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Ancient marine resource exploitation in the coastal strip of *Cyrenaica*: Some evidence of fish-related industry in *Cyrenaica*?

Mohamed A Hesein

Introduction

The economic and productive activities of Roman *Cyrenaica* have received little attention in scholarship. Most of the information about manufactures and production is very restricted. Olive and wine presses, well known from other parts of North Africa, have not yet been fully documented or studied in this region¹. The most important work has been carried out at the ancient sites of *Euesperides* and *Berenice*, both of which lie beneath the modern city of Benghazi², revealing considerable information regarding the economic and trade activities of this part of *Cyrenaica*. However, almost nothing has hitherto been known about the level of coastal exploitation in the region and its economic role in *Cyrenaica*. Although some archaeological missions are working at a few coastal sites in this region, many questions regarding the economic and manufacturing roles of these sites have not been answered. Information about fish-related manufacturing and production is still very obscure. Until now only rare studies have examined the scale of exploitation of the marine resources in the region³ or the extent to which the *Cyrenaican* coastal inhabitants used the sea as a source of income. A survey carried out by the author in 2010 and 2012 has revealed new evidence of abundant archaeological remains scattered along the shore of *Cyrenaica*⁴, indicating intensive exploitation of

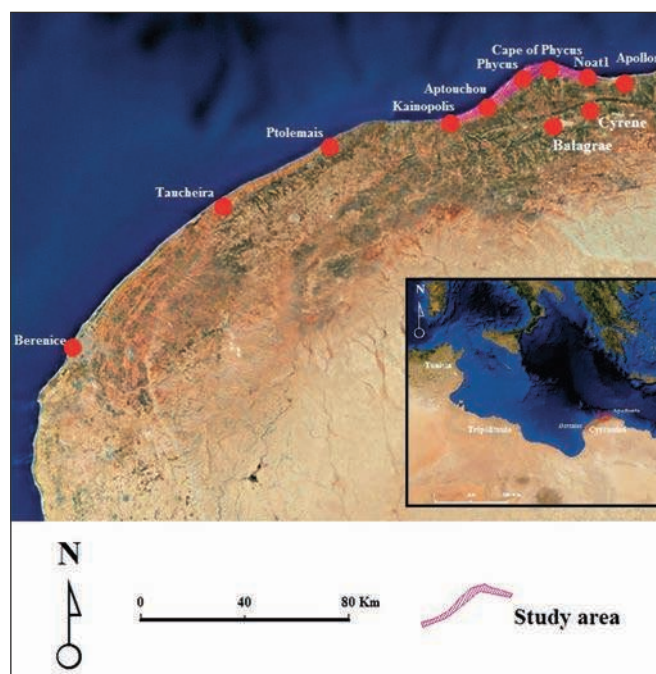


Fig. 1. The distribution of sites within the study area
(© Mohamed A Hesein).

marine resources. The purpose of this paper is to analyse the evidence to assess the likelihood of fish-related production activities in the area.

1. Area studied

The field survey documented six sites that were probably associated with the exploitation of marine resources. The sites are distributed within an area measuring 50 km west-east (**Fig. 1**) lying along the coastal strip of Al-Jabel Al-Akhdar (Green Mountain). Starting from the ancient site of *Kainopolis* (El-Agla), located about 35 km east of the ancient site of *Ptolemais* (Tolmeitha), to the area of Noatl, about 15 km to the west of *Apollonia* (Susa).

likely related to fish production. For more discussion and analytical studies of these remains, see my forthcoming PhD thesis (Hesein forthcoming).

I would like to express my greatest gratitude to Dr. Victoria Leitch for her continuous support and encouragement. I am grateful to Dr. Nick M. Ray and Dr. Matthew Hobson for their feedback and advice on the early draft of this paper. I am most grateful to Ahmed Emrage and David Davidson for sharing with me their research before publication. A special thanks to Professor David Mattingly, my PhD supervisor, for his useful and fruitful suggestions and guidance. Finally, I wish to thank my friend Ahmed El-Hayan for motivating and helping me during my field survey. Any errors or mistakes in the article are mine.

1. Wilson 2004; Buzaian 2009. Oil and wine presses in *Cyrenaica* are currently being surveyed and studied by Ahmed Buzaian.

2. Wilson *et al.* 1999; Lloyd 1977/1979.

3. Wilson, Megías 2008.

4. The data demonstrates in this article is a preliminary examination of some archaeological remains which seem to be more

2. The archaeological remains

2.1. Cape of Phycus (Al-Mamloh)

Al-Mamloh is an archaeological site that lies about 7 km east of *Phycus*. Here, a number of archaeological remains are preserved in an area covering more than 1 km², including remains of a fortification, a villa and an industrial complex. This latter structure lies 35 m from the sea and covers an area of 2000 m² (Fig. 2).

Large-scale excavation is needed to understand the function of the site, however, from the ground we can assume that the site comprised a rectangular structure surrounded by external walls. There is a well located 9 m in front of this structure which is still in use today.

The building consists of a set of tanks of different shapes and sizes, mainly rectangular, built of stone and lined with *opus signinum* (Fig. 2a). By tracing the foundations the following features can be identified:

Eight tanks (numbered from 1 to 8), which seem to vary in size and shape. Most are rectangular apart from tank 6 which has curved corners. The dimensions of the tanks are 2.80 × 2.40 m, 1.50 × 2.50 m, 1.60 × 2.40 m, 1.60 × 1.50 m, 1.60 × 1.40 m, 1.50 × 2.50 m, 1.20 × 1.30 m, 1.20 × 1.13 m and 1.00 × 0.70 m. Depths are uncertain.

Three basins can be only partly traced (9, 10 and 11). Although their shape and size cannot be accurately determined, it is probable that they were the same shape

as the basins next to them. For instance, basin 9 is more likely to be similar in shape to basins 1 and 2.

2.2. *Phycus* (Zawiet El-Hamama)

Phycus lies 25 km to the north-west of *Cyrene* and about 30 km west of *Apollonia*. The archaeological remains that appear to be related to fish production are located in two different areas (sites 1 and 2) within the ancient site of *Phycus* (Figs. 3, 3a and 3b).

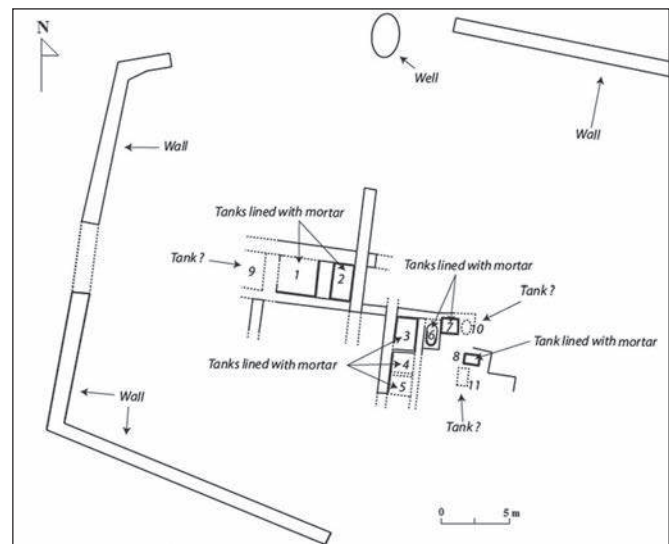


Fig. 2. The possible fish-processing site at cape of *Phycus* (Al-Mamloh) (© Mohamed A Hesein).



Fig. 2a. Detail of waterproofing in Vat 3, facing west (© Mohamed A Hesein).

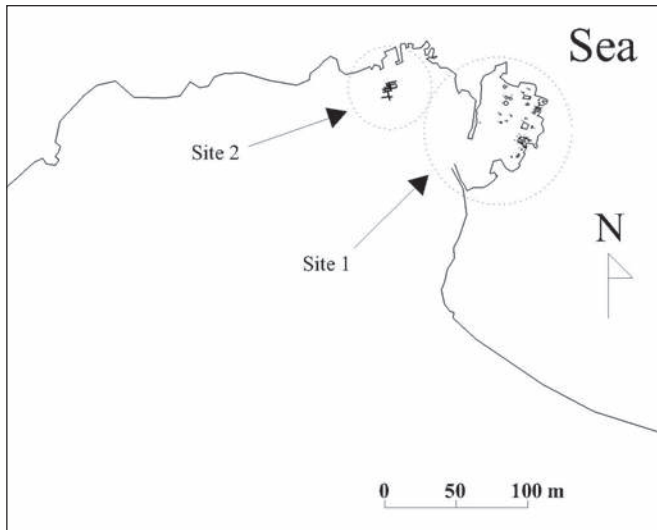


Fig. 3. Possible fish-related productions at the ancient site of *Phycus* (Zawiet El-Hamama) (© Mohamed A Hesein).

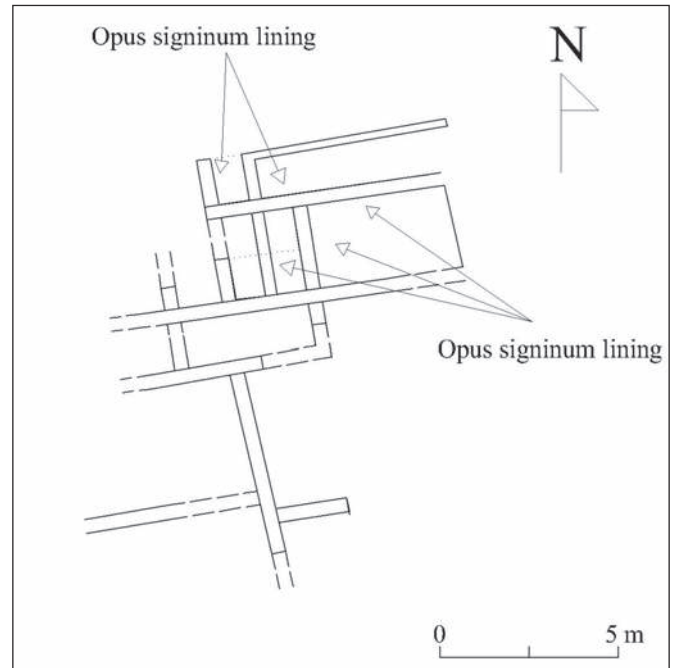


Fig. 3b. Initial plan for the site 2 (tanks?) at *Phycus* (Zawiet El-Hamama) (© Mohamed A Hesein).

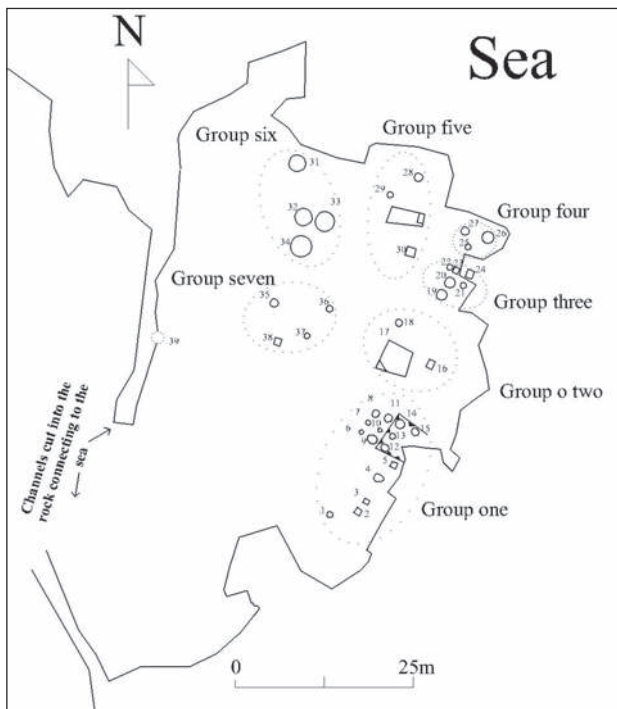


Fig. 3a. Distribution of tanks in site 1 at *Phycus* (Zawiet El-Hamama) (© Mohamed A Hesein).

Fig. 3c. Vat 2 within group 1, facing west (Photo: Mohamed A Hesein).

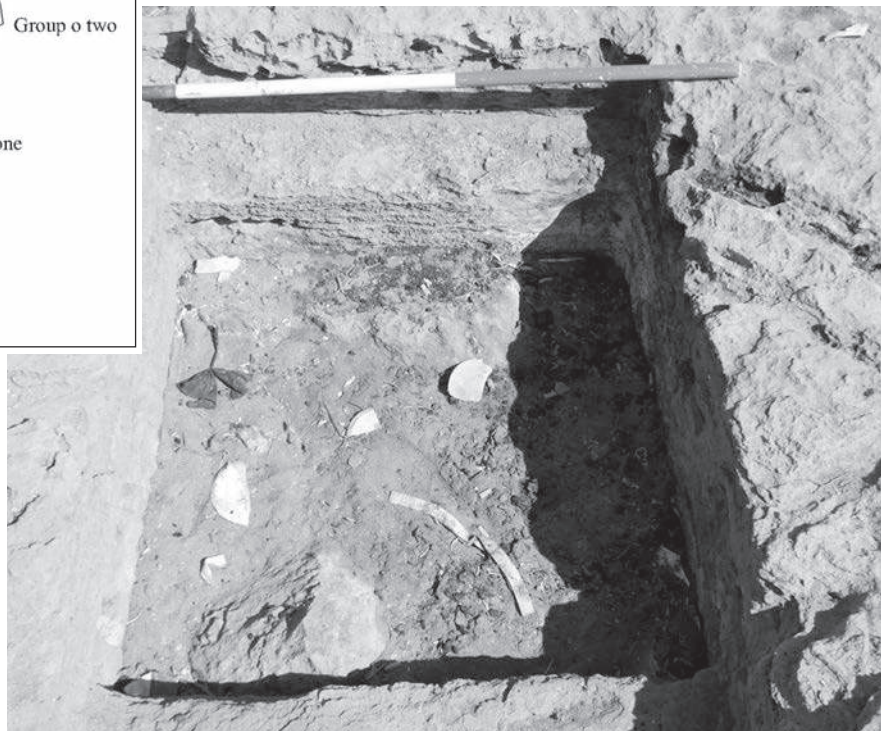




Fig. 3d. Side of group 3, looking south (© Mohamed A Hesein).

2.2.1. Site 1

The site lies on the eastern headland of the promontory. This zone contains more than 30 tanks or vats (**Fig. 3a**) distributed as seven groups in an area of 2000 m².

Group one

1 - A row of five vats cut into the rock vertically (Numbered from 1 to 5). Vat 2 (**Fig. 3c**) measures 1 m², while vats 3 and 5 are rectangular measuring 0.70 × 0.60 m and 0.90 × 0.95 m respectively. Vats 1 and 4 are bottle-shaped⁵, their opening diameters are 1 m and 1.4 m. The depth was not identified for this group because of the accumulation of soil that covered them. All vats are lined with waterproof plaster (*opus signinum*).

5. It is remarkable that the most of the vats recorded at site 1 at *Phycus* and sites 1 and 2 at Al-Hanya seem to be bottle-shaped, widening out below a narrow neck. In any case, the diameter that has been provided is the measurement of the opening mouth.

2 - A row of ten vats (numbered from 6 to 15) cut into the rock. All the vats are lined up three by three. The vats vary in size and shape, six having a round mouth (vats 6, 7, 8, 10, 11, 13, 14 and 15) measuring 0.80, 1, 0.75, 1.15, 0.75, 1.25, 1 and 1.5 m in diameter respectively and two are oval (vats 9 and 12) measuring 1.4 and 1.25 m. All the vats are lined with *opus signinum*. The first line of three vats (12, 13, 14 and 15) was built half a metre lower than the ground level of the others in the group.

Group two

This is a set of three vats (16, 17 and 18). Vats 16 and 17 are rectangular, measuring 1.20 × 0.95 m and 4.36 × 3.87 m respectively. Vat 18 is bottle-shaped with an opening diameter of 1.20 m. As with Group One, the three vats are lined with *opus signinum*.

Group three

This set of 6 vats (19, 20, 21, 22, 23 and 24) (**Fig. 3d**). is located 3.70 m north of Group Two. Vats 19, 20, 21 and 22 are bottle-shaped, with outlet diameters of 1.50,

1.40 and 1.20 m respectively. Vats 22 and 23 were interconnected measuring $(2.0 \times 3.0 \text{ m})$ and were faced with *opus signinum*. The eastern side of vats 21 and 22 facing the sea is completely destroyed by erosion, which allows us to estimate its depth as more than 1.5 m.

Group Four

To the north of Group Three is a set of three bottle-shaped vats (25 (**Fig. 3e**), 26 and 27). Vat 25 has been eroded by the sea, leaving its southern side visible in section. It has a circular opening measuring 0.85 m in diameter. It is about 2 m in depth with its cylindrical shaft lined with *opus signinum*. Vats 26 and 27 are located to the north of the previous one and are bottle-shaped, measuring 1.70 and 1.20 m respectively. Their depths have not been identified as they are full of soil. Both are lined with *opus signinum*.

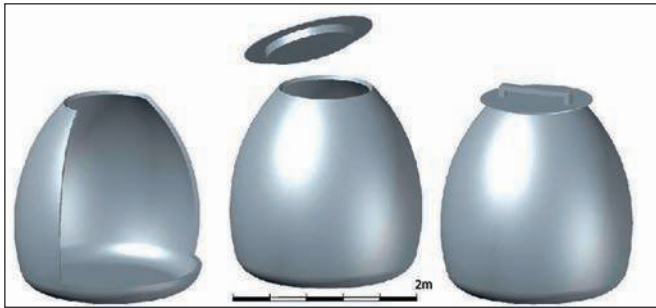


Fig. 3e. An imagined vat which is similar to the shape of vat 25 in *Phycus*, the total capacity of this vat is about 5.25 m^3 .

The lid shown in this image is just imaginary, and its shape does not rely upon archaeological evidence (© Mohamed A Hesein).

Group five

This group is a set of three vats (28, 29 and 30) of varying shape and size. Vats 28 and 29 are bottle-shaped with outlet diameters of 1.23 m and 0.89 m respectively. Vat 30 is rectangular measuring $1.30 \times 1.24 \text{ m}$. There is a rectangular cut in rock located between vat 28, 29 and 30 of unclear purpose. The depth of all these cannot be determined because they are full of soil, as for nearly all the vats at this site.

Group Six

This group is located to the northwest of Group Four and contains four vats (31, 32, 33 and 34). These are the largest bottle-shaped vats (**Fig. 3f**) at the site with opening diameters of 2.25 m, 2.48 m, 2.8 m and 3.1 m respectively, again with undetermined depths. All four vats are lined with *opus signinum*.



Fig. 3f. Vats 32, 33 and 34 within group 6, facing south-west (© Mohamed A Hesein).

Group seven

A set of four vats (35, 36, 37 and 38) of varying size and shape, located between 4 and 7 m apart. Vats 35, 36 and 37 are bottle-shaped with opening diameters of 1.2, 1 and 0.76 m respectively and are lined with *opus signinum*. The remaining vat (38) has a rectangular opening leading to a large rectangular tank measuring about $3.0 \times 2.0 \text{ m}$ with a depth of at least 2 m. The tank is lined with *opus signinum*. This tank most probably served as a water cistern.

There are two channels cut into the rock running from the sea into the site. One runs north to south and is about 2 m wide and about 1 m deep. The other runs from the southeast to the northwest and is about 2 m wide and 0.20 m deep.

2.2.2. Site 2

This site is located to the west of site 1. It is difficult at the moment to identify the whole plan of this site as it is covered by sand. Some of the visible remains indicate a complex building lying beneath the sand. The general impression is that it possessed a set of tanks or basins (?) of different sizes and shapes (mostly rectangular) built of stone and lined with *opus signinum* (**Fig. 3b**).

2.3. Aptouchou (Al-Haniya)

A number of vats were found along the shore of the ancient site of *Haniya*, 13 km west of *Phycus*. The vats can be divided into two groups according to their location (**Fig. 4**).

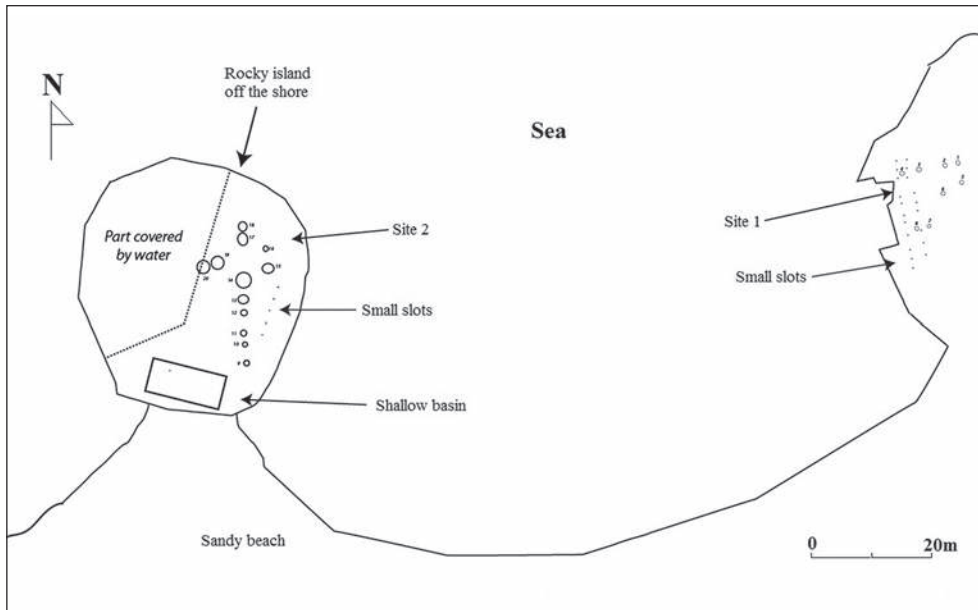


Fig. 4. Distribution of vats within site 1 and 2 at ancient *Aptouchou* (Al-Haniya) (© Mohamed A Hesein).



Fig. 4a. Vat 3 within site 1 at *Aptouchou* (Al-Haniya), facing south-east (© Mohamed A Hesein).

2.3.1. Site 1

A set of vats (numbered from 1 to 8) lies on the rocky area overlooking the sea. All the vats are cut into the rock and are circular with neck diameters of 0.90, 0.80, 0.90, 0.80, 0.80, 0.70, 0.70, and 0.80 m respectively with unidentified depths (**Fig. 4a**).

2.3.2. Site 2

This group occupies a small rocky island adjoining the shore, located 200 m to the west of site 1. The depth of the water around the island varies. For instance, on the shore side the water does not exceed 0.50 m in depth, whereas on the other sides, the water is 1.50 m to 2.50 m in depth. The island and site 1 serve to form a bay.



Fig. 4b. Vats 4, 5 and 6 within site 2 at *Aptouchou* (Al-Haniya), facing south (© Mohamed A Hesein).

Site 2 consists of 12 circular vats in a line (**Fig. 4b**), cut into the rock. These vats vary in size with their diameters being: 1.10, 0.85, 1.10, 1.150, 1.60, 2.80, 1.70, 0.90, 2.20, 1.70, 2.30 and 2.40 m. In both areas there are small slots cut into the rock 0.2 m in diameter. This might suggest that the vats were covered, and that the slots supported wooden columns holding some sort of roof. All of the vats in both areas are lined with *opus signinum*.

2.4. Kainopolis (Al-Agla)

Al-Agla lies 30 km north-west of *Phycus* and 35 km east of the ancient site of *Ptolemais*. As with other sites that have been found along this coast, there are a number of archaeological remains scattered around the site which might belong to fish-related production (**Fig. 5**).

A set of twelve vats lies in shallow water (numbered from 1 to 12), installed in four rows (**Fig. 5a**). Each row consists of three vats of 2 m diameter. Because they are covered by water and sand their depths cannot be identified and it is difficult to assess whether they are lined with *opus signinum*.

The second set of vats (numbers 13 and 14) is located 10 m to the south of the first set and consists of two circular vats built of small stones mixed with *opus signinum* and small ceramic fragments (**Fig. 5b**). The upper parts of the vats are eroded away. The bases have 2 m diameters. The remaining height of both vats does not exceed 0.20 m. They seem to be similar in size to vats recorded at the ancient sites of *Berenice* and *Taucheira*⁶.

The third set of vats comprises two vats (numbered 15 and 16) built of stones and lined with a thick layer of *opus signinum* to the south-west of vats 13 and 14. It is difficult at the moment to reconstruct the whole structure without excavation (**Fig. 5c**). However, on the ground it seems that they are rectangular, similar to one of the examples to the west.

A vat (number 17) built of stone and lined with a thick layer of *opus signinum* is located to the south-west of vat 16. Unlike the previous examples, this one takes a large circular shape with a diameter of 4 m.

It is worth mentioning that these vats or basins exist with other archaeological features within the building complex. Large-scale investigation and excavation is needed to get a more detailed picture of these sites.

3. Discussion

In evaluating the significance of the ancient fish-processing industry in *Cyrenaica*, two points should be considered. First, we must note the references made by ancient writers to the high demand for marine products in the Roman period, especially the growing demand for fish sauces such as *garum* and *liquamen*.⁷ Secondly, we need to assess if there was a growth in this industry over time at coastal sites with the construction of new sites or the development of pre-existing ones. Certainly the exploitation of marine products seems to have increased during the Roman period in this area.

3.1. Evidence from ancient texts

The ancient texts mention more than 25 sites along the coast of *Cyrenaica*⁸, of which my survey only covers a small number. Some pre-existing ports flourished and developed into independent cities. For example, *Apollonia*, the port of *Cyrene*, was established as a small harbour to serve the city, but grew considerably and became an independent city. The same scenario happened at *Barce* and its port (*Ptolemais*). These examples show that access to the sea went beyond the need for an easy means of transportation and indicate a growing interest in the active exploitation of marine resources. Additionally, *Cyrenaica* is not an isolated example, but displays a similar path of development noted at many sites around the Mediterranean.

Synesius (letter 148) describes villagers who live far south of *Cyrenaica*. He stated there were no urban agglomerations, roads or commercial areas in that region. Two important statements can be extracted. First, there was production and marketing of salt in the coastal region of *Cyrenaica*. As he said in the letter "the people here do not take to the sea, even for the purpose of getting their salt". Secondly, *Cyrenaican* people, at least who live near to the sea, were aware of the importance of the sea as a source of food, as he said "the people here refuse to believe that the sea too is able to nourish mankind".

3.2. The evidence from the archaeology – fish or other productions?

The intensive installations along the shore of *Cyrenaica* offer possible confirmation for the large-scale

6. Lloyd 1977; Buzaian 2000.

7. Trakadas 2004a; Curtis 1983; 1991.

8. Scylacis Caryandensis 108; Strabo Geography 20; Ptolemy Geography IV; Stadiasums Magni Maris; Synesius 170, 171.



Fig. 5. Google Earth imagery illustrating the distribution of remains at Kainopolis (Al-Agla).



Fig. 5a. Vats by the shore in Al-Agla, facing north (© Mohamed A Hesein).



Fig. 5b. Vat 13, facing west (© Mohamed A Hesein).



Fig. 5c. Vat 15, facing east (© Mohamed A Hesein).

exploitation of marine resources. The presence of a large variety of vats on, or a few metres from the sea requires us to consider the exact purpose of their construction. However, if we admit theoretically that the main purpose of these vats was to keep and preserve fresh water, then why would a site such as *Phycus* reserve an area for more than 35 vats cut into the rock? There are four wells (two of which are still in use today) a few hundred metres west of the promontory where the vats were cut. Why did they need these huge quantities of water? I think it is inaccurate to adopt the interpretation of fresh water storage.

Hypothetically, it is more practical to build one large cistern for keeping water instead of building 6, 9 or 12 aligned vats containing a low volume of water. Additionally, the deliberate arrangements of the vats indicate that the purpose was for an elaborate process and different types of products.

In addition, the water cistern that found in *Cyrenaica* had a different geometric arrangement. In a personal communication, Ahmed Emrage confirms that in his recent field survey in *Cyrenaica*, three types of water cistern have been identified. The first type has a narrow opening (**Fig. 6a**) leading to a huge water collecting square chamber; the depth of this type is up to 6 m. The second is a vaulted rectangular cistern containing one or two chambers (**Fig. 6b**), more than two in some cases, divided by an arched wall. This type of water cistern has been found in different areas in *Cyrenaica* such as *Ptolemais*.⁹ The third is a huge rectangular shape, with a roof sometimes supported by a column.

Presumably, some of the larger vats I have identified were for the collection and preservation of water. Such quantities suggest that there was an industrial process being carried out nearby which required a huge amount of water.

Another production process that can be rejected is purple dye manufacture. The possibility of such production is not compatible with rock-cut vats. As Andrew Wilson states "the production of purple dye required heating the shellfish, which could not be done in sunken vats".¹⁰ He confirms that the new evidence that comes from purple dye production sites at *Meninx* (Jerba) and *Euesperides* (Benghazi) suggests that this production did not need vats¹¹. Furthermore, the absence of remains of murex shells or burning remains at the sites described above supports this view. Indeed, these vats do not seem to have been intended for textile dyeing, leather tanning



Fig. 6a. Water cistern, type 1, facing north (from Emrage forthcoming).



Fig. 6b. Example of vaulted cistern that found in *Cyrenaica*, facing north (from Emrage forthcoming).

or rinsing. Such tanks would require the vat to be built above ground level with their bases at floor level¹².

Nevertheless, the absence of permanent elements such as oil presses around these installations excludes the possibility that these vats were for keeping olive oil products. Additionally, presses were mainly built in the hinterland of the main cities and not on the coast. This has also been confirmed by the recent archaeological field survey by Ahmed Buzaian¹³.

There remain two possible productions which might have carried out in these vats: wine fermentation and fish-related production. Wilson¹⁴ refers to a number of bottled-shaped vats which have a similar structure to

9. Kenrick 2013.

10. Wilson 2006, p. 527.

11. Wilson 2006; Wilson, Tébar Megías 2008.

12. Wilson 2003; Tébar Megías, Wilson 2008.

13. Buzaian 2012.

14. Wilson 2001.

those presented above. These vats have been recorded inside the circuit wall of some coastal cities, namely *Ptolemais*, *Taucheira*, *Berenice*¹⁵ and another set of five vats was located in the rocky area by the shore of *Apollonia*¹⁶. Wilson argues that such vats are more likely to be associated with wine production using a treading floor.

However, Wilson does not seem to demonstrate any concrete evidence for the existence of treading floors associated with those vats, except the one at *Taucheira* which he seems to be in some doubt about. He states that "since no olive pressing structures have been found nearby (such as orthostats, press beds or olive mills), I am inclined to believe that they were more likely to have been used for the fermentation of wine. This suggestion receives some support from the presence a little to the north, though not in strict demonstrable association with the vats, of a feature which I would identify as a wine treading floor"¹⁷.

Although I have some doubt about the presence of fish-related production within cities, as this would produce a strong and unpleasant smell during the process¹⁸, *garum* workshops have been found inside the ancient city of *Pompeii*¹⁹. Indeed, there is no sign of an associated treading floor near the vats mentioned by Wilson at *Apollonia*²⁰. Adding to that the occurrence of submerged *vivaria*²¹ 100 m to the north-east of these vats, it seems very likely that these vats could have been associated with fish-related production.

Looking at another example from *Apollonia*, work carried out by a French mission revealed a house containing six vats (with depths of 3.00 m) sunk into the ground, similar to those found at *Taucheira*²². Samples from the vats have been taken for chemical analysis; the first results did not show any evidence of fish processing in these vats. Subsequently, in personal communication, the French chemist who did the analysis confirmed to me that, after comparing the results from the *Apollonia* vats with those from other fish production sites around the Mediterranean, fish sauce might be present in the samples. If the new chemical evidence confirms that

fish products were in these vats, it strongly suggests that such vats inside the city walls could be involved, to some degree, in fish production.

However, square or rectangular area with drainage which might have connected to these vats does not seem to exist in my survey area. This excludes the hypothesis of an association with wine-treading vats such as the one found at the ancient site of *Balagrae*²³.

Also, it is a mistake to assume that wine was pressed inland and then brought in animal skins to the shore for storage in these vats while awaiting shipping. It is impractical on several grounds, not least the multiple transshipments of wine or olive oil, between pressing and shipping. Add to that, cutting one big vat in the ground instead of six is more beneficial for storing a single type of substance (as explained above for water). Additionally, it makes more sense to fill wine or olive oil directly from transport skins into amphorae and then to store them in a warehouse while waiting for shipping, marketing or local consumption.

The existence of these vats a few metres from the sea, and especially on the promontories and small islets seems to suggest the possibility that they could be used for fish-related products. Similar examples have been noted by the shore in *Ptolemais*. Many vats cut into the rock in the promontory have been recorded by Yorke and Davidson and have been initially interpreted as a fish factory²⁴. Supporting this view, are the large quantities of fish-related production sites that have been found along the shores of Mediterranean. Some of these industries were cut into the rocky areas.

Identical forms were found in different places along the coast of Tunisia. At the ancient site of *Gummi* (Mahdia), for example, 153 vats cut into the rock were found. They come in four main shapes: 64 circular (almost oval), 39 rectangular, 5 cylindrical and 1 square²⁵. This set of vats lie on a peninsula which overlooks the passage for seasonal fish migration. Such geometrical structures and shapes were found at other sites, such as *Thaenae*, *Sullectum*, Sidi Daoud and El-Mamoura in Tunisia and have been interpreted as *cetariae* for the fish industry²⁶. In Algeria, according to Yorke and Davidson, a number of circular fish vats cut into the rock were found in Tipasa and other rectangular fish tanks cut into the rock were found at the ancient site of Cherchel²⁷. In southern Spain and Morocco, as a third example, fish production

15. In terms of location, it should differentiate between vats located inside the circuit walls of cities (e.g. those mentioned by Wilson), and those along the shore (e.g. those identified by the author in the surveyed area, and those by the shore of *Ptolemais* mentioned by Yorke and Davidson).

16. Flemming 1972; Lloyd 1977; Buzaian 2000; Wilson 2001.

17. Wilson 2001, p. 32.

18. Curtis 1991.

19. Bernal *et al.* 2009.

20. Based on personal observation of these vats.

21. Flemming 1972.

22. Buzaian 2000; Wilson 2001.

23. *Balagrae* is an ancient city locating inland about 15 km to the west of *Cyrene* (see **Fig. 1**). Buzaian, Bentaher 2002/2006.

24. Yorke, Davidson forthcoming.

25. Ameer 2005.

26. *Id.*

27. Yorke, Davidson 1969.

tanks of different sizes and shapes were found cut into the rock (**Fig. 7**)²⁸.

Some of these features seem to have the same character as those found on the coast of *Cyrenaica*. Several fish vats (*cetariae*) were found along the coast between Santa Pola and Punta de L'Arenal cut into the rock in the promontory areas²⁹. Circular vats, for example, sunk into the ground were also found at the ancient site of *Baelo*. Furthermore, in Ceuta, there are large circular lined holes cut into the ground located within a fish installation.

It is worth mentioning that these types of features found in different fish production sites such as Calpe and Punta de L'Arenal have been interpreted as vats for producing fish sauces³⁰.

Elsewhere in the Mediterranean, on Crete, which faces the coast of *Cyrenaica*, rows of vats varying in size and cut into the rock were found at *Chersonesos* and *Siteia*. The vats served as *vivaria* for storing live fish during the migratory seasons, to be sold later in the markets rather than as breeding basins³¹. Similarly, several rock-cut tanks connected to the sea by channels were found in Tunisia, and were used for breeding or holding fish for salting³². These types of tank connected to the sea by channels were identified also in *Apollonia*³³ and other sites in *Cyrenaica*³⁴.

Producing fish sauces and other fish products does not require a specific shape or size of container³⁵. Manilius and Columella state that salted fish were placed in succession in large *cetariae* or ceramic containers³⁶. Supporting this idea, the *dolia* that have been found in the *garum* workshop at *Pompeii* suggest (**Fig. 8**) that they were used as containers for making *garum*³⁷. The circular shape is highly suggestive of an installation for making *garum* sauce, as such structures facilitate stirring, which is part of the process³⁸.

The second set of examples of what seem to be fish tanks comprise rectangular tanks set next to each other. These tanks were found in different locations in the surveyed area such as *Phycus*, Cape of *Phycus* and



Fig. 7. *Cetariae* cut into the rock at Praia de Angeiras (Trakadas 2004b, p. 59).



Fig. 8. *Dolia* that have been found in the *garum* workshop at *Pompeii* (© Mohamed A Hesein).

28. Trakadas 2004b.

29. *Id.*

30. *Id.*

31. Davaras 1974.

32. Slim *et al.* 2004.

33. Flemming 1972.

34. For further discussion of *vivaria*, see my forthcoming thesis.

35. Slim *et al.* 2007; Curtis 1983.

36. Manilius 5.656-81; Columella 12.55.4.

37. Bernal *et al.* 2009; Wilson 2006.

38. Trakadas 2004b.

Kainopolis. It is difficult to trace the whole structures as most of them are covered by sand or disturbed by human activities. Large-scale excavation is needed to obtain a comprehensive picture of the remains, their depth and their exact function. Generally, the structures are probably sets of tanks of different shapes and sizes mainly rectangular. They were built of brick and the interior walls were faced with *opus signinum*.

However, my preliminary interpretation, related to the size, shape and location a few metres from the sea, is that they were fish salting tanks. These tanks seem to have the same structural format to examples found in Sabratha and interpreted as salted fish tanks by Andrew Wilson³⁹ and those found along the coast of Tunisia⁴⁰. The square and rectangular tank shapes are probably the most common types for salted fish *cetariae* that have been found around the Mediterranean basin.

Conclusion

The rectangular and square vats scattered along the shore of *Cyrenaica* such as those at *Phycus* and Cape of *Phycus* might be attributed, with some confidence, to the production of salted fish. However, the neighbouring bottle-shaped vats should be interpreted with caution at the present time. Wine fermentation is one possibility, but *garum* production should not be discounted.

Large-scale excavation and chemical analyses are required to prove this idea conclusively and to provide evidence for what was carried out at these manufacturing sites. However, my interpretation is based on the comparison of vats of similar shapes and sizes along the coast of North Africa, and the location of these vats close to the sea. It seems likely that the function of these sites could be fish-related processing, with *garum* production being carried out in the bottle-shaped vats, and salted fish processing in the rectangular or square tanks.

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39. Wilson 1999.

40. Slim et al. 2004; Ben-Lazreg et al. 1995.

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