The Jortveit farm wetland: A Neolithic fishing site on the Skagerrak coast, Norway

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In 1931, several osseous and lithic artefacts, as well as fish and whalebones, were discovered in the wetland at the Jortveit farm in Southern Norway. In 2018-19, a small-scale excavation at the original find location took place and a series of AMS-dates were produced. The excavation identified a mud profile with exceptional preservation conditions. At ~125-130 cm depth, the mud contained unburnt fish and whale bones, burnt wooden sticks and lithic artefacts. AMS-dates of stray finds and samples retrieved during the excavation date to the period roughly between 3700-2500 cal BCE, i.e. Scandinavian Early and Middle Neolithic Periods. Nearly all bones belong to the Atlantic bluefin tuna (*Thunnus thynnus*), but there was found also cod (*Gadus morhua*) and orca (*Orcinus orca*). The results are compared to local climate and landscape reconstructions, and the question of marine adaptation in the Neolithic is discussed. We find that the Jortveit site represented a patch in the landscape for specialised marine adaptation in the Neolithic.

Keywords: Atlantic bluefin tuna; Orcinus orca; toggling harpoon; barbed harpoon; fishhook; excavation; wetland; Neolithic.

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Introduction

The question of economic adaptation in the Scandinavian Early and Middle Neolithic Periods (3900-2350 cal BCE) has been a subject of debate within Norwegian Neolithic research, and opinions have shifted due to changing empirical realities. With reference to the scarce evidence of farming and husbandry before the Late Neolithic/Early Bronze Age, doubt has been shared about there ever having been a 'Neolithic' Period in Norway (Prescott, 1996). Conversely, evidence of ritual behaviour has led others to argue that specific regions of Eastern Norway were fully integrated in the north group of the Funnel Beaker Culture (3900-2800 cal BCE), though evidently adapted to a new landscape previously inhabited by a hunter-fisher-gatherer population (Bakker, 1979; Glørstad and Solheim, 2015; Glørstad and Sundström, 2014; Østmo, 2007). Others again, have stressed the numerous and well-documented coastal and high-mountain hunter-fisher-gatherer settlements in Southern Norway where occupations often persisted throughout the Neolithic. These have been interpreted as indicative of an affluent – and primarily – forager economy in the Early and Middle Neolithic (Bergsvik, 2012; Solheim, 2012).

Based on excavations recently conducted at the Jortveit wetland site on the central Skagerrak Coast, this paper presents new insights on coastal adaptation in Southern Norway during the Early and Middle Neolithic. A small-scale excavation took place at Jortveit in 2018-19, and a selection of artefacts discovered in the early 20th century have now been AMS-dated. We find that in a period of the Neolithic, when farming was practiced in large parts of Scandinavia, a specialized marine adaptation emerged at Jortveit that was focused on the seasonal exploitation of Atlantic bluefin tuna (*Thunnus thynnus*). This practice was probably more widespread along the Skagerrak and the western Swedish coast than indicated by the Jortveit site alone. However, though fishing is the main activity currently documented at Jortveit, the finds also demonstrate contact with farming communities. We argue that it is conceivable, based on the tool inventory, that the introduction of farming in Scandinavia was a background, or maybe even a prerequisite for the type of coastal adaptation that took place at Jortveit and along the Skagerrak Coast.¨

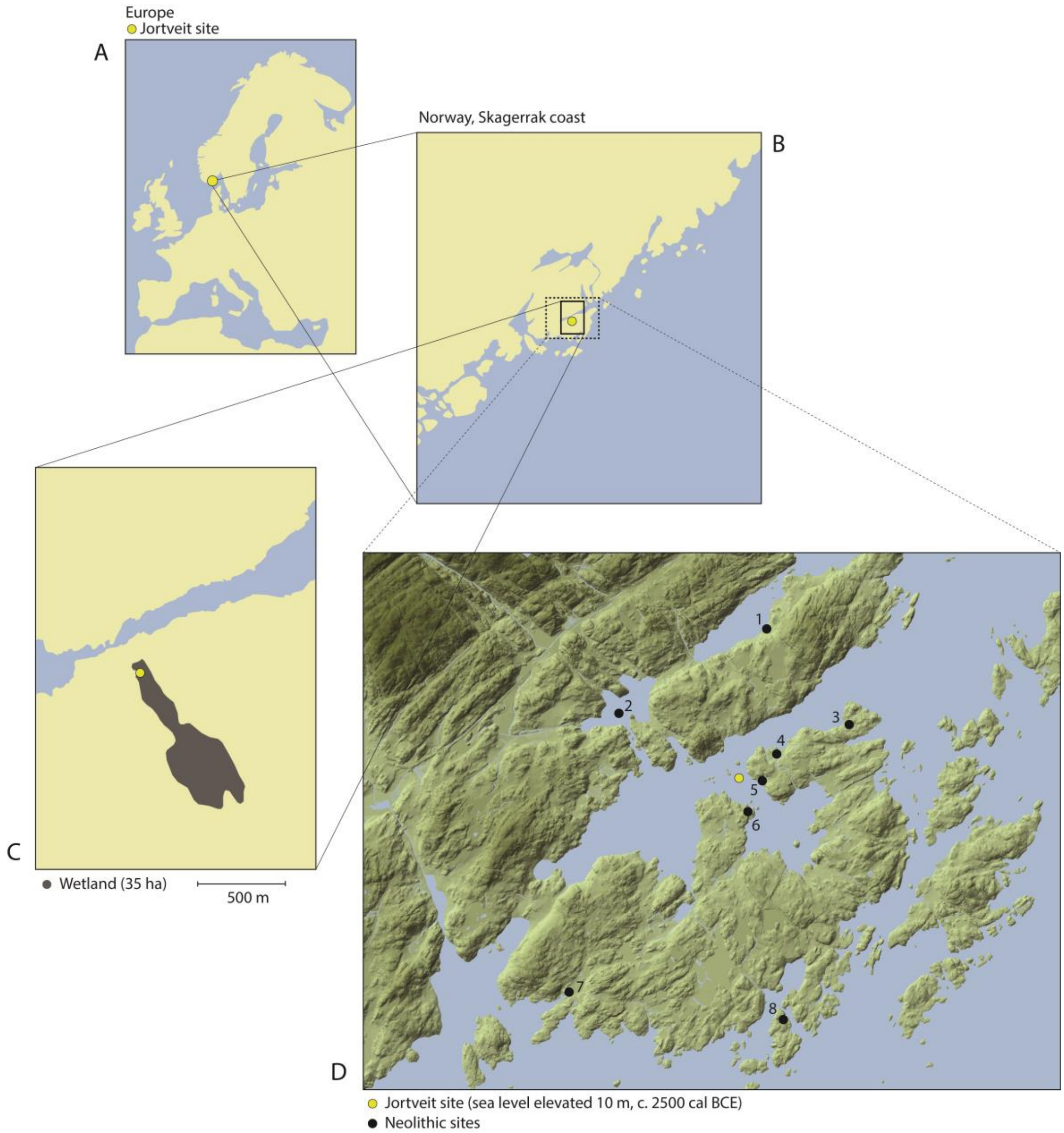

Figure 1. Location of the Jortveit wetland site and other Neolithic find spots at the Homborsund peninsula. Down right: 1: Vågsholt, 2: Amtedal, 3: Espevig, 4: Buhagen, Yellow dot: Jortveit wetland site, 5: Jortveit II, 6: Jortveit III, 7: Rørmoen, 8: Granly.

Background

Site history

At the Homborsund Peninsula on the central Skagerrak Coast in Southern Norway (58.27 °N, 8.5 °S), there is today a wetland area (35 ha) sheltered against the Skagerrak Sea on all sides except via a narrow sound in the northwest (Figure 1). In 1931, local farmers drained the wetland on the Jortveit farm and discovered osseous and lithic tools mixed with fish and whalebones inside stinking mud at ~170 cm depth (Bjørn, 1932) (Figure 2 and 3). Guided by scholars via mail, the archaeological artefacts were transported to the Museum of Cultural History in Oslo, and the zoological samples to the Museum of Natural History in Oslo. In the years that followed, more artefacts appeared coincidentally both in the ditches at Jortveit and on dry land at nearby farms (Figure 4). Though the Jortveit assemblage, particularly the osseous artefacts, achieved high status in Norwegian research due to its exceptional preservation (Bakka, 1973; Gaustad, 1961; Gjessing, 1945, 1941a, 1941b; Hagen, 1967; Magnus and Myhre, 1976; Østmo, 2008), investigations at Jortveit never continued. Thus, the true age and function of the site remained unexplored.

The bay formation at Jortveit

In order to understand the function of the Jortveit site today, it is necessary to take into account the sea level history of the area, as relative sea levels in Norway have changed drastically throughout the Holocene. The Skagerrak Coast is a c. 140 km straight coastline from the southern tip of Norway to the Oslo fjord in the northeast. It forms an archipelago dominated by skerries, deep, narrow sounds, and a generally hilly terrain with occasional wetlands, e.g. marshes, ponds and minor lakes. Together, these elements form a landscape referred to in Norwegian as 'skjaergaard' (Romundset, 2018, p. 465).

Surveys and excavations have identified hundreds of Mesolithic and Neolithic sites along the Skagerrak Coast (Nielsen et al., 2016, 2013; Reitan and Sundström, 2018). A vast majority of them were shore bound during occupations in the Stone Age, but they have since risen from the seashore due to post-glacial land uplift (isostacy) (Romundset, 2018, p. 475, Figure 3.2.12). Based on previous sea level studies in adjacent areas (e.g. Midtbø et al, 2000; Romundset, 2018), it is probable that the Jortveit wetland transformed from an open sea bottom and into a sheltered lagoon around ~3900/3800 cal BCE (Figure 1). It stayed a lagoon until sometime after ~500 cal BCE, when it turned brackish due to continued isostacy. The wetland eventually rose from the sea and changed into a fresh water marsh under which the prehistoric seabed was preserved.

Archaeological artefacts from 1931

Inside the prehistoric seabed at Jortveit, three bone points were discovered in 1931 (Figure 2). Two of them are of the toggling harpoon type (Figure 3), similar in shape and function to late historical iron harpoons ('skutel') used in tuna and basking shark (*Cetorinhus maximus*) fishing in Norway (Kalland, 2014). The toggling harpoons from

Jortveit also bear resemblance to socket harpoons known from Inuit material culture (Helmer, 1991; McCartney, 1984; Tuck, 1970), as well as harpoons discovered at Neolithic lake-dwellings in Central Europe (Torke 1993). Prehistoric parallels to the Jortveit toggling harpoons in Norway are from Skipshelleren (layer 3-4), a rock shelter site located in Vikafjorden in Straume on the western coast, where two toggling harpoons occurred in mixed cultural layers (Bøe, 1934, p. 60; Rosvold et al., 2013 with references).

The third bone point from Jortveit is a single row barbed harpoon, broken at the base. Similar harpoons occurred also at Skipshelleren and in the child burial at Bjønnhammaren, a rock shelter site located on the island Tustna on the northwestern coast (Haug, 2011). These barbed harpoons resemble Middle Neolithic harpoons found in Denmark, Southern Sweden and the Eastern Baltic, and date the period to ~3000-2450 cal BCE (Becker 1951; Iversen, 2010; Lõugas et al., 2007; Oldeberg, 1952 Abb. 266). The latter often have a perforated base, thus indicating how the harpoon from Jortveit might have looked like before it broke in prehistoric times (Andersen, 1972; Becker, 1951, pp. 160–161).

The fishhook from Jortveit also has contemporary parallels in Denmark and Sweden (Becker 1951), and it differs in shape from known Mesolithic fishhooks from Southern Norway (Bergsvik and David 2015). A characteristic trait on the Jortveit fishhook type is the oblique wrapping detail and their relatively large size. Similar hooks were found at Skipshelleren (Bøe, 1934) and the open-air site Slettabø (layer 2) on the southwestern coast (Skjølsvold, 1977). Radiocarbon dates from both sites confirm a Middle Neolithic Age (for a discussion of layer 2 at Slettabø, see Glørstad, 1996).

The lithic points of flint and slate (or shale) from Jortveit are typical for the Early and Middle Neolithic (3900-2350 cal BCE) in this region (Bergsvik, 2002; Nærøy, 1994; Nielsen et al., 2019). The flint arrowheads follow Becker's (1951) typology of Pitted Ware Culture projectiles from tanged points with direct retouch (i.e. types A and B) to heavily retouched trihedral points (type C). The single slate point is broken but shows parallel sides, rhombic cross section, and a facetted base, which is typical for the Middle Neolithic in Southern Norway (Bergsvik, 2002; Olsen 1992; but see Gjessing, 1942, pp. 163, 170).

Figure 2. Archaeological and zoological finds from the Jortveit wetland site. These finds were discovered 1.7 m deep in a drainage ditch in 1931 in the northern end of the wetland. Top row: Neolithic flint arrowheads of different types (Beckers' type A-C), and a fragment of a slate arrowhead (D). Middle row: Osseous fish hook (E), toggling harpoons (F), single row barbed harpoon (G), wooden torch (H), vertebrae from Atlantic bluefin tuna (Thunnus thynnys) (I), lower jaw from orca (Orcinus orca) (J).

Figure 3. Toggling harpoons found coincidentally by laymen at Jortveit. These artefacts were deposited and encapsulated inside the soft-bottom seabed between 3700 and 2500 cal BCE. The harpoon to the left dates directly to 3635-3369 cal BCE (Table 1).

Figure 4. Selection of lithic artefacts found coincidentally at farms surrounding the wetland area at Jortveit. Top row: fragment of polygonal stone battle-axe (Zápotocký Type KIII) and a knuckle shaped grinding stone from the Espevig farm (No. 3 in Figure 1). Bottom row: polished flint axe with hollowed edge from the Granly farm (No. 8 in Figure 1) and a trihedral flint projectile point presumably recovered from a wetland context at the Amtedal farm (No. 2 in Figure 1).

Zoological samples from 1931

The 1931 zoological samples from Jortveit belong to one Atlantic bluefin tuna and one killer whale, or orca (*Orcinus orca*). The six tuna vertebrae indicate an age of >13 y (Gunn et al., 2008; Lee et al., 1983), and size estimation is roughly ~150 kg and ~160 cm fork length, which classify the individual as a 'big tuna' in accordance to modern fishery standards (Hamre, 1957). Tuna bones also occurred at the Neolithic sites Skipshelleren in Norway (Olsen, 1976), and at Ånneröd (Alin, 1955), Gröninge (Särlvik, 1976), Sandhem (Jonsson, 2007), and Hakeröd (Jonsson, 2002) in Western Sweden, as well as at Stora Förvar on Gotland (Ericson, 1989; Knape and Ericson, 1983). Tuna bones are known to appear occasionally on Late Mesolithic (Ertebølle) coastal settlements in Southern Scandinavia, such as at Italiensvej in Eastern Denmark and Tågerup in Southwestern Sweden (Enghoff et al., 2007; Karsten and Knarrström 2003).

The orca from Jortveit is represented by a broken, lower left mandible. Age and size estimation based on single mandibles is problematic, but the preserved row of teeth (360 mm) itself indicate roughly 5-9 m length and a maximum weight of ~4000 kg (Clark et al., 2000; Heyning and Dahlheim, 1988). Striking points and cut marks indicate intentional breaking, perhaps for marrow extraction. Bones from orca were also documented at the Neolithic site Rörvik (Henrici, 1936; Kaelas, 1973) in Western Sweden, and again at Stora Förvar on Gotland (Ericson, 1989; Knape and Ericson, 1983). It could be mentioned that Clark (1947, p. 100) listed one orca vertebrae from Lindö on Langeland in Denmark, a site Becker (1951, p. 157-180) came to consider a typical Funnel Beaker Culture site. Bones from orca do not appear on Mesolithic sites in Norway, but a few depictions in rock art have been documented (Jaksland, 2005, p. 101, Fig. 17; Mikkelsen, 1977, p. 152). As was the case with tuna, bones from orca appear occasionally on Ertebølle sites, such as the skull fragment from Lystrup Enge (Aaris-Sørensen et al., 2010), the rib bone from Ertebølle (Clark 1947), and the tooth from Vængesø III (Andersen 2018, p. 186).

Results

The 2018-19 excavations at Jortveit

In 2018-19, six trenches dug along the northern drainage ditch at Jortveit showed shifting stratigraphy from north to south (Figure 5). In the northernmost trenches, a shell layer (*Mutilus edulis*, *Ostre edulis*) occurred below ~40 cm of modern cultivation (shell layer described in Bakke, 1933). At 80-100 cm depth, the shell layer changed from a domination of oysters into a variation of small and fragmented shell species, with a few rocks in the transition. In the southern trenches, i.e. trench 2 and 6, a layer of marine mud occurred below the modern cultivation and a subsequent ~50 cm thick layer of silty clay.

At the depth level ~125-130 cm, the mud in trench 2 and 6 was filled with unburnt fish bones and wooden sticks, some of which were burnt. We refer to this horizontally deposited horizon as 'the bone layer'. Inside the bone layer, wood samples (*Betula*) and primarily unburnt fish bones (*Thunnus thynnus*, *Gadus morhua*) were collected for age estimation. The presence of marine mud covered by silty clay in the soil profile indicate the presence of a soft-bottom lagoon before the area was isolated due to isostacy. When the osseous and lithic tools were deposited in this layer, the lagoon at Jortveit was ~11-9 m deep. However, as the research have shown that wetlands tend to compress after isolation and drainage (Coles, 1988), it is conceivable that the mud at Jortveit was even thicker and the lagoon shallower than suggested here. If the artefacts' height above sea level was measured correctly in 1931, which we have no reason to dispute, then the wetlands have subsequently sunken at least ~40 cm.

AMS-dates

Four samples collected in 1931 and seven samples retrieved in-situ from the 'bone layer' in 2018-19 were AMS-dated (Table 1, Figure 6). The quantity of preserved collagen in bones falls during degradation (Hedges et al., 1995). As collagen content is an important variable in sample extraction from osseous artefacts for ^{14}C-dating, we measured collagent content in the 1931 artefacts from very small samples before extracting samples large enough for ^{14}C-dating. This was done in order to ensure that a proper amount of collagen was extracted for dating. We used fourier-transform infrared spectroscopy (FTIR) (Perkin Elmer Spectrum 400 FT-IR/FT-NIR Spectrometer) to measure the collagen content of each sample three times before calculating a mean value. Relatively low amounts of collagen were found (Table 1). The toggling harpoon had mean content of 11.1 % and the barbed harpoon 12.2 %, while the tuna and orca contained even lesser amounts, 6.9 % and 8.5 % respectively. The variations observed here could be due to different storage facilities of archaeological versus zoological finds after 1931.

The dated wood and charcoal samples were retrieved from the 'bone layer' at ~125-130 cm depth (~135-130 cm above 2019 sea level) in profile 2 and 6. A piece of wood from of the torch (Figure 2 H) found in 1931 was also dated. Raw BP ages were calibrated in OxCal (v4.3.2) using the IntCal 13 atmospheric curve (Bronk Ramsey, 2017; Reimer et al., 2013). In Figure 6, the orca and tuna ages were calibrated with an Atlantic marine reservoir effect (MRE) (380±30 y) taken into account (Mangerud et al., 2006). Alternatively, as tunas probably migrated from the Mediterranean (see below), the tuna BP ages could be calibrated with a Mediterranean MRE (390±85 y) (Siani et al., 2000), but the calibrated ages are in every case very similar.

To summarize, the AMS-dates indicate a continuous activity in and around the lagoon at Jortveit between roughly 3700 and 2500 cal BCE. Unfortunately, the youngest dates (LuS-13502, LuS-13895) hit a plateau in the calibration curve, resulting in a large range of possible dates. Thus, it is conceivable, considering our prior knowledge of the site, that activity ended around 2800 cal BCE, but we nonetheless suggest a conservative estimate of 2500 cal BCE.

Local climate reconstruction

The mid-4th millennium BCE (Figure 7) marks the end of the Holocene Climatic Optimum (HCO), which involved a drop of temperature in Northern Europe, and thus the start of the Subboreal Period (3700-450 cal BCE) (Seppä et al., 2009; Velle et al., 2005). In Southern Norway, this transition is visible in a reactivation of glacier formation (e.g. Jostedalsbreen) and a lowering of the tree limit around 3300-3100 cal BCE (Eide et al., 2006; Karlén and Kuylenstierna, 1996; Mayewski et al., 2004; Nesje and Kvamme, 1991). Effects on temperatures were regionally specific in Scandinavia, and estimated mean July temperatures from lake basins close to Jortveit (Figure 8, B and C) do not show strong deviations in this period (Eide et al., 2006; Nesje et al., 2005; Seppä et al., 2009). However, in Eastern Norway and Western Sweden, the vegetation history show a decline of linden (*Tilia*) followed by elm (*Ulmus*) in the period 3900-3500 cal BCE (Henningsmoen and Høeg, 1985; Wieckowska-lüth et al., 2017). Temperature reconstruction from Lake Trehörningen and a humification index from Kortlandamossen in Western Sweden also show a trending temperature drop in this period (Antonsson and Seppä, 2007; Borgmark, 2005; Seppä et al., 2009).

Estimations of mean sea surface temperatures (SST) also mirror the end of the climatic optimum. In the period 4000-3500 cal BCE, a drop in SST is recorded for the Norwegian Sea (Calvo et al., 2002). Sediment analyses on Northern Jutland have identified a ‘high-energy environment’ and a strengthening of the Jutland current in the period 4300-3500 cal BCE (Conradsen and Heier-Nielsen, 1995; Gyllencreutz, 2005;

Jiang et al., 1998; Leth, 1996). This impact on sea currents also changed the morphology of the coastal strip of Northern Jutland and eventually formed the Skagen spit-system around 3500 cal BCE (Johannessen and Nielsen, 2006; Petersen, 1991). SST in the Central Skagerrak Sea did not change markedly, while the northeastern part of Skagerrak experienced a drastic ~5-6 °C drop in the period 4300-3400 cal BCE (Butruille et al., 2017; Krossa et al., 2017). According to Krossa et al. (2017, p. 1595), this drop in temperature probably documents 'the onset of a longer-lasting disconnection between the SST evolution in the Northeast and West-Central Skagerrak'. Changes in sea currents are also documented in the Southwestern Baltic sea through increased surface water salinity and inflow of saline water in the period 4000-3000 cal BCE, indicating 'enhanced primary productivity' (Bincewska et al., 2018, p. 307, for an alternative interpretation see Warden et al. 2017).

These climatic trends correlate with long-term changes in the archaeological record. In Western Norway, an increased utilization of marine mammals on coastal hunter-fisher-gatherer sites occur after 3500 cal BCE, which also marks the transition from the Early to the Middle Neolithic in that region (Hufthammer, 1997). Demographic frequency studies have identified a loss of signal of cultural carbon in the period 3400-3100 cal BCE in both Southern Norway and Southern Sweden, and the rise of hunter-fisher-gatherer societies, e.g. the Pitted Ware Culture (Hinz et al. 2012; Nielsen et al. 2019). In Eastern Norway, ~3500 cal BCE correlates with a shift in settlement locations from inland towards the coast and marine resources (Nielsen et al. 2019). Large areas of Denmark were cultivated by 3700 cal BCE (Warden et al. 2017), but a boom in radiocarbon dates from stationary fish weirs occur at ~3500 cal BCE on the Danish islands (Fischer, 2007). In the Baltic Sea Region, this boom coincides with an increased exploitation of marine mammals, particularly the low Arctic harp seal (*Phoca groenlandica*) by members of the Pitted Ware Culture (Fornander et al., 2008; Storå, 2002; Storå and Ericson, 2004).

Thus, although local mean July temperatures and local SST (Central Skagerrak Sea) seem to have been stable when fishing activity took place at Jortveit, environmental changes have been documented in neighboring regions of Scandinavia. Of particular relevance to Jortveit is the increase of the Jutland current and evidence pertaining to high primary productivity in the Southeastern Baltic Sea. On this background, it is conceivable that coastal dwellers on the Skagerrak Coast were already accustomed to sea travels and exploitation of select marine species (Figure 8). These would evidently include large fish species such as bluefin tuna and toothed whales. Both tuna and orca subsist largely on herring and mackerel, and such species often occur together with tuna and orca on Neolithic settlements (e.g. discussion of StoraFörvar in Knape and Ericson, 1983).

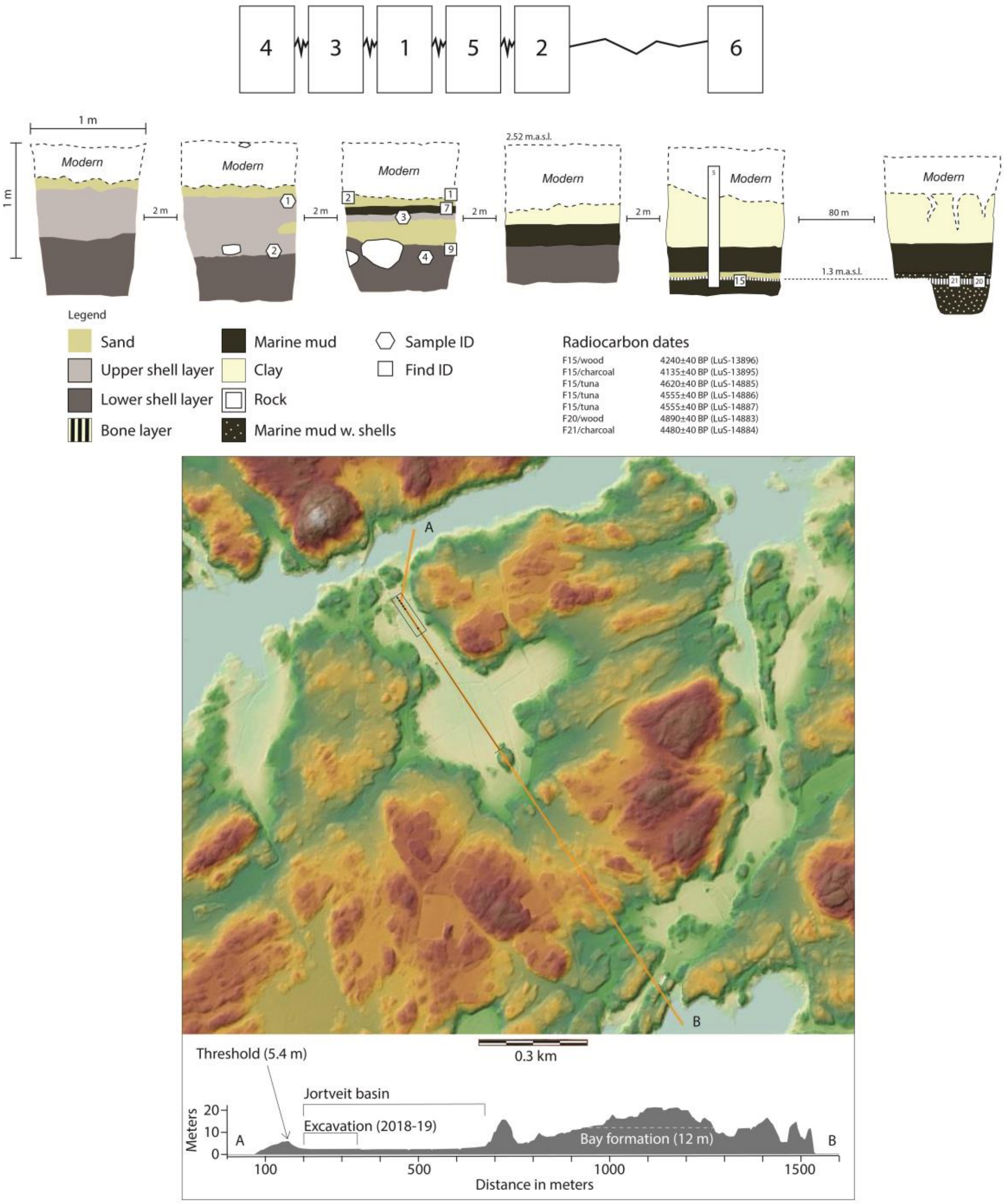

Figure 5. Soil profiles (above) at the Jortveit wetland site documented in 2018-19, and (below) topographic cross sectional model of the wetland and the surrounding area. (Map source: www.hoydedata.no).

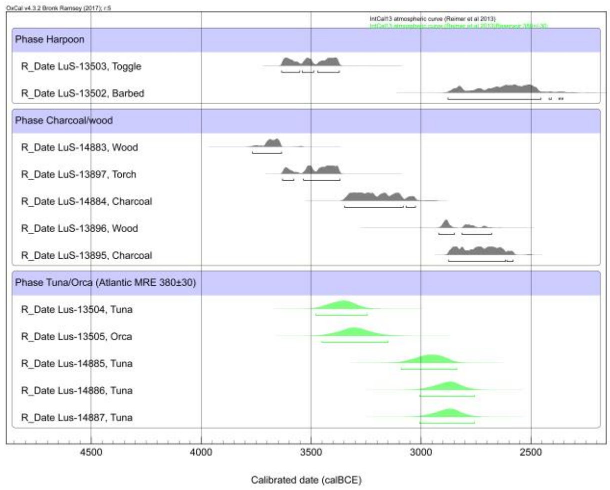

Figure 6. Plot with calibrated AMS-dates from Jortveit.

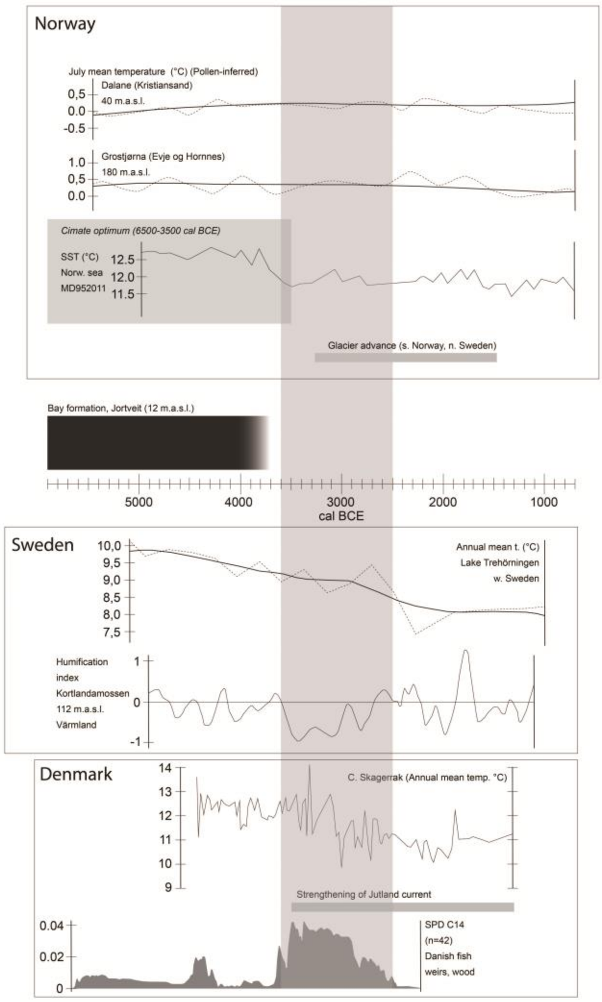

Figure 7. Local climate reconstruction based on climate records from Norway, Sweden and Denmark, and selected archaeological data. Sources given in the main text. Dark grey vertical column marks the temporal limits of the radiocarbon dates from Jortveit.

Discussion

Coastal adaptation in the Neolithic

The climate data paint a background picture of the Central Skagerrak Coast as a relatively stable environment in the mid-4th mill BCE, when evidence of tuna fishing and whaling appear in the archaeological record at Jortveit. The reconstructed cultural landscape surrounding the site indicate the presence of a hunter-fisher-gatherer community centered on a productive patch in the landscape. Though dated to the Early and Middle Neolithic, there is no direct evidence of a Neolithic economy at Jortveit, nor is there such evidence from any known contemporary coastal site in Southern Norway. Directly dated kernels (*Hordeum vulgare*, *Triticum dicoccum*) from the site Kvastad A2, located in the hinterland some kilometers northeast of Jortveit, show that crops were indeed grown in the region when the fishing at Jortveit took place (Reitan et al., 2018). It is probable that the dwellers on the Homborsund Peninsula were aware of such farming practices and perhaps even took part in it on a seasonal basis. The occurrence of a polygonal battle-axe close to Jortveit and the toggling harpoons found in the wetland do show contact with farming societies. As shown by Zápotocký (1992), the Scandinavian polygonal battle-axe types with a bent neck, such as the type KIII axe that occur close to Jortveit (Figure 4, top row left), originate in the Pfyn and Mondsee groups of the Early Funnel Beaker Culture. The few finds of the characteristic toggling harpoons known from Central Europe seem to indicate a similar diffusion route for these tools as well (Torke 1993). It is on this archaeological background we argue that the Neolithization of Southern Scandinavia, and the social networks it formed, was a prerequisite for the type of coastal adaptation emerging at Jortveit.

A dependency on marine resources in Scandinavia during the Neolithic has been a subject of debate (Fischer, 2007, 2002; Schulting 2015). Almgren (1906) first noticed the preserved seal bones at Neolithic settlements in Eastern Sweden, such as Åloppe in Uppland. Some decades later, Becker (1951) synthesized the many Neolithic coastal hunter-fisher-gatherer sites in Denmark, Sweden and Norway as a single phenomenon, namely the *Grubekeramisk kultur* (Pitted Ware Culture). Becker considered the two contemporary Neolithic groups, the Funnel Beaker Culture and the Pitted Ware Culture, as separate cultures and populations with unique historical trajectories. Based on δ13C-values from human skeletons, Tauber (1986) argued for a diet based on nearly 100 % agriculture products among Neolithic farmers, i.e. Funnel Beaker Culture, as a contrast to Mesolithic foragers with a diet heavily based on marine resources. This was challenged by Fischer (2007), with reference to Neolithic fish bones of fresh water species with δ13C-values equal to terrestrial food sources (-20.9 to -26.7 %). The question of marine orientation in Denmark then shifted from whether people ate fish at all, to which species were actually consumed.

In Western Sweden, Sjögren (2003) found a similar pattern as Tauber from stable isotopes in human and dog bones; a mixed diet in the Early Neolithic followed by a clear terrestrial diet in the Early Middle Neolithic, and then a clear marine diet in the Pitted Ware Culture. In Eastern Sweden, Lidén (1996) initially found continued exploitation of marine resources in the Neolithic regardless of cultural affiliation, i.e. Funnel Beaker Culture versus Pitted Ware Culture. However, the dependency of aquatic resources was highest in coastal regions, and conversely terrestrial sources were highest in inland contexts, a pattern subsequent studies have confirmed (Fornander et al., 2008). However, a connection between Funnel Beaker Culture and terrestrial food sources, and between Pitted Ware Culture and aquatic food sources, is also strengthened by recent studies (Eriksson et al., 2008).

Studies of Neolithic pottery groups, such as the well-known Fagervik sequence on the east coast of Sweden, have also found a continuous sequence from Early Funnel Beaker Culture pots to ‘typical’ Pitted Ware (Larsson, 2009). In Southern Norway, Hinsch (1955) argued that a population of farmers with origins in Southern Scandinavia settled in Eastern Norway in the Early Neolithic but that some centuries later, this society had collapsed and the population mixed with the local foragers (a process referred to as a de-Neolithisation)—the outcome of which was the Pitted Ware Culture. In a recent study, Nielsen et al. (2019) identified population fluctuations correlating with the de-Neolithisation period, but these were not connected with changes in economic strategies. With the exception of a few hinterland and possibly farming related sites in the eastern region of Norway, nearly all Neolithic occupation sites from this period are associated with the exploitation of wild resources.

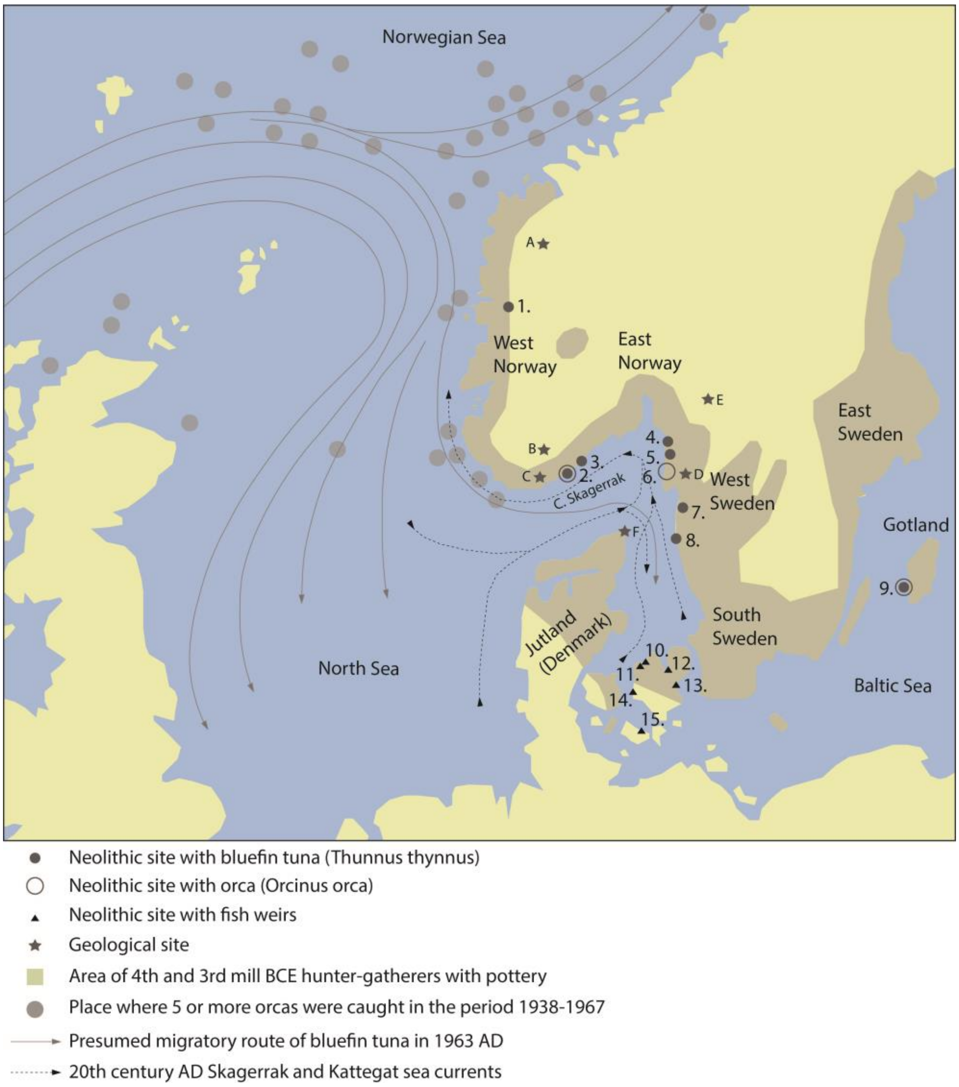

Figure 8. Location of Neolithic sites mentioned in the text with bones from bluefin tuna (dots), orca (circles), and with constructed fish weirs (triangle). 1: Skipshelleren, 2: Jortveit, 3: Alveberget, 4: Ånnerød, 5: Sandhem, 6: Rörvik, 7: Hakeröd, 8: Gröninge, 9: Stora Förvar, 10: Nekselø, 11: Smakkerup Huse, 12: Sankt Klaravej, 13: Ølby Lyng, 14: Oleslyst: 15; Oreby Rende. A: Jostedalsbreen, B: Grostjørna, C: Dalane, D: Lake Trehörningen, E: Kortlandamossen, F: Skagen. The presumed migratory route of bluefin tuna is drawn after Tiews (1963). Places where orcas were caught by Norwegians in the period 1938-1967 drawn after Jonsgård and Lyshoel (1969, Figure 1). Sea currents in the Skagerrak Sea drawn after Conradsen and Heier-Nielsen (1995, Figure 1).

Figure 9. Historical iron harpoon (‘skutel’) from Austefjord, southwest Norway. These harpoons were used for coast near tuna fishing and whaling in the 19th century. (Inventory no. AMU.0063, Austefjord Museum, Photo: Ragnar Albertsen, Austefjord Museum, with permission).

An archaeology of patches

From an anthropological viewpoint, a change in subsistence strategy from terrestrial to aquatic, or vice versa, would not have happened coincidentally in the past. This is mainly because adaptive strategies are presumed to be dependent on a range of cultural and natural factors (Erlandson and Rick, 2010; Kelly, 2013). Hunter-gatherer societies found to be heavily dependent on aquatic resources often dwell in geographically small but highly populated territories, as was probably the case at Jortveit and more generally along the Skagerrak Coast during the Neolithic. This state of population density is due to the low availability of terrestrial meat sources within the local ecological system. Low availability of terrestrial meat sources restricts how a society can depend on meat, since hunting in cold areas, in global terms, often require relatively large territories (Kelly, 2013, p. 46). Hence, the presence of a population adapted to a marine environment, such as at Jortveit, attest to low availability of terrestrial meat compared to the more easily available marine resources. It could therefore be hypothesized that such communities would have the technology and expertise to harvest enough marine resources to feed a relatively large population.

The 'skjaergaard' landscape formation along the Skagerrak Coast produces a patchy landscape enabling great ecological and thus cultural diversity (Price and Brown, 1985; Wiens, 1976; Winterhalder, 1980; Yesner, 1980). When discussing how societies with mixed farming and fishing economies would have found time devoted to foraging, hunting and fishing, Bulbeck (2013, p. 570) noted that communities 'differ from each other in their subsistence pursuits based on the resource patches to which they have access, and their skills in recognizing and harvesting the edible resources contained in those patches'. At Jortveit and in the surrounding area, the hunter-fisher-gatherers, perhaps acquainted with farming communities, discovered the potential gain in seasonal tuna fishing and whaling. The technology enabling fisheries focused on large fish species (i.e. toggling harpoons) was probably acquired through trading networks or intermarriage relations. When applied within the patch, this technology probably boosted the size of their returns. Following this line of thought, the Jortveit lagoon represented a microenvironment for specialized foraging, a form of 'cultivated landscape' (Terrell et al., 2003) where high return rates were accomplished during the right season. In other seasons, fractions of the community could seek different activities, such as hinterland hunting or even farming near the coast (Reitan et al., 2018, p. 557).

Fishing with toggling harpoons at Jortveit

Considering the evidence of foraging at Jortveit, it is perhaps not correct as some Norwegian historians have suggested (Kalland, 2014, p. 13), that the importance of whaling in prehistory decreased after the introduction of farming. The Jortveit site, in addition to a number of contemporary sites in Southern Norway and Sweden (Figure 8), supports the opposite view, namely that both tuna fishing and whaling represented good return rates for stationary communities in the Neolithic. The evidence of tuna fishing and whaling at Jortveit even implicates the presence of complex marine technologies (Erlandson et al., 2009), the exact shape of which we have yet to discover.

Even though it is tempting to interpret the 'bone layer' at Jortveit as representing waste from butchering and cleansing of fish, historical accounts do suggest a different scenario, namely that the tuna bones (or some of them) could be a direct result of failed catches. In the mid-20th century AD, the feeding migration of tuna from the Mediterranean started after spawning in April, May and June, and they appeared on the Norwegian Coast from July to October (Tiews, 1963). Though the ethnography of tuna fishing in Northern Europe is limited – the first accounts of tuna (norw: *størje*) fishing with toggling harpoons in Norway date to 1762 (reviewed in Lindquist, 1994) – an account from the southwestern coast of Norway is informative. According to Steinsnes (1956, p. 72), 19th century herring fishers caught tuna regularly with 'skutel' when tuna shoals surrounded the herring (Figure 9). On these occasions, a majority of the tuna eagerly caught the herring while swimming in high speed, while some of them drifted calmly around the shoals, presumably to regain strength. Staying oblivious towards the boats, these 'drifters' were pierced with toggling harpoons, which were attached to lines. Having been pierced, the tuna usually swam towards the bottom of the sea in order to scour the harpoon off (or so the anglers believed), and catches were often lost in this way. Thus, it is conceivable that the bone layer at Jortveit represent remains from such failed catches. The occurrence of fishing equipment inside the seabed supports this interpretation.

It is also interesting to note that even though the use of toggling harpoons for tuna and basking shark fishing in Norway appear in historical sources from the mid-18th century AD, the earliest historical accounts of toggling harpoons point to whaling as their primary use (Lindquist, 1994). As with the tuna fishery, whaling with toggling harpoons was also an opportunistic activity that took place when whales were observed near the coast by occasion. The literary sources describe near-coast whaling in the late 19th century as highly social events. Children often spotted the whales, and the catch itself attracted various members of the local communities, i.e. old and young, including dogs, the latter often creating 'messy' situations on land (Kalland, 2014). There is no reason to suspect a different scenario in prehistoric contexts, such as at Jortveit.

Conclusion

The recent investigations at Jortveit show that in the period of roughly 3700-2500 cal BCE, the site as we know it was located at the bottom of a ~9-11m deep and sheltered lagoon. The mud layer, in which tuna bones were documented in-situ by excavations in 2018-19, represent a former seabed. It is thus likely that all stray finds discovered in the wetland, starting in 1931, were once encapsulated inside this mud layer. It is also likely that the complete wetland area (35 ha) at Homborsund as of 2019, which includes the Jortveit farm, represent the true extension of this fossilised, soft-bottom mud layer. So far, all finds and samples from Jortveit date to the Early and Middle Neolithic Periods (3900-2350 cal BCE). The fauna material indicate that mostly Atlantic bluefin tuna, but also cod and orca were caught inside the lagoon. This was a period when the Skagerrak

Region of Norway was inhabited by a hunter-fisher-gatherer population, some of which knew of and practiced farming.

Nearly a century after its discovery, we can now interpret the Jortveit wetland site based on new stratigraphic and radiocarbon evidence. On a different note, it is unfortunate to admit that this narrative is not exclusive to Jortveit, as wetland sites in Southern Norway in general remain poorly investigated (however, see Bang-Andersen, 1947; Gjessing, 1920; Gulliksen et al., 1975; Persson, 2014; Saxlund, 1908, 1907). It will be a time consuming, yet truly great task for future archaeologists to re-explore the many known, but for various reasons neglected, wetland contexts in Southern Norway.

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Table 1. AMS-dates from the Jortveit site. (See online article.)