UNDERWATER ARCHAEOLOGY

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Contents

Summary

The field of underwater archaeology, and its various aspects, has made many excellent contributions not only to our understanding of humanity's interaction with the sea and

the maritime environment, but also to our basic understanding of human prehistory and history. Anthropologically-oriented archaeology with shipwreck sites has also developed important interpretations. However, the potential of underwater archaeology to substantially augment our understanding of humanity and the past remains unfulfilled. There are several challenges that, when met, will introduce significant opportunities and results. They include unresolved conflict with treasure hunters, a lack of consistent public outreach, and hence a lack of public appreciation and support, and the simple relative youth of the discipline, the technical difficulty and high cost of research, the difficulties of access and protection, and rapid technological change.

1. Introduction

Underwater archaeology is the systematic study of past human life, behaviors, activities and cultures using the physical (or material) remains (including sites, structures and artifacts) as well as other evidence found in the underwater (or submerged) environment. Such evidence may exist beneath fresh (or inland) waters or beneath salt (or marine) waters. It may be visible on the bed of the water body (i.e. seabed) or buried beneath sediment.

Underwater archaeological sites may consist of the remains of ships (shipwrecks), boats (boat finds), other watercraft or vessels and aircraft, as well as cultural material that was accidentally dropped, lost overboard, or deliberately deposited into the water body. They include the remains of structures that were originally built wholly or partly underwater (such as fish traps, crannogs, bridges, piers, jetties, and wharves). They also include the remains of human activity that originally took place on dry or marshy land that has subsequently been inundated, either by rising water levels or by marine (or fluvial) erosion.

The term underwater archaeology simply refers to the environment in which the practice of archaeology is undertaken. Contemporary definitions of underwater archaeology overlap with definitions of:

- *Maritime archaeology*. The archaeological study of humans and their interactions with the sea, that can include sites that are not underwater but that are related to maritime activities such as lighthouses, port constructions, or shore-based whaling stations.

- *Marine archaeology*. The archaeological study of material remains created by humans that are submerged in the marine (or saltwater) environment, such as submerged aircraft.

- *Nautical archaeology*. The archaeological study of ships and shipbuilding. Like maritime archaeology it can include sites that are not underwater but that are related to ships and shipbuilding including ship burials, and shipwreck remains in the terrestrial environment or shipbuilding yards.

In order to practice a suitable standard of underwater archaeology, appropriate academic qualifications, training, and experience are required. Training in archaeological

technique alone will not suffice. Tertiary (preferably postgraduate) education in anthropological, historical, and archaeological theory, methodology, and research practice need to be combined with suitable qualifications and experience in working underwater. Advanced level training in technical diving is also advantageous, specifically in working on underwater sites at depth, in surf, in poor or limited visibility, or other conditions that may be hazardous. When conducting archaeology in the underwater environment, an underwater archaeologist will often have one or more geographical, temporal, thematic, or cultural specialties or interests such as European wooden ship-building of the Medieval period, Bronze Age sea-borne trade in the Mediterranean, or Confederate blockade-runner Paddle steamers. Other archaeologists may focus on themes such as ship symbols, site formation processes, or computer modeling. Technically oriented archaeologists may focus their efforts in areas such as remote sensing, survey methodology, or conservation.

Underwater archaeological activity must conform to all of the legislative and administrative requirements of the nation or state/province within whose internal waters, territorial seas, or Exclusive Economic Zone (EEZ) the work is being conducted.

It should also take into consideration international conventions and guidelines for the protection and management of the underwater cultural heritage including the *United Nations Convention on the Law of the Sea* (UNCLOS) and the UNESCO *Draft Convention on the Protection of Underwater Cultural Heritage*. Furthermore underwater archaeologists should be guided by codes of practice and codes of ethics such as the ICOM *Code of Professional Ethics*, and the Australian Institute for Maritime Archaeology (AIMA) *Code of Ethics*.

2. Aims

The aims of underwater archaeology (including marine, maritime, and nautical archaeology) are to integrate archaeological data and interpretation into the broader study of the human past, emphasizing not only materials from submerged sites, but also from maritime activities, arguably one of the more universal human endeavors. Inasmuch as two-thirds of the earth is covered by water, many human civilizations have turned to the sea, lakes, and rivers for sustenance, transportation, and war. To obtain as complete an understanding of the past, archaeological reconstructions of the past, as well as anthropological interpretations of human behavior, must include information from submerged or underwater sites.

Archaeology underwater is a relatively new sub-discipline of archaeology, and is just now passing from a pioneering period that spanned the last half of the twentieth century. The aims of archaeologists working in this field, over the next century, will focus on better integration of their data and interpretation with the wider professional community, and better dissemination of their research to the public. Other aims will include combating treasure hunting and commercial salvage of archaeologically significant shipwrecks, and adapting to the late twentieth century development of new technologies that have unlocked the potential to discover, examine, excavate, or plunder sites at any depth in the ocean.

3. The Environment

Underwater archaeology is conducted in naturally occurring bodies of fresh or salt water such as oceans, seas, lakes, rivers, streams, swamps, marshes, caves, sinkholes, and cenotes, as well as bodies of water constructed by human beings such as reservoirs, dams, canals, and wells. The underwater environment provides the underwater archaeologist with both opportunities and challenges, which can result in the long-term preservation of some cultural materials, but also the rapid deterioration of certain cultural materials when the environmental conditions are changed.

The work of maritime archaeologists can be accomplished on sites that are now buried but were formerly underwater, including bogs, former riverbeds, or urban settings along reclaimed waterfronts. Shipwreck work occasionally takes place on beaches as well as underwater. In all these cases, however, the material studied is almost always still in a wet environment, be it mud, wet sand, or bog.

3.1 Preservation

The underwater environment can preserve complex associations of cultural material in better condition than they may be preserved on a terrestrial archaeological site. After a period of time an underwater archaeological site may reach an approximate state of equilibrium with its environment. As a result certain types of cultural material may remain in a remarkably good state of preservation of considerable periods of time (hundreds or even thousands of years).

3.2 Deterioration

It has been suggested that shipwrecks are like time capsules and to a very limited extent this may be true in that the majority of the site's structure and artifact assemblage were deposited on one particular day in the past. Nevertheless taphonomic or site formation (post-depositional) processes will affect the site over time resulting in the deterioration or destruction of certain materials or parts of the site, as well as the addition of cultural material to the site

By definition cultural material removed from any underwater archaeological site will be waterlogged and depending upon the type of water (fresh or salt water) and the type of material, it may be saturated with chloride ions. Physical and chemical processes as well as biological organisms cause deterioration to, and in some cases the eventual destruction of, underwater archaeological sites, structures, and artifacts. The rate of deterioration for certain materials may slow after a period of time particularly in anaerobic conditions (without oxygen) and when buried by sediment.

There are two principal processes affecting, and potentially threatening, underwater archaeological sites. These arise from environmental processes, and human activities. Naturally occurring environmental processes such as changes in sea level and marine (or fluvial) erosion may affect, and potentially threaten, underwater archaeological sites. Changes in sediment levels or current patterns over a site may result in the damage to the site. Such changes may be cyclical and can only be assessed by observation of the

site over a period of time. Recent research on the wreck of RMS *Titanic* (1912) has identified a metal-eating species of bacteria that may also pose a threat to submerged iron and steel shipwrecks. By far the greatest threat to underwater archaeological sites is deliberate or inadvertent damage or destruction of the site and/or its associated artifacts caused by human activity. This includes dredging and other forms of harbor maintenance and clearing, damage from deep trawling and other fishing activity, anchoring, and deliberate salvage, souvenir hunting, or looting.

4. Methodology, Techniques, and Equipment

In order for human beings to remain submerged in the underwater environment for any length of time, at virtually any depth below the water surface, requires the use of special equipment. In relatively shallow water (usually less than 40 meters water depth) one option is diving where a diver is supplied with a compressed gas supply such as SCUBA or surface-supplied air. Recent advances in diving technology, termed technical or mixed gas diving involving the use of Nitrox and Trimix, have extended the water depths achieved by divers to beyond 80 meters. Technical diving uses tethered diving systems, gas mixtures other than air, and training specific to diving at depth. Nevertheless at the present time, the vast majority of the oceans of the world are too deep for diving activity and human beings can only physically reach and work in relatively shallow water depths. To work in the underwater environment at depths beyond about 100 meters involves using a submersible (or submarine) or the adoption of a technical diving regime.

Submersibles offer increasing opportunities for underwater archaeology without exposing the relatively unprotected human body to the inherent dangers of diving at depth. Submersibles also allow for a human presence on sites at depths were diving is impossible with current technologies, such as deep ocean wreck sites like *Titanic*. The first submersible used for archaeological research was the 1960s-built *Asherah*. Built for the University of Pennsylvania for the then-infant Institute of Nautical Archaeology, *Asherah* worked on Mediterranean shipwreck sites under the direction of Dr. George F. Bass.

The research submersible *Alcoa Seaprobe* was the next to be used for archaeological work. *Seaprobe* carried divers to the wreck of USS *Monitor* in 1979. The US submersible *Alvin*, developed for the US Navy in 1964, has conducted many military and scientific missions, including the exploration of RMS *Titanic*. Other deep ocean submersibles—the Russian *Mir* 1 and *Mir* 2, and the French *Nautile*—have also dived on *Titanic*. These commercial uses have not been archaeological, but they demonstrated that archaeological work was possible. Work by *Mir 1* and *Mir 2* to document and encapsulate portions of the sunken Soviet nuclear submarine *Komsomolets* at a depth of 1700 metres in 1989 was a further demonstration of the ability of deep ocean submersibles, operated by skilled pilots, to conduct intricate work like archaeology. . This potential has since been explored and proved with projects such as Dr. Robert Ballard and Dr. Anna Marguerite McCann's surveys of the Mediterranean, Black Sea, and the survey and excavation of shipwrecks at Skerki Bank in the Mediterranean.

The costs of sending a manned submersible into the deep are high but the costs are dropping. Once the domain of the military and government-funded bodies like Woods Hole Oceanographic Institute, deep-sea exploration has extended to the commercial world, as the employment of *Nautile*, and the *Mirs* in *Titanic* projects demonstrates. For shallower work, tethered diving suits are becoming less expensive and allow people to descend into the depths without fear of decompression sickness. They include the most recent update of the armored diving suit, in this case a one-atmosphere body fitting Newtsuit. Developed between 1979 and 1987 by International Hardsuits, a Canadian firm, the Newtsuit dives to 1000 feet with the diver safely inside. Foot pedals control a thruster pack, and while tethered to the surface, the Newtsuit diver can spend 48 hours submerged without surface air. While employed in military and commercial salvage operations, the Newtsuit has yet to be employed on an archaeological project.

The alternative to actually placing people on an underwater archaeological site involves the use of a Remote Operated Vehicle (ROV) or remote sensing equipment (underwater geophysical) equipment such as Side Scan Sonar, Magnetometers, Metal Detectors, Sub-Bottom profilers, or CHIRP systems. Remote Operated Vehicles are robotic devices, tethered to a support ship on the surface that carries still or video cameras. ROVs can also carry manipulating devices for excavation or recovery of materials ranging from geological samples or artifacts.

4.1 Regional or Site Inventory

In order to assess and manage underwater archaeological sites it is necessary to undertake a process of regional or site inventory to establish information about what sites and cultural material actually exists underwater. Information about the location, nature, extent and significance of underwater archaeological sites needs to be compiled into a database for each nation and/or state/province.

A regional survey may take one of two forms—a random sample or a stratified sample. A random sample regional survey would take the form of conducting an intensive visual and/or remote sensing survey of a selected percentage (say 10%) of an area for archaeological sites, structures or artifacts. Such a survey methodology may be more suitable for area surveys of anchorages or jetty sites. A stratified sample regional survey distinguishes areas within the total survey area on the basis of differences in environmental factors such as topography and water depth and cultural factors such as shipping routes and the location of ports. Increased levels of coverage (or over sampling) in areas with a higher probability of sites, structures or artifacts may be more suitable for area surveys for shipwrecks.

States, museums, cultural resource managers and professional and avocational organizations have undertaken numerous regional surveys, some of extensive areas, throughout the world. Notable examples include the work of the Institute of Nautical Archaeology in the eastern Mediterranean, the U.S. National Park Service in the national parks and marine protected areas of the United States, the Western Australian Maritime Museum in western Australia, GRAN in France, and Parks Canada's surveys of Canadian national parks areas.

4.2 Site Survey and Recording

Site survey is the process of measuring and recording the site features, spatial arrangements, distributions and relationships between cultural materials on an underwater archaeological site. Site survey requires that the accurate location of any item of cultural material must be measured and recorded before it is moved or raised. Site survey recording may take the form of the use of physical measurements such as trilateration, or a three-dimensional grid frame system, and/or electronic systems such as the Sonic High-Frequency Archaeological Ranging System (SHARPS) or similar system. In addition to physical and/or electronic measurements, a site survey should include the use of underwater photographic recording such as site photographs, a photomosaic, stereo-photogrammetry, and/or video recording. Site survey methodology may also employ remote sensing equipment such as metal detectors, magnetometers, and/or sub-bottom profilers.

A pre-disturbance survey of every underwater archaeological site must be undertaken before any cultural material is moved or raised.

4.3 Excavation

Excavation is the process of uncovering all or part of an underwater archaeological site by removing the sediment, recording the location, type, size, and amount of cultural material and then removing or recovering all or part of that material. Excavation is a destructive process and will radically change or destroy the archaeological record.

Excavation of an underwater archaeological site should only be undertaken when the site and/or artifacts are threatened with disturbance or destruction as a result of human activity, or through environmental processes; or previous research and a written research design have demonstrated that only through excavation can answers be found to specific research questions.

5. Sites and Structures

5.1 Submerged or Inundated Terrestrial Sites

Terrestrial prehistoric archaeological sites throughout the world have become submerged as a result of naturally occurring rising sea level, or inundated in human created water storage such as reservoirs and dams. Submerged prehistoric sites with material including lithic artifacts, human remains, and organic cultural material have been found at underwater archaeological sites such as Little Salt Spring (Florida, USA), Warm Mineral Springs (Florida, USA), and Montague Harbor (British Columbia, Canada). Other prehistoric and protohistoric sites with submerged remains include Iron Age villages covered by rising water levels in Swiss lakes, as well as crannogs in Ireland and Scotland.

Harbor constructions include wharves, moles, quays, jetties, piers, fortifications, canals, or artificial docks that have become submerged by rising sea-level, caused by catastrophic events such as earthquakes, or simply as a result of natural site-formation and deterioration processes. Examples of sites studied and/or excavated within the last

few decades are: Caesarea Maritima, Cosa Dvaraka, Hoff's Store, Kencherai, Pontia, and Port Royal.

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Biographical Sketches

James P. Delgado has led or participated in shipwreck expeditions around the world. His undersea explorations around the world include RMS *Titanic*, the recent discovery of *Carpathia*, the ship that rescued *Titanic*'s survivors, USS *Arizona*, the sunken fleet of atomic-bombed warships at Bikini Atoll, and the 1846 wreck of the United States naval brig *Somers* whose tragic story inspired Herman Melville's *Billy Budd*. Delgado is executive director of the Vancouver Maritime Museum in Vancouver, British Columbia. Previously, he was the head of the U.S. government's maritime preservation program and was the maritime historian for the U.S. National Park Service. When not at the museum, he is the co-host of the new National Geographic televisions series *The Sea Hunters* along with best-selling author Clive Cussler. Delgado's active participation in the study and preservation of shipwreck sites includes a membership in the International Commission on Monuments and Site (ICOMOS) committee on underwater cultural heritage. A Fellow of the Royal Geographical Society and a Fellow of the Explorers' Club, Delgado is the author or editor of nearly thirty books and numerous articles, most recently *Across the Top of the World: The Quest for the Northwest Passage*. His other books include *The British Museum Encyclopedia of Underwater and Maritime Archaeology;* Ghost *Fleet: The Sunken Ships of Bikini Atoll*; *Pearl Harbor Recalled: New Images from the Day of Infamy; Great American Ships*; *To California by Sea: A Maritime History of the Gold Rush* and three books for children Wrecks *of American Warships, Native American Shipwrecks,* and *Shipwrecks of the Westward Movement*.

Dr Mark Staniforth is senior lecturer in historical and maritime Archaeology (Department of Archaeology) at the Flinders University of South Australia. His Ph.D. looked at issues of trade, capitalism, and consumption through the study of material such as the Chinese export porcelain from the Wreck of the *Sydney Cove* (1797). He spent six years as Curator of Maritime Archaeology at the Australian National Maritime Museum (ANMM) in Sydney (1987–1993). Before that he was the senior maritime archaeologist at the Victoria Archaeological Survey (VAS) 1982–1987. He has been involved in maritime archaeological work in every Australian state and on many of the well-known projects conducted in Australia in the past 25 years including *Batavia* (1629), *Zeewyk* (1727), *HMS Pandora* (1790), *HMS Sirius* (1791), *Sydney Cove* (1797), *James Matthews* (1841), and *William Salthouse* (1841). He has published extensively in Australia including *the Bulletin of the Australian Institute for Maritime Archaeology*, *The Great Circle*, and *Australasian Historical Archaeology*. He has also published in international and overseas journals such as *Historical Archaeology*, *Underwater Archaeology*, *International Journal of Maritime History*, *The Bermuda Journal of Archaeology*, and *Maritime History*. Dr Staniforth is an elected member of the Advisory Council on Underwater Archaeology (ACUA). He is a past President and Vice-President of the Australian Institute For Maritime Archaeology (AIMA), former Secretary of the SA Chapter of the Australian Association of Consulting Archaeologists (AACA) and former Chairperson of the NSW Maritime Archaeology Advisory Panel (MAAP). He is currently president of the Australian Association for Maritime History (AAMH), and the book reviews editor of the refereed journal *The Great Circle*.