

High-resolution underwater archaeological prospection and 3D documentation in Austrian lakes

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Introduction:

The underwater archaeological exploration of Upper Austrian lakes offers unique insights into prehistoric settlement structures and culturally and historically relevant finds under water. This paper presents current investigations, progress and methods in the prospection and documentation of underwater archaeological sites in lakes Mondsee and Attersee. The use of high-resolution sonar technologies such as multibeam echo sounding and sediment sonar measurements in combination with diving investigations for 3D underwater documentation using image-based modelling enables the detailed recording and analysis of historical and archaeological finds and sites. The necessity and urgency of detailed prospection and documentation to protect sensitive sites and objects is discussed in relation to the recently massively invasive quagga mussel. Interdisciplinary cooperation is essential for a comprehensive understanding of underwater archaeological sites, is emphasised.

Material:

The Upper Austrian lakes Attersee and Mondsee contain archaeological and historical relevant traces from past cultures, such as prehistoric pile dwelling remains, sunken boats, cars, aircraft parts, and intentionally disposed objects. With the goal to explore the last white spots on our maps, archaeological prospection and documentation of cultural heritage underwater is exemplarily tested in these lakes. High-resolution multibeam- and sediment sonar data are acquired and objects and sites inspected by research divers for detailed documentation. The work is conducted in close collaboration with the national management team for the UNESCO World Heritage Prehistoric Pile Dwellings around the Alps (PALAFITTES). Several objects of historical and archaeological relevance in Lake Attersee have been investigated, as well as the Station See in Lake Mondsee, home to the so called Mondsee Culture (Pohl 2016, Ruttkay et al. 2004).

Methodology:

Large-scale underwater archaeological prospection is conducted using modern sonar technology for the detailed mapping of the lake floors and shallow underwater environments.

Side-scan-, multibeam- and sediment-sonar systems are used (Wu et al. 2021). Side-scan measurements permit the recording of high-resolution images of the lake floor, and multibeam surveys can result in detailed bathymetric 3D models of lake floor, while sediment sonar mapping can be used to illuminate structures within the sediments. Objects on the lake floor and sites of interest are visited by scooter-propelled research divers and documented with the help of detailed underwater photogrammetry conducted in boustrophedonical survey pattern. Using image based modelling and large numbers of photographs, detailed 3D digital models of objects and sites are generated for archaeological and historical analysis, and to serve as baselines in the framework of future monitoring projects.

Results:

Detailed digital 3D models were generated for a wooden logboat dated to 1550 CE, several car wrecks, teleprinters, auxiliary aircraft tanks, and two prehistoric pile dwellings sites, i.e. the sites Sprungturmgrube in Attersee and Station See in Mondsee.

Discussion:

The massive increase of invasive quagga mussels over the past years is threatening future possibilities to detect and identify objects on the lake floor. It is highly likely that thick mussel infestations will damage weak prehistoric wooden remains, such as prehistoric piles or log boats, but as well more recent objects. In addition to the problems caused by quagga mussels, underwater excavations in connection with metal detection, construction projects and changes in water movements due to climatic changes (high tides, extremely low tides) also pose a threat to conservation and systematic recording. Difficulties in the photogrammetric documentation due to changing light conditions in shallow water can be overcome with artificial lighting. Due to visibility issues, shallow water surveys are restricted to the winter period. Navigation in murky waters across larger sites can be challenging. Georeferencing of finds and sites is best conducted using GNSS survey buoys or tilt-sensitive RTK-GNSS receivers in shallow water.

Conclusions:

There exists an urgent need for detailed exploration, prospection and documentation of archaeologically and historically important cultural heritage in Austrian lakes, while it is still possible. The proposed approach permit unprecedented imaging of, and insights into outstanding World Heritage sites under threat.

References:

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