

| Submerged Cultural Sites: opening a time capsule

by David Nutley

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Drop something in the ocean and it is gone forever. Well, perhaps not. With increasingly sophisticated technologies, the world's oceans and inland waters are delivering up extraordinary evidence of humanity's past. The secrets of our ancestors, both ancient and more recent, are becoming increasingly accessible. Accessibility however is not just a question of finding and recovering. Understanding these gifts from our predecessors requires best practice, archaeological investigation and analysis. Anything less is likely to destroy these precious time capsules. Visibility and other environmental variables can be extremely challenging underwater, while sites can be very fragile. Protecting and understanding these environments require specialized observation skills. This is the role of archaeology.

The sea's reputation as a destroyer is legendary. Storms, reefs and other natural forces have taken a heavy toll on human life, while sea-based vessels of all types are vulnerable to tempests and sudden impact on rocky shores.



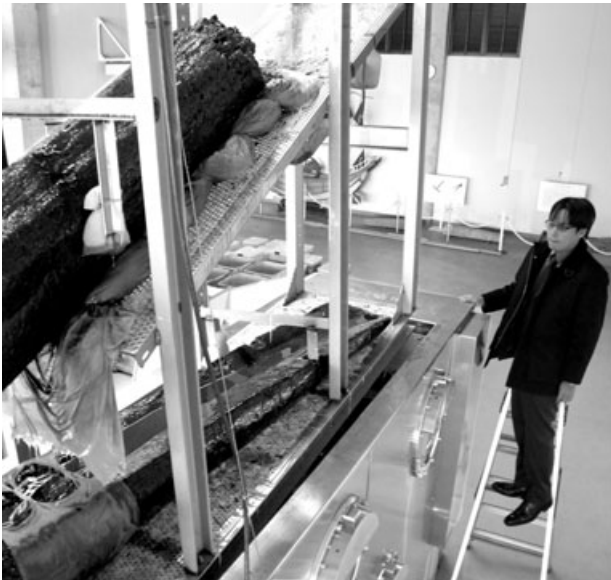
1. Ship graveyard in Newcastle (Australia).

Rafts, dugout canoes, sailing boats and the most powerful ocean-going iron and steel ships are all found among the lists of vessels lost at sea. To this tally can be added losses arising from warfare and human error. In all, millions of recorded vessels have sunk into the ocean's depths.¹ Inland waters, rivers, lakes and estuaries also have their own hazards and are littered with the remains of wrecked or abandoned riverboats.

The sea can also take a heavy toll on land sites. In recent years we have seen the effects of appalling damage visited upon coastal communities by tsunamis in South-East Asia and Hurricane Katrina in New Orleans. In addition, the potential

impacts of impending rises in sea level as a result of global warming are becoming increasingly apparent. We are not the first generation to deal with such events: many of our present coastlines lie many kilometres back from where our ancestors stood 25,000 years ago, and even further inland from where they stood 140,000 years ago.² Our coastal towns stand on land they would have considered high ground – up to 100 m above their coastline. Their forestlands, lakes, rivers, farms and dwelling places now lie beneath our coastal waters.

The sea does destroy and its immediate effects can be devastating. However, once an object is submerged, water can be a great preserver of



2. Portion of an anchor from the Kublai Khan fleet wrecked at Taskashima (Japan).

cultural heritage. This was graphically demonstrated during the December 2004 Asian tsunami. The destruction on land was devastating, particularly at points where the land and sea met. In addition to the human toll, homes, port facilities, farms and trees were unable to withstand the immense power of the breaking waves. However, underwater archaeological sites, even those close to shore, suffered almost no damage. The 1659 Dutch shipwreck, *Avondster*, for example, was partially covered with a new layer of protective sand.³

Once underwater, material culture generally has a much greater chance of survival than on land. This is powerfully demonstrated in Figure 3, which is based upon materials found in archaeological excavations. This graph shows the relationship between the general survival of different materials on land and in

underwater environments. For most materials, the chances of survival are significantly enhanced by underwater immersion. Only very inert materials like gold and certain types of stone are unlikely to demonstrate any difference in behaviour.

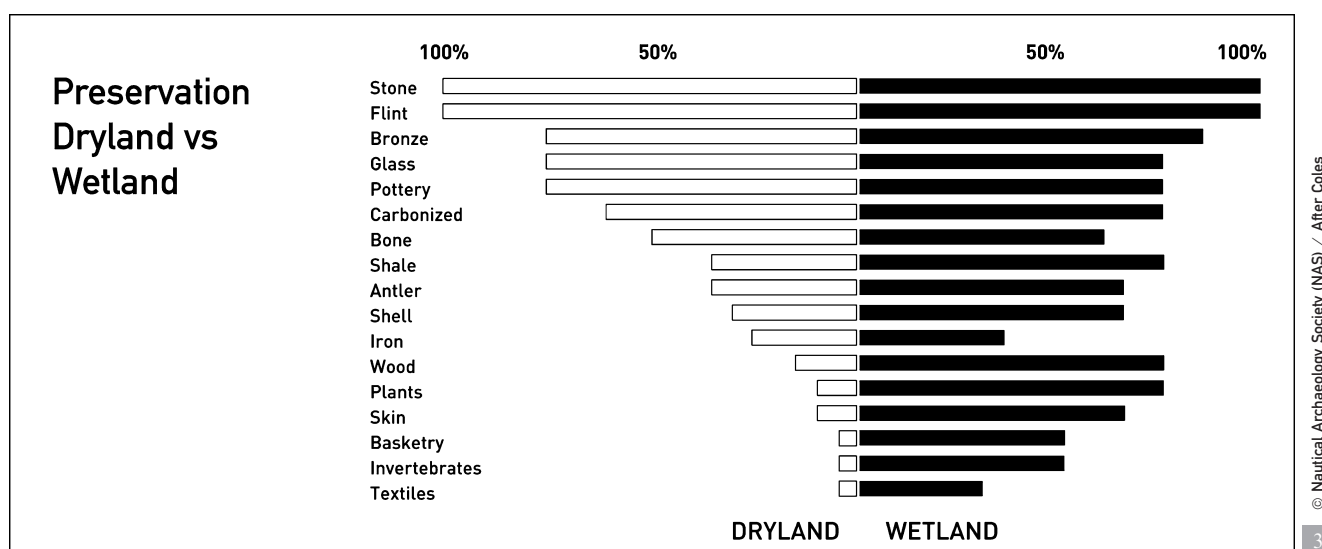
Many underwater sites have been preserved by the sea for hundreds or even thousands of years. These represent different cultures and lie in varied geographical and environmental settings, scattered across the world's oceans, seas, waterways, lakes, swamps and bogs.

What types of sites lie under water?

The 2001 UNESCO Convention for the Protection of the Underwater Cultural Heritage defines this heritage as: 'all traces of human existence having a cultural, historical or archaeological character which have been partially or totally under water, periodically or continuously, for at least 100 years'.⁴

Since human beings need water to live, our societies have always been situated predominantly near coasts, rivers or lakes. Oceans, seas and waterways have also been used for transport and industry since time immemorial. The number of human-made artefacts that have ended up underwater, either through natural causes, accident, design or warfare, is thus unsurprising.

There are four major overarching categories of submerged archaeological site which determine the nature of the sites that may be found: a) functionality, b) chronology, c) how the



3. Survival of clues on underwater sites relative to dry sites – information is often better preserved and protected underwater.

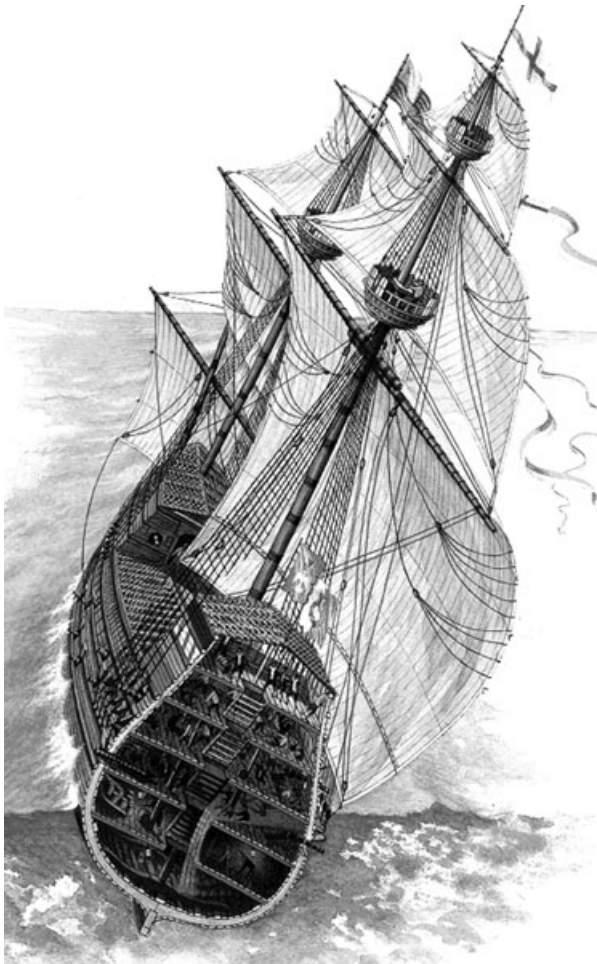
material came to be underwater, and
d) environmental.

Functionality

Functionality relates to the manufacture of the artefacts that comprise the site. For instance, in a shipwreck site this would refer to items such as the ship's structure, its cargo, or the possessions of the passengers and crew. Important questions include: what was the purpose for which the ship was built? Was cargo, capacity or speed the main consideration? Was it built primarily as a cargo or passenger vessel? Was it meant to operate on rivers, lakes, short coastal voyages or long, open ocean voyages? Was it built for recreational use, commerce or warfare? All these factors will influence the configuration of the ship, the type of materials used in its construction, the strength of the hull, the nature and quantity of the cargo on-board, and the types of personal possessions being carried.

A vessel like the *Sydney Cove*, lost on a small island in Bass Strait off the Australian south coast in 1797, provides an example of a shipwreck site that can be interpreted to reveal the ship's function. The *Sydney Cove* was carrying a cargo of general goods from Calcutta in India to Sydney on the east coast of Australia. It would be generally expected that a vessel on this route would be designed to withstand the demanding conditions of the southern Indian Ocean and the Roaring Forties⁵ south of Australia. Archaeological research at the site, however, revealed a ship that was lightly built and much more suited to work along the relatively sheltered coastline of the subcontinent. The *Sydney Cove* had been sent on what was to be an ill-judged and fateful voyage⁶ – one for which the ship was never intended.

The Tudor ship *Mary Rose* in contrast was built for battle at sea. Heavily armed and solidly built as befitting the flagship of the English king,



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4. Artist's impression of Henry VIII's *Mary Rose*.

Henry VIII, this was a vessel constructed with the best materials available taking advantage of the latest technologies in naval warfare.⁷ The holds of the *Mary Rose* were filled not with goods of trade, but with gun barrels, cannonballs, gunpowder, longbows, arrows and surgeon's equipment for treating the wounded. In addition, the ship carried the normal materials required to keep a vessel at sea: sails and rigging materials, a ship's galley with cooking equipment and tableware, navigational

aids and the personal items of the soldiers and crew (Figure 4).

The tradition of timber fighting ships continued up until the middle of the nineteenth century. Then, in March 1862, the ironclad USS *Monitor* and CSS *Virginia* engaged in a four-hour battle. The outcome was a draw with both vessels retiring essentially unhurt; the effectiveness of defensive ironclad hulls had been proven. This encounter hastened the end of wooden-hulled warships and their traditional use of broadside engagement.⁸ The *Monitor* later foundered, however, while being towed on New Year's Eve the same year. Documentation regarding the remains of this warship provides a comparative record of the survival of wooden and iron shipwrecks. Unlike the *Mary Rose*, the *Monitor* did not become buried in sand but lay above the seabed for approximately 121 years before being discovered in 1973.⁹ Instead of rotting away like the exposed wooden hull of the *Mary Rose*, the *Monitor's* exposed hull remained largely intact as a result of the inherent strength of the ironclad hull and the turret gun.

For aircraft, the need for speed and relative lightness effectively precluded the application of armour plating. However, lightweight metals such as aluminium corrode rapidly in seawater, and in electrolytic connection with other metals, such as iron, form galvanic cells that can further accelerate decay. However, the functions of aircraft have still determined their form. Cargo planes are generally large and slow whereas military fighter planes are sleek with just enough carrying capacity to accommodate crew, fuel and armaments. Aircraft designed to land and take off from water, such as the Catalina flying boats of the Second World War,

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have undercarriages fitted with floats instead of wheels, and may also have fuselage specifically adapted to act as a hull when on the water.

When considering harbours and ports as types of site, it should be noted that pipelines and cables are specifically excluded from protection under the Convention, as are other installations that remain in use or have been adapted for other uses (including wharves, jetties and navigational aids or sea walls). Aside from this important consideration, harbours and ports are an important feature of underwater cultural heritage. They not only act as the interface between ships plying the oceans, but also form the infrastructure required to support those ships, and to load and unload their important cargoes. In addition, they potentially include homes and dwelling places used by the crew and their families.

A number of major port facilities have been inundated by sea-level rise or tectonic movement over the centuries and have thereafter been the subject of archaeological investigation. These include sites such as Port Royal in Jamaica. Below the waters of modern-day Kingston Harbour is a sunken city dating back to 1655 when the English invaded and took Jamaica from the Spanish.¹⁰ An earthquake in 1692 resulted in two-thirds of the town being submerged within minutes; an event that has been likened to the instant burial of Pompeii under volcanic ash. It is therefore unsurprising that the site has been described as ‘perhaps the best-preserved English town in the world’.¹¹

Harbours or ports require the construction of facilities suited to the cargoes, under

transportation, the ships transporting those cargoes, and the nature of the marine environment in which the facilities are located. This produces an endless variety of engineering solutions. Facilities located along inland riverbanks that are subject to great variation in river levels may range from a series of stepped easements within the riverbank to a complex, multi-storeyed wharf structure such as that at Bourke on the Darling River in western New South Wales, Australia.¹² In estuaries, the wharves or jetties may range from small-scale structures of stone, wood or concrete to massive complexes catering for a large number of ocean-going vessels.

Extractive industries such as fishing also make use of underwater infrastructures, including those made from organic materials such as woven reeds, barriers built from wooden sticks or other types of barrier or trap constructed from stone. They may also range from structures unchanged since prehistoric times to relatively modern fish ladders. The choice of materials for construction is decided by the particular function of the structure, the nature of the resources being extracted, and the natural materials available. Once abandoned (due to changes in technology, culture or sea-level), each structure will behave differently depending on the materials employed, the environment in which they were built, and the environmental changes that occurred following abandonment. These factors determine how such sites survive or, indeed, whether they survive at all.

Sites of human habitation including hearths, stone tools and even organic materials have also been found underwater.¹³ Some of these are located along original shorelines in ‘open’

settings,¹⁴ while others may exist within the shelter of naturally occurring caves.¹⁵

Chronology

The nature of sites is inevitably related to the age in which they were created. Cultural values, the availability of certain materials, access to markets and technological developments all play a role in forming the material culture of a particular era. Similar factors have existed throughout the ages, but the choices available or made by different cultures throughout time have varied enormously. This chronological variation is reflected in the nature and distribution of underwater cultural heritage sites as well as in the nature of the sites themselves.

Fishing has grown from a daily activity in coastal or inland waters to vessels scouring the oceans over extended periods. Trading vessels have developed from small, one-person rafts or dugouts to multi-level, 400 m-plus steel behemoths. The potential archaeological footprint of a person fishing with a hand spear or fishing line with shell hook in a small canoe in sheltered waters is significantly different to that of a large nineteenth-century whaling ship with a sizeable sturdy wooden keel, enormous wooden frames and framing knees, iron tri-pots, iron or copper-alloy fastenings and a copper-sheathed wooden hull – not to mention a few iron cannons to help protect against marauders.

Given the nature of water, with currents, tides, floods and wind all working to drive a vessel where it may not want to go, it was vital for a ship's captain to be able to anchor the vessel. The era in which a ship was built determined the

type of anchor. In certain eras this might consist of a large stone tied to the boat by rope. In fifteenth-century China, a large 5 m wooden and stone structure would likely have been used, an example of which was found at the site of the wreckage of Kublai Khan's fleet of 4,400 ships, lost as the result of a storm at Takashima, Japan in 1281.¹⁶ During the nineteenth century, advances in iron technology led to changes in the form of ship's anchors. Where the weight of an anchor had originally been the key to holding a ship fast, the focus moved to the size and weight of the anchor chain, which quickly replaced the rope cables that had formerly been used to attach the anchor to the ship. With the weight of the anchor assuming less importance, its size, in proportion to the length of the ship, was correspondingly reduced. In addition, the arms and flukes that fasten the anchor to the seabed underwent changes in form and proportion. Anchors are therefore an important indicator for determining the age and size of a shipwreck.

Chronology contributes one other important aspect in terms of the archaeological record. As noted earlier, most of the destruction to cultural heritage occurs during the process of submersion, but, once on the bed of a sea or lake, deterioration begins to slow down. For first few months the rate of deterioration will remain fairly high, and the rate of decay will still be significant over the first few years, despite continually reducing in pace. After a hundred years, a level of stability is normally reached. If the site has survived this long, then a long-term future can usually be expected, short of a major natural event or human-induced upheaval. In 1960, archaeologist George Bass led an archaeological excavation of a

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shipwreck site in the Mediterranean that dated from around 1200 BC, thus proving conclusively that underwater cultural heritage can survive thousands of years.¹⁷

Whether a site is predominantly organic (e.g. wood), or inorganic (i.e. stone or iron), its character will reflect the time of its construction and its demise. These and other dating options are essential for understanding the stories that these sites can tell us and future generations.

How cultural heritage comes to be underwater

The third key factor in determining the nature of an underwater cultural heritage site is the manner in which it came to be underwater in the first place. Sites that were originally intended to be underwater (e.g. stone fish traps or concrete port facilities such as Caesarea Maritima) are generally constructed to withstand local forces and pressures. As such, they may survive essentially intact almost indefinitely. However, an item that was never intended to remain underwater is quite a different proposition. Ships were designed to sail on water, not to rest on the seabed.

If a ship has been damaged prior to sinking, this will affect the archaeological nature of the wreck site. A ship that has run on to a reef may have a broken keel – the ‘backbone’ of the vessel. This will weaken its overall shape and, may result in increased break-up of the hull on the seabed, and a much wider distribution of artefacts. If the ship caught fire and burned to the waterline before sinking, then the hull is unlikely to retain much of the original cargo or ship’s fittings: these will have been consumed before sinking, fallen into the sea, or washed overboard

during the descent. Similarly, a vessel struck by a mine, aerial bombardment or torpedo may also have suffered extensive destruction and weakening of key structural elements before sinking. This will also be a factor in interpretation of the remains on the seabed.

If a ship suddenly sinks at sea, however, either as a result of warfare or perhaps extreme weather conditions, it may end up on the seabed relatively intact. Similarly, an aircraft that ditches into the sea after running out of fuel may leave a significantly different record on the seabed than one that crashes into the sea at high speed.

Environment

The fourth key factor in the creation of an underwater cultural heritage site is the local environment. In 1988, at Eden on the south-east coast of Australia, two very similar fishing boats – the *Henry Bolte* and the *Tasman Hauler* – were scuttled in the same area and in similar depths of water. Today the two sites show markedly different patterns of site formation and decay. The *Henry Bolte* settled on to a hard, flat reef while the *Tasman Hauler* settled on to sand. The *Tasman Hauler* has therefore had its hull cushioned, which has created a level of stability that appears to have resulted in a relatively slow rate of deterioration. In addition, this stability also appears to have encouraged colonization by a wealth of brightly coloured marine life, which has attached itself to the surface of the structure. In contrast, the *Henry Bolte* has developed relatively little marine growth¹⁸ and is breaking up at a greater rate.

Generally, ships lost on shallow rocky reefs deteriorate very quickly, regardless of whether they

are made of wood, iron or steel. At the other end of the scale lie ships lost in deep water with little if any current, light or oxygen, and very cold temperatures. The *Titanic* is perhaps the best known of these sites and its ability to remain relatively intact since 1912 reflects the tranquillity of the environment in which it lies. Over relatively recent years that environmental stability has changed significantly following the discovery of the wreck site and subsequent visitations by submarines and remotely operated videos. It is therefore of little surprise that increased deterioration of the site has been noted since the first visitations.

Elsewhere, there is dramatic evidence of the ability of wooden ships to survive in conditions of low temperature, low light, low oxygen and minimal current. These include sites such as the 1813 wrecks of the *Hamilton* and *Scourge* in Lake Ontario, Canada, which are being managed and documented through the City of Hamilton's Hamilton-Scourge Project.¹⁹ Arguably the most dramatic example of the survival of a wooden ship is the *Vasa* in Sweden. The *Vasa*, the pride of the fleet of Swedish King Gustavus Adolphus Rex Sueciae, sank within a nautical mile of the start of the vessel's maiden voyage in 1628. The remains were found in 1956 and just five years later, the vessel was raised, underwent conservation and was placed on public exhibition. Astonishingly, the ship was about 95 per cent intact. This was due to its partial burial in clay and mud, while the inability of marine borers to exist in these waters was also a key factor.²⁰

These examples of fully preserved ships illustrate the potential for natural conservation on or

below the seabed, even in environments that are neither cold nor devoid of oxygen and light, and where strong currents exist. A covering of sand or mud instantly removes the abrasive effects of currents. It also shuts out light, reduces or precludes the presence of oxygen, prevents access by marine borers (such as teredo worm), and keeps temperatures at a constant level. Since ships' hulls tend to sink into sand or mud, wooden ships in temperate or even tropical waters can remain substantially intact. The *Swift* off the Argentinean coast²¹ and the *Pandora*²² off the north-east coast of Australia are two such examples.

Another special group of shipwreck sites are those that have not sunk entirely beneath the waves, but are instead located along riverbanks, on the banks of river estuaries, or wrecked semi-high and dry on coastal shores. These sites provide unique opportunities for observing the effects of constant wetting and drying actions on both timber and iron or steel vessels. Many of these ships were not lost through misfortune but instead abandoned at the end of their working life. The potential to learn from these sites has been well illustrated through projects such as the Submerged Resource Center of the US Department of the Interior's National Parks Service²³ and the 'Graveyard of Ships' project in South Australia.²⁴

Context and integrity

Sites that have been subject to disciplined archaeological research programmes constantly reveal information on structural details and material culture. This information is dependent on detailed recording of the relationships between

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artefacts found at the site. These relationships can be related to the original purposes of the artefacts on-board the functioning ship. Without knowing precisely where an artefact was found it is often impossible to know how it related to the original site – regardless of whether it was a ship, aircraft, port infrastructure, fishing trap or site of human habitation. The documentation of context is just as central to the work of an archaeologist as it is to that of a forensic detective. It is for this reason that the unauthorized disturbance of underwater cultural heritage sites is illegal in many countries and also prohibited by the 2001 Convention. The disturbance of sites without adequate documentation of the context of all site elements results in the irretrievable loss of site integrity.

‘Integrity’ is not a matter of whether a site is intact in the sense of its original form. A shipwreck may have been dashed to pieces against a sheer cliff but the wreck site can still be interpreted. For example, key elements such as anchors and anchor chains will indicate the position of the bow. Rock-solid concretions quickly form after the loss of a large ship and can resist the most powerful currents for many years.

Conclusion

There are considerable variables within each of the four categories mentioned in this article. In addition, each category overlaps with the others. It is this interaction that produces the almost infinite diversity of underwater cultural heritage sites. This diversity means that no two sites are ever quite alike. The information contained within each site and the behavioural characteristics of the artefacts within it

are often particular to the site, as shown previously in the example from Eden. Researchers must constantly remember that the information on site A will not necessarily be the same as that on site B. This of course poses particular challenges. In the same way, it cannot be assumed that site-stabilization methods that work on site A will work in the same way on site B, or that the conservation methods that work on artefact A will also work on artefact B.

Underwater cultural heritage sites are truly time capsules of infinite variety, each with a story to tell. There is also the strong possibility of ancient sites lying buried within offshore peat beds or beneath the silt of our coastal estuarine systems and continental shelves which could date back at least tens of thousands of years. If their stories are to be preserved and potentially revealed and recorded, international cooperation and best practice archaeological investigation are absolute imperatives. The 2001 Convention is based on best practice and has been developed with the input of numerous countries. Its key principles acknowledge the variety of site types found underwater, their significance, and the need for sound and sustainable management of this unique heritage. With the increase in access provided by new technologies, the 2001 Convention is the best hope that these sites have for being respectfully treated as windows into the past – as time capsules with meaning.

| NOTES

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