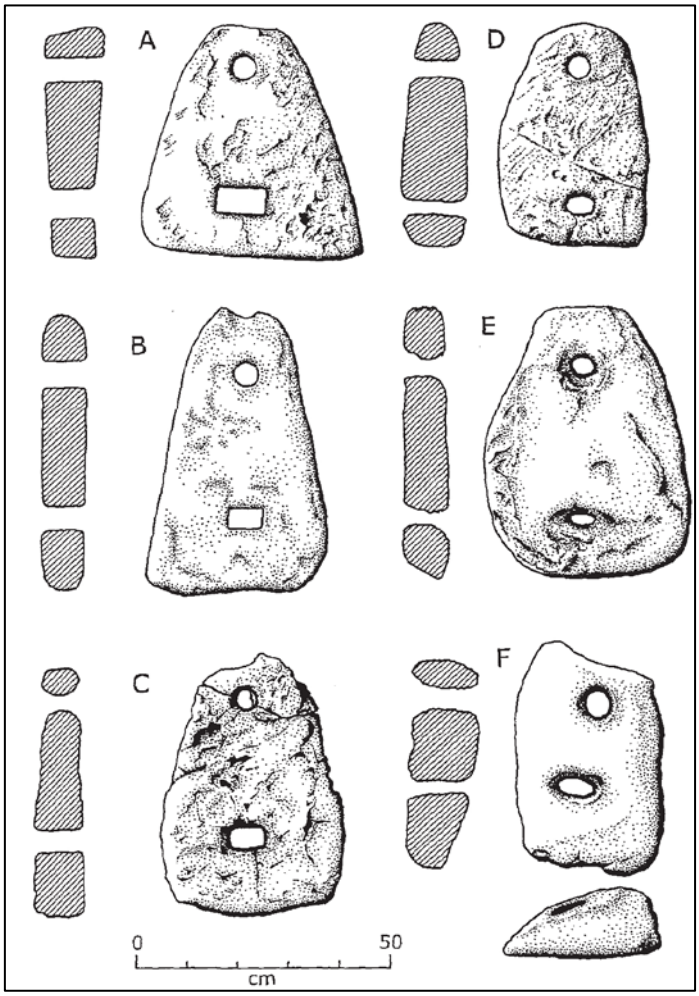


Figure 3.2: The six Sicar Rock stone anchors. The presence of two holes at opposite ends of the anchors suggest they were composite stone anchors (from McCarthy 2012:23).

Iron anchor finds in the British Isles and Scandinavia have provided far more data relating to economic and technological activity than their stone predecessors. The earliest archaeological example of an iron anchor, and one of the earliest dated anchors in northern Europe, was found in 1881 in an Iron Age hillfort in Bulbury, Dorset (Figure 3.3). The anchor has a design that is very similar to contemporary Mediterranean examples. Through comparative analysis with Mediterranean anchors, the Bulbury anchor was dated to the first half of the 1st century CE. The use of a mooring chain, rather than rope, means that it was most likely a vernacular production, although one heavily influenced by Mediterranean anchor design (Cunliffe 1972). An anchor of identical shape was found in 1888 on Priestside farm, near Dumfries, Scotland (see p. 46 and Figure 5.2 below). It has been roughly dated to the Roman era, as it is thought to have been used on a Roman naval ship operating out of the nearby Roman fort at Lantonside on the Nith Estuary (Dumfries Museum 2012).

The presence of iron anchors in the British Isles, either manufactured locally or imported, appears to coincide with the Roman occupation of Britain in 43 CE. Evidence of earlier anchors in British waters exist, but were more likely associated with vessels of the Mediterranean than with local manufacture.

Figure 3.3: The anchor found in Bulbury Hillfort, Dorset (from Cunliffe 1972:301, Plate LIV, removed due to copyright restrictions).

A number of ancient lead anchor stocks have been found in British waters. A Mediterranean style fixed anchor stock was found off the coast off Porth Felen, Wales in 1974 (Figure 3.4). Despite being found in British waters, the stock (and anchor) most likely was not made locally (Jones 2011:65). Using comparative analysis with other Mediterranean anchors, Boon determined the stock was most likely from a Mediterranean merchant vessel of the 2ndor 1st century BCE (Allanson-Jones 2011:64; Boon 1977:240). The Plymouth Sound Project (PSP) in Plymouth, England, found a lead anchor stock core (Figure 3.5) that is believed to have originated from an even earlier period. Typological comparison of the core to Mediterranean examples dated the stock to between the 5th and 2nd centuries BCE (Green 2015). This core would have been formed from molten lead, poured into a wooden anchor stock frame and then encased in it. This type of anchor stock saw its earliest use in the 5th century BCE, predating the solid lead stock type that the Porth Felen anchor possessed (Trethewey 2001:109-114). Although not indicative of the anchor's development in the region, such anchor stock finds contribute to understanding the extent of economic contact between the Mediterranean and northern Europe.

Figure 3.4: The Porth Felen lead anchor stock (from Boon 1977:239, removed due to copyright restrictions).

Figure 3.5: The lead anchor stock core found in Plymouth (Green 2015, removed due to copyright restrictions).

The largest source of contextual iron anchor finds in northern Europe come from the Viking period. Viking ship remains and burials have provided a wealth of information about Viking boatbuilding and the types of anchors used during in the Viking/medieval period. Excavation of the Gokstad ship burial (890 CE) in 1882 produced one of the first archaeological Viking ships excavated and the first found to contain an iron anchor. Excavated a year after the Bulbury anchor find, the Gokstad's anchor disintegrated before it could be recorded; however, a 2.75m-long wooden anchor was found intact with the ship burial (Figure 3.6). The oak stock is cylindrical and tapers from the middle towards each end. There is a rectangular hole through the centre, which the iron shank of the anchor itself would have passed. Despite the anchor having disintegrated, this rare find of a Viking anchor stock provided valuable details about one element of Viking anchor design (Gjessing 1951:5-9; Nicolaysen 1971:40).

Figure 3.6: A top-down orthophotograph of the Gokstad anchor stock, showing its cylindrical, tapering design (photogrammetry by Author, with the permission of the Viking Ship Museum, Oslo).

The Oseberg ship (820 CE) was found as part of a Viking ship burial in southern Norway and excavated in 1903. It is the earliest such site to yield an intact, surviving iron anchor (See pp. 47-48, Figure 5.3 below). The find comprises one iron anchor and two wooden stocks. The anchor appears to have the form of a Type B anchor in Kapitän's typology (Figure 3.8), the most diagnostic feature of this type being a curve in the anchor's arms. This form is a departure from the angled arm design of the Bulbury and Priestside anchors. The arms of the Oseberg anchor have blunt, spearheaded ends, and the anchor has both a crown and a shank ring. The two wooden stocks are of similar design as the Gokstad stock, indicating that the Gokstad anchor may have been similar in design to the Oseberg anchor (McGrail 1998:255).

The Ladby ship, dated to the very end of the 9th century CE (900 CE), is a later period Viking longship, built smaller and with a more slender profile than the Gokstad or Oseberg ships. An iron anchor was found resting against the port side of the vessel during its 1935 excavation (Figure 3.7). The Ladby anchor is unique, as it was found with an intact anchor chain attached to the top of the shank. Like the Oseberg anchor, the Ladby anchor has curved arms, although curves are more defined, but it is also one of the first Viking anchors to possess true flukes, which are small and almond-shaped. The Ladby anchor was not found with a stock, but the lack of a stock hole suggests that it had a stock similar to those of the Oseberg and Gokstad anchors.

Figure 3.7: the Ladby anchor, in situ in the Ladby ship burial during site excavation in 1935 (Vikingeskibsmuseet 2017, removed due to copyright restrictions).

Many Viking-era anchors with no ship context have been found across the Viking world (Jensen 1991:22; Carpenter 1995:44-45; Rieck 2004). Such finds often are difficult to date, relying upon stratigraphy, associated materials or comparative analysis with other anchors, such as those from Ladby and Oseberg. One such anchor was found in Ribe, Denmark, an important trading and maritime centre in the Viking world (Figure 5.10). Excavated in 1974-75, the anchor's morphology and metallurgical composition are similar to those of the Oseberg anchor, although it is significantly larger. Metal and slag compositional analyses indicate the anchor may have been manufactured in southern Norway, as is the case for the Oseberg anchor (Buchwald 2005:296). Medieval anchors in northern Europe appear to share several common features. These include: curved arms, rings at the crown and upper shank end, wooden stocks that were fitted over the anchor (as opposed to a metal stock running through the shank), and either no anchor flukes or small 'proto-flukes'. While the style and size of these features vary, and anchor design changed and developed throughout the period, many diagnostic features remain a staple on anchors throughout the Viking-era.

3.2.1 The origins of iron anchor technology in northern Europe

Debate over the origins of the iron anchor in northern Europe is limited in historical and archaeological literature. The primary issue is whether anchor technology was imported from the Mediterranean, or if it can be ascribed to a local development, and usually is discussed in conjunction with the earliest dated anchors in the region.

As part of his study on Iron Age Britain, Barry Cunliffe (1972) argues that the Bulbury anchor is evidence for pre-Roman iron anchor technology in the British Isles, albeit a technology that was heavily influenced by contact between the Mediterranean and pre-Roman Britain. His argument for independent development of iron anchors in northern Europe is strengthened by Julius Caesar's commentaries on the Gallic wars, written in 56 BCE. In the source, Caesar describes a naval battle between the Romans and the Veneti, a tribe situated in modern day Brittany, France. In the description, Caesar comments on the design and fittings of the Veneti ships, stating that "the [Veneti] anchors were secured fast by iron chains instead of cables [ropes]" (Caesar 3.13).

Although this passage is unclear as to the nature of the anchors themselves, it implies that prior to Roman occupation of the British Isles and its integration into the empire, cultures in northern Europe had already developed at least elements of ironwork in their anchor designs. Based on this evidence, and on the similarities between Roman-period anchors in the Mediterranean and the Bulbury anchor, Iron anchor technology may have been imported to northern Europe from the Mediterranean, and then adapted by societies such as the Veneti to better suit to the conditions of the northern European waters.

3.3 Anchor typologies: History of development

The earliest attempt to classify and present a chronology of the anchor's development were by Friedrich Moll in the early 20th century in two articles (Moll 1919; Moll 1927) where he discusses the development of the anchor from its earliest forms to 1500 CE. Although lacking the abundant archaeological examples of ancient anchors available to later scholars, Moll combined the limited record of then known anchor finds with a significant body of primary literary sources and imagery to present a chronology of the anchor's development in Europe. In his second article, Moll (1927:293-332) again relied upon documentary sources as a means of establishing the date of adoption and use of anchors from various regions of the world.

The Mediterranean

Numerous archaeologists have contributed to the development of a typology for Mediterranean anchors. Modern discussion of an anchor typology, based on both primary literary sources and archaeological finds, dates to the early 1960s. Honor Frost was one of the earliest contributors to an anchor typology in the Mediterranean. She highlighted the significance of the numerous stone anchors found across the eastern Mediterranean and proved that they could be assigned a date and place of origin, even if found outside an archaeological context (Wachsmann 1998:255). Frost's first article on the topic in 1963 dealt with Bronze Age stone anchors and presented the first chronology for an anchor type in the region. Although focused primarily on stone anchors, the article also discussed wooden and iron anchors. Frost (1963) suggested that three basic types of stone anchors were used in the Mediterranean. The first was the 'weight' or 'rock' anchor, a simple stone that relied on its weight alone to hold a vessel and contained a single hole for a rope line. The second was a 'sand' anchor, designed specifically to be used on sandy seabeds. This type had both a rope hole and three more holes for wooden flukes, allowing the anchor to grip to the seafloor. Thirdly, the 'composite anchor', used for both sandy and rocky seabeds.

The anchor would have been trapezoidal, with a rope hole at the top and two holes at the bottom for gripping flukes (Frost 1963). Although Frost's 1963 publication focused primarily on stone anchors, it was pivotal in beginning the discussion about an anchor typology for the Mediterranean. It was the first article to compile anchor finds in the region and prove the benefit of identifying anchors and dating them through analysis of their form and features. Frost expanded this work in 1966, further highlighting the importance of anchor identification and classification, and how these could increase understanding of the economic and technological capabilities of the culture that produced the anchor.

Frost (1966) argued that an anchor typology could be used not only to classify an anchor find, but also elucidate such phenomenon as the expansion of trade routes and cultural contact in the Mediterranean. Frost argued that this was possible since patterns could be identified through the remains of anchors scattered across the Mediterranean, with these patterns representing ancient trade routes. This argument emphasized the importance of anchors beyond what she had said in her earlier publication and continued to promote the usefulness of anchor typologies aiding archaeological understanding of ancient seafaring. A number of other publications have built upon Frost's original typology through new archaeological finds. These publications have incorporated anchor types outside the simple stone anchors of the Bronze Age, incorporating anchor types used in the region up to the medieval era.

Gerhard Kapitän's work on anchor typology in the Mediterranean has proved as beneficial as Frost's 1963 article in contributing to the development of an anchor typology for the Mediterranean. Kapitän (1978:269-277) first applied typological designation to an anchor study in Cape Graziano, Italy. Although this typology was piecemeal and confined to the context of the Cape Graziano study, it further displayed the potential for anchor typologies to benefit maritime archaeologists. In 1984, Kapitän (1984:33-44) published a full system for anchor classification and a more comprehensive anchor typology. Kapitän's article was heavily influenced by Frost's 1963 article, but greatly expanded upon her work, classifying Mediterranean anchor finds from the earliest stone sinker anchors up to the Y-shaped anchors of the late Byzantine period (Figure 3.8). Kapitän also identified the geographical dispersion of anchors types used, giving both temporal and spatial context to his typology. In addition, Kapitän's typology took into consideration the need for flexibility, allowing it to be updated as new anchor finds are added to the archaeological record.

Figure 3.8: Kapitän's typology for iron anchors in the Mediterranean (from Kapitän 1984:42-43, removed due to copyright restrictions).

Since its publication, Kapitän's typology has been used to date and identify anchor types in a wide range of studies in the Mediterranean (Eliyahu et al 2010:233-245; Haldane 1990:19-24; Van Duivenvoorde 2012:397-407; Vortuba et al 2016:1-7; Wachsmann 1998). It also has since been expanded and given greater depth with the creation of new sub-types. Douglas Haldane (1990:19-24) was one of the first to expand upon Kapitän's typology through reassessment of the anchor types it presented.

Adding new anchor finds since Kapitän's 1984 article to the typology, Haldane's argued that the type C anchors of the Roman imperial period should be further divided into two distinct categories, based on the two anchor types found on the Dramont D and Dramont F shipwrecks, two mid to late Roman Imperial vessels found off the French coast. Haldane suggested from the design of the anchor from late Roman Dramont F wreck be subclassified, instead of being the same as the Dramont D anchors as Kapitän suggested. This subclassification was suggested due to the arms and anchor ring being different in design from the anchor of the earlier Dramont D wreck. Haldane's article also expanded on the classification categories for anchors, and established a typology for anchors stocks to help geographically and temporally date the varying types used in the Mediterranean. Haldane established that four types of anchor stock were used. The first stocks were made of stone, the second represented a transition between stone and lead stocks, the third represented lead stocked anchors and the fourth represented the change that occurred in lead stocks as anchors themselves transitioned from wooden to metal. Haldane's article greatly expanded upon the accuracy and diversity of anchors that could be dated through an anchor typology.

Okorokov (1993:185-186) continued to fine tune Kapitän's typology, using new interpretations of anchors to introduce a sub-classification for Kapitän's type E (Y-shaped) anchors. Okorokov argued for two categories of Y-shaped anchors based on the presence of a crown. This argument was taken further by Van Doorninck (2004:233-234) who, using evidence from anchors found on the 11th-century CE Serçe Limanı shipwreck, for adding a third typological type based on the degree of slope which Y-shaped anchor arms slope is another typological factor, with anchors whose arms only slope slightly representing a separate subtype of Kapitän Type E anchors.

Alessandra Nibbi (1993), writing 30 years after Frost's 1963 article greatly expanded upon it, and suggested alterations to the system of classification. Taking into account additional finds of stone anchors in the western Mediterranean and Red Sea over the 30 year interim. Nibbi argued that some classifications for anchors used by Frost were inaccurate, and that certain terms Frost used to describe stone anchors should be readdressed. One example was the idea of a 'weighted' anchor, the earliest stone form of stone anchor. Nibbi argued that a vessel could not be reliably held to any type of seafloor, sandy or rocky, through sheer weight alone. Instead, Nibbi's work suggested using simpler terms to define anchor types, allowing for a more open interpretation of anchor types and how they functioned, especially in regions outside of the eastern Mediterranean.

Northern Europe

In contrast to the Mediterranean, serious discussion of an anchor typology in northern Europe has been extremely limited. As was the case in the Mediterranean, Moll's 1919 article was the earliest discussion of anchor development in northern Europe. Moll (1919:50) used available archaeological and primary literary source data available on northern European anchors for his chronology. This included archaeological evidence for anchors from the Nydam, Oseberg and Gokstad ships.

Aside from Moll's discussion about anchor development in northern Europe, the work of German maritime archaeologist Detlev Ellmers' is one of the few serious discussions that has contributed to the development of an anchor typology for the region. Ellmers (1988) laid out the development of anchors in northern Europe throughout the Viking and medieval periods, emphasizing the changing style of the flukes as a typological marker. Ellmers' stated that the flukes of anchors in the early Viking period were typically cast in the same process as the rest of the anchor, and that rather than possessing true flukes, early Viking anchor arms would taper to points. Later in the Viking period, anchors in northern Europe begin to develop small, 'almond' shaped flukes, which became increasing larger in size. By the 13th century CE, anchors possessed large, distinct triangular flukes (Ellmers 1988:157).

Flemming Rieck (2004) criticised Ellmers' approach, arguing that focusing on a single diagnostic feature could not be used as the basis for typological assessment. In addition, there are anchors that do not fit perfectly into this system of classification, and the limited dataset of anchor finds in the region meant the accuracy of Ellmers' system of classification was limited. Nonetheless, Ellmers' article highly significant in contributing to an anchor typology in northern Europe and is a preliminary attempt at creating a typological system for anchor types in the region.

The creation and continual refinement of an anchor typology for the Mediterranean, spanning from the Bronze Age to the Byzantine era, demonstrates the utility of a relative dating system based on typological features. Additions of new anchor finds, and ongoing adjustments continue to improve the typology, and the spatial and temporal context that it can be used. Northern Europe contains far less examples of anchor finds to build a typology on, but by combining archaeological and primary literary source evidence, a typology for the Viking/medieval period is possible. Despite this, there has been a significant lack in the discussion and debate regarding typological assessment as a means of dating anchors in northern Europe. A number of authors have suggested compiling the available data on medieval anchors in the region in order to create an anchor typology (Rieck 2004; McGrail 1998; Sørenson 2001), but to date little has been accomplished towards this end. Using similar parameters established by the anchor typology used in the Mediterranean, this thesis intends to establish an anchor typology for northern Europe that will provide further insight into the anchor types used in northern Europe during the middle ages to track the change, or lack thereof, of anchors between the 8th - 13th centuries CE.

4. Methods

This chapter will discuss the methodology employed to develop an anchor typology for medieval northern Europe and to understand the cultural and economic influences responsible for anchor development. Two stages of research were necessary to compile the base dataset for an anchor typology. Firstly, a comprehensive literature review was undertaken to provide a solid understanding of the anchor, its development and previous attempts at creating a typology based on archaeological finds (Chapter 3). The second stage comprised original research to identify, and record anchor finds in northern Europe.

4.1 Literature Review

The literature review provided the context for producing and interpreting the anchor typology, especially cultural and economic influences that may have impacted anchor technology and its development in northern Europe. Literature was selected based on regional and contextual parameters. Regionally, literature was broken up into three different categories: 1) literature which relates to northern European history; 2) literature that relates to Mediterranean history; and 3) literature which discusses the history of interaction between these two regions. An additional subcategory was created for northern European literature, which focused on the regional interactions between the Viking cultures of Scandinavia and the rest of the region. Literature was broken down into two further categories: historical and archaeological literature. Historical literature focused on the broad history of a regions people and their development as a seafaring society. Archaeological literature focused on publications about anchor finds in northern Europe and the Mediterranean, as well as literature discussing the general history of anchor development and the history of typological assessment as a means of dating anchors. This literature would help to determine if a study of this nature had been attempted previously in northern Europe. Literature that discussed the Mediterranean helped to understand how typological assessment had been applied to anchors already. The knowledge and context both forms of literature provided helped to better interpret the nature of archaeological finds that were identified during the study.

4.1.1 Anchor Database and Data Collection

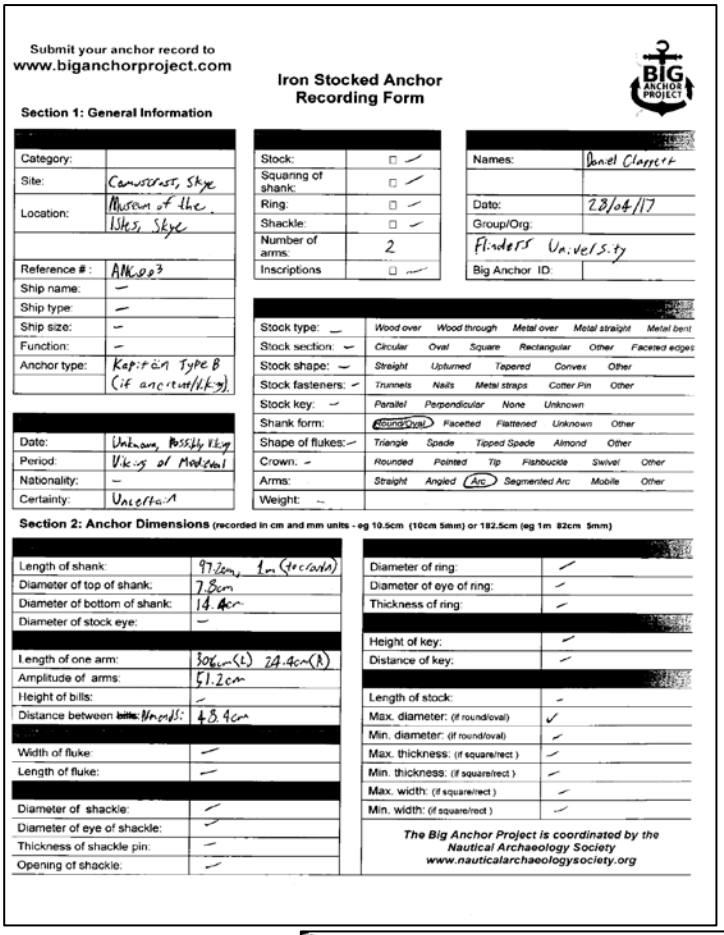
Anchors were recorded in three different ways. Firstly, anchors were recorded from literature discussing anchors finds, mainly archaeological site reports and books discussing the general history of maritime technologies. Secondly, online archaeological databases that focused on the archaeological record of countries in the study area were consulted for anchor finds. Databases accessed include the Nautical Archaeological Society's Big Anchor Project[1], Historic Environment Scotland's Canmore database[2], Wessex Archaeology's Project SAMPHIRE reports[3] and the University of Oslo's Museum of Cultural History database[4].

[1] Big Anchor Project 2017 The Big Anchor Project. Retrieved 3rd March 2017 from <http://www.biganchorproject.com/>
[2] Historic Environment Scotland 2017 Canmore: National Record of the Historic Environment. Retrieved 15th February from <https://canmore.org.uk/>
[3] Wessex Archaeology 2015 SAMPHIRE. Retrieved 29th January 2017 from <http://blogs.wessexarch.co.uk/samphire/>
[4] University of Oslo 2017 UNIMUS database Retrieved 15th June 2017 from <http://www.unimus.no/>

Lastly, museums and specialists in the field of Viking and medieval maritime archaeology, artefact conservation and metallurgy were consulted for information on anchors that are unpublished or not included in any archaeological database. To compile and manage anchor finds, a database detailing anchors and information related to them was created (Appendix A). Information recorded was based on both archaeological and diagnostic information about the anchor. Archaeological information recorded included the anchor's find site, date of find, current location and, if available, the anchor's age and the means of dating. Diagnostic information gathered included dimensional data (length and diameter of shank, length and diameter of each arm, arm amplitude and spread (distance from arm tip to arm tip), cross-sectional shape of the shank and arms and weight), the presence of specific features (such as flukes and anchor rings) and the measurement of these features. The database also classified anchors typologically, initially, using Kapitän's (1984) Mediterranean classification system. This helped to establish a preliminary classification system, which was modified for other anchors based on anchor types identified.

4.2 Anchor Recording

Anchors were recorded based on the dimensions and diagnostic features. The literature review informed what features of an anchor were diagnostic and how to interpret an anchor based on its form and features. In this study, the diagnostic features that were most useful for identifying a certain anchor type were the flukes, the cross sections of the shank and arms, the presence of a stock hole and the presence of a crown hole. The size of an anchor was also a useful diagnostic feature for determining an anchor's type. The NAS Big Anchor Project's method of recording iron anchors provided a basis of recording an anchors, but required some modification to include greater detail and to be more appropriate for medieval northern European anchors. Detailed measurements of an anchor's arm diameters and cross-sectional shape, fluke size and shape, and crown-hole rings were all added to the recording forms. The author was the primary recorder, and this work was continued by William Murray of the Scottish Conservation Studio and Arne Jouttijärvi of Heimdal Archaeometry after he had returned to Australia (Big Anchor Project 2008). In total, 17 iron anchors ranging from the 1st century CE to the 14th century CE were identified and recorded. Of these, only 13 anchors could be used for typological assessment, due to the difficulty of reliably dating the remaining four.



Submit your anchor record to
www.biganchorproject.com

Iron Stocked Anchor Recording Form

Section 1: General Information

Category:	
Site:	Camusdrast, Skye
Location:	Museum of the Isles, Skye
Reference #:	AMK003
Ship name:	–
Ship type:	–
Ship size:	–
Function:	–
Anchor type:	Kapitän Type B (if ancient/viking)

Stock:	☐ ✓
Squaring of shank:	☐ ✓
Ring:	☐ ✓
Shackle:	☐ ✓
Number of arms:	2
Inscriptions	☐ –

Names:	Daniel Clarrett
Date:	28/04/17
Group/Org:	Flinders University
Big Anchor ID:	

Date:	Unknown, Possibly Viking
Period:	Viking or Medieval
Nationality:	–
Certainty:	Uncertain

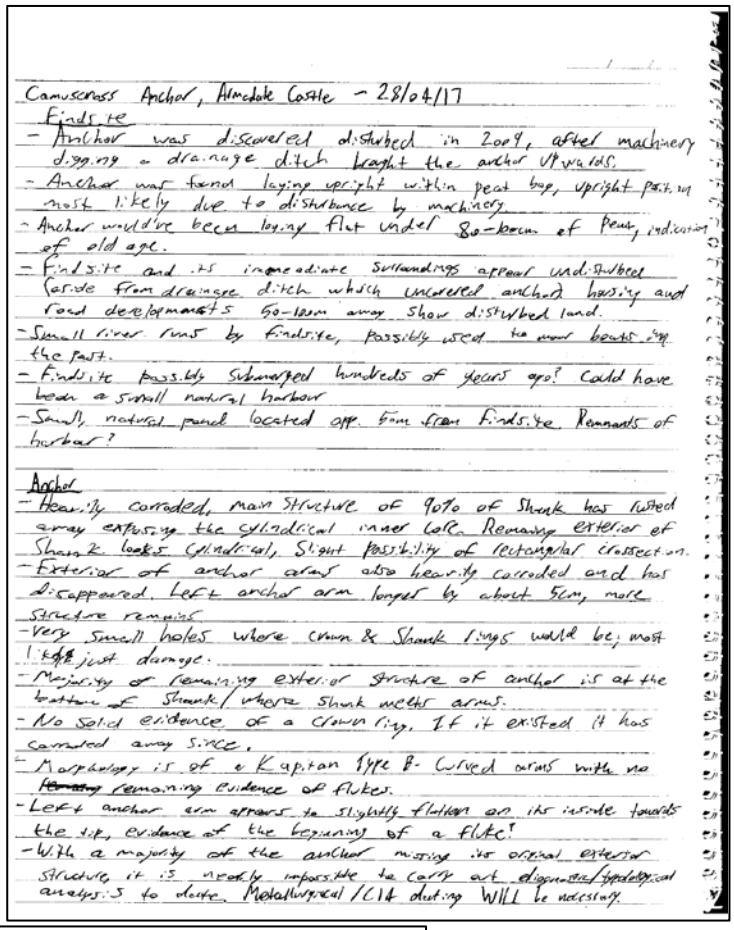
Stock type: –	Wood over	Wood through	Metal over	Metal straight	Metal bent
Stock section: –	Circular	Oval	Square	Rectangular	Other / Faceted edges
Stock shape: –	Straight	Upturned	Tapered	Convex	Other
Stock fasteners: –	Trunnels	Nails	Metal straps	Cotter Pin	Other
Stock key: –	Parallel	Perpendicular	None	Unknown	
Shank form:	(Round/Oval)	Facetted	Flattened	Unknown	Other
Shape of flukes: –	Triangle	Spade	Tipped Spade	Almond	Other
Crown: –	Rounded	Pointed	Tip	Fishbuckle	Swivel / Other
Arms:	Straight	Angled	(Arc)	Segmented Arc	Mobile / Other
Weight: –					

Section 2: Anchor Dimensions (recorded in cm and mm units - eg 10.5cm (10cm 5mm) or 182.5cm (eg 1m 82cm 5mm))

Length of shank:	97.2cm, 1m (recorded)
Diameter of top of shank:	7.8cm
Diameter of bottom of shank:	14.4cm
Diameter of stock eye:	–
Length of one arm:	30.6cm (L) 24.4cm (R)
Amplitude of arms:	51.2cm
Height of bills:	–
Distance between ~~bills~~ fluke tips:	48.4cm
Width of fluke:	–
Length of fluke:	–
Diameter of shackle:	–
Diameter of eye of shackle:	–
Thickness of shackle pin:	–
Opening of shackle:	–

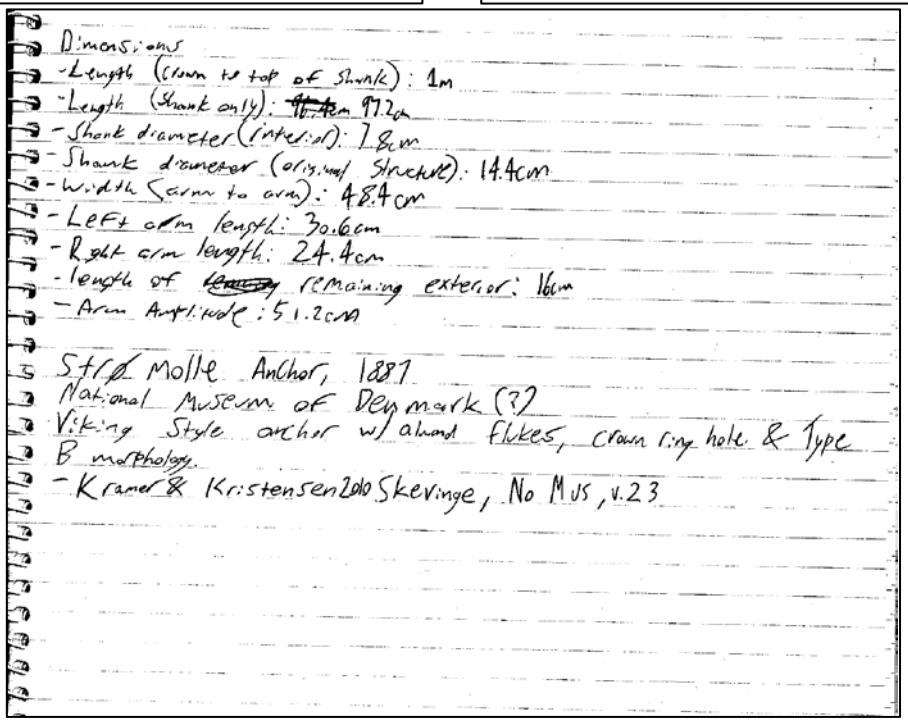
Diameter of ring:	–
Diameter of eye of ring:	–
Thickness of ring:	–
Height of key:	–
Distance of key:	–
Length of stock:	–
Max. diameter: (if round/oval)	✓
Min. diameter: (if round/oval)	–
Max. thickness: (if square/rect.)	–
Min. thickness: (if square/rect.)	–
Max. width: (if square/rect.)	–
Min. width: (if square/rect.)	–

The Big Anchor Project is coordinated by the Nautical Archaeology Society
www.nauticalarchaeologysociety.org



Camusdrast Anchor, Almedale Castle - 28/04/17
Find site
- Anchor was discovered disturbed in 2004, after machinery digging a drainage ditch brought the anchor up via JCB.
- Anchor was found laying upright within peat bog, upright position most likely due to disturbance by machinery.
- Anchor would've been laying flat under 80-100cm of peat, indicating of old age.
- Find site and its immediate surroundings appear undisturbed (aside from drainage ditch which uncovered anchor) having only road developments 50-100m away. Show disturbed land.
- Small river runs by Find site, possibly used to moor boats in the past.
- Find site possibly submerged hundreds of years ago? Could have been a small natural harbour
- Small, natural pond located approx 50m from Find site. Remnants of harbour?

Anchor
- Heavily corroded, main structure of 90% of Shank has rusted away exposing the cylindrical inner core. Remaining exterior of Shank looks cylindrical, Slight possibility of rectangular crosssection.
- Exterior of anchor arms also heavily corroded and has disappeared. Left anchor arm longer by about 5cm, more structure remains
- Very small holes where crown & Shank rings would be, most likely just damage.
- Majority of remaining exterior structure of anchor is at the bottom of Shank / where Shank meets arms.
- No solid evidence of a crown ring, If it existed it has corroded away since.
- Morphology is of a Kapitan Type B- Curved arms with no ~~flukes~~ remaining evidence of flukes.
- Left anchor arm appears to slightly flatten on its inside towards the tip, evidence of the beginning of a fluke?
- With a majority of the anchor missing its original exterior structure, it is nearly impossible to carry out diagnostic/typological analysis to date. Metallurgical /C14 dating WILL be necessary.



Dimensions
- Length (crown to top of Shank): 1m
- Length (Shank only): ~~96.4cm~~ 97.2cm
- Shank diameter (interior): 7.8cm
- Shank diameter (original structure): 14.4cm
- Width (arm to arm): 48.4cm
- Left arm length: 30.6cm
- Right arm length: 24.4cm
- length of ~~flukes~~ remaining exterior: 16cm
- Arm Amplitude: 51.2cm

Str Ø Molle Anchor, 1887
National Museum of Denmark (?)
Viking Style anchor w/ almond flukes, crown ring hole & Type B morphology.
- Kramer & Kristensen 2010 Skeringe, No MJS, v.23

Figure 4.1: An example of anchor recording form with notations and measurements taken by the anchor (images by Author).

The third method of recording used was to take detailed images of an anchor's diagnostic features, as well as photogrammetric images of the anchor. These would be used for further, detailed analysis of each anchor. Diagnostic photos were taken of the anchor as a whole, followed by images focusing on specific features of the anchor. An 8cm photo scale card was used in all forms of photography to provide spatial context to the image. Photogrammetry was captured through photographing an anchor on 360-degree spectrum and at three different angles to provide as much visual information to the 3D modelling software as possible (Figure 4.2). Objects with a distinct shape and colour were placed around the anchor during photogrammetric imaging as a point of reference for the 3D modelling software.Both forms of photography were captured using the standard rear camera of an iPhone SE, and the 3D modelling software used was Agisoft Photoscan.

Figure 4.2: An example of the spectrum that images were taken at for photogrammetry (from Mallison 2013, removed due to copyright restrictions).

4.3 Anchor Classification

Initially, classifications used for anchors were based on the anchor typology used in the Mediterranean created by key contributors to this dating system. Kapitän's anchor typology was the most useful, due to its focus on iron anchors and its comprehensive chronology that extends into the medieval period. Kapitän's typology was used as the basis for anchor classification, and was adapted to anchors in northern Europe.

Anchor classifications were based on diagnostic morphological features. Anchors that had been dated through stratigraphy, C14 analysis or from associated materials and were contemporaries of each other were also grouped together. Diagnostic features used to determine an anchor's class were the presence of flukes, and if so their size and shape, whether an anchor possessed a shank and crown ring or one of the two, the size and shape of an anchor crown, the cross-section shape of its arms and shank, and if an anchors shank widened at its top. A sub-classification was also created, using an anchors weight and size to determine its date. This sub-classification also was intended to see whether the evolution of a vessels size through the study period was also reflected in an anchor's size, as well as if anchor size reflected improvements in metallurgical methods and technology.

4.4 Limitations and Constraints

Information related to shipbuilding in northern Europe and the use of anchors relied heavily on secondary source material, based on either primary literary source pictorial representations of anchors or archaeological evidence. Access to anchors was limited by location, time, financial constraints and restricted access by three museums. Two of the six iron anchors recorded were unable to be removed from their displays, and recording was limited to photography and notation. One of the six iron anchors had its display removed, but measurements were unable to be taken. These limitations did not allow for detailed measurements or photogrammetry of the anchors, although this was partially overcome through archaeological reports and museums. Anchors that were housed in remote areas, or in locations that were unable to be accessed due to time and financial constraints.

The methodology used in this thesis allowed for a firm understanding in the development of anchors over the period in question, and for a typology to be established. The literature review made the second stage of research possible, as it identified the existing archaeological record of dated medieval iron anchors from northern Europe. Along with accurate recording and identification of diagnostic features in anchors, these stages allowed for an anchor typology to be created. The next chapter will discuss the application and results of typologically assessing medieval anchors in northern Europe.

5. Results

Typological analysis showed that four distinct anchor types existing in northern Europe between the 1st and 16th centuries CE, but in the study period (8th – 13th centuries CE), only two distinct anchor types were used. The first anchor type, designated Viking Type 1, was developed and used during the 8th and 9th centuries CE. The 10th century CE was a transitional period that lead to a second anchor type, designated Viking Type 2, which was used from the 11th – 13th centuries CE. The two anchor types from outside the study period are a pre-Viking type used in the 1st - 8th century CE and post-Viking type used in the 13th century CE.

Anchor Type	Period	General Characteristics	Example
Pre-Viking	1st-8th century CE	No flukes; angled arms; iron stock running through the shank (transition to wooden; fastened shank in the 4th-5th century CE Nydam anchor); rectangular arm cross section.	Bulbury anchor, 1st century CE, (image removed due to copyright restrictions).
Viking Type 1	8th-10th century CE	Curved arms; tapering 'spearhead' points instead of flukes; wooden, fastened stock; triangular arm cross-section.	Oseberg anchor, 9th century CE (image removed due to copyright restrictions).
Viking Type 2	10th-13th century CE	Curved arms; small, 'almond-shaped' flukes, becoming increasingly large in the 12th-13th centuries CE; wooden, fastened stock; rectangular arm cross section.	Kalmar anchor, 13th century CE (image removed due to copyright restrictions).
Post-Viking	From 14th century CE	Curved arms; large, triangular flukes welded onto arms; both wooden, fastened stocks and iron stocks running through shank; several metres long.	See section 5.4, Figure 5.19 for primary literary source depiction of this anchor type

Table 5.1: Chronological order of the four anchor types identified (Author; Åkerlund 1951 Cunliffe 1972; Rieck 2004).

5.2 Pre-Viking Anchor Types

There are only three known examples of iron anchors prior to the 8th century CE, with only two still in existence (Cunliffe 1972; Truckell 1964:60-61). The anchors that survive from this period are significantly different to anchors of the early Viking age in both form and features. A strong Mediterranean influence is present in the design of these anchors, and they display similar diagnostic features and morphology to anchors found in the Mediterranean dated to the 1st century BCE – 1st century CE.

The Bulbury Anchor

The Bulbury anchor from Dorset (Figure 3.4, Table 5.1, 1) is dated to the 1st century CE, and is most-intact example of a pre-Viking anchor (Cunliffe 1972:300). The anchor is 1.44m long and 0.78m wide from arm to arm. It possesses angled arms (Kapitän type A) giving the anchor the appearance of an arrowhead. The anchor does not have flukes and slightly tapers at the end of each arm, a form not seen in later Viking anchors. The Bulbury anchor's shank and arms are both rectangular in cross section, another feature which is different to early Viking-era anchors. One of the biggest design differences between the Bulbury anchor and Viking anchors is the presence of a stock hole.

An iron stock would have passed through this hole, a feature not seen on Viking anchors which had wooden stocks fastened over the shank. The Bulbury anchor predates the Viking-era by 600-700 years, but fragments of a later 3rd-4th century CE anchor from Nydam, Denmark provides evidence of pre-Viking anchor design closer to the beginning of the Viking-era.

The Nydam Anchor

The Nydam bog was first excavated in 1866 and again in 1993 and 1997. During the 19th century CE excavations the remains of three boats and "a large iron anchor, of the same shape and construction as those now in use" (Engelhardt 1865:13). Engelhardt's statement implies that the anchor was a similar shape to admiralty anchors used in the 19th century CE, and that by the time of the construction of the Nydam ship (350 – 400 AD) anchors in northern Europe had begun to be constructed with curved arms. The earliest Viking anchors of the 8th – 9th centuries CE possess curved arms, and the evidence from the Nydam excavation suggests the transition from straight, angled arms to curved arms occurred around the 4th – 5th centuries CE. Unfortunately, the Second Schleswig War between Denmark and Germany in the 19th century CE halted further work on the anchor, and the anchor itself no longer exists. However, archaeological work in 1993 uncovered a small section of what is believed to be the anchor's shank, measuring 0.39m and rectangular in cross section (Buchwald 2005:274). Further archaeological work in 1997 uncovered a large portion of the anchor's stock (Figure 5.1), which is cylindrical in shape and tapers to each end. This stock type is also similar examples found on Viking anchors, and constructed of oak (Figure 5.1). The Nydam anchor's curved arms, as implied in the 19th century CE report, along with the shape of the anchor's shank and wooden stock are similar to the design of later Viking anchors, suggesting many of the features on Viking-era anchors were developed by the 4thand 5th centuries CE.

Figure 5.1: The Nydam anchor stock at the Nydam bog (The NAVIS Project, removed due to copyright restrictions).

The Priestside Anchor

An iron anchor was found in 1888 south of Dumfries, Scotland (Figure 5.2). The anchor is highly corroded, but is similar in design to the Bulbury anchor, with angled arms and rectangular shank and arm cross sections.

Figure 5.2: The Priestside anchor, showing its angled arms and rectangular cross sections (Author, with the permission of Dumfries Museum and Camera Obscura, Dumfries).

The anchor only measure 0.864m long, but is missing much of its original material. Given its size, it may have been similar in size to that of the Bulbury example. The ends of the shank and each arm are missing their ends, and there is no indication of whether or not the anchor originally had flukes or not. It is likely the anchor had a crown ring hole that was filled with rust from corrosion. The anchor's morphology, its size and its proximity to a Roman fort on the Nith estuary makes most likely to be a pre-Viking anchor, dating to the 1st - 2nd centuries CE (Truckell 1964:60).

5.3 Viking-Era Anchors

Viking anchor types appear to have had two different stages of development, with the diagnostic features most indicative of this change being the flukes and cross-sectional shape of the arms. Anchors of the early Viking-era (8th – 9th centuries CE) lack defined flukes, and instead possess 'proto-flukes'. Their arms taper towards their ends, the tips of which were hammered flat into a 'spearhead' shape. The other distinct feature indicative of early Viking anchors is the triangular cross-section of the arms. All anchors known from this period have this style, except for an 8th century CE anchor found in Ribe, which will be discussed at the end of this section. As this anchor type emerged in the archaeological record concurrent with the first Viking invasions, this anchor type has been designated "Viking Type 1".

5.3.1 Viking Anchors (Type 1)

The Oseberg Anchor

The Oseberg anchor is one of the most well dated and best-preserved Viking anchors known, and its design is representative of the Viking Type 1 anchor (Figure 5.3). The Oseberg anchor was found as part of the ship burial which gives the anchor its name. The anchor was dated from dendrochronological analysis of the Oseberg ship to the early 800's CE, dating its creation and use to the beginning of the Viking-era (Williams 2014). The anchor is very well-preserved and provides clear diagnostic and morphological information.

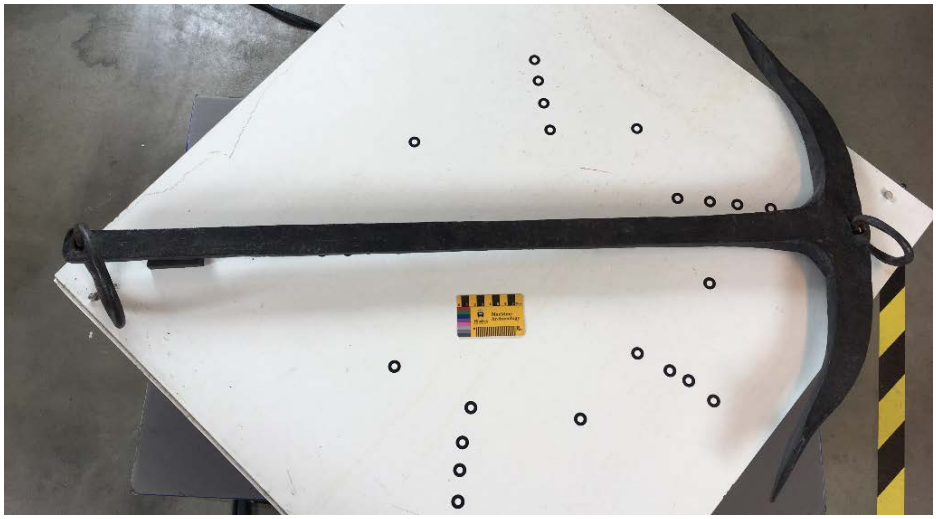


Figure 5.3: The Oseberg Anchor, displaying its diagnostic and morphological features (photo by Author, with the permission of the Viking Ship Museum, Oslo).

Oseberg Anchor - Archaeological Information	
Date of find	1903
Location	Oseberg Farm, Tønsberg, Norway
Anchor date	Early 9th century CE
Dating method	Associated materials (dendrochronology of ship burial timbers)
Area of Manufacture	Southern Norway
Anchor type	Kapitän Type B, Viking Type 1
Diagnostic Information	
Length	1.04m
Width (arm to arm)	66.8cm
Weight	9.8kg
Shank cross section (midpoint)	Rectangular, 4.5cm x 2cm
Arm cross section (midpoint)	Triangular, 4.5 x 3cm
Anchor ring at shank?	Yes
Anchor ring at crown?	Yes
Anchor ring diameter(s)	13.4cm x 13.6cm (shank), 8cm x 7.8cm (crown)
Fluke/arm type	Spearhead shaped (tapering)
Material	Wrought iron

Table 5.2: Archaeological and diagnostic Information of the Oseberg anchor (Author and Nordeide 2011).

The anchor has tapering arms in the shape of a spearhead, one of the primary diagnostic indicators of this anchor type. It also possesses a shank and crown anchor ring and the cross sections of its shank is rectangular and its arms triangular. The Oseberg anchor is also typical of the size of early Viking anchors, which are generally an average length of one metre. Given the size of the Oseberg ship is 22 metres, it is likely that the anchor was either not a part of the original ship or the vessel possessed numerous anchors of a similar size to the Oseberg anchor (Rieck 2004:177).

The Blackfriars Anchor

The Blackfriars anchor (Figure 5.4, 5.5) was found in 1969 on the bank of the River Thames, London. The anchor is missing the upper half of its shank, but the remaining material is in good condition. The anchor was dated stratigraphically and through comparative analysis with the Oseberg anchor, giving it a depositional date of the 9th century CE (Marsden 1994:160-161).

Figure 5.4: Drawing of the Blackfriars anchor's features and dimensions (from Marsden 1994:161, removed due to copyright restrictions).

Figure 5.5: The remaining material of the Blackfriars anchor (Museum of London 2015, removed due to copyright restrictions).

Like the Oseberg anchor, the Blackfriars anchor possesses spearhead shaped, tapering arms which end in blunt points rather than true flukes. The anchor's cross sections are also the same as the Oseberg's with a rectangular shank and triangular arms. The anchor has a small crown-hole with an anchor ring. The anchor measures 60cm in length, but it was possibly double that size before it was damaged reaching a length of 1.2m, making it slightly larger than the Oseberg anchor.

Blackfriars Anchor - Archaeological Information	
Date of Find	1969
Location	Blackfriars, London
Anchor date	Early medieval (approximately 9th century CE)
Dating method	Comparative and stratigraphic analysis
Area of manufacture	Unknown
Anchor type	Kapitän type B, Viking Type 1
Diagnostic Information	
Length	60cm (damaged), 120cm (original, estimated).
Width (arm to arm)	90cm
Weight	14kg
Shank cross section	Rectangular, 6.5cm x 3cm
Arm cross section	Triangular, 6.8 x 3cm
Anchor ring at crown?	Yes
Anchor ring diameter	16.5cm (crown)
Fluke/arm type	Spearheaded shaped (tapering)
Material	Wrought iron

Table 5.3: Archaeological and diagnostic information of the Blackfriars anchor (Marsden 1994:160-162).

The Blackfriars anchor is a unique find, because it is the only example of a Viking-style anchor found in England. It is dated is during a period where there was significant dispute and overlap between Viking and Anglo-Saxon control of London (Besant 2010:31). However, due to Viking occupation of London being land-based, the anchor's presence most likely implies that the anchor belongs to an Anglo-Saxon ship, and its design was influenced heavily by Viking anchor design.

Strø Mølle Anchor

The Strø Mølle anchor (Figure 5.6, 5.7) was found in 1887 in the northeastern area of Zealand, Denmark. It was found just southeast Strø Mølle, after which the anchor is named, and is in good condition. The anchor measures 1.19m and 71.4cm wide, making it identical in size and shape to the Oseberg anchor. The anchor's arm and shank cross sections are again triangular and rectangular, as is the case with Oseberg. The anchor's arms differ slightly in shape, with the tapered, spearheaded tips being more defined and closer to resembling flukes. The anchor has a far larger shank ring and hole than the Oseberg anchor. The anchor's form and features are both indicative of this anchor still being a Viking Type 1, but the increased prominence of the tips of its arms is a feature seen on later Viking anchors. This makes the Strø Mølle anchor most likely dates to the late 9th century CE.

Figure 5.6: The Strø Mølle anchor in its entirety (photo by A. Jouttijärvi).

Figure 5.7: The Strø Mølle anchor's left arm, displaying its slightly more prominent arm tips (photo by A. Jouttijärvi).

The Hananger Anchor

A farmer in Hanangermona, Norway found the Hananger (or Hanangermona) anchor (Figure 5.8) in 1974. The Museum of Culture History in Oslo acquired the anchor in the 1990's, after it had been part of a private collection since the 1970s (Stylegar 2012). The anchor is very similar to the Oseberg anchor in both size and shape. The anchor is 1.10m long and 65cm wide, making it only 6cm longer than the Oseberg anchor and 10 cm shorter than the assumed length of the Blackfriars anchor. The Hananger anchor's arm cross section is triangular, and both arms taper into a spearhead shape at either end, as is typical of a Viking Type 1 anchor. As the anchor was disturbed prior to archaeological investigation, it can only be dated relatively. Due to its similarities to the Oseberg anchor, it is believed to be early Viking period (Oslo Museum of Cultural History) and a speculated to have been from the 9th century CE (Stylegar 2012).

Figure 5.8: The Hananger Anchor to scale (Oslo Museum of Cultural History, removed due to copyright restrictions).

The Ribe Anchor

The Ribe anchor (Figure 5.9, 5.10) was found in the important Viking age coastal city of Ribe during construction of an office building in 1974. Partially uncovered, construction works were halted and archaeologists at the Ribe museum were contacted to assess and excavate the remainder of the anchor during the winter months of 1974-1975. Enough of the anchor remained in situ that the stratigraphic layer which it had been deposited could be used to date it.

When compared to nearby areas that had been excavated stratigraphically analysed, a deposition date of 750-800 CE was given to the anchor, making it the earliest dated Viking- era anchor (Rieck 2004:173). The anchor was brought to the museum in eight separate fragments, three of which represented the anchor proper and the remaining five fragments being part of the anchor's chain. The anchor was heavily corroded, and underwent significant conservation after excavation. The Ribe anchor measures 1.5m long and 95cm wide with a weight of 27.5kg. This makes the anchor significantly larger than any other Viking Type 1 anchor. Despite its large size, the Ribe anchor has a similar profile to the Oseberg anchor, possessing a small crown and curved, tapering arms. The anchor's arms are triangular in cross section, and its shank is rectangular. The anchor would have had a wooden stock fastened over it and possesses an anchor ring at its crown and the top of the shank. Despite having nearly all the features of a Viking Type 1 anchor, the Ribe anchor is a unique find that is dissimilar to contemporary anchors. The anchor is different in design to a Viking Type 1 anchor, primarily due to its large size and slight flukes, a feature not seen in most other Viking Type 1 anchors. The size and the presence of flukes on the 8th century CE Ribe anchor, features that do not become common until the 10th century CE on Viking anchors, make the Ribe anchor an anomaly in the progression of Viking anchor design.

Figure 5.9: Drawing of the Ribe anchor taken after excavation (from Rieck 2004, removed due to copyright restrictions)
Figure 5.10: The Ribe anchor in the Viking Museum Ribe (photo by Author).

The trend in anchor design appears to have shifted in the beginning of the 10th century CE. Anchors begin to take on a different profile most notably in the design of flukes and the size of the anchor. Anchor flukes become more defined, with small 'almond' shaped fluke allowing for the anchor to have an improved grip on the seafloor (Ellmers 1988) Flukes continue to become larger are more distinct throughout the 10th – 13th centuries CE. Archaeologically, there are far fewer examples of this anchor style that have been securely dated compared to Viking Type 1 anchors. However, beginning in the 11th century CE, primary literary source imagery depicting this anchor type is far more abundant than for Viking Type 1 anchors. The earliest literary source image of the later Viking anchor is the 11th century CE Bayeux Tapestry (Figure 2.6), which contains images of large anchors with developed, well-defined flukes.

5.3.2 Viking Anchors (Type 2)

The Ladby Anchor

The Ladby anchor (Figure 5.11) is one of the earliest Viking anchors to show a transition towards a Type 2 anchor in its shape and design. The Ladby anchor was found in 1935 as part of the Ladby ship burial. It was dated by proxy materials found alongside it in the Ladby ship burial, and to the early 10th century CE (Sørensen 2001).

Figure 5.11: The Ladby Anchor lying vertical against the port side of the Ladby ship, as it was found during excavation in 1935 (photo by Author, with the permission of the Viking Museum, Ladby).

The anchor possesses similar features found on Viking Type 1 anchors, with the same cross section shapes, a shank and crown ring, curved arms and no stock hole, indicating that the anchor's stock would have been fastened over it. The anchor underwent significant conservation work in 1997-98, and is a very well-preserved example of a Viking anchor. The Ladby anchor is unique for possessing a fully intact anchor chain, something no other Viking anchor has been found with.

The Ladby anchor looks similar in design to a Viking Type 1 anchor, but there are subtle differences. Most notably, the anchor's arms are different in shape. Rather than arms that taper to blunt spearheaded ends, the Ladby anchor's arms smoothly transition into points. At each end of the arms there are small, almond shaped flukes. Although small, the anchor's flukes represent a transition from the design typical of Viking Type 1 anchors. The cross section of the Ladby anchor's arms also differ from Viking Type 1 anchors, and are nearly rectangular in shape. The anchor is also larger and heavier than a Viking Type 1 anchor, and is 1.36 metres long, 84cm wide and weighs 27.95kg (Sørensen 2001).

Figure 5.12: Drawing of the Ladby Anchor without its chain, highlighting its dimensions and the reduced tapering in the triangular arm cross section (from Sølver 1945:53, removed due to copyright restrictions).

This increase in size only makes the Ladby anchor slightly larger than the assumed size of the Blackfriars anchor, but because a consistent increase in the size of anchors occurs throughout the 10th – 13th centuries CE, the Ladby anchor could be seen as the first step in this trend. The Ladby anchor's date and similarities to many of the Viking Type 1 anchors makes its design transitional between Viking Type 1 and Type 2 anchors, a transition that appears to have occurred during the 10th century CE.

Ladby Anchor - Archaeological Information	
Date of find	1935
Location	Ladby ship burial, Denmark
Anchor date	Early 10th century CE
Dating method	Associated materials
Area of manufacture	Unknown, possibly Southern Norway
Anchor type	Kapitän type B, Viking Type 2
Diagnostic Information	
Length	1.36m
Width (arm to arm)	84cm
Weight	27.95kg
Shank cross section	Rectangular
Arm cross section	Triangular
Anchor ring at crown?	Yes
Flukes	Small, almond shaped
Material	Wrought iron, slag-filled

Table 5.4 Archaeological and diagnostic information of the Ladby anchor (after Sørensen 2001).

The Arkona Anchor Fragment

The Arkona anchor (Figure 5.13) was found in an oval house pit in 2015 amongst other metal objects during excavations in Arkona, on the German Baltic coast (Ruchhöft 2016). Only very little of the anchor survives, with the bottom on the anchor's shank, its crown ring hole and the beginning of its left arm remaining. Although very little of the anchor still exists, enough diagnostic material remains to compare to the contemporary Ladby anchor. Its crown ring hole is typical of a medieval anchor, and the cross section of its shank and arm is very similar to the Ladby anchor. The anchor's shank cross section is rectangular and the shank/arm transition implies the anchor's arms were curved. The anchor fragment is 40.5cm long and at its widest point measures 20.2cm. The weight of the remaining material is 6.2kg, but it is believed its original weight would have been approximately 25kg, making it a similar weight to the Ladby anchor without a chain. The anchor has been dated to the 10th century CE by dating finds contained in the same layer the fragment (Ruchhöft 2016:139). This means the Arkona anchor is a contemporary of the Ladby anchor, reinforcing the likelihood of it being of similar design.

Figure 5.13: The Arkona Anchor Fragment, its dimensions both front facing and side on (photo by S. Suhr, removed due to copyright restrictions).

Figure 5.14: The Arkona anchor fragment overlayed upon a drawing of the Ladby anchor, highlighting their similar design and dimensions (from Solver 1946; photo by S. Suhr, removed due to copyright restrictions).

The Sigtuna Anchor

The Sigtuna anchor (Figure 5.15) was found in 1961 in Sigtuna, Sweden during sewer repairs in one of the city's streets. The anchor was given a minimum date of creation based on the estimated foundation date of Sigtuna, around 1,000 CE (Edberg 2013:196). This dating method was combined with stratigraphic evidence where the anchor was found, and the anchor was given a rough date sometime in the 11th century CE. The anchor's design shows a continued departure from the Viking Type 1 design. While still maintaining a shank, crown ring and curved arms, the anchor's shank is significantly longer, measuring 1.69 metres long. The ends of the arms and its flukes no longer exist, and the total width of the anchor is 82cm. But the Sigtuna anchor most likely reached one-metre in length originally (Edberg 2013:202). The cross section of the anchor's arms is rectangular, departing from the triangular section shape of Viking Type 1 anchors and the Ladby anchor.

Figure 5.15: A photograph and scaled drawing of the Sigtuna anchor, with the drawing highlighting the anchor's rectangular cross sections (from Edberg 2013:202, removed due to copyright restrictions).

Sigtuna Anchor - Archaeological Information	
Date of find	1961
Location	Sigtuna, Sweden
Anchor date	11th century CE
Dating method	Stratigraphic
Area of manufacture	Unknown
Anchor type	Kapitän type B, Viking Type 2
Diagnostic Information	
Length	1.69m
Width (arm to arm)	82cm
Weight	25kg
Shank cross section	Rectangular
Arm cross section	Rectangular
Anchor ring at crown?	Yes
Flukes	Unknown
Material	Wrought iron

Table 5.5: Archaeological and diagnostic information of the Sigtuna anchor (from Edberg 2013).

The design of the Sigtuna anchor is one of the first to display a significant departure from a Viking Type 1, primarily because of its size. It is likely that prior to being damaged that the Sigtuna anchor would have possessed flukes even more defined than those on Ladby.

The Vestnes Anchor

The Vestnes anchor (Figure 5.16) was found in 1985 during construction works in Vestnes, in western Norway. The anchor was found in a disturbed condition, but was dated by comparative analysis with other Viking and medieval anchors and through study of the location of the anchor's finding and how it correlated to the past sea-levels. This analysis gave the Vestnes anchor a rough date of between 950-1200 AD (Carpenter 1995:45). The anchor's design is indicative of a Viking Type 2 anchor. Its flukes are significantly larger than those seen on earlier anchors like Ladby and measure 9cm across.

The anchor's cross sections are also both rectangular in the shank and arms. Continuing the trend of larger anchors as well, the Vestnes anchor is unique, because it is one of the largest Viking anchors to have been found. It measures 2.02m long, 1.25m wide and has a weight of 36.4kg (Carpenter 1995:44). The Vestnes anchor is most likely from the late-Viking/high-medieval era. The anchor's design bridges the gap between Viking Type 1 anchors of the 8th-9th century CE, and later-medieval style anchors post 13th century CE (Carpenter 1995:45). The anchor type that the Vestnes anchor would gradually develop into sees further evolution in the late medieval Kalmar anchor, which represents one of the latest anchors that fit into a Viking anchor typology.

Figure 5.16: The Vestnes anchor, Highlighting its large flukes and size (from Carpenter 1995, removed due to copyright restrictions).

The Kalmar Anchor

The Kalmar anchor was found during construction of a dam in Slottsfjärden, the old harbor region in the Swedish city of Kalmar. The excavations took place in 1933-34 and uncovered numerous maritime artefacts and shipwrecks from the medieval period of the city. Amongst the findings were numerous anchors of the Viking Type 2 style, intact with both the iron structure of the anchor and accompanying wooden stocks (Figure 5.17).

Figure 5.17: Drawing of the largest of the Kalmar anchor's, showing its dimensions (from Åkerlund 1951, removed due to copyright restrictions).

The design seen in Figure 5.17 is the design of all the anchors, with the only difference being the anchor's size and condition (Åkerlund 1951:155). The Kalmar anchor's flukes are very prominent, being twice the size of the Vestnes anchor's flukes (Carpenter 1995:45). Again, the cross section of the Kalmar anchor's shank and arms are both rectangular, and it possesses both a shank and a crown ring hole. The shank ring is thicker and slightly larger than seen on the Viking Type 2 Sigtuna anchor. Although no Viking Type 2 anchor has been identified with a stock, The Kalmar anchor's stock is different from surviving Viking stocks of the 9th century CE. Oak is still the material used for the Kalmar anchor's stock, but rather than being cylindrical in shape, the Kalmar anchor stock is rectangular. Whether this design is a diagnostic feature of Viking Type 2 anchors is unknown due to the lack of surviving anchor stocks from the later Viking period, but the design of the Kalmar anchor stock is similar to designs seen in other, later medieval anchors.

The Kalmar anchor was most likely made in the 13th century CE, because of its design, the stratigraphic deposition layer it was found in and the age of the associated materials found alongside the anchor (Åkerlund 1951:155). Its design is like both the earlier Type 2 Viking anchors, as well as anchors that begin to appear in 14th - 15th century CE primary literary source depictions of anchors. The Kalmar anchor represents the last known Viking-style anchor in northern Europe. From the 14th century CE on, we see the introduction of late medieval anchors in the region, which are markedly different from the previous anchors discussed because of design changes in size, flukes, and the removal of features like the crown ring.

5.4 Post-Viking Anchor Types

Post Viking anchors begin to emerge in northern Europe in the late 13th century CE. The design of these anchors is similar to the admiralty-style anchor used extensively during the 18th - 19th centuries CE. Despite an increase in primary literary sources of late medieval anchors, there is no known anchors from 14th century CE until the mid-16th century CE that have been found (Curryer 1999:38; Upham 1983:11). The change in anchor design can only be witnessed in literary source imagery. The amount of primary literary source imagery available significantly increases beginning in the late 13th century CE. Depiction of anchors in art and technical documents such as ship inventories provide further details of the number of anchors a vessel of the period would have carried and their weight (Friel 1995).

The artistic depiction of ships and their anchors in manuscripts, tapestries and town seals are the best source of understanding the design of post-Viking anchors in northern Europe, although their reliability is limited. These sources are abundant in the 14th - 15th centuries CE, and provide evidence of the design that anchors took on in this period. Late 13th - early 14th century CE depictions show both continuity in anchor designs seen in the late Viking-era, as well as continued development into the shape of an admiralty style anchor. The late 13th century CE town seal of Portsmouth for example (Figure 5.18) shows an anchor similar in design to anchors seen in the Viking period, with rings at the crown and top of the shank, as well as what appears to be an anchor stock fastened over the shank.

Figure 5.18: The late 13th century CE town seal of Portsmouth, depicting an anchor at the ships bow (National Maritime Museum, SEC0072, removed due to copyright restrictions).

Figure 5.19: Scene from Queen Mary's Psalter, depicting Noah entering the Ark. Below is shown an anchor similar to the admiralty style (British Library, Royal MS 2 B VII, f. 6v).

The continuity in this anchor design shifts remarkably in the depiction of an anchor in the early 14th century CE Queen Mary's Psalter. One section of the manuscript (Figure 5.19) depicts Noah boarding the Ark, under which is an anchor of the admiralty style is depicted. The stock appears to run through the shank rather than be fastened to it, although this is unlikely as iron stocks are not reintroduced until the 19th century CE (Curryer 1999:110). The anchor possesses very large flukes. Despite the significant change in anchor design, some features present on Viking-era anchors still exist, such as ring at the anchor's crown. A similar anchor to the one depicted in Queen Mary's Psalter is seen in the town seal of Winchelsea of the same period. The seal (Figure 2.4) shows a partially submerged anchor with a stock running through the anchor's shank. This style of anchor appears in numerous manuscripts throughout the 14th century CE (Figure 5.20, 5.22), indicating that some features from the Viking-era continued to persist in the late medieval period while also displaying the continued development in the shape and size of flukes.

Figure 5.20: The Luttrell Psalter of the mid-14th century CE, depicting a deployed iron anchor (British Library, Additional MS 42130 f. 161v).

Figure: 5.21: The Roman de Brut manuscript of the mid-14th century CE, depicting a wooden-stocked anchor being deployed from the vessels bow (British Library, Egerton MS 3028 f. 81).

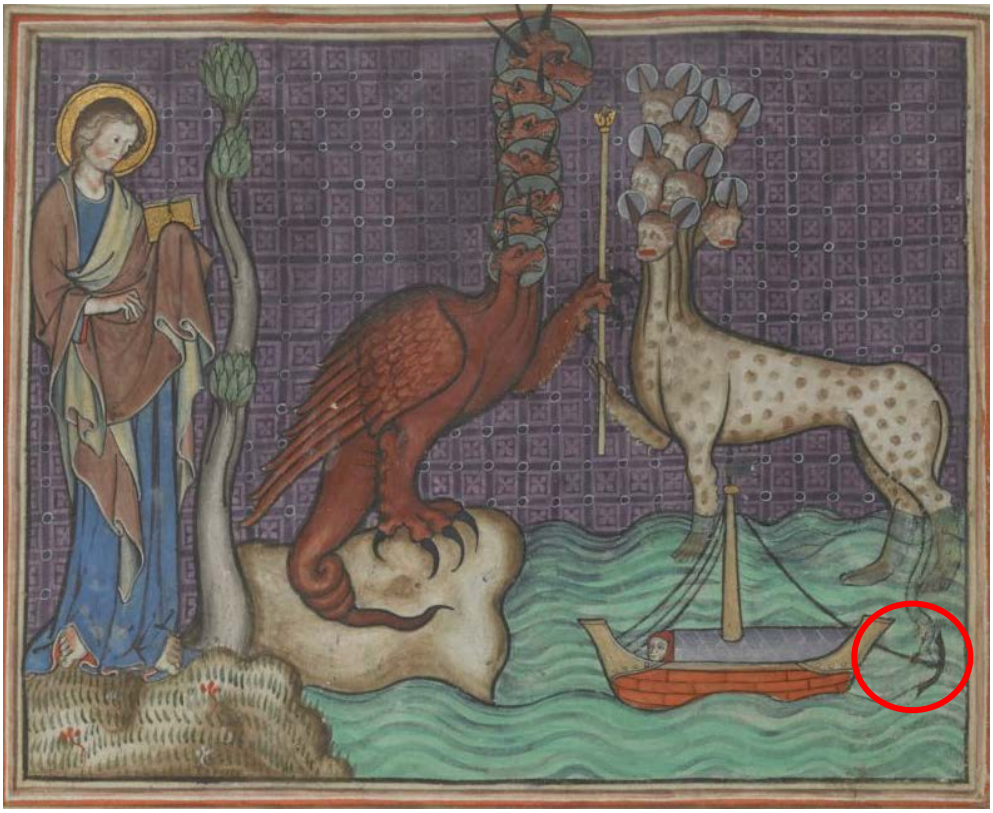


Figure 5.22: Scene of a ship at sea with its anchor deployed in the mid-13th century CE French Apocalypse manuscript, one of the earliest examples of a primary literary source image of the study period which depicts an anchor (British Library, Additional MS 17333 f. 21v).

Descriptions of anchors in primary literary sources tend to be very brief, generally only describing the number of anchors on a ship, their weight and cost. This information still provides important information about post-Viking anchors and of vessels. Evidence from 14th century CE English ship inventories show that anchors were made significantly larger than even the largest anchors of the Viking period. Anchors constructed for a galley built in Winchelsea during the 14th century CE measured 4.27m in length, twice the size of the Vestnes anchor (Friel 1995:124). The weight of the anchors aboard vessels of the 14th century CE is also significantly heavier. A description of the anchors carried by the 14th century CE royal ship *Grande Cogge*, states the vessels smallest anchor weighed 425kg and its largest anchors weighed over one ton.

There is a significant gap in understanding of late medieval anchor development, due to the lack of anchor finds between the 13th - 16th centuries CE. The abundance of Viking-era anchors in contrast may be because the practice of ship burial used by Viking and Anglo-Saxon cultures allowed for better preservation of archaeological materials. Another possible reason for fewer anchor finds in the later medieval period is because of the tendency for shipwrights to reuse ship equipment over the course of several vessels lifespans (Curryer 1999:37). Nevertheless, the abundance of primary literary source material depicting and describing anchors of the period gives an idea of how anchors continued to develop in both design and dimensions in the late medieval/early Renaissance period.

The archaeological record of anchors in northern Europe suggests a gradual evolution in the design of anchors between CE 750 – 1300. This evolution seems is seen predominantly in anchors of Viking and Scandinavian origin. There is a change in both design and size. The shape of an anchor's arm cross section and its flukes and change differ from the 8th-9th centuries CE and the 10th-12th centuries CE, with the exception of the Ribe anchor, which has morphological and diagnostic traits of both Viking Type 1 and Type 2 anchors. Despite the morphological evolution visible between the 8th - 13th centuries CE, the dataset presented here is small and limited; the typology would benefit greatly from further archaeological finds, particularly from the later Viking period of the 10th-13th centuries CE where archaeological evidence of seafaring technology is especially rare. Despite this, the preliminary analysis of known anchors from northern Europe during this period, as well as contemporary primary literary sources, have identified two distinct types of anchors that existed during the Viking-era in northern Europe.

6. Discussion

This chapter will discuss the results of typological assessment, and what interpretation of this typology reveals about the influences of Viking and Mediterranean shipbuilding on anchor development in the study area. The discussion will then shift to the recommendations for future work that will improve and expand upon this typology. The case study of dating the Camuscross anchor will also be discussed, and assess how effective typological assessment can be for dating medieval anchors.

6.1 Typological Assessment in Northern Europe: Benefits and Limitations

Although this project was inspired by the goal of developing a typology to date and assess the Camuscross anchor, the typology only proved partially useful in achieving this. However, the potential of this typology became clear when applying it to other anchor finds in northern Europe. Diagnostic features that prove most useful for typological dating are flukes, the cross-section shape of an anchor's arms, and the presence of both a stock hole and a crown-hole. Anchor size also appears to play a factor in determining an anchors date, because of the gradual increase in the size of anchors across the study period. This is the case when comparing Viking Type 2 anchors, which are generally larger, to Type 1 anchors. The identification of this two distinct anchor types bring up further questions as to why the transition from Viking Type 1 to Viking Type 2 occurred.

There are numerous reasons why from the 10th century CE onwards there is a shift towards larger, Type 2 Viking anchors. One possible reason is to do with contemporary developments in shipbuilding. Vessels of the early 10th century CE were designed to be small and maneuverable, and were not well-suited to naval combat. The most famous vessel of this type is the Viking longship (Williams 2011:197), which saw widespread use across northern Europe in the 10th – 11th centuries CE. When Viking raiding and settlement declined in the later medieval, vessels were adapted for naval combat purposes, rather than for raiding. Small, low-profile vessels such as longships were replaced by taller, heavier vessels. This development began around the 12th century CE, and appears to have been a response to vessels being equipped with more powerful missile weapons, such as the crossbow (Bill 2011:179). This led to longships being phased out as the main vessel for naval combat in northern Europe, being replaced by the larger cog in the 13th century CE (Friel 1995:35). Larger ships require larger anchors, which in turn required devices that would allow them to be lowered and raised. In the 13th century CE, the first windlasses appear to be fitted to northern European vessels (Friel 1995:120), allowing larger anchors to be produced for larger ships. The reason for the later medieval transition to larger, Type 2 anchors is likely because of a change in the size of vessels and the development of the windlass, which allowed for large, heavy objects like an anchor to be raised (McGrail 1998:256-257).

One anomaly of this typology is the 8th century CE Ribe anchor, an anchor with a design more like a 10th – 11th century CE Type 2 anchor. One possible explanation for the Ribe anchor is related to the size of 8th - 9th century CE Viking ships.

Ships of the early Viking period, such as the Gokstad ship, were general-purpose vessels that were larger and less capable of the long, deep-water voyages of later Viking longships (Williams 2014:48). In the 10th century CE, the Viking ship type that is part of the popular imagination today developed as a distinct type of vessel, dedicated solely for raiding and troop transport (Bill 2011:174-177; Williams 2014:55-56). However, large, wider vessels remained in use for the purpose of cargo, called a *knarr* (Jesch 2001:128). The larger size of early Viking period vessels may explain why the Ribe anchor is far larger than any other Viking Type 1 anchor.

The Ribe anchor's design does not seem to be indicative of a regional style of design either. Although found in Denmark, metallurgical analysis points to southern Norway as the most likely place of production (Buchwald 2004; Buchwald 2005). This is also the likely the place of manufacture of the Ladby anchor, and it is likely that a large amount of the metal used for Viking vessels originated here. Another possible explanation for the Ribe anchor's design may relate to its place of manufacture. The increase in Viking vessels correlates with the Viking expansion into Europe in the 9th century CE. The increased need of iron for vessels may have reduced the materials available to make large anchors, leading to smaller anchors like the Oseberg anchor. This explanation is reinforced when considering the difficulty of producing large, complex metal objects like the Ribe anchor using early medieval metallurgical techniques. Early medieval bloomer furnaces were small in size and only able to produce a limited amount of iron and slag metal (Tylecote 2002:75-77). Because of this a large object with a complex shape like the Ribe anchor would have required great effort to produce. To fully explain if the Ribe anchor is anomalous, or a chance find of a common anchor type for the 8th century CE, further anchor finds from across the study period, particularly from the 8th and 9th centuries CE are needed. This would greatly improve the explanation behind the Ribe anchor's size and design, and also provide a greater understanding of the relationship between the size of an anchor and the vessel that carried it would also help to remove gaps in our understanding of the nature of early Viking anchors.

The lack of reliably dated medieval anchors is one of the primary limitations of this study. There is a bias in the record of anchor finds from northern Europe, with the best-dated and best-preserved examples coming from Scandinavia. One reason for this could be due to the prominence of Scandinavia as a centre of shipbuilding and metallurgy in this period, with high-quality Viking anchors surviving more so than other northern European anchors. Despite this, Viking type anchors across northern Europe, so determining the influence of Viking anchor technology on the rest of northern Europe is still possible. To overcome the limited archaeological evidence, relying on a combination of primary and archaeological sources was necessary in this study to minimise gaps in understanding of anchor design and development. At present, relying on archaeological material alone for an anchor typology of all of northern Europe is insufficient. However, using primary literary source imagery to corroborate the limited archaeological evidence allows for a consistent enough picture of anchor development during the study period for this anchor typology to be beneficial. Because of the lack of primary literary source imagery available in early in the study period (8th – 10th century CE), literary source imagery was most useful for analysing anchor design at the end of the study period, beginning with the 11th century CE Bayeux Tapestry.

One possible reason for the lack of archaeological evidence in this later period is Scandinavia's conversion to Christianity. Because the most well-preserved Viking anchors are from ship burials, when pagan burial practices like ship burial were abandoned this way of preserving ships would have also been lost. Viking cultures converted to Christianity (Gräslund 2011:639-640) roughly around the same time anchor finds decline, in 11th century CE (Brink 2011:621). The later medieval practice of reusing ship equipment on several different vessels may also explain the lack of anchors in the later study period (Curryer 1999:37).

6.2 Cultural and Economic Influences on Iron Anchor Design in Northern Europe

The anchors analysed throughout the study period in northern Europe display attributes that indicate the design of the anchor was influenced heavily by Viking and Mediterranean cultures. The earliest iron anchors found in northern Europe share a design similar to anchors used in the Mediterranean. Mediterranean-style anchor design disappear in northern Europe beginning in the 5th century CE, when the shape and size of anchors diverge between the two regions. Anchors in northern Europe retain curved arms, rectangular shanks and develop fastened anchor stocks from the 5th century CE onwards, while anchors in the Mediterranean develop arms at right angles to the shank and abandon features such as a crown ring (Eliyahu et al 2011:235-236). Beginning with the Nydam anchor in northern Europe, anchors take on many of the features used on Viking anchors, especially Viking Type 1 anchors of the 8th – 10th centuries CE. This design appears to have originated from Scandinavia, as the earliest and most frequent examples of this design originate there.

Cultural and Economic Influences on Iron Anchor Design: The Mediterranean

The period when the Mediterranean had the most influence on anchor design in northern Europe, particularly within the British Isles, was in the 1st – 2nd centuries CE. Evidence for this influence comes from the shape and design of the Bulbury and Priestside anchors (Figure 3.3, 5.2). The Priestside anchor is most likely Roman in origin, the Bulbury anchor is likely to be vernacular, due to its find in a vernacular hillfort and its use of chain as a means of mooring, which is different from the Mediterranean tradition of rope. Despite this, both anchors use a style like anchors that were used in the Mediterranean between the 2nd century BCE and 1st century CE. Anchors used in both regions share features such as rectangular shank cross sections and iron stocks. The similarity in anchors from both regions during the 1st century CE can be seen between the Bulbury anchor from Dorset (Figure 6.3) and the Pompeii anchor from southern Italy (Figure 6.1). The anchors share many similar features, such as rectangular sectioned arms and stock holes for a metal stock (Cunliffe 1972:300; Ucelli 1950:239). The similarity of these two anchors suggests that iron anchor technology in northern Europe saw its origins in the Mediterranean.

Figure 6.1 (top left): Technical drawing of the Pompeii anchor, found in southern Italy and dated to 79 CE (from Ucelli 1950:239, removed due to copyright restrictions).

Figure 6.2 (top right): Technical drawing of the Villepey anchor, found off the French coast and dated to the early 2nd century CE (from Benoit 1960:45-49, removed due to copyright restrictions).

Figure 6.3 (bottom left): Technical drawing of the Bulbury anchor, dated to the early 1st century CE (from Cunliffe 1972:301, removed due to copyright restrictions).

Figure 6.4 (bottom right): Orthophotograph of the 1st – 2nd century CE Priestside anchor from Scotland (photogrammetry by Author, with the permission of Dumfries Museum and Camera Obscura, Dumfries).

The proximity and contact between the Roman Empire and northern Europe further suggests that iron anchors were adapted by local cultures in the region based on Mediterranean designs (Cunliffe 2005:480; Bill 2011:170). This evidence is seen archaeologically, with examples of Roman anchors in the Mediterranean from the 1st century BCE onwards using a style similar to the Bulbury and Pompeii anchor (Benoit 1958:26; Benoit 1960:48). Although Viking anchors share many similarities with contemporary Mediterranean anchors, there are differences in design between the two regions. These differences include the use of an anchor chain to moor the anchor, as seen with the Bulbury anchor. This contrasts with the Mediterranean tradition of using rope. It is suggested in Caesar's *Comentarii de Bello Gallico,* along with archaeological evidence that iron anchors may have already existed in northern Europe, and then adapted by the cultures of the region to better serve the conditions of the North Sea and English Channel (Caesar 3.13).

Cunliffe (1972) has suggested the use of iron chain with a fully iron anchor would overcome the issue of an anchors stock rising while moored and dislodging flukes from the seabed (Cunliffe 1972:302). These reasons may have led to local cultures of northern Europe adapting iron anchors to be used with chains for use in the more volatile waters of the North Sea, allowing the anchor to be firmly moored from the weight of the chain and overcome the issue of the anchor dislodging.

Northern European anchor design diverges from Mediterranean anchors from the 4th-5th centuries CE on. Anchors used in the Mediterranean from the 4th century CE onwards developed to have no crown-hole and straight arms that run parallel to the shank (Figure 6.5) while retaining an iron stock. (Joncheray 1975:116-118; Joncheray 1977:7; Eliyahu et al 2011). In contrast, the contemporary Nydam anchor retained its curved arms and possessed a wooden, fastened stock (Rieck 2004) in contrast to developments in the Mediterranean. The style of the Nydam anchor appears to have originated in Scandinavia, and there appears to be a Nordic influence prevalent from the 4th century CE onwards.

Figure 6.5: The arms/shank bottom of the anchor from the Dramont F shipwreck in France, showing its flat arms and prominent crown. Dated to the 4th century CE (from Joncheray 1977:7, removed due to copyright restrictions).

Cultural and Economic Influence on Iron Anchor Design: Scandinavia

Due to the limited archaeological evidence for iron anchor technology outside of Scandinavia, determining the influence the region had on iron anchor technology in northern Europe is difficult. The only Viking-era anchor to be found outside Scandinavia is the 9th century CE Blackfriars anchor, which has forms and features like those found on contemporary Viking anchors. It is unknown if the anchor was vernacular, or used on a Scandinavian vessel moored on the River Thames, but its presence in Viking/Anglo-Saxon London suggests at least a connection between the maritime technologies used in Scandinavia and the British Isles (Marsden 1994:162).

While the extent of Scandinavian influence on anchor design cannot be ascertained through anchor finds alone, the influence of Viking culture in the region can be seen in other sources. Viking settlement and assimilation throughout northern Europe has been well-documented (Hadley and Richards 1997; McGovern 1990; Sawyer 1971) and the earliest and the most intense settlement occurred in Iceland and across the British Isles (Figure 6.6). The impact of Viking raiding on the English kingdoms was significant. The Viking's dominance of seafaring enabled huge successes in raiding and occupying much of England and the Scottish Isles (Williams 2011). In response to these gains, the Anglo-Saxon kingdoms, in particular the Kingdom of Wessex under Alfred the Great went to great effort to build and improve their navies to ward off Viking raiders (Abels 1998:305). Viking longships heavily influenced the ships built by Alfred. The widespread use of the longship for offense and defense to counter Viking raids in Britain reflects the extent to which Viking shipbuilding altered vernacular seafaring practices.

Figure 6.6: The temporal and spatial extent of Viking settlement and raiding in Europe (Washington Post 2014, removed due to copyright restrictions).

Extensive archaeological evidence exists of Viking settlement across the Scottish Isles, Ireland and eastern England. Viking burials at numerous sites in Dublin corroborate primary literary source evidence of Viking rule in the area during the 9th - 10th centuries CE (Downham 2008:22-23). Across the Viking *Danelaw* in England, there is archaeological finds of Viking rule. This evidence ranges from hordes of Viking coins that were produced during the existence of the *Danelaw* (Figure 6.7) to evidence of settlement layout and Anglo-Scandinavian artefacts (Richards 2011:46-61). In the isle of Skye, the site of Rubh' an Dùnain (Figure 6.8) is notable for evidence of Viking settlement and seafaring (Dixon 1990). A small, shallow loch in the area had a canal and quay system constructed between it and the Irish Sea, allowing vessels to harbor in the loch. This canal is attributed to the Vikings because of evidence and interpretation of a 12th century CE ship timber of Viking ship design found in the loch, indicating the canal was active from at least the 12th century CE.

Figure 6.7: A Scandinavian coin imitating King Alfred's monogram type.
One of the earliest dated coins found in the *Danelaw* (Fitzwilliam Museum 2017, removed due to copyright restrictions).

Figure 6.8: The location of Rubh' an Dùnain on the Isle of Skye in red (Historic Environment Scotland 2013).

Its design suggests that Viking clinker-built vessels were harboured in the loch from at least the early 12th century CE (Dixon 1990). The presence of this ship timber and construction of the canal and quay system of Rubh' an Dùnain (Martin 2009:92) all suggest a significant investment by Viking seafarers to exert control of the Scottish Isles. All this evidence reflects the significant level of Viking activity, including both raiding and settlement, occurring in the British Isles. Ethnographic evidence further contributes to understanding of the extent Viking cultures settled across the British Isles. Ethnographic evidence ranges from place names that have a Scandinavian origin in areas like the Isles of Orkney and Shetland (Cowan 2011:37) to the term *Danelaw,* used as early as the 10th century CE to describe the areas of Anglo-Saxon England under Viking control (Holman 2001:1-2). The impact that Viking settlement had on seafaring and culture in the British Isles suggests that the strong connection between the cultures of Scandinavia and Britain.

Primary source information about the influence of Viking shipbuilding technology on the British Isles can also be seen in development of vernacular watercraft in the region after the initial Viking invasion. The *Birlinn* (Figure 6.9) is a type of watercraft that was locally built and used in the Hebrides for over 800 years. It appears in primary literary source writing and imagery from the earliest period of Viking settlement to as late as the early 18th century CE (McCarthy et al 2015:17; McWhannell 2002:14-26). Its design is heavily influenced from Viking longboats, with a long, slender hull profile, clinker planking, a single-mast, and square sail (Rixson 1998).

Figure 6.9: Carving of a *Birlinn* on the tomb of Alexander Macleod, 16th century CE (Clan Donald Heritage, removed due to copyright restrictions).

The Bayeux tapestry again is a significant primary literary source for understanding medieval seafaring in northern Europe. The vessels depicted are vessels that are designed in the traditional Viking style, with most of the vessels either being longships or *knarrs* (Figure 6.10). The date and place of creation of the Bayeux tapestry is important, because it reflects the extent at which Scandinavian style vessels were adapted across northern Europe. The proliferation of this ship type in northern Europe is also extensive temporally, as seen in the longevity of its use in the Hebrides (McWhannell 2002:15).

Figure 6.10: A scene from the Bayeux Tapestry depicting Norman ships sailing to England (Scene 1J, Bayeux Museum, Bayeux, removed due to copyright restrictions).

6.3 Future Work and Recommendations

To establish an anchor typology for medieval northern Europe which is accurate and comprehensive, new forms of analysis and absolute dating need to be applied on existing anchors that are suspected to be Viking/medieval. In addition, an effort to find and identify archaeological examples of anchors that can be contextually dated would also be beneficial. In addition, Relative dating systems such as a typology can be improved with a combination of absolute dating techniques. The more corroborating sources of evidence that can point to an anchors date and place of origin; the more accurate an approximate date for the construction of an anchor and the location where anchors iron originated from can be obtained. The Mediterranean anchor typology was developed over the course of decades by numerous contributors, with each relying on new finds and methods of dating to improve the typology. If the same effort is applied to developing an anchor typology in northern Europe, it will become increasingly accurate and reliable as a means of relative dating.

Two forms of absolute dating have the potential to improve interpretation of existing anchors that are believed to be Viking or medieval. Firstly, metallurgical analysis of an iron anchor would involve measurement of several properties relating to its creation and the materials used to make it. This includes analysis of the iron's carbon content, types of welds used by a blacksmith to create the anchor, the amount of slag metal in anchors structure and the homogeneity of iron and slag in the anchor. This method of analysis has been used multiple times on Viking-era anchors in Scandinavia (Buchwald 2005:296-298) and is useful for providing contextual information about an anchor. Analysis of an anchor's iron carbon content and the chemical composition of slag metal can indicate what method of firing was used to create the metal of the anchor. In northern Europe, bloomery furnaces were used through the middle ages until the 14th -15th century CE, when the invention of the blast furnace begun to replace bloomer furnaces (Tylecote 1992:76-77). Using this form of analysis can help determine whether an anchor was produced during the middle ages or later (Buchwald 1998:87-89). Analysis of the welding methods used to create an anchor can further help to provide a date and place of origin for an anchor.

Using comparative analysis with dated Viking/medieval anchors with identical welding patterns can provide a rough date and place of origin for the construction of an anchor.

Finally, analysis of the slag metal used in an anchor and its chemical composition can reflect the composition of the ore used to create the anchor, providing a geographic origin for the iron in the anchor. Archaeometallurgy utilizing trace metals analysis has been carried out on a number of the anchors presented in this study, as has been particularly useful in determining the geographic origin of the material used to create them (Buchwald 2004:183-185). Radiocarbon C14 analysis of an anchor can provide an even more accurate date for its creation. Radiocarbon C14 analysis of iron objects was initially developed and proven in the late 1960's (Van der Merwe 1969). If the material used for fuel in a furnace contains carbon, such as charcoal, carbon is absorbed into the object being manufactured during the firing process (Cresswell 1992:898). The carbon content absorbed into the iron is very low, between 0-4% depending on the smelting process (Oinonen et al 2009).

Radiocarbon dating using accelerometer mass spectrometry (AMS) can be used to analyse these trace amounts of carbon present in the iron, with the required amount of carbon necessary reducing as the technology improves. This method of dating for anchors that are potentially Viking/medieval in origin could prove immensely useful in either confirming or contradicting these notions. Despite the potential of these absolute dating methods, most of the anchors analysed in this study have not had metallurgical or radiocarbon analysis performed on them, hence the absence of these methods in this study.

Case Study: Absolute dating and typological assessment of the Camuscross anchor from the Isle of Skye, Scotland

The case study of the Camuscross anchor shows the benefits of absolute dating methods combined with typological assessment. When initial archaeological work on the Camuscross anchor began in 2013-2014 (McCarthy et al 2014), the damage and corrosion on the anchor meant that the anchors physical features provided little interpretative information to date the anchor. Evidence that could be used to date the anchor was restricted to the stratigraphy of the area it was found in, and the method of construction used on the anchor, which was revealed through x-ray scanning the anchors shank/arm transition (Figure 6.11).

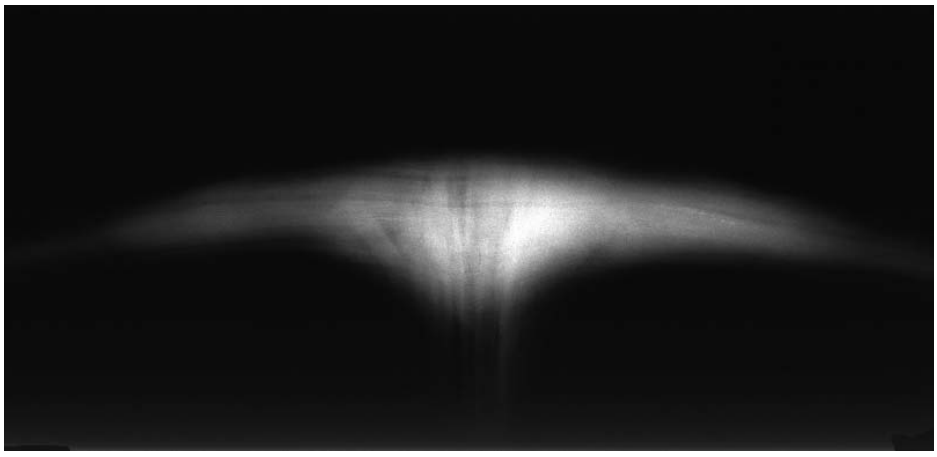


Figure 6.11: X-ray image of the Camuscross anchor, showing how the anchors shank and arms were joined (from Roberts et al 2014:37).

The date of the anchor was estimated by roughly dating the 60cm thick blanket peat beneath which the anchor was deposited, using an annual peat formation rate of 0.001m (Keddy 2010:193). Using this peat formation rate as the basis for dating, the preliminary estimate made for the date of the anchor was at least several centuries old, likely 15th century CE (Roberts et al 2014:38), but the first recommendation for future work was to pursue detailed typological and metallurgical analysis. Typological assessment of the Camuscross anchor was carried out in 2017, which highlighted several diagnostic indicators about the anchors date and origin. The anchor has curved arms, a feature common to both types of Viking anchors. At 1.0m long and 0.484 wide (arm to arm), the anchor is the same general size as early 9th-century CE Viking anchors. The x-ray imagery taken of the anchors shank and arms in 2014 also contributed to the typological assessment of the anchor, revealing the metallurgical methods used to bind these two parts together.

Viking anchors, such as the 8th-century CE Ribe anchor have a similar welding method to the Camuscross anchor, as they were not fully forged in a single process (Buchwald 2005:297). However, the method of binding the shank to the arms is different in examined Viking anchors from what is seen in the Camuscross anchor, with the anchor's shank and arms being forged separately, then joined by 'folding' the shank around the anchor arms (Roberts et al 2014:37; Jouttijärvi 2017:6).

An unpublished technical report by Heimdal Archaeometry discusses metallurgical analysis undertaken on the Camuscross anchor in 2017. Examination of the homogeneity of the anchor's iron and slag metal content revealed that the anchor would have been forged in a bloomer furnace, making the likely date of manufacture no later than the 14th century CE, aligning with the interpretation made in 2013-2014 from site interpretation. Further analysis of the slag metal indicated that the ore source for the anchor's iron is from either northern Germany or Jutland (Figure 6.12). In addition to analysis of the content of the metal in the anchor, detailed analysis of the welding patterns and smelting technology used on the anchor revealed that the anchor was likely to have been made later than the Viking period (Jouttijärvi 2017:1).

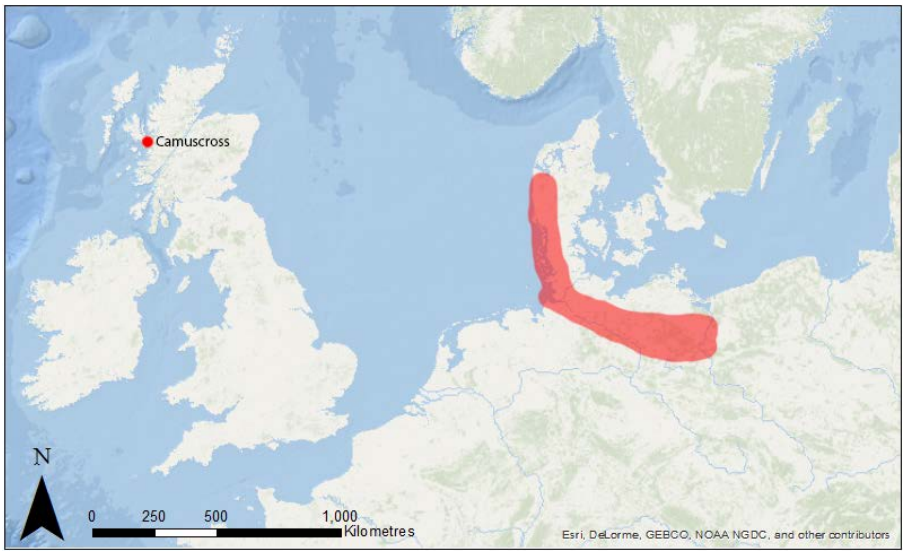


Figure 6.12: The most likely area of origin for the iron used in the Camuscross anchor, highlighted in red (Image by Author, ESRI after Jouttijärvi 2017:12).

The interdisciplinary approach taken to date the Camuscross anchor combined both relative and absolute dating methods, which has demonstrated the benefit of a combined approach to dating anchors. The anchor was found out of context and possessed few physical characteristics interpret its date. However, based on the anchors shape, interpretation of its position in the peat layer, and the metallurgical methods used in its creation, a date ranging from 11th century CE to the 14th century CE can be given to the anchor. Future radiocarbon dating of the anchors iron could prove that many of northern Europe's undated anchors could be dated to time of construction and geographical origin using these methods. Assigning a reliable date to an anchor also contributes to improving relative dating methods and typology. This, in turn presents a clearer picture of the chronological development of anchors in northern Europe.

7. Conclusion

Iron anchors used in northern Europe from the 1st to the 14th - 15th century CE display a gradual development in size, shape and other design features. The design of the earliest iron anchors in the region most likely was either based on or heavily influenced by Mediterranean-style iron anchors. The features most indicative of this influence are angled arms and an iron stock that runs through the anchor's shank. Other features indicative of early iron anchors are a shank and arms with rectangular cross sections and a lack of flukes. Although no iron anchors between the 4th - 8th centuries CE still exist, archaeological literature describing the 4th century CE Nydam anchor suggests that by at least the 4th century CE, northern European iron anchors began to be take on a different shape and design from contemporary Mediterranean anchors. This evidence is from the 4th century CE Nydam anchor, which is described as having curved arms (Engelhardt 1865). In addition, wooden stocks found at the Nydam bog site further suggest an abandonment of iron stocks in favour of wooden stocks that were fastened around an anchors shank. These two design features continue to be present on iron anchors throughout the study period of this thesis (CE 750 – 1300). Anchors at the beginning of the study period are small, with no flukes and triangularly cross sectioned arms (Section 5.3.1). These attributes begin to change in the 10th century CE when a number of developments can be observed in anchor design (Section 5.3.2). Anchors become larger in size, the cross section of an anchor's arms becomes rectangular and the first true flukes are introduced to iron anchors. Arms with a rectangular cross section continue to be present on anchors to the end of the study period and into the 14th century CE, but the size of iron anchors and the definition in anchor flukes continues to increase. By the end of the study period, anchors are large, at least 2 metres long, and possess large, triangular flukes (Figure 5.17). Primary source literature suggests that after the 14th century CE, anchors continued to increase in size, in some cases measuring several metres long and weighing up to a ton (Friel 1995). Primary source imagery shows that anchors of the 14th – 15th centuries CE continue to have the same design that anchors at the end of the study period had.

There appears to be external cultural influences behind the design, and change in design, of iron anchors throughout their development. Iron anchor technology was most likely brought to northern Europe (Cunliffe 1972) in the 1st century CE from contact with the Roman world, although primary literary evidence suggests a possible vernacular origin for this technology. A vernacular shipbuilding tradition persisted in the region (Unger 1980:55-56), but archaeological evidence points to several maritime technologies or shipbuilding styles used in northern Europe during the 1st and 2nd centuries CE that incorporate Mediterranean-style designs (McGrail 2014:123-134). Amongst these shipbuilding methods are a Mediterranean-style anchor, which is also the earliest archaeological evidence for iron anchor technology in northern Europe. Scandinavian cultures, predominantly the Viking culture, also appear to have had a large influence on anchor design during the middle ages. Although the record of medieval iron anchors in northern Europe is limited, there is a consistency in the design and development of anchors found in the region. The most consistent features of this anchor design are curved arms, a crown ring hole and a wooden, fastened stock.

The earliest examples of northern European anchors with these attributes exist in Scandinavia, with the 4th-century CE Nydam anchor possibly the earliest example of Viking-era anchor design. The 8th - 9th century CE Ribe and Oseberg anchors are the earliest still-existing examples from the Viking period that have these characteristics. Viking-period anchors found in the British Isles and across the continental north all have similar design features, indicating that anchor types from the Nordic tradition had a strong influence on the design of anchors throughout the region.

In order to create a reliable, chronological typology for anchors in medieval northern Europe, more anchors are needed from the region and further work is required on existing anchors. Currently, there are large gaps in the archaeological record for iron anchors in the region, especially for the later medieval period (12th-15th centuries CE). Existing anchors that are undated, but are believed to be Viking in origin, can be subjected to absolute dating such as metallurgical analysis and new techniques which apply radiocarbon analysis to fabrication methods. This will allow an approximate date that is far more reliable than comparative analysis alone, particularly given the limited number of reliably dated Viking anchors that exist. Anchor finds dated using these methods could be incorporated into the anchor typology, which could both corroborate their dating and strengthen the typology and its chronological sequencing.

This study has unearthed new questions that will benefit future studies related to anchor development in medieval northern Europe. Why was the Mediterranean-style anchor adopted in the 1st century CE, and then later abandoned in the 4th century CE; what factors drove anchor design from Viking Type 1 to Type 2, in the 10th century CE; and how can the anomalous design of the 8th-century CE Ribe anchor be explained (does it represent a separate trend-line in anchor development, does it require lowering the introduction date for Type 2 anchors, or is it simply illustrative of the insufficient number of anchor finds)? This study has introduced a framework in which future studies relating to anchors in northern Europe and their development can be contextualized, using the parameters for certain types of anchor designs to help identify and interpret future anchor finds. This will allow for a better understanding of the development of iron anchor technology, and their cultural drivers, in medieval northern Europe.

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Appendices

Appendix A: Medieval Iron Anchor Database

Name	Location of find	Anchor date (approximate)	Anchor type (Adapted from Kapitän 1984)	Date of find	Current Location	Length	Width (between arms)	Weight	Shank cross section shape	Arm cross section shape
Bulbury anchor	Bulbury Hillfort, Dorset	mid-1st century CE	Type A, Pre-Viking	1881	Dorset County Museum	1.44m	78cm	N/A	rectangular	rectangular
Priestside anchor	Priestside, Scotland, UK	Roman (1st-2nd century CE)	Type A, Pre-Viking	1888	Dumfries, Scotland	84.6cm	59.6cm	N/A	rectangular	rectangular
Nydam anchor	Nydam Bog, Øster Sottrup, Denmark	3rd-4th century CE	Type B, Pre-Viking (Based on excavation notes)	1863	N/A, Destroyed or lost during Second Schleswig War	N/A	N/A	N/A	N/A	N/A
Oseberg ship anchor	Oseberg Ship Burial Mound, Oseberg, Norway	820 AD	Type B, Viking Type 1	1903	Viking Ship Museum, Oslo	1.04m	66.8cm	9.8kg	rectangular	triangular
Blackfriars' anchor	Blackfriars, London, UK	9th - 11th century CE	Type B, Viking Type 1	1969	Museum of London, London	60cm (DAMAGED)	90cm	14kg	rectangular	triangular
Ness anchor	Ness ship burial, Hamaroy Nordland, Norway	mid-9th - mid 10th century CE	Type B, Viking Type 1	2011	Tromsø Museum	1.00m	50cm	N/A	rectangular	triangular
Strø Molle anchor	Strø Molle, Zealand, Denmark	Possibly 9th century CE	Type B, Viking Type 1	1887	National Museum of Denmark, Copenhagen	1.19m	71.4cm	N/A	rectangular	triangular
Ribe anchor	Ribe, Norway	AD 750-800	Type B, Viking Type 1/2	1974	Viking Ship Museum, Ribe	1.5m		27.5kg	rectangular	triangular
Ladby ship anchor	Ladby Ship Burial, Ladby	900 AD	Type B, Viking Type 2	1935	Viking Ship Museum, Oslo	1.36m	84cm	27.95kg	rectangular	rectangular
Vestnes anchor	Vestnes, Norway	10th-11th century CE	Type B, Viking Type 2	1985	N/A	2.02m	1.25m	36.4kg	rectangular	rectangular
Sigtuna anchor	Lake Malaren, Sigtuna, Sweden	1100 AD	Type B, Viking Type 2	1961	N/A	1.69m	82cm (Damaged)	25kg	rectangular	rectangular
Arkona anchor fragment	Mecklenburg-Vorpommern, Arkona, Germany	11th century CE	Type B, Viking Type 2	2015	Landesamt für Kultur und Denkmalpflege Mecklenburg-Vorpommern	40.5cm (FRAGMENT)	20.2cm (hypothesised)	6.2kg	rectangular	N/A
Kalmar anchor	Slottsfjärden, Kalmar, Sweden	13th century CE	Type B, Post-Viking	1934	N/A	N/A	N/A	N/A	rectangular	rectangular
Chapelle de Prigny Marine Anchors (x3 anchors)	Chapel grounds of Chapelle de Prigney, France	Unknown, possibly 13th-14th century CE	Type B, Post-Viking	1871	Chapelle de Prigny & Musee Dobree, Nantes	Between 2.2-2.3m	Between 1.1-1.2m	N/A	rectangular	rectangular
Hamme Anchor	Scheldt River, Hamme	Unknown possibly 13th-14th century CE	Type B, Post-Viking	1953	Van Bogaert-Wauters Museum, Hamme	0.98m	59cm	N/A	rectangular	rectangular
Camuscross Anchor	Camuscross, Isle of Skye, Scotland	14th - 15th century CE	Type B, Unknown (Post-Viking?)	2009	Museum of the Isles, Skye	1.00m	48.4cm	N/A	N/A	N/A