6 Submerged Stone Age coastal zones in Denmark: investigation strategies and results
by Ole Grøn and Jørgen Skaarup

Abstract
Excavation of submerged prehistoric sites by diving archaeologists shows that it is possible to obtain degrees of high resolution stratigraphic information comparable to excavation on dry land. Many sites have been eroded so that the remaining deposit has been disturbed and concentrated, but a few sites are completely intact. Examples are given of different sites, and the use of acoustics followed by diving excavation.

Introduction
Systematic excavation of submerged Stone Age sites was initiated in Denmark in 1976 by Langelands Museum. Since then systematic surveys for, and excavations of, such sites have been carried out by this and other Danish institutions (Skaarup 1983, forthcoming). A number of methods and strategies have been tested, and some experience — some rather costly and difficult to obtain — has been gained (Grøn 1990, 1996).

One of the first and most important findings is that the sea floor is not an unlimited paradise of Mesolithic and Neolithic landscapes with well-preserved settlement remains. Sounds and channels with currents that work their way down through the glacial clays alternate with areas where deep sedimentation makes it extremely difficult to locate and investigate the well-preserved landscape surfaces. Only in a few areas are these both preserved and easy to access so that investigation can be carried out under controlled circumstances.

A second finding is that we must accept — in spite of the significant technological advances that have been made in recent years with regard to survey methodology — that there are limitations to the areas where these innovations can be applied successfully. A reasonable response seems to be to focus investigation and preservation strategies in the areas allowing the use of the new technologies, and to develop a series of meaningful investigation and preservation strategies for the remaining areas. One should, however, take into account that pockets with good preservation can appear in the most unexpected situations.

To demonstrate the potential of marine archaeology, a Mesolithic dwelling and a boat burial (early Ertebølle culture) excavated by Langelands Museum in the period 1990–93 will be briefly presented later in this paper. To underline the importance of the development of an investigation and preservation strategy for locating and dealing with such finds, the next section outlines the strategic thinking as developed at the museum in the 80s and 90s.

Investigation, survey, and management strategies
Recognising the potential of the well-preserved submerged Mesolithic and Neolithic landscapes in the South Funen Archipelago, in 1972, Langelands Museum started a systematic registration and monitoring of submerged cultural heritage sites from the Mesolithic and Neolithic in collaboration with sports divers from the Funen area (Skaarup 1983). In 1983–43 submerged Stone Age settlements were registered in this area. In the total Funen area — the museum’s present area of marine archaeological responsibility — 126 Stone Age settlements have been registered to date (Skaarup, forthcoming).

The excavation of the submerged kitchen midden Møllegabet I (Skaarup forthcoming) started a development of excavation technology that in time led to an investigation approach close to that employed on dry land. The large areas with Stone Age tree stumps preserved and exposed on the seafloor made it natural to start thinking in terms of the reconstruction of prehistoric cultural landscapes. A survey of different parts of the South Funen Archipelago carried out by Jørgen Dencker and Ole Grøn in 1986 showed that the most promising area for a cultural landscape study comprised two apparently intact lake basins with a shoreline around −4.5m, submerged in the Sub-Boreal, and the zone around them.

Seismic profiling of the southern of the two basins (Fig 6.1) was carried out in collaboration with Professor Jens Tyge Møller, Aarhus University, in the period 1989–91. A series of borings were carried out, and one palynological profile was analysed by Else Kolsstrup to calibrate and interpret the seismic profiles. This effort revealed that the banks of the approximately 15 x 15km large basin consisted of a several-hundred-metre-wide and generally 2m-thick layer of peat and gyttja surrounding the 6–8m-deep central part of the basin. The erosion of the peat and gyttja layers
and the more recent sedimentation covering them seems minimal. There is some erosion and deposition of sandy sediments near the Ristinge barrier, but it appears that large and undisturbed areas with good conditions for preservation of organic matter are retained in the basin, which contains registered Mesolithic and Neolithic sites.

One problem identified is the difficulty of locating the sites that are not eroded — and therefore are especially valuable. The dual frequency ‘Sounding 30’ sediment echo-sounder owned by Aarhus University was not able to distinguish layers with the characteristics one would expect Mesolithic cultural layers to have. A second problem was that the Decca navigation we had access to with its ±25m tolerance was far too imprecise to register and relocate smaller features observed in the seismic profiles (Grøn 1990). Initial funding for the landscape project had been provided by Niels Højlund’s Culture Foundation. The project came to a halt because funding to follow up the initial results could not be obtained.

In the period 1993–96 Ole Grøn had (as part of the Danish National Museum’s Centre for Maritime Archaeology) the opportunity to develop a survey technique based on a 2–22kHz chirp from Datasonics and an Ashtech DGPS navigation system, which to a reasonable degree solved the two basic technical problems. The defined focus of the project was features younger than the Stone Age (Bronze Age, Iron Age, Viking Age, and medieval), but it was demonstrated that the partly excavated culture layer from the Kongemose site Blak in the Roskilde Fjord was clearly visible in the recordings (Fig 6.2) (Grøn et al. 1998).

Even though the technological basis for a systematic survey and monitoring of submerged prehistoric landscapes and sites is far from fully developed, a useful basis has been created.

**The excavation of a submerged Mesolithic dwelling and a boat grave**

In 1990–93 Langelands Museum excavated at Mallegabet II, a submerged Mesolithic dwelling and a boat grave outside Ejeskøbing in the South Funen Archipelago.

The remains of a skeleton of a young man lay in and around the remains of a dugout (the dugout dated to K5640:4900–4730 cal BC and the skeletal remains in it to K6040:5230–4960 cal BC). A number of poles apparently related to the feature may originally have supported it so that it was located above the water (Grøn and Skaarup 1993; Skaarup 1995; Skaarup forthcoming).

The dwelling (K6681: 5280–5140 cal BC and K6682: 5280–5080 cal BC) was located in a pit, approximately 5×3m large and 200mm deep,
with the lower parts of some wall stakes and two inner stakes preserved. A coherent layer of bark pieces covered the northern half of the dwelling—a feature that in section appears to be an earth-built platform. The floor and the platform were covered by twigs and bracken leaves, and the front of the platform seems to have been supported by cloven hazel branches (Figs 6.3 and 6.4).

The two inner stakes were located adjacent to the two areas interpreted as hearths just in front of the platform, and the door seems to have been in the western end, from where the sea could be observed.

The excavation of the site in 500 × 500mm squares and 50mm layers allowed a detailed reconstruction of the activity patterns in the dwelling. Below the platform there appear to be two working places where flint-knapping and repair of hunting weapons were carried out. Furthermore two proposed women’s seating places were distinguished on the platform (Grøn 1995a, 2003). A fifth area just inside the proposed entrance seemed atypical as a regular personal seating area, but may have been a position that was used by visitors or by inhabitants when they wanted to observe the nearby sea.

On the basis of studies of dwelling organisation in hunter-gatherer societies, on archaeological material and ethnoarchaeological studies in Siberia, the dwelling has been interpreted
Redeposited light, grey sand with many stones from 2 cm to larger rocks

Grey, sandy, greasy culture layer with a content of charcoal and many bark pieces of varying sizes (platform)

Dark, sandy, greasy culture layer with a high content of charcoal and branches (platform)

Grey, sandy, culture layer with a content of charcoal

Dark, sandy, greasy culture layer with a high content of charcoal

Water deposited sand

Not excavated

Branches

Bark layer

Layer of organic matter containing among other things a high fraction of leaves

Horizons with organic matter, charcoal and for the lower one a little worked flint - appears to be water deposited

Figure 6.4  N–S section through the dwelling pit showing the earth-built platform

Figure 6.5  Upper: the dwelling organisation found with the Evenki reindeer hunters in Siberia. Lower: the dwelling organisation suggested for the early Ertebolle dwelling excavated. Shade code: □ = females; △ = males; ◯ = bark-covered platform; □ = hearth

as a two-family dwelling (Fig 6.5) (Grøn 1989, 1995a, forthcoming; Grøn and Kuznetsov 2003).

Conclusion

This paper demonstrates that it is possible to develop methods for locating and monitoring submerged Stone Age sites and landscapes in areas with good preservation that facilitate the application of acoustic techniques. It also shows that the submerged cultural heritage can elucidate aspects of prehistoric life that are difficult to address on land. Therefore the development of systematic and coherent strategies for the management of this cultural resource is of extreme importance.
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Research priorities and collaboration with industry

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