The ethics behind climate change: Small Island Developing States in the Pacific as new underwater cultural heritage

Dr. Elena Perez-Alvaro
Licit Cultural Heritage Ltd.
elenaperezalvaro@gmail.com

Abstract

Predictions forecast changes in climate that may affect underwater cultural heritage in the future. Warmer waters mean more chemical changes and the proliferation of teredo navalis. Ocean currents may cause disturbances to the layer of sediment protecting underwater cultural heritage sites. The rises in sea levels would reduce the amount of time an air-breathing diver can safely spend under water and hence their productivity. Rises would also mean expansion, which could raise the problem of ocean delimitation. Also our land tangible cultural heritage will be submerged: entire nations and their cultural heritage may disappear, an issue affecting mostly the Small Island Developing States -many of them in the Pacific-, more vulnerable to rises in sea levels. Their identity as citizens of their cities, as members of a community with their own tangible past, complete with their cultural heritage, will disappear. Their land heritage will become underwater cultural heritage but for more than 100 years will not be protected under the 2001 UNESCO Convention. This paper will look at climate change in these Asia-Pacific communities from the ethics as a core element and will study the introduction of these flooded areas as new underwater cultural heritage, proposing an Asia-Pacific values-orientated qualification of underwater cultural heritage as a natural resource.

Key words: SIDS, tangible cultural heritage, climate change, UNESCO Convention

Introduction

One of the commonly agreed principles of preservation of underwater cultural heritage named by the *2001 UNESCO Convention on the Protection of the Underwater Cultural Heritage* is the preservation *in situ*

as the first option (Preamble, Article 2.5. and Rule 1 of the Annex (UNESCO, 2001). The reason for this being mainly because archaeological objects are better preserved under layers of mud and in saline water. The ship, once she has sunk and lies at the seabed, reaches a state of equilibrium with the upper parts destroyed and the buried remains covered (Green, 1990). After reaching this state of equilibrium, the wreck will either be only disturbed by human intervention or by geological changes like the ones forecast by climate change (Wachsmann, 2011).

Global warming is, as (Chapman, 2003) observes, an environmental and political issue. Climate change is warming the oceans and the ice at the poles is melting causing sea levels to rise. Oceans are also being over fertilized and suffering chemical changes, such as acidification or changes on the salinity. Currents also may change their pattern and consequently, ecosystems are becoming increasingly endangered.

These climate changes will have a direct impact on underwater cultural heritage (Dunkley, 2013); (Van de Noort, 2013). Higher global surface temperature will dry out some submerged heritage and, on the contrary, sea-level rises will flood many coastal areas, creating new underwater cultural heritage. In fact, climate change will raise the sea level enough to inundate 136 sites considered by UNESCO to be cultural and historical treasures (Marzeion and Levermann, 2014). In addition, each one of the changes (warmer waters, changes in currents, rising oceans and chemical changes) will have a different effect on the various materials that constitute a submerged archaeological site.

Small Island Developing States (SIDS) are vulnerable to rises in sea levels and even become uninhabitable (UNESCO, 2008). In this regard, some authors warn that climate change will also modify social and cultural behaviours, with communities changing how they live and work, migrating

and abandoning their heritage. Therefore, all heritage needs to be considered vulnerable to natural disasters (UNESCO, 2008).

The first part of this paper will analyse some cases of sites affected by climate change that have already happened. Later, we will look at the concept of “climate change”. The third part studies what would happen to these Small Islands Developing States and the concept of identity. We will next be looking to both ethical and legal aspects of climate change affecting the cultural heritage. Finally, this paper will propose a new policy for the preservation of underwater cultural heritage under the threat of the climate change.

Issue

Climate change has already caused damages to underwater cultural heritage. Sheridan and Sheridan (2013) state that civilization is heading to informed self-destruction. They define culture as “the last cab off the climate rank”. Several examples:

1. In Spain, a Phoenician shipwreck is being exposed due to the change of currents affecting the oceans. The shipwreck that was 25 years ago at a depth of 6 metres it is now only at a depth of 1.8 metres (Rubio, 2014). Its preservation *in situ* may not be the best option anymore, since it is now readily accessible to human intervention and to further changes in the currents that may damage her.
2. The raising of sea levels has disturbed the underwater graves of soldiers killed in World War II on the Marshall Islands (McGrath, 2014). The tides have exposed a cemetery containing 26 human bodies and the coffins and human remains are being washed away.
3. According to a leaked diplomatic cable[1], the Dalai Lama called attention to the climate changes that Tibet is suffering. Although

Tibet is entirely landlocked, its temples are being inundated which will convert them to underwater cultural heritage in the future, an example that could be repeated:

> The Dalai Lama argued that the political agenda should be sidelined for five to ten years and the international community should shift its focus to climate change on the Tibetan plateau. Melting glaciers, deforestation and increasingly polluted water from mining projects were problems that 'cannot wait.' The Dalai Lama criticized China's energy policy, alleging that dam construction in Kham and Amdo have displaced thousands of Tibetans and left temples and monasteries underwater.

In view of these examples, climate change is an ultimate moral challenge and cultural heritage managers have to be prepared for policy's changes (Sheridan and Sheridan, 2013). If the current global temperature is prolonged over the next two millennia, 40 of the UNESCO Cultural World Heritage sites will be affected. Of the 720 sites listed in the cultural and mixed categories in the UNESCO World Heritage list, 136 of them will be impacted by rises in sea levels (Marzeion and Levermann, 2014). In addition, 3 to 12 countries will lose more than half of their current land surface (Marzeion and Levermann, 2014).

Consequently, climate change may affect the underwater cultural heritage in two forms:

a) Additional submerged places will be created and, on the contrary, previously submerged places will become exposed.

A total of fifteen of the world's twenty megacities are situated by the sea. "If water levels rise even further, by 3, 4 or 5 metres in centuries to come, we will have to give up some of the cities" (Rahmstorf and Richardson, 2009). These underwater cities or even countries will be in the future underwater cultural heritage. This paper will focus on this aspect.

b) The current underwater cultural heritage will be affected, damaged or moved.

Variations in seawater follow universal chemical, physical and biological laws. The shipwreck, in contact with water, experiences equilibrium (Florian, 1987). At 400-800 metres depth archaeological sites experience low and near constant water temperatures all year-round (Daly, 2011). Sunlight, a biodeterioration accelerator, does not penetrate below 200m. At the seafloor the current speeds are often very low with minimal tidal effects and sediment transfer rates are also low. Erosion by currents, tidal movements or changes in water circulation, resulting in objects being removed and displaced is a real threat as well as erosion by dredging, fishing and anchoring. Sediment accretion will be also having consequences (Chapman, 2003): archaeological deposits could be buried by accreting silts. As a consequence, the discovering of the new underwater sites would be more difficult.

State of knowledge

Earth is a planet with high water content (71%). In fact it should be called Ocean, instead of Earth as the volume of water is 1370 million km^3 (Rahmstorf and Richardson, 2009). There are four main climate changes that will affect the oceans:

1. *The Warming of the Waters.* There have always been fluctuations in water temperature, especially in the surface layer of water that is in direct contact with the atmosphere (the top 50–200 metres). The temperature in this layer has increased by more than 3°C in the last 50 years. Such an increase in temperature will most likely gradually spread to deeper layers, where shipwrecks and other heritage sites are located. This warming could result in changes such as coral bleaching and species migration. Other issues will also affect

underwater tangible heritage such as chemical changes or the increasing of shipworms.

2. *Currents.* Some experts predict that climate change could cause a possible interruption of the thermohaline circulation, largely responsible for regulating the earth's temperature. Such change would affect the submerged heritage in different ways, such as the modification of the sediment layer. Much underwater cultural heritage is preserved at present thanks to a protective layer of sediment, mostly formed by microorganisms. Any disturbance of this layer could damage the archaeological materials. A change in currents can also displace some or all of a submerged archaeological site, decontextualizing it from its original location or otherwise dispersing the objects.
3. *Chemical Changes.* A variety of chemical changes might occur in the waters as a result of climate change such as acidity and salinity. If the pH of seawater decreases and the oxygen increases, it will become more acidic. As a consequence, underwater material is more likely to corrode. Also textiles dissolve more readily in acidic water, meaning any archaeological textiles remaining under water would likely be lost. Changes in salinity may also be proved problematic since salinity also accelerates corrosion.
4. *The Rising Sea Levels*. Increased global temperatures melts land ice, which adds water to the sea. Similarly, an increase in water temperature results in the expansion of the sea, since warm water occupies a larger volume than colder water. Sea levels react only very slowly, and it takes many centuries—or even millennia—for large continental ice masses to melt. However, since ice masses are becoming wetter because of the contact with water, they will almost certainly melt at a much faster rate. Researchers estimate

that there will be a rise in the sea level of between 18 and 59 cm by the year 2100; but it could exceed one metre. The rising sea level would be the most difficult challenge facing cultural heritage. Not only could it submerge the land-based cultural heritage, but underwater cultural heritage might also be affected. Some of the issues recognised in this regard are as follows:

- Increased depth. More water means greater depth and shipwrecks lying on the seabed will be subject to greater pressure, which may be more than they can withstand.
- Prospection. It would have an effect, mainly due to the reduction in the amount of time a diver can remain under water.
- Marine boundaries. Higher sea levels will result in legal maritime boundaries becoming less well-defined. Political issues and legal disputes are expected to arise in the affected areas and the melting of the Arctic will open new maritime commercial routes which will translate into claiming of new territories as we will see.
- Flooding. Some land-based archaeological sites will flood, meaning that some cultural heritage will become *underwater* cultural heritage.
- Increased storms. Higher sea levels will cause more powerful storms that will devastate low-lying areas. These will be in the form of tropical storms and hurricanes/cyclones, at best eroding at worst destroying both land and underwater heritage.

Although these are largely predictions for the future, some cultural heritage sites are already experiencing these changes.

Small Islands Developing States

The Pacific Islands region comprises 22 countries and territories, nine of them fully independent (Barnett and Campbell, 2010). It is divided into

three regions: Melanesia -of large cultural diversity and more than 800 languages spoken-, Polynesia -more homogenous- with “only” 30 languages- and Micronesia -with strong links to the United States (Barnett and Campbell, 2010). This cultural diversity may change for the effects of climate change.

The IPCC 4th assessment report identifies small island states as being the most vulnerable countries of the world to the adverse impacts of climate change. The Pacific is in fact one of the world’s most vulnerable regions. Not only their cultural heritage will be affected but also their agriculture, water resources, forestry, tourism and other industry-related sectors. However, the impact of climate change in these communities will not only be noticeable on flooding lands, but also in its effects on agricultural production and fisheries, and, as a consequence, in the availability of food. However, there has been little research on understanding how people is going to adapt to climate change.

For instance, the Tuvalu State is already losing not only its territory because of the floodings, but also its identity and heritage: its culture as a nation is transforming. Communities on the Torres Strait are also suffering king tides and flooding that make life non-viable. The islands will probably be completely submerged in the future, meaning 7000 people already have to adapt to climate change. Australia has invited them to live on Australian territory but this would mean that the land of such states—and, therefore, their tangible culture—will be lost.

There are two basic responses to climate change for these territories: mitigation and adaptation. Mitigation includes all policies and laws that have been drafted on climate change. Adaptation has its origins in evolutionary biology, seen as the basis for natural selections and it implies long-term processes. This paper proposes a mix of mitigation and

adaptation actions in order to understand and face the effects of climate change on the cultural heritage.

Ethical dilemmas

This section will highlight the main ethical dilemmas attached to the loss of a territory, as it is going to happen to some Asia-Pacific States.

1. *Identity* seems a concept intrinsically linked to the concept of heritage. For Ashworth (2007) heritage is a need of the individual and of society to reinforce a socio-cultural identity: it is a contemporary commodity and it is linked to the concept of "national identity" that can be shaped through a few selected points of heritage and supporting mythologies. An object of heritage can become an evocative symbol of identification that acts as a trigger for emotions and narratives.

2. *Emotion*: this identification of a person with a place or an object is established because the person identifies itself with the place (or object) and feels something related to it. In this regard, Smith (2006) concludes that the "real sense of heritage is when our emotions and sense of self are truly engaged". The emotional value of heritage is felt and it is reinforced through experiences and re-experiences that create a sense of nostalgia (Smith and Waterton, 2009). Heritage is then not valued for the specific information it contains but for the notions it evokes among people.

3. *Memories*: memories, as emotions, are not spontaneous but they need to be actively remembered (Smith and Waterton, 2009): they need a root in a concrete object or site and need to be maintained. Cultural heritage is intrinsically political and symbolic, used *in lieu* of description to evoke memories or emotions. And it is highly selective.

If some Small Island Developing States of the Pacific leave their territories and, as a consequence, part of their tangible cultural heritage,

they will lose part of their identity, their memories and the emotions that they experience with their heritage.

Legal perspective

Legislation can be used to minimize human threats to underwater cultural heritage. There is only 1.9 million km² of ocean area where nature conservation regulations apply. There is some Marine Protected Areas (MPA) but some authors (Rahmstorf and Richardson, 2009) believe that at least 20 to 30% of the world's oceans should be protected.

The Intergovernmental Panel on Climate Change (IPCC, 2007), Group I concludes that the oceans are warming and the salinification of water is changing. Although they are not visible ocean circulation changes, the ocean biogeochemistry is changing since there is evidence of decreased oxygen concentrations. And the sea level is definitely rising (IPCC, 2007). Despite of all this information, international instruments fails to protect cultural heritage from climate change forces (Sheridan and Sheridan, 2013). There are gaps in the capacity of the legislation for future protection. Only the *Convention Concerning the Protection of the Worlds Cultural and Natural Heritage* (1972) has some response to climate change (Sheridan and Sheridan, 2013). The *2001 UNESCO Convention on the Protection of the Underwater Cultural Heritage* does not mention climate change as an adverse factor for underwater cultural heritage. However, Dromgoole (2013) feels that the term in the definition "partially or totally underwater, periodically or continuously, for at least 100 years" is of importance for the predicted sea level changes due to climate change. However, and despite this minor concession, the Convention does not explicitly mention "climate change" and as a consequence, it does not propose solutions. Neither the 1982 UNCLOS Convention does.

The *UN Framework Convention on Climate Change* (1992) has no direct reference to underwater cultural heritage, nor does the *Kyoto Protocol* (1997) which aims to reduce the levels of greenhouse gases.

The instruments that try to cover the topic provide good intentions rather than solutions. They make a good starting point for the development of the field, although they tend to be vague and imprecise and no remedies are proposed. As a consequence, there is a need for ranking the potential impact of climate change on individual heritage and determining the vulnerability, sensitivity and resilience to future changes (Howard, 2003).

Conclusions

As this paper has tried to demonstrate, rises in sea levels, warmer waters, ocean acidification and changes in currents will affect underwater cultural heritage (Dunkley, 2013). Warmer waters mean more energetic oceans (that cause more erosion) and the migration of invasive species. It also means expansion, which will cause the problem of oceans delimitation. In addition, this rises in sea levels will reduce the amount of time and productivity an air-breathing diver can spend under water safely. In addition, saltier waters mean less clear waters. Changes in ocean temperatures also affect and alter oceanic currents which will have an impact on underwater visibility for divers besides of the erosion of the heritage. And although the direct effects of acidification are not still well understood (but it is known that will harm marine fauna) it increases the current rates of metal corrosion, which will be particularly harmful to the underwater heritage of the World Wars (Dunkley, 2013).

Each site deserves unique treatment and it is difficult to set common criteria. The climate change consequences on heritage need different strands of research, like risk factors, socio-economic research and nature and cultural stress factors (UNESCO, 2008). Some authors predict that

future generations will face damage and loss of underwater cultural heritage or will have to make great efforts to protect them (Marzeion and Levermann, 2014).

However, as Sheridan and Sheridan (2013) observe, it seems that people may need to see their cultural heritage threatened, temples washed away or cathedrals destroyed by flooding to be convinced of the effects of climate change in culture and to evaluate and propose solutions. However, it is erroneous to assume that the most visible remains are the most threatened. There is a need for practical and political response to the effects of climate change on underwater cultural heritage but also a priority of raising awareness of the impacts. Some authors emphasise the inadequate financial resources and a lack of creativity on managing underwater cultural heritage despite it being a growing "industry" (Kingsley, 2011). Some inter-agency cooperation might be necessary (Van de Noort, 2013), as well as convincing policy makers to include climate change impacts in planning (Cassar and Pender, 2005).

This paper proposes the inclusion of underwater cultural heritage as natural heritage, which is another subject on policy agendas for protecting the world's oceans from climate change. The differentiation between cultural and natural is a barrier that excludes underwater cultural heritage and avoids a common interdisciplinary work, as it will be seen in the next section. However, is an *Asia-Pacific* values-orientated qualification of underwater cultural heritage as a natural resource, focusing on identifying and recovering the connections between the nature and culture sectors.

Proposal

The present study focuses the required actions to manage the underwater cultural heritage under the threat of climate change in four steps: recognizing the loss, starting the debate, creating a legal framework in

which situate the debate and recognizing underwater cultural heritage as a natural resource.

1. Recognizing the loss: there have already been two periods of climate change in the past which could have affected the heritage. It is essential to understand that although climate change does destroy the heritage, it also creates new heritage (for instance flooded cities or islands will become underwater cultural heritage in 100 years). This is an ethical issue on heritage as process: understanding that it is inevitable to lose some cultural heritage but that we will also gain some. On these premises, however, it is again the time to evaluate the importance of the sites and to undertake actions to preserve the selected ones.

2. Starting the debate: climate change debate has occupied few concerns in the archaeological and heritage arena. Whatever the causes, the effects may be devastating (Chapman, 2003). This paper has tried to trigger the debate, which needs to be discussed and disseminated through academic, social and political agendas.

3. Creating a legal framework: the 2001 UNESCO Convention that guides States on the management of their underwater cultural heritage does not include climate change as a danger to the heritage. As with any other international instruments, the authors of the Convention would hope to become an example to the states (Carman, 2013). If this Convention does not take climate change into consideration neither will States. This paper presents a high-risk concept: underwater cultural heritage is a part of the oceans and as a consequence underwater cultural heritage preservation has more similarities to *underwater natural* heritage than to *terrestrial cultural* heritage. Although the methodology (archaeology) and the ethical concerns that both underwater and land heritage face have a major equivalence, in the aspects of preserving and facing climate change, underwater cultural heritage has to fight the same battles as the

natural heritage in the oceans. The changes that will affect them are the same. As a consequence, the same legal and political agendas on climate change affecting the oceans should already include (as coral reefs are included) underwater cultural heritage on their agendas.

4. Recognizing underwater cultural heritage as a natural resource: Aznar-Gómez (2013) states that although underwater cultural heritage is not considered a natural resource by the UNCLOS Convention, the seabed and the sand is covering the archaeological objects. Also the non-sedentary fishing species live around artificial reefs made by shipwrecks. For this reason, some authors (Rössler, 2006) have tried to link cultural and biological diversity for the better preservation of underwater cultural heritage. In fact, the *1972 Convention Concerning the Protection of the World Cultural and Natural Heritage* is an instrument for the preservation of both, cultural and natural heritage. Aplin (2002) argues that distinction between natural and cultural heritage is blurred and Chapman (2003) reminds the close relationship between ecological and archaeological site management and suggests a liaison between archaeologists and other parties interested in natural environment. Lixinski (2008: 379) claims that the “nature and culture dichotomy” listed in the *1972 World Heritage Convention* is simply artificial, as it is proved to be in the wording “the combined works of nature and man”. According to the author, the holistic approach to heritage seen as “significance” and not as a place or as an object blurs that dichotomy. Accordingly, it is necessary to adjust natural policies on the oceans to accommodate underwater cultural heritage. If shipwrecks are considered artificial reefs, the same preservation policies applied to natural reefs can be applied to the artificial ones (that is, underwater cultural heritage).

Endnotes

[1] US embassy cables. *The guardian*. 10th August 2010 Available at: http://www.theguardian.com/world/us-embassy-cables-documents/220120

References

Aplin, G. 2002. *Heritage identification, conservation and management*. Oxford: Oxford University Press.

Ashworth, G. J. 2007. On townscapes, heritages and identities. In: Institute for Advanced Studies Colloquium on Urban-Rural (2007). *Flows and Boundaries*. Lancaster: Lancaster University.

Aznar-Gómez, M.J. 2013. Treasure hunters. In: *AIMA 13 Conference: Towards Ratification: Australia's Underwater Cultural Heritage*. [Unpublished paper]. Canberra: 4 October 2013

Barnett, J., and Campbell, J. 2010. *Climate change and small island states: Power, knowledge, and the South Pacific*. Earthscan.

Carman, J. 2013. Legislation in Archaeology: Overview and Introduction. In: C. Smith (2013) *Encyclopaedia of Global Archaeology*. New York: Springer: 4469-4485

Cassar, M. and Pender, R. 2005. *The impact of climate change on cultural heritage: evidence and response.* Published in the 14th Triennial Meeting The Hague Preprints. Vol. II.

Chapman, H. P. 2003. Global warming: The implications for sustainable archaeological resource management. *Conservation and management of archaeological sites*, *5*(4): 241-245.

Daly, C. 2011. *Climate change and the Conservation of Archaeological sites: a review of impacts theory conservation and management of archaeological sites*. Dublin Institute of Technology, vol. 13, no 4: 293-310.

Dromgoole, S. 2013. *Underwater cultural heritage and international law*. Cambridge University Press. (Vol. 101).

Dunkley, M. 2013. Ocean Climate Change and Underwater Archaeology. [online]. *English Heritage* 12th September 2013. Available at: http://heritagecalling.com/2013/09/12/oceanic-climate-change-and-underwater-archaeology/.

Florian, M-L.E. 1987. Deterioration of organic materials other than wood. In C. Pearson (1987). *Conservation of marine archaeological objects*. Butterworth and Co Publishers: 21-54.

Green, J. 1990. *Maritime Archaeology: A technical Handbook*. San Diego: Academic Press.

Howard, P. 2003. *Heritage: management, interpretation, identity*. London: Library of Congress Cataloguing-in Publication Data.

IPCC 2007. Intergovernmental Panel on Climate Change Fourth Assessment Report on Climate Change. Available at: https://www.ipcc-wg1.unibe.ch/.

Kingsley, S. 2011. Challenges of Maritime Archaeology: in too deep. In: T.F. King (2011). *A companion to cultural resource management.* Wiley: Blackwell Publications: 223-244.

Kyoto Protocol 1997. United Nations. Available at: http://unfccc.int/kyoto_protocol/items/2830.php.

Lixinski, L. 2008. World Heritage and the Heritage of the World: Book Review. By F.Francioni and F. Lenzerini. The 1972 World Heritage Convention: A Commentary, Oxford, Oxford University Press, 2008 *European Journal of Legal Studies*. Vol 2 (1) 2008: 371-386.

McGrath, M. 2014. Climate change helps seas disturb Japanese war dead [online]*. BBC News: Science and Environment.* 7th June 2014. Available at: http://www.bbc.com/news/science-environment-27742957.

Marzeion, B. and Levermann, A. 2014. Loss of cultural world heritage and currently inhabited places to sea-level rise. *Environmental Research Letters*. 9 (2014) 034001: 1-7.

Rahmstorf, S. and Richardson, K. 2009. *Our threatened Oceans. The sustainability Project*. London: Haus Publishing.

Rössler, M. 2006. World Heritage- Linking Cultural and Biological Diversity. In: B.T. Hoffman (2006). *Art and Cultural Heritage: Law, Policy and Practice.* Cambridge: Cambridge University Press: 201-205.

Rubio, M. 2014. Peligro: el mar devuelve el barco fenicio. [online]. *Laverdad.es: Murcia*. 6th May 2014. Available at: http://www.laverdad.es/murcia/v/20140505/mazarron/peligro-devuelve-barco-fenicio-20140505.html.

Sheridan, R. and Sheridan, J. 2013. *International heritage instruments and climate change*. Illinois: Common Ground Publishing LLC.

Smith, L. 2006. *Uses of Heritage*. London and New York: Routledge.

Smith, L. and Waterton, E. 2009. *Heritage, Communities and Archaeology.* Wiltshire: Duckworth Debates in Archaeology.

UNESCO 1972. Convention concerning the Protection of the World Cultural and Natural Heritage. Paris, 16 November 1972. Available at: http://whc.unesco.org/en/conventiontext/.

UNESCO 2001. Convention on the Protection of the Underwater Cultural Heritage. Paris, 2 November 2001. Available at: http://unesdoc.unesco.org/images/0012/001260/126065e.pdf.

UNESCO 2008. Policy Document on the Impacts of Climate Change on World Heritage Properties. UNESCO World Heritage Centre publications on climate change. Available at: http://whc.unesco.org/en/CC-policy-document/

United Nations Framework Convention on Climate Change 1994. United Nations "Rio Conventions". Available at: http://unfccc.int/essential_background/convention/items/6036.php.

Van de Noort, R. 2013. Wetland Archaeology in the 21st Century: Adapting to Climate Change. In F. Menotti and A. O'Sullivan (2013). *The Oxford Handbook of Wetland Archaeology.* Oxford: Oxford University Press: 719-732.

Wachsmann, S. 2011. Deep-submergence Archaeology. In: A. Catsambis, B. Ford and D.L. Hamilton (2011). *The Oxford Handbook of Maritime Archaeology*. Oxford: Oxford University Press: 202-221.

Biography

Elena Perez-Alvaro, doctor in Underwater Cultural Heritage, is a cultural heritage consultant for Licit Cultural Heritage Ltd. Her primary responsibility is to provide the clients with curatorial specialist advice, from management to legal or uses advice. Her publications consider ethical, legal and management aspects of cultural heritage, including the valuation and interpretation of cultural heritage, protection from climate change, the enhancement of intangible heritage, the relationship between natural and cultural heritage, cultural heritage of colonised countries or the cultural heritage of indigenous communities. She has also undertaken a wide variety of teaching posts, including at university level.