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THE MARINE MALACOLOGICAL REMAINS FROM THE CHALCOLITHIC FORTIFIED SETTLEMENT AT OUTEIRO REDONDO (SESIMBRA): COLLECTION STRATEGIES USED BY A SEDENTARY COMMUNITY FROM THE 3RD MILLENNIUM BC ON THE PORTUGUESE COAST

Restos marinos malacológicos del asentamiento calcolítico fortificado de Outeiro Redondo (Sesimbra): estrategias de recolección utilizadas por una comunidad sedentaria del III milenio a. C. en la costa portuguesa

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Abstract: The malacological collection of Outeiro Redondo showed the predominance of rocky substrate species and tidal levels between supralittoral zone and upper and middle levels of mediolittoral zone. The genus *Patella* have a overwhelming predomination, with 93,81% of the MNI, acquiring the remaining marine species a residual character.

The distribution of faunal remains and the degree of fragmentation analysis along the diachrony of occupation make possible to identify an occupation floor, at the bottom of the stratigraphical sequence, which time will intensify the activity of gathering shellfish, resulting in an episode of anthropic pressure that decline the average sizes of adult individuals selected.

With the viability of direct and daily rhythm access to these resources, the study of gathering techniques showed possible to identify the presence of marks (in borders of genus *Patella* shells) that indicate the use of tools like a sharp or puncturing instrument to extract molluscs from the substrate. In addition, taphonomic evidences analysis came to confirm the acquisition of shells in the beach in order to use them as scrapers or burnisher or as ornamental elements (beads).

Key words: Gathering. Coastal resources. Consumption. *Post mortem* use. Taphonomic alterations.

Resumen: El análisis de la malacofauna recogida en Outeiro Redondo ha demostrado el predominio del género *Patella* (93,81% de NMI) con una clara superioridad de *Patella intermedia* y *Patella ulyssiponensis.* La distribución de los restos mostró una mayor abundancia en los niveles artificiales 20-40 cm y 80-100 cm. Para este último se puede proponer la hipótesis de que correspondería a un piso de ocupación humana, así como que el aumento de la presión antrópica asociada a la recolección se tradujo en la disminución de los tamaños medios de los ejemplares de *P. intermedia*, desde la base hasta la parte superior de la estratigrafía.

Este estudio ha comprobado el predominio de la explotación en los ambientes costeros de sustrato rocoso, sobre todo de especies de la zona mediolitoral con una posible recolección de ritmo diario.

Las alteraciones tafonómicas ilustran el aprovechamiento de estos recursos y demuestran la práctica de la recolección, la reutilización de conchas tras del consumo y la cosecha de conchas en la playa para diversos fines, en situación *post mortem*. Así, ha sido posible identificar restos que se han utilizado sin cambio de su morfología, muy distintos de otros intencionalmente transformados.

Palabras clave: Recolección. Recursos marinos. Consumo. Uso *post mortem*. Alteraciones tafonómicas.

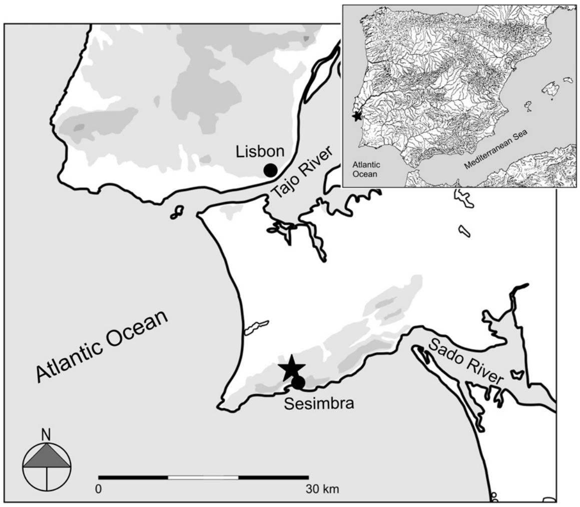

FIG. 1. *Outeiro Redondo: situation in the Arrabida region and in the Iberian Peninsula.*

1. Location

The fortified Chalcolithic settlement of Outeiro Redondo (Sesimbra) is located on an isolated hilltop, part of a line of Late Jurassic hard limestone uplands (the "Azóia Limestones") that stretches in a northeast-southwesterly direction and includes the mound with the castle of Sesimbra and the knoll of Moinho da Forca. Its coordinates are: 38º 27' 16" lat. N; 9º 06' 02" long. W of Greenwich (Fig. 1).

It overlooks the bay of Sesimbra and thus offers an excellent vantage point over the only part of the coastline suitable for landing and disembarkation (the coastline to the east and west of the bay is very sheer and rocky). Indeed, the hilltop is visible from the sea (Fig. 2). Consequently, the inhabitants of the settlement had a close relationship with the coast, as is shown by the abundant remains of seafood exhumed during the course of excavations. These are now the subject of systematic study, the first of its kind –in terms of breadth and depth– undertaken on a collection of this nature in Portugal.

2. Works and results

Before the start of the archaeological excavations in May 2005, it was confirmed that some of the structures were visible on the surface of the terrain, forming a line of large blocks that included an arched structure, later proved to be a large bastion (Fig. 3).

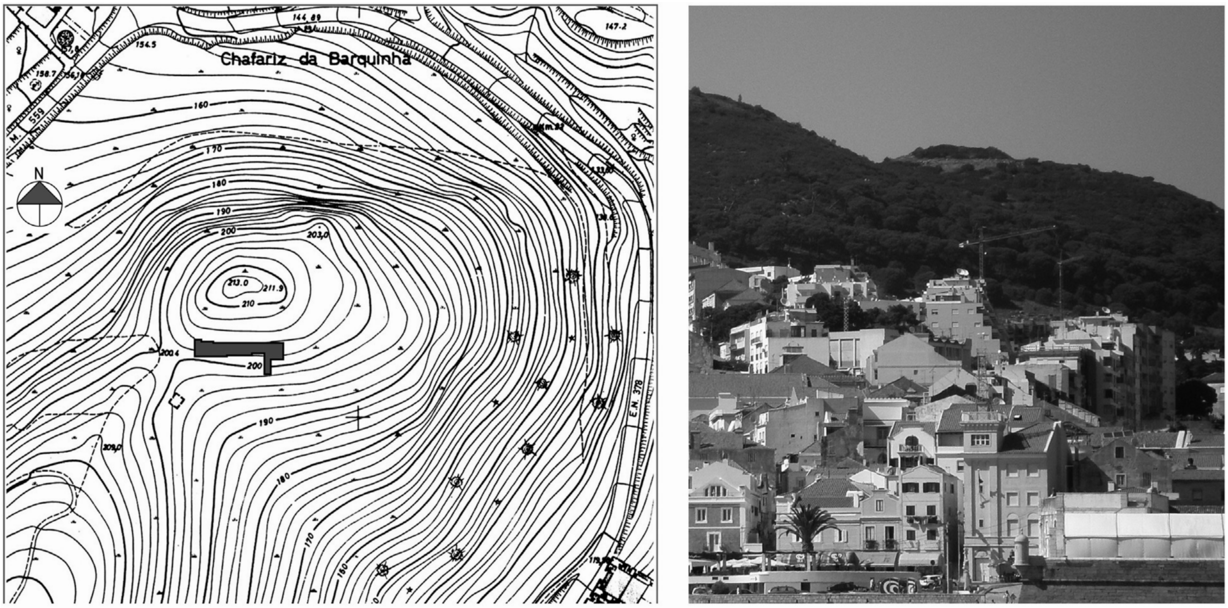

FIG. 2. *Excavated area and view of the hilltop from the sea.*

This was sketched by O. da Veiga Ferreira in his field notebook, since published (Cardoso, 2001: fig. 13), shortly after Gustavo Marques first announced the discovery of the prehistoric settlement to the Archaeological Section of the Lisbon Geographic Society (Cardoso, 2009). However, no graphic information corresponding to it was ever published.

The remains collected by Gustavo Marques indicated that the settlement had lasted a long time, dating from the early Chalcolithic and persisting well into the Full Chalcolithic, a fact that was fully demonstrated in the respective study and publication (Cardoso, 2009). This led to the organization of a multi-year excavation programme, carried out between May 2005 and November 2008 within the ambit of a four-year project (2004-2007) approved and funded by the now extinct Portuguese Institute of Archaeology within the framework of the National Plan for Archaeological Works, whose last campaign (2008) was financed by the Calouste Gulbenkian Foundation.

The excavations demonstrated the importance of the site, which corresponded to a fortified settlement (Fig. 4), smallish in size, consisting of at least two lines of defensive structures (Fig. 5). It was reinforced on the outside by semi-circular bastions, which would have surrounded it on the highest part, now occupied by a rocky escarpment. However, it is possible that this acropolis was originally occupied by dwellings, and that the sediments formed there later eroded away and were deposited nearby, where the slope was less steep. There they may have become mixed up with other archaeological remains subsequently recovered during the course of the excavations. The deposition of these sediments on the southern side created a new topographic surface that rested directly on the

FIG. 3. *Bastion C, partial view from the inner side, after excavation.*

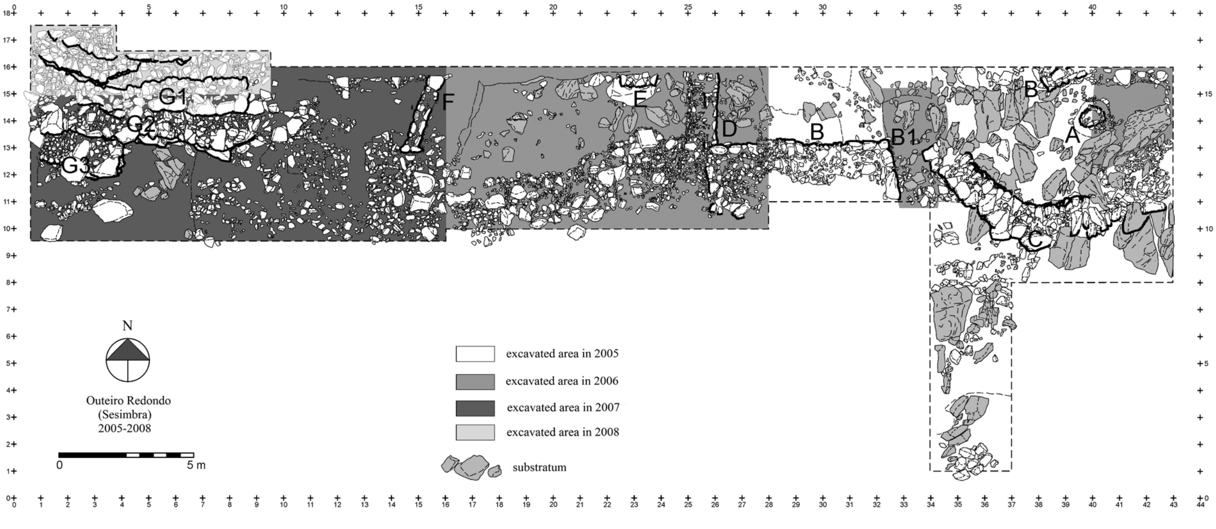

FIG. 4. *Outeiro Redondo: excavated area between 2005 and 2008.*

FIG. 5. *Partial view of the Eastern part of the excavation in Outeiro Redondo, showing the walled system of contention of earth, producing a terrace in the upper part of the slope, in the top of the figure.*

rocky substratum, enabling the foundations to be laid for the defensive structure, while at the same time preserving this layer in the state in which it is found today.

Although the fortified area was small in size, it has been possible to define the stratigraphic sequence of chronological-cultural expression, closely related to the construction of a complex defensive mechanism. As yet, only a small part has been explored, but has already shown that the oldest phase of occupation corresponded to the Early Chalcolithic of Estremadura, represented by ceramic vessels with fluted patterns ("cups" and bowls), and that it lasted into the Full Chalcolithic, characterised by the presence of ceramic vessels decorated with "folha de acacia" pattern. The steepness of the excavated area affected the vertical distribution of the materials, as mentioned above, causing eroded materials from higher areas to be transported to more sheltered areas lower down, producing a mixture of remains from various periods. Given the complexity of this taphonomic phenomena, the conclusions drawn since the first excavation campaign in 2005 (which made cultural attributions on the basis of the archaeographic content of each stratigraphic layer) should be considered as having "merely statistical value" (Cardoso, 2010: 6).

3. Stratigraphy and occupation

The most complete stratigraphic succession identified, along the northern side of the excavation (Fig. 6) is as follows, going from top to bottom[1]:

— **Layer 1**: loose chocolate-brown topsoil containing abundant limestone fragments resulting from the collapse of the adjacent defensive structure –unexcavated area–.

The most modern archaeological materials date from the Full Chalcolithic of Estremadura, though there are a few ceramic fragments from an earlier period, which will apparently have fallen from the oldest part of the site –the acropolis–, presently occupied by a rocky outcrop. This layer is 0,20 m thick at most, and on or near the surface were found a few bell-shaped fragments belonging to recipients maritime beakers.

— **Layer 2**: layer of earth that is lighter-coloured and more compact than the previous one due to a higher percentage of clay, with fewer stones, generally smaller in size. The upper part –between 0,20 and 0,40 m deep– contains pottery fragments which, judging by their type and decoration, are predominantly from the Full Chalcolithic of Estremadura. This corresponds to the phase of strong sedimentation, with the transportation of materials from various parts of the site, situated on higher levels, preceding their redeposition, with the consequent mixing of materials from various periods, both the early and Full Chalcolithic.

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[1] This does not differ significantly from the description already presented by Cardoso (2010: 103-104).

— **Layer 3**: light-brown layer of marlaceous clay, with many small limestone blocks, numerous scattered carbonous particles, and ceramic materials characteristic of the Early Chalcolithic of Estremadura. This layer, which is not always represented in the excavated area, corresponds to an occupation floor, where a well-preserved combustion structure has been identified. It is 0,60 m thick at most, and at a depth of 0,60 to 1,20 m on average. This may be included in the late part of the Early Chalcolithic of Estremadura.

— **Layer 4**: reddish-brown in colour, with abundant small blocks, partly resulting from the mechanical break-up of the rocky substrate on which it is based, and from which it partly resulted –*terra rossa*–. It is almost entirely devoid of archaeological remains, and anything collected from this layer also date from the Early Chalcolithic. It corresponds to the first human occupation of the site, resting directly upon the geological substrate, underlying the wall on the western side of the excavated area; thus it may be concluded that this occupation preceded the construction of the earliest part of the defensive structure.

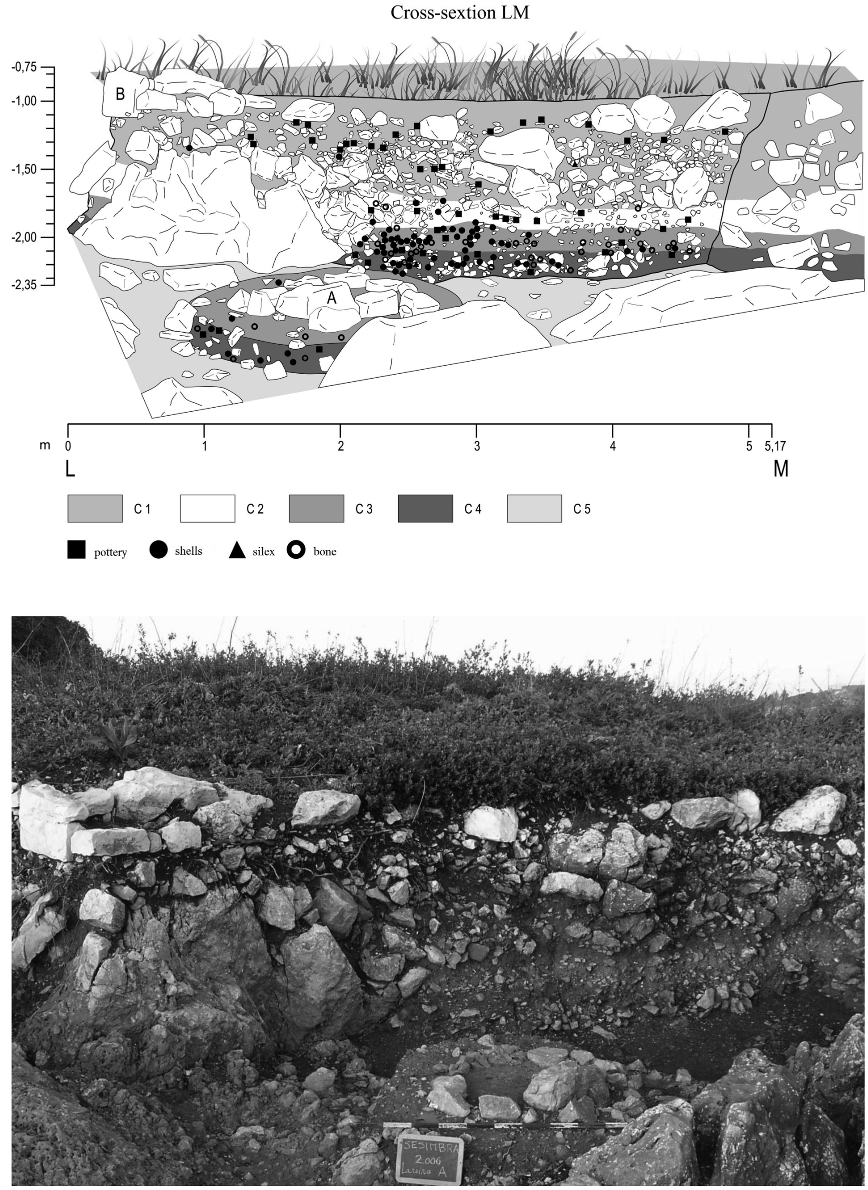

FIG. 6. *Stratigraphic sequence observed in the Eastern part of the excavation area; near the bottom of the sequence, a fire structure is preserved.*

— **Layer 5**: this corresponds to the bedrock of hard white Jurassic limestones –"Azóia limestones"–, and is very irregular, producing outcrops during the first archaeological occupation. These limestone anfractuosities are partly filled with reddish sand-clay deposits, resulting from the process of incipient karren formation, which will have occurred at the time when those rocky formations were outcrops.

This description shows that the first part of the stratigraphic sequence raises few taphonomic problems, as the materials found are typically consistent and compatible with the Early Chalcolithic.

However, from a depth of around 0,80 m to the surface, there is more mixing, due to the influence of the topography, expressed by the morphology of the present-day slope. Hence, chronocultural attributions can only be made on a statistical basis. As there are a few Full Chalcolithic productions of the "folha de acacia" pattern at that depth, and in the light of the situation found in Leceia, where such productions occur only exceptionally in the layer characteristic of the Early Chalcolithic –although, at that site, the specific conditions of accumulation/sedimentation are much less favourable to the kind of mixing of materials found in Outeiro Redondo–, the conclusion reached is that these deposits were formed during the Full Chalcolithic. This interpretation has proved decisive for the reading of the chronometric results obtained, as will be seen below.

4. Absolute chronology

Some 20 samples from the marine and terrestrial biospheres –shells of *Patella* sp., *Pecten maximus*, *Ruditapes decussatus* and *Cerastoderma edule* in the first case, and non-identified mammalian fauna in the second– were dated using radiocarbon. Each sample of seashells consisted of mollusc shells of the same species and whole unbroken valves. After some discussion (Cardoso, Soares and Martins, 2010-2011), two main clusters were identified from the sum of the probability distributions of the various dates calibrated from each "phase". The oldest occupation dates from 2540-2480 BC (1 σ) or 2610-2460 BC (2 σ), corresponding to the Early Chalcolithic, while the more recent is from 2340-2180 BC (1 σ) or 2440-2110 BC (2 σ), in the Full Chalcolithic.

These chronometric results were validated by comparison with other inhabited sites from the 3rd millennium BC of Estremadura, including some important unpublished results, such as the fortified Chalcolithic settlement at Moita da Ladra (Vila Franca de Xira). Thus, the dates obtained for Layer 3 of Outeiro Redondo, corresponding to materials collected at depths of between 0,60 and 1,20 m, indicate a late phase of the Early Chalcolithic. That is to say, the first occupation of the site will have occurred in the middle of the 3rd millennium BC, while the Full Chalcolithic, which corresponds to most of the materials collected up to a depth of 0,60 m, would have lasted here into the middle of the last quarter of that millennium. This chronostratigraphic context will provide the framework for the interpretation and discussion of the malacological remains, analysed below.

5. Study of malacological fauna

5.1. Objectives and methods

To date, studies devoted exclusively to malacological remains recovered from archaeological contexts are scarce in Portugal. Indeed, after a few pioneering works published in the 1950s and 1960s (Ferreira, 1956; Silva, 1963, 1966), only forty years later appeared the first academic study about shells remains on archaeological collections[2], which followed other works, including the now published.

The collection was analysed with a view to gleaning information about the environment and ecology of the malacofauna to which this human community had access (Coelho and Cardoso, 2010-2011). The main objective was to understand more about the way the community managed the available resources –in this case, of the marine ecosystem– and to gauge the importance of malacofauna for this prehistoric community from the purpose and methods of acquisition.

The fauna was collected in sectors, using the grid system –the grid units were labelled by means of two axes, one numerical and one alphabetic–, with excavation in artificial levels 20 cm deep. This study considers the remains found in Squares A1 to A9 and B3 to B5.

Identifying malacological remains is a difficult process, as the organic world is extremely diverse; hence, the degree of accuracy achieved may vary

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[2] Coelho, M. D. (2006): *A fauna malacológica de Porto Torrão. Os moluscos no Neolítico final/Calcolítico do Sul de Portugal*. Dissertação de Mestrado em Pré-História e Arqueologia apresentada à Faculdade de Letras da Universidade de Lisboa; texto policopiado.

considerably in accordance with the characteristics of the collection in question and the constraints involved in the process of analysis (Morales Muñiz, 1988). The identification was carried out with the help of standard catalogues (Bruyne, 2006; Dance, 1996; Fechter & Falkner, 1993; Macedo, Macedo & Borges, 1998; Saldanha, 1985; Tebble, 1976), supplemented, where possible, by consultation of specimen collections, and took account of the scheme put forward in CLEMAM, Taxonomic Database on European Marine Mollusca (http://www.somali.asso.fr/clemam).

In order to avoid inaccurate classification due to the small size of the specimen or poor state of conservation, the categorization was done at the level of genus, or in some cases, family. In extreme cases, the categories indeterminate marine molluscs –bivalves or gastropods– and indeterminate land molluscs were used, and in one case the remains were categorised as mere indeterminate. This made it possible to calculate the quantity of indeterminates from the total number of remains (NR), which could then be presented as a quantity and/or percentage, enabling our interpretations to be tested by others (Valente, 1997).

5.2. Anthropic intervention: malacofauna in archaeological contexts

Numerous explanations have been put forward for the presence of mollusc shells in archaeological sites, based not only upon previous archaeological records, but also upon ethnographic parallels. In fact, so many suggestions have been made that it is impossible to list them all here. For example, they may have been used, with or without prior transformation, as adornments, utensils, vessels, sound instruments, decorative motifs and raw material for pottery as well as building materials, or for hardening clay and for dyeing –extraction of the colour purple–.

The factors affecting the acquisition and selection of shells may go beyond mere availability and accessibility. Some may acquire a symbolic charge on account of their rarity or specific characteristics, or because of the significance attributed to them –particularly in the funerary context, where mollusc shells are often found–.

When the original shape of the shells has been changed, it is usually to enable them to be used as utensils or, more commonly, as objects of personal adornment, such as bracelets, buttons, beads, pendants, etc. In these cases, it is important to study the tools and technologies used in their production.

When interpreting the various taphonomic processes affecting the organism, we need to consider the time span between collection and deposition of the remains. Deposition may result when the object is discarded, often because it has lost its value or use; thus, remains are often found in areas of domestic waste accumulation –i.e. places where domestic activities, including consumption, took place– or production –workshops, where the raw materials were transformed–.

The objects' appearance will also vary according to use. These differences are manifested not only in the characteristics of individual items, but also in the clusters in which they are found, which provide contexts, illustrating the variety and nature of forms of accumulation (Chenorkian, 1988) and the time span of deposition. There are a number of variables to be considered here, such as the speed of accumulation, forms of dispersion, and management/organization of the occupied space.

Voluntary deposition, on the other hand, is when the deposition has not occurred by chance, but clearly has some intention or significance. This is the case with votive depositions, for example, connected to rituals of a magical or religious nature (Gonçalves, 1988-89: 61; Silva, 1996).

The intentionality or otherwise of the deposition may affect the degree of exposure on the surface. There are various agents that can cause alterations to the state of conservation and taxonomic composition of a malacological collection, including human and animal action such as trampling –which usually leads to increased fragmentation– or the maintenance and use of occupied areas –sometimes resulting in the transportation and dispersion of the remains–.

5.3. Sociocultural aspects

Human communities, with their different forms of social organization and economic strategies, attribute different degrees of importance to

Identification	**Weight (g)**	**% (g)**	**MNI**	**% MNI**	**NR**	**% NR**
Patella sp.	37765,77	62,43	10842	93,81	14226	79,73
Haliotis sp.	1,55	0,003	0	0	1	0,01
Calliostoma conulus	1,72	0,003	1	0,01	1	0,01
Osilinus lineatus	241,87	0,4	71	0,61	162	0,91
Osilinus sp.	30,14	0,05	16	0,14	27	0,15
Bittium sp.	0,01	0	1	0,01	1	0,01
Turritella communis	5,65	0,01	0	0	2	0,01
Littorina sp.	0,01	0	2	0,02	2	0,01
Semicassis saburon	177,91	0,29	13	0,11	17	0,1
Ranella olearium	19,67	0,03	1	0,01	1	0,01
Charonia lampas	114,12	0,19	2	0,02	2	0,01
Charonia sp.	132,18	0,22	1	0,01	8	0,04
Nassarius reticulatus	8,25	0,01	4	0,03	4	0,02
Stramonita haemastoma	2558,49	4,23	70	0,61	308	1,73
Mitra cornicula	1,95	0	1	0,01	1	0,01
Siphonaria pectinata	73,68	0,12	36	0,31	37	0,21
Mytilus edulis	919,34	1,52	142	1,23	1170	6,56
Pecten maximus	8001,88	13,23	55	0,48	937	5,25
Talochlamys multistriatus	5,22	0,01	1	0,01	1	0,01
Ostrea edulis	652,41	1,08	11	0,1	16	0,1
Acanthocardia sp.	2024,67	3,35	31	0,27	165	0,92
Laevicardium crassum	2929,17	4,84	73	0,63	209	1,17
Cardiidae (Fam.)	7,68	0,01	1	0,01	1	0,01
Mactra glauca	31,72	0,05	4	0,03	4	0,02
Mactra sp.	14,62	0,02	4	0,03	4	0,02
Spisula elliptica	3,27	0,01	1	0,01	2	0,01
Lutraria sp.	43,73	0,07	1	0,01	9	0,05
Mactridae (Fam.)	20,03	0,03	2	0,02	5	0,03
Solen marginatus	6,72	0,01	4	0,03	25	0,14
Tellinidae / Veneridae (Fam.)	4,12	0,01	0	0	1	0,01
Venus casina	9,11	0,02	0	0	1	0,01
Venus verrucosa	37,71	0,06	2	0,02	2	0,01
Dosinia exoleta	19,78	0,03	2	0,02	2	0,01
Callista chione	4173,22	6,9	140	1,21	376	2,11
Ruditapes decussatus	79,15	0,13	20	0,17	48	0,27
Pholas dactylus	0,46	0	0	0	1	0,01
Bivalve marinho indeterminado	64,61	0,11	1	0,01	22	0,12
Gastrópode marinho indeterminado	311,12	0,51	1	0,01	40	0,22
TOTAL	**60492,71**		**11557**		**17842**	

FIG. 7. *Overview of the marine species identified.*

molluscs as a resource. Hence, there are considerable variations with regards to the investment made in their acquisition and the number of community members participating in the process (Claassen, 1998: 179).

Diets may be reconstituted by identifying the species destined for consumption and then deciding if they were selected on the basis of availability, size or some other criteria. Changes in the age profile of the molluscs may indicate episodes of over-exploitation, when gathering was so intensive that it exceeded the creatures' capacity to replenish themselves –i.e. the shellfish collected become progressively younger and smaller, with long-term repercussions upon the abundance of the resource–.

As well as being excellent seasonal indicators, molluscs also provide evidence of cultural and environmental changes. There may be alterations in the different species collected, or in the importance of malacofauna generally in relation to other food sources, as well as changes in the choice of catchment area.

Remains found at archaeological sites may shed light on the existence of certain activities and functions, and periods of occupation. They can provide evidence of the technologies and artefacts associated with their collection and consumption, and can contribute to the characterization of the human occupation, subsistence strategies, social organization, and the habits and traditions practised at a particular place and time.

We know of prehistoric sites –of hunter-gatherer or not-completely-sedentarized communities– where the consumption of molluscs was valued not as a primary food source, but because environmental conditions led these cultural groups to adopt particular subsistence strategies.

The resource was a main source of subsistence, along with game, for agro-pastoral societies at sites of sporadic occupation along the coast –where segments of the community would probably go from time to time–. In fully sedentarized communities, where domestic animals and agricultural products took precedence over hunting and gathering, molluscs had a less significant role in the diet. However, they were still consumed as a complement to other food sources, particularly in coastal areas, where gathering could be quite intense.

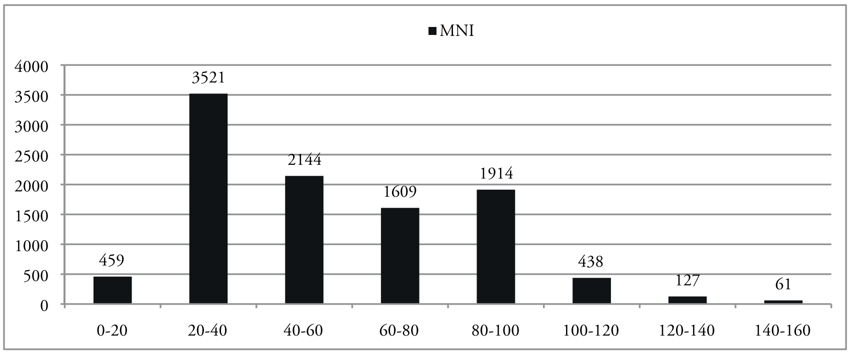

FIG. 8. *Distribution of* MNI *of the genus* Patella *over time – artificial stratigraphy (artificial levels from 0-20 cm to 140-160 cm).*

When the resource was found some distance away, a considerable investment was needed to acquire it, in terms of transportation and conservation. This would have endowed it with a rare or exotic character, giving it greater social value as a restricted good. In such situations, it is important to look at the supra-regional contacts and exchange systems in operation –in function of the network of settlements in which the community was inserted–: mobility patterns –of people and goods–, interactions with the exterior and the –direct or indirect– means through which these take place.

6. The collection

Using the "hierarchical" system of taxonomic and anatomical classification (Morales Muñiz, 1988), 38 *taxa* were distinguished in this collection: 16 species of marine bivalves, 17 species of marine gastropods and 5 species of terrestrial gastropods. The universe under appreciation contains a total number of remains (NR) of 17.901 (NR), with a minimum number of individuals (MNI) of 11.623 and a total weight of 60.54 g. The genus *Patella* accounts for 93.81% of the MNI in the collection, which means that other species have only a residual presence compared to it. Of those, the most represented are *Osilinus lineatus* (Da Costa, 1778), *Stramonita haemastoma* (Linnaeus, 1767), *Mytilus edulis* (Linnaeus, 1758), *Pecten maximus* (Linnaeus, 1758), *Acanthocardia* sp. (Linnaeus, 1758), *Laevicardium crassum* (Gmelin, 1791) and *Callista chione* (Linnaeus, 1758). The general inventory of the marine species identified is showed next (Fig. 7).

The relative distribution of species changes over time, as reflected by an artificial stratigraphy consisting of levels 20 cm thick. This allows some inferences to be made. There is a concentration at the artificial level of 20-40 cm, followed by level 80-100 cm and then levels 40-60 cm and 60-80 cm. In all these, there is a predomination of the genus *Patella*, followed, in terms of weight, by the species *Pecten maximus* (Linnaeus, 1758) and *Callista chione (ibidem). Laevicardium crassum* (Gmelin, 1791) also has significant expression (Fig. 8).

The distribution of the four species of the genus *Patella* was studied according to depth in the excavated grid units. In all areas and at all depths, the species *P. intermedia* (Murray, 1897) (Fig. 17, n.º 1) predominated, followed by *P. ulyssiponensis* (Gmelin, 1791) (Fig. 17, n.º 4). Compared to these, the presence of *P. rustica* (Linnaeus, 1758) (Fig. 17, n.º 2) and *P. vulgata* (Linnaeus, 1758) (Fig. 17, n.º 3) was only residual presence.

The spatial distribution of the main species identified (Squares A1 to B5) shows a concentration, in weight, of the genus *Patella*, in Squares A4 and A8, followed by Squares A3 and A7. The second most abundant species, *Pecten maximus* (Linnaeus, 1758), occurred mainly in Square A4, followed by Squares A3 and A1. In Squares A3 and A4, there were more examples of the species *Stramonita haemastoma* (Linnaeus, 1767) and *Callista chione* (Linnaeus, 1758), while *Laevicardium crassum* (Gmelin, 1791) was more widespread in Squares A1 and A3.

When the distribution by weight of the genus *Patella* was analysed in accordance with area and depth of occurrence, a concentration was found in Squares A4 and A3 at the level of 80-100 cm. In Squares A6 and A8, the concentration was

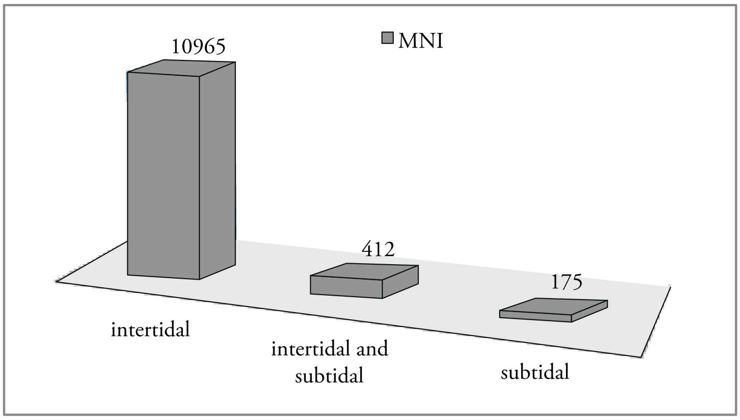

FIG. 9. *Distribution (by MNI) of marine species according to viable bathymetric levels.*

recorded at level 20-40 cm, while in Square A7 it occurred at 40-60 cm. Next in importance were levels 60-80 cm in Squares A4 and A8.

As regards the species *Osilinus lineatus*, the highest value was found in level 60-80 cm of Square A2. Also worthy of mention are levels 20-40 cm of Squares A4 to B3, within which Square A8 had some representativity.

As for the species *Stramonita haemastoma*, the greatest concentrations were in Squares A3 and A4. In the former, the highest values appeared at levels 80-100 cm, 100-120 cm and 120-140 cm, while in the latter, levels 0-20 cm, 80-100 cm and 100-120 cm were the most significant. In Square A2, there were also relatively high values at level 60-80 cm.

For the species *Mytilus edulis*, the greatest concentrations were found in Squares A3 and A4, at levels 40-60 cm, 60-80 cm and –particularly– 80-100 cm in the case of the former, and at 60-80 cm, 80-100 cm and 100-120 cm in the latter. The first grid units have little expression and the remains are merely residual after Square A5.

As regards *Pecten maximus*, there was a concentration at level 20-40 cm of Square A1. In Square A3, level 40-60 cm was the most important, followed by 80-100 cm and 60-80 cm. In Square A4, levels 100-120 cm and 60-80 cm contained the most examples, in that order, while in Square A5 level 20-40 cm stands out.

As for the species *Laevicardium crassum*, the highest values were recorded in Squares A1, A3 and A4. In Square A1, levels 20-40 cm and 0-20 cm were the most significant, while in Square A3, it was levels 40-60 cm, 60-80 cm and 80-100 cm. In Square A4, there were moderate concentrations at level 60-80 cm.

As regards the genus *Acanthocardia*, the greatest concentrations were found in Squares A1, A2, A3 and A4. In Square A1, level 20-40 cm has the highest values. In Square A2, level 0-20 cm comes first, while in Square A3, there are more than 100 g at level 40-60 cm. In Square A4, levels 60-80 cm and 100-120 cm were the most significant.

The species *Callista chione* has relative expression in Squares A1, A2, A3 and A4. In Squares A1 and A2, level 20-40 cm stands out, while in Square A3, it is level 40-60 cm and –as with Square A4– also 60-80 cm, followed by 80-100 cm.

Finally, for the remaining marine species, the greatest concentrations were found in Squares A1, A3, A4 and A6. In Square A1, levels 60-80 cm and 20-40 cm were the most represented. For Square A3, the highest value was found at level 80-100 cm, while level 60-80 cm also had some expression. In Square A4, levels 60-80 cm and 80-100 cm are identical, but 100-120 cm is the most important. Finally, in Square A6, the level best represented is 20-40 cm.

7. Discussion

7.1. Ecological aspects

Whether or not a mollusc species is collectable usually depends upon its tidal level. This characteristic makes it possible to gauge the viability of gathering, taking into account the technologies available in the chronological period in question. However, caution should be used when exercising this principle; just because we have no knowledge about the existence of a particular technique or instrument, this does not mean that such might not have been used to facilitate the gathering of species that may have been inaccessible as live molluscs. Thus, the use of certain species as food is considered as a hypothesis, as there is no information available to corroborate it.

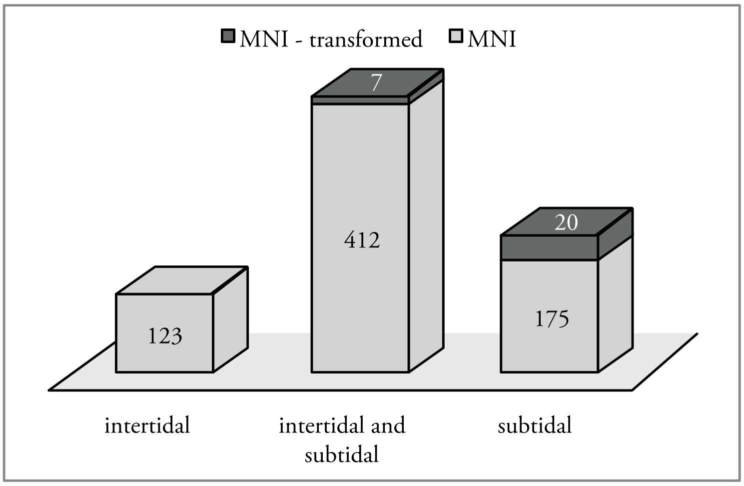

FIG. 10. *Distribution (by* MNI*) of marine species according to viable bathymetric levels with the exception of the genus* Patella *(representation of the* MNI *of transformed specimens).*

Species from the mediolittoral area will always be overvalued because of the importance that the genus *Patella* has in this particular collection. Other species from the same zone are also represented, such as *Osilinus lineatus* and *Mytilus edulis*.

From the infralittoral area, the species *Callista chione* (Fig. 17, n.º 13) predominates, followed by *Stramonita haemastoma* (Fig. 17, n.º 7), *Laevicardium crassum*, *Pecten maximus* (Fig. 17, n.º 9) and *Acanthocardia* sp. (Fig. 17, n.º 12). It may have been possible to gather the first of these at low tide, while *Stramonita haemastoma* could have been gathered from rocks in the mediolittoral zone. However, the last three species are completely subtidal. We can only tell if these molluscs were collected alive through the taphonomic alterations undergone, a matter that will be discussed later.

From the analysis of species distribution according to the respective tidal level, it was found that there was a predominance of individuals from the mediolittoral or intertidal zone (Fig. 9), though of course, as has already been mentioned, this abundance is essentially related with the overwhelming predomination of the genus *Patella*, which accounts for 93,81% of the MNI.

Identification	**intertidal**			**MNI**
P. intermedia	░	▒		890
P. rustica	░	▒		32
P. vulgata	░	▒		47
P. ulyssiponensis		▒	▓	595

░ intertidal - upper level
▒ intertidal - middle level
▓ intertidal - lower level

FIG. 11. *Correspondence between the species of the genus* Patella *and their optimum bathymetric range.*

As the intertidal zone predominates, species of subtidal distribution are scantily represented, and those of an intertidal/subtidal nature even less so. However, when the genus *Patella* is removed from the analysis, individuals of an intertidal/subtidal nature become more significant, followed by those that are strictly subtidal; species that are strictly intertidal are represented least. It should be pointed out that individuals showing the most signs of transformation tend to be subtidal in character (Fig. 10), suggesting that their shells were collected from beaches and that they were not intended as food.

As it would have been possible to gather the species found at the supralittoral, upper intertidal and middle intertidal levels on a daily basis, and occasional gathering could have occurred at the lower intertidal level (Dupont, 2006). Thus, it is important to identify the dominant species within the genus *Patella*, in order to determine if the acquisition was on a daily basis or merely occasional. From Figure 11, we can conclude that the four *Patella* species could have been collected on a daily basis, even *P. ulyssiponensis* (Fig. 17, n.º 4), which could be found at the lower level of the mediolittoral zone, available at low tide.

Artificial level	Minimum length (mm)	Maximum length (mm)	Average
0-20 (50)	25,13	50,25	37,64
20-40 (531)	23,92	57,24	36,17
40-60 (314)	19,25	54,51	37,09
60-80 (295)	25,87	56,03	38,11
80-100 (272)	25,90	62,54	37,68
100-120 (105)	29,44	54,85	39,40
120-140 (44)	31,32	67,22	41,72
140-160 (35)	27,34	62,83	40,76

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FIG. 12. *Length of genus* Patella *by artificial levels.*

7.2. Substratum

Most of the marine molluscs in this collection are associated with rocky substrates, once more due to the predominance of the genus *Patella*. However, the species *Mytilus edulis*, often found on rocky surfaces at the middle and lower levels of the mediolittoral zone, was also represented. *Osilinus lineatus* and *Stramonita haemastoma* (Fig. 17, n.º 7), which have some expression in the collection under analysis, are typically associated with the rocky substrate of the upper and middle intertidal –in the first case– and subtidal –in the second– zones, which means that they could have been collected directly on an occasional basis.

These observations suggest that an exploitation scenario that gave predominance to the collection of species from rocky environments, where most of the resources could easily have been obtained. We will return to this question later (*cf.* Fig. 16) in the context of the collection/subsistence strategies adopted.

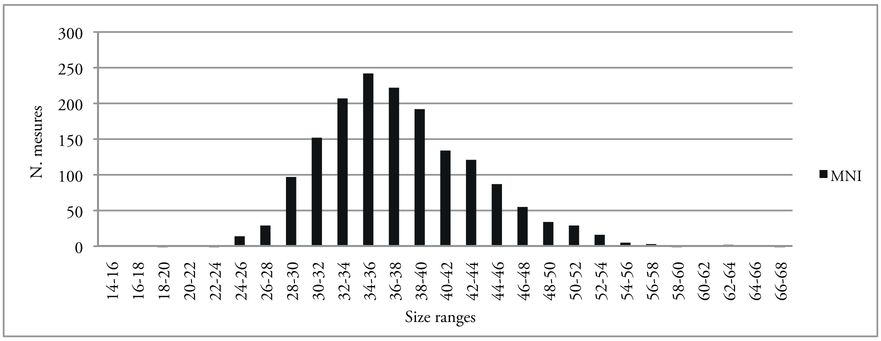

FIG. 13. *Distribution of the number of individuals of the genus* Patella *by size (in mm).*

7.3. Collection strategies

7.3.1. Size

The size and shape of the mollusc shells may shed some light on the ecological conditions of their habitat. It is also important to identify features –such as size of the specimens– that may have caused certain species to be collected instead of others, and to identify shifts and continuities in collection patterns over time. Thus, a size analysis was performed on the specimens of the genus *Patella* and its species *P. intermedia*, *P. rustica*, *P. ulyssiponensis* and *P. vulgata* (Fig. 17, n.º 1-4), present in this collection.

Figure 12 shows that the individuals collected were adults with an average length of 37,44 mm. Although there are few variations or discrepancies in the distribution of sizes, it should be pointed out that there were more average-sized specimens at the lower levels of the stratigraphy, and fewer at level 80-100 cm. It can be seen from the stratigraphic sequence that there are more records at the higher levels, and a reduction in size in relation to the older levels. Moreover, the larger individuals were recorded at level 120-140 cm, while the smallest were found at level 40-60 cm. It should also be pointed out that level 20-40 cm has the largest number of records –531– and the lowest average in the sample –around 36,17 mm–.

These observations may reflect moments of greater exploitation of this genus, with a consequent reduction in the average size of samples collected. Similarly, the older levels, which have larger specimens, may correspond to the period when these resources had not yet become the object of intensive exploitation.

The distribution of examples of the *Patella* genus according to size (Fig. 13) shows a predominance of adult individuals of 34-36 mm –242 examples–; indeed, there were very few cases smaller than 24-26 mm. The biometric analysis

P. intermedia				***P. ulyssiponensis***			
Artificial lv.	**Min. Length**	**Max. Length**	**Average**	**Artificial lv.**	**Min. Length**	**Max. Length**	**Average**
0-20 (37)	25,13	46,45	36,20	0-20 (12)	30,33	50,25	41,67
20-40 (324)	23,92	50,99	35,00	20-40 (178)	27,24	57,24	38,52
40-60 (177)	25,05	49,15	35,43	40-60 (122)	27,61	54,51	39,94
60-80 (147)	26,65	56,03	36,35	60-80 (133)	25,87	55,25	39,96
80-100 (150)	27,00	49,79	34,85	80-100 (109)	28,28	62,54	41,72
100-120 (62)	29,44	47,74	36,90	100-120 (39)	33,64	54,85	43,32
120-140 (23)	31,32	48,72	38,58	120-140 (18)	34,96	67,22	45,20
140-160 (20)	27,34	47,12	38,29	140-160(7)	38,82	62,83	45,66
P. rustica				***P. vulgata***			
Artificial lv.	**Min. Length**	**Max. Length**	**Average**	**Artificial lv.**	**Min. Length**	**Max. Length**	**Average**
0-20 (1)	42,63	42,63	42,63	0-20 (0)	_	_	_
20-40 (9)	26,95	34,7	31,31	20-40 (19)	25,68	49,51	36,35
40-60 (8)	27,67	34,46	32,47	40-60 (4)	31,48	50,17	39,08
60-80 (7)	28,61	44,55	38,40	60-80 (7)	35,95	43,84	39,66
80-100 (4)	25,90	48,40	37,18	80-100 (9)	28,65	42,28	36,18
100-120 (1)	31,37	31,37	31,37	100-120 (2)	43,34	44,21	43,78
120-140 (2)	42,96	44,93	43,95	120-140 (1)	46,76	46,76	46,76
140-160 (1)	50,70	50,70	50,70	140-160 (7)	30,75	48,84	41,51

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FIG. 14. *Measurements (length) of genus* Patella *at the various artificial levels.*

showed the distribution of size –length– of individuals belonging to the different species of *Patella* sp. identified in the collection.

Of the results presented in Figure 14, *P. intermedia* had the highest values at lower levels, declining thereafter –in this species, the drop in the average size of the specimens occurred at level 80-100 cm–. As for *P. ulyssiponensis*, the largest of the group measured, the specimens with the largest average size also occurred at the older levels, decreasing in subsequent ones, with only a slight increase at the uppermost level –0-20 cm–. In the species *P. rustica* and *P. vulgata*, the small number of samples prevented any representative reading of the results.

Figure 15 shows the changes in the average length of *Osilinus lineatus*. Here too there is a tendency for the size of the individuals to decrease over time, although the lack of numerical representativity means that this cannot be confirmed.

7.3.2. The biotopes exploited

The most frequent tidal level, substratum, marks of extraction/consumption, and marks of

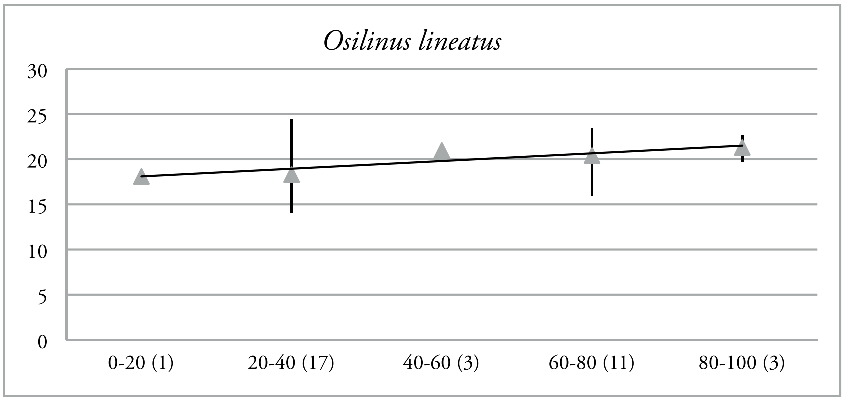

FIG. 15. *Distribution of size (length) of the species* Osilinus lineatus *throughout the stratigraphy. [( ) – n.º of measurements at each level].*

Identification	Tidal level + viable	supra	intertidal			sub	Substrate	Extr/Cons	Transf/Use	MNI
Siphonaria pectinata	supralittoral	░					rocky	5		36
Osilinus lineatus	mediolittoral		░	▒			rocky			71
Osilinus sp.	mediolittoral		░	▒			rocky			16
Patella sp.	mediolittoral		░	▒	▒		rocky	636	45	10842
Littorina sp.	mediolittoral		░	▒	▒	▓	rocky			2
Bittium sp.	mediolittoral			▒	▒	▓	rocky			1
Nassarius reticulatus	mediolittoral			▒	▒	▓	muddy-sand			4
Mytilus edulis	mediolittoral			▒	▒	▓	rocky		2	142
Ostrea edulis	mediolittoral			▒	▒	▓	rocky		2	11
Solen marginatus	mediolittoral			▒	▒	▓	muddy-sand			4
Pholas dactylus	mediolittoral			▒	▒	▓	rocky			0
Ruditapes decussatus	mediolittoral			▒	▒	▓	muddy-sand			20
										11149
Haliotis sp.	infralittoral				▒	▓	rocky			0
Calliostoma conulus	infralittoral				▒	▓	rocky			1
Charonia lampas	infralittoral				▒	▓	rocky			2
Charonia sp.	infralittoral				▒	▓	rocky			1
Stramonita haemastoma	infralittoral				▒	▓	rocky			70
Mitra cornicula	infralittoral				▒	▓	rocky		1	1
Venus verrucosa	infralittoral				▒	▓	sandy			2
Dosinia exoleta	infralittoral				▒	▓	muddy-sand	1		2
Mactra glauca	infralittoral				▒	▓	sandy			4
Mactra sp.	infralittoral				▒	▓	sandy			4
Lutraria sp.	infralittoral				▒	▓	muddy-sand			1
Callista chione	infralittoral				▒	▓	sandy			140
Turritella communis	infralittoral					▓	muddy-sand			0
Semicassis saburon	infralittoral					▓	muddy-sand			13
Pecten maximus	infralittoral					▓	sandy		17	55
Talochlamys multistriatus	infralittoral					▓	muddy-sand			1
Acanthocardia sp.	infralittoral					▓	muddy-sand			31
Laevicardium crassum	infralittoral					▓	muddy-sand	2	1	73
Spisula elliptica	infralittoral					▓	muddy-sand			1
Venus casina	infralittoral					▓	muddy-sand			0
										402
Ranella olearium	circalittoral					▓	muddy			1
										1

░	supratidal
░	intertidal - upper level
▒	intertidal - middle level
▒	intertidal - lower level
▓	subtidal
░	records with anthropic transformation

FIG. 16. *Tidal level, substratum, marks of extraction/consumption, marks of transformation/use and MNI for each marine species identified.*

transformation/use are showed in Fig. 16, with regard to the various marine species identified. There is a predominance of species associated with the mediolittoral zone, particularly the genus *Patella*, the group most represented in the collection. This genus, to which the species *Siphonaria pectinata* belongs –which accounts for 13,89% of shells with signs of anthropic action– bore the most marks: 5.87% of individuals had marks on the margin of the shell resulting from the use of a sharp instrument to prise the mollusc from the substratum.

The species *Mytilus edulis*, *Osilinus lineatus, Osilinus* sp. and *Ostrea edulis*, which are quite well represented in the records, have the same optimum bathymetric range as *Patella*, and are also found in rocky environments –the last named may develop in various type of substratum–. Also from the rocky substrate, but of the infralittoral zone, is the species *Stramonita haemastoma* (Fig. 17, n.º 7), which, as mentioned before, could have also been collected at the lower level of the intertidal zone. The acquisition of molluscs (as opposed to the empty shell) might have been possible sporadically, as this species is not strictly subtidal in character. Thus, we cannot discount the possibility that these molluscs might have been collected for food, although a methodological experiment carried out on the remains from Squares A1 and A2 revealed that 17 remains –out of 39– bore signs of erosion in a marine environment, with marked rounding of the shell structure and ornamentation. This indicates that only the shell was collected and not the live mollusc. On the level of the MNI, 7 out of 18 individuals appear to have been collected on the beach.

There does not appear to have been significant exploitation of other environments of the intertidal zone, as only the species *Ruditapes decussatus* (Fig. 17, n.º 14), found in muddy-sand beds, has much expression. This contrasts with the fact that other settlements from the same period, such as Porto Torrão, have revealed a taste for the consumption of this species, which were brought there from the Sado estuary (Coelho, 2006).

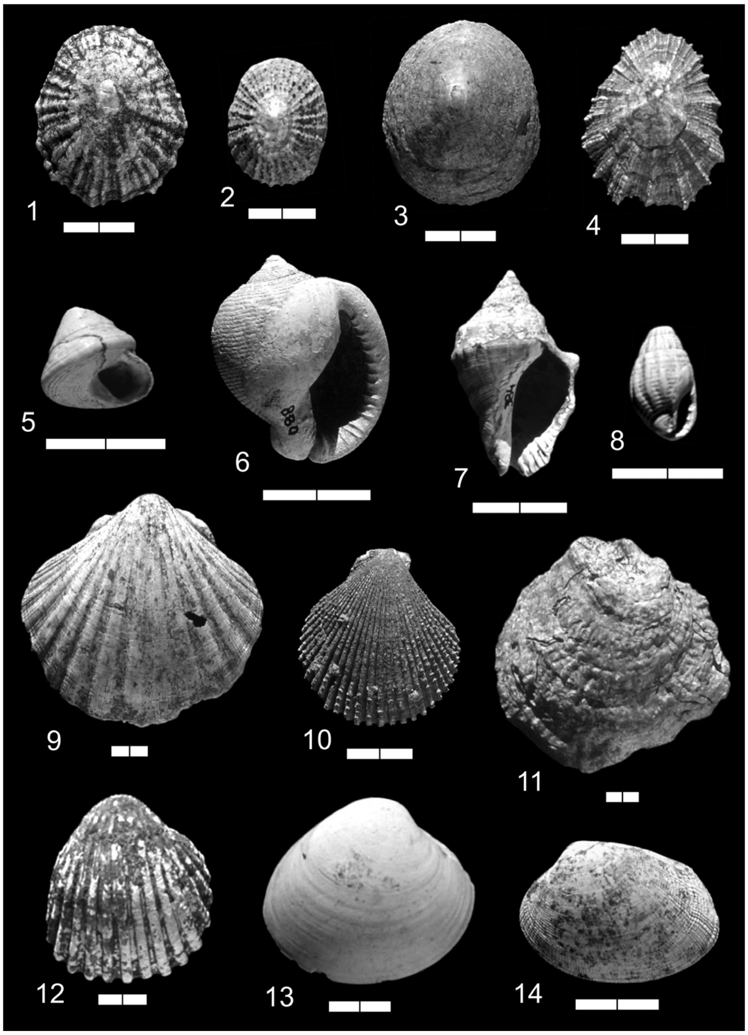

Fig. 17. *Marine species: 1.* Patella intermedia*; 2.* Patella rustica*; 3.* Patella vulgata*; 4.* Patella ulyssiponensis*; 5.* Calliostoma colunus*; 6.* Semicassis saburon*; 7.* Stramonita haemastoma*; 8.* Nassarius reticulatus *showing marine abrasion; 9.* Pecten maximus*; 10.* Talochlamys multistriatus*; 11.* Ostrea edulis *showing bioerosion by* Meandropolydora *sp.; 12.* Acanthocardia *sp.; 13.* Callista chione*; 14.* Ruditapes decussatus. *Each subdivision of the scale corresponds to 1 cm.*

The other intertidal species from sandy or muddy-sand beds that could have been collected directly seem to have been gathered only spasmodically, either because they were only accessible at restricted times, or because they were rare in their respective biotopes. An exception is *Callista*

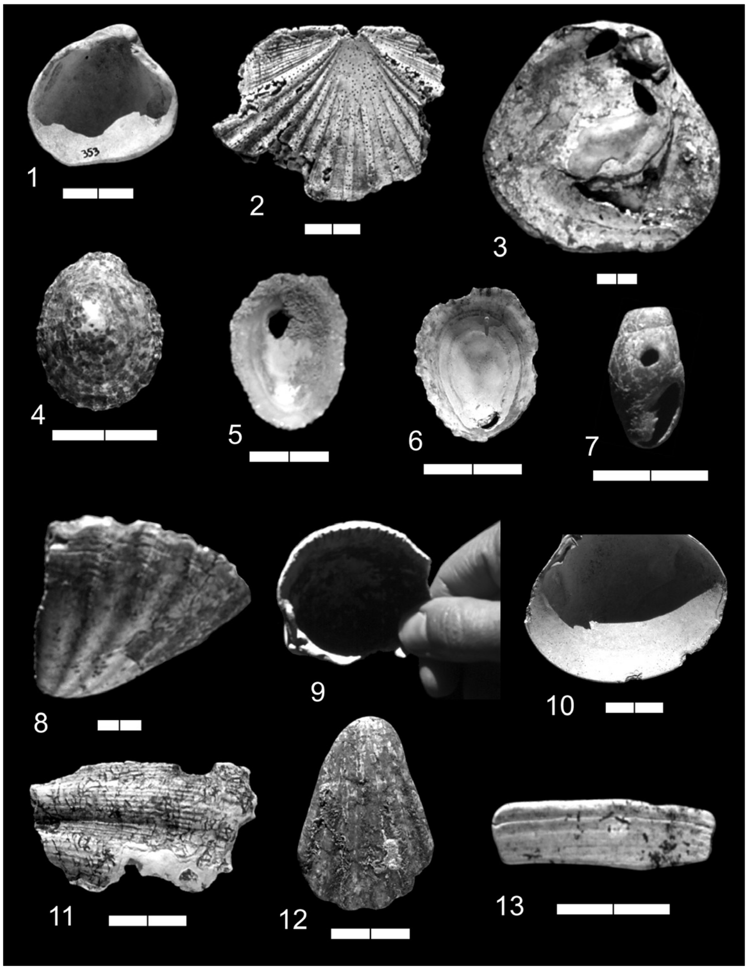

FIG. 18. *Marine species: 1.* Laevicardium crassum *showing marine abrasion; 2.* Pecten maximus *showing bioerosion by* Entobia *sp.; 3.* Ostrea edulis *showing bioerosion by* Gastrochaenolites *sp.; 4.* Patella rustica *showing extraction mark on the edge; 5.* Patella intermedia *drilling; 6.* Patella intermedia *drilling; 7.* Mitra cornicula *drilling; 8.* Pecten maximus *(fragment showing polished edge); 9.* Laevicardium crassum *(fragment showing polished edge); 10.* Callista chione *(fragment showing cut marks on the edge); 11.* Pecten maximus *(fragment showing perforation partially conserved); 12.* Pecten maximus *(fragment showing polished edges); 13.* Callista chione *(fragment showing polished edges). Each subdivision of the scale corresponds to 1 cm.*

chione (Fig. 17, n.º 13), which is represented by 140 individuals. Despite only being located at the lower level of the intertidal zone, it is more frequent in the subtidal zone, where direct collection would not have been possible. The taphonomic analysis carried out on Squares A6 to B5, where 57 remains were found, revealed only 9 with possible marks of marine erosion, indicating a residual *post mortem* collection. This interpretation is supported by the absence of encrusting or perforating colonizations on the internal surface.

Thus, we need to consider the hypothesis that there was sporadic collection of these molluscs, which would imply the occasional exploitation of sandy beds, in addition to rocky ones. In the case of the species *Laevicardium crassum*, this is associated to muddy-sand beds at the subtidal level. Direct collection could only have taken place very occasionally and would have implied the use of special techniques, which are difficult to confirm.

Of the 43 remains of *Laevicardium crassum* analysed, 5 showed *post mortem* alterations due to marine erosion (Fig. 18, n.º 1). In addition to these, 13 remains showed strong alterations that may have resulted from erosion in the marine environment or may have been caused by diagenetic phenomena occurring at the archaeological deposit. As with the previous species, these remains do not show any signs of encrustation or perforations by organisms on their surfaces.

There is also doubt as to the purpose of gathering with regard to a group of *L. crassum* shells, as one of the specimens bears signs of transformation. The hypothesis that these were collected *post mortem* is supported by the fact that these shells are not only robust and resistant, but are also aesthetically appealing, with ornamentation similar to the *Glycymeris* –not represented in this collection–.

For the species *Pecten maximus*, which is subtidal and subsists in sandy beds, the question is again raised of the viability of gathering because of the depth at which these organisms develop –between the limit of the low tide in the infralittoral zone, down to 250 m–. In the archaeological literature, they are frequently mentioned in association with funerary contexts and are considered to carry a strong symbolic charge –probably due to their size and ornamental features–. However, it was necessary to find some evidence of this in this collection.

In the taphonomic analysis, 102 remains of this species were observed, of which 14 presented vestiges of marine erosion. There were also cases of encrustations and perforations caused by colonizing organisms (Fig. 18, n.º 2), with 3 cases of encrustations and 8 cases of perforations of the internal surface of the shell, corresponding to *post mortem* alterations. There were also 17 cases bearing marks of anthropic transformation, visible in a macroscopic level, which supports the hypothesis that this species was acquired and used *post mortem*. This is in fact one of the most numerous shell groups, despite the fact that the species in question is one of those that would have been less likely to have been collected for food, as mentioned above. Nevertheless, there is a possibility that they were, and that the shells were then reused after consumption.

For the species *Acanthocardia* sp. (Fig. 17, n.º 12), found in muddy-sand beds in the subtidal zone, there was an assemblage of 165 remains corresponding to 31 MNI. Here too we need to question whether the molluscs were collected live, as their accessibility would have been strongly conditioned by the depth at which they are found (from the infralittoral zone to 350 metres). Of the 14 remains analysed from a taphonomic point of view, 4 presented marks of marine erosion, indicating that the shells were collected from beaches. None bore signs of encrustations or perforation caused by organisms, but neither did they show signs of transformation or use.

In short, as regards the strategies used for the gathering, the most significant data relates to the exploitation of rocky substrates, as the genus *Patella* may have constituted a daily complement to the community's diet. This is corroborated by the notable presence of another species from similar environments, such as *Siphonaria pectinata*, *Mytilus edulis*, *Osilinus lineatus*, *Osilinus* sp. and even *Ostrea edulis* (Fig. 17, n.º 11), suggesting the systematic exploration of the rocky coastline from the supralittoral to the upper and middle levels of the mediolittoral zone.

The easy access from Outeiro Redondo to the rocky coast (Cardoso, 2010) explains the quantity of malacological remains collected, confirming the importance of this resource for the food economy of the human community established there. The biometric analysis of the genus *Patella* shows that adult molluscs were selected. However, there are indications that this activity generated a slight reduction in average size, revealing a decline in availability as a result of increased anthropic pressure. This size alteration analysis suggests that the resource was in fact exploited intensively, perhaps on a daily basis.

There seems to have been little exploitation of shifting beds, as can be attested by the scanty presence of *Ruditapes decussatus* and *Callista chione* –the latter could only have been collected very occasionally–. The bay of Sesimbra may at that time have formed a small estuary for the stream that today runs the town of Sesimbra, which would have been propitious for the existence of *Ruditapes decussatus*, represented by a small number of individuals. Thus, they would not have had to have been transported from the Tagus or Sado estuaries. In the case of the species *Callista chione*, it is doubtful that this would have contributed to the diet of the community. For although there are several specimens without any marks of erosion, bioerosion or transformation, which may suggest collection for food purposes, they could only have been collected directly in exceptional tides. Thus, it is more likely that indirect collection methods were used.

8. Anthropic marks

In this preliminary and macroscopic study the criteria analysis consisted in description of mark location in the shell, direction and orientation stigmas, marks contours, edges characterization –sharp to rolled–, mark shape and respective dimensions.

Identification	NR	Thermoaltered remains	%
Patella sp.	14226	104	0,73
Stramonita haemastoma	308	7	2,27
Mitra cornicula	1	1	100
Siphonaria pectinata	37	3	8,11
Mytilus edulis	1170	33	2,82
Pecten maximus	937	114	12,17
Acanthocardia sp.	165	12	7,27
Laevicardium crassum	209	6	2,87
Mactra glauca	4	1	25
Mactra sp.	4	1	25
Dosinia exoleta	2	1	50
Callista chione	376	18	4,79
Ruditapes decussatus	48	2	4,17

FIG. 19. *Quantification and percentage of thermoaltered remains.*

8.1. Marks of extraction and consumption

Given the predominance of the genus *Patella* in the collection, it is important to check for marks of extraction. As molluscs of this species stick closely to the substratum, the hypothesis needs to be considered that they were prised out with the aid of a tool, which would have left marks on the surface of the shell. In fact, alterations of possible anthropic origin were found on the margins of all 636 shells of this genus. In order refine the results, a sample of 45 specimens was selected, to which were applied the criteria described above. In 26 of these shells, the marks seemed to be recent, as their borders were fresh, while in 19, older marks were identified (Fig. 18, n.º 4), showing evidence of concretions or other subsequent taphonomic alterations. The marks are located at a similar place on the posterior and anterior margins of the shells –in 10 and 9 cases respectively–, although there is some variation in the point of impact. They were probably created by a sharp object, which caused an indentation that was regular in shape in most cases –15 regular and 4 irregular– and predominantly semi-circular –16 semi-circular, 1 conical, 1 trapezoidal and 1 irregular–.

As a hypothesis, we suggest that these marks could have been produced by an awl or puncturing instrument that was circular in cross-section with an average diameter of 4,5 mm. This type of artefact has in fact been documented at the archaeological site of Outeiro Redondo (Cardoso, 2010: 121; fig. 36, n.os 5, 6, 10 and: 122, fig. 37, n.os 2, 13, and: 124 fig. 38, n.º 10, and: 125 fig. 39, n.º 3 and: 126 fig. 40, n.º 10).

In addition to the marks identified on the genus *Patella*, possible extraction marks were also found on three samples of the species *Siphonaria pectinata*, with identical characteristics.

8.2. Marks of transformation/use

Molluscs destined for consumption were usually boiled or exposed to fire so briefly that it left no signs of alteration on the malacological remains (Chenorkian, 1990). This means that the thermoalterations identified in many cases will probably have resulted from a rejection scenario –i.e. domestic waste thrown into fireplaces–. However, it is not possible to definitively exclude the possibility that these marks resulted from culinary practices of the type mentioned above. These marks were quantified below (Fig. 19).

Of the 303 remains with vestiges of thermoalteration, it is the species that are less well represented in the collection that present the greatest number of thermoaltered remains. This is the case with the species *Mitra cornicula* –of which the only example identified was altered in this way–, *Dosinia exoleta* –two of the remains were thermoaltered– and *Mactra glauca* and *Mactra* sp. (one of the four remains of each group was altered). Of the remaining species, *Pecten maximus* is worthy of mention, followed by *Siphonaria pectinata*, *Acanthocardia* sp., *Callista chione* and *Ruditapes decussatus*.

As mentioned above, mollusc shells may have many different uses, beyond human consumption, whether or not the specimens show signs of use or transformation. What is more, the acquisition and selection of these shells has to do with factors that go beyond mere availability and accessibility. This paper aims to provide an inventory of the remains that have been transformed or show signs of use, in order to determine which species were selected and the kind of use they

Identification	**R. Transf./Use**	**%**	**Observations**
Patella sp.	23	0,16	1 rounded border and 22 perforations
Mitra cornicula	1	100	1 perforation
Mytilus edulis	2	0,17	1 incision (ext surface); 1 abrasion (internal and external surface)
Pecten maximus	19	2,03	12 polished borders; 5 shaped and polished; 1 perforation; 1 border notch
Ostrea edulis	2	12,5	1 polished border; 1 perforation
Laevicardium crassum	1	0,48	1 polished border
Callista chione	2	0,53	1 border notch; 1 shaped and polished record

FIG. 20. *Summary of inventory of malacological remains bearing marks of transformation/use.*

were subjected to, in order to gauge if there was a direct relationship between the two. This approach was already object of several studies that revealed an insuspected utilisation of collected shells as different kinds of artefacts (Vigie and Courtin, 1986; Pascual, 2008; Cuenca, Solana and Gutiérrez, 2010).

Figure 10 shows a particular incidence of transformed shells in species of a subtidal character –and which could not generally have been used for food–. This means that these specimens must have been deliberately collected from beaches. All cases of alteration in function of the species are listed below (Fig. 20).

Only 7 of the 33 marine species identified present marks of transformation or use. In the case of species of the *Patella* genus, the one most intensively exploited for food purposes, the most viable hypothesis is that these specimens were reused after consumption. In fact, the specimens that have been transformed are not clearly differentiated from the others in terms of size, ornamentation, colour, or pre-transformation alterations.

Most of the marks identified on *Patella* sp. are perforations (Fig. 18, n.º 5-6), with the exception of an atypical fragment –Type 1– of *Patella ulyssiponensis* collected from Square A4 (level 100-120 cm), which bears marks of fire, and has a rounded fracture, possibly resulting from abrasion on the surface of the fracture.

Of the perforated specimens, one of Type 0 –complete individual– and 21 of Type 1 –apical fragment with preserved muscle scar– have a perforation on the body of the shell –the perforation occurs in the area of the apex in only two cases–, made from the internal surface to the external one. This suggests the shell was to be used as an adornment. These orifices show no signs of use, with no evidence of rolling –on the diagenetic concretions–. They are predominantly irregular in shape –only 6 cases have a regular outline–; 8 are ellipsoidal; 7 irregular, 5 circular, one semi-circular and one quadrangular.

As regards the maximum diameters of the marks, there is great variability, ranging from 1,84 mm to 11,02 mm –average 5,02 mm–. The area affected in most cases exceeds the limits of the marks, with partial suppression of the shell's structure in the zone around the point of impact. Unlike the marks of extraction, these may have resulted from a sequence of blows –probably direct percussion– made by a sharp object.

There is one fragment where the hole seems to have been started but left unfinished, as it does not perforate the shell completely, leaving the external surface of the shell intact. The one sample of *Mitra cornicula* –a fragmented specimen with signs of thermoalteration– has a perforation on the back of the last whorl (Fig. 18, n.º 7). The hole is regular in shape and ellipsoidal, with a rolled rounded fracture. This suggests that the perforation was of anthropic origin or resulted from the predatory activity of another gastropod –in the marine environment–. On the other hand, the evidence of rolling may be associated with marks of use, possibly as a pendant.

Similarly, there are two specimens of *Mytilus edulis* that bear signs of possible anthropic alteration. The first has four incisions on the external surface of one fragment. Because of its straight lines, which gives it a geometric shape, it does not seem to have resulted from bioerosion –such as that caused by *Meandropolydora* sp.–. Similarly,

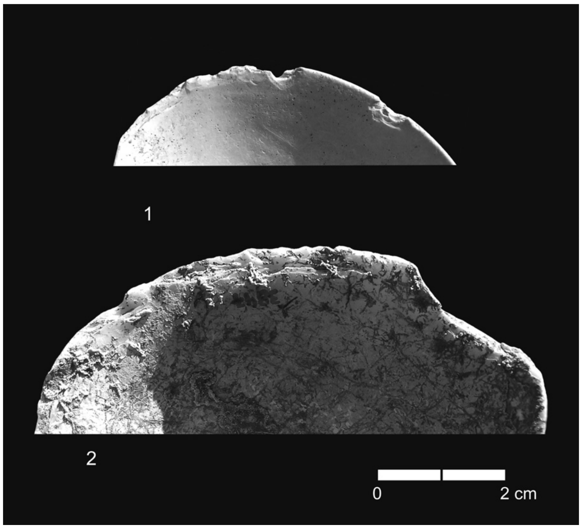

FIG. 21. *Detail of two valves of* Callista chione *showing continuous or discontinuous notches along the internal margin, used, possibly, as scrapers; each subdivision of the scale corresponds to 1 cm.*

the second specimen corresponds to a ventral fragment worn by possible abrasion, which has flattened the naturally convex surface of the shell. However, the small size of the fragment means that definite conclusions cannot be drawn about the origins of this alteration.

The species *Pecten maximus* is the one that reveals the greatest number of cases of transformation/use. The twelve fragments with polished margins (Fig. 18, n.º 8) indicate possible use as utensils –without prior alteration of the shell's natural shape–, as the polishing would have resulted from intensive use, resulting in the total rounding of this part of the shell.

However, the same cannot be said of the five other cases identified, in which the shell's original shape has been altered, resulting in five small plaques of indeterminate function (Fig. 18, n.º 12). These pieces were obtained by first shaping and then polishing the margins, giving it a rounded outline. There is a variety of shapes: 2 are sub-triangular –one of which is fragmented–, 1 rounded and another sub-rectangular –the shape is not clear as it is fragmented–. This group also contains a triangular-shaped piece that may not have been finished, as there are no signs of polishing on the margins, although the shell seems to have been worked to produce a particular shape.

Still with regard to the species *Pecten maximus*, one valve fragment was identified with perforation (Fig. 18, n.º 11). Semi-circular in shape –partially preserved, due to the subsequent fracturing of the fragment–, with irregular contours and no rounding, this orifice resulted from direct percussion, and has a maximum diameter of 8,39 mm. There are no signs of use. In addition, a ventral fragment was identified with two possible notches on the margin.

For the species *Ostrea edulis*, two specimens were recorded with possible anthropic alterations. The first concerns the polishing of the margin of a large right valve, perhaps as the result of being used as a tool. The other has a perforation on the umbo of a fragmented left valve. This perforation, which is approximately 9,84 mm in diameter and ellipsoidal in shape, with irregular contours, does not show signs of use but has fresh borders under the diagenetic concretions. It may well have been perforated in order to produce a pendant.

The *Laevicardium crassum* shell with signs of alteration (Fig. 18, n.º 9) corresponds to a fragmented left valve with evident signs of use on the ventral margin, probably the result of being used as a tool.

For the species *Callista chione*, two valves were identified with notches on the margin –made from the internal surface to the external–, of indeterminate function, maybe as scrapers (Fig. 18, n.º 10 and Fig. 21, n.º 1, 2). There was also a plaque-type fragment, sub-rectangular in shape (Fig. 18, n.º 13), with regular rounded contours, which might also have been produced in preparation for the making of a pendant; however, no perforation was made, suggesting that the piece is unfinished.

Finally, there is an umbonal fragment that is problematic. The shell has been so altered that it is impossible to identify the species, while signs of rounding in the area of the fracture and on the external surface raise doubts as to its origin. It is not possible to determine if this alteration resulted from powerful marine erosion or if it corresponds to anthropic transformation –i.e. the polishing of surfaces to produce a rounded piece of indeterminate function–.

Identification	**Weight (g)**	**% (g)**	**MNI**	**% MNI**	**NR**	**% NR**	**Tidal level**	**Substrate**
Haliotis sp.	1,55	0,003	0	0	1	0,01	infralittoral: lower intertidal/subtidal	rocky
Calliostoma conulus	1,72	0,003	1	0,01	1	0,01	infralittoral: lower intertidal/subtidal	rocky
Bittium sp.	0,01	0	1	0,01	1	0,01	mediolittoral: middle, lower intertidal/subtidal	rocky
Turritella communis	5,65	0,01	0	0	2	0,01	infralittoral: subtidal	muddy-sand
Littorina sp.	0,01	0	2	0,02	2	0,01	upper, middle, lower mediolittoral/subtidal	rocky
Semicassis saburon	177,91	0,29	13	0,11	17	0,1	infralittoral: subtidal	muddy-sand
Ranella olearium	19,67	0,03	1	0,01	1	0,01	circalittoral: subtidal	muddy
Charonia lampas	114,12	0,19	2	0,02	2	0,01	infralittoral: lower intertidal/subtidal	rocky
Charonia sp.	132,18	0,22	1	0,01	8	0,04	infralittoral: lower intertidal/subtidal	rocky
Nassarius reticulatus	8,25	0,01	4	0,03	4	0,02	mediolittoral: middle, lower intertidal/subtidal	muddy-sand
Talochlamys multistriatus	5,22	0,01	1	0,01	1	0,01	infralittoral: subtidal	muddy-sand
Cardiidae (Fam.)	7,68	0,01	1	0,01	1	0,01	mediolittoral: middle, lower intertidal/subtidal	muddy-sand/sandy
Mactra glauca	31,72	0,05	4	0,03	4	0,02	infralittoral: lower intertidal/subtidal	sandy
Mactra sp.	14,62	0,02	4	0,03	4	0,02	infralittoral: lower intertidal/subtidal	sandy
Spisula elliptica	3,27	0,01	1	0,01	2	0,01	infralittoral: subtidal	muddy-sand
Lutraria sp.	43,73	0,07	1	0,01	9	0,05	infralittoral: lower intertidal/subtidal	muddy-sand
Mactridae (Fam.)	20,03	0,03	2	0,02	5	0,03	mediolittoral: middle, lower intertidal/subtidal	muddy-sand/sandy
Solen marginatus	6,72	0,01	4	0,03	25	0,14	mediolittoral: middle, lower intertidal/subtidal	muddy-sand
Tellinidae / Veneridae (Fam.)	4,12	0,01	0	0	1	0,01	mediolittoral: middle, lower intertidal/subtidal	muddy-sand/sandy
Venus casina	9,11	0,02	0	0	1	0,01	infralittoral: subtidal	muddy-sand
Venus verrucosa	37,71	0,06	2	0,02	2	0,01	infralittoral: lower intertidal/subtidal	sandy
Dosinia exoleta	19,78	0,03	2	0,02	2	0,01	infralittoral: lower intertidal/subtidal	muddy-sand
Pholas dactylus	0,46	0	0	0	1	0,01	mediolittoral: middle, lower intertidal/subtidal	rocky
TOTAL	**665,24**		**47**		**97**			

▨	species with > MNI

FIG. 22. *Malacological species with low incidence in the collection.*

8.3. *Marine mollusc species with low incidence in the collection*

The remaining species from the marine biotope form a small group with a total mass of 665 g, 47 MNI and 97 NR, which means that it is residual in relation to the collection as a whole. However, within this, some species stand out with regards to MNI: *Semicassis saburon* (Bruguière, 1792), *Nassarius reticulatus* (Linnaeus, 1758), *Mactra glauca* (Born, 1778), *Mactra* sp. and *Solen marginatus* (Pulteney, 1799).

Semicassis saburon (Fig. 17, n.º 6) is a marine gastropod that lives at subtidal depths –rocky substrate or detrital areas of muddy sand–, inaccessible to man. Thus, the specimens identified must have been collected *post mortem*.

The species *Mactra glauca* and *Mactra* sp. can be gathered occasionally, as they are located on the lower level of the intertidal zone in sandy substrates. However, the fact that few individuals identified –4 MNI for each case– means that we cannot draw any firm conclusions about recollection processes, or even if they were intentionally obtained.

The same can be said of the bivalve *Solen marginatus* and the gastropod *Nassarius reticulateus* (Fig. 17, n.º 8). Both can be collected periodically, and although there is evidence that *Solen marginatus* was used for food, this is much less likely in the case of was usually perforated and used as an object of adornment. However, it is not possible to conclude from this small sample whether it was deliberately sought for the purpose of consumption.

For the species shown in Figure 22, it is difficult to suggest a reason for their presence, as the

Fragmentation type	Quant	%
Type 0	2251	15,99
Type 1	8457	60,08
Type 2	47	0,33
Type 3	77	0,55
Type 4	1214	8,62
Type 5	2031	14,43

FIG. 23. *Quantification and percentage of fragmentation types in the limpet group.*

small number of records may be due to the fact that the work at the excavation site was not done with sieve –reliance on specimens visible to macroscopic level limits the sample's representativity within the malacological spectrum–.

The few examples and small size of some of the species may also indicate cases of *malacofaune accompagnatrice* (Dupont, 2006); *acompanhadora ou acessória* (Dupont and Araújo, 2010: 56), i.e. species that were not collected intentionally but were brought along with other sea products. Although we cannot discount the possibility that some of these species were recollected for consumption, in most cases, their small number and the impossibility of recollecting them directly makes it more likely that these shells were acquired *post mortem*, selected for their physical –and aesthetic– characteristics, to be used for a purpose other than food.

8.4. Degree of fragmentation

The analysis of the general state of conservation of the collection also considered the degree of fragmentation of the best-represented species, i.e. those of the genus *Patella* –which accounts for 79.73% of the NR and 93.81% of the MNI of the whole collection–. There were also limpets of the species *Siphonaria pectinata*, with a predominance of Type 1 remains –i.e. shells where the apex and muscle scar were preserved but the margin was missing– followed by remains of Type 0 –complete shells– and, in order of numerical importance, Type 5 –debris–, as can be seen in Fig. 23. Thus, this group was in a good state of preservation.

When the distribution of fragmentation types is analysed by Squares (Fig. 24), high values were

	A1	A2	A3	A4	A5	A6	A7	A8	A9	B3	B4	B5
Type 0	102	118	325	575	87	207	319	404	38	63	13	0
Type 1	419	525	705	1624	527	798	1165	2075	150	354	92	23
Type 2	7	6	0	14	3	4	6	7	0	0	0	0
Type 3	3	5	2	3	4	7	17	31	2	2	1	0
Type 4	60	53	154	137	75	184	156	338	18	31	7	1
Type 5	35	0	321	478	78	178	250	458	2	181	35	15

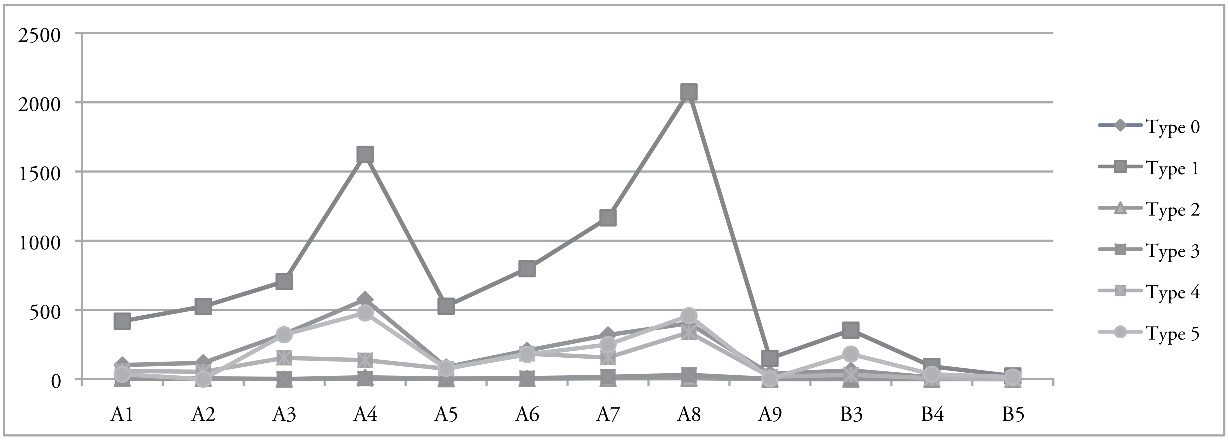

FIG. 24. *Distribution of limpet remains of each fragmentation type by squares.*

Type	0-20	%	20-40	%	40-60	%	60-80	%	80-100	%	100-120	%	120-140	%	140-160	%
Type 0	53	9,91	685	14,07	392	12,46	403	21,94	517	18,54	122	17,58	44	30,14	35	55,56
Type 1	416	77,76	3021	62,06	1979	62,93	1217	66,25	1399	50,16	316	45,53	83	56,85	26	41,27
Type 2	1	0,19	15	0,31	12	0,38	9	0,49	7	0,25	3	0,43	0	0	0	0
Type 3	2	0,37	34	0,7	27	0,86	6	0,33	4	0,14	4	0,58	0	0	0	0
Type 4	31	5,79	575	11,81	295	9,38	113	6,15	178	6,38	20	2,88	0	0	2	3,17
Type 5	32	5,98	538	11,05	440	13,99	89	4,84	684	24,52	229	33	19	13,01	0	0
TOTAL	**535**		**4868**		**3145**		**1837**		**2789**		**694**		**146**		**63**	

FIG. 25. *Distribution of the number of limpet remains of each fragmentation type by squares.*

found in Squares A4 and A8, with a direct ratio between the different types. There was linearity and low representativity of Types 2 and 3 remains, and a predominance of Type 1, in all Squares.

In the distribution of percentages per artificial level, there was a tendency for an inverse relationship between Types 1 and 0, in that the percentage of Type 0 diminished from the lower levels to the top, with more complete specimens found at the base of the stratigraphy. Type 1 –apical fragments with preserved muscle scars and no margins– were more prevalent at surface levels, decreasing lower down.

However, this relationship is not corroborated in the case of other fragmentation types. In fact, between Types 4 –ring fragments where less than half the border is preserved– and 5 –debris–, there is an inverse relationship, as Type 5 increases from top to bottom, to a depth of 120 cm, while Type 4 decreases.

Finally, it should be pointed out that more examples of Type 5 are found at levels 100-120 cm and 80-100 cm, proportional to Types 0 and 1, perhaps because there has been more time for decay.

If we compare these data with the fragmentation level of the bivalve that is best represented in the collection, *Mytilus edulis*, we find that the artificial levels 80-100 cm and 100-120 cm are those with the highest percentage of fragments (Fig. 26). On the other hand, most of the best-preserved remains are recorded at level 140-160 cm. The remains of *Pecten maximus* show a similar pattern, as there is a greater proportion of fragments at level 100-120 cm (Fig. 27).

This shows that artificial level 100-120 cm had the highest numbers of small fragments, raising the hypothesis that this might be because they are located on a level of anthropic occupation. The dynamic inherent in the use of a space, with all the daily routines and activities that this involves, may increase the degree of fragmentation of the remains –culminating, in some cases, in the trampling of these items–. This is a viable

Type	0-20	%	20-40	%	40-60	%	60-80	%	80-100	%	100-120	%	120-140	%	140-160	%
CV	0	0	5	1,85	3	2,27	6	4,14	0	0	0	0	0	0	0	0
FragV	0	0	5	1,85	5	3,79	8	5,52	10	2,11	0	0	0	0	1	50
UmbF	1	9,09	21	7,78	23	17,42	33	22,76	18	3,8	0	0	1	6,67	0	0
CardF	6	54,55	19	7,04	35	26,52	18	12,41	12	2,53	2	2,44	3	20	0	0
Frag	4	36,36	220	81,48	66	50	80	55,17	434	91,56	80	97,56	11	73,33	1	50
TOTAL	**11**		**270**		**132**		**145**		**474**		**82**		**15**		**2**	

CV= complete valve; FragV= fragmented valve; UmbF= umbonal fragment; CardF= cardinal fragment; Frag= fragment.

FIG. 26. *Distribution of the number of and percentage of remains of* Mytilus edulis *by artificial levels.*

Type	0-20	%	20-40	%	40-60	%	60-80	%	80-100	%	100-120	%	120-140	%	140-160	%
CV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FragV	2	1,63	2	0,79	2	1,05	1	0,88	2	2,04	0	0	0	0	0	0
UmbF	1	0,81	6	2,37	4	2,09	1	0,88	2	2,04	2	1,71	0	0	0	0
CardF	31	25,2	85	33,6	69	36,13	39	34,21	30	30,61	19	16,24	8	57,14	1	33,33
Frag	89	72,36	160	63,24	116	60,73	73	64,04	64	65,31	96	82,05	6	42,86	2	66,67
TOTAL	**123**		**253**		**191**		**114**		**98**		**117**		**14**		**3**	

CV= complete valve; FragV= fragmented valve; UmbF= umbonal fragment; CardF= cardinal fragment; Frag= fragment.

FIG. 27. *Distribution of the number and percentage of remains of* Pecten maximus *by artificial levels.*

hypothesis, given that no post-depositional taphonomic processes could be identified that could have distinguished the fragmentation index at the 100-120 cm level.

9. Conclusions

The malacological collection of Outeiro Redondo results from various archaeological interventions carried out between 2005 and 2008 under the supervision of the second-named author. There were some limitations to this approach. For example, it was impossible to define a clear stratigraphic sequence that reflected the rhythms of formation of the preserved contexts –i.e. the dynamics presiding over the formation of the archaeological deposits and their evolution to the present day–. As already mentioned, the distribution analysis was conducted by means of a Cartesian grid –2 x 2 m, with a numerical axis and an alphabetic axis, divided into artificial levels of 20 cm–.

Another constraint affecting the results has to do with the fact that the samples were collected in a macroscopic level –i.e. without sieving–, making it likely that some species would predominate over others. However, given the minimum size needed for a mollusc to have been of interest as food, we do not believe that there was a significant loss of information at this level.

There was a total of 17.901 malacological remains at the site (NR) and a minimum of 11,623 individuals (MNI), with a total weight of 60.535,85 g 38 *taxa* were identified, distributed between 16 species of marine bivalves, 17 species of marine gastropods and 5 species of continental terrestrial gastropods.

In this collection, concentrations –in terms of weight– occurred in Squares A4, A3 and A8. The genus *Patella* predominated in Squares A3, A4, A6, A7 and A8, while species such as *Stramonita haemastoma*, *Mytilus edulis*, *Pecten maximus*, *Laevicardium crassum*, *Acanthocardia* sp. and *Callista chione* had some expression, particularly between Squares A1 and A4 –they were merely residual in other division–. As regards distribution by artificial level, the highest values occurred in levels 20-40 cm and 80-100 cm.

Within the species of the genus *Patella* –93,81% of the quantified MNI–, the species *Patella intermedia* and *Patella ulyssiponensis* predominate, and the species *Patella rustica* and *Patella vulgata* are merely residual. As regards vertical distribution, the highest values were observed at levels 20-40 cm and 80-100 cm –the latter is directly related with a level of occupation, which is clearly shown to be important–. The biometric analysis, for its part, showed a direct correspondence between the intensity of exploitation of species *P. intermedia* and a decline in the average size of individuals collected. Thus, we can conclude that more investment was required to collect these molluscs as a result of anthropic pressure, which affected the average size by creating a scarcity of larger specimens.

Further evidence of the relationship between anthropic pressure and resource availability is the fact that the highest biometric averages are found at older levels; thus there was a tendency for sizes to reduce over time. There was also evidence that molluscs were being selected because of their size, with a preference for adult individuals of this genus.

When the degree of fragmentation of different species is analysed –comparing the data from the genus *Patella* with that of the species *Mytilus edulis* and *Pecten maximus*–, it was found that the artificial level 100-120 cm yielded higher values. This observation is consistent with the hypothesis that this level corresponds to the foundations of the occupation floor at depths of 80-100 cm, which –as mentioned above– coincides with one of the biggest concentrations of *Patella* shells, indicating intense human occupation.

In characterising the tidal levels at which gathering took place, we concluded that most examples corresponded to the mediolittoral zone, intertidal in nature, due to the fact that *Patella intermedia* develops at upper and middle levels of the mediolittoral zone, while *Patella ulyssiponensis* is located at the middle and lower levels of the same area.

Given the viability of direct access to these resources, it is likely that they were gathered on a daily basis. The acquisition of molluscs of this species indicates the exploitation of open coastal zones with rocky substrates, to which other species such as *Osilinus lineatus* and *Mytilus edulis* are also associated. These are also represented in this collection, though in smaller numbers.

As regards the exploitation of sandy and muddy-sand substrate zones through direct human access, the values presented are marginal compared to the situation described. In the case of mud beds, *Ruditapes decussatus* may have been collected regularly (from the medium and lower levels of the intertidal zone), though these remains account for only 0,27% of the NR. Of the sandy substrate, the species *Callista chione*, found on the lower level of the mediolittoral zone, is predominant –accounting for 2,11% of the NR–.

With regards to other non-rocky coastal environments, the question is raised of their proximity and accessibility to the archaeological site. *Ruditapes decussatus* and *Callista chione* may have been gathered from the sandy zone at Sesimbra; indeed, it is possible that the former was gathered from a seasonal estuary zone, where the stream –that now flows underground sear Sesimbra– entered the sea.

In the case of *Callista chione*, there are doubts as to whether it would have contributed to the diet of these prehistoric people, but if it did, it could only have been accessed directly at exceptional moments of low tide.

As regards gathering techniques, molluscs attached to the substrate would have been extracted using a sharp instrument, as proved by the extraction marks identified on examples of the genus *Patella*. These marks suggest that the tools used were regular in shape with a thick cross-section, probably made of silex, and indeed awls corresponding to this description are represented in the archaeological records.

Analyses were also done of the marks caused by transformation and/or use, and it was found that shells of the genus *Patella* seem to have been reused, as some examples were perforated. This suggests they were used as items of adornment, despite the fact that they were extremely abundant and bore no signs of use, nor had any characteristics that distinguished them from the other remains that were rejected. Shells of the species *Mitra cornicula*, *Ostrea edulis* and *Pecten maximus* also had intentional perforations, probably for the same purpose.

Marks of use are visible on examples of *Pecten maximus and Laevicardium crassum*, suggesting they were used as utensils –probably scrapers–, without their original shape having been altered in any way. Other remains seem to have been shaped and polished, particularly in species *Pecten maximus* and *Callista chione.* Some notches were observed on the edges of *Pecten maximus* and *Callista chione*, and incision and abrasion on *Mytilus edulis*.

As far as we know today, it was not possible to collect molluscs directly from the subtidal zone –except perhaps by diving while holding one's breath–. However, it might have been done from boats, using tools such as wooden rakes. In fact, two large fragments of copper hooks have been found in this settlement, which indicates that this community engaged in line fishing, either from the beach or from boats. This might presuppose the existence of other equipment that has not survived. However, it is significant that it is the subtidal species that show the most signs of transformation and use, suggesting that they were acquired *post mortem*, probably in the beach.

Other species that are present in smaller numbers also seem to correspond to *post mortem* collection, particularly when they are rare or have features that make them aesthetically appealing, as is the case with *Semicassis saburon*.

In short, the fortified Chalcolithic settlement of Outeiro Redondo –which dates from periods of notable economic and social change, involving technological development and the consolidation of the agro-pastoral model– shows evidence of the systematic exploitation of marine resources. Shellfish played an important role in the diet of these people, characteristic of a large spectrum economy in which both fish and shellfish could have been consumed on a daily basis. A similar situation has been found in other sites more or less contemporary with Outeiro Redondo, such as Rotura (Setúbal), Ponta da Passadeira (Barreiro) and Possanco (Grândola). Indeed, in some cases, the consumption of shellfish was so significant that it resulted in the formation of shell levels, showing that these resources were fundamental and intensely exploited –sometimes on seasonal basis, as in Possanco– (Silva *et al.*, 1986).

Combing for molluscs may have varied in terms of intensity and periodicity, in accordance with subsistence needs, the time/distance ratio, and costs of exploitation and use. But other factors may also have played a role, such as the form of social and economic organization, the desire to acquire products from further afield, the persistence of food habits and traditions through different time frames, and the historical trajectory of each human community.

Malacofauna is not only valued as food, but also has a range of other uses and significances: some were clearly used as utensils in daily life, with or without transformation, while others acquired a symbolic, ritualistic, sacred or differentiating value, in funeral contexts and other spheres of daily life. Some will have had aesthetic characteristics and dimensions that gave them rarity value.

Finally, it should be emphasised that the findings at Outeiro Redondo should not be interpreted exclusively in the light of a theoretical model based on a linear form of ecological determinism, although this can explain some of the adaptations made by the human communities to better exploit the resources potentially available in their environment. For communities that are fully sedentary and consolidated from the economic point of view, practising agriculture and domesticating livestock –with full use of secondary products–, marine resources would have had a complementary role in the economy, within complex intra- or intercommunity social dynamics and modes of organization that transcend the simple rule of supply and demand.

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