Archaeological studies of shell-remains at Punangatu (Futuna island/Vanuatu) – How can we identify and classify shellfish to understand their historical use?

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Abstract: This article, based on the master's thesis of the first author, aims to identify and classify by species different shellfish collected in a Vanuatu archaeological site. We want to analyse how these shells have been modified and utilized to produce furniture and artefacts. The results show that the Punangatu shell assemblage is dominated by Gastropods, in particular by the families of Turbnidae and Trochidae, which were easy and accessible to exploit. The two families are still consumed today. But the share of shellfish and the importance of fishing during the island's initial settlement and over time remains unclear. It would be necessary in the future to study other sites of the island to better understand the societal role of marine resources.

Keywords: Futuna island, Vanuatu, shellfish, Gastropods, archaeological surveys

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Introduction

Futuna is a high island which geographically lies in the southern Vanuatu archipelago (Fig. 1). It is more precisely located to the east of the island of Tanna, and is part of the province of Tafea. The work carried out by North American archaeologists Richard and Mary Elizabeth Shutler in the 1950s and 1960s on Futuna highlighted the prehistoric occupation of the island and allowed for the discovery of several burials in rock shelters (Shutler et al. 2002). New work has been taken up on Futuna within the framework of two complementary projects: "Polynesian enclaves in Vanuatu: Funerary archeology and definition of Polynesian migrations", led by Valentin (CNRS) and funded by the Archaeological Excavations Commission, Minister des Affaires Etrangères (MEAE), 2017-2020; and "3000 years of settlement and interaction in southern Vanuatu" (DP 160103578), co-led by Flexner (University of Sydney), Bedford (Australian National University) and Valentin (CNRS), and funded by the Australian Research Council (ARC). The first results document outdoor occupations by the sea (Flexner et al. 2018).

The first author's research involves studying the shells of an archaeological test pit (Unit A) in a rock shelter in Punangatu on the island of Futuna. The objectives are to identify the different shellfish collected, and to classify them by species according to the different layers in order to understand the methods of their use over time. The aim is also to identify shells that have been modified to produce artefacts or archaeological furniture, for example shell adze, ornaments and shell ornaments (such as hooks, pearls, and bracelets).

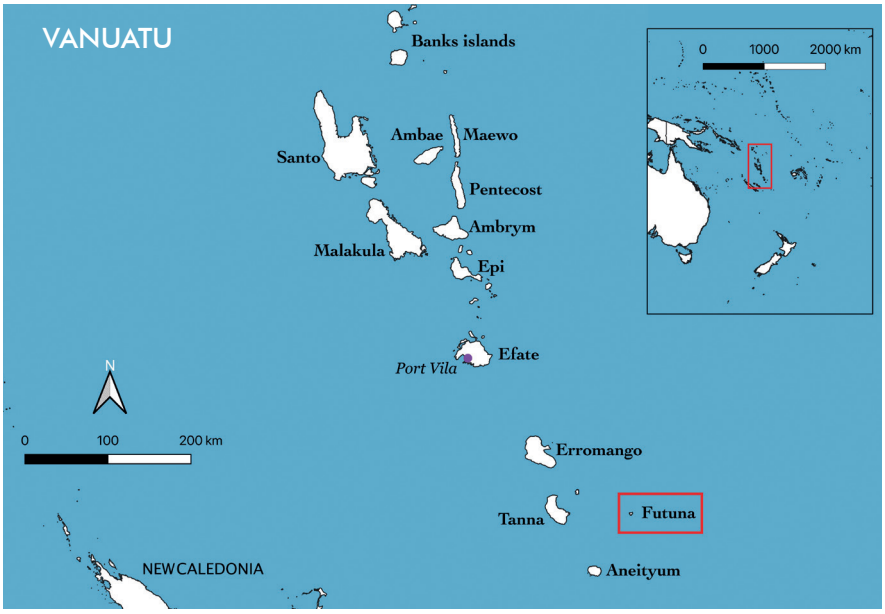

Figure 1: Localisation map of Futuna island in the archipelago of Vanuatu.

Sources: Maps of the World 2019; Kowasch 2020. Cartography: Kowasch 2020.

Human groups settled for the first time during the Lapita expansion around 3000 BP in Vanuatu (Kinaston et al. 2014; Kirch 1997). Occupations dating from this period have been discovered in the north and center of the archipelago (Bedford 2006). This ancient occupation, according to research, seems less developed in the south of the archipelago, although

there is evidence of Lapita sites in Aneityum and Erromango (Bedford et al. 2016)(Fig. 1). Fishing and the collection of marine resources played a key role from the start of settlement (Bellwood 1985; Sand and Bedford 2007). Fish and shellfish make up a large share of food resources (Bouffandeau et al. 2018; Claassen 1991). At that time, shells were also used to make ornaments (Langley et al. 2019) and artefacts (Szabo 2010). These marine resources still play an important role in the economies and daily life of Vanuatu islanders. However, recent archaeological research has highlighted cultural transformations (Bedford and Spriggs 2014). In central and northern Vanuatu, the share of fishing and shellfish collecting has evolved over time. From 2,500 years BP, the food of populations seems based on terrestrial products rather than marine resources (Valentin et al. 2010; Valentin et al. 2014; Kinaston et al. 2014). Comparable studies do not exist for the south of the archipelago.

Malacological research also makes it possible to define the different categories of shellfish species found in certain sites and the choices involved in the exploitation of these marine resources. The collection of shellfish was assumed to correspond to an optimal pattern of foraging in different areas for the first occupants of Punangatu (Bedford 2006). It is a first step to distinguish anthropogenic deposits and natural deposits.

Anthropogenic shell mounds are defined as sites where prehistoric or contemporary humans live, where they practice the daily activities necessary for the survival of the group, where they dispose of their waste and where, sometimes, they bury their dead. They can also be found in rock shelters, as in the case of Punangatu, around areas of habitat or outside in another place. In these anthropic shell mounds, one can find all kinds of shells which can be modified or not, and which are linked to a domestic activity. Other terms can designate anthropogenic shell mounds in different countries such as "shell deposits", "kitchen middens", "midden", and "mounds" (Céci 1984:63; Figuti 1992:24). Another important point to emphasize is that shell deposits are not only prehistoric, but can also be recent.

There are also natural shell deposits. These mostly consist of either shells accumulated on the beach at the high-water mark, or dead shells in natural schools. Several criteria differentiate them from those of anthropogenic origin. Shellfish "tests", that is, shells, can be guided by physical factors such as the swell when they are deposited after their death (Henderson et al. 2002). This type of natural deposit will not have the same composition as anthropogenic deposits, and can contain imported species.

Among these natural factors of deposition can be cited those accumulated or brought by animals, such as for example certain birds, which cause shell breakings typical of tests (Claassen 1998). Depending on the avifauna in question, the shells can be broken into very small fragments and the sizes of the individuals are then, as for those of marine accumulation, disparate (Cocaign 1989; Vigié-Chevalier 1998). The action of the wind is not negligible either in the formation of certain accumulations of shells (Claassen 1998).

The factors presented above are not necessarily all observed for each natural deposit. In fact, it is the association of several of them that makes the difference vis-à-vis an anthropogenic repository. The presence of small shells in anthropogenic accumulations can correspond to a specialized use as bait of the malacofauna (Chenorkian 1983), or to animals fixed on the shells collected (Gruet and Prigent 1986).

The work presented here was undertaken as part of a Masters of Archaeology of the first author and focuses on the analysis and identification of a significant number of shells from the site of Punangatu, on the island of Futuna in the south of Vanuatu. The occupation of the site started at around 2000 BP and covers a long period which lasts until today. The objective was to obtain data on each stratigraphic layer in order to be able to analyze the exploitation of the marine resources implemented by the occupants of the site over time. The reflection revolves around several questions, centered particularly on the site of Punangatu but also relevant to the other archaeological sites of the island:

- Are there any changes in the composition of the shell assembly at Futuna?
- Is there a real change in the size of shells overexploitation over time in Futuna?
- How was the site occupied by its first occupants?

The first part of the paper sets out the material studied, in particular its history and excavation, as well as the different study methods used in this research. The second part of this malacological study details the results obtained. The third part discusses the issues raised.

Methods

Site description

As part of the Masters of Archaeology project, the study concerns a substantial collection of 15 kilograms of shellfish from the coastal site of Punangatu (see Fig. 2). It was obtained during archaeological excavations carried out in 2018 in which Frédérique Valentin (CNRS) and the paper's first author participated.

Excavation description

Punangatu is a rock shelter located in the northwest of Futuna Island in Herald Bay. The rock shelter is located about 200 meters from the sea and stretches along the coast with a length of 100 meters.

A 4 square meter excavation was undertaken at the site made up of four different units A, B, C and D. The excavation uncovered 8 stratigraphic layers (layer 1, layer 2 (composed of three passes), layer 3, layer 4, layer 6, layer 7, layer 8) and an archaeological structure (hearth feature = oven).

A 2m × 2m test pit was dug about ten centimeters from the rock shelter wall. The excavation was generally aligned from North to South and divided into four units: A, B, C, and D. The excavation does not only allow to make inferences about human occupations but to get a globally better understanding of the site. The rock shelter is quite large and could have been chosen to house a significant number of people. The four units were excavated to a depth of 200 cm. However, the excavation in unit C descends to a depth of 340 cm from the datum. The unit B test pit was only excavated to a depth of 150 cm because there was a large rock in the center of the excavation. The rock covered more than half of the test pit and appears to have been rolled along the slope. Adornments, pearl oysters, modified shells, hooks, and a ceramic sherd were discovered at a depth of 180-190 cm, corresponding to the layer 7. Two hooks were discovered in unit A at a depth of 70-80 cm (layer 2) and unit B at 90-100 cm (layer 3) below the datum. The one in unit A is probably the top part of the hook to which the string is attached and the one in unit B seems to be the part of the base that forms the sharp edge forming the hook. Archaeological tools made from Conus sp were

also discovered in units A and C.

However, the archaeological material mainly comprises shells that were exploited by the former occupants of the site, made up of several different species. We have studied the shells coming from unit A as part of this research.

Stratigraphy

Layer 1 corresponds to the upper layer. It is between the surface and 60 cm. It is a layer of brown color mixed with sand. We were able to notice the presence of shells as well as charcoal but no animal bones. This layer was impacted by the passage of Cyclone Pam in 2015, hence the presence of sand washed in by the action of the waves.

Layer 2 corresponds to the second stratigraphic layer with a depth of 60-90 cm. It is composed of dark brown soil mixed with sand in the eastern part of the test pit. It contains a structure covering the entire excavation. We could see a strong presence of shells, charcoals, some modified shells as well as bones. We found a hook in this layer made from a *Turbo marmoratus* in the western part of the hole. We took a soil sample there.

Layer 3 corresponds to the third layer of the excavation. It is between 90-100 cm. The color of the ground is dark black with some charcoals, shells, bones and some corals discovered at the bottom of the level. We discovered a structure (hearth feature) there.

Layer 4 is the fourth layer of the test pit located 100-110 cm deep. It includes a structure (hearth feature) containing a large quantity of shells, bones, corals and the presence of large stones at the bottom.

Layer 5 corresponds to the fifth layer of the excavation of unit A with a depth of 110-120 cm. This layer contains a deposit of sand with charcoals, animal bones and stones on the surface. We found fish bones as well as crustacean (crab) remains.

Layer 6 is found at a depth of 120-140 cm. The color of the ground is black brown and it contains shells as well as bones of animals covered with large stones forming a structure (hearth feature). We also found fish bones and charcoal.

Layer 7 is found at a depth of 150-180 cm. The soil has a texture of sand mixed with gravel containing human bones, fish bones and shell fragments. There is also the presence of a human tooth, quartz, shell pearls, modified shells and a potential ceramic shard.

Source: Sarvanu 2018.

Figure 2: Archaeological site on Futuna island.

Layer 8 was the deepest deposit excavated, at a depth of 180-210 cm. It has a texture of black soil mixed with gravel in the southern part. We found shell fragments (*Turbo sp*), human bones, quartz, a small ceramic sherd and charcoal. It is limited by a large stone which is the extension of the wall of a cave towards the southwest part.

Dating

Concerning the dating, charcoal samples were taken, in particular in the following stratigraphic layers: layer 4 (100-110 cm) of unit A; and layer 11 (230-240 cm) and layer 12 of unit C (300-310) cm. For the dating, we have only focused on those two layers (11 and 12). Layers 11 and 12 were not studied because of the low quantity of shells. The charcoal samples were sent to the University of Waikato (New Zealand) for dating in the Radiocarbon Dating Laboratory (RDL). According to the results obtained, layer 12 of unit C dates from 2279 ± 18 BP (Calibrated date), (Wk49080 R_Date), and layer 11 of unit C dates from 386 ± 20 BP (Calibrated date), (Wk4978 R_Date). These two stratigraphic layers (layer 11 (230-240 cm) and layer 12 (300-310 cm)) of unit C correspond to a certain period of occupation of the site between 3000 and 2300 BP +. The first occupation of the site is therefore directly post-Lapita. Layer 4 (100-110 cm) of unit A corresponds to a much more recent period of occupation occurring before European contact. These results demonstrate that the occupation of the Punangatu site is very old and also show an evolution of occupation by these former occupants.

Identification

Several steps and criteria are necessary for the identification and classification of shell species. First of all, the general form of the shells makes it possible to associate a shell with a class:

- Turbine or conical shell: class of Gastropods
- Shell composed of two valves: class of Bivalves

For these identifications, we drew on the nomenclature proposed in the thesis of Dupont 2003: "The malacofauna of mesolithic and neolithic sites of the Atlantic facade of France".

This method of study also makes it possible to associate the different malacological species by their genus, their scientific name, as well as their family. This method is used for all stratigraphic layers, i.e. layer 1, layer 2, layer 3, layer 4, layer 6, layer 8 and the hearth feature structure of the unit A test pit. It also facilitates the sorting of shells in order to classify them into two major classes: Bivalves and Gastropods.

Different vernacular names are used for the same species in different regions of the world. Likewise, scientific designations are sometimes revised by systematicians in general. For example, a shell, formerly called *Turbo setosus*, has been renamed *Turbo argyrostomus*. The ignorance of some of the synonyms can lead to confusion of malacofaunal specters. Certain differences between the malacofauna spectra of two sites can be diverted or changed by the use of variable names according to the authors and according to the work to which they refer to identify or determine the species (Dupont 2003).

The characteristics of the species correspond to current data on their biology and ecology. On the species pres-

entation sheets, the dimensions are also mentioned, because they present an important characteristic of the specific determination. The measurements carried out correspond to those obtained on the archaeological samples.

Quantification

In the context of this research, the quantification method makes it possible to count the different species found in each layer. Depending on the information sought and the excavation techniques used, the study of shells or malacology can be quantified according to several variables. Three of them were applied to the archaeological material studied: weighing, the Number of Remains (NR) and the Minimum Number of Individuals (MNI).

The weight of the remains provides a quantitative approach to each species present in the survey. The weighing also allows to have a total mass and a proportion in percentage of the quantity of each species, in particular the Bivalves and the Gastropods present in each stratigraphic layer.

After the weight, we used the percentage calculation for each layer. This method calculates the total percentage of each malacological species by multiplying the total weight of each species by 100 and dividing by the total weight of the layer.

This method makes it possible to assess the proportion of each species and to make comparisons between the layers. The calculation of the percentage also permits to highlight the rate of consumption and a comparison of each malacological species of the survey as a whole.

The Number of Remains corresponds to the count of all shell fragments and whole shells, the largest dimension of which is greater than or equal to a certain size, whether the test is whole or not. The minimum size taken as a reference is necessarily dependent on the sampling technique. In addition, the NR is very sensitive to the degree of fragmentation of archaeological material (Chaix and Méniel 1996: 56). Theoretically, a mesh of 5 millimeters is necessary for counting the smallest species of shellfish; this is what was used during the excavation of the Punangatu site.

The MNI makes it possible to limit the distortion of fragmentation of shellfish in the counting (Chaix and Méniel 1996: 56). In this malacological study, certain criteria were used to differentiate the MNI from the NR. For Turbine Gastropods, the count of the MNI is associated with the presence of the "opening" and the "peristome" of the shell. This approach is also applied for Bivalves depending on the location and presence of the "hinge" and that of the "palleal sinus". It allows to relate a total mass of shells to an average mass of an individual. This mass value is used to get an estimate of flesh and what is consumed (Dupont 2003).

Taphonomic Study

"Taphonomy is the study of all the processes that modify or transform an artifact after it has been abandoned" (Larousse Dictionary 2011). Taphonomic processes are distinguished by their physical impact on the shells and are often easily recognizable. Their order of discussion will be concretion, perforation, fragmentation, abrasion or abduction and erosion. The cultural process of consumption by the former occupants of the site will complete the picture (Claassen 1993).

Many aquatic animals look for a hard surface (or substrate) to support their skeleton, and shells are often chosen. Coastal archaeologists are well aware of the attachment of oysters to each other, as well as barnacle concretions. The activities of these creatures erode the peristome or opening, erode and hollow the surface of the shell. Heavy encrustations occur on exposed dead shells and at the water-sediment interface in calm or low-energy aquatic habitats. The shell ornaments increase the available surface. The mineralogy of shells also influences the levels of concretions (Claassen 1993).

The modification or fracturing of the shell of the species may have started well before their burial in the sediment. The shells can be affected by anthropogenic or natural stigmas of their environment, by their disposal by humans or by their discovery during the excavation of archaeological sites or even after.

The action of lithophages or parasitic marine organisms (fungi, cyanobacteria, ...) should not be overlooked. Abductions by these marine parasites mainly appear on the columellar edges of the opening and on the last turn or spire, because they are the fragile parts of the shell.

To assess the fragmentation rate in the two selected stratigraphic layers (Layer 2 and Layer 4) and the burnt feature structure, the study relied on a classification of three different categories of shell fragments. For this, we used three different criteria, namely: FPC = almost complete fragment where there is the presence of an opening (peristome) and apex; FMC = complete medium fragment where we only have the presence of an opening but no apex; and PF = small fragments. These criteria help to determine if the fragmentation is due to an anthropic activity (if they were fractured by a striker or not), or natural, in particular trampling and disturbances linked to natural disasters for example.

The taphonomic study also permits to study anthropogenic modifications. For this, a study centered on the shapes of the perforations is carried out, examining whether they are circular or rectangular. Then comes examination of the aspect of the edges – whether they are serrated, smooth or dense. Finally, it is also important to measure the size (in millimeters) and the location of the perforations. These methods generally allow us to determine if the perforation is due to an anthropic activity (human activity) or a natural deposit.

First results

Concerning the study of this malacological collection, we were able to note a significant number of malacological species in the assembly.

The composition of the assembly of the unit A test pit makes it possible to determine the main malacological species found and exploited by the ancient human groups of Futuna. The families of Gastropods are much more represented than the families of Bivalves. By studying the assemblage in its entirety, we could note a strong domination or concentration of gastropods, more particularly the turbos with three different species (*Turbo setosus, Turbo margaritaceus, Turbo argyrostomus*) and the trochus with in particular three different species (*Troca niloticus, Troca malaticus, Trochus verrucosus*) in each layer.

This strong domination of gastropods could result from the fact that prehistoric populations were oriented more towards the collection of gastropods than bivalves. Collecting or picking up gastropods is also easier and faster because these malacological resources are often found on the coral reef, in particular turbos and trochus for example.

To summarize, we were able to note an important representation of the Gastropods, more particularly of the families of *Turbinidae* and *Ttrochidae*. On the other hand, certain species less represented in the assemblage (the cowries *Cypraea sp* and *Tridacnidae*) could perhaps indicate the result of cultural exchange because

the shells were economically valued (such as for ceremonial events) in Futuna and its surrounding islands.

Conclusion

In order to describe the evolution of the various activities related to the exploitation of marine malacofauna at the Punangatu site, several methods have been applied to the archaeological material. The implementation of these methods of study, such as the taphonomy of shells, contributes to understand the collection of significant quantities of shells on the archaeological sites of the island. The species give us information on their position on the coral reef. This allows to identify the places exploited by humans in the collection of seashells, and whether these marine resources are accessible on dry feet or not. The study of shell mounds therefore tells us whether the shells have been collected washed up (dead) on the beach or before.

The Punangatu shell assemblage is dominated by Gastropods, and more particularly by the families of Turbnidae and Trochidae. This malacological dominance suggests that the former occupants of the site favored the exploitation or collection of Gastropods rather than Bivalves. This dominant composition may be because these two species are easier to collect or because the others are absent. In all the layers of test pit A, we find the strong dominance of Turbinidae and Trochidae compared to other malacological species. These alone represent 90% of the assemblage. The two families are still consumed today in Vanuatu. The exploitation of marine resources in Punangatu is mainly intended for subsistence activity.

The share of shellfish in food and the importance of fishing compared to other land-based subsistence activities, during the island's initial settlement and over time, remains unclear. However, this is a major question that would contribute to define whether the exploitation of marine resources was a priority for these first occupants of the island. For this, it is necessary to study other sites of the island to better answer this question.

Nevertheless, the geographical location of the site has shown that the former occupants of the site were rather oriented towards subsistence activity, focused on the exploitation of marine resources. The type of occupation of this site is temporary, possibly even a camp, which favored the exploitation of these marine resources.

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