

Fieldwork Methodology in South American Maritime Archaeology: A Critical Review

Amaru Argüeso¹ · Nicolás C. Ciarlo^{1,2,3}

© Springer Science+Business Media, LLC, part of Springer Nature 2017

Abstract In archaeology, data obtained from the analysis of material evidence (i.e., the archaeological record) from extensive excavations have been a significant means for the ultimate development of interpretations about human life in the past. Therefore, the methodological procedures and tools employed during fieldwork are of crucial importance due to their effect on the information likely to be recovered. In the case of maritime archaeology, the development of rigorous methods and techniques allowed for reaching outcomes as solid as those from the work performed on land. These improvements constituted one of the principal supports—if not, the most important pillar—for its acceptance as a scientific field of study. Over time, the growing diversity of sites under study (e.g., shipwrecks, ports, dockyards, and prehistoric settlements) and the underwater environments encountered made it clear that there was a need for the application of specific methodological criteria, in accordance with the particularities of the sites and of each study (e.g., the research aims and the available resources). This article presents some ideas concerning the methodologies used in South American investigations that have exhibited a strong emphasis on the analysis of historical shipwrecks (the sixteenth to twentieth centuries). Based on a state-of-the-knowledge review of these research projects, in particular where excavations were conducted, the article focuses on the details of the main strategies adopted and results achieved. The ideas proposed in this article can be useful as a starting point for future activities of surveying, recording, and excavating shipwrecks.

✉ Amaru Argüeso
amaruargueso.aa@gmail.com

¹ Area of Research on Underwater Archaeology, Program of Historical Archaeology and Pluridisciplinary Studies, Department of Social Sciences, National University of Lujan (Headquarters in Ciudad de Buenos Aires), Ecuador 871 (C1214ACM), Autonomous City of Buenos Aires, Argentina

² National Scientific and Technical Research Council (CONICET), Autonomous City of Buenos Aires, Argentina

³ Archaeometallurgy Group, Materials Laboratory, Mechanical Engineering Department, School of Engineering, University of Buenos Aires, Autonomous City of Buenos Aires, Argentina

Resumen En Arqueología, los datos obtenidos del análisis de la evidencia material (es decir, el registro arqueológico) procedente de excavaciones extensas han sido un medio significativo utilizado para la elaboración ulterior de interpretaciones sobre la vida humana en el pasado. Por lo tanto, los procedimientos metodológicos y las herramientas empleadas durante el trabajo de campo son de crucial importancia debido a sus implicaciones en la información susceptible de ser recuperada. En el caso de la arqueología marítima, el desarrollo de métodos y técnicas rigurosas permitió alcanzar resultados tan sólidos como los de los trabajos realizadas en tierra. Estas mejoras constituyeron uno de los principales apoyos, si no el pilar más importante, para su aceptación como campo científico del conocimiento. A través del tiempo, la diversidad cada vez mayor de los sitios en estudio (por ejemplo, naufragios, puertos, astilleros y asentamientos prehistóricos) y los ambientes submarinos considerados, puso de manifiesto la necesidad de aplicar criterios metodológicos específicos, de acuerdo con las particularidades de los sitios y de cada estudio (por ejemplo, los objetivos de investigación y los recursos disponibles). En este artículo presentamos algunas reflexiones sobre las metodologías utilizadas en las investigaciones sudamericanas, que han mostrado un fuerte énfasis en el análisis de los naufragios históricos (siglos XVI al XX). Sobre la base de un estado de la técnica de las investigaciones, en particular, donde las excavaciones se llevaron a cabo, nos centramos en los detalles de las principales estrategias adoptadas y los resultados logrados. Las ideas propuestas en este trabajo pueden ser útiles como punto de partida para futuras actividades de levantamiento, registro y excavación en naufragios.

Keywords Maritime archaeology · Shipwrecks · Fieldwork methodology · South America

Introduction

In archaeology, the data obtained from excavated material evidence are the main basis from which archaeologists develop their interpretations of the human past. In this context, methodological strategies and tools applied during fieldwork are of the utmost importance, given their implications on the nature and validity of the information possible to recover. In the case of maritime archaeology, in particular, the underwater environment in which many investigations are conducted implies certain limitations (e.g., the time available for effective work at the sites and the recording tools) and demands the application of a repertoire of specific procedures and techniques. Over time, given problems related to the conservation of water-logged materials once extracted from their context, among other reasons, different strategies of work have been adopted, including non-intrusive activities.

In this article, some thoughts regarding methodologies applied in the research of underwater sites in South America are presented. Research carried out in this region has presented a strong and ongoing emphasis on shipwrecks from the sixteenth to the twentieth centuries (e.g., Murray et al. 2008; Carabias 2009a, b; Elkin et al. 2011, 2015; Valentini and García Cano 2012a; see also Elkin 2011, for a general review of investigations in the region). Despite singular cases, it is possible to recognize a series of shared features in the South American context regarding the history of maritime archaeology in the region, the sites under study and the human and economic resources available. The research and fieldwork possibilities have been tethered to these and other variables. As a result, in the case of underwater excavations, it is possible to identify certain theoretical-methodological parallels as well. Reflecting upon these points, this article aims to highlight the importance

of excavation in maritime archaeology, whose results can and should contribute to the knowledge of topics dealt with by archaeology as a whole.

The article is divided into four main parts. In the first section, certain terminological and semantic issues regarding the fields of knowledge in which the studies of shipwrecks are usually framed are clarified. Then, the first years of the specialty known as underwater archaeology are reviewed, highlighting the relevance that underwater excavation work has had and discussing some of the fieldwork strategies that have been introduced since then; non-intrusive activities, in situ conservation and the limit of excavations (partial vs. total) are considered. In the third section, the situation in South America is presented, stressing the results of excavations of shipwrecks from the eighteenth to twentieth centuries in which the authors had the opportunity to participate. Last but not least, a brief consideration is made regarding the importance of underwater excavation for the research of historical shipwrecks in the region.

Some Definitions

Archaeological shipwreck research, with which this article mainly deals, is generally framed within any of the following specialties: underwater archaeology, marine or submarine archaeology, naval or nautical archaeology, and maritime archaeology. As these labels suggest, all of them are closely related to each other, notwithstanding some significant differences. Originally, the most widely applied expression to refer to not only archaeological research but also to legislation, conservation, management and dissemination of materials that lie beneath the water, was the first: underwater archaeology. This is particularly applicable in many English and Spanish-speaking scenarios. The numerous sites found in marine environments were included by some scholars within the second term. Throughout the consolidation and subsequent development of research, the different terms listed above were coined—partly as a result of greater theoretical and methodological precision, partly as a consequence of a greater circumscription of each field and preferences for specific topics.

Taking this into account, it can be said that *underwater* archaeology implies a methodological definition. It is the field of research that deals with archaeological sites that lie within an aquatic setting, whether it is marine, riverine or lacustrine, on the bed of the water body or beneath the sediment, regardless of whether they represent activities linked to these environments or not. A different case can be made for *marine* archaeology, where the focus is indeed placed on evidence produced by human action in a particular environment, i.e., marine, that takes place on a body of water. *Nautical* archaeology is devoted to the study of ships, primarily but not exclusively concerning design, construction and sailing. Although in practice it is impossible to separate both aspects, in the last definition the emphasis is placed on the analytical problem and not the depositional environment of the remains. In fact, research tends to focus on a variety of sources of information. Those of archaeological nature also come from land sites (see Jasinski 1999:3; Flatman and Staniforth 2006:168; among others, for a discussion on the scope of each specialty).

A widely recognized delimitation of the field of maritime archaeology was provided in late 1970s by K. Muckelroy in his book *Maritime Archaeology*. There, he defined it as “the scientific study of the material remains of man and his activity on the sea” and added “it is only at sea that seafaring disasters can occur, so it is under the surface of the sea that the bulk of evidence must lie” (Muckelroy 1978:9). From a critical perspective, M.E. Jasinski

noted this idea lacked a humanistic perspective and was almost exclusively focused in the material evidence located under water. Thus, Muckelroy was referring to *marine* archaeology. According to Jasinski, S. McGrail went a little further, and extended the scope of the field to consider as relevant other aquatic environments (e.g., rivers and lakes) and evidence that lies out of the water. Nonetheless, he also focused primarily in aspects relative to ships (whatever their type), or in what we could nowadays refer as *nautical* archaeology (Jasinski 1999:7, 8). McGrail emphasized the relationship between land and water and thus the need to integrate diverse sources of information on past maritime activities—not exclusively nautical—that are found both under water and on land (McGrail 2001). He went even further by considering the symbolic and cognitive aspects that underlie social practices. More recently, J. Adams (2001) placed the emphasis on the place that naval activities occupied within a wider social, economic, political and symbolic system.

J. Flatman and M. Staniforth (2006) included past human interactions with the seas, rivers and lakes under the scope of the specialty. Their proposal integrates a wide variety of sites, not restricted to those that are directly associated with sailing or aquatic environments. They take into account both the wide diversity of ships that have existed and aircraft that has appeared recently in history. They also consider human remains and objects found at the sites, as well as artefacts deposited accidentally or intentionally in any body of water; structures built entirely or partially under water (e.g., bridges and piers) and even the physical traces of activities that were originally developed on land and then flooded. They also mention terrestrial sites, which are not submerged, but are related to maritime activities (e.g., lighthouses, harbour constructions and coastal camps) and coastal, riverine and lacustrine landscapes.

It is clear that the boundaries that define these and other specialties are more permeable and dynamic than fixed. However, the most significant difference between underwater and maritime archaeology is probably that the latter has been considered a field of research not restricted to the environment in which the studied materials are found (Catsambis et al. 2011:xiv). This is, most likely, the main strength of the term regarding the delimitation of the field.

In short, these are fields that partially overlap, but retain their particularities. It is necessary to understand these terms within the different contexts (history of ideas), but also to be aware of the assignment to one or another frequently lies in issues of practical nature (e.g., facing singular issues of research, legislation, or conservation). Whether one definition is preferable to another, this article emphasizes the relevance that underwater excavation has had in the development of maritime archaeology and in our knowledge of the human past, particularly regarding ships and activities related to them.

Underwater Excavation at the Birth of the Specialty

To review the development of the specialty since its constitution as a field of study in its own right lie beyond the scope of this article. Nonetheless, it is worthwhile to briefly refer to this, especially with respect to the fundamentals of the methodological procedures used on underwater sites (for this development, see i.e., Jasinski 1999; Delgado 2000; Bass 2011; Gould 2011; Meide 2013).

The first underwater archaeological ventures of the twentieth century were salvage operations oriented to the collection of antiquities, using deep diving, pre-SCUBA equipment. The focus was primarily placed on recovering works of art. What most work

had in common during this period was the non-systematic nature of the extractions, performed by divers with no training or experience in archaeology, who were supervised by archaeologists from the surface. Practically, this scenario lasted until the 1960s, when a turning point in the history of the specialty took place. The first systematic excavations of shipwrecks were undertaken, and expanded globally in the following decade. These endeavours were taken up by archaeologists that were also trained divers, and it was only then when excavation, survey and recording methods were developed and put into practice for the first time. In its fundamentals, many of them continue to be applied nowadays.

The development of a rigorous methodology allowed for the results obtained under water to be as reliable as those from archaeological work on land. This was one of the principal grounds, if not the main one, for the acceptance of the specialty by the academic community. A key theoretical and methodological issue was put forward by G. Bass, classical archaeologist and founder of the Institute of Nautical Archaeology: the principles and practice in archaeology remain the same, regardless of whether it is carried out in land or under water (Delgado 2000:9).¹ Since then, there have been significant methodological advances in the field of diving and exploration, excavation, surveying, recording and preservation techniques and a development of research projects, university programs, meetings, and publications, of national and international reach (Bass 2011; see, for these developments Delgado 1997, Babits and Van Tilburg 1998, Ruppé and Barstad 2002 and Catsambis et al. 2011).

Eventually, the increasing diversity of sites studied, such as shipwrecks, harbours, shipyards, and prehistoric settlements, and aquatic settings considered, led to the application of new criteria, in accordance with the particularities of the sites and constraints of each study (e.g., in research projects: the aims and resources available). Furthermore, several discussions were prompted regarding the orientation of investigations, mainly those carried out on shipwrecks. In this process, nuances, breaks, and even discontinuities can be recognized.

During the 1960s and 1970s, most of the studies were centred on methods, new technologies available, shipbuilding and artefact typologies (Adams 2003:7). It should be noted this was an unavoidable step in the development of the specialty. As a matter of fact, some investigations provided excellent data on the design and construction of ships and their associated artefacts, which were analysed in relation to their particular historical context (Cockrell 1983:209). From the late 1970s to the beginnings of the 1980s, a turning point took place, which would in many ways affect the subsequent theoretical and methodological developments. Two publications have been widely recognized as seminal works: *Maritime Archaeology*, written by Muckelroy (1978), and a compilation of presentations delivered at a symposium entitled *Shipwreck Archaeology*, which took place in Santa Fe, New Mexico, USA, in 1981. The latter was edited as a book by R.A. Gould (1983a). The first book and the majority of chapters from the second were eminent representatives of

¹ In 1960, George Bass conducted the first excavation of this kind in a Bronze Age shipwreck (1200 BC) at Cape Gelidonya, Turkey. That year, John Goggin, from the University of Florida, published an article which was, for most of the professionals of the country, the first formal introduction to the practice of archaeology under water. Regarding methodological standards, he defined underwater archaeology “as the recovery and interpretation of human remains and cultural materials of the past from underwater by archaeologists”. According to Meide, he seems to have anticipated Bass’ statement when pointing out that “[i]t is far easier to teach diving to an archaeologist than archaeology to a diver!” (Goggin 1960:350) Apart from Bass’ work, important discoveries and investigations were carried out in the 1960s in different parts of the world, which included shipwrecks at Roskilde, Denmark, *Vasa* (Sweden), and later *Mary Rose* (England), *Batavia* (Australia) and ships belonging to the Spanish Armada (Ireland).

processual thought in archaeology, alternative to the historiographic or particularistic approaches that prevailed at the time. According to M. Harpster (2009), Muckelroy was the white knight who incorporated the ideas from the ‘New Archaeology’ and suggested the use of statistical models to handle great amounts of information and discern spatial patterns, in order to reconstruct the site formation processes that operated on shipwrecks.

In retrospective, C. Meide recently noted that processual archaeology had a relatively limited influence in the totality of shipwreck investigations. It is likely, he stated, that the aspects that have prevailed lie in the studies on site formation processes, the experimentation, the application of statistical analyses, and the stratified sampling of the sites. Additionally, he stated that the historiographic or particularistic approaches, represented by Bass’ work in Gould’s *Shipwreck Anthropology*, will probably remain important, given the potential of several sites to produce exceptional amounts of information. In the broadest of terms, these kind of studies focus on the complete excavation and thorough analysis of a shipwreck and all its associated materials, including the recovery and reconstruction of the hull (Meide 2013:10–11). From Bass’ own perspective, the objectives of nautical archaeologists remain, in their vast majority, alike those of classical and medieval archaeologists and art historians (Bass 2011:9).

The discussion on particularist versus universalist (nomothetic) approaches has been a heated one. According to Watson (1983), as in other archaeological areas, research on shipwrecks can be both specific and general in the matters they cover. In a conciliatory attempt, she proposed that both emphases are essential and inseparable; and, in fact, are present in every researcher’s work. She added that the studies of historical character are necessary, although they should not be considered as a goal in themselves, and that they can be applied to answer to broader social problematics that transcend single or multiple sites. From a more pragmatic view, Adams (2003) posed the question of how concrete or significant the distinction between both positions is, if, as a matter of fact, they are interdependent (Adams 2003:10).

Regarding the theoretical and methodological implications of these analytical perspectives, that which concerns extensive excavations plays a significant role. Excavation, considered in the context of an archaeological project, continues to be a crucial part of the research process. The ethical problem that its practice implies was discussed by T. Rehren, among others. He expressed that this procedure implies the replacement of material evidence and its initial integrity by—an inescapably limited—documentation, along with—an even more limited—sampling and storage of remains, but it is conducted to obtain information that contributes to our knowledge of past societies (Rehren 2002). This is essential to archaeology.

Is it the totality of the remains of a ship (extensive excavation) or just a part (partial excavation)² that is excavated? Those that plead for the complete study of a site, defend the need to obtain a picture as complete and precise as possible of a type of site that can be considered as a unit: broadly speaking, a shipwreck represents an event of well-defined spatial and temporal boundaries. Bass, who remains one of the main advocates of this position, posed that the strategy of partial excavation has led to historical inaccuracies that, in some cases, could then be amended if a full excavation had been conducted (Bass 2011:10). The interpretation of partially excavated historical shipwrecks is likely to be less compromised than that derived from, for instance, classic and medieval shipwrecks, to some extent due to the richness of historical sources available for recent times. And were it

² No differentiation is made here between exploratory test trenches, but the excavation of representative areas given the particular guidelines of a research project.

necessary to review and correct the results obtained at a certain moment, it would only represent an usual procedure in the scientific practice. The scenario will depend heavily on the problem in question and, thus, of the data required for its analysis, which should always be representative. It is essential, as R. Steffy (1978) posed, to examine closely even the tiniest piece of evidence to search for as much information as possible. In this sense, it is worth noting that many aspects relative to, for example, naval architecture, can be adequately examined through a fraction of the remains available. Many investigations carried out according to these standards are proof of this (e.g., Murray et al. 2009; Elkin et al. 2011; to quote a few cases from Argentinean Patagonia). It would be risky to propose a single theory in advance, and it is likely that each site and topic demand a solution according to their particularities. Gould seems correct when he pleaded for a more selective excavation, according to a research project's design and questions (Gould 1983b:9).

Archaeological excavations have occupied a central place in the history of archaeology as a scientific discipline to understand the human past. However, in maritime archaeology the international trend is to grant priority—but not exclusively—to those research strategies that generate a minimum impact on the sites. The emphasis is increasingly placed in their long-term preservation, and thus activities that can irreversibly alter the conditions of a site must be based in meritorious arguments, in particular: the relevance of the case for the knowledge of aspects of the past that are considered of scientific interest or the (proved) risk of destruction under which a particular site is found. Before analysing some cases from South America, reference must be made to these kinds of research and preservation strategies of submerged archaeological sites.

On Non-intrusive Strategies

In general, non-intrusive (or as little invasive as possible) actions and methods seem to be based on a policy of minimal intervention on sites. The main argument is the need to preserve their integrity for future generations, even though shipwrecks are subject to a continuous degrading process. The usefulness of non-intrusive methods applied before and after an excavation begins, was recently highlighted for the case of investigations carried out on land (Burrell 2014). One must agree with this criterion which, in essence, pleads for the importance of the archaeological heritage (a non-renewable material resource) as an unparalleled source for knowledge of the past. Nonetheless, the heuristic limitations associated with this type of approach are unavoidable every time a site is chosen for study given its scientific relevance. Non-intrusive techniques may be of particular interest for a starting-off approach at a regional level, when the aim is to identify and define the potential of underwater cultural heritage. However, it should not be considered the most appropriate strategy a priori, regardless of the characteristics of the sites, the research objectives and the means available for their study.

There are some elements to consider in favour of and against this kind of praxis. As for the positive features, some of the following can be mentioned: (1) underwater operations are focused on the survey and recording of the remains that appear on the substratum (e.g., above the seabed), so they require logistics and resources simpler than those required for excavation; (2) the protection of sites that may be at imminent risk of damage is primarily done in situ; (3) it is possible to cover large geographic areas and account for a broad number of sites, which is extremely important when making a detailed archaeological

database (*carta arqueológica*, in Spanish); (4) in particular conditions, currently available techniques (e.g., photogrammetry) allow for surveys to be performed in a short time, with a degree of detail previously unknown and in places beyond the reach of scuba divers (see works published in Menna et al. 2015); and (5) are a valuable means for site mapping and documentation by students and local collaborators associated with archaeological research projects (some proposals of the Nautical Archaeology Society and the Maritime Archaeological and Historical Society, of international renown, seek this purpose). The aforementioned preservation of the remains for their public enjoyment and study in the years to come can be added to this list. This aim also is in line with what was proposed by the UNESCO Convention on the Protection of the Underwater Cultural Heritage (2001).³ Most of these elements are particularly valuable in the case of developing regions. Such is the situation in the South American context, which has an extensive maritime heritage still waiting to be studied. In the case of historical shipwrecks, although the available documentary references are often profuse, the number of sites studied archaeologically is still very low. In relation to the latter, it is likely that Chile and Argentina are at the forefront, given the long trajectory of the research practitioners there have carried out.

These and other favourable aspects have served for years to highlight the relevance of non-intrusive (or non-invasive) activities. But these actions could be considered, after all, one of the first steps of a research project. As already seen, the *par excellence* method by which archaeology collects data is excavation. This activity still holds a privileged place within the complex process of archaeological investigation. This applies to archaeology as a whole, irrespective of the scenario in which works are carried out, i.e., on land or under water. There was a time when underwater archaeologists, worried about the need to imprint rigorousness and professionalism in their work—which meant, to recall, the recognition of underwater archaeology by the academic community—turned their focus towards the work done on land. More than half a century later, the specialty has reached significant theoretical and methodological maturity, but has also paid a price: a growing isolation of maritime archaeologists in relation to investigations carried out on land by their colleagues, as with historical or post-medieval archaeology.⁴ Perhaps the emphasis on non-intrusive action is, to some extent, a consequence of this gradual estrangement.

Based on what has been mentioned above, excavations offer a range of possibilities for the analysis of sites that need to be better explored. Considering the issues associated with conservation, the positive experiences based on the excavation, monitoring and in situ preservation of sites both under water or waterlogged are worth mentioning (e.g., Manders 2006; Bethncourt et al. 2014; Murray et al. 2015).⁵ In certain cases, the partial or complete

³ One of the main motivations for the declaration of the Convention is related to the commitment to improve “the effectiveness of measures at international, regional and national levels for the preservation in situ or, if necessary for scientific or protective purposes, the careful recovery of underwater cultural heritage” (UNESCO 2001: 51).

⁴ In America, the distinction between prehistory and history has been marked essentially by the arrival of Europeans to the continent. In the ‘Archaeology of American tradition’ (in the majority of countries of America), archaeological sites temporally situated after this event, for which documentary sources are also usually available, are considered as “historical”. In Europe, where societies have not experienced such discontinuity, research in archaeology has been organized by periods. Given its proximity to the temporal framework and the problems analyzed, post-medieval archeology (post-AD 1450) is considered as the closest counterpart to historical archeology in America.

⁵ Taking this strategy into consideration, and leaving aside its particularities, it is possible to assume that the conservation of underwater sites is not necessarily more complicated than that of sites located on land (see Maarleveld 2014).

reburial of materials from excavated sites after their recording and sampling is an option to be considered (see Demas 2004; Valentini and García Cano 2012b).

Archaeological Research in South America

The archaeological projects developed in the South American region selected for this article have moved along different paths. For the particular purposes of this presentation they can be grouped into two types: (1) research motivated mainly by the scientific interest of certain wrecks (or other kind of sites); and (2) studies framed in archaeological impact assessments, in response to the normative systems that regulate both public and private work in maritime contexts (e.g., extension of harbour terminals). These activities, which show a remarkable growth in the region, have contributed to the identification of a significant number of sites and, sometimes, gave rise to the planning and development of archaeological research projects. In the case of shipwrecks, those studies that have defined naval architecture, nautical equipment, ordnance, and the plethora of objects carried on board by the crew as units of analysis, will be specially considered for the discussion.

Below, a selection of research, both from published and unpublished reports, and in which the authors have participated actively, is presented. First, in Colombia, some of the environmental consulting and archaeological research work carried out in the Bay of Cartagena and its surroundings by the team of the Terra Firme Foundation is considered. Secondly, in the case of Chile, the research carried out in the Bay of Valparaíso, framed within the projects of the Maritime Archaeological Consultant ÀRKA, is addressed. Finally, in Argentina, the results of excavation activities on the sloop-of-war HMS *Swift* (1770) are discussed, conducted by the Underwater Archaeology Program (PROAS) of the National Institute of Anthropology (INAPL).

Chile: Sites S3_PV (*Infatigable*) and S3-4_PV (Muelle Fiscal)

From the numerous shipwrecks excavated in Chile, two sites were selected. Both are located close to each other, at one of the berths in Terminal No. 1 of the Valparaíso harbour. This selection was motivated precisely by the problem implied by their spatial proximity. Both sites were located, together with a third one not referred to here, during an archaeological assessment prior to dredging works at the area.

The task was carried out by ÀRKA, which has been dedicated to archaeological activities under the current legislation on underwater cultural heritage for more than a decade, and under the scientific direction of Diego Carabias Amor. Since being found, both sites were alternatively excavated in several campaigns. Eventually, these activities developed into leading scientific research projects.

The location of the sites created a huge methodological challenge, as they are both located in the anchoring area of large vessels (container ships). This demanded an arduous and meticulous coordination with the vessels' unremitting mooring manoeuvres. Likewise, given the depth at which they lie (20 m), the sites tend to receive the direct impact of the water flow caused by the propellers of vessels and tugboats. These factors affected the equipment that was installed for the development of archaeological fieldwork, such as baselines, grids, etc., as well as the material remains exposed during excavations.

As regards environmental conditions, the visibility fluctuates from 6 m to null. This variability is caused by the pluvial discharge that flows into the area surrounding the sites,

mostly due to runoff from the hills of the city of Valparaiso. For this reason, archaeological activities had to be put on hold for many days in several instances, until the minimally required conditions (at least a visibility of 1 m) were restored.

S3_PV Site (*Infatigable*)

The first site is known as S3_PV due to its location in front of the third dock of Terminal No. 1 of Valparaiso harbour.⁶ The site was studied over several archaeological fieldwork seasons from 2006 to the present. In this period, the initial tasks of recording, surface collection of finds, wood sampling for botanical analysis and detailed documentation of shipbuilding and design, and the consecutive phases of excavation and recovery of numerous artefacts, have been carried out. Once the information from the archaeological remains was processed, together with a detailed analysis of historical documents, the site was identified as the shipwreck of *Infatigable*.

The transport ship *Infatigable* sunk due to an accidental explosion on August 3, 1855. Its study has contributed to documenting unknown aspects of the social and material life aboard a Chilean Navy vessel from the mid-nineteenth century. From the wooden hull, only the bottom remains, under a layer of metallic bars frequently used as ballast in contemporary warships.

An enormous amount of material remains not corresponding to the hull were found at the site. Evidence of personal weapons included ammunition and remains of firearms, both short- and long-barrelled. The edged weapons found include scabbards and remains of official and boarding sabres and knives. The diverse seamanship tasks on board are reflected in a variety of toolkits. The nautical instruments are represented by a telescope, a sextant and a barometer. The ceramic array is characterised by table earthenware of European origin, mainly British. Globular glazed *botijas* (earthenware jugs) of Hispanic provenance, used as liquid and food containers, can also be highlighted. Different marks that were commonly used as means of personal identification by the crew could be observed on the earthenware (plates and bowls): notches, Roman numerals and inscribed names. Alcohol consumption is evident from a varied array of glass and ceramic bottles; additionally, fragmented and whole clay pipes and remains of seeds and tobacco were found. Among the clothing remains, diverse naval, military and civilian buttons manufactured in the United States of America, England, and France were found, together with buckles, insignias and remains of shoes.

In sum, the specialized and systematic analysis of the artefacts from *Infatigable* allows for the investigation of the material and social world of the seamanship, soldiers and officers that were part of the Chilean Navy.

S3-4_PV Site (Muelle Fiscal)

The second site is called S3-4_PV, because it is located between docks 3 and 4 of Terminal No. 1 of Valparaiso harbour, about 60 m away from the previous shipwreck.⁷ As for its

⁶ The specific information of the site was reproduced here by permission of the authors of the following report of ARKA. (Carabias 2009a, b). Results of the research conducted by the Centro de Investigación en Arqueología Marítima del Pacífico Sur Oriental (ARQMAR) were presented recently (Carabias et al. 2015). See also Carabias (2015), for a general review of the studies carried out in the Valparaiso Bay.

⁷ Information of the site was reproduced here by permission of the authors from ARKA: (Carabias 2012). As for the previous case, see also Carabias (2015).

main features, both at the time of its discovery and during the first interventions, this site did not present visible remains of any ship structure. There was, however, an area of dense concentration of archaeological material, both whole and fragmented. At first it was posed that the absence of structural remains could be explained if they had been exposed over time. The good preservation of timbers from nearby and even earlier sites, among them *Infatigable*, implied more likely that this absence was not due to natural deterioration agents. Alternatively, the shipwreck possibly associated to the artefact concentration could lie somewhere near the remains.

Excavation work reported a great amount of osteological remains of mammals, slag and coal, bricks, earthenware, liquid containers, food and pharmacopoeia, and personal objects, among others. The analysis of the recovered diagnostic material pointed towards a sample from a period ranging from 1880 to 1910. By the study of documentary sources, such as historical cartography, it was possible to identify the area of the concentration as the former site where the *Muelle Fiscal* (official pier for customs control) stood and more precisely as the outer side, destined mostly for the mooring of deep-draught steamships.⁸

Thus, and given the absence of shipwreck structural remains, it was concluded that the site was a product of the discard of materials associated with cleaning, loading and unloading practices of the vessels moored at the pier. During the period in which it functioned, ships remained anchored for a long time and debris was generated by the daily consumption of different goods. The site is, in sum, a multicomponent site that resulted from the repetitive use of maritime space. In the period studied, discarded products from Valparaiso were directly thrown off the pier to the sea at locations specifically defined by local ordinance, although these regulations were not rigorously abided by.

The material is evidence of the intense European cultural influences and increasing importation of consumption goods during the period. The bottles recovered from the site show the wide variety of beers, wines and liquors that were imported from Europe. Bottles of soda water and mineral water manufactured between 1880 and 1910 in England, Scotland and Ireland, were also found. Additionally, there were finds of glazed stoneware vessels (manufactured in Bristol from 1835 onwards) that were used during the nineteenth century as containers for diverse liquids, ranging from alcoholic beverages to chemical products. Together with the evidence mentioned, the presence of clay pipes manufactured in British and France, which display a wide variety of decorative designs, provide a further account of the practices in Valparaiso at the end of the nineteenth century.

The integration of archaeological works carried out on the coastline and under water helped in the understanding of the historical process of Valparaiso's modernization. Likewise, the site offers detailed information of diverse aspects of life on board cargo and passenger steamships, including social hierarchies and cultural influences, among others. In other words, the research contributed to an initial archaeological approximation to the long-distance movement of people and products between Europe and Chile, in the context of a globalized capitalist economy.

As a reflection, it is worth noting that precise information was obtained through extensive archaeological excavation of representative sections previously defined, which

⁸ The *Muelle Fiscal* represented the first great harbor construction work that took place in Chile during the nineteenth century. It was built between 1873 and 1883 and functioned from 1884 until the second half of the twentieth century. It had a length of 237 m and was 15.5 m wide. It allowed mooring the deep-draft vessels on the exterior and two of regular size in the interior. With enhancement works at the port in 1912, the pier was dismantled and part of its structure recycled. The piles of concrete blocks served as a support for the new line of seawalls, and as a consequence part of the actual berth follows the original orientation axis.

allowed for the identification of two sites close to each other, both in terms of location and chronology. Had they been studied by non-intrusive methods or with exploratory test trenches, this would have been impossible to understand. The sites are still studied by research projects, given the great interest they represent for the knowledge of maritime activities in the region.

Colombia: Manzanillo 15 and San Felipe Sites

In this section, fieldwork research at two sites within the bay of Cartagena de Indias will be presented. The first one, called Manzanillo 15, was located during archaeological work linked to the environmental impact assessment carried out by the Terra Firme Foundation, prior to the dredging of the port's main access channel. Activities there were performed under the scientific direction of Dr. Carlos del Cairo Hurtado, with the support of the Colombian Institute of Anthropology and History (ICANH), and following standards proposed by the archaeologists involved. Remains were found while checking anomalies previously recorded with side-scan sonar. The second site, named San Felipe, resulted from the monitoring of dredging activities at the mouth of the Boca Chica channel. In this place, articulated remains of a wooden ship appeared on the seabed when inspecting the slopes of the new channel created by the dredge.

In both cases, it was decided to carry out underwater excavation work, with the aim to establish their archaeological integrity and the degree of dispersion of the remains. It should be emphasized that these questions could only be answered through excavation. Each site will be treated separately below.

Manzanillo 15 Site

As mentioned above, archaeological activities were carried out in a harbour setting.⁹ In this context, to obtain the approval for excavation tasks required an arduous process of negotiation, since they would delay projected building works. In addition, the poor diving conditions at this site have to be highlighted. The prevailing low visibility (1 m) and the site location at the main entrance channel to the internationally-used Cartagena de Indias harbour both demanded precise coordination with the movements of large ships.

The first superficial find was a section of what seemed to be a wooden keel. Close to it, ten other structural pieces and one iron cannon were found lying on the seabed. Through excavation, the remains of more than 50 timbers in very good condition were revealed. These structural pieces were arranged in discrete concentrations within an area of about 1200 m² and some were found partially articulated. Excavations at this site covered an effective area of approximately 400 m².

Two interrelated key facts were identified. First, based on the pieces' layout, it was established that the vessel remains had been displaced from their original position (or place of sinking). Secondly, the absence of portable artefacts (nautical equipment, crew's personal possessions, etc.) in the entire excavated area also points to a heavily disturbed site, most likely due to past dredging work. Due to the low integrity of the shipwreck, and seeking to avoid future damage by dredging, a detailed plan of the extant and subsequent displacement of all structural parts was carried out. This allowed preservation of the remains for further investigation.

⁹ The information on the site can be found in the following report, reproduced here by permission of the authors: del Cairo Hurtado (2016a).

The success of an excavation relies upon the possibility to achieve an understanding of an archaeological site that is hard to get from the observation of objects found on the surface of the seabed alone. This was of great significance, as the results obtained from excavation guided the planning and implementation of the archaeological rescue. The duration of activities, number of people involved, methodology, infrastructure and rescue strategy, could only be established based on knowledge of the state in which the remains were found.

San Felipe Site

As mentioned above, this site was found during the archaeological monitoring of the dredging of marginal areas.¹⁰ These activities were part of the requirements proposed by archaeologists for environmental impact assessment of Boca Chica. Contrasted to the previous case, once reported, this site became part of a long-term research project. Two main reasons account for the latter. On one hand, it was impossible for the site to be damaged by dredging works, as they had already been completed. On the other hand, given the apparent integrity of the remains and their specific location, they had a special archaeological potential. The place where the site lies might correspond to the sinking of one of the Spanish ships commanded by Blaz de Lezo, which in 1741 were intentionally sunk to block the entrance to Cartagena de Indias and thus prevent the British fleet, under the command of Admiral Vernon, to invade the city.

The site lies on a sand slope, which was created by the dredging works. Among the debris that appeared on the seabed, the keel, the keelson, several floors, and timbers of the ceiling and hull planking, could be identified. The dredging operations broke through the vessel, so that the hull remains are currently exposed in a cross-sectional view. Taking this into consideration, the following research aims were developed:

- a. To determine the state of conservation of the ship's remains and to evaluate site formation processes, both natural and man-made.
- b. To establish the approximate percentage of the ship that could still remain in situ, in order to estimate what part of the structure was broken down.
- c. To carry out a detailed survey of the structural components with the aim to assess, based on the historical sources of the battle's participants, the origins and period of use of the ship.
- d. If elements related to the cargo, armament, ballast, etc., were found, to evaluate the contextual integrity of artefacts and the temporal coherence between them and the period of the ship's construction (according to their morphological features).

Fieldwork made it possible to answer these matters. First, it was confirmed that large portions of the ship's structure have survived. These were well preserved and exhibited a high degree of articulation, which allowed for a detailed observation of the architectural details. In this regard, a clear differential in the preservation of the site is marked by the line of sedimentation: the wood remains are mainly preserved below the seabed. Taking into account the degree to which the remains are exposed to local fishermen's nets, the high

¹⁰ Specific data of this site were reproduced here from the following unpublished report with the kind permission of the author: del Cairo Hurtado (2016b). This work is framed on the lengthy research on Maritime archaeology and Conflict archaeology that del Cairo Hurtado has carried out in Cartagena de Indias (e.g., del Cairo Hurtado et al. 2003; del Cairo Hurtado and García Chaves 2006; del Cairo Hurtado 2009, 2011a, 2011b).

visibility and shallow waters at the site, as well as the environment of the Colombian Caribbean Sea, it can be stated that the shipwreck is in very good condition.

Second, these surveys and further open-area excavations made it possible to observe that at least 50% of the ship was not affected by the severe action of dredging. Based on this work, it was determined that the remaining structure corresponds to the ship's hold. By means of a trench made on the centre line, nearly 15 m of the keel and keelson, with their respective floors and the first futtocks, as well as the inner and outer planking, were made visible. In addition, based on supplementary surveys, other structural remains were recognized around 4 m off each side of the keel.

Third, through the survey and recording of the visible structural remains, it was determined that the hull suffered the most severe damage near the master frame. Since the project is at an initial stage, it could not yet be established if the missing section corresponds to the bow or stern. It should be noted that shipbuilding features and the size of the main structural elements are consistent with the rate of warships used in 1741. In this regard, samples from different timbers were obtained for wood species identification, and results will help to assess the provenance of timbers use for ship's construction.

Fourth, concerning archaeological remains, a high quantity of ceramic artefacts with little fragmentation (many can be reassembled) was noticed in stratigraphy. Globular *botijas* of Hispanic origin predominate. These remains suggest, at first, that the wreck could correspond to one of the Spanish ships already mentioned. Part of the ballast was also found, represented by considerable amounts of small and medium-sized basalt stones. This evidence reinforces statements made above about the integrity of the site.

Looking back on the two cases described, it is worth mentioning that the information gathered during these first fieldwork seasons (in 2015 and 2016) has been significant both in terms of underwater heritage protection—a still unresolved issue in Colombia—and for scientific maritime archaeological research.

Argentina: HMS *Swift*

For the case of Argentina, the site selected here can be considered emblematic given it was one of the principal causes, if not the main, for the development of maritime archaeology in the country. It is HMS *Swift*, a sloop-of-war that was part of the British naval squadron commissioned at the station Port Egmont in Malvinas/Falkland Islands, and sunk in Puerto Deseado, Province of Santa Cruz, in 1770.

The site is very well preserved, a fact almost unprecedented with other historical shipwrecks of South America. It also presents a high archaeological integrity, because of several interacting circumstances. This scenario was one of the main motivations for a group of archaeologists with professional backgrounds in terrestrial projects to begin a research project with emphasis on underwater excavation under the scientific direction of Dr. Elkin (PROAS-INAPL). More than a decade of fieldwork on this site inspired the present publication, as this article aims to reflect upon the importance that the excavation of underwater sites has for their understanding.

HMS *Swift* was non-intrusively studied since the late 1980s to mid-1990s by a group of architects from the International Council on Monuments and Sites (ICOMOS), dedicated to the preservation of underwater cultural heritage (see García Cano 1996). This work constitutes one of the first approaches to an underwater archaeological site in the country, although the contribution for the research questions asked later was of limited scope (see below). It is important to highlight that the choice not to intervene at the site was wise at the time, as the team lacked archaeologists. With the creation of a research project

designed, directed and executed by archaeologists in 1997/1998, a new strategy for investigating underwater sites in Argentina was begun. Since then, the need to assess archaeological questions in light of the results obtained from excavation and material analyses was posed.

The PROAS archaeological work started with the systematic mapping and superficial recovery of diagnostic artefacts, parallel with the drawing of a site plan. The latter would constitute the main means to link the archaeological material finds to the different sectors of the ship. As for research guidelines, 2×2 m excavation grids were proposed for excavation taking into account the original ship's lines drawings. They were set at representative places where the questions posed could be answered. As researchers were dealing with a single-component site, it was determined that it would be excavated following artificial levels. This would help to understand how formation processes could have operated on the spatial distribution of artefacts. It should be noted that difficulties related with the natural environment of the site had to be confronted since the very beginning. A reduced visibility (mean average of 1 m, occasionally down to less than 30 cm) and high currents both during incoming and outgoing tides, frequently limited and interrupted the excavation. As fieldwork seasons followed, research was directed toward different goals, which lead to the close correlation of diverse analytical units. Thus were studied naval shipbuilding and design, cultural and natural site formation processes, naval technology, clothing, food, spatial distribution on board and social hierarchy, among others (see Elkin et al. 2007, 2011; Elkin and Argüeso 2010).

As for shipbuilding and design, excavation revealed structural remains and allowed for the study of construction details. It was in this way that researchers discovered a modification in the deck's design made after the original construction, closely related to the need to allocate more crew members. Modifications in the configuration of the stern section, including the extension of the sternpost and quarterdeck, were identified. These modifications are related to the purpose of HMS *Swift* and particularly to its last destination: the distance and logistics for this southern-most context would have demanded more crew members and a longer period of navigation (Murray 2012; Murray et al. 2010).

Other relevant topics in the research were motivated by the find of human remains, belonging to a member of the crew, during excavation at the stern and captain's cabin. A notable aspect was the high degree of correspondence between archaeological evidence and the systemic context, for which written sources are available. In the account of the wreck made by HMS *Swift*'s lieutenant, it is mentioned that before the ship sank, some private marines were trying to lower the amount of bilge water with buckets by means of a human chain that went from the storeroom to the upper deck (Gower 1803). (The storeroom was accessed through the captain's cabin.) The buckets and the human remains found during excavations were located close to the entrance of the former. Subsequent analyses revealed that the remains were those of a young individual whose age matched the age range of two of the marines who died in the wrecking event (Barrientos et al. 2011). Additionally, part of a uniform was found directly associated with the remains, and its features reinforced this conclusion (Maier et al. 2010).

These examples, among others (see Elkin et al. 2011), show the type and quality of information that can be obtained through the interpretation of the archaeological context and the analysis of materials recovered during excavations carried out under the guidelines of a defined research plan.

Final Thoughts

Potential access to the material associated with archaeological sites is frequently subject to the way in which the remains are approached. In this article, it was not the intention to establish a scale of the studies carried out in maritime archaeology; instead, the intention was to contrast the scope of strategies that include excavation against non-intrusive approaches. In particular, the focus was placed on the positive impact of the excavation strategies applied to the research topics of different South American archaeological projects, especially historical shipwrecks.

It is possible to appreciate that in each of the sites considered, archaeologists had to face different working situations, and consequently particular technical solutions were applied. The sites had in common unfavourable environmental conditions for fieldwork, a fact especially relevant. In spite of the challenges, researchers were able to fulfil the standards of an archaeological excavation.

Another circumstance common to the cases in question is related to the general socio-economic panorama of South American countries, in particular regarding scientific policies. In this context, the difficulties faced to obtain archaeological research subsidies is significant, as this undermines the possibility to undertake long-term studies, or mines their continuity over time. The situation is not so different for the case of fieldwork carried out as a result of archaeological impact assessments. Current legislation on the preservation of underwater cultural heritage is relatively recent in the region, leaving aside it is not well known by all those involved in its safeguard. In this context, archaeologists must invest great efforts in management, for authorities require companies to carry out archaeological impact assessment studies, rescue and monitoring activities of underwater and coastal sites.

One of the main challenges involved when working with materials from underwater contexts has been their conservation, especially once they are excavated and recovered. The lack of an adequate infrastructure and economic and human resources to accomplish this fundamental goal exerted in many cases a strong emphasis in favour of non-intrusive archaeological work. Given that in any research project there is a *continuum* between surveying, excavating, analysing, and conserving materials of a site—a kind of operational chain—it is necessary to find a way for this difficulty not to become an impediment for archaeological work. In this sense, as was mentioned, an increasing number of cases in the world are applying both excavation and in situ conservation strategies.

The situation outlined above, however, has not impeded the development of maritime archaeology in South America. Within this context, both in the cases presented and in many others developed over the last 20 years, it has been possible to undertake archaeological projects that included excavations under water. In this article, excavation of underwater sites is seen as a fundamental way to obtain significant information about the sites. The results achieved to date in this region are a testimony of its potential.

Acknowledgements The authors wish to express their gratitude to Diego Carabias Amor (Chile), Carlos del Cairo Hurtado (Colombia), and Dolores Elkin (Argentina), directors of the archaeological projects referred in this article, for their support. A special thanks to Diego and Carlos, who allowed the authors to reproduce unpublished reports of the sites mentioned in this article. Also, we are thankful to Jorge Manuel Herrera Tovar and Arturo Rey da Silva, for their invitation to collaborate with this publication. Finally, a special thanks to Ana Castell, for her generous contribution with the translation of the manuscript.

References

- Adams J (2001) Ships and boats as archaeological source material. *World Archaeol* 32(3):292–310
- Adams J (2003) Ships, innovation and social change. Aspects of carvel shipbuilding in northern Europe 1450–1850. *Stockholm Studies in Archaeology No. 24/Stockholm Marine Archaeology Reports No. 3*. Stockholm
- Babits LE, Van Tilburg H (eds) (1998) *Maritime archaeology. A reader of substantive and theoretical contributions*. The plenum series in underwater archaeology. Plenum Press, New York
- Barrientos G, Béguelin M, Bernal V, García Guraieb S, Ghidini G (2011) Estudio bioarqueológico del esqueleto recuperado en la corbeta británica del siglo XVIII HMS *Swift* (Puerto Deseado, Santa Cruz, República Argentina). In: Elkin D, Murray C, Bastida R, Grosso M, Argüeso A, Vainstub D, Underwood Ch, Ciarlo NC (eds) *El naufragio de la HMS Swift (1770): Arqueología marítima en la Patagonia* (Sección Estudios Especializados, pp 1–26). Vázquez Mazzini Editores, Buenos Aires
- Bass GF (2011) The development of maritime archaeology. In: Catsambis A, Ford B, Hamilton DL (eds) *The Oxford handbook of maritime archaeology*. Oxford University Press, New York, pp 3–22
- Bethencourt M, Fernández-Montblanc T, Izquierdo A (2014) ARQUEOMONITOR: Contribución de las condiciones físicas, químicas y biológicas en el deterioro y salvaguarda del Patrimonio Cultural Subacuático. Influencia sobre las velocidades de corrosión en la artillería de dos pecios asociados a la Batalla de Trafalgar (1805). In: Nieto Prieto X, Bethencourt M (eds) *Arqueología subacuática española* (Proceedings of the I Congreso de Arqueología Náutica y Subacuática Española, Cartagena, 14th to 16th March 2013), vol 2. Editorial de la Universidad de Cádiz, Cádiz, pp 331–341
- Burrell I (2014) What are non-intrusive archaeological survey techniques, and how are they used to archaeological advantages during excavation. *Post Hole* 36:8–13
- Carabias D (2009a) Encuentro de dos mundos. Naufragio del H.M.S. Wager en la Patagonia. Consejo Nacional de la Cultura y la Artes, Valparaíso
- Carabias D (2009b) Informe Arka. Plan Integral de Supervisión, Intervención y Manejo Proyecto “Dragado de Mantenimiento del Frente de Atrache No. 1—Puerto Valparaíso”, Comuna de Valparaíso, V Región. Report requested by Terminal Pacífico Sur Valparaíso S.A. and presented to the Consejo de Monumentos Nacionales. Ms
- Carabias D (2012) Informe Arka. Caracterización Arqueológica Subacuática Sitio S3-4 PV, Muelle Fiscal, Puerto Valparaíso. Proyecto “Extensión y Mejoramiento Frente de Atrache No. 1 del Puerto de Valparaíso, Comuna de Valparaíso, V Región. Report requested by Terminal Pacífico Sur Valparaíso S.A. REF. INF 10/2012. Valparaíso, Chile. Ms
- Carabias D (2015) Valparaíso: el patrimonio bajo la cota cero del puerto principal. *Cultura y Desarrollo* 13:34–37
- Carabias D, Simonetti R, Morales C, López P (2015) Investigación, conservación y análisis de los restos de un transporte del Estado: la barca Infatigable (1855), at the XX Congreso Nacional de Arqueología Chilena, 5th to 9th October, Concepción, Chile. Ms
- Catsambis A, Ford B, Hamilton DL (eds) (2011) *The Oxford handbook of maritime archaeology*. Oxford University Press, New York
- Cockrell WA (1983) A trial classificatory model for the analysis of shipwrecks. In: Gould R (ed) *Shipwreck anthropology*. University of New Mexico Press, Albuquerque, pp 207–217
- del Cairo Hurtado C (2009) *Arqueología de la Guerra en la Batería de San Felipe, Isla de Tierra Bomba, Cartagena de Indias*. Centro de Estudios Socioculturales e Internacionales, CESO, Bogotá
- del Cairo Hurtado C (2011a) Tácticas defensivas y tácticas ofensivas: Arqueología de una batalla en la Isla de Tierra Bomba, Cartagena de Indias, siglo XVIII. *Revista de Arqueología Histórica Argentina y Latinoamericana* 5:11–34
- del Cairo Hurtado C (2011b) Polyvalence, conjunction et superposition des paysages maritimes de la guerre en Carthage des Indes. Master Thesis of the Université Paris 1 Panthéon-Sorbonne, Paris. Ms
- del Cairo Hurtado (2016a) Informe Final Terra Firme and Colombian Institute of Anthropology and History. Plan de relocalización de los restos de un naufragio de Manzanillo 15 en el marco de dragado y profundización del Canal de Manzanillo y Bocachica. Cartagena de Indias, Colombia. Ms
- del Cairo Hurtado C (2016b) Informe Final Terra Firme and Colombian Institute of Anthropology and History Investigación arqueológica y medidas de protección, intervención y divulgación del pecio localizado en Bocachica. Cartagena de Indias, Colombia. Ms
- del Cairo Hurtado C, García Chaves MC (2006) Entre naves y fuertes: la estrategia militar de don Blaz de Lezo en 1741. In: del Cairo Hurtado C, García Chaves MC (eds) *Historias sumergidas. Hacia la protección del patrimonio cultural subacuático en Latinoamérica*. Universidad Externado de Colombia, Bogotá, pp 261–282

- del Cairo Hurtado C, Fuquen C, García Chaves MC, Perez F, Peña O (2003) El ataque inglés a Cartagena. Arqueología de un naufragio. In: Castillo Murillejo NC, Alvis Palma DN (eds) El mundo marino de Colombia: investigación y desarrollo de territorios olvidados. Universidad Nacional de Colombia, Bogotá, pp 262–273
- Delgado J (1997) Encyclopedia of underwater and maritime archaeology. British Museum Press, London
- Delgado J (2000) Underwater archaeology at the dawn of the 21st century. *Hist Archaeol* 34(4):9–13
- Demas M (2004) Site unseen: the case for reburial of archaeological sites. *Conserv Manag Archaeol Sites* 6(3/4):137–154
- Elkin D (2011) Shipwreck archaeology in South America. In: Catsambis A, Ford B, Hamilton DL (eds) Oxford handbook of maritime archaeology. Oxford University Press, New York, pp 685–707
- Elkin D, Argüeso A (2010) Aportes teórico-metodológicos para arqueología náutica de momentos históricos. In: Oliva F, de Grandis N, Rodríguez J (eds) Arqueología argentina en los inicios de un nuevo siglo, vol 3. Laborde Libros Editor, Rosario, pp 337–345
- Elkin D, Argüeso A, Grosso M, Murray C, Vainstub D, Bastida R, Dellino V (2007) Archaeological research on HMS *Swift*: a British Sloop-of-War lost off Patagonia, Southern Argentina, in 1770. *Int J Naut Archaeol* 36(1):32–58
- Elkin D, Murray C, Bastida R, Grosso M, Argüeso A, Vainstub D, Underwood Ch, Ciarlo NC (2011) El naufragio de la HMS *Swift* (1770): Arqueología marítima en la Patagonia. Vázquez Mazzini Editores, Buenos Aires
- Elkin D, Murray C, Grosso M, Gutiérrez G, Trassens M, Bastida R (2015) Investigaciones interdisciplinarias en sitios arqueológicos de naufragio en el Golfo Nuevo (provincia del Chubut): primeros resultados. *Cuadernos del Instituto Nacional de Antropología y Pensamiento Latinoamericano* 24(1):21–40
- Flatman J, Staniforth M (2006) Historical maritime archaeology. In: Hicks D, Beaudry M (eds) The Cambridge companion to historical archaeology. Cambridge University Press, Cambridge, pp 168–188
- García Cano J (1996) Operación no intrusiva en un sitio de arqueología subacuática en Argentina. El caso de la Sloop H.M.S. *Swift*. *Anuario de la Universidad Internacional SEK* 2:45–65
- Goggin FM (1960) Underwater archaeology: it's nature and limitations. *Am Antiq* 25(3):348–354
- Gould RA (ed) (1983a) Shipwreck anthropology. University of New Mexico Press, Albuquerque
- Gould RA (1983b) Looking below the surface: shipwreck archaeology as anthropology. In: Gould RA (ed) Shipwreck anthropology. University of New Mexico Press, Albuquerque, pp 3–22
- Gould RA (2011) Archaeology and the social history of ships. Cambridge University Press, Cambridge
- Gower E (1803) An account of the loss of his majesty's sloop *Swift*, in Port Desire on the Coast of Patagonia on the 18th of March, 1770. Winchester and Son, London
- Harpster M (2009) Keith Muckelroy: methods, ideas and maritime archaeology. *J Marit Archaeol* 4(1):67–82
- Jasinski ME (1999) Which way now? Maritime archaeology and underwater archaeology into the 21st century. Paper presented at the world archaeological congress 4, pp 1–22. University of Cape Town, South Africa
- Maarleveld TJ (2014) Underwater sites in archaeological conservation and preservation. In: Smith C (ed) Encyclopedia of global archaeology. Springer, New York, pp 7420–7427
- Maier MS, Gómez BA, Parera SD, Elkin D, De Rosa H, Ciarlo NC, Svoboda H (2010) Characterization of cultural remains associated to a human skeleton found at the site HMS *Swift* (1770). *J Mol Struct* 978(1–3):191–194
- Manders MR (2006) La protección in situ de un navío colonial holandés en aguas de Sri Lanka. In: Grenier R, Nutley D, Cochran I (eds) Underwater cultural heritage at risk: managing natural and human impacts (Heritage at Risk Special Edition, pp 58–61). International Council on Monuments and Sites, Paris
- McGrail S (2001) Boats of the world, from the stone age to medieval times. Oxford University Press, Oxford
- Meide Ch (2013) The development of maritime archaeology as a discipline and the evolving use of theory by maritime archaeologists. Dissertation Position Paper No. 2, Department of Anthropology, College of William & Mary, Williamsburg, Virginia, USA
- Menna F, Nocerino E, Del Pizzo S, Bruno F, Remondino F (eds) (2015) The international archives of the photogrammetry, remote sensing and spatial information sciences. ISPRS Archives, vol. XL-5/W5. Proceedings of the underwater 3d recording and modeling. TC V, CIPA, 16th and 17th April, 2015. Piano di Sorrento, Italy. www.int-arch-photogramm-remote-sens-spatial-inf-sci.net/XL-5-W5/index.html
- Muckelroy K (1978) Maritime archaeology. Cambridge University Press, Cambridge
- Murray C (2012) La corvette *Swift* (1763–1770). Continuité et changement dans l'architecture navale du XVIII^e siècle. *Neptunia* 267:35–45

- Murray C, Vainstrib D, Bastida R, Manders M (2008) *Tras la estela del Hoorn. Arqueología de un naufragio holandés en la Patagonia*. Vázquez Mazzini Editores, Buenos Aires
- Murray C, Grosso M, Elkin D, Coronato F, De Rosa H, Castro MA, Ciarlo NC (2009) Un sitio costero vulnerable: el naufragio de “Bahía Galenses” (Puerto Madryn, Chubut, Argentina). In: Salemme M, Santiago F, Álvarez M, Piana E, Vázquez M, Mansur E (eds) *Arqueología de la Patagonia. Una mirada desde el último confín*, vol 2. Editorial Utopías, Ushuaia, pp 1093–1108
- Murray C, Vainstrib D, Argüeso A (2010) *Arquitectura naval del siglo XVIII. Caso de estudio: sloop-of-war HMS Swift (1763–1770)*. In: Oliva F, de Grandis N, Rodríguez J (eds) *Arqueología argentina en los inicios de un nuevo siglo*, vol 3. Laborde Libros Editor, Rosario, pp 359–370
- Murray C, Coronato F, Paniquelli M, Ezcurra H (2015) *Protección in situ de sitios arqueológicos de naufragio: el caso de Bahía Galenses (Puerto Madryn, Chubut)*. In: Palacios OM, Vázquez C, Ciarlo NC (eds) *Patrimonio Cultural: la Gestión, el Arte, la Arqueología y las Ciencias Exactas Aplicadas*, Año 4. Ediciones Nuevos Tiempos, Buenos Aires, pp 201–211
- Rehren T (2002) *Object integrity: or why do we excavate?* *Papers from the Institute of Archaeology* 13:9–12. University College London, London
- Ruppé CV, Barstad JF (eds) (2002) *International handbook of underwater archaeology*. Kluwer Academic, New York
- Steffy R (1978) *Maximum results from minimum remains*. In: Arnold III JB (ed) *Beneath the waters of time, proceedings of the ninth conference of underwater archaeology*, pp 53–55. Texas Antiquities Committee Publication No. 6. Austin
- United Nations Educational, Scientific and Cultural Organization—UNESCO (2001) *Convention on the protection of the underwater cultural heritage*, Paris. <http://unesdoc.unesco.org/images/0012/001246/124687e.pdf#page=56>
- Valentini MP, García Cano J (2012a) *Un mercante español en el Puerto de Buenos Aires* (publication in CD). Dirección General de Patrimonio e Instituto Histórico, Buenos Aires
- Valentini MP, García Cano J (2012b) *Conservación y preservación: generalidades. Reenterramiento preventivo*. In: Valentini M, García Cano J (eds) *Un mercante español en el Puerto de Buenos Aires* (publication in CD, pp 69–73). Dirección General de Patrimonio e Instituto Histórico, Buenos Aires
- Watson PJ (1983) *Method and theory in shipwreck archaeology*. In: Gould R (ed) *Shipwreck anthropology*. University of New Mexico Press, Albuquerque, pp 23–36