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## **A methodology for studying shipwreck sites formation processes**

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**Abstract:** Comprehending the role that formation processes play in the constitution of an archaeological site is fundamental for a more precise interpretation of the data collected in it. Concerning shipwreck sites, such processes possess certain peculiarities which must be taken into account. However, that subject is not sufficiently developed in the literature, lacking a comprehensive treatment of all kinds of processes. Hence, the present work aims at proposing a methodology for studying archaeological formation processes that influence shipwreck sites. To this end, a bibliographical review is conducted focusing on shipwreck sites. The purpose of such review is twofold: (1) studying how this problem was approached at previous works (2) identifying issues in those approaches that could be improved. After that, we present the methodology hereby proposed, which aims at studying the influence of formation processes in an archaeological site of interest in an embracing way, considering natural and cultural factors that act at the pre-depositional, depositional and post-depositional periods.

**Key-words:** Archaeological formation processes, Nautical Archaeology, Archaeology at Wet Environments.

### **1. Introduction**

Several human and natural factors influence the archaeological record in varied ways, including its creation. At post-deposition, sometimes these factors also modify some characteristics of the objects, like their size and colour. They can also alter the location of artefacts and even deteriorate them. Considering this fact, it is important to understand how the archaeological sites were formed to increase the reliability of the interpretations (MURPHY 1997, 386).

The cultural formation processes, which are related to human activity, are defined by Schiffer (1996, 7) as those that transform artefacts after their initial period of use, cause their deposition and their modification during the post-deposition.

The natural formation processes are the events provoked by environmental factors. In this case, they correspond to chemical, biological and physical agents that, together or alone, reduce the artefacts to more stable and simpler forms (SCHIFFER 1996, 7).

The area within Archaeology which studies the formation processes is called Formation Theory. Archaeological formation processes, in its turn, were defined, by Bahn (2001, 165), as: “the sum total of processes, natural and cultural, acting individually or in concert, that results in the archaeological record as it exists today”.

An important observation is that formation processes act differently in distinct archaeological sites. Furthermore, when we compare their influence in a terrestrial site

with that which they exert in an underwater site, this difference is even bigger. Also, the archaeological work done underwater is basically the same, however the techniques and methods must be adapted to the wet environment.

The first archaeologist to research the archaeological formation processes of shipwreck sites was Keith Muckelroy. His main contribution is the book **Maritime Archaeology** (1978), in which he addresses the archaeological research at the sea, including the study of archaeological formation processes.

Since then, few works were published with this subject, as pointed out by Stewart (1999, 566) in an article in which he studies several formation processes that act in underwater sites. In 2002, O'Shea published a study about shipwreck sites at the Great Lakes, USA. Other than those, we can mention the following works: Quinn (2006), about the action of scour; Gibbs (2006), which analyses the cultural formation processes considering all the stages of a disaster (pre-impact, impact, recoil, rescue and post-disaster); Leino *et al* (2011), which conducts a study about the environmental factors that act on the shipwreck site of the vessel *Vrow Maria*.

Hence, considering the importance of this subject for obtaining solidly grounded information when studying an archaeological site and the scarcity of works which address it with an embracing approach, we aim to develop a novel methodology for investigating the influence of archaeological formation processes at shipwreck sites. In this article, we present an analysis of three previous studies about that subject (Section 2). In Section 3, we discuss some research questions that can be posed at shipwreck sites. Finally, in Section 4 we present a preview of the Methodology for studying shipwreck sites, which currently under development.

## **2. Previous works**

In this section we make an analysis of three previous works about archaeological formation processes in shipwreck sites. Our aim is assessing how these studies were conducted. We established five aspects to be considered in the analysis: (1) the research objectives; (2) the possibility of posing additional questions related to the studied site; (3) whether all depositional periods were investigated; (4) whether both natural and cultural archaeological processes were considered and (5) whether sources other than the archaeological record were taken into account.

The choice of the aspects above enumerated can be justified as follows. Items (1) and (2) are related with the potential information that the studied site can provide, which is not always fully exploited because one is often only interested in a particular analysis. The relevance of items (3) and (4) lies in the importance of adopting an embracing approach for attaining reliable conclusions. Finally, item (5) refer to the diversity of sources of information utilized by the archaeologist, which can bring useful elements to the analysis.

There are few study cases published in this field, mostly theoretical articles, as Stewart (1999) and Gibbs (2006), for example. Nonetheless, there are interesting practical works, as those we analyse in the sequel.

## 2.1. Reference 1

The first article which we analyse was published by John O'Shea in 2002. This study is not focused on a single shipwreck, but on a whole region at the Great Lakes, in the United States, where a lot of accidents took place. The shipwrecks of that region have some characteristics in common, as, e.g., they are all in shallow water and their materials are scattered. Additionally, the major wreck cause in that region is stranding (O'SHEA 2002, 215).

O'Shea (2002, 215) established three goals for his research: (1) localise and identify the shipwrecks of that area; (2) investigate how the archaeological deposits came to be in their present locations and (3) identify systematic elements in those processes which can be applied to assure the preservation of the site.

For guaranteeing the conservation of the archaeological site, is important to study the archaeological formation processes that act in the post-deposition. After that, it is essential to keep monitoring the conditions of the site, because changes in the environment may break the equilibrium established between the archaeological remains and the surrounds. In that case is possible that the archaeological material will deteriorate until a new equilibrium is settled.

On his research, O'Shea analyses the cultural and natural formation processes that influence the site in the depositional and post-depositional periods. The pre-deposition was only mentioned briefly. He observed that, because of some characteristics of the analysed region, there is a pattern concerning the shipwrecks: the scattered materials and most of the vessels have stranded.

According to the analysed paper, the main consequence of these processes on the deposition and post-deposition is the scattering of materials (O'SHEA 2002, 220-222). Such processes can have human and natural origins.

Other than the scattering of materials, the recovery of artefacts occurs in that region, which can take place just after deposition or in the post-depositional period (O'SHEA 2002, 221). This cultural formation process influences the sites in many ways. When it is done after the wreck, for example, the crew involved in the action can lose some objects in the site. That material can be similar to those from the wrecked vessel, which can interfere in the interpretation of the archaeologist (MUCKELROY 1978, 56).

Table 1 summarizes our observation regarding the aspects mentioned in the beginning of the section.

One of the goals of the research is to ensure the preservation of the site. Considering this fact, the study of the marine fauna and flora is another possibility of analysis on that region. Depending on the species found in a region, they can have an important role in the preservation or in the deterioration of the archaeological material.

Other possibility of study in that region is to identify the elements of one wreck. Furthermore, one could analyse the pre-depositional processes and the events on the deposition (examples on Section 3).

## 2.2. Reference 2

The second analysed paper was written by a group of researchers: Elkin, Argüeso, Grosso, Murray, Vainstub, Bastida and Musgrave. The object of their work is the British sloop-of-war, HSM *Swift*, wrecked in Patagonia, in the south of Argentina, in 1770 (ELKIN *et al* 2007, 32).

This paper investigated many aspects of the site, but only the section which deals with archaeological formation processes is relevant for our propose, which aims at the preservation of the site (ELKIN *et al* 2007, 51). In this part, the authors analyse the natural formation processes of the post-depositional period.

Considering the pre-depositional and depositional periods, the authors make a description of the wreck based on historical sources (ELKIN *et al* 2007, 34-35). However, an analysis of the material culture for validating the information obtained from historical sources was not done.

Again, we have summarized our main observation in Table 1.

Hence, there are other possibilities of analysis in future research that can be made at that site, especially considering the good state of preservation of the vessel (ELKIN *et al* 2007, 35). For instance, two possible studies are: investigating the process of wrecking and its causes based on material culture and studying the characteristics of the construction of the ship. The latter can be useful for other researchers that are interested in another ship with similar origin, i.e., built in the same place during the same period, but which is not well conserved.

An important contribution of Elkin *et al* (2007, 51-55) is the experimental archaeology stage, which was very important to gain knowledge about the effects of the fauna and the flora into the site and assure its preservation. In that stage, they conducted bio-deterioration studies focused on the biofouling and wood borers, aiming to analyse the effect of these elements on the artefacts and their structure.

## 2.3. Reference 3

The last analysed paper were written by a group of researchers: Leino, Ruuskanen, Flinkman, Kaasinem, Klemelä, Hietala and Nappu. They investigated the remains of the Dutch merchant vessel *Vrow Maria*, wrecked at the coast of Finland in 1771.

Their research was focused on analysing the physical, chemical and biological variables which act on the site, in order to assure its preservation. Particularly, they report conclusions of a biological survey and new data about the physical effects of the currents (LEINO *et al* 2011, 135).

Their work concerns also natural formation processes that act in the post-deposition. The authors made a brief analysis about the localisation and the position of an anchor and they concluded that it corroborated the historical sources about the wrecking (LEINO *et*

al 2011, 134). However, an analysis of the material culture in order to study the events of pre-deposition and deposition was not made.

The reader can find a summary of our observation in Table 1.

On the one hand, such choice is justified by the goals of the research. On the other hand, and especially if we consider the good state of preservation of the remains (LEINO *et al* 2011, 133), there are others possibilities of studies, as, for example, identifying the cultural formation processes that acted in the pre-depositional and depositional periods.

### 3. Discussion

If one intends to study the wreck of a vessel with an embracing approach, the research goals must evidently be embracing as well. With regard to this, there are some aspects of site formation which were not investigated in the works discussed in Section 2. In this section, we thus suggest some research goals which could also be pursued.

One possible aspect to be analysed is trying to infer how the wreck occurred, which was not included in the works discussed in Section 2. Some actions in the **pre-depositional** period can contribute to the wreck, like the preparation of the crew, the verification of the conditions of the ship structure and the choice of the navigation route (GIBBS 2006, 9 table 2). Still in the pre-deposition, when the crew identify that they are close to a dangerous situation, they can take some action to avoid it, as, for example, changing the route of navigation (GIBBS 2006, 9 table 2). Sometimes, the crew should take some drastic measure, as, e.g., throwing heavy objects in the sea. These actions can also be done at the moment of the impact.

The activities during this period can leave evidence on the sea bed. To infer what happened during the pre-deposition, the researcher should analyse the objects in the site and their disposition. If the actions taken to save the ship were successful, on the sea bed there will be only objects which were thrown away, otherwise, the ship remains will be there too, maybe a little far if it was still able to float after the impact (GIBBS 2006, 9 table 2).

Concerning the **depositional period**, in some cases it is possible to identify the initial position of the ship in the moment of the impact, which is important for characterising the action of formation processes of that period. This kind of analysis was not present in the works studied in Section 2. For example, observing the localisation of some artefacts, such as cannons and ballast, the archaeologist can infer the localisation of the vessel in the site if the skull was damaged (MARTIN 2011, 55-56) since, in that case, they will be the first objects to fall out of the ship. For others examples, see Stewart (2006, 568-569).

Other aspect the should be considered is that human and natural agents influence the process of wrecking (MARTIN 2011, 48), i.e., they act jointly from the depositional period on. Considering the example of the previous paragraph regarding the analysis of objects that may have fallen into the sea because of a damage in the skull, it is important to take into account that the action of the currents can also influence their localisation, as

well as some processes in the post-depositional period.

During the **post-deposition**, many cultural and formation processes act on the site and can interfere in the localisation and preservation of elements which are relevant to the study, and thus it is important to verify which processes act on a specific site and what are their causes. With respect to this, the papers analysed on Section 2 addressed most of the relevant processes, such as the action of the fauna and the flora (Reference 2 and 3), the scavenging (Reference 1) and the action of the currents (Reference 3).

#### **4. Towards a methodology for studying a shipwreck site**

The underwater archaeological research must go through the same stages as the one done in surface. More specifically, one should formulate research questions, collect the data after that, analyse the material and finally publish the results. In the following, we discuss some general principles which can serve as a guide in that kind of archaeological research. These principles shall form the basis of a methodology for studying shipwreck sites, which is the ultimate goal of this research but is still under study.

A bibliographical review should be part of the **data collection**. In addition to consulting the existing archaeological research related to the site of interest, the archaeologist should also look for useful information in publications of other disciplines, since there are few about archaeological formation processes. It should be kept in mind that the aim of this review is to help the archaeologist, and not to substitute the analysis of the material culture.

Concerning the cultural formation processes, the researcher should search the History and naval architecture bibliographies, for example. The information collected during that review can also contribute to the artefact analysis.

To study the natural formation processes, the archaeologist must consult works in maritime biology and oceanography, for example. This can contribute with important information about the environment where the site is localised, such as the fauna and flora or the currents.

The main task involved in the data collection stage is the field work. A first dive for a systematic survey at the site should be made, to recognise and document it and its characteristics. These data will be used to plan the next dives. In particular, it is important to observe if the site is in a steep region and, if so, whether there are objects that have rolled. It is also important to pay attention to the localisation of some heavy objects, such as cannons and others made by metal (see Section 3).

As a part of the data collection, oral sources from the community should be consulted. They can help with information about the site, such as the characteristics of the place, and inform whether some objects have been withdrawn. In particular, such inquiry is important since the fishermen can also provoke some cultural processes, because their fishing nets can move the artefacts or take them out.

After those stages, a **data analysis** must be conducted. An important part of this stage is verifying the origin of the artefacts collected as samples. After the shipwreck, some material can be added to site and complicate its analysis.

## **5. Final remarks**

In this work, pointed several principles of great importance for studying archaeological formation processes of shipwreck sites, which is fundamental for obtaining solidly grounded information about an archaeological site. These principles will constitute the basis of a methodology for studying formation processes of shipwreck sites, which is currently under development.

In order to raise important issues concerning the treatment of that subject in the literature, we selected and analysed three existing works from this field. From this study, we concluded that there are other aspects that are relevant, but were not taken into account in these works. After that, we discussed some possible research goals which could be established for obtaining other relevant information about their respective shipwrecks.

As a continuation of this research, we intend to fully elaborate the methodology mentioned in Section 4. Next, we envisage the validation of this approach through the study of some real shipwrecks sites.

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