In-situ preservation and storage: Practitioner attitudes and behaviours

Nicole Ortmann
Department of Archaeology, Flinders University, GPO 2100, ADELAIDE, South Australia 5001 Australia
Email: nicole.ortmann@alumni.ubc.ca
Jennifer F. McKinnon
Department of Archaeology, Flinders University, GPO 2100, ADELAIDE, South Australia 5001, Australia
Email: Jennifer.mckinnon@flinders.edu.au
Vicki Richards
Department of Materials Conservation, Western Australian Museum, Shipwreck Galleries, 45-47 Cliff Street, FREMANTLE, Western Australia 6160, Australia
Email: vicki.richards@museum.wa.gov.au

Introduction

In the last few years, trends in submerged cultural heritage management have been towards *in-situ* preservation and storage for a number of reasons, such as financial and curatorial considerations. *In-situ* forms of preservation and storage are consistently being emphasised as the preferred option under most circumstances for preserving submerged and waterlogged cultural heritage for future generations (Babits & Van Tilburg 1998: 590; Bergstrand & Nyström Godfrey 2007: 7; Corfield 1996: 33; Dean & The Nautical Archaeology Society 1992: 332; Green 2003: 470; 15; International Council on Monuments and Sites 1996: 1–5; Oxley 1998: 159; Stewart, Murdock & Waddell 1995: 793; United Nations Educational, Scientific and Cultural Organization 2001: 56–61). The United Nations Educational, Scientific and Cultural Organization (UNESCO) underscores the use of *in -situ* methods in its 2001 Convention on the Protection of the Underwater Cultural Heritage (United Nations Educational, Scientific and Cultural Organization 2001: 51, 58-60) as does the 1996 Charter for the Protection and Management of the Underwater Cultural Heritage adopted by the International Council on Monuments and Sites (International Council on Monuments and Sites 1996: 2). Many other organisations, while not formally installing *in-situ* preservation into their by-laws or constitutions, still stress the importance of this concept in their educational programmes; the Nautical Archaeology Society (NAS) in the United Kingdom is one such group.

Textbooks focussing on underwater archaeology or heritage management often include sections about *in-situ* preservation (Babits & Van Tilburg 1998: 590; Dean & The Nautical Archaeology Society 1992: 332; Green 2003: 470). However, a review of these texts shows that the concept is poorly defined. While archaeological sites in submerged and wetland areas continue to be located, proving that natural preservation is possible, the chemical, biological and physical mechanisms behind these finds have only recently begun to be explored and the results have not yet filtered into the textbooks (Caple *et al.* 1997: 57; Corfield 1996: 32; Manders 2004: 279; Oxley 1998: 159).

With UNESCO having taken effect on 2 January 2009, the prevalence of *in-situ* programmes stands to increase and the methods used could impact protection of submerged cultural heritage either positively or negatively. As more emphasis is placed on protecting submerged cultural heritage, it becomes crucial to understand how *in-situ* preservation and storage is perceived and utilised to protect submerged heritage.

In 2008 a questionnaire was developed to query and evaluate attitudes towards the use of *in-situ* preservation and storage by practitioners throughout the world. At a basic level, it was designed to determine who is using *in-situ* preservation methods and why, what the motivations and reasons are for using or not using these methods and what methods are most prevalent and why. The questionnaire aimed at identifying the issues facing advocates and opponents alike and highlighting the practical, academic and personal reasoning that is currently informing practitioners' attitudes towards the practice of *in-situ* preservation and storage. Further, by demonstrating these current attitudes, the questionnaire would allow practitioners to engage in meaningful dialogue. This dialogue will help steer research towards not only developing improved methods from the scientific point of view, but also understanding the ethical issues of preserving submerged cultural heritage, implementing sustainable management programmes and continuing to gather the types of data integral to archaeological investigations. This paper presents the results of that questionnaire.

Developing and delivering the questionnaire

A number of texts were consulted for the development of the questionnaire (Alreck & Settle 2004; De Vaus 2002; Foddy 1988; Foddy 1993). The sampling method chosen to define participants followed the method of non-probability purposive sampling (De Vaus 2002: 91). This is based on the notion that the questions to be asked require a certain amount of insider knowledge in the field of maritime and underwater archaeology, as well as conventional and *in-situ* methods of preservation. An initial list of those invited to participate was drawn in part from a review of the relevant literature; this provided a solid basis from which to expand as it was composed of current practitioners in the scientific, archaeological and heritage conservation and management communities. In addition, discussions with individuals from within these communities and known to the researchers identified other participants through professional relationships. The Nautical Archaeology Society in the United Kingdom agreed to circulate a request for participation to the

membership, and the web-based Museum of Underwater Archaeology (MUA) posted a notice on its website. Other groups included members of The Conservation Digest and Sub-Arch list serves, as well as the Society for Historical Archaeology (SHA), the Australasian Institute for Maritime Archaeology (AIMA) and the American Institute for Conservation (AIC). Through this method of networking, a representative sample of practitioners covering most professions, such as research scientists, archaeologists, conservators and academics in related fields, was created.

The people involved in the practice of *in-situ* preservation and storage are a varied group with a diverse knowledge base. They work in countries around the world in a number of different areas, such as government heritage agencies, public and private museums, university departments, not-for-profit agencies and consulting firms. As a result, the questionnaire had to be developed in such a way as to be understood by this entire group—not just in terms of possible language barriers, but also in terms of inclusive definitions.

In terms of survey design, preliminary research identified two main theoretical areas to pursue: attitudes and behaviours. Surveys designed to assess attitudes investigate how existing knowledge affects actions (Alreck & Settle, 2004: 13–14). This was intended to highlight the familiarity of practitioners with the literature about *in-situ* preservation and storage and its influence on their actions. The second, behavioural survey, was intended to assess questions such as 'what, where, when and how often' (Alreck & Settle, 2004: 20) in order to understand the types of *in-situ* preservation and storage methods previously used, those being currently used and what techniques may be used in future. It also allowed for the ability to identify changes in patterns and routines (Alreck & Settle, 2004: 20–21).

It was important to define some of the key concepts that would be discussed in the questionnaire. Thus the following definitions of *in-situ* preservation and *in-situ* storage were provided to the participants along with definitions for archaeological survey, conservation survey, excavation, monitoring, underwater site and waterlogged terrestrial sites.

In-situ *preservation*
Any steps taken on a site or intervention with a site in order to extend its longevity while maintaining original context and spatial position; while artefacts and features may have been excavated and/or removed, the site itself remains in place and retains all or a majority of its original context.

In-situ *storage*
Any steps taken to preserve the physical, historical and aesthetic integrity of artefacts and features excavated from a site through the creation of a separate space where items are stored within the confines of an environment similar or deemed to be more beneficial to that from which they were removed.

By using the definitions presented above, the questionnaire could be analysed in a consistent manner. The definitions were also intended to focus respondents, hopefully reducing the numbers of varied interpretations that can occur with self-administered questionnaires (De Vaus 2002: 49). Defining *in-situ* preservation and storage early on in the process also aided in creating indicators that would later be developed into the questions posed.

It is important to note that limitations are expected with surveys. Those identified as issues in this questionnaire included failure of participants to respond (Alreck & Settle, 2004: 37, 205), individual participants interpreting questions in different ways (Foddy 1993: 189), issues between the relationship of what respondents reported they did and what they actually did (Foddy 1993: 3) and misapplication of statistical methods (Alreck & Settle 2004: 269). Some of these, such as the use of the correct statistical methods, have been addressed through research and questionnaire design, as well as understanding the types of questions asked. Others, such as response rates, were accepted as inherent risks to survey methodology.

The best delivery system for this questionnaire was an online method, using the free survey software SurveyMonkey™. This allowed participants to access the questionnaire easily and eliminated the inherent problems associated with completing paper questionnaires and return post although this option was also made available (Alreck & Settle, 2004: 183).

The analysis tool provided by SurveyMonkey.com™ is relatively simple. As a more in-depth analysis was desired, a separate statistical analysis programme was utilised. SPSS™ Statistics 17.0 (formerly Statistics Package for Social Sciences) was the programme used to analyse data collected from the questionnaire.

Results of the questionnaire

The questionnaire was sent to 210 individuals in 12 countries. Eighty-nine individuals responded which represents a response rate of 42%. Typically response rates for surveys tend to be low; however in this instance the response rate was high based on standard response rates to surveys (Alreck & Settle, 2004: 35, 205). It is possible that this response rate represents a high degree of interest in *in-situ* preservation and storage by practitioners, or that practitioners in general are pleased to respond to surveys. The population size of those interested in the preservation of underwater cultural heritage is small and many of the respondents knew at least one of the researchers and in some cases all three which may also account for a high response rate. Nevertheless, the response rate was encouraging.

It is difficult to assess whether or not the sample is representative of the population. This stems in part from the fact that the total size of the population is difficult to determine. Archaeologists and cultural heritage managers are often required to work in a variety of sectors and sub-disciplines other than maritime or underwater archaeology. Conservators also may be specialists or work in a variety of areas. It becomes even more difficult to

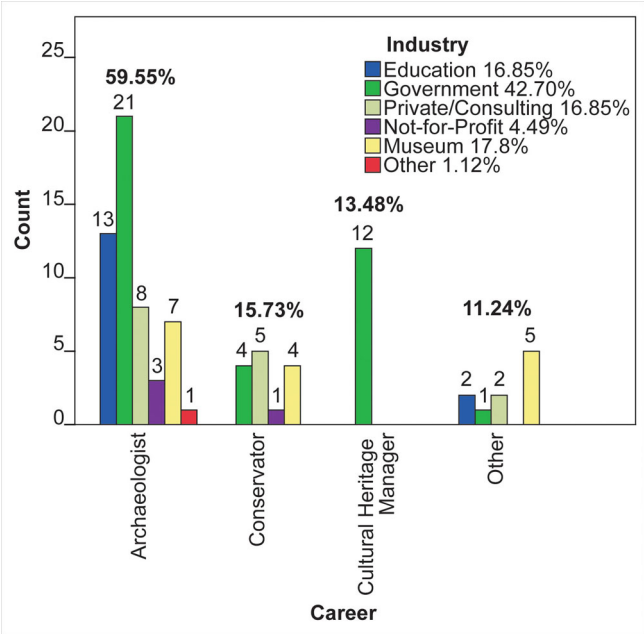

Figure 1. Responses by percentage and career versus sector.

determine the numbers of those individuals who work in disciplines such as chemistry, biology or oceanography, where interaction and interdisciplinary discourse may occur, whether frequent or infrequent. When all of these factors are taken into account, the sample may be more representative of archaeologists, cultural heritage managers and conservators than any other group.

Background information

As the development and use of *in-situ* preservation and storage is a multidisciplinary one, patterns can be brought to light about how the different careers and sectors viewed these methods. Two introductory questions were created that focused on how the respondents viewed themselves in terms of their profession and sector (Fig. 1).

The comparison of career versus sector shows some expected results. All cultural heritage managers are employed in the government sector, as are a large number of archaeologists. Museum staff are evenly divided between archaeology, conservation and 'other'. None of the respondents were chemists, biologists or oceanographers. This does not mean that these professions are not involved in preservation of underwater cultural heritage. It is possible that they were either among those who did not participate or they responded, but did not view those categories as their primary profession.

Sector designations themselves were not without issue. Respondents could define themselves within more than one sector. For instance, in some countries, museum employees are also government employees.

Section A: General site questions and Section B: *In-situ* preservation and storage

The largest portion of the survey was split into two sections (A and B) and focused on what types of *in-situ* preservation and storage are utilised and how many practitioners are using these procedures. The questions were developed on the basis that there should exist three types of practitioners: those who use *in-situ* preservation, those who have used it in the past but no longer use it and those who have never used it. It also stood to reason that there would be a number of factors influencing decisions about the use of *in-situ* preservation and that in many cases it would be unlikely to stem from a single reason.

Section A addressed the general conditions of sites regularly investigated by the sample population. Question A1 concentrated on types of sites and demonstrated that a full complement of sites are being investigated, with the two most prominent being shallow sites (those less than 10 m) and mid-depth sites (those between 10 m and 30 m). How the sites were situated relative to their environment also proved extensive in range, with those partially buried and those in a constant state of flux most dominant (A2). Archaeological surveys and excavation were the types of investigation most prevalent, though more than half of respondents have also performed conservation surveys on sites (A3).

Visual inspection of materials and basic measurements, such as temperature, salinity and water pH were the most readily recorded information collected during conservation surveys (A4). Responses provided in the 'other' category include wood identification, bacterial analysis and tests for biological degradation. While 49 respondents specified that they had conducted formal conservation surveys (A3), 59 responded to just collecting specific conservation survey data (A4). This demonstrates that while formal conservation surveys may not be undertaken all the time, collection of some pertinent data may be collected as part of another activity.

Seventy-nine of the 81 respondents who specified they had undertaken excavations had participated in conventional excavation and retrieval followed by conservation of recovered material remains (A5). Two-thirds have used *in-situ* preservation, while over one-third has used *in-situ* storage. Sixteen report having worked on sites in which the material remains were destroyed after excavation. As expected, the majority of materials excavated were wood/cellulose organics and ferrous metals, though all materials were well represented (A6).

Some respondents took advantage of the open-ended response area at the end of Section A to clarify and expand their answers. Many of them noted that it was difficult to generalise about sites as the methods of survey and excavation are decided upon in a site-specific manner. This was one of the limitations noted during the development of the survey, but was acknowledged as an acceptable risk. Comments made by respondents will be further explored later in the article.

Figure 2 shows that, of the respondents, 70 have previously used some form of *in-situ* methods and techniques, while 13 respondents have never used any form of *in-situ* preservation (B1). In the follow up question (B2), of the 70 respondents who have utilised *in-situ* preservation and storage, almost all (66) stated they

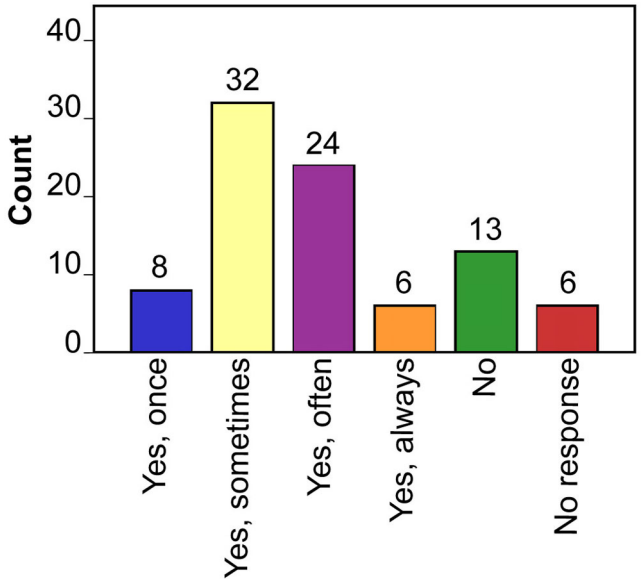

Figure 2. Responses to use of *in-situ* preservation and storage (B1).

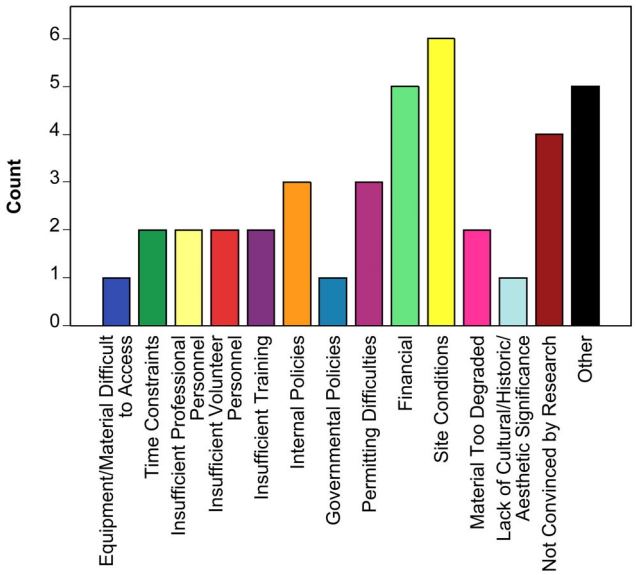

Figure 3. Reasons for never using *in-situ* preservation (B13).

would continue to use these methods and techniques, while three would not.

For those who have never used *in-situ* preservation or storage (B13), 'site conditions' was given as the primary reason, followed closely by financial considerations and 'other' (Fig. 3). Of the five reasons listed in the 'other' category, four respondents cited excavation and recovery of all cultural remains. Lack of convincing research also featured prominently. As thirteen people answered this question and there were 39 responses, each respondent had on average three reasons for not choosing to use *in-situ* methods and techniques. As expected, complex issues appear to be involved when making site management decisions.

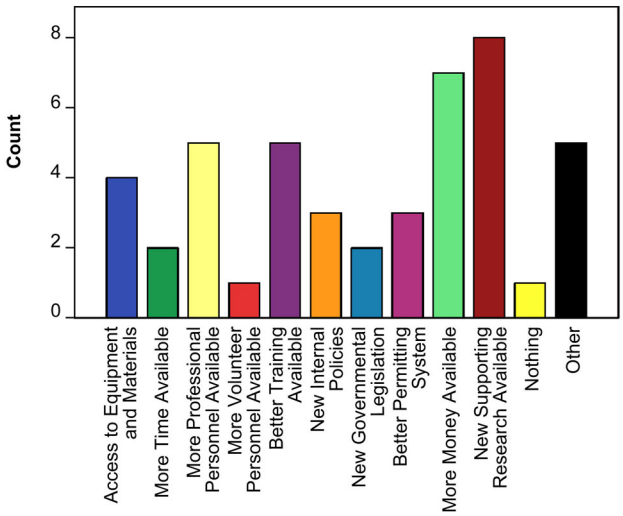

Figure 4. Reasons given for reconsidering use of *in-situ* methods in the future (B4 and B14).

Of the three respondents who have used *in-situ* methods and techniques in the past but have chosen not to continue using them (B3), access to equipment and materials to carry out the necessary work and 'other' were two main reasons. This is slightly misleading as one of the responses in the 'other' category was the respondent felt there was not enough research to support the idea, although with the caveat that they felt that this was primarily in regards to *in-situ* storage rather than *in-situ* preservation. This response could have fit within the category of 'insufficient suitable research'. Government legislation was a factor for one of the three respondents.

For all those not currently using *in-situ* methods and techniques (B4 and B14), new supporting research and access to funds were the two main reasons given for reconsidering their decisions in the future (Fig. 4). Also important was having access to professional personnel and better training. A number of other factors were raised under the 'other' category. One respondent would use *in-situ* preservation and storage provided there would continue to be the ability to learn from the site and it would not be used simply as a way to avoid the issues inherent in managing sites. Another would consider utilising *in-situ* methods as long as there remained the guaranteed ability for site access and that it could be done in a way that would prohibit looting. For one other respondent, site size, quantity of material and site location were factors for consideration.

As there was a possibility that career and sector demarcations impacted whether or not *in-situ* preservation and storage was employed, the background questions were

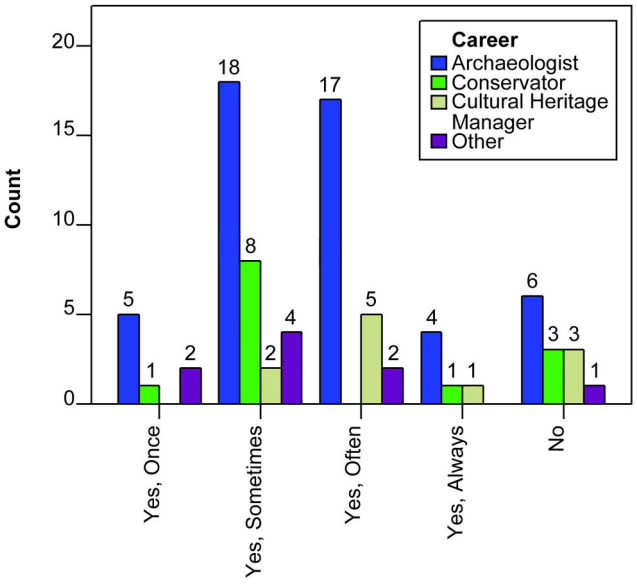

Figure 5. Career versus use of *in-situ* methods.

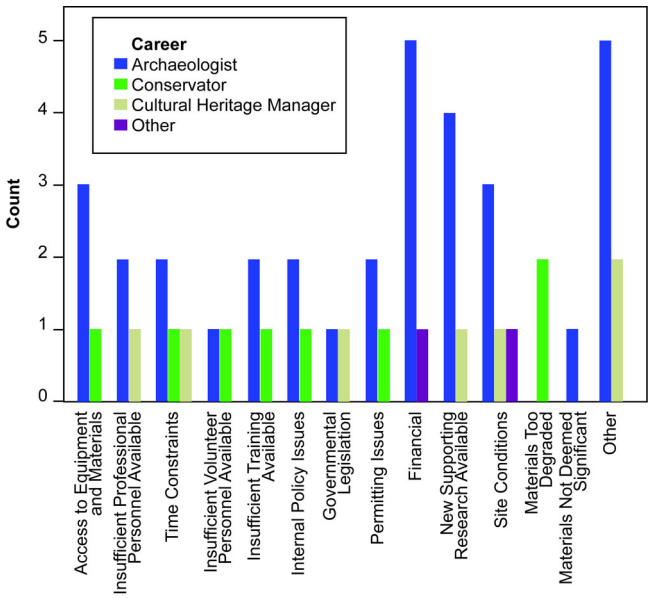

Figure 6. Career versus reasons for not using *in-situ* methods.

analysed alongside responses to use. Figure 5 presents a graph showing that a majority of archaeologists (66%) use *in-situ* preservation and storage. A similar pattern is apparent in all other cases, though conservators and cultural heritage managers were more likely not to have used *in-situ* methods. There are several possible reasons for this. In the case of cultural heritage managers, the prospect of government interference or indifference exists, as does time and funding issues. Also, cultural heritage managers may not be trained in archaeology, but rather management, and thus would not be expected to conduct such methods. Conservators, on the other hand, may be more likely to have assessed the sites and determined that *in-situ* preservation was not appropriate. It is also possible that many conservators do not dive and are essentially laboratory based, conducting active conservation on recovered artefacts.

A review of Figure 6 shows that conservators did have a reason for not choosing to utilise *in-situ* methods and techniques in certain instances. Materials that were too degraded were not deemed suitable. However, conservators were, as a whole, influenced by many of the same factors as archaeologists and cultural heritage managers, such as lack of personnel to carry out the procedures, permitting issues and inability to access required materials and equipment. Perhaps this graph best demonstrates that there are a number of factors that influence the use of this form of preservation.

A number of statistical tests for measure of associations were run; these included Lambda, Cramer's V, Goodman and Kruskal and Uncertainty Coefficient. These associations showed little to no relationship between choice of career and decisions to use or not use *in-situ* preservation and storage. Since no obvious relationships exist, decisions may derive from institutional or agency policies, availability of personnel, previous education, personal experience and financial concerns.

In terms of approaching which *in-situ* methods and techniques would be used (B5), the large majority of respondents noted that their choice would not necessarily be the same as approaches previously taken. Reasons for this (B6) centred on the development of site-specific programmes, access to money and the availability of new research and techniques. This clearly follows the pattern of thought put forth by many respondents in Section A, concerning the difficulties in generalising about sites.

The responses to the question B7 show that reburial and sandbagging are the primary methods of *in-situ* preservation being used by practitioners. Shade cloth and geotextiles have been used by a third of respondents, as has the technique of sediment drops. While sacrificial anodes were overlooked as a response in the development of the questionnaire, perhaps an unforgivable oversight, it did appear as a response to the 'other' category. Also noted was the building of underwater containers of sorts, either for the deposition of sediment (i.e. road crash barriers) or as open water storage boxes in anoxic waters.

In-situ storage has been used by practitioners in a number of circumstances, such as on sites threatened by development or where the environment was seen as detrimental to the ongoing survival of material remains. One respondent noted that storage was used to facilitate research access to recovered artefacts; another expanded this thought by adding that locating artefacts was made easier by *in-situ* storage. Five respondents mentioned lack of project funding, while three others mentioned that storage was used to inhibit looting by divers. Responses showed the majority of reburial in instances of *in-situ* storage was in an environment similar to the original site (B9). Most respondents who reburied materials in a different environment failed to address the follow-up question posed. Of those that did, one cited the best

compromise available at the time, designed to keep the timbers wet, another pointed to the decision to use an area that was less prone to scouring and a third noted that the move from beneath the sediment into open water occurred in a specific environment in which anoxic levels existed above and below the sediment.

While the majority of respondents did not use packaging materials in their reburial schemes (B10), of those that did use a variety of materials, the most popular was tagging items. In one case, net-lined cradles were constructed to hold amphorae. Twelve of the 24 respondents used some type of marker to re-identify artefacts. Where packaging materials were not used, the majority of respondents believed they were unnecessary. Time constraints also played a role in the decision to forego packaging.

A variety of comments were made in the open-ended section at the conclusion of Section B. Some respondents used the space to clarify their stance; others expanded answers given by providing more particulars about specific sites. Responses to this section will be discussed later in the article.

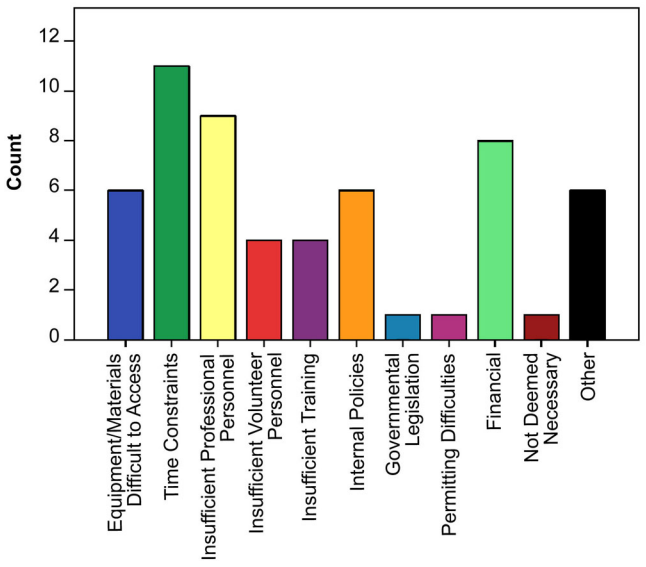

Figure 7. Reasons for not utilising monitoring (C8).

Section C: Site monitoring

The third section of the questionnaire focused on monitoring sites. Early on, the decision was made to allow respondents who do not use *in-situ* preservation and storage to answer questions in this section. While monitoring in itself may not actively preserve the site, it is an integral part of the *in-situ* process and due to the assumed cost efficiency, it was presumed to be one of the more well-utilised methods.

Sixty-two of the 81 respondents answered "yes" to having some form of monitoring plan (C1). Of those 62, only 13 report formal monitoring schedules exist (C2). Types of schedules include purposively timed site visits and on-site dataloggers. Those who do institute formal schedules, however, often have difficulties maintaining them. Four respondents remarked that while they make every attempt to maintain the set schedules, planned excursions are often interrupted by weather, availability of personnel, funding and politics. Two respondents noted that over the course of their careers, they have worked for institutions that have either not monitored at all or only monitor certain sites.

Reasons for monitoring sites were varied. Most included a combination of ensuring the integrity of the site, updating existing site plans and monitoring *in-situ* preservation. Other reasons focused on cultural heritage management of public sites by ensuring safe access for the diving community, cleaning interpretive materials and monitoring occurrence of looting. One respondent was concerned about whether *in-situ* methods were able to preserve the integrity of the site.

For all respondents, visual means of monitoring such as on-site note taking, photography and videography were the most prevalent forms of monitoring (C4). Although not asked in the questionnaire, a likely reason for this is that it remains a relatively cost-effective procedure that can rely on volunteers, pencils and paper at its minimum. Almost half of respondents use other methods, such as sampling and analysis of materials and sediment or corrosion measurements. Cameras and video equipment remained the most chosen pieces of equipment (C5). Other responses included total station; multibeam and side scan sonar; dataloggers and sediment corers.

Two-thirds of respondents relied on single use equipment brought to the site each time for collecting measurements (C6). Of the remaining third, only five had permanent monitoring equipment set up on site, while 17 collected samples and analysed them ex situ. Twenty-two respondents commented on whether or not they would make changes to their monitoring process and what those changes would be (C7). Four believed that their monitoring programmes were adequate. Four would like to use on-site equipment, while two would employ advanced technology or newer equipment on site. One respondent had begun to incorporate an on-site corrosion study into the monitoring scheme. Seven references were made to being constricted by available funds and four cited personnel as the deciding factor. Volunteers were considered to be integral to site monitoring, with one respondent looking to involve more avocational groups in data collection.

Time constraints, lack of availability of professional personnel and lack of adequate funding were the primary reasons chosen by those who do not monitor sites (Fig. 7). Other important issues are the internal policies of the organisation and difficulties accessing equipment and materials. Two respondents reported a difficulty that could be prevalent in consulting projects: the inability to access the site once the project is deemed complete. This could have serious ramifications for sites that are not in the public domain. There remains the chance that treasure-hunters or salvors will manage to circumvent government legislation and policy, especially when practitioners already report that lack of funds and personnel currently hinder site management.

Factors that would cause respondents to reconsider their stance on monitoring paralleled those reasons given for not monitoring. Increased funding and available time were the main considerations. One respondent noted the inherent difficulty in coercing clients to carry out continued monitoring after the consultancy was completed. While recommendations may be made in the final report, once the contract of employment comes to a close, little can be done in the way of ensuring recommendations are carried out.

The open-ended question following Section C was also well utilised. Again, many chose to clarify or expand their answers; lack of funding and personnel remained a theme throughout. These comments will feature more prominently in the discussion of emerging issues below.

Open-ended results

The previous section presented a quantitative analysis of the administered questionnaire. The comments made in the open-ended sections of the questionnaire are qualitative and perhaps more telling than the numbers of practitioners using *in-situ* preservation and storage or how many used which method.

When reviewing the statements made by practitioners in these sections, five main themes emerged:

1. Practitioners point to the lack of convincing research into methods and a shortfall of quantitative data demonstrating the success of in-situ preservation and storage.
2. The ease with which some agencies approach *in-situ* preservation and storage, which can be misread as an 'out of sight, out of mind' attitude, raises concern among practitioners.
3. The idea that *in-situ* preservation and storage is meant to curtail any and all excavation and the implications that mentality has on the discipline of maritime archaeology concerns archaeologists in particular.
4. The idea that *in-situ* preservation and storage is the 'best' form of conservation for underwater cultural heritage concerns a broad range of practitioners.
5. Practitioners are concerned with how *in-situ* methods and techniques impact access in terms of researchers and the general public.

Each of these issues is an important aspect in considering the options available to practitioners for choosing to use or not use *in-situ* preservation methods. Obviously, different understandings exist about *in-situ* preservation and storage and these need to be addressed. Below, issues identified from the questionnaire will be approached separately in terms of the effects on practitioners and what dialogue and research is necessary to create a cohesive approach that is acceptable to all practitioners involved.

Lack of convincing research and a shortfall of quantitative data demonstrating success

It is imperative that the techniques and the science on which *in-situ* preservation and storage strategies are based continue to be investigated and published. This is highlighted in the questionnaire, with 35% of respondents choosing not to use *in-situ* preservation and storage due to a perceived lack of supporting research. Two responses take this idea of insufficient research one step further; the first commented that the science behind *in-situ* techniques remains poorly developed, while the second queries how and where investigations take place.

A review of the literature on *in-situ* preservation clearly demonstrates that while a small percentage of practitioners believe the science to be underdeveloped, this is not the case. The physical, chemical and biological mechanisms associated with preservation and decay have been, and continue to be, explored. The research is well structured, following accepted tenets of scientific research (Bergstrand & Nyström Godfrey 2007; Gregory 2007; Helms 2005; Helms *et al.*, 2004; Huisman *et al.* 2008). Researchers themselves remain acutely aware that there are still many factors that require further investigation and where gaps in the literature exist, research remains ongoing (Björdal *et al.* 2000; Björdal *et al.* 1999; Björdal & Nilsson 2008; Björdal & Nilsson 2007; Björdal & Nilsson 2002; Björdal & Nilsson 1999; Bohm *et al.* 2007; Gregory 2007; Helms 2005; Helms *et al.* 2004; Nilsson 1999; Nilsson & Björdal 2008a; Nilsson & Björdal 2008b; Nyström Godfrey *et al.* 2007; Peacock 2007; Richards & MacLeod 2007).

It is likely that where such results are published plays a key role in the perception that scientific research into the processes of *in-situ* preservation and storage is underdeveloped. Due to the nature of this research, it tends to appear in scientific journals such as International Biodeterioration and Biodegradation or in conference proceedings by specialist groups, such as the conservation committees formed within the International Council on Monuments and Sites (ICOM). Even if practitioners are aware of these publications, they may be difficult for those outside of the discipline to understand, thus affecting knowledge and access.

As to whether or not experimentation with techniques should be carried out on archaeological sites, field projects such as 'Reburial and Analyses of Archaeological Remains' (RAAR), a study taking place in Marstrand, Sweden, designed to span 50 years in order to explore the long-term outcomes of reburial on archaeological materials, are important to the study of *in-situ* preservation and storage, particularly when coupled with laboratory experiments. Important information has also been gathered during projects completed on archaeological sites that are actively being investigated. Comments provided in Section A of the questionnaire stress the significance of site-specific choices when investigating underwater cultural heritage. Data collected during two European Union sponsored projects, 'Preserving cultural heritage by preventing bacterial decay of wood in foundation piles and archaeological sites' (BACPOLES) and 'Monitoring, Safeguarding and Visualising North-European Shipwreck Sites' (MoSS), allowed researchers to explore how different materials, environments and processes on varying sites affect preservation (Manders

2004: 279). So while the respondent correctly identifies the need to devise off-site controlled experiments in order to isolate important variables, it is neither practical nor feasible to halt experimentation on archaeological sites.

The lack of funds and personnel available to properly manage sites, including the use of *in-situ* preservation and storage in many instances, also has ramifications in terms of laboratory or field experimentation. Both of these problems seriously limit the number of experiments that can be undertaken. Not exploring these ideas on archaeological sites may be detrimental in the end, as at-risk sites may be left to deteriorate further in the interim. For example, even though it served as only a temporary fix, sandbagging *William Salthouse*, a wooden wreck located in Port Philip Bay, Victoria, Australia, allowed cultural resource managers to investigate a more permanent way to stabilise the wreck (Harvey 1996: 1; Hosty 1988: 13). The experimental use of artificial sea-grass on the site provided, for the most part, protection in the medium term. Had the decision been made not to test the sea-grass theory, the site may well have been destroyed before an acceptable off-site experiment produced the necessary supporting data.

On the wreck of *James Matthews* in Western Australia, sandbags again have provided adequate, though understandably temporary, protection without having a detrimental effect (Godfrey *et al.* 2005: 64; Winton & Richards 2005: 79). The project has ably combined temporary measures with off-site experimentation of plastic 'crash barriers'. The off-site experiment has yielded important information (Winton & Richards, 2005: 86–87), but in reality the use of a larger matrix around *James Matthews* may have unforeseen difficulties which have the potential to adversely affect preservation. There remains a certain amount of inherent risk regardless of how much off-site experimentation is completed. As long as it is carried out in an ethical and logical fashion, experimentation on archaeological sites has the ability to provide new data and to perfect methodology while providing real-time preservation.

Results from phase one of the RAAR project underscores the need for continued research (Bergstrand & Nyström Godfrey 2007: 7–8). Previous conclusions such as the 50 cm anoxic burial depth have been shown to be less reliable than originally believed (Bergstrand & Nyström Godfrey 2007: 8). Preliminary results also show that reburial of certain materials may be problematic and that reburial may be more material specific than first assumed as, for example, with glass and low-fired earthenware (Bohm *et al.* 2007: 25–26).

More research is also required to fully characterise the nature of the anoxic burial environment and the microbes present. Not only is it not yet known which bacterial species cause biodeterioration of organics (Björdal & Nilsson 2008: 869), but also it is not understood how the use of various elements such as sulphur and iron by these organisms will affect long-term preservation of reburied materials (Huisman *et al.* 2008: 33). Other parameters, such as pH and redox potential also need to be better understood through sampling and monitoring the environments on site (Caple 1998: 122). New technologies will inevitably aid researchers in collecting this data. While Gregory (2007: 25) believes that at present dataloggers can be unreliable and expensive, he feels that advances in their design may make them more relevant for practitioners in the near future.

There is no doubt that the literature points to the steady and continued accumulation of quantifiable data supporting *in-situ* preservation and storage. While by no means complete, the level and quality of data to date points to the usefulness of *in-situ* techniques within underwater cultural resource management and practitioners generally accept this to be true. Nonetheless, exploring long-term effects and developing cost-efficient techniques should remain at the forefront of investigations into *in-situ* preservation and storage.

In-situ *equals 'out of sight, out of mind'; maintaining active management*

Practitioners also expressed their concern that while *in-situ* preservation and storage provided cost- and resource-effective means of protection, they may be manipulated by those who fund management programmes, leaving sites only marginally protected. Three respondents spoke of the fear that government management agencies prefer *in-situ* management programmes as they appear to be a 'do-nothing' approach that leaves the cultural heritage both out of sight and out of mind. Another notes that when "you can't tell the difference between in-situ [sic] preservation and neglect then its [sic] actually just neglect". Some practitioners find it concerning that the potential may exist for bureaucrats intent on protecting the financial bottom line to adopt the 'do-nothing' attitude and label it *in-situ* preservation. It is imperative that a clear and concise definition of *in-situ* preservation and storage exists to counter this misconception. *In-situ* preservation must be viewed as an active tool, which incorporates monitoring and pro-active initiatives to slow deterioration.

Some agencies have used *in-situ* preservation and storage to their advantage. For example, Davidde (2002: 83) explores the Italian approach to underwater resource management. While the primary focus is on public accessibility, the use of *in-situ* methods has allowed the Italian Government to actively manage sites for which they are responsible. In the United States, Florida is also dedicated to preserving submerged heritage for public access and has used sacrificial anodes and conservation surveys to help maintain their system of underwater parks and trails (D. Scott-Ireton, 2008, pers. comm., 22 September). What is interesting in this small sample is that areas developed for or frequented by the public are likely to be preserved in a more proactive fashion than those less accessible.

What is less obvious is whether sites outside the public sphere receive the same level of treatment. Possibly those sites that have a champion or a significance that stirs public opinion, such as the Duart Point wreck (MacLeod

1995: 53; Gregory 1995: 61; Martin 1995: 15) or HMS *Pandora* (Guthrie *et al.* 1994: 19; Gesner 1993: 7), may be more likely to receive treatment than those without. While it is indeed difficult to afford every site the same level of investigation and protection, it may be easier to not become involved if *in-situ* preservation and storage becomes entwined with the 'do-nothing' attitude. Not all agencies approach *in-situ* methods and techniques as a cost-efficient management tool. One respondent reported their agency viewed *in-situ* as too expensive in terms of time commitments.

Most practitioners also viewed monitoring as an important yet often underdeveloped element of both *in-situ* preservation and storage and site management. Access to funding and personnel was once again a reason for failure to monitor, even though it was understood to be essential to the site's management plan. Again, those funding work appear to be less than convinced of its necessity; "[W]e are still in the middle of a political fight to get enough funding to be able to execute an overall monitoring scheme" reports one respondent. In other words, state department managers need to be convinced of the necessity. These responses point to a need to educate policy makers, budget designers and management above the level of the practitioners.

One method that appears regularly in both the literature (Beasley 1994: 150; Hall 1994: 157) and questionnaire responses is the use of avocational archaeologists to assist where funding and personnel are limited. One respondent noted that management plans for several World War II vehicles included the training of locals as site stewards and engaging with dive operators as these groups represent stakeholders in the resource. While this is one way of circumventing the lack of funding and personnel, it does nothing to hold agencies accountable for the resources under their control. Involving the public in the management of their heritage is certainly a key to managing sites as well as lobbying agencies. What else can be done beyond increasing funding in order to mobilise agencies is yet to be determined.

Curtailing excavation

In-situ preservation and storage has unfortunately acquired a negative persona in some circles. This is a result of two different groups: commercial salvors or treasure-hunters and archaeologists. The first group wishes to exploit the resource for monetary gain and often manipulates public opinion by claiming *in-situ* techniques are unsuccessful and that they are in fact protecting underwater cultural heritage by retrieving it for the public (Grenier 2006; Hall 2007: 2). One respondent mentioned the intentional use of deceptive information by treasure hunting and salvage groups in order to convince the courts and the public that *in-situ* techniques do not protect submerged cultural heritage.

A small number of archaeologists in the questionnaire, on the other hand, caution against its use by pointing out that it can prevent excavation and, therefore, the collecting of archaeological knowledge. Comments made in this vein included "…[w]ithout excavation we learn nothing, either archaeological, historical or technological. Leaving it to the future is a cop out". Although in this case, the respondent did concede that *in-situ* preservation and storage does have its place within maritime archaeology. Another felt that the development of maritime archaeology could be hindered by the lack of excavations in recent years, citing 'a continued regression in training and technology which are a direct consequence of the continued (and increasing) reluctance to proactively and intrusively investigate sites'. One other respondent believed that money spent on poorly understood *in-situ* techniques was money not spent on collecting data that can 'justify the importance of maritime archaeology'.

Interestingly, the literature does not support these allegations. It was difficult to locate many articles that developed the idea that preservation of underwater cultural heritage was curtailing excavation. For example, Sutherland (2002: 163) feels that a misunderstanding of marine artefact conservation, especially the emphasis on the expense involved, means that sites that could be contributing knowledge are not being excavated. She then ties this into the ease with which these same sites then become victims of treasure hunters and salvors. Browsing the contents of the International Journal of Nautical Archaeology certainly gives the impression that excavation is continuing to occur. Is this then an issue only in the minds of a few, or is it far more prevalent? If indeed it is being voiced in the back room at conferences with growing emphasis, practitioners need to bring it to the forefront of discussion in order that it can be addressed.

Projects, such as RAAR are also beginning to show that there is the possibility of utilising *in-situ* storage methods in order to continue exploring sites through excavation. The prospect of creating storage areas that will allow for the retrieval of material for research holds for some the answer to maintaining a balance between preserving submerged cultural heritage and continuing to collect knowledge. Certainly, a framework will need to be created that takes into account risks to the cultural material and shipwreck, as well as risks to the environment and ecology of the created storage area (A. Viduka, 2008, pers. comm., April). Also important in this debate will be public access factors.

The literature does provide ample examples of articles about the ethics of treasure hunting and commercial salvage, although these seem to be written from the archaeological perspective. It has been noted that, unlike other archaeological sub-disciplines, maritime archaeology appears obsessed with the illicit procurement of artefacts (Maarleveld & Auer 2008: 69). Within the structure of the questionnaire, it was impossible to distinguish those archaeologists working for treasure hunting or salvage groups on the basis of their answers. This is contrary to one respondent's statement that: '[t]here is wide-spread confusion among members of the professional community, as well as among the public regarding in-situ [sic] preservation and storage. This is intentional among some segments of the salvage/treasure-

hunting groups to justify the 'marine peril' argument that furthers their chances of success in obtaining salvage awards'. In fact, the majority of archaeologists cited the lack of funds and other issues, such as complete excavation of sites, as reasons for not using *in-situ* techniques.

The above examples clearly demonstrate one of the problems inherent with self-administered questionnaires. There is no way to determine whether or not respondents are providing an accurate picture of reality (Foddy 1993: 3). With differences of opinions existing about who qualifies as an archaeologist or what constitutes a treasure hunter, it is difficult in an anonymous questionnaire such as this to clearly determine whether or not treasure hunters and the archaeologists associated with their work are attempting to subvert understandings of *in-situ* preservation and storage. Neither can it be determined whether uses of *in-situ* techniques are causing a decrease in excavations. New emphasis on underwater museums and trails for the public may play a part in limiting excavation as may the development of more sophisticated research designs. Perhaps a project utilising an interview-style survey would be able to collect in-depth information on this topic. Round table discussions at conferences might also be beneficial.

In situ *is the 'best' form of practice*

'In situ [sic] preservation/reburial is not a universal panacea for maritime archaeology. It is a real tool in the methodology of the profession that can be used in conjunction with a risk management framework.' As this respondent states, there is a dichotomy within maritime archaeology as to how *in-situ* preservation and storage is used and understood. The UNESCO Convention (United Nations Educational, Scientific and Cultural Organization, 2001) and the ICOMOS Charter (International Council on Monuments and Sites, 1996) state that *in-situ* preservation should be considered as the first option. However, as many of the respondents stated at various points throughout the survey, it remains but one tool to be considered and its use should depend upon a number of considerations. This includes site significance, the environment of the site, access to necessary and on-going funding and the development of a clear and well-constructed research plan.

As Green (2003: 371) states, '[a] pragmatic approach to CRM is a mix of *in-situ* preservation and archaeological excavation'. In his 2003 text Maritime archaeology: a technical handbook, Green dedicates a chapter to defining cultural resource management. While not going into any specifics about the techniques of *in-situ* preservation and storage, Green does provide an in-depth and concise account of how to create a cultural resource management plan (Green 2003: 370–371). By creating a site-specific plan that takes into account all the variables, underwater cultural heritage can be protected in a way that is 'best' for each site. If the 'best' protection for the site is to be found in a full excavation with retrieval, conservation and display of all cultural materials, then the classic tenets of archaeology can be justified.

Benchmarking these parameters in a formal way may help convince agencies to become more active in managing sites. Five respondents expressed a desire to be able to monitor sites more frequently and in a scheduled fashion. Another noted that as *in-situ* preservation and storage becomes more prevalent, a 'standardised framework for collection management *in situ* will need to be established'. Bernier (2006: 64) concurs, noting that such guidelines will need to provide clear direction and allow for consistency without being either too lax or too constrictive for cultural resource managers. This will allow managers to make decisions in the best interests of the site. As one respondent stated, options must exist that can allow for 'pure research' or to mitigate a sensitive and threatened site.

Managing cultural heritage often relies heavily on the amount of funding available. On the surface, *in-situ* preservation and storage can appear to be the cost-efficient choice as compared to excavation, conservation and curation. However, as with most maritime archaeological activities, there is the potential for *in-situ* preservation and storage to be an expensive endeavour. As protecting William Salthouse has shown, *in-situ* methods and techniques can be costly (Harvey 1996: 1). Equipment, such as data loggers and electrodes, can be expensive. Maintaining and monitoring a site over a number of years can be costly in terms of time and personnel. It is essential that the best management decision is made, whether that is *in-situ* preservation or excavation. As one respondent notes: 'Financial restrictions aside, we can still study and enjoy the resources, left in situ [sic], for many years into the future. Gaining knowledge from the sites is one of the most important aspects of leaving sites in situ [sic]'.

Impacts to access

The final issue focuses on how *in-situ* preservation and storage can be used or adapted for the public's best interests. Access remains an important topic for cultural resource managers. As noted by one respondent, *in-situ* preservation and storage could be seen to keep underwater cultural heritage out of the public's domain. Certainly, leaving cultural heritage underwater does limit the number of individuals who are able to interact with a particular site. However, rarely does a museum have its entire collection on display and certain terrestrial sites remain closed to the public due to their fragility. The cave at Lascaux, France, for example, has been closed to the public since 1963, when it was noted that the paintings were being damaged as a result of environmental changes caused by visitation (Delluc & Delluc, 1984: 194). Submerged cultural heritage must be treated with the same consideration; fragile sites need a higher level of protection.

This is not to say that submerged cultural heritage should be made off-limits to the public. Indeed, as noted by many respondents, the public can have an important impact on how sites are managed. Seven respondents stated that they would be more likely to use *in-situ* techniques or monitor sites if more volunteers were available. Well-trained volunteers could be utilised in a number of ways, including collecting data and monitoring

sites protected by *in-situ* methods. Volunteers, however, are those members of the public who are interested in actively working to protect their cultural heritage. Many members of the public simply want to enjoy cultural heritage through historic trails and museums. Using *in-situ* preservation and storage along side other management tools such as monitoring and public interpretation was mentioned by four respondents, by way of underwater parks, trails and museums.

In-situ techniques have allowed wrecks, such as *William Salthouse*, SS *Xantho* and those in Florida's underwater heritage preserves, to be enjoyed by the public. Of course, this method also has its drawbacks, as noted by respondents. With looting by treasure hunters and recreational divers still an issue, a small minority of practitioners feel *in-situ* preservation leaves wrecks vulnerable. Archaeologists in Florida did consider this and as a result, replaced some artefacts that were possible targets for looting with replicas (D. Scott-Ireton, 2008, pers. comm., 22 September).

Ultimately, the public will not have access to underwater heritage if it is not preserved in one form or another. With space in museums at a premium, it has become a challenge for cultural resource managers to balance the on-going preservation of underwater sites with public access. If utilised well, *in-situ* preservation affords cultural resource managers a way to achieve both. As one respondent noted, technology is advancing quickly and the ability to create real-time underwater museums is fast becoming a possibility. This has been tried with some success in Italy (Davidde 2002: 83), and Florida recently unveiled its new website Museums in the Sea (Division of Historical Resources, Bureau of Archaeological Research 2007) to showcase its underwater archaeological preserves. Videos and images of the site allow the non-diving public to explore underwater cultural heritage they otherwise could not access. While these videos, and so on, are not real-time at present, it will be possible in the future.

Discussion

Through the use of a questionnaire, this article set out to determine which practitioners were using *in-situ* techniques and what the prevailing attitudes were towards the techniques available. Eighty-nine individuals representing 12 countries and a number of disciplines answered the questionnaire over a two-month period. The majority of respondents were archaeologists and in terms of employment sector, most were from within government. This may not be fully representative of practitioner population because as previously noted, *in-situ* preservation is multidisciplinary in nature.

The results of the questionnaire brought to light some interesting and unexpected results. Practitioners on the whole stated that they were using *in-situ* methods. Only 13 responded that they had never used *in-situ* preservation or storage. The clearest message from this is that most practitioners see merit in *in-situ* preservation and storage; however they are not fully endorsing it as the only tool available. The caveat is that it should not be used as a blanket policy. The best form of cultural resource management is to consider the whole arsenal of tools available, to assess each site on an individual basis and to formulate a site-specific management plan that includes contemplating the funding, personnel, equipment and knowledge base available. Perhaps key to this is the development of open discussion by all practitioners and the continuance of research projects on the techniques that allow experts from diverse areas to collaborate.

Challenges

Perhaps the biggest challenge to this research will be creating and maintaining the interdisciplinary discussion necessary to ensure that ideas and findings are disseminated to all practitioners. The interdisciplinary nature of the investigations makes it challenging in terms of locating academic materials. Articles are not only found in archaeological and cultural resource management journals such as The International Journal of Nautical Archaeology and the Journal of Cultural Heritage, but also in a number of scientific journals, such as International Biodegradation and Biodeterioration and Marine Chemistry. Some, like the Journal of Archaeological Science, attempt to bridge the gap by looking at the scientific rather than the humanistic advances of archaeology. Conference publications, such as those released by the ICOM conservation working groups, remain an important source of information, but are not as easily accessed as journals, which tend to be accessible online. Also to be considered is the vast ocean of inaccessible 'grey literature' which includes hundreds of underwater survey and shipwreck reports.

It is important to create ways in which new methods and findings can be communicated between groups (McCarthy 1987: 9). The joint conference held by the Australasian Institute for Maritime Archaeology and the Australian Society for Historical Archaeology in September of 2008 is an example of a venue in which such discourse can occur. A session chaired by Vicki Richards of the Western Australian Museum focused on *in-situ* preservation and featured a wide variety of practitioners in archaeology, cultural resource management, conservation and materials science.

Archaeologists and cultural resource managers are not typically trained in conservation or material sciences, nor are conservators and material scientists typically trained in archaeology or cultural resource management. University programmes also need to reflect emerging *in-situ* practices. Traditionally, conservation topics in archaeology have focussed on conventional laboratory treatment of *ex-situ* artefacts. Educating those who are training to become practitioners is an important aspect of changing attitudes towards *in-situ* preservation and storage. Developing courses that demonstrate the values and methods of *in-situ* techniques should be considered by course convenors. Only in the last couple years have courses been developed to provide maritime archaeology students with both scientific background and practical experience in using *in-situ* preservation as a tool (for

example, Flinders University, South Australia and University of Western Australia, Perth).

Diverse opinions exist about the value and effectiveness of *in-situ* preservation and storage. While only one respondent stated that nothing would change their mind about its use, it is clear that no one solution will satisfy practitioners. More research into the chemical, mechanical and environmental issues ranked first and foremost as a reason to reconsider *in situ* as an archaeological tool. But it is important to note that this must be considered alongside other concerns such as funding, personnel, training and protection from looting.

While research projects continue to provide new data, certain ideas about *in-situ* methods and storage will change. Some however, such as access for the public and best practices for cultural heritage management in terms of site significance and archaeological research potential, will continue to be debated. When viewed alongside the scientific literature, the questionnaire demonstrates that practitioners need to engage in active and ongoing discussions about *in-situ* preservation and storage, not only among and between themselves, but with policy makers and the public.

Into the future

The future of *in-situ* preservation and storage is one of continued research. There is still much to learn about the deterioration of archaeological materials in both exposed and buried marine environments. But there are other issues associated with *in-situ* preservation and storage that deserve to be investigated. One such area is the uneasy relationship between government bureaucracies and the archaeologists and cultural heritage managers they employ. As identified in the questionnaire, this relationship impacts heavily on the types of site protection afforded to underwater cultural heritage. If agencies fail to grasp the implications that a 'do-nothing' approach has for underwater sites, the public may come to equate *in-situ* preservation with the continued destruction of underwater cultural heritage.

Educating those who are responsible for funding the preservation of underwater cultural heritage will be perhaps the most difficult trial for those practicing *in-situ* techniques. Governments in particular are known to cut funding to culture, especially in difficult economic times. Those responsible for ensuring their spending does not exceed their budget will be hard pressed to understand the implications for heritage that cannot be readily seen or accessed. 'Out of site, out of mind' remains a continued issue in submerged cultural resource management. The development of a clear definition of *in-situ* preservation and storage will prevent the methods from continuing to be associated with a 'do-nothing' mindset.

Another area in which *in-situ* preservation and storage stands to play an important role is in the development of the underwater museum. Public access continues to be at the heart of many cultural resource management debates and providing an entrée into an arena that many members of the public cannot access will be an integral part of future management plans. By preserving sites *in situ* and making use of technologies, such as television and the internet, a large portion of the public will be able to virtually 'visit' underwater sites. This may aid in accessing higher levels of funding for future projects by actively involving the public. The underwater museum will also be a challenge for those developing *in-situ* techniques. Many of the techniques employed presently cannot be reconciled with public access. Reburial by its very nature prohibits access without recourse to excavation, as do other techniques, such as geo-textiles and artificial sea-grass, which encourage sedimentation. The development of *in-situ* techniques that will serve to both preserve the site and allow access will be a necessary avenue for research. Such research also has the potential to lead to a better understanding of public impacts on sites.

In-situ storage could, in the long run, prove to be an economical way to store cultural material. At present, museums have little space in which to store and display large collections of waterlogged material. Conservation and storage costs are often prohibitive. Research into the development of underwater storage areas could be a possible solution that will allow archaeologists to continue to excavate submerged sites. Results from projects such as RAAR could be utilised as a starting point for new research into site-specific applications. Integral to the development of storage areas is further research into the practical and administrative challenges, such as accessing items and ensuring environmental storage levels are met and maintained. It may be assumed that, like the *in-situ* processes themselves, challenges to administration and access will need to be investigated on an area-specific basis.

Conclusion

On 2 January 2009, the UNESCO Convention for the Protection of the Underwater Cultural Heritage entered into force. This document recognises *in-situ* preservation and storage as an important device in the tool kit of maritime archaeologists and submerged cultural heritage managers. It is important that *in-situ* preservation and storage is understood in terms of its definitions and capabilities. This article explored the current attitudes held towards *in-situ* preservation and storage. It demonstrated through a practitioner questionnaire that *in-situ* preservation is a dynamic field relying heavily on interdisciplinary discourse. Practitioners do, on the whole, support *in-situ* techniques, but have some very specific requirements for further research and use. As one respondent stated: 'The in situ [sic] protection of sites is an integrated part of this management process. Recent international standards state that in-situ [sic] preservation is the first option to be considered when managing a site. Not the 'best' option, as some would have us believe, but the 'first' option. If there is good reason to intrusively investigate a site, then that may be a viable option. In situ [sic] preservation is simply one tool in the archaeologist's armoury, albeit an important and useful one'.

Appendix: Practitioner Questionnaire

In-situ *preservation and storage of materials from submerged maritime sites*
Preservation of waterlogged archaeological materials found in maritime, submerged or terrestrial environments has always posed difficulties for archaeologists and conservators. It is well known that, while a larger number of artefacts made from a variety of different materials are more likely to be preserved in a waterlogged environment, these items require extensive and often expensive conservation to remain stable in air. Given the costs associated with some of the larger scale projects conducted to date, such as the *Mary Rose, Batavia* and *Vasa*, museums, governments and other cultural agencies are finding it more difficult to justify the expenditure involved with these types of projects in order to recover and stabilise such culturally important and physically sensitive materials. Increasingly, it is becoming acceptable practice to preserve or store waterlogged materials in their original environment and not recover and treat them with conventional conservation methods before storing them in typical museum-style settings and storage. However, very little work to date has focused on whether these *in-situ* methods are the best form of preservation for these items. With new research emerging, it is important to understand the methods professionals are choosing when working in submerged environments and the factors that inform their decisions concerning the preservation of these sites, features and artefacts. This questionnaire seeks to explore current practices and viewpoints about the use of *in-situ* preservation or *in-situ* storage when dealing with submerged maritime sites and materials.

Definitions
To clarify interpretation, the following definitions have been used in creating this survey.

Archaeological survey
A non-destructive survey that records the site partially or in its entirety by means of all or any of the following: photographic and videographic media; conventional forms of measurement such as baseline offsets, trilateration and drawing frames; electronic forms of measurement such as total station; and any other form of site recording that does not include excavation in any form.

Conservation survey
Any form of survey that collects information on site conditions, be they environmental, physical, chemical or biological, that can be used to inform conservation programmes for the site, features or artefacts, separately or as a whole, either conventional or *in situ*.

Excavation
Any activity on a site involving the recovery of data via disturbance of sediments, whether it is a test pit, a trench or full recovery of the contents of the site.

In-situ *preservation*
Any steps taken on or intervention with a site in order to extend its longevity while maintaining original context and spatial position; while artefacts and features may have been excavated and/or removed, the site itself remains in place and retains all or a majority of its original context.

In-situ *storage*
Any steps taken to preserve the physical, historical and aesthetic integrity of artefacts and features excavated from a site through the creation of a separate space where items are stored within the confines of an environment similar or deemed to be more beneficial to that from which they were removed.

Maritime archaeology
The study of human interaction with the sea through seafaring; this includes not only the vessels themselves, but port and harbour structures; fishing, whaling and other maritime subsistence activities; lighthouse and shore-based structures that aid in seafaring; and any other type of site that has connections to the use of the sea and its resources by humans.

Monitoring
Any observations made regarding either a site, including features and artefacts within it, or a storage area, made by use of human senses or by equipment of any type, that are used to assess the area to inform new procedures, answer research questions, gather information on conservation, or provide an informative view of the area in general.

Underwater site
Any site, feature or artefact found in a body of water, whether it is a lake, river or sea; these sites may include those that have become inundated over time and are currently underwater, such as habitation or ceremonial sites.

Waterlogged terrestrial sites
For the purposes of this questionnaire, any site that may now be treated as a terrestrial site, but was at some previous time under any body of water such as a lake, river or sea and which people interacted with as a water body for the purposes of transport, subsistence, economy or ceremony. These sites will not include sites that have always been terrestrial but yet waterlogged unless they can be clearly related to the maritime landscape through the above definition of maritime archaeology.

Background Information
1. If you were to describe yourself in terms of your profession, which designation best describes you? Please choose only one.
   - ☐ Archaeologist
   - ☐ Conservator
   - ☐ Cultural Heritage Manager
   - ☐ Chemist

- Biologist
- Oceanographer
- Other

2. In which sector are you mainly employed? Please choose only one.
   - Education
   - Government
   - Private/Consulting
   - Not-for-Profit
   - Museum
   - Other

Section A: General Site Questions

1. On what types of sites have you or your organisation worked? Check all that apply.
   - Waterlogged terrestrial sites as defined in this survey
   - Intertidal sites that were:
     - Always waterlogged
     - Always dry
     - Some parts always waterlogged; some parts always dry
     - Subject to fluctuations, with parts that dry out and re-wet
   - Shallow underwater sites (1–10 m/3–30 ft)
   - Mid depth underwater sites (11–30 m/31–100 ft)
   - Deep underwater sites (below 30 m/100 ft)
2. How was the site(s) situated in relation to its environment? Check all that apply.
   - Completely exposed, or proud of the sediment
   - Completely buried in sediment
   - Partially exposed and partially buried
   - Varied; site was constantly in flux, subjected to exposure/reburial cycles
   - Other
3. What sort of work was conducted on the site? Check all that apply.
   - Archaeological survey as per the definitions
   - Conservation survey as per the definitions
   - Excavation as per the definitions
   - Other
4. If a conservation survey was conducted, what type of information was collected/processed? Check all that apply.
   - Water temperature
   - Salinity
   - Water pH
   - Other types of chemical analysis on collected water
   - Redox potential of water
   - Sediment composition
   - Corrosion potential of metals
   - Visual inspection of materials
   - Chemical analysis of materials
   - Other
5. If excavations occurred, what was done with the cultural material? Check all that apply.
   - Recovery coupled with conventional conservation and storage
   - In-situ preservation
   - In-situ storage
   - Recorded/analysed then destroyed
   - Other
6. What types of materials were found on the site? Check all that apply.
   - Wood, cellulose organics
   - Leather, bone, shell, antler/horn
   - Ferrous metals
   - Non-ferrous metals
   - Silicates, porcelain, stone
   - Other

   Please make any additional comments you feel are important about general site conditions in the space below.

Section B: *In-Situ* Preservation and Storage

1. Have you or your organisation used *in-situ* preservation or storage and how often is it employed on sites?
   - Yes, once
   - Yes, sometimes
   - Yes, often
   - Yes, always
   - No, never; if so, proceed to Question 13
2. Would you or your organisation continue to use *in-situ* preservation or storage as a method of conservation?
   - Yes; if so, continue to Question 5
   - No; if so, continue to next question
3. If you answered 'no' to the Question 2, what factors have contributed to the decision to not use *in-situ* preservation or storage as a method of preservation? Check all that apply.
   - Equipment and/or materials required in preservation process are difficult to access
   - Time constraints
   - Insufficient professional personnel available
   - Insufficient volunteer personnel available
   - Insufficient training of current personnel and/or volunteers
   - Internal policies of organisation
   - Governmental legislation
   - Governmental/agency permitting difficulties
   - Financial
   - Not convinced of reliability/suitability by current research
   - Other
4. What, if anything, would convince you or your organisation to use *in-situ* preservation or storage for future work? Check all that apply, then proceed to Section C.

- ☐ Better access to necessary equipment and/or materials required for preservation process
- ☐ More time available for process
- ☐ More professional personnel available
- ☐ More volunteer personnel available
- ☐ Better training for professional and/or volunteer personnel
- ☐ New or updated internal policies
- ☐ New or updated government legislation
- ☐ Permitting system with less associated difficulties
- ☐ More money available for projects
- ☐ New research supporting the benefits of in-situ preservation/storage
- ☐ Nothing could convince me of its feasibility
- ☐ Other

5. If you answered 'yes' to question 2, would you use the same preservation programme?
   - ☐ The same as conducted previously; if so, continue on to Question 7
   - ☐ Different from what was conducted previously
   - ☐ It would depend
6. If you were to make changes or consider a different approach, what would inform your decisions? Check all that apply.
   - ☐ Each site requires a preservation programme specifically developed for that site
   - ☐ Changes in structure have occurred in the organisation that necessitate changes to internal programmes
   - ☐ Finances available to specific projects
   - ☐ New research and techniques have become available
   - ☐ Other
7. What form(s) of *in-situ* preservation or storage have you or your organisation used on project(s)? Check all that apply.
   - ☐ Reburial with backfill with sediment excavated from site
   - ☐ Reburial via sediment drop with sediment brought to site from elsewhere
   - ☐ Artificial sea-grass
   - ☐ Shade cloth/debris nets
   - ☐ Tarpaulin/geo-textiles
   - ☐ Sandbags
   - ☐ Excavation and reburial of materials in a different area (*in-situ* storage)
   - ☐ Other
8. If *in-situ* storage was used rather than *in-situ* preservation, why? Check all that apply.
   - ☐ Development threatened current site
   - ☐ Environment on site threatened preservation
   - ☐ Site was dangerous to shipping, commerce or recreation
   - ☐ Government legislation and/or policy required removal
   - ☐ Other
9. If materials were removed from their original site and reburied elsewhere, what was the new environment?
   - ☐ Similar to the original environment in terms of sediment, pH, redox, etc.
   - ☐ Different to the original environment in terms of sediment, pH, redox, etc.; if so, why?
10. If you reburied materials either on the original site or in a designated storage area, were materials packaged before being reburied?
    - ☐ Yes; if so, proceed to Question 11
    - ☐ No; if so, proceed to Question 12
11. If you used packing materials and other items associated with packing, what types were used? Check all that apply.
    - ☐ Crates
      - ☐ Wood
      - ☐ Polyethylene
      - ☐ Other
    - ☐ Bags
    - ☐ Geo-textiles
    - ☐ Wadding
    - ☐ Cord
    - ☐ Tags
    - ☐ Markers, pens, pencils, etc.
12. If you did not use packaging, why? Check all that apply.
    - ☐ Material are difficult to access
    - ☐ Time constraints
    - ☐ Insufficient professional personnel available
    - ☐ Insufficient volunteer personnel available
    - ☐ Insufficient training of current personnel and/or volunteers
    - ☐ Internal policies of organisation
    - ☐ Governmental legislation
    - ☐ Governmental/agency permitting difficulties
    - ☐ Financial
    - ☐ Didn't believe it was necessary
    - ☐ Other
13. If you answered 'no' to the Question 1, what factors have contributed to the decision to not use *in-situ* preservation or storage as a method of conservation? Check all that apply.
    - ☐ Equipment and/or materials required in preservation process are difficult to access
    - ☐ Time constraints
    - ☐ Insufficient professional personnel available
    - ☐ Insufficient volunteer personnel available
    - ☐ Insufficient training of current personnel and/or volunteers
    - ☐ Internal policies of organisation
    - ☐ Governmental legislation
    - ☐ Governmental/agency permitting difficulties
    - ☐ Financial
    - ☐ Site conditions, such as accessibility, depth

- ☐ Materials were too degraded
- ☐ Materials were not culturally, historically or aesthetically significant
- ☐ Not convinced of reliability/suitability by current research
- ☐ Other

14. What, if anything, would convince you or your organisation to use *in-situ* preservation or storage for future work? Check all that apply.
    - ☐ Better access to necessary equipment and/or materials required for preservation process
    - ☐ More time available for process
    - ☐ More professional personnel available
    - ☐ More volunteer personnel available
    - ☐ Better training for professional and/or volunteer personnel
    - ☐ New or updated internal policies
    - ☐ New or updated government legislation
    - ☐ Permitting system with less associated difficulties
    - ☐ More money available for projects
    - ☐ New research supporting the benefits of *in-situ* preservation/storage
    - ☐ Nothing could convince me of its feasibility
    - ☐ Other

    Please make any additional comments you feel are important about *in-situ* preservation and storage in the space below.

Section C: Site Monitoring

1. Regardless of whether or not *in-situ* preservation or storage was used, do you or your organisation have a site monitoring plan for site(s) you have investigated?
    - ☐ Yes; if so, proceed to Question 2
    - ☐ No; if so, proceed to Question 8
2. If you do monitor sites, do you have a formal schedule for this work?
    - ☐ Yes, we have a formal schedule; if so, briefly, how is it scheduled and what types of procedures does it entail?
    - ☐ No, it is dependent on a number of factors including available time, funds and personnel as well as site location and conditions
3. Why do you monitor the site(s)?
    - ☐ To ensure the integrity of the site and for updating necessary site plans
    - ☐ To ensure the integrity of the site and monitor *in-situ* preservation or storage
    - ☐ Other
4. What types of monitoring do you use on the site(s)? Check all that apply.
    - ☐ Visual monitoring, including photography, videography and notes
    - ☐ Materials sampling and analysis
    - ☐ Sediment sampling and analysis
    - ☐ Corrosion measurements
    - ☐ Other
5. What types of equipment do you use during your monitoring? Check all that apply.
    - ☐ Cameras and/or video equipment
    - ☐ Dipwells, *in-situ* sampling and subsequent analysis
    - ☐ Electrodes, *in-situ* or *ex-situ* water/corrosion/sediment measurements
    - ☐ None
    - ☐ Other
6. Do you have monitoring equipment set up on site permanently?
    - ☐ Yes
    - ☐ No; single use equipment is brought in each time
    - ☐ No; samples are collected on site and analysed *ex-situ*
7. Are there any changes you would make to your current site monitoring processes? Explain briefly. If you answered 'no' to Question 1, why? Check all that apply.
    - ☐ Equipment and/or materials required for monitoring procedures are difficult to access
    - ☐ Time constraints
    - ☐ Insufficient professional personnel available
    - ☐ Insufficient volunteer personnel available
    - ☐ Insufficient training of current personnel and/or volunteers
    - ☐ Internal policies of organisation
    - ☐ Government legislation
    - ☐ Governmental/agency permitting difficulties
    - ☐ Financial
    - ☐ Didn't believe it was necessary
    - ☐ Other
8. What if anything would convince you or your organisation to monitor sites in the future? Check all that apply.
    - ☐ Better access to necessary equipment and/or materials required for monitoring procedures
    - ☐ More time available for process
    - ☐ More professional personnel available
    - ☐ More volunteer personnel available
    - ☐ Better training for professional and/or volunteer personnel
    - ☐ New or updated internal policies
    - ☐ New or updated government legislation
    - ☐ Permitting system with less associated difficulties
    - ☐ More money available for projects
    - ☐ New research supporting the benefits of monitoring *in-situ* preservation/storage
    - ☐ Nothing could convince me of its feasibility
    - ☐ Other

    Please make any additional comments you feel are important about site monitoring in the space below.

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