Shipwreck graves and their conservation management[1]

Ian D MacLeod

Western Australian Musuem
Collections Research Centre
Locked Bag 49, Welshpool
Western Australia 6986
ian.macleod@museum.wa.gov.au

Abstract

One of the emerging issues affecting the conservation management of shipwreck sites is the way in which we respond to the presence of skeletal remains. There exists a series of rationalisation processes that can be applied to justify archaeological intervention on an historic shipwreck site, and these form the basis of the Code of Ethics of bodies such as the Australian Institute of Maritime Archaeology. While there appears to have been little discussion in the conservation literature of the ethical issues associated with materials from a site which is either a mass grave or from which skeletal materials have been recovered, the topic has been more widely canvassed in the archaeological literature (Carrell 1989, DCMS 2007a, McCarthy 2004, Smith 2004). A number of discussion papers have been presented by maritime archaeologists but the implications of the ethical constraints have not been readily communicated to conservators (DCMS 2007b, Murphy 2005, Smith 2004). This paper presents comments about the nature of some typical shipwrecks which contain remains of the people who were carried on them as crew or passengers, and how the presence of human remains has been managed. Particular emphasis is placed on the issues surrounding war graves such as the American Civil War submarine *HL Hunley*, the RMS *Titanic* and the World War II battleship USS *Arizona*.

Keywords: shipwrecks, human remains, conservation management, spiritual elements, legislation

Introduction

Timbers and a multitude of artefacts recovered from the *Mary Rose* (1545), *Batavia* (1629) and *Pandora* (1799) have helped to provide insights into the methods used in ship construction over the past 400 years. Apart from this decidedly fascinating area of research, the objects used by the crew and passengers in their everyday life provide a direct connection with a distant past. The navigational equipment and other appurtenances associated with seafaring indicate how the technology of celestial navigation was changing over a time when major advances were being made. The systematic archaeological excavation of these three sites has also seen the recovery of human remains. Issues of how to manage such material has normally not aroused much discussion, as there are few known direct lineal descendants of the persons concerned, since the identity of the original passengers and crew is largely unknown. However, this issue has become very significant for those concerned with the management and the excavation of more recent wrecks such as those of the RMS *Titanic* (1912) and warships associated with World War II, such as the USS *Arizona*, sunk in Pearl Harbor in 1942. It would appear that there are two sets of standards being applied to the same problem.

In the case of the twentieth century wrecks, the fact that many of those entombed in the wrecks have known identities and surviving family members and descendants makes the proper care and management of those mortal remains all the more important. The Council for British Archaeology reported in 2004 that an arbitrary date of 75 years for approval to disturb human remains seems to have been applied by the Department of Culture, Media and Sport of the UK government (CBA 2004). As such, maritime archaeologists and conservators are less keen to become too deeply involved in such projects, often for fear of being condemned by their colleagues.

Historic shipwrecks provide a unique resource of information to the whole community through the work

1 Elements of this paper were presented as a plenary lecture at the ICOM-CC Triennial Meeting in Washington, DC, in September 1993 and have not been previously published.

of maritime archaeologists, conservators and physical anthropologists since the materials recovered from these sites provide a rare insight into the lives and times of ordinary people who travelled by or worked on the sea. Whilst histories of the rich and famous are well documented, the lives of the bulk of the population are poorly recorded and less is known of the trials and tribulations of sailors and passengers in past centuries.

Cooperation and liaison between maritime archaeologists and conservators has resulted in objects being recovered and ultimately displayed in a much better state of preservation than is routinely the case when excavation proceeds without the seamless integration of conservation services. Conservation treatment and analysis, performed in collaboration with other specialist research, ensures maximisation of historical and technical information enters the archaeological record. There exists an inherent dilemma between the physical requirements of conservation and the spiritual and ethical issues associated with recovery of human skeletal material (and its possible reinterment) and hallowing of the site. The case studies presented here are listed in order of the date of the wreck, since it would appear that the age of the human remains has a direct bearing on the way in which they have been managed.

Case studies of some shipwreck graves

'Mary Rose' (1545)

The recovery of the English warship of Henry VIII, *Mary Rose*, from the murky waters of the Solent in 1978, is one of the great events of modern times. The retrieval of the wooden longbows in excellent states of preservation has enabled historians to calculate the operational strength of the English archers, since the bows could still be tensioned and strung. The data has provided new information on the speed of the arrows and their power to penetrate armour. It has assisted historians in their understanding of the firepower that resulted in the English victory at the battle of Agincourt in 1415 against overwhelming odds (Figure 1). The fine mud of the Solent resulted in anaerobic conditions over a significant portion of the vessel, which is why so many of the hull timbers have survived the ravages of limnoria and the teredo 'worms'. This special environment also preserved a plethora of other organic remains, including the bones of many of the hapless crew that went down when the vessel suddenly heeled over, capsized and sank.

The recovery of human remains poses the issue of how to deal reverently with the material. The ethical issues associated with treatment of human skeletal remains have to be balanced against the legitimate needs of the historians and the general public who have a strong desire to understand their past. The analysis of muscle attachments and human dentition can provide the forensic pathologist with unique data on the health and hygiene, diet, and general living habits of people in past times (Rule 1982, Stirland 2002). Owing to the nature of the wreck site most of the human remains were not recovered as complete individuals but as collections of skeletal material. A service was held at the Anglican Cathedral, Portsmouth in 1984 using a 1545 English Rite for the Burial of the Dead. The interment of the bones of an 'unknown sailor' within the Cathedral provides a memorial to all those who perished with the ship. The service was co-celebrated with both Roman Catholic and Anglican clergy. The bulk of the human remains from the wreck of the *Mary Rose* are in the eponymously named museum, isolated from other objects, kept within the reserve collection under lock and key; access is restricted. It was only through post-excavation sorting by the *Mary Rose* Trust's anthropologist that 91 relatively complete individuals were isolated, with the remains of a total of 179 individuals being represented in the skeletal store. Each year on the anniversary of the burial, members of the local community and the Trust lay a wreath on the tomb in Portsmouth Cathedral (Jones 2008).

Figure 1. Diver recovering a long bow from the wreck site of the Mary Rose 1545. Photo: Patrick Baker, Western Australian Museum.

'Batavia' (1629) wreck and landsite

The Dutch East Indiaman *Batavia* was built in 1628 and wrecked on its maiden voyage

Figure 2. Children's depiction of the Batavia massacre.

on the Houtman Abrolhos Islands off the Western Australian coast on 4 June 1629. Although no lives were lost on the actual shipwreck, the subsequent events that unfolded after the captain Francisco Pelsaert set off to find a rescue vessel in Batavia (Jakarta), saw Jeronimus Cornelisz, the supercargo, or person in charge of the cargo and managing all commercial transactions of the voyage, lead a rebellion (Figure 2). This action resulted in 125 men, women and children being raped and murdered (Drake Brockman 1963, Edwards 1966). The successful return of Pelsaert and the trial of the ringleaders of the rebellion, their summary execution on the Islands and the dispensing of justice to the other mutineers in the Dutch East Indies have been well documented (Jansz 1647). The recovery of material and human remains from the wreck and adjacent land sites has brought to historians and maritime archaeologists a wealth of information about life in the first quarter of the seventeenth century (Pasveer et al. 1998, Pasveer 2000).

Underwater excavation of the wreck is justified because it has provided a unique insight into the methods of manufacturing ships in the early 17th century (Green, 1989). Since no ship plans were extant, it was an archaeological exercise to determine the method of construction of the vessel. This showed that the *Batavia* had been built shell first, with the hull planking going on first, then the ribs and the inner planking being fixed in position last of all. The charred timbers from the inside of the vessel were due to selective burning of timber, since this plasticises major lengths of the timber and allows them to follow the desired contours. The artefacts themselves give an insight into cannon production between the casting dates of 1603–1616, which included the apparent recycling of old bronze cannon to make new ones free of the effects of wear and tear (MacLeod 1987). The recovery of genuine 16th century forgeries on the wreck has provided another insight into the economic realities of the Spanish Netherlands province of Gelderland in 1528 (MacLeod 1984, Green 1998).

Exhibited skeletal materials

The management of all the wreck materials recovered from the four Dutch shipwrecks off the Western Australian coast is coordinated through the Australian Netherlands Committee on Old Dutch Shipwrecks (ANCODS). All Australian shipwrecks are protected under the Australian Commonwealth *Historic Shipwrecks Act 1976* (no 190 of 1976); the Western Australian Museum wrecks in state waters are covered by Western Australian legislation through the *Maritime Archaeology Act* (No 66 of 1973). Visitors to the Western Australian Museum Shipwreck Galleries enter the *Batavia* gallery to see the conserved and reconstructed stern section towering high above them. Behind the timbers, the pre-fabricated sandstone archway for the fort in Batavia, which was part of the cargo manifest, has been erected. The stones of this structure, along with several thousand cannon balls, assisted the vessel to grind a hollow in the brittle coral reef, which ultimately saved this section of the vessel from total disintegration. In the rear of the gallery, the presence of the skeleton of one victim of the mutiny helps create the unique atmosphere of the gallery (Figure 3). A reconstruction of a grave found in the shallow coral sand on Beacon Island shows all the major bones of one of the victims of the mutiny. There is a sharp cut in the skull and also the jaw has been severed on one side and the scapula cut through. The decision to exhibit the skeletal material was only made after consultation with the Dutch government who, as legal inheritors of the Vereenigde Oost-Indische Compagnie (VOC or the Dutch East India Company) and its assets, had the responsibilities of determining the fate of skeletal materials from the wrecks. The only skeletons that were removed from the island were those in danger of being destroyed or lost, associated with building of new huts for the fishermen.

The living dead

Having assisted in the preparation of the skeleton for a bicentennial shipwreck exhibition in 1987 and experiencing no qualms about dealing with human remains, the author's first visit to Beacon Island was

Figure 3. Skeleton of Batavia (1629) massacre victim on exhibition at the WA Museum Shipwreck Galleries in Fremantle. Photo: Patrick Baker, Western Australian Museum.

profoundly disturbing as I gradually became aware of a very real sense of unease. This was similar to the feelings that many people have recorded on sites of atrocities such as in the German concentration camps of World War II. The author has also been similarly disquieted at historic Scottish battle sites, such as the massacre of Glencoe (1692) and the battle fields of Culloden Moor where the English destroyed the Jacobite army in 1746. My initial thoughts were that I was just imagining the stories recorded by Hugh Edwards' historical novel *Island of Angry Ghosts*, which relates the events of the massacre, but the unexpected awareness of a *presence* was nevertheless very real (Edwards 1966).

At that time, a number of groups were considering the cultural-tourism potential of the *Batavia* wreck site and Beacon Island. It seemed to be a great opportunity for capitalising on a unique resource that would create a much-needed boost to the local economy of Geraldton, which is located 50 km away on the mainland. These discussions highlighted the need for an integrated conservation management plan. The primary considerations included the nature of the archaeological site of the wreck, which is managed under the *Historic Shipwrecks Act*. Beacon Island is also a declared historical site and an A Class wildlife reserve. Visits by tourists and their activities on the island need to be effectively managed through close supervision. Meetings with staff at the Western Australian Museum, Geraldton noted that other colleagues had experienced similar unease on the island. After much discussion, they organised an ecumenical service of hallowing the island. The event took place at dawn after the party of ministers, priests and a rabbi stepped ashore. It has been reported that a different atmosphere is now experienced when they visit the island (McGrath 1998).

In the middle of 1999 an expedition of archaeologists travelled to Beacon Island to conduct a series of excavations of the areas in which some skeletal material had been accidentally disturbed during sewage works. The full-scale archaeological excavation of the area uncovered what is believed to be the mortal remains of a group, possibly family members (Figure 4). Testing of the skeletal material for DNA characteristics is in progress. Media coverage at the time of the excavations resulted in some degree of public disquiet over the issue of why, after all this time, the site is being excavated since details of the massacre had been documented in the seventeenth century. This disquiet was expressed through Letters to the Editor of *The West Australian* newspaper. It has been resolved that once the conservators have pieced together the fragmented skulls of the victims and all the forensic data has been obtained, the polyvinyl acetate emulsion will be dissolved from the skeletal materials and the fragments will be reburied on the island (Pasveer 2000, Corvaia 1999). This process has not yet been instigated owing to complexities associated with changed regulations governing activities in the Abrolhos Islands which, apart from the being the location for the *Batavia* and *Zeewijk* (1722) shipwrecks, are the home of major mutton-bird breeding colonies and are also marine reserves.

HMS 'Pandora' (1797)

Following the mutiny on HMS *Bounty* and the epic voyages in an open boat by Captain Bligh from the South Pacific to Timor, the British Government sent out HMS *Pandora*, a 24-gun frigate, to search for the

Figure 4. Excavation and stabilization of human remains, Beacon Island. Photo, Patrick Baker, Western Australian Museum.

mutineers and bring them back to face justice in Britain. Those who had remained in Tahiti were captured and put in a cage-like structure on the deck of the Pandora which then began its long journey back to England. After travelling roughly one third of the return trip, the vessel was wrecked in the Torres Strait, off the north Queensland coast of Australia. Since the pumps failed to stem the influx of water, the captain ordered the ship to be abandoned but resisted any temptation to release the locked up mutineers. With assistance from kindlier officers, some of the prisoners managed to escape but several mutineers and crew went down with the vessel. During the 1987 season of trial excavations, a number of bones were recovered. Clinical pathological examination of the bones in one area revealed that there was a mixture of animal bones, such as pork and beef from the ship's food, and also human bones.

The forensic data obtained from the decayed bones on the *Pandora*, just like those from the *Mary Rose*, points out the need for them to be subjected to close examination. It is often very difficult for the uninitiated to effectively discern the difference between human and animal bones, particularly when they are in an advanced state of decay. The scientific examination of animal bones also provides veterinary pathologists with a unique source of data. Since the historical interval from which the bones came is very well defined, shipwreck animal bones provide unequivocal data on the development of breeding and the nutritional status of the animals from the various countries of origin (Gesner, 1991).

After documentation, the human elements were collected and taken back to the site for reburial with an appropriate ceremony that took note of the trauma that those who lost their lives on the wreck site must have experienced. This is a very sensitive response to the issue of human remains that are caught up in the archaeological context of a significant and socially important historic shipwreck.

'Hamilton' and 'Scourge' (1813)

On 8 August 1813, the United States Navy armed schooners *Hamilton* and *Scourge* sank in a fierce and sudden storm into 300 feet of water in Lake Ontario. The sinking vessels took 53 sailors to their graves. There were 19 survivors, and significant contemporary accounts of the wrecking were recorded. It was the single greatest loss of life on the Great Lakes occurring in the war of 1812, in which the forces of the United States of America attempted to seize Canadian lands.

The reason why the Hamilton had a figurehead of Diana, the Roman goddess of the hunt, on the bow is that the ship was originally called *Diana* until it was captured by the Americans and subsequently renamed the *Hamilton*. Similarly when the Americans confiscated the British ship *Lord Nelson* (Figure 4) they had renamed the vessel *Scourge*. The war of 1812 ended with the Treaty of Ghent signed on Christmas Eve in 1814, and although the whereabouts of the vessels was approximately known, their precise location was revealed only in 1975 after a four-year search by the Royal Ontario Museum. The overall state of preservation of the inorganic and organic materials is remarkably good which is consistent with the great depth of the wreck site, a salinity of less than 5 parts per million and water temperatures ranging from 2°C–5°C. Initially it was planned to recover these wrecks and to preserve the timbers and the materials in a manner similar to that of the wreck of the *Wasa* (1628). The discussions about the distribution of the wrecks and contents indicated support for them to go on display in the City of Hamilton in Ontario, since the remains of these two vessels are a powerful display reminder of the events of the 1812 war, which was won by Canada.

Following advice from various conservation centres, the planned recovery of the wrecks has gone into abeyance as the economic costs appeared to be prohibitive. There appears to be little consideration that

Figures 5 and 6 (from left). Figurehead of Lord Nelson of the eponymously named vessel later renamed *Scourge*. Photo: National Geographic Magazine; view of the *HL Hunle*y (1864) on its support cradle on the Warren Lasch laboratory. Photo: Hunley Commission.

recovery of the ships would result in a major disturbance of a war grave. Although the formal ownership of the wrecks and their remains have been transferred to the City of Hamilton in Ontario, the bones and personal effects will be left undisturbed under a bilateral agreement between Canada and the United States of America. With sites such as these, it is important that some form of monitoring take place on a regular basis to ensure the continued stability of the wrecks. Current work on wrecks in shallower sites in Lake Huron have indicated that the average corrosion rate of iron in these cold freshwater lakes is between $^{1}/_{10^{th}}$ and $^{1}/_{50^{th}}$ the rate normally observed for concreted marine iron in warm oxygenated seawater (MacLeod 1993). Thus the continued storage and management of these sites at a depth of 300 feet and in cold fresh water is probably the most advisable storage environment possible for the metals which hold together structural elements of the ships. It should be noted that biological decay would still be taking place and that any changes, such as the introduction of species from the discharge of untreated ballast water from passing ships, could have a devastating impact on the ecology of the wreck site since these animals colonise substrates such as degraded bones. The introduction of zebra mussels in Lake Huron has resulted in significant changes in colonisation of some sites. Site managers understand that biological decay will continue at a low rate and that ultimately human remains will be no longer discernable from the surrounding environment.

The submarine 'HL Hunley' (1864)

In the immediate aftermath of the sinking of the Union ship *Housatonic*, the Confederate submarine *Hunley* sank in the murky waters of Charleston Harbor in 1864, taking with her the eight members of the crew. This event marked a turning point in the American Civil War. The ill-fated submarine had previously met with two accidents, which resulted in all but a few losing their lives. The deceased previous crew members had received burial honours appropriate to the time and one complement of the crew were recently excavated from their common seafarers' grave and reinterred with full military honours in the Magnolia Cemetery in Charleston, South Carolina. The initial interment was without any ceremony to avoid attention being drawn to the secret nature of the assignments. The submarine designer Horace Lawson Hunley also lies in the Magnolia Cemetery after drowning with the crew in the second sinking. During the fall of 1999 the *Hunley* Commission organised a symposium in Charleston to consider the issues associated with the planned recovery of the *Hunley* in June 2000. A number of conservators and archaeologists met for three days to consider the issues associated with the recovery and subsequent excavation of the interior of the submarine.

This bold initiative of the *Hunley* Commission was to use the expert team to test the proposed methodologies of recovery and conservation. Apart from the archaeological imperative of trying to determine the physical reasons for the sudden sinking of the submarine, the other compelling reason behind the recovery operation was to 'bring home' the crew for burial. The *Hunley* has significance on an international naval history level as the first submarine to successfully deploy a torpedo and to sink a targeted vessel. It was determined that the vessel would be recovered and transported to a specially designed treatment and

holding tank in the nearby naval yard in Charleston Harbor. Once safely installed on the custom-built recovery cradle, the excavation proceeded in the laboratory using traditional archaeological techniques, while recording the maximum amount of data on the nature of the substrates within the containment vessel, the riveted wrought iron walls of the submarine (Mardikian 2004). A specially designed morgue that had been prepared to receive the captain and the seven other crew allowed for respectful storage of the human remains while the full forensic analysis was undertaken. Having concluded this work, which included DNA typing (Downs et al. 2002), facial reconstruction, forensic dentistry etc., the bodies were placed in coffins and given a full military funeral. The third crew were buried in the same area of the Magnolia Cemetery as the first two crews after a very public ceremonial journey from the laboratory through the streets of Charleston to their final resting place.

Since this submarine has played a pivotal role in the international development of underwater warfare, there were compelling naval historical reasons, as well as a host of archaeological imperatives, why the excavation should have proceeded. So many questions can only be answered via a recovery excavation. Owing to the black water conditions (very low visibility) of the site and the geological and sedimentary analysis which indicates that the site has been stable for more than 100 years, it was clearly an appropriate procedure to proceed with the recovery of the submarine (Figure 5). The provision of a purpose-built facility and the engagement of an internationally renowned shipwreck conservator on a 10-year contract are good indicators that all the conservation ethics associated with such a wreck have been taken into full consideration. The planned public exhibition of the treated submarine in the Charleston Museum will ensure that the information about the site, the wreck and its crew will reach the maximum audience.

RMS 'Titanic' (1912)

Within living memory, the wreck of the White Star Liner *Titanic* in 1912 stands out as one of the most significant losses in contemporary maritime history. Built as the 'unsinkable' vessel, her collision with an iceberg resulted in enormous loss of life. Over the past 20 years, a series of explorations of the site has shown scenes of stacked plates and other materials lying scattered on the seabed. Clearly in use at the time it was wrecked, cutlery and food utensils and peoples' personal possessions has an evocative power resulting in a strong emotional link to the wreck. All these factors have led to a very high level of public interest in the wreck and a great debate as to whether or not we should be interfering with a mass grave (Elia 2001).

Although the *Hamilton* and the *Scourge* wrecks claimed 53 lives and the *Pandora* consumed 28 persons, these paled in comparison with the *Batavia*, which took 125 men, women and children. However, none of these can match the total drama of the wrecking of the *Titanic*, since this stands out because of the 1,250 people who were entombed as the vessel sank. Part of the immense public interest in the *Titanic* and the materials existing on the site is how fast they are decaying or how well they are being preserved in a cold, low-oxygenated, high-pressure marine environment. Many of the objects, which lie scattered around the wreck site, have been crushed under the great surface pressures of a water depth of 3,800 metres (Ballard 1988) which provides conservators with unusual challenges. Artefacts skilfully conserved by Electricity de France in Paris and conservators at LP3 Conservation in Semur-en-Auxois, have been exhibited with great public acclaim (Montluçon & Lacoudre 1989).

Analysis of the iron fastenings on the lifeboat davit and on the massive spare connecting rod bearing show that the *Titanic* is corroding at approximately 1 mm in 80 years or 0.0123 mm/year, which is extraordinarily high for such a deep and cold wreck site, characterised by currents of about 0.2 knots and only 0.2 parts per million dissolved oxygen. The underlying cause for the rapid rate of decay of the *Titanic* 'tomb' also affects the rate of decay of human bones. The increasing solubility of calcium carbonate as pressure increases and temperature falls means that no protective concretion will form on the iron wreck (Berner 1971) nor will human bones remain stable. Apart from the increased solubility of calcium carbonate–based minerals in human bones, the iron corrosion products are acting as a major nutrient source in what is an inherently sterile environment. Thus the provision of essential nutrients to aerobic and anaerobic bacteria will accelerate corrosion and general decay (Stoffyn-Egli & Buckley 1995, MacLeod & Pennec 2004), and the acidic metabolites will accelerate the decay of human bones. The main factor associated with the loss of human bones on the *Titanic* wreck site is due to the greatly increased solubility of calcium carbonate with increasing water depth below the first few hundred metres, as shown in Figure 7.

Because of the high corrosion rate, the *Titanic* is undergoing a relatively rapid change in its condition, and the vessel is losing its ability to maintain an essentially intact burial site. With the use of specialised equipment for retrieval of artefacts from the scattered debris field, it is now relatively easy to carry out recovery operations. The crew of the salvage firm RMS *Titanic* Inc were not specifically briefed on the management of human

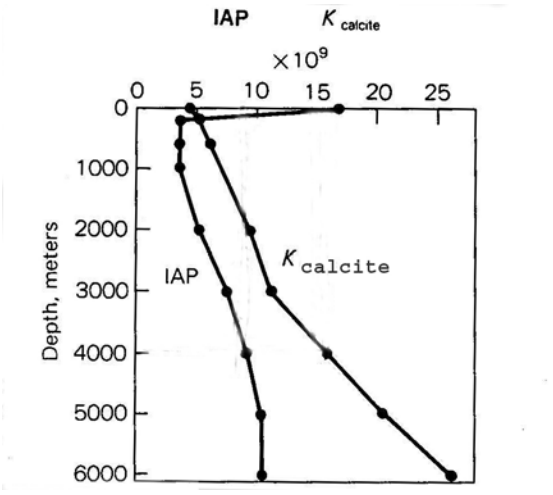

Figure 7. Distribution of ionic activity product (IAP) and the solubility constant Kcalcite with water depth in the North Pacific Ocean. (Principles of Chemical Sedimentology, 1971)

remains as none were expected to have survived in the deep conditions. However, they held a commemorative ceremony to honour the dead. The first evening after they arrived on site, the team leaders gave speeches and threw a wreath into the water off the stern. The ship's horn blew a long and haunting salute before the work of recovery began (Wozniak 2008).

While some would consider this opportunistic sampling of materials of historical and commercial interest, others see it as robbing the graves of the dead (Elia 2001). The counter-argument, provided by RMS *Titanic* Inc., is that they wish the story of the wonderful skill and craftsmanship that went into the material and the manufacture of the *Titanic* to be told to as wide an audience as possible. This is the reason why they recovered the massive 2½ tonne, 2m diameter spare coupling ring from the crankshaft which has cast white-metal bearings inside a giant cast-iron structure. Other objects, like oboes, clarinets and other woodwind instruments, have been placed on exhibition as poignant reminders of how the band kept playing as the ship went down. The sinking of the *Titanic* occurred at a watershed of what was a technological and a social revolution in shipping at the time. In that context, there is justification for recovery of selected materials, excluding human remains, provided that the objects form the core of an exhibition, in a museum-related context. Such exhibitions act as a memorial for those who died on the wreck. Public access to the site is not economically or environmentally sustainable so it could be reasoned that there is a social value associated with the development of this material and its exhibition. The *Titanic* exhibition material deliberately excludes any images of human remains as there are known living relatives of those who lost their lives on the vessel. To the author's knowledge there has been no hallowing service for the lost crew and passengers of this wreck site.

USS 'Arizona' (1941)

In 1941 the Japanese bombed the American naval base at Pearl Harbour, Ohahu, Hawaii, and many ships were sent to the bottom. The most famous of them all was the battleship USS *Arizona*, which lies on the bottom of Pearl Harbour and contains the remains of the thousands of American sailors who went down with their ship. The wrecks in this underwater national memorial park are under the control of the United States National Parks Authority. In the 1960s the Authority carried out corrosion surveys of material on the site in an attempt to establish the nature of the way in which the wreck is corroding. Currently they have an active management program for the site, but the site stabilisation options have traditionally been focused on maintaining the integrity of the site as an historic monument and a war grave, rather than direct intervention on the wreck (Lenihan 1989). Is it allowable to intervene on this site and install various cathodic protection treatment facilities that will halt, or at least slow down the corrosion rate of these significant wrecks? The alternative is to let them gradually corrode with the passage of time until they are but hollow shells of their former selves and very prone to collapse as a result of accidental anchor damage or being rammed by a large naval vessel. With increasing years the impact of the memorial might be seen to diminish as the numbers of families with living memories of World War II decreases, but the work of the National Parks Authority and their promotion of the site make this possibility less likely to occur. At this point, the impact of the site may diminish. Despite these uncertainties we have the responsibility for preserving the wrecks in their current condition in order that future generations might stop, look and think and be amazed at the enormity of the event that took place at the moment of the attack.

As former crew members of the vessel die the most common request is for their ashes to be interred in the third barbette so that they can lie among their fellow 1,100 sailors and marines who perished during the initial bombing raid. By actively conserving the structure containing the physical remains of former crew members it will be possible to preserve at least a significant element of the whole ship. In 1992 more than 1.5 million visitors toured the site of the USS *Arizona*. A recently published corrosion report on the *Arizona* (Johnson et al. 2006) has demonstrated the different microenvironment on the port and starboard sides of the vessel. The possibility

of incorporating some form of cathodic protection to allow for *in-situ* treatment of the whole of the battleship is currently being assessed by the US National Parks Authority. Owing to the proximity to shore-based power supplies of direct current the *Arizona* site presents a unique opportunity to keep intact the physical remains of a battleship and so preserve forever the human remains that lie interred on the site.

Future issues

The significance of historic shipwrecks and the preservation of the associated artefacts, the presence of human remains, and the contextual relationships of the wreck sites are not solely the preserve of the maritime archaeologists, material scientists or conservators. Proper handling of the ethical, religious and social implications of site management, recovery and conservation of human remains on wrecked aeroplanes and ships will make the public more aware of the true value of these cultural resources. Conservation training programs should include a topic on how to manage spiritual issues associated with human remains and sacred sites.

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Biography

Ian MacLeod manages the care and conservation of the collections of the Western Australian Museum and has nearly 30 years of conservation experience in treating materials from historic shipwrecks. He has a deep awareness of the spiritual presence on rock art sites, on shipwreck graves and on land sites where the dead lie in a troubled sleep. He has specialised in metals and rock art conservation and developed in situ conservation methods for preservation of iron shipwreck materials in the ocean.