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SOMMAIRE

The Jetty with Platform: A Distinctive Port Structure from North Africa

David L. Stone*

Keywords: Africa Proconsularis*; port; jetty; economy; amphorae; architecture*

Abstract: *A distinctive type of artificial port structure has been found in* Africa Proconsularis*, but not elsewhere in the Mediterranean. This structure is identified here as a 'jetty with platform', due to its main components: a straight jetty extending from the shoreline and a large platform attached to the outer end of the jetty. The article considers the chronological, environmental, and technological factors that may be responsible for the construction of this type of jetty, which is found at* Acholla*,* Gigthis*,* Leptiminus*, Ras Segala, and possibly* Lepcis Magna. it may be an example of the type but cannot be confirmed on present evidence. The article then considers the geology of the east coast of Tunisia and the nature of shipping and port construction in the Roman-period Mediterranean. It argues that the shallow waters on the east coast of *Africa Proconsularis*, the expansion of commercial activity in Roman period, the spread of concrete technology, and the availability of local stone, all featured in the unusual design of these port structures.

Mots-clés : *Afrique Proconsulaire ; port ; jetée ; économie ; amphores ; architecture*

Résumé : *Un type particulier de port artificiel, inconnu en Méditerranée, a été trouvé en Afrique proconsulaire. Cette structure est identifiée ici comme une « jetée avec plate-forme » en raison de ses principales composantes : une jetée droite, partant du rivage, terminée par une grande plate-forme fixée à son extrémité extérieure. L'article examine les facteurs chronologiques, environnementaux et technologiques ayant pu influer sur la construction de ce type de jetée, présentes à* Acholla*,* Gigthis*,* Leptiminus*, Ras Segala, et peut-être* Leptis Magna.

Introduction

This article examines a distinctive type of port structure, five of which are present at four different towns in *Africa Proconsularis*. No examples are known from elsewhere in the Mediterranean. This article identifies these examples as a single architectural type for the first time, and refers to this type as a 'jetty with platform', because the basic plan of each structure combines two elements: a straight jetty extended from the shoreline, and a large platform attached to the outer end of the jetty. The aim of this paper is to assess the common features and purposes of 'jetties with platforms'. Why was a design combining a jetty with a platform utilized several times in *Africa Proconsularis*, when Mediterranean ports were commonly designed with straight jetties alone? What function did the platform – the unusual feature in this arrangement – serve? Were local building techniques responsible for the construction of this type of structure in this region? Or did local conditions somehow require this shape of harbor as opposed to a more common type? The article begins with a discussion of the structures and the locations at which they were found, including a 'possible' jetty with platform;

Detailed evidence for most ports in *Africa Proconsularis*, including the provinces of *Byzacena* and Tripolitania into which *Proconsularis* was subdivided under Diocletian, is limited, apart from what the excavations at Carthage and *Lepcis Magna* have provided[1]. The picture that can be derived from ancient textual sources is also imprecise[2]. From ancient texts it is thus impossible to determine, among other things, which harbors possessed built structures such as jetties and which did not. It is clear, however, that several ancient authors described North Africa as lacking in ports (*importuosum*). Those sources (chiefly, Sallust[3],

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1. For an overview of the ports of North Africa, from *Mauretania Tingitana* to Cyrenaica, see Stone 2014. For Carthage, see Hurst 1994, 2010. For *Lepcis Magna*, see Bartoccini 1958.

2. Leonard 1997.

3. Sall., *Iug.*, 17.5, "*mare saevum, importuosum*".

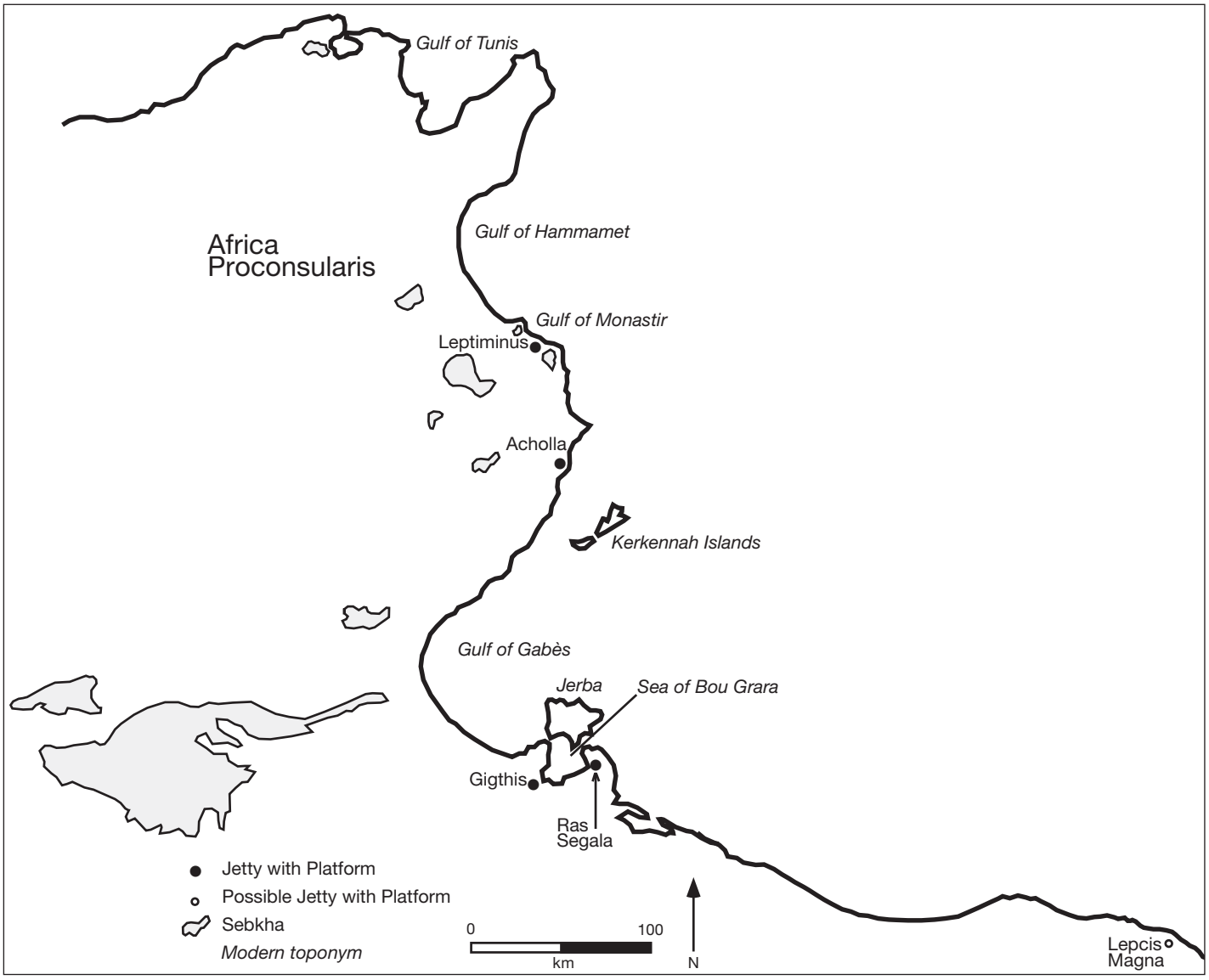


Fig. 1 : Locations of all jetties with platforms in *Africa Proconsularis*.

Pliny the Elder[4], Strabo[5], and Pomponius Mela[6]) wrote between 50 B.C. and 80 A.D. Although they may have provided a picture that was accurate at that time, many jetties in *Africa Proconsularis* were probably constructed between the 1st and 3rd c. A.D.[7]. Thus, the observations of these ancient sources quickly (to judge on a timescale relevant to modern scholars, anyway) became obsolete. Modern historians of the ancient economy, such as J. Rougé, have nonetheless followed ancient authors in downplaying the importance of African ports[8]. Some recent examinations of the evidence for North African ports have argued that these were more numerous and more important than is generally recognized[9]. The archaeological evidence in particular suggests that there was much greater connectivity, and far more artificial port structures, along the North African coastline. On this basis, it is now possible to reject thoroughly interpretations of the port facilities of the African coastline based mainly on literary sources. This article aligns with the recent archaeological examinations by pointing out how four (or possibly five) North African ports were designed to provide adequate docking facilities for ships at shallow-water ports in order to facilitate economic activity.

It is important to clarify the terminology in this article before considering individual structures, since some terms have multiple meanings, and the sense in which they have

4. Plin., *nat*., 5.

5. Str., 17.3.20.

6. Mela, 1.30-32.

7. See, for example, the evidence for dating the port structures at *Gigthis* and *Leptiminus* discussed above.

8. Rougé 1966, p. 133-134; 144-145.

9. The surveys of Yorke and Davidson in the 1960s and 1970s, though not fully published, contributed much new information (Yorke 1967; Yorke, Davidson 1985). Significant trade across the Syrtes in the Hellenistic period has also been noted (Quinn 2011). The importance of concrete technology in facilitating construction of African ports has also been mentioned (Wilson 2011a). My own analysis synthesized the evidence for artificial port structures between Cyrenaica and *Mauretania Tingitana* (Stone 2014).

Harbor	Jetty	Platform	Platform area	Wharf length§	References
Definite					
Acholla	230+	70 x 100	7000	560+	Slim *et alii* 2004, p. 138 and 242; Wilson 2011a, p. 51.
Gigthis	17 x 140	semicircle, diam. = 45	796	240	Slim *et alii* 2004, p. 105-106; Constans 1916, p. 70.
Leptiminus	10 x 370	80 x 100	8000	720	Davidson 1992; Leptiminus 3, 2011, p. 142-145; Slim *et alii* 2004, p. 154.
Ras Segala (S)	9 x 320	18 x 35	630	490	Slim *et alii* 2004, p. 103-105.
Ras Segala (N)	7 x 90	16 x 32*	512*	170	Slim *et alii* 2004, p. 103-105.
Possible					
Lepcis Magna (4th-6th c. only)	50 x 250?	50 x 100?	5000?	500?	Bartoccini 1958; Laronde 1988; Beltrame 2012.

Table 1. Jetties with platforms in *Africa Proconsularis*. Dimensions for jetty, platform, and wharf length are given in meters; dimensions for platform area are given in square meters. A + indicates that the structure continues but could not be measured any further, and a * indicates the number was ascertained via satellite imagery, not a previous publication. § Wharf length was calculated from the length of platforms and jetties (all sides). Only the outer half of the jetty was included in the calculation, since the location in shallow water may have meant that some of the jetty was unusable.

been used in the past has not always been clear. "Jetty" refers to an artificial structure that extended from the shore into the water, providing a landing pier and sheltering boats on its leeward side. "Platform" indicates a broad structure that terminates a jetty while expanding its width to maximize docking space in deep water. "Wharf length" refers to the total length along which boats may have docked so their cargoes could be loaded and unloaded[10]. The word "quay" refers to a mooring dock constructed on the shoreline. A "breakwater" is a wall that is not connected to the shore. Most ancient breakwaters were designed to reduce the force of waves before they reached the area where ships were docked in a harbor. The word "mole" does not appear in this article. In the scholarship on ancient harbors, it commonly refers to any artificial landing pier in the water, whether or not it is connected to the shore. Since "mole" can indicate a jetty which extended from the shore or an unconnected breakwater at which ships could dock, its meaning cannot always be precisely understood, and for this reason I have decided to avoid it.

Jetties with platforms

The harbors of *Leptiminus*, *Acholla*, and *Gigthis* all feature a jetty with platform. At Ras Segala, two separate examples of a jetty with platform have been found. *Lepcis Magna* is the location of a further possible, but not definite, example also discussed below (see fig. 1 for all sites). The measurements of each structure, the features associated with them, and important previous publications have been listed together (table 1). The visible remains of all of these structures have been previously planned and recorded. Excavations have not taken place at any jetties with platforms, including the possible one at *Lepcis Magna*, which was overlooked when Italian archaeologists excavated elsewhere at the port. The shape and size of each jetty were variable, ranging from approximately 100 to 500 m in length, and being approximately 10 m or more in width. The platforms also varied in size, from 500 to 8000 m^2. Five were rectangular in shape, forming either L or T shapes where they attached to jetties. One was semicircular. Plans of all of the structures have been presented at the same scale, for ease of comparison (fig. 2). It has been possible to add to some of the known measurements with satellite photography, and also to discover new features. Satellite pictures of the port structures, again at the same scale, can also be juxtaposed for comparison (fig. 3)[11].

Leptiminus (fig. 2, 3)

Discussion begins in the North with the structure at *Leptiminus*, which may have been the largest in this group. A recent study has mapped it, adding to our understanding of its plan and materials[12]. The jetty was c.370 m in length, and had a rectangular platform c.80 x 100 m (8000 m^2 in area). From the end of the jetty, the platform made a dog-leg turn to the west at an angle of 315 degrees. The total wharf space was approximately 720 m. A c.10 m-wide paved surface ran along its eastern, leeward, edge. The exterior walls of this surface were comprised of ashlar blocks of approximately 1.00 x 0.50 x 0.50 m in size. Between them lay a fill of mortared rubble. Since this paved surface was oriented at 20 degrees, as was the grid plan in this region of the city, it may have been a continuation of the road network laid out between the 1st and 3rd c. A.D.[13] A single line of ashlar blocks ran parallel to the jetty at a distance of 50 m

10. Wharf length was calculated by adding the length of the sides of jetties and platforms. Since the jetties with platforms considered in this paper were all located in shallow water, the entire length of the jetty may not have been sufficiently deep for docking. I included only the outer half of the jetty in the calculation in table 1. This arbitrary measure was necessary since it was impossible to gauge the depth alongside each of the jetties in antiquity, and therefore to discover the amount of the jetty along which vessels could have docked.

11. *Lepcis Magna* is not included in fig. 3 because its possible jetty with platforms is not visible in current satellite images.

12. Davidson 1992; Leptiminus 3, 2011, p. 142-145.

13. Leptiminus 3, 2011, p. 142-145.

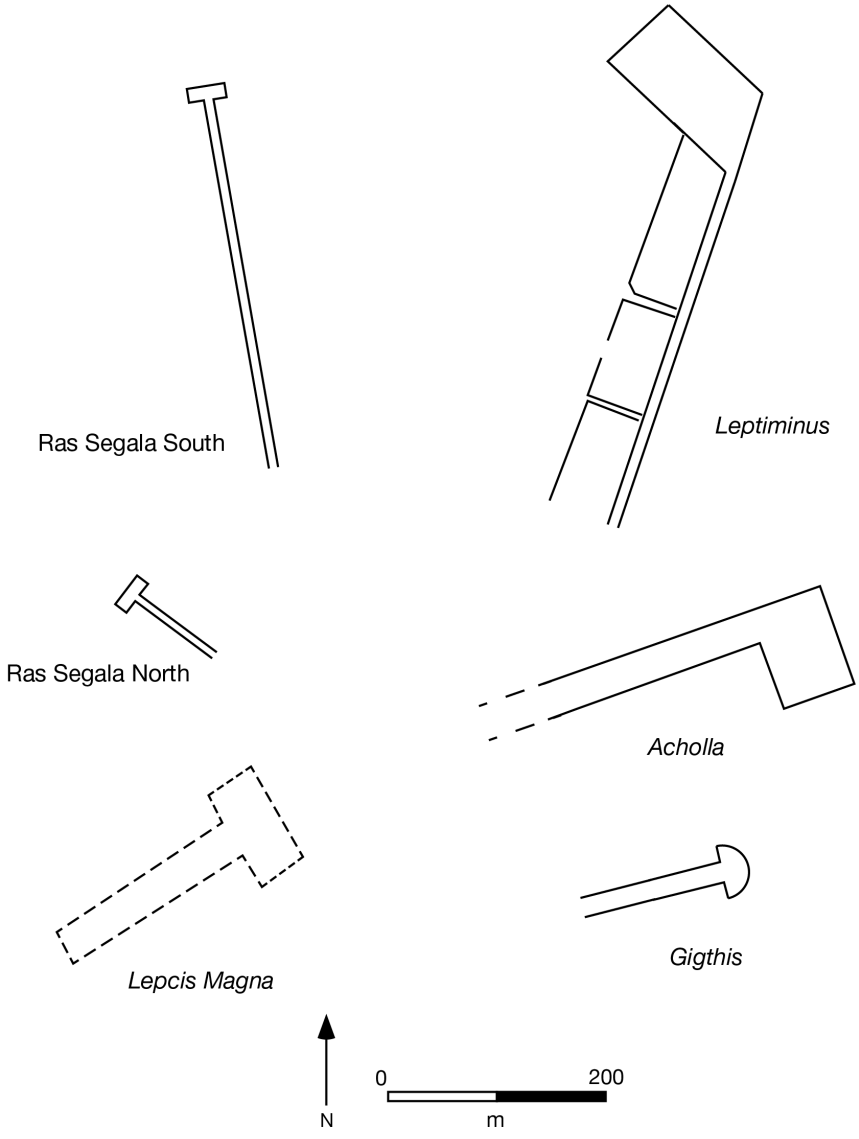
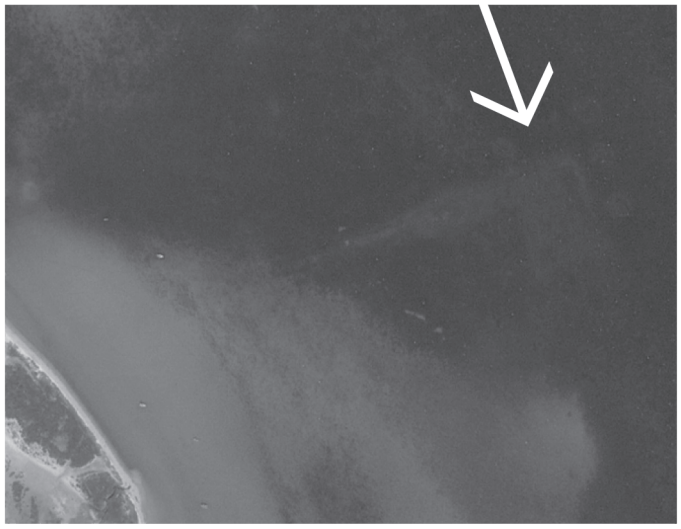


Fig. 2 : Plans of all jetties with platforms at the same scale.

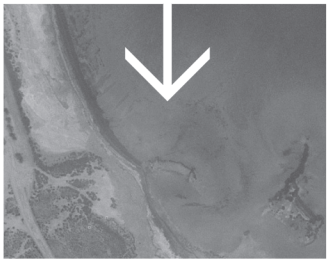
from it. In addition to this line, a series of perpendicular lines formed three rectangular compartments. D. Davidson suggested that these were tanks for raising fish, and this idea was repeated in later publications of the *Leptiminus* project[14]. But a reconsideration of the plan in comparison with those of other North African ports now leads the present author to regard the outer line of ashlars as more likely a breakwater that slowed waves before they reached the jetty. Cisterns and fish-salting vats were discovered in the vicinity of the base of the jetty[15].

Historical evidence regarding *Leptiminus* is as well or better preserved than any of the other ports discussed here, and the results of an archaeological project conducted in the 1990s and 2000s have enhanced our knowledge of the city[16]. The town advanced in status almost as rapidly as any other in Africa under Roman rule, and was promoted to *colonia* by Trajan[17]. Its rise was no doubt facilitated by investment in agricultural and productive facilities. The town had a number of pottery kilns and fish-salting vats, and it seems likely that its countryside was heavily involved in olive oil production[18]. The kilns produced the major oil, fish, and wine amphorae (Africana IA, IB, IIB, IIC, IID, Keay 61, Keay 62)[19]. Amphorae originating at *Leptiminus* and exported within the Roman Empire have been identified due to the presence of *LEP* (or a variant of these letters) in stamps[20].

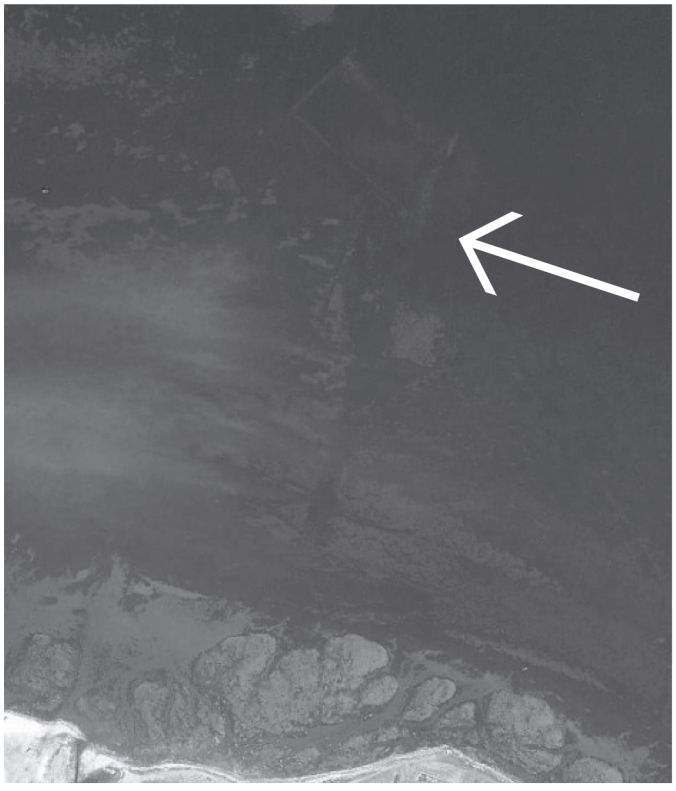
14. Davidson 1992, p. 172-174; Leptiminus 3, 2011, p. 142-145.
15. Leptiminus 3, 2011, p. 144-145.
16. Leptiminus 1, 1992; Leptiminus 2, 2001; Leptiminus 3, 2011.
17. Gascou 1972a.
18. Stone, Mattingly 2011.
19. Dore 2011.
20. Stone 2009.



Acholla

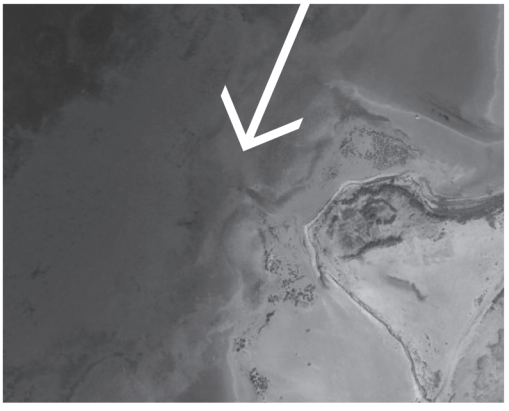


Gigthis



Leptiminus

Ras Segala South



Ras Segala North

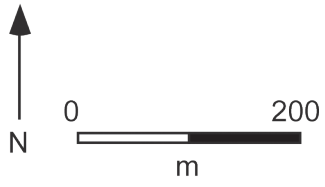


Fig. 3 : Jetties with platforms identifiable with satellite imagery at the same scale (the structure at *Lepcis Magna* is not identifiable with current satellite imagery).

Acholla (fig. 2, 3)

A jetty is located in the northernmost area of the city at *Acholla*. It extends at least 230 m in length, but may be even longer, as an indiscernible amount is covered with sand[21]. The size of the platform is c.70 x 100 m (7000 m^2 in area), and the total wharf space 560+ m. From the end of the jetty, oriented at an angle of 65 degrees, the platform made a dog-leg turn to the south at 155 degrees. The jetty was constructed with a mortared rubble interior that was faced with parallel lines of ashlar masonry[22].

Limited excavations focusing on houses and mosaics were carried out at *Acholla* from 1947 to 1956; the site has not otherwise been investigated in detail, but several types of material remains document its involvement in export production[23]. Perhaps most significantly, the countryside around *Acholla* was extensively centuriated. It belonged to the so-called "southeastern centuriation pattern" documented by A. Caillemer and R. Chevallier[24]. D. Mattingly has argued that the type of centuriation found here is consistent with olive cultivation[25]. Surface collections indicate that its major pottery products were the Africana I and II amphorae[26]. These forms are suggestive of olive oil, wine, and fish exports. Fish-salting vats have to date not been documented at *Acholla*.

Gigthis (fig. 2, 3)

The arrangement of the jetty at *Gigthis* is typical of the others in this group, at 17 x 140 m, but the disposition of the platform is not. Rather than a rectangle like the others, it is a semicircle, of 45 m in diameter (796 m^2 in area). The total wharf length equals 240 m. The jetty is oriented at an angle of 75 degrees. It consisted of a double alignment of white oolithic limestone blocks, which derived from the Rejiche formation[27]. A semicircular line of these blocks formed the platform. Over time, the action of the waves and salt has corroded all of these blocks. Previous studies have not mentioned the materials used in the interior of the jetty, though mortared rubble appears probable.

Gigthis was excavated in the early 20th century. Attention focused on the Forum and its temples, and much of the evidence dated from the mid-2nd c. A.D. At that time, one of its citizens, M. Servilius Draco Albucianus, successfully petitioned Antoninus Pius to grant the town the status of *municipium* with the *ius Latium maius*[28]. In his report on investigations at the site, L. Constans dated the port structure at *Gigthis* to the first half of 2nd c. A.D., on the basis of parallels between Corinthian capitals found on the jetty and those at Temple A and in the portico in the Forum of *Gigthis*[29]. More detailed examination would be desirable to test this association, as even if the column capitals in all three areas were identical, the installation of a colonnade along the jetty may not have been undertaken at the same time that the jetty was constructed.

Rather less consideration has been given to the economy of *Gigthis*. Olive and wine-pressing equipment has been discovered at three sites in the vicinity of *Gigthis*[30]. Murex production and fish-salting are both known nearby[31]. Evidence for local amphora production has not yet been discovered. From a broader regional perspective, however, *Gigthis* fits well into a pattern of harbor towns producing olive oil, wine, and fish-sauce for export. Kilns nearby at Guellala on Jerba produced African variants of Dressel 2/4 amphorae[32]. Meninx on Jerba possessed a jetty, whose length is unknown, as it has survived only in part[33]. Ras Segala, considered next, adds further evidence of nearby amphora production.

Ras Segala (fig. 2, 3)

There are not one, but two, jetties with platforms at Ras Segala. The distance between them is approximately 500 m. The southern (S) jetty is 9 m wide and 320 m long. Its platform is c.18 x 35 m in size (630 m^2 in area), and its total wharf space is 490 m. It extends from the shore at 347 degrees. The northern (N) is smaller, at 7 m wide and 90 m long. Its platform measures c.16 x 32 in size (512 m^2 in area). The total wharf space of the northern jetty is 170 m[34]. It extends from the shore at 309 degrees. Although both platforms are rectangular, like those of *Acholla* and *Leptiminus*, the shape of the jetties and platforms is different from those at the other towns. The platforms at Ras Segala form a T with the jetties, while elsewhere they make an L shape. The exterior walls of the southern jetty were composed of a line of ashlars made of Rejiche formation sandstone. The interior was filled with mortared rubble. The N jetty was constructed in a similar fashion. A large multi-chambered cistern has been identified at its base[35]. The existence of two jetties with platforms at Ras Segala is unusual.

21. Table 1 indicates a length of 230+ m for the jetty. Other estimates of its length are 350 and 500 m (Wilson 2011a, p. 51; Slim *et alii* 2004, p. 138).
22. Slim *et alii* 2004, p. 138.
23. The main published results include the study of mosaics from several houses (Gozlan 1992; Gozlan *et alii* 2001).
24. Caillemer, Chevallier 1957.
25. Mattingly 1996, p. 227-228.
26. Peacock, Bejaoui, Ben Lazreg 1990, p. 61-63.
27. Slim *et alii* 2004, p. 105.
28. Gascou 1972b, p. 138-142.
29. Constans 1916, p. 70.
30. Drine 1999.
31. Slim *et alii* 2004, p. 287-288.
32. Bonifay 2004, p. 29.
33. *Island* 2009, p. 153-159.
34. The measurements were drawn from Slim *et alii* 2004, p. 104 with the exception of those for the northern platform, which were estimated from the satellite photograph.
35. Cistern: Slim *et alii* 2004, p. 104, fig. 74.

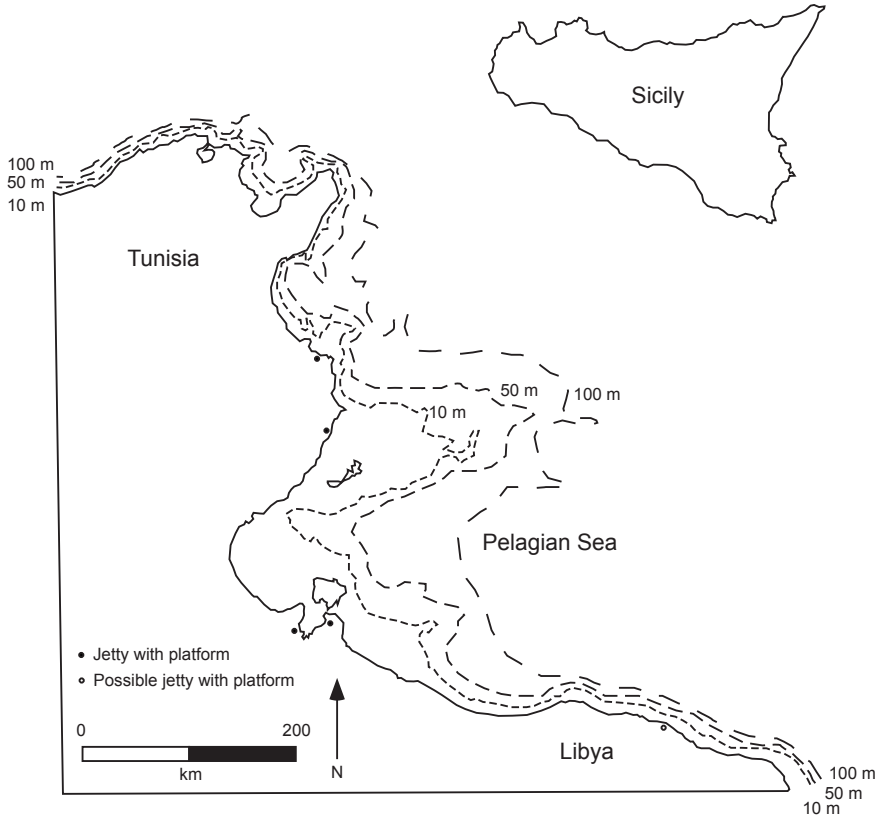


Fig. 4 : Bathymetric map of Mediterranean Sea off E. coast of Tunisia. The 10-, 50-, and 100-m isobathyic lines are shown. Locations of jetties with platforms are marked.

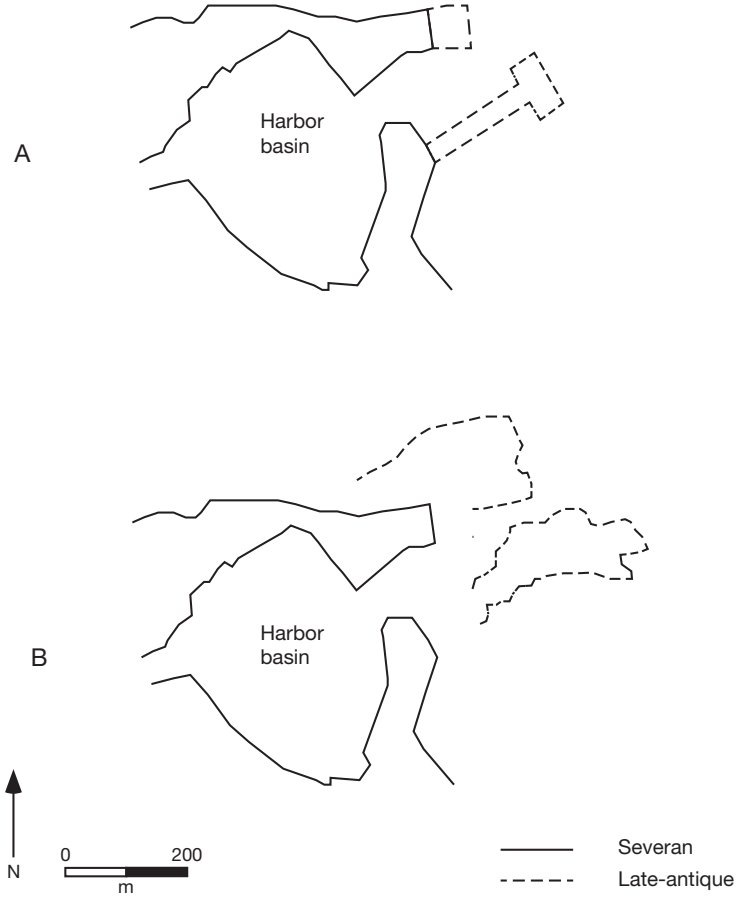


Fig. 5 : Two reconstructions of the late-antique harbor structures at *Lepcis Magna*. A: Laronde's reconstruction, showing a jetty with platform connected to the east side of the harbor (after Laronde 1988, p. 345). B: Beltrame's reconstruction, showing a linear arrangement of blocks connected to the east side of the harbor (after Beltrame 2012, p. 322).

It could be explained if the shorter N jetty ceased to function, perhaps due to siltation. The longer S jetty could have been constructed later, extending further into the Sea of Bou Grara. Since both platforms are similar in size, the explanation does not appear to be that a bigger platform was desired, but rather that a longer jetty was required.

The port structures at Ras Segala are somewhat unusual, in that no major ancient settlement has been identified in the immediate vicinity. The closest ancient town, *Zitha*, slightly less than 10 km to the east, appears to have been connected with them[36]. Surface collections at *Zitha* have yielded amphora wasters, enabling M. Bonifay to conclude that *Zitha* produced African variants of Dressel 2/4 (Schöne-Mau XXXV), as well as Tripolitana I and Tripolitana III amphorae[37]. The African Dressel 2/4 variants date from the 1st to the middle of the 2nd c. A.D. and probably contained wine. Tripolitana I and III amphorae appear to have carried olive oil, due to their presence at Monte Testaccio and to the absence of a pitch lining. The former dates from the 1st to the mid-2nd c., after which it was replaced by the latter which was produced until the early 4th c. Imitations of Africana I and IIA amphorae may also have been discovered[38]. Olive and/or wine-pressing equipment has recently been discovered at several sites on the Zarzis peninsula in the vicinity of Ras Segala and *Zitha*, though intensive surveys have not been carried out[39].

Lepcis Magna (fig. 2, 5)

A possible sixth example of a jetty with platform at *Lepcis Magna* has been studied and published twice, but the two drawings of its plan are contradictory. Since further examination is required to determine if it conforms to the type, I treat it as a possible example here.

The port at *Lepcis Magna* underwent several stages of construction[40]. It has been suggested that two quays and two temples were built in the first phase, which occurred in the middle of the 1st c. A.D. Sometime later, perhaps during the Hadrianic era, a dam was built across the wadi Lebda to divert sediments from the harbor area. The best-known and most monumental phase of construction took place during the reign of Septimius Severus (193-211 A.D.). At this time an enclosure-type harbor was built, consisting of four sides forming a closed space with a narrow entrance at the outermost point. Each of the four sides was wide enough to accommodate storage facilities and a road. A lighthouse was constructed at the entrance to the harbor, and three additional temples were erected within the harbor basin[41]. In the latest phase, between the 4th and 6th c. A.D., repairs and additions were made to the harbor structures after the dam across the wadi Lebda was broken, possibly in the 4th c. The sediments transported down the wadi led to a progressive siltation of the harbor basin, which filled between 550 and 650 A.D.[42] It is in the latest phase that a feature which may possibly be identified as a 'jetty with platform' was added to the artificial harbor at *Lepcis Magna*.

The possible jetty with platform appears in a plan of the harbor at *Lepcis Magna* published by A. Laronde, based on studies he carried out in the 1980s (fig. 5A)[43]. Laronde's plan in fact has two late-antique features connected to the outermost segments of the Severan harbor. According to Laronde, these were mentioned by early visitors to the site, but were overlooked by the site's excavators. The possible jetty with platform is connected to the East side of the Severan harbor. It has a T-shape consisting of a jetty c.200 m long and a platform c.50 x c.100 m (5000 m^2 in area). In appearance it is similar to the structures at Ras Segala. A second structure connected to the North side was a straight jetty that extended c.100 m[44]. Underwater studies carried out by Laronde showed that both of these structures were made of spolia, including grey granite columns and white marble capitals similar to those present in the Severan basilica[45]. He argued that these structures were utilized as docks for ships in the late-antique period, in opposition to the suggestion made by E. Salza Prina Ricotti that the port had silted shortly after construction during the reign of Septimius Severus and was not used again[46]. Laronde's plan has been reproduced subsequently by other archaeologists who have considered the harbor area of *Lepcis Magna*[47].

An investigation both of these additional harbor structures at *Lepcis Magna* conducted in 2009 has recently been published by C. Beltrame[48]. Beltrame's conclusions were largely different from Laronde's, although the two researchers did agree on a similar 4th-6th c. date for the structures. Beltrame claimed that the late-antique additions in the harbor had a different plan. Instead of a jetty with platform, his new plan shows a linear extension to the East side of the Severan harbor at an angle of c.60 degrees (fig. 5B)[49]. The dimensions proposed by both Laronde and Beltrame for

36. Slim *et alii* 2004, p. 105, have identified Ras Segala as the port of *Zitha*.
37. Bonifay 2004, p. 28-29; Bonifay *et alii* 2002-2003, p. 154-155.
38. Bonifay *et alii* 2010, p. 325-326.
39. Drine 1999.
40. Bartoccini 1958.
41. On the lighthouse and temples, see Tuck 2008, p. 335-339.
42. Beltrame 2012, p. 322.
43. Laronde 1988, p. 345.
44. Laronde 1988, p. 344-348.
45. Laronde 1988, p. 346.
46. Salza Prina Ricotti 1973, p. 95-101. Salza Prina Ricotti's view has largely been disregarded, but may still be found in the literature, however (cf. Giardina 2010, p. 53).
47. Mattingly 1995, p. 117. I thank David Mattingly for his suggestion that I consider the late-antique addition to the harbor as a possible jetty with platform.
48. Beltrame 2012, p. 320-325.
49. Beltrame 2012, p. 322.

this structure are comparable, 250 and 280 m. Beltrame's plan for the late-antique structure on the North side of the harbor is also different. Beltrame's plan shows a structure c.150 x c.200 m, much larger than the c.75 x c.100 m one in Laronde's plan. Beltrame also concluded that the late-antique additions did not function as docks because they were below the water surface in antiquity. According to Beltrame, "these 'structures' were a sort of breakwater, built between the 4th and the mid-6th c. to try to stop a build-up of sand in the harbor entrance in a period when the basin was, in part, already seriously compromised by silting from the wadi, but probably still in a condition to be used"[50].

At present, there is insufficient information to determine whether a jetty with platform was built at *Lepcis Magna*. Laronde's plan, or Beltrame's, or neither may be correct. Geomorphological testing of the extent of sea-level change since antiquity, through measurements, coring, and assessment of the coastline in the vicinity of *Lepcis Magna*, could determine when the Severan harbor filled with silt and became impossible to use. Additional examination of the plan of the late-antique structure connected the East side of the harbor would also be desirable to determine its shape and construction date.

Lepcis Magna was a major Libyphoenician center in the Punic period, and one of the most important cities of North Africa in antiquity in the Roman era, as well as the capital of the region (and later province) of Tripolitania. It was promoted to *municipium* between 74 and 77 A.D., and to *colonia* in 109[51]. The city possessed a full range of amenities, from baths, markets, fora, temples, a theater, an amphitheater, and a circus, that have been examined by many scholars during the last 100 years. From the 1st c. B.C. to 3rd c. A.D., *Lepcis Magna* exported olive oil and fish products from its large *territorium*, and probably served as a point of embarkation for slaves transported across the Sahara[52]. In late antiquity, at the time when a jetty with platform may have been built, the city's importance diminished. Building activity is attested until c.360 A.D., but the size of the city center was reduced in the 4th and 5th c. Far less is known about the city's products from the 4th to 6th c., although a survey of the countryside demonstrated a decline in settlement and economic activity from c.250 to c.450 A.D.[53]. It might be reasonable to suggest that the 4th-mid 6th c. additions to the harbor were made earlier rather than later. Nevertheless, the production of small amphorae, possibly for the export of olive oil, is attested in the 9th and 10th c. in the "Tempio Flavio" adjacent to the harbor. This activity implies greater continuity in the harbor area than has often been thought[54].

50. Beltrame 2012, p. 325.

51. See Gascou 1972b, p. 75-80; Mattingly 1995, p. 116-122.

52. Economy: Mattingly 1995, p. 138-159. Slaves: Braconi 2005. Evidence from *territorium*: Munzi *et alii* 2004-2005.

53. City center: Mattingly 1995, p. 181-185. Mid 3rd to mid 5th c. decline: Munzi *et alii* 2004-2005, p. 450-461.

54. Dolciotti 2007, p. 261-263.

Comparing the port towns of *Africa Proconsularis*

The four towns (*Acholla*, *Gigthis*, *Leptiminus*, and *Zitha*) at which the port structures were definitively built share several features[55]. They appear to have been settled, and then to have come under the control of Carthage, between the 5th and 3rd c. B.C. The *tophet* at *Acholla*, the cemeteries at *Leptiminus* and *Gigthis*, and other material remains from these sites reflect the influence of both Punic and indigenous cultures prior to the Third Punic War. Historical sources indicate that at least two of the towns (*Acholla* and *Leptiminus*) took the side of Rome against Carthage in 146 B.C., were named *populi liberi* in the *Lex agraria* of 111 B.C., and sided with Julius Caesar against Pompey in 46 B.C. In the aftermath of conquest, the Roman state will have put into place regular taxation policies and the means to mobilize agricultural surpluses. Not all of the towns may have been governed equally – the presence of centuriation in the hinterland of *Acholla* and the corresponding absence near *Leptiminus* are a strong indication of different treatment – but evidence at each indicates major investments in rural properties[56]. Nonetheless, each witnessed substantial urban development between the 1st and 3rd c. A.D., with the majority of their remains dating to this period. *Leptiminus* was promoted to a *colonia* under Trajan. *Gigthis* became a *municipium* under Antoninus Pius. *Zitha* became a *municipium* at an unknown date, probably in the late 2nd or early 3rd c. A.D.[57].

Lepcis Magna, where a fifth possible example has been suggested, was the main city in the region of Tripolitania, and was a more notable settlement than the others considered here. Its municipal history is well known. The city achieved the rank of *municipium* between 74 and 77 A.D., became a *colonia* in 109, and was granted the status of *ius Italicum* c. 203 A.D. The rank of *Acholla* is not known, but it has not been extensively investigated. It is suggested here that it probably attained at least the status of *municipium* like the other towns. Judging from inscriptions, the political landscape in each town was dominated by a few families. Involvement in the production and export of olive oil, fish, and possibly wine may account for the wealth accumulated by these families. At least some of the profits of these activities were reinvested in the towns, as the remains of public buildings and elaborately decorated houses and tombs indicate. The history of the towns diverges somewhat in late antiquity, with *Lepcis Magna*, *Acholla*, and *Leptiminus* active through the Byzantine period, but *Gigthis* and *Zitha* perhaps no longer inhabited.

55. The following overview has been compiled from multiple publications about each site: *Acholla* (Picard 1947; Gozlan 1992); *Gigthis* (Constans 1916); *Leptiminus* (Leptiminus 1, 1992; Leptiminus 2, 2001; Leptiminus 3, 2011); *Zitha* (Mattingly 1995, p. 132; Reinach, Babelon 1886, p. 54-65).

56. For a view of the process at *Leptiminus*, see Stone, Mattingly 2011, p. 52-56.

57. Gascou 1972b, p. 307-308. Both the Antonine Itinerary and the Peutinger Table indicate that *Zitha* was a *municipium* (*Itin. Anton.Aug.* 60,2; *Tab. Peut.* 6,5 and 7,1).

This article will next examine how the jetties with platforms related to regional geological features. Then it will investigate how they played a significant part in the overall commercial endeavors of central *Africa Proconsularis*.

The Geology of the Pelagian Sea (Lesser Syrtis)

The Mediterranean Sea between Sicily and Tunisia is shallow, rarely attaining depths greater than 500 m. Most of the rest of the Mediterranean on the other hand surpasses 1000 m in depth. The shallow depths have been caused by extension of the African continental platform into the Mediterranean. This formation is known in maritime circles as the Pelagian Platform (or Pelagian Shelf), and this portion of the Mediterranean as the Pelagian Sea[58]. In antiquity, it was known as the Lesser Syrtis. It extends about 120 km off the east coast of Tunisia and is characterized by depths between 0 and 400 m (fig. 4). Within this region, the zone that extends from Ras Qabboudia (Tunisia) in the northwest to Zuwarah (Libya) in the southeast is especially shallow. It encompasses an area more than 20,000 sq. km in size, including Jerba, the Sea of Bou Grara, the Gulf of Gabès, and the Kerkennah Islands. Close to the coastline, the pattern of shallow waters is even more pronounced. Within the 500 sq. km Sea of Bou Grara, for example, the depth rarely exceeds 5 m. Three of the four port towns containing jetties with platforms were located within this vast area of shallows. The other port, *Leptiminus*, lay in a separate and smaller, but similar, zone of shallows. This is the Gulf of Monastir (300 sq. km), which extends from Monastir to Ras Dimas. Within the Gulf of Monastir, the extension of the continental platform is noticeable as well, and within a kilometer of the shoreline the depth is rarely greater than 2 m[59].

The shallow nature of the Pelagian Sea (Lesser Syrtis) was apparent to ancient sailors, as the text of both Strabo's *Geography* and Pomponius Mela's *Description of the World* emphatically indicated:

> "The difficulty with both this Syrtis and the Little Syrtis is that in many places their deep waters contain shallows, and the result is, at the ebb and the flow of the tides, that sailors sometimes fall into the shallows and stick there, and that the safe escape of a boat is rare. On this account sailors keep at a distance when voyaging along the coast, taking precautions not to be caught off their guard and driven by winds into these gulfs. However, the disposition of man to take risks causes him to try anything in the world, and particularly voyages along coasts"[60].

The lesser Syrtis "has no ports and is frightening and dangerous because of the shallowness of its frequent shoals and even more dangerous because of the reversing movements of the sea as it flows in and out"[61].

Despite the difficulties of navigating in shallow waters, there were abundant advantages for the inhabitants of these coastal regions. The extension of the continental shelf caused the bottom to slope only very gradually, and created a superb ecosystem for small fish to grow, especially due to the presence of sandy mudflats and dense *Posidonia* meadows[62]. The harvesting of fish seems to have been a major aspect of the subsistence strategies of ancient coastal residents. The evidence includes a very large number of fish-salting vats and "factories" discovered at sites along the central and southern Tunisian coastline[63]. The remains of murex shells indicating purple dye production are also prominent in southern Tunisia. Representations of fishing from the shore or from small boats, which are characteristic of mosaic scenes in *Africa Proconsularis*, must bear some witness to these practices, even though we should not read these scenes as indicative of 'daily life'[64].

The harbor at *Lepcis Magna* is not situated in a zone of shallows like the other ports discussed in this article. The seafloor offshore from the city slopes quite quickly into deep water (fig. 4). The natural setting would not appear to necessitate a jetty with platform. If a break in the dam along the wadi Lebda had caused siltation of the harbor basin, and silt had settled beyond the main entrance to the harbor, however, then the water level may have been shallow, and it may have been necessary to build jetties projecting beyond the Severan harbor basin. A jetty with platform may have provided additional docking area for ships in deeper water. A. Di Vita has suggested that a break in the dam occurred as a result of an earthquake in 365 A.D., a date which fits with the chronology proposed by several scholars for the rebuilding of the harbor[65]. Still, this scenario remains hypothetical.

The Use and Significance of Jetties with Platforms

In the ancient Mediterranean, commercial exchange frequently was conducted without port structures. Boats could alight in shallow water or beach themselves onshore in order to be loaded or unloaded[66]. They could also dock

58. Burollet, Clairefond, Winnock 1979; Tawadros 2012, p. 48-49.
59. Brahim 2005, p. 22; Leptiminus 3, 2011, p. 205-206.
60. Strabo, 17.3.20 (trans. Jones H., Loeb edition, vol. 8, 1932, p. 197).
61. Mela, 1.30-32 (trans. Romer 1998, p. 45).
62. Burollet 1981.
63. Slim *et alii* 2004, p. 264-297. Fishing net weights and fishing hooks have also been found (Bonifay *et alii* 2002-2003, p. 170, nos 283-286). Cf. also Trousset 1998.
64. Slim *et alii* 2004, p. 281-285; Leptiminus 3, 2011, p. 211-213.
65. Di Vita 1990, p. 464.
66. We should expect that smaller vessels regularly came to shore, and that even larger boats might have done so where the shoreline was not rocky, as I have argued elsewhere (Stone 2014, p. 579-580).

offshore and be serviced by lighters[67]. Port structures were not built in the majority of harbors, even after the techniques of harbor construction with ashlar masonry or concrete came to be established. However, the construction of artificial port structures was an important development that facilitated shipping and trade by making it easier and safer for boats to load and unload. The artificial port structures employed in the design of harbors varied, especially over time. A standard element in the design was a jetty extending from the shore into the sea, usually in a straight line. Sometimes the jetty linked the coast to an offshore island. At other times two jetties formed curving arms to shelter a harbor space, a design employed frequently on the Tyrrhenian coast of Italy (e.g., in the Claudian port at Ostia). Other common features were quays, breakwaters, and lighthouses, and less common features were slipways and channels[68]. In harbors with such port structures, it seems that the usual method for loading and unloading a ship was to land it broadside, tie it fast with a rope, and stretch a plank between it and the structure[69]. The cargo would then be carried across the plank[70]. These methods protected the ship against wind, waves, and storms and improved the speed at which a boat could be serviced. With the short sailing season in the Mediterranean and the potential for dangerous conditions to arise, these advantages were significant.

Two aspects of ancient ports are generally employed for comparing their size: harbor area and wharf length. K. Schörle has shown that harbor area is a useful index for Italian ports, but it is not relevant to most North African ports, very few of which were enclosed[71]. I have argued previously that wharf length is the best index for North African ports, as it provides an idea of how much docking space was available to ships, and therefore what the capacity of a port was[72]. Both *Gigthis* and Ras Segala (N) have short wharf lengths (c.200 m). *Leptiminus*, *Acholla*, Ras Segala (S), and *Lepcis Magna*, have longer wharf lengths (c.500-700 m)[73].

The figure of wharf length does not provide the best gauge of activities at the jetties with platforms, however. Instead, the most useful measurement of the scale of the operations at these jetties can be identified as platform area, because it is here that ships would have loaded and unloaded in deeper water along this outer part of the port structure (table 1). As this areal measurement indicates, jetties with platforms belong to two groups of different sizes. First are the large platforms, c.5000-8000 m^2, at *Leptiminus*, *Acholla*, and *Lepcis Magna*. Second are the small platforms, c.500-800 m^2, at *Gigthis* and Ras Segala. The difference in scale between these two groups of jetties with platforms suggests that onloading and offloading activities were much more significant in the first group. Indications of scale at *Leptiminus* and *Lepcis Magna* derive not only from the evidence for economic activities discussed above, but also from evidence that these cities were the seats of imperial officials (*procuratores*) charged with collecting taxes and tribute in an organized and efficient manner. No such official is known at *Gigthis* or Ras Segala (*Zitha*), by contrast, although one was located in the neighboring city of *Meninx*. At *Acholla*, although clear evidence for the status of this town is lacking, the size of the platform indicates substantial capacity for accommodating ships and cargoes, and thus makes it probable that it was the location of considerable economic activity[74].

In addition to the scale of the jetties with platforms, the size of ships they served is an important factor to consider. Some long-distance sailing vessels known from antiquity were large (500 tons burden or more), but these appear to have been most common in the late Republic and early Empire. G. Houston first argued on the basis of shipwreck data that the majority may have been of a small size (100 tons burden or less), and a later analysis of A.J. Parker reached the same conclusion[75]. In a recent reevaluation, A. Wilson concluded that "most merchant ships were relatively small, under 100 tons. The evidence from shipwrecks supports this impression, but does suggest some important developments in the size of larger ships between the Hellenistic and Early Mediaeval periods"[76]. Such vessels would probably have been less than 20 m in length and had drafts between 1 and 2 m. Of the more than 60 shipwrecks that have been found with cargoes of predominantly or exclusively North African goods, most are of this small size[77]. The Dramont E wreck, perhaps the largest of the known African cargoes, weighed about 40-45 tons and was nearly 16 m in length. It dated to the second quarter of the 5th c. A.D.[78]. Many others were

67. The Morocco Maritime Survey has found evidence of offshore anchorages where long-distance transport vessels appear to have waited for cargoes to be delivered (and removed) by smaller ships (Erbati, Trakadas 2008).

68. On the design of harbors, see Blackman 1982a, b.

69. Blackman 1988, p. 11.

70. A good illustration from antiquity is the well-known relief of the unloading of a ship that dates to the 3rd c. A.D.; it is now in the Torlonia Museum, but said to be from Portus (Casson 1994, p. 103). It shows a man carrying an amphora down a plank and receiving a token from an official, who is behind a desk. The scene also includes two other officials and a second man about to disembark while carrying an amphora.

71. Schörle 2011, p. 96.

72. Stone 2014, p. 582.

73. If, as hypothesized above, Ras Segala (S) was the second port structure at this location, the length of its jetty may have been determined by a need to extend farther into the Sea of Bou Grara.

74. For imperial officials associated with *Leptiminus*, see *CIL* 8.11105; *CIL* 8.16452-16453; *IRT* 97; *ILAlg* 1.2035; *AE* 2004, 1484. For *Lepcis Magna*, see: *CIL* 8.11105; *CIL* 8.16452-16453; *AE* 1973, 76. For Meninx, see *Not. dign. occ*. XI 64-73.

75. For this argument, see Houston 1988; Parker 1992, p. 26.

76. Wilson 2011b, p. 213.

77. See Bonifay 2007 on ships containing African cargoes.

78. Santamaria 1995, p. 175-177. For the dating of the three shipwrecks mentioned here, see Bonifay 2004, p. 464.

smaller in size. The partially excavated Plemmirio B wreck, found near Syracuse in Sicily, dated to c.200 A.D. The ship has been estimated at 12-18 m in length, and contained about 1 ton of iron bars and perhaps 200 amphorae, weighing about 13 tons. The excavators used Instrumental Neutron Activation Analysis to place the provenance of the latter at *Sullecthum*[79]. A shipwreck discovered at Giglio Porto dated from the first quarter of the 3rd c. A.D. The stern of the ship was recovered. The excavators estimated the entire ship measured 15 x 5 x 1.7 m[80]. Two superimposed levels of amphorae made up the cargo, of probably at least 100 amphorae. The cargo carried should thus have weighed at least 6 tons[81]. The excavators described the cargo as "homogeneous", and noted the presence on the wreck of several stamped amphorae. One bore the stamp HONO/RATI. A similar stamp HONOR was discovered on an amphora from a kiln site at *Leptiminus*[82], leading M. Bonifay to make the tentative suggestion that the ship's entire cargo originated at *Leptiminus*[83]. The Giglio Port wreck is thus the only one that has been associated with any of the towns discussed in this article.

Since these three ships with known African cargoes were relatively small in size, it is reasonable to expect that jetties with platforms could have accommodated them, and many of the others suggested to have carried African cargoes. To gain a better understanding of the capabilities of jetties with platforms, it would be necessary to assess the depth of the water alongside them. Depth assessments of ancient port structures are notoriously problematic, however. Measurements of the height of each port structure, the depth of the modern sea, the location of any erosion marks on the structure, and the extent of sea-level change since antiquity are required[84]. These measurements are not available for the jetties with platforms, but given our knowledge of conditions in the Pelagian Sea, it is reasonable to suggest that they were designed to service ships with drafts of 1.5 to 2 m at maximum, and perhaps even less. Such a suggestion is consistent with recent assessments of the depth of port structures at *Antium*, *Cosa*, and *Portus* in Italy. Roman harbor structures here once were assumed to have been situated in water c.2 to 3 m in depth, but now appear to have been located in much shallower surroundings[85]. The information we have about the size of transport vessels in the Roman period is nevertheless consistent with the idea that many Roman ships could have been accommodated at these Italian jetties, and also at all the African jetties with platforms.

All of the jetties with platforms appear to have been constructed in the same fashion. Their facing consisted of ashlar blocks laid lengthwise in single or double rows. These ashlars were quarried from local stone of the Rejiche formation, a Eutyrrhenian deposit recognizable due to its plentiful marine shells. It has several outcrops between Monastir and the Zarzis peninsula[86]. For the interior of the jetties and the platforms, a concrete which set underwater appears to have been combined with large quantities of rubble. The mixture may have cured in place within the ashlar facings[87]. The transmission from Italy of knowledge regarding the use of underwater concrete in the last century B.C. was clearly important in the construction of jetties with platforms[88]. That does not imply, however, that we should conclude that 'advanced' Roman technology enabled the construction of buildings that could not have been attempted previously. The structures made use of a very large amount of locally quarried Rejiche formation stone, with which they certainly could have been constructed in their entirety. It is more reasonable to suggest that the use of concrete made the process of construction faster, easier and less expensive, but does not in itself explain the existence of jetties with platforms. The fact that these jetties were constructed with stone and concrete has enabled their discovery and classification, however.

Conclusion

An explanation for construction should be found in the need to circumvent problems caused by the extreme shallows in this region of the Mediterranean. The low sea level necessitated long jetties to gain access to deeper water; once that water had been reached, platforms offered ample space at which vessels could dock. It would have been possible to build longer jetties, but there were at least two reasons not to do so: use of the platform meant that it would be possible to carry goods shorter distances to and from the shore, and longer jetties would have required more building materials, and therefore been more costly. It was almost certainly to improve one or more of these aspects of shipping that jetties

79. Gibbins 2001.

80. *Relitti* 1991, p. 121. There is a discrepancy in reporting the dimensions of this ship. Parker 1992, p. 454, cited the measurements of the ship as 30 x 8 x 3 m. Using these dimensions, Wilson (2011b, p. 215) listed this wreck as weighing between 130 and 160 tons. It is not clear which dimensions are correct.

81. *Relitti* 1991, p. 117-134.

82. Peacock, Bejaoui, Ben Lazreg 1989, p. 198.

83. Bonifay 2007, p. 256. One difficulty with the association of the Giglio wreck with *Leptiminus* is the discrepancy between the reading of the two stamps HONOR and HONO/RATI. Other amphorae from this wreck bear anepigraphic stamps with parallels at *Leptiminus*, however (Stone, Mattingly, Opait 2011, p. 379-382).

84. A study of the entire Tunisian coastline has suggested that changes of 50-75 cm have been common in central and southern Tunisia, and something in this range would probably apply to most of these harbors. The study has also shown the regularity of shoreline displacement since antiquity. The shoreline has remained unchanged along only 20% of the country's coast; it has receded along 75% and advanced along 5%. Along almost the entire area considered here the sea-level has risen (Slim *et alii* 2004, p. 229-254).

85. Oleson *et alii* 2004, p. 221.

86. Slim *et alii* 2004, p. 256-258; Paskoff, Sanlaville 1983, p. 92-98, 153-157; Mahmoudi 1988.

87. This method may be similar to that suggested by Oleson *et alii* 2004, at *Caesarea Maritima*, although at that site a wooden formwork was employed.

88. As discussed by Wilson 2011a, p. 49-50.

with platforms were built. An alternative explanation is that the jetties with platforms represent an example of competitive emulation among coastal cities, although this cannot be proven. Evidence at *Leptiminus* and *Gigthis* suggests construction in the 2nd c. A.D., and a date for all of the structures except *Lepcis Magna* in the 2nd and 3rd c. is reasonable. For those inclined to see emulation as a motive for construction, contemporaneity and geographical proximity would provide a suitable context.

The heightened scale of commercial activity along the coast of *Africa Proconsularis* in the 2nd through and 4th c. A.D. makes it more logical to suggest an economic rationale lay behind the construction of artificial port structures, however. Intensive cultivation of olives in the flat plains in the hinterland of these towns has been documented, there is growing evidence for viticulture[89], and the shallow nature of the sea provided excellent breeding grounds for small fish, which could be harvested with simple fishing technologies. Transport amphorae for these commodities were normally designed to hold 40-70 liters or more; when filled, they weighed as much or more in kilograms, considering the weight of the vessel. In order for the Roman state, and the inhabitants of these towns to mobilize tribute payments as well as agricultural and maritime and surpluses, it was necessary to build jetties with platforms, improving facilities for loading and unloading boats. An additional argument along these lines concerns the extent of goods imported at these ports. We lack good data on imports at *Acholla*, *Gigthis*, Ras Segala, and *Lepcis Magna* (in late antiquity when the possible jetty with platform may have been constructed) but imports have been documented at *Leptiminus*. Survey and excavation at this city produced evidence for a wide range of materials: millstones, marbles, iron and iron ores, glass, pumice, fine pottery, cooking wares, wine amphorae, and even stamped Italian bricks[90]. Imports could have been part of the reason that jetties with platforms were constructed at this site, as well as at the other sites if comparable evidence is discovered. The novel shape of the jetty with platform should be interpreted as an efficient design allowing ships to dock in the shallow waters of *Africa Proconsularis*.

The number of known jetties with platforms is small, and their geographical spread is currently limited to central *Africa Proconsularis*. It is possible that through publication of these examples more will be identified. Within *Africa Proconsularis*, one might speculate that other ports located in the Gulf of Gabès may have possessed similar features. The important settlement of *Thyna* (where modern salt pans may overlie an ancient jetty), or the *municipium* of *Macomades*, where production of Keay LIX and VIIB amphorae has been documented, appear to this author as likely candidates. *Taparura* is another. Bathymetric maps indicate that the only large Mediterranean region with comparable shallows near the coastline is the northern Adriatic. It is also possible that ports here, or elsewhere where there were locally shallow harbors, may have utilized the design of a jetty with platform to circumvent problems with shallows near shore.

89. On wine production, see Brun 2004, p. 200-204.

90. Leptiminus 3, 2011, p. 255-261.

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