SHELLS AT THE HELLENISTIC AND ROMAN *CETARIAE* OF PORTOPALO DI CAPO PASSERO (SYRACUSE, SICILY): FIRST EVIDENCE

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CONCHAS EN LAS *CETARIAE* HELENÍSTICAS Y ROMANAS DE PORTOPALO DI CAPO PASSERO (SIRACUSA, SICILIA): PRIMERAS EVIDENCIAS. Abordamos el estudio de los moluscos marinos recuperados en el yacimiento haliéutico de Portopalo di Capo Passero (Siracusa) durante la primera campaña de excavaciones (2019) en el marco del proyecto italo-español Archeofish. La muestra está formada por ocho especies de gasterópodos marinos (*Bolinus brandaris*, *Phorcus turbinatus*, *Patella caerulea*, *Patella ulyssiponensis*, *Hexaplex trunculus*, *Euthria cornea*, *Siphonaria pectinata* y *Cerithium vulgatum*), dos de bivalvos (*Cerastoderma glaucum* y *Donax trunculus*) y un decápodo (*Brachyura*).

Es una muestra discreta (102 NR y 90 NMI); su relevancia deriva en constituir los primeros datos arqueomalacológicos de una factoría de salazones helenístico-romana en Sicilia. Por especies, los patélidos son los que han mostrado unos valores más elevados, seguidos de *Phorcus* sp. y *Phorcus turbinatus*. La Fase II o romano-republicana (mediados del s. III – s. I a.C.) es la que presenta un mayor volumen de moluscos, mientras que en la de época tardorromana (Fase IV, ss. IV – V d.C.), el registro arqueomalacológico es limitado.

Se detecta una discreta presencia de conchas en comparación con otros recursos marinos, como los peces, especialmente los atunes. A pesar de ello, resulta interesante la presencia de moluscos en todos los niveles de ocupación documentados, con algunos cambios a lo largo del tiempo. Se detecta igualmente una prevalencia de lapas (*Patella* sp., *Patella caerulea* y *Patella ulyssiponensis*) y otros caracoles marinos (*Phorcus* sp. y *Phorcus turbinatus*), evidenciando prácticas de recolección de marisco, principalmente de especies que habitan en sustratos de roca, los cuales serían recolectados a mano.

Palabras clave: *Portus pachyni; cetariae; conchas; arqueomalacología; época helenística, romana y tardorromana; factorías de salazones.*

CONQUILLES A LES *CETARIAE* HEL·LENÍSTIQUES I ROMANES DE PORTOPALO DI CAPO PASSERO (SIRACUSA, SICÍLIA): PRIMERES EVIDÈNCIES. Abordem l'estudi dels mol·luscs marins recuperats en el jaciment halièutic de Portopalo di Capo Passero (Siracusa) durant la primera campanya d'excavacions (2019) en el marc del projecte italo-espanyol Archeofish. La mostra es formada per vuit espècies de gasteròpodes marins (*Bolinus brandaris, Phorcus turbinatus, Patella caerulea, Patella ulyssiponensis, Hexaplex trunculus, Euthria còrnia, Siphonaria pectinata* i *Cerithium vulgatum*), dues de bivalves (*Cerastoderma glaucum* i *Donax trunculus*) i un decàpode (*Brachyura*).

És una mostra discreta (102 NR i 90 NMI); seva rellevància es produeix per constituir les primeres dades arqueomalacològiques d'una factoria de salaons

hel·lenístic-romana a Sicília. Per espècies, els patèl·lids són els que han mostrat uns valors més elevats, seguits de *Phorcus* sp. i *Phorcus turbinatus*. La Fase II o romà-republicana (mitjan s. III – s. I aC) és la que presenta un major volum de mol·luscs, mentre que a la d'època tardoromana (Fase IV, s. IV – V dC), el registre arqueomalacològic és limitat.
Es detecta una discreta presència de conquilles en comparació amb altres recursos marins, com els peixos, especialment les tonyines. Tot i això, resulta interessant la presència de mol·luscs en tots els nivells d'ocupació documentats, amb alguns canvis al llarg de el temps. Es detecta igualment una prevalença de pegellides (*Patella* sp., *Patella caerulea* i *Patella ulyssiponensis*) i altres caragols marins (*Phorcus* sp. I *Phorcus turbinatus*), evidenciant pràctiques de recol·lecció de marisc, principalment d'espècies que habiten en substrats de roca, els quals serien recol·lectats a mà.
Paraules clau: *Portus pachyni*; *Cetariae*; Conquiles; Arqueomalacologia; Època hel·lenística, romana i tardoromana; Factories de salaons.

SHELLS AT THE HELLENISTIC AND ROMAN *CETARIAE* OF PORTOPALO DI CAPO PASSERO (SYRACUSE, SICILY): FIRST EVIDENCE. The present paper addresses the study of sea molluscs found in the halieutic site of Portopalo di Capo Passero (Syracuse) during the first excavation season (2019) undertaken in the framework of the Italian-Spanish project Archeofish. The sample comprises eight species of sea gastropods (*Bolinus brandaris*, *Phorcus turbinatus*, *Patella caerulea*, *Patella ulyssiponensis*, *Hexaplex trunculus*, *Euthria cornea*, *Siphonaria pectinata* and *Cerithium vulgatum*), two bivalves (*Cerastoderma glaucum* and *Donax trunculus*) and a decapod (*Brachyura*).
The sample is not especially large (102 NR and 90 MNI); its relevance derives from the fact that they are the first archaeo-malacological samples published from a Hellenistic-Roman salted fish factory in Sicily. By species, limpets are the most abundant, followed by *Phorcus* sp. and *Phorcus turbinatus*. Most molluscs have been found in contexts dated to Phase II (Roman Republican period, mid-3rd to 1st century BC), whereas the amount of evidence dated to the Late Roman period (Phase IV; 4th – 5th century AD) is much more limited.
The number of shells is small compared with that of other marine resources, especially tuna. Molluscs are, however, present in all contexts, and some changes can be detected over time. There is a substantial number of limpets (*Patella* sp., *Patella caerulea* and *Patella ulyssiponensis*) and sea snails (*Phorcus* sp. and *Phorcus turbinatus*), which suggests that shellfish was deliberately gathered, especially rock-dwelling species, which would be collected by hand.
Keywords: *Portus pachyni*; *Cetariae*; Shells; Archaeomalacology; Hellenistic period, Roman & Late Roman period; Salted fish factory

1. INTRODUCTION

Archaeofish, a joint two-year project undertaken by the Italian *Istituto di Scienze per il Patrimonio Culturale* del *Consiglio Nazionale delle Ricerche* and *Universidad de Cádiz*, aims to study Greco-Hellenistic and Roman fish-salting factories in Portopalo di Capo Passero and Vendicari, in the Sicilian province of Syracuse (figure 1). The first excavation season took place in September 2019 in Portopalo di Capo Passero, a well-known and published archaeological site whose date ranges between the Greco-Hellenistic period (5th-4th century BC) to the Late Roman period, without interruptions (Bacci, 1982-1983; Bacci 1984-1985; Basile 1992; Botte 2009, 86-88; Felici 2018, 119-122). The present paper addresses the hitherto unpublished shell and crustacean assemblage found in the site

during the first excavation season. The evidence collected allows us to make some inferences concerning the fish-salting process and the role played by molluscs within it.

Fig. 1. Location of the Portopalo and Vendicari fish-salting sites sites in the southeast of Sicily (A), and general aerial view of the Portopalo di Capo Passero *cetariae* during the archaeological activity of September 2019 (B).
Fig. 1. *Localización de los yacimientos haliéuticos de Portopalo y Vendicari en el sureste de Sicilia (A), y vista aérea general de las* cetariae *de Portopalo di Capo Passero durante la actividad arqueológica de septiembre de 2019 (B).*

Although our evidence is not too abundant, it presents us with the first opportunity to assess the role played my marine molluscs and crustaceans in the halieutic chaîne opératoire in southeast Sicily; the publication of the excavation of the *cetariae* of Portopalo in the 1980s and 1990s offers no information about the presence of marine invertebrates in these factories. References to sea resources in the context of Sicilian fish-salting factories are broad and generally limited to the decorative value of sea shells (Purpura, 1982, 57-58, note 1). More recent studies are beginning to pay more attention to these malacological resources, for instance with the publication of images of various bivalve and limpets specimens found in the fill of a 4th-3rd-century BC cistern in Contrada Niura de Noto, several kilometres from the coast, which suggests that these species were eaten during the Greek period (Lanteri and Fitula, 2019, 41, fig. 8). Most archaeo-malacological studies refer to prehistoric and, to a lesser extent, Greek contexts, but the information pertaining to the Roman and Late Roman period remains minimal (Di Salvo and Schimmenti, 2019). This is in spite of the abundant presence of sea species in iconographic sources, such as Greek coins – e.g. the famous crab of *Akragas* – and Greek pottery decoration – e.g. the Attic, south Italian and Sicilian fish dishes dated to the 4th and fist half of the 3rd century BC, which are so abundant in the southeast of the island, depicting fish, cephalopods, crustaceans and molluscs (Mollo, 2019, 155-158).

The aim of these pages is twofold. First, to emphasise the need to examine this evidence in coastal Greek, Hellenistic, Roman and Late Roman sites, and to make a first multidisciplinary assessment of the role played my molluscs in the fish-salting factories of Portopalo. We must not forget that this is the most important known fish-processing site in Sicily, because of its longevity (nearly a millennium, between the 5th century BC and the 5th century AD), its size (over 4 hectares) and the number of production structures identified (over 50 vats to date); as such, it is an ideal site to begin this new avenue of enquiry in Hellenistic and Roman Sicily.

2. MATERIALS AND METHODS

The excavation appied the widely followed stratigraphic method, and the evidence is presented according to the stratigraphic context in which they were found (S.U. – stratigraphic units).

When analysing mollusc remains from archaeological contexts we must be aware of the limitations of the material. These have chiefly to do with preservation (they may be eroded by microorganisms, de-calcified, broken, etc.) and the inherent fragility of the material, which can sometimes pose a challenge to their anatomical and taxonomic classification, ultimately affecting the representativeness of different species.

When collecting these remains during excavation, attention must be paid to taphonomic conditions, which often need to be recorded *in situ* by the excavator to avoid the loss of potentially vital information. Taphonomy examines the depositional and postdepositional processes that affect terrestrial fauna, including marine remains, from the moment of their burial (Claasen 1998; Gutiérrez 2009). In order to fully understand these variables, we need as wide a sample of taxa as possible (Estévez 2000). The archaeologists must judge where to carry out the sample, and how large this sample must be. Small clusters must be collected in full, as was done in Portopalo. Once in the laboratory, the samples must be carefully cleaned and identified; in our case, this process was carried out in the facilities provided by the Comune di Portopalo di Capo Passero. The material was analysed with reference to a basic bibliography (Lindner, 1983; Gofas *et al.,* 2012, Hayward *et al.,* 1998; Sabelli, 1980, to mention only the most significant titles) and a shared modern reference collection. In addition, the nomenclature was homogenised according to database CLEMAM (*Check list of European marine mollusca https://www.bodc. ac.uk/resources/inventories/edmed/report/4628/*), published by the National Natural History Museum, Paris.

Following this, the remains are analysed quantitatively (number of remains – NR – and minimum number of individuals – MNI). The estimation of these figures are based on a series of abundance indexes (NR and MNI per species). Concerning bivalves, the estimates are based on complete valves + valve fragments with hinge + hinge fragments (anterior or posterior, whichever are most abundant). For spiral-shaped gastropods, the indexes are based on complete individuals + fragmented individuals + apical-umbilical fragments; for non-spiral-shaped gastropods the formula is complete individuals + fragmented individuals + apical fragments (Gutiérrez, 2009). This multidisciplinary methodology allows us to approach collection and use patterns in each archaeological context.

In the case of Portopalo, all remains found were collected, cleaned, classified, counted and taphonomically characterised by context. In the 2019 season the remains were subject to a preliminary selection, which means that not all stratigraphic contexts are included in the present study.

3. RESULTS

The taxonomic distribution of marine invertebrates found in the site is as follows. In relation to marine bivalves, they stand out (figure 2):

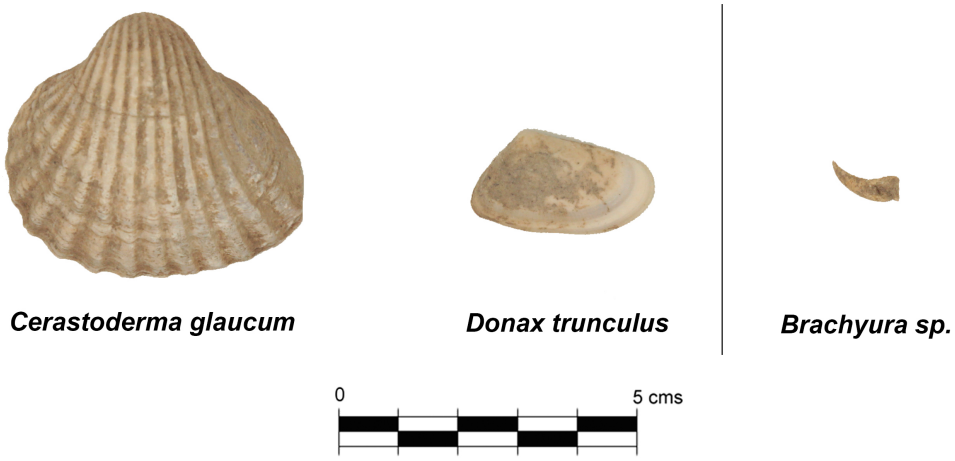

Fig 2. Marine bivalves and decapod documented in the *cetariae* of Portopalo (2019 campaign).
Fig 2. *Bivalvos marinos y decápodo documentados en las* cetariae *de Portopalo (campaña de 2019).*

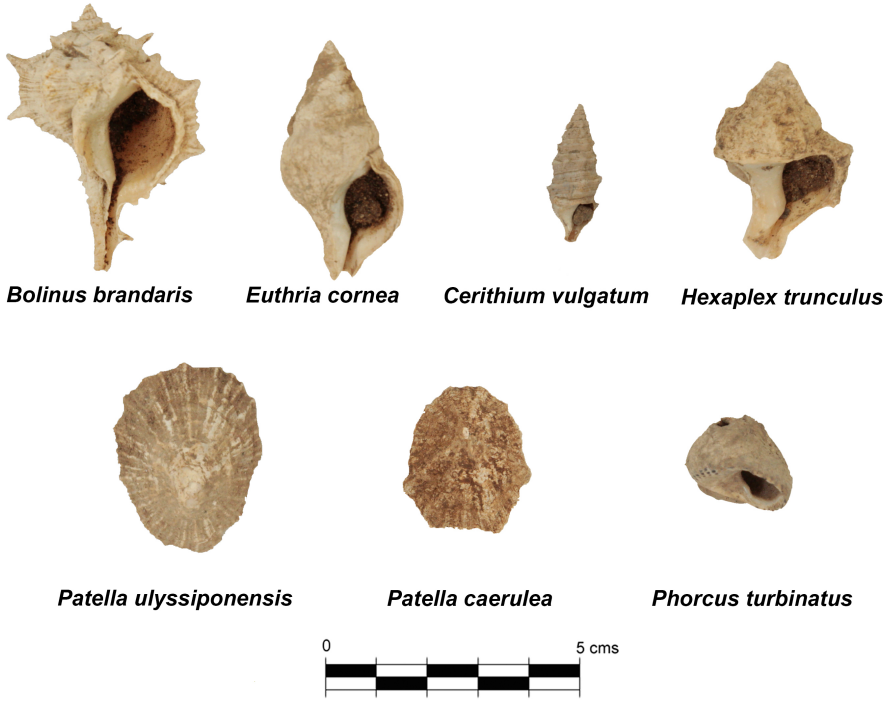

Fig. 3. Marine gastropods in Portopalo (2019 campaign).
Fig. 3. *Gasterópodos marinos documentados en Portopalo (campaña de 2019).*

Cerastoderma glaucum (Poiret, 1789). Bivalve of the Cardiidae family. It is a highly nutritious species. The shell is triangular, c. 2-3 cm long, with 22-28 radial ribs. It inhabits sandy and silty intertidal and infralitoral bottoms in the Atlantic and the Mediterranean.

Donax trunculus (Linné, 1758). Bivalve of the Donacidae family. Robust triangular elongated shell, c. 4 cm long. It lives in sandy intertidal bottoms, a few metres below the surface, in the Mediterranean, the Atlantic and the Black Sea, where they are particularly abundant.

The marine gastropod taxa identified are as follows (figure 3):

Bolinus brandaris (Linné, 1758) is a gastropod of the Muricidae family. Its shell can reach 7 cm long; it is globular in shape and presents spikes and a long siphonal canal. They are edible, but in Antiquity they were chiefly exploited for the glands used to make purple dye. They are common in Mediterranean sandy/silty intertidal areas in open coasts.

Cerithium vulgatum (Bruguière, 1792). Gastropod of the Cerethiidae family. It presents a robust spiral shell, approximately 7 cm long and 2-3 cm in diameter; the shell is made up small cordons, and the suture is not very pronounced. It lives in infralitoral rocky and sandy/silty areas in the Mediterranean and, more rarely, the Atlantic.

Euthria cornea (Linné, 1758). Gastropod of the Buccinidae family. The spiral shell is relatively robust, and it reaches up to 6 cm long. It lives in intertidal rocky bottoms, being common in both the Atlantic and the Mediterranean.

Hexaplex trunculus (Linné, 1758). Gastropod of the Muricidae family is approximately 8 cm long, and the shell is more compact, with serrated folds and a much shorter siphonal canal; not all specimens present spikes. As *Bolinus brandaris* is edible and quite appreciated in Antiquity by its purple dye production potential.

Patella caerulea (Linné, 1758). Gastropod of the Patellidae family. Flattish oval or pentagonal shell, with uneven radial ribs; the shell is between 2 and 6 cm long. It lives in rocky areas, up to a few metres deep, especially in the Mediterranean.

Patella ulyssiponensis (Gmelin, 1791). Gastropod of the Patellidae family. The shell is between 2 and 5 cm long, quite robust, ribbed and polygonal in shape; the anterior end is somewhat narrower than the posterior one. It lives in low intertidal areas, generally on exposed hard surfaces in the Black Sea, the Mediterranean and part of the Atlantic.

Phorcus turbinatus (Von Born, 1778). Gastropod of the Trochidae family. Despite its small size (3-4 cm in diameter) the spiral-shaped shell is quite robust. They highly appreciated for their flavour. It lives in intertidal, surf-exposed rocky areas in the Mediterranean.

Siphonaria pectinata (Linné, 1758). Gastropod of the Siphonariida*e* family. This species is easily mistaken with limpets. The shell is between 1 and 3 cm long, low and conical in shape. The exterior presents fine radial ribs, some of which are more pronounced. It lives in rocky intertidal areas, from Portugal to the Canaries, and is also common in the Mediterranean.

Finally, in relation to crustaceans, it has been described:

Brachyura. Crabs are usually present in archaeological contexts with some frequency, with claws being documented in most cases. Its presence in this type of context denotes its collection, processing and consumption.

As illustrated by the table, which is ordered by phase (figure 4), the archaeo-malacological assemblage includes eight different species of gastropods, two of bivalves and one of decapods.

PORTOPALO ´19									
Area	**SU**	**Chronology**	**Species**	**NR**	**% NR**	**MNI**	**% MNI**	**NR**	**NMI**
1	1	**Phase V Modern (surface)**	*Bolinus brandaris*	1	0,98	1	1,11	7	7
			Phorcus turbinatus	1	0,98	1	1,11		
			Patella sp.	1	0,98	1	1,11		
	300		*Cerastoderma glaucum*	1	0,98	1	1,11		
	900		*Patella caerulea*	2	1,96	2	2,22		
			Patella sp.	1	0,98	1	1,11		
	100	**Phase II Roman – Republican (3rd-1st century BC)**	*Cerastoderma glaucum*	4	3,92	1	1,11	61	53
			Phorcus turbinatus	1	0,98	1	1,11		
			Patella sp.	6	5,88	5	5,55		
	101		*Hexaplex trunculus*	3	2,94	2	2,22		
			Phorcus turbinatus	3	2,94	2	2,22		
			Patella sp.	7	6,86	7	7,77		
	301		*Cerastoderma glaucum*	1	0,98	1	1,11		
			Donax trunculus	1	0,98	1	1,11		
			Phorcus turbinatus	4	3,92	3	3,33		
			Patella caerulea	2	1,96	2	2,22		
			Patella ullysiponensis	4	3,92	4	4,44		
			Patella sp.	10	9,80	10	10,00		
	302		*Brachyura* sp.	1	0,98	1	1,11		
			Cerastoderma glaucum	1	0,98	1	1,11		
			Phorcus turbinatus	3	2,94	3	3,33		
	704		*Patella* sp.	5	4,90	5	5,55		
			Phorcus turbinatus	3	2,94	2	2,22		
			Cerastoderma glaucum	1	0,98	1	1,11		
	705		*Patella* sp.	1	0,98	1	1,11		
	102	**Phase I Greco-Hellenistic (5th- 3rd century BC)**	*Brachyura* sp.	1	0,98	1	1,11	9	6
			Cerastoderma glaucum	2	1,96	1	1,11		
			Hexaplex trunculus	1	0,98	1	1,11		
			Patella sp.	1	0,98	1	1,11		
	104		*Cerastoderma glaucum*	1	0,98	1	1,11		
			Patella sp.	3	2,94	1	1,11		
2	401	**Phase V Modern (surface)**	*Siphonaria pectinata*	1	0,98	1	1,11	3	3
			Patella sp.	1	0,98	1	1,11		
	600		*Euthria cornea*	1	0,98	1	1,11		
	403	**Phase IV Late Roman (4th – 5th century AD)**	*Phorcus turbinatus*	1	0,98	1	1,11	21	20
			Phorcus sp.	2	1,96	2	2,22		
	409		*Phorcus turbinatus*	1	0,98	1	1,11		
			Bolinus brandaris	1	0,98	1	1,11		
			Euthria cornea	1	0,98	1	1,11		
			Patella sp.	5	4,90	4	4,44		
	410		*Cerastoderma glaucum*	1	0,98	1	1,11		
			Cerithium vulgatum	2	1,96	2	2,22		
			Bolinus brandaris	6	5,88	6	6,66		
			Euthria cornea	1	0,98	1	1,11		
	203	**Phase I Greco-Hellenistic (5th- 3rd century BC)**	*Patella* sp.	1	0,98	1	1,11	1	1
			TOTAL:	**102**	**100**	**90**	**100**	**102**	**90**

Fig. 4. Overall values of marine malacofauna and crustaceans documented during the first excavation season at Portopalo (2019).

Fig. 4. *Valores globales de los moluscos marinos y crustáceos de la primera campaña arqueológica de Portopalo (2019).*

A total of 102 remains, belonging to a minimum of 90 individuals (1.13 remains per individual) were found in the two excavation areas. This index indicates the good state of preservation of the remains. By species, limpets are the most abundant, with 50 remains

and a minimum of 46 individuals; this include 42 remains (41.17%) and a minimum of 38 individuals (42.22%) of *Patella* sp; 4 remains (3.92%) and 4 individuals (4.44%) each of *Patella caerulea* and *Patella ulyssiponensis*; and 19 remains (18.62%) of at least 16 individuals (17.77%) of *Phorcus* sp. and *Phorcus turbinatus*. A total of 12 remains (11.76%) from a minimum of 11 individuals, have been identified as members of the Muricidae family (*Bolinus brandaris* and *Hexaplex trunculus*) (12.22%). The remaining species were found in negligible numbers.

4. DISCUSSION

This first preliminary analysis of the archaeo-malacological assemblage from Portopalo di Capo Passero highlights the importance of this fish-processing facilities; in addition to approximately a hundred malacological remains, the excavation also yielded substantial structural and ichthyological evidence (mostly tuna remains).

The *cetariae* of Portopalo comprised a complex stratigraphic sequence, which has been divided into several phases: Phase I, Greco-Hellenistic (5^{th}-3^{rd} century BC); Phase II, Roman-Republican (mid-3^{rd}-1^{st} century BC); Phase III, Early Imperial (1^{st}-3^{rd} century AD); Phase IV, Late Roman (4^{th}-5^{th} century AD); Phase V, Modern. Marine remains were abundant in all periods (figures 5 and 6), except for the Early Imperial period (Phase III), few contexts of which have been excavated (in soundings 4 and 6 in Area AR-2).

Another characteristic of this assemblage is that a certain homogeneity is evidenced in relation to the species collected throughout the sequence, both in taxonomic variability and in the degree of quantification. Concerning the topsoil, which is recent in date, molluscs were present in three SUs in Area 1 (SU 1, 300 and 900) and two in Area 2 (SU 401 and 600). The malacological record includes *Patella* sp. (3 NR; 3 MNI), *Patella caerulea* (2 NR; 2 MNI), *Bolinus brandaris*, *Phorcus turbinatus*, *Cerastoderma glaucum*, *Siphonaria pectinata* and *Euthria cornea* (1 NR; 1 NMI each). Rather than representing current gathering and consumption patterns, these remains must be interpreted as relicts, which cannot be precisely dated (coming from the upper layers of trenches 3, 4, 6 & 9).

Concerning Phase IV (Late Roman period), malacological remains have only been found in Area AR-2, because Basile's old excavation of AR-1 led to the complete removal of the upper section of the sequence. The malacological assemblage comprises 21 remains from at least 20 individuals (figure 5). The following species are represented: *Bolinus brandaris* (7 NR; 7 MNI); *Patella* sp. (5 NR; 4 MNI), *Phorcus turbinatus* (2 NR; 2 MNI), *Phorcus* sp. (2 NR; 2 MNI); *Euthria cornea* (2 NR; 2 MNI); *Cerithium vulgatum* (2 NR; 2 MNI) and *Cerastoderma glaucum* (1 NR; 1 MNI). This amounts to 22.2% of the whole assemblage in terms of MNI, and 20.6% in terms of NR. These remains point to the exploitation of sea resources during Late Antiquity, and open interesting future avenues concerning the function of these shells, because it is uncertain whether the *cetariae* producing *salsamenta* and *garum* and the tuna traps of Portopalo were still in operation during this period (4^{th} and 5^{th} century AD). At any rate, the remains confirm that shellfish gathering was taking place in Late Antique Portopalo di Capo Passero, because these species need to be captured by hand, with the aid of metal lancets (especially the limpets); the fact that they were found in two different strata (SU 403 and 409) seems to rule out the possibility that they were caught in trawling nets; a similar example is found

in the multi-species shell midden excavated in *Carteia*, Bay of Algeciras, dated to the last quarter of the 4th century (375 – 400), in which these two species account for 20% of the whole assemblage (Bernal-Casasola *et alii* 2008, 221).

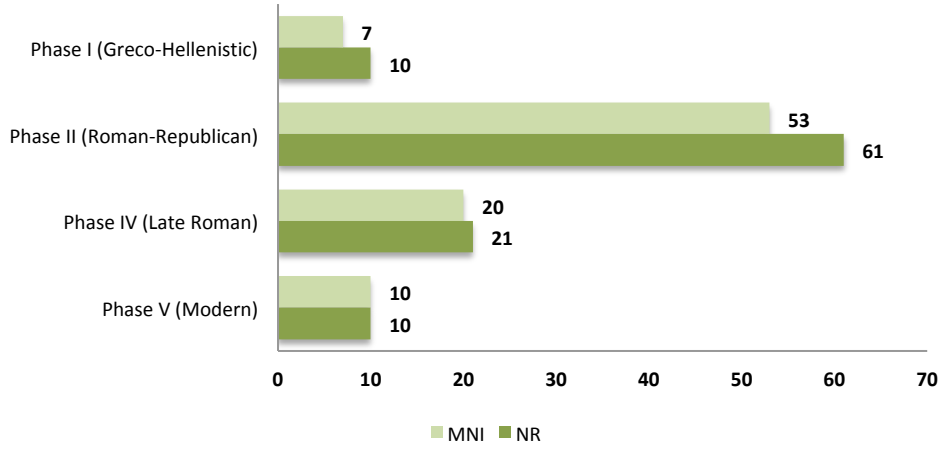

Fig. 5. Graph with the NF and MNI values of the malacofauna by occupation levels.
Fig. 5. *Gráfica con los valores de NR y NMI de la malacofauna por niveles de ocupación.*

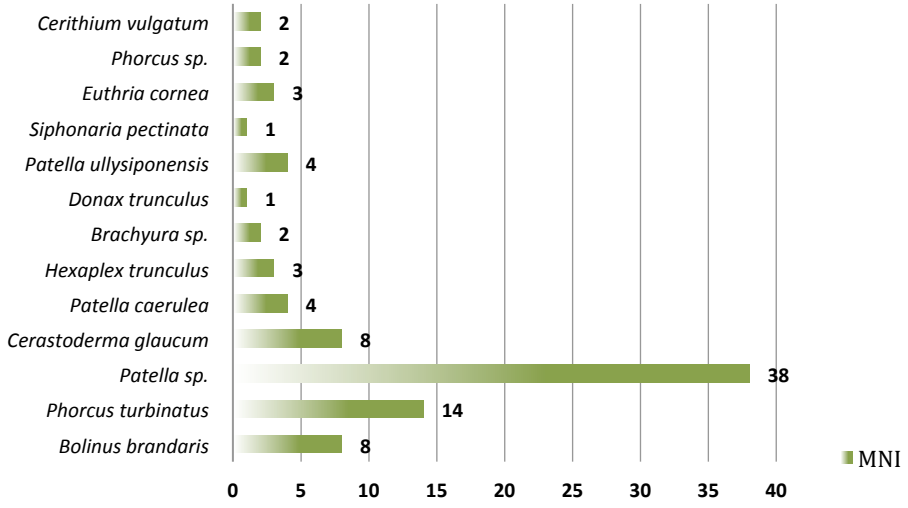

Fig. 6. Graphic representation of MNI by species in the archaeological site.
Fig. 6*. Representación gráfica de NMI por especies en el yacimiento.*

The so-called Phase II (Roman Republican, mid-3rd-1st century BC) is the one with the most malacological remains (61 from a minimum of 53 individuals), as illustrated in figure 5; this phase has been documented in Area 1, in the levels that overlay the top of the vats in Sounding 1 (SU 100, 101); and the top and middle interior fills of salting vat V-17 (SU

301, 302) and the mid-abandonment fills of vat V-1 (SU 704, 705), both of which are dated to 125-75 BC. In these layers, the most abundant species are *Patella* sp. (35 NR; 34 MNI); *Phorcus turbinatus* (14 NR; 11 MNI); *Cerastoderma glaucum* (7 NMI; 4 MNI); *Patella ullysiponensis* (4 NR; 4 MNI); *Hexaplex trunculus* (3 NR; 2 MNI); *Patella caerulea* (2 NR; 2 MNI); *Brachyura* sp. (1 NR; 1 MNI); and *Donax trunculus* (1 NR; 1 MNI).

Finally, the oldest horizon of the site, dated between the 5th and early 3rd century BC (Phase I), has yielded *Patella* sp. (5 NR; 3 MNI); *Cerastoderma glaucum* (3 NR; 2 MNI); *Hexaplex trunculus* (1 NR; 1 MNI); and *Brachyura* sp. (1 NR; 1 MNI). They come from the fills found inside salting vats V-7 (SU 102, 104) and V-33 (SU 203).

This preliminary study has attested the presence of mollusc shells and crustacean fragments among the marine remains found in fish-processing factories, although this presence is dwarfed by the volume of fish remains. At any rate, the fact that these remains were found in multiple contexts related to fish-processing activities seems significant (21 contexts, or 17 if sea snails, which are considered a later intrusion, are not taken into account). In ten out of these seventeen contexts (58.8%), the malacological remains are found in association with the refuse from tuna-butchering practices, so these ones may plausibly be associated with the chaîne opératoire involved in fish-processing; similar associations have been found in the *Fretum Gaditanum,* where some sites (especially *Gades*, *Carteia* and *Baelo Claudia*) have yielded clear evidence for the use of these resources in the preparation of fish preserves, including the presence of shell middens in *cetariae* – suggesting the de-shelling of hundreds of individuals for their meat (Bernal-Casasola, 2011) – and the results of biomolecular tests, which have allowed us to identify the production of oyster *garum* at *Baelo Claudia* (Garnier *et al.,* 2018). The evidence from Portopalo is still scarce, but this is an interesting future research avenue; the discovery of multiple mollusc shell remains inside salting vats is certainly an encouraging sign.

On the other hand, slightly different distribution patterns are attested in different periods. *Hexaplex trunculus* and *Donax trunculus* are more common in Roman Republican contexts, and *Bolinus brandaris*, *Euthria cornea* and *Cerithium vulgatum* are only attested in Late Roman contexts. However, as illustrated in figure 7, the distribution by species is generally quite even throughout the sequence, especially concerning the different species of limpets and some *taxa* of bivalves (*Cerastoderma glaucum*), which are attested in the Greco-Hellenistic, Roman Republican and Late Roman periods. Also significant is the presence of crabs (decapods: *Brachyura* sp.) between the 5th and 1st century BC, which suggests that they may have been added to the fish products prepared in Portopalo; these species are seldom found in fish-processing contexts.

The assemblage is predominantly constituted by limpets (*Patella* sp., *Patella caerulea* and *Patella ulyssiponensis*) and sea snails (*Phorcus* sp. y *Phorcus turbinatus*), which amount to 70% of the whole sample; this suggests that deliberate gathering practices were in operation, the most valued species being rock-dwelling species, which are collected by hand. Other taxa, such as various members of the Muricidae family and some bivalves, also seem to have been captured on purpose. The remaining taxa appear in negligible numbers, and their interpretation is less straightforward. Future excavation seasons will hopefully present a clearer picture.

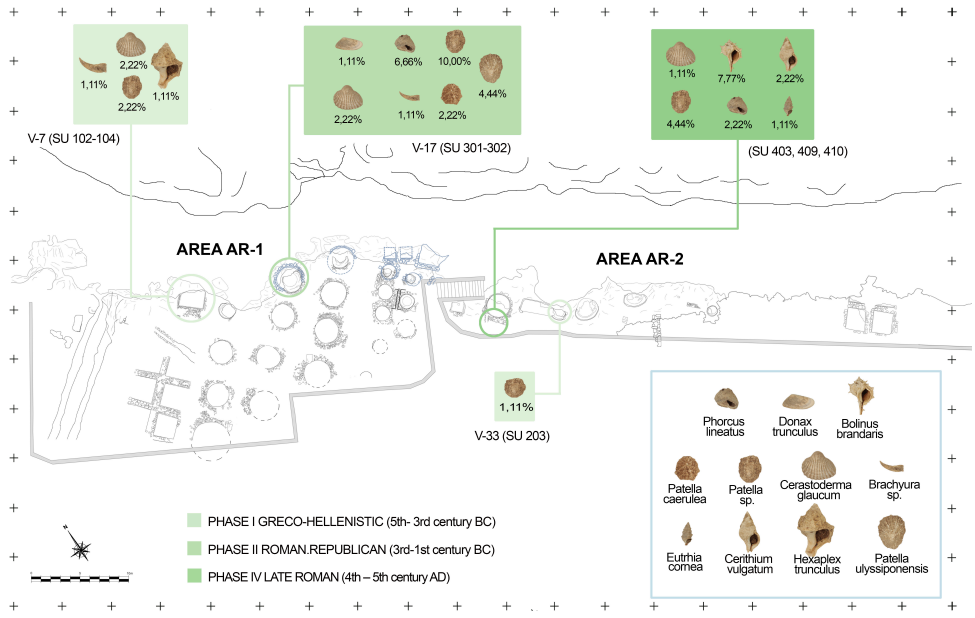

Fig. 7. Planimetry of the AR-1 and AR-2 areas with the location of the main marine invertebrates findings associated with archaeological structures (% in MNI).
Fig. 7. *Planimetría de las áreas AR-1 y AR-2 con la ubicación de los principales hallazgos de invertebrados marinos asociados a estructuras arqueológicas (% en NMI).*

Almost all the species documented in the site are edible, except *Euthria cornea* and *Cerithium vulgatum*, the presence of which may be the result of the use of trawling nets, used to capture other species, the presence of which at the site is abundantly attested, for instance tuna; the use of these nets is also suggested by the discovery of stone net weights in various contexts. Along with this, the documentation of crab pincers suggests the use of these species in the chaîne opératoire of fish processing.

Although the evidence is still scarce, it suggests that shellfish played an important role in the elaboration of fish preserves, probably *garum mixtum*, or to improve the flavour of fermented fish sauces.

The absence in the record of some species, such as mussels, should be investigated in the future. It has been argued that mussels were bottled in Sicilian Dressel 21-22 amphorae, whose *tituli picti* have been developed as *Mal(akoi)* or 'molluscs'; mussels were prominently depicted on the coins issued by the city of *Cumae* from the 5th century BC (Botte 2009, 150-152).

No shell middens were identified in the first excavation season. The preparation of purple dye has been attested in other Sicilian sites, for instance in the Punic contexts found in the islet of Motya (Reese 2005); this issue should be investigated in the future, since it seems reasonable for fish-processing factories to have also engaged in the preparation of these prestigious dyes, although the hard evidence in this regard in Portopalo is limited to date to the identification of a few isolated specimens of Muricidae,

namely *Hexaplex trunculus* and *Bolinus brandaris*, which were among the most highly valued species for the purple industry in the Atlantic and Mediterranean coasts.

The fish-processing structures found at the site, its location in a wide bay, and the archaeo-zoological evidence presented here are encouraging features, and it is to be expected that the site will yield abundant news about the exploitation and processing of marine resources in the Greco-Hellenistic and Roman periods; this activity did not cease with the end of Antiquity, but continued through the medieval and modern periods with the small *Tonnara di Portopalo* and the major *Tonnara di Capo Passero* (Salerno, 2009; Malandrino, 2018).

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