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A submerged Mesolithic lagoonal landscape in the Baltic Sea, south-eastern Sweden – Early Holocene environmental reconstruction and shore-level displacement based on a multiproxy approach

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ABSTRACT

Remains of a submerged landscape around the mouth of a small river are preserved off the Baltic Sea coast at Haväng in south-eastern Sweden. Organic-rich sediment ridges with abundant wood remains and archaeological artefacts extend 3 km from the modern coast to depths of at least 20 m below the present sea level. This exceptionally well-preserved material gives evidence of a lagoonal environment surrounded by a pine-dominated forest, which was inhabited by Mesolithic humans during two low-stand phases of the Baltic Basin, from the Yoldia Sea stage to the Initial Littorina Sea stage (c. 11,700–8000 cal BP). As part of ongoing efforts to reconstruct the local landscape development and to refine the shore-level displacement history during the Early Holocene, a 3-m sediment sequence was collected at 8 m b.s.l. and dated by radiocarbon analysis. A multi-proxy stratigraphic approach was applied to the sediment record, including pollen, diatom, organic and inorganic elemental analyses. This stratigraphic dataset is explored in the context of detailed bathymetry of the area based on multibeam echo sounding and surveillance and sampling of artefacts by divers. The investigated sediment sequence reflects a stable, highly productive lagoonal environment with an unusually high sediment accumulation rate at c. 9100–8600 cal BP. The uppermost 1-m part of the sequence represents a destabilized depositional environment interpreted as reflecting an increased influence of brackish water due to the approaching coastline during the Littorina transgression. The shore-level displacement in the area is characterized by rapid water-level fluctuations. Following a regression to around 22 m b.s.l. during the Yoldia Sea stage, the Ancylus transgression reached a maximum of 2 m b.s.l., followed by a second regression to a low-stand at 12 m b.s.l. during the Initial Littorina Sea stage. Several unprecedented archaeological findings made in the study area are presented and discussed, including stationary fishing constructions, dated to c.9100–8400 cal BP. These constructions, the oldest known in Northern Europe, indicate extensive riverine and lagoonal fishing, previously not recorded during the Mesolithic in Sweden. Furthermore, bones and antlers of red deer with slaughter marks and a unique pick axe made of elk antler provide evidence of human exploitation of terrestrial resources. The Haväng site shows the strong potential of submerged landscapes as palaeoecological source materials, and demonstrates the importance of resources at coastal settings near river mouths for Mesolithic communities.

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1. Introduction

The Baltic Basin has undergone a dynamic development since the deglaciation of its southernmost parts, which began at c.

16,000 cal BP (Houmark-Nielsen and Kjaer, 2003; Stroeven et al., 2015). This is reflected in the present landscapes around the Baltic Sea, and effects of the shore-level displacement can be seen off the coast of the Hanö Bay in south-eastern Sweden (Fig. 1), where a submerged forest landscape with remains of pine (*Pinus sylvestris*) trees, organic-rich deposits and archaeological artefacts can be found. Due to relative water level changes and tilted

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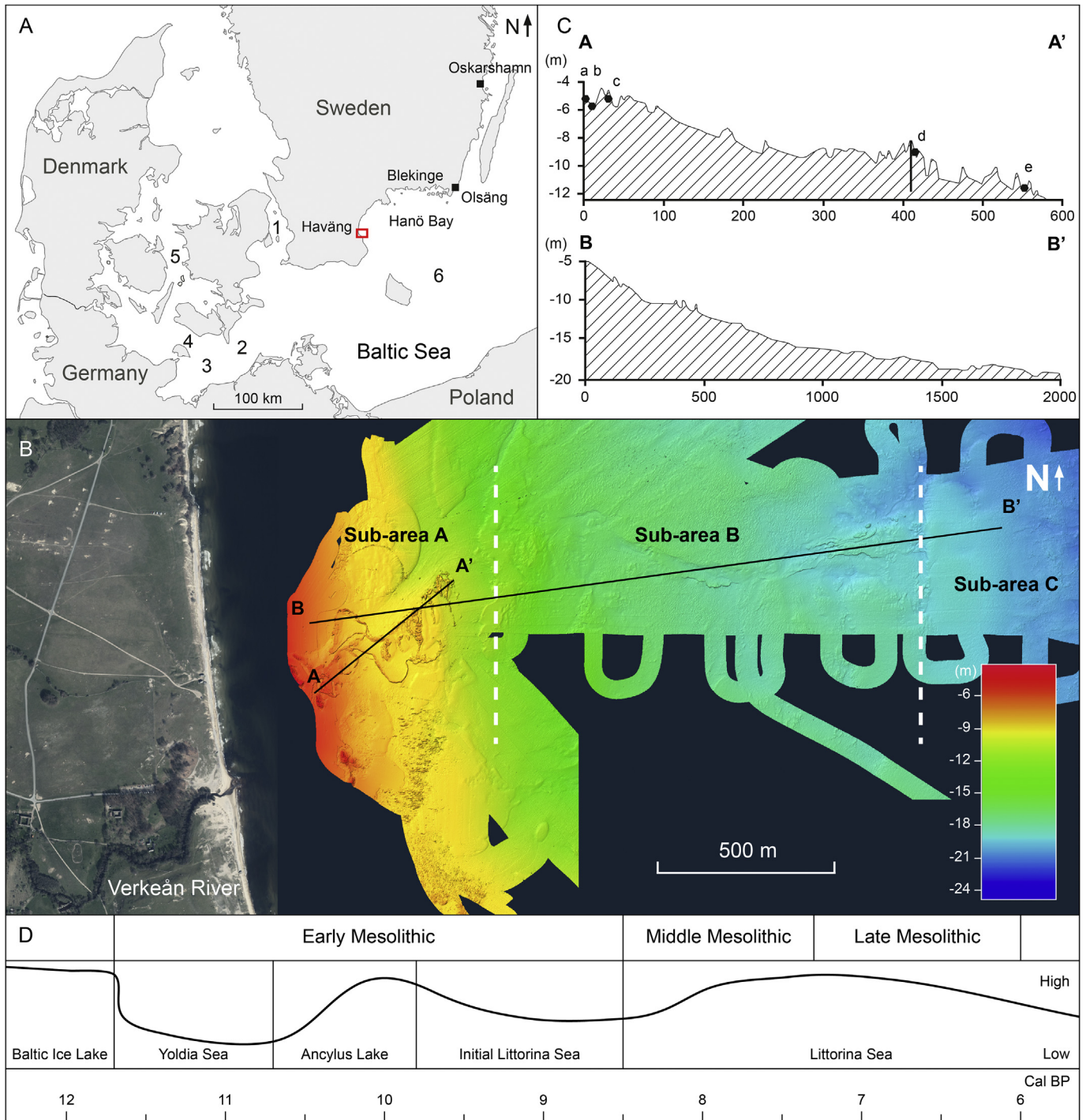


Fig. 1. Study area information. A. Map showing the position of the Haväng area (red rectangle), in south-eastern Sweden. Other localities discussed in the paper are indicated; 1 Öresund Strait, 2 Darss Sill, 3 Mecklenburg Bay, 4 Fehmarn Belt, 5 Great Belt and 6 Bornholm Basin. B. Aerial photograph and bathymetric map of the Haväng area. The submerged study area is divided into sub-areas A, B and C. The lower reaches and mouth of the present-day Verkeån River can be seen in the bottom left corner. C. Transect A–A' shows the depth profile of subarea A with artefact sites a–e indicated. The black vertical line represents the sampled sediment sequence. Transect B–B' shows the depth profile of the entire study area. D. Early Holocene chronology for southern Scandinavia showing the Baltic Sea and archaeological stages relative to the calibrated time scale. The black line indicates generalized water-level changes in the northern Hanö Bay area, based on Berglund and Björck (1994). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

shores since the last deglaciation many of the coastal Mesolithic sites in the southern Baltic are now submerged. This has led to an excellent state of preservation, which is rarely found at terrestrial archaeological sites (Fischer, 1995). The extent of submerged archaeological sites in Sweden is largely unknown, and to

date only approximately 60 Mesolithic sites are recorded (Holmlund et al., forthcoming). The Mesolithic in northern Europe starts at the onset of the Holocene, c. 11,700 cal BP, and lasts until the introduction of agriculture at c. 6000 cal BP (Zvelebil, 2008).

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