

Central Transit Places: The Archaeology of Man-Made Navigable Waterways in Iron Age
Scandinavia A.D. 400–800

Anthony B. Del Rio

A Thesis in the Fields of Anthropology & Archaeology
for the Degree of Master of Liberal Arts in Extension Studies

Harvard University

March 2020

Abstract

Man-made navigable waterways within the Scandinavian homelands during the Migration Period (A.D. 400–550) and Late Germanic Iron Age (A.D. 550–800) are remarkably rare and represent significant investments of human capital comparable to other contemporary monumental construction projects such as the Danevirke fortifications in northern Germany. The Migration Period Spangereid Canal in southern Norway and the Late Germanic Iron Age Kanhave Canal on the Danish island of Samsø are the only two examples of native prehistoric Scandinavian canals known to exist. Previous studies consist of localized research confined to each canal site region and reflect compartmentalized investigations of the socio-political organizations of Migration Period Norway and Late Germanic Iron Age Denmark. The archaeological, artefactual, literary, and linguistic segregation of Spangereid and Kanhave canal site research hinders consideration of possible connections to the materialization of power concentration and central place formation in the broader cultural landscapes of southern Scandinavia.

This research consists of an examination of the Spangereid and Kanhave canals within the contexts of power concentration and central place formation while considering several hypotheses. The first is that power was linked to places where a large amount of resources were allocated to develop the physical landscape. The second considers whether massive undertakings such as canal sites required the leadership of a single unified central authority to exist. The third contemplates whether such a central authority used a strategy of “social mechanics”, whereby the canal sites were created as

“mechanisms” for the purposes of integration and control. Finally, the thesis hypothesizes that the canal sites should be considered as “central transit places” in the prehistoric Scandinavian landscape.

Employing a multidisciplinary theoretical framework that juxtaposes archaeology with Old Norse sources, historical documents, toponymy, and geology to gain a *longue durée* perspective, the thesis looks to account for methodological problems associated with traditional mono-theoretical frameworks, such as those used in previous site-specific studies. The interpretations in these studies are typically based on small-scale investigations, which focus on singular types of evidence. By contrast, the present study’s framework includes a larger breadth of evidence than has previously been applied to the study of Scandinavian canal sites, and enables a multi-angled, long-term interpretation of their culture areas.

The application of this multidisciplinary theoretical framework demonstrates that the areas in which the canal sites of prehistoric Denmark and southern Norway were constructed were highly valued by both local and distant Scandinavian populations. Status grave sites, fortifications, building remains, textiles, prestige goods, and a continual usage and growth of the surrounding landscape in the following centuries mark the canal sites as social focal points within each region. The amount of labor and resources required to construct the canals during the 5th and 8th centuries, and their subsequent disuse in the following centuries, demonstrate not only that political change was rapid both in Denmark and southern Norway, but also that the canals were at points valuable enough to merit the continued investment of human capital. Danish territories in particular, influenced by their vicinity to neighboring continental states, internal and

external conflict, and evolutions in international trade, exhibited the most comprehensive and accelerated political changes. The Spangereid Canal in southern Norway shows the most developed ground plan in the immediate vicinity of the canal site, with centuries of continual habitation and construction developments in the form of boathouses, homes, and status graves. The first five phases of the Danevirke were contemporary with the Spangereid Canal's use and the Kanhave Canal's construction, suggesting that central authorities were already wielding their power to create social, labor-intensive engineering works in the Scandinavian landscape.

This study supports and furthers the model in which authorities of greater and lesser Scandinavian regions used "social mechanisms" to gradually coalesce polities through the domination of local and regional trade, the re-orienting of social focus, and a restructuring of their regional landscapes by way of investments in construction projects such as canals.

Frontispiece



Dedication

This thesis is dedicated to my children—the very best parts of me.

Acknowledgments

I could not have completed this project without the tremendous perpetual support of my family, friends and colleagues, both in and out of academia. I did not arrive here alone, and so it is with great humility that I wish to thank and honor my parents, who, through their examples gave me a foundation of hope, and instilled in me the belief that I can achieve any dream with grit and patience.

This thesis could not have been possible without the unyielding support of my thesis director, Professor Stephen Mitchell, who over these many months tirelessly advised me, revised drafts, and provided patient guidance, which lay the foundation for my future as a scholar and archaeologist. It was his earnest and passionate appreciation for ancient Scandinavian works of literature and lore that excited my own curiosity, and imbued in me a deep affection for the language of the past. Steve has been an irreplaceable mentor to me, and his thoughts, advice, and friendship are more valuable to me than any words can express.

I wish to thank my friends and colleagues at Harvard, including my thesis research advisor Professor Donald Ostrowski for helping me to focus the scope of this research, Chuck Houston for his indispensable counsel through the years, Professor Ari Caramanica for her thoughtful guidance in my pursuit of a PhD, Abigail Bernard for her encouragement, and for reading and commenting on early drafts of this project, and all others who although not mentioned by name, contributed their time and expertise on

archaeology, Scandinavian prehistory, and on the various scholarly disciplines necessary for this paper's completion.

It is with immense gratitude that I thank my friends at Aarhus University and the Moesgaard Museum for teaching me what it means to be an archaeologist, and for seeing how dear archaeology is to me. Dr. Peter Jensen, Dr. Peter Hambro Mikkelsen, Professor Pernille Hermann, Mr. Christian Adamsen, and Dr. Peter Mose Jensen inspired and encouraged me to take archaeology as far as I can. It was on Samsø that I realized without question that my future lay in the past.

Finally, for the financial support that I received while completing this project, and throughout my time as a student at Harvard, I am forever indebted to the United States Navy, and to the Navy SEAL Foundation. I wish to especially thank those uncommon men who fill the ranks of the SEAL teams – who believed in and supported me through all of our years together. You will always be my brothers, and it is because of you that I am here today, ready for the next mission.

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–Part 1–

Scandinavian Canal Sites in Context

Chapter 1

Introduction to Scandinavian Canal Sites

This thesis offers a new interdisciplinary perspective on the study of prehistoric Scandinavian canals. It focuses on the ways in which Migration Period (A.D. 400–550) and Late Germanic Iron Age (A.D. 550–800) Scandinavians consolidated authority, altered the physical landscape, and interacted with neighboring territories through complex maritime trade networks. This introductory chapter presents two identified prehistoric Scandinavian canal sites, reviews existing knowledge on the study of prehistoric artificial navigable waterways, and develops the overarching aims, methods, and structure of this research. Section 1.1 Canal Sites introduces the subject of this thesis, defining the term “canal”, outlining the current knowledge on such sites, and presenting a brief overview of the two prehistoric man-made canals identified within the Scandinavian homelands. In Section 1.2 The Study of Prehistoric Canals, I present an overview of the development of canal studies in general, as well as the theoretical approaches taken thus far to interpret the findings. Finally, in Section 1.3 A Comparative Study of Scandinavian Canal Sites, I discuss the scope and structure of this thesis, presenting a range of perspectives to use in reconsideration of the Scandinavian canal sites.

1.1 Canal Sites

The term “canal” indicates a manmade navigable waterway that provides a line of conveyance from one transition zone in a transportation network to another. Canal construction is an artificial modification of the land that requires centralized oversight,

technology, a relatively high amount of human capital, and economic resources (cf. Blair 2007a; Bond 2007, 155–57; Ellmers 2007; Westerdahl 2006).

Canals are primarily characterized by their fairway trenches. Fairway depths and cross-section widths were dependent on the sizes of vessels requiring their use (cf. Blair 2007a, 4, who compared English canal and vessel cross-sections). Technical layout and longitudinal profiles provide a more comprehensive classification. For example, the technical requirements of a canal that connects two bodies of water are dependent on the homogeneity between their water levels. The layout of the Scandinavian canals presents two cases where the fairway depths were dependent on balancing the mild fluctuations between water levels at each connection point.

In most cases, canal earthen walls were shaped similarly to a ship's hull, with sidewalls that diverged outward as they rose from the trench bottom and were often reinforced with horizontal timber planking commonly buttressed by vertical stakes. Canal fairway lengths vary regionally, but the Scandinavian canals were cut within areas requiring approximately 250-500m of fairway to connect their respective bodies of water together.

Prehistoric northern European canal sites in general are unique and are interpreted as significant sites within the cultural landscape. In both the Spangereid and Kanhave canal cases, the sites are considered elite locations—an interpretation based primarily on the inherent socio-political requirements of such monumental undertakings.

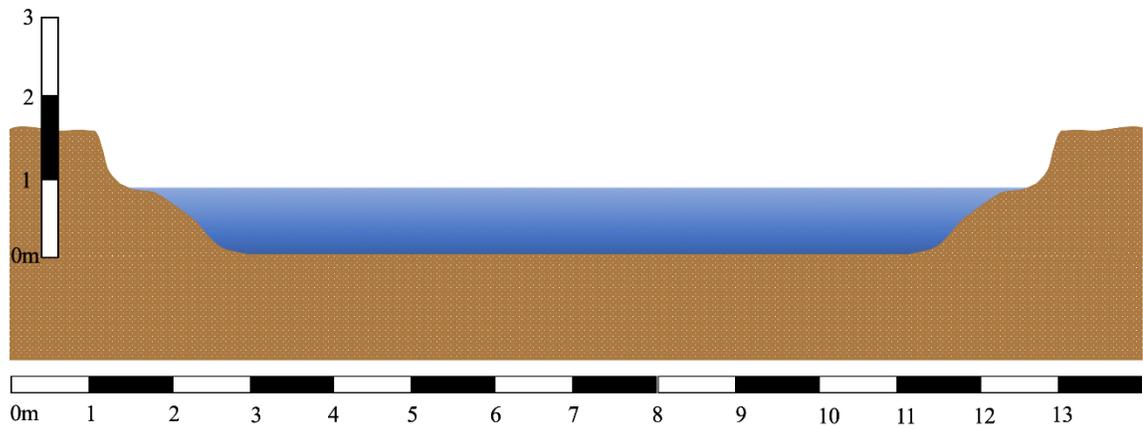


Figure 1.1. Simplified cross section of the Kanhave Canal.

(Based on Nørgård Jørgensen 2002)

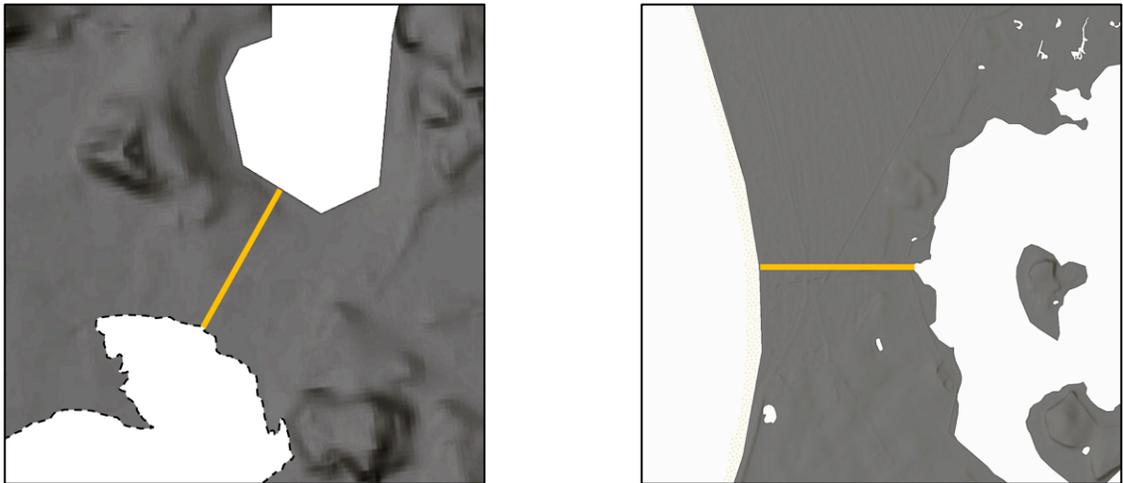


Figure 1.2. Spangereid (left) and Kanhave (right) as "shortcut" or "parallel" canals.

The Spangereid and Kanhave canals share similar technical characteristics, and may be classified as “parallel” or “shortcut” canals due to their configurations linking two bodies of water together (Carnap-Bornheim et al. 2018). These types of canals are meant to provide passage around obstacles or to diminish transit time by serving as connection nodes between naturally established waterway hubs present within transit networks.

1.1.1 Scandinavian Canal Sites

The two Scandinavian canal sites identified herein are the Kanhave Canal on the island of Samsø in Denmark, and the Spangereid Canal on the Lindesnes peninsula in southern Norway. The dating methodology for the canals was markedly different; whereas prehistoric water-level measurements were used to date the Spangereid to the Migration Period (A.D. 400–550), dendrochronological techniques were used to date the Kanhave to the Late Germanic Iron Age (A.D. 550–800). Both the Spangereid in Norway and the Kanhave in Denmark are recognized as the earliest examples of artificial waterway constructions in the Scandinavian homelands. The canal sites are considered to be identifiers of centralized authority, and the parallel chronology between the canal constructions and other elements within territorial defensive networks strongly suggest that the canals may have played a role in the emergence of centralized Scandinavian kingdoms.

Both the Spangereid and Kanhave canals represented gateways between two bodies of water, allowing local authorities to ease and encourage movement through their realm of control. These authorities could levy taxes from those wishing to pass through the canal as well as move their fleets more efficiently than they could by more common

methods of lifting, hauling, and portaging their ships overland. In a broader sense, canals represent healthy social and trade systems.

It is the scarcity of canal sites within the Scandinavian homelands that presents them as statistical outliers – further distinguishing them from other construction projects across the cultural landscape, including the Danevirke fortification system in Schleswig-Holstein, (part of modern Germany), and Germanic Iron Age pole blockages (sea defenses) of Margrethes Bro and Æ Lei in Haderslev Fjord (Lindblad et al. 2010, 76). The above projects are considered indicators of royal initiative, yet the essential motivations behind the construction of the Spangereid and Kanhave canals remains unclear. The further study of Scandinavian canals thus carries significant potential for understanding the emergence and development of centralized authority within the Scandinavian homelands.



Figure 1.3. The two identified Scandinavian canal sites discussed here.

Both the Spangereid and Kanhave canals were initially identified through a combination of historical knowledge kept within the collective memories of the local populations, aerial photography, and subsequent excavations. For example, the Spangereid Canal was known colloquially as “Groben” for many years,¹ but the exact

¹ The term “Groben” appears to be German for “course/rough” and may relate to the Norwegian term “gruven”, which means “mine” – as in “something excavated”.

location of the Migration Period (A.D. 400–550) canal was not identified until excavations began during the late 19th century (Stylegar 1999). It is thus likely that other canal sites exist within the Scandinavian homelands. However, prehistoric canal sites are often difficult to identify without prior knowledge of their existence due to the erosive nature of the coastal or fluvial geologies within which they were built.

1.2 The Study of Prehistoric Canals

Having broadly defined canals and outlined the Scandinavian sites, it is useful to begin with an overview of the development of canal studies, as well as the theoretical approaches taken to interpret the findings.

1.2.1 Archaeological Theory and Historical Approaches

The excavations of the Spangereid and Kanhave canals can benefit from processual interpretive approaches that go beyond the limitations of cultural-historical interpretations. Showcased in several papers that discuss the socio-political implications of large-scale construction projects within prehistoric Scandinavia, the Kanhave in particular has seen widespread acceptance as an icon of centralized royal power in Denmark (cf. O. Olsen 1989, 29; Roesdahl 1982, 39; Asingh 2005, 117).

The Kanhave Canal was first excavated in the 1960s by Danish archaeologist Hans Stilesdal and researched primarily by Kjeld Christensen and Anne Nørgård Jørgensen. Christensen's research was subsequently published as part of the volume *Stavns Fjord – et natur – og kulturhistorisk forskningsområde på Samsø* (1995), a work that brought together interpretations of the vast material data collected on Samsø up to that point. Christensen's study was focused on the form and construction of the canal,

with little attention given to written sources, and architectural details overpowered more broad interpretations as to why the canal was built.

The subsequent interpretive work of Nørgård Jørgensen furthered the generally accepted hypothesis that posited the Kanhave Canal was constructed as part of a larger military defense network instigated by centralized royal authorities based elsewhere in Denmark. This interpretation was largely due to a hypothesized connection to other contemporary large-scale engineering projects – or more specifically, the early phases of Danish defensive networks such as the Danevirke. In addition to the prevalence of the *snekke* place-name,² the presence of shipbuilding materials such as nails and loom weights (for producing cloth sails) within the archaeological record underline Samsø's naval character. The Kanhave Canal has thus often been considered by Danish archaeologists as a functional component of a larger defensive network attached to centralized royal power (Blair 2007a, 4; Nørgård Jørgensen 1998). This culture-historical approach has merit but is dismissive of the gaps present within the archaeological record, and further, it does not provide an explanation for the mechanisms by which change occurred on Samsø.

While the Kanhave site was cast as a location linked to militarized Danish royal authority, the Spangereid Canal site received a similar cultural-historical interpretation of its archaeology. Norwegian archaeologist Olaf Rugh first formally excavated the greater part of Spangereid during the late 19th century. Rugh's work revealed to a large extent the rich significance of greater Spangereid not only on the Lindesnes Peninsula, but also within Vest-Agder County in general. Rugh's findings were instrumental in forming the

² For a brief discussion of the *snekke* place-name, see below Section 2.4.

foundation for later interpretations by Norwegian archaeologist Frans-Arne Stylegar and German archaeologist Oliver Grimm. Stylegar and Grimm re-excavated the Spangereid site in 2001, subsequently publishing their findings and interpretations in several journals, including the extensive article *Das südnorwegische Spangereid – ein Beitrag zur Diskussion archäologischer Zentralplätze und norwegischer ringförmiger Anlagen* (2003). Stylegar and Grimm presented the immense amount of material data as a strong case for Spangereid to be entered as a candidate for central place status within greater Norway, noting that the town's significance was established from as early as the Late Roman Period (A.D. 200–400). Although their work, and subsequent studies of Spangereid that followed, focused broadly on the greater site rather than on the canal itself, their work and that of the Danish archaeologists on Samsø have contributed greatly to the discussion of Scandinavian maritime archaeology and central place studies in general.

1.2.2 Key Issues

Excavation reports and subsequent interpretations of findings from the Spangereid and Kanhave canal sites have been published, but the core similarities and differences between the canals have never been assessed – likely due to the compartmental nature of archaeological scholarship being composed and retained in different countries. To date, a comparative study between the Spangereid and Kanhave canal sites has not been conducted. Therefore, there exists little reference to identity, theme, or continuity in human behavior and agency at such sites. Thus, a synthesis of the evidence in comparison and context is required and remains the challenge that the present study intends to address.

Despite the breadth of knowledge that we possess about the Scandinavian Migration Period (A.D. 400–550) and the Late Germanic Iron Age (A.D. 550–800), knowledge of the fundamental nature of Scandinavian canals, their identification in the modern landscape, their spatial organization, and their manner of construction remains limited. These deficiencies are partly due to the fact that the study of Scandinavian canals has received limited focus since the research conducted by 19th and 20th-century archaeologists.

Finally, whereas other Scandinavian locations have been assessed through post-processual archaeological approaches (e.g. Hedeager 2001; Thurston 2010), there is a lack of theoretical interpretation to the canal sites, and the majority of the scholarship relating to them has taken a descriptive form rather than an interpretive approach. These shortfalls have led to the present state of affairs, where we are left without a way to explain *why* the canals were built. Engaging with these key issues is therefore the basis for the beginning of this thesis.

1.3 A Comparative Study of Scandinavian Canal Sites

This research takes a contextual and comparative approach to the study of prehistoric Scandinavian canal sites. The following section lays out the structure of the research, identifying the aims, and the methods used to address them.

1.3.1 Primary Aims

In this study I will explore (1) how Scandinavians may have constructed canals during the Germanic Iron Age; (2) what spatial patterns exist between the Kanhave Canal on the island of Samsø in Denmark, and the Spangereid Canal at Lindesnes in southern Norway;

and (3) whether or not the data indicate that Scandinavian canal sites were used as “social mechanisms” to centralize power across the maritime landscape, thus indicating a form of central place identity. Although the Spangereid and Kanhave canal sites are unique unto themselves due to environmental conditions, geological limitations, and spatially driven cultural distinctions, I intend to distill similarities and disparities amongst them through this research.

1.3.2 Methodology

This study examines an aspect of the Scandinavian landscape that has up to this point been somewhat neglected in Scandinavian archaeological studies and maritime studies in general. Thus, it now seems necessary to aggregate as many avenues of investigation as possible regarding the similarities (and dissimilarities) of canal sites in the prehistoric Scandinavian maritime landscape. A central aim here is to highlight material continuities between the presently identified Scandinavian canal sites with surveys of their surrounding landscapes to provide insight into their characteristics and themes, structure, scope, spatial organization, and development. Using this data, it may be possible to determine whether or not the locations of canals and harbors identify places of centralized power in the Migration Period (A.D. 400–550) and Late Germanic Iron Age (A.D. 550–800).

Central to this study is the notion that Scandinavian canal sites may have represented centers of gravity in the Scandinavian cultural landscape. That the sites could have been used by political leaders as “social mechanisms” to consolidate control over trade, local/regional economy, military strength, and perhaps even religious practices, is a concept worth investigating. When examining the prehistoric past, it is important to look

at the contextual material record (concerning artifacts as well as organic and environmental remains) as tangible clues to be used in conjunction with other non-material sources to develop a more complete understanding of past human activity. Understanding the cultural landscape is an important component in this process, as it allows archaeologists to analyze human behavior and interpret history from an objective perspective, influenced by both material and cultural aspects.

The canals and artificial waterways of Early Medieval Europe (A.D. 410–1066) are frequently co-located with harbors and supportive settlements, but the precise nature of such settings remains unclear. To fully understand the unique character of these construction projects, and how they impacted the greater maritime landscape, it is necessary to review northern European canal and harbor building activity throughout time and space.

Eighth-century Scandinavians possessed an advanced understanding of ship-construction, which allowed them to traverse shallower waters than their continental European contemporaries. Unfortunately for modern archaeologists, the shallow drafts of Scandinavian vessels also meant that fewer modifications to the natural environment were necessary for their transit or mooring, thus making contemporary efforts to identify harbors and canals more problematic. It is possible that Scandinavian canals doubled as harbors. The advanced design of clinker-built vessels allowed for a great deal of flexibility when beaching them along shores and waterways. With this understanding, I include an analysis of canal structure, including angles and compositions of their respective side slopes to analyze the probability that the canal sites not only served as avenues for maritime transit, but also as anchorage points (Section 4.4.1).

It is generally accepted that the maritime culture of Scandinavia relied on sea-routes and inland waterways to traverse the austere landscape of northern Europe. Often requiring innovative methods to exploit the inner-country waterways and fjord systems, Scandinavians portaged their ships over land, but also occasionally created canals. These transportation systems allowed Scandinavians to circumvent dangerous sea routes, consolidate military forces and expedite movement, collect taxes and tribute, shorten voyages, and disregard wind conditions necessary for sea travel. What is not known is the extent of the global maritime power structure at each canal site. The material record indicates trade (or piracy) with surrounding regions of the period, a concept supported by the excavation of artifacts relating to the Roman, Frankish, and Arabic worlds.

A number of place-names surrounding the maritime environment involve not only the names of Scandinavian deities, but also specific ship types; one example being the toponym *snekke* as it appears in two locations at Spangereid (Section 2.4.1), and nine locations on Samsø (Asingh 2005, 115) (Section 2.4.2). The literary record is rich in place-names, as well as accounts of human activity relating to the regions investigated here. Thus, it is necessary to include documentary evidence such as Roman accounts, Icelandic saga literature, later historic chronicles, and other informative literary sources as they pertain to the canal sites. The works of Snorri Sturluson, Tacitus, Saxo Grammaticus and other early authors provide fragments of information that, when combined, present a relatively cohesive narrative of events.

A small note on language and terminology: The Old Norse (*ON*) personal names and terms used in this thesis are not translated into their English (*Eng*) equivalents and are presented in their nominative forms, e.g. Óðinn in lieu of Odin and *berserkr* in place

of Eng berserker.³ Included here are modern locations and names that have ON equivalents and that are represented in their ON forms when referring to them as they existed during the Germanic Iron Age. For example, modern Samsø is known in the ON texts as “Sámsey”. When referring to the island in general, I will maintain the modern Danish form “Samsø”, but when referring to the island as it is depicted in the ON literary source material, I will maintain the ON form “Sámsey”. Additionally, rather than changing the nominative noun forms to those of the genitive when English grammar would traditionally dictate, I have chosen to hold the ON nominative endings, and pluralize the noun in English (adding an *apostrophe s*) when possession is indicated, e.g. Óðinn’s in place of genitive ON Óðins. Moreover, I have chosen to maintain the character form ƿ instead of ö when referring to ON proper names and information derived from literary source materials. These choices are primarily meant to ease readability and preserve the continuity of this study.

Regarding time-period terminology, the Scandinavian divisions of the western European Early Medieval Period (A.D. 410–1066) generally vary by region and are traditionally periodized as the “Migration Period”—also known as the “Early Germanic Iron Age” (A.D. 400–550), the “Late Germanic Iron Age” (A.D. 550–800),⁴ and the “Viking Age” (A.D. 800–1050). In Norway, the Late Germanic Iron Age is referred to as the Merovingian Age, named for the dynasty that ruled much of Francia from ca. A.D.

³ In the case of more than one *berserkr*, I will maintain the ON nominative plural form *berserkir* (Eng berserkers). Additionally, the ON singular *berserkr* is equivalent to Norwegian (Nwg) *berserk*. However, in this thesis, the term “berserk” will be used to indicate social status or class, i.e. “berserk brothers” (a group of brothers who belong to the (Eng) berserker warrior class).

⁴ The broader time-period encompassing both the Migration Period/Early Germanic Iron Age and Late Germanic Iron Age/Merovingian/Vendel is generally referred to simply as the “Germanic Iron Age” (A.D. 400–800).

476 to 750, a period prior to the consolidation of the Frankish kingdom under Charles Martel during the early 8th century. While Denmark retains the periodized naming convention “Late Germanic Iron Age”, this time-period is referred to as the Vendel Period in Sweden. For the purpose of consistency in this thesis, I will maintain the terms “Migration Period” when referring to the Early Germanic Iron Age, and “Late Germanic Iron Age” when referring to the Merovingian Period in Norway, the Vendel Period in Sweden, and their equivalent in Denmark.

1.3.3 Structure of the Study

This introductory chapter presented the main concepts of the thesis, discussed its aims and methodology and now concludes with its structure. The thesis is divided into two parts. Part 1 Scandinavian Canal Sites in Context includes chapters 1, 2, and 3, which are comprised of presentations of the evidence collected and researched for this study. Part 1 lays the foundation for Part 2 Scandinavian Canal Sites in Comparison, in which I present my findings, and conclude the thesis. Part 2 includes Chapter 4 Findings, Chapter 5 Research Methods, and Chapter 6 Research Limitations.

Chapter 2 Scandinavian Canal Sites in Context provides a focused composite study of Migration Period (A.D. 400–550) and Late Germanic Iron Age (A.D. 550–800) Scandinavia, aggregating data from literary source materials, published scholarship, geography, and place-name evidence to provide a framework for the study of the canals in the context of Scandinavian political evolution. Chapter 2 opens with Section 2.1 Antecedents of Scandinavian Canals in Europe and the Mediterranean, which surveys the historic usage of canals from the Pre-Roman Iron Age (500–1 B.C.) to the Late Roman Period (A.D. 284–476) in Europe. In Section 2.2 Power in Context – The Cultural

Geography of Europe, I summarize the south Scandinavian and northern European socio-political climates contemporary with the Spangereid and Kanhave canals' site constructions and use, both on regional and local scales. Section 2.2 follows with brief discussions of important sites within southern Scandinavia during the Migration Period (A.D. 400–550) and the Late Germanic Iron Age (A.D. 550–800). Section 2.2 is intended to present chronological context that may provide further evidence of Scandinavian power centralization at each respective canal site. In Section 2.3 Literary Source Material, I present a survey of written sources and literature—including abridged versions of the relevant Norse saga narratives and poetry as they relate to Agder, Lindesnes, and Samsø. An all-inclusive, multi-disciplinary approach to this research includes an analysis of written sources relating to the material record. Several locations such as Birka, Ribe, Hedeby, Kaupang, Samsø, and harbors on Gotland are cited in the sagas, and have been validated through archaeological survey, illustrating the potential value of supplementing an archaeological investigation with an interpretation of historical narratives to assist in determining the potential for identification of future archaeological sites. Chapter 2 closes with Section 2.4 Place-Name Evidence, which presents a survey of the toponymy at the Spangereid site and the Island of Samsø.

Chapter 3 The Archaeology of Scandinavian Canal Sites focuses on the built environment and opens with Section 3.1 Excavation History, which introduces the timeline of archaeological interest and fieldwork at the canal sites. Section 3.2 Architecture presents the distinctive physical structures of the canal sites. Section 3.2 includes information on construction schemes (3.2.1), architectural styles (3.2.2), and wall types (3.2.3). Chapter 3 continues with Section 3.3 Local-Scale Spatial

Organization, which includes data on surrounding material landscapes to provide spatial reference. Chapter 3 closes with Section 3.4 Climate, Geology, and Dating, a section focused on geological information relating to climate and post-glacial isostatic uplift, as well as the methods by which the Spangereid and Kanhave canal sites were dated. Part 1 concludes with Chapter 3, and Part 2 opens with Chapter 4.

Chapter 4 Findings presents the conclusions of this study, briefly reviewing previous approaches to the available evidence, including an examination of the current scholarly consensus on Scandinavian “central place” identity and composition, a presentation of the canal sites within their spatial contexts, and a material comparison between the sites. Chapter 4 further presents an analysis of each canal site’s measurements and spatial distributions to determine their suitability to behave as harbors for contemporary Scandinavian ship-types (Section 4.4.1). Chapter 4 closes with theoretical interpretations and explanations of the analysis results, attempts to answer the above research questions, provides justifications for the approaches used, and highlights research and theoretical methods that may encourage interdisciplinary approaches to the study of prehistoric artificial waterways.

The closing chapters of this thesis consist of research methodologies and research limitations. Chapter 5 Research Methods considers the aims and procedures used in this study, and Chapter 6 Research Limitations presents the hindrances encountered during the thesis process. The six chapters contained herein focus on combining the archaeological, literary, geological, and linguistic material relating to the two identified man-made navigable waterway sites in the Scandinavian homelands during the Migration Period (A.D. 400–550) and Late Germanic Iron Age (A.D. 550–800). This

interdisciplinary approach seeks to use theoretical methodologies that require a combination of practical and scholarly knowledge to elucidate the similarities between the Spangereid and Kanhave canal sites, and further establish their roles in the consolidation of power across the Scandinavian maritime landscape.

Chapter 2

Scandinavian Canal Sites in Context

This chapter is concerned with the historical, literary source material, and place-name data relating to northern Europe and southern Scandinavia—specifically Lindesnes and Samsø during the Migration Period (A.D. 400–550) and Late Germanic Iron Age (A.D. 550–800). The purpose here is to bring together current historical and written evidence for the reconstruction of elite human agency in prehistoric canal construction, to reflect the regional socio-political picture during canal construction, and to set the stage for Chapter 3 The Archaeology of Scandinavian Canal Sites, and later, Chapter 4 Findings.

This chapter opens with a brief discussion on the tradition of canal building in prehistoric Europe and the Mediterranean (Section 2.1), followed by a historic narrative of the socio-political conditions external and internal to Scandinavia during the periods of Scandinavian canal construction (Section 2.2), and synopses of the literary source material and Norse saga literature as they relate to Agder, Lindesnes, and Samsø (Section 2.3). Chapter 2 concludes with surveys and distribution maps of the place-name evidence at Spangereid and on Samsø (Section 2.4).

2.1 Antecedents of Scandinavian Canals in Europe and the Mediterranean

The art of canal building is part of a long tradition of hydraulic engineering practices dating to the 12th century B.C., when ancient irrigation canal systems were constructed to feed the ever-moving Assyrian capitals (Bagg 2000). Some early fairways were built for short-term use, as seen in cases where expedient canals were constructed solely to

support ship movement during military campaigns. These types of canals were abandoned once their purposes were served. Xerxes I for example, cut a navigable waterway through the isthmus of Actium during the Persian invasion of Greece in 481 B.C. The evidence suggests that the canal was abandoned after it was used to facilitate his fleet. British archaeologist James Bond (2007, 162) argues that abandonment of these “military canals” was commonplace, as there is no evidence to suggest long-term use.⁵

The practice of canal building continued in ancient Egypt, where Ptolemy II reopened and enlarged a canal thought to be constructed by Darius I during his conquest of Egypt. During construction of the modern Suez Canal, commemorative stone was uncovered that bore an inscription honoring Darius for creating a waterway linking Egypt to Persia (Pliny 1938, 166, vol 5). It was also in Egypt that in the 1970s a team of geologists surveying a branch of the Nile discovered another 70m wide artificial channel cut into the frontier landscape (Sneh et al. 1975).

The art of conducting water within an artificial channel continued with the Romans, who not only resurrected Ptolemy’s canal in Egypt, but practiced canal building extensively between the time of the Roman Republic (509–27 B.C.) and the 2nd century A.D., which included waterway construction schemes proposed by Julius Caesar and Nero along the banks of the Tiber (Blair 2007a, 3; Bond 2007, 161–62).

It is generally accepted that the Romans brought canal technology to continental Europe and Roman Britain, using army resources and slave labor to modify and link together river courses and seaways (Bond 2007). Fourteen Roman canals were completed during the Classical Period (8th century B.C.–6th century A.D.), and in all, 19 canals were

⁵ For an example of a short-term “military canal” in Icelandic saga literature see Section 4.2.3.

constructed within continental Europe and the Mediterranean between ca. 650 B.C. and A.D. 400 (Figure 2.1).



Figure 2.1. Navigable Canals Within Continental Europe and the Mediterranean,

ca. 650 B.C. – A.D. 400.

(After Bond 2007, 160)

After the fall of Rome in the 5th century, the rise of the Frankish Empire changed the face of post-Roman Europe. In A.D. 780 Charlemagne attempted to connect the European watershed by linking together the Rhine and Danube basins with a 30-meter wide canal (Zielhofer et al. 2014). Located in the modern German state of Bavaria, the Fossa Carolina, or Karlsgraben as it is known colloquially, was a failure of large-scale maritime engineering, but the practice of cutting a navigable waterway through land was one that relied on a technology that held its value and would survive elsewhere in northern Europe, as displayed by river diversions around Caen, France in the 1060s (Bond 2007, 171–73).

It was in Scandinavia that the practice of canal construction appears to have continued, and may have inspired other subsequent canals, such as those in Anglo-Saxon England (Blair 2007a, 4). More than fifty years before Charlemagne's attempt on Karlsgraben, two canals were already established and in use in southern Scandinavia—the Spangereid Canal, cut through the Lindesnes isthmus in southern Norway, and the Kanhave Canal, located on Samsø, an island off the east coast of Jutland in Denmark.

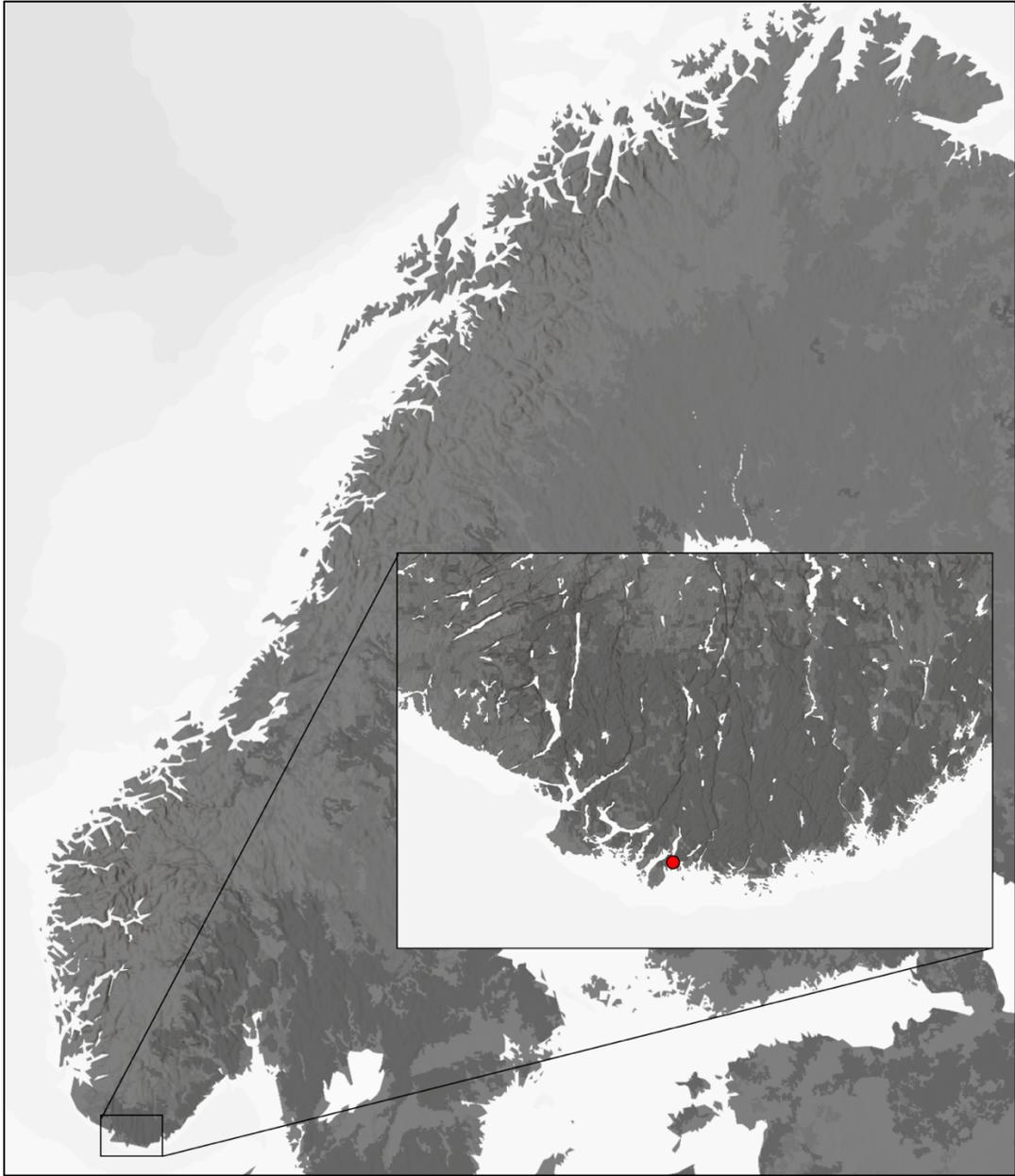


Figure 2.2. Lindesnes Peninsula and Spangereid within Norway.



Figure 2.3. Samsø and the Kanhave Canal within Denmark.

2.2 Power in Context—The Cultural Geography of Europe

A historical reconstruction of the Spangereid and Kanhave canals requires context reflecting the social conditions and economic developments of Norway, Denmark, and

continental Europe contemporary with their constructions. This section presents historical data relating to the local and regional circumstances leading up to the emergence of power within the Scandinavian homelands during the development of the Scandinavian canals.

2.2.1 The Socio-Political Landscape of Continental Europe during the Germanic Iron Age

It is largely accepted that the decline of the Roman Empire created a vacuum within its receding European territories, thus ushering in a new age of tribal diaspora known as the Migration Period (A.D. 400–550) (Thurston 2001, 57–58; Hedeager 2011). It was an era in which continental Europe saw a continuous flood of Germanic, Hunnic and Slavonic tribes from the east. Through territorial expansions, Slavonic colonies emerged in the northern reaches of modern Germany, including the region of Holstein, set between the rivers Elbe and Eider (Vogel 1972, 29; Brather 2001, 30). In A.D. 476, what remained of the western Roman Empire was overcome by Odoacer, an Ostrogothic Scandinavian leader who led the Heruli into Italy to form what became known as the Ostrogothic kingdom (Thurston 2001, 57).⁶

Nearly two centuries later, Pepin II (Pepin of Herstal), Duke and Prince of the Franks conducted a series of conquests over the tribal lands of Europe, bringing many of them within the borders of the newly established Frankish kingdom under his authority during the mid-7th century. Pepin was succeeded by Charles Martel, who ruled between A.D. 718 and 741. Martel reconsolidated power, centralizing authority in Gaul by way of

⁶ The Preface of Jordanes' *Getica* mentions that the Heruli originated in Scandza and were driven from their lands by the Dani tribe.

military campaigns against the Saxons, setting the stage for the future of Frankish feudalism (White 1964, 2–14). Martel is additionally recognized as the “savior of Christendom” for his victories against the Muslim invasions in pivotal battles, particularly the battle of Poitiers in 732 (Gibbon 1781, vol. 3, ch. 52). During Martel’s reign, trade between the Franks and Scandinavian peoples continued in the form of exchanges for precious metals such as silver, gems, glass, textiles, and Frankish weapons. In return, furs, amber, bog-iron, bronze, and clay utility items that were prepared by Scandinavians were traded in well-connected, far-reaching markets.

The Frankish Kingdom pushed its territorial boundaries northward through military conquest. During the early 700s, the Franks subdued the Frisian tribes of northern Gaul and Germania. The Franks, led by Charles Martel and later, his son Pepin the Short, pressed into Saxon territories, leading to a decades-long struggle between the Saxons and the Franks, a conflict that culminated during Charlemagne’s command of the Carolingian Empire during the early 9th century (McKitterick 1995, 2001; Shuler 2010).

The impact of the long-distance communication, trade, and political alliances between the polities of Scandinavia and continental Europe was significant and is a topic worthy of further study. The following section focuses on the socio-political conditions internal to the Scandinavia homelands.

2.2.2 The Socio-Political Landscape of Scandinavia in the Germanic Iron Age

During the Migration Period (A.D. 400–550) and Late Germanic Iron Age (A.D. 550–800), the territories of what comprise modern Denmark, Norway, and Sweden were hardly uniform in terms of their politics and governmental structures. Influenced by centuries of interactions with the Roman Empire, indigenous political concepts such as

the Germanic *þing* (“thing”– assembly) emerged (Brink 2003a; 2003b; 2004),⁷ and loose alliances between chiefdoms led to the gradual formation of polities within the Scandinavian homelands (Thurston 2001). In his A.D. 98 manuscript *Germania*,⁸ Roman historian Cornelius Tacitus described the communal nature and policies of the Germanic assembly (*þing*), as well as the competing trade and interactions between the chiefdoms of the Weser-Rhine, Elbe, North Sea Germanic tribes, and the Roman Empire (Tacitus 2009; Maurer 1942). The prestige-goods based economy of pre–Viking Age Scandinavia eventually fell into decline alongside the fall of the Roman Empire, leading to the Scandinavian Migration Period (A.D. 400–550), a time when small polities merged into larger political centers; a trend that continued into the Late Germanic Iron Age (A.D. 550–800).

It was during the Migration Period (A.D. 400–550) that the archaeological data indicate marked changes in the organization of Scandinavia’s elite economy. The prestige-based system of the ruling class within southern Scandinavia temporarily collapsed, and elites no longer buried their dead with luxury goods or made costly sacrificial bog offerings, but seemed to have held on to their wealth, as indicated by finds in settlement archaeology (Thurston 2001, 58). Nevertheless, the elite requirement of luxury goods necessary for social and ritual obligations continued in the wake of the collapse of the Roman Empire. This economical deficit caused Scandinavians to exploit the resources of regions further north (Myhre 2003, 91), and in the process of trading

⁷ The Germanic *þing* was a governing assembly of free men presided over by law speakers.

⁸ It is important to note that Tacitus did not travel to Scandinavia but received his information second-hand. See (Gudeman 1900). One such source is speculated to be from an older work by Pliny the Elder. See (Van De Woestijne 1958).

northern wares, interactions between Southern Scandinavians and the indigenous Sámi of northern Scandinavia increased. These interactions influenced Norse religious practices throughout the Germanic Iron Age (Price 2019).

During the Migration Period (A.D. 400–550) and Late Germanic Iron Age (A.D. 550–800), the Scandinavian peoples were largely pre-literate, although a runic system known as the *futhark* existed (Faulkes and Perkins 1993; Williams 2011). Regionally variable runic inscriptions and stone monuments were used to record inheritance rights and political titles, as well as to declare property or object ownership (Thurston 2001, 25).

Despite a lack of formal literary tradition, Germanic Iron Age Scandinavians maintained a rich oral tradition, passing along religious and cultural beliefs, law, and mythologies into the collective social memory through stories, song, poetry, and communal gatherings. The Scandinavian peoples were not geographically isolated by the environments in which they lived but interacted with their neighbors through trade networks. Such connectivity allowed Scandinavian territories to exchange goods and technologies with continental Europe. For example, we know that the Scandinavians traded with the Franks for luxury materials in exchange for raw materials such as furs and amber.

Such processes played a role in the emergence of Scandinavian political and economic organization, and in the construction of proto-urban centers such as Kaupang in southern Norway, and Ribe, considered the first Danish settlement and trading post/market place in ca. A.D. 700 (Hedeager 2011, 16; Hodges 1982; I. L. Hansen and

Wickham 2000).⁹ Trade was critical to the growing Scandinavian economies, and waterborne shipping lanes were crucial to the movement of goods (including slaves) as well as migrants. The satellite islands surrounding the coastal regions of places such as *Jylland* (Jutland) provided a strategic advantage to such trade throughout the maritime environment. The primacy afforded by their locations within trading lanes allowed islands such as Gotland, Bornholm, Funen, and *Sjælland* (Zealand) to prosper.

Scandinavia during the Germanic Iron Age (A.D. 400–800) was a series of independent chiefdoms and petty kingdoms vying for regional control. The evolving character of Scandinavian society during this period was fostered through the use of two forms of communal centers. The chieftain or king's hall offered a venue for communication to be passed vertically through the social hierarchies (Herschend 1993), while the *þing* (*thing*) allowed for lateral dispersion of information to the greater community (Brink 1999). During that time, an unknown number of small polities existed in Norway. There was no centralized authority, but it is estimated that at least 20 petty realms existed in the whole of Norway in A.D. 700 (Solberg 2000).

As discussed above in Section 2.2.1, long-distance contacts and cross-cultural encounters with continental Europe provided the inhabitants of Scandinavia with a venue for the exchange of ideas, goods, and technology. After the fall of the Roman Empire however, international trade faltered, and regional Scandinavian rulers were left to decide whether to maintain their socio-political authority through smaller-scale trade networks or to allow their social status to degrade through the attrition of luxury goods (Hedeager 1987). The answer to the decision is clearly defined, as the early 8th century brought with

⁹ For an overview of early Scandinavian settlements, see (Magnus 2002).

it a surge of regional trade, and with the emergence of 8th-century emporia such as Hedeby and Ribe in Denmark, Birka in Sweden, and Kaupang in Norway, Scandinavian urbanization began to take place (Hodges 1982; Skre, Stabell, and Sørensen 2007).

Excavations of early 8th-century Scandinavian sites such as Ribe, and 9th-century *Slesvig* (Hedeby), provide evidence of utilitarian workshops and vast trade networks with routes eventually connecting Scandinavians with Frankish and Carolingian Europe, the Byzantine Empire, and the ‘Abbāsīd dynasty caliphate of the Middle East. A fact worth citing, Ribe was founded during the same century as Islamic Baghdad (founded ca. 762), and functioned as an emporium during the time that the Spangereid and Kanhave canals were in use (J. Jensen 1982, 922).

With respect to archaeological indicators of early settlement patterns in southern Scandinavia, evidence suggests that prior to and contemporary with the Danevirke’s construction (ca. A.D. 700–1100), there existed systems of powerful elites who wielded growing influence on societies in general. These settlement patterns and central place formations indicate continuous trends of economic, religious, military, and political transitions during the Migration Period (A.D. 400–550), which continued to develop into central-place complexes such as those at Gudme, Tissø and Lejre in Denmark, and Uppåkra (modern Sweden). Such evidence offers insight into a system of aristocracy that already existed at the time of the Danevirke’s earliest phases of construction (ca. A.D. 700).¹⁰

With the rise of aristocracies and the formations of central-places, Scandinavian artist-craftsmen evolved their styles to coincide with the information passed along

¹⁰ For a comprehensive list of the Danevirke’s construction phases see (Dobat 2008).

expanding trade networks. In the beginning of the 8th century, Nordic pictorial art began to see influences from northern England. Classified as “Baroque” style D (Figure 2.4) (J. Jensen 1982, 917), this type of art was “typified by evenly undulating animal bodies that continued into extended animal heads, usually of the same width as the body” (J. Jensen 1982, 916). Such iconography has been found amongst grave goods at sites such as Nørre Sandegård on Bornholm.

During the 8th century, Nordic art continued to evolve, acquiring an indigenous form of animal motifs in surface-covering compositions, blended together with continental plant ornamentation and vine motifs, and classified as style F, or “Mission Style”. The largest example of Nordic Mission Style art was found on a rectangular costume ornament discovered on Hesselholm by Stavns Fjord on Samsø (Figure 2.5) (J. Jensen 1982, 917; Adamsen 1995). One thing is clear, throughout all of the phases of Nordic art styles, the animal was an ever-present symbol.



Figure 2.4. Rectangular costume ornament decorated in the “Baroque” style D (Early 8th century).

(Photo: The National Museum of Denmark)



Figure 2.5. 16.8cm long gilt bronze rectangular costume ornament plate decorated in the “Mission” Style F (8th century). Found on Hesselholm within Stavns Fjord on Samsø.

(Photo: The National Museum of Denmark)

The Migration Period (A.D. 400–550) and Late Germanic Iron Age (A.D. 550–800) were dynamic eras of military and political posturing in Scandinavia, as well as in the rest of northern Europe. These were periods characterized primarily by small-scale raiding and warfare, and secondarily by prestige-goods economies based on network-style rulership and elite controlled trade. This type of exchange was controlled through taxation on the activities inherent to trade, rather than controlling it through specialists (Thurstun 2001, 60). As the early Scandinavian states formed, regional leaders vied for higher levels of authority both at home and abroad. In a lengthy period of political and economic centralization based on episodic infighting and political maneuvering,

ideologies, power structures, and settlement patterns evolved, and with them, the borders of core-areas gradually coalesced until the early states were born centuries later (cf. Thurston 2001, 18; Nithard 1972, 94, 96).

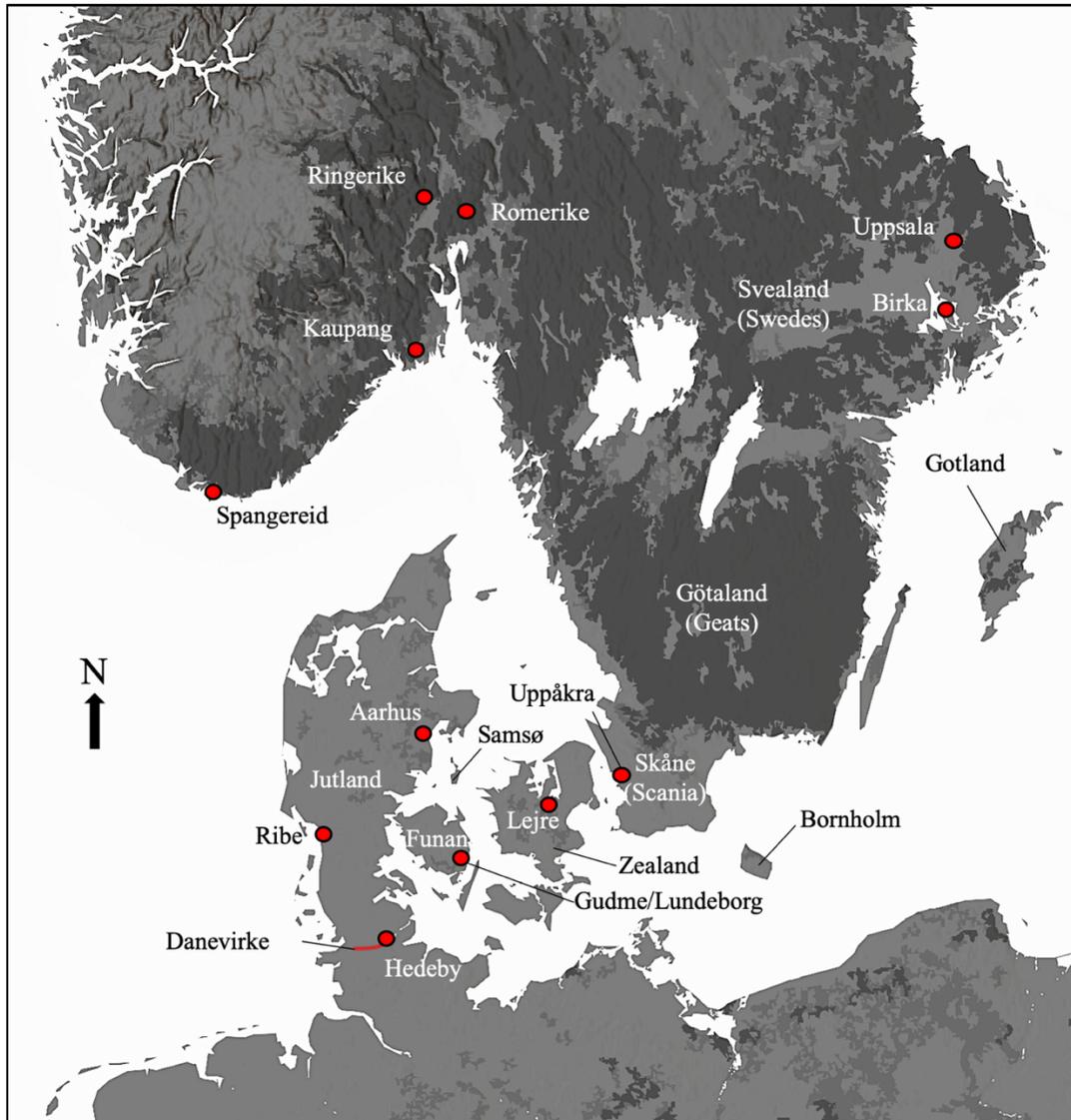


Figure 2.6. Map of southern Scandinavia, 8th century.

2.3 Literary Source Material

Several forms of contemporary and later written documentation exist to provide context on historical events, environments, and processes within prehistoric Scandinavia. These sources include narratives, annals, and chronicles ordinarily transcribed by clergy or professional scribes. The addition of literary records to this research provides cultural context and may serve to bolster an understanding of the material data, as accounts of Scandinavian daily life, culture, trends, politics, trade, and more are collated within the literary sources. Despite distortions in the chronology and historical framework, subjectivity based on author agenda, or literary embellishments that may exist, the Norse saga literature and other textual resources contain evidence that, when used in conjunction with archaeological evidence and historical data, present the cultures of the Vikings and their predecessors in ways that enable researchers to piece together a more complete picture of the ways in which prehistoric Scandinavian societies may have looked. A cross-referencing of archaeological sites against the corpus of textual resources permits a greater understanding of a site's purpose, use, and context. Further, previously excavated or other presently unidentified Scandinavian canal sites depicted in the literary record can indicate that the canal sites were chosen for some greater importance than mere convenience and may suggest that they were used to consolidate power in the maritime environment.

Unfortunately, there seems to be few reliable extant by-name-identified political leaders (non-legendary) within southern Scandinavia who ruled contemporaneously with the Spangereid or Kanhave canal constructions. Further, aside from Jordanes' *Getica*, and such works of medieval Icelandic literature as those by Snorri Sturluson, there appear to

be scant mentions of interactions between continental Europe and southern Norway during the Migration Period (A.D. 400–550) (Thurston 2001, 23–68).

After Tacitus' *Germania*, the earliest mentions of geographic locations and tribal groups within southern Scandinavia appear in Jordanes' *The Origin and Deeds of the Goths*, or *Getica*, written in the 6th century A.D. (Thurston 2001, 61–63). For instance, we know that prior to the unification of Norway in ca. A.D. 872 under Harald Fairhair, *Agðir* (modern Agder) was a petty kingdom inhabited by the *Egðir* tribe (Krag 2011, 645); a name that may refer to the *Augandzi*, a tribe residing amongst the nations of *Scandza*, as mentioned by Jordanes in *Getica* (Jordanes 2017, 3).

Mentions of Danish rulers and their interactions with the Franks appear in the *Annales Regni Francorum*, or Royal Frankish Annals—documentary sources written between the mid-8th and early 9th centuries. The Annals provide clues to political organization and name a potential Danish ruler from the 9th century—Hemming, King of the Danes. Hemming is said to have made a peace treaty with Charlemagne through the use of special envoys (including Hemming's two brothers; Hankwin and Angantýr) who met on the River Eider at Heiligen to exchange oaths (Nithard 1972, 94).¹¹

Another mention of early Danish rulership appears in an 8th-century text describing the events of a ca. A.D. 714 journey by Willibrord, a Northumbrian missionary who travelled to the lands of “the wild Danish tribes” (*ferocissimos Danorum populus*) in the first recorded Christian mission to Scandinavia (Helle 2003, 60–93; Alcuinus 1851). In a hagiography entitled *The Life of St. Willibrord of Utrecht*, Anglo-Latin clergyman Alcuin of York recounts that during Willibrord's travels through

¹¹ Heiligen is a location south of border between modern Denmark and Germany.

southern Scandinavia, the missionary attempted to convert Ongendus (Angantýr in Old Norse) (J. Jensen 1982), king of the Danes during the early 8th century. Little is known about Ongendus’ reign, however Willibrord describes the king as “a man crueller than any wild animal and harder than stone” (*homo omni fera crudelior et omni lapide durior*) (Alcuinus 1851). Despite the label of savagery, Willibrord was permitted to purchase, instruct, and baptize 30 young Danish boys (returning with them), and to travel throughout Ongendus’ realm in peace.

If Alcuin’s narrative account of Willibrord’s travels is legitimate, Ongendus is the most likely candidate to have ruled Denmark (or a large portion of it) during the early phases of the Danevirke’s construction (ca. A.D. 700), the founding of Ribe (ca. 710 A.D.), and most significantly for the purpose of this research, the construction of the Kanhave Canal (ca. A.D. 726).

It is perhaps worth mentioning that the first literary remarks that specify the Kanhave Canal by name were in Laurids de Thurah’s 1758 work entitled *Omstændelig og Tilforladelig Beskrivelse af Øen Samsø (Lengthy and Reliable Description of the Island of Samsø)*:

Der, hvor Heden slipper, er et Steen-Gierde, kaldet Kahn-Have, som skiller den Sydlige og Nordlige Deel af Landet fra hinanden... strax derved er en Canal 16. á 20. Fod bred, som gaaer fra det Østre til vestre Hav i lige Linie, som giver Anledning til at troe, at der igiennem har været Seilads i forige Tider; Nu er denne Canal ganske tør; Men dens lige Strækning og Dybhed frem for den anden Mark, giver Anledning at slutte, at den er med Flid anlagt...

There, where the heath recedes,¹² is a stone wall,¹³ called Kahn-Have,¹⁴ which separates the southern and northern parts of the island from each

¹² *slipper* alt., subsides

¹³ *Gierde* (modern Danish *gærde*) is cognate with “garden”, “yard”, etc. indicating enclosure, something enclosed, although in this case the barrier, marker, etc. doing the enclosing.

other... right next to it is a canal 16 to 20 feet wide, which goes from the eastern to the western sea in a straight line, which gives [one] reason to believe that through it there have in earlier times been voyages.¹⁵ This canal is now quite dry, but its straightness¹⁶ and depth in comparison with the adjoining fields gives reason to conclude that it was executed diligently...¹⁷ (Thurah 1758, 23, 37; K. Christensen 1995, 99; Danmarks Stednavne 1922).

2.3.1 Norse Saga Literature

As indicated above in Section 2.2.2, Migration Period (A.D. 400–550) and Germanic Iron Age (A.D. 550–800) Scandinavian peoples were pre-literate, therefore no indigenous contemporary written accounts exist to shed light on the inner workings of the emerging economies or tell us of the rulers and realm borders during those periods of Scandinavian prehistory. Scandinavian societies were comprised largely of oral-tradition based cultures, which relied on *social memory* to retain and relay their history through song and poetry (Fentress and Wickham 1992).

This section includes the epic poems and narratives of Icelandic saga literature that were taken from this long-term collective social memory and transcribed in the form of poetry and epic prose during the 13th century. The accounts herein relate to the regions of Agder and the Lindesnes peninsula in southern Norway, and the island of Samsø in Denmark—the locations at which the Spangereid and Kanhave canal sites are found. These works are important to the reconstruction of historical events, however, as with

¹⁴ For more information on the etymology of “Kanhave” see Introduction and p104 of (Danmarks Stednavne 1922), in which the translated text states that: “The first element [Kan] most likely derives from Old Danish *Kane*, ‘boat, knot ship, (oak) dugout.’”

¹⁵ *Seilads* alt., sailings

¹⁶ *lige Strækning* alt., level quality, plumb quality

¹⁷ *Flid anlagt* alt., created/brought about with care

other literary sources, one must be cautious of potential political bias inherent to the writings (Thurston 2001, 25–26). A discussion of the use of saga literature in this research can be found in Section 4.2.

2.3.1.1 Regarding Agder and Lindesnes. In ca. A.D. 1230, Snorri Sturluson, an Icelandic poet and historian wrote *Heimskringla* (*ON Kringla heimsins*: lit. “the orb of the earth”) (Cleasby and Guðbrandur Vigfússon 1957, 251, 355; Geir T. Zoëga 2004, 192, 249), a collection of sagas concerned with early Norwegian and Swedish royalty. The sagas often confer titles to the regional rulers. In thirteen polities, including Agder (the county where Lindesnes and the Spangereid canal are located), the petty rulers are referred to as *konungar* (kings), while in other Norwegian locations, leaders are called *jarlar* (Snorri Sturluson 2011a). This information is important, as such details in Old Norse (ON) literature can be used (along with runic inscriptions, place-names, and archaeological material findings) to further indicate the locations of central places within the Scandinavian landscape (Brink 1999). For instance, Lindesnes and Vest-Agder (*ON* Agðir) are mentioned on several occasions in saga literature and possess several place-names worthy of investigation in this respect.

Snorri Sturluson’s work is the earliest written account of consolidated rulership in Agðir. According to *Heimskringla*, Haraldr inn granrauði (the Red-Bearded) (Snorri Sturluson 2011f; Cleasby and Guðbrandur Vigfússon 1957, 211; Geir T. Zoëga 2004, 170), son of Herbrand Vigbrandsson, rules Agðir at the same time that Guðrøðr inn gøfugláti (the worshipful, generous, noble) rules Vestfold (a region southwest of modern Oslo) (Cleasby and Guðbrandur Vigfússon 1957, 223; Geir T. Zoëga 2004, 177). When

Guðrøðr's wife Álfhildr dies, he sends men west to Agðir in an effort to bid for Haraldr's daughter Ása's hand in marriage. When Haraldr refuses, Guðrøðr gathers his men, sets sail for Agðir, and ambushes an unwitting Haraldr at his farm. Upon Haraldr and his son Gyrðr's deaths in the ensuing battle, Guðrøðr forcibly takes Ása to Vestfold where she becomes his wife. After bearing Guðrøðr a son—Hálfðan svartí (the black), she sends an assassin to kill an inebriated Guðrøðr by spearing him through (Snorri Sturluson 2011f). It should be mentioned that Hálfðan svartí sires a son who would eventually unify all of Norway into one realm: Haraldr inn hárfagri (Harald Fairhair).

It appears that Haraldr granrauði's obscure grandfather, Vigbrands af Agðir (lit. Vigbrands of Agder) may have ruled over Agðir ca. A.D. 690 (Jón Espólín 1980). Based on prehistoric water level measurements taken by Norwegian and German archaeologists, it seems likely that the Spangereid Canal was already established at that time.¹⁸ According to the 17th-century Icelandic scholar Jón Espólín (1980), Vigbrands af Agðir was the legendary first king of Agðir, and patriarch of the aforementioned dynasty.

Lindesnes, or the “Naze” (promontory or headland), as it was often referred to, is a significant place within Norse saga literature. The peninsula is mentioned several times in both the sagas and skaldic poetry (Titlestad 1996, 63). As discussed above, Snorri Sturluson (2011a) briefly presents Agðir in a subordinate role to Vestfold, but Agðir also emerges as an important coastal area through which kings and jarls transited their fleets (Rølfesen 1981). The province of Agðir appears to have been a noteworthy location in Icelandic saga literature, and features prominently in *Óláfs saga Tryggvasonar* (*King Olaf Tryggvason's Saga*).

¹⁸ See discussion in Section 3.4.

In chapter 15, Danish King Haraldr Gormsson (Harald Bluetooth) brings together a fleet of 600 ships comprised of men from all over Scandinavia, along with the jarls and petty kings deposed by the sons of Gunnhildr konungamóðir (mother of kings), which includes Norwegian Jarl Hákon Sigurðarson, and petty Norwegian King Guðrøðr Bjarnarson's son Haraldr grenski. When the fleet arrives in Viken (a location in Norway), the people there surrender, and many others join the cause. Much of southern Norway is subsequently divided amongst the jarls and petty kings who side with Haraldr Gormsson. Haraldr grenski receives the inherited titles and lands lost to Gunnhildr's sons, including Vingulmørk (Vingulmark), Vestfold, and Agðir as far as Líðandisnes (Lindesnes). Likewise, Jarl Hákon is given seven districts. Satisfied that Norway is to become Christian and remain under the control of those agreeable to him, Haraldr Gormsson, king of Denmark returns home (Snorri Sturluson 2011d).

In chapter 58: After Haraldr Gormsson's death, his son Sveinn Haraldsson tjúgu-skegg (Sweyn *fork-beard*) rules over Denmark (Cleasby and Guðbrandur Vigfússon 1957, 636; Geir T. Zoëga 2004, 439), while King Óláfr Tryggvason rules over Norway. King Óláfr gives the lands north of Sognsær (Sognefjord) and east to Líðandisnes to Erlingr Skjálgsson, his brother-in-law, as a wedding gift. Instead of obtaining a jarldom as offered by king Óláfr, Erlingr is to retain the title of *hersir* (military leader) (Brink 1999, 424), in accordance with his family tradition (Snorri Sturluson 2011d).

The final mention of Líðandisnes in *Óláfs saga Tryggvasonar* is in chapter 113. Óláfr Tryggvasonar dies in the epic Battle of Svǫldr (Svolder), an ambush set by the combined forces of Danish King Sveinn Haraldsson tjúgu-skegg, Óláfr Skotkonung, king of the Svíar (Swedes), and Eiríkr Hákonarson, jarl of Lade in Norway. Óláfr

Tryggvasonar's ship, *Ormr enn langi* (The Long Serpent) is commandeered by Eiríkr (Snorri Sturluson 2011d, 232), who sails to a Norway split three ways between the victors. Eiríkr receives several districts, including north Agðir, all the way to Líðandisnes (Snorri Sturluson 2011d).

Mentions of Líðandisnes continue in one of the *konunga sögur* (*kings' sagas*), *Óláfs saga ins helga* (*Saga of St. Olaf*), where in chapters 53 and 81, King Óláfr Haraldsson of Norway travels westward along the coast of Vík (modern Viken) to stop at Líðandisnes. In the first instance (chapter 53), he waits on fair winds to hurriedly depart northward to Þrándheimr (Trondheim), and in chapter 81, the saga states that he departs Líðandisnes and heads north to Hǫrðaland (Snorri Sturluson 2011c).

Chapter 85 tells of an Icelander named Þórarinn Nefjólffsson, who is a guest of King Óláfr. Þórarinn is said to be very ugly, with the king even going so far as to have a conversation with him about the ugliness of his foot, and wagering that Þórarinn could not find another more ugly than his own. Þórarinn wins the wager by revealing his other foot, more hideous than the first. A term of his victory is for Þórarinn to become one of the king's men. When the request is granted, Þórarinn is tasked with taking custody of Hrærekr, the deposed and blinded king of Heiðmǫrk, escorting him to exile in Greenland, and handing him over to Leifr Eiríksson. The saga states: "...when Þórarinn was ready and there was a favorable wind, then he sailed all along the outer route beyond the islands, and north of Líðandisnes he set his course out to sea. The winds were not very favorable, but he took care most of all to keep away from the shore" (Snorri Sturluson 2011c).

The final mention of Líðandisnes in *Óláfs saga ins helga* occurs in chapter 116. Erlingr Skjálgsson (noted above) rules over the lands from Sognsær in the north, and east to Líðandisnes. In time, King Óláfr feels that Erlingr is becoming too powerful, so he appoints a man named Áslákr Fitjaskalli a fiefdom and asks Áslákr to increase his power at Erlingr's expense. This condition is not possible to fulfill, and King Óláfr summons Erlingr to meet at Túnsberg to discuss the unfair treatment of nobles in Erlingr's domain. "I am told this about your power, Erlingr, that there is no one to the north of Sognsær as far as Líðandisnes who can maintain his freedom because of you" (Snorri Sturluson 2011c). Erlingr, Áslákr, and King Óláfr soon reconcile their differences, as each realize that a symbiotic relationship would better serve each party involved.

The domain between Líðandisnes and Sognsær are mentioned several other times in passages relating to its rulership, taxation, meetings, and social exchanges (Snorri Sturluson 2011e; 2011b). In addition, there is one mention of Líðandisnes in chapter 28 of *Magnúss saga Erlingssonar* (*Magnus Erlingsson's Saga*): When a Danish force led by King Valdamarr threatens Vík, Erlingr skakki is compelled to levy a large fleet, which he brings to Líðandisnes. There he receives word that the Danish army had plundered Vík but returned to Denmark shortly thereafter. At Líðandisnes, leave is granted for the levied men, and Erlingr sails, along with those that remain, toward Dyrsa in Jutland, where he defeats the Danish fleet and subsequently returns to Norway (Snorri Sturluson 2011b).

2.3.1.2 Regarding Denmark and Samsø. The Danish island of Samsø has a storied past, evidenced through the material record excavated at several prehistoric sites. Literary materials are rich in lore relating to the island, and perhaps most famous of these stories

is that of a legendary battle involving *berserkir* (berserkers) as recorded in several Icelandic sagas, Faroese ballads, and other works including Saxo Grammaticus' *Gesta Danorum*. The story begins as Angantýr's berserkr father, Arngrímr, gifts his son the mighty sword Tyrfingr, a cursed weapon forged by *dvergar* (dwarfs) that could cut through armor as if it were cloth. Angantýr and his eleven brothers, themselves berserkir, terrorize the countryside of their native Sweden. In time, Angantýr's brother, Hjǫrvarðr, swears an oath to marry Ingibjörg, daughter of Ingjaldr, the Swedish king. At Uppsala, a feud erupts when Hjálmar, one of Ingjaldr's champion warriors, forbids the marriage of Ingibjörg to a berserkr. The princess decides to marry Hjálmar, a decision that causes Hjǫrvarðr to challenge Hjálmar to *hólmanga* (duel) on the island of Samsø (Saxo Grammaticus 2015; Turville-Petre and Tolkien 1956).

When the twelve berserk brothers arrive at the island, they find the crews of Hjálmar and Ǫrvar-Oddr's (Arrow-Odd, sworn brother of Hjálmar) warships harbored at Munarvágr, a location that has since been lost (Trap 1954). The brothers go into a berserkr fury,¹⁹ biting their shields, screaming, and violently cutting the crewmen down. Hjálmar and Ǫrvar-Oddr, upon returning to find their kinsmen slain, attack Angantýr and his brothers, slaying them, but not before Hjálmar is mortally wounded by Tyrfingr (Saxo Grammaticus 2015; Turville-Petre and Tolkien 1956).

The twelve brothers are buried with the cursed sword on Samsø in barrows meant to prevent the sword from ever being used again. But the saga *Hervarar saga ok Heiðreks* contains a poem called *Hervararkviða* (*The Waking of Angantýr*), which tells us that

¹⁹ The ON term for this trance-like state is *berserksgangr*, which means "fury of the berserkers" (Geir T. Zoëga 2004, 50). For more information on *berserksgangr* see (Cleasby and Guðbrandur Vigfússon 1957, 61).

Angantýr's daughter, Hervör, a shieldmaiden,²⁰ visits his grave to awaken his revenant and claim the cursed sword for herself. Abandoned by her fearful allies, Hervör ventures onto the island of Sámsey (modern Samsø) alone, and, seeing the flaming barrows in the distance, approaches her father's mound, demanding Tyrfingr in defiance of his revenant's wishes (Turville-Petre and Tolkien 1956).

Although the legendary graves of the twelve brothers have never been found, several mounds exist on Samsø that are locally thought to be related to the legend—one such place being *Angantýrs höj* (Angantýr's mound), located south of the Kanhave Canal.

Munarvágr (bay of endless longing) is thought to be modern Mårup vig (Trap 1954). References to Munarvágr and Samsø appear again in *Ragnars saga Loðbrókar ok sona hans* (*Saga of Ragnar Lodbrok and his sons*). Set long after Ragnar's death, one of the saga's final chapters recounts the story of a group of sailors who disembark their warships at Munarvágr, and discover a wooden idol, 40 ells high.²¹ The tree-man idol recites a poem to them, stating that he had been raised to be worshipped by the sons of Ragnar Lodbrok (Trap 1954; Byock 2004).

The early Norse form of the Danish suffix -ø ("island") was -ey, as it still is in modern Icelandic. The older form of -ø as -ey is reflected in ON texts referencing Samsø, where the island's name maintains its prior spelling: "Sámsey".²² As such, reference to Sámsey exists in the poem *Lokasenna*, found in the Poetic Edda. In the exchanges of insults between the trickster Loki and the Æsir, Loki slanders Óðinn (referred to as

²⁰ Ch IX of *Hervarar saga ok Heiðreks* says "Hún var skjaldmær".

²¹ An *ell* is a unit of measurement, generally the length of one's elbow to the tip of the longest finger, hence: *el-bow*.

²² The -a- is usually normalized to -á- implying that the toponym may be derived from the masculine name Sámr – Sámsey.

(Jálkr) in the text) (Snorri Sturluson 1998), claiming that Óðinn had practiced *seiðr*,²³ a feminine form of magic on the island of Samsø:

Loki qvað:
“Enn þic síða kóðo Sámseyo í,
oc draptu á vétt sem vǫlor;
vitca líki fórtu verþiód yfir,
oc hugða ec þat args aðal.”
(Lokasenna v. 24)

Loki said (to Odin):
But you, they say, practiced *seiðr* on Sámsey,²⁴
and you beat on the drum as seeresses do,
in the likeness of a wizard you journeyed over mankind, and that I thought
the hallmark of a pervert (Larrington 2014, 85).

2.3.2 Literary Source Material Relating to Danish Kingship in the Late Germanic Iron Age

Regarding the early 8th-century Danish elite, historian Saxo Grammaticus' writings and Norse saga literature refer to the reign of Haraldr hilditǫnn (Harald Wartooth), a legendary king of Denmark, who is said to have ruled over Sjælland (modern Zealand), and expanded his father's realm to include part of Sweden as well as Jutland (Saxo Grammaticus 2015; Turville-Petre and Tolkien 1956). According to the fragmentary Icelandic text *Sögubrot af nokkrum fornkonungum* (*Fragment of a Saga about certain Ancient Kings*),²⁵ Haraldr's grandfather, King Ívarr inn víðfaðmi (the Far-Reaching) dies,

²³ For further information on *seiðr*, see (Raudvere 2011).

²⁴ Correction of modern Scandinavian *sejd* to ON *seiðr*. See (Mitchell, forthcoming).

²⁵ *Sögubrot af nokkrum fornkonungum* is thought to be related to the now-lost *Skjöldunga saga*.

leaving the realms of Skåne (Scania),²⁶ and Denmark to a then 15-year-old Haraldr. Upon Ívarr's death, the previously displaced petty kings of the Scanian provinces wish to recover their lost authority, but Haraldr prevails in the wars that follow, and reclaims his grandfather's inheritance. He places Sigurðr Hringr (Ring) as subordinate king over Skåne, including Vestra-Gautland (West Götaland), while Haraldr remains in Denmark, ruling over Danish lands and Austr-Gautland (East Götaland) (cf. Guðni Jónsson and Bjarni Vilhjálmsón 1944).

During the mid-8th century, Haraldr, an ardent follower of Norse religious tradition, is nearing old age and fears the commoner's fate of Niflheimr. He seeks a warrior's death—one that would send him to feast with Óðinn in preparation for Ragnarøk amongst his kinsmen in Valhöll (Valhalla). Haraldr asks Sigurðr for a battle that would give Haraldr a warrior's death. Sigurðr agrees, and for seven years the two sides gather large forces in preparation for battle. The Danes and their allies, the Eastern Geats, are led by Haraldr, while the Swedes, Estonians, and the Western Geats are led by Sigurðr, culminating in the legendary Battle of Brávellir, fought in the mid-8th century, and ending with Haraldr's death and Sigurðr's sovereign rulership over Denmark and Sweden (Turville-Petre and Tolkien 1956; Saxo Grammaticus 2015). The veracity of such accounts has faced scrutiny over time, leading to a general consensus that the historicity of the events of Haraldr hilditǫnn's life is impossible to verify.

2.4 Place-Name Evidence

²⁶ Also "Skán" in ON.

Although archaeology is an essential source of evidence for reconstructing the cultural landscapes of prehistoric Scandinavia, material data as the sole source for analysis is often not enough to form a complete image. Alongside historical documents and narrative literature, place-names (toponyms) are an important component to the socio-cultural landscape, and a vital fount of unbiased (yet sparsely narrative) information, offering another reconstructive dimension to Scandinavian prehistory (Brink 2011, 57).

Place-names can indicate the use of an area and assist researchers in interpreting the central function of that area in the context of the cultural period in question. For example, the Danish toponym *bavn* means beacon, and is often associated with locations along the crest of a hill. One can therefore deduce that *bavn* may indicate the use of such a hill as a beacon to signal observers at other such sites. Scandinavian naming conventions consisted of not only geographical features, but also cultic and theophoric sites, settlements, districts, and countries, as in *Danmark* (Denmark), which represents the terms *mark* “dividing forest”²⁷ and *Danir*,²⁸ the name of the group living there (Brink 2011, 59).

Another example is the *snekke* toponym prefix, which appears often within Scandinavian land surveys and registries. *Snekke* (ON *snekkja*) may be a later evolution of the ON term *skeið*, a word that appears to have a “central” or “middle” connotative theme, and when used as a suffix (i.e. *-skeið*), seems to relate to a span of time during a day or season (cf. Geir T. Zoëga 2004). *Skeið* is also identified as the personification of mid-ship, or the part of the ship nearest the mast. But the most likely definition of *skeið* is

²⁷ *Mark* is possibly the name of the forest separating the *Danir* from the Saxons to the south. See (Brink 2011).

²⁸ The name *Danir* is obscure and debated. See (Brink 2011).

“war-ship”, “galley” (*snekkjur ok skeiðir*) (Geir T. Zoëga 2004, 370), and “a kind of *swift-sailing ship of war* of the class *langskip*, but distinguished from *dreki*...” (Cleasby and Guðbrandur Vigfússon 1957, 542). Norwegian philologist Eldar Heide agrees with the latter definition, further identifying *skeið* as a primary type of long, slender warship used during the early Viking Age (Heide 2014).²⁹ It is suggested that *skeiðar* was a warship category, and that the 29.5m long Skuldelev 2 (ca. A.D. 1060), as well as the 31m long Hedeby 1 (ca. A.D. 985), and the 36m long Roskilde 6 (ca. A.D. 1025) ship should be considered examples of the *skeið* classification (Heide 2014, 112; Crumlin-Pedersen 1991).

Hundreds of place-names with the prefix *snekke* exist all over Scandinavia. Its presence indicates the use of these areas for maritime purposes, for both merchant ships and naval forces. By examining the known toponyms and landscape naming patterns in the vicinities of the Scandinavian canal sites, a more complete scene emerges, and displays the significance of the sites within the Scandinavian maritime landscape of the Migration Period (A.D. 400–550) and Late Germanic Iron Age (A.D. 550–800).³⁰

2.4.1 Spangereid

The Spangereid canal site and Lindesnes display two *snekke*-related toponyms:

Snekkehammeren (*Nwg* ship-hammer or small mountain), and *Snekkestø* (*Nwg* ship-stand). There are five toponyms containing the term *drajet*, all located around the mouth

²⁹ Norwegian philologist Eldar Heide suggests that the *skeið* was dually purposed, being utilized as a warship or a transport vessel as situations dictated. See (Heide 2014).

³⁰ Further discussion on the significance of place-names in the study of Scandinavian canal sites and central place identification is presented in Section 4.3. Additional information can be found in (Brink 2018).

of Kjerkevågen. The term *drajet* is likely related to ON *draga* and Nynorsk *drage* (to drag) (Cleasby and Guðbrandur Vigfússon 1957, 102; cf. Stylegar 1999). Norwegian archaeologist Frans-Arne Stylegar (1999, 138) has proposed that the presence of the place-names *Sommerdrajet*, *Vinterdrajet*, *Presthusdrajet*, *Stokkedrajet* and *Njervedrajet* along the northern coast of Kjerkevågen further indicate the use of the land for ship-dragging/towing.³¹ At Spangereid, *Presthusdrajet* (the house of the priest) occurs once, and there are three instances of the term *Njerve*, one with the suffix *-åsen* (*Nwg* hill). Stylegar (1999) suggests that the place-name *Njerve* may indicate that the Migration Period (A.D. 400–550) population at Spangereid held a possible religious connection to the Norse god Njōrðr (Njord).

Locations of several former large farms have retained their names into the modern era. These farms include Midbø, Gahre, Haugtuna, and Njerve. In *Agders Historie 800-1350*, Torbjørn Låg (1999) suggests that the name Agder (as in the county of Vest-Agder) is derived from the ON *Agðir*, a name related to ON *Egðir*, a tribe that resided in the *fylki* (ON county/district/shire ruled by a *fylkir*) of *Agðir* during the Germanic Iron Age (A.D. 400–800) (Cleasby and Guðbrandur Vigfússon 1957, 179; Geir T. Zoëga 2004, 153; cf. Låg 1999; Krag 2011, 645).³²

³¹ See Section 4.3.

³² For more information on the ON terms *fylki* and *fylkir* and their applications regarding Norwegian land use, see (Cleasby and Guðbrandur Vigfússon 1957, 179).

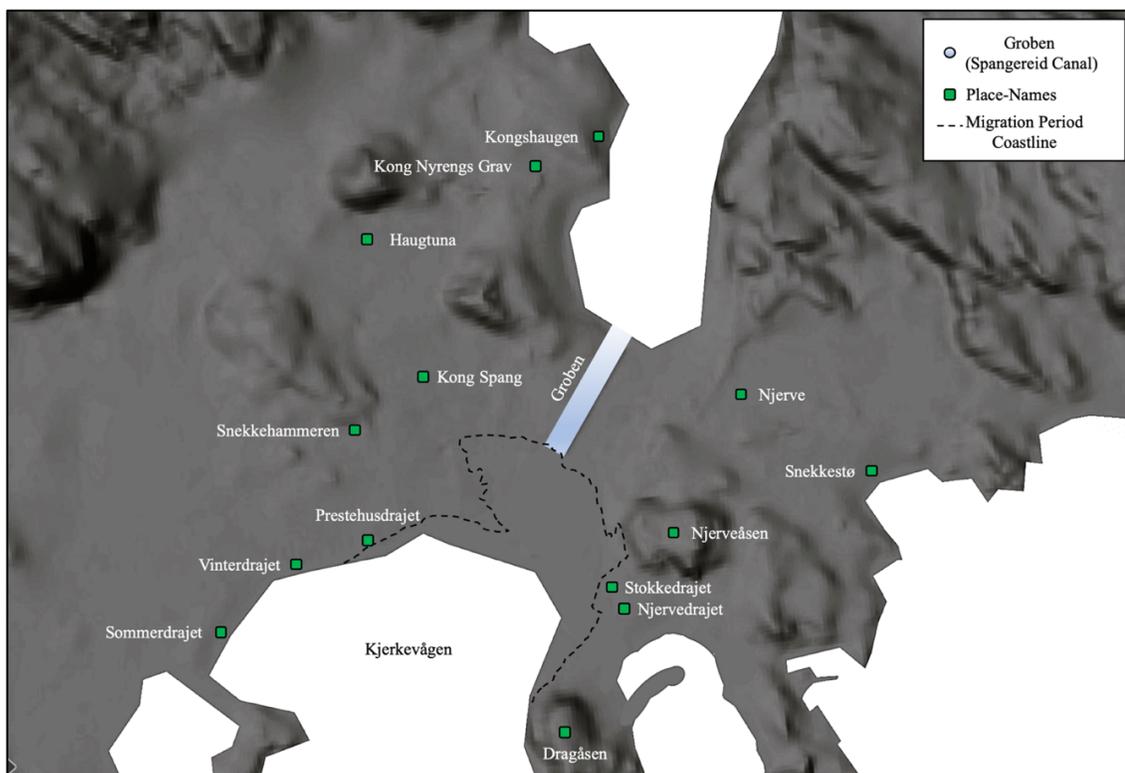


Figure 2.7. Spangereid toponym map.

(After Stylegar and Grimm 2003a, 101)

2.4.2 Samsø

A study of the 1683 and 1688 land registers of King Christian V indicate 103 localities possessing the *snekke* toponym prefix in Denmark, including nine on Samsø (Figure 2.8) (Asingh 2005, 115), with the closest to the Kanhave being *Snekkehøj* (snekke mound/height) (Alstrup and Olsen 1991).

Samsø has a large concentration of *snekke* place-names when compared to the region as a whole. It is suggested that this concentration may indicate that Samsø was,

along with Helgenæs to the north, used as a staging area for warships during a defense of Aros (modern Aarhus) (Asingh 2005, 114).

Additionally, Mols and the Helgenæs peninsula are divided by a land portage called *Draget*. There are eight examples of the *snekke* toponym prefix between them (Skamby Madsen and Vinner 2005b, 102–3).

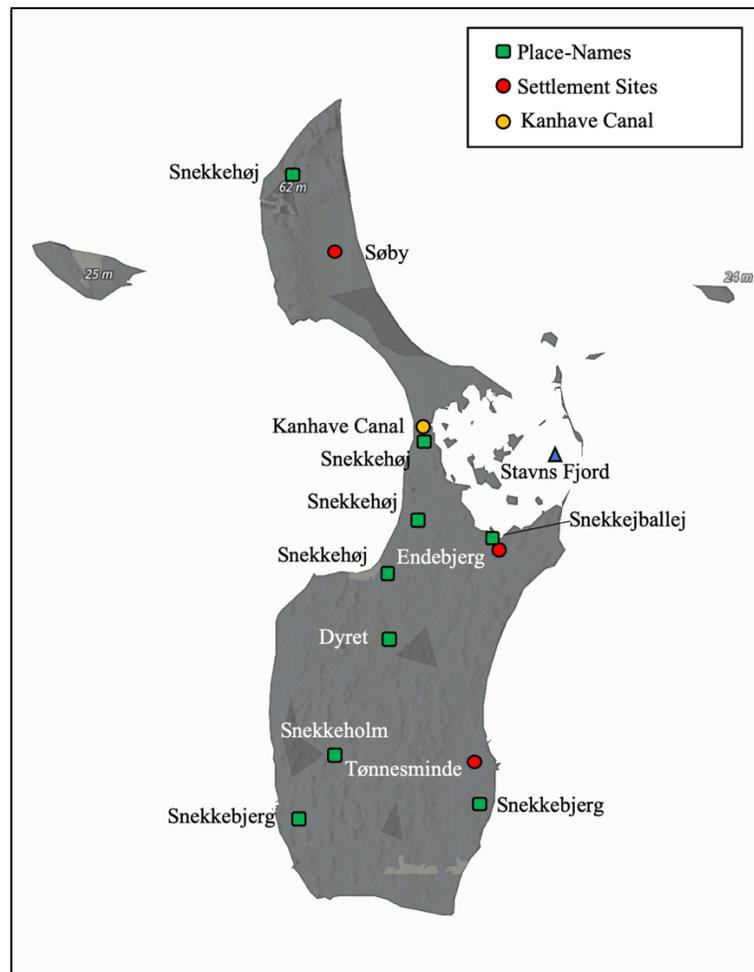


Figure 2.8. Place-names on Samsø.

(After Asingh 2005, 115)

Chapter Summary

This chapter placed the Spangereid and Kanhave canal sites within a chronologically ordered global context by presenting a brief history of the development of canal building throughout Scandinavia and elsewhere in northern Europe. Further, it provided an overview of the socio-political conditions and significant locations within the Scandinavian homelands during the Migration Period (A.D. 400–550) and Late Germanic Iron Age (A.D. 550–800), presented condensed versions literary source materials and Norse saga literature relating to the canal site regions, and provided a survey of place-names both at the canal sites and within their immediate vicinity.

In temporally contextualizing the Spangereid and Kanhave canal sites within the framework of written history, we gain a glimpse of the ways in which the inhabitants of southern Scandinavia viewed their inner and outer worlds. Through natural processes inherent to intimate contact between the diverse cultures of the continental Europeans, Sámi, and Scandinavians, a spatially varied, complex, and gradual process of assimilation and integration occurred in Scandinavia, and its expression is manifested in the social, political, economic, and religious evolutions that occurred during the Germanic Iron Age.

The following chapter presents the physical record of the Spangereid and Kanhave canal sites. Chapter 3 The Archaeology of Scandinavian Canal Sites provides an overview of the built environment and will include lines of physical evidence from the local-scale peripheral landscapes of the Spangereid and Kanhave canals. The data, in conjunction with those of the current chapter will form the base dataset to be examined and presented in Chapter 4 Findings.

Chapter 3

The Archaeology of Scandinavian Canal Sites

Much of what is known about the cultural landscapes of preliterate Scandinavia is derived from the synthesis of intermittent works by medieval chroniclers and Roman authors. Since Scandinavian prehistory lacks the indigenous contemporary written records so crucial to our understanding of the societies and cultures within the homelands, we must turn to archaeology for answers. Historical archaeologist Tina Thurston aptly describes the need for the integration of archaeology into Germanic Iron Age research strategies: “Archaeology is often the study of prehistory; the reading of a record that is missing the underlying social and cultural constructs that ordered and structured the worlds we wish to recover” (2001, 40).

Thus, this chapter’s theme focuses on the core of the thesis: the built environment, which includes archaeological, artifactual, and geoarchaeological data to examine, critically assess, and compare the material records of the Spangereid and Kanhave canals. The material records and archaeological assemblages recorded during excavations of Scandinavian canal sites offer tangible evidence that may indicate the emergence of the canal building technology in southern Scandinavia, the purpose of the canal constructions, their functions, and the overall common culture of canal sites within the Scandinavian maritime land/seascapes.

Section 3.1 Excavation History presents a background of archaeological interest and the history of excavation at the canal sites. Section 3.2 Architecture accounts for site

topography, canal construction and composition, and the physical remains excavated at each site. This section is followed by Section 3.3 Local-Scale Spatial Organization, which places the canal sites within the spatial context of the concentrically expanding material landscapes that surround them. Section 3.3 includes brief overviews of each canal's corresponding harbor, beginning with Kjerkevågen at Spangereid and continuing with Stavnsfjord on Samsø. This chapter concludes with geological surveys and dating methodologies of each canal site (Section 3.4).

3.1 Excavation History

The two Scandinavian canals studied in this thesis have relatively long archaeological histories, with the earliest dating back to excavations of the Spangereid “canal complex” in the late 19th century by Norwegian archaeologist Oluf Rygh. His investigations revealed over 40 burials, and 8 large boathouses at the mouth of Kjerkevågen (Rygh 1880). Several boat graves, a potential hall construction, and a ring-shaped court site (*Nwg tunanlegg*) were later excavated during the 1970s, and again in the 1990s (Stylegar 1999). Parts of the ancient canal are still visible today, with a well-preserved 60m stretch on the southern shore of Høllebukta at the mouth of Lenefjorden. The modern canal, dug in 2005 and opened by Queen Sonja in 2007, runs 930m from Store Båly (Great Baily/Harbor) to Lenefjorden.

The Migration Period (A.D. 400–550) Spangereid Canal—colloquially referred to as “Grogen”—rests at the center of the old parish bearing the same name.³³ The Spangereid parish is in Lindesnes (*Eng Naze*), a municipality of Vest-Agder county

³³ For more information on “Grogen”, see footnote in Section 1.2.1.

located in the traditional district of Sørlandet (Southern Norway). Spangereid was at one time its own municipality but was in 1964 absorbed (along with Vigmostad and Sør-Audnedal) into greater Lindesnes (Thorsnæs 2017). The Lindesnes peninsula forms the southernmost point of mainland Norway, with a coastline dividing the Skagerrak Strait from the North Sea and bordering the southern portions of Grønsfjorden and Lenefjorden.

The Kanhave Canal bisects the island of Samsø, situated in the south Kattegat, and located 15km off the east coast of Jutland in Denmark. The canal was excavated in three stages; first in 1960, then in 1977, and finally in 1979 (K. Christensen 1995, 99). Archaeological interest on Samsø has traditionally been focused on earlier periods, yet there is a reasonable amount of material data from the Germanic Iron Age (A.D. 400–800) that displays the important role of the island during that early stage in Danish prehistory.

Several Migration Period (A.D. 400–550) findings displaying settlement patterns were excavated on the small island of Eskholm, located within Stavns Fjord. Single object finds occurred on Hesselholm, including an 8th-century bronze mount (Figure 2.5.), and two Berdal type tortoise brooches dated to the Viking Age (A.D. 800–1050). Additionally, several rows of yew piles were discovered at the western shore of Stavns Fjord, south of the Kanhave Canal (Section 3.3.2.1).

Aside from Stavns Fjord, Samsø currently displays three Germanic Iron Age (A.D. 400–800) and Viking Age (A.D. 800–1050) settlement sites of interest: (1) Endebjerg, first excavated in 1988 by Danish archaeologist Christian Adamsen, and in 2018 by a joint Harvard/Aarhus University/Moesgaard Museum team. Endebjerg's excavations revealed a longhouse, supportive sunken-featured buildings, and evidence of

ship building functionality (Section 3.3.2.2); (2) Tønnesminde, a similar site, was excavated 6 times, beginning in 1999 and ending with the final excavation in 2017. Tønnesminde also presented a longhouse and sunken-featured buildings, along with evidence of trade (Section 3.3.2.3); and (3) Søby, a Viking Age site first excavated in the 1970s. The Søby site did not display a longhouse but presented 19 sunken-featured buildings (Section 3.3.2.4).

Both the Spangereid and Kanhave canals existed in diverse and dynamic environments with settlement patterns that contrast with the concentric expansions of each general site. Although the Kanhave Canal does not display the same spatial development pattern seen at Spangereid, the island of Samsø as a whole displays a large enough amount of contemporary data to infer that the Kanhave Canal was likely to have been supported by sites more distant to it. Perhaps there was less of a demand for proximally clustered settlement constructions on Samsø than there was at Spangereid during the Germanic Iron Age.

The following section examines the materials used in the Spangereid and Kanhave canal constructions, and accounts for the spatial patterns that exist within the site structures of the Spangereid and Kanhave canal sites.

3.2 Architecture

The Spangereid and Kanhave canals share similar architectural characteristics, including straight trenches cut into soil strata composed predominantly of sand, long waterway courses connecting bodies of water, and obtuse sloping walls reinforced with panels supported by post-in-trench timber staves. Additionally, the Spangereid and Kanhave

canal sites do not appear in isolation, but within the proximity of supporting infrastructure.

Scandinavian canals are more than simply cuts through the land. Although we do not know the essential motivation behind their construction, we can determine with relative certainty that they represent freedom of movement, and reflect human ingenuity and agency, as well as organization and planning.

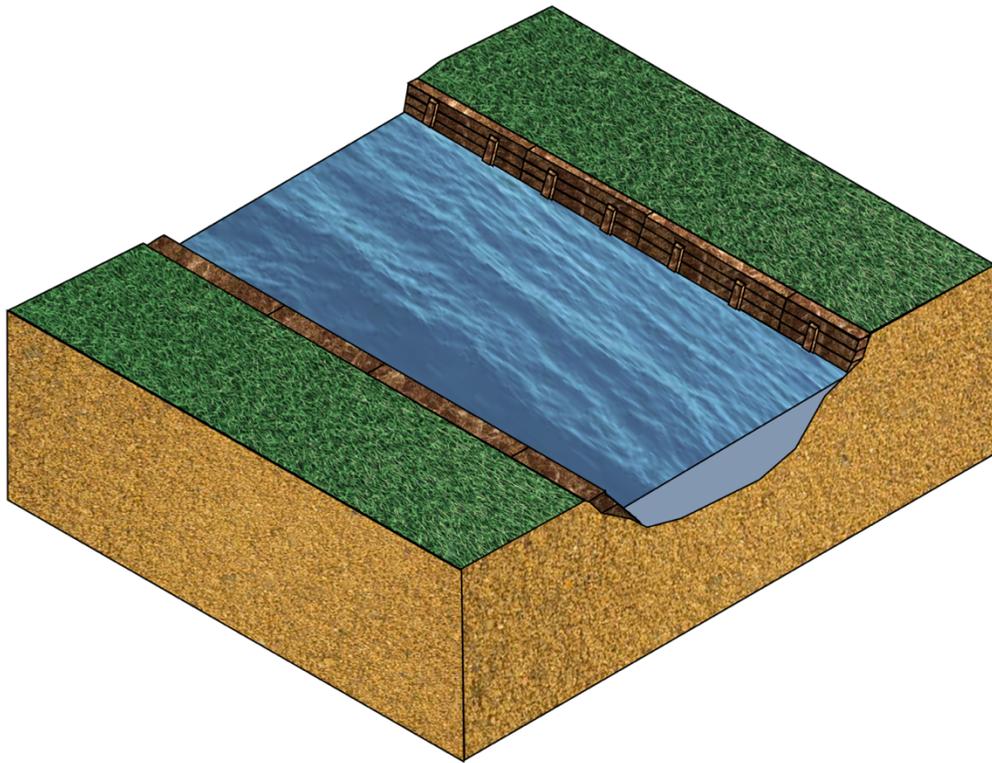


Figure 3.1. Idealized reconstruction of the Scandinavian canals showing fairway watercourse and reinforced timber bulwarks.

3.2.1 Construction Schemes

The canalization schemes of the Spangereid and Kanhave sites appear as uniform trenches cut through narrow isthmuses with fairway watercourses that connected seaways at each of the canals' endpoint nodes. Both sites exhibit carefully planned layouts, and behave as transit hubs, connecting sea-lane transportation networks by linking the banks of protected harbors to the shores of bays. For example, the Spangereid Canal's fairway watercourse connected the Migration Period (A.D. 400–550) upper bank of Kjerkevågen with the southern shore of Norway's inner fjord system at Høllabukta (Stylegar and Grimm 2003b), while the Kanhave Canal linked the western banks of Stavns Fjord with the eastern shore of Mårup Vig (K. Christensen 1995).

Canal	Connection Nodes
Spangereid	A) Kjerkevågen (Protected Harbor) B) Høllabukta → Lenefjorden (Bay/Fjord)
Kanhave	A) Stavns Fjord (Protected Harbor) B) Mårup Vig → Kattegut (Bay)

Table 3.1. Connection nodes of the Scandinavian canals.

3.2.2 Architectural Styles

The Scandinavian canals were exceptionally large, with 10-12m wide waterway courses formed by 1.25-2m deep trenches cut into the soil strata and measuring between 250–500m in length. The Spangereid and Kanhave canals display similar construction styles

further indicated by obtuse sloping walls reinforced with wooden planks and supported by post-in-trench timber staves.³⁴

The Spangereid Canal's measurements were assessed at approximately 250m long, 10–12m wide, and 2m deep (Stylegar and Grimm 2003a). At its lowest layer, the canal trench width was assessed at 7m. The bottommost layer of the canal was assessed to have been ca. 0.9m above the present sea level, and the fairway channel is thought to have had a 1-1.5m high water level at the time of its use. The Spangereid Canal rests in a 500m wide isthmus, and cuts the Lindesnes peninsula from north to south, separating much of the peninsula from mainland Norway. The isthmus has a maximum extant height of 2.90m above sea level (ASL).

The Kanhave Canal was measured at 500m long (Hall 2007, 22), and 12m wide, with a maximum water depth of 1.25m (H. H. Hansen and Aaby 1995). The channel cuts the island of Samsø in half, and links the Bay of Sælvigbugten (at Mårup Vig) with Stavnsfjord (K. Christensen 1995, 101). Nearly 11,000m² of earth were removed to form the channel during the Late Germanic Iron Age (A.D. 550–800) (Danmarks Kulturarvs Forening 2019). The Kanhave Canal is known as one of the pre-Viking Age's largest engineering works. It is seen as a mark of social expansion and consolidation of Danish political power, along with large construction projects of the late 10th century at Trelleborg, Fyrkat, Nonnebakken and Aggersborg, Ravning Enge, and the Danevirke.

³⁴ Organic materials found along the lowermost portions of the Spangereid Canal's wall layers were interpreted as the remains of wooden timbers. For more information, see Section 3.2.3 and (Stylegar and Grimm 2003b). In contrast, the Kanhave Canal walls retained well-preserved timber and staves that were discovered during its primary excavation. It is not known if the Kanhave's wall planks represent the original wall reinforcements or later repairs, however, several samples were dendrochronologically dated, revealing that the earliest sample originated ca. A.D. 726. For more information, cf. footnote on p119 and see (K. Christensen 1995).

Both the Spangereid and Kanhave canals are distributed in coastal environments, with soil strata dominated by granular marine sand. Further, the Spangereid Canal's geology displays a small percentage of decayed organic matter (peat), while the Kanhave displays detrital and glacial clay deposits within its soil strata.³⁵

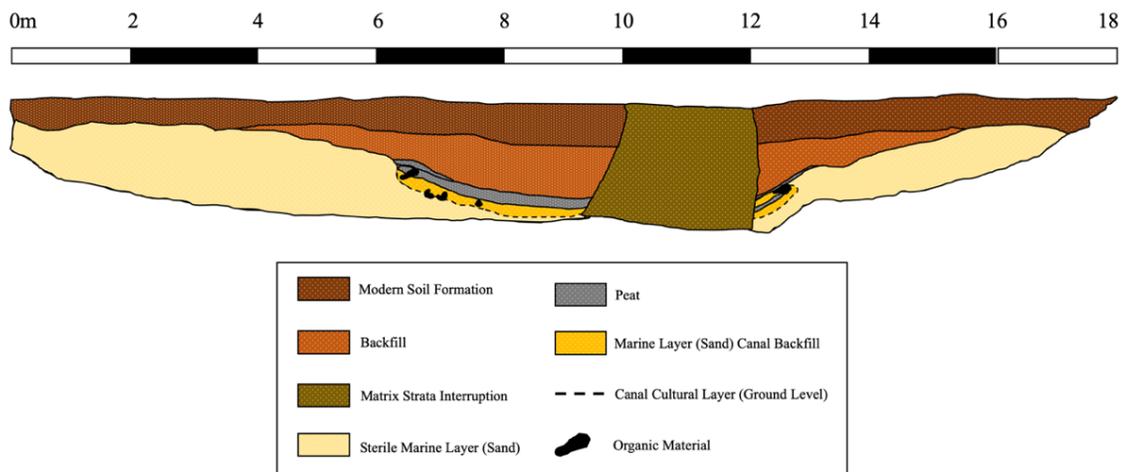


Figure 3.2. Simplified *south* profile of the Spangereid canal.

(Redrawn from Stylegar and Grimm 2003a, 448).

³⁵ Water-level depths are depicted here as maximal for each canal, however, daily levels would have been dependent on tidal flux.

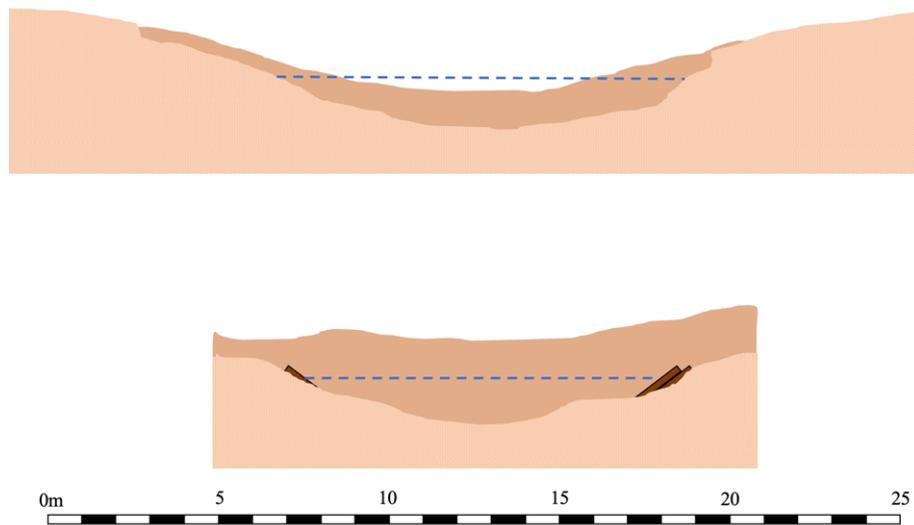


Figure 3.3. Excavated sections of the Kanhave Canal measured by Hans Stilesdal, 1960. *The eastern excavation site (top) displays a cut at the deepest point. The soil strata are composed of a higher clay content than at the western excavation site. The western excavation site (bottom) displays a section where oak planks protected the canal walls from collapsing. Dashes indicate canal fairway water level at a depth of 1.25m.*

(Redrawn from K. Christensen 1995)

Canal	Canal Width at Highest Edge	Canal Width at Water Level	Canal Width at Bottom Layer	Canal Length	Canal Depth	Max. Water Level Depth	Canal Soil Composition
Spangereid	18m (est.)	10-12m	7m	250m	2m	1.5-2m	Sand, Peat
Kanhave	26m	11.5m	9.5m	500m	2m	1.25m	Sand, Clay

Table 3.2. Physical Properties of the Spangereid and Kanhave canals.

3.2.3 Canal Wall Typology

Canal walls generally fall into two categories: Reinforced and natural. The Spangereid Canal site exhibited a U-shaped depression with sloping sides and organic material at the canal's bottom layer, which were interpreted as the remains of wooden stabilization timbers. Deep (wood) stake imprints were also found, as well as woodwork residue along the canal walls (See Fig 3.2.) (Stylegar and Grimm 2003a).

The Kanhave Canal's side walls were reinforced to support the loose/sandy soil composition characteristic of its coastal location. This reinforcement consisted of side walls rivetted by horizontal beech, oak, aspen, and lime planking panels 2-3.5m in length, with slots for 0.5m long pegs hammered into the canal sides (Figure 3.4 and Figure 3.5) (Etting, Engberg, and Frandsen 2012, 15; K. Christensen 1995, 106). The planks were retained by thick diagonal oak piles spaced out in 3-meter intervals.



Figure 3.4. Wooden panels exposed during the Kanhave Canal's 1960 excavation.

(Photo by Hans Stiesdal, 1960).



Figure 3.5. Wooden panels on the southern side of the Kanhave Canal, exposed during the 1977 excavation.

The horizontal panels are primarily beech. The slanted poles are aspen. (Photo by Niels Bonde, 1977)

Canal	Reinforced	Wall Materials and Determinant Factors
Spangereid	Yes (Interpreted)	Organic material interpreted as woodwork residue along canal walls. Post-in-trench imprints within bottommost canal fairway watercourse layer.
Kanhave	Yes	Well-preserved timber planking and supportive stakes constructed of beech, oak, aspen, and lime found along canal walls during excavation.

Table 3.3. Canal wall typology and composition.

3.3 Local-Scale Spatial Organization

The spatial organization of the Kanhave canal site differs greatly from Spangereid’s “canal complex” style layout, with its proximally clustered features and place-names

indicating a center of gravity around the canal.³⁶ In contrast, Samsø's Late Germanic Iron Age (A.D. 550–800) built environment appears to be spread out concentrically across the island, with functional structures occurring at supportive sites located further inland from the canal.

This section presents the local-scale spatial organization of the Spangereid Canal complex and relevant site data from excavations across Late Germanic Iron Age (A.D. 550–800) Samsø to provide information on neighboring archaeological sites and their assemblages, artefactual data (including single object metal-detector finds), and spatial layouts that comprised the cultural landscapes contemporary with each canal.

3.3.1 Spangereid

Much of the contemporary archaeological data pertaining to the Spangereid Canal is located within the periphery of the canal site. This section focuses on that material, presenting information on grave fields, several large boathouses, a large interpreted hall construction, radially arranged features indicative of a court site, and defensive hilltop fortifications.

3.3.1.1 Burials/Graves. There are three known grave fields in the vicinity of Spangereid. On the west side of the canal, and just south of Haugtuna is the largest: a 25-hectare burial ground. A smaller field is located east of the canal at the mouth of Høllebukta, and the last grave field lies between Njerneåsen and Dragåsen, on the small peninsula bordering the western shore of Kjerkevågen (Stylegar and Grimm 2003b).

³⁶ For further information on place-name clusters and how they apply to central place theory see (Brink 2018).

The first mention of burial grounds in Spangereid were made by Norwegian clergyman and historian Peder Claussøn Friis (1881). Later reports indicated that several objects, including swords and a golden spiral ring were recovered during early excavations. Aside from the sparse information remaining from those investigations, a 20m in diameter cremation grave mound in the vicinity of Kong Spang (west of the canal site) was excavated in the 1700s, and was said to have contained several sword fragments, as well as 1 bronze vessel. Neither the fragments nor the vessel are believed to have survived into the modern era. Additionally, Kongshaugen (King's Mound), is a location believed to have once contained the 45m in diameter, 5m-high ship-burial mound of Viking-Age (A.D. 800–1050) petty king (or chieftain) Nyreng. The hill was removed in the 1970s, and little information remains of its previous contents (Stylegar and Grimm 2003b).

In the late 19th century, Norwegian archaeologist Oluf Rygh investigated 44 mounds (many of which were cremation graves) within the large grave field to the west of the Spangereid Canal site, resulting in the discovery of five “status graves” (containing gold objects, bronze or glass vessels) dating to the Migration Period (A.D. 400–550) (Stylegar and Grimm 2003b).

Rygh numbered the 44 graves that he studied. Grave 40 was a burial chamber with a length of 3m, and width of 1.5m. The recessed grave was bordered and covered by stone slabs and was located in a mound measuring 12m in diameter. Within the grave, a person lay on a bed of animal pelts and textiles, and the grave itself was adorned with a number of silver objects. Based on a study of Grave 40's construction and goods, it was assessed by Norwegian archaeologist Frans-Arne Stylegar as comparable to Snartemo

Grave V, and therefore dates to the Migration Period (A.D. 400–550). In addition, Spangereid's Grave 34 contained the same construction characteristics as Grave 40, however none of the contents of Grave 34 were preserved (Rygh 1880).

In total, 15 graves were assessed as “status graves” dating to the Migration Period. Ten graves were discovered to have golden, silver, bronze or glass objects, including 1 triangular ornamental bronze fitting, 1 glass jar fragment, 1 golden finger ring, 1 bronze fibula, and 1 18cm knife (Stylegar and Grimm 2003b).

A group of 12 boat graves were investigated, and two revealed gender-specific goods indicating female boat burials. Nine of the graves were present in a group within the large grave field located south of Haugtuna and west of the Spangereid Canal. One such grave was of a female set within a boat measuring 7m in length, and containing lavish textiles, including two gilded bronze brooches (Rygh 1880). The remaining three graves were either on the edge or beyond the border of the large burial ground. The boat grave located in the grave field west of the Spangereid Canal, and at the mouth of Høllebukta was a cremation grave containing 1 set of iron scissors, 12 glass beads, loom weights, clinker nails, 2 knives, and 1 Viking-Age ceramic pot (Rygh 1880). Another female boat grave was located under the longitudinal outer wall of the large boathouse within the southern border of the large western grave field. The boat grave was unique in that it was richly equipped with high-status objects: 4 early iconographic Scandinavian coins bearing ship imagery and symbology, 2 oval brooches, 2 bronze bracelets, 1 necklace of 52 pearls, 1 knife, 1 whetstone, and 1 Frankish denarius bearing the image of Louis the Pious (Stylegar and Grimm 2003b). All twelve boat graves were dated to the

Late Germanic Iron (A.D. 550–800) / Early Viking Age (A.D. 800–1050), and over half were flat graves, unmarked by traditional mounds.

3.3.1.2 Large Boathouses. Several archaeological surveys were conducted in Kjerkevågen during the 1970s resulting in the discoveries of as many as 24 rectangular features with open ends facing toward the water. Internal wall lengths vary between 15–27m, and the features have been interpreted as boathouses/boat-sheds, or ON nausts (Cleasby and Guðbrandur Vigfússon 1957, 146; Geir T. Zoëga 2004, 308). Seven of these boathouses have been interpreted as belonging to the Migration Period (A.D. 400–550) (Stylegar 1999).

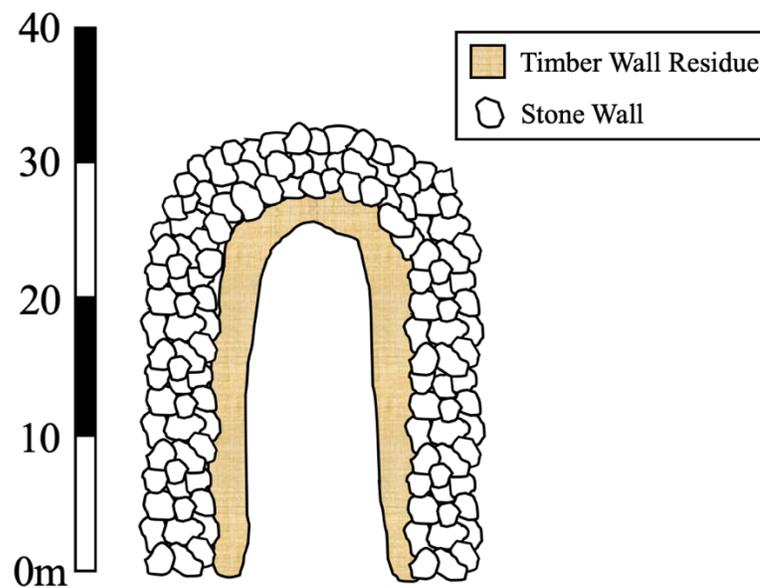


Figure 3.6. Idealized Migration Period boathouse at Spangereid.

(Redrawn from Stylegar and Grimm 2003b, 94).



Figure 3.7. Artist interpretation of a Migration Period boathouse in southern Norway.

(Reproduced with kind permission from arkikon.no., 2019)

3.3.1.3 Interpreted Hall Construction. Haugtuna is a 15m high hill approx. 570m west of Høllebukta's eastern shore. The hill is named for the farm that once stood upon it. In 2001, traces of an east to west oriented boat-shaped hall structure were located on Haugtuna. It was assessed that the western portion of the hall measured 15m in length, and that the inner transverse and longitudinal walls measured 8m in width. Much of the rest of the structure was imperceptible (with the exception of a double rampart wall on the north side, east of the below mentioned entry point) due to modern use of the site, but it is estimated that the entire hall measured 45m long \times 8m wide (Stylegar and Grimm 2003b, 86), and had an entry point within the northern wall. Fire-cracked stones were discovered at the site, indicating settlement, and use (Stylegar and Grimm 2003b).

In efforts to date the Haugtuna hall, Norwegian archaeologist Frans-Arne Stylegar and German archaeologist Oliver Grimm compared its design and shape against the Forsand hall site, and noted similarities, including the large continuous hall section. They then compared double rampart feature against the Borg hall's similar feature (Stylegar and Grimm 2003b). The findings were inconclusive, and the hall at Haugtuna remains undated due to sparse material data at the site (Reiersen 2017).

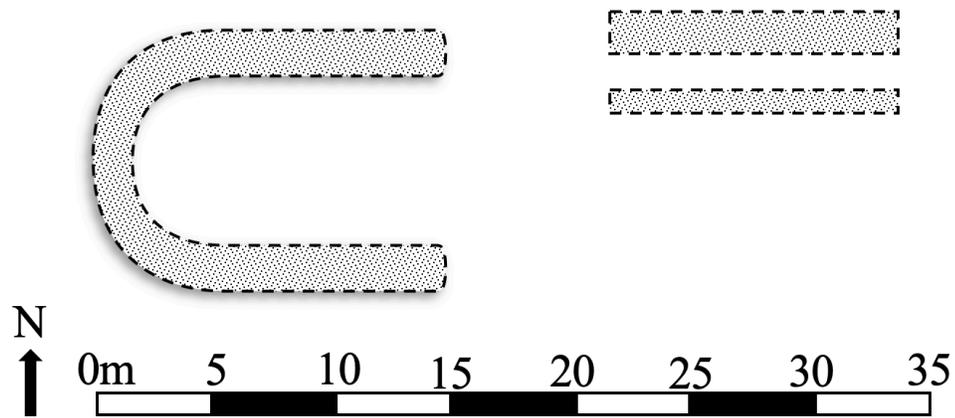


Figure 3.8. Interpreted hall construction at Haugtuna.
(Redrawn from Stylegar and Grimm 2003b, 99).

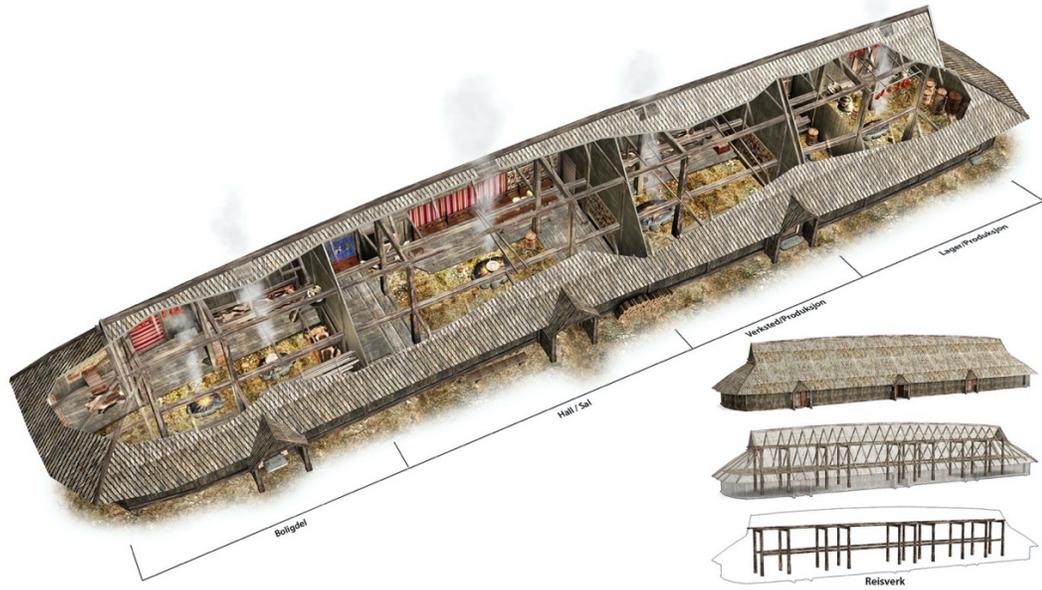


Figure 3.9. Artist interpretation of a Migration Period Scandinavian hall.

(Reproduced with kind permission from arkikon.no., 2019)

3.3.1.4 Radially Arranged Features. In the late 19th century, Oluf Rygh discovered several elongated depressions located within the eastern section of the aforementioned large burial mound. Upon preliminary investigation, the features surrounding the depressions were interpreted by Rygh to represent funerary monuments, but during later excavations he observed that the features were piled stone and peat walls (Rygh 1880). The area was again surveyed during the 1970s, and finally, in 1999 investigators discovered ten features arranged in groups of twos and threes, forming an overall oval shape, with their narrow, open ends oriented around a clear central space. The features' internal dimensions varied, with some measuring 7m × 2m, and others 10m × 3m. The features were assessed as each having two large central hearths, with indications of cooking pits external to the structures, and beyond the common central space. These

radially arranged features are known in Norway as *tunanlegg* (Stylegar and Grimm 2003b).³⁷

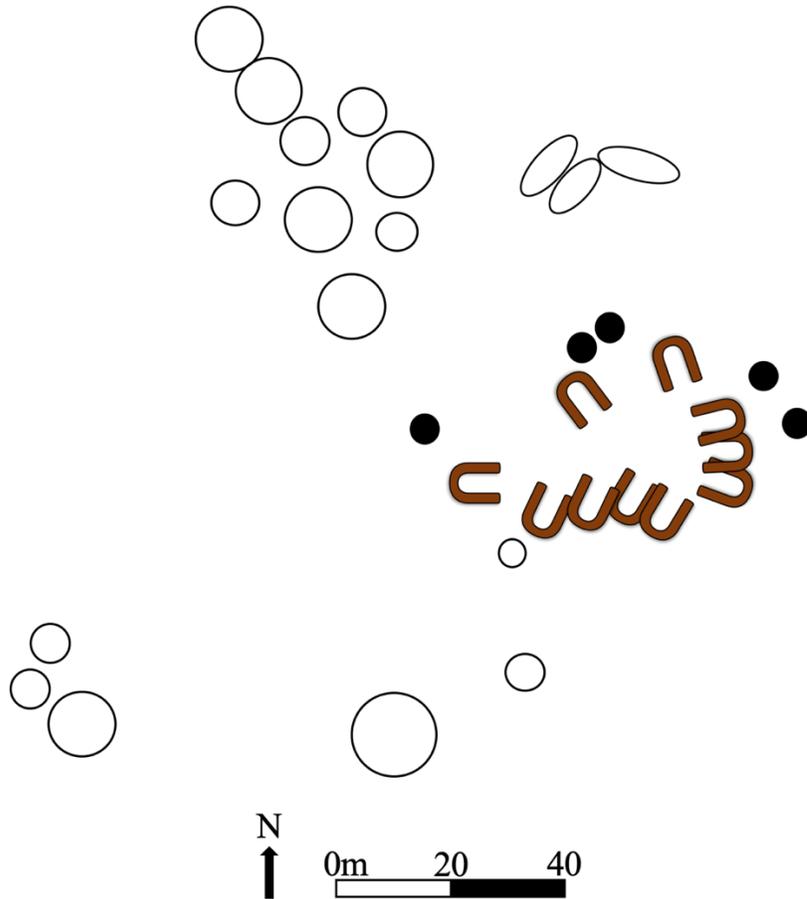


Figure 3.10. Radially arranged features at Spangereid (Tunanlegg).

Symbols: ● – cooking pit, ○ – burial mound. (Redrawn from Stylegar and Grimm 2003b, 96).

³⁷ For more information on *tunanlegg*, see Section 4.5.2.



Figure 3.11. Artist interpretation of a Tunanlegg.

(Reproduced with kind permission from arkikon.no., 2019)

3.3.1.5 Fortifications. Three features were surveyed on hills Røsefjellet, Njerneåsen, and Dragåsen in the vicinity of Spangereid. Each feature was interpreted as a fortification structure (Stylegar and Grimm 2003a). The Norwegian term for hill fortifications is bygdeborg. Dragåsen is the best preserved of the three, as it has retained a system of stone walls around the highest apex of the steep hill that bears its name. The fortification features have been studied and interpreted as possible fallback positions in the event of crisis. As of this writing, the features remain undated (Stylegar and Grimm 2003b).

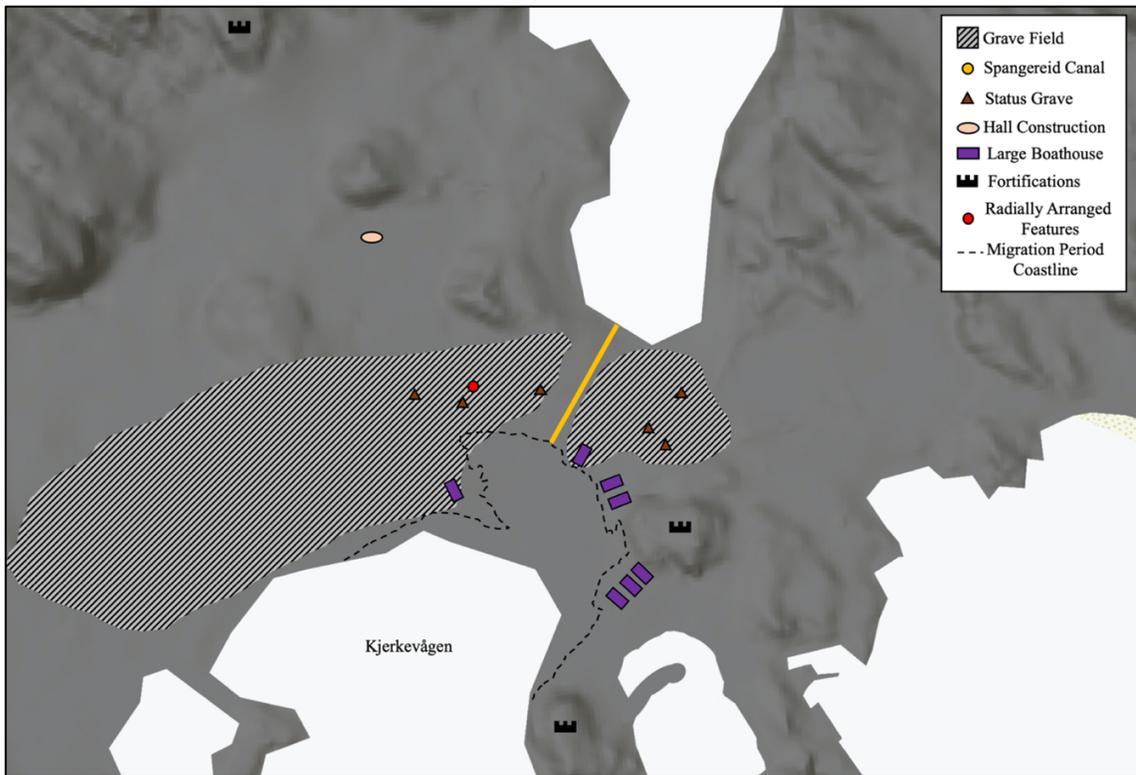


Figure 3.12. Map of key features and locations at Spangereid.

(Redrawn from Grimm 2010b, 119).

3.3.2 Samsø

Samsø is rich in material culture dating back to the Mesolithic Period (12500–3900 B.C.), when the hunters and fishermen of the Ertebølle culture exploited the rich marine life of Stavns Fjord and left their refuse in a kitchen midden on Hjortholm (J. Jensen 1982, 90). The Ertebølle settlements at Alstrup and Endebjerg, as well as those of the Neolithic (3900–1700 B.C.) Funnelbeaker culture at Tønnesminde, established a human presence on the small Danish island that continued through the Bronze Age (1700–500 B.C.), to the Migration Period (A.D. 400–550), and into the Late Germanic Iron Age (A.D. 550–800).

This section presents the material data excavated at Stavns Fjord and the settlements of Endebjerg, Tønnesminde, and Søby, which were considered functional during the time that the Kanhave Canal was in use at the end of the Germanic Iron Age.

3.3.2.1 Stavns Fjord. Stavns Fjord is a natural harbor, providing protection from the sea, and anchorage for ships along its shallow banks. Several islands exist in the fjord, with elevated positions suitable as observation points to detect ship movements from the Djursland peninsula in the north, west to Aros (modern day Aarhus), and the shipping lanes along the Storebælt (Great Belt), a vast strait to the east of Samsø. It is thought that the harbor at Stavns Fjord was used as a traffic junction, and served as a position for the defense of Aros during the Viking Age (Asingh 2005, 114).

Excavations during the 20th century have exposed the (pre)historical contents of Stavns Fjord's islets. As referenced above (Figure 2.5), investigations on Hesselholm revealed an example of Germanic Iron Age (A.D. 400–800)/Viking Age (A.D. 800–1050) Nordic art, indicating a burial contemporary with the Kanhave Canal's period of use. Other sites include Eskholm, where settlement traces consisting of hearths containing charcoal (yew) were radiocarbon dated to ca. A.D. 400 (Adamsen 1995, 92).

In 1974, an unusually low tide revealed a series of more than 100 wooden pilings along the western shore of the fjord. A survey was conducted the following year (continuing into 1977), during which 14 rows of 2–60 piles were located, beginning between 50–70m offshore. In total, 219 piles were found. The rows form a pattern fluctuating between 8 and 56m long, and according to Danish archaeologist Christian Adamsen, appear to form 30–40m wide “stalls” (1995, 76). Pile measurements taken in

1975 revealed an average diameter of 10.8cm, with lengths reaching an average of 10cm from the seafloor (in situ). Two thirds of the piles had an average tilt of 25–45 degrees, and 9 possessed “side branches”. A sample consisting of 8 piles was later excavated, with an average length of 2.75, composed of roof-timber, yew, and pine cut by axe (Adamsen 1995, 78). Radiocarbon dating was used to determine the age of 6 samples, resulting in an average date of A.D. 350–370.³⁸

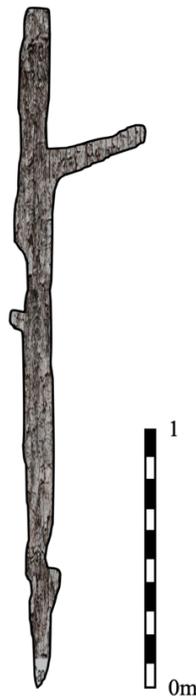


Figure 3.13. Example of wooden piling from the sample group at Stavns Fjord.

(Redrawn from Adamsen 1995).

³⁸ This dating places the piles within the Late Roman Iron Age (A.D. 200–400).

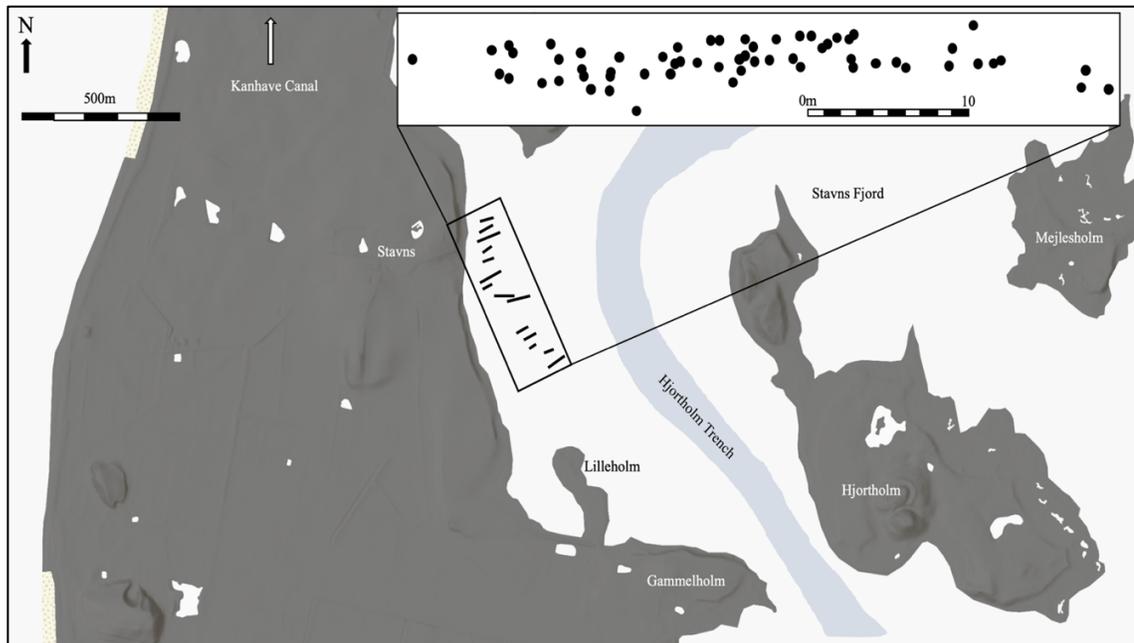


Figure 3.14. Wooden piling group at Stavns Fjord.

Projection displays overhead layout of pilings. (Redrawn from Adamsen 1995).

3.3.2.2 *Endebjerg*. The Endebjerg site lies on a ridge 300m from the waters at the southern shore of Stavns Fjord. The first excavations at Endebjerg were conducted by Danish archaeologist Christian Adamsen via the Samsø Museum in 1988 (Rigsantikvarens arkæologiske sekretariat 1989). The excavation revealed a small Late Iron–Early Viking Age settlement that included four sunken-featured buildings (3.5 of which were excavated),³⁹ and a 27m long, 5.5–9m wide longhouse (Figure 1.16) (Adamsen 1995, 82). The longhouse was the first discovered on Samsø, and is thought to date to the early 8th century (Adamsen 1995, 68–96). The longhouse was oriented East to West, contained two entrances, and six sets of roof-bearing posts. Roman Iron Age (A.D.

³⁹ For further information on Sunken-featured buildings, also known as Grubenhaus or pit-houses, see (Brink and Price 2011, 449 and Chapter 8).

1–400) and Germanic Iron Age (A.D. 400–800) items including iron nails, clay objects, earthen vessels, and ceramics were discovered during the earliest excavations (1988, 89, 90). Additionally, a green glass rim sherd dated to the Late Germanic Iron Age (A.D. 550-800) was discovered and assessed as Frisian or Frankish in origin.

Notably, one of the sunken-featured buildings contained hundreds of well-preserved fish and sea-borne animal bones (165 cod bones, 1 flatfish bone, and 1 seal bone), unique in that the bones were the first discovered in a farming settlement of Viking Age Denmark (Adamsen 1995). The 1988-1990 excavations also revealed 2.5 glass beads, multiple loom weights (composed of glossy-surfaced, unburnt clay), a key, several nails, along with rectangular, rhombic, and square rivets, a hooked object made of copper containing silver, and originating in England, an iron lock, an iron knife and several black schist whetstones from Norway, 262 land-animal bone fragments (58% pigs, 23% cows, 16% sheep/goats, and 3% horses), a rare burnt-clay lamp base piece possessing a similar motif to a Viking Age comb found in Hedeby, and a glass rim-herd from Francia (Adamsen 1995).

Magnetometer surveys conducted in 2017 and excavations continued in 2018 revealed ceramics (including an ornamented and stamped example), rim sherds, iron slag, metal fragments, loom weights, an iron key, Viking Age glass beads, and animal bones and teeth (horse jawbone and pig tooth). Further excavations of postholes discovered in and around the settlement revealed a group of animal bones from varying species, including a goat mandible within one of the postholes.

Across the world, the work of amateur as well as professional metal detectorists has uncovered many single objects both within site areas and displaced beyond their

borders. Three notable metal detector finds from the Endebjerg site include an iron object shaped similarly to a small cannon, a sword pommel fragment (Figure 3.15), and an Arabic dirham hack-silver fragment (Figure 3.16) discovered in a field adjacent to the site.

Feature	Quantity	Dimensions and Detail	Interpretations
Longhouse	1	27m long × 5.5–9m wide 6 sets of roof-bearing posts	Layout indicates early 8 th - century dating. Assemblages indicate trade, ship construction/repair.
Sunken-Featured Buildings	4	Mean depth of cultural layers 55cm–62cm	Assemblages indicate trade, textiles, metal working (iron), ship construction/repair.

Table 3.4. Site features at Endebjerg.



Figure 3.15. Sword Pommel Fragment (2018 Endebjerg excavation).



Figure 3.16. Hack-Silver Arabic Dirham Fragment. (2018 Endebjerg excavation).

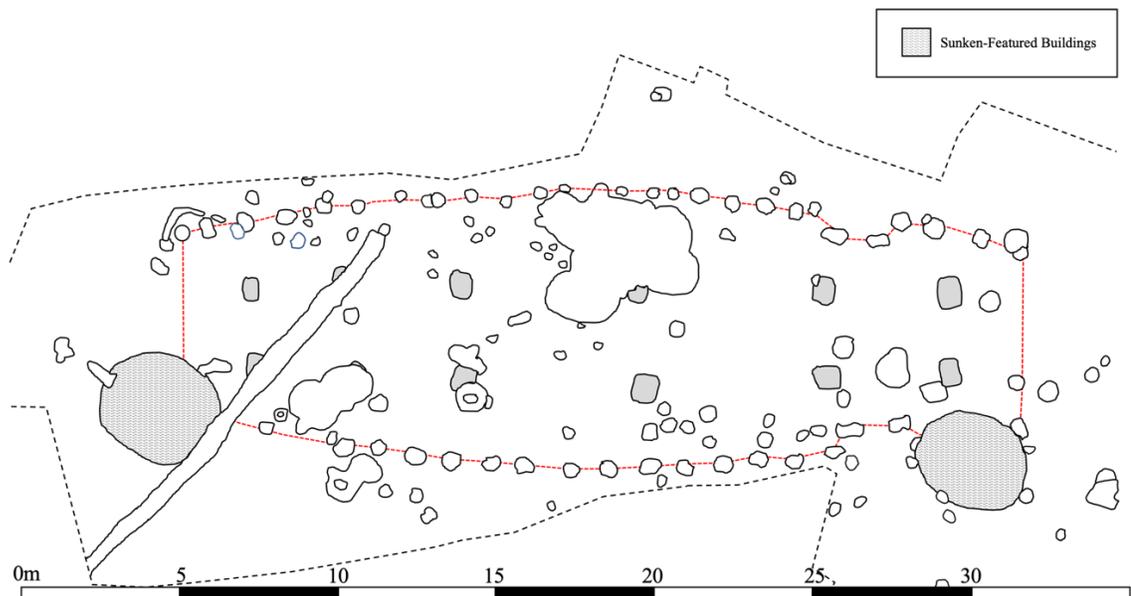


Figure 3.17. Late Germanic Iron Age Longhouse and sunken-featured buildings (1988

Endebjerg excavation).

(Redrawn from Adamsen 1988).

3.3.2.3 *Tønnesminde*. Excavations in 1999 at Tønnesminde, near Ballen,⁴⁰ revealed that human occupation (Funnel Beaker Culture) existed at the site as early as the Early Neolithic Period (3900–1700 B.C.) (Sørensen 1999, 1). Later metal-detector surveys (2010) revealed Viking Age (A.D. 800–1050) artifacts, leading to further excavations (beginning in 2013) of Pre-Roman Iron Age (500–1 B.C.) and Viking Age settlements, including four 3m in diameter, 10-30cm deep sunken-featured buildings and a three-aisle longhouse 20m long × 5m wide (Christiansen 2014, 6).

The sunken-featured buildings appeared to have flat floors and roof-bearing posts at the eastern and western walls. Material objects collected at the sunken-featured buildings during the 2014 and 2015 excavations included fragments of pottery, a soapstone vessel, loom weights, and spindle whorls (items used in the production of textiles), glass beads, iron rivets, iron knives and whetstones, indicating that the settlement existed ca. A.D. 900 (Christiansen 2014, 1, 5). Metal detected finds included part of a 9th-century West Frankish brooch.

Rows of postholes indicative of a fence line were uncovered along the northern part of the excavated area, and during the 2000 excavation, a large pit containing Viking Age pot sherds and the fragment of a human jaw were found on a nearby hill, approximately 200m east of the site at Tønnesminde (Christiansen 2014, 3, 6). Overhead imagery of the hill revealed circular ring ditch crop marks, the presence of which are a possible indicator of burial grounds (Christiansen 2014, 4–5).

⁴⁰ The Tønnesminde site rests on the grounds of a farm formerly located in Tranebjerg Sogn, now Samsø parish (these details relate to recent aspects of church/state administration).

Feature	Quantity	Dimensions and Detail	Interpretations
Longhouse	1	20m long × 5m wide 3 sets of roof-bearing posts	Layout indicates Viking Age (A.D. 800–1050) dating.
Sunken-Featured Buildings	4	3m diameter × 10-30cm deep	Assemblages indicate trade, blacksmithing (iron smelting, metalworking), textiles, ship construction/repair.

Table 3.5. Site features at Tønnesminde.



Figure 3.18. Artist interpretation of a Germanic Iron Age Scandinavian longhouse.

Bolig: Residential area, Fjøs: Cowshed (Reproduced with kind permission from arkikon.no., 2019)

3.3.2.4 *Søby*. *Søby* was a settlement positioned between the modern towns of Nordby and Mårup on Samsø's northern island. The site was examined during several fieldwork seasons, and in two main excavation areas totaling approximately 1,100m² (P. B.

Christensen 1983). Søby is a habitation site dated to the Viking Age (A.D. 800–1050), and consists of 19 sunken-featured buildings within an area measuring approximately 70m (N to S) × 230m (E to W).

One of the sunken-featured buildings investigated was a four-sided oblong structure measuring 3.5m × 4.0m. Labeled EO, the building was oriented east to west, with shallow postholes in its four corners, postholes in the middle of the east and west walls, and traces of sitting/sleeping benches excavated along its north and west walls. EO's floor layer was dug approximately 45cm into the surrounding soil, with layers of large, flat stones, as well as a subsequent layer of charcoal found beneath the stones in the SW corner. The findings were compared to a sunken-featured building at Aarhus Sønder vold, and based on similarities between the sites, EO was dated to the 10th century A.D. (P. B. Christensen 1983, 150).

In contrast to EO, another sunken-featured building labeled EP was circular, but possessed the same depth and diametric measurements as EO (3.5m diameter). Postholes determined to be traces of roof-bearing posts were located along the NW and SE walls, and several light layers of sand, considered as “seasonal floor layers”, or possibly back-fill layers remained stratified atop the lowest cultural floor layer (P. B. Christensen 1983, 150).

Finds within the sunken-featured buildings at Søby include: three bone combs (in EP), one of which was dated to the 9th–10th centuries, and is comparable in features to the type found in a grave from Barre in the Hebrides (P. B. Christensen 1983, 151).⁴¹

⁴¹ See findings at the settlement site of Jarlshof on the Shetlands, in (Brøgger 1935).

Several areas of the site contained ceramics that, when compared to the sample groups found at Aarhus Sønder vold, placed the Søby finds within Ceramic Horizon I (11th century).⁴² The latest dating of pottery from Søby came from samples excavated at EO, determined to fall within the Teterow and Vipperow horizon groups, originating from Slavic influences south of the Baltic, and dated to ca. A.D. 1000.

Articles of textile production were found at the site, and consist of numerous burnt and unburnt loom-weights, spindle-whorls (one comparable to the Trelleborg *inter alia* type, with the rest being of the Jutland-Fyn type), 2 bone pins comparable to 5 samples found at Birka and 10 found at Hedeby (Schwarz-Mackensen's type 4), and a bone weaving-comb similar to those found at Oseberg, Sigtuna, and specifically Birka (P. B. Christensen 1983, 153). Other finds such as glass beads, soapstone vessel fragments, iron knives, iron nails and bolts, and whetstones, provide evidence to indicate that habitation existed at the Søby settlement between ca. A.D. 900–1000 (P. B. Christensen 1983, 154).

Feature	Quantity	Dimensions and Detail	Interpretations
Sunken-Featured Buildings	19	Habitation area measures approximately 70m (N to S) × 230m (E to W)	Artifacts and assemblages indicate Viking Age (A.D. 800–1050) site dating, trade, metalworking (iron), textiles, ship construction/repair.

Table 3.6. Site features at Søby.

⁴² In archaeology, a “horizon” is a scheme of periodization based on distinctive sample typologies. It is used to categorize pottery and ceramics that possess specific traits such as color, style, shape, hardness, manufacturing techniques, and decoration, which can assist in tracking the rapid diffusions of such types of pottery across cultural frontiers.

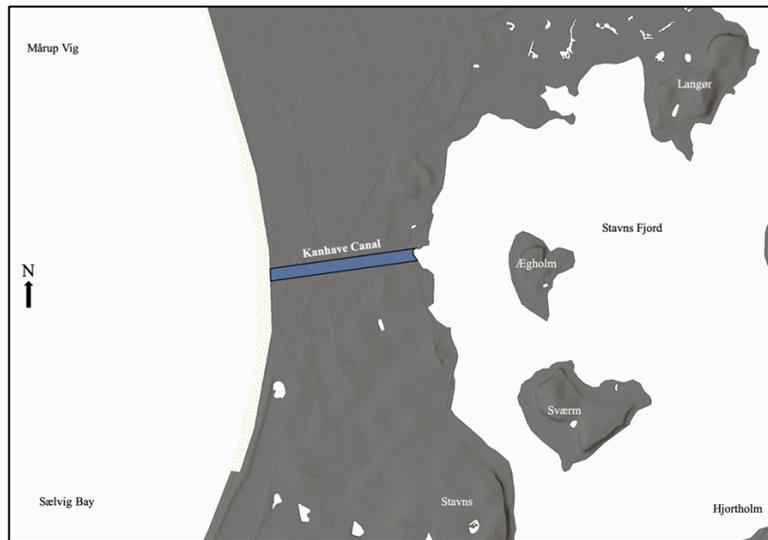


Figure 3.19. Kanhave Canal Overhead.

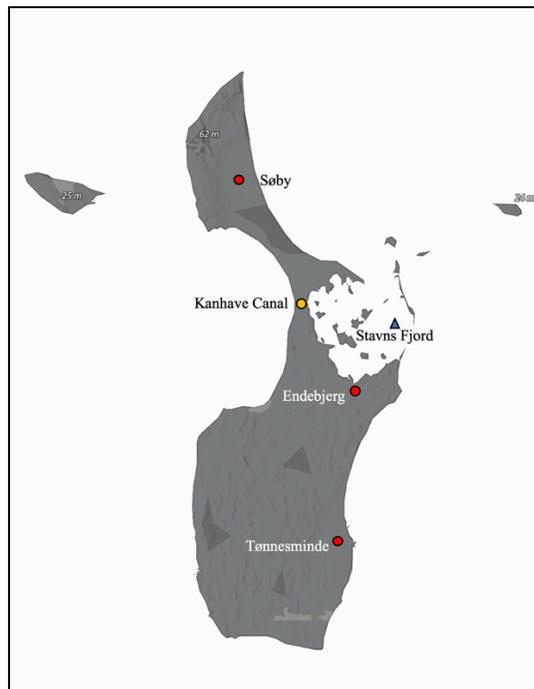


Figure 3.20. Map of Samsø depicting the Kanhave Canal, Tønnesminde, Endebjerg and Søby archaeological sites.

3.4 Climate, Geology, and Dating

It is important to consider that both the Spangereid and Kanhave canals served as connection hubs that linked two distinct seaways together. To avoid the need for locks or lifts within the fairway watercourses, the canals required that the linked seaways were of relatively homogenous water levels.

The Spangereid connected the southern shore of Høllabukta, a bay within Lenefjord, with the northern shore of Kjerkevågen, a protected harbor located where the North Sea and the Skagerrak Strait merge, in an area known for strong easterly winds and choppy seas. The average mean tidal range of the Skagerrak Strait occurs at 7.4m, with regularly occurring water level deviations of 2.1m.

The Kanhave Canal linked Mårup Vig, a bay located in the Kattegat Strait, with Stavns Fjord, a shallow, naturally protected harbor. Samsø receives sea-wind at moderate speeds, with fluctuations occurring between south-easterly and westerly directions (Cappelen and Jørgensen 1999, 296). The average mean tidal range of the southern Kattegat Sea occurs at 0.3m, with regularly occurring water level deviations of < 1m (Kroon, Kabuth, and Westh 2013).

3.4.1 The Effects of Post-Glacial Isostatic Rebound on the Scandinavian Canals

Post glacial isostatic uplift has affected Scandinavia to such an extent that researchers dated the Spangereid Canal using measurements based on historic water levels and the rate at which Norway is rising (Grimm 2010b). During the last glacial maximum (LGM), large ice sheets covered Scandinavia, the Barents Sea, and the northern British Isles. Subsequent to the LGM, the ice sheets disappeared, and solid earth readjusted towards a new isostatic equilibrium. Post-glacial rebound (PGR), also called glacial isostatic

adjustment, is the rise of land masses no longer depressed by the massive ice sheets of the last Ice Age (NASA 2019). The resulting surface uplift causes southern Norway to rise at a rate of 8-10mm/yr (Emery and Aubrey 1985).

Investigations into sea levels during the time that the Spangereid Canal was constructed indicate that the bottom level of the canal was approximately 0.9m above present sea level, and the canal is thought to have had a 1-1.5m high water level at the time of its use (Stylegar and Grimm 2003a). The rate of land elevation increase since the Migration Period (A.D. 400–550) means that the Lindesnes isthmus is wider today than it was at the time that the canal was built. Its current width is approx. 500m, with a maximum height of 2.8m ASL, while at Lista (20km west of Spangereid), the greatest extant elevation during the time between the Migration Period and present was 2.5m (Prøsch-Danielsen 1996). Recent soundings at the site of the boathouses located at Kjerkevågen reveal a height of 2-4m ASL (Stylegar 1999).

Initial dating of the Spangereid Canal comprised of isotopic analyses of organic materials discovered within the fill layer and horizontal turf layer, determined to have become sedimented after the canal fell out of use. The combined results of the radiocarbon dating between the two samples presented a mean threshold of 894 YBP with a standard deviation of ± 110 years. These data indicate that the canal was constructed in ca. A.D. 1125 (calculated from: Stylegar and Grimm 2003a). The stratigraphy of the canal indicated an earlier age, suggesting that other dating methods were necessary to date the canal more precisely. The Spangereid Canal did not reach the modern coastline of Kjerkevågen. Analysis based on post-glacial isostatic water-level measurements indicated that the Spangereid Canal was likely constructed either in the

Migration Period (ca. A.D. 400–550) or Norwegian Merovingian Age (A.D. 550–800) (Stylegar and Grimm 2003b; Stylegar 2006; Grimm 2010b). Thus, the Spangereid Canal’s construction date preceded that of the Kanhave Canal.

Post-glacial isostatic rebound has also affected the Kanhave Canal. It is estimated that the water level of the canal would have been between 0.7-1m, 60-90cm higher 1,300 years ago than it is today due to post-glacial uplift. This sea-level adjustment places the Late Germanic Iron Age (A.D. 550–800) water level at the middle of the side wall, and the water at the naturally protected harbor of Stavnsfjord approximately 0.5m higher than it is today (K. Christensen 1995).

3.4.2 Dating of the Kanhave Canal

During the 1979 excavation, a sample of well-preserved bulwark timber taken from the oldest portion of the canal and dendrochronologically dated to A.D. 726 (Nørgård Jørgensen 2002, 137; Daly 2002, 155).⁴³

Canal	Dating	Dating Method
Spangereid	Migration Period / Early Germanic Iron Age (A.D. 400-550)	Radiocarbon (¹⁴ C), Sea-level measurements
Kanhave	ca. A.D. 726	Dendrochronology

Table 3.7. Dating of the Spangereid and Kanhave canals.

⁴³ For more information on the Kanhave Canal’s walls see Section 3.2.3.

Chapter Summary

This chapter focused on the material record of the Scandinavian canal sites and their local-scale peripheral archaeology. The evidence reveals that Spangereid and Samsø held unique statuses within Migration Period (A.D. 400–550) and Late Germanic Iron Age (A.D. 550–800) Scandinavia. Thurston (2001, 60, 61) frames elite control in terms of evidence presented in the physical remains of features such as boundary earthworks, and property and boundary markings impressed within the landscapes of 8th and 9th-century emporia such as Ribe, Hedeby, and Löddeköpinge. These structures are interpreted as evidence of centralized administration, regulation of space, and fortification supplied by elite rulers.

In the case of the Scandinavian canal sites, Spangereid's numerous features, including boathouses, status graves, hall constructions, court sites, and boat graves, coupled with the Samsø's physical archaeology and artifactual assemblages indicating trade, metalwork, and boat repair at Stavns Fjord and the settlements of Endebjerg, Tønnesminde, and Søby, attest to the significance of Spangereid and Samsø within the contexts of the Scandinavian cultural and maritime land/seascapes of the Germanic Iron Age.

Although we still do not know the essential motivations for initial investment in the canals, a combination of the historical, literary, and place-name data presented in Chapter 2, combined with the archeological, artefactual, and geoarchaeological data addressed here, form the data set for this interdisciplinary study of prehistoric Scandinavian canals—the results, observations, and implications of which will be presented in the culmination of this research: Chapter 4 Findings.

-Part 2-

Scandinavian Canal Sites in Comparison

Chapter 4

Findings

The previous chapters focused on reconstructing the cultural landscapes of Denmark and southern Norway during the transitions of the Migration Period (A.D. 400–550) and Late Germanic Iron Age (A.D. 550–800). The Kanhave Canal was dendrochronologically dated to A.D. 726 (K. Christensen 1995; Adamsen 1995), while analysis based on post-glacial isostatic rebound measurements indicated that the Spangereid Canal was likely constructed during the Migration Period/Early Germanic Iron Age (Stylegar and Grimm 2003b; Stylegar 2006; Grimm 2010b). In order to properly analyze the data, the information was first reconstructed through the identification of important disciplinary components such as archaeology, literary source materials, historical accounts, place-names, and geology. I will outline and discuss the methods used to survey materials, select criteria, reconstruct the landscapes, and analyze the data in a later chapter. The following sections summarize the findings of this study, discuss their significance, and highlight insights that may lead to future research in the study of prehistoric central places and canal sites in Scandinavia.

4.1 Scandinavian Canal Sites in Context

4.1.1 Defining Power Concentration and Central Place Formation in Scandinavia

In determining whether the Scandinavian canal sites served as political centers of gravity, the first step is to define the meaning of power concentration and central place formation

in the Scandinavian landscape. Lotte Hedeager (2011, 14) is clear that during the periods in which the Spangereid and Kanhave canals were constructed there was no contemporary textual evidence of Scandinavian origin for us to analyze, thus the archaeological record becomes increasingly significant.

Rich settlement sites classified as Germanic Iron Age “central places” commonly contain evidence of extended casting and trade in the form of high quantities of metal finds (cf. Larsson and Hårdh 1998; 2002; Hedeager 2001; Jørgensen 2003). Jørgen Jensen (1982, 755) bolsters the term’s conditions to include a merging of three functional locations: (1) sacred site, (2) meeting place, and (3) metalworking crafts site. From such regional power bases (central places), the elite controlled trade, crafts, and cultic practices through spheres of influence. In addition to the materialistic structure underlying the role of central places, the activities and objects relating to long-distance trade held ideological qualities that were manifested through the symbolic transformation of objects into prestige goods (Hedeager 2011, 15). Hedeager continues by adding that artisans such as metal smiths or weavers held a special status in Germanic Iron Age (A.D. 400–800) Scandinavia, as their work, through its symbolic and ritual transformation of raw materials such as gold and silver into prestige or ritual objects, connected the craftsmen with the societies’ conception of the quality of power.

Along with archaeology, medieval Icelandic literature can be consulted to further elucidate the conditions underpinning “central place” identity in prehistoric Scandinavia. In a preparatory study of central place structure, Stefan Brink (1996) discusses the ideological universe of the texts, and the hall’s great significance within them. According to Brink, it was the magnate farms and halls that defined the focal point of a “central

place” during the Late Germanic Iron Age (A.D. 550–800). Ulf Näsman (1999, 1) and Lars Jørgensen (2003) agree that at the heart of this “powerful” place was the elite’s hall, or ON *salr*.⁴⁴ Often located several kilometers inland, such places functioned as centers of law creation, cult establishment, trade, and are associated with prestige crafts (Hedeager 2011, 16).

During the Late Roman Iron Age (A.D. 200–400), elites demonstrated their prosperity in burials, but that behavior changed during the Germanic Iron Age (A.D. 400–800). The custom of communal weapon offerings ceased, and elites marked their consolidated social status through costly sacrificial depositions in the form of silver or gold object hoards (J. Jensen 1982, 838–39). Hedeager (2011, 14) further presents the hoards as possible instruments through which Migration Period (A.D. 400–550) Scandinavians organized the cultural landscape. According to Hedeager, it was through such sacrifices and others, that elites sought to gain the favor of the gods in efforts to solicit their will in social matters such as harvests and warfare.

Swedish archaeologist Anders Andrén (2014, 42) cites written accounts by Arabic travelers Ibn Fadlan and Al-Tartushi as well as archaeological remains from sites such as Helgö as evidence indicating the use of ritual depositions placed around “cosmic posts”—central place features associated with Old Norse cosmology and representative of the “world tree”. Andrén maintains that such posts, staves, and “village trees” (or “farm trees”) played a central role in the layout of certain Germanic Iron Age (A.D. 400–800)

⁴⁴ See discussion in (Herschend 1998).

central places,⁴⁵ and, in addition to place-name evidence suggestive of their presence, the “cosmic posts/trees” were likely surrounded by constructions such as cairns and three-pointed stone settings (tricorn) that he believes identified their locations (Andrén 2014, 27-63; cf. Brink 2001).

Andrén (2014, 186) underlines the marked cultural transitions that occurred during the 5th and 6th centuries as a basis for what he defines as a transformation of the Scandinavian cosmovision—the components of which include: “an end of weapon deposits, most hillforts and ringforts, most stone-enclosed settlements, and the solar cycle” (2014, 186), combined with the 6th-century emergence of new, more permanent forms of land/ritual-controlling aristocracies connected with central places such as Gamla Uppsala and Lejre. Andrén argues that this new ruling elite claimed divine origin and influenced the narratives of the Norse pantheon, whose members gradually assumed the same patterns of life as the Scandinavian aristocracy. Although these patterns are recognizable to us within the later Icelandic saga narratives and artifactual evidence, their inception caused the older motifs to be replaced, making interpretation of designs predating the transitions problematic. Andrén concludes that the cultural, religious, and socio-political changes that occurred during the 5th and 6th centuries were so profound that the period should be considered as a “literal golden age” in Scandinavian prehistory (Andrén 2014, 186).⁴⁶

⁴⁵ Andrén cites Valsnäs on Öland as an example of a Late Roman Iron Age (A.D. 200–400) and Migration Period (A.D. 400–550) site with a centrally placed solitary tricorn stone setting that functioned as a “village tree” marker. See (Andrén 2014, 59-62).

⁴⁶ For an in-depth study on the archaeology of Old Norse cosmology see (Andrén 2014).

By the beginning of the 6th century, bracteates began to appear alongside an emerging warrior elite class establishing itself within the Scandinavian homelands (J. Jensen 1982, 868).⁴⁷ The bracteates came in several variant forms depicting active figural scenes, animal ornamentation, and portraits of the Nordic gods, with Óðinn predominantly featured (J. Jensen 1982, 869–70).⁴⁸ Finds dating to the 7th and 8th centuries—miniature image-laden gold sheets known as *guldgubber*—represent evidence of “central place” cultic practices, while status burials and boat graves containing rich goods and military equipment represented elements of a warrior aristocracy modeled on the Frankish *hird* structure, and whose interment was a component of power distribution in Scandinavian “central places”.

In considering the physical conditions required for central place identification, hierarchical societies, specialization of settlements, a centralization of economic, religious, and judicial affairs, specialization of labor, peaceful internal conditions, bilateral kinship system and inheritance (Myhre 1979, 255–60), and long-term habitation continuity merge together with the functions that each of their constituent parts provide to the elite milieu to indicate the significance of a “place”. Although both Samsø and Spangereid exhibit several “central place” characteristics, defining the Scandinavian canal sites as central places is not crucial to determining their value as magnetic centers of gravity in the social landscape. Answers to questions such as which component(s) (considering canals and settlements) were constructed for the purpose of supporting the other(s) may be initially addressed through the dating of each structure, however one

⁴⁷ Bracteates were ornamental, disk-shaped pendants of thinly beaten precious metals characteristic of early Scandinavian cultures.

⁴⁸ Religious landscapes symbolism will be briefly addressed later in this chapter.

must be careful not to assume causality solely based on the relative dating of objects in the cultural landscapes.

It is important to consider that the cultural landscapes of canal sites differ from traditional land-based ground plans in that the canal sites merge together elements of both terrestrial and maritime cultural landscapes, the latter of which consists of several distinct elements such as anchorages, harbors, fishing villages, beacons, and sea routes (Westerdahl 1980). In addition, the unique liminal geography of Scandinavian canal sites places them in transition zones between the sea and land, connecting both types of cultural landscapes. The canal sites are exceptional locations, containing several types of exclusively maritime-type place names and structures. In a sense, the canal sites can be considered “central *transit* places”.

4.2 Significance in Medieval Literature

Although the Migration Period (A.D. 400–550) and Late Germanic Iron Age (A.D. 550–800) canal sites do not directly feature in the literary record, both the island of Samsø and the area around Spangereid play substantial roles in the legacy literature preserved in Iceland. It is important to consider the historical accuracy and importance of the written sagas when applying them to the framework of Scandinavian archaeological study.

To consider the historical accuracy of orally derived knowledge in the Scandinavian saga literature, Gísli Sigurðsson (2004) investigated the Vinland sagas, detailed narratives depicting locations foreign to the writers, and of which they “had no firsthand knowledge” (Gísli Sigurðsson 2004, 301). Through this test case, Gísli made a significant and robust argument stating that the main features of information conveyed in the medieval Icelandic texts are likely to be accurate if the breadth of information

provided is general in its scope. Gísli continued his discussion with the position that it was both narrative and artistic conventions that produced the incidental minutiae described within the sagas, concluding that it is in such details, rather than in the broad-scope information, where we will find the less plausible material commonly attributed to literary texts. It is important to consider that the sagas were meant to recall important landmarks, retaining them for posterity within the written versions of stories originally derived from Scandinavian oral traditions. This argument can be applied to other saga material as we canvass the literature pertinent to the regions of the canal sites.

4.2.1 Kanhave Canal

The direct references to Samsø in saga literature and in continental sources relate the significance of the island in Scandinavian prehistory. Featured prominently in several sagas is the *berserkr* “Battle on Samsø”, also recorded in Saxo Grammaticus’ *Gesta Danorum*, written in the late 12th century.⁴⁹

Details of the battle aside, it is the geography of the story that I would like to focus on in this discussion. The story opened in the state of Garðaríki (Kievan Rus’) where the *vikingr* Arngrímr became a great lord under King Sigrlami. Arngrímr received the legendary sword Tyrfing, married the king’s daughter, and took her to his ancestral home on the island of Bólmr.⁵⁰ When their 12 champion *berserkr* sons were grown, one vowed to marry the princess of Sweden, so the brothers arrived at the court at Uppsala to

⁴⁹ For more information see Section 2.3.

⁵⁰ The island of Bólmr has been identified as Bolmsö “near Växjö” in Småland. However, this assertion has been challenged. See note in (Turville-Petre and Tolkien 1956, 74).

fulfill the vow. The proposal denied, the brother who made it challenged the princess' true suitor to *hólmganga* on the island of Samsø.

This is a crucial turning point in the story, as the remainder shifts its focus to Samsø. It is evident that everything leading to this point set the stage for the events on that island. It is most important to emphasize the choice of Samsø in this duel. The term *hólmganga* can be translated as: *hólm*– “small island” and *ganga*– “to go, to walk”. With many small islands in southern Sweden from which to choose, it is of particular interest that Samsø was appointed as location for the duel, especially when considering that the island is located ca. 800km (by ship) from Uppsala. Even the brothers' ancestral home of Bólmr seems more logistically suited than Samsø.

Magic is a theme associated with the literature of Samsø. This trend includes the aforementioned sword Tyrfing, the flaming island barrows and revenant of Angantýr, *Ragnars saga Loðbrókar ok sona hans* account of a speaking tree-man idol, and *Lokasenna*, with the dialogue between Loki and Óðinn, the latter practicing *seiðr* on the island. Later in Section 4.5.1 I will address the mound dedicated to Óðinn, still located on the southern part of Samsø.

That Samsø was chosen from hundreds of other possible islands as the stage for the story, and that the saga writers chose to identify the harbor of Munarvágr is testament to Samsø's significance in Scandinavian oral tradition.

4.2.2 Spangereid Canal

Saga accounts of Lindesnes depict the peninsula as a central location where Scandinavian seafarers sought haven from unfavorable weather conditions or sea states, and where

kings, jarls, and *hersirs* met to gather and stage their forces prior to waging war or travelling through to other areas of the known world.

In *Heimskringla*, Snorri Sturluson presents information on the politics of Norway during the time of St Óláfr (early 11th century). These details provide important insight on the political structure at Lindesnes, presenting the peninsula as a polity within a larger district ruled by a *hersir* who answered only to the king of Norway. This man was not a puppet leader, but a political appointee loyal to the king. The *hersir* who ruled Lindesnes had the authority to levy troops and ships, and to wage war against the Danes. Although the accounts in *Heimskringla* occurred several centuries after the construction of the Spangereid Canal, they provide information regarding social hierarchy on the peninsula, indicating that Lindesnes was still independently ruled by a powerful military leader closely connected with the Norwegian monarchy during the turn of the 11th century (Snorri Sturluson 2011a). This account shows that Lindesnes grew in political importance over the centuries that followed the Spangereid Canal construction.

Remarks about Samsø and Lindesnes abound in the sagas, with several including entire sections that dominate the narratives, and are dedicated to relating accounts of events that took place at both locations. We should also consider that when compiling *Heimskringla*, Snorri cut down the earlier source texts, preserving the information deemed most important (cf. Snorri Sturluson 2011a, vii).⁵¹ That information on Lindesnes survived the *Heimskringla* cuts is important to consider, and sets the precedent in which we should also consider that the author(s) of Samsø's saga literature may have taken similar liberties, making the island's inclusion in the final product significant *a fortiori*.

⁵¹ Of volume 3.

4.2.3 Further Saga Material

In Chapter Seven of *Óláfs saga helga*, 12-year-old Norwegian King Óláfr Haraldsson sailed to Svíþjóð (Sweden) to seek retribution for the slaying of his father by the Svíar (Swedes). While ravaging the shores of Loḡrinn (Lake Mälaren) near Sigtúna, King Óláfr became trapped by the Swedish king who had blocked King Óláfr's escape to the Baltic sea. The Swedish king mustered a great army and many ships, and lay chains across Stokksund. When King Óláfr realized the trap, he had his men cut a channel through a meadowed area called Agnafit, believed to be located near modern Stockholm. Heavy rains and thawing snow caused Mälaren to swell, thus inundating the shores of the lake, and the canal. By removing the rudders of his ships, King Óláfr steered by oar, crossed over the shallow canal to escape the Swedish trap, and exfiltrated his ships to the Baltic (Snorri Sturluson 2011a).

If we assume the framework set by Gísli Sigurðsson (2004), we can accept the general information provided within the literature regarding the island of Samsø and Lindesnes as true. Since there is no propaganda benefit for the writers, we may accept that the general information presented is fairly reported. In a manner of speaking, Samsø and Lindesnes can be identified as central places in Scandinavian literature. By adding the fact that major construction projects such as canal sites are also located in such areas of significance, one can conclude that their formations were not coincidental, but intentional.

4.3 Place-Name Evidence

The vocabulary of the place-names found within the surrounding landscapes of the Spangereid and Kanhave canals is consistent with terms identified with water transport

and seafaring activity. Of primary significance, the term *snekke* appears twice at the Spangereid Canal site and nine times on Samsø. *Snekke* is considered to be a name-type used for warships (cf. Malmros 1985, 94–107; Holmberg and Skamby Madsen 1998), but, as Eldar Heide (2014, 112) suggests, *snekke* may have represented a dual-purpose ship. In accepting the latter concept, it is likely that the presence of the toponym *snekke* indicates that Samsø and Spangereid were significant locations for crew-transport and/or cargo vessel transit within the transportation network. The corresponding topography of *snekke* place-names at Samsø and Spangereid is indicative of the presence of harbors meant to facilitate the *snekke* ship class (Westerdahl 1992, 10).⁵²

Naming the land helped to identify seafaring markers during navigation (Westerdahl 1980; 1992). Terms and word components such as *snekke*, *drag-*, *drajet*, *Njerve*, and *Øns-* identify precise locations at Samsø and at Spangereid. Perhaps the naming of the land was also a means of solidifying its ownership and designation for specific purposes. As discussed above in Section 2.4.1 Frans-Arne Stylegar (1999) has suggested that the place-name suffix *-drajet* indicates the sections of land used for dragging or towing boats. When overlaid by the spatial dispositions of the recorded *nausts* (ON boat-houses/ship-sheds, discussed in Section 4.5.2 below) excavated along the northern shore of Kjerkevågen,⁵³ the place-name evidence further enhances the Migration Period (A.D. 400–550) layout of the Spangereid canal complex and indicates

⁵² Through personal correspondence with the author on November 19, 2019, Moesgaard Museum's Deputy Director, Peter Hambro Mikkelsen, made the author aware of a general consensus indicating that the place-name prefix *snekke* is also thought to represent wharfs for building ships. Dr. Hambro Mikkelsen added that *Snekke-eng* (Snekke-meadow) could also be interpreted as the meadow where ships were built.

⁵³ For more information on the etymology of ON *naust*, Dan. *nøst* and Ork. *noust*, see (Cleasby and Guðbrandur Vigfússon 1957, 146).

that the place-names may refer to the remnants of the boat-houses to which vessels were “dragged”.

Stefan Brink (2018) argues that place-names serve as “memorials” to real or imagined “place-qualities” in the mutually dependent contexts of space and time. Thus the location becomes “charged” with the fusion of space-time, and this charge is retained through the location’s transformation from “place” to “memorial” (cf. Brink 2001, 81; 2018). Accordingly, place-names represent “memory” within the collective consciousness of the populations that use them to mark the land with such “memory pegs” (identifying function, ownership, landmark topography, or to memorialize an event that occurred at the location).

An important aspect to consider, Brink’s Swedish case studies concluded that the distribution of place-names within “central places” often form condensed clusters “where the hall, the retinue, the cult sites, the farm of the (black?) smith, the assembly site, etc. are found in a small settlement district, normally only a couple of hundred metres apart...thus forming a *central (place) complex*” (Brink 1999, 425).⁵⁴ This information is highly consequential for Spangereid in particular, because the site’s place-name distributions appear in clusters with spacings similar to those found in the Swedish settlements analyzed in Brink’s case studies. Further study is required, but it is possible that Spangereid may later be considered for entry amongst the growing list of central place complexes in Scandinavia.

It should be acknowledged however, that Brink later (2018) addresses the reader with a warning of the potential pitfalls inherent to small-scale place-names (such as those

⁵⁴ Tønnesminde displayed evidence of a smith and iron smelting. See Section 3.3.2.3.

used to identify meadows and fields), which may have been changed over time, and further, that the likelihood of such place-names existing prior to ca. 500–800 BP is dubious (Brink 2018).⁵⁵

Nevertheless, it seems probable that through the naming of areas within their domain with toponyms and their identifying prefix/suffixes, elites on Samsø and Spangereid could use the land to preserve their authority over maritime transit networks and religious sites, encouraging others to use elite-owned lands for the purposes designated by the place-names under elite control. Through such a practice, elites would further root their position in the cultural landscapes and control the populations that used their lands for functional purposes, including the navigable channels cut through them.⁵⁶

4.4 The Built Environment

The history of Iron Age Denmark and southern Norway is primarily sourced from archaeological remains. Having discussed the findings of the literary source material and place-name data analyses, I will focus the thesis on the findings from my analysis of the Spangereid and Kanhave canal site physical arrangements, including their classifications, physical attributes in the context of Scandinavian ship-types, and the canals' potential for use as harbors/anchorage points.

⁵⁵ For a discussion, as well as case studies on Scandinavian onomastics, see (Brink 2018).

⁵⁶ The present interpretations of place-name evidence related to the Spangereid and Kanhave canal sites indicate that there are opportunities for further research to more thoroughly investigate the toponymies of prehistoric artificial waterway sites.

4.4.1 Physical Arrangement

Navigable canal sites can generally be defined first by their connectivity to harbor networks, and then by their configuration (Carnap-Bornheim et al. 2018, 355). Both the Spangereid and Kanhave canal systems link together two bodies of water. These types of channels are defined as “shortcut”, or “bypass” canals for their style, characterized by a navigable, artificial channel cut to reduce travel distance by connecting two harbors within a transport zone, and that may or may not circumvent an obstacle (Blair 2007a, 6; Carnap-Bornheim et al. 2018, 355). Other types of canals include the “feeder-stream”, which is akin to a modern dead-end street or cul-de-sac, and connects a commercial or production site with a body of water (Blair 2007a, 6; Carnap-Bornheim et al. 2018, 355), and the “watershed canal”, which is cut to link two separate harbor networks or transport zones (Carnap-Bornheim et al. 2018, 355). The most well-known example of the latter is the Charlemagne’s Karlsgraben (Fossa Carolina) canal, meant to connect the Rhine and Danube river systems (Blair 2007a).

Both the Spangereid and Kanhave channels are monumental geological engineering building projects cut into the local landscape, with natural sloping banks reinforced by timber bulwarks, and shallow, U-shaped trench profiles (Stylegar and Grimm 2003b; K. Christensen 1995). The Scandinavian canals are located along coastlines and represent transition zones, connecting outer waterway transportation routes with sheltered estuaries (for instance, Blair 2007a, 1–20; Bond 2007, 155–57; Westerdahl 2006, 35).

The Spangereid and Kanhave canals share similar spatial dimensions. Although watercourse length is the variable most dependent on strategic geography, each canal is

cut into an area with a maximal length of approximately 500m.⁵⁷ The similar geographic distances may indicate that canal site choice accounted for specific measurements such as the length of the geographic area into which the channel was cut. At 250m, the Spangereid Canal's watercourse is half the length of the Kanhave Canal's, but water levels in 8th-century Norway were such that the length of the Spangereid Canal watercourse was sufficient enough to link both Høllebukta to the previously extended coastline of Kjerkevågen (Grimm 2010b; Stylegar 2006). Thus, both the Spangereid and Kanhave are "bypass" canals cut as transit hubs connecting the nodes of two bodies of water together within their transportation networks.

John Blair's (2007a) comparison of canal cross-sections with English vessel cross-sections suggests that canal water depth and watercourse width reflect regional site conditions and vessel characteristics. Both the Spangereid and Kanhave canals were assessed at approximately 11m wide, with depths of 1.25m (Kanhave), and 1.5-2m (Spangereid). The Kanhave could thus not support the unusually long and narrow Haithabu ship, with a draft of ca. 1.5m (Crumlin-Pedersen 1997), but it could support the Ladby ship from Funen, the A.D. 900 Western Slavic Puck 2 (Litwin 1995), and all of the Skuldelev ships with the exception of the Skuldelev 1 cargo vessel, which had a draft of approximately 1.25-1.3m (Skamby Madsen and Vinner 2005a, 83; Roesdahl 1998, 89). The Spangereid Canal's depth of 1.5-2m could support all of the above vessel drafts, with the exception of the Haithabu ship. The Spangereid and Kanhave canal surface water level breadths measured 10.5-11m (Stylegar and Grimm 2003b; K. Christensen 1995),

⁵⁷ Jensen places the Kanhave length measurement at 580m (J. Jensen 1982, 933), while other estimates include 500m (Asingh 2005, 116), and still others remain vague (K. Christensen 1995, 108–9).

permitting the (width-wise) passage of all of the above ship-types (Skamby Madsen and Vinner 2005a, 82–83; Litwin 1995; Crumlin-Pedersen 1997).

With lengths that surpass the widths of both the Spangereid and Kanhave canal watercourses, none of the aforementioned ships would have the ability to turn during passage within the canal watercourses, unless they were dragged ashore along the canal walls. This movement would only be likely if the wall-angles were sufficiently obtuse to support the upward hauling of a ship across their angular planes. The Spangereid Canal watercourse was measured approximately 10-12m wide at the highest edge, 7m wide at the bottom layer, and 2m deep (Stylegar and Grimm 2003a), while the upper edge of the Kanhave Canal wall was measured approximately 26m wide,⁵⁸ the surface water breadth measured 11.5m, 9.5m wide at the bottom layer, and had a depth of 1.25m (K. Christensen 1995, 109). These measurements when calculated present obtuse wall angles of approximately 165 degrees for the Spangereid Canal, and 145 degrees for the Kanhave Canal.⁵⁹

Thus, both the Spangereid and Kanhave canals present sidewall angles shallow enough to support the slipping and portaging of vessels within their watercourses. In this manner, ships with bow to stern measurements longer than the widths of the canals still retained maneuverability within the channel watercourses by having one of their ends hauled ashore, using the canal wall upper edge as a fulcrum, and pivoting the vessel.⁶⁰

⁵⁸ The water-level width measurement was assessed at 11.5m, determined by the condition that the water surface remained 0.25m below the upper edge of the canal walls (26m wide) (cf. K. Christensen 1995, 109). It is unclear whether the Spangereid width measurement of 10-12m relates to the water surface level or the physical walls of the canal.

⁵⁹ In this instance, the lower angles of an inverted isosceles trapezoid (the canal trench shapes).

⁶⁰ Dependent on a vessel's tensile strength when rotated along a central axis.

With the above data, it is clear that the shallow angular architecture of the canal walls present the conditions necessary to allow ships to be beached along their watercourse banks. Thus, the canals could have fulfilled dual roles as transit hubs and as harbors. Further evidence of the latter concept is present in an example of two *nausts* located along the watercourse banks of the Viking Age Rubh' an Dùnain Canal at Bracadale, on Skye (Martin 2009).

4.5 Scandinavian Canal Sites in Comparison

The Migration Period (A.D. 300–550) Spangereid and Late Germanic Iron Age (A.D. 550–800) Kanhave canal sites emerge out of the landscapes of southern Scandinavia as important, potentially strategic monuments. In this section I will present the findings from my analyses of the archaeological and artefactual data pertaining to the Spangereid and Kanhave canal sites and their peripheries, and discuss the potential motives behind their constructions.

4.5.1 Samsø

Although Søby was a significant settlement during the 10th–11th centuries, its dating means that the settlement was not contemporary with the construction of the Kanhave Canal in A.D. 726, therefore, I will focus the discussion on the sites of Endebjerg and Tønnesminde, as their dating is more contemporaneous to the canal's establishment.

Both the Endebjerg and Tønnesminde sites display the central hall and utility buildings/workshops (sunken-featured buildings) that supported it. It is possible that Endebjerg was a farm complex from the Late Germanic Iron Age (A.D. 550–800), as the

hall was dated to the early 8th century. This dating places Endebjerg's hall's construction concurrent with the construction of the Kanhave Canal (A.D. 726). Tønnesminde's three aisled longhouse was dated to the Viking Age (A.D. 800–1050), making its construction post-Kanhave, unless future evidence supports an earlier construction.⁶¹ It is perhaps worth mentioning that the Tønnesminde site displayed material evidence of a Roman Iron Age (A.D. 1–400) settlement, which, when added to the Viking Age (A.D. 800–1050) material data indicates that a continual occupation between the time-period horizons is likely.

It is unclear whether the halls at Endebjerg or Tønnesminde indicate banqueting halls, or the private/official spaces of elites. It is possible, and likely that the settlements at Endebjerg and Tønnesminde are not isolated, but part of small complexes consisting of several enclosed farms that have yet to be surveyed and excavated. The site at Tønnesminde displayed a row of postholes along the northern boundary of the site, indicating an enclosing fence in alignment with the patterns displayed in ground plans of other enclosed farm complexes of the period (for instance, J. Jensen 1982, 836).

However, at 27m and 20m long, the size of the halls at Endebjerg and Tønnesminde are considered small when compared to those at other enclosed farm settlements such as Hjemsted in southern Jutland (J. Jensen 1982, 836; Adamsen 1995). In such cases, the hall sizes increased proportionally with the size of the settlements as they grew over time (J. Jensen 1982, 836). This evolution was manifested through several

⁶¹ Stephen Mitchell reports (personal correspondence, January 13, 2020) a discussion at the time of the longhouse excavations at Tønnesminde that the date might be closer to the Late Germanic Iron Age—perhaps even that it was extant contemporaneously with Kanhave Canal's construction. This position urges a reassessment of the Tønnesminde longhouse's dating to mitigate the risk of questionable data.

construction phases,⁶² which are evident in the site soil composition. If the halls at Tønnesminde and Endebjerg are in fact part of larger farm complexes, it is possible that the excavated hall structures represent the latest stage of construction, and that there may be clusters of nearby farms with halls of similar dimensions. For comparison, the early 8th-century village at Vorbasse consisted of a group of small individual farms, each with their buildings nested within “a rectangular enclosure, from 50 × 50m to 50 × 110m in area” (J. Jensen 1982, 882). At the present time, there is little evidence—other than several single object metal detector finds in a field adjacent Endebjerg—to suggest that other contemporaneous farms exist in the vicinity of the two sites.

Due to Endebjerg’s hall dating and the site’s vicinity to the Kanhave Canal, I will discuss it further. In the case that Endebjerg does represent the private and official space of a chieftain or magnate farmer, they would likely have received the benefits of craftwork from the four surrounding sunken-featured workshops, as well as taxes or tribute from local farms and trade network systems (including in this case the Kanhave Canal and a potential harbor at Stavns Fjord) in return for protection. The craftsmen of Endebjerg worked metals and maritime textiles and equipment, and possibly glass. This craftsmanship is displayed by the objects found: iron nails, loom weights, iron slag, refuse from casting, and various semi-manufactures. Additionally, the iron nails and loom weights (used in the process of weaving textiles such as cloth sails) demonstrate that clinker-built ships may have been repaired or possibly built at Endebjerg.

The proper house construction at Endebjerg signifies a year-round occupation, and it appears that, in spite of the Kanhave’s disuse in ca. A.D. 800 (Nørgård Jørgensen

⁶² These phases may have been the result of generational evolution, as the farms were passed on and renewed by farmers and their progeny.

2002, 137; Daly 2002), the site at Endebjerg was used for centuries after, testified through finds such as a 9th-century Peterson Type O sword pommel fragment and Arabic dirham hack-silver fragment metal-detected in an adjacent field.⁶³ Animal remains indicate that the occupants of Endebjerg consumed pigs, cows, goats, fish, and seal. Although an osteological analysis is required to determine the exact dating of the animal remains, it is evident that food at Endebjerg was abundant during its occupation. Evidence of long-distance trade exists in the form of Frisian glass, an iron lock and knife originating in England, Norwegian whetstones, horse bones, and metal objects containing copper, gold, and silver. It is clear that ships travelled long distances to visit Samsø, bringing with them raw materials and luxury goods from continental Europe and the Middle East.

It is likely that Endebjerg was supported by Stavns Fjord and the Kanhave Canal. At prehistoric sites such as Gudme on Fyn, the settlement was located further inland than the harbor of Lundeborg, which lay 5km away, but supported Gudme with raw materials and exotic goods (J. Jensen 1982, 748–55). Endebjerg parallels this trend in that it currently lies 300m from the southern coast of Stavns Fjord, and was closer to the shore at the time of the Kanhave Canal's use due to glacial isostatic adjustment.

The Kanhave Canal would have provided travelers to the island with ease of movement from Stavns Fjord to Mårup Vig. The canal formed a centrally located meeting place from which to conduct trade, and the ideal harbor at Stavns Fjord would have provided travelers a safe haven. By controlling traffic through the canal, an authority could control traffic within the Fjord, resulting in wealth consolidation and

⁶³ See Section 3.3.

economic growth. What is clear is that regulating and maintaining the canal would have required oversight by a central authority. Whether that authority rested on Samsø in the form of a small polity that answered to a greater authority, or solely in the hands of an independent local elite with political and economic contacts remains to be seen.

It is currently understood that Endebjerg was a small sunken-featured building settlement that supported itself through fishing and animal husbandry (Asingh 2005, 114). Endebjerg provides evidence of trade, with relatively sophisticated trade goods indicative of upper-class settlement patterns (Sindbæk 2011). Perhaps a closer look at the surrounding landscape will provide further clues to its use.

More studies on Samsø are required to determine whether a survey of other sites is required. Many tombs dot the landscape, ranging from early Neolithic burial mounds and *jættestuer* (dolmens),⁶⁴ Bronze Age coffin burials, and late Viking Age burials. The majority of the 125 burial mounds and dolmens on Samsø are located south of the canal. It is also worth mentioning that although Samsø contains no evidence of hoards, a cult center or sacral site in the form of the place-name *Dyret*, formerly *Othensberg* (1424), and then in 1445, *Odensbergh*, or *Óðinn's Mound* exists (Mitchell, forthcoming).

Sacral place names are traditionally located within transitional zones located between land and water (Brink 1996; Andersen 1998). Samsø may have represented that transitional zone for 8th-century Danes. Sacral topography was shaped through deliberately chosen localities, linking this world to the Other World (Hedeager 2011, 14; 1999). Additionally, Óðinn was considered “the prince of the gods, the master of runes and magic, who had power over life and death” (J. Jensen 1982, 870). He is understood to

⁶⁴ In the simplest sense, dolmens were large stone tombs erected around the deceased.

be the Scandinavian god representative of ancient warrior cults (Simek 2006).

Particularly, *berserkirnir* are believed to have worshipped him, a concept that may further connect the island of Samsø to Scandinavian saga literature depicting the 12 *berserkr* brothers who fought and died there.

It appears that the sites at Endebjerg, Tønnesminde, and Søby continued to function long after the Kanhave Canal fell out of use. At present, the ground plan of the Kanhave Canal site is comprised of only the canal itself, and no other settlement indicators have been surveyed. It is therefore not possible to demonstrate settlement at the Kanhave canal site. It is conceivable that the short-lived canal may have been constructed in an attempt to anticipate the formation of the settlement of Endebjerg, Tønnesminde or the later town of Søby. Perhaps the canal was an unsuccessful attempt to reorganize the island's political or military affinities. The broader picture, including the contemporary phases of the Danevirke construction signify that political transitions were occurring consistently during the early part of the 8th century.

There seems to be a general consensus that posits that the monumental efforts needed to construct Kanhave Canal would have been wasted on trade, and thus the canal's construction was most certainly a military effort (cf. O. Olsen 1989, 29; Roesdahl 1982, 39). This position is based on the theory that Samsø was used as an early warning naval base, where a central Danish king's fleet was pre-staged in Stavns Fjord, utilizing the canal for the strategic purposes of rapid mobilization and maneuvering of vessels from one side of the island to the other in defense of Aros (Modern Aarhus).

Undoubtedly, Stavns Fjord and the Kanhave Canal would have provided elites with strategic naval benefits, however, the material evidence to date does not seem to

support such a claim. If the canal's sole purpose for construction was to support military activities in the Kattegat, as in the case where a fleet would have been staged in support of Aarhus, it follows that traces of military activity in Stavns Fjord and the surrounding terrain would be located on Samsø, and that evidence of supportive logistical infrastructures such as buildings for the manufacture and repair of martial tools, defensive positions, living spaces large enough to support a fleet, traces of weaponry, ship parts and anchorages, material waste, etc., would be visible, but as of this writing, they are not.⁶⁵

In addition to this argument, we must consider the importance of the prestige component in 8th-century Scandinavian cultures. As described in Section 4.1.1, elites were willing to mark their social status through costly material depositions and displays of extravagant spending. Why then would an investment into a construction project be any less significant as a medium for the symbolic display of political power (as well as power over the land) and wealth?

Aside from the 4th-century piles depicted in Chapter 3, which are located in Stavns Fjord approximately 1.15km south of the eastern edge of the Kanhave Canal, current material evidence does not support the staging of a vast fleet of warships in Stavns Fjord during the 8th century, although as Pauline Asingh (2005, 114), Else Roesdahl (1982), and Christian Adamsen (1995) suggest, and with which I agree, Stavns Fjord is an ideal natural harbor for such a purpose. Therefore, I believe that further

⁶⁵ Despite the milder Danish climate than that of Norway, the presence or absence of boathouses should not be a factor completely dismissed in the case of Samsø and Stavns Fjord. Through correspondence to the author on November 19, 2019, Moesgaard Museum's Deputy Director, Dr. Peter Hambro Mikkelsen made the author aware of a suspected boathouse (*naust*) located on Samsø. At this time the potential boathouse has not been investigated, and there is currently no information on its dating. Dr. Hambro Mikkelsen added that the Limsfjord area of Stavns Fjord is a likely location for further examples of boathouses on Samsø.

maritime archaeological surveys are required to determine if the archaeological record can be bolstered enough to support such a claim.⁶⁶ It is worth noting that a possible parallel to the piles at Stavns Fjord exists at Hedeby, where semicircular rows of piles and a series of pile constructions were surveyed, with the latter example interpreted as jetties (Roesdahl 1982, 37–38). I would add that we cannot expect to find piles as the only evidence of a harbor. The keels and shallow-drafted nature of Scandinavian ships meant that they could have easily been beached, which would leave no trace of their presence. Roesdahl (1982, 38) makes considerable use of this point.⁶⁷

In addition to the above assertions, I propose that the Kanhave Canal could not have been constructed for the purpose of protecting Aarhus. Olaf Olsen (1989, 27–32) and Henning Andersen (1971) note that Aarhus was not formed until the 10th century, while Jensen (1982, 933) is clear that Aarhus as a fortified city “had still not yet been founded” at the time of the Kanhave Canal’s construction. However, more recent archaeological findings updated Aarhus’ settlement horizon to the late 700s (Skov 2005, 16). Hans Skov states that both artefact typology and radiocarbon dating indicate Aarhus as a settlement in the 770s. It is thus worth considering that the earliest dating of Aarhus being A.D. 770 (Skov 2008, 1; Skov 2005, 16), places Aarhus’ earliest settlement formation nearly a half century after the Kanhave Canal was constructed. Thus, the dendrochronological dating of the Kanhave Canal to A.D. 726 reveals that it was

⁶⁶ For example, more contemporary evidence may emerge through ¹⁴C or dendrochronological dating of other samples taken from the pile rows.

⁶⁷ On the likelihood that the canals may have also served as harbors see my argument in Section 4.4.1.

constructed prior to the establishment of Aarhus, and therefore would not have been constructed for the purpose of facilitating military movement in Aarhus' defense.⁶⁸

One of the major points of the above mentioned Stavns Fjord/Kanhave Canal naval base claim relies on the theory that the Kanhave Canal served to display the power of a singular Danish monarch. One could propose that if we take *Orosius*, a chronicle compiled by Alfred the Great, and adduced in Thurston (2001, 66) at face value, we see that 9th-century trader Wulfstan's travels to the Danish realms reveal political divisions extant into the 800s, and that the political structure consisted of distinct major and minor polities. The account states that there was an individual king residing over the small island of Bornholm (also, J. Jensen 1982, 902). Therefore, it is possible, and likely that the island of Samsø, may have had its own independent rulership during the time that the Kanhave Canal was constructed. In this case, I agree that such a display of power would benefit a petty king, as their sphere of control would be limited, and the construction of a major monument would have a greater social impact on their subordinates and peer elites. But where did such a king reside on Samsø? As stated in Section 4.1.1, Samsø contains only moderate evidence of central place structure.

It is worth restating that the erection of ramparts during the first phases of the Danevirke (ca. A.D. 700, 737) occurred simultaneously with Frankish Imperial and Slavonic immigrant expansion. Such a period of stress due to foreign agency would affect the entirety of the Danish realm, causing a chain reaction of military and political

⁶⁸ The dating here diminishes the likelihood of an anticipatory construction for the Kanhave Canal/Aros (modern Aarhus) defense argument. Dendrochronological dating places the year that the wood sample taken from the canal wall was likely removed from its parent tree to ca. A.D. 726. It is possible that the sample could have been from a wall section used or reused at a later date to repair the canal sidewall, however, the probability of later usage nearer to the formation date of Aros (ca. A.D. 770) is dependent on 8th century wood preservation techniques and rates of decay. Such a hypothesis requires further analysis beyond the scope of this study.

posturing that could have manifested all over, and in many forms. A bolstering of regional maritime defense would manifest in the increased number of fleets, vessels, fighting men, the construction of defensive works, and strategic altering of the landscape to support them. Undoubtedly, the Kanhave Canal could have played a role in a wider naval defense infrastructure, however, without material evidence for a military fleet harbored in Stavns Fjord, or traces of military habitation, it is difficult to add Samsø to the list of Danish military offensive/defensive locations during the time that the Kanhave Canal was constructed.

It is possible that the Kanhave Canal planner(s) saw an opportunity for economic and political growth at the center of shipping lanes within the Kattegat. Samsø was a prime location to focus commerce, especially during the 8th-century boom in world trade.⁶⁹ Just as it is thought that Ribe was constructed to attract foreign trade (J. Jensen 1982, 927), perhaps the canal and a local trading settlement were seen as an opportunity by an elite to attract similar wealth to the island. Samsø's north and south islands have a history of cultural and dialectical distinction between them (H. H. Hansen and Aaby 1995). It is thus also possible that the Kanhave Canal was constructed as a means for elites on either side to divert trade from one island to the other, or, in a symbiotic effort to split the difference, allowing trade through Stavns Fjord to affect both islands equally.

Finally, the possibility exists that the Kanhave Canal's construction may have been seen as an opportunity by local elites to ease the movement of trade goods and military forces already using Stavns Fjord and Mårup Vig as harbors during the

⁶⁹ Evidence for pre-Viking Age far-reaching trade exists in objects such as the Buddha figure, North African Coptic ladle, and Irish bishop's crozier found in the 8th-century strata on Helgö in Mälaren (cf. Lundstroem 1978; Androshchuk 2007).

Germanic Iron Age (A.D. 400–800). The cultural and economic developments in places such as Søby, Tønnesminde, and Endebjerg indicate that Samsø and Stavns Fjord continued to remain significant components to Danish trade and seafaring within the Kattegat during the Viking Age (A.D. 800–1050) (K. Christensen 1995).

4.5.2 Spangereid

In contrast to the spatial disposition of material data at the Kanhave Canal site, the settlement at Spangereid appears to develop on both sides of the canal (Stylegar and Grimm 2003a). This layout places the Spangereid Canal at the center of a larger site, whereas no habitation or production structures were surveyed in close proximity to the Kanhave Canal site (K. Christensen 1995). One of the most significant indicators of early power centralization at Spangereid is the presence of 25 Migration Period (A.D. 400–550) *nausts* (boat-houses/sheds) (Stylegar and Grimm 2005, 261), seven of which form a semi-circle at the Migration Period coastline of Kjerkevågen (Grimm 2010b, 119). The presence of Migration Period (A.D. 400–550) and Late Germanic Iron Age (A.D. 550–800) boathouses is considered an indicator of localized economic and political organization, as clusters of *nausts* were often “concentrated around the chieftains’ administrative centers” (Myhre 1985, 36; Westerdahl 1992, 10). Although Danish examples of *nausts* exist at Harre Vig in northwestern Jutland (for instance, Ramskou 1960, 2; Bill and Grimm 2002), boathouses should not be considered as determinant factors in the formation of the Kanhave Canal site. Boathouses were not a necessary component to Danish ship preservation at home due to the more temperate climate of Denmark in contrast to that of Norway, where boathouses were needed to preserve boats when not in use.

Naust size (length and breadth) and location relative to the shoreline are predicated by the types of ships housed within them (Myhre 1985, 42). A larger ship would require a boathouse close to the coast, as it would not be dragged ashore as easy as smaller boats. The boathouses at Spangereid vary in their internal lengths from 15–27m (Stylegar 1999). Although 15m is not indicative of large vessels, such a *naust* size could support Skuldelev 6, which was built in 11th-century western Norway (Crumlin-Pedersen 2002, 245–78; Trakadas 2011, 43). While the median length *nausts* were capable of housing ships of the ca. 18m “Tune” type (Marstrander 1986), a 27m boathouse at Spangereid could support ships the size of all five Skuldelev ships with the exception of the 30m-long Skuldelev 2 (Crumlin-Pedersen 2002, 132–278). The Oseberg and Gokstad ship types are considered “royal ships” used for special voyages and ceremonies (Roesdahl 1998, 86), but their measurements indicate that it was possible to house mast-lowered versions of their types in the Spangereid boathouses. A more likely candidate however, as its dating is relative to A.D. 700, is the ship discovered in a Kvalsund bog at Sunnmøre in western Norway that was 18m long and 3m wide (Hall 2007, 51), and is possibly the earliest example of a Scandinavian ship with a sail. The large concentration of boathouses at Spangereid are considered second only to those found at Hafrsfjord near Stavanger (Stylegar and Grimm 2005, 261).

Another significant component in the Spangereid ground plan is the proposed great hall at Haugtuna. Although currently undated, Haugtuna bears some similarities in size and layout to other large Migration Period (A.D. 400–550) / Merovingian (Norwegian Late Germanic Iron Age, A.D. 550–800) halls such as those found at Forsand and Borg (Stylegar and Grimm 2003b). When placed within the context of the

greater region, the 45m hall at Haugtuna is one of only two large halls found in Migration Period and Late Germanic Iron Age Vest-Agder, the other is at the (possibly high-status) settlement of Sosteli (Reiersen 2017; Stylegar and Jessen 2012, 140). Haugtuna's length of 45m is indicative of Migration Period elite settlement milieus (Reiersen 2017). The presence of the large hall at Haugtuna, and its proximity to the canal suggest that the canal was the centerpiece of a high-status settlement. From Haugtuna, an elite could oversee all traffic moving through their domain. It is also conceivable that other large halls existed within the Spangereid complex at the time of the canal's use, as evidenced by the later presence of several large farms during the High Middle Ages (ca. A.D. 1050–1300), including: Njerve and Midbø (owned by the Norwegian king), Stokke, Presthus, and Gahre (Stylegar and Grimm 2003b).

To the south of the Haugtuna hall construction, the 25-hectare, east to west grave field contains over 40 graves, and provides several indicators of elite presence and influence through time. Of the graves excavated in the large grave field and in another smaller grave field across the canal, there were 15 Migration Period (A.D. 400–550) status graves, 5 large grave mounds, and 12 Late Germanic Iron Age (A.D. 550–800) / Early Viking Age (A.D. 800–1050) boat graves spread east to west across the canal site, suggesting that the grave fields were built and evolved with the canal at the center. Grave fields were places where social memory and group identity could be preserved, and a large grave field, such as the example at Spangereid suggests that there was a large community that may have been composed of more than one settlement with complex socio-political organization (Theuws, De Jong, and Van Rhijn 2001; Larsson and Hårdh

2002). Figure 3.12 displays the grave field ground plans, along with several other significant features consolidated around the canal.

Each of the archaeological features provided a function. The three undated fortifications on hills at Røsefjellet, Njerneåsen, and Dragåsen provided over-watch for the settlement from the north, east and south, while the *tunanlegg* (radially arranged features) served as a meeting place for local farmers (cf. Brink et al. 2011; A. B. Olsen 2005; Storli 2010; Grimm 2010a).⁷⁰ Spangereid's *tunanlegg* bears resemblances to parallels at Sausjord (A. B. Olsen 2013), Leksaren and Klauhaugane on Jæren (Grimm 2010a, 129), and *tunanleggs* at Åse and Leknes (Storli 2010, 139). There are currently 30 known *tunanleggs* in Norway, generally interpreted as Germanic Iron Age (A.D. 400–800) assembly sites serving other functions including ceremonial and ritual activities (A. B. Olsen 2013).

Asle Olsen (2013) suggests that the *tunanlegg* feature may represent the Norwegian predecessor of the Icelandic *þing*, and that its disappearance from later period excavations may be attributed to the gradual territorial consolidations under national kings. Keeping this concept in mind, the physical organization and localized nature of Spangereid's *tunanlegg* suggests that the *tunanlegg*'s open central space may have served as a meeting place for independent local farmers to conduct collective-based judicial and electoral proceedings. Additionally, the absence of weapon associated findings at the Spangereid *tunanlegg* suggests that it did not function militarily. Thus, it seems reasonable that the Spangereid *tunanlegg* did not belong to a singular elite farmer but served a coalition between several farms that produced cooperative agricultural and

⁷⁰ For more information on *tunanleggs*, see Section 3.3.1.4.

possibly material surplus for the larger settlement. *Tunanleggs* generally suggest long-term use, with some, such as Sausjord providing evidence of use dating back to the Roman Iron Age (A.D. 1–400) (A. B. Olsen 2013). The dating and spatial proximity of the Spangereid *tunanlegg* to the canal and the large western grave field suggest that all three may have coexisted and coevolved over time, and that the local community organized at the *tunanlegg* several times per year to elect leaders and settle disputes.

Saga literature and later reports on status-grave finds indicate that during the Migration Period (A.D. 400–550) and Late Germanic Iron Age (A.D. 550–800), petty elites with links to higher-status regional leaders oversaw small Norwegian polities such as Spangereid.⁷¹ The evidence underlines Spangereid status as a chosen “central” location, likely for its geographic qualities, as we see that the canal was constructed earlier than the Spangereid settlement (Stylegar and Grimm 2003b; Stylegar 2006; Grimm 2010b), and that the settlement ground-plan is built around the canal. In this light, the canal is the focal point in the Migration Period (A.D. 400–550) settlement. Spangereid’s *nausts*, the 45-meter long hall at Haugtuna, 12 boat graves, 10 radially arranged features, and 15 status graves indicate the evolving “central” nature of the site (Stylegar and Grimm 2003b).

With the Lindesnes isthmus presented as a central location in the sagas, a rich maritime toponymy, and the inherently narrow geography of Spangereid between two bodies of water, the site was a prime location for a canal that would encourage travelers to pass through an elite domain (or the domain of several unified elites) and ease movement of ship traffic (including that of the Norwegian king) by offering an

⁷¹ See discussion in (Stylegar and Grimm 2003b).

alternative to circumnavigating the Lindesnes isthmus. Thus, observing the continual growth of the built environment surrounding the canal makes it increasingly likely that the channel location was the catalyst for increased economic and socio-political growth at Spangereid. The creation of a canal at Spangereid not only improved navigation throughout the maritime transportation networks of southern Norway, but also centralized a position of authority by elected leader(s) who oversaw ship traffic through the channel transit hub.

4.6 Identifying Prehistoric Scandinavian Canals

Place names, literature, and historical records can assist in identifying anthropogenically originated waterway channels, while the primary visible identifiers of human channel constructions are found in areas where the flow of water deviates from a likely natural course, such as in straight waterway sections, irregular sloping profiles, and raised levees (Rhodes 2007). Straight lines rarely occur in nature; thus, a search may begin by locating areas of human intervention through field-walking, map or chart surveys, and aerial or satellite photography, but it should be considered that the possibilities exist for human error or a cartographer's potential tendency to forego accurate landscape representations for idealized standards. A reliable investigation should therefore avoid an over-reliance on maps and charts but use them as primary tools for further investigation.

Along with the aforementioned physically identifying features, several other indicators of human agency exist in the maritime landscape: bank reinforcements, building materials within the channel, evidence of silted former channels, channels that do not follow the natural course of a valley, sudden directional changes in watercourses, stepped downstream profiles, alignments with and proximity to settlements, roads, and

other landscape features (cf. Blair 2007b; Rhodes 2007). For example, both the Spangereid and Kanhave canals exist near settlements and within narrow areas between two bodies of water, with their waterway courses left clearly identifiable in the landscape. Like forest trails, which if left unattended are reclaimed by nature, man-made waterway channels require continued maintenance or will become silted in by natural fluvial processes. The Kanhave Canal is evidence for this natural reclamation process, and although it later fell out of use, Christensen (1995) argues that during the time in which the channel functioned as a navigable waterway, its walls were continually maintained. The inherent need for maintenance insinuates that to exist in perpetuity, canals require supportive infrastructures to be placed within their proximities. It thus remains possible that Scandinavian canals and supportive sites emerged as construction “packages”—a case in which the canal was to exist in symbiosis with another support site.

Topographic and bathymetric Light Detection and Ranging (LiDAR) methods offer the ability to generate precise three-dimensional information about human environments, while avoiding the problematic nature of high-resolution satellite imagery or aerial photography (Brock, Purkis, and Coastal Education & Research Foundation 2009). Using discrete airborne lidar data to identify canals in suspected landscapes, researchers can visually digitize them and compare the results with field measurements using GPS.

Several other interdisciplinary techniques exist that may assist in determining human agency in the maritime landscape. By analyzing sediment cores through a merging of palynology, malacology, and radiocarbon dating techniques, is possible to reconstruct the plant and animal life within canal sediment landscapes, the findings of

which can assist in dating when a channel was abandoned (Rhodes 2007). Additionally, Optically Stimulated Luminescence dating techniques (OSL) do not require the presence of organic life, and have been used to determine age relationships within fluvial sediments (Aitken 1998; Feathers 2000).

4.7 Conclusions

The nature of navigable canals and the size of the sites that surround them are indicative of collective organization, suggesting that both Spangereid and Samsø gained identity and status as populations gathered through the localization and construction of the canals at socio-politically and economically strategic locations. Continual habitation and site evolution suggest that Spangereid and Samsø retained their functions after the canals were discontinued, and it should thus be considered that Scandinavian canals relate to site continuity by providing initial identity to the landscape. Structural relative dating indicates that Spangereid and Samsø display unique and complex use over a long period of time, which spans beyond the life of the canals.

The possibility should not be excluded that the constructors of the Migration Period (A.D. 400–550) and Late Germanic Iron Age (A.D. 550–800) canals were elected leaders who, with the support of their local constituent farmers, brought to bear the collective power of the community to cut channels into the landscape that would serve the community as a whole, through the economic and socio-political bolstering produced by the creation of a navigable waterway connecting the community landscape with the greater maritime transportation network. Both the nature of Samsø's small farming community and the *tunanlegg* at Spangereid, coupled with the *þing* social mechanic present the possibility that the channel constructions were collective efforts, decided upon

by the gathering of local farmstead owners and implemented by their elected leaders to coalesce ship traffic and trade within their shared domain.

Furthermore, we should consider that the number of imported prestige-goods that fed the Scandinavian elite economy was considerably diminished after the fall of Rome. Throughout the Migration Period (A.D. 400–550), luxury items that were once considered easily accessible gradually became limited. Thus, control of trade lanes throughout the Scandinavian homelands became critically important to sustain elite status. With control of international and regional trade further incentivized, elites, determined to maintain their prestige through social and ritual obligations, reorganized the economy by tightening their grip on the luxury goods that moved throughout complex trade networks. It is therefore possible that the constructors of the Spangereid and Kanhave canals may have been local elites who sought to maintain their social status through control of trade lanes and the funneling of goods within their realms of control.⁷²

Although it is not currently possible to identify with specificity those who coalesced the required wealth, manpower, and authority to undertake such large-scale construction projects that brought forth the Kanhave and Spangereid canals, current data suggest that the choice of placement was carefully planned and executed to centralize socio-political and economic control of traffic through portions of the maritime transit environment. By distinguishing landmarks with place-name labels and solidifying a presence in the cultural landscape with settlements, fortifications, and transitional byways that offered ease of movement to ship traffic, local elites cultivated a discernible amount of prestige and control for their community, thus profiting from a growing economy that

⁷² For further discussion see Section 2.2.1 of this paper, and (Thurston 2001, 57–60).

passed through their domain. When coupled with literary accounts depicting Samsø and Lindesnes, the continual use and growth of sites such as Spangereid, Søby, Endebjerg, and Tønnesminde provide further evidence of Samsø and Lindesnes' political and cultural significance in Migration Period (A.D. 400–550) and Late Germanic Iron Age (A.D. 550–800) Scandinavia.

There remains a continuing need for more subtle excavations on Samsø and at Spangereid that will elucidate data to further our understanding of “central *transit* places” such as Scandinavian canal sites. Through the use of interdisciplinary techniques such as those described in Section 4.6 of this chapter, and in collaboration with other disciplines, new avenues for investigation may emerge. Despite the conspicuous lack of documentary sources, the archaeological study of canals assists in the study of political organization, and thus the extent of prehistoric human activity in the maritime environment.

Chapter 5

Research Methods

The approach I take here to assess the role of Migration Period (A.D. 400–550) and Late Germanic Iron Age (A.D. 550–800) canals in power centralization is to construct a theoretical framework that enlists historical, literary source material, and toponymical data to create temporal context for the archaeological, artefactual, and geoarchaeological data at the core of the research. By examining regional and local-scale long-term changes through a process of landscape interpretation and locational analysis, I assess the dynamic forms of human agency that mark the Scandinavian canals as complex, social, and political entities indicative of power concentration within the culturally diverse prehistoric landscapes of southern Scandinavia.

These methods allow me to trace the presence of the Spangereid and Kanhave canal sites through space and time, and to respond to the research aims discussed below.

Aim 1: Determine Compositional Congruencies Between the Canal Sites

Goal

The goal of this experiment is to determine whether similarities exist in the engineering, construction, and composition of the Spangereid and Kanhave canal sites. Aim 1 is to assess the Spangereid and Kanhave canal material compositions in an attempt to answer the following questions: Is it possible that Scandinavian canals were used as harbors? Are

there congruencies in the canal structures, construction materials, or mode of construction for the canal sites?

Rationale

The objective of this study is to establish a congruency in form and patterns of construction between the canal sites to determine material and constructive similarities and/or relationships between the canals, thereby leading to the conclusion that the Scandinavian peoples may have held a common understanding of canal construction despite spatial disposition or cultural variation.

Experimental Design

To address Aim 1, I follow a systematic comparative analysis protocol for archaeological, artefactual and geoarchaeological data relevant to the canal sites and their architectural compositions. This analysis is completed by using material data sets and measurements from both canal sites, assessing the composition of each site, and analyzing the data by comparing the results.

Expected Results/Alternative Approaches

Based upon the lack of material comparison conducted in previous studies of the individual canal sites, I hypothesize that Scandinavian canals were also used as harbors, and that congruencies between the Spangereid and Kanhave canal sites do exist, indicating a common understanding of canal engineering across the Scandinavian maritime landscape.

Aim 2: Determine the Historical and Spatial Congruencies Between the Canal Sites

Goal

The primary objective of spatial composition analysis is to identify groups of related artifacts and structures that provide insight into archaeological questions relating to the Spangereid and Kanhave canal sites. The goal of this experiment is to determine the material and spatial congruencies between the canal sites and surrounding cultural landscapes to derive evidence for power centralization. Aim 2 attempts to answer the following questions: Are the canal sites similarly patterned? Are there funerary structures (land of the dead) identified on one side of the canal sites while habitation units (land of the living) exist on the other? Are there any similarities in the dispersion of structures? Supporting sites? Do the canals serve as demarcation lines? What did the human activity look like both militarily and culturally? Based on the results of previous studies, I hypothesize that Aim 2 will establish that the canal sites were centers of power, and that they shaped nearby cultural landscapes.

Rationale

Data sets from the Spangereid and Kanhave canal sites are interpreted independently in earlier works and until now have not been systematically assessed and compared to each other. A study of historical, literary source material, and toponymic data relevant to the canal sites placed within the spatial context of their respective surrounding archaeological landscapes provides essential cultural and behavioral data to assess the diversification and dispersal of Scandinavian populations around the Spangereid and Kanhave canal sites.

Experimental Design

To address Aim 2, I conduct an intra-site and outwardly concentric spatial structure analysis and compare the component arrangements with the spatial organization of each canal site. In addition, I survey the material records of each site, accounting for the distribution of features and archaeological assemblages, habitation units, specialized activity areas, contemporary sea level data, proximal toponymy, depictions in literary source material, and canal site distances to known trade centers or political high seats. This experiment surveys the regional socio-political landscapes and cultures of each site at the time of canal construction and use, as well as the positions of the canal sites relative to other excavated sites in their vicinities.

Expected Results/Alternative Approaches

By taking the canal sites out of isolation and placing them within their social, temporal, and spatial contexts, the results of Aim 1 and Aim 2 are hypothesized to display significant similarities between the sites, and to present data that will help archaeologists further interpret artificial navigable waterways within the context of the Scandinavian maritime landscape.

Chapter 6

Research Limitations

There were three principal limitations to my research. First and foremost, much of the research conducted for this thesis was based on data derived from two canal sites, which had been excavated individually, and by diverse teams of archaeologists from two countries. It seems reasonable then to say that the inherent disparities between the amount of data collected, their manner of excavation, techniques, data collection, filing, synthesis, dating, and subsequent interpretation of both the sites and their component archaeological assemblages are to be expected. Therefore, without a common intersubjective and transparent system of analysis across the sites, the data were subject to inherent variances and inconsistencies in theoretical and methodological schools, which reflect distinct ways of viewing, describing, measuring, and approaching an archaeological site, and follow in accordance with the laws, systems, customs and methodology of the archaeologists' respective countries. These issues were further exacerbated not only by differences in geography, geology and research intensity, but by the accidental disruption of the sites' cultural layers by farming implements such as ploughing. The movement of artifacts by such means could have implications for chronology and provenience. Accordingly, single-object finds are common, and were included in this thesis. Regarding historical accuracy, there must be an acceptable margin

of error, considering the variables, but all attempts should be made to narrow the margin as much as possible through risk mitigation.

Another research limitation was language. Both the Kanhave Canal in Denmark and the Spangereid Canal in Norway were excavated by local archaeologists who interpreted the sites and synthesized the data into reports, scholarly articles and other literature written in their respective languages. The author of this thesis is a native English speaker and is reliant on translation services to interpret materials written in Norwegian, Danish, and German. The margin of error in translating esoteric terminology, idiosyncratic verbiage, definitions, expressions, and colloquialisms was considered, and measures (such as layered translation practices) were put in place to ensure that accuracy remained at the forefront of the translations.

The third research limitation was the author's ability to acquire all relevant data pertaining to the canal sites. The author knows of no world-wide, or even European, archaeological database that aggregates excavation reports and data from sites around the world. With an inability to travel to the canal sites due to budget and schedule limitations, data for this thesis was limited to what the author could acquire through open-source research and potential communication with museums and archaeologists abroad. Technologically, the spatial analysis depicted in this thesis would have benefited further from the use of a geospatial framework such as ArcGIS, however this process required that the author receive clearances to acquire all of the aggregate geospatial data from whomever retains it for each canal site.

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