Multi-service taphonomy. Shells, garbage, and floating palimpsests

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ABSTRACT

We discuss the importance of widening the scope of taphonomy, arguing that it is critical to study of different classes of materials within this framework. We introduce several examples related to the deposition of marine shells and garbage. In particular, we focus on debris generated by tsunamis

Keywords: Taphonomy; Garbage; Tsunami; Palimpsest.

RESUMEN

TAFONOMÍA MULTISERVICIO. VALVAS, BASURA Y PALIMPSESTOS FLOTANTES. Se presenta una discusión acerca de la importancia de ampliar el campo de la tafonomía, considerando distintas clases de materiales. Se presentan varios ejemplos, relacionados con la depositación de valvas marinas y el estudio de la basura en diferentes contextos. Se desarrolla en particular el caso de los desechos derivados de la acción de tsunamis.

Palabras clave: Tafonomía; Basura; Tsunami; Palimpsesto.

INTRODUCTION

The concept of "site formation processes" is necessary "to build a sound foundation for archaeological inference" (Schiffer 1987: 8). According to Schiffer, taphonomy is one of several research strategies –along with ethnoarchaeology or experimental archaeology– that inform our understanding of the principles of site formation (Schiffer 1987: 8-9). Schiffer also suggested that what we see today is a distorted image of what was deposited in the past and that these distortions can be rectified (Schiffer 1976). His view is flawed in at least two ways, however. First, such distortions rarely can be rectified. Instead, they can be understood and used to select the most appropriate scale of analysis. Second, taphonomy goes well beyond supplying principles of site formation, generating independent paleobiological, paleoclimatological and palaeoecological data (Gifford 1981). The goals of taphonomy are the subject of intense discussion (Lyman 2010; Thiébaut *et al.* 2010; Dominguez-Rodrigo *et al.* 2011). As I have said elsewhere, "taphonomy studies the constant tension between preservational and destructive media" (Borrero 2011: 270). The focus is not on bones specifically, but on these tensions as recorded in different materials. This is coincident with the efforts of Peter Hiscock (1985) and others (Bordes 2003; Borrazzo 2006) who are developing systematic studies of taphonomic effects on lithic tools, for example. Moreover, Dominguez-Rodrigo *et al.* (2011) recently noted that taphonomy has broadened its referential scope to incorporate humans as taphonomic agents, and that "the non-organic materials of archaeological (and palaeontological) sites might also be studied taphonomically" (Dominguez-Rodrigo *et al.* 2011: 4). Broadening the scope of taphonomy is desirable since it will facilitate comparative research (Coumont *et al.* 2010). This objective is more or less convergent with the goals of classic formation studies (Schiffer 1987), adding an interest in preservation that goes beyond establishing links between behavior and discard. It is becoming clear that this extension of taphonomic studies is operative at several levels (Borrazzo 2011a; Eren *et al.* 2011; Ratto and Carniglia 2013).

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Taphonomy should integrate studies of different material types. For example, what we learn through the taphonomic study of bones can guide our expectations for other materials (Borrero 2011: 269-270; VanDerwarker and Peres 2013), and this concept of "multi-service taphonomy" has applications even beyond the realm of archaeology. Indeed a number of taphonomic studies of non-bone organic materials already exist, including pollen (Campbell 1999), rock art (Brady and Gunn 2012), and even oil (Lipps 2008). But there is also a taphonomy of non-organic materials such as photographs –including the study of formation processes and posterior alterations (Fiore and Varela 2009: 21)– and of lithics, as I have mentioned.

The subject of all these discussions is the same: the tensions between preservational and destructive media, and the information that can be gleaned from those tensions. Naturally, all of these studies are focused on differential preservation, but only some of them are simultaneously interested in decoding the environmental signal associated with taphonomic marks. Of course, a comparison between corroded and well-preserved plumbing also provides information about the environment in which each is found. Studies restricted to the description of preservational differences are incomplete since it is an understanding of the processes that led to the differences that is really important (Behrensmeyer and Kidwell 1985).

All these approaches to taphonomy can be improved and expanded by experimentation. Good examples of such research are the studies by Fernández Jalvo *et al.* (2010) on pollen found on coprolites, Borrazzo (2011b) on the morphological changes to artifacts deposited on the surface, Blanco and Lynch (2011) on the ways of producing rock art, and Pickering and Egeland (2006) on percussion marks on bones. This broad approach to taphonomy may be useful in a number of ways. Importantly, neither new disciplines nor new terminology is required to do the job. What is required is a theoretical and methodological program to make taphonomy fully operative. The importance of creating relevant frames of reference cannot be exaggerated (Dominguez-Rodrigo 2012). I will introduce some examples that not only work at different scales, but also serve more than one discipline (Hayashida 2005).

HIGH- AND LOW-ENERGY TAPHONOMY

It is useful to refer to the Taphonomically Active Zone (TAZ), where destructive potential is high. This is a common concept in discussing preservation of shell beds (Ritter *et al.* 2013), but it is applicable to a variety of other situations as well (*i.e.*, places with high incidence of carnivore activity, etc.). Identifying TAZs is a way to separate areas where preservation is unlikely from those areas within a region where preservation is likely to be good. For example, it could be useful to classify archaeological shell-middens in terms of their topographic location or distance from the upper intertidal zone; in other words, to differentiate shell-middens within and distant from the locally defined TAZ. Experiments can then be designed to reproduce the conditions in the TAZ and derive expectations for preservation.

TAZs are appropriate places to learn about the formation and preservation of the archaeological record. For example, I generated a model of contamination of archaeological sites by modern vertebrate bones. A number of factors can contribute to such contamination including, trampling, generally associated with the regular use of paths by guanaco (*Lama guanicoe*) and some degree of overlap between paths, the places were animals died, and the distributions of prehistoric settlements (Borrero 1990). Of course, I was able to recognize this process in a place where all –or most– of these factors coincide, a true TAZ. The high ratio of archaeological sites contaminated with recently incorporated guanaco bones indicated the importance of the observation. However, the conditions of my model are not always met and its applicability is limited to locations where those conditions exist. Still, even slight variations in those conditions help us develop new criteria that can be useful for identifying intrusive bones (Borrero 2001). So, in a sense, the utility of any such modeling exercise is the ability to go from obvious cases represented by TAZs to the more common archaeological situations away from such places.

It is important to bear in mind that taphonomic processes occur in both high and low energy environments (Petraglia and Nash 1987). We know something about areas where disturbance is high, but we also need to know which places are only mildly affected or relatively unaffected by the main taphonomic processes. We must also be ready to extract the environmental information implied by those very markers of little disturbance, be it a paucity of weathering, corrosion, or any other process.

Combining disciplines like taphonomy and ethnoarchaeology can provide a clearer picture of formation processes. For example, it is a useful exercise to examine the ethnoarchaeological record associated with the discard of mollusks by the Ambarra on the Australian coasts with TAZ criteria in mind (Meehan 1982). This should help us understand the likelihood of preservation of mollusks discarded by the Ambarra and, in turn, inform comparisons with other regions. At least two important depositional principles are derived from the Ambarra study: (1) in some cases associated with the exploitation of *Batissa violacea* and *Crassostrea amara* "usually only flesh, but sometimes a few shells as well, is carried back to home base" (Meehan 1982: 117). Similar observations are available from ancient sources (Cook 1946: 51). This indicates the existence of more than one depositional setting for mollusk shells, only one of which would be archaeologically visible. As asserted by Bailey (2007: 205),"If the individual episodes of shellgathering that make up a large mound, or the individual assemblages of stone tools that make up a layer in a stratified cave, had been dispersed across the landscape, many would now be lost to view", and will be affected by destructive processes. In Bailey's words, this constitutes a particular archaeological phenomenon: a spatial palimpsest. (2) It was observed that "shells were relocated several times during a single occupation, becoming intermixed with shells from previous occupations or dead shells that formed a normal part of beach debris, or else they were washed away by high tides" (Meehan 1982: 117). Beyond the implication that our expectations for finding ordered occupational sequences should be low, the information provided by this study is basically taphonomic. It clearly states that palimpsests of cultural and natural processes are to be expected. Also, it says something about the location of the deposits, the expectations for associated artifacts and the energy of the processes involved.

GARBOLOGY

Garbage studies[1], a classic actualistic approach to site formation, clearly demonstrate that formation processes and taphonomy are closely aligned For example, Weberman, the infamous garbologist, describes his rapid discovery of the benefits of scavenging garbage from Bob Dylan's garbage can: "I lifted the lid … I reached in and the first thing … that I pulled out of Dylan's garbage was a half-finished letter written by Bob Dylan to Johnny Cash" (Weberman 1980: 1). It goes without saying that the utility of this approach requires a taphonomic approach; Weberman's great discovery –the Dylan letter– was preserved because it was not in contact with humid rejects –like diapers, which were also present– or other destructive materials.

Since Weberman's discovery, a less "owner"-focused, more systematic approach to garbage was developed (Rathje and Murphy 1992). The distinction between items that preserve in the long-term and those that preserve in the short-term was crucial for the success of the approach. Needless to say, garbage is not restricted to bones. Undoubtedly, garbage studies are a basic element for the construction of discard theories. They offer evidence of factors like "messiness of the items discarded" (Murray 1980), otherwise difficult to obtain but nonetheless important for understanding the archaeological record. Returning to Weberman, at some point he asked himself if he was trespassing the rights of other people (or specifically those of Bob Dylan), but concluded that in the post-Watergate times that action was acceptable. Unfortunately, when he applied the same tactics in 1980 to the garbage of ex-president Richard Nixon, Secret Service agents arrested him (Rathje and Murphy 1992). Leaving legal problems aside it is important to learn about garbage. I intend to demonstrate this by examining a particular class of garbage: floating garbage.

FLOATING PALIMPSESTS

Some of the most impressive sources of highly mobile debris are tsunamis. It was recently stated that "to accurately predict future coastal hazards, one must identify the records that are generated by the processes associated with these hazards and recognize what will be preserved" (Arcos *et al.* 2013: 9). In other words, taphonomy is required to understand important ecological issues like the oceanic distribution of the five million tons of waste generated by the March 11, 2011 tsunami in Japan. The NOAA agency modeled the potential distribution of that waste, indicating that "debris could pass near or wash ashore in the Northwestern Hawaiian Islands in spring 2012, approach the West Coast of the United States in 2013, and circle back to Hawaii in 2014 to 2016" (NOAA 2011: 1).

Not all five million tons of waste was strictly floating. The debris is classifiable into items that have sunk and *flotsam* –floating garbage– which, 15 months after the tsunami, had already reached the coasts of North America, between California and Alaska. This material –after a long stay in the ocean environment– was mostly restricted to plastic, but even a Harley-Davidson in a container was found. Obviously, there are taphonomic processes acting on these materials. For example, perforating organisms accelerate the sinking of different materials, particularly wood. Generally speaking, many remains decayed swiftly, up to the point when they were reduced to floating glass and especially polyethylene and polypropylene that cover thousands of square kilometers (United Nations 2012: 41). This material will slowly disintegrate, to become what we generically call microplastic (Erikson 2012). In contrast, we must remember that ultraviolet rays will swiftly break up plastic in desert environments (Weisman 2007). From a taphonomic point of view the floating materials can be separated in "high" and "low-windage", depending on "how much of it is exposed to the wind" (Erikson 2012: 20). The Ministry of Environment of British Columbia, Canada, like other institutions along the Pacific coast, issued bulletins with instructions on how to deal with debris from the tsunami, explaining which were dangerous.

No doubt on the basis of taphonomic and forensic considerations, it was reported that "It is extremely unlikely any human remains from the tsunami will reach Canada" (Ministry of Environment 2012: 1).

So far I have presented a detailed example focused on the last high impact tsunami on the coasts of Japan, but this is only one of many examples. For example, in Chile there are records of tsunamis at least since the 1550s (Urrutia de Habun and Lanza Lezcano 1993). More impressive, there are records of 22 tsunamis for the Galápagos Islands between 1960 and 2011 (Arcos *et al.* 2013), at least 245 tsunamis for the Pacific between 1900 and 1983, and 229 for the Mediterranean in historic times (Auger 1993: 119).

On the other hand, a depositional record testifying to the existence of tsunamis and related phenomena was found at the Peruvian coast (Spiske *et al.* 2013). This is not always the case, but clearly indicates the tsunamis can sometimes be easily recognized, while other times they are nearly impossible to detect. Perhaps some indications can be found at archaeological sites disturbed or destroyed by tsunamis (Clague and Bobrowsky 1994; Cole *et al.* 1996; Hutchinson and MacMillan 1997), a subject that has received general treatment (Renfrew 1979; Estevez 2005). For example, Colin Renfrew writes that when excavating an archaeological site affected by a tsunami, "large chunks of debris immediately recognizable as intrusive" should be found (Renfrew 1979: 578). Needless to say, the importance of taphonomy for this evaluation cannot be understated. It was generally accepted that tsunamis debris can be easily identified and isolated from other deposits like those resulting from storms. However, difficulty arises from what Arcos and collaborators call "amalgamated deposits" (palimpsests; Arcos *et al.* 2013). An endless variety of artifacts result from the action of tsunamis. However, when discussing the effects of specific events, like that of Japan, it is possible to identify items of Japanese origin (United Nations 2012), but usually their link with specific phenomena can only be achieved through contemporaneous testimonies, as demonstrated by the study of Galápagos (Arcos *et al.* 2013: 16). Unfortunately, there is almost no way of telling the age of floating microplastic (Humes 2013: 133 ss.). In cases like that of the 1975 Makran Trench tsunami in the northern Arabian sea it was a combination of "concentrations of angular shell fragments, articulated bivalves (out of life position)", particle size and a predominance of foraminiferous marine taxa that was used to identify the relevant sediments (Pilarczyk and Reinhardt 2012: 129). A recent "Pepsi label from plastic bottle" and other debris helped to identify "the reworking of the upper sediments" (Pilarczyk and Reinhardt 2012: 130). In the case of the 1755 tsunami on the Gibraltar coast there were evidences of palimpsests in the form of Pliocene foraminifera within a Late Quaternary deposit. Also, the remains of a hand grenade that "was in use during the 18th Century", that was related to alternative hostile scenarios between 1727 and 1779-1783 were found (Rodríguez-Vidal *et al.* 2011: 187). Any improvement in the taphonomy of tsunamis should be useful in the program of understanding and maintenance of the oceans.

Summing up my impression of the debris resulting from tsunamis, it must be stated that these floating palimpsests are going to be the basis of future taphonomic evaluations. A wide and comparative concept of taphonomy is necessary for these evaluations. I cannot see any utility in separating the study of different raw materials by discipline; information on the distribution of plastic is useful in the evaluation of the destiny of other classes of debris, for example. In this way we can learn about the velocity and direction of drift in the ocean, materials' resistance to and persistence through different processes, and locations where flotsam is likely to appear in the future. There are short –and long– term ecological implications, and there are also different lifecycles for different materials, all of which are the stuff of taphonomy.

I have focused on tsunamis, but they are not the only forces circulating materials in the ocean. The observation rate of different debris in the ocean was high for the last several decades. During the Atlantic crossings of the papyrus boat Ra in 1969-1970, flotsam was recorded every day (Heyerdahl 1972). In 2005, even the supposedly limpid environment of Kingman reef in the Pacific, to which access is restricted, was heavily affected by the plastic "rain" (Weisman 2007). The preservational-destructive tensions in those diverse assemblages of artifacts will determine which will survive and where. There are other classes of materials, like wastewaters, that are discharged into the oceans in massive amounts and that have even a greater ecological impact (George 2009); their relationships with the survival of different materials still needs to be elucidated. Inspection of the oceans constantly reminds us of the recently recognized importance of humans as coevolutionary agents (Odling-Smee *et al.* 2003; Rick and Erlandson 2008). However, within this panorama of garbage and extensive contamination, not everything is negative; floating garbage wreckage sites may have constructive uses as well. For example, there is archaeological evidence for opportunistic scavenging of wood from European wreckages to construct huts at Herschel Island, Chile (Solari 1992). Also, there are probably many Robinson Crusoe-style stories in which wreckages offer more than construction material. However, the main point is that the best contribution that can be made with those materials is to understand and, if possible, control them.

CONCLUSIONS

I have presented some examples trying to convey the notion that the range of applications of taphonomy should be unrestricted. I chose to focus on actualistic cases, somewhat related to ethnoarchaeology, garbology or ecology, as a way to demonstrate the wide array of taphonomic studies that currently exists. Results are not always spectacular, problems are not always solved and usually we learn that we really do not know as much as we believed. Generally speaking, most of our difficulties in accepting this, or even accepting that taphonomy is a crucial component of our research agenda, result from viewing the link between the archaeological record and our interpretations as a fingerprint, when in fact it is only a footprint. We should not expect precision and that is the reason why palimpsests are not our worst enemies, but the valuable preserved parts of the record (Borrero 2011). They are so important that instead of the usual plangent cries that go with the discovery of palimpsests, we should hear cheering shouts. I would like to emphasize that my defense of the palimpsest is not based exclusively on its offer of different levels of organization not appreciated at the ethnographic scale (Bailey 1981; Binford 1981, among others), but it is predicated on the notion that they are the usual form in which the record is presented to us for study.

In accordance with Lyman, what I am suggesting here can be read as a misuse of the term taphonomy, that "exacerbate confusion and misunderstanding" (Lyman 2010: 1). However, I feel that real confusion arises when we try to maintain our trade within the narrow confines of tradition. In the end, the name of the discipline is not important. What is important is that if this claim for a unity of taphonomy is wrong, no major harm will be done to the disciplines of archaeology, ecology or paleontology, yet, there is always danger in ignoring the need to "proceed taphonomically".

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NOTES

1.- The archaeological study of modern refuse. Such a study is archaeological in the sense that "past" denotes any amount of elapsed time, from a millisecond to a million years or more" (Schiffer and Miller 1999: 52). Not all archaeologists agree that the study of ongoing cultural systems is archaeological (Trigger 1989: 371). Nonetheless, there are strong methodological reasons to maintain not only its relevance for the understanding of the deep past, but also its archaeological character *per se* (Gould and Schiffer 1981).