

ENERGY ISLAND BORNHOLM  
Geoarchaeological Analysis of Energy Island Bornholm  
Interconnector Transect

VIR 2937



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VIKINGESKIBS  
MUSEET

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***Interconnector Transects***

***VIR 2813***

***John Howorth***

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Cover illustration: wreck SSS\_B3A\_0076. © Vikingskibsmuseet.

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INTERCONNECTOR TRANSECTSS

STED- OG LOK. NR. 401375-67

## Geoarchaeological Analysis of Energy Island Bornholm – Interconnector Transects

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## **Abstract**

Energinet has requested that the Viking Ship Museum identify potential cultural heritage objects (CHOs) located at the planned wind farm sites and related cable routes of the Energy Island Bornholm. This report covers the Interconnector Transectss between Bornholm and Zealand (Sjælland).

The Viking Ship Museum has identified a number of possible cultural historical objects on the seabed in the geophysical data, including 18 potential wrecks, 9 potential anchors and 58 mounds plus four so-called "mound-no-height". Moreover, the paleo-terrain that best represents the terrain during the Late Palaeolithic and Early Mesolithic, between c. 9400 BC and 8400 BC, was analysed and a number of potential settlement 'hotspots' were highlighted.

## **Dansk resumé**

Energinet har anmodet Vikingskibsmuseet (VIR) om at identificere potentielle kulturhistoriske objekter i den planlagte Vindmøllepark *Bornholm Energiø* og dens kabelkorridorer i Østersøen. Nuværende rapport dækker Interconnectortransekter mellem Bornholm og Sjælland.

Vikingskibsmuseet har identificeret et antal potentielle kulturhistoriske objekter, heraf 18 potentielle vrage, 9 potentielle ankre, 58 "mound" og fire "mound-no-height" (bunke, bunke uden højde). Desuden er et palæo-terræn, tolket som den bedste repræsentation af terrænoverfladen i sen Palæolitikum, tidlig Mesolitikum mellem ca. 9400 BC og 8400 BC, blevet analyseret og steder udpeget for potentielle bosættelses-"hotspots".



**Figure 1. Map showing the areas included in the Energy Island Bornholm. The Interconnector Transects is coloured red. Illustration: Marie Jonsson © Vikingeskibsmuseet.**

## ***Introduction***

Following a decision by the Danish Parliament in June 2020, Denmark is on the path to establishing offshore energy infrastructure in the Danish North Sea and the Danish Baltic Sea to connect offshore wind energy to the Danish mainland and to neighbouring countries via offshore energy hubs called *Energy Islands*. In the Baltic Sea, the Energy island is the existing island of Bornholm.

The Interconnector Transectss covers a large area and is split into two main portions; the west portion close to Zealand, and the east portion near Bornholm (Figure 1). The east portion overlaps considerably with the Export Transect and therefore, targets which appear the Export Transect are included in this report.

**Table 1. Abbreviations used in the text**

CHO	Cultural history object	Kulturhistorisk objekt
DMA	Danish Maritime Authority	Søfartsstyrelsen
EEZ	Exclusive Economic Zone	Eksklusiv økonomisk zone
GIS	Geographical information system	Geografisk informationssystem
HF	High frequency	Højfrekvent
LF	Low frequency	Lavfrekvent
MAG	Magnetometer, magnetic	Magnetometer, magnetisk
MBES	Multibeam echo sounder	Flerstråleekkolod
MMO	Man-made object	Menneskeskabt objekt
ROV	Remotely operated vehicle	Fjernstyret undervandsfartøj
SBP	Sub-Bottom Profile	
SSS	Sidescan Sonar	Sideseende sonar
VIR	Viking Ship Museum, Roskilde	Vikingskibsmuseet i Roskilde
WGS 84	World geodetic system 1984	

### ***Project data***

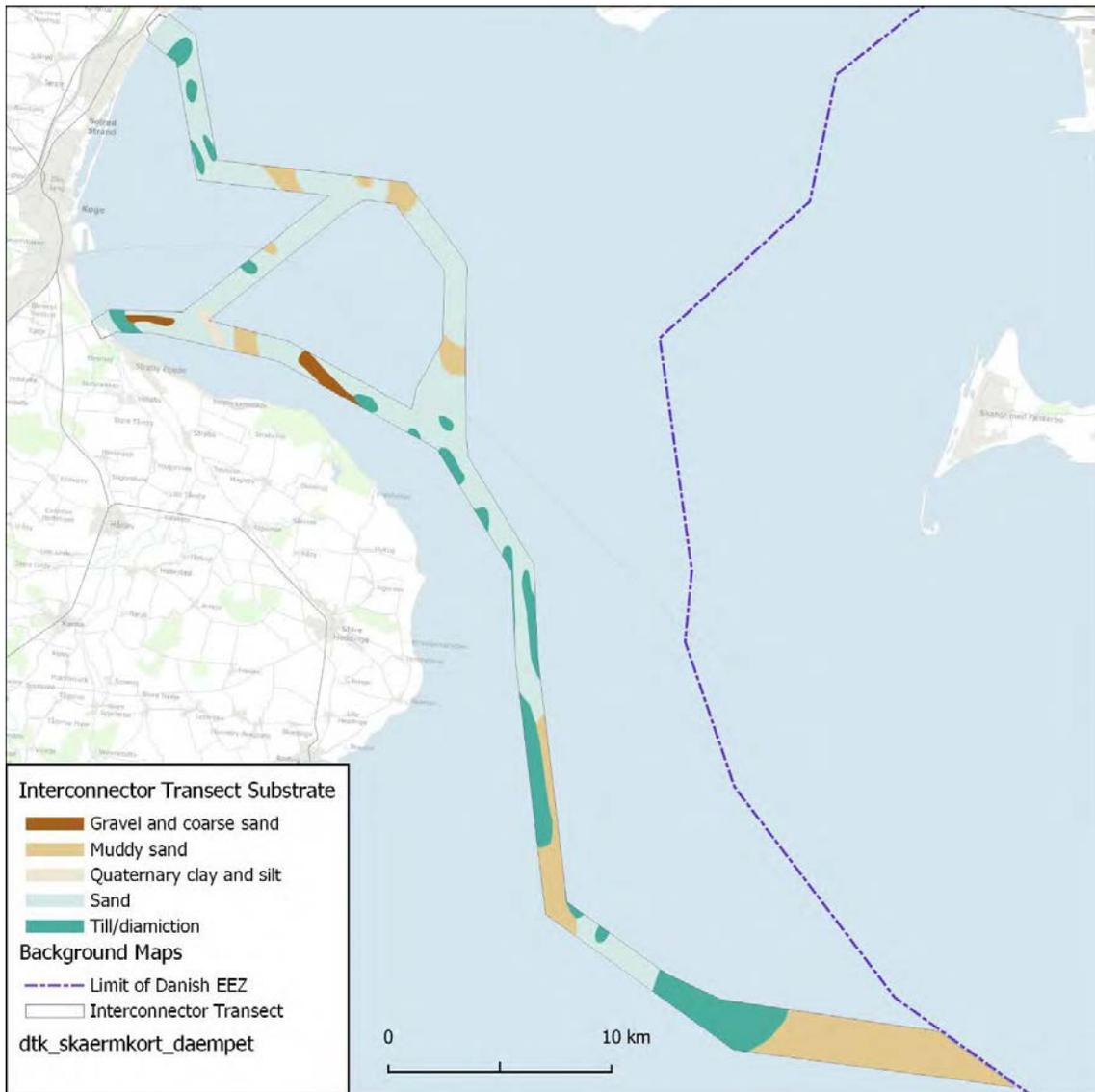
The Sidescan Sonar (SSS) data screening for the Interconnector Transects was completed at the Viking Ship Museum in Roskilde, Denmark by maritime archaeologists Marie Jonsson, Torben Malm, Staffan Lundblad and John Howorth.

The entire Energy Island Bornholm project archive is filed at VIR under file no. 2937.

### ***Topography, terrain and geology***

#### **Western Portion**

The western portion of the Interconnector Transects is long and relatively narrow, running from Køge Bay in the north and down to the limit of the Danish EEZ in the south east. The seabed substrate across this area is extremely varied comprising till, mud, gravel, sand, silt, and clay. Although sand and muddy sand is the predominant make-up of the seabed across the whole area with some significant areas of till towards the south (Figure 2).



**Figure 2. Seabed substrate in the western portion of the Interconnector Transects. Data collated by GEUS. Illustration: John Howorth ©Vikingskibsmuseet. Contains data from EMODnet © European Union, 2022 and data from Styrelsen for Dataforsyning og Effektivisering.**

The depth of the seabed along this part of the route varies widely from around 33 metres in the south-east shallowing to approximately 20 metres as the route heads north. In Køge Bay the sea is around 15 to 7 metres deep before eventually coming up onto land just to the north and south of Køge at Karlstrup and Strøby respectively. There is a large number of rocky reefs and sand banks along the coastline around Køge Bay which have been the site of wrecks and groundings of ships over several centuries. These features also act to trap objects which wave action tends to break up close to land, increasing the likelihood of finding a high number of man-made targets (MMOs) in the SSS data.

Two large naval battles took place in Køge Bay in 1677 and 1710. These battles resulted in several ships sinking in the area and evidence of these could be found on the seabed.

In the late 19<sup>th</sup> and throughout the 20<sup>th</sup> Century, this area was extensively fished via the use of pound nets, stationary nets which are held in place by a series of wooden posts and weights, the remains of which still lie on the seabed.

The area has also been the site of the extraction of aggregates, namely sand and gravel, both from the seabed and on land. This has caused disturbance on the seabed.

The activities mentioned above coupled with the fact that the Baltic Sea has a long history as a busy shipping channel, as well as the prevalence of rocky reefs and sandbanks means there is an increased likelihood of CHOs in this area.

The shallow water of Køge Bay means that large parts of the seabed was dry land during the Mesolithic period. Over this period, the retreating ice changed the coastline drastically (Oakley & Pickworth, 2023). Sub-bottom profile (SBP) and multibeam echo sounder (MBES) data has been used to study the submerged terrain to identify likely areas for human activity and settlement.

### **Eastern Portion**

The eastern portion of the Interconnector Transects is also long and relatively narrow running from Sose Bay in the east and out to the limit of the Danish EEZ in the west. The seabed substrate across this area is therefore fairly varied comprising rock, till, sand, silt, and clay close to Bornholm changing to sand and mud as the route heads westwards (Figure 3). The depth of the water is fairly shallow, between 5 and 15 metres for the first half of the route out from Bornholm. The seabed then drops away sharply from about 20 metres to over 45 metres deep towards the western end.

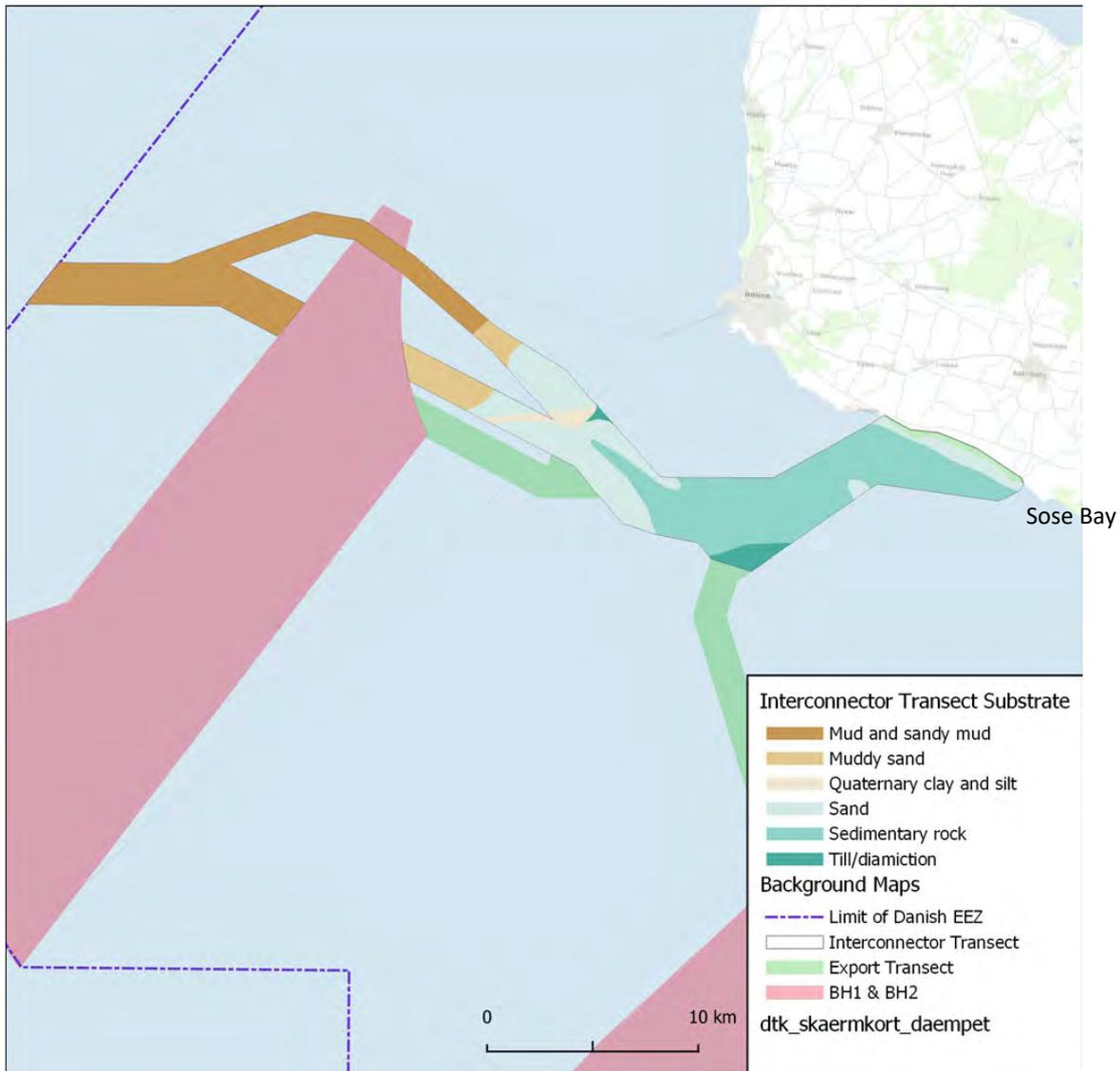
Sose Bay was the site of the sinking of at least 15 ships in 1678 and the wrecks likely remain on the seabed although not all of them have been identified and registered. Artefacts such as musket balls, tin plates, coins, sword parts, silver goblets and spoons have been found in this area by recreational divers and fishermen. Large numbers of human bones presumably from victims of the mass foundering were also reported in the late 19<sup>th</sup> century and there is a chance that there may still be human remains in the area.

Within 1.3 kilometres of the shore, there are four wrecks registered with the *Fund og Fortidsminder*, reportedly from the mass foundering, although one, FF 150703, has not been verified.

These factors, on top of the fact that Bornholm is situated within an area that has been an important and busy shipping channel throughout history, means there is a likelihood of a high number of CHOs in this area.

The shallow water close to Bornholm also offers up the potential for prehistoric remains. An Iron Age quern-stone and a potential stone-age settlement site have both been discovered on the seabed within 500 metres from the coast and there are several known prehistoric monuments on land, along the coastline.

Large parts of the seabed in Sose Bay would have been dry land during the Mesolithic period (Jensen & Bennike, 2021). SBP and MBES data has been used to study the submerged terrain in order to identify likely areas for human activity and settlement. The submarine terrain close to Bornholm contains areas that would have been suitable for human habitation but there is a widespread lack of sedimentation which may inhibit preservation and thus limit the potential to find Mesolithic archaeology in the greater part of the area.



**Figure 3. Seabed substrate in the eastern portion of the Interconnector Transects. Data collated by GEUS, GPDN and PGI-NRI. Illustration: John Howorth ©Vikingskibsmuseet. Contains data from EMODnet © European Union, 2022 and data from Styrelsen for Dataforsyning og Effektivisering.**

### ***Coordinate system***

The present report and associated digital files archived at VIR use the coordinate system: UTM zone 33N, WGS 84, unless otherwise specified.

### ***Methodology***

Using Sonarwiz (v.7.10) software, all High Frequency (HF) SSS data for the route of the Interconnector Transects was screened and potential archaeological targets were selected based on their shape and size, and the potential for being a Cultural Historical Object (CHO) . The target was then checked for matching anomalies in other datasets:

- The surveyor's SSS targets
- The surveyor's Magnetic (MAG) anomalies
- Danish national registry of CHO finds *Fund og Fortidsminder* (FF) (<https://www.kulturarv.dk/ffreg/>).

Targets were then exported to a mapping project in QGIS (v.3.28.4 – Firenze), where further matches were made from the following records:

- Søfartsstyrelsens vragregister – The Danish Maritime Authority's Register for Wrecks.
- Hold databasen – a database from the Agency for Culture and Palaces which contains a list of potential wrecks where the positions have not yet been further investigated.
- Vragguiden – Denmark's largest online wreck database for and by recreational divers.
- Nord Stream 1 and 2 – information from the museum's archives, VIR 2545 and VIR 2740.
- Baltic Pipe - information from the museum's archives, VIR 2813.

Furthermore, extra attention has been paid towards any targets that are found within 500 metres of a registered CHO as they may be related which means that the registration can help identify and/or date the target.

Within this report, references made to objects registered with *Fund og Fortidsminder* are preceded with FF followed by the unique *system number*.

## Results

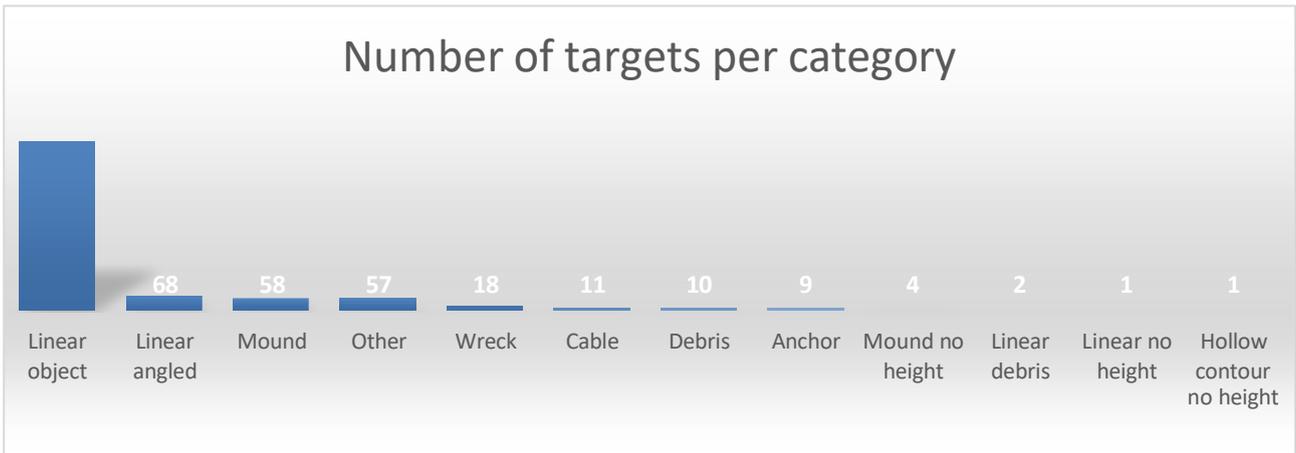
Due to the size and shape of the Interconnector Transects the results are split into two groups, east and west.

In total there are 1040 targets identified in the SSS data. Each target was assigned a category, a list of the categories used can be seen below. The vast majority of these are so-called *linear objects*. There is a total of 18 *wrecks*, 9 *anchors* and 62 *mounds*, which includes 4 *mounds with no height* (Figure 4).

### List of target categories

Each target category is described below:

<i>Anchor</i>	Anchor/potential anchor
<i>Cable</i>	Cable, chain etc.
<i>Debris</i>	Manmade object, debris
<i>Hollow contour no height</i>	Ship-shaped object without shadow
<i>Linear angled</i>	Angled linear object, with or without shadow
<i>Linear Debris</i>	Area of scattered linear objects
<i>Linear no height</i>	Linear object of certain size, without shadow but still noteworthy
<i>Linear object</i>	Linear object of certain size and with shadow
<i>Mound</i>	Mound, potentially ballast from broken down wreck
<i>Mound no height</i>	Mound without shadow but still noteworthy
<i>Other</i>	Other type of object. See description
<i>Wreck</i>	Wreck/potential wreck

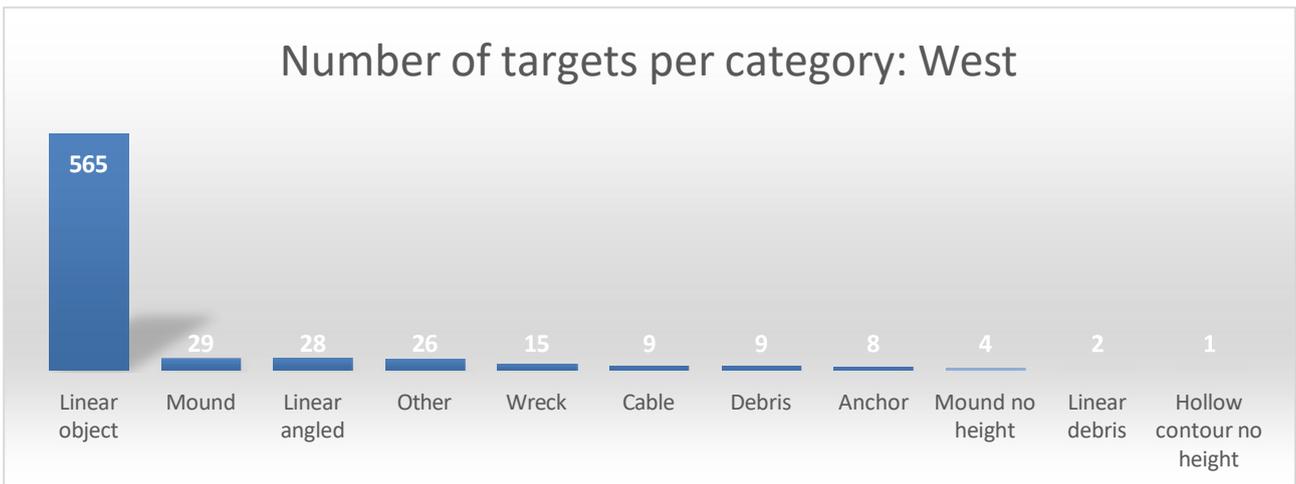


**Figure 4. Target categories and number of occurrences, both east and west areas combined.**

All targets are potentially CHO's. The different linear objects can be remains from fish weirs, wreck parts or cargo. Debris can be remains of cargo or broken up wrecks. Cables is used collectively for cables, wires and ropes, all of which can be part of fish traps or wrecks or anchors. These categories are not presented in full below in the same manner as Wrecks, anchors and mounds, as this would make a too detailed report. However, all targets are covered in Appendix 2, and should be considered as CHO's until investigated.

### ***Interconnector Transects - West***

A total of 687 targets were identified and geolocated within the western portion of the Interconnector Transects, including 15 possible wrecks, 8 potential anchors, and 33 mounds and so-called "mound no height" (Figure 5). All the information regarding the potential wrecks, anchors, and mounds can be found in Appendices 1a, 1b, and 1c respectively. An overview map of all targets identified in the SSS screening can be seen in Appendix 3.

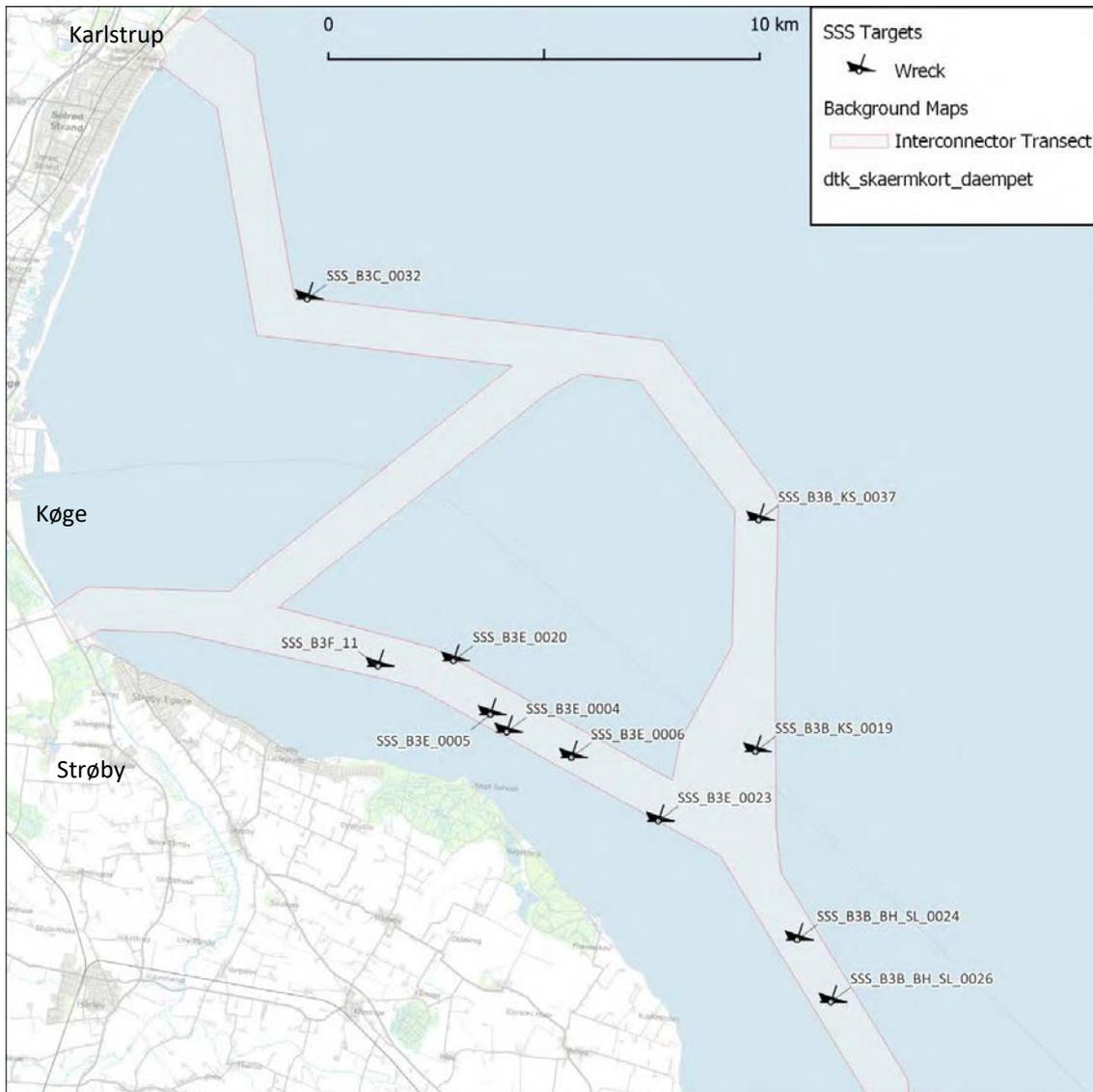


**Figure 5. Target categories and number of occurrences, western portion.**

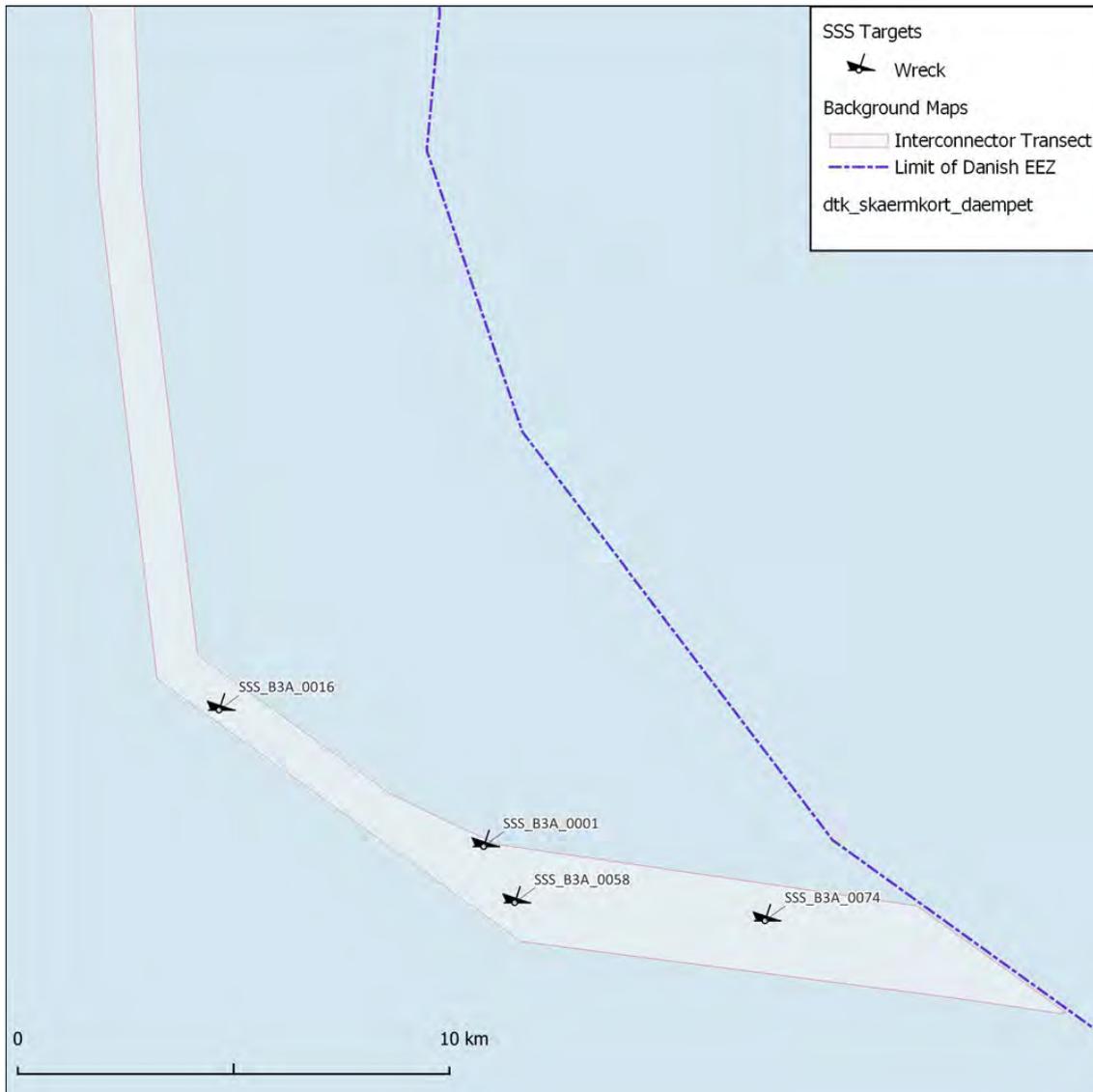
### **Wrecks**

There are fifteen potential wrecks identified in the SSS data within the west portion of the Interconnector Transects (Figure 6 and Figure 7). Six of the potential wrecks are situated either close to or directly on the site of wrecks that that have been registered with the Fund og Fortidsminder,

the Danish Maritime Authority's (DMA) Register for Wrecks, Vragguiden, or Holdddatabasen. Several of these are either named or could be one of two named wrecks in close proximity.



**Figure 6. Overview of the location of possible wrecks in the northern part of the western portion of the Interconnector Transects. Illustration: John Howorth © Vikingskibsmuseet. Contains data from Styrelsen for Dataforsyning og Effektivisering.**



**Figure 7. Overview of the location of possible wrecks in the southern part of the western portion of the Interconnector Transects. Illustration: John Howorth © Vikingskibsmuseet. Contains data from Styrelsen for Dataforsyning og Effektivisering.**

The closest records to the potential wreck **SSS\_B3B\_KS\_0019** are FF 150213 and an object in the DMA's Register for Wrecks, both identify this wreck as being *Kobberskibet* (the Copper Ship), a ship which sank in 1873 with its cargo of stone, coal, and port. In Vragguiden there is a mention of the name *Kobberskibet* located about 170 metres to the northeast of this target.

Within a 500-metre radius of SSS\_B3B\_KS\_0019, there are 24 targets identified by VIR as well as an area of debris covering 14037 m<sup>2</sup> (Figure 8). There are several linear objects which lie in a fairly concentrated group to the southeast of the main debris field which could be further wreckage or cargo. Within this potentially extended area of debris are two *mounds*, SSS\_B3B\_KS\_0028 and SSS\_B3B\_KS\_0029, which are potentially buried objects. A further four mounds have been identified to the north of the main debris field which could also be buried debris. A cable has been identified within the debris field which runs over 60 metres towards the southwest from the stern of



during the same project (Jonsson & H. Thomsen, 2022). The description for BP06\_VIRSSS0125 states that it is presumably the wreck of the *Amalia*, a schooner with a cargo of iron which sank in 1923 and this is also how it is registered with *Fund og Fortidsminder*, FF 245393. However, the DMA's Register for Wrecks identifies this wreck as the *Jacob Procoroff*, a steamship which sank at the beginning of 1893 or end of 1892. Furthermore, an entry in Vragguiden, identified as the *Amalia*, lies approximately 110 metres to the northeast with the location described as secure although nothing has been identified in the current SSS data at that point (Figure 9).

There is also an object registered in Holddatabasen and subsequently registered with *Fund og Fortidsminder*, FF 184984. It lies approximately 250 metres to the southeast of SSS\_B3A\_0058 and has a similar description to the *Amalia*, but, as this is an object in Holddatabasen, the exact location may not be secure. All that was seen in this position from the SSS data were two very faint possible linear objects, SSS\_B3A\_0098 and SSS\_B3A\_0099.

Another *Fund og Fortidsminder* record, FF 184008, lies approximately 250 metres to the east of SSS\_B3A\_0058, and has also been described as the wreck of the *Jacob Procoroff*, although nothing was identified in this area from the SSS data.

Five linear objects within the immediate proximity of the main area of the potential wreck, SSS\_B3A\_0059 - SSS\_B3A\_0063, are presumably wreck parts.

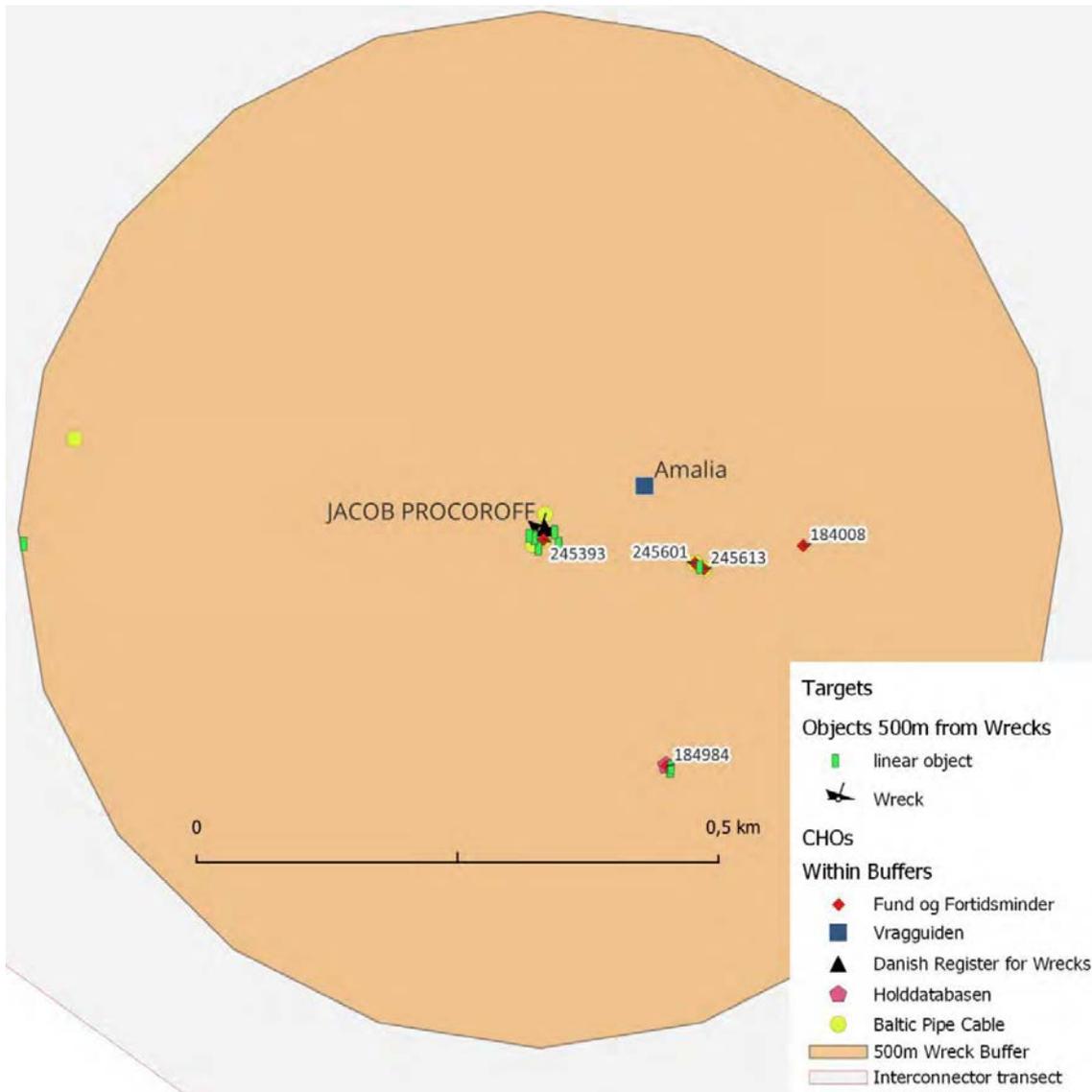
Two metal pipes were identified during the Baltic Pipe project, VIR\_SSS\_0338 and BP06\_VIRSSS0119 (Jonsson & H. Thomsen, 2022), and were subsequently entered into the *Fund og Fortidsminder* as FF 245613 and FF 245601 respectively. Both are described as wreckage that might originate from either the *Jacob Procoroff* or *Amalia*. Only one linear object was spotted in the same area in the current project, SSS\_B3A\_0057, and could be one of the two objects from the Baltic Pipe project.

The information above means that the potential wreck could be one of two different wrecks but there is no way to ascertain which unless further investigation is undertaken.

**SSS\_B3A\_0016** is potentially a wreck with an associated anchor, SSS\_B3A\_0018, and anchor chain, SSS\_B3A\_0017. There are only six targets, apart from the anchor and cable, within a 500-metre radius. All are linear objects and appear to be scattered at random. The closest record to SSS\_B3A\_0016 is a wreck in the DMA's Register for Wrecks and associated FF 177820, identified as a motor ship named the *Primo* (Figure 10), which states the ship sank in 1934. Wrecks are usually given a protected status once they are over 100 years old.

One nearby record from Vragguiden describes a 1930s wreck identified as the *Bingo* which sits between the two points identified as the *Primo* in the DMA's register and Holddatabasen.

The closest record to another potential wreck, **SSS\_B3F\_11**, is an entry into the DMA's Register for Wrecks and associated FF 177810, identified as a 1930s ship called the *Caroline*.



**Figure 9. Area around SSS\_B3A\_0058 showing the wreck named Jacob Procoroff in the DMA's Register for Wrecks, but in the same area as FF 245393 which identifies the wreck as the Amalia. FF 184008 has also been identified as the Jacob Procoroff. The description of FF 184984 fits the Amalia. The Amalia also appears in Vragguiden located to the northeast of the main wreck. No other definite wrecks were spotted in this area in the current project. Illustration: John Howorth © Vikingskibsmuseet.**

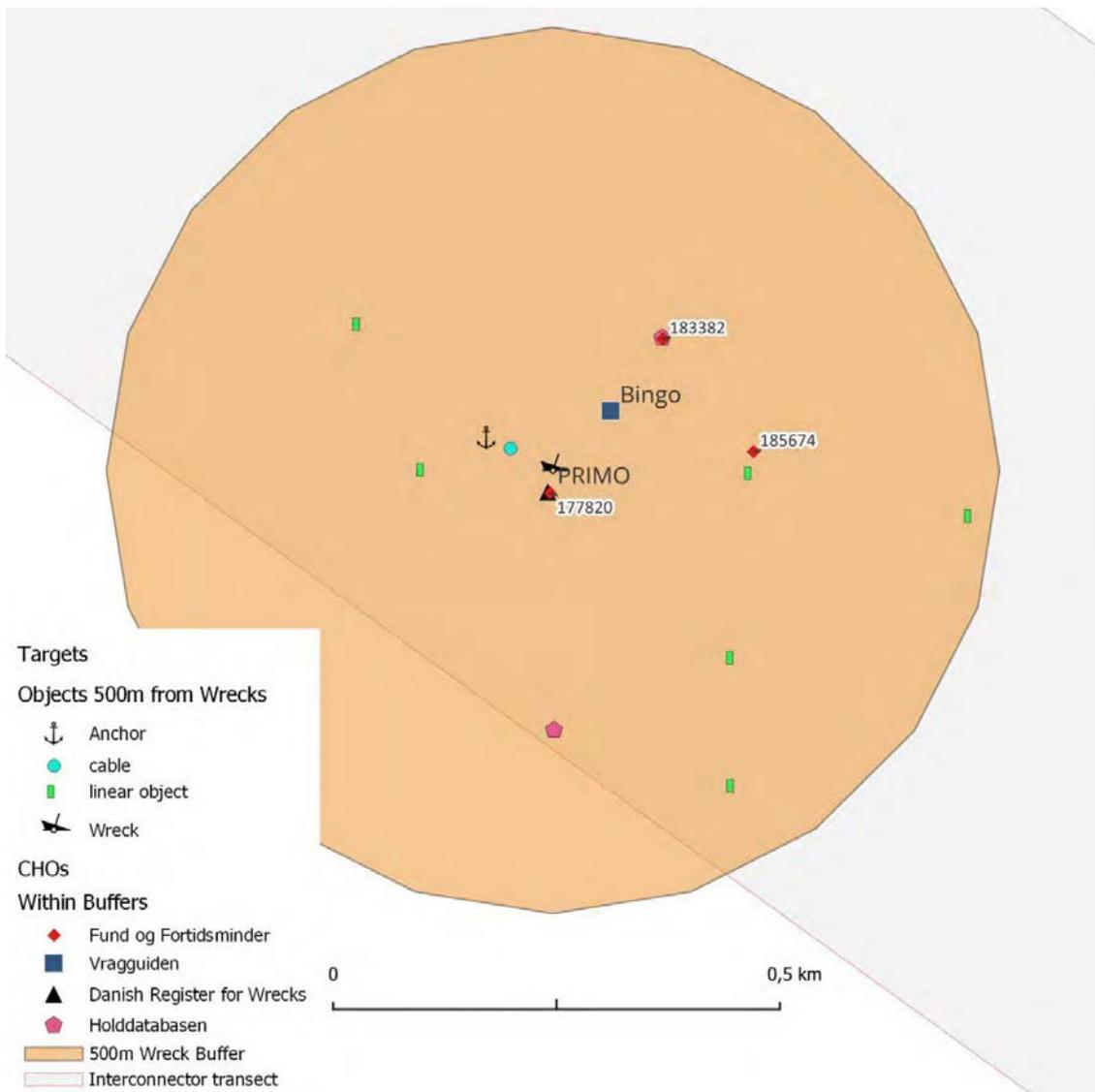


Figure 10. The wreck, SSS\_B3A\_0016, in the centre, showing the nearby targets and CHOs. Identified as the PRIMO in the DMA's Register for Wrecks. The Bingo, from Vragguiden is also shown but is likely to be the same wreck either misidentified or misnamed. Illustration: John Howorth © Vikingskibsmuseet.

### Unsure Identification

The following targets may be related to previously identified CHOs but their location or description casts some doubt over the identification.

**SSS\_B3A\_0074** is a wreck with possible mast parts lying to one side. It was identified in the Baltic Pipe project and subsequently registered as FF 245391, where it has been posited that it could be the wreck of the fishing vessel, *Marie K-974*, which sank in 1944 (Jonsson & H. Thomsen, 2022). The closest record which identifies a wreck by the name of *Marie* is 450 metres to the north and registered in Vragguiden with an uncertain position. However, the DMA's Register for Wrecks lists the *Marie K-974* as being 2.5 kilometres to the west along with an object in Holddatabasen identified as the *Marie* and the associated FF 177992. No definitive wreck was found in the present SSS data at the position of the object in Vragguiden nor in the location suggested by the DMA's

Register for Wrecks. Although four linear objects were identified within 80 metres from the latter (SSS\_B3A\_0066 – SSS\_B3A\_0069).

It is possible that there is a misidentification in the DMA's Register for Wrecks and that this is the actual location for the wreck of the *Marie K-974*.

Approximately 130 metres to the east of the wreck is FF 245618, a piece of metal wreck debris spotted in the Baltic Pipe project (Jonsson & H. Thomsen, 2022). It was not seen in the SSS data for this project but there is a MAG anomaly in that location so it is possible that the object is still present but is now buried.

**SSS\_B3B\_BH\_SL\_0026** is a rocky mound surrounded by potential debris situated approximately 3.5 kilometres northeast off the coast of the Holtug limestone quarry. There are no previously known CHOs in the immediate vicinity. The closest recorded wreck is found in the DMA's wreck register and identified as the *Ariadne*, a motor ship from 1945, and FF 178029, although this is over a kilometre away.

There are 13 linear objects which appear to spread out from the wreck site towards the north and west. These could potentially be debris from the wreck.

Another potential wreck close to the potential position of the *Ariadne* is **SSS\_B3B\_BH\_SL\_0024**. This is described as being overturned and is located in the centre of the Interconnector Transects approximately 1.5 kilometres to the north-northwest of the previous wreck. This wreck is closer to the DMA's positioning of the *Ariadne* but it is still over 570 metres away.

The closest VIR target to the *Ariadne* and unidentified wreck mentioned in Vragguiden is a *mound*, **SSS\_B3B\_BH\_SL\_0022**. This is described as a potential buried object and is located just over 10 metres away from the Vragguiden wreck and about 100 metres from the DMA's record of the *Ariadne*.

### **Unidentified Potential Wrecks**

The following targets have little or no correlation with previously known CHOs. It is important that these targets are still investigated despite not knowing their origin at this time.

**SSS\_B3E\_0023**, **SSS\_B3E\_0025**, and **SSS\_B3E\_0028** constitute a potential wreck with associated anchor and debris respectively. The wreck itself appears to be the outline and frames of a vessel. The anchor is also very distinct in the SSS image.

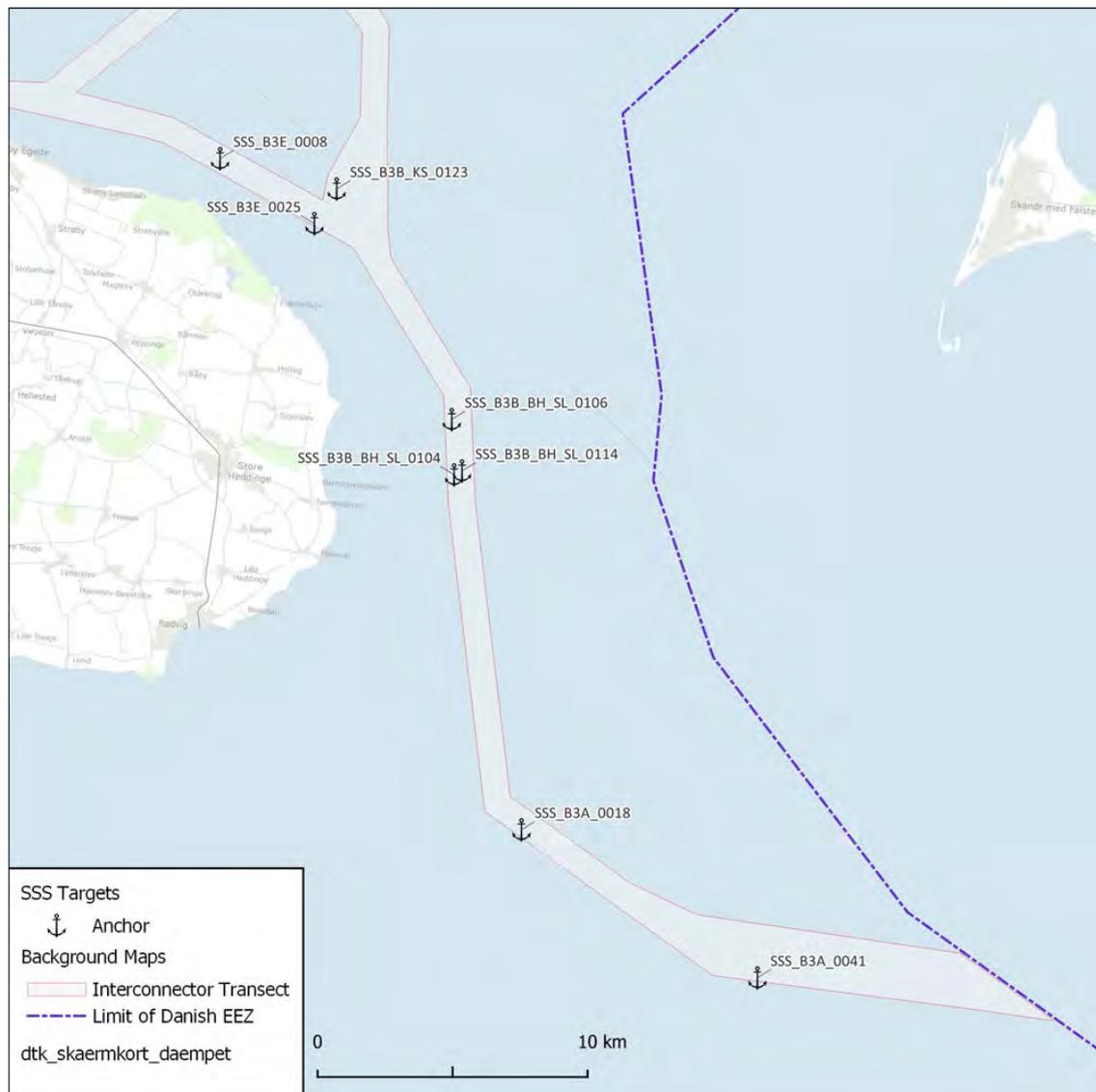
Five more potential wrecks have been identified in the SSS data, these are: **SSS\_B3C\_0032**, a possible small craft with the interpretation based on size and shape; **SSS\_B3A\_0001**, a potential overturned wreck with an unidentified wreck reported in Vragguiden around 400 metres to the northwest; **SSS\_B3E\_0006**, a broken up wooden object surrounded by a rocky seabed; **SSS\_B3B\_KS\_0037**, possibly part of a wreck or another type of debris such as a fishing net; and **SSS\_B3E\_0020**, which is potentially a broken up wooden object described as a likely shipwreck.

**SSS\_B3E\_0004** and **SSS\_B3E\_0005** are a further two potential wrecks which lie around 560 metres apart. Both lie almost equidistant from an anchor, **SSS\_B3E\_0008**, which lies to the north and east of each one respectively.

## Anchors

There is a total of eight potential anchors in the western portion of the Interconnector Transects. Three of these have already been discussed in conjunction with wrecks, but the other five seem solitary, separate from visible ship remains.

In the northern portion of the western part of the Interconnector Transects, there are three possible anchors. Two of these, SSS\_B3E\_0008 and SSS\_B3E\_0025, have already been discussed in conjunction with wrecks.



**Figure 11. Overview of anchors within the Interconnector Transects. Illustration: John Howorth © Vikingskibsmuseet. Contains data from Styrelsen for Dataforsyning og Effektivisering.**

**SSS\_B3B\_KS\_0123** is the easternmost of the three and not directly related to any of the wrecks in the area. It is described as an unusual shaped object and potential anchor. There are no previously known CHOs in the immediate area. It could be associated with *Kobberskibet* which is located

about 1.5 kilometres to the east, but it is also 1.6 kilometres north of SSS\_B3E\_0023, a wreck discussed earlier. There is a line of seven linear objects between 200 metres and 500 metres to the south, which could be an indication of a wreck related to the anchor.

In the southern part of the route, there are five anchors. **SSS\_B3A\_0018** has already been discussed in relation to the wreck of the *Primo*.

**SSS\_B3B\_BH\_SL\_0106** is the same as MAG anomaly M\_GR\_WPA\_B3B\_0233 and MMO S-GR-WPA\_B3B\_0053. Potential cargo or ballast from a wreck, **SSS\_B3B\_BH\_SL\_0105**, lies approximately 280 metres to the south.

**SSS\_B3B\_BH\_SL\_0114** is still attached to a cable/rope/chain, it is around 215 metres from another cable, **SSS\_B3B\_BH\_SL\_0068**, to which it may also be associated. The cable could also be associated with **SSS\_B3B\_BH\_SL\_0104**, another anchor about 330 metres from this one.

**SSS\_B3A\_0041** is about 350 metres from an object spotted in the Baltic Pipe project, PL112001-A1\_DK\_GAZ-926 and the same as VIR target, **SSS\_B3A\_0103** described as an object within a depression and could also be another anchor.

## Mounds

There is a total of 33 *mounds* in the western portion of the Interconnector Transects including four mounds with no height. A *mound* is a boat-shaped or rectangular feature, with or without a bathymetric high, of a size indicating that it may represent the cargo or ballast from a vessel; possibly covering preserved hull elements of the vessel and hence a potential *wreck*. However, and of special relevance for the present case, they may also be spoil heaps from aggregates extraction.

The vast majority are situated towards the north (Figure 12 and Figure 13). Some mounds, such as **SSS\_B3B\_BH\_SL\_0022** and **SSS\_B3B\_BH\_SL\_0105**, have already been discussed above in relation to wrecks or anchors. The mounds described below are those which are believed to have a higher likelihood of being of historical interest or are unusual in appearance and may need further investigation.

**SSS\_B3A\_0046** is a very regular shaped mound which was also identified during the Baltic Pipe project and subsequently registered with *Fund og Fortidsminder*, FF 245610. The target was investigated by ROV during the Baltic Pipe project and was found to be a wreck buried in the sediment with a cargo of yellow bricks showing on the surface of the seabed (Jonsson & H. Thomsen, 2022).

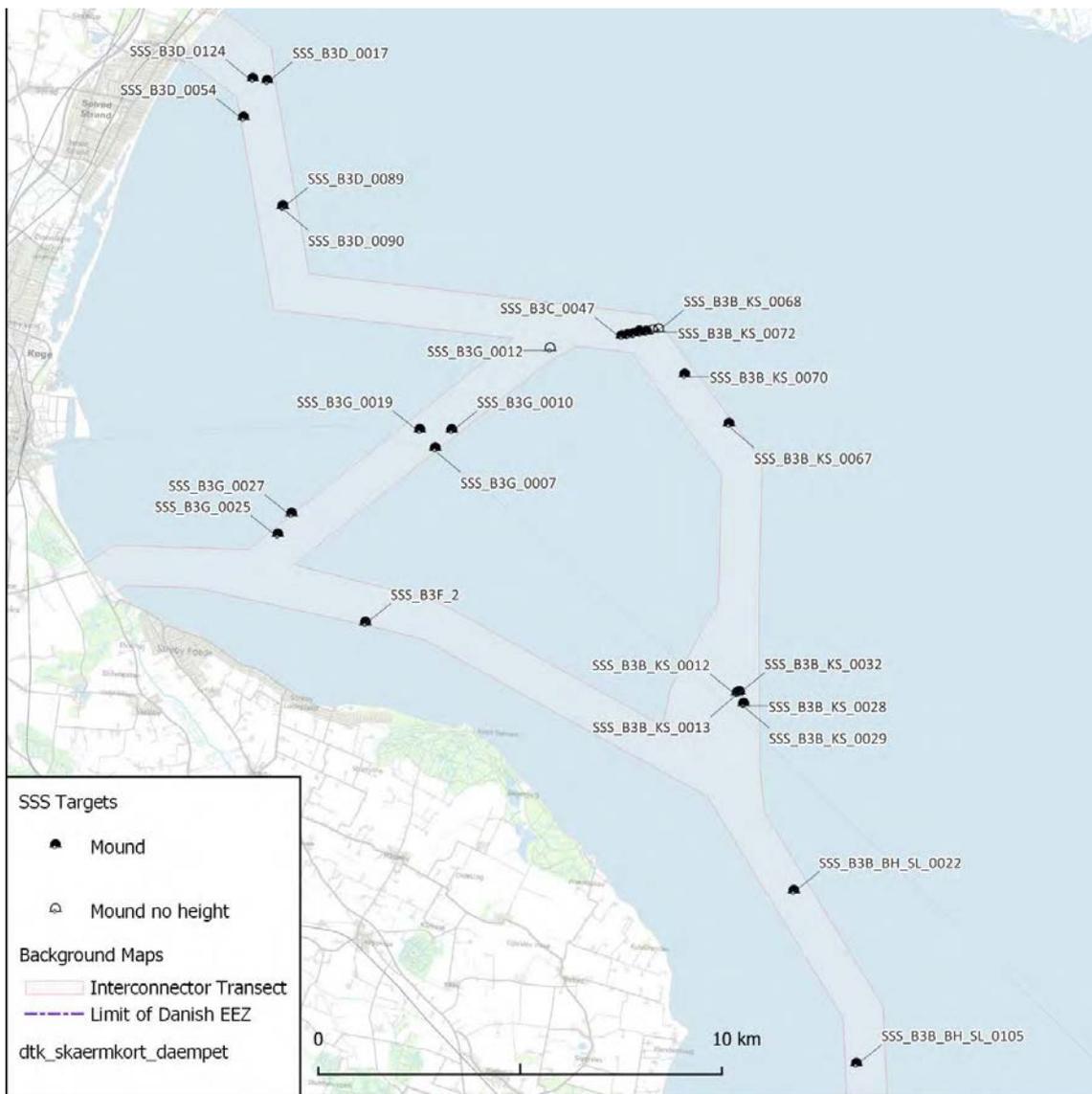
Running across the Interconnector Transects in the northeastern part of the route is a line of 9 mounds and mounds-no-height. Numbers **SSS\_B3C\_0043** to **SSS\_B3C\_0048**, **SSS\_B3B\_KS\_0068**, **SSS\_B3B\_KS\_0072**, and **SSS\_B3B\_KS\_0074**. They lie in an almost perfectly straight line and only occur across an area of muddy sand, none appear in the areas of sand (Figure 14). This could indicate that they are a result of modern disturbance, such as an earlier cable route. There are MAG anomalies close by but they are too high in number and too scattered to determine if any correlate with the line of mounds.

**SSS\_B3D\_0017**, **SSS\_B3D\_0054** and **SSS\_B3D\_0124** are close to where the route makes landfall at Karlstrup Strand. The latter two are described as being possible ballast mounds. It appears that there were many groundings along this area of coastline, as evidenced by a point used to register eleven different *Fund og Fortidsminder* objects. This point is a so-called “Administrative Area Point” and represents wrecks reported in nearby but without an exact location. There are also large numbers of linear objects visible in the SSS data in this area which are potentially wreck parts. However, the area is also the site of a number of pound nets to which these linear objects may

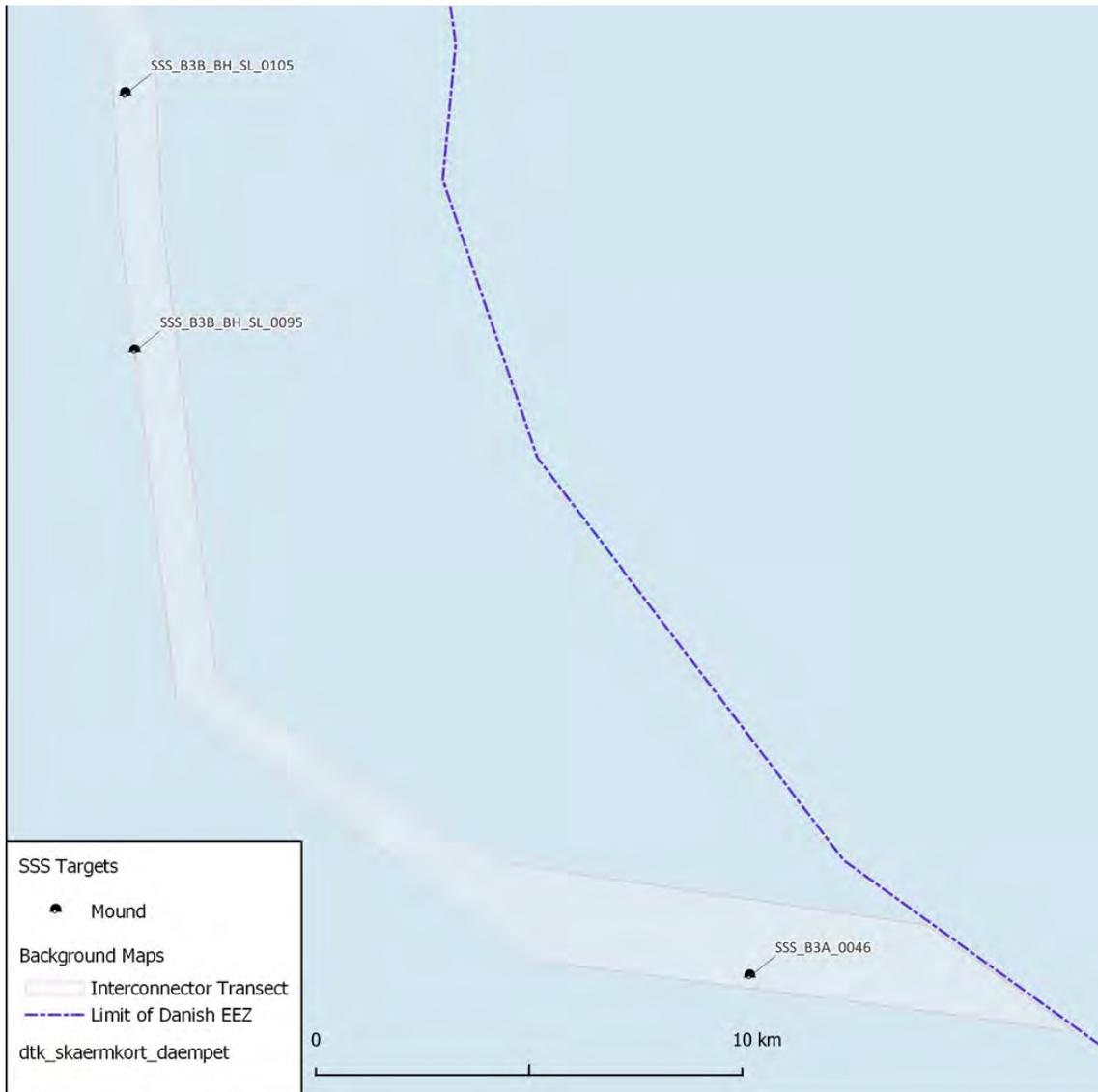
belong. This form of fishing necessitated the areas to be kept free of rocks to avoid damage to the nets. Piles of rocks in this area could be a result of fishermen moving rocks away from the rows of nets.

**SSS\_B3D\_0089** and **SSS\_B3D\_0090** are two mounds close to one another. There is a possibility that they are ballast from a wreck but they are both situated at the end of a pound net fishing system called Grænsevejen (Figure 16).

**SSS\_B3F\_2** is described as a possible ballast mound in an area devoid of previously known CHOs.



**Figure 12. Overview of mounds and mounds-no-height in the northern section of the western part of the Interconnector Transects. A close-up of the line of mounds to the northwest can be seen in Figure 14. Illustration: John Howorth © Vikingskibsmuseet. Contains data from Styrelsen for Dataforsyning og Effektivisering.**

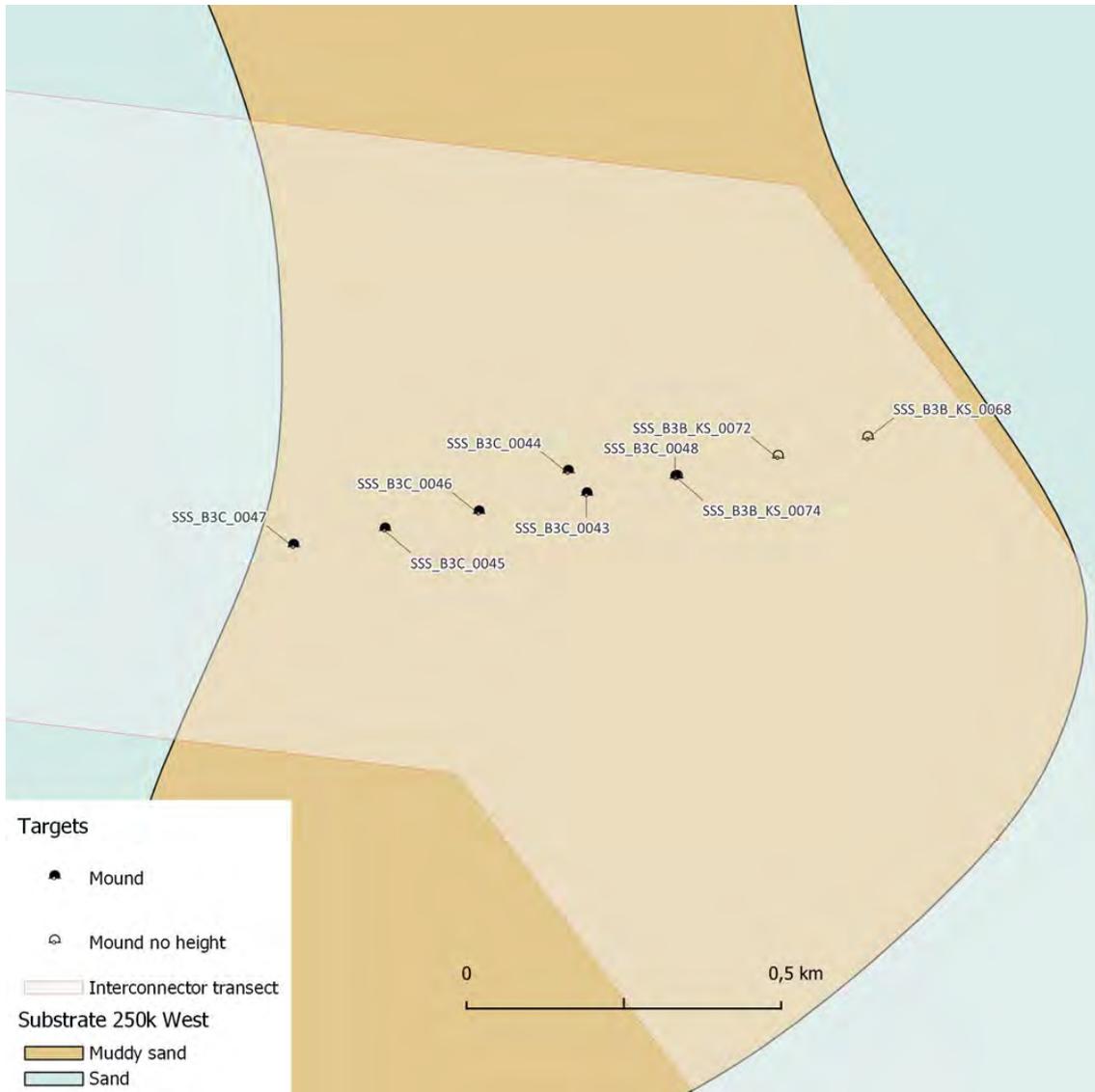


**Figure 13. Overview of mounds and mounds-no-height in the southern section of the western part of the Interconnector Transects. Illustration: John Howorth © Vikingeskibsmuseet. Contains data from Styrelsen for Dataforsyning og Effektivisering.**

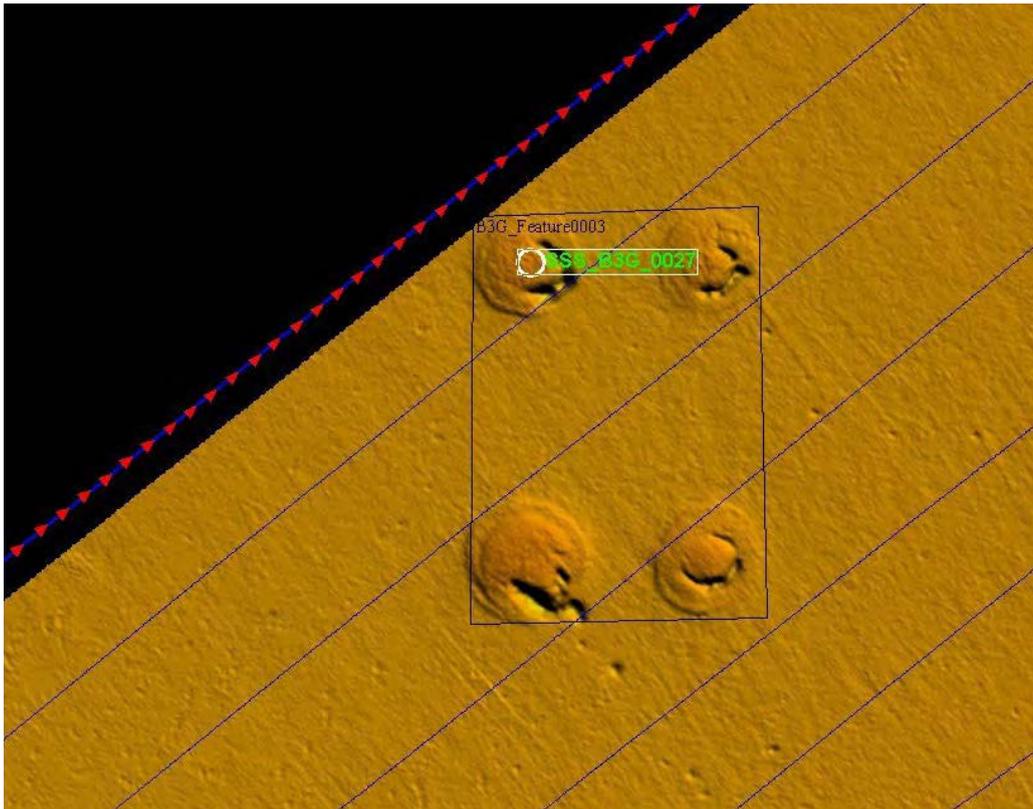
**SSS\_B3G\_0007, SSS\_B3G\_0010 and SSS\_B3G\_0019** are described as possible ballast mounds. There are no previously known CHOs in this area. The first two lie in slightly shallower water which is connected to an area in which a number of prehistoric finds were discovered, a part of the bay which used to be an island or peninsula during the stone age. All three also lie close to an area that was licensed for aggregate extraction, Juelsgrund Nord. It is possible that the mounds could be a result of this activity.

**SSS\_B3G\_0027** is one of four similar sized mounds in a formation which creates a rectangle 60 metres by 40 metres. It is unknown what this feature is. It appears to be fairly modern but this cannot be confirmed until closer inspection (Figure 15).

**SSS\_B3B\_BH\_SL\_0095** lies slightly outside cable route, and **SSS\_B3G\_0012**, **SSS\_B3G\_0025**, **SSS\_B3B\_KS\_0067** and **SSS\_B3B\_KS\_0070** are mounds which have no nearby CHOs or other visible objects of interest.



**Figure 14. The line of mounds crossing an area of muddy sand in an almost perfectly straight line, disappearing in the area of sand. Graphics: John Howorth ©Vikingskibsmuseet. Contains data from EMODnet © European Union, 2022. Data collated by GEUS.**



**Figure 15. MBES image of SSS\_B3G\_0027 and related circular mounds. Illustration: Marie Jonsson © Vikingskibsmuseet.**

## **Pound Net Fishing, Køge Bay**

Throughout the last century, Køge Bay was the site of a number of pound net fisheries. This is a form of stationary fishing in which rows of nets run perpendicular to the coast leading the fish into a pound or trap. The nets are held in place by a series of wooden posts and weights. The “lead” nets often extended several kilometres into the bay and these cross into parts of the Interconnector Transects route (Figure 16).

Evidence for this fishing activity is likely visible in the SSS data. Many linear objects with attached ropes are visible on the northernmost part of the route just before it makes landfall at Karlstrup Strand. This is particularly evident around the head of the *Grænsevejen* row where many MMOs and linear objects have been flagged in the SSS data (Figure 16). There are also concentrations of linear objects around *Solrødrækken* and *Trylleskovrækken*, although here the objects are a more scattered and it is not clear whether they are part of the fishing system, wreck parts, or driftwood.

Evidence for pound net fishing is also visible farther south just before the Interconnector Transects makes landfall to the south of Køge. There is no obvious pattern to the linear objects but there is an area described with long lines which is thought to be related to fishing activity.

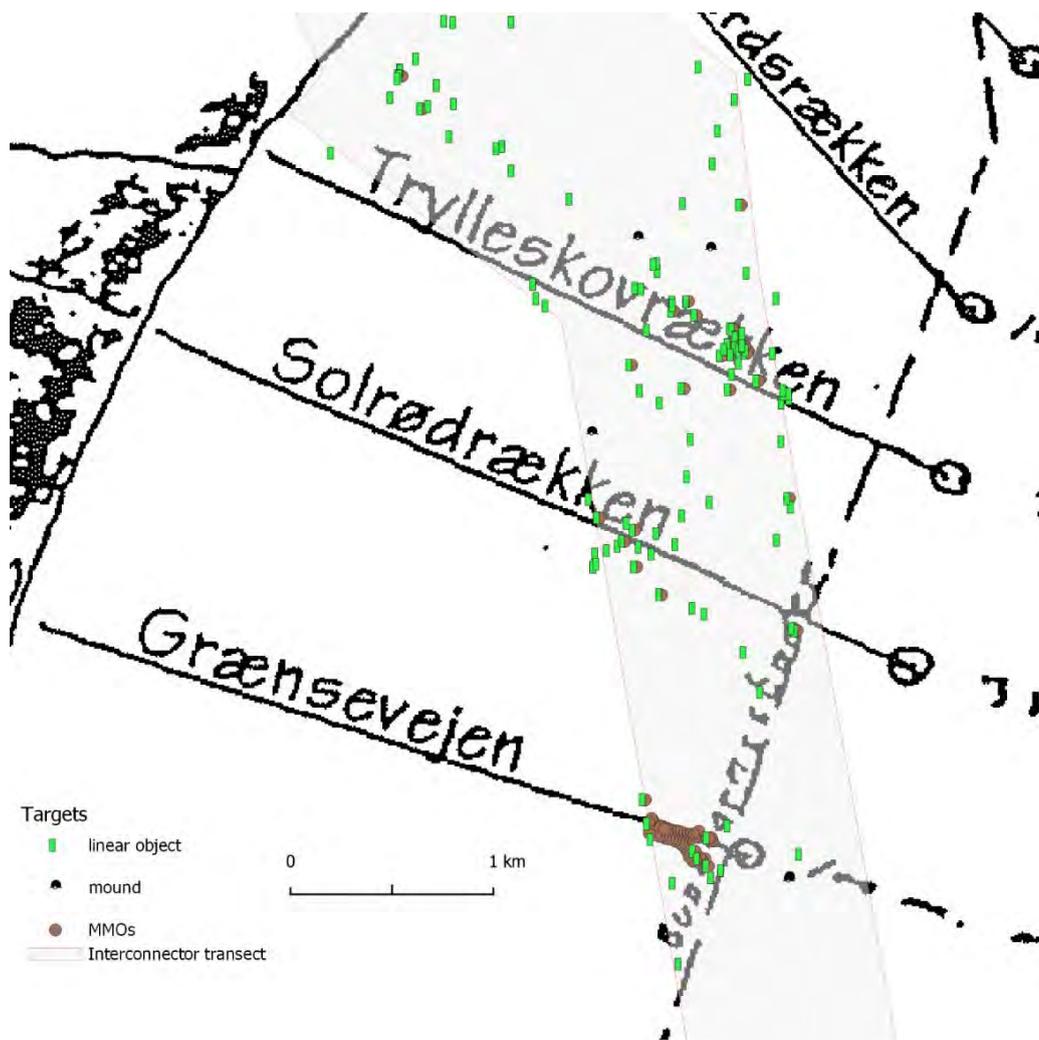
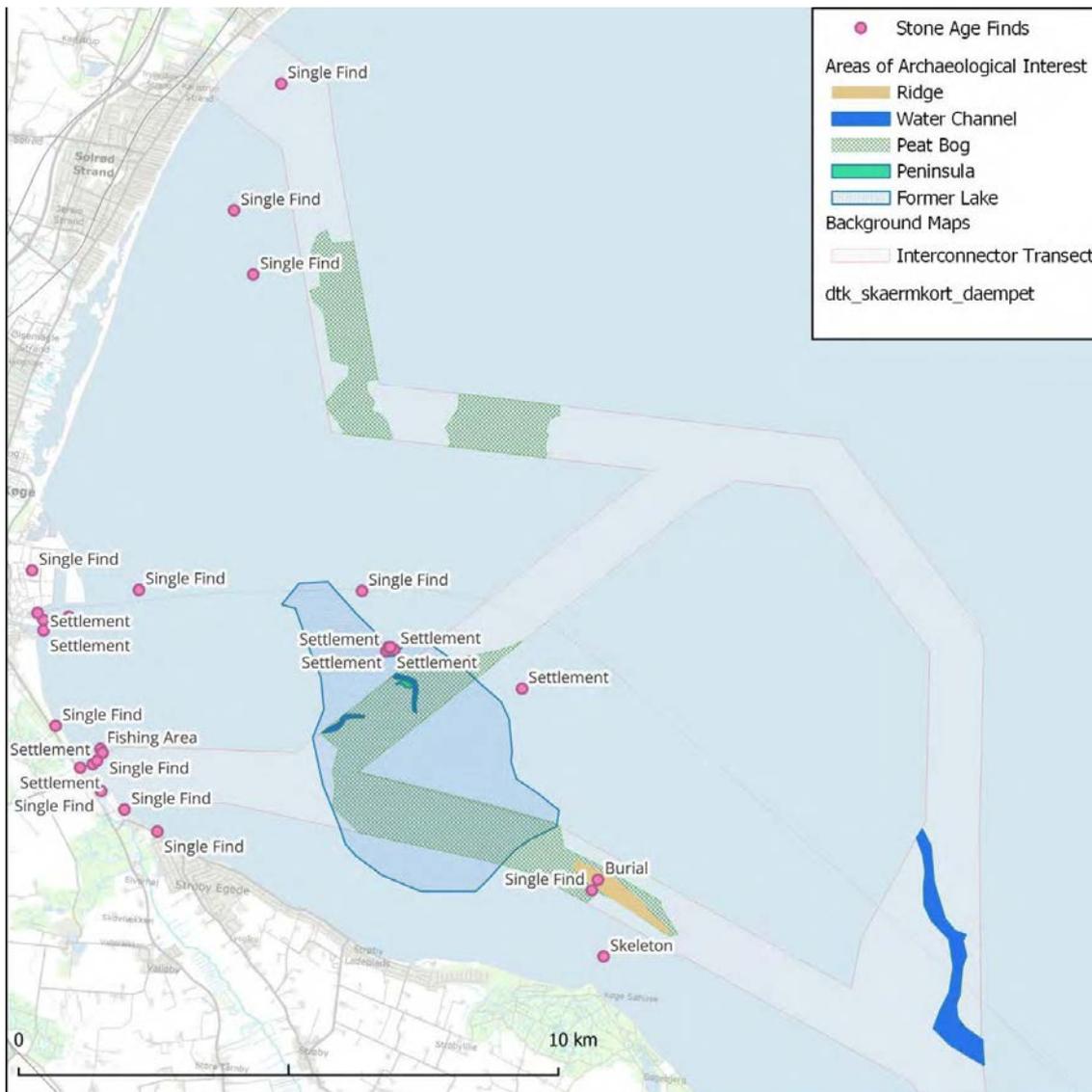


Figure 16. Close-up of pound net fishing rows which cross the Interconnector Transects with overlay of VIR targets. The number of objects around the head of Grænsevejen is particularly conclusive. There appears to be concentrations of linear objects at Trylleskovrækken and Solrødrækken too. Sketch map from *Bundgarnsfiskerne i Mosede*, (Sedal, 1997). Georeferenced by Marie Jonsson, Vikingskibsmuseet. Illustration John Howorth © Vikingskibsmuseet.

## Stone-Age Potential

Køge Bugt presents a difficult geoarchaeological case. On the one hand, the geophysical data display few and vague indications of settlement potential, on the other hand there is nevertheless a substantial record of previous finds – also of a nature suggesting not only good preservation conditions but also a high research potential. Large parts of the bay have been subjected to aggregate extraction for decades, but the very fact that an aggregate resource is still present and actively being exploited also means that potential finds-bearing layers can also be preserved. The dredging activity also directly influences the quality of the collection and interpretation of geophysical data. All in all, the combined evidence warrants particular diligence and a more than average careful approach towards potential Mesolithic remains in the area.



**Figure 17. Stone Age find sites in and around the Interconnector Transects. Prehistoric topography (*Areas of Archaeological Interest*) interpreted from SBP data provided by Ocean Infinity on behalf of Energinet. Graphics: John Howorth © Vikingskibsmuseet. Contains data from Styrelsen for Dataforsyning og Effektivisering.**

A geophysical survey was carried out by Ocean Infinity and the report (Oakley & Pickworth, 2023) was used to study the sub-bottom profiles and bathymetry to analyse potential sites of Mesolithic settlement.

Due to the fluctuating water levels throughout the post glacial period, the shorelines changed significantly. During a period of low-stand water level about 11700 years BP, the water was around 45 metres below present levels (Figure 23). The water depth then increased significantly over a relatively short period of time. According to a geological desk study of the cable routes, it is considered that evidence for archaeological sites from the early and mid-Mesolithic period are the most likely to be found in the Baltic Sea (Jensen & Bennike, 2021).

There is a total of six stone-age finds registered with *Fund og Fortidsminder* within the western portion of the Interconnector Transects and there are a further 22 in the near vicinity (Figure 17). The finds tend to be located in areas of shallow water either close to the shore or on underwater ridges.

The following text refers to the survey blocks for locations (see Figure 18 for location of survey blocks).

There are four main areas where these stone-age finds occur, these finds show the potential for preservation of stone-age material. A lack of previously found artefacts, however, does not indicate a lack of potential to discover possible further stone-age sites and artefacts in an area.

Two of these areas are at the points where the Interconnector Transects makes landfall to the north and south of Køge with most of the finds being within the southern area, close to Strøby.

A flint tool, FF 152381, and two settlements, FF 152477 and FF 224287, are located at the southern landfall area near Strøby. Just outside the area, mainly towards the north, there are further signs of settlement including worked flints and fish traps. These all occur at the mouths of two small rivers, Tryggevælde Å and Vedskølle Å. During the Mesolithic period, when the water levels were lower, the routes of these two rivers would have continued across the now submerged landscape.

To the north of Vedskølle Å there is a large cluster of prehistoric monuments sitting on a promontory overlooking the mouth of the river and the coastline illustrating the importance of this area in that period. It is possible that further evidence for stone-age settlement may be found submerged in the area close to the shoreline within block B3F.

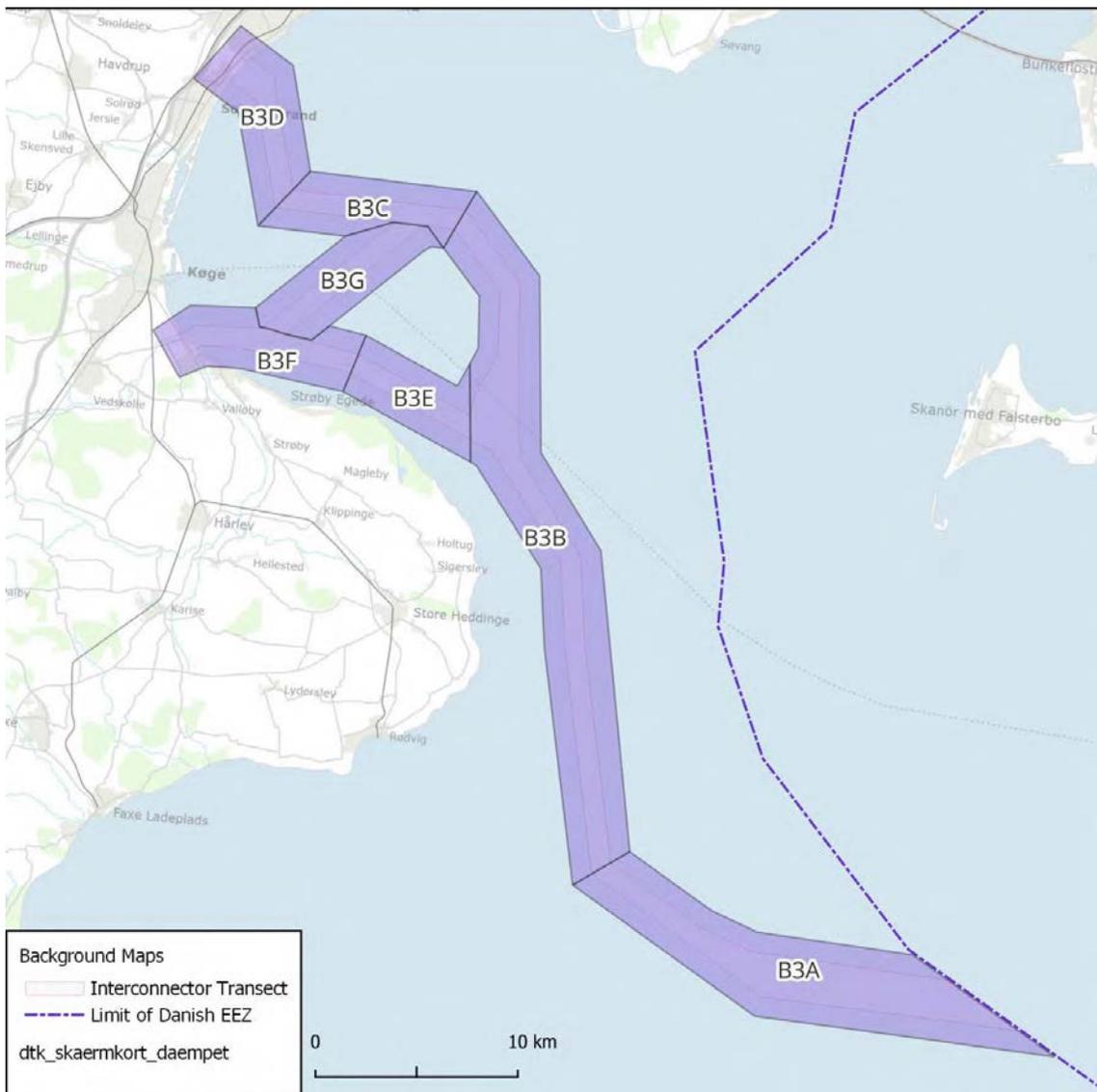
Close to the northern landfall at Karlstrup, an axe made from elk antler, FF 213806, was discovered during sand extraction in the 1950s. Further stone-age discoveries have been made in the vicinity during sand and gravel extraction in the first half of the 20<sup>th</sup> century. These finds consist of worked flints and diverse animal bones dating to the Mesolithic period. FF 137256 and FF 152444, are administrative points for these finds which had no exact location data but were found scattered around Køge Bay. The worked flint artefacts and animal bones were found within, or close to, a submerged peat bog off the coast of Solrød. The Sub Bottom Profiling (SBP) (Oakley & Pickworth, 2023) in this area shows that a large area of this peat bog still survives and runs for approximately 6 kilometres along the route between blocks B3C and B3D, at depths of 10.5 metres to 12.5 metres below sea level (Figure 18). The thickness of the peat is up to 0.8 metres in some areas. There is potential for Mesolithic finds within and around this peat bog.

Just under a kilometre to the north of the peat bog, there is a drop of up to a metre in the seabed. This sudden change in depth could be related to a submerged shoreline, the edge of a water channel, or disturbance from sand extraction.

The third area of stone-age finds is located towards the southern end of block B3G. Nothing has been previously identified within the Interconnector Transects itself, but worked flint from the Mesolithic period and rooted tree stumps have been discovered on either side of the route, located on peninsulas or headlands at the edge of a large submerged former lake or lagoon. The route of the Interconnector Transects runs through a slightly deeper area between the two main areas of finds but there are nonetheless parts of the submerged landscape that would have been above the water level during the Mesolithic period.

Two former water channels run into the submerged former lake from the north and west. There is a possible submerged peninsula on the south side of the northern channel which is potentially a spot where Mesolithic settlement could be found.

Over time, the lake and its channels have filled with clay/peat and sand/peat, creating a large deep peat bog. The submerged land surface to the northeast of this peat bog rises relatively sharply and it may be possible to find stone-age remains along this edge.



**Figure 18. Overview of survey blocks across the western portion of the Interconnector Transects. Graphics: John Howorth © Vikingskibsmuseet. Contains data from Styrelsen for Dataforsyning og Effektivisering.**

The former lake and later peat bog extend into the eastern part of block B3F and the northern part of B3E. The surviving clay/peat deposits continue south to meet the fourth area of previously registered stone-age finds, just to the north of Køge Sønakke and located fairly centrally within the Interconnector Transects. An underwater ridge is located in this area, possibly a former headland or island, and this is where the discovery of a human cranium, FF 215331, and a stone axe, FF 90907 were registered. Several more skeletal remains and worked flints, FF 90893, were found just over 1.3 kilometres to the south. All the artefacts were discovered during sand and gravel extraction in the 1940s and 50s and all are Mesolithic in date. The seabed in the area is uneven and appears to have been disturbed by aggregate extraction. However, the SBP shows that the area contains freshwater clay/peat, of which the ridge appears to be mainly formed. The ridge may have formed through the erosion of a larger previous deposit or it may be the result of nearby aggregate extraction, either through deposition of spoil or the removal of original deposits nearby or both.

There is a good possibility of finding further preserved Stone-Age artefacts in this area based on the terrain and the presence of peat.

**Table 2. List of known Stone-Age artefacts discovered within the western portion of the Interconnector Transects**

FF Number	Place name	Type
90907	Køge Bugt	Stone Axe
152381	Strøby egede	Some worked flint (although some found to be natural)
152477	Vedskølle å	Settlement
213806	Køge Bugt	Axe made from elk antler
215331	Køge Sønakke	Burial
224287	Vedskølle Åmunding Syd	Settlement

Towards the southern end of block B3B\_KS, is a submerged water channel which is approximately 200 metres wide and up to 2 metres deep. It is situated in an area between 16 metres and 18 metres below sea level. No previous stone-age finds have been recorded in this area but there may be potential for settlement along the edge of the channel.

During the geophysical screening and target inspections for the Baltic Pipe project, 46 rooted stumps were identified (Jonsson & H. Thomsen, 2022). These indicate *in situ* forests within the area. This discovery was made several kilometres from the route of the current project. However, it does indicate that there is potential to find similar features in some of the shallower waters in the Interconnector Transects. One linear object, SSS\_B3B\_KS\_0106, has been described as a possible tree trunk and lies at a depth of around 14 metres about midway along block B3B\_KS. Remains of rooted trees have previously been found in two places close to the Interconnect Transect. One was close to shore near the Strøby landfall, FF 224287, and the second was by one of the registered settlements to the east of B3G, FF 215330. Both were found in water less than 10 metres deep. This indicates a possibility of the discovery of further tree remains and submerged forest in the area, thus indirectly confirming the preservation potential for any settlement remains in the area.

In conclusion, there are several areas along the western portion of the Interconnector Transects which have good potential for finding Stone-Age human activity.

Probably the best potential for finding evidence of stone-age human activity is in and around the submerged peat bogs as they were a good source of readily available resources. Freshwater sand/peat and freshwater clay/peat detected in the SBP data are indications of this type of environment. These two types of sediment were found in the southern part of block B3D and the west of block B3C, which also correlate with previous discoveries of flint tools and animal bones from the Mesolithic Period. Artefacts are often discovered in the gravel and sand layers immediately below layers of peat. Evidence for peat bog was also detected in the SBP data towards the southern half of B3G, the eastern half of B3F, and the western half of B3E. This area largely represents the gradual infilling of a large former lake and transformation into peat bog. The peat layers in this area extend south-eastwards to an underwater ridge. High points in the terrain would have provided drier areas suitable for settlement. The finds of human skeletal evidence close to this ridge support this idea. It is difficult to know the full extent of quarrying activity in this area and its impact on the terrain.

The former lake which precedes the above peat bog also provides potential for the discovery of stone-age material. The main point of interest is a small peninsula at the edge of a deep water-channel which fed into the former lake towards its northern edge.

As the route heads south and east into deeper water, the terrain becomes less suitable for finding stone-age human activity. A submerged channel in the northern half of B3B provides some possibility for suitable settlement areas but the lack of organic sedimentation means the likelihood of finding anything is remote.

The deepest areas of the Interconnector Transects, the southern half of B3B and the whole of block B3A are very deep with a fairly featureless terrain. If rooted tree stumps are discovered in the ROV investigations of SSS objects, these may be indications of submerged forest which, although not direct evidence for human activity, provide evidence that there was an environment in which humans could survive.

## Interconnector Transects - East

A total of 344 targets were identified and geolocated within the eastern portion of the Interconnector Transects, including 3 wrecks, 1 anchor, and 29 mounds (Figure 19). All the information regarding the potential wrecks, anchors, and mounds can be found in Appendices 1a, 1b, and 1c respectively. An overview map of all targets identified in the SSS screening can be seen in Appendix 4.

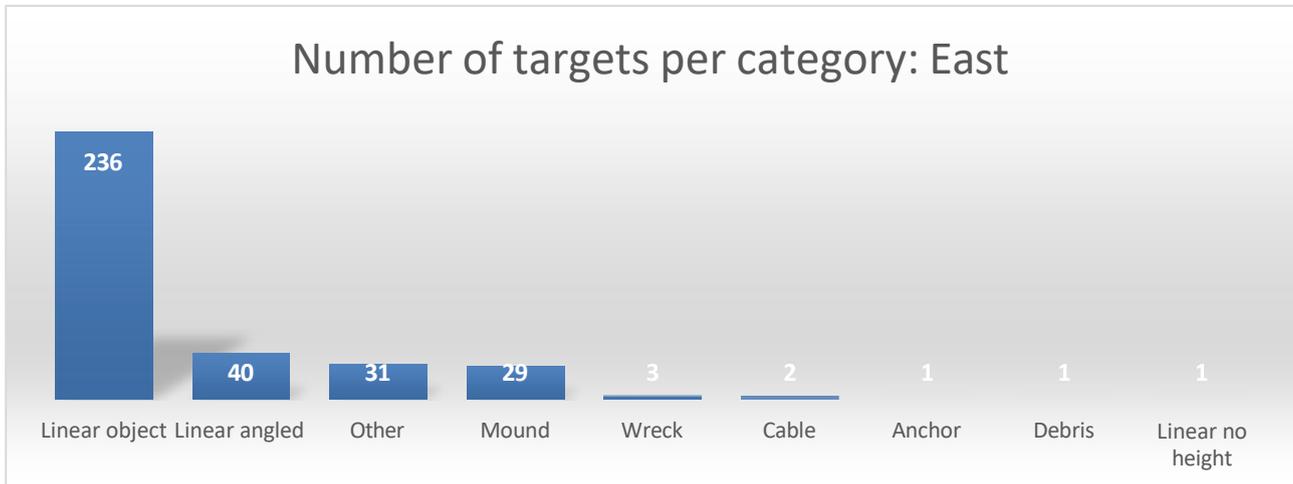


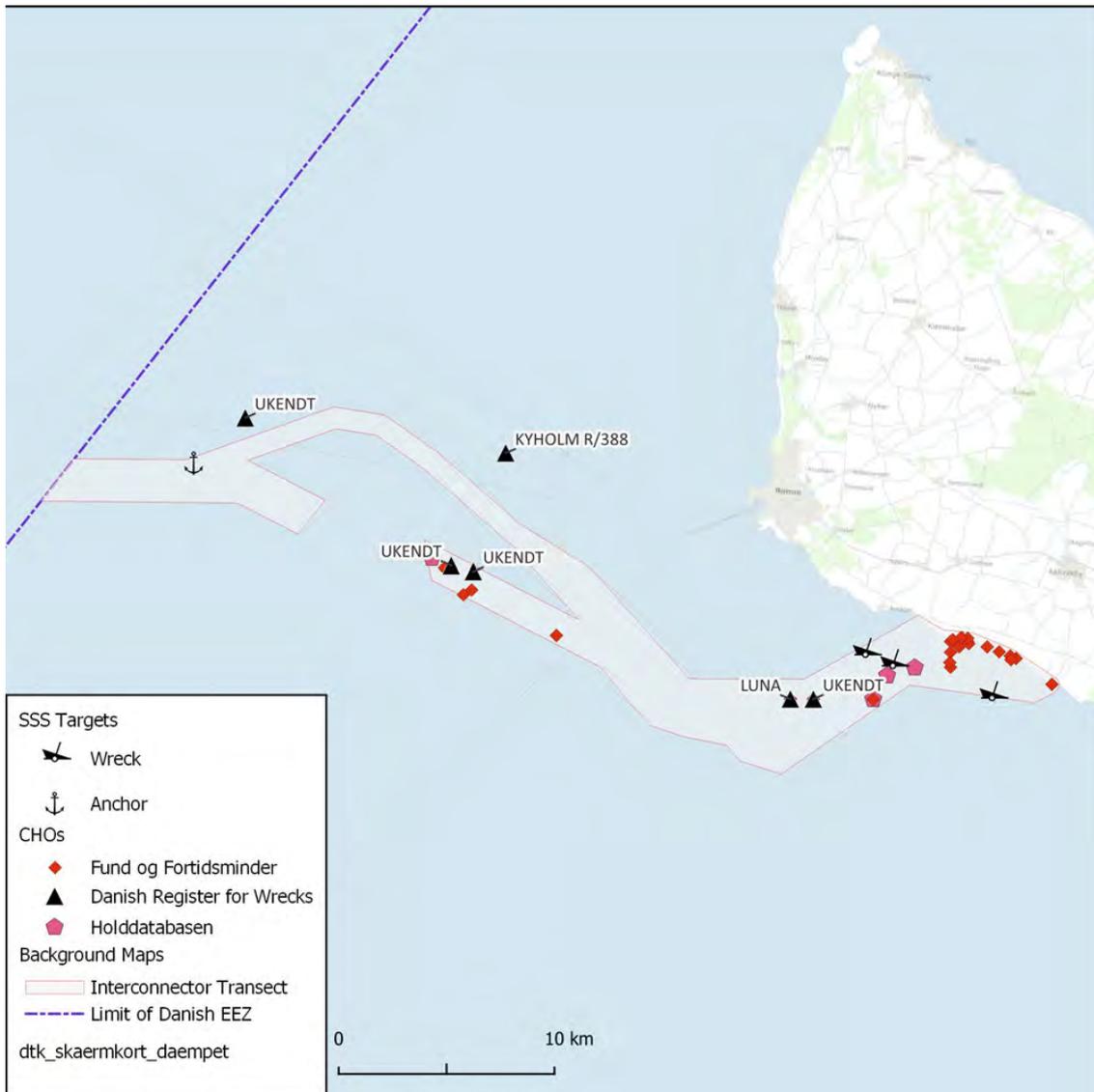
Figure 19. Target categories and number of occurrences, eastern portion.

## Wrecks

There are three targets labelled as potential wrecks in the SSS data; SSS\_B1A\_0046, SSS\_B1A\_0084, and SSS\_B1A\_0087. All of them are less than three kilometres from land but none of them are within 500 metres of any previously identified CHOs. Furthermore, one of the potential wrecks, SSS\_B1A\_0084, actually lies around 50 metres just outside the Interconnector Transects area, although, in the case that this target is identified as a significant wreck, future safety zones around the target may affect the Transect area.

SSS\_B1A\_0046, is however, surrounded by potentially related objects seen in the SSS data. A cable, SSS\_B1A\_0090, is situated about 30 metres away. A linear object, SSS\_B1A\_0047, is also possibly part of the wreck and there are two further linear objects situated approximately 150 metres to the north. A *mound*, SSS\_B1A\_0045, described in the survey data as an “odd mound with lines running along and across” and being “either natural, or frame elements from wreck” is situated about 165 metres to the northeast. Both the mound and the potential wreck could be part of the same object, or they may be two separate wrecks. A further four linear objects have been identified approximately 260 metres to the south which have been described as potential wreck parts, SSS\_B1A\_0100 to SSS\_B1A\_0103. These linear objects lie approximately halfway between the wreck and number 3979 in Holddatabasen.

SSS\_B1A\_0084 is described in the survey data as a good size for ballast mound with a few linear objects visible in SSS image, while SSS\_B1A\_0087 is described as a pile of linear objects, although the image looks like it could also be cracked rocks.



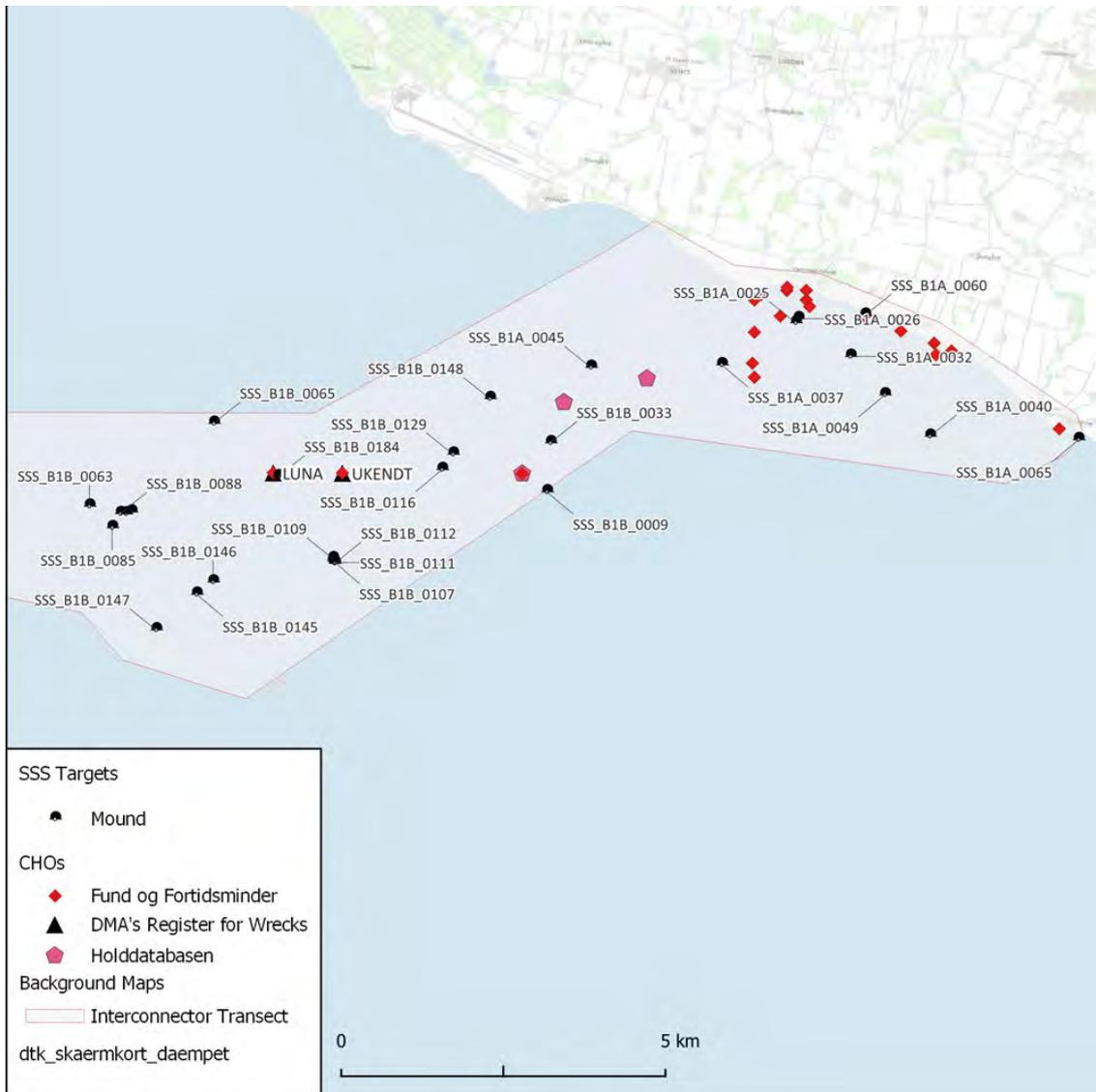
**Figure 20. Wrecks and anchor shown in relation to previously known CHOs. Illustration: John Howorth © Vikingskibsmuseet. Contains data from Styrelsen for Dataforsyning og Effektivisering.**

## Anchor

Only one possible anchor has been identified in the SSS data in the eastern portion of the Interconnector Transects, SSS\_B1E\_BH\_0014. The description of the object states that it appears to be debris and could possibly be an anchor. There are no previously known CHOs within the vicinity of this potential anchor. The only other target nearby, SSS\_B1E\_BH\_0008, is described as possible debris, fishing equipment or, alternatively, a rock. The anchor and this target may be related but there is nothing else to suggest that there may be a potential wreck in this area.

## Mounds

There is a total of 29 *mounds* and all are within 9 kilometres from the coast. The seabed in this area is very uneven and mainly made up of rock so it is possible that some of the mounds may be natural features.



**Figure 21. Mounds shown in relation to previously known CHOs. Illustration: John Howorth © Vikingskibsmuseet. Contains data from Styrelsen for Dataforsyning og Effektivisering.**

Very few of the mounds correlate closely with previously known CHOs.

One of the most promising mounds is SSS\_B1A\_0060. This is described as a faint mound, possible ballast discovered close to the Sose Bay foundering site. It correlates closely with FF 150225, a number of artefacts from the base of a wreck, found during fishing activities and possibly related to the mass wrecking of Swedish ships in 1678.

Two mounds also in Sose Bay, SSS\_B1A\_0025 and SSS\_B1A\_0026, are close to two wreck sites from the mass foundering of 1678, FF 150222 and FF 150223. Both mounds are described as flat and lie approximately 70 metres apart. The two mounds are equally distant from a potential prehistoric settlement site, FF 152669, that was discovered by divers in 2001. There are also two groups of linear objects, SSS\_B1A\_0015 and SSS\_B1A\_0016, which lie close to one another around 220 metres from the shore in the Sose Bay area within 400 metres of the two mounds. They are located less than 200 metres from FF 150224 and FF 197346, and only 250 metres from FF 150226, which are points from where a number of artefacts relating to the Sose Bay foundering were recovered. They lie 200 metres and 275 metres from FF 150222 and FF 150223 respectively. Two more *Fund og Fortidsminder* objects lie within 500 metres of these groups of linear objects, FF 150226 and FF 219713, which are also linked to the mass sinking in 1678. Two linear objects, SSS\_B1A\_0001 and SSS\_B1A\_0059, as well as a possible rope or cable, SSS\_B1A\_0082, lie just to the east of the two shipwreck sites, FF 150222 and FF 150223 (Figure 22).

Two targets, SSS\_B1A\_0057 and SSS\_B1A\_0058, are also within 500 metres of the two mounds. These are probably not directly related to the mounds themselves but they are close to two objects from the *Fund og Fortidsminder* register, FF 150224 and FF 197346, so they are significant for this area which is congested with finds from the Sose Bay foundering. SSS\_B1A\_0058 is a curving object which may be a rope or cable.

SSS\_B1A\_0037 is another mound within the Sose Bay area and lies within 500 metres from the site of where a ship, the *Blakgrund*, grounded in 1858, FF 151001. It also corresponds with a MAG anomaly. A nearby linear object, SSS\_B1A\_0012, has been described as a probable cable and could be related if this mound is a wreck. The mound is also just over 500 metres away from the site of a ship which sank in during the mass foundering and there is the possibility that this could be related.

There are a further four mounds in the Sose Bay area, SSS\_B1A\_0032, SSS\_B1A\_0040, SSS\_B1A\_0049, and SSS\_B1A\_0065. The latter is located just outside the Interconnector Transects area, approximately 120 metres from where a stone age artefact was recovered, FF 141402, and about 330 metres from the site of a medieval harbour, FF 151555.

The first two, SSS\_B1A\_0032 and SSS\_B1A\_0040, are possible ballast mounds and have very few other VIR targets nearby. SSS\_B1A\_0049 is located close to two targets that have been described as possible wrecks, SSS\_B1A\_0022 and SSS\_B1A\_0051.

Another exception is SSS\_B1B\_0184, which lies within 100 metres of a wreck registered as the *Luna* in the DMA's register for wrecks and in the *Fund og Fortidsminder* register as a fishing vessel lost in 1952.

The following five mounds are also located between 3 and 6 kilometres from the coast.

SSS\_B1B\_0009 is described as a potential ballast mound and is situated about 465 metres from FF 187033, a ship which sank in 1942. The ship also corresponds with record no. 11692 in *Holddatabasen*. Within 500 metres of this wreck site are four more VIR targets which could potentially be wreck debris: three linear objects with no description, SSS\_B1B\_0020, SSS\_B1B\_0034, and SSS\_B1B\_0038; and one categorised as "Other", SSS\_B1B\_0044, described as a relatively square possible buried object.

The last four of these five mounds, SSS\_B1B\_0033, SSS\_B1B\_0116, SSS\_B1B\_0129, and SSS\_B1B\_0148, are not close to any previously known CHOs, the closest targets are mainly linear objects. The significance of the linear objects in this area is difficult to assess as there is such a large number and many have no description.



## Sose Bay

There is a high number of finds/features registered with Fund og Fortidsminder within 1.5 kilometres of the coastline, in the Sose Bay area. Eighteen of these are found either in the water or on the shore. Of these eighteen, six are wrecks. Two of which are from the 19<sup>th</sup> century, FF 151001 and FF 154637; three are dated to the Sose Bay foundering in 1678, *Fund og Fortidsminder* entries FF 150222, FF 150223, and FF 150703; and one, FF 150699, has been given a date of 1800-1848 in the register but has been described as possibly originating from the Sose Bay foundering.

FF 219713, a device for measuring the calibre of canons was found close to FF 150699 which supports the earlier date. Within 100 metres of the wreck, there are two linear objects, SSS\_B1A\_0054 and SSS\_B1A\_0055, and a possible debris field, SSS\_B1A\_0099, which could also be wreck parts.

Seven of the FF points denote where single finds, or groups of finds, were discovered. Six of these are from the same time period as the Sose Bay foundering: FF 150221, FF 150224, FF 150225, FF 150226, FF 197346, and FF 219713 which has been discussed above. The seventh point, FF 214591, is an iron age quern-stone.

Within 500 metres of FF 150221 are SSS\_B1A\_0017 and SSS\_B1A\_0018, a “peanut shaped outline” and a linear object respectively. They are just over 100 metres apart and described as possible wreck parts.

There are a number of linear objects, SSS\_B1A\_0068 to SSS\_B1A\_0071, closely grouped together in a possible debris field about 100 metres from the shore within the Sose Bay and approximately 330 metres from the above-mentioned FF 150225. They are also approximately 260 metres from the iron age quern stone.

Two FF numbers refer to hearths/fireplaces, FF 378 and FF 141273, reportedly from the pre-medieval period that were discovered along the shoreline. One number refers to evidence of a settlement found approximately 500 metres off the modern coast, FF 152669.

There is an additional FF number located on land at Sose Odde which also could have significance for any work to be carried out in the Sose Bay area. FF 123190 is a report from 1876 which describes a large number of human bones being discovered along the beach in this area and links them to the Sose Bay foundering. Although none of the targets from the SSS data match the description of bones, it remains a possibility that human remains could be found.

The final FF number, FF 151555, relates to a medieval harbour located at the very north-eastern edge of the area.

SSS\_B1A\_0005 is described as a group of linear objects that could be wreck parts and is located just over 500 metres from Sose Odde so there is a possibility that this could be linked to the Sose Bay foundering.

The high concentration of registered finds from the Sose Bay foundering in this area, the prehistoric finds, the two 19<sup>th</sup> century wrecks, and the presence of a medieval harbour indicate that there is a heightened probability that objects identified in the SSS data are historically significant.

## Other Targets

Five linear objects, SSS\_B1B\_0176 and SSS\_B1B\_0178 to SSS\_B1B\_0181, are located about 400 metres from the site of a shipwreck, the identity of which is unknown. The latter is described as a possible rope or cable and it appears that there could be an anchor towards one end. The objects are

fairly closely grouped together and may represent parts of a wreck that have drifted from the original site.

SSS\_B1A\_0053 is described as a ship-shaped anomaly and lies about 75 metres off the shore approximately 1 kilometre to the northwest of Sose Odde. Although, there are no previous CHOs in the near vicinity and very few targets identified in the SSS data.

There are a number of linear objects located between 300 and 400 metres to the northwest of an unidentified wreck in the DMA's register for wrecks also registered as FF 186848. This is an unknown vessel which sank in 1942. SSS\_B1B\_0176 and SSS\_B1B\_0178 to SSS\_B1B\_0181 are linear objects in close proximity to one another and described as wreck parts, with SSS\_B1B\_0181 described as a possible rope.

Towards the southern part of the eastern portion of the Interconnector Transects, there is a potential debris field which includes linear objects, SSS\_B1B\_0119 to SSS\_B1B\_0123 and is close to a further three linear objects, SSS\_B1B\_0126 to SSS\_B1B\_0128. These linear objects could represent the remains of a wreck.

SSS\_B1A\_0091 is a cable found relatively close to number 3980 in Holdtabasen, no other targets of significance are nearby, but this could be an anchor cable/rope/chain from a vessel that may have sunk in the near vicinity.

## **Pound Net Fishing**

As was the case in Køge Bay, there may also be evidence for pound net fishing in Sose Bay, although not at the same level of intensity. Towards the southeast side of the Interconnector Transects, approximately 600 metres from the shore, there are two linear objects SSS\_B1A\_0028 and SSS\_B1A\_0029 which are joined by a polyline which is described as a row of objects with further linear objects to one side. There is a similar feature located at about 100 metres to the southeast.

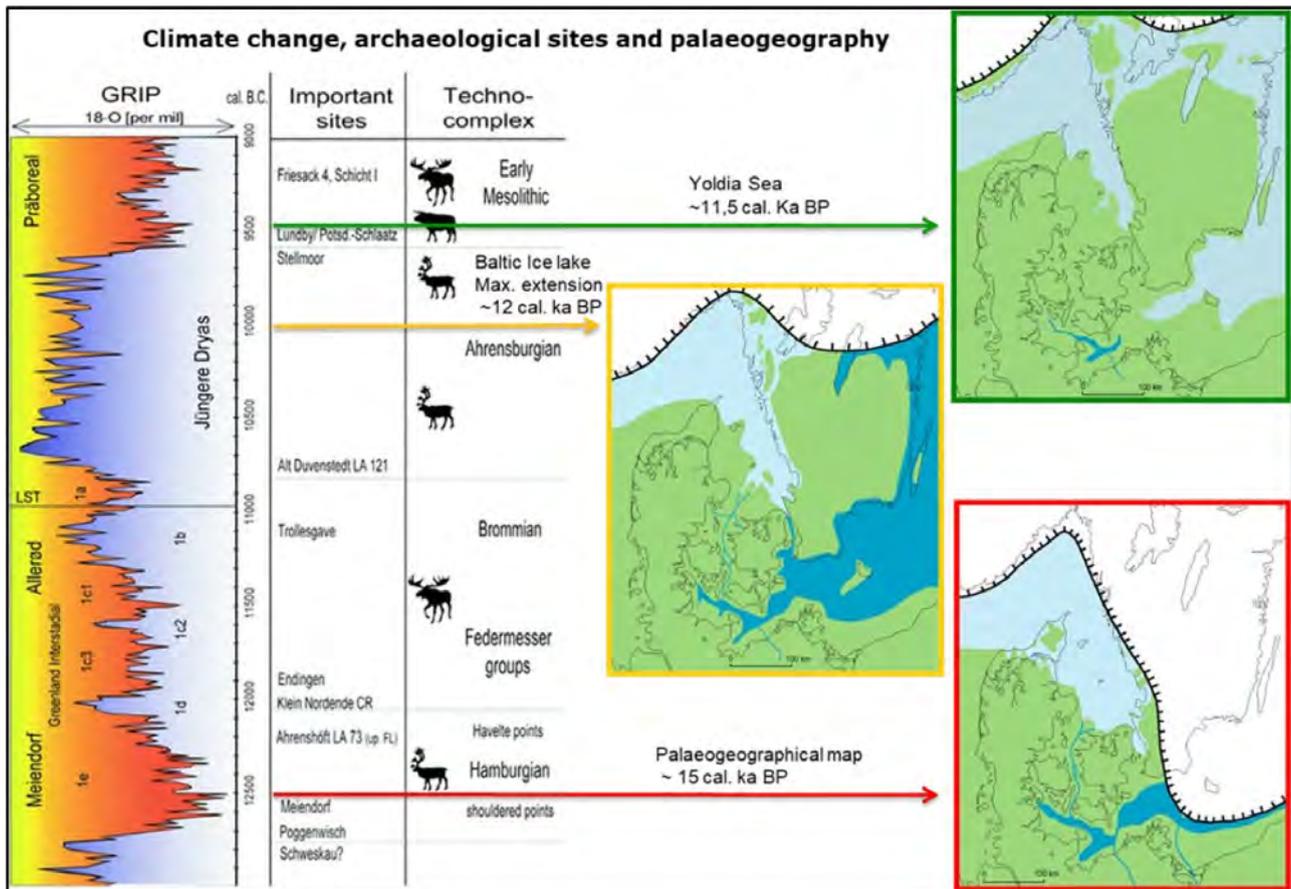
## **Stone-Age Potential**

A geophysical survey carried out by Ocean Infinity on behalf of Energinet (Oakley & Pickworth, 2023) was used to study the sub-bottom profiles and bathymetry to analyse potential sites of Mesolithic settlement. Previous discoveries, recorded in *Fund of Fortidsminder*, have also been used to analyse the potential of the preservation of stone-age finds. Due to the fluctuating water levels throughout the post glacial period, the shorelines have changed significantly. During a period of low-stand water level about 11700 years BP, the water was around 45 metres below present levels (Figure 23). The water depth then increased significantly over a relatively short period of time.

According to a geological desk study of the cable routes, it is considered that evidence for archaeological sites from the early and mid-Mesolithic period are the most likely to be found in the Baltic Sea (Jensen & Bennike, 2021).

There are three entries into the *Fund og Fortidsminder* register for potential stone-age CHOs within the eastern portion of the Interconnector Transects, all of which lack a secure date (Figure 24).

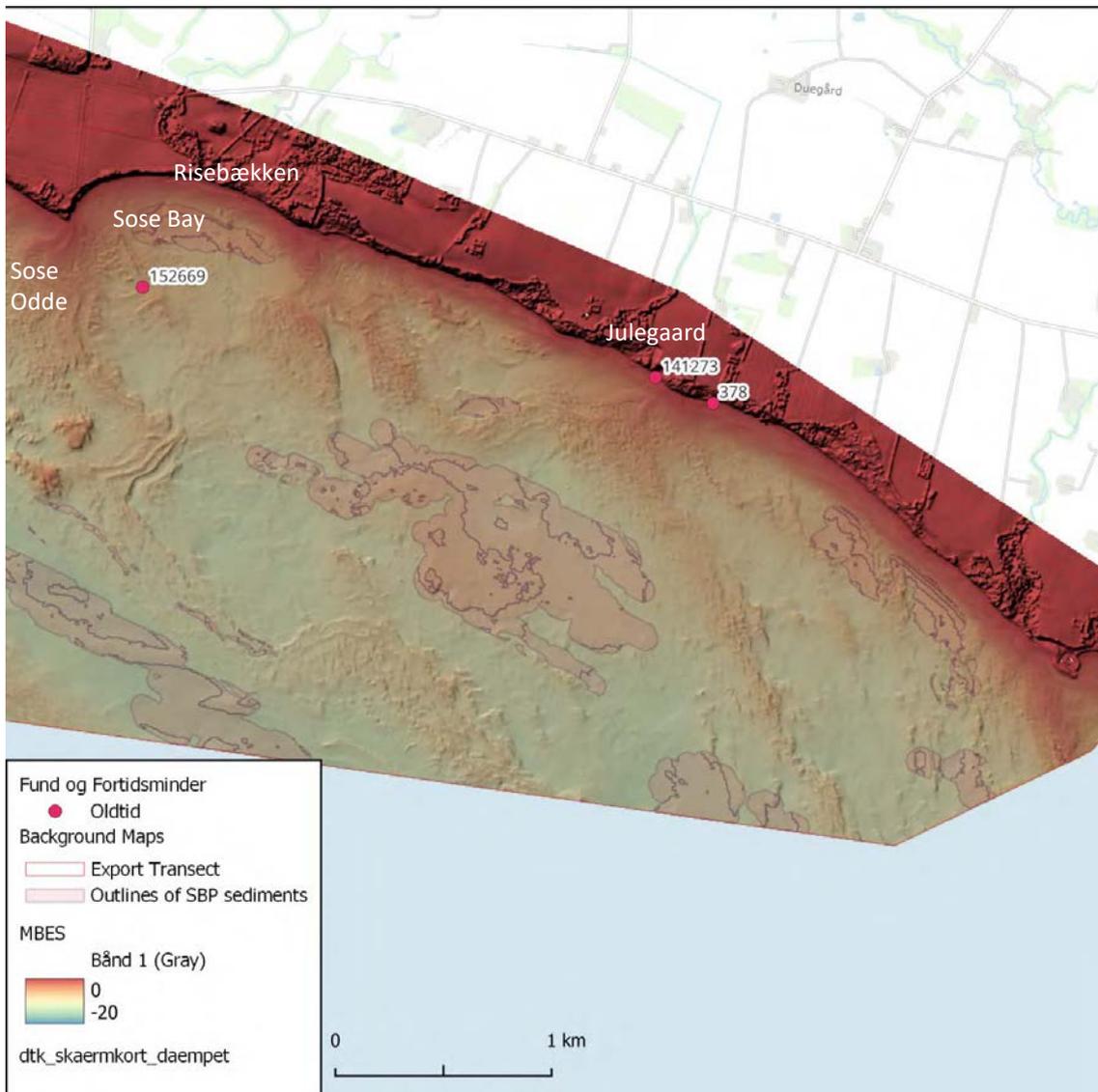
Two of these entries are clay-lined firepits with no further evidence of settlement, FF 378 and FF 141273, both were discovered eroded out of the coastal bluff. There is a possibility that there are similar, still buried, features along this stretch of coast and potentially more substantial settlement remains buried along the coastal bluff itself.



**Figure 23. Late glacial and Holocene general paleogeography in the Danish area and related archeological cultures. (Jensen & Bennike, 2021, s. 58)**

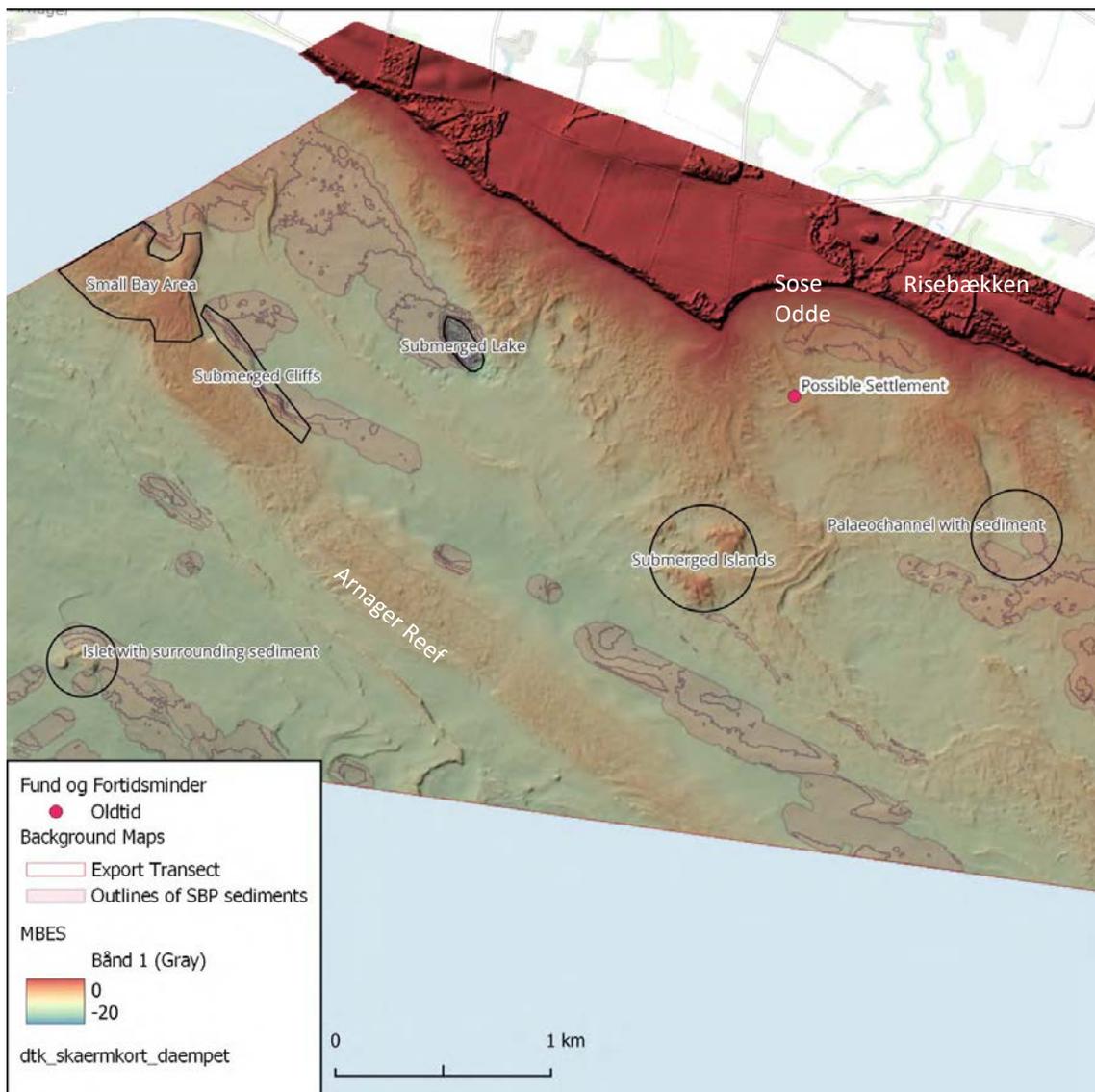
The third entry, FF 152669, is described as a possible stone-age settlement. It is located at about 500 metres from the shore at a depth of between 1.5 and 2 metres below sea level. There are reports of flint and burnt bones within a burnt area, possible fire pit or hearth, but no finds have been collected from the site. The possible settlement site is situated within a submerged delta where there are several palaeochannels leading from extant small streams on Bornholm to the east of Sose Odde. This type of terrain could have been suitable for settlement during the Mesolithic period.

However, according to the SBP data there is a lack of surviving sediment in this area which lessens the probability of finding archaeological remains. At the mouth of one of the small streams, just off the coast of Risebækken, there is an area of marine sand approximately 200 metres by 600 metres where archaeological evidence could survive (Figure 24). A similar area is found towards the southeast of the Interconnector Transects, close to Boderne Havn, at the mouth of a small river, Læså. The sediment in these areas could preserve archaeology on the seabed and could also contain objects washed down the streams from sites on the land, especially as the rivers and streams run past several prehistoric monuments.



**Figure 24. Location of CHOs mentioned in the Fund og Fortidsminder register placed over the MBES data and sediments identified from the SBP. Data provided by Ocean Infinity on behalf of Energinet (Oakley & Pickworth, 2023). Illustration: John Howorth © Vikingskibsmuseet. Contains data from Styrelsen for Dataforsyning og Effektivisering.**

There is a further area of marine sand lying across a submerged palaeochannel located at around 900 metres to the southwest of the coast at Julegaard (Figure 24). At some point during the Mesolithic period, this area would have been on the banks of a wide river and potentially a suitable area for settlement. The sediment could contain preserved settlement evidence such as worked flints, charcoal, butchered animal bones, or fish traps/weirs.



**Figure 25. The northwest portion of the Interconnector Transects showing various terrain features which have the potential for archaeological remains from the Mesolithic period. SBP and MBES data provided by Ocean Infinity on behalf of Energinet (Oakley & Pickworth, 2023). Illustration: John Howorth © Vikingeskibsmuseet. Contains data from Styrelsen for Dataforsyning og Effektivisering.**

Approximately 1 kilometre to the south of Sose Odde, there are two submerged islands. At their highest points, these lie at just 3 and 4 metres below sea level, compared with the surrounding terrain which lies at depths of around 10 metres. The two ‘islands’ are over 100 metres in width and length and may have been suitable for settlement during the Mesolithic period. Unfortunately, there is a lack of surviving sediment on the ‘islands’ themselves, however, there is marine sand lying to the south and southeast which has the potential to hold evidence for human habitation.

A farther 600 metres out from the 'islands', lies Arnager Reef, a submerged rocky peninsula which runs across the entire width of the cable route. Traditionally, this kind of terrain is well suited for prehistoric settlement, especially along the edge closest to the contemporary coastline. Again, there is a lack of sediment on the highest points but there are a few areas of marine sand in the deeper areas along its eastern edge. A particularly promising area is situated at the north-western extent where the submerged terrain forms a sheltered, almost harbour-like, area between two ridges (Figure 25). There is some marine sand in the deeper parts between the ridges where evidence for settlement could have been washed down from the 'high' points. Evidence for fish traps/weirs could also be present in/beneath this sand deposit. Just to the south of this potential 'harbour' area, there is a sharp drop between the reef and the lower terrain to the northeast. For a time during the Mesolithic period, these would have been 3-metre-high cliffs. Along the top and immediately below these submerged cliffs, there is marine sand up to a metre thick in some areas, potentially containing archaeology.

A final interesting feature close to the Bornholm coast is a deep hollow in the seabed. This is a potential submerged lake and is 250 metres long, 150 metres wide, and 6 metres deeper than the surrounding seabed at its deepest. The sediment to the west and northwest of this feature is 0.4 metres thick in some places and could preserve evidence of settlement or human activity on the shores of the lake.

Farther out from the coast, 3 kilometres from the present shoreline, lies a small submerged islet. Again, there is no SBP data for sedimentation on the top of this feature but there are areas of marine sand which could preserve archaeological layers surrounding the base of it.

The highlighted areas in Figure 25 are where there is a higher likelihood of discovering evidence for human activity in the Mesolithic period.

Farther along the cable route there is the possibility that tree remains, rooted and unrooted, will be found among the many *linear objects* that have been identified in the SSS data across the Rønne Banke, particularly where there is sedimentation. In the Baltic Pipe project, a large area of rooted tree stumps was found on the Rønne Banke at depths between 16 and 19 metres. Uprooted tree remains were identified in deeper waters, around 30 metres deep, to the west and southeast of Rønne Banke (Jonsson & H. Thomsen, 2022).

In conclusion, the submerged terrain in the shallower areas of the Interconnector Transects, close to Bornholm, is very promising in terms of finding human activity from the Mesolithic period. There is little to no sedimentation across large parts of this terrain but there are still several areas which may contain preserved stone-age material. The sediments within the potential submerged delta area, particularly those at the mouths of extant rivers and across the large palaeochannel, may be covering stone-age layers. The sediment layers immediately to the east of Arnager Reef, especially by the small sheltered 'bay' area at the northern end, also hold potential for preserving stone-age archaeology. Likewise, the sediments around the submerged lake are potentially covering evidence

for Mesolithic settlement. The small patches of sediment to the southeast of the submerged islands would also be an area of interest, as are those sediments immediately around the base of the small submerged islet around 3 kilometres from the present shore.

As the cable route moves farther away from the island of Bornholm, the submarine terrain becomes more featureless with thicker sedimentation and it is difficult to identify possible areas for Mesolithic settlement or activity. The deeper areas have also been under water for a longer period of time and were only dry land for a relatively short time (Jensen & Bennike, 2021). However, the previous Baltic Pipe project identified areas of submerged forest in some of these slightly deeper waters (Jonsson & H. Thomsen, 2022). Finding similar features within the Interconnector Transects could be seen as evidence for the possibility of preservation for settlement remains in the area.

The deepest parts of this cable route, the areas beyond the edge of Rønne Banke, hold the least potential for finding any preserved remains from the stone age as they were already underwater from the time humans began to settle the landscape.

## ***Future Work***

For the present route design (2022\_04\_14 MMT\_Updated\_Route), all the SSS targets from the separate survey blocks have been merged into a single GIS file:

*VIR\_SSS\_Interconnector\_transect*

The GIS file corresponds to Appendix 2 in this report.

In previous projects, it was common practice to create so-called first-generation exclusion zones around potential CHOs depending on the nature and size of the object. An assessment was then made on whether these zones intersected the future work areas. The targets with buffer zones which intersected the work areas were then more closely studied in the side scan and multibeam sonar and the buffer zone was reassessed based on the type, shape, and extent of object. However, more recent guidelines from the Danish Agency for Culture and Palaces urge against the use of these preliminary exclusion zones before visual inspection (Appendix 5).

All targets which are within, and in close proximity to, the proposed work areas should be visually inspected by ROV and the footage screened by archaeologists from VIR in order to further assess their significance. Targets which, through this process, are positively identified as CHOs, will be reported to the National Sites and Monuments register (*Fund og Fortidsminder*). A definitive exclusion zone can then be created around any protected archaeological objects.

The same goes for the potential stone age sites, initial potential sites have been highlighted, but in order to conclude any positively identified sites, further investigation is needed. Such investigations could include dive and/or machine test pit excavations.

If the client's work cannot be carried out due to an exclusion zone or altered to avoid it, special dispensation can be sought. This dispensation would typically state that a marine archaeological survey or excavation would need to be carried out on the site.

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Appendices available on request from The Viking Ship Museum

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