

THE CONSTRUCTION, USE AND EVOLUTION OF THE HELLENISTIC AND ROMAN HARBOURS OF THE AEGEAN

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Abstract

One of the fundamental premises on which the successful function of harbours as centres of commerce and interaction is based is their ability to accommodate and handle ships and their cargoes. This is especially the case during periods in which seaborne trade and travel acquire a major role like the Hellenistic and Roman ones. But, despite the important developments in the study of the harbours of the period, their operation as ship havens and the practicalities of ship and cargo handling have largely eluded the attention of previous scholarship that has addressed the operation of ancient harbours mainly through their history and architecture. The primary aim of this thesis is to understand the harbours of the Hellenistic and Roman Aegean vis-à-vis their relationship with ships and seamanship and the practical issues related with it. In order to do so I approach harbours ‘through the eyes of the mariners’, devising a new methodology that combines data on ship typology, size and handling with the reconstruction of the three harbours chosen as case studies (Delos, Lechaion and Kenchreai). By employing this methodology I address, in an innovative and inclusive manner, the relationship of harbours with ship and cargo traffic, an essential practical aspect of their operation that largely dictated their function and development.

Through the combined study of ships and harbours a complicated image of versatility appears. The three case study harbours were in their majority small, shallow and exposed areas, often fragmented into various smaller anchorages. They were also related with sandy beaches, ideal for the accommodation and beaching of small vessels and lighters but not of ships of medium and large capacity. Docking facilities were few, exposed and most probably reserved for stone and marble cargoes. Anchoring in the open and employing lighters was most likely the main method of using these harbours, allowing ships to sail more easily from and to harbour basins, change anchorages and avoid the entanglement in small and often cramped spaces. Harbour works in the sea were few as well as technologically simple, with a focus on the creation of monumental commercial infrastructures on land instead. Functionality and adaptability were the main elements in the operation of the harbours studied, which despite their relative simplicity still functioned perfectly as commercial centres, marketplaces and maritime façades of cities, states and regions.

The successful application of the methodology of this thesis to the case study harbours highlights the possibilities it has concerning the better and more inclusive understanding of harbours as human spaces. It also underlines its dynamics as a methodological tool that can be applied in other contemporary sites, historical periods and different geographical regions.

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It should be stressed here that this study would have not been possible without my participation in the recent archaeological projects in two of the case study harbours, Delos and Lechaion. Through my active involvement in these projects, for which I am very grateful to the co-directors Mantha Zarmakoupi and Björn Lovén respectively, I had the unique opportunity not only to have a personal view of the harbour sites but also to have access to new finds and results of the on-going research, something that allowed me to gain a unique understanding of the two sites and to formulate my research accordingly. I am thus grateful to the directors of these projects and to all my colleagues there for sharing with me their knowledge and views on the results of the project, as well as on many aspects of the harbour's dynamic geomorphology. Furthermore, during the duration of the project I practiced and further developed my skills as a surveyor and an illustrator, creating the first planar and artistic reconstructions of the harbour. These skills form vital elements of the methodology employed in this research, as it will be shown below.

Various colleagues and friends all around the world offered also their help, feedback and criticism, which have decisively contributed to my study. I would sincerely like to thank Lucy Blue, Björn Lovén, Panagiotis Athanassopoulos, Paraskevi Micha, Dina Vafeiadou, Aylin Güngör, Gregory Votruba, Emmanuel Nantet, Catherine Bouras, Antoine Chabrol, Giulia Boetto, Gary Reger, Christy Constantakopoulou, Dimitrios Karambas, Sarah James, Chris Hayward and Mark Lawall.

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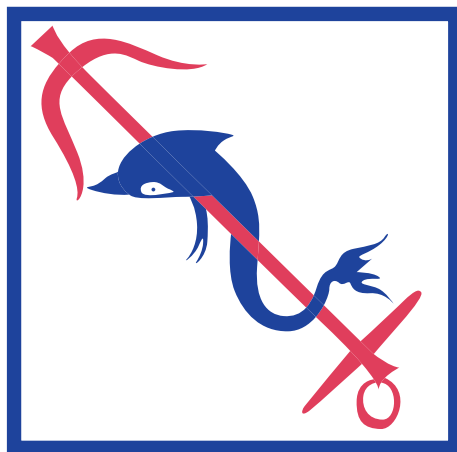
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1. Introduction

Harbours are amongst the most important and remarkable human structures and spaces. They play a crucial role as major centres of exchange and interface and nodal points in commercial, cultural and political networks. As such, they provide a unique insight into their contemporaneous world by connecting different aspects of human life and especially in regions and time periods in which human interaction via the sea acquires great importance. This study deals with such a region, the Aegean Sea, and focuses on the Hellenistic and Roman period, during which seamanship, maritime trade and mobility grew to unprecedented levels and became a very important feature of the lives of contemporary people.

A key aspect of the function of harbours throughout their history is that their successful operation is fundamentally dependent on ships and seamanship. The form and number of the ships that a harbour is required to accommodate and its ability to do so is what largely dictates its importance and allows harbours to develop into significant commercial and urban centres. In turn the natural and artificial configuration of harbours dictates the form and size of ships that can use them and the methods mariners will employ for this. This mutual dependability between harbours and ships constitutes a major field of research that can shed light not only on the operation and evolution of harbours but also on more general aspects of contemporary commerce, technology and architecture in a way that has not yet been exploited in its full potential by scholarship. This study examines Hellenistic and Roman harbours of the Aegean in relationship to the ships and cargoes they served, and the role this relationship played in their operation and development. This is done by creating and applying a new methodology based on the principle that harbours are built and operated to predominantly serve ships and their cargoes. The methodology devised includes the use of quantitative methods and introduces the synthesis of a much wider and more inclusive variety of data, handling them through new and up-to-date illustrative methods and the creation of reconstructions of the three case study harbours. In the following pages I will present the main research question and aims of my research, review previous scholarship and highlight the gaps my study covers, and finally thoroughly outline the methodology that has been devised and will be applied, as well as the datasets that are used.

This study would have not been possible without my participation in the recent archaeological projects in two of the case study harbours, Delos and Lechaion. Through my active involvement in these projects, I had the unique opportunity not only to gain a personal view of the harbour sites but also to have access to new finds and results of the on-going research, which, although not included in this thesis unless already published, allowed me to gain a unique understanding of the two sites and to formulate my research accordingly, participating in the on-going discussions over the original form of each harbour and the new finds. These discussions functioned as an indispensable foundation on which I developed my own research by basing it on a very good understanding of such a unique site and associating ships and seamanship with this improved knowledge of the harbour.

1.1. The research question and the aims of this study

As noted above, this study targets the Hellenistic and Roman harbours of the Aegean vis-à-vis contemporary ships and seamanship. It concerns the relationship of these harbours, of which three have been chosen as case studies (Delos, Lechaion and Kenchreai), with contemporary ships and seamanship and the different ways in which ships as well as their cargoes were handled within them. Consequently the primary aim of this research is to understand the rapport between harbours and the ships that used them, as well as the cargoes these ships carried and, at a subsequent second level, its ramifications in contemporary commercial networks, economy, architecture and urban planning of the cities related with them. My study combines various different aspects of harbour and ship archaeology (**Fig.1.1**): the configuration of ships, seamanship and harbour environments and the various features of ship and cargo handling within the case study harbours (capacity, circulation, methods of accommodating ships and dealing with the handling of cargoes of various types).

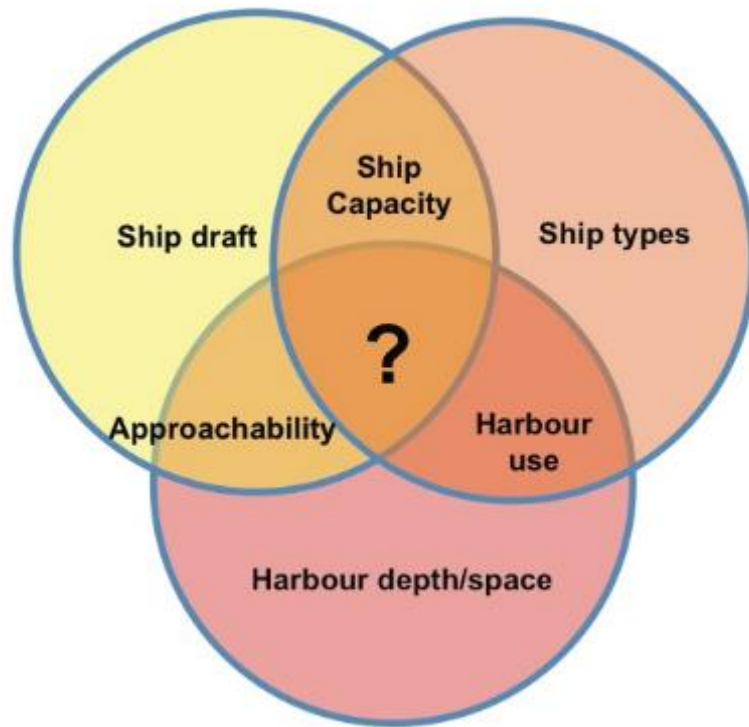


Fig.1.1. Schematic presentation of the various aspects of ship and harbour configuration that relate to this study's research question.

The primary aim of this study is achieved through the creation and application of a new inclusive methodology that connects harbours with ships and seamanship, a methodology largely missing from scholarship (see 1.3). This forms the study's secondary aim: to devise this new methodology, apply it and test it on specific harbours. Through applying this methodology in the three case study harbours, its potential and dynamics are explored and demonstrated. This serves to establish a new interpretation and study tool that can be used both in other sites of the same period, as well as in sites that belong to other regions and historical periods and comprises a very important outcome of this study, as this can create a useful platform for future applications in scholarship.

1.2. Harbours as a source of information

Harbours serve various needs and have a multi-levelled function, from centres of seamanship and thriving markets to coastal settlements and monumental establishments. Their importance lies, as it will be explained in the following lines, in this unique and complex operation that unifies different aspects and functions.¹ This is why the study of

¹ Delano Smith 1979, 327; Karmon 1985; Rickman 1985; Rogers 2013; Reger 2016, 14; Feuser 2020, 2-6.

ancient harbours, and especially of the ones belonging to the Hellenistic and Roman period, is important and can add considerably to our understanding of the human past.

Harbours are built and operate in a specific geographical position, which essentially constitutes a portal between the land and the sea, the hinterland and the foreland, but also a nodal point in different commercial networks.² They also serve the requirements of a given sea traffic and of the economy and people this relates to.³ It is exactly for these requirements their natural configuration is artificially enhanced in various degrees, often rendering them some of the most complex and technically advanced structures of their time.⁴ Furthermore, and following their prominence as commercial centres described above, they often become the maritime façade and main gateway of the cities, regions and states they serve, being the first and last thing travellers and visitors experience when they reach or leave a foreign land. Thus they regularly evolve into spaces where political ideas are displayed in a unique ‘scenography’ through lavish and carefully planned monuments and buildings.⁵ Finally, harbours as settlements are “autonomous realities”,⁶ combining a variety of functions and services (commercial, religious, recreational etc.), all related to the reception and handling of ships, people and cargoes and develop a “nautical economy”,⁷ creating an indispensable link between the local populations and the outer world or foreland as well as their own hinterland and fellow citizens.⁸

Through all these different roles and functions, harbours connect to every aspect of contemporary society. This solidifies their importance as archaeological sites, which is particularly the case for the harbours of the Hellenistic and Roman Mediterranean. This “brilliant, crowded, lively age”⁹ was marked by significant changes both in macro and micro levels, especially in the economic sector,¹⁰ largely thanks to the unification of the Mediterranean world that started under Alexander the Great and was completed with the Roman Empire.¹¹ The gradual Roman conquest of the Hellenistic East, despite the often

² Karmon 1985, 2-5; Horden & Purcell 2000, 392; Schörle 2011, 93-5.

³ Hopkins 1983, 85-96; Davies 2006, 78; Leidwanger 2013; Bouras 2016.

⁴ Rostovtzeff 1941, 1042; Oleson 1988, 147; Morhange & Marriner 2010.

⁵ Bouras 2008; 2014; Arnaud 2015a; Ugolini 2020; Feuser 2020, 305-19.

⁶ Reger 2016, 12-5.

⁷ Gibbins 2001, 294-5.

⁸ Monge 2004, 229; Reger 2016, 12-5.

⁹ Grant 1990, ix.

¹⁰ Archibald 2005, 1.

¹¹ Horden & Purcell 2000, 27; Chaniotis 2018, 10-30.

accompanying by warfare and destruction (e.g. the obliteration of Carthage or Corinth by the Romans and the sacking of Delos by Mithridates; see **Chapter 3**) not only did not disrupt the financial development of the region but stimulated it even more.¹² The general pacification of the Mediterranean, the substantial rise of the population and the lack of borders made the sheer volume of trade and exchange, often served by new, larger, and technologically improved ship types, grow to unprecedented levels (see **Chapter 2**).¹³ This brought new demands to contemporary harbours, which were to serve a rising number of merchantmen (often of great tonnage), variable types of merchandise (grain and other victuals, works of art, enslaved people, marble etc.), as well as to house equally variable related facilities and activities (shipyards, markets, storage facilities, lodging of ship crews and travellers, etc.). The crowding of people around harbours and the importance they acquired turned many of them into some of the most densely populated and monumental establishments of their time, often under the generous patronage of powerful elites.¹⁴ Old and new technologies were employed in the construction and maintenance of harbours: along with the older 'Greek' technique of constructing ashlar quays on rubble foundations, or of casting blocks from the surface of the water, the ground-braking technology of maritime concrete was also introduced by Roman engineers. Extensive dredging was employed too from the Hellenistic period onwards.¹⁵

Nevertheless, and despite the fact that there are various ways one can approach the operation and development of Hellenistic and Roman harbours, the reason why they, as well as essentially all harbours in human history, were primarily constructed, developed and operated was the accommodation of ships and the handling of their cargoes. There is a strong dialectic relationship between the physical form of a harbour (which is potentially enhanced through human intervention) and the ships and cargoes it has to serve and handle: the configuration of a harbour is what dictates the number, type and size of ships it can accommodate and subsequently the types and quantity of cargoes that can be handled there, or even the number, occupation and origin of people who dwell there. Accordingly, the type and number of ships and quantity and kinds of cargoes a harbour is required to

¹² Paterson 1998, 150; Temin 2013, 2.

¹³ Casson 1974, 121-2.

¹⁴ Casson 1971, 366-7; MacDonald 1986, 262; Bouras 2008; 2014; Oleson & Hohlfelder 2011, 814-6; Boehm 2018, 127; Feuser 2020, 311-2.

¹⁵ Casson 1971, 367-8; Oleson 1988, 148; Rickman 1996, 285; Morhange & Marriner 2010; Brandon et al. 2021.

serve dictates the way it operates, its evolution and the creation of various harbour works.¹⁶ This is the reason why the research question of this study is so important and why answering and creating a methodological framework for that can significantly promote the study of harbours in general.

What becomes evident through the study of the data used here, which will be elaborated in the following pages is that Hellenistic and Roman harbours of the Aegean and of the Mediterranean in general were complicated and diverse spaces, whose configuration and operation varied greatly according to specific conditions. Such conditions reflected the variety of ships that frequented these harbours, which ranged from 'mega-freighters' of more than 350 tons to small cabotage vessels of less than 20 tons, with a respectively diversified draught and size. Cargoes also varied from bulk cargoes of victuals (oil, wine and grain) to enslaved people, luxury items and stone or marble, according to the different commercial networks harbours served. Correspondingly harbours did not follow a single pattern of organization or development, their administrators carefully choosing the type and extent of harbour works according to their different needs and resources. Even in the most active harbours like Delos or Lechaion sea infrastructures were limited and many basins remained shallow and minor in size, ideal for the use of small capacity vessels but not of larger ones, which would anchor in the open and use lighters, the latter best served by the extended shallow natural beaches found in all of the three case study harbours. A tendency to avoid creating monumental and imposing, but expensive harbour works is apparent, in favour of more functional infrastructures, often related with the creation of a 'merchant-friendly' space on land through the construction of agoras and warehouses. The successful, often proverbial, commercial development of the case study harbours and the cities they served proves that the selection of such a way to handle ships and cargoes and administer harbours was highly effective, consistent with the conditions of contemporary trade, as well as with the abilities of contemporary ships. The former could make excellent use of every coastal environment, employing different methods according to the conditions they met up with.

¹⁶ Boetto 2010, 112-3; Schörle 2011, 94-5; Zarmakoupi 2018b, 31-2.

1.3. The research of Hellenistic and Roman harbours and ships

The study of Hellenistic and Roman harbours of the Mediterranean, despite being a relatively new field, has progressed rapidly during the last century in a multitude of fields and areas, with a corresponding number of finds, methodologies and approaches, many directly related with the scopes of my study. It is therefore very important, before I proceed with the examination and analysis of the data of my research, to have a clear and coherent idea of its predecessors, to highlight important similar approaches, underline examples of research that have operated as stimuli and case studies, and to clarify the gaps that my study aims to cover.

1.3.1. Discoveries and methodologies

Early scholarship on the ancient harbours in the Mediterranean has been characterised, not surprisingly, by an antiquarian approach, which deeply influenced its development for many decades. This was related both to the general lack of interest of scholars in the ancient economy and seamanship, as well as to their inability to practically access and comprehend the harbours that were, in their great majority, submerged.¹⁷ Similarly ancient ships were virtually unknown, ship studies based on indirect written and iconographical evidence.¹⁸ Ancient harbour works, especially the best-preserved Roman concrete ones (**Fig.1.2**), were aptly noted by

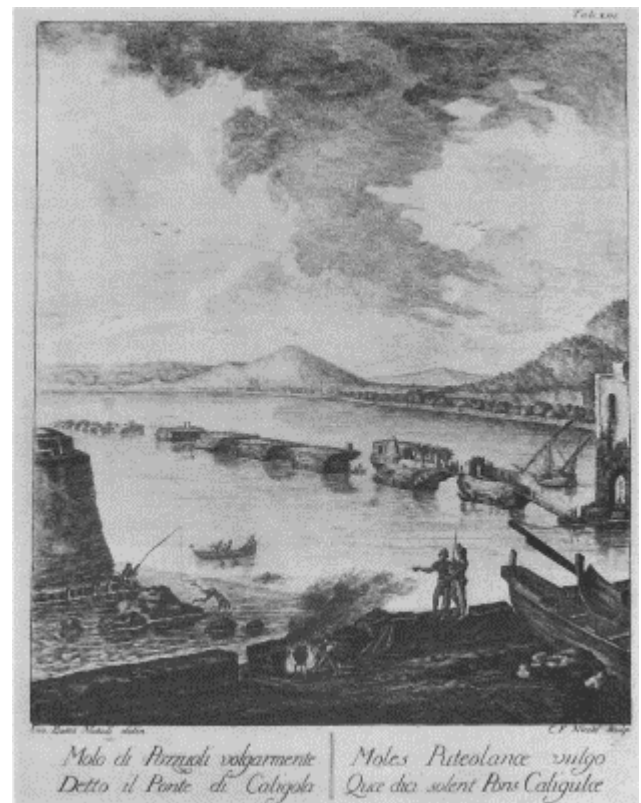


Fig.1.2. The arched mole at Puteoli. Engraving of 1768 by Paoli (Blackman 1982b, Fig.7).

¹⁷ Although the heavy diving gear or copper hat equipment was standard by the middle of the 19th century and employed in a variety of underwater operations, including the salvaging of antiquities, it remained cumbersome, difficult to handle and potentially dangerous and no archaeologist ever attempted to use it. It was a pioneering 'amateur' clergyman, Reverend Odo Blundell in the crannogs of Scotland (1910) who ventured in diving himself, decades before any trained archaeologist would do it (Muckelroy 1978, 11-3).

¹⁸ Torr 1895.

antiquarians since the 16th century,¹⁹ but the harbours' role as commercial centres was not fully appreciated, with research mostly focusing on the recovery of works of art.²⁰ Even when certain harbours were incorporated in general, often very meticulous, archaeological surveys (e.g. Piraeus, Mytilene and Lechaion),²¹ they were seen as annexes of coastal cities and not as independent sites. It was naval surveyors and engineers who first encountered and documented harbour remains during their work (e.g. Béla Gerster at Lechaion and Kenchreai or Gaston Jondet at Alexandria).²² But although important topographical data was collected, especially in sites that were to be heavily affected by modern development, engineers had no interest or the background to further study the configuration and function of these harbours.

The first inclusive studies of ancient harbours appeared around 1900, initially by geologists who used ancient structures to date geological coastal changes but were selective and brief concerning the archaeology.²³ In 1901 Robert Günther made a pioneering study of the coastal remains of Pausilipon near Naples, thoroughly documenting the local geomorphology, ancient structures (villas, harbours) and finds and including comparative iconographical parallels from Pompeian frescoes.²⁴ The engineer Athanasios Georgiades followed in 1907, with his study of six semi-submerged ancient harbours of Greece (Lechaion, Kenchreai, Eretria, Anthedon, Larymna and Histiaia). Georgiades focused on less monumental sites, compiling a plain but coherent account, including (unfortunately often inaccurate; **Fig.3.48**) plans with bathymetric contours and the study of written sources.²⁵

¹⁹ The first detailed and rather accurate map of Portus was created by Antonio Labacco around 1550. Blackman 1982b, Figs.2 & 7; Morelli et al. 2011, 47, Fig.4.3

²⁰ Travellers and antiquarians of the 18th century did not hide their disappointment when they visited important ancient harbour cities and witnessed the lack of visible remains of their harbour works and considered them lost for ever (Marriner & Morhange 2007, 138). On the early excavations at Portus, in which antiquarians were mainly interested in undearthing works of art see Lanciani 1868; Dixon 2019, 17-20.

²¹ On the early surveys of Piraeus see Curtius et al. 1881-1900 and Graser 1872; on Mytilene see Koldewey 1890; on Lechaion see Skias 1907. It is noteworthy that Johann Graser developed innovative methods of surveying submerged finds of shipsheds in Piraeus with relative accuracy from the surface by using a floating measuring stick attached to weights at the sea bottom. However, he misinterpreted many remains due to the lack of knowledge on similar sites (Lovén 2011, 17).

²² Gerster 1884, 225-6; Jondet 1916; Muckelroy 1978, 83-4. Jondet, lacking the knowledge of dating submerged harbour works, erroneously considered the remains of Alexandria harbour Pharaonic and more precisely of the time of Ramses II (Jondet 1916, 72-3), whereas other contemporary scholars even suggested that it was Minoan foundation (Weill 1919, 17-23).

²³ Negris 1904a, 1904b; 1907; Cayeux 1907.

²⁴ Günther 1903; 1913.

²⁵ Georgiades 1907.



Fig.1.3. The “Pointe des pilastres” buildings during the 1909 excavations by Pâris (Duchène and Philippe Fraisse in 2001, Pl.XLI).

The first thoroughly archaeological approach to a Hellenistic/Roman harbour was the article of Johannès Pâris on the harbours of Delos in 1916 (**Fig.1.3**). Following the first short study of ancient remains recently excavated by the French School of Athens (École française d'Athènes, henceforward EFA) along the

city's western coast²⁶ and including detailed bathymetric data collected by the French Navy,²⁷ Pâris was the first to target the maritime façade of Delos and to make a series of innovative methodological suggestions. He divided the coastal zone into a series of basins and treated harbours as distinct spatial entities and not as simple annexes of the neighbouring city.²⁸ Pâris also combined archaeological, historical, and ethnographical data in an approach that predated much later developments in scholarship, using evidence from the nearby harbour of Mykonos (see **1.3.3**).²⁹ Following the same principles Pâris also published a briefer account on the harbour of Lechaion (1915) but did not conduct any fieldwork of his own there.

The first effort for an inclusive study of all Mediterranean harbours from antiquity was made by Karl Lehmann-Hartleben in 1923. In this long and scrupulous study the scholar included all known ancient harbours of the Mediterranean and created a narrative of their evolution from Prehistory to Roman times. He was the first to divide military from commercial harbours and to underline the role of *emporía* (commercial harbours or trading stations), whereas the Hellenistic and Roman period was discussed in two long chapters.³⁰ Contrary to Pâris' approach, however, this seminal book lacked personal observation and

²⁶ Ardaillon 1896.

²⁷ Duchène et al. 2001, 33-9.

²⁸ Pâris did not venture in any underwater exploration in Delos, but did organise a small land excavation on what he believed was one of the silted basins of the harbour (Duchène et al. 2001, 113-5).

²⁹ Pâris 1916, Figs.4-7.

³⁰ Lehmann-Hartleben 1923, 122-217; Daum et al. 2014.



Fig.1.4. Excavations at the harbour of Lepcis Magna (Bartoccini 1958, Pl.VIII).



Fig.1.5. The North Mole of Portus during excavation (Testaguzza 1970, p. 87).

fieldwork, being mostly based on written evidence, and it overlooked issues such as bathymetry and the handling of ships and cargoes³¹ and was also poorly illustrated.³²

All these early studies of Mediterranean harbours in general, despite showing the potential of further research, were greatly hampered by the reluctance of archaeologists to dive and the inability of geologists to acknowledge sea level rise, an issue that was still debated amongst specialists.³³ Harbours were not included in field research, despite the fact that the first shipwrecks were already being excavated (Antikythera and Mahdia),³⁴ nor new technologies were employed (with the exception of Antoine Poidebard's underwater and aerial surveys of several Levantine harbours).³⁵ It was actually the historians of the period

³¹ Rickman 1985, 103.

³² Blackman 1982a, 86.

³³ Blackman 1982a, 86. Although Phocion Negris had already suggested that a steady sea level rise had occurred since antiquity his view was sternly rejected by Lucien Cayeux in 1907, 115-6; cf. Marriner & Morhange 2007, 142.

³⁴ Muckelroy 1978, 12-3.

³⁵ The Jesuit father Antoine Poidebard was the first amateur archaeologist to employ hardhat divers, as well as aerial photography in order to locate and document the remains of submerged harbours in modern Syria and Lebanon, paving the way for all future research methodologies (Muckelroy 1978, 13; Denise & Nordiguan

who ‘rediscovered’ harbours, especially those of the Hellenistic and Roman periods, following the recent developments in the scholarship on ancient trade and economy. Martin Charlesworth and Michael Rostovtzeff were the first scholars to explore the economic history of the Hellenistic and Roman world, in which commerce and harbours played an essential role. Rostovtzeff in particular underlined the importance of Hellenistic harbours as competitive and monumental trading centres and suggested the first general classification for them (see below **1.3.2**).³⁶

The introduction of the SCUBA (Self-Contained Underwater Breathing Apparatus) after World War II allowed for the first time the undertaking of proper underwater surveys and excavations and the study of submerged sites.³⁷ A long series of organized surveys explored and mapped the harbours along the North African coast, Apollonia, Athlit, Cosa, Phaselis, Pyrgi and Halieis, amongst others.³⁸ It is worth mentioning here the pioneering and meticulous survey and subsequent study of the harbour of Apollonia in Libya by a team from Cambridge University (1958-9), in which not only the whole of the complex, double-basin harbour was surveyed, but the first concrete evidence on sea level rise in the Mediterranean was collected.³⁹

The need to properly explore, study and date ancient harbours and the progress in excavation and diving techniques made the first pioneering large-scale underwater excavations possible. These included the Roman-period harbours of Caesarea Maritima (since the 1960’s) and Kenchreai (1963-68), during which harbours were meticulously surveyed, mapped and substantial parts of their remains excavated.⁴⁰ Meanwhile land excavations in silted harbours like Miletus, Ephesus, Portus and Lepcis Magna greatly enriched the knowledge on the relationship between these harbours and the urban

2004). It is worth noting here that he is reported to have said in 1937 that “the sole object of our investigation was to establish a method” (Blot 1996, 43; cf. Semaan 2018, 87). His work was continued by Honor Frost in the 1960’s.

³⁶ Charlesworth 1926, 76, 115-7; Rostovtzeff 1926; 1941, 1042-3, 1263-8.

³⁷ Shaw 972, 99-100; Muckelroy 1978, 78-81; Blackman 1982a, 86-90; Oleson & Hohlefeldler 2011, 810

³⁸ On the first surveys of the harbours of the North African coast see Yorke & Davidson 1969; on Apollonia see Flemming 1960; 1965; 1971; on Athlit see Linder 1967; on Cosa see Lewis 1973; MacCann 1979; McCann et al. 1987; on Phaselis see Blackman 1973; for Pyrgi see Oleson 1977; for Halieis see Jameson 1973.

³⁹ Flemming 1961; 1965; 1971. The first research was followed by a French mission (1986-98), which largely confirmed the conclusions reached concerning sea level rise and the configuration of the ancient harbour by Flemming (Laronde & Sintès 1998; Sintès 2010).

⁴⁰ On the history of the excavations of Caesarea Maritima see Oleson 1989 and 1994 and on Kenchreai see Scranton et al. 1978.

environment of important “port-cities” (Figs. 1.4-5).⁴¹ These studies, however, focused on the architecture and monumentality of the harbours and did not include the handling of ships and cargoes, despite the fact that the knowledge on ancient seamanship was drastically improving thanks to the excavation of many Mediterranean shipwrecks (most of them dating between the late Hellenistic and early Roman Imperial periods).⁴²

In the same period Honor Frost became the first maritime archaeologist to specialize in harbours. Focusing on the Early Iron Age harbours of the Levantine coast and continuing Poidebard’s research, she developed an interdisciplinary methodology by combining geology, aerial photography and underwater photogrammetry in a meticulous documentation of harbour remains both underwater as well as on land. Frost saw harbours as “functional units” that combined all human activities along coastal zones, her pioneering approach foreseeing much later developments in scholarship.⁴³ Meanwhile, taking advantage of the increasing number of excavations of shipwrecks and harbours, most dating to the Roman period, Lionel Casson in 1971 and Joseph Shaw in 1972 attempted syntheses of archaeological discoveries and literary sources for the first time since Lehmann-Hartleben. Both scholars provided contextualized, well-researched overviews of the subject of harbour organisation and operation but did not address the important issues of harbour size, depth and ship accommodation (see also below 1.3.3).⁴⁴ In the same years geologists finally confirmed the steady rise of the sea level in the Mediterranean during the Holocene (1 mm per year), marking the naissance of modern harbour geoarchaeology.⁴⁵

⁴¹ Bartoccini 1958; Testaguzza 1970; Blackman 1982a, 88. The term “port-city” was introduced by Karl Polanyi in 1957, 54.

⁴² Gianfrotta & Pomey 1981; Steffy 1994; Pomey & Rieth 2005; Pomey et al. 2012

⁴³ Frost 1964; 1966; 1972. On the use of the term “functional units” see Frost 1966, 14. The impact of Frost’s pioneering studies was not felt immediately, since many were published much later and her methodology was not adopted by other researchers either in the Levantine coast or in other regions in the years that followed. Frost never managed to organise an excavation in any of the harbours she studied and her copious researches were cut short by the political unrest and the subsequent Lebanese Civil War during the late 1960’s and restarted only after 1990 (Semaan 2018, 91-3). The results of her studies were largely confirmed by later research (Carayon 2019, 103-4).

⁴⁴ Frost 1966, 14; 1973; Semaan 2018, 87-93; Carayon 2019, 85-7. Several general accounts appeared in other important textbooks of the period but, although they did offer comprehensive accounts of harbour archaeology, targeted very specific areas of study: Keith Muckelroy (1978, 75-84) focused on Phoenician “proto-harbours” and *cothons*, Nicholas Flemming (1980) geological changes and sea-level rise and Piero Gianfrotta and Patrice Pomey (1981, 312-26) Roman harbour works and *piscinae* fish tanks.

⁴⁵ Flemming & Czartoryska 1969; Flemming et al. 1971; Flemming 1971; 1980; cf. Marriner & Morhange 2007, 142. The confirmation of the sea level rise did, however, suggested by Flemming, not instantly solve every issue in the ancient harbours’ configuration, as the later proved to be subject to specific regional conditions, as well as siltation and dredging (Dalongeville & Fouache 2005; Morhange & Marriner 2010).

An innovative approach to one of the most important harbours of the Hellenistic and Roman Mediterranean was attempted in 1981 by the architect Alexandros Papageorgiou-Venetas in his study of the urban environment of Hellenistic and Roman Delos. The author, drawing upon the contemporary theories on urbanism and ekistics, used the latest mapping and quantitative methods to assess the development of the ancient city, including its maritime façade, which he considered an indispensable part of the urban fabric. But despite the importance of the study the results were problematic: all of the evidence was taken from earlier publications, which the author took for granted, and did not proceed from any new fieldwork. Furthermore, little space was left for any detailed discussion of the harbours (see also **1.3.3**).⁴⁶

Towards the end of the 20th century and although more harbours continued to be surveyed and excavated, harbour archaeology progressed little in terms of methodology and theory. It was the development of geoarchaeology that started delivering new and detailed data on the form and development of ancient harbours, especially the silted ones, initiating a series of very fruitful research projects that continue until today (e.g. in Portus, Tyre Miletus, Ephesus and Utica).⁴⁷ Another field that started emerging in the same period was the study of the technology employed in harbour construction. David Blackman in 1982 was the first to outline the three basic consecutive types of harbour technology ('Phoenician' rock-cut basins, 'Greek' rubble and ashlar moles and 'Roman' concrete moles and quays), a division largely valid today and John Oleson in 1988 gave a clear but short overview of the use of Roman maritime concrete in harbour construction.⁴⁸

Another study of the harbours of ancient Delos in a more inclusive manner was attempted by Hervé Duchène and Philippe Fraisse in 2001. Mostly focusing on the Hellenistic period, the book collected material concerning the harbours of the island, including unpublished plans and excavation reports, in an ambitious effort to incorporate the whole "harbour landscape"⁴⁹ of the island into one narrative. However, and despite its richness in

⁴⁶ For largely negative reviews of the book of Papageorgiou-Venetas on Delos see Scranton 1982 and Bruneau 1984. Amongst other, the author was heavily criticized for uncritically applying modern-era quantitative methods in the study of an ancient city.

⁴⁷ Raban 1985; 1988; Euzennat 1987; Mohrange 2000; Zaccaria 2001; Fouache 2003; Fouache & Pavlopoulos 2005; Marriner & Morhange 2007, 144; Müllenhoff et al. 2009; Morhange & Marriner 2010; Delile et al. 2015a; 2015b; Kotarba-Morley 2015; Papatheodorou et al. 2015; Salomon et al. 2016.

⁴⁸ Blackman 1982a; 1982b; Oleson 1988; Rickman 1996; Blackman 2008b, 643-7; Wilson 2011b, 46-7.

⁴⁹ The term "harbour landscape" ("paysage portuaire") was first introduced by Charles Picard in his study of Roman harbour iconography in 1959.

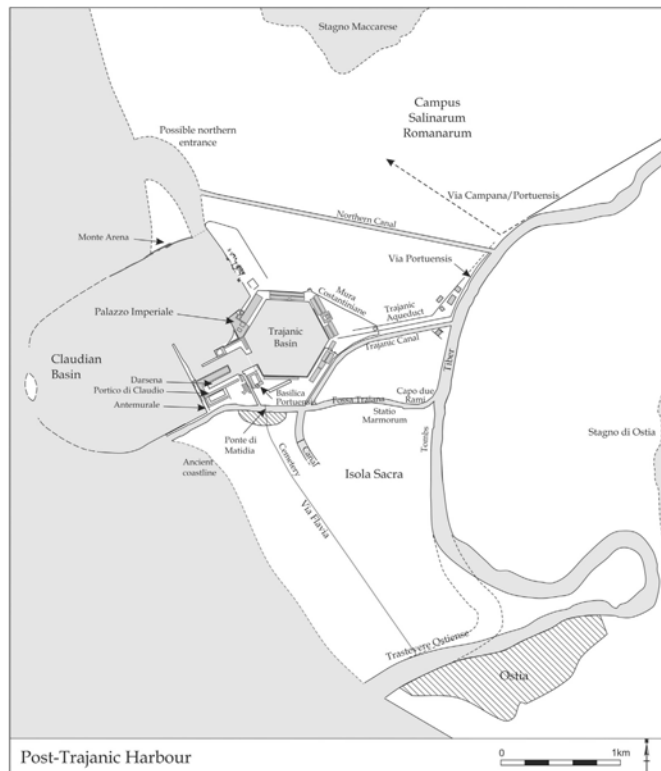


Fig.1.6. Map of the Portus and Ostia area in late antiquity, according to latest archaeological and geomorphological researches (Keay et al. 2014, Fig.2).

data, the publication remained inconclusive: fieldwork was limited to a brief underwater survey and small-scale land excavations,⁵⁰ whereas the technology of the harbour works was not discussed, nor were the implications of ship accommodation and handling. No comparative material from other harbours was studied and no new suggestions about the original form of the harbours were proposed.

Around the beginning of the 21st century and along with the advantages in survey and geophysical analysis methods the study of

Hellenistic and Roman harbours was enriched by a series of new methodological and theoretical approaches. Seamanship and harbours became part of a wider innovative debate over the economic history and archaeology of the period in a series of collective volumes.⁵¹ Commercial networks were explored through the diligent use of archaeological evidence concerning specific geographical areas and case studies as well as more general subjects.⁵² Maritime technology, including both shipbuilding and harbour construction, was targeted, as an essential part of economic and social history by the collective works of Damian Robinson, Andrew Wilson, William Harris and Kristine Iara.⁵³ Specialised studies on ancient Mediterranean seamanship by Pascal Arnaud and James Beresford also included its relationship with anchorages and harbours, focusing, however, mostly on ship technology,

⁵⁰ Submerged remains of the “Great Mole” and of Skardanas bay were surveyed and sondages were carried out at the area of the coastal warehouses/shops or “magasins”. For a review of the book of Duchène and Fraisse on Delos see Hellmann 2003.

⁵¹ Bresson & Rouillard 1993; Gallina Zevi & Claridge 1996; Archibald et al. 2001; Scheidel & von Reden 2002; Archibald et al. 2005; Scheidel et al. 2007.

⁵² Malkin et al. 2009; Demetriou 2012; Schäfer 2016; Constantakopoulou 2017; Leidwanger & Knappet 2018.

⁵³ Robinson & Wilson 2011; Harris & Iara 2011.

geography and climatic conditions.⁵⁴

Within this general scientific framework several collective volumes dedicated to harbours were published, dealing with specific case studies as well as with more general methodological and interdisciplinary issues.⁵⁵ The monumentality and organization of Hellenistic and Roman harbours of the Aegean and the Mediterranean in relationship to urban spaces was studied by Catherine Bouras and Stefan Feuser.⁵⁶ Other similar studies, based on recent interdisciplinary fieldwork, were also published for harbours of Asia Minor like Ephesus, Elaia, and Alexandria Troas.⁵⁷ Mantha Zarmakoupi and Federico Ugolini dealt with the iconography of Roman harbours in 2020. An important study of harbours in relationship to the political interplay in the Roman period was made by Arnaud in 2015. Other scholars targeted harbour networks. Bouras explored the harbour network of Roman imperial period in the Aegean,⁵⁸ Andrew Wilson, Katia Schörle and Candace Rice discussed the division of the Mediterranean into two distinctive harbour networks (east-west),⁵⁹ whilst the harbours of Portus/Ostia were thoroughly discussed in a series of publications (**Fig.1.6**),⁶⁰ in which their form and function, as well as their relationship with their hinterland and foreland was studied. The Roman maritime concrete technology was meticulously explored by the Roman Maritime Concrete Survey (ROMACONS) project⁶¹ that combined extensive fieldwork data and experimentation with the study of written evidence. New classifications of harbours were also devised in the same period by Nicholas Carayon and Chiara Mauro, both focusing on their geophysical configuration,⁶² whereas in 2013 Justin Leidwanger explored a series of late antiquity Cypriot harbours that were not equipped with any substantial harbour works, introducing the term “opportunistic harbours”.⁶³ In 2011 Katia Schörle, drawing upon earlier studies on historical geography,⁶⁴ suggested a hierarchical scheme of the Roman harbours of the Tyrrhenian coast based on their size and importance.

⁵⁴ Arnaud 2005; Beresford 2013.

⁵⁵ Ladstätter et al. 2014; Preiser-Kapeller & Daim 2015; von Carnap-Bornheim et al. 2018.

⁵⁶ Bouras 2012; 2014; Feuser 2020.

⁵⁷ On the harbour of Ephesus see Steksal 2014 and Ladstätter 2016, on Elaia see Pirson 2014 and Feuser et al. 2018 and on Alexandria Troas see Feuser 2009; 2011.

⁵⁸ Bouras (2008; 2016).

⁵⁹ Wilson et al. 2012).

⁶⁰ Keay 2010; Boetto 2010; Keay & Boetto 2010; Keay & Paroli 2011; Keay 2012; Germoni et al. 2018.

⁶¹ Brandon et al. 2005; 2014,

⁶² Carayon 2008; Mauro 2017.

⁶³ Leidwanger 2013, 221.

⁶⁴ Karmon 1985; Horden & Purcell 2000.

A similar approach was developed by Stefan Feuser in 2016, who suggested a division of harbours according to their function in long and short-distance trade and their importance in inter-urban trade, introducing the financial theory of the “central flow”⁶⁵ in the study of harbours and harbour cities (see also 1.3.3). A more inclusive and interdisciplinary landscape-based approach to a specific harbour case was made by Ania Kotarba-Morley in 2015, in her work on the harbour of Berenike Troglodytica in the Red Sea. The scholar combined written, archaeological and geomorphological data on the operation, development and demise of this harbour in close relationship with landscape dynamics, seamanship and commercial networks.

One final note should be made here concerning the recent scholarship in two of the case study harbours of this thesis, Lechaion and Delos. Lechaion was extensively surveyed and excavated between 2014 and 2018 by the Lechaion Harbour Project, a research that also included geophysical research and produced the first up-to-date evidence on the form and function of the ancient harbour.⁶⁶ Delos was, also for the first time, the target of a series of extended underwater explorations, starting with the Delos Underwater Survey Project (2013-16) and continuing with the Delos Underwater Project (since 2017).⁶⁷ Through underwater survey and excavation, as well as remote sensing and coring the two projects offered, for the first time, solid archaeological and geomorphological evidence on the form, evolution and function of these two important harbours.

1.3.2. Debates and discourses

Thanks to the development of the archaeology of harbours described above, as well as of the study of ancient Mediterranean seamanship and commercial history, a series of important debates and discourses have appeared in scholarship. These include various issues related to the research question of this study.

⁶⁵ Taylor et al. 2010.

⁶⁶ Güngör & Lovén 2018. Recent fieldwork on Lechaion also included a land survey and excavation project in close proximity to the Inner Harbour (Lechaion Harbour and Settlement Project), which, unfortunately, has not yet published any of its finds. For information on this project see <https://cla.csulb.edu/departments/classics/lechaion-harbor-and-settlement-land-project/> and <https://www.facebook.com/pages/category/Nonprofit-Organization/Lechaion-Harbor-and-Settlement-Land-Project-1113896465406374/>.

⁶⁷ Zarmakoupi 2015, 124-6; 2018b; Zarmakoupi & Athanasoula 2018.

One of the earlier debates regarding harbour archaeology focused on their relationship with urban environments, a very important aspect, as will be discussed in **Chapter 4**, of the operation of many harbours of the period studied (e.g. Lepcis Magna, Miletus, Ephesus), as well as of two of the case studies of this research (Delos and Kenchreal). In 1896 Edouard Ardaillon, the first excavator of Delos' Main Harbour area, underlined the connection of the harbour with the monuments, agoras and other buildings lying along the west coast of the island.⁶⁸ Pâris continued Ardaillon's study in 1916, but focused on the maritime façade of the city, not moving his scope any further inland, an approach also adopted by Lehmann-Hartleben in 1923.⁶⁹ This independence of harbours corresponded to the notion of their function as ports-of-trade⁷⁰ and as distinctive spaces "where the terrestrial zone of consumption and production abuts the maritime domain of redistribution and communication".⁷¹ Despite the fact that the importance of harbours as parts of great urbanization projects was duly recognized,⁷² many studies have focused on the existence of a more-or-less separated maritime façade, or on the strict delineation of harbour space through fortifications, gates or other monuments.⁷³ William MacDonald, in his seminar study on Roman architecture even suggested an antagonistic relationship of harbours with the adjoining cities.⁷⁴ This 'wall' between the city and the harbour was breached with recent studies that exploited the better understanding of the urban development of Hellenistic and Roman cities and suggested a new way of relating the two spaces. Nicholas Purcell underlined the complexity of the harbours of Rome in relationship to their urban hinterland and was followed by Pavlos Karvonis and Mantha Zarmakoupi who meticulously examined the commercial establishments and spaces of Hellenistic Delos (shops, warehouses, workshops) and showed that these were not concentrated in special

⁶⁸ Auguste Jardé, who continued the excavation of the Theatre Quarter of Delos, made some interesting observations concerning the difficulty of circulation between the city and the seafront, due to the narrowness of the crooked streets (1906, 640).

⁶⁹ Daum et al. 2014, 11. The integration of coastal cities with harbours was mostly observed through the formers' inclusion within the cities' fortifications, especially of the military ones (city walls were the only urban features included in Lehmann-Hartleben's plans).

⁷⁰ Polanyi 1957, 54; 1963.

⁷¹ Purcell 1996, 272, 277; cf. Horden & Purcell 2000, 392. The discussion over the form and function of the emporia in the Greco-Roman Mediterranean has been a long, complicated and ongoing one, with various approaches and debates concerning the whole subject (Bresson & Rouillard 1993; Demetriou 2012; Gailledrat et al. 2018).

⁷² Rougé 1966, 121; Boehm 2018, 127; Feuser 2020.

⁷³ Duchêne et al. 2001; Bouras 2008.

⁷⁴ MacDonald 1986, 262.

areas but dispersed all around the urban fabric.⁷⁵ This rendered the whole settlement a true ‘merchant city’ or an integrated *emporion*, as was suggested by Duchêne and Zarmakoupi,⁷⁶ with commercial functions dispersed within the whole city and the limits between the maritime façade and the urban hinterland being fluid and their relationship reciprocal and interchanging.

A similar debate, related to the spatial organisation, location, hierarchy and financial function of harbours concerns their relationship with their hinterlands and forelands and their role within commercial networks. The concept of hinterland and foreland was introduced to harbour studies by Jean Rougé in his seminal work on commerce during the Roman imperial period: the author underlined the importance of an extended hinterland for the operation of harbours, functioning as nodal points between “producer” and “consuming cities”.⁷⁷ The dependence of a successful harbour on a productive hinterland was acknowledged by Keith Hopkins, Yehuda Karmon and Ryan Boehm,⁷⁸ who all related important commercial networks and the harbours that served them with extended hinterlands and large cities that provided both the main goods exchanged (agricultural products) as well as the populations to consume them.⁷⁹ But although such approaches were rather straightforward in harbours adjoining large and densely populated regions like Carthage or Alexandria or “mega-cities” like Rome or Antioch,⁸⁰ recent studies showed the parallel operation of successful harbours lacking a proper hinterland and thus serving relatively small populations, like Hellenistic Delos⁸¹ or hinterlands lacking proper harbours and served by series of rudimentary, “opportunistic” harbours like Cyprus in late antiquity.⁸² In the first case such harbours could be associated with the operation of long-haul networks and the function of harbours as transit centres and clearing houses,⁸³ whilst in the second with smaller, but equally important, versatile and more dynamic local networks.⁸⁴

⁷⁵ Purcell 1996, 276-7; Karvonis 2008; Zarmakoupi 2013a; 2013b; 2014; 2018a.

⁷⁶ Duchêne 1993; Zarmakoupi 2018b.

⁷⁷ Rougé 1966, 121. The terms “producer” and “consuming cities” were introduced by Max Weber in 1958.

⁷⁸ Hopkins 1983, 105; Karmon 1985, 1-5; Boehm 2018, 127.

⁷⁹ Horden & Purcell 2000, 105-8.

⁸⁰ Karmon 1985, 3; Morley 2007; Boehm 2018, 127.

⁸¹ Reger 1994, 51-5; Zarmakoupi 2018b, 31.

⁸² Leidwanger 2013.

⁸³ Rostovtzeff 1941, 1263; Bresson & Rouillard 1993; Demetriou 2012.

⁸⁴ Horden & Purcell 2000, 393; Archibald 2005, 1; Alcock 2007, 686-9; Gambin 2012.



Fig.1.7. Artistic reconstruction of the lighthouse of Alexandria by Jean-Claude Golvin (<https://jeanclaudegolvin.com/en/>).

Infrastructure and technology concern another discourse over Hellenistic and Roman harbours, also related with harbour classifications and hierarchies. The impressive size and monumentality of several harbours, as documented in written sources (e.g. Vitruvius' descriptions of an ideal harbour)⁸⁵ and in a series of archaeological finds (e.g. the Severan harbour of Lepcis Magna or the famous lighthouse of Alexandria; **Fig.1.7**)⁸⁶ flagged them as “models of really clever and efficient planning and artistic creations of a high order, beautifully laid out and adorned with imposing buildings and decorative sculptures”, as eloquently described by

Rostovtzeff.⁸⁷ The further study of harbours like Lepcis Magna, Portus, Alexandria,⁸⁸ as well as the recent study of maritime concrete and dredging technology⁸⁹ confirmed the size and technical complexity of harbour infrastructures, as well as the amount of resources invested in them.⁹⁰ This approach relates to one of the longer and most complicated debates over the economic history of antiquity, particularly for the Roman period. ‘Substantivists’ see the economies of antiquity as predominantly based on subsistence, reciprocity and “non-market” exchange systems whereas ‘formalists’ or neoclassical economists see ancient economies as universal and highly advanced “market economies”, where utility maximization plays a crucial role, much like what happens in modern times.⁹¹ The approach of ‘formalists’ is in accordance with the refined organization of the large, monumental harbours of the period,

⁸⁵ Vitruvius 5.12.1. Cf. Dubois 1905; Casson 1971, 366.

⁸⁶ Bartoccini 1958; Blackman 2008b, 643-9; Oleson & Hohlefeldler 2011, 814-9; Empereur 2004.

⁸⁷ Rostovtzeff 1941, 1042.

⁸⁸ Bartoccini 1958; Feuser 2020, 188-228; Rickman 1996; 2002; Keay 2012a; Goddio & Bernand 2004; Goddio & Fabre 2008, 266-74.

⁸⁹ Morhange & Marriner 2010; Brandon et al. 2021; Salomon et al. 2016.

⁹⁰ Paterson 1998, 161.

⁹¹ Polanyi 1957; Archibald 2005, 3; Reger 2005, 331.



Fig.1.8. View of the cove of Avdimou in Cyprus, where, according to archaeological finds, an important local harbour operated in the Late Roman period (Leidwanger 2013, Fig.7).

as well as with the increased employment of bulkier, more advanced merchantmen, which would correspondingly require larger and deeper harbours, something that culminated within the framework of a “proto-industrial” economy of the Roman world.⁹²

A closer look, however, at many harbours of the period revealed a more complex image. Catherine Delano Smith, in her seminal work on the

historical geography of the Western Mediterranean, was the first to underline the diachronically successful operation of smaller and shallower harbours, equipped with little (or none at all) harbour infrastructures (**Fig.1.8**).⁹³ Karmon suggested a clear distinction between less elaborate harbours serving local traffic and the ones related to long distance, ‘great’ trade.⁹⁴ Such an approach has been productively exploited in more recent years with studies dealing with the parallel operation of short and long-haul trade networks⁹⁵ and the corresponding configuration of harbours, even when dealing with specialised cargoes like marble and stone.⁹⁶ This notion most likely reflects the operation of smaller, simpler merchantmen in ‘secondary’ or local trade networks. The lack of substantial infrastructure has also been thoroughly noted at least for one of the case studies, Delos, by Duchêne, Zarmakoupi and Alain Bresson.⁹⁷ Such ‘simple’ harbours might support substantivist approaches, according to which ancient economy was predominantly tied to its environment and did not involve utility maximisation.⁹⁸ The possibility, however, of harbours to serve both types of commerce has been little explored, studies focusing on either the ‘great trade’

⁹² Rougé 1966, 71-3; Archibald 2005, 10; Pomey 2011, 48-9.

⁹³ Delano Smith 1979, 361-5.

⁹⁴ Karmon 1985, 5-6.

⁹⁵ Hopkins 1983, 85, 94-6; Davies 2001, 21-2; Lawall 2005, 202; Tchernia 2011, 88.

⁹⁶ Russell 2013a, 139-40.

⁹⁷ Duchêne 1993, 125; Zarmakoupi 2013b, §5-7; Bresson 2016, 90-1.

⁹⁸ Polanyi 1957; Archibald 2005, 3.

mostly of grain towards the great urban centres, or on local networks and cabotage.⁹⁹ This study can shed light on this issue by clarifying the capacity of harbours in terms of ship traffic as well as in terms of cargoes they can handle.

Directly linked to the sophistication and the existence or not of harbour infrastructures, as well as to the debate over ‘substantivism versus formalism’ or “primitivism versus modernism”,¹⁰⁰ is the advance of the technology of harbour works. A rather linear development was suggested by David Blackman, progressing from the relatively primitive “Phoenician” rock-cut harbours to the sophisticated concrete ones of the Roman period, a view followed by later scholars too.¹⁰¹ But this scheme has been challenged: the survival of the “Greek” method, attested by various ashlar moles dating to the Roman period (e.g. Kenchreai, Kyme, Lepcis Magna), as well as the absence of advanced harbour works in whole regions like Cyprus has shown that the issue of harbour technology development is more complicated than once thought.¹⁰² This is one of the issues discussed in this study too.

Harbour infrastructures as well as the development and application of specific construction and maintenance technologies are both issues related with the role institutions (states, rulers, cities, laws) played in contemporary economy and commerce. Scholars in the past, like Jean Rougé or Neville Morley, had recognized only a marginal, usually driven by political and not practical reasons, intervention by the state, especially the Roman one, in the creation of networks and harbours.¹⁰³ Nevertheless, sources documenting state intervention in the construction of harbours and in the facilitation of trade,¹⁰⁴ as well as the high costs of harbour construction and maintenance,¹⁰⁵ point towards more active and efficient intervention schemes. Neoclassicism and New Institutional Economics, focusing largely on the role institutions played in economy, commerce and subsequently the operation of harbours in the ancient Mediterranean, have recently tackled these issues

⁹⁹ Wilson et al. 2013; Gibbins 2001, 288.

¹⁰⁰ Reger 2005, 331.

¹⁰¹ Blackman 1982a; 1982b; 2008; Rickman 1996; Wilson 2011b, 46-7.

¹⁰² Robert Hohlfelder (1985) was one of the first scholars to note, based on archaeological data, the slow pace of the construction of the Roman harbour of Kenchreai, whereas Justin Leidwanger (2013) explored a series of Cypriot harbours that were not equipped with any substantial harbour works, introducing the term “opportunistic harbours”.

¹⁰³ Rougé 1966; Morley 2007, 585; Beresford 2013, 51-2.

¹⁰⁴ Garnsey 1998, 533-5; Arnaud 2015b.

¹⁰⁵ MacDonald 1986, 262; Arnaud 2025b, 66-7.

through a series of very useful analyses.¹⁰⁶ According to them state intervention, practiced through political and monetary unification, establishing prices of foodstuffs, suppression of piracy¹⁰⁷, introduction of new technologies and creation of harbour networks¹⁰⁸ not only would lower the costs of sea transportation but would also improve the overall well-being of people, allowing for the intensification of trade and subsequent financial growth, despite the fact that economy remained largely dependent on agriculture.¹⁰⁹ The relationship of state agents with harbour construction, operation and maintenance is related to the scope of this study, contextualizing the results of my research with contemporary economy and society.

Classification of harbours is a final important debate in scholarship and a methodological and interpretative tool that concerns both their configuration as well as their function, issues directly connected with the scope of this thesis. The main and quite straightforward, division between harbours serving naval galleys and merchantmen or commercial galleys, often under the terms *λιμὴν κλειστός* (closed harbour) and *ἐμπόριον/emporion* respectively, was introduced by Lehmann-Hartleben in 1923, and is still widely employed, especially in Classical and Hellenistic sites where naval arsenals were common.¹¹⁰ Nevertheless this was not a universal rule, with harbours like Kos, Delos or Marseilles¹¹¹ combining both functions. A more explicit classification of commercial harbours, based on their function in trade networks was suggested by Rostovtzeff as early as 1941. Rostovtzeff classified harbours as: a) outlets of specific hinterlands, b) termini of important trade routes and c) transit ports or clearing houses.¹¹² This classification preceded subsequent notions of harbours as gateways to hinterlands as well as ports-of-trade (see above) and also addressed the importance of harbours located at the ends of trade routes but was unfortunately never used as a platform for any further study of ancient harbours. A different typology related with the harbours' spatial, natural or artificial, configuration was devised by Carayon on the Phoenician and Carthaginian harbours and by Mauro on the Archaic and Classical harbours of Greece.¹¹³ These scholars focused on the geographical

¹⁰⁶ The most important papers on the application of New *Institutional Economics in ancient economy can be found in the Cambridge Economic History of the Greco-Roman World* (Scheidel et al. 2007).

¹⁰⁷ Lo Cascio 2007, 226-7.

¹⁰⁸ Morel 2007; Robinson et al. 2020.

¹⁰⁹ Schneider 2007, 169-70.

¹¹⁰ Blackman & Rankov 2013, 185-230; Bouras 2014.

¹¹¹ Dûchene et al. 2001, 153-4; Hesnard et al. 2001, 174; Bouras 2014, 677.

¹¹² Rostovtzeff 1941, 1263-4.

¹¹³ Carayon 2008; Mauro 2017.

configuration of harbours and the existence or not of harbour works. They did not, however, deal with later harbours, nor did they include data on the actual size, depth and function. Harbour size was targeted by Schörle in her study of the Roman harbours of the Tyrrhenian coast, but the scholar, whose scope was regional, deliberately avoided creating a strict typology based on that, due to the lack of evidence, roughly dividing and ranking harbours as: a) major ones, b) small ones, c) off-coast island and d) villa harbours.¹¹⁴

1.3.3. Ships and harbours: towards a combined study

As discussed above, scholarship has predominantly engaged harbours in relationship to their commercial role, as well as their connection with the hinterland, the urban fabric around them and their architecture, but has rarely explored the connection between ships and harbour spaces. Ships on the other hand have been meticulously studied in terms of shipbuilding, operation and cargo, but not in relationship to the places where they were bound to sail from and to. Several attempts have been done, however, for such a combined study, some of which have provided stimulus and are important predecessors for this study.

The first scholar who studied harbours and ships in a common context was Pâris. The pioneering archaeologist calculated a maximum of 100-150 merchantmen docked side-first on what he considered as a series of continuous docks on the west coast of Delos' city. This was a totally arbitrary number, since Pâris lacked data on both the actual configuration of ancient and the original form of the harbours and the coastline.¹¹⁵ But Pâris also proceeded in other relative fields of study, by addressing Delos' geographical position, ancient sea routes and climatic conditions, protection from the prevailing winds, and by also using ethnoarchaeological parallels (from the harbour of Mykonos) concerning the beaching of ships and the possible use of quays. Pâris laid down the guidelines of a proper interdisciplinary approach, in which all available data would be combined to reach a comprehensive understanding of a harbour's function and operation, especially concerning ships and seamanship.¹¹⁶

¹¹⁴ Schörle in 2011.

¹¹⁵ Pâris 1916, 33. Despite his overall meticulousness, Pâris did not explain how he reached the number of 100-150 ships that he considered to have been able to use the basins of Delos' harbour.

¹¹⁶ Pâris 1916, Figs.4-7, 9, 15. The classical archaeologist Armin von Gerkan, in a short article about ancient Mediterranean harbours, included in the honorary volume for Wilhelm Dörpfeldt's 80th birthday (von Gerkan 1933, Fig.5), published an interesting cross-section reconstruction of the quays of Lepcis Magna, where he placed the stern of a galley, resting on a strip of beach dividing the quays with the sea and being

Casson was the first to recognise the importance of specialised service vessels for ancient harbours, initially in his study of the harbour and riverboats connecting Portus/Ostia with Rome and then in his seminal work on ancient Mediterranean ships and seamanship.¹¹⁷ In the former harbours and ships of all types were discussed in adequate detail, but little was done towards an inclusive account of how they interacted and influenced each other, despite the author's knowledge on ancient ships. This approach was also followed by Shaw in his 1972 discussion on Hellenistic and Roman harbours who did not consider the practical issues of the operation of ships and cargoes within harbour environments either.¹¹⁸ The issue of ship handling within harbours was briefly but aptly discussed in 1979 by Delano Smith, who underlined both the limited size and lack of infrastructure of various harbours (see above **1.3.2**), as well as the importance of ship draught and harbour depth. Although the geographer did not discuss the issue in detail, she thoroughly flagged the complex nature of harbour configuration and ship operation within them, as well as the need for a combined study of the subject.¹¹⁹ Delano Smith's overall approach was implemented in studies in the following decades, but these mostly targeted the harbours' natural and human geography,¹²⁰ whereas others addressed the important issue of size and tonnage of ancient ships,¹²¹ but without properly combining the two fields within a common framework.

An effort to relate ship and cargo traffic with the harbours of a 'port-city' was attempted by Papageorgiou-Venetas in 1981. The author incorporated data on late Hellenistic and early Roman merchantmen and calculated the number of ships that could use the harbours and the storage facilities of Delos in relationship to the total amount of imports of the settlement. His conclusions were, however, problematic. By not considering the

tied to one of the large mooring stones of the harbour. This reconstruction took into consideration sea level change, inability to construct ashlar moles underwater and the possibility of ships berthing at a distance from the quays, all ideas that will be explored in my thesis. Unfortunately von Gerkan did not discuss this image, nor did he make any further similar suggestions for other ancient harbours.

¹¹⁷ Casson 1965; 1971, 329-43.

¹¹⁸ It is quite interesting that Shaw, although using more detailed and up-to-date data, did not properly address the issues of ship accommodation and harbour function and did not include any bathymetric data in the plans he published, whereas in the cases of Delos and Lechaion, he reproduced the obsolete and highly inaccurate plans of Ardaillon and Georgiades.

¹¹⁹ "The full story of the coastlands, the coastal cities, and the ports of Mediterranean Europe, has not yet been told" (Delano Smith 1979, 327). The author also correctly speculated that the maximum draught of most of the Roman period merchantmen did not exceed 3 metres.

¹²⁰ Rickman 1985; 1988; Karmon 1985; Horden & Purcell 2000; cf. Schörle 2011, 93.

¹²¹ Houston 1988; Nantet 2016; 2020c.

change in sea level, despite it having been already confirmed by geologists,¹²² the author basically replicated Pâris' plans, considering the quays of the Main and Merchant Harbours as proper docks where ships of any draught could berth. As for the handling of cargoes, his calculations were based on the assumption that all merchantmen of the period were *myriophoroi* (10,000 amphorae carriers; see **Chapter 2**) and not ships of any other capacity. No alternative methods of using the island's harbours were considered and, although bathymetric data were thoroughly included in the maps produced, the connection with the draught of ships using the harbours of the island was not discussed.

With the renewed interest in the commercial history of the Hellenistic and Roman Mediterranean and the introduction of quantitative methods in scholarship at the beginning of the 21st century a series of new studies fruitfully explored the relationship of ships and harbours. Geoffrey Rickman and Johann Brand discussed the cargo volume and its handling in the harbours serving Rome, also relating it with ship tonnage and loading/unloading practices, but not ship draught and alternative methods beyond docking.¹²³ Gregory Votruba followed, with his studies on the anchoring techniques, as well as of various beaching methods in the ancient Mediterranean, without, however, addressing the issue of draught in detail.¹²⁴ Draught was briefly mentioned by Sabine Marlier and Piero Dell' Amico in relationship to the ability of the small-draught *dolia* carriers to navigate shallow estuaries and rivers,¹²⁵ but it was Giulia Boetto who, in 2010, for the first time approached a Roman harbour as "seen from the sea" ("vu de la mer").¹²⁶ In this brief but well-researched article, the scholar suggested a model for how ships would have used Portus, mainly its best-known Trajanic extension and the channel network around it. She did so by exploiting all available material on the site, drawing upon data from ships lost at sea or scuttled (especially of the local Fiumicino harbour/river ships) and proposing a division of zones, based on an updated division of ship types according to their tonnage and draught. Boetto explored the possibility of specific harbour areas to accommodate and serve ships of certain size and draught, including the *statio marmorum* (marble sector) and underlined the variability of ships of different types and tonnage using the harbour. Although the article did not include any

¹²² Flemming et al. 1973; Flemming 1980.

¹²³ Rickman 2002; Brandt 2005.

¹²⁵ Marlier 2008; Dell' Amico 2011.

¹²⁶ Boetto 2010, 112.

bathymetric data,¹²⁷ as well as alternative ways of using the harbour, it illustrated a holistic, multidisciplinary approach to the problem of harbour capacity and ship/cargo handling, an approach that will also be an essential part of the methodology of this thesis. The role of ships in the creation and development of a harbour was also studied in length by Kotarba-Morley on her study of the Berenike Troglodytica on the coast of the Red Sea, where extended data on local ship typology, configuration and methods of use was fruitfully incorporated in the discussion over the operation of a specific harbour.¹²⁸

1.4. Methodology

What becomes evident through the analysis of the research question and the literature review of the previous pages is the need to design and implement a new methodology that can answer this study's research question. The lack, with few exceptions, of more detailed and inclusive studies on the role ship and cargo handling played in the operation and development of ancient harbours was caused not only by the lack of interest of early scholars, but also by the lack of a suitable methodology that could be applied to more than one case study. In the following pages I will present and clarify this methodology, its main concept, phases and tasks, as well as the reasons why specific case studies were chosen and how various types of data were selected and approached throughout it.

1.4.1. Methodological principles, tools and stages

This study is based on a fundamental principle that connects its research question, aims and methodology: harbours are spaces and structures whose function and success is founded on their relationship with the ships and the cargoes that are handled through them. In order to comprehend their operation and development one needs to have a clear understanding of the ships that use them, as well as the form these harbours have and the possible ways ships and cargoes can be handled within them. Thus any analysis of ancient harbours as centres of commerce and seamanship must be based on a solid knowledge of their original form and operation in relationship predominantly to ship and cargo traffic, as these are documented through all available sources. Harbours must be seen 'through the eyes of the mariners',

¹²⁷ The studies on the original depth of Portus and Ostia were only published later (Vittori et al. 2015; Salomon et al. 2016).

¹²⁸ Kotarba-Morley 2015, 291-355.

their operation and association with their contemporary world indispensably connected with their nautical function.

In order to understand the relationship of ancient harbours with ships and cargoes the methodology of this study was developed around the concepts of inclusiveness, collectiveness, quantification and standardization. This is due not only to the multi-levelled function of harbours as centres of shipping, commerce and other human activities (see **1.2**), but also to their complex dual nature as natural and anthropogenic “amphibious” spaces.¹²⁹ Harbours combine natural features like size, depth, exposure to the sea, types of seabed and coastline with human interventions of various forms, such as protective works, dredging operations and commercial infrastructures.¹³⁰ They are also commonly related with coastal cities, with which they develop a reciprocal relationship, especially within common schemes of financial growth and urban planning (e.g. Delos, Miletus, Ephesus),¹³¹ but also with other cities located further inland whose trade they serve (e.g. Corinth, Rome, Pergamon).¹³² Thus a variety of data (ship form and equipment, harbour configuration and infrastructure, climatic conditions etc.) has to be examined and synthesised in order to reach a reliable reconstruction scenario (or scenarios) of the original configuration of harbours and of the ship and cargo traffic that took place within them.¹³³ By examining only certain datasets one cannot have the full picture of the complex operation of a harbour and a more inclusive approach that combines every form of information that relates to the fundamental function of harbours as ship havens and centres of sea-borne commerce is necessary.

Standardization is required in order to produce results that are comparable and relatable to each other and is done through the creation of planar reconstructions that highlight the same aspects of harbour operation: shore configuration, depth, size and type of harbour works and land infrastructures related with the function of each harbour. Standardization is also achieved via the creation of comparative tables that concern the characteristics of the ships of the period (size, tonnage, draught, cargo) as well as the size of the case study harbours and of other contemporary ones and the number and typology of

¹²⁹ Delano Smith 1979, 326-7. See also the use of the term “amphibious” for the inhabitants of the coasts of the Mediterranean by Strabo: “for we are in a certain sense amphibious, not exclusively connected with the land, but with the sea as well” (1.1.16).

¹³⁰ Wilson 2011b, 46-51.

¹³¹ Feuser 2020, 9-20.

¹³² Salmon 1984, 31-7; Keay 2012b, 39-52, Steksal 2014.

¹³³ Kotarba-Morley 2015, 356-61.

ships that could be accommodated within them. This codification of data through plans, reconstructions and tables provides a platform for any further analysis and facilitates the extraction of conclusions and the answering of this thesis' research question. It also organizes the data used in this study in a coherent way for use by future scholarship.

Quantification is another important element of the methodology of this study, directly related with standardization. The operation of harbours is, as already underlined, fundamentally dependant on the practicalities of ship and cargo handling, both elements of material culture that can be properly studied through quantification methods. Such methods have already been employed not only to the study of the ancient economy and commerce¹³⁴ but also to seamanship and harbour archaeology (see also **1.3.2**)¹³⁵ and have offered important results, based on finds and not on often vague and fragmented historical sources. Such a methodological tool can also greatly assist the organization of material used in this study as well as strengthen all following analysis by providing tangible, precise and comparable results, essential for the best understanding of any material object or space, such as ships and harbours. In the case of the harbours studied in this thesis evidence that can be exploited through standardization includes ship size and draught, harbour size and depth, as well the capacity of harbour infrastructures (warehouses, agoras etc.) to handle ship cargoes of various kinds (grain, stone, enslaved people etc.).

Within this framework reconstruction is a fundamental tool of analysis and forms the core of the methodology developed here. There are two reasons that make reconstructions so important and they correspond to two levels of research and analysis respectively: on the one hand the great dynamics of the coastal environment of the Mediterranean (sea level rise, subsidence and uplift incidents and siltation), as well as human intervention of various kinds (reclamation, dredging and destruction of ancient remains),¹³⁶ have largely altered the form ancient harbours have today. As we will see in **Chapter 3**, all three case studies have been largely affected by natural or human factors (siltation and human intervention Delos' Main Harbour, subsidence in Kenchreai and sea level rise in all three sites). In order to understand the original function and capacity of these harbours, we must reconstruct their original configuration as well as the original form of harbour works and infrastructure

¹³⁴ Schneidel & von Reden 2002; Wilson 2009

¹³⁵ Parker 1992a; Brandt 2005; Boetto 2010; Kotarba-Morley 2015, 229.

¹³⁶ Marriner et al. 2014; Marriner & Morhange 2006; Marriner & Morhange 2007, 146-62; Kotarba-Morley 2015, 25-6.

(jetties, quays, lighthouses, urban landscape etc.). On the other hand the reconstruction of harbour capacity and operation concerning the numbers and tonnage of ships that could be accommodated there, based on the aforementioned reconstruction of the harbour environment during the period studied, forms the basic analytical tool of this research. It tackles one of the thesis' main questions, which concerns the number and type of ships that could fit inside harbours and the ways this could be done.

These two types or levels of reconstruction are achieved through the application of illustrative methods that unify and codify different types of data into detailed site plans and different types of reconstruction. Such methods have been known and employed in various fields of archaeology, especially concerning topography and the handling of survey and excavation data (mainly through the application of Geographic Information Systems),¹³⁷ but concerning architecture have largely been limited to teaching purposes and informing the public, especially the digital re-creations.¹³⁸ As such they have illustrated studies and have summarized results but have not been used as analytical and interpretation tools with few exceptions.¹³⁹ The division between architecture and archaeology, the first creating 'snapshots' of architecture and urbanism, unrelated with the contemporary historical background, and the second "building components and spaces, rather than ancient city-scapes"¹⁴⁰ has created a gap in methodology and scholarship. The methodology applied in this study does not aim in the plainly visual recreation of the ancient harbour landscapes but on the combination and cross-referencing of various types of data and the production of different scenarios through the creation of these reconstructions. This concerns data like ship draught and harbour depth that is not visible in a graphic reconstruction but that largely dictate the actual function of these spaces.

The analytical potential of bridging the two fields of harbour and ship archaeology through reconstructing harbour space and ship traffic is a very important asset of this study.

¹³⁷ Wheatley & Gillings 2002; Chapman 2006; Conolly & Lake 2006.

¹³⁸ Novitski 1998.

¹³⁹ Boetto (2010) used the latest research data on the harbour of Portus to include data on ships and their size by inserting ship figures in scale within the plan, in a way very similar to the methodology of this thesis. The architectural remains of Portus were also thoroughly studied through 3D and procedural modelling and analysis by the Portus Project (www.portusproject.org), but the analysis remained limited to land infrastructures and their architecture and did not include data on harbour depth and the coastline, focusing largely on the reconstructions' educational role. In a similar manner, although not considering harbours, Diane Favro and Christopher Johanson (2010) used virtual reality reconstructions to insert human figures in the Roman Forum and explore the human experience aspects of funeral processions.

¹⁴⁰ Favro 2006, 322-3.

On the one hand it consists a crucial part of the assessment and combination of data. Several questions appear during the creation of different reconstructions of the harbours discussed (size, original form of coast and harbour works, depth, seabed etc.) and have to be sufficiently answered through this process. This greatly improves the level of understanding of each harbour's form and function and helps combining and comparing different datasets within the same working context. It also allows the presentation of the results of this study in a comprehensive way for the reader, clarifying the points made by the research. A series of mapping and illustration software tools are used, as we will see below, in combination in this research (Autodesk CAD, ESRI ArcGIS, Adobe Illustrator), always according to the aims of the study in each phase and to the best representation and analysis of data.¹⁴¹ An important criterion for the choice of software is its ability to recreate harbour landscapes and include and represent all the data considered necessary for the purposes of this study.

The basis for every reconstruction is updated and metrically accurate surveys of the harbours studied, which are found in various recent publications of these sites (see **Chapter 3**). The archaeological remains are naturally included, as these are documented in various topographical surveys (e.g. the inclusive and highly detailed Atlas of Delos by the EFA or the 1903 topographical survey of Lechaion).¹⁴² Older surveys, despite their possible topographical inaccuracies, are also important for the documentation of structures and features now obscured by modern development (e.g. the first plans of Delos' Main Harbour).¹⁴³ Equally important is the bathymetry of the harbours discussed. This has been documented in detail in previous publications, with data either taken from the maps of the Hydrographic Service of the Greek Navy (Lechaion and Kenchreai) or by special fathoming surveys (Delos).¹⁴⁴ Further data can be found in naval maps of the 18th and 19th century, which, although not always as accurate as more recent surveys, document not only features today lost or obstructed (coast configuration, ancient remains) but, very importantly, also the use the harbours by sailing ships in the past (particularly in the case of Delos).¹⁴⁵ Finally

¹⁴¹ Although adequate topographic and architectural data exist for the case study sites, allowing for the creation of intricate virtual reality models, these have been considered unnecessary for the purposes of this study. Simpler and more convenient mapping schemes have been chosen since it is beyond the scope and potential of this study to make 'realistic' recreations of whole urban areas (for a critical approach on the use of virtual reality in archaeology see Gillings 1997, 253 and Favro 2006, 326).

¹⁴² Skias 1907, T.I; Moretti et al. 2015.

¹⁴³ Ardaillon 1896, Pls.II-III.

¹⁴⁴ Georgiades 1907, Pl.I; Scranton et al. 1978, Fig.4; Duchêne et al. 2001, 36-9, Theodoulou 2002, Fig.11.

¹⁴⁵ Gallois 1910.

satellite and aerial photography provide further information on the configuration of the harbours today, of various natural and anthropogenic features of the coastline and seabed, as well as of recent changes not yet documented in scholarship (e.g. the movement of the northern rubble jetty at Delos' Main Harbour due to wave and drift action; see **3.1**). Such photographs have been obtained through Google Earth mainly, but also through the already georeferenced aerial map of Delos provided online by the EFA (sig-delos.efa.gr). Older aerial photographs have also been examined (e.g. the 1960 aerial photograph of Lechaion by the Geographical Service of the Greek Army)¹⁴⁶ but have been included in the data only if they provided new evidence for the harbour sites.

After their collection and first evaluation the data described above is digitized and combined with the use of AutoCAD software. Maps and aerial photographs are inserted in CAD files and are georeferenced in accordance to topographical data included in them (the Atlas of Delos provides such information) or, when these are absent, in accordance to various features of buildings and the coastline, as accurate as possible. This can be a tedious process especially for early plans of the harbours studied where survey data are inaccurate and several features have to be incorporated with a certain degree of acknowledged inaccuracy (e.g. the first plan of Delos' Main Harbour).¹⁴⁷ With different maps, plans and photographs placed at their right position new maps are created by tracing the old ones in AutoCAD. The features related to the scope of this study (shoreline, bathymetry, harbour works, coastal buildings etc.) are especially highlighted in this process (**Fig.1.9A**).

¹⁴⁶ Theodoulou 2002, Fig.3.

¹⁴⁷ Ardaillon 1896, Pls.II-III.

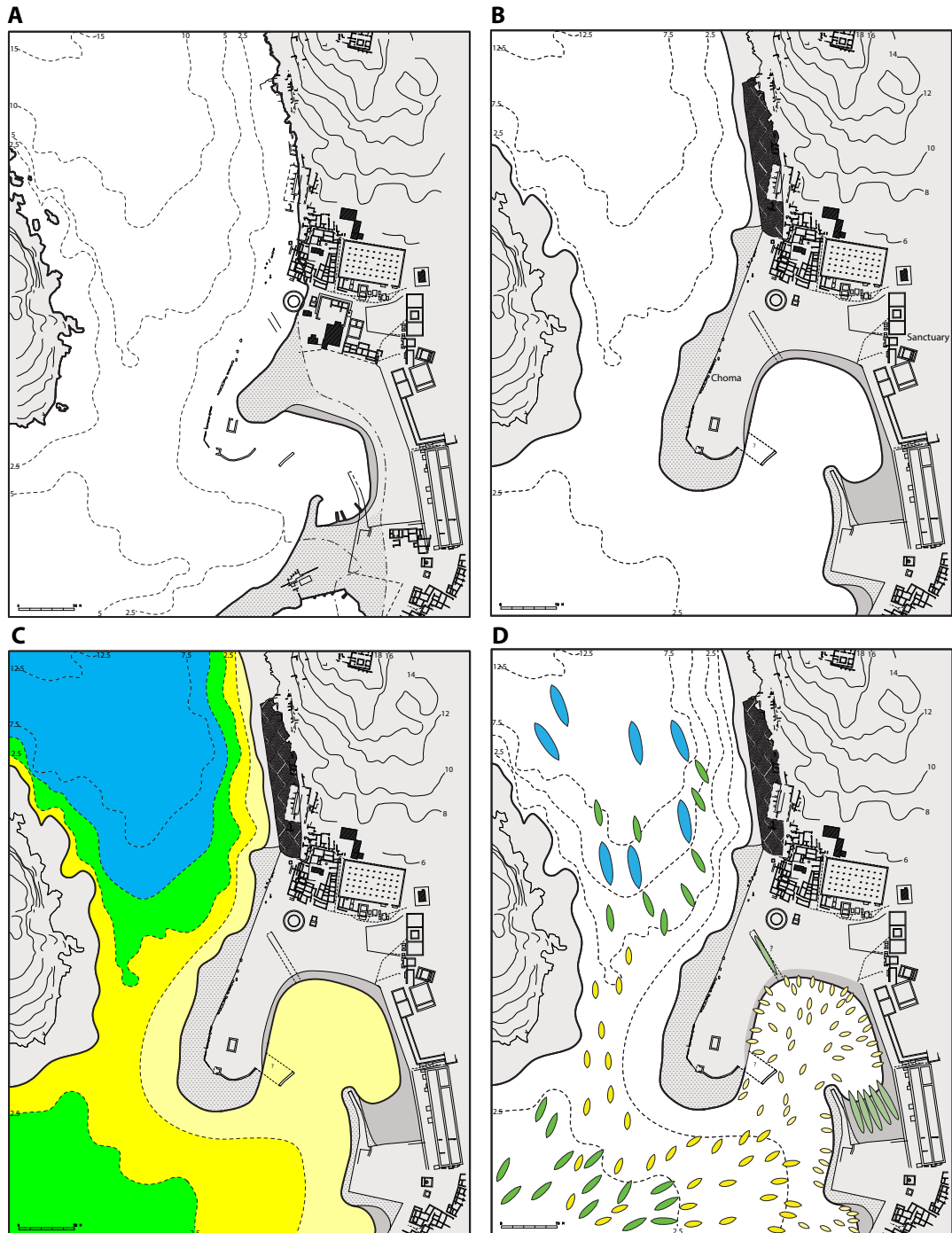


Fig.1.9. The four stages of harbour reconstruction employed in this thesis, as seen through the example of Delos' Main Harbour: A. The harbour as it is today. B. The harbour as it would have been during antiquity. C. The harbour divided in zones according to its approachability by ships of different draught. D. A suggestion of how ships could have used the harbour in antiquity (drawings by the author).

A very important part of the reconstructions is bathymetry. The available material documents bathymetry rather roughly, in certain cases with contours spaced at a distance of up to 5 m (Delos) and often along sporadic soundings (Kenchreai). In order to create a more detailed bathymetric relief of the harbour sites' seabed this data is inserted in ArcGIS and

new, more detailed contours are produced, that can then be used for the more detailed calculation of the ancient sea level and accordingly harbour depth.¹⁴⁸ Finally the maps created are rendered through Adobe Illustrator in order to be more clear and comprehensive to the reader, as well as to facilitate their handling as vector files. Colours and special hatching are also added at this stage in order to make the final reconstructions easier to read and understand, especially concerning the different depth zones and types of coast (beaches, rock, reefs).

These maps form the basis for the reconstruction of the harbours studied as they were during the Hellenistic and Roman period (**Fig.1.9C-D**). The first task is to adjust the sea level according to the geophysical data and to move the shore accordingly. In most cases the sea level has considerably risen (2-2.5m), whereas in certain cases (Delos' Main Harbour, Lechaion's Outer Harbour) siltation has also affected the configuration of the basins. The change in the sea level affects also the bathymetric contours that have to be similarly adjusted. In the case of Delos' Skardanas Harbour and Lechaion due to the dynamic coastal environment, where the sea level rise is combined with uplift and siltation, two reconstructions are created, each corresponding to a different scenario concerning the original form of the harbour (see **3.1** and **3.2**). Another important task is to remove any modern structures and recreate the original bathymetry beneath them (namely the rubble moles around Delos' Main Harbour where contours are available thanks to soundings undertaken before the construction of the modern moles). Harbour works and structures along the coast are also reconstructed with caution to indicate clearly the parts added and recreated even when this is done with great probability. Finally a series of cross-sections of the harbour basins are created, based on the previous plans. This is done not only to make the harbours' configuration clearer but also to test, in the following stage of analysis, the ability of ships of various types, sizes and draught to approach and use these areas, how close they could approach the shore and harbour works and the ability of people to approach them through walking in shallow water.

¹⁴⁸ It should be noted here that the ArcGIS software has been used only for this purpose in this study and not for the inclusion of all available data. This has been done because it has been considered easier to create CAD files that incorporate all available data, since this data concern mainly the topography and structures of the harbours discussed and not excavation data, whereas the various analytical tools offered by the GIS software (e.g. visibility, distance, hydrology) are not useful for the purposes of this study, addressing issues related with the land and not the water area.

Having reconstructed the original configuration of the case study harbours the next task is to insert ships into them. This is done in two steps: the first one is to divide the sea areas in and around harbour basins in zones according to the spaces that ships of different draughts could use according to the reconstructed bathymetry (or bathymetries in case of different scenarios) and the draught these ships would have, which is presented in **Chapter 2 (Fig.1.9C)**. The second step is to calculate the number of ships that could practically fit in these spaces, as well as the docks and beaches of these harbours. Thanks to the reconstruction of the harbour basins in CAD software it is easy to calculate the areas each depth zone covered and by using the maximum space ships of various kinds would occupy, as this was assessed through the study of shipwrecks and texts in **Chapter 2**, we can calculate the maximum number of ships each zone could accommodate (**Fig.1.9D**). An issue that arises here is the discrepancy between the maximum number of ships that could theoretically fit into harbour areas and the actual number that could be accommodated there and still allow enough space for ship circulation and handling. The aforementioned method allows for the calculation of a theoretical, maximum number of ships that could be accommodated within harbour basins, a highly unlikely scenario since cramping ships next to each other would leave little space for the circulation of other vessels and could also be dangerous in case of an abrupt change of wind. In order to suggest a more functional number and typology of ships that could use the case study harbours an empirical method is employed: the figures of ships of different sizes are inserted into the reconstructed plans of the harbours studied according to the areas that were approachable by them. This allows for the creation of a more credible scenario of how these harbours could have functioned, with respect to the size of ships, depths, as well as the protection offered by natural or artificial features.¹⁴⁹

A final tool of analysis of the evidence and presentation of the results of this study are free-hand drawings that constitute the final stage of the reconstruction process. They, on the one hand, serve the comprehensive presentation of the results of this study to the reader and on the other they constitute part of the analysis. In order to create these drawings I have to combine different kinds of data concerning the harbours (landscape,

¹⁴⁹ For a similar method of inserting ship figures in scale in the reconstruction of an ancient harbour see Kotarba-Morley 2015, Figs.7.50-1. Nevertheless in Kotarba-Morley's study no bathymetric data was included, neither any different type of ships than ships covering an area of 25x7 metres.

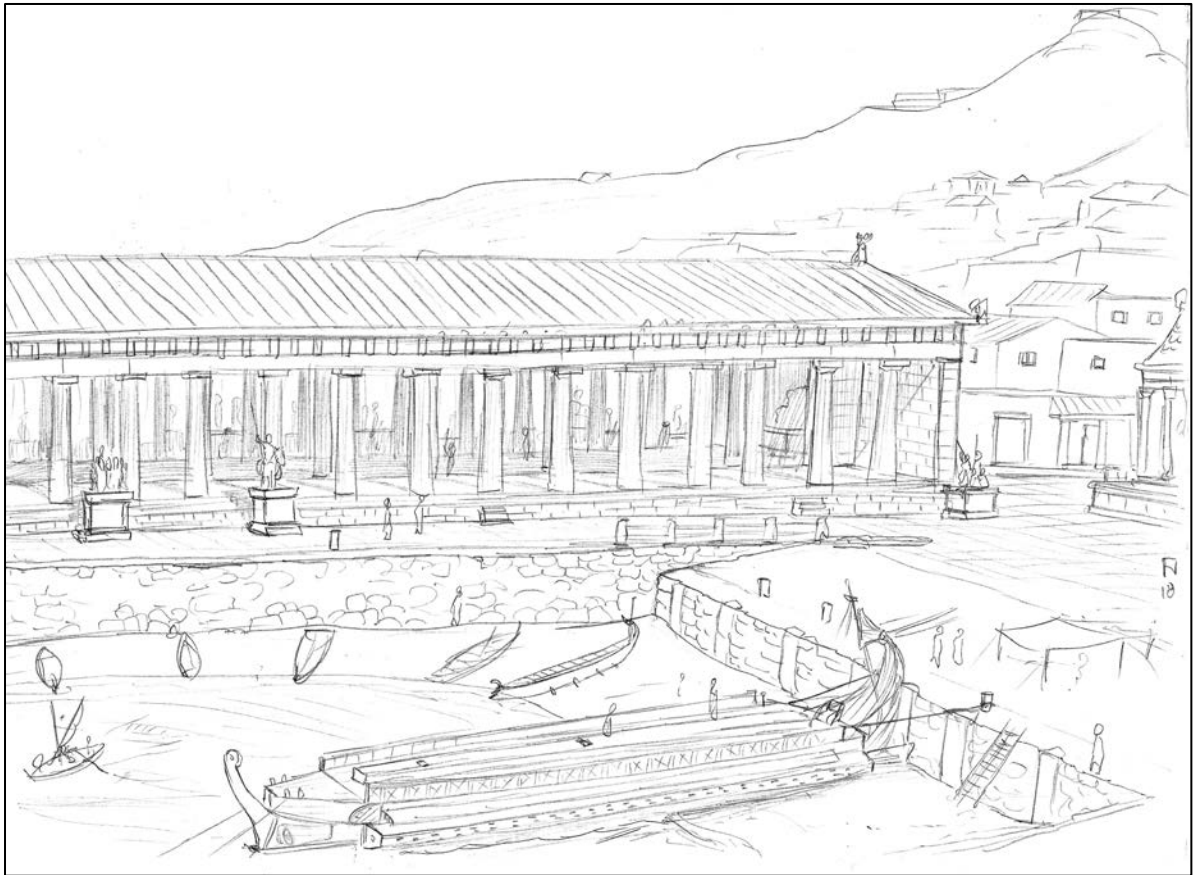


Fig.1.10. A rough sketch of how the south-eastern corner of Delos' Main Harbour, most likely the area where the galley harbour was located, could have looked like around 100 BCE (drawing by the author).

architecture, use by ships etc.), as I do in the previous planar reconstructions, but through these drawings new challenges appear concerning the form of harbour works and land infrastructure, the stationing and movement of ships, as well as the configuration of the whole urban landscape around the harbours. By creating these drawings from rough sketches to final inked and detailed reconstructions, all data examined are combined, including the natural and urban landscape of the harbours, along with a suggestion of how these spaces could have functioned during the period studied concerning ship accommodation and traffic and what would the image they would have presented to the people arriving there (**Fig.1.10**).

In summary the methodology of this thesis operates in a step-like process of consecutive tasks towards the fulfilment of the aims of this research (**Fig.1.11**). They allow the gradual and thorough construction of arguments through the collection and assessment of different data. The first task concerns the critical presentation of material concerning ship form and handling (**Chapter 2**) and of the three case study harbours (**Chapter 3**). Features

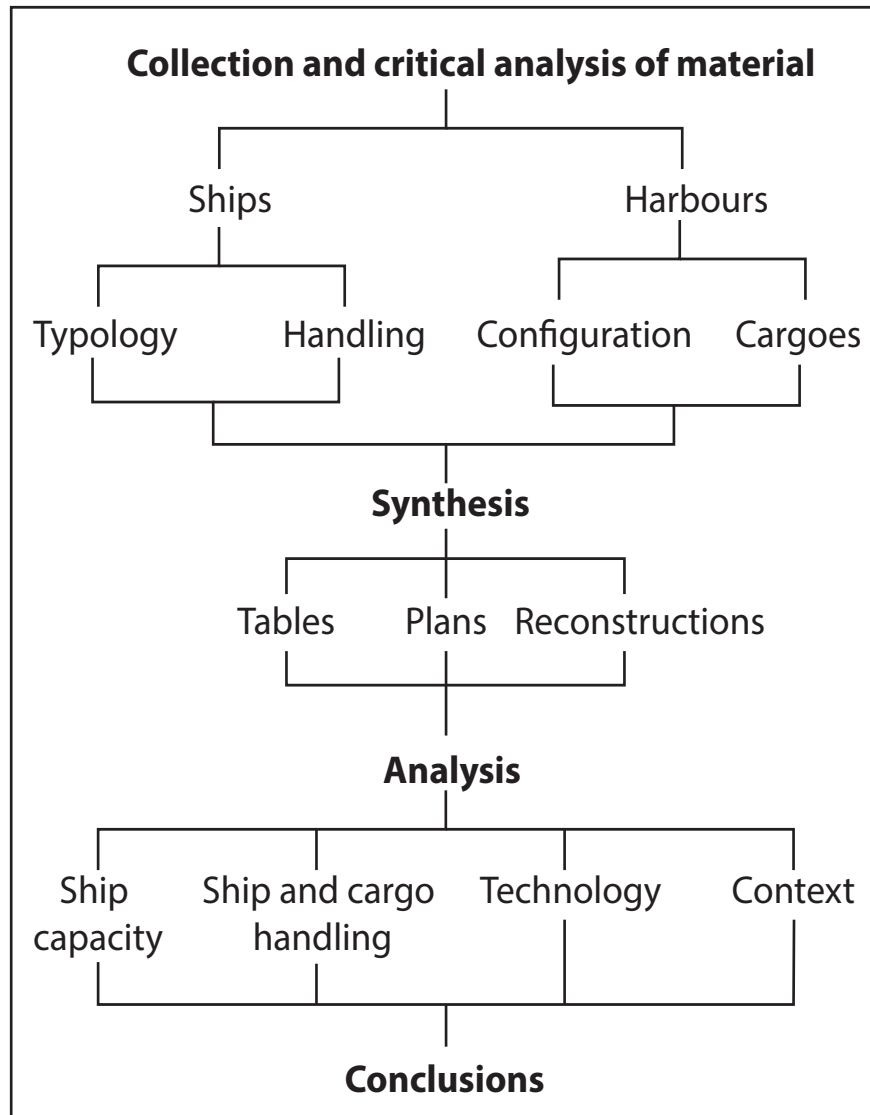


Fig.1.11. Flow diagram describing the methodology and stages of this thesis.

related to the research question and the methodology of this study are thoroughly scrutinised in this stage. In the case of ships this includes ship typology (tonnage, draught) as well as methods of handling ships in coastal environments (anchoring, docking, beaching). In the case of harbours this includes their overall configuration (size, depth, coast etc.), as well as the information available on the different cargoes handled there. Data is codified with the creation of a series of detailed comparative tables. Then all data is thoroughly analysed and cross-examined, both concerning the case studies as well as other harbours of the period (**Chapter 4**). This analysis includes all aspects of ship and harbour operation such as capacity, handling and technology, as well as a contextualisation of the discussion within a



Fig.1.11. Map of the Aegean region with the main Hellenistic and Roman harbours mentioned in the text.

general historical framework. The final conclusions of the whole study are summarised and presented in **Chapter 5**.

1.4.2. The case studies

A multitude of Hellenistic and Roman harbours have been known since the early days of harbour studies in the Aegean and the Mediterranean and many have been excavated and studied (see **1.3**). Various catalogues have been compiled both concerning harbours of specific regions¹⁵⁰ or of the Mediterranean in general.¹⁵¹ It is not, however, within the scope of this research to create another almanac of Hellenistic and Roman harbours. This is not simply due to the very large number of harbour sites known, but mainly because of the aims

¹⁵⁰ See Schörle 2011 for the Tyrrhenian coast or Mauro 2017 for the Aegean.

¹⁵¹ Lehmann-Hartleben 1923; de Graauw 2020.

of this research that require the thorough and extended application and testing of the methodology designed in very specific sites with the inclusion of all available data. Only three case study harbours have therefore been selected, Delos, Lechaion and Kenchreai (**Fig.1.12**). These sites can be sufficiently examined within the extent of this thesis and fulfil certain criteria defined for addressing the principal research question as historical importance, availability of material and variability of site configuration.

As underlined above the methodology of this study focuses on inclusiveness, collectiveness, standardization and quantification in order to produce more accurate and comparable results through the detailed reconstruction of the harbours studied as well as the ways ships and cargoes were handled within them. Therefore every source, from archaeological remains to geomorphology and from iconography to written evidence, is used. In order, however, to examine various datasets on ship and harbour configuration and use (see **1.4.3**), these sources need to be available to scholarship. In other words it is essential for the aims of this research to target sites for which adequate data have been provided through written sources, archaeology, geosciences and iconography. Harbours of great importance for which adequate information do not exist, either because archaeological and written sources are scarce or because the sites have been distorted by modern development, do not fit the methodology of this research (e.g. Piraeus' Kantharos or Rhodes). The availability of data is secured on the one hand by the historical importance of harbours, thanks to which more plentiful and variant written sources (historical texts, literature, inscriptions) document their operation and commercial role and on the other by the existence of published material through archaeological and geomorphological researches, which also depend on the historical importance of harbours that has drew the attention of researchers.

The three case study harbours and the cities they served, Delos and Corinth, played a major role in the Aegean during the Hellenistic and Roman period and had a parallel and often antagonistic history. Delos was the port-of-trade *par excellence* of the Hellenistic and early Roman Mediterranean.¹⁵² During the period of Independence (314-167 BCE)¹⁵³ the city

¹⁵² The significance of Hellenistic and Roman Delos as a commercial centre is explicitly underlined by a series of ancient authors: Pausanias (3.23.3–6) mentions Delos as the emporion (trading station or market) of all Greece. Pliny (*Nat.*34.9) reports that the market of Delos is frequented by “all the world”. Lucilius referred to the busy harbour of Puteoli as “a lesser Delos” (*Satires*, cited in Paulus, ex Festo 88.4), underlining the

had started to establish itself around commercial activities, transforming from a small sanctuary settlement to a thriving cosmopolitan trade centre. Delos' prosperity was further stimulated thanks to the establishment of the free port by the Romans in 166 BCE¹⁵⁴ and the city witnessed a swift and unprecedented commercial and urban development until its two destructions during the Mithridatic Wars (88 and 67 BCE).¹⁵⁵ "Wealthy Corinth"¹⁵⁶ was essentially Delos' commercial rival and successor and its importance as a sea power was considered to have been similar to that of Carthage by the Romans.¹⁵⁷ The city was annihilated by the Romans in 146 BCE¹⁵⁸ and was largely substituted as a commercial centre by Delos, who witnessed its most lucrative years in this period.¹⁵⁹ After a century of desolation (referred to as the 'interim period')¹⁶⁰ Corinth re-emerged as an important city and administrative and commercial centre after its rebuilding as a Roman colony in 44 BCE.¹⁶¹ This included the total reconstruction of the city's harbours, which were to replace Delos as a trade centre through the entire Roman Imperial Period.¹⁶²

The second reason for choosing the three case studies is the abundance and availability of material (which is connected to their historical importance). The significance of Delos and Corinth as two of the most important cities of ancient Greece triggered the early interest of archaeologists and the beginning of large-scale, long-term excavations and other research (since 1872 in Delos and 1896 in Corinth), which also included the local harbours

proverbial importance of the Delian market. Pliny (*Nat.*34.9) and Cicero (*Q.Rosc.* 133) also report on the high quality of the Delian bronzes. Cf. Lawall 2005, 214 and Zarmakoupi 2013b, n.4.

¹⁵³ On the beginning of the Delian independence and the foundation of the Nesiotic League see Diod.19.62.9; IG XI, 2, 135. Cf. Tréheux 1948.

¹⁵⁴ Plb.30.20.10; Strab.10.5.4. Cf. Roussel 1987.

¹⁵⁵ App.*Mith.*5.28; Paus.3.23.3-4; Strab.10.5.4. Cf. Hatzfeld 1919, 34, 36; Green 1990, 384-5; Rauh 1993.

¹⁵⁶ Hom.*Il.* 2.570; Strab.8.6.20.

¹⁵⁷ Both Thucydides (1.13.2) and Strabo (8.6.20) underline the importance of Corinth as a commercial hub thanks to its ideal geographical position between Italy and the Aegean, as well as the control over the Isthmus, whilst Thucydides also notes the long shipbuilding tradition of the city. Cicero states that by destroying Carthage and Corinth the Romans had "put out those twin eyes of the sea-coast" (*N.D.*3.91), whereas he also reports that prior to the destruction of 146 BCE the Corinthians were so focused on trade that they had abandoned agriculture (*Rep.*2.7). Cf. Purcell 1996, 271 and Gruen 1984, 299.

¹⁵⁸ Diod.32.4.5 & 32.27.1-2; Paus.2.1.2; Liv.*Periochae* 52; Strab.8.6.23. Cf. Engels 1990, 197.

¹⁵⁹ According to Strabo (10.5.4) the resettlement of many merchants from Corinth, after its destruction in 146 BCE, to Delos greatly contributed to the commercial development of the island towards the end of the Hellenistic period.

¹⁶⁰ Despite the proverbial desolation of Corinth during the Interim Period (see Cicero's lament over the city's ruins related to his visit there in 79-77 BCE; *Tusc.* 3.53) archaeological finds suggest that Corinthia was still a nodal point in commercial traffic, although not a "viable political entity" anymore (James 2010, 221).

¹⁶¹ On the reconstruction of Corinth as a Roman colony see App.*Pun.*20.136, Plut.*Caes.*57.5 and Dio Cassius, 43.50.3-5. On Corinth as the capital of Roman Achaëa see *Acts* 18.12-7, Apul.*Met.*10.18, Kent 1966, n.153, Meritt 1932, nos.75-6, 80-3 and West 1931, nos.53-75.

¹⁶² Rougé 1966, 152; Engels 1990, 33.

(see **1.3** and **Chapter 3**). This research accumulated an abundance of material (archaeological, epigraphic, geomorphological etc.), which has offered the necessary hard evidence that is used in this research.¹⁶³ The combination of different sources of information (written evidence, excavation results, geophysical researches etc.) allows the better understanding of them through their reconstruction and analysis. Underwater investigations have also been undertaken in all three sites and have provided first-hand evidence for their form and function, that is very important for the methodology of this study (see **1.3.1**).

The case study harbours were also chosen because of their differences. The three sites present diverse natural and anthropogenic configurations: Delos is a small, arid island at the centre of the Cyclades. It was served in antiquity by a number of harbours dispersed around the island, all connected with the dense urban fabric of the prosperous late Hellenistic city. This was equipped and embellished with various buildings related to its commercial function but with few harbour works.¹⁶⁴ Lechaion on the other hand lies on the open, sandy coast of the Northern Peloponnese and initially included two very large harbours, a deeper external and a shallower estuary one and was not related, at least to our present knowledge, to any substantial coastal settlement.¹⁶⁵ Finally, Kenchreai can be considered a 'model' harbour: located in a sandy, deep natural bay, it was protected by two moles and surrounded by ashlar quays and a well-planned settlement, equipped with all the necessary facilities useful for an important harbour of the Imperial Roman Period.¹⁶⁶ Each of these sites presents a unique configuration and offers the opportunity to explore how on the one hand ancient mariners tackled different harbour spaces and on the other how contemporary engineers and harbour administrators faced the challenge of creating and maintaining harbours in different natural environments, as well as how their choices affected the ship traffic there and vice versa.

1.4.3. The selection and handling of the material

As underlined in the previous pages, in order to understand the complicated nature of harbours as centres of seamanship, commerce and human interaction it is essential to

¹⁶³ For an overview of scholarship on Delos see Bruneau & Ducat 2005 and especially on issues concerning commerce and shipping Zarmakoupi 2015; for Corinth and Corinthia see Williams & Boukidis 2003 and Kissas & Niemeier 2013.

¹⁶⁴ Zarmakoupi & Athanasoula 2017; Zarmakoupi 2018b.

¹⁶⁵ Rothaus 1995; Theodoulou 2002; Güngör & Lovén 2018.

¹⁶⁶ Scranton et al. 1978.

combine a variety of different sources: archaeology, geomorphology, written evidence and iconography. The scrutiny and combination of different data allows for a more accurate reconstruction and thus a better understanding of the configuration and function of these harbours in relationship to the more dynamic ship and cargo traffic, an understanding that forms the core of this research. The accuracy of all reconstructions cannot of course be checked against the original form of the harbours, severely altered by time and natural changes or human interventions, but by combining sources of different types and cross-examining them within the process of recreating ancient harbour environments the results reached become much more credible and as close to reality as possible.

The different types of material selected and studied in this thesis have been selected not just because of their availability but, more importantly, for the information relatable to the research question and aims of this research these can offer. As different datasets each presents specific characteristics and has to be approached differently and critically, with respect both to its potential and limits. In the following lines I will present each of these datasets, explain the reasons it was chosen and highlight its potential and drawbacks.

Archaeological data forms the main source of information of this study. As first-hand evidence, it constitutes the most reliable testimony on the original form and operation of harbours and ships and thus provides the most solid data for any further analysis. However, it also presents certain limitations and requires critical assessment, as well as different handling, since it covers two considerably different fields, harbours and shipwrecks. Ship remains, including vessels lost or scuttled at sea, coastal areas and inland waters, can reliably document the types, size and equipment of ancient ships but also their cargoes, provenance, as well as the ways they were handled. Fortunately for this study the period under investigation marks a great peak in the number of shipwrecks discovered in the Mediterranean, reflecting the intensification of maritime mobility and allowing for an advanced knowledge of seamanship and a thorough statistical analysis of ship traffic.¹⁶⁷ Nevertheless, several implications have to be taken into account: the preservation of ancient wooden hulls is, mainly due to the action of the *teredo navalis* shipworm, problematic in the Mediterranean and various portions of them survive, depending on the protection of the wood by sediments and cargoes, from largely intact hulls to a few pieces of wood. This

¹⁶⁷ Parker 1992a, Figs.3-5; Gibbins 2001; Strauss 2013; Nantet 2020c, 76-80.

diminishes the actual number of ship finds that can deliver precise data on the overall ship configuration and construction.¹⁶⁸ Moreover, the preservation and survival of ships and cargoes is greatly affected by salvaging and looting, both common since antiquity,¹⁶⁹ as well as by the different progress of underwater research in various countries that impairs the creation of more inclusive statistics on ancient shipwrecks.¹⁷⁰ Nonetheless, ship finds remain the most direct source of information on ancient seamanship, thus they have been extensively used for the formulation of the basic comparative tables in this study, but always after a thorough scrutiny of their reliability as evidence (**Chapter 2** and **Appendix I**). These tables predominantly include data that can be safely confirmed by research and with indications of their accuracy and all statistics are considered with a certain degree of reservation and different scenarios are suggested (see **Chapter 2**).

Harbour sites constitute the second type of archaeological evidence used here and includes all known harbours works, submerged or not, as well as other types of infrastructure related to harbour operations in any way. Similar to shipwrecks ancient Mediterranean harbours, including the three case studies, have been preserved and excavated to various extents (see **1.3.1**). An important aspect of the assessment of this material is the ability to properly date structures. With many harbours being used before as well as after the period studied, it is essential to clarify which structures were operable during these years in order to establish the form of the harbours with precision. Another methodological issue considers the spatial extent of areas where related material is to be sought and collected. In other words where does a harbour stop and where does its rural or urban hinterland begin? This forms a challenge for this study, especially in a site like Delos, where the harbours and their commercial functions are incorporated within the city's urban fabric.¹⁷¹ My research, however, considers each harbour and its hinterland an integrated space and avoids drawing boundaries between harbour and no-harbour urban areas. This reflects the conceptualisation of harbours as an extended unified space that comprises commercial, religious and habitation zones at the same time.¹⁷² The harbour as a centre of commerce and a gateway to/from the outer world or foreland of each settlement or

¹⁶⁸ Wilson 2011b, 33-9; Boetto 2012.

¹⁶⁹ Tchernia et al. 1978, 29-31; Pomey 1982, 139.

¹⁷⁰ Wilson 2011b, 33-9; Manning 2018, 257-9.

¹⁷¹ Duchêne et al. 2001; Karvonis 2008, 218-9; Zarmakoupi 2018a, 206-7.

¹⁷² Purcell 1996, 277-9; Reger 2016; Feuser 2020.

hinterland influences every aspect of the surrounding human landscape. Thus evidence of their operation and, more importantly, of their role in their contemporary world should be sought in a much more extended space and the investigation should include any kind of data, from imported goods to road networks and from inscriptions to quarries (see **1.2**). This complex and often laborious approach gives a unique opportunity to study and understand harbours in their totality and connect the handling of ships and cargoes within them not only with a demarcated harbour space but with a whole hinterland related to them.

Equally important and closely related to archaeological data is the harbour geomorphology. The natural configuration of these sites, which fundamentally constitute geographical and geological units, is what largely influences their original creation and ensuing operation concerning the size and number of ships they could shelter and their relation with the hinterland.¹⁷³ Furthermore, the perpetual change of coastal environments, including human interventions, is the major factor that has created the image ancient harbours present today, in the case of the Mediterranean causing most of them to have become submerged or silted.¹⁷⁴ The thorough scrutiny of the geomorphology of harbours allows us to 'go back in time', recreate the form the harbours and their surroundings had in the period studied and suggest possible scenarios on their original configuration, especially in cases where substantial geological changes have occurred.¹⁷⁵ Geomorphological research offers very reliable information, being based on solid data collected through field surveys and interpreted through lab analysis. The main problem with such datasets is, however, on the one hand their availability, since they require extended and costly geophysical research that is not always easily undertaken and on the other their precision. Although geomorphological research, especially through the application of coring, can detect changes in stratigraphy corresponding to natural or anthropogenic developments in harbour configuration, their dating can vary greatly, depending on the existence of datable material like pottery and organic remains. In certain cases intrusive finds can give problematic evidence and human interventions like dredging can greatly disturb the stratigraphic

¹⁷³ Delano Smith 1979, 327; Karmon 1985, 2-6; Kotarba-Morley 2015, 36-9.

¹⁷⁴ Marriner & Morhange 2007, 145-85.

¹⁷⁵ Both the Cyclades, as well as Corinthia, has been the target of numerous geological studies during the last 50 years. Especially in the case of Corinthia, the very dynamic sea environment of the Corinthian Gulf, as well as the multiple seismic faults of the Saronic Gulf, have drawn the attention of various field researches, which have already produced an impressive set of data (see **Chapter 3**).

sequence.¹⁷⁶ Therefore results of such surveys should be thoroughly scrutinised and examined in relationship to archaeological and historical data, whereas in some cases their insufficiency to offer useable results should be plainly acknowledged.

Another important and precise dataset is the climatic conditions of each area studied, mostly in relation to the prevailing and seasonal winds, which have hardly changed since antiquity. These would naturally influence the choice of the harbours' location, the handling of ships around them and the construction of specific protective works around them.¹⁷⁷

Written sources constitute another type of evidence related with the scope of this thesis and provide information on almost every aspect of ship and harbour form and operation, especially during Greco-Roman antiquity.¹⁷⁸ They belong to a wide variety of types (historical and geographical texts, poetry, fiction etc.), come from the whole geographical extent of the Mediterranean world and include important information concerning ships as well as harbours. The major drawbacks of written evidence are scarcity, indirectness and vagueness: on the one hand direct sources (state decrees, archives, registries etc.) are rare and often fragmentary, whereas their dispersal is uneven (in Lechaion and Kenchreai virtually no inscriptions survive concerning the harbours or the settlements, whereas Delos preserves abundant epigraphic material; see **Chapter 3**). On the other hand most information on ships and harbours comes mostly from historical, geographical and literary texts, which are very often elusive, offering various clues on ships and harbours, but usually indirectly and compiled by authors with little knowledge or interest in seamanship and harbour operation. Even geographical texts, in which harbours are systematically listed, give too brief information and even replicate older sources (e.g. Strabo).¹⁷⁹ Thus, any approach to written evidence should be done with caution and in as much possible combination with other written and mostly with archaeological sources that can help to assess their reliability.

Iconography is another rich source of information concerning ancient ships and harbours of the Hellenistic and Roman period. Numerous images in a variety of means and qualities, from sculptures to frescoes and from mosaics to graffiti, document vessels of

¹⁷⁶ Marriner & Morhange 2007, 184.

¹⁷⁷ Beresford 2013, 53-103. Cf. Kotarba-Morley 2015, 233-4.

¹⁷⁸ Casson 1971; Pomey & Rieth 2005, 53-5; Blackman 1982a, 79-80; Brandon et al. 2021, 11-36.

¹⁷⁹ Hornblower & Spawforth 1998, 692; Dueck 2000, 44. An example of Strabo's replication of older sources is the shipsheds of Carthage, which he reports as operating in his time, although archaeological data has shown that these were never rebuilt after the destruction of the city by the Romans in 146 BCE (Hurst 1994, 27-8).

different kinds, including ships operating in coasts and harbours,¹⁸⁰ as well as harbours, especially from the Imperial Roman period.¹⁸¹ Despite this richness of iconography, however, it remains, above all, pictorial art and not a naturalistic reconstruction of reality, its main goal being to convey ideas through artistic means and not to give blueprints of objects or structures.¹⁸² To this, the trend of copying or creatively and unrealistically interpreting older sources should be added, something very common in Roman art.¹⁸³ Although the iconography of ships and of harbours has often been confirmed by archaeological finds (e.g. the hull shape of the Madrague de Giens shipwreck or the depictions of the harbour of Kenchreai),¹⁸⁴ it should be considered as a secondary source basically reaffirming archaeological finds and its value being largely dependent on the existence and reliability of the later.

Nevertheless, iconography often consists of the only kind of evidence on the methods of using harbours and approaching coasts. Anchoring, beaching and docking are aspects of ship handling that, with very few exceptions, seldom leave traces in the field,¹⁸⁵ but are commonly part of iconographical schemes (usually related to mythological scenes), or appear in scenes related with the depiction of harbour activities (e.g. the famous Torlonia harbour relief).¹⁸⁶ Although such iconography should be, as noted above, not taken as a naturalistic recreation of reality, the actual choice by ancient artists of specific ship types and methods of using harbours, especially when these are irrelevant to established iconographic schemes (mythological circles or historical scenes), is a good indication of vessels and practices that these artists would have witnessed in their contemporary harbours and would have transferred in their artwork.

One last indirect source of information concerning the operation and handling of ships and cargoes in relationship to harbours and coasts is maritime ethnoarchaeology as well as the use of more recent historical and iconographical data. With various types of ships, especially the smaller ones, having progressed little in terms of size and tonnage even until more recent years, the use of comparative material can be very helpful in order to

¹⁸⁰ Basch 1987; Pomey & Rieth 2005, 61-8.

¹⁸¹ Boyce 1958; Picard 1959; Blackman 1982a; Zarmakoupi 2020; Ugolini 2020.

¹⁸² Pomey & Rieth 2005, 61-8.

¹⁸³ Bruneau 1981, 116-8; Zarmakoupi 2020; Ugolini 2020, 72.

¹⁸⁴ Scranton et al. 1978, 148-9; Pomey 1997, 89.

¹⁸⁵ Votruba 2014, 13.

¹⁸⁶ Blackman 2008b, 651; Felici 2019.



Fig.1.13. *St Nicholas resuscitates a young boy. Painting by Ambrogio Lorenzetti (1327-32; Uffizi Gallery, Florence; Amato 2017, 185).*

understand the handling of ships in harbours and coastal environments.¹⁸⁷

Within this study such parallels mostly relate to the practice of anchoring in the open and using lighters (e.g. the 1327-32 painting by Ambrogio Lorenzetti where a ship is unloading grain directly into a lighter; **Fig.1.13**) and to the use of shallow harbour basins without deep docks (e.g. a series of photographs of small harbours of the Aegean in the first half of the 20th century; see **Chapter 2**). Such data, despite their evident usefulness, should,

nevertheless, be approached not as actual documentations or survivals of ancient practices but as possible scenarios: the use of specific techniques in more recent periods or even in modern times should highlight the possible application and implications of certain methods but not be taken as a proof for their use and exact form in antiquity.

1.5. Conclusions

This chapter established the basis for the research that follows. It outlined the thesis' principal aims, it presented the previous related scholarship, highlighting the fields this study aims to cover and presented in detail the methodology that will be followed, its principles, stages and databases. What is evident through the examination of previous research in relationship to the aims and research question of this study is the absence of any existing methodology for approaching harbours from the perspective of mariners and, hence, the need to create a new one that can unite the two different lines of evidence, harbours and ships. In the following two chapters the datasets related with the scope of this study are examined and analysed: initially the typology and configuration of ships and their handling and then the data and reconstructions of the three cases study harbours will be presented, creating the framework for the ensuing discussion and the answering of the thesis' aims.

¹⁸⁷ For examples of such approaches see Delano Smith 1979, 365; Houston 1988; Votruba 2017.



2. Ships and cargoes in the Hellenistic and Roman Mediterranean

As outlined in the previous chapter, this study focuses on the examination of Hellenistic and Roman harbours of the Aegean in relationship to the ships that used them. In order to fully understand this complicated relationship we need first to comprehend the configuration and typology of these ships, as well as the methods these could and would likely employ when using harbours and other coastal environments. This chapter addresses these two fundamental issues, highlighting the features mostly related to the accommodation and handling of vessels within harbour environments: size, tonnage, draught and equipment.

2.1. Ship typology

The division of ships into specific categories according to various characteristics reflects their use and operation and relates to their needs when using harbours. It also plays an important role within the methodology of this study, allowing for the categorisation of ships according to measurable and comparable characteristics like size and tonnage, directly related to the ability of harbours to accommodate them. As we shall see, the issue of ship typology is a complicated one and more than one division of ship types was used in antiquity, each time corresponding to different conditions but also to the different ways ships were experienced by contemporary people.

2.1.1. Long and round ships

A very basic typology of ship types in the Greco-Roman antiquity concerns the division between long/oared and round/sailed ships (**Fig.2.1**). The term *μακρά πλοία/naves longae* (long ships) explicitly described oared ships by focusing on their distinctive hull form in comparison to the beamier *στρογγυλά πλοία* (round ships) or often just *πλοία* (ships), *όλκάδες* (ships that can be towed) in Greek and *naves onerariae* (ships of burden), *ponto* (ferryboat) or *corbita* (basket) in Latin.¹⁸⁸ The common use of this nomenclature highlights

¹⁸⁸ On the distinction between round and long ships see Hdt.1.163, Theophr.*Hist.Plant*.5.7.1 and Polyaeus 5.16.3. For examples of the common use of the term *όλκάς* see Hdt.3.135, Thuc.7.7.3, Eur.*Cycl*.505, Dio Cassius, 42.2.3. For the use of the term *πλοία* to denote galleys see Thuc.7.7.3. For the term *naves onerariae* see Cic.*Fam*.12.15.2, Dig.49.15.2, Caes.*Gal*.3.23.2 and Liv.29.25.11. For *ponto* see Caes.*Gal*.3.29.3 and for *corbita* see Lucilius, Satires, quoted in Nonius 533, Pl.*Cas*.778, Pl.*Poen*.3.1.40 and Cic.*Att*.16.6.1. See also the

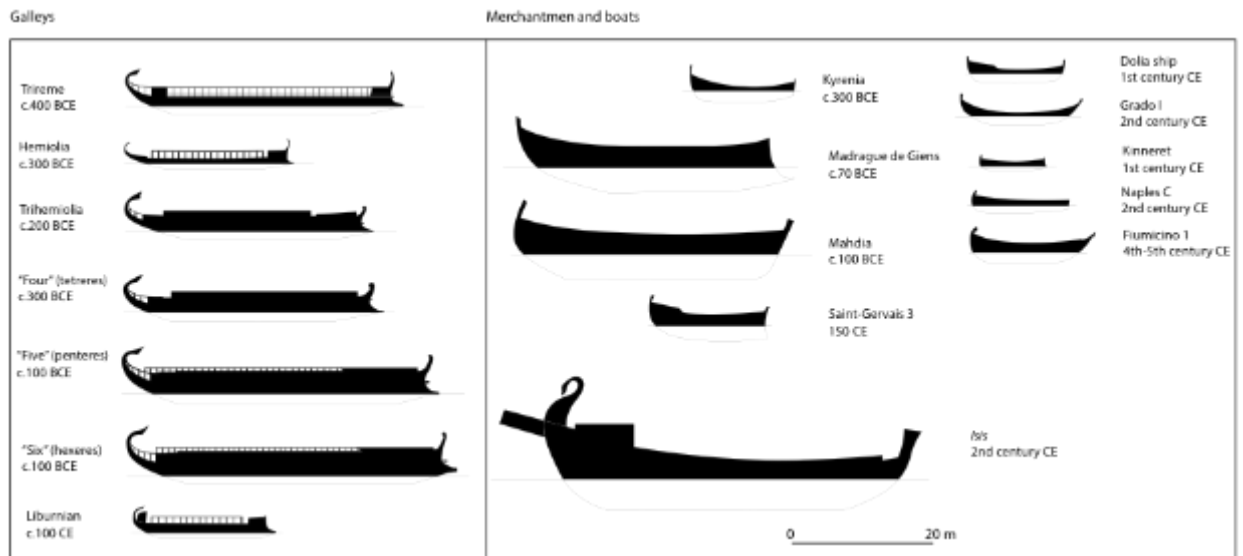


Fig. 2.1. A comparison between the profiles of Hellenistic and Roman galleys and merchant ships in the Mediterranean (drawing by the author; galley profiles are based on the reconstructions of Morisson & Coates 1996, 76; other hull profiles are based on various shipwrecks, see **Appendix I**).

the clear discrepancy between the military and the merchant vessels. Although written sources make no direct reference to the means of propulsion of each category, it is clear that for contemporary people long, slender and fast ships, predominantly using oars, were fit for military operations of various kinds (ramming clashes, raids, reconnaissance etc.), and that round ships, heavy, bulky and slow, propelled mainly by sails, were appropriate for the transportation of cargoes. The existence of these two broad categories reflected, as we will see, the general layout of many harbours that were commonly divided into military and merchant sectors. Such a simple and comprehensible categorisation cannot however be explicit: it does not include differences in tonnage and size, hybrid types like merchant galleys, as well as the large number of small, multi-purpose service vessels, very common and extremely important in every harbour and period. Thus further classifications of the two main categories were necessary.

2.1.2. The division and typology of round ships

Hellenistic and Roman written sources divided round ships either through the type of cargo they carried or based on their size and tonnage. These two classifications were used simultaneously and, occasionally, overlapped.

Althiburus mosaic in Tunisia (3rd-4th century CE) where two of the ships depicted are named *ponto* and *corbita*. Cf. Casson 1971, 157, n.1, 169-70, Fig.137.

The first typology of round ships was based on their cargo. Written sources document *ὀλκάδες σιταγωγοί* or *πλοία σιτηγά/σιταγωγά* (grain ships), *ὀλκάδες οἶναγωγοί* (wine ships) and *πλοία λιθηγά* or *λιθολόγοι* (stone ships) in Greek with the equivalent *naves frumentariae*, *vinariae* and *lapidariae* in Latin.¹⁸⁹ Grain ships appear more often in texts, with fewer references to wine and stone carriers. Little can be, however, deduced on the actual configuration of the ships of each category. References to grain, wine or stone carriers are often part of the writers' prose and relate with images of heavy burden or great size: the comedian Pherecrates mentions a wine carrier as a proverbially large ship,¹⁹⁰ whereas Petronius uses the term *navis lapidaria* as a metaphor for the burdens of hard work.¹⁹¹ More explicit but rare are references in inscriptions, which mention stone carriers supplying building material for various construction projects but give no further information about them (e.g. Delos, Didyma).¹⁹²

Specific cargo categories most likely never matched specific ship sizes or types. The main evidence comes from shipwrecks carrying various quantities of amphorae and stone or marble. Amphora carriers are of all different sizes, from tiny coasters to ships of more than 350 tons (**Appendix I, Table 1**).¹⁹³ Concerning stone carriers, which are quite common in the period studied, Ben Russell's meticulous examination revealed that not only could they have various dimensions but that there was nothing in their construction to differentiate them from other seagoing vessels.¹⁹⁴ A certain degree of specialization did most likely exist, particularly for cargoes requiring careful handling like stone and marble or exotic animals for the amphitheatre games during the Imperial period. Such specialisation would have mainly been related to the internal arrangement of ships (supports for heavy cargoes, special holds

¹⁸⁹ On the term *πλοία σιτηγά/σιταγωγά* see Thuc.6.44.1, Dem.50.20 and P. Cairo Zen. 59031. On the term *ὀλκάδες οἶναγωγοί* see Pherecrates 143.4-5 and for *πλοία λιθηγά* or *λιθολόγοι* see P. Cairo Zen. 59172.6. On the term *naves frumentariae* see Caes.Civ.3.96.4, SHA, Gordiani Tres, 29.2 and P. Lond. 2851 = Fink 63, ii 33. On the term *naves vinariae* see Dig.47.2. On the *naves lapidariae* see Petr.Sat.117.12, Cf. Casson 1971, 169, n.4.

¹⁹⁰ Pherecrates, 143.4-5.

¹⁹¹ "You seem to think I am a beast of burden or a ship for carrying stones" (Petr.Sat. 117.12).

¹⁹² IG, II2.203, B97; Rev.Phil.50.70.

¹⁹³ Archaeological finds, although preserving direct evidence of ship configuration and their cargoes, cannot be considered representative, since they do not include all cargoes: whereas amphorae filled with wine and olive oil survive in large numbers, perishable goods like grain carried in sacks or in holds do not persist in the Mediterranean waters. And amphorae cargoes also offer protection to wooden ship hulls, which are most likely to disintegrate when under other, more delicate, cargoes.

¹⁹⁴ Russell 2013a, 129-31; 2013b, 350; cf. Beltrame & Vittorio 2012, 146.

for animals etc.) and above all to the experience of the crews but not to the overall construction and form of the ships.¹⁹⁵

A note should be made here concerning the seaborne transportation of enslaved people during the Hellenistic and Roman period in the Mediterranean. Despite the increasing importance of slavery and the growing numbers of enslaved people being traded in the great markets of the period, many of which, like Delos, specialized in this form of trade¹⁹⁶, information about special ships for their transportation is totally absent. Although it can be certain that large numbers of enslaved people travelled via the sea, no archaeological remains in shipwrecks or written evidence document the size and capacity of such ships, nor do they give any evidence for any special type of ‘slaveship’.

The second, more explicit in terms of capacity and closer to modern standards, classification of merchant ships was based on their tonnage/capacity. Although there is little evidence that any universal and systematic categorisation of merchantmen based on their tonnage existed during the Hellenistic and Roman period, a series of written sources can shed light on this issue. The earliest one is the Thasos harbour inscription (second half of the 3rd century BCE). It regulated the tonnage of ships that were allowed to be hauled out of the water in two unspecified areas of the city’s harbour and listed the penalties for trespassers and the officers assigned to impose them. The beginning of the fragmentary text can be restored and translated as follows:

Within the space marked by the first boundary stone it is forbidden to haul a ship of less than 3,000 talents (about 80 tons) on land and within the space marked by the second boundary stone it is forbidden to haul a ship of less than 5,000 talents (about 130 tons) on land (translated by the author).¹⁹⁷ The bad preservation of the inscription has caused a

¹⁹⁵ Mackinnon 2006, 12-4; Russell 2013a, 130-1.

¹⁹⁶ Strab.14.5.2; Trümper 2009, 20-8, 31; Morley 2011, 210, 212; Scheidel 2011, 293-302; Kay 2014, 178-81, 200.

¹⁹⁷ IG, XII, Suppl. 348; Launey 1933, 394-401; Blackman 1995, 75-9. The Thasos inscription’s original text is as follows:

“[πλ]οῖον μὴ [ἀ]νέλκειν ἐν τοῖς τῶν . . . ργ . . . τοῦ μὲν πρώτου ἐλά[σσω φόρ]-
[τον ἄγον τρον ἄγ[λ]ίων ταλάντων, τοῦ <δὲ> δευτέρου[υ] ἐλάσσω ἄγο[ν] πεντα[κ]ισ-
χλιδίων] τε[λάντω]ν. ὃς δ’ ἂν παρὰ ταῦτα ἀνειρύσῃ, ἀποτεισάτω πέντε [στα]-
[τῆρας] τῇ πόλει· πρηξάντων δὲ <οἱ> ἐπιστάται. ἂν δὲ τι ἀμ[φ]ι[σβ]ητήτ[αι],
[δικασάσθων οἱ] ἀπόλογοι παρὰ δικασταῖς αὐτοῖς· τὴν δὲ καταδίκ[η]ατα[πα]-
[ραδόντων τρατῆ]ς ἐπιστάταις· οἱ δὲ ἐκπρηξάντων. ἂν δὲ μὴ ἐκπρήξωσι[ν, αὐ]-
[τοῖ ὀφειλόντω]ν. ἂν δὲ οἱ ἀπόλογοι μὴ δικάσωνται ἢ μὴ παραδῶσιν τοῖς
[ἐπιστάταις, ὑπ]όδικοι ἔστωσαν τοῖς εἰσι[οῦ]σιν ἀπολόγοις . 4-5.
[. . . c.8 . . . τοῖς ἐπ]ιστάται[ς] τοὺς παρὰ τὸ [ψ]ή[φ]ισμα ἀνέλκοντας . 2-3.

debate on the ship tonnage of the second line: Launey and Casson restored the number as 3,000 talents,¹⁹⁸ whereas Blackman, although he could not reject Launey's restoration, convincingly argued that alternative numbers were possible (2,000, 4,000 or 7,000 talents).¹⁹⁹ This important inscription indicates a rough division of merchantmen into a class of small capacity ships (up to 80 tons) and a class of middle capacity ships (up to 150 tons) but does not fully define the range of capacity of various groups or types of ships but marks its highest point clearly for reasons of harbour operation and possibly toll charging.

Another source related to a division of merchantmen based on capacity is the calculation of ship tonnage by Hero of Alexandria (middle of the 1st century CE). Hero employed an empirical formula to calculate the tonnage of ships based on their overall dimensions by using three examples: one of 768 amphorae (7,680 *modii* or 58 tons), one of 1,920 amphorae (19,200 *modii* or 95 tons) and one of 2,520 amphorae (25,200 *modii* or 144 tons).²⁰⁰ It is unknown whether Hero chose his examples following any established classification of merchantmen, although two of his ships are very close the vessels mentioned by the Thasos harbour inscription (95 and 144 tons compared to 80 and 130 tons in Thasos). The discrepancy could be due to the empirical nature of the calculations and the regional variations of size units, but Hero generally avoids rounding up his numbers and the way he expressed his measurements indicates he had access to very specific ships and was not interested in creating a generic typology of merchantmen.

[. c.25. τῶι] ἐθέλοντι εἰ[— — — — —].”

¹⁹⁸ Launey 1933, 398-9; Casson 1971, 171, n.23. Cf. Nantet 2020c, 79.

¹⁹⁹ Blackman 1995, 77-9.

²⁰⁰ “A ship has a length of 24 feet, a width of 6 feet, its hold depth is 4 feet; you have to find how many amphorae or modii it contains. I do as follows: I multiply the width with the hold depth; that makes 24 feet. I multiply that with the length, that makes 576 feet. I add one third of that to 576 and that makes 768. This is how many amphorae it contains. Each amphora contains 10 modii, which makes 7680” (Hero of Alexandria, *Stereometrica*, II.50; translated by the author). Cf. Strauss 2007, 101. “Let us suppose a ship has a length of 50 feet from end to end, a width of 12 feet and a hold depth 7 feet. Do as follows: multiply 50 with 12; this makes 600. I multiply this with the hold depth of 7; that makes 4,200. I multiply this by 6; they become 25,200. This is how many modii the ship can accommodate” (Hero of Alexandria, *Stereometrica*, II.50; translated by the author). “We will measure a ship, whose length is 48 cubits, the width of its bottom 4 cubits and the width of the stem 6 cubits, the upper width of the stern 8 cubits and the upper width of the middle 9 cubits; we must find how many modii it can accommodate. You do as follows; you add the width of the stern and the stem; that makes 14. You divide this by half and it makes 7. You add the width of the middle; that makes 16 cubits. You divide this by half and it makes 8; I multiply this with the width of the bottom part of the middle, that is 4 cubits; that makes 32. That is multiplied with the total length of 48 cubits; it makes 1536 cubits. Each cubit contains 12 ½ Italian modii and that makes 19,200 modii. This is the number of modii the ships contains” (Hero of Alexandria, *Stereometrica*, II.52; translated by the author).

Both sources avoid acknowledging ships larger than 144 tons. Shipwrecks and written sources firmly document that such ships were not at all unknown during at least Heros' time.²⁰¹ The Antirhodos shipwreck that sunk in the harbour of Alexandria around the time Hero was born was a 250-ton merchantman,²⁰² whilst the contemporary author Philo of Alexandria regularly mentions ships of up to 350 tons (*myriophoroi*).²⁰³ In the case of Hero, it is quite possible that the scholar did not have access to larger ships to practice his formulas, or that the latter did not operate well with larger vessels.²⁰⁴ In the case of the Thasos inscription it is also likely that larger ships could not be accommodated in the areas delineated due to their draught or that these were much fewer and special arrangements were made when these used the harbour.

These two important sources do not also take into account a more practical division of ship types, based on their rough capacity as amphorae carriers.²⁰⁵ Ancient Greek and Latin texts mention *μυριοφόροι*, *μυριόφορτοι* or *μυριαγωγοί* (10,000 amphorae or 350-500 tons), *τρισχιλιοφόροι* (3,000 amphorae or 75-150 tons) and *χιλιοφόροι* (1,000 amphorae or 15-17 tons).²⁰⁶ The most common term is *μυριοφόρος* (*myriophoros* in Latin), which appears regularly from the 5th century BCE until the 1st century CE. The existence of ships of such great tonnage has been verified in at least two shipwrecks, the early 1st-century BCE ships of Albenga and of Madrague de Giens.²⁰⁷ References to the 3,000 and 1,000 amphora carriers on the other hand are scarce: Dionysius of Halicarnassus mentions 3,000 amphorae carriers

²⁰¹ Wallinga 1964, 4-5; Pomey & Tchernia 1978, 235-7.

²⁰² Sandrin et al. 2013.

²⁰³ "For at times broad gulfs, through the sea's being withdrawn by ebbing, suddenly become a far-reaching stretch of sand, and a little later, as it is poured back, they become deep seas navigable not merely by small barges but by ships of many tons burden (*myriophoroi*)" (Philo, *Opif.*38.1); "ships with a capacity of 10,000 amphorae full of cargo" (Philo, *Plant.*6.1). Cf. Wallinga 1964, 5.

²⁰⁴ There is also the possibility that Hero had copied the formulas from earlier Greek or Egyptian texts, but the use of the Roman modius alongside the Egyptian artab strongly indicates that the text belonged to a period after the Roman conquest of Egypt in 30 BCE.

²⁰⁵ Wallinga 1964.

²⁰⁶ For the term *μυριοφόροι*/*myriophoroi*, *μυριόφορτοι* and *μυριαγωγοί*, see Thuc.7.56.2, Ctesias, *Indica* 6, Strab.3.3.1, Automedon, *Anth.Gr.*10.23, Philon of Alexandria, *De Opificio Mundi* 38.1, id. *De Plantatione Noe* 6.24 and *De Aeternitatae Mundi* 26.138. For the term *τρισχιλιοφόροι* see D.H.3.44.3. For the term *χιλιοφόροι* see Dio Cassius, 56.27.3. Cf. Wallinga 1964, 3-6 and Nantet 2016, 115-6.

²⁰⁷ Pomey & Tchernia 1978, 233-7.

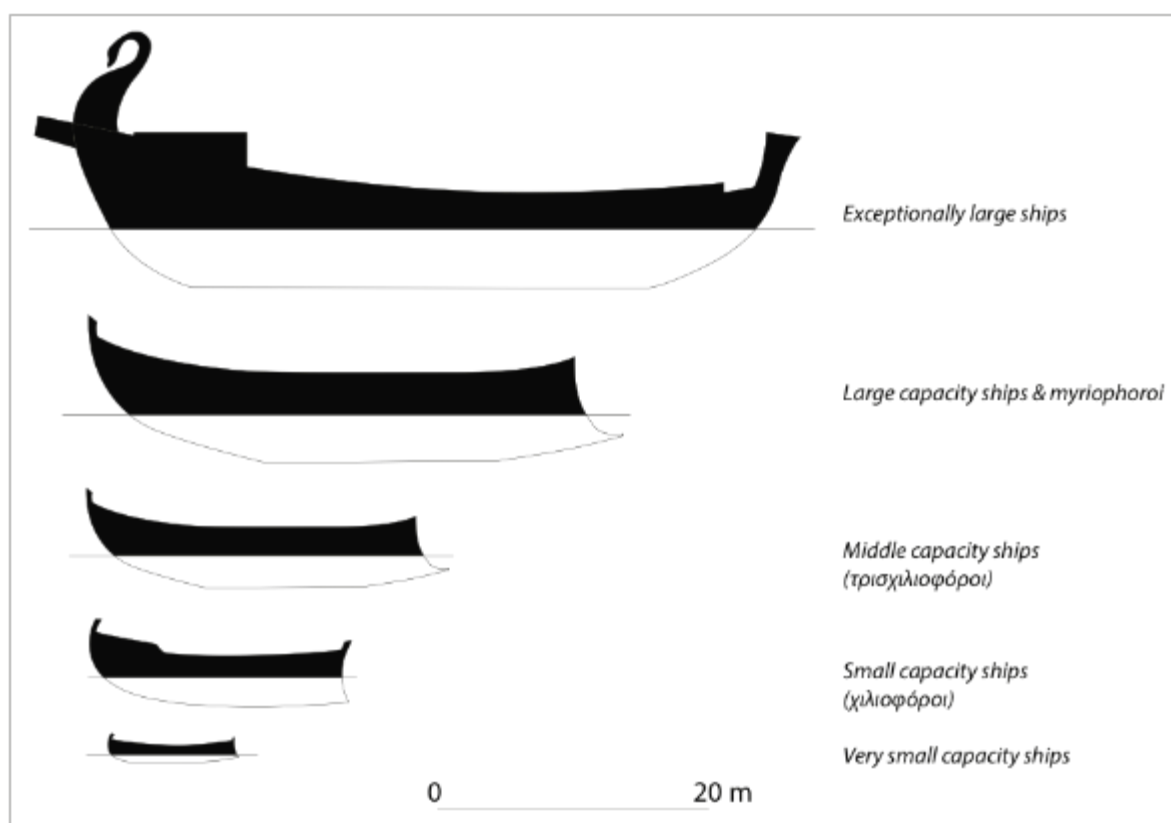


Fig. 2.2. A comparison of the dimensions of the forms of the main categories of merchantmen in Hellenistic and Roman times (drawing by the author).

that would reach Rome through the Tiber,²⁰⁸ whereas the *χλιοφόρος* is mentioned by Dio Cassius, reporting on Augustus prohibiting exiles from acquiring a ship larger than that.²⁰⁹

Using the capacity of ships in amphorae, *artabs* or *modii* would have been likely the most practical ship division.²¹⁰ The occurrence of *μυριοφόροι*, *τρισχilioφόροι* and *χλιοφόροι* in written sources shows that this must have been a convenient, and comprehensible way to describe ships of medium and small capacity. It remains, however, doubtful whether it was ever adopted by the authorities or by mariners and shipbuilders.²¹¹ The only direct evidence for such a nomenclature are the shipwrecks, which, unfortunately, present a fragmentary image of the ships of the period: the accidental nature of their preservation and discovery, the lack of any 'label' of capacity on any of them, and finally the

²⁰⁸ "Accordingly, oared ships however large and merchantmen up to three thousand bushels burden enter at the mouth of the river and are rowed and towed up to Rome, while those of a larger size ride at anchor off the mouth, where they are unloaded and loaded again by river boats", (D.H. 3.44.3).

²⁰⁹ "Besides this, he enjoined upon the exiles that they should not cross the sea to any other point, and should not possess more than one ship of burden having a capacity of a thousand amphorae and two ships driven by oars" (Dio Cassius, 56.27.3).

²¹⁰ A similar division was established in later periods with the exclusive use of barrels as capacity units in the Venetian navy (Lane 1992, 247).

²¹¹ Wallinga 1964, 18.

plain fact that the a surviving cargo does not necessarily correspond to the capacity of the vessel (overloaded, half-loaded ships or perishable cargo are common in seaborne trade throughout time)²¹² render shipwrecks a rather insecure source for any standardized division of ships according to their tonnage (see **1.4.3**).

Based on a combination of data supplied by the ancient sources, shipwrecks and previous studies on the subject I am proposing an inclusive classification of ships according to their tonnage and size (**Tables 2.1-2**). This is largely based on two divisions already suggested by Casson, Parker and Boetto.²¹³ Casson and Parker divided ships in small capacity vessels (less than 75 tons or 1,500 amphorae), medium capacity vessels (75-200 tons or 2,000-3,000 amphorae) and large capacity vessels (over 250 tons or more than 6,000 amphorae). Boetto enriched the division by adding the category of the exceptionally large freighters of c.1,200 tons and the *myriophoroi* of 350-500 tons. My division of ships is a combination of both these approaches with the addition of a fifth category of smaller boats, using tonnage as the main division criterion (**Tables 2.1-2; Fig.2.2**). Thus round ships are divided into exceptionally large freighters (more than 500 tons), *myriophoroi* (350-500 tons or 10,000 amphorae), large capacity ships (150-350 or 3,000 amphorae), middle capacity ships (75-150 tons or 1,000 amphorae), small capacity ships (15-75 tons), whilst the category of very small capacity vessels is added (less than 15 tons). The division is quite conventional, but by categorising vessels according to their tonnage and their corresponding dimensions, the data collected can be better organised and used in calculating the capacity of the harbours under investigation. Furthermore, it combines the tonnage of ships, as known through shipwrecks and written sources, with the division in *μυριοφόροι*, *τρισεχλιοφόροι* and *χιλιοφόροι*.

²¹² Russell 2013a, 113; Manning 2018, 257-9.

²¹³ Casson 1971, 171-2; Parker 1992b, 89; Boetto 2010, T.1.

Categories	Capacity (t)	Length (m)	Beam (m)	Height from keel to deck (m)	Draught (m)
Exceptionally large cargo ships	1,200-1,700	50-55	14	7	4.5
Myriophoroi	350-500 (10,000 amphorae or 50,000 modii)	40	9-12	4-5	3.5-4
Large capacity ships	170-300 (5,000 amphorae or 50,000 modii)	21-40	8-14	3.7-5	2-4
Medium capacity ships	75-150 (3,000 amphorae or 20,000 modii)	15-30	4-8	2-3	1-2.3
Small capacity ships	15-75 (1,000 amphorae or 10,000 modii)	13-25	4-7	2-3	1-2
Very small capacity ships	≤15	6-13	2-5	0.5-2	0.5-1.2

Table 2.1. A typology of merchantmen and service vessels during the Hellenistic and Roman period according to their tonnage and dimensions.

Type	Length	Beam	Area covered
Large ships	35-40 m	8-15 m	280-600 m ²
Medium ships	18-30 m	7-9 m	125-270 m ²
Small ships	14-25 m	5-7 m	70-175 m ²
Very small ships	8-14 m	2-4.5 m	16-63 m ²

Table 2.2. A comparative table of the approximate area that would have been covered by various sizes of Hellenistic and Roman ships of the Mediterranean (sizes according to **Table 2.1**).

2.1.3. The division and typology of galleys

Written sources document a long list of names for Hellenistic and Roman oared vessels, as well as different classifications.²¹⁴ Galleys, which are above all ships built around their rowing crew, were basically divided according to the number of oarsmen they could accommodate on each cluster of superimposed banks per side with a variety of terms (*trireme*, *tetreres*, *penteres* etc.). Smaller units could be named after the number of rowing files (e.g. *δίκροτος*, i.e. double-banked) or by their total number of oarsmen (e.g.

²¹⁴ Morrison & Coates 1996, 255.

triakonter/τριακόντορος, i.e. with 30 oarsmen), and some would be distinguished by their use as κατάσκοπος/*speculatoria* (spy and reconnaissance boat).²¹⁵

Tonnage was of little importance for galleys and is never documented, since none of these vessels was built to carry any substantial cargo. Iconography, although rich concerning galleys in the period studied, gives little evidence of the actual type of ship portrayed, with the exception of a 1st century BCE-1st century CE *quadrireme* ('four') in a graffiti from Alba Fucentia, Pompe, Pompeii, identified as such by an inscription.²¹⁶ According to the thorough reconstruction of the form and size of various galley types made by John Morrison & John Coates (**Table 2.3**; **Fig.2.1**), the draught of these ships would remain quite small, ranging between 1 and 1.5 m, and even smaller for service galleys like ship C from Pisa.²¹⁷

Categories	Date	Displacement (t)	Length (m)	Beam on waterline (m)	Overall beam (m)	Height (m)	Draught (m)
Trireme	400 BCE	48	40	3.7	5.6	3.6	1.1
Early "five"	400 BCE	100	45	5.2	6.4	4.4	1.5
"Four"	300 BCE	60	37	4.6	5.6	3.4	1.3
"Five"	100 BCE	110	45	5.3	7.0	4.4	1.5
"Six"	100 BCE	125	47	5.7	7.5	4.8	1.5
"Seven"	100 BCE	133	47	5.7	7.5	4.8	1.5
"Five"	50 CE	125	45	5.7	8.2	4.6	1.6
Liburnian	100 CE	14.5	20	3.0	3.9	2.8	0.76
Hemiolia	300 BCE	14	24	2.7	4.3		0.78
Trihemiolia	300 BCE	41	35	4.0	5.8	3.5	1.1
Marsala Punic galley (liburnian?)	241-235 BCE		35		4.8		

Table 2.3. A comparative table of the sizes and tonnage of various galleys of the Mediterranean (according to Morrison & Coates 1996, Appendix D).

2.1.4. Specialised ships and cargoes

Beyond the all-purpose merchantmen of the period, which, as we saw above, were used for a variety of cargoes and presented similar dimensions and characteristics, there are certain types of ships carrying specific cargoes and whose use and/or configuration marks them as important categories who played a significant role in the operation of contemporary

²¹⁵ Due to their importance in warfare galley names appear very commonly in a wide range of historical and literature texts, as well as in many inscriptions and papyri. For a series of such references see Casson 1971, 97-147; Morrison & Coates 1996, 255-77.

²¹⁶ Guarducci 1953, 119-20, Fig.5. Cf. Morrison & Coates 1996, 238-9, n.38.

²¹⁷ Kyprouli 2012, 30.



Fig.2.3. A grain freighter from the Isis Ciminiana tomb in Ostia, Vatican Museums (2nd-3rd century CE; Rickman 2003, 137).

commerce and, subsequently, harbours. These were the grain freighters, the stone carriers and the *dolia* ships.

The grain freighters

Probably the largest and most important cargo travelling around the Mediterranean during the Hellenistic and Roman period was grain. By the 1st century CE the ‘mega-cities’ of the Mediterranean depended on the import of grain and other victuals to avoid famine and consequently civil unrest.²¹⁸ The importance of the grain freighters in the life of these cities (and especially Rome from where most of the available data comes from)²¹⁹ is vividly described in Seneca’s account of the joyful festivities that marked the arrival of the Alexandria grain fleet at the harbour of Puteoli around June each year.²²⁰ As a result the need to accommodate and serve these ships would have played a major role in the development and operation almost all the harbours of the period, even of the smaller ones,

²¹⁸ Garnsey 1988, 218-27.

²¹⁹ Sirks 1991; Brandt 2005.

²²⁰ “Suddenly there came into our view to-day the ‘Alexandrian’ ships, – I mean those which are usually sent ahead to announce the coming of the fleet; they are called ‘mail-boats.’ The Campanians are glad to see them; all the rabble of Puteoli stand on the docks, and can recognize the ‘Alexandrian’ boats, no matter how great the crowd of vessels, by the very trim of their sails. For they alone may keep spread their topsails, which all ships use when out at sea, because nothing sends a ship along so well as its upper canvas; that is where most of the speed is obtained. So when the breeze has stiffened and becomes stronger than is comfortable, they set their yards lower; for the wind has less force near the surface of the water. Accordingly, when they have made Capreae and the headland whence tall Pallas watches on the stormy peak, all other vessels are bidden to be content with the mainsail, and the topsail stands out conspicuously on the ‘Alexandrian’ mail-boats” (Sen.Ep.77.1-2).

which would serve local provisioning networks or act as important intermediate stations to long-haul networks.²²¹

What was the actual tonnage and size of the ships that carried the much needed grain cargoes? Direct information on these ships is inadequate, since grain is a material that totally disintegrates under water and thus no known shipwreck has ever been identified as a grain freighter. A unique image of a ship on which grain is loaded in sacks survives in a 2nd-3rd century CE fresco from the Tomb of Isis Ciminiana in Ostia (**Fig.2.3**), but the ship is unfortunately too stylised and out of proportion to offer any plausible clues on its size.²²² Whether an average grain ship existed is very doubtful, as we will see below in **2.3.3**. In terms of total tonnage of grain carried by sea to provision certain urban centres like Rome, things were complicated. Ships would regularly carry mixed cargoes, whereas the *annona* system of grain provisioning only included segments of the population and the later *annona militaris* only concerned the army.²²³ Substantial portions of local needs could also be covered by local production, even in relatively arid regions like the Cyclades.²²⁴ Victuals would also be carried by land, notwithstanding the low speed and the higher cost.²²⁵ Finally, although written sources in general verify that grain ships made a single trip every year during the most favourable Spring/Summer season,²²⁶ the possibility of more than one annual voyage should not be excluded, especially for short-haul networks.

A certain number of these ships must have been of great capacity, their use being a reasonable choice for the ship-owners.²²⁷ Apart from the safety a larger ship could offer in rough seas,²²⁸ it would also increase the margin of profit, especially when a bulk cargo like grain could be sold as a whole in the markets of the great cities. However, written sources do not document any grain ship of great size arriving at the harbours of Italy in the 1st century CE, notwithstanding the rising population of the peninsula. Claudius' decree offering privileges for ship owners placing their ships in the service of the *annona* mentioned vessels

²²¹ Hopkins 1983, 85, 94-6; Reger 1994, 51-3.

²²² Basch 1987, 468, Fig.1048; Mataix Farrándiz 2018, 87. The Isis Ciminiana ship fresco was found in 1867, it was detached, largely restored and partly repainted and is now exhibited at the Vatican Museum.

²²³ Morley 2007, 584; Temin 2013, 32.

²²⁴ Reger 1994, 109.

²²⁵ Hopkins 1983, 104; Brandt 2005, 38.

²²⁶ Casson 1971, 297-9.

²²⁷ Morley 2007, 585.

²²⁸ Freeman Trimalchio in the *Satyricon*, describing how he boldly built "bigger, better and more expensive ships", states that a "huge ship has a certain security about her" (Petr.76).



Fig.2.4. Mosaic from the statio of the traders of Sullectum in Ostia (c.200 CE; Pomey 1997, 85).

of not less than 10,000 *modii* or 68 tons but said nothing about any larger ones.²²⁹ In the same period a graffito on an amphora from Pompei documents a grain ship of 15,200 *modii* or 100 tons.²³⁰ Shipwreck evidence similarly points towards smaller ships, although the former could be

affected by the lack of preservation of ships with perishable material (see above). Although larger ships would theoretically be safer and sturdier, written sources suggest not only that all grain ships were very vulnerable to storms even in some of the busiest harbours like the Claudian Portus (see Tacitus' report on the storm that destroyed 200 merchantmen inside the harbour of Portus in 62 CE),²³¹ but that they often could not easily enter the harbour basins, as Flavius Josephus mentions for the Great Harbour of Alexandria.²³² The operation of large vessels could result both in great profits but also in great losses even within harbours, thus it is not surprising that the rise of trade in grain in the Roman Mediterranean did not automatically trigger the creation of larger ships. Despite the fact that large capacity *myriophoroi* like the Madrague de Giens and the Albenga shipwrecks appear in the late Republican period, serving the rapidly increasing needs of Italy in victuals, both ships carried wine from Gaul and not grain. Corporations and great ship owners operating multiple ships could represent a better risk management strategy, but we lack any documentation both on the exact number of ships each could employ, as well as on their tonnage.²³³

Although not confirmed by shipwreck finds, a certain number of larger ships seem to have been in use during the Antonine period. Lucian describes with awe the gigantic 1,200-

²²⁹ Gaius, *Inst.* I.32c; Suet. *Cl.* 18-9.

²³⁰ *CIL* IV 9591; Mataix Ferrándiz 2018, 165.

²³¹ Tac. *Ann.* 15.18.

²³² "About this island are built very great piers, the handiwork of men, against which, when the sea dashes itself, and its waves are broken against those boundaries, the navigation becomes very troublesome, and the entrance through so narrow a passage is rendered dangerous" (*J.BJ.* 4.10.5). Cf. Belov 2015, 55.

²³³ Casson 1971, 315.

tons *Isis* grain freighter around 150 CE²³⁴ and also reports two three-masted vessels (one of them belonging to the Alexandria fleet),²³⁵ whereas towards the end of the century Philostratus mentions a three-masted ship in the harbour of Smyrna.²³⁶ In Ostia, at the *statio* of Sullecthum, a merchant corporation related with the import of commodities from Africa, the unique image of a three-masted merchantman is preserved and dates around 200 CE (Fig.2.4).²³⁷ The existence of three masts on ships, a rather rare occurrence in the Greco-Roman antiquity, clearly points towards ships of great capacity (see 2.4.1). In the same period the Roman decree offering exemptions from public services to ship owners that would build and operate grain freighters of up to 350 tons is dated.²³⁸ This possible rise of ship size could also be related with the interest of Commodus (180-192 CE) to boost trade with Africa by creating an African grain fleet.²³⁹

Although written evidence indicate that in certain periods grain freighters of large of even very large capacity were indeed built and operated, these would have naturally been few, since they required substantial funding, equipment and crew and would serve very specific routes related to large markets that could consume such great cargoes. The majority of grain freighters remained most likely, as also indicated by the size of shipwrecks, of medium or small capacity, being easier to build, maintain and operate. However, the importance of large-capacity ships was great not because of their numbers, but because of their great tonnage and the ability to provide sufficient provisioning for many consumers with single cargoes, which, in turn, could also be taxed accordingly. This would have naturally played an important role in the development and operation of the harbours these ships visited.

²³⁴ Luc.Nav. 5-9. Cf. Casson 1971, 186-8 and Houston 1987.

²³⁵ Luc.Pseudol.27; Lex.15.

²³⁶ Philostr.VA 4.9.

²³⁷ Meiggs 1960, Pl.XXIVb.

²³⁸ Scaevola, Dig. 50.5.3.

²³⁹ The *Historia Augusta* biographies, the text that refers to the organization of an African grain fleet by Commodus, has been proven very controversial (SHA, *Commodus* 17.7). It is however interesting that during the same period an increase of imports from Africa is attested by the excavations in the *horea* of Portus harbours (Keay 2010, 13; 2012b, 44), whereas the interest of Commodus to boost seaborne trade can also be inferred by some iconographic sources (Syme 1971).

Stone carriers

A special category of ships that becomes increasingly important by the late Hellenistic and especially the Roman imperial period is the stone carriers.²⁴⁰ With the needs of cities or sanctuaries rising considerably thanks to grandiose projects funded by the Hellenistic kingdoms and then by Rome, stone carriers became very important in contemporary ship traffic and this is verified by the number of shipwrecks and the variety of cargoes these transported.²⁴¹ Although, as noted above, the wooden remains of these shipwrecks do not indicate that these were in any way different than other cargo ships of the period, their handling required, as we will see below, special infrastructures, machinery, expertise and an abundant labour force.

The *dolia* ships

Towards the end of the 1st century BCE the *dolia* ships appear (**Fig.2.5**). According to a number of shipwrecks they all belong to the category of small vessels, with a length of 18 to 20 m, a beam of about 6 m, a capacity of about 60 tons and an estimated draught of 1.5 m (**Appendix I, Table 3**). Although their size was not great, they could transport nearly double the amount of liquid products than amphorae-carriers of similar size, thanks to the use of the *dolia* containers.²⁴² The *dolia* ships seem to fall out of use after the middle of the 1st century CE. The need to empty and fill the *dolia* bulky containers, as well as to remove them from the ships when necessary, required some special equipment in the harbours they would encounter, as will be discussed in **2.5.2**.²⁴³



Fig. 2.5. Model of a *dolia* ship based on various shipwreck finds (Centre Camille Jullian).

²⁴⁰ Casson 1971, 169, n.4.

²⁴¹ Russell 2011; 2013a, 114-8; 2013b.

²⁴² Marlier 2008, 170; Dell' Amico 2011, 70.

²⁴³ Robinson et al. 2020, 104.

2.2. Construction methods and hull forms

The form, capacity and operation of the ships of the period studied was naturally influenced by the ways these were built. The construction method almost exclusively employed in Mediterranean shipbuilding from the 4th century BCE and until the end of antiquity was the mortise-and-tenon technique (**Fig.2.6**).²⁴⁴ Having almost totally replaced the method of lashed or sewn ships at least in seagoing ships,²⁴⁵ it consisted of the erection of the shell of the hull first, with planks joined together by wooden tenons and treenails and the subsequent addition of the framing. The method remained the most common technique for all seagoing vessels

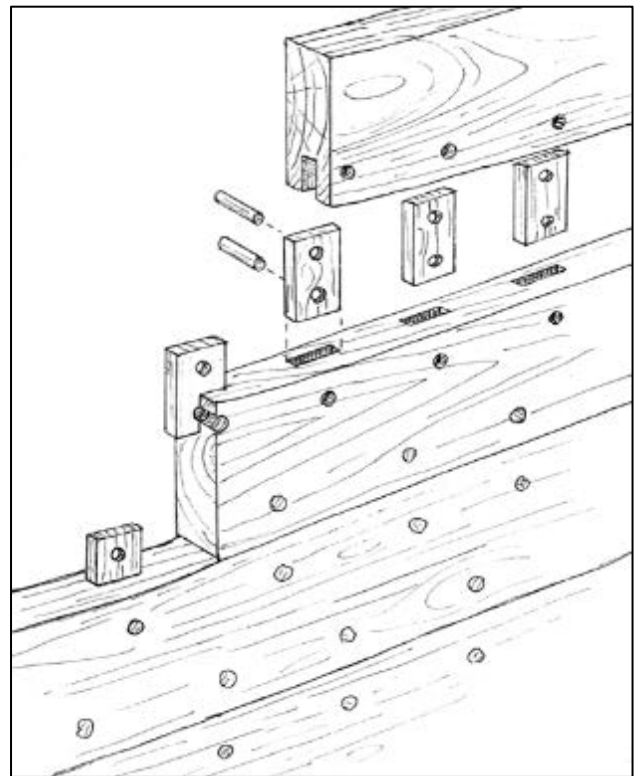


Fig.2.6. Schematic plan of the mortise-and-tenon construction method (drawing by the author)

in the Hellenistic and Roman period.²⁴⁶ Change was slow, with a steady movement towards a frame-first method of construction through the application of prefabricated parts²⁴⁷ and the increase of the role framing played in hull construction.²⁴⁸ The method was employed widely in every type of ship, from seagoing to river or harbour vessels (e.g. the Nemi lake barges or the Kinneret lake boat), as well as in ships outside the Mediterranean world but within the limits of the Roman Empire (e.g. the County Hall ship in London).²⁴⁹

Although the mortise-and-tenon method was employed in almost every seagoing ship of the period, hull forms presented a much greater variability²⁵⁰ and indicate the

²⁴⁴ Steffy 1994, 40-77; Pomey 2011, 22.

²⁴⁵ Pomey 2011, 40-53; Beresford 2013, 11-2.

²⁴⁶ Although sewn seagoing vessels gradually fell out of use in the Levant and the Western Mediterranean, they remained common in the tradition of the Adriatic as a local shipbuilding tradition both for boats and for larger vessels (e.g. the ships of Pula 1 & 2, Comacchio and Stella 1). For an overview of all sewn-boat finds in the Mediterranean and the Black Sea see Pomey & Boetto 2019.

²⁴⁷ Pomey & Rieth 2005, 168-9; Olaberria 2014, 355-61, 364-6.

²⁴⁸ Pomey et al. 2012, 305; McGrail 2013; Pomey 2020, 36-8.

²⁴⁹ Steffy 1994, 65-7, 71-2.

²⁵⁰ Whitewright 2011a, 92-3.

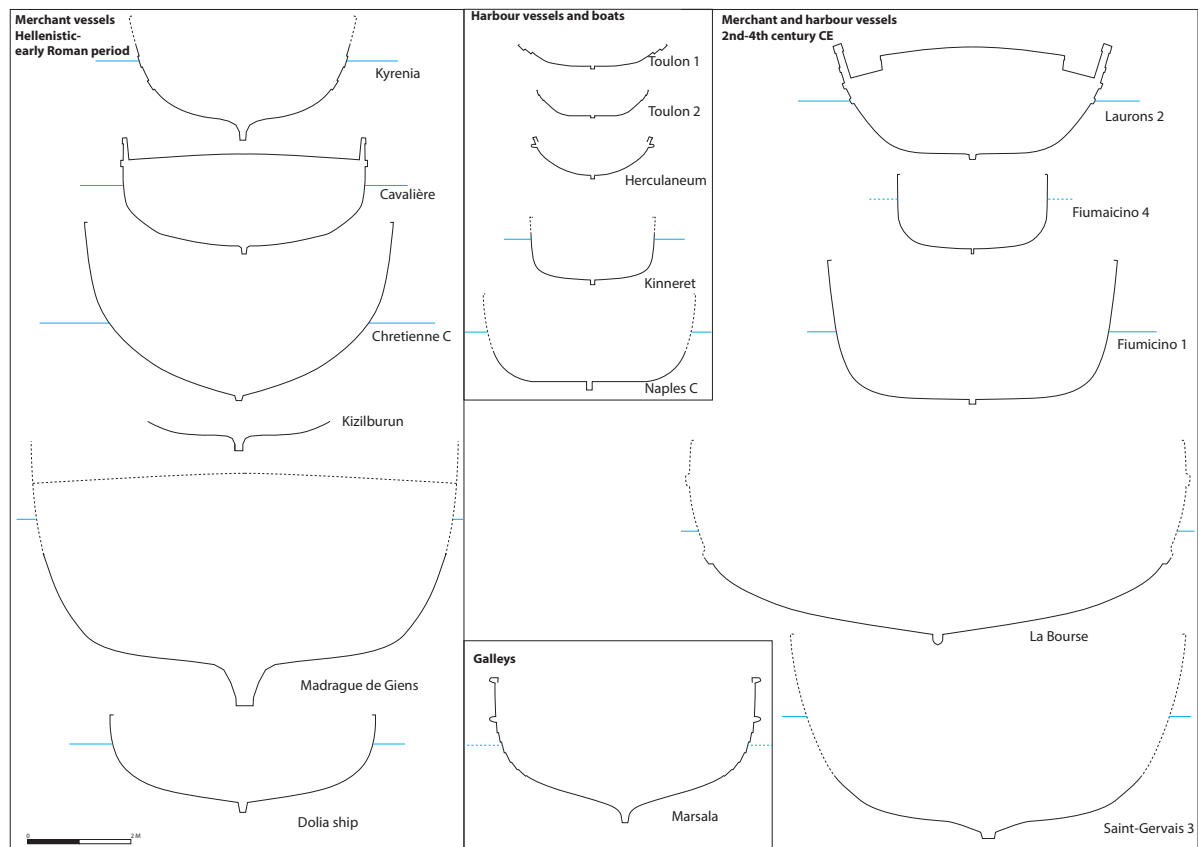


Fig. 2.7. A comparison between the mid-ship cross-section of various Hellenistic and Roman ships of the Mediterranean (drawing by the author; for references on each ship see **Appendix I**)

different approaches in the use of vessels, especially within coastal environments (**Fig.2.7**). Two types of hulls have been distinguished, conventionally named “Hellenistic” and “Roman Imperial”.²⁵¹ The “Hellenistic” hulls had a wineglass form with a deep, wedge-shaped keel. This advanced hydrodynamic form was improved by a longitudinally curved keel and a perpendicular stem post (e.g. Kyrenia) or a protruding cutwater (e.g. Madrague de Giens; **Figs.2.2 & 9**). The sailing qualities of such hulls were excellent, as proved by the extensive sea trials of the Kyrenia ship replica, whereas the protruding keel and the cutwater helped steering and speed, and resisted leeway, especially when sailing close to the wind.²⁵² Thanks to its sailing performance this type of hull was in use until the 7th century CE, as shown by a series of shipwrecks, whilst cutwaters remained a feature of many merchant ships at least until the 3rd century CE, according to iconography.²⁵³ The wineglass hull could have been

²⁵¹ Pomey et al. 2012; Pomey 2020.

²⁵² Whitewright 2011a, 92; Beresford 2013, 120-2.

²⁵³ Basch 1987, Figs.156-62, 1076, 1105-6, 1108-10; Pomey et al. 2012, 250-68.

used in galleys too, its hydrodynamic qualities making it ideal for the needs of oared vessels.²⁵⁴

The second hull form belonged to the “Imperial Roman” type. It was characterised by a rectangular, small keel, a flatter bottom and fuller lines and simple curved ends (e.g. Cavalière, Kizilburun, Chretienne C; **Fig.2.7**).²⁵⁵ These hulls were easier and cheaper to build than the “Hellenistic” ones, had a relatively larger cargo capacity and could approach shallow areas more easily, although their sailing abilities were to a certain degree compromised. Despite their overall simplicity these vessels never acquired a totally flat bottom, which would have been ideal for shallow waters, beaching and hauling on land, a form that became a standard feature for all Medieval Mediterranean ships.²⁵⁶ There were, however, two types of ships that clearly moved towards a flatter bottom: the *dolia* ships and harbour service vessels (**Figs.2.2 & 2.7**). In the first case, the hulls discovered have an almost flat bottom and a small, rectangular keel. This allows them not only to accommodate a cargo of large *dolia* containers, but also to approach shallower areas. Marlier and Boetto have suggested that it was the estuaries and the great rivers of the western Mediterranean that these ships were specially designed to navigate, although none has been found in their proximities.²⁵⁷ Marlier has also suggested a harbour use, convincingly arguing that since the bulky *dolia* were not to be removed from the ship, their filling and emptying would have to be done by siphons when the ship was docked and thus they had to maintain a small draught in order to approach docks or banks.²⁵⁸ To this I could add the easiness with which these relatively small vessels (**Appendix I, Table 3**) could be, when emptied, drawn on land for maintenance thanks to their flat bottoms. The second type of ships to acquire a simpler, box-like hull was the harbour vessels that appeared in the archaeological record after the 1st century CE. The earlier ones are the *horeiae*, the working boats found in the harbours of Naples, Toulon and Ostia and also known from texts and iconography (**Fig.2.8**). They all have a small keel and a flat central hull area, their almost perpendicular sides allowing for a larger

²⁵⁴ Coates 1995, 131; Morrison & Coates 1996, Appendix D). The use of a wineglass-shaped hull in galleys can be suggested by the only surviving galley hull, the Marsala Punic wreck (Frost et al. 1981, 241-77). Recent studies, however, have casted doubt over the original configuration of the ship that could have also been a round ship (Polakowski 2020).

²⁵⁵ Charlin et al. 1978; Littlefield 2012; Joncheray 1975.

²⁵⁶ Steffy 1994, 85-100.

²⁵⁷ Marlier 2008, 164-7; Boetto 2012, 167-8.

²⁵⁸ Marlier 2008, 167.

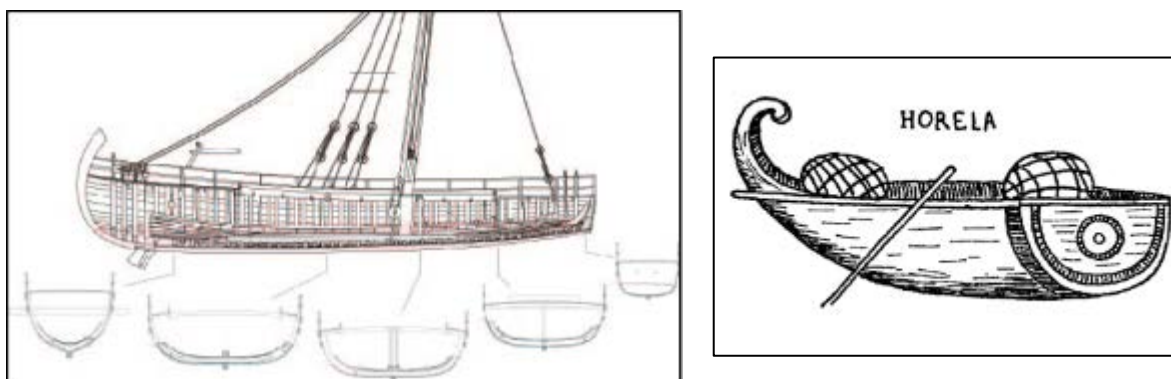


Fig. 2.8. Left: A reconstruction of the Naples C horeia-type ship as a sailing ship (Boetto & Poveda 2014, 65). Right: A horeia-type boat according to the Althiburus mosaic, Tunisia (Casson 1971, Fig.137)

cargo capacity. Although the smaller ones (Toulon 1 and 2) could be considered service or even fishing boats, the largest ones (Naples C and Isola Sacra I) were built to carry cargoes (**Appendix I, Table 4**).²⁵⁹ A similar configuration, although without the transom end, is found in the 4th-5th-century CE *naves caudicariae* from Fiumicino/Portus.²⁶⁰ The box-like hull and the small, straight keel, as well as the highly systemized construction method point towards ships that were to be used in fluvial or harbour environments as cheap and efficient cargo transporters.

2.3. Size, tonnage and draught

The issue of draught is probably the most important factor that dictates the ability of a ship to enter and use a harbour, an issue dependant to the overall dimensions and subsequent tonnage of a hull (**Figs.2.1-2; Tables 2.1-3**). For many years it has been considered that a steady rise in ship size and tonnage was the norm in the evolution of merchantmen from the Hellenistic and towards the Roman Imperial period,²⁶¹ but, as we will see below, the situation is much more complicated.

2.3.1. The Hellenistic period

Although certain larger ships did exist (e.g. the 130-tons Alonissos shipwreck from the late 5th century BCE),²⁶² the majority of Mediterranean merchantmen before the 4th century BCE were relatively small, between 70 and 115 tons and many were no more than 15-20 m long

²⁵⁹ Boetto 2009; Boetto et al. 2017.

²⁶⁰ Boetto 2011.

²⁶¹ Casson 1971, 172-3; Pomey 2011, 48-9.

²⁶² Hadjidaki 1996.

with a capacity of about 20 tons, as indicated by various shipwrecks.²⁶³ Thanks to their small size, light construction and limited tonnage these ships had a draught of no more than 1.5 m even when fully loaded. Naval fleets similarly consisted mainly of triremes, whose tonnage and draught was even smaller (it has been calculated that a manned trireme's draught did not exceed 1.1 m; **Table 2.3**).²⁶⁴

It was the intense military antagonism of the Hellenistic kingdoms from the end of the 4th century BCE onward that first triggered the construction of heavier oared vessels.²⁶⁵ Multi-banked galleys with very large oar crews and much greater displacement than triremes were soon developed (it is calculated that the *ἐπτήρης* or 'seven' was 47 m long and had a displacement of 133 tons; **Table 2.3**). However, thanks to the necessary design of all oared vessels (long, low, slender hulls that allow for efficient rowing and minimum drag), their draught hardly ever exceeded 1.5 m and it would have become even smaller as crews and equipment were disembarked when galleys were stationed in harbours or beached (**Fig.2.1**).²⁶⁶ Certain exceptionally large galleys were built, like the *Λεοντοφόρος* of Lysimachus (c.280 BCE)²⁶⁷ or the *τεσσαρακοντήρης* ('forty') of Ptolemy IV (c.215 BCE).²⁶⁸ According to the written evidence both ships were more than 110 m long, whereas the *τεσσαρακοντήρης* was apparently a unique gigantic catamaran.²⁶⁹ Much like the contemporary *Syracusia* 'mega freighter' (see below), these were rare and prestige ships, unfit for much practical use and very difficult to even be launched or hauled on land.²⁷⁰ The 'ships of the line' of the Hellenistic naval fleets remained regular polyremes with relatively limited sizes and draught.

A uniquely large cargo ship of the Hellenistic period was the grain freighter *Syracusia*.²⁷¹ According to the description by Athenaeus the gigantic and lavish ship had a capacity of 1,700 tons and could not be accommodated (the author uses the term *δέχεσθαι*, "to be received") by any of the contemporary harbours and was put on display after its

²⁶³ Gibbins 2001, 283-8; Kahanov 2003, T.31; Nantet 2016, 116-7.

²⁶⁴ Morrison & Coates 1996, Appendix D.

²⁶⁵ Murray 2012, 3-12; Pomey 2020, 28.

²⁶⁶ Morrison & Coates 1996, 323-4.

²⁶⁷ Memnon, *History of Herakleia* 8.

²⁶⁸ Ath.5.37.

²⁶⁹ Casson 1971, 108-16.

²⁷⁰ It has been argued that the only use of exceptionally large Hellenistic galleys would have been as fighting platforms in siege warfare (Murray 2012, 249-50).

²⁷¹ Ath.5.37, 5.206-9. Cf. Casson 1971, 185-6.

maiden voyage.²⁷² According to its tonnage its draught must have been no less than 4-5 m. The inability of the gigantic ship to enter harbours clearly indicates that it was totally unfit for any practical use. Concerning less exceptional merchantmen, shipwrecks offer no clues about any evident change in ship size and tonnage in the Hellenistic period since very few dating to this period preserve parts of their hull.²⁷³ The shipwrecks of Kyrenia (late-4th century BCE), Serçe Limani (280-275 BCE) and of the Hellenistic ship of Pisa (2nd century BCE) were no more than 15 m long and 4 m wide, with a draught of about 1 m.²⁷⁴ Iconography is equally poor concerning merchantmen of the period.²⁷⁵

This should not, however, be considered as firm proof for the prevalence of small ships in the Hellenistic Mediterranean. At least ten inscriptions from Delos, Ephesus, Samos and Athens document donations of grain cargoes and date from the end of the 4th century to 179 BCE (**Table 2.4**).²⁷⁶ Six of these cargoes belong to ships of medium capacity (95-120 tons), three to ships of large capacity (165-330 tons) and only one most likely to a ship of small capacity (20 tons, if not referring to a fraction of a larger cargo). The commonest size is c. 3,000 μέδιμνοι or 120 tons (five cargoes), followed by two donations of 4,000 μέδιμνοι or 165 tons. The fact that inscriptions do not mention any double cargoes and the regularity of the quantities are strong indications that these were single shiploads. Even the 330 tons of the inscription of 208/7 BCE might have been carried by a single large freighter. Finally, the Thasos inscription (see above), although not documenting any medium tonnage for the ships of the period, suggests that ships of 130 tons were numerous enough to have a special area of the harbour assigned to them.

²⁷² "On board were loaded ninety thousand bushels of grain, ten thousand jars Sicilian salt-fish, six hundred tons of wool, and other front amounting to six hundred tons. Quite apart from this was the provisioning of the crew. But when Hieron began to get reports of all the harbours, either that they could not receive his ship at all, or that great danger to the ship was involved, he determined to send it as a present to King Ptolemy at Alexandria; for there was in fact a scarcity of grain throughout Egypt. And so he did; and the ship was brought to Alexandria, where it was pulled up on shore" (Ath.5.209).

²⁷³ Nantet 2020b, 4.

²⁷⁴ Steffy 1994, 42-59; Pulak et al. 1987; Bonino 2003, 183-221.

²⁷⁵ Around 215 BCE in Rome, Quintus Claudius banned senators from owning any seagoing ship of a capacity of more than 300 amphorae (i.e. a very small capacity ship; Table 2.1; Liv.21.63.3). Although this reference could point towards relatively small capacities in the average size of merchantmen of the period, it could also be an excessive measure of the Roman republic, targeting the richness of various senators.

²⁷⁶ Casson 1971, 183-4.

City	Date	Amount		References
		<i>Medimnoi</i>	Tons	
Delos	1 st half of 3 rd century BCE	500	20	IGXI.4.627
Ephesus	c.300 BCE	2,333	95	Syll. ³ 354
Delos	179 BCE	2,800	115	ID 442A 100-105
Samos	End of 4 th century BCE	3,000	120	SEG I 361
Athens	c.325/4 BCE	3,000	120	IGII ² 360
Athens	324/3 BCE	3,000	120	IGII ² 363
Athens	320/19 BCE	3,000	120	IGII ² 398
Athens	c.330 BCE	4,000	165	IGII ² 408
Athens	320/19 BCE	4,000	165	IGII ² 400
Athens	208/7 BCE	8,000	330	IGII ² 845

Table 2.4. A list of grain cargoes donated to various Greek cities during the Hellenistic period (based on Casson 1971, 183-4).

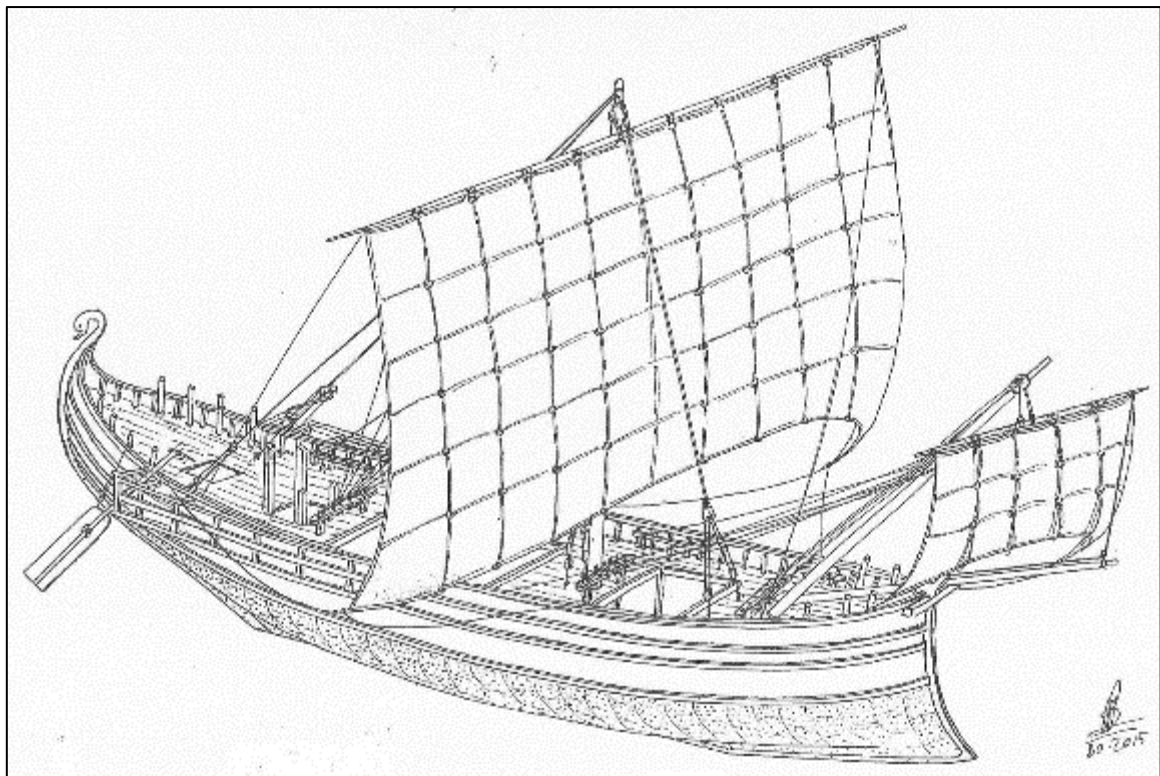


Fig.2.9. Conjectural reconstruction of the Madrague de Giens shipwreck (Bonino 2018, Fig.10).

2.3.2. The Late Republican and Imperial Roman period

Although the passage from the Hellenistic to the Roman period through the conquest of the Greek East by Rome was more of a natural evolution than an abrupt change,²⁷⁷ the *pax Romana* resulted in a substantial culmination of changes in the maritime economy and commerce.²⁷⁸ These changes began to be evident in shipwrecks from the end of the 2nd century BCE.²⁷⁹ The Spargi wreck in Sardinia (120-100 BCE) is the first known merchantman with a capacity of 200-300 tons.²⁸⁰ The large-capacity (*myriophoroi*) shipwrecks of Mahdia, Albenga and Madrague de Giens (**Figs.2.1, 2.7 & 2.9; Appendix I, Table 1**) followed in the first half of the 1st century BCE.²⁸¹ All had a length of about 40 m, a beam of 10 m and a draught of 3.5 to 4 m. This boom in the sizes of ships is, however, limited to a very specific period and geographic area (southern Gaul) and it does not mark, at least according to archaeological evidence, a universal use of ships of such great capacity. In the following two centuries only four shipwrecks of over 200 tons are dated, not exceeding a length of c.30 m and a capacity of 250 tons (Punta del Francese, Saint-Tropez, Torre Sgarrata and Marzamemi I).

Despite their relative scarcity in the archaeological record, however, large ships continued to be built, according to written evidence. Scaevola mentions ships of 350 tons in the in the second half of the 2nd century CE,²⁸² whereas in the same period the *Isis* ‘mega-freighter’ of 1,200 tons and almost certainly other similar ships were sailing the Mediterranean.²⁸³ Three-masted ships, although most likely rare, were a familiar site in the great harbours of the period. A sea-going ship of 511 tons travelling from Ostia to Alexandria is also documented in a 2nd-century CE papyrus from Egypt.²⁸⁴ The lack of large-capacity shipwrecks is probably due to the fact that, as noted above, the intense sea traffic moved towards the East in areas where the conditions of preservation and study of shipwrecks are

²⁷⁷ Chaniotis 2018, 3-4

²⁷⁸ Archibald 2005, 1; Gibbins 2001, 288; Pomey 2011, 48-9; Chaniotis 2018, 311.

²⁷⁹ Pomey 2020, 32-40.

²⁸⁰ Gianfrotta & Pomey 1981, 339; Nantet 2020c, 83.

²⁸¹ Pomey & Tchernia 1978, 233-5.

²⁸² “Exemption from public employments is granted to those who have constructed ships destined for the transport of provisions for the Roman people, which have a capacity of not less than fifty thousand measures of grain, or several, each of which has a capacity of not less than ten thousand measures, as long as the said ships are suitable for navigation, or where they provide others in their stead. Senators, however, are not entitled to this exemption. According to the Julian Law on Extortions, they have no right to have ships”, (Scaev.*Dig.* 50.5.3).

²⁸³ *Luc.Nav.* 5-9. Casson 1971, 186-8; Houston 1987.

²⁸⁴ P.Bingen 77. Cf. Nantet 2016, T.38

not as favourable as they have been in the west, particularly in southern France (see **1.4.3**).²⁸⁵ Furthermore it has been reasonably suggested that the development of harbour networks in areas like the Tyrrhenian Sea and southern France made travels safer and caused a drop in the number of shipwrecks (see **Chapter 4**).²⁸⁶ The Antirrhodos shipwreck, a beamy freighter of 250 tons, dated to the end of the 1st century BCE or the beginning of the 1st century CE, as well as the similar Caesarea Maritima shipwreck of the 1st century CE are indications of the new route the great cargo ships of the period would take in order to satisfy the supply of Rome with grain.²⁸⁷ A series of shipwrecks, as well as written evidence, on the other hand, document the continuity of small and medium capacity ships, the “backbone of ancient maritime commerce”.²⁸⁸ According to the shipwreck data, small-capacity merchantmen continued to have the dimensions, tonnage and draught of their predecessors of the Hellenistic period: the medium capacity vessels were 18 to 25 m long, had a draught of 1.5 to 2.3 m and could carry 80 to 130 tons (**Appendix I, Table 2**). An interesting but difficult to explain fact is the relative scarcity of medium capacity shipwrecks in the Hellenistic and Roman period: only six examples compared to the 10 large and the 27 small capacity ships are to be found in my documentation (**Appendix I, Tables 2 & 3**).

2.3.3. The issue of the average ship size and tonnage

One of the basic questions related to the ship traffic and consequently ship and cargo handling in the Hellenistic and Roman harbours concerns the average size of these ships. The rationale behind this discussion in relationship to my study is straightforward: the bigger the majority of ships were the greater the depth and size of the harbours they visited would have to be, as well as the resources that would have to be invested to construct and maintain them. In other words the rise in the number and average tonnage of merchantmen could instigate the construction of more elaborate harbours or, vice-versa, the construction of larger and deeper harbours would allow the construction and employment of even larger vessels in the commercial networks of the period.

²⁸⁵ L' Hour 1997, 161; Wilson 2011b, 40; Boetto 2012, 153; Russell 2013a, 112, n.89.

²⁸⁶ Robinson et al. 2020, 103-4.

²⁸⁷ Fitzgerald 1995; Sandrin et al. 2013; Nantet 2020c, 84.

²⁸⁸ Gibbins 2001, 294-5.



Fig.2.10. *A merchantman under sail. Relief from the tomb of Naevolia Tyche, Pompeii (c.50 CE; Whitewright 2008, 266).*

Following the established thesis that the volume of seaborne commerce of the Roman period had reached an unprecedented volume, several scholars have considered the average size of Roman ships of the late Republican and early

Imperial period to be much higher than before,²⁸⁹ with Casson suggesting that any ship below 70-80 tons was not part of the regular merchant fleet. This view fits well both with the large scale of Roman trade and the “proto-industrial” nature of Roman economy²⁹⁰ and could also explain the impressive developments in harbour construction of the early Imperial period (see 4.5). A more thorough scrutiny of the data discussed above shows, however, that this interpretation is far from certain. As we already saw the first shipwreck of more than 200 tons is dated around the end of the 2nd century BCE (Spargi), followed by the first *myriophoroi* (**Appendix I, Table 1**). This period coincides with the rapid expansion of Roman rule and the political and financial unification of the Mediterranean and shipwrecks appear to verify a steep increase in the average tonnage, compared to the previous period. However, the abovementioned shipwrecks belong to a very specific time period and are limited to a very specific geographical area, the western Mediterranean. As noted by Emmanuel Nantet,²⁹¹ the rise of ship tonnage appears to have been a local phenomenon and not a general trend throughout the Mediterranean, subject to very specific financial and socio-political conditions. The coherent amphorae cargoes and their location indicates that these ships served a particular trade network, which included the exchange of Italian wine

²⁸⁹ Rougé 1966, 415-21; Casson 1971, 170-3.

²⁹⁰ Archibald 2005, 10.

²⁹¹ Nantet 2016, 122.

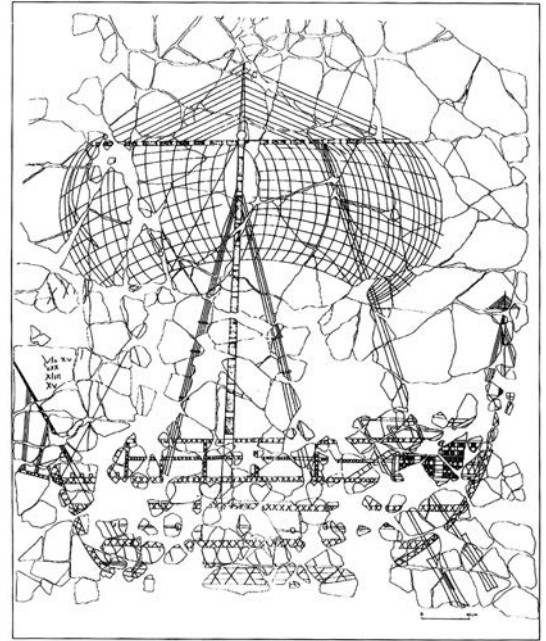
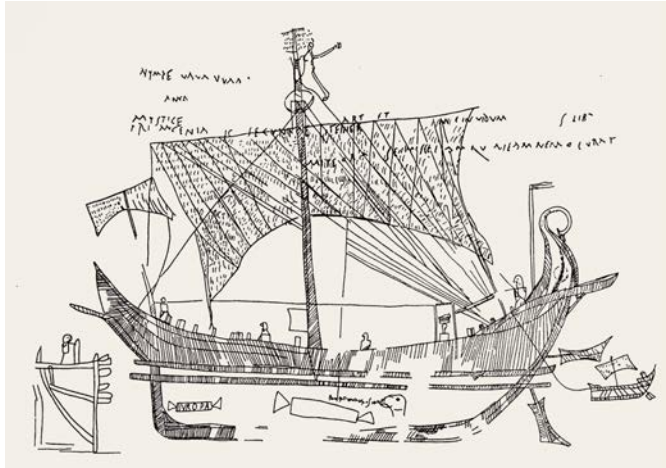


Fig.2.11. Graffiti of ships on walls of Roman houses. Left: the “Europa” ship (House of the Ship, Pompei, 1st century BCE; Langner 2001, Pompeji, I, 15.2.3). Right: a merchantman from the Roman villa at Cucuron in Vaucluse, France (1st century CE; Sabrié et al. 1993, 30).

with metal and enslaved people from Gaul before its full annexation by the Romans in the middle of the 1st century BCE.²⁹² According to shipwreck data *myriophoroi* became more rare in the ensuing centuries (see above).

Written sources give equally inconclusive evidence: as we have already seen references to ships of over 150 tons are rare and span from the 5th century BCE to the 1st century CE.²⁹³ On the contrary, texts more often mention ships of 150, 100 or 75 tons. Iconography is also vague. Although the highly detailed images of merchantmen of the early Imperial period give the impression of vessels of great size (**Figs.2.10-11**), it is impossible to ascertain their actual tonnage. According to the conventions of contemporary art, human figures are out of scale and greatly oversized, whereas naturalism is by far not the artists’ main goal.²⁹⁴ The elaborate decoration and the presence of two masts cannot be firm evidence on the tonnage of the vessels portrayed (even ships of medium and small capacity would regularly carry a foremast; see **2.4.1**). As for the various pieces of equipment (gangplanks, cabins, capstans), it is a mere assumption to attribute them to ships of larger tonnage and deny the possibility of smaller ships being equipped with them.

Under these considerations, the fundamental question arising is whether ships larger than 150 tons were exceptions to the rule and that the bulk of trade was undertaken by

²⁹² Tchernia 2011, 87-8; Nantet 2016, 122-3.

²⁹³ Wallinga 1964, 3-5.

²⁹⁴ Basch 1987, 1018-62.

ships of medium to small tonnage. These not only constitute the majority of vessels discovered by archaeological research (6 ships of medium and 26 ships of small capacity against 2 *myriophoroi* and 9 ships of large capacity; **Appendix I, Tables 1-3**) but also appear more regularly in written sources. Wallinga and Houston, the former using historical parallels from the 17th and 19th century harbour registries, suggested that very few vessels of larger tonnage did exist and their role in trade was secondary compared to the much larger fleet of medium and small tonnage ships.²⁹⁵ Such a fleet could obviously take advantage of smaller, shallower and less protected harbours or anchorages, whereas their lower construction, manning and maintenance costs would offer another inducement for their construction and employment.

Both approaches on the average ship tonnage are sound and derive from thorough interpretations of the evidence. They are, nevertheless, based on the assumption that an average, standard category of ships existed and carried the burden of trade, travel and exchange, with smaller or larger ships accordingly having a limited, marginal role in the 'great trade' of the period.²⁹⁶ Written sources clearly ignore the existence of such a thing as a 'regular' or 'average' merchantman. As we saw above (**2.1.2**), beyond a generic division amongst oared/military and sailed/merchant vessels, ships were mainly divided according to their use and cargo, not their tonnage or construction, and archaeological finds firmly document the similarities both in the form as well as in the construction methods of all vessels.²⁹⁷ The intricate procedure of measuring the capacity of vessels did concern scholars like Hero and almost certainly taxation authorities too, but nothing points out to any standardization. In the case of the Thasos inscription ships are described as broader categories reaching a certain maximum capacity related to the harbour organisation, without any reference to any 'average' ships frequenting the harbour. Similarly, Hero's calculations concern a series of vessels of which none is marked as 'average' or 'regular'. Moreover, no regulations were ever issued by contemporary authorities in order to control the size ships had to have in order to be part of any trade network, as it would happen in Medieval Venice for construction and taxation reasons.²⁹⁸ Finally, the appearance of the *myriophoroi* in various texts is most probably due to the notion of them being the largest

²⁹⁵ Wallinga 1964, 27; Houston 1988.

²⁹⁶ Rougé 1966, 415-21; Wilson 2011b, 54-5.

²⁹⁷ Pomey & Rieth 2005, 164.

²⁹⁸ Lane 1992, 247.

ships, their name referring to the word *μύριοι* (10,000), easily recognisable by the predominantly Greek-speaking readers.

Shipwrecks offer equally inconclusive clues about any conformity of tonnage. Despite their similarities in construction no shipwreck is identical to the other. This can be associated with the conditions under which these ships were built. Contrary to galleys, merchantmen and other types of working vessels were built according to the demands of a diversified clientele, ranging from wealthy landholders or corporations to individuals with limited resources. Thus commissioning any ship could depend on a variety of factors, from the availability of funds and the amount of cargo each had to carry to risk margins or even the availability of timber. Ship owners could also invest in more ships of small tonnage than in a single or few large ones. This heterogeneity matched the diversity of the people, interests and habits of the ancient Mediterranean.²⁹⁹ Warships on the other hand most probably followed rules concerning their size, oar crew and construction, necessary for their swift construction and operation in naval fleets. Galleys were most likely built by commissioned private shipyards under specific plans and instructions in order to maintain this regularity.³⁰⁰ Iconography shows the similarities between ship types,³⁰¹ whilst the Romans were able to promptly create a fleet of 100 'fives' by copying a captured Carthaginian galley in 260 BCE.³⁰²

2.4. Propulsion, steering and equipment

The means of propulsion and handling, as well as the necessary equipment a ship possesses are essential factors that can dictate its operation and potential but also its shortcomings when employed in any specific sea and especially coastal environment. The ships of the period discussed were equipped with a variety of such means and were quite advanced, as we will see.

²⁹⁹ Harpster 2017, 62.

³⁰⁰ The operation of state-ran shipwrights for the construction and maintenance of galleys, as well as of specialized galley shipwrights is not well attested in written sources of the Hellenistic and Roman period. A single reference to a long-ships shipyard comes from Ennius (cited by Servius, A.11.326).

³⁰¹ Basch 1987, 342-91, 418-54.

³⁰² Pl.Nat.16.192; Morrison & Coates 1996, 43.

2.4.1. Means of propulsion and steering

Oars and sails were the main means of propulsion for the ships of the period studied, as happened throughout the whole of antiquity and until modern times. Considering oars, they allowed ships not to be dependent on the unpredictable winds and gave the advantage of controlled speed. They could be also used for steering, allowing vessels to approach shallower areas safely. Oars were employed on galleys, vessels designed and built around their rowing crews, but not in most of merchantmen. According to the ergonomics of rowing, the bigger the angle of the oar to the water surface the more difficult and less effective it is for it to be operated.³⁰³ The height of the merchantmen's gunwale did not allow the use of oars at a workable angle, whereas oar ports could not be opened on the sides of the hull without jeopardizing its safety and oarsmen could not be accommodated in the hold without diminishing the ship's cargo capacity. These vessels had to depend on sails or tugboats for approaching harbours and coasts in general. Only small capacity merchantmen with a lower freeboard could use oars as auxiliary power and means of steering, especially inside harbours. Boats on the other hand could employ oars much like galleys whenever they needed thanks to their low freeboard. The hybrid merchant galleys could apparently take advantage of both sails and oars, something that would have greatly helped their operation both in the open sea as well as in coastal environments. Due, however, to the need to accommodate a rowing crew and to maintain a low freeboard, they could match neither regular galleys nor regular merchantmen in terms of speed and capacity respectively. Their use was therefore limited to very specific areas that offered favourable conditions, like the Nile, where *κέρκουροι* merchant galleys of considerable size are documented in a series of papyri.³⁰⁴ Although we should not exclude the possibility that certain types of merchant galleys frequented Mediterranean harbours of the period, including the case study harbours, the lack of data on their draught and size (papyri only document their overall tonnage) makes it impossible to assert their possible operation within these harbours.

³⁰³ Shaw 1995.

³⁰⁴ Casson 1995, 119-21. Papyric evidence clearly documents *κέρκουροι* of considerable tonnage (450 tons; Arnaud 2015b, 107; see also **Appendix I, Table 1**), but there is no mention of their use in the open sea and they most likely operated as bulky river barges in the calm waters of the Nile.

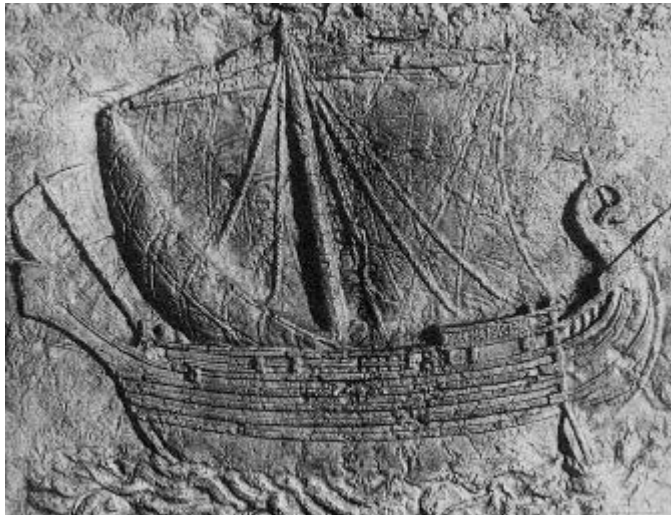


Fig.2.12. A merchantman under full sail. Sarcophagus relief from Sidon (mid-1st century CE; Whitewright 2008, 268).

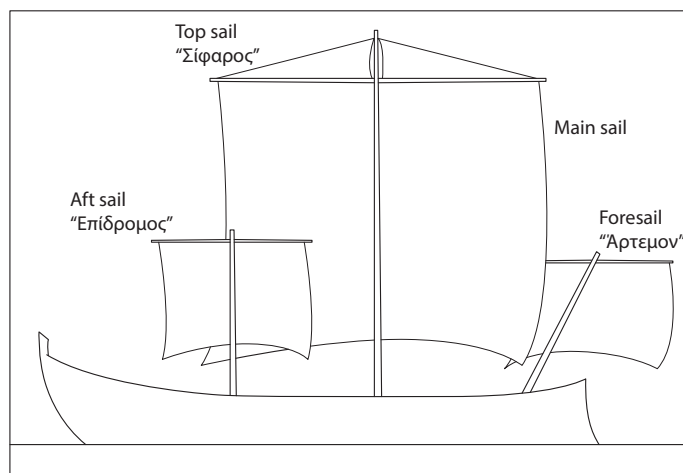


Fig.2.13. Schematic drawing of the different types of sail employed in Hellenistic and Roman ships (drawing by the author).

Sails remained the main means of propulsion for merchantmen but also for galleys, when they had to make longer voyages. In the case of the former, although sails were regularly employed, as iconography and texts verify,³⁰⁵ all rigging was removed and stored during sea battles and when the ships were stationed in harbours or arsenals.³⁰⁶ The mail sail type of the period was the loose-footed square sail (Figs.2.12 & 13).³⁰⁷ Despite its simplicity compared to more recent types of rig, the square sail allowed ships to achieve great speed and to sail close to the wind and could thus permit a sailing season extending beyond the favourable summer months.³⁰⁸ Ships would commonly carry one or two masts, each with a single sail of that

type. The foresail (ἄρτεμων/artemon) was a smaller version of the mainsail, hoisted on an inclined mast set over the ship's bow. Known since the Classical period, it was adopted by the majority of merchantmen by the 1st century BCE.³⁰⁹ Foresails could be used even in smaller ships like the 17-m long Saint Gervais 3 (Appendix I, Table 2) or in one of the recently discovered Roman shipwrecks in the Black Sea (c.13-m long).³¹⁰ Despite the superficially conservative nature of sailing in this period, experimentation and adoption of

³⁰⁵ Casson 1971, 235-8.

³⁰⁶ Casson 1971, 235-6.

³⁰⁷ Whitewright 2017, 230.

³⁰⁸ Beresford 2013, 12-3; Whitewright 2011b, 10.

³⁰⁹ Beltrame 1996; Arnaud 2011a, 152; Whitewright 2011a, Fig.6.2.

³¹⁰ Beltrame 1996, 135; Whitewright 2018.

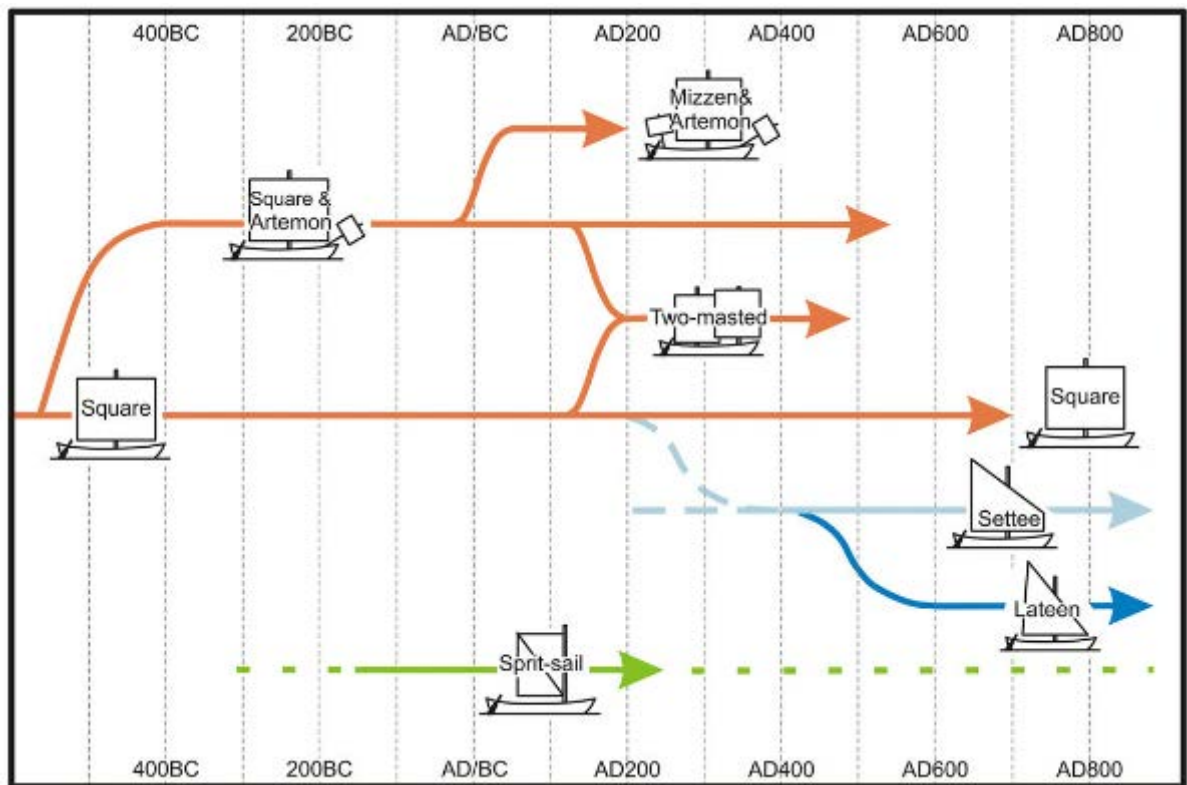


Fig.2.14. Schematic evolution of the sails in the ancient Mediterranean (Whitewright 2018, Fig.5).

new types of sails was constant. A triangular topsail (σίφαρος/*siparum*; **Figs.2.12-3**) was introduced above the main sail and appears in the iconography of the 1st and the 2nd century CE.³¹¹ Iconography also documents the introduction of the spritsail in the 2nd century BCE and of the lateen or settee in the 2nd century CE. The two former types, however, seem to have been used only by small vessels.³¹²

Another important, albeit poorly documented, innovation was the introduction of a third mast and sail. Three-masted ships (τριάρμενοι) are mentioned in written sources as ships related to the transport of grain from Alexandria.³¹³ The only clear image of a small mizzenmast hoisting a square sail is to be found at the mosaic of the *statio* of Sullethum in Ostia (**Fig.2.4**), and it is possible that the Madrague de Giens ship also carried a third mast (**Fig.2.9**).³¹⁴ Apart from its name (ἐπίδρομος), written sources give no further information about its form and the way it was used.³¹⁵

³¹¹ Casson 1971, 241-2. According to Seneca (*Ep.*77), only the Alexandria grain fleet was allowed to hoist the *siparum* sail.

³¹² Whitewright 2017, 228-30

³¹³ Luc.Nav.14; *Pseudol.*27; *Lex.*15; Philostr.VA 4.9; Casson 1971, 242-3.

³¹⁴ Pomey 1997, 85; Beresford 2013, 123-4.

³¹⁵ Tchernia 2011, 83-5.

Neither the foresail, although widely used, or the more rare topsail did much to increase the speed of sailing ships. But mariners could choose amongst various combinations of sails according to the weather and the spaces in which they had to navigate (**Fig.2.14**). The use of the foresail and mizzen sail would greatly improve the manoeuvrability of the ship when sailing on close-hauled courses³¹⁶ and could operate as a main sail when reduced speed was required, the square loose-footed sails being relatively difficult to trim, or counteracted the dragging of the anchors by using the breeze and wind against it. In terms of harbour use, these sails could be beneficial to merchantmen by improving their steering and control and allowing them to move independently within enclosed areas, especially in places where tugboats were not available.

Finally the steering method of all ships in the period discussed consisted of the quarter rudders in the form of large oars fixed on the sides of the stern (**Figs.2.9-12**). Notwithstanding varieties on mounting, size and shape, this simple device remained basically unaltered throughout the period. The quarter rudders could operate successfully and allow even larger ships to be easily controlled under any conditions and in every environment.³¹⁷ Only some river craft or tugboats had long scoop rudders occasionally mounted on the sternpost.³¹⁸

2.4.2. Equipment

Various pieces of ship equipment were used in Hellenistic and Roman times in order to improve their performance. Some of these were pre-existing and others introduced during this period, as documented by written and archaeological evidence, as well as iconography. This equipment was, as we will see below, very important for the handling of ships in coastal environments.

³¹⁶ Whitewright 2011b, 8.

³¹⁷ Mott 1997, 19-39.

³¹⁸ Casson 1971, Figs.189, 193.

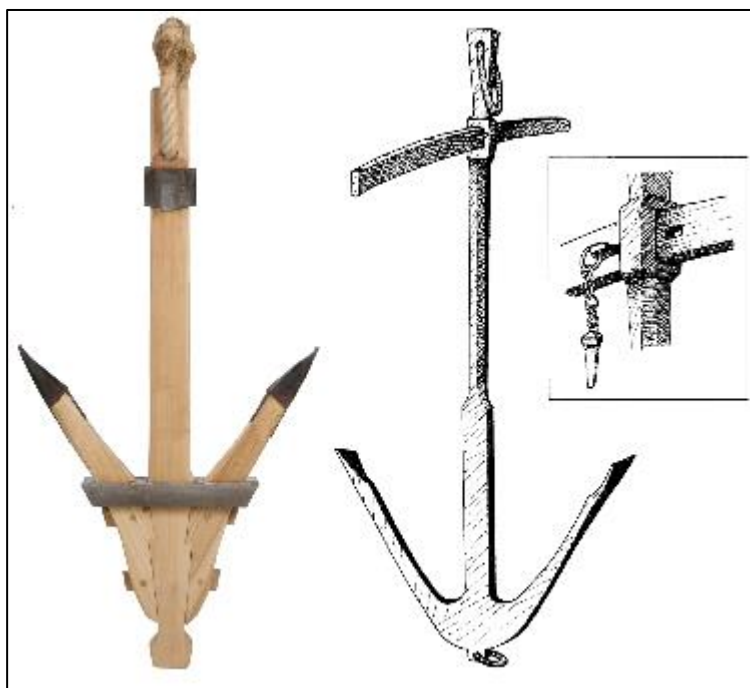


Fig.2.15. *The two main types of anchors used during the Hellenistic and Roman period reconstructed. Left: wooden anchor with lead stock, shoulder collar and teeth (replica by Votruba 2014, 436). Right: late Hellenistic iron anchor from Ashkelon (Galili et al. 2010, Fig.6).*

Anchors were the most useful piece of equipment in ancient ships. When used properly they secured vessels by preventing them from being stranded or crashing on the shore or to each other. A great number of Hellenistic and especially Roman anchors of various types have been found.³¹⁹ Most of them were wooden anchors with lead or stone stocks, a type known since the archaic period, whereas iron anchors with wooden stocks, as well as fully iron ones were

introduced in the Hellenistic period (**Fig.2.15**).³²⁰ Two-armed anchors were very common, although one-armed ones were also used. As suggested by shipwreck evidence and a reference in the Acts, large ships would normally carry three to six anchors (although there are examples of ships with eight or nine anchors), one of them often referred to as “sacred” and used as the ship’s last resort when other anchors were lost.³²¹ Mariners could cast up to four anchors in cases of emergency, as they did on the vessel in which Saint Paul travelled

³¹⁹ For general information on Mediterranean anchors of the Hellenistic and Roman period see Perone Mercanti 1979, Kapitän 1984, Haldane 1990 and Votruba 2014.

³²⁰ Casson 1971, 252-8. Gianfrotta 1980, 105. Simple stone anchors seem to fall out of use for seagoing vessels in the Hellenistic period. Few examples come from lagoonal or lake environments in the Levant (Votruba 2014, 74-5).

³²¹ Acts, 27.29-32. For the four or five anchors of the Mahdia shipwreck see Merlin 1909, 667-8 and de Frondeville 1965, 41; for the four anchors of the Taranto shipwreck see Throckmorton 1987, 78-9. For the Sud-Lavezzi B shipwreck that carried nine anchors see Liou 1982, 446, Liou & Domergue 1990, 47 and Parker 1992a, no.1118. For the Punta Scaletta shipwreck that was discovered with seven or eight anchors on board see Lamboglia 1964, 254, tav.II and Parker 1992a, no.960. On the “sacred anchor” see Pollux, 1.93, Plut.Cor.32.1, Luc.J.Tr.51 and Luc.Fug.13 (cf. Votruba 2014, 15-8). According to Votruba it remains doubtful whether the “sacred anchor” was in any ways different or heavier than the others, as suggested by Casson 1971, 255.

before committing the “sacred” one.³²² Handling of large anchors of up to 700 kilograms would have required enough hands (available at least onboard larger ships) and capstans, whose use on ships is attested by a passage by Lucian, as well as by the image of a *navis caudicaria* at the mosaic at the Piazzale delle Corporazioni in Ostia.³²³ The loss of anchors was a common problem, especially since the use of chains instead of ropes was most likely unknown in the Mediterranean.³²⁴ Mishandling or misappropriation was also not unknown. Synesius reports that the ship carrying him from Alexandria to Cyrene in 402 CE had two anchors, one of which had been sold so that the ship had to dangerously ride on a single one, implying that three anchors were required for each seagoing vessel.³²⁵ This number is also given by an Egyptian papyrus of 212 CE that lists the full equipment of a ship, including regular iron-stock anchors and one with only one arm.³²⁶

Written sources also mention the cables used by ships to secure themselves when being stationed close to the coast. The exquisite hemp used for the *Syracusia* cables is mentioned by Athenaeus, whereas Appian describes the variety of cables available at the harbour of Carthage.³²⁷ Cork buoys, used to mark cables and anchors are also reported in written sources.³²⁸

Gangplanks also became a standard part of the merchantmen’s equipment in the Roman period. The invention of the *corvus* boarding device for galleys in the 3rd century BCE might have been the idea behind the adoption of such devices in merchantmen, but the first fixed gangplanks appear in iconography only after the 1st century BCE (**Figs.2.11, 2.18, 2.23-4**).³²⁹ They were long and sturdy devices, firmly attached on the ships’ bows and controlled by ropes and tackles from the foremast. Textual evidence does not mention anything about

³²² “Fearing that we would run aground on rocky ground, they let go four anchors from the stern, and wished for daylight” (Acts 27.29).

³²³ Luc.Nav.5; Boetto 2010, Fig.8.

³²⁴ The only reference to the use of chain instead of rope for anchor cables is made by Caesar, when he describes the ships of the Veneti as using chains instead of rope for their anchors (Gal.3.13.5; cf. Casson 1971, 252, n.108). Caesar reports this as something exceptional, indicating the chains were not used at all in the Mediterranean.

³²⁵ “Our ship was riding in the open sea, for the spot was not a harbour, and it was riding on a single anchor. The second anchor had been sold. And a third Amarantus (the captain) did not possess” (Syn.,Ep. 4.23).

³²⁶ P.Lond. 1164h. Cf. Casson 1971, 258.

³²⁷ Ath.5.206d; App.Pun.14.96.

³²⁸ “A third kind have a porous bark, which is so light that they actually make from it floats for anchors and nets” (Paus.8.12.1); “It [cork oak] is used particularly for ships’ anchor cables and fishing nets” (Plin.Nat.16.34). Cf. Casson 1971, 257, n.133.

³²⁹ Plb.1.22. Basch 1987, Figs. 1031, 1035, 1043, 1045.

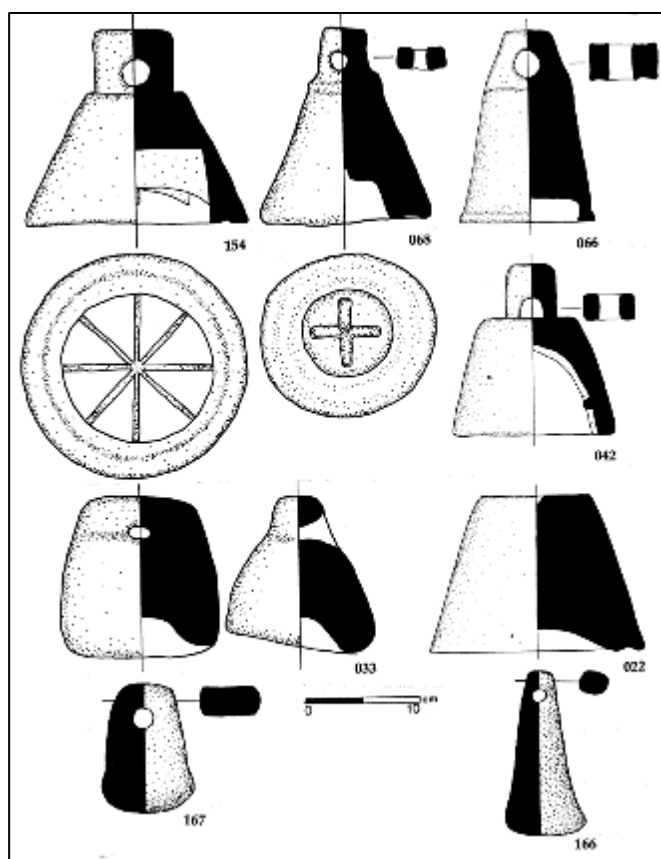


Fig.2.16. Various lead sounding weights of the Roman period (Oleson 2000, Fig.4).

them, apart from the Egyptian papyrus of 212 CE (see above), which documents a gangplank as part of a ship's basic equipment.

Ship boats also become part of the merchantmen's standard equipment during the period studied. They are often documented in Hellenistic and Roman written sources³³⁰ and start appearing in iconography from 1st century BCE onwards, hauled and used by merchantmen (Fig.2.11).³³¹ Their use, as we will see, must have been great in the safe handling of ships and cargoes.

Finally, although sounding weights were by no means an invention

of the period, they were widely employed and perfected during the Hellenistic and Roman period (Fig.2.16).³³² Bigger and more elaborate cast sounding weights become very common from the 2nd century BCE onwards.³³³ The use and development of these devices can be related to the need of larger ships to safely approach treacherous areas, especially estuaries and lagoons.

2.5. The handling and operation of ships and cargoes

The different types of ships described in the previous section had to serve equally different, often ever-changing needs, and use different natural or anthropogenic spaces, making the best out of every diverse and often unfriendly coastal environment. Each harbour or anchorage, very much like each ship, was unique and a great degree of adaptability was

³³⁰ Ath.209; Philostr.VA.4.9.

³³¹ Basch 1987, Figs.1030, 1038, 1051.

³³² Oleson 2000; 2008b; Wilson 2011b, 45-6.

³³³ Beresford 2013, 198.

required from the mariners of the time in order to sufficiently attend to the needs of the sea networks they served.

2.5.1. The various methods of approaching and using harbours

The development of ships and seamanship during the Hellenistic and Roman period in the Mediterranean allowed the use of a variety of methods and techniques of approaching and using harbours, each adapted to different conditions and serving, as we will see in the following pages, different needs, ships, and cargoes.

Anchoring

Archaeological evidence on ship anchoring is relatively scarce, since such a practice leaves few traces in the field, whereas anchor finds can be accidental and not easily related with specific anchoring practices and can also come from their use for the attachment of other devices, such as pontoons, barges, floating bridges or fish traps.³³⁴ Nevertheless large anchor assemblages found in and around ancient harbours and anchorages, can offer very important evidence on the operation of harbours when they are studied in a meticulous and coherent way (e.g. Alexandria or Ashkelon).³³⁵ Shipwrecks also provide solid data on the use of anchors, at least concerning their numbers and types, and several ships have been found with their whole anchor gear still in place³³⁶, although they are not often related with organised harbour use but with accidents and emergency anchoring.

Written evidence is the main source concerning anchoring practices in the period studied. Several texts mention the casting of single or multiple anchors³³⁷ but give no further details on their handling. A common practice, which was very important in the operation of harbours, was anchoring outside harbour basins. This is first documented around 350 BCE when Demosthenes reports the case of two merchants who anchored their freighter outside the harbour of Piraeus:

³³⁴ Votruba 2014, 70-1.

³³⁵ Belov 2015, 55; Empereur & Soukiassian 2015; Tzalas 2015; Galili et al. 2010.

³³⁶ E.g. the Mahdia shipwreck (Merlin 1909, 667-8; de Frondeville 1965, 41), the Taranto shipwreck (Throckmorton 1987, 78-9), the Sud-Lavezzi B shipwreck (Liou 1982, 446; Liou & Domergue 1990, 47; Parker 1992a, no.1118) and the Punta Scaletta shipwreck (Lamboglia 1964, 254, tav.II; Parker 1992a, no.960)/. Cf. Votruba 2014, 148-52.

³³⁷ Dem.50.22; Plut.*Quaes.Conv.*731d; App.*BC* 5.89; Philostr.*VA* 8.14.

*When they arrived here they did not put into your port, but came to anchor in thieves' harbour, which is beyond the signs marking your merchant port... for anyone can sail forth from that harbour to whatever point he wishes and at any moment he pleases.*³³⁸ Although the size and cargo of the ship is not documented, it was not the lack of space and depth which made the two merchants anchor in the open sea (Piraeus' main harbour was large and deep enough for any kind of ship), but, as clearly stated by the orator, the possibility of quickly sailing away without being controlled by the authorities.³³⁹ The text insinuates that this was a practice "not unlawful, but suspicious,"³⁴⁰ possibly also allowing the quasi-legal avoidance of port fees.

Information on anchoring in the open sea appears again in written sources of the 1st century BCE and the 1st century CE. Dionysius of Halicarnassus reports that ships of over 3,000 amphorae or 150 tons could not enter the river harbour of Ostia due to silting and had to anchor in the mouth of Tiber and use lighters.³⁴¹ Strabo is more explicit about the same issue:

*This city is harbourless, owing to the accumulation of the alluvial deposit brought down by the Tiber, which is swelled by numerous rivers; vessels therefore bring to anchor hovering on the wave, but not without danger; however, gain overcomes everything, for there is an abundance of lighters in readiness to freight and unfreight the larger ships, before they approach the mouth of the river, and thus enable them to perform their voyage speedily. Being lightened of a part of their cargo, they enter the river and sail up to Rome, a distance of about 190 stadia.*³⁴²

Other written sources give little direct information about anchoring inside or outside harbours. Tacitus reports the sinking of 200 merchant ships inside the new Claudian harbour of Portus in 62 CE by a violent storm³⁴³ but does not clarify whether these ships were anchored or docked. It is however reasonable to assume that at least a portion of these

³³⁸ Dem.35.28.

³³⁹ Beresford 2013, 48; Nantet 2016, 224.

³⁴⁰ Isager & Hanser 1975, 170-1.

³⁴¹ "Accordingly, oared ships however large and merchantmen up to three thousand bushels burden enter at the mouth of the river and are rowed and towed up to Rome, while those of a larger size ride at anchor off the mouth, where they are unloaded and loaded again by river boats" (D.H. 3.44.3). Cf. Houston 1988, 562.

³⁴² Str.5.3.5. Cf. Robinson et al. 2020, 105.

³⁴³ "There was no addition to the price, although about two hundred ships were destroyed in the very harbour by a violent storm, and one hundred more, which had sailed up the Tiber, by an accidental fire" (Tac. Ann. 15.18).

vessels were anchored in the spacious harbour basin that was just constructed by Claudius.³⁴⁴ Aelius Aristides around the middle of the 2nd century CE gives a more eloquent account of anchored ships being blocked and destroyed by a storm in the harbour of Delos around 150 CE in his book *Sacred Tales*:³⁴⁵

It was close to dawn and a ferocious storm broke and the sea was shaken by a wild tempest and flooded everything; other ships in the harbour were thrown on land and others fell against each other and crashed. The ship that brought us there, having her cables cut was plunging up and down and was barely saved by the agitated sailors (translated by the author). Although Aelius Aristides' text deals mainly with dreams and religion, it also includes a highly accurate 'diary' of the author's everyday life and the way he describes his adventures in Delos indicates that we are dealing with a first-hand account and not an imaginary event.³⁴⁶

One last source on anchoring concerns the exposed and dangerous coasts of the Levant. Around the end of the 1st century CE Flavius Josephus reports:

*...every ship coasting along Phoenicia towards Egypt had to ride out southwest headwinds riding at anchor in the open sea. Even when this wind blows gently, such great waves are stirred up against the reefs that the backwash of the surge makes the sea wild far off shore.*³⁴⁷ Josephus' description is clear about the danger of anchoring close to the shore in unprotected areas with reefs and shoals, where strong surge is created and the need for mariners to secure their vessels in the open.

³⁴⁴ Although Tacitus does not specify the capacity or the type of ships destroyed by the tempest, these were almost certainly seagoing grain carriers, since the text is related to Nero's distribution of grain to the people of Rome. Temin (2013, 31-2) has suggested that these ships could have belonged to the harbour's service boats or to the riverboats of Tiber, but it is quite unlikely that the loss of these small ships would have made such an impression to the author and would have so badly cramped the distribution of grain to the capital.

³⁴⁵ Ael.Ar. *Sacred Tales*, D.32-7.

³⁴⁶ Behr 1968, 116.

³⁴⁷ J.BJ 1.409.

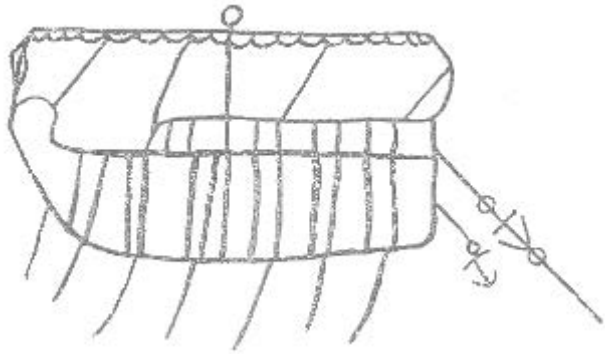


Fig.2.17. Ship graffiti from Tell Sandahannah-Marisa, Israel (2nd century BCE-2nd century CE; Votruba 2014, Fig.7).



Fig.2.18. A 1st-century CE fresco from Stabiae depicting a harbour scene (Spathari & Karagiorghis 1995, Fig.199).

showed and it remains uncertain whether these vessels are actually anchored or draught beached. The fresco belongs to the highly stylised sacro-idyllic landscape murals of the period and it is questionable whether it documents existing practices or not.³⁵¹ A similar image of ships possibly anchored within an enclosed harbour basin comes from a 3rd-century

Iconography is vague concerning anchoring. Anchors appear often in pictorial art, especially as symbols of supplication towards various pagan deities and later of Christianity,³⁴⁸ but no clear image of a ship lying at an anchor survives, apart from some crude and roughly dated Roman graffiti (Fig.2.17).³⁴⁹ Indirect information about anchoring inside a protected harbour could come from a fresco from Stabiae, dating around the middle of the 1st century CE (Fig.2.18). The fresco depicts a monumental harbour with elaborate arched jetties; four merchantmen are stationed in the middle of the harbour basin, their yards and sails lowered, and covered by awnings.³⁵⁰ Two of the ships appear to have anchored in the middle of the harbour basin. No anchor cables are

³⁴⁸ Unfortunately an inclusive catalogue of anchor iconography during the period studied has not yet been compiled; for collections of various anchor images see Basch 1987 and Votruba 2014.

³⁴⁹ Basch 1987, Figs.1052, 1097.

³⁵⁰ Zarmakoupi 2020, Fig.1, 148; Ugolini 2020, Fig.2.12.

³⁵¹ Ling 1991, 149; Croisille 2010, 122-5, 137-9; Zarmakoupi 2020; Ugolini 2020, Fig.2.12.

CE mosaic from the Nile Villa of Lepcis Magna (**Fig.2.19**).³⁵² The standing masts of two or three ships with their sails furled are protruding behind the porticoes crowning a harbour mole. Although it is quite possible that what is depicted here are ships anchored within a harbour (the fact that their masts have not been lowered indicates they have just arrived or they are temporarily anchored there) the mosaic is, much like the Stabiae fresco, too stylised to confirm any such hypothesis.

Unloading or loading ships that lay at anchor has been a common method applied in more recent periods. An early-14th century painting by Ambrogio Lorenzetti (**Fig.1.13**) shows two merchantmen anchored in the open sea while a boat is loading bulk grain from one of them through an open chute directly into a lighter next to it. In recent years such practices have been common in shallow harbours or anchorages, especially of the Aegean, as documented in photographic evidence (**Fig.2.20**). The practice of employing lighters was also common in larger harbours that were affected by siltation (e.g. Ostia, Portus, Naples).³⁵³



Fig.2.19. Detail from the Mosaic of the Eroses, Nile Villa, Lepcis Magna (3rd century CE; www.livius.org).

Lying at anchor, either in the open sea or inside a harbour deep and spacious enough to accommodate ships would naturally be an excellent choice for mariners when using harbours. Even for smaller ships, casting their anchors in deep water would offer the advantage of keeping the vessel away from dangerous coasts and shallows, which were major hazards for fragile wooden hulls. Another advantage of anchoring, especially outside secluded harbours, was the ability to easily set sail, without being caught in the harbour's traffic and, as Demosthenes described, without being controlled by local authorities. The handling of ships while anchoring could be assisted by the ships' boats (their use already common in the

³⁵² Ugolini 2020, 104-8, Fig.3.4.

³⁵³ Casson 1965; Boetto 2010. For the common use of lighters in more recent years see Delano Smith 1979, 364.



Fig.2.20. Loading timber in Mount Athos (D.Charisiades, 1947; Benaki Museum).

merchantmen of the period; see **2.4.2**), as explicitly described by a reference in the *Acts*.³⁵⁴ Kedging (i.e. dropping the anchor from the boat and then hauling the ship towards that direction) could also be applied in a similar manner, although the former is not documented in antiquity. Additional support

could come from the application of the foresail or the mizzen, which could lower and control the speed of a vessel as it was manoeuvring to a safe anchoring position (see **2.4.1**).

Several important drawbacks, however, resulted from lying at anchor. The most important was the constant wave action, which, especially outside protected areas and in deeper waters could be very harmful. According to the refraction principle (the height of the wave is equal to the depth below it)³⁵⁵ ships anchored in deep water faced higher and stronger waves. The constant action of naval shipworms and the growth of marine flora underneath the relatively static ships would also be a problem; the first caused irreversible damage to the wood and the second made hulls heavier, rougher, and consequently slower, requiring regular cleaning. Further, chains were most likely never used as anchor cables and ships ran the danger of having their anchor cables cut and drifting uncontrollably, as Aelius Aristides describes in the harbour of Delos.³⁵⁶ Finally, a ship anchored in the open would have to employ lighters to load/unload its cargo. Although the merchantmen of the period were commonly equipped with their own boats, the unloading and loading of whole cargoes would require many more lighters, personnel and time. If a *horeia*-type service vessel of about 10 tons like the ones discovered in Naples and Toulon (**Fig.2.8**)³⁵⁷ was employed to unload a ship of 130-150 tons it would have taken at least 13 trips and more than five days

³⁵⁴ "And as the sailors were seeking to flee out of the ship, and had lowered the boat into the sea, pretending they would lay out anchors from the foreship" (*Acts* 27.30-2).

³⁵⁵ King 1972, 96-8; Beresford 2013, 31-3.

³⁵⁶ Ael.Ar. *Sacred Tales*, D.32-7.

³⁵⁷ Boetto 2005; 2009, 291-4.

to conclude the task, depending on the distance from the shore and the number of porters that could be employed in the small space of both vessels (it is calculated that the same task would take five days with 15 workers employed if the same ship was docked).³⁵⁸ More than one service vessel and more workers would then have to be employed to load/unload the ship when anchored, with the corresponding delays and expenses.

Despite these implications, however, the practice appears to have been far from uncommon in the period studied. By the late Republican and early Imperial Roman period the majority of ships most likely were using this way of approaching the shores and harbours. A good example for this practice is the harbours of Ostia and Portus (**Fig.1.6**). Dionysius of Halicarnassus and Strabo describe the river harbour of Ostia as an area packed with ships waiting to have their cargoes transhipped towards Rome and facing the dangers of a “harbourless” coast.³⁵⁹ Although Dionysius mentions that ships less than 150 tons could sail the Tiber up to Rome, this does not necessarily mean that all commanders would have the time and take the risk of navigating the treacherous, ever-changing meanders of the river. As a consequence large numbers of ships of various tonnage would have to be stationed at the mouth of Tiber. The small harbour river of Ostia (its original size was no more than two hectares), although regularly dredged as early as the 4th century BCE,³⁶⁰ was prone to silting both from the sea as well as from the river, a problem underlined by Strabo. The geographer’s report of ships “hovering on the waves” fits the description of ships anchoring in the open and not in the calmer waters of the Tiber or in the small Ostia harbour. The Claudian Portus aspired to solve this problem with its huge basin of c.200 hectares, protected by long artificial quays and with a monumental lighthouse at its entrance, offering enough space and depth for all merchantmen supplying the growing population of Rome to anchor within it.³⁶¹ The Trajanic octagonal expansion was probably intended more for docking, offering a continuous line of concrete docks with direct access to warehouses surrounding it, but it had a relatively limited space for anchoring in the middle and a single narrow entrance. In contrast the massive Claudian basin was more adaptable to accommodate ships anchored there.

³⁵⁸ Brandt 2005, 35-6.

³⁵⁹ Str.5.3.5; D.H. 3.44.3.

³⁶⁰ Keay 2012b, 41; Salomon et al. 2016, 8-9, Figs.3-4.

³⁶¹ Testaguzza 1970, 71-9; Hague 1973, 293-303; Keay 2012b, 44.

Other harbours of the Mediterranean, despite their importance, must have been even more exposed but this did not prevent mariners from anchoring there. Aelius Aristides' vivid account of the sudden storm that threw anchored ships out of the water in Delos documents such a case. The author does not clarify whether ships were anchored or docked, but he reports that the cables were cut and that it took great effort to save his ship from stranding. Had the ship been draught beached or docked, the violent storm would have probably thrown it to the shore, as it did with other vessels. Straight, open coasts like the Levantine one caused a heavy swell to rise and made anchoring close to the shore dangerous, as described by Flavius Josephus. The author is explicit about the problem of the exposed shore, where waves and swell could abruptly rise, shifting sand from the beaches and creating a dangerously dynamic environment.³⁶² Although Josephus does mention that anchoring closer to the shore was preferable, he implies that ships could still anchor in the open as well. The anchor assemblages from contemporary shipwrecks, consisting mainly of relatively few and large anchors compared with later periods, suggests the same thing. Later medieval ships needed more and smaller anchors to practice coastal anchoring, in which greater manoeuvrability was required and more anchors were likely to be lost. Larger anchors were ideal for anchoring in open spaces and, despite their size, could be handled by the crews and the ship's boat.³⁶³

In general the practice of anchoring and not berthing appears to have been a very rational choice for the mariners of the period and to have been employed regularly, despite the danger of sudden storms and turns of the wind, incidents far from rare in the Mediterranean.³⁶⁴ The need to use the busy and cramped basins of the important harbours of the period, as well as open, unprotected shores must have left no choice for the mariners but to trust their safety to anchors and develop techniques for their successful use.

³⁶² "This city is situate in Phoenicia, in the passage by sea to Egypt, between Joppa and Dora, which are lesser maritime cities, and not fit for havens, on account of the impetuous south winds that beat upon them, which rolling the sands that come from the sea against the shores, do not admit of ships lying in their station; but the merchants are generally there forced to ride at their anchors in the sea itself" (J.AJ.15.333-4).

³⁶³ Votruba 2014, 149.

³⁶⁴ Beresford 2013, 63-79.

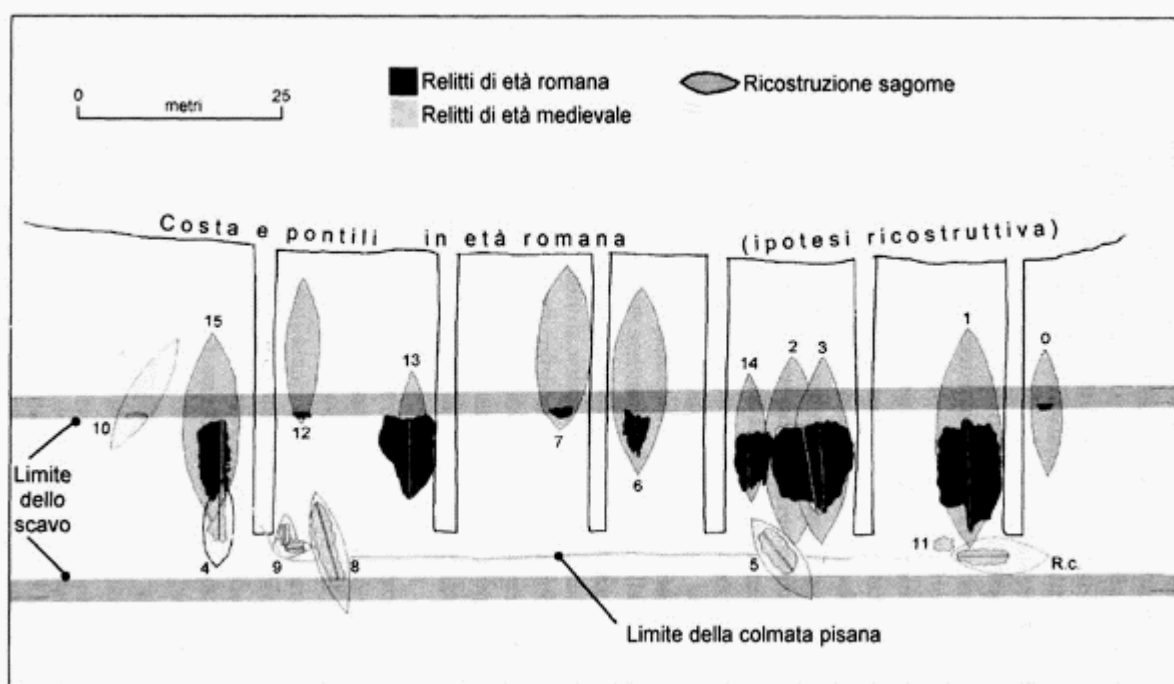


Fig.2.21. Plan of the Olbia late Roman and medieval shipwrecks (D'Oriano 2002, Fig.5).

Docking

Docking is a standard practice in modern harbours, thanks to the advanced hydraulic concrete and dredging technologies employed, but it seems to have been much less common in antiquity. Although several Hellenistic and Roman ships have been found very close to moles and jetties within harbours (e.g. Fiumicino/Portus, Marseilles, Naples), few can be securely related with berthing facilities.³⁶⁵ A much more informative find comes from the harbour of Olbia in Sardinia (**Fig.2.21**). A series of ten late Roman merchantmen were found scuttled at their berths (the incident is most likely related with the Vandal invasions of 456 and 474 CE). All ships were berthed tidily parallel to each other, facing the land and originally lying in a small depth of no more than 1.45 m.³⁶⁶ Six of them were cargo ships, 20-25 m long and the other smaller vessels, 10-15 m long, all berthed between narrow wooden piers or simple rows of posts. Unfortunately the ancient coast lay beyond the limit of this salvage excavation and it remains unknown whether ships were originally facing a man-made quay or a natural beach. The Olbia finds verify the practice of berthing bow-first towards the shore, documented also in iconography (see below).

³⁶⁵ Boat C from Pisa, a Julio-Claudian period small auxiliary galley was found tied on what appears to have been a freestanding wooden pole near the ancient beach but not berthed onto any structure like a jetty or a mole (Camilli 2002; Bruni 2002, 50).

³⁶⁶ D'Oriano 2002, 1255-7; D'Oriano & Riccardi 2004, 89-90; Porqueddu et al. 2010, 9.



Fig.2.22. Mooring stone at the “merchant harbour” of Delos (Duchêne et al. 2001, Pl.LI.1).

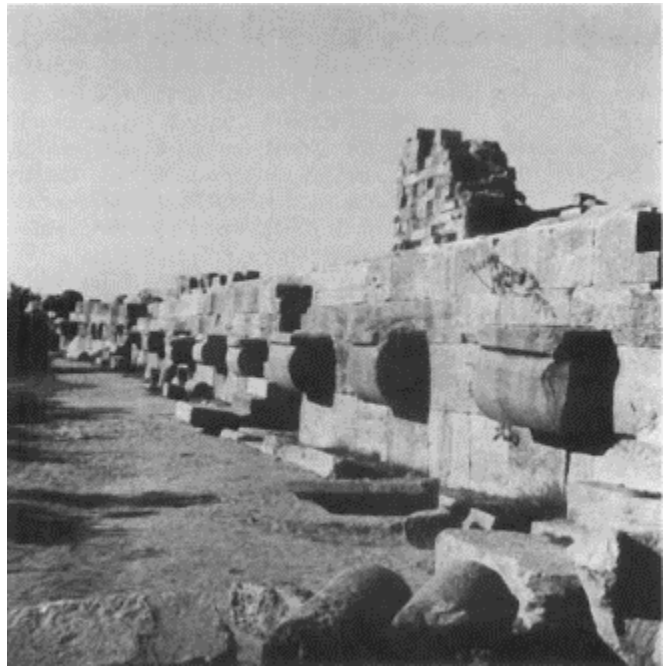


Fig.2.23. Mooring stones at the quays of Lepcis Magna (Blackman 1982b, Fig.11).

Further archaeological evidence for the employment of docking in the period studied comes from the presence of a large number of mooring stones in harbours. From plain conical stone posts like the ones in Delos to elaborate perforated blocks like the ones in Lepcis Magna (**Figs.2.22-3**), such devices are a very common feature in contemporary harbours.³⁶⁷ However, the existence of mooring stones, although indicating the use of piers, quays and beaches by ships, should not be taken as a firm proof for docking, since, as we shall see, the depth and nature of the seabed did not always permit that and various alternative methods of docking could be employed.

Written evidence does not provide explicit information about ships mooring in any way directly on docks and unloading their cargoes. Three inscriptions from Delos (345, 281 and 274 BCE) mention the deposition of building material on the *χῶμα*, which has been identified as the “Great Mole” of the Main Harbour,³⁶⁸ but give no clues whether the material was unloaded from ships directly on the mole or just stored there. When Vitruvius, towards the end of the 1st century BCE, gives his instructions on how to construct a harbour, he mentions porticoes, shipyards, entrances and towers, but no quays, jetties or mooring

³⁶⁷ Blackman 1982b, Fig.11; Duchêne et al. 2001, Pls.L-LI.1; Blackman 2008, 651; Votruba 2014, Figs.97-101.

³⁶⁸ *ID* 104.4; *IG* X2 159, A, 1.28; *IG* X2 199, A, 1.33; Hellmann 1980; Duchêne et al. 2001, 147.



Fig.2.24. Detail from the Torlonia harbour relief (c.200 CE; Casson 1971, Fig.144).



Fig.2.25. Relief from Narbonne (3rd century CE; Gianfrotta & Pomey 1997, 127).

stones.³⁶⁹ It remains a problem why Vitruvius appears to ignore such structures and devices, whose existence has been verified by archaeological finds.

Notwithstanding the richness in contemporary ship and harbour iconography, only three images of vessels docked on a constructed quay survive. The first is the Torlonia relief (**Fig.2.24**; c.200 CE) that portrays in great detail a busy harbour scene, most likely the river harbour of Rome or Ostia.³⁷⁰ One of the ships is firmly tied on a

perforated stone and is unloading her cargo via a gangplank at the bow on a quay, which is not visible but implied by the sizeable bollard stone.³⁷¹ The second is a relief from Narbonne (**Fig.2.25**; 3rd century CE), depicting an oared vessel with a ram-like projection and a furled sail (possibly a merchant galley) with two porters loading baskets through a long gangplank at the bow.³⁷² The gangplank is resting on a low rectangular surface next to the waves that is most probably a stone or concrete dock. The third image is the *Europa* ship graffito from the House of the Ship in Pompeii (**Fig.2.11** Left; 1st century CE), in which a two-masted merchantman, equipped with a raised gangplank too, is shown approaching what appears to

³⁶⁹ “The subject of the usefulness of harbours is one which I must not omit, but must explain by what means ships are sheltered in them from storms. If their situation has natural advantages, with projecting capes or promontories which curve or return inwards by their natural conformation, such harbours are obviously of the greatest service. Round them, of course, colonnades or shipyards must be built, or passages from the colonnades to the business quarters, and towers must be set up on both sides, from which chains can be drawn across by machinery” (Vitr. 5.12.1).

³⁷⁰ Ugolini 2020, 108-12.

³⁷¹ Casson 1971, Fig.144; Blackman 1982a, 83, Fig.2; Basch 1987, Figs.1038, 1044; Felici 2019.

³⁷² Espérandieu 1907, n.685; Bonsangue 2016, 30, Fig.2.

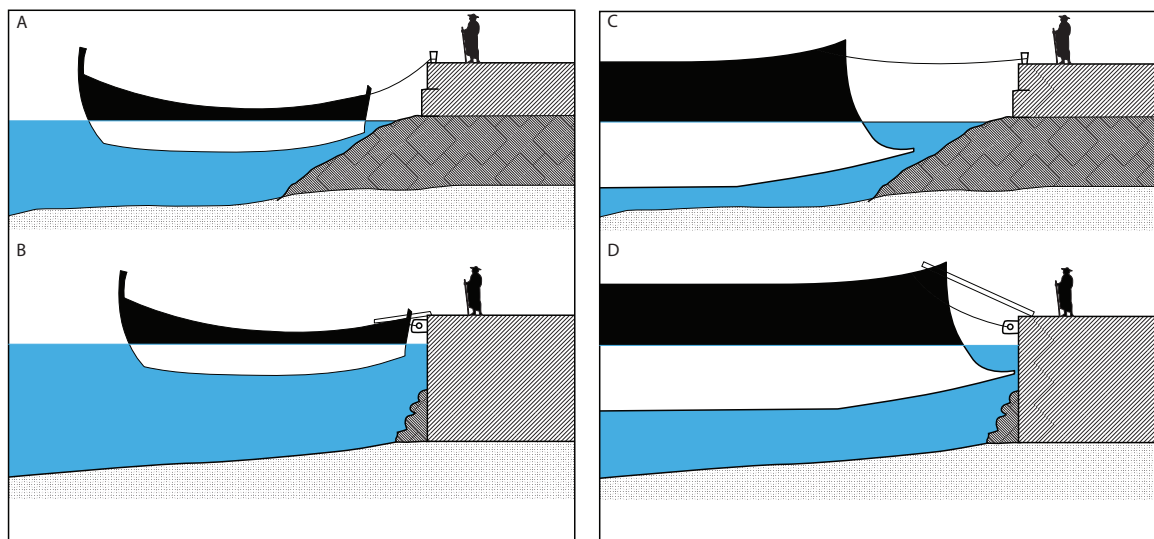


Fig.2.26. Schematic plan of different ways docks built on dry land (A, C) and docks built underwater with the use of hydraulic concrete (B, D) could be used by smaller and larger ships (drawing by the author).

be a wooden quay.³⁷³ Various horizontal projections and one vertical one most likely indicate bollards on which the ship is about to be attached.

Berthing directly on a dock is the most convenient solution for ships using a harbour. Stone, concrete or wooden quays allow the safe attachment of the ship on mooring stones or poles and give plenty of space for the workers and the handling of cargoes, as well as for the operation of cranes or other devices (see below 2.5.2). The drawbacks of docking consist on one hand of the danger of ships crashing onto a quay or jetty in case of an abrupt change of weather and on the other of the need to construct and maintain a stable dock with enough depth in front of it so ships can approach it and use it. As noted above, direct evidence concerning the practice of docking is very few, with the Olbia ships and the Torlonia and the Narbonne reliefs and Pompeii graffito being the only sources known so far. Could this mean that the practice of docking was rarely applied and that ships anchored and employed lighters or were beached in order to use harbours?

The lack of documentation for docking can be partly explained by the practicalities of quay construction. Until the 1st century BCE harbours of the Mediterranean were constructed with the so-called 'Greek method' (Fig.2.26A, C).³⁷⁴ This consisted by the erection of simple rubble breakwaters and the construction of ashlar quays on top of them,

³⁷³ Langner 2001, Pompeii, I, 15.2.3. The existence of the quay in the graffito was only noticed when it was published by Langner, with all previous publications excluding it from the whole image.

³⁷⁴ Casson 1971, 336-7; Rickman 1996, 285; Blackman 2008b, 643-4.

above water level, since there was no way of erecting proper walls under the surface of the sea without the use of hydraulic concrete. Building underwater ashlar jetties by casting blocks from the surface was attempted in the Hellenistic harbour of Amathus,³⁷⁵ Delos' Gourni, Lechaion (see **Chapter 3**) and Centumecellae,³⁷⁶ but it appears that the method was too complicated and short-lived (see **4.3**). Most Hellenistic harbours constituted of ashlar quays with a narrow strip of sand, rock or rubble between the retaining wall and the sea, which also prevented the waves from reaching structures and undermining them. Smaller ships could reach the quay and dock on it bow-first, especially when they were equipped with raised and curved ends (**Fig.2.26A**). Larger ships, on the other hand, could only approach as close as the nature of the seabed allowed. A sandy beach with a small inclination was a negative factor, whereas a steeper, rubble foundation made things easier (**Fig.2.26B**). The existence of protruding cutwaters or rams, although improving the seaworthiness of these ships as well as assisting draught beaching would make docking on ashlar quays even more difficult, keeping the bows of ships at a certain distance from the quays (**Fig.2.26D**). An additional problem with the rubble foundation would be the danger of resting the wooden keel or cutwater on a hard surface, which could seriously damage the hull. The use of gangplanks could improve things. They could operate as bridges from the ship lying at a certain distance from the quay and allow it to use less deep quays. Iconography, however, only documents their use on docks in the Torlonia and the Narbonne reliefs and in all the other sources (see below) it is related with beached vessels and the device is used as a ladder and not as a bridge. Thus the common appearance of gangplanks in iconography cannot be safely related with the predominance of docking in this given period.

³⁷⁵ Empereur & Koželj 2017.

³⁷⁶ Plin.*Ep.*6.31.16-7. Cf. Quilici 1993.

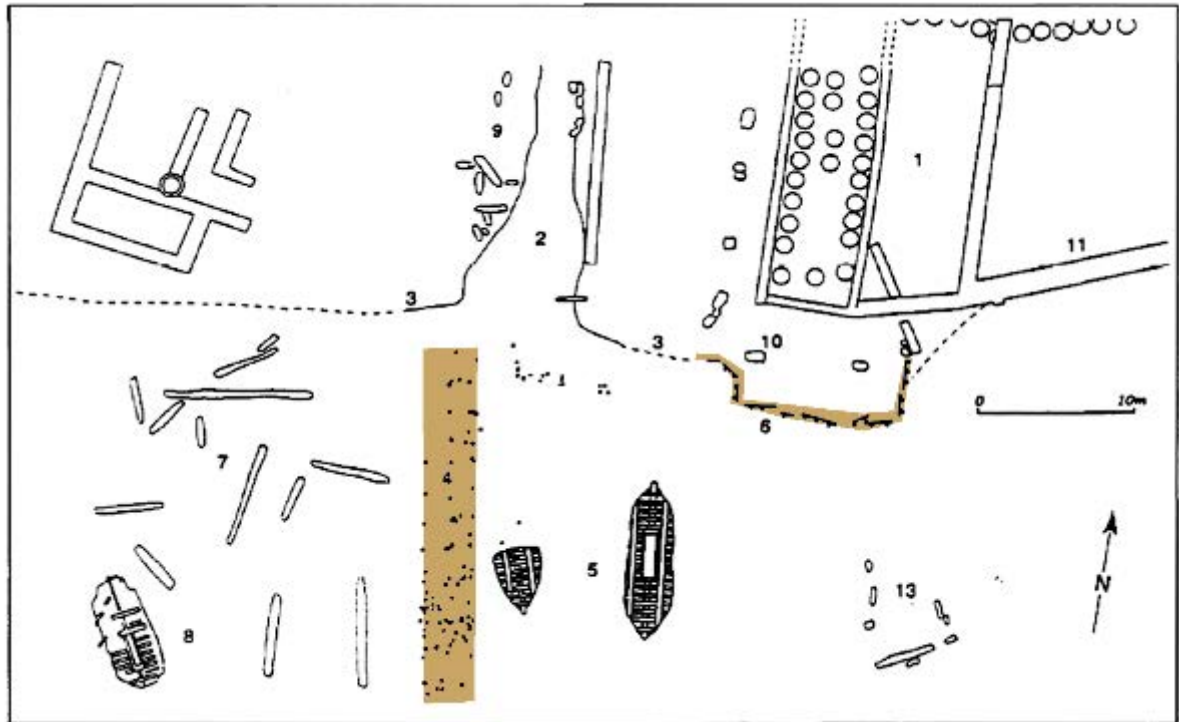


Fig.2.27. Plan of ancient harbour of Marseilles; the wooden jetty (4) and the pile quay (6) are marked in colour by the author (Hesnard 1994, Fig.7).

An alternative method of docking would have been the use of wooden jetties, their existence documented for the period in finds from Pisa (2nd century BCE), Marseilles (1st century CE) and Naples (2nd century CE), as well as, most likely, on the *Europa* ship graffito in Pompeii (**Fig. 2.11**)³⁷⁷ and in a series of stylized sacro-idyllic Pompeian harbour frescoes.³⁷⁸ Oddly enough, no mention of such structures is made in written sources. The Marseilles wooden jetty had a length of about 30 m and a width of 5 m, creating a fairly spacious and long platform, which would reach most probably to a depth of 3-4 m (**Fig.2.27**), whereas the Pisa one was a much smaller structure, probably serving lighters. Unfortunately wooden jetties are, for the moment, totally absent from the harbours of the Aegean and of the east in general, even in sites where the preservation of wooden remains is very favourable (e.g. Lechaion; see **3.2**).

³⁷⁷ Hesnard 1994, 209-10; Langner 2001, Pompeii, I, 15.2.3; Bruni 2002, 36; Giampaola et al. 2005, 60.

³⁷⁸ Blackman 2008b, 649; Zarmakoupi 2020, Figs.1 & 3.

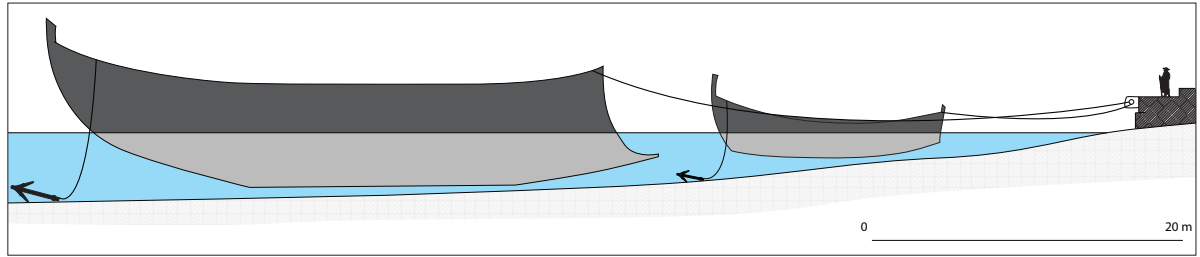


Fig.2.28 Schematic plan of the method of docking at a distance from the quays (drawing by the author).

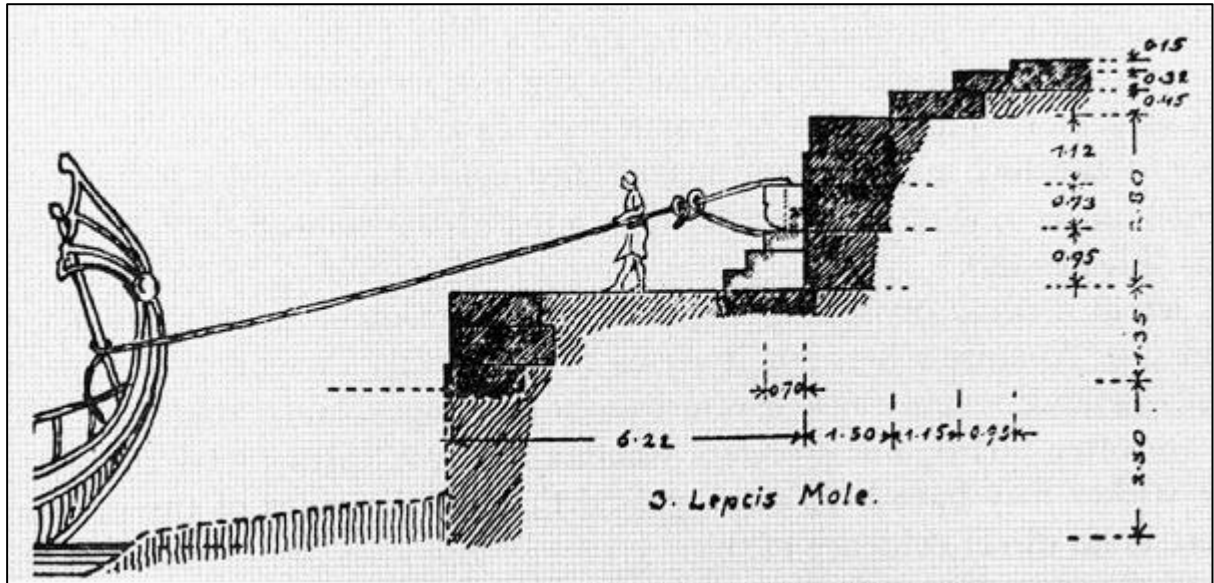


Fig.2.29. Reconstructed section of the quays of Lepcis Magna (von Gerkan 1933, Fig.5).

The application of hydraulic concrete in harbour construction around the middle of the 1st century BCE was what allowed all ships to freely approach docks (**Fig.2.26B, D**). According to archaeological evidence, concrete structures could reach a depth of up to 9 m (Cosa harbour),³⁷⁹ thus offering ample depth for even the largest ships of the period to moor with safety (**Table 2.1**). The Torlonia relief most probably depicts such a structure (**Fig.2.24**), built in water deep enough to allow a merchantman of considerable size to berth directly onto it. Nevertheless, hydraulic concrete, as will be discussed in more detail in **Chapter 4**, was not evenly distributed along the coasts of the Mediterranean. The technical complexity and the high cost of material made the use of such technology unpractical for many local communities.³⁸⁰ A further problem of the use of maritime concrete quays was their longevity. Such structures were constantly exposed to strong natural wear by wave and current action and threatened by the unstable seabed and tectonic movement. Claudian

³⁷⁹ Brandon et al 2014, 208.

³⁸⁰ Brandon et al. 2021, 74.

Portus was already problematic due to the hastiness of construction as soon as it was finished,³⁸¹ whereas Caesarea's quays and jetties had largely collapsed by the end of the 1st century CE and were in need of extensive repairs.³⁸² And a dilapidated concrete structure, although it could still operate as a breakwater, could hardly serve the docking of vessels and the handling of cargoes and it would be an unwise decision for ships to use it as a proper dock.

An alternative method of docking could, however, be employed in many harbours. As noted already, the common existence of elaborate and large mooring stones shows that these quays were constructed so that ships could somehow be attached to them. Ships could still use them by dropping an anchor at a certain distance and attaching long cables to bollard stones, thus keeping a safe distance from quays but also taking advantage of their stability (**Fig.2.28**). Appian, in his description of the Carthage's merchant harbour in the 2nd century BCE, mentions the presence of a variety of tackles (*πείσματα ἧν ἐν αὐτῷ πυκνὰ καὶ ποικίλα*),³⁸³ suggesting that these ropes were a permanent feature of the harbour, attached on the coast and mariners could easily pick them up and secure their vessels without approaching too close to the docks. Cork buoys, whose use was known in the period (see **2.4.2**), could assist in that practice. This could have been the case in the quays of Lepcis Magna, as Armin von Gerkan had suggested (**Fig.2.29**). Even, however, if this method of docking secured ships without the dangers of approaching the quays was used, it could do little to solve the issue of loading and unloading without the use of lighters.

In general docking appears to have been a relatively complex method of using harbours in the Hellenistic and Roman period. Although it was definitely employed in certain harbours, namely the ones built with the application of hydraulic concrete and the ones equipped with wooden jetties, it remains a relatively poorly documented method and the lack of evidence suggest a limited use, especially in the Aegean.

³⁸¹ Brandon et al. 2021, Fig.4.30, 60-1.

³⁸² Reinhardt & Raban 1999, 814; Brandon et al. 2021, 79-81; Goodman-Tchernov & Austin 2015, 452-3.

³⁸³ App.*Pun.*14.96. Cf. the reference to cables (*πείσματα*) attached on the shore in Aesch.*Supp.*764-9.

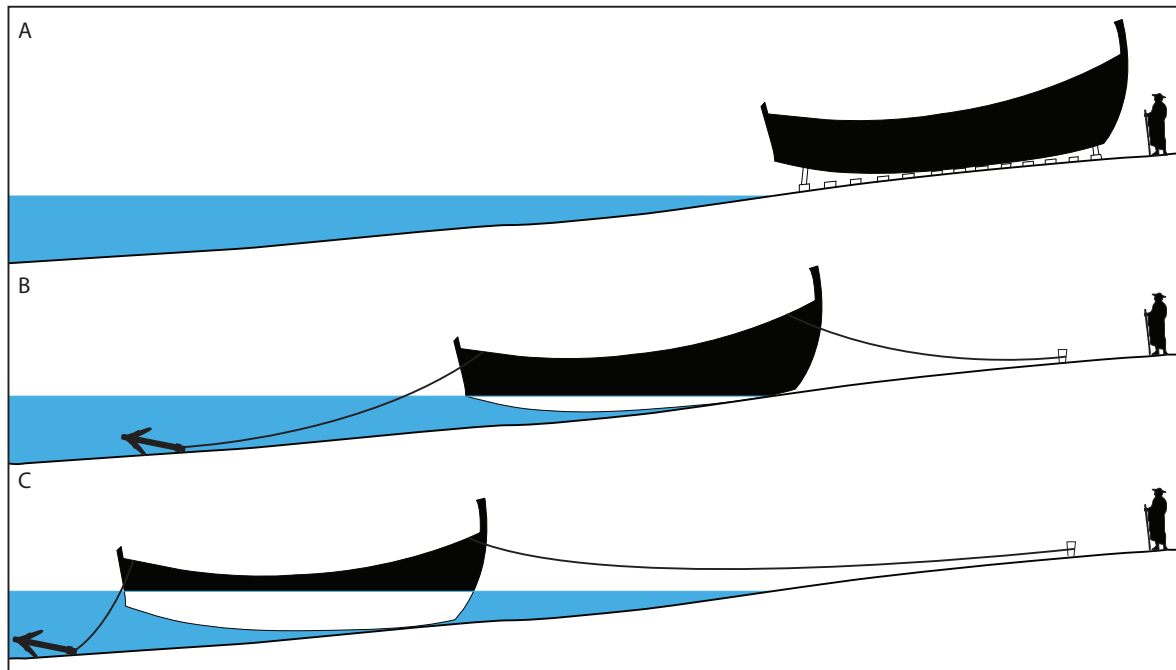


Fig.2.30. The three main methods employable for beaching ships in antiquity: A) Hauling a ship out of the water; B) Beaching an unloaded ship with its stern on the beach and its bow in the water; C) Draught beaching (drawing by the author).

Beaching

Before addressing the implications of beaching during the period studied, we must clarify that more than one method or type of beaching exist (**Fig.2.30**).³⁸⁴

- Driving a ship onto the beach so it can rest its bow on the shore.
- Slightly lifting a ship's bow so it can rest on the shore (a method applied in boats).
- Hauling a ship out of the water.
- Draught beaching in shallow water.
- Tide beaching with the ship, secured by anchors, floating or resting on the seabed according to the tide.
- Storm beaching, when a ship is actually run aground in a case of emergency.

The first two methods are limited to smaller vessels and potentially galleys (drift beaching), whereas tide beaching is impossible in the Mediterranean due to the small tides (20-30 cm).³⁸⁵ As for storm beaching this is no different than running aground or scuttling a vessel and it cannot be in any way considered a regular way of using a harbour. Due to the configuration and use of ancient ships, beaching methods were employed differently in the

³⁸⁴ Votruba 2017, 7-8, Fig.1.

³⁸⁵ Morton 2001, 45; Beresford 2003, 100-3.

light, oar-powered galleys and in the bulkier, sail-propelled round ships and I will continue by examining them separately.

Although beaching has been considered by scholars a standard practice for every kind of ancient galley since the time of Homer,³⁸⁶ it is very difficult to locate archaeological evidence for it. No remains of any beached galley has been found and the practice of hauling galleys on dry land is documented indirectly by the operation of slipways and shipsheds. The great majority of the shipsheds were, however, built in the Classical period and only some appear to have been built or survived in the Hellenistic and Roman period.³⁸⁷ Pottery evidence suggests that the great arsenal of Carthage was not erected before 200 BCE and operated for only a few years before its final destruction by the Romans in 146 BCE.³⁸⁸ Similar evidence also suggest that the shipsheds of Rhodes were built in the middle of the 3rd century BCE, renovated in the middle of the 2nd century BCE and abandoned by the end of the same century.³⁸⁹ Strabo also documents the operation of shipsheds in Carthage and Cyzicus, as well as in Alexandria,³⁹⁰ but no remains of them have been yet found of the latter. Finally inscriptions of the 2nd century BCE mention the repair of shipsheds in the case of Corfu and the employment of specialised personnel in the case of Kos (νέολκοι, “ship-haulers”).³⁹¹ Probably around the same period the ὄρος boundary stone from the harbour of Delos delineates a “long ships’ cove” (see 3.1.5) but gives no information whether these ships were beached and in which manner.³⁹²

References concerning the beaching of galleys in Hellenistic and Roman literature are scarce. Theophrastus, around 300 BCE, mentions the use of oak, a hard and durable wood,

³⁸⁶ Tarn 1905, 124; Casson 1971, 89-90.

³⁸⁷ Blackman & Rankov 2013, 263-542.

³⁸⁸ Hurst 1994, 27-8. Cf. Blackman & Rankov 2013, 307-18.

³⁸⁹ Blackman & Rankov 2013, 509-17.

³⁹⁰ Strab.12.8.11 (Cyzicus), 17.1.9-10 (Alexandria) and 17.3.14-5 (Carthage). Strabo’s descriptions and information have, nevertheless, been questioned by scholars as replications of older sources. In the case of shipshed complexes like the ones in Carthage it is believed that he was drawing his information from older sources (Hornblower & Spawforth 1998, 692; Dueck 2000, 44).

³⁹¹ *IG*, 9.1692, *IG*, 9.1² 4.874; *Syll.*³III, 132-4 no.1000.22. A series of secondary naval bases with smaller, unroofed slipways, usually carved on rocky shores, which could accommodate small naval units date in the Hellenistic period (e.g. Alimnia, Matala, Setaea) but dating is based on material from adjoining settlements and not from finds inside the slipways themselves (see the updated catalogue compiled by Blackman & Rankov 2013, 263-542).

³⁹² *ID* 2556; Roussel 1916, 299, n.3; Dûchene et al. 2001, 153-4.

for the keels of galleys to facilitate their hauling on beaches,³⁹³ implying that this was a common task for them.³⁹⁴ In Latin texts hauling galleys out of the water appears in two sources: the tragic poet Pacuvius (middle of the 2nd century BCE), refers to the use of *tonsillae* (mooring poles reinforced with iron) for securing ships on the beach.³⁹⁵ Vergil in his *Aeneid* (c.20 BCE) describes a galley loosening the stern cables and swiftly sailing or rowing away from the beach, most probably referring to a ship resting her stern on the shore.³⁹⁶ It is difficult to ascertain whether these poetic works document practices of their time or whether they refer to an imaginary, ideal past, especially the *Aeneid*. However, Pacuvius appears to be describing with precision a device used in his time (the term is not mentioned in older sources), documenting a practice well established and known to contemporary people.

An important lacuna of Latin sources concerns information about the Roman slipways and shipsheds. Although the Roman naval fleet during the *pax romana* was considerably reduced, several small units continued to operate, stationed in various bases around the Mediterranean.³⁹⁷ The term *navalia* (shipshed or shipyard) is quite often mentioned.³⁹⁸ Vitruvius gives clear instructions on the orientation of the *navalia* shipsheds, on using as little wood as possible due of the danger of fire and on making them wide enough to accommodate even the largest galleys.³⁹⁹ However the actual configuration of these establishments remains unknown, since none has been identified yet in the archaeological record.

³⁹³ “But the keel for a trireme is made of oak, that it may stand the hauling; and for merchantmen it is made of fir. However they put an oaken keel under this when they are hauling, or for smaller vessels a keel of beech; and the sheathing is made entirely of this wood” (Thpr. *Hist.Plant*.5.7.2). Cf. Votruba 2017, 13.

³⁹⁴ The Marsala I Punic galley, however, the only surviving ancient galley, had a pine keel and this questions whether Theophrastus’ advice was actually employed (Frost 1997). Nevertheless, the identification of this ship as an actual galley has been recently questioned (Polakowski 2020).

³⁹⁵ “According to Verrius (a *tonsilla* is) a stake hewn to a point and, he thinks, tipped with an iron prong. He says that is fixed on shore for mooring a ship” (Pac.*Med*.231). Cf. Votruba 2017, 217.

³⁹⁶ “Thus having said, he bid us to sea;/ We loose from shore our haulsers, and obey,/ And soon with swelling sails pursue the wat’ry way” (Verg.*A*.3.269-71).

³⁹⁷ Reddé 1986, 145-309; Rankov 1995.

³⁹⁸ Reddé 1986, 160; Blackman & Rankov 2013, 30.

³⁹⁹ “When this is completed, the arsenals are to be constructed chiefly with a northern aspect; for if they are to the south, the heat will generate and nourish the rot, the worm, the ship worm, and other noxious insects; and timber should be sparingly used in these buildings on account of fire. No rule can be given for the size, but they must be suited to receive the largest ships, so that, if drawn ashore, there may be plenty of room for them. In this book, as far as it has occurred to me, I have treated of the public buildings necessary for the use of a city: in that following, I shall treat of the convenience and symmetry of private houses” (Vitr.5.12.7).



Fig.2.31. *The abduction of Helen by Paris. Drawing of a lost Roman fresco from the Albani collection (Basch 1987, Fig.954).*

Iconography is a relatively richer source of information on the practice of galley beaching in the period studied. Fragments of the Telephus frieze from Pergamon show a man climbing on the stern of a galley through a ladder; the ship is most probably resting her stern on a beach (first half of the 2nd century BCE).⁴⁰⁰ In a Roman fresco from the Albani collection

Helen and Paris are disembarking from a galley through a ladder at the stern; the galley appears to be afloat next to the shore (**Fig.2.31**).⁴⁰¹ A similar scene comes from a Roman sarcophagus, today at the Weimar castle.⁴⁰² These images document the practice of galleys resting their sterns in shallow water or on a beach and employing ladders to access the beach, without having been hauled out of the water completely. Much like the written sources iconography also documents this practice of beaching as something familiar to their contemporaries. The stylisation and bad preservation of these images unfortunately leaves a lot to be desired about the practicalities of this form of beaching.⁴⁰³

But what was the actual frequency and usefulness of galley beaching during the Hellenistic and Roman period? It has long been assumed that, just as for their classical predecessors, galleys were incapable of spending extended periods afloat and that they had to be regularly hauled out of the water to avoid rough seas and have their hulls dried.⁴⁰⁴ The regular, almost daily, beaching of galleys has been convincingly questioned by Cynthia

⁴⁰⁰ Basch 1987, Fig.945.

⁴⁰¹ Basch 1987, Fig.954.

⁴⁰² Basch 1987, Fig.917.

⁴⁰³ A note should be made here on a series of Pompeian frescoes and mosaics, as well as some Roman late Republican coins, which were considered to show galleys hauled within vaulted shipsheds (Blackman 2008a, 23-5; Blackman & Rankov 2013, 36-9). A closer study of this material has shown that these were not actual images of shipsheds but decorative elements of the frescoes and mosaics and, in the case of the coins, pictured the rostra assembly platform in the Roman Forum that was decorated with warships' rams (Crawford 1974, 482).

⁴⁰⁴ Tarn 1905, 124; Casson 1971, 89-90.

Harrison,⁴⁰⁵ who emphasized that the application of pitch and other protective material against ship worms attested both in written sources and shipwrecks, made galley hulls much more resilient than once thought and although hauling was regularly employed in the arsenals for maintenance in the winter months, it was not a common practice throughout the year. Hauling a galley, whose hull was by definition slimmer and more lightly built compared to merchantmen, out of the water would create more troubles than the ones it solved, especially on unprepared beaches. Both the technology and the labour force were available, especially to the large fleets of the Hellenistic kingdoms, Carthage and Rome, and written sources regularly report the beaching of galleys.⁴⁰⁶ But the improved seaworthiness and sturdier construction of the large galley types employed⁴⁰⁷ must have made hauling a less common practice than before and it could have contributed to the gradual decline of the shipshed naval bases, which appear to have become obsolete by the Roman Imperial period (see above).

Galleys could, however, easily employ draught beaching. Cables would secure the vessel on the beach, attached to natural features or wooden poles inserted there (*tonsillae*), while the anchors were cast in the opposite direction and cables were tightened (**Fig.2.30B**). According to the texts and iconography presented above, galleys used this method by approaching the beach stern-first, thus allowing the ship to leave the coast by using oars. Thanks to their low draught and freeboard, galleys could easily disembark their crew through ladders or gangplanks directly on the beach or in very shallow water.

Although, as we saw above, several merchantmen and larger service vessels have been located within harbour environments (e.g. the Antirrhodos shipwreck in Alexandria or the Fiumicino/*Portus caudicariae*), none has been found beached. The Olbia ships might have been partially beached, with just enough space to float due to the small depth the shore had during the late Roman period (1.35-1.45 m; **Fig.2.33**).⁴⁰⁸ Indirect evidence might

⁴⁰⁵ Harrison 1999; 2003, 82-3.

⁴⁰⁶ Diod.20.47.1-2; Plb.1.51.12, 3.96.5. According to the 4th century BCE naval inscriptions of Athens, a trireme with a net weight of 20 tons required at least 140 men to be pulled on a specially prepared slipway and 70 to be hauled back into the water (*JG* 1³ 153.6-9; Blackman & Rankov 2013, 117-8). With a crew of about 200 it would have been relatively easy to perform such operation. Larger Hellenistic and Roman galleys would have naturally been heavier but they would also have a correspondingly larger crew to haul the ships out of the water when needed.

⁴⁰⁷ Morrison & Coates 1996, 41-2; Beresford 2013, 150-3.

⁴⁰⁸ Porqueddu et al. 2010, 8-9, Fig.8. Concerning the Olbia ships and if the geophysical data is correct, that would have given them barely enough depth to float, according to the estimated draught of ships of this

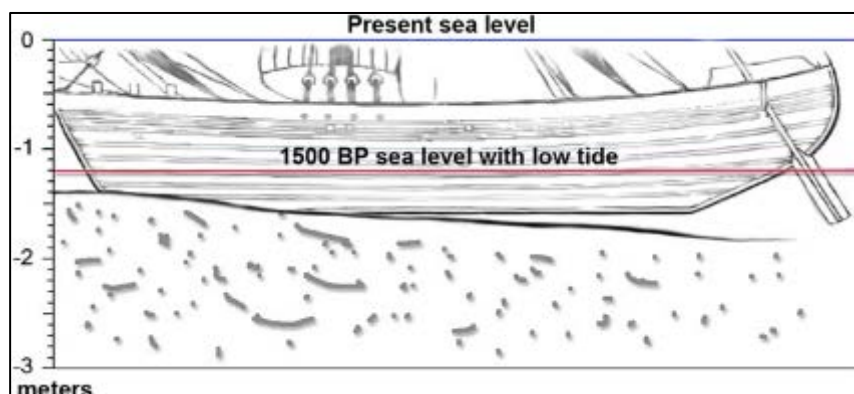


Fig. 2.32. Hypothetical plan of a ship berthed at the late Roman harbour of Olbia (Porqueddu 2010, Fig. 8).

come from the use of extended cutwaters at the bows of various round ships like Madrague de Giens (Fig. 2.9) or Saint Gervais 3 (150 CE).⁴⁰⁹ According to a recent study of the Marsala II shipwreck

these devices, beyond improving the hydrodynamic quality of the hulls, protected the bows from digging into the sand of the beaches and thus becoming trapped when draught beached.⁴¹⁰ Shipyards where merchantmen would be hauled for maintenance have been excavated at Marseilles (3rd-2nd century BCE) and Olbia (1st century CE), but no remains of any ship were found on the simple slipways discovered.⁴¹¹

Written sources give little information on the beaching of merchantmen. The Thasos harbour inscription explicitly refers to hauling ships on land (the verb *ἀνελκείν* = hauling is used; see 2.1.2). The use of this specific term indicates that the ships were totally hauled on the beach for maintenance and protection and did not just rest their bows on the sand or draught beached. Theophrastus also reports on the use of oak false keels, bilge ways or hauling timbers by merchantmen and smaller vessels for the operation of hauling.⁴¹² The issue of hauling or docking exceptionally large vessels appears in Athenaeus' account on the *Syracusia*.⁴¹³ The author specifically mentions the use of the screw-windlass, invented by Archimedes, to haul the massive hull into the water. When the ship reached Alexandria it was docked or hauled (*ἐνελκῆθη*) but no further details are given. The use of devices for the hauling of ships on land is mentioned in later Latin sources, but the term

size (Table 3; it has been suggested by the excavators that these ships had a draught of no more than half a metre, but that would be unlikely according to the draught calculated for ships of this size).

⁴⁰⁹ Pomey 1982; Liou et al. 1990.

⁴¹⁰ Averdung & Pedersen 2012.

⁴¹¹ Hesnard 1994, 205-6; Gavini et al. 2014; Riccardi et al. 2017.

⁴¹² Thphr.Hist.Plant.5.7.2.

⁴¹³ Ath.5.206d-209; Casson 1971, 184-6.



Fig.2.33. Relief from Portus, depicting a ship unloading an amphorae cargo in a harbour (late-3rd century CE; Brandt 2005, Fig.7).

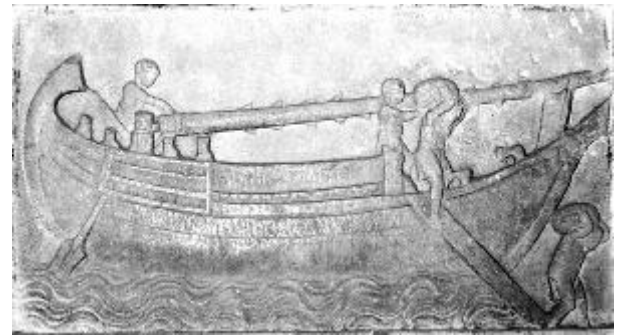


Fig.2.34. Sarcophagus relief from Salerno, depicting a caudicaria unloading her cargo (late-3rd century CE; Theiss 2017, Fig.5).

used is *machinae* (machines), which could mean anything, from tackles and pulleys to windlasses.⁴¹⁴

Iconography offers more evidence for the application of beaching by merchantmen, especially for the Roman period: one of the ships sheltered in the monumental harbour depicted in the 1st century CE Stabiae fresco (**Fig.2.18**) is being unloaded by a porter through a gangplank resting on a beach and it is very likely draught beaching is being employed. A late-3rd century CE relief of the guild of the *tabularii* (record keepers) of Portus shows a merchant ship unloading a cargo of amphorae via an inclined gangplank, on what appears to be a low bank or beach next to the supervising administrators; an arch indicates the presence of a city (**Fig.2.33**).⁴¹⁵ A late-3rd century CE sarcophagus from Salerno cathedral portrays what has been identified as a *navis caudicaria* unloading her cargo through a gangplank at the bow (**Fig.2.34**).⁴¹⁶ As in the Ostia relief, the inclination of the gangplank and the total lack of any harbour structure indicate that the unloading is being done on a natural coast or beach. Finally a 3rd century CE mosaic from Hadrumentum in Tunisia portrays a merchantman unloading its cargo by hand, while beached or moored in shallow water (**Fig.2.35**); wave lines reach up to the ankles of the porters.⁴¹⁷ Due to the stylisation and lack of proportion in the human figures, it is very difficult to ascertain the type and size of the ship portrayed. The fact that unloading is done by hand indicates a small ship with a low freeboard and small draught, something also implied by the absence of a foresail.

⁴¹⁴ Hor.*Carm.*1.4.2; Liv.25.11.18; Blackman 2008a, 661.

⁴¹⁵ Brandt 2005, Fig.7; Blackman 1982a, 83; Basch 1987, 464, Fig.1037.

⁴¹⁶ Casson 1965, 33; Höckman 1994, Fig.10; Theiss 2017, Fig.5.

⁴¹⁷ Foucher 1960, 77-9, no.57.169, Pl.XLIIa; Basch 1987, 481, Fig.1106; Wilson 2011b, 49.



Fig.2.35. Mosaic from Hadrumetum, Tunisia, with a ship unloading firewood or bronze ingots as it is resting in shallow water (3rd-century CE; Bardo Museum; Wilson 2011b, Fig.2.23).

All of the above iconographical sources have to be examined with caution and under the conventions of pictorial art (see 1.4.3). The importance of these images, however, lies, in my view, not in what they actually portray but in what they omit: in the case of the Stabiae fresco, although the ships are surrounded by elaborate moles and a wooden pier, the unloading is being done directly on a natural beach. In the *tabularii* relief no quay or any other harbour work is pictured, although a harbour city is marked by the arched building. In the case of the Salerno relief there is no indication of any harbour structure at all, as if the ship is using a natural sea or riverbank. The Hadrumetum mosaic has no indication of any coast either; the former is also the only iconographical source documenting the practice of unloading a vessel by hand when draught beached or floating in shallow water, a practice widely employed for small ships up until recent years around the world.⁴¹⁸ Although by modern standards beaching is not considered a choice for properly using a harbour, due to the size and tonnage of modern cargo vessels, in the past and in areas like the Aegean it was by far a very popular one even until the 20th century (Fig.2.36).⁴¹⁹ The main advantage of beaching is its simplicity, since it requires no artificial harbour and can be practiced wherever shallow, sandy coasts are available, something not uncommon in the Aegean and the Mediterranean in general. When a ship is hauled on land it is sheltered from the waves, apart from the rare case of an abrupt and strong storm that might drag it back into the water

⁴¹⁸ Houston 1988, 561; Wilson 2011b, 49; Votruba 2017, 19.

⁴¹⁹ Pâris 1916, 33-4, Fig.9; Houston 1988, 561.



Fig.2.36. Vernacular shipyards of the Aegean. Left: Perama (V.Papaioannou, 1945-6; Benaki Museum; ΦΑ_6_B.9206). Right: Thasos (N.Tombazis, 1960; Benaki Museum; ΦΑ_10_11321).

if it is not secured well. Further, when a ship is partly beached or draught beached in shallow water, even in exposed areas, the strength of waves deteriorates thanks to the refraction principle, especially when beaches have a mild gradient and the water remains relatively calm.⁴²⁰ Ships are also not in danger of crashing onto rocky coasts or stone quays in case of a strong surge, whereas the sandy beach allows the easy approach to the ships by porters.

Despite its advantages, beaching can be also a problematic method of using harbours and shores. Mariners employing different variations of beaching have to be very cautious not to allow their ships to be stranded by the waves and the currents, because in this case the very small tides of the Mediterranean can do little to assist a ship return to deeper waters, especially when loaded. In the case of hauling a ship on dry land, the logistics become the main concern. The larger the ship the more and bigger supports and bilge ways are needed and this can be a considerable problem in regions like the Cyclades or the Levant where wood can be scarce and expensive. Ship hulls are also built to be supported by water and when this is missing, they become prone to sagging, especially if they remain on dry land for a long period and are not supported properly. Furthermore, the beach needs to have a proper inclination either natural or prepared by digging⁴²¹ and adequate width to accommodate larger ships. Accordingly more labour force or special devices are required, and whereas the large rowing crews of galleys could easily supply adequate hands for this,

⁴²⁰ King 1972, 96-8; Beresford 2013, 31-3.

⁴²¹ Coates 1999, Fig.5.

the crews of merchantmen would be totally inadequate for such operations. In the case of even a small capacity vessel of a net weight of four tons like the Ma'agan Mikhael or the Kyrenia ships,⁴²² at least 35 men would have to be employed, in analogy to the 140 men needed to haul a 20-ton trireme out of the water (according to a naval inscription of Piraeus dating in 440-425 BCE).⁴²³ With small ships having a crew of no more than four or five men,⁴²⁴ finding enough people or animals to haul them onto a beach would be a serious problem for ship commanders. The application of pulleys and capstans could make things much easier, but these devices would be available only in organised shipyards and not in any given beach or harbour. Hauling out of the water also requires the emptying of the vessel from its cargo and gear, another time and labour-consuming operation. However, even if not done on such a regular basis, hauling out of the water for maintenance was crucial for ships, securing their longevity and proper operation and for this reason special hauling facilities were established in harbours like Marseilles, Olbia⁴²⁵ and Delos (see **3.1**).

Draught beaching with bow facing the coast could have been a solution to the problems of hauling a round ship out of the water, bypassing the need for infrastructures and labour force. Further, being close to the beach assisted loading/unloading and boarding. As shipwrecks and iconography confirm, the ships' bows were much lower than their sterns and were often left without a bulwark to assist boarding and the use of gangplanks,⁴²⁶ whereas the stern of merchantmen was less convenient also because of the presence of the rudders and their housing. As we saw above, the shipwrecks of Olbia could as well have employed draught beaching. Using the bow for beaching in shallow water seems like a peculiar choice for merchantmen, since they would have to back up to leave their berthing, but with boats being a common part of each ship's equipment that would have been relatively easy. Smaller vessels could employ oars thanks to their low freeboard too (see above **2.4.1**).

⁴²² Winters & Kahanov 2003, 131.

⁴²³ "...μεδ' ηενι ανεγκυ[σαι]/ [ανδρασι] ελαπτον ε τε]τραράκοντα και [ηεκ]/[ατόν, μεδε καθελκύσαι] ελαπτον ε εϊκοσ[ι κ]/ [αι] ηεκατόν ανδράσι..." (IG, I3, 153, 6-9). On the reconstruction of the fragmentary inscription's numbers see Blackman & Rankov 2013, 117-8.

⁴²⁴ Johnston 1997, 227.

⁴²⁵ Hesnard 1994, 203-7; Gavini & Riccardi 2010.

⁴²⁶ Casson 1965, Pl.IV.1; Basch 1987, Figs.1031, 1082, 1108-10.

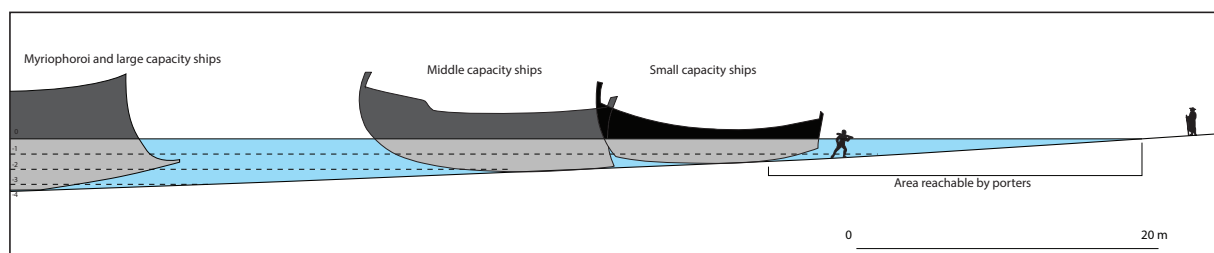


Fig.2.37. Drawing of the ways various types of ships could be beached and their ability to be unloaded by porters (drawing by the author).

The practice of draught beaching appears to have been a good choice for using beaches and shallow harbours and it is not surprising that it is documented, as we saw, in a variety of sources. However, when this operation is considered within the beach/coastal context, the image becomes more complicated (**Fig.2.37**): in order for a ship to be loaded or unloaded by hand, porters would have to be able to walk up to the ship's bow or stern. The average stature of ancient Greek males of classical antiquity is considered to have been 168.2 cm (± 5.38).⁴²⁷ Such a stature would allow porters to approach draught-beached ships with a draught of 1.5 m, although most probably anything above 1.2 m would be an unworkable scenario for them. And the only ships with such a small draught were ships of small capacity and particularly the ones with a low freeboard. Ships of medium and large capacity were practically unreachable by the porters. The use of gangplanks would only slightly reduce the depth and would be of little use for ships of large capacity. This means that only ships of small size could take advantage of a beach as a loading/unloading site without the help of lighters. Hauling loaded ships on the beach would be not only impractical but also dangerous for the vessels, as noted above. Thus, although beaching could be employed by many merchant ships, the loading and unloading of cargo would still largely require jetties or service boats.

Towing and piloting

Towing and piloting are two techniques very common in modern times, especially for larger ships and for dangerous passages and unfamiliar harbours. Both methods were employed also during the period studied, but data is scarce.

⁴²⁷ Grmek 1989, 109; Koukli & al. 2020. The issue of the anatomically reconstructed stature of the ancient populations of the Mediterranean has been a complicated one, mainly due to the lack of sufficient studies. It should be noted here that, according to the evidence so far, Aegean Greek populations were slightly taller than their Italian, Spanish and Sardinian contemporaries (Giannecchini & Moggi-Cecchi 2008).



Fig.2.38. Relief from isola Sacra, Ostia, depicting a tugboat (2nd century CE; Casson 1965, Pl.1.1).

The use of towboats is something that cannot be easily documented in the archaeological record, for the simple reason that it was a task that could be undertaken by any kind of oared vessel and the chances of two ships being lost as one was towing the other are highly improbable. Indirect

archaeological evidence however comes from the configuration of various service boats found in Toulon and Naples. Several of the *horeia* vessels (Naples C; Toulon 1 & 2) were small and low enough to be rowed and used for towing larger vessels (**Fig.2.8**).⁴²⁸ The small galley (Boat C) from Pisa could have also doubled as a towboat when needed.⁴²⁹ Written sources preserve various references to the practice of towing vessels. Amongst the numerable references to the ship boats of larger merchantmen the term *ἐφόλκιον* or *ἐφολκίς* (tugboat) appears frequently⁴³⁰ indicating that the practice of towing was very common. The actual task of towing is reported by Philostratus around the end of the 2nd century CE, who mentions that, as a merchant ship was about to set sail from the harbour of Smyrna, some oarsmen were getting into the ship's *ἐφολκίς*, in order to tow it safely outside the harbour⁴³¹ and by Synesius, who reports ships being towed in the harbour of Alexandria around 400 CE.⁴³² Iconography preserves only one definite image of a boat towing another ship. A relief from Isola Sacra, Ostia, dated in the Hadrianic period, portrays a tugboat connected by a stretched cable to a ship not shown, probably a *caudicaria* river barge (**Fig.2.38**). The boat is manned by three oarsmen and a helmsman.⁴³³ The long scoop used

⁴²⁸ Boetto 2009; Boetto & Poveda 2014.

⁴²⁹ Camilli 2002; Bonino 2010.

⁴³⁰ Plut.*Pomp.*40.5; Ath.5.208f; Philostr. VA 4.32; Ach.Tat.3.4.1. Cf. Casson 1971, 248, n.93.

⁴³¹ "Now look at that ship's crew, how some of them being rowers have embarked in the tug-boats, while others are winding up and making fast the anchors, and others again are spreading the sails to the wind, and others are keeping an outlook at bow and stern" (Philostr. VA 4.9).

⁴³² "One ship was being towed in; another was moving with all sails set; another was propelled by oars" (Syn.Ep.148.6).

⁴³³ Casson 1965, Pl.I.1.

instead of a side rudder is not seen in any depictions of seagoing vessels in the ancient Mediterranean, but only in river ships (see **2.4.1**) and this is a good indication that this vessel was used in the Tiber or in the canals around Ostia and Portus.⁴³⁴ The numerous members of the two guilds of the *lenuncularii* in 2nd and 3rd century CE Ostia/Portus could as well have served the towing of ships in the important harbours, but this remains unverified by the inscriptions.⁴³⁵

Concerning piloting the presence of specialized and experienced helmsmen or sailing masters (*πηδαλιούχος* or *gubernator*) is firmly attested in many ancient texts,⁴³⁶ but only two written sources refer to the employment of pilots as special guides in unknown and dangerous passages by ships in antiquity. The first one is the *Periplus Maris Erythraei* where we read:⁴³⁷

Because of this, native fishermen in the King's service, stationed at the very entrance in well-manned large boats called trappaga and cotymba, go up the coast as far as Syrastrène, from which they pilot vessels to Barygaza. And they steer them straight from the mouth of the bay between the shoals with their crews; and they tow them to fixed stations, going up with the beginning of the flood, and lying through the ebb at anchorages and in basins.

In the description of Synesius' troublesome voyage from Alexandria to Cyrene we read:⁴³⁸

...a man in rustic garb signalled and pointed out which were the places of danger, and those that we might approach in safety. Finally, he came out to us in a boat with two oars, and this he made fast to our vessel. Then he took over the helm, and our Syrian gladly relinquished to him the conduct of the ship. So after proceeding not more than fifty stadia, he brought her to anchor in a delightful little harbour, which I believe is called Azarium and there disembarked us on the beach. We acclaimed him as our saviour and good angel. A little while later, he brought in another ship, and then again another, and before evening had fallen, we were in all five vessels saved by this godsend old man....

A unique image of what appears to be a pilot boat comes from a 2nd-century CE

⁴³⁴ Mott 1997, 107.

⁴³⁵ Casson 1965, 34-5.

⁴³⁶ E.g. Ezekiel 27.29; Aristoph.*Kn.*542-4; Sen.*Ep.*95.7.

⁴³⁷ *Periplus Maris Erythraei* §44

⁴³⁸ Syn.*Ep.*4.28-9. For a commentary on the specific text see Kahanov 2006.

mosaic from the Palazzo Diotallevi at Rimini (**Fig.2.39**).⁴³⁹ A boat with three rowers and a helmsman is leading two merchantmen inside a harbour, its entrance marked by a tower-like structure where a man is operating a small beacon. Both ships appear to be of considerable size, equipped with two masts and a gangplank, whereas the first one to the left is towing a ship boat similar to the one leading them. The sailors of both vessels have already lowered the foresail yard and are working on the brails of the mainsail, in order to lower the vessels' speed. An interesting detail on the boat is the presence of a long staff or pole that could be used either for fathoming or for controlling the boat when close to docks or ships (the *κοντός/contos* in Greek and Latin sources).⁴⁴⁰

Although the *Periplus* and Synesius do not describe piloting as something extraordinary, the silence of other sources suggests an uncommon practice. Neither individual pilots, nor their trade unions are mentioned in inscriptions, whilst Josephus, when describing how ships had difficulties entering the great harbour of Alexandria, did not mention the employment of local pilots, but that ships waited until conditions became more favourable.⁴⁴¹ Ships appear to have been operating on their own devices when approaching a harbour or a coast. Piloting of fathoming boats could also be employed but sources only document them in the case of the Barygaza delta and on the Rimini mosaic.⁴⁴²



Fig.2.39. Mosaic from the Palazzo Diotallevi in Rimini showing two merchantmen entering a harbour, marked by a tower and a possible lighthouse, following a pilot boat (2nd century CE; Friedman 2005/06, Fig.1).

⁴³⁹ Friedman 2005/06, Fig.1; Ugolini 2015; 2020, Figs.5.1-2, 174-81.

⁴⁴⁰ Verg.A.5.208-9; App.BC.5.89, Pollux 1.93.

⁴⁴¹ J.BJ.4.10.5.

⁴⁴² Ugolini (2015; 2020, 180) has suggested that Seneca's reference to the *navis tabellaria*, the ships that went ahead of the rest of the Alexandria grain fleet to inform the people of Puteoli that the fleet was to arrive (Ep.77.1-2), were pilot boats and relates them with the Rimini mosaic. The author, however, makes no mention of any ship or boat leading the fleet into the harbour.

2.5.2. Special cargoes and vessels

The previous sector refers to the 'regular' ships, i.e. most of the merchantmen of the period that would carry bulk (grain, wine, olive oil etc.) or mixed cargoes, as well as passengers. There were, nevertheless, special categories of ships related to certain cargoes that presented certain peculiarities worth addressing, especially when it comes to their use within harbours.⁴⁴³

Stone carriers

Stone carriers constitute a special category of ships. Although their numbers and importance increased in the Imperial period, they remained similar to the other



Fig.2.40. The Haterii mausoleum relief (early 2nd century CE; Vatican Museums, <http://www.museivaticani.va/content/museivaticani/en/collezioni/musei/museo-gregoriano-profano/Mausoleo-degli-Haterii.html>).

merchant vessels and it seems that it was the skill of their crew in handling heavy cargoes that distinguished them (see 2.1.4). The ways, however, these ships operated and were handled in harbours had to be very specific. Stone carriers had to berth with their broad side next to natural or artificial quays and use cranes for loading and unloading their cumbersome cargoes.⁴⁴⁴ Cranes could not be operated if ships were berthed stem-first on the quays, due to the distance between the bow and the hold in the middle of the ship and the presence of the ship's foremast, whereas simple, makeshift gaff cranes attached to ships' masts would not be able to support the weight of large marble or stone pieces without breaking or damaging the ship itself.⁴⁴⁵ This meant that harbours serving such ships had to be equipped with basins deep enough to allow them to berth directly at the quays (according to shipwreck evidence some of these ships had a draught of up to 2 m; **Appendix**

⁴⁴³ As already mentioned other special 'cargoes' like enslaved people and animals for the circus games were also common in the period studied, but due to the lack of evidence of any kind, especially of shipwrecks, prevents any further study of the ways these were handled in the sea and within harbours.

⁴⁴⁴ Robinson et al. 2020, 104.

⁴⁴⁵ Vitruvius (10.2.8-10) describes the existence of simple gaff cranes for loading and unloading ships, but does not mention their use on the ships themselves. Cf. Landels 1978, 94-5.

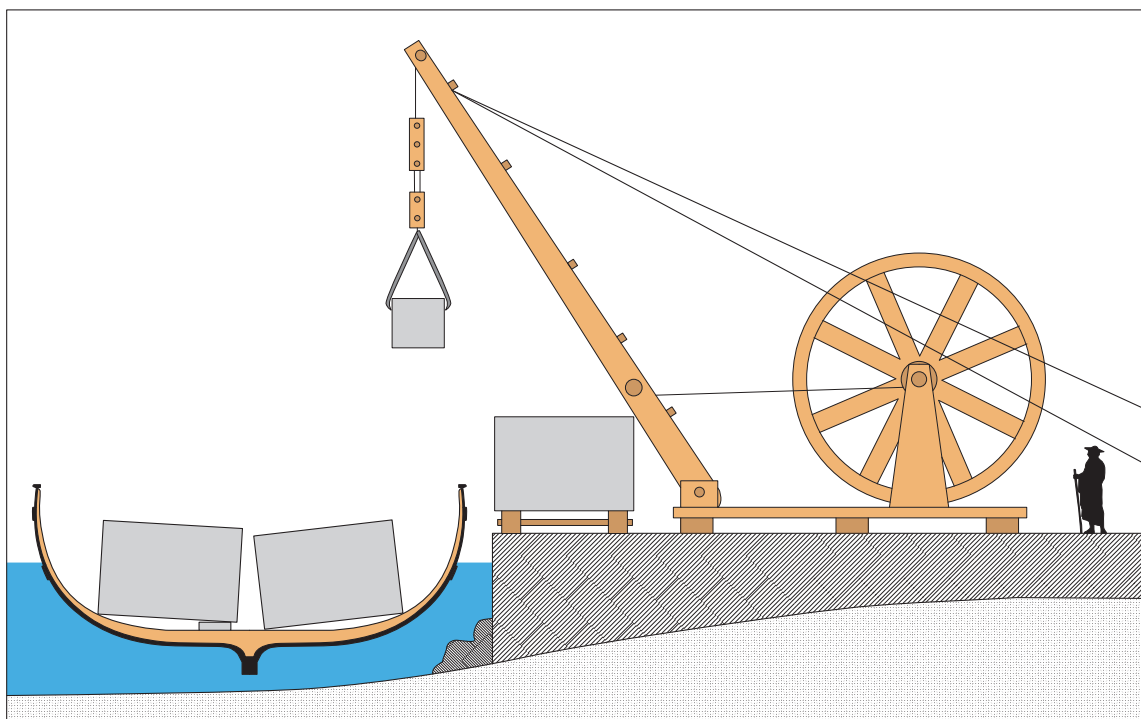


Fig.2.41. Reconstruction of the loading of a stone carrier (drawing by the author). The ship has been based on the remains of the Kizilburun shipwreck, which constitutes the best-preserved stone carrier excavated (Littlefield 2012). The upper part of the hull has been tentatively reconstructed according to the measurements given by Littlefield and the form other vessels of the period had. The blocks pictured are also based on the cargo of the same ship that mainly included eight large column drums, each weighing about 5-6 tons (Carlson & Aylward 2010), amongst other stone objects and amphorae. The crane is based on the form of a two-masted treadmill crane as known from iconography (the Capua and Haterii reliefs). The dimensions of the crane (c.10 m in height) are the minimum required to lift an object of about 5 tons above the ground, according to the calculations of O'Connor (1993, 49-50) and the experiments of Meighörner-Schardt (1990, 59). The crane is also supported by heavy-duty blocks that allow it to move alongside the quay. The quay has a relatively small depth in front of it (c.2 m), just enough for the ship to berth and is a concrete or ashlar structure.

I, Table 2 & 3), whilst the quays in turn would have to be spacious and solid enough to accommodate the stone blocks and the heavy-duty cranes.

According to the cargoes discovered in shipwrecks even blocks of up to 13 tons (the columns of the Torre Chianca ship)⁴⁴⁶ could be transported via the sea, although most blocks usually measured five-six tons each (e.g. the column drums of the Kizilburun shipwreck).⁴⁴⁷ Only cranes of substantial size, like the ones portrayed in the Capua and the Haterii relief (Fig.2.40)⁴⁴⁸ could be used to lift and place stone blocks inside a ship's hold. According to

⁴⁴⁶ Strauss 2007, 184; Russell 2013b, Table 1.

⁴⁴⁷ Carlson & Aylward 2010, Table 2.

⁴⁴⁸ O'Connor 1993, 49-50; Lancaster 1999, 426; Ulrich 2008, 37, Fig.2.4.

modern experiments,⁴⁴⁹ it required a crane measuring 10 m in height, using at least one three-pulley block and powered by five men in a treadmill to lift a 5-ton block from the ground (**Fig.2.41**). Even if cranes did not have to lift blocks to any considerable height with ships being on the same level or lower than the docks, they remained large and complicated installations. Their construction, maintenance and operation, even if these were simple, temporarily set, 'shear-legs' devices, required many skilled and unskilled labourers⁴⁵⁰ and road infrastructures to make sure the heavy cargoes could make their way to/from the ship. Accidents must have been a great concern for the mariners and the stone merchants. A large block falling inside a wooden hull would cause its immediate sinking. The need for adequate facilities, space, technical support and labour force must have made such specialised harbours few and limited to quarry sites or to specific great harbours of the period.

The *dolia* ships

The other type of specialized ship known from this period that presented complications concerning its accommodation in harbours were the *dolia* ships. These vessels, although, as we saw above, would not have exceeded a length of 20 and a draught of 1.5 m, had to be berthed next to a quay for their containers to be moved, filled and emptied (**Fig.2.42**). A filled *dolium* of c.2,600 litres would weight about 0.9 tons,⁴⁵¹ whereas an empty one roughly 200-300 kilograms, thus in both cases their removal from a hold required mechanical means. Emptying and filling *dolia* could be done manually, but this would be a time-consuming operation especially on an anchored, partly decked vessel (**Fig.2.5**). The application of siphons or Archimedes' screw, both devices known and used in Hellenistic and Roman times has been suggested.⁴⁵² This would have minimised costs and losses, but both devices presented certain problems: siphons could facilitate the filling of *dolia* on board but not their emptying, since they require the receiving container to be lower than the delivering one. Screw pumps could be employed for the unloading of the content on harbour quays, but, due to the necessary inclination of the device, it could not reach the bottom of the *dolia* (**Fig.2.42, top right**). It is unlikely that similar devices would be available in every harbour or that the small *dolia* ships would be transporting them as they sailed. The filling and emptying

⁴⁴⁹ Meighörner-Schardt 1990, 59.

⁴⁵⁰ Landels 1978, Fig.26; Russell 2013a, 137.

⁴⁵¹ Marlier & Sciallano 2008, 120.

⁴⁵² Gille 1980, 132-3; Wilson 2008, 353; Ulrich 2008, 42; Marlier 2008, 167.

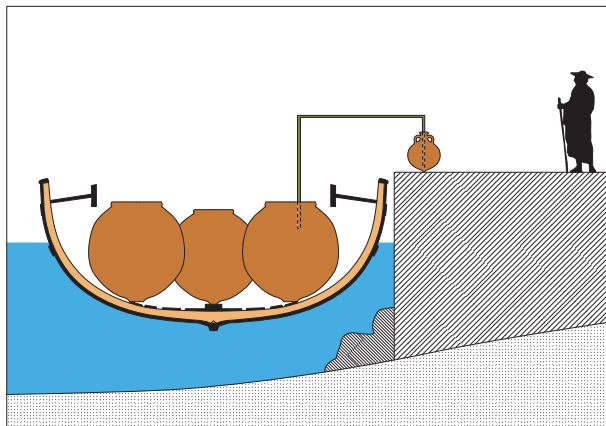
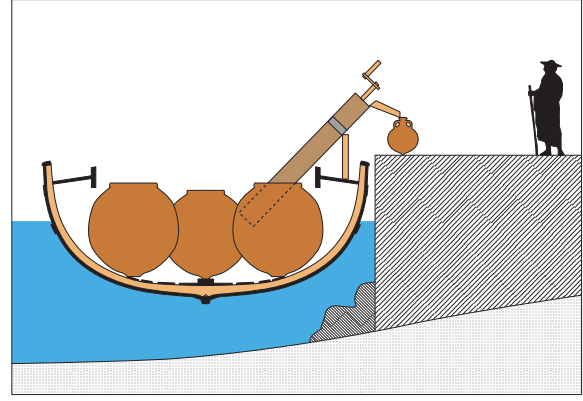
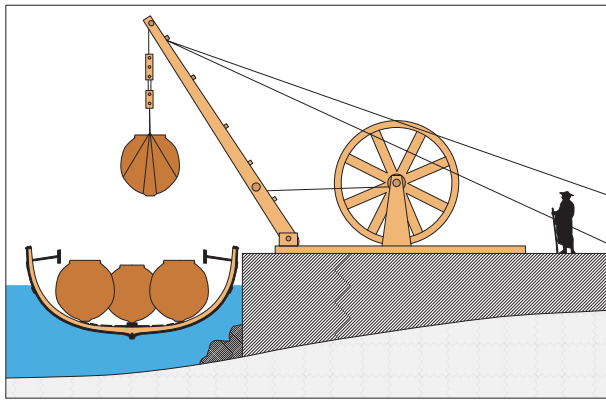


Fig.2.42. Reconstruction of the various methods of loading and unloading a dolia carrier. The dimensions, form and cargo of the ship pictured are all based on the shipwrecks of Cavalière and Ladispoli, as they were used for a reconstruction of a typical dolia carrier by Carre & Roman (2008). At the top left the removal of a dolium with the use of a crane is shown. The crane follows the pattern of a two-masted Roman crane of mediocre dimensions (6-8 m), since the empty dolium would weigh no more than 200-300 kilograms and a full one less than 1 ton (Marlier & Sciallano 2008, 120). The top right drawing shows the application of Archimedes' screw to empty the content of the dolia in smaller containers on a quay. The screw is based in Vitruvius's description (10.6.1-4) and on surviving examples from Egypt (Hodges 1970, Fig.212-3). The bottom left drawing shows the application of a simple siphon for the loading of the ship.

of the *dolia* on board manually with the use of simple containers which were then loaded to lighters appears to have been the simplest solution to this problem.⁴⁵³

2.6. Conclusions

The scrutiny of the evidence related to the ships of the Hellenistic and Roman Mediterranean presents a very complex image of ship typology and seamanship. Concerning commercial shipping, vessels of various types and sizes operated side-by-side carrying various cargoes from grain and wine to stone and marble in various networks and an 'average merchantman' seems to have never existed. Ships did not differ much in terms of construction and equipment but were distinguished by their cargoes and their specific, often

⁴⁵³ Mataix Ferrándiz 2018, 96.

interchanging, use. Despite a relative increase in ship size and tonnage that is reflected in the construction of several large capacity vessels and even of some exceptionally large freighters, the majority of ships remained of medium and small capacity. The former, although of limited cargo capacity, were much easier to construct, handle and manoeuvre, especially within harbour environments, and formed the “backbone” of commercial shipping.⁴⁵⁴ Other types of ships consisted of the numerous small service vessels, extremely useful in the operation of harbours, as well as the galley fleets, the latter, however, diminishing in importance and size with the establishment of the *pax romana*. Rigging and equipment was considerably improved during the period studied, significantly enhancing the merchantmen’s seaworthiness but also their ability to approach coasts and harbours with safety.

The variety of ships and cargoes in the Hellenistic and Roman Mediterranean could not but reflect on the variety of methods employed by them when approaching the coast, which in turn was equally variable. Docking, anchoring, beaching, towing and piloting were practices that all ships would employ in different ways according to their cargo, climatic conditions, nature of the coast or simply to the experience of their commanders and crew. Beyond certain ships with specific cargoes (stone and marble, *dolia*), the majority of the ships of the period could make the best of every environment and were versatile enough to take advantage of every opportunity or need they encountered. The method, however, that appears to have been the most convenient and common when ships approached harbours, was anchoring in the open and using lighters. Such a method would allow ships to avoid their tedious and potentially dangerous entanglement into secluded basins and could function into any coastal and harbour environment. All ship and cargo practices, as we will see in the following pages, would have had a great impact on the construction, organization, and commercial function of contemporary harbours.

⁴⁵⁴ Gibbins 2001, 294.



3. The case study harbours

In the previous chapter I discussed the typology, form and capacity of Mediterranean ships during the Hellenistic and Roman period, as well as their equipment and the various methods mariners could apply when approaching shores and harbours. In this chapter the three case study sites, Delos, Lechaion and Kenchreai, will be examined. The harbours' original configuration during the period studied will be presented, highlighting important issues related to the research question of this study such as harbour size, depth, and infrastructure, as well as the specific ship and cargo traffic these harbours served. The main aim is the creation of reliable reconstructions of these spaces, reconstructions that combine all available data and can then be used in the subsequent synthesis and analysis of ships and seamanship vis-à-vis harbours and answering of the main research question.

3.1. Delos

Delos was the commercial harbour *par excellence* of the Hellenistic and early Roman period in the Aegean.⁴⁵⁵ Beginning in the period of independence in 314 BCE,⁴⁵⁶ and especially after the establishment of the free port by the Romans in 166,⁴⁵⁷ BCE the sacred island of Apollo was transformed from an important but small sanctuary settlement into a cosmopolitan, prosperous *emporion*, one of the major exchange and clearing centres of the Mediterranean, with direct links both with the Hellenistic East as well as with Rome.⁴⁵⁸ The diversity of people, ships and cargoes that would arrive at the island renders it a unique and multi-level case study concerning the operation of a highly successful harbour of the period. Delos is also a site well known through extended excavations and studies and largely unobstructed by modern development.⁴⁵⁹

⁴⁵⁵ Paus.3.23.3–6; Pl.Nat.34.9; Lucilius, *Satires*, cited in Paulus, ex Festo 88.4; Cic.Q.Rosc.133.

⁴⁵⁶ Diod.30.20.10; IG, XI, 2, 135. Cf. Tréheux 1948.

⁴⁵⁷ Pol.30.20.10; Strab.10.5.4. Cf. Roussel 1987.

⁴⁵⁸ Hatzfeld 1912; 1919, 34; Larsen 1938, 334–57; Rauh 1993; Reger 1994.

⁴⁵⁹ The islands of Delos and Rhénia have been declared an integrated protected archaeological site by the Greek Ministry of Culture in 2012, whereas Delos has been a UNESCO World Heritage Site since 1990. Modern interventions were mainly done during the years of the “great excavation” of the French School and include the museum and the houses for the workers and other personnel, still in use today. Unfortunately the greatest intervention in Delos was the construction of the rubble jetties at the Main Harbour, which covered great part of the ancient harbour structures.

Delos presents the paradox of a harbour city that developed without the existence of a large, deep harbour. The island never truly had an enclosed natural or artificial anchorage able to accommodate even small numbers of medium and large capacity ships, partly due to the rapidness of its development and abrupt demise before the middle of the 1st century BCE, but also due to the nature of the trade practiced on the small island, which did not actually require the use of an enclosed basin. Notwithstanding the long history of excavation and research on Hellenistic Delos,⁴⁶⁰ the maritime façade and the harbours of the island has been targeted by scholarship and field research, with the exception of Pâris' pioneering article of 1916, only relatively recently.⁴⁶¹ These important studies have revisited the function of the whole island both as a port-of-trade as well as an integrated harbour city served by more than one anchorages, but have not tackled the issue of harbour operation in relationship to ship and cargo handling, an issue that will be covered in this study.

3.1.1. Geomorphology and climatic conditions

Delos is located in the middle of the Aegean archipelago, with the Cyclades “dancing” around her, according to Callimachus' poetic description (**Fig.1.12**)⁴⁶² and on the main sea routes crossing the Archipelago, which played a major role in its development into an important religious and financial centre.⁴⁶³ Delos is a small, elongated island with a maximum length of 5 km and a width of 1.3 km, oriented on a north to south axis (**Fig.3.1**). The island's relief is hilly, with mount Kynthos (112 m), the island's main landmark, visible from a great distance (**Fig.3.2**). Small plateaus divide the hills with the larger one located to the northeast of the ancient city.⁴⁶⁴ The sanctuary of Apollo, around which the later settlement developed, is situated in the plain to the east of the Main Harbour (**Figs.3.3 & 4**).⁴⁶⁵ Several intermittent torrents flow on the island, Inopos being the most important

⁴⁶⁰ Bruneau & Ducat 2005; Zarmakoupi 2015.

⁴⁶¹ Duchêne et al. 2001; Zarmakoupi 2014; 2018b.

⁴⁶² “Asteria, island of incense, around and about thee the isles have made a circle and set themselves about thee as a choir” (Call.*Del.* 300-1). Cf. Constantakopoulou 2007, 25-6.

⁴⁶³ Morton 2001, 312; Arnaud 2005, 225; Bouras 2016, 216-8, Fig.1; Constantakopoulou 2017.

⁴⁶⁴ Cayeux 1911, 187-214; Desruelles 2004, 32-3; Bruneau & Ducat 2005, 29.

⁴⁶⁵ Bruneau et al. 1996, Fig.35; Desruelles & Hasenohr 2018, 31-4. The most accurate and updated topographical and archaeological survey of the island is the Atlas of Delos, published by the EFA (Moretti et al. in 2015). The data of this important work are also available online, along with high quality aerial photographs. Many of these plans and photographs have been used in this study (<https://www.efa.gr/index.php/en/recherche/sites-de-fouilles/cyclades/delos/13-systeme-d-information-geographique>; referred as ©EFA in the text and captions).

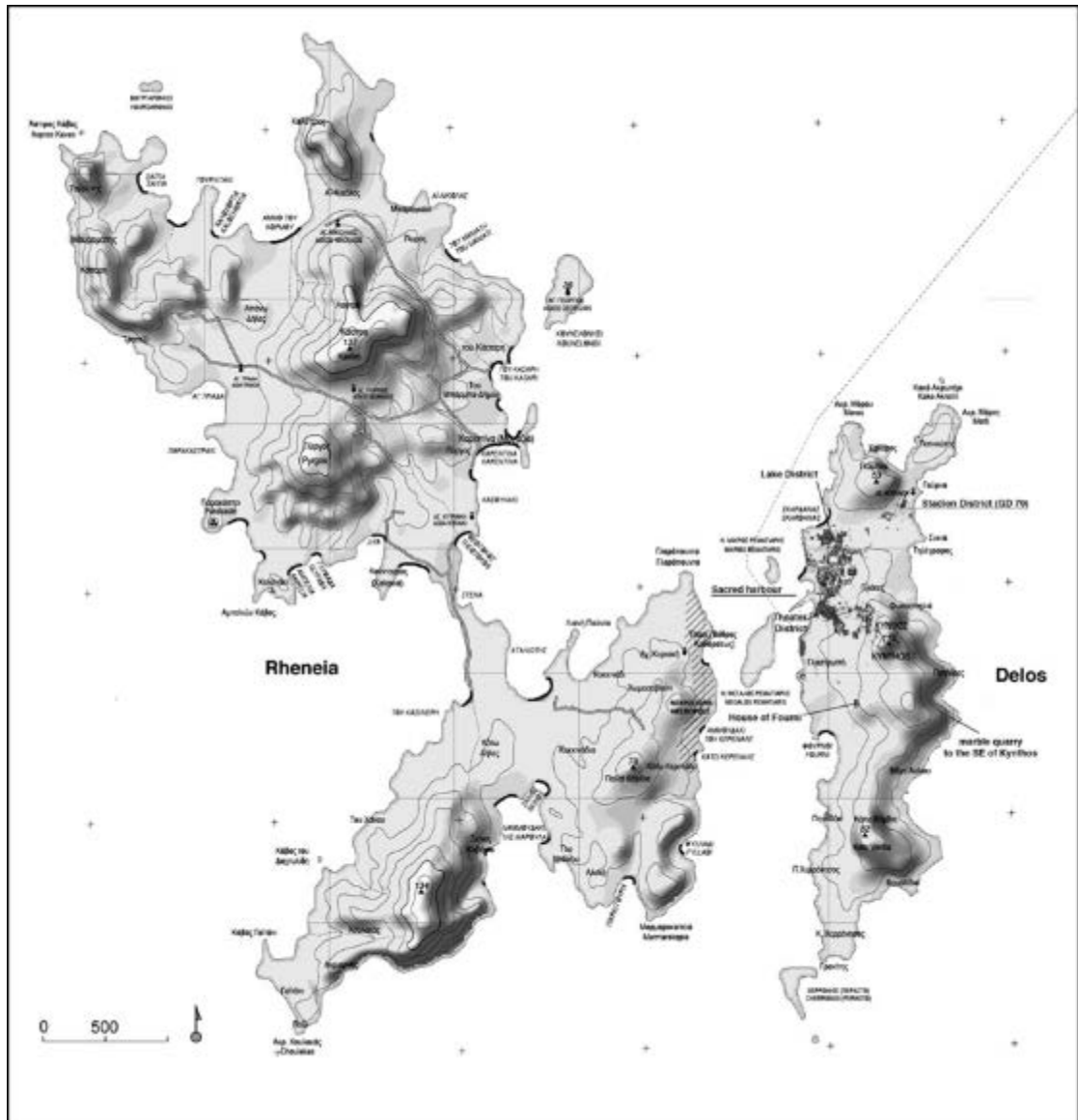


Fig.3.1. Map of Delos and Rheneia (Zarmakoupi 2015, Map 9).

one.⁴⁶⁶ Delos, as well as nearby Rhenia, although semi-arid islands, even compared to the dryness of the rest of the Cyclades and probably already deforested by the Hellenistic period, were extensively cultivated in antiquity, as the numerous farms discovered show.⁴⁶⁷ Animal husbandry was well much developed on both islands, according to the inscriptions of the sanctuary.⁴⁶⁸

The Delian coast is fragmented into many small bays and peninsulas (**Figs.3.1 & 3**). The shore is rocky and precipitous, especially in the island's northern half. The western side is generally less steep, particularly at its centre, where a series of beaches are to be found.

⁴⁶⁶ Desruelles 2004.

⁴⁶⁷ Bruneau & Ducat 2005, 80-2, 319; Desruelles & Hasenohr 2018, 37.

⁴⁶⁸ IG, XI.2, 287A, 143-74; IG, XI.2, 154A, 41; ID, 452, & ID, 467; ID, 353A, 28-36. Cf. Raptopoulos 2014, 41; Constantakopoulou 2017, 171-81.



Fig.3.2. *The central part of Delos with Apollo's sanctuary in the foreground and mount Kynthos at the back (photograph by the author).*

Geologically Delos, Rhenia and Mykonos constitute an integrated complex, the largest part of their terrain covered by eruptive granite rocks. What remains belongs to the Southern Cyclades Islands unit (alpine formations comprised of schist and gneiss with thin intercalations of marble).⁴⁶⁹ Local stone of every kind was extensively quarried and used as building material in the ancient city.⁴⁷⁰ An

important feature related with the depth of the ancient harbours is the presence of a solid crystalline basement just underneath the surface sediments and the rock formations of the coasts and sea bottom. Neo-tectonic activity has been weak and no considerable uplift or subsidence has been documented.⁴⁷¹

The seas around Delos are generally deep. The channel between Rhenia and Delos reaches a depth of 50 m and the seabed is sandy with small rock formations protruding from it (**Fig.3.40**).⁴⁷² A strong current runs through the channel from north to south but can often be reversed unexpectedly.⁴⁷³ Shores are mostly steep under water, apart from the sandy areas of the west coast. The two landmarks of the channel are the Great and Small Rematiaris rocky islets, which offer protection from the northern winds but can also be hazardous for navigation. When anchoring between Delos and Rhenia modern sailing ships use Rhenia's anchorages or the southern part of the channel, where the currents and the winds become milder. There are few dangerous reefs and shoals around Delos: to the south the Cherronissi low rocky peninsula and to the north the Kako Akrotiri steep cape (**Figs.3.1 & 40**). The approach to Delos is done today mainly from the west via the channel, but in the past, according to the accounts of European travellers, all harbours and anchorages of the

⁴⁶⁹ Cayeux 1911; Desruelles 2004, 26-7, Fig.37; Papanikolaou 2005, 271-3; Mourtzas 2011, 3.

⁴⁷⁰ Chamonard 1922-24, 233-6; Vallois 1966, 70.

⁴⁷¹ Hejl et al. 2002, 54-5; Piper & Perissoratis 2003.

⁴⁷² Cayeux 1911, Fig.94; Desruelles 2004, Fig.24.

⁴⁷³ Morton 2001, 37-45, 90-7.

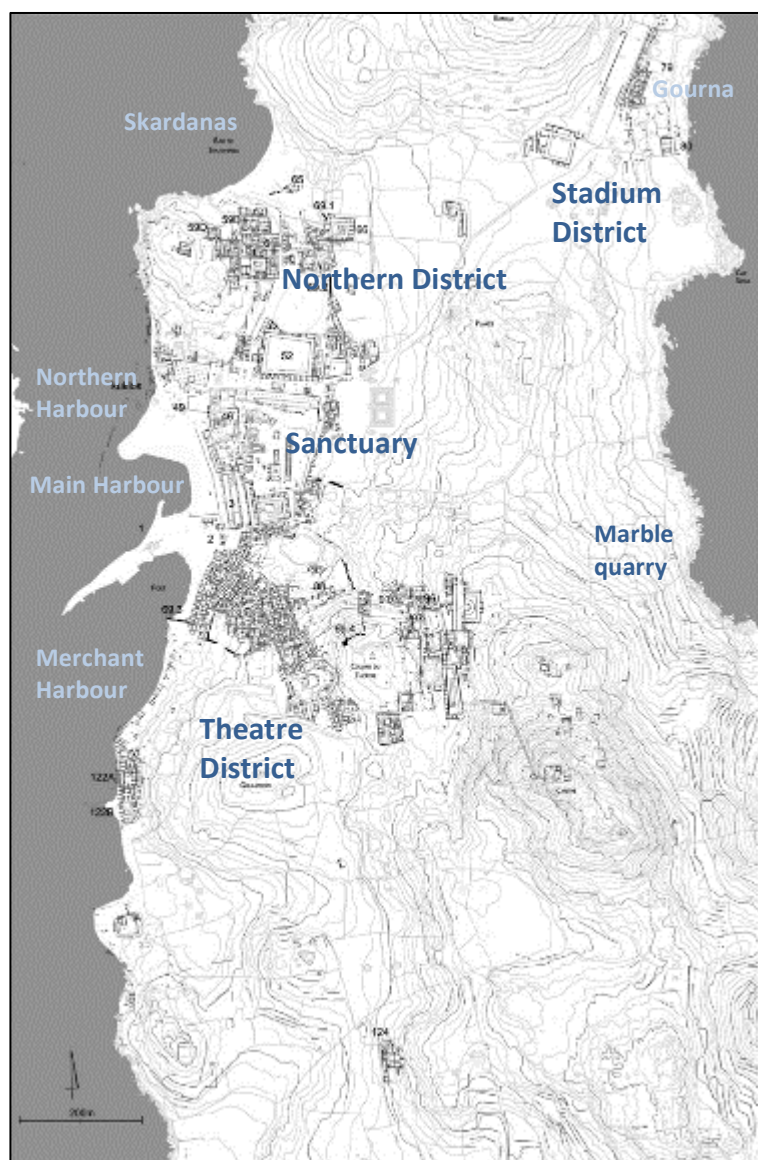


Fig.3.3. The central part of the island of Delos with indications of the ancient harbours, as well as of other important sites mentioned in the text (Moretti et al. 2015, Pl.15 with the names added by the author).

island would be used.⁴⁷⁴ Travellers also mention that larger ships could easily anchor in the deep waters of the channel and disembark their passengers with boats, whereas maps of the 18th and 19th centuries mark the area to the south of the Rematiaris islets as a good anchorage.⁴⁷⁵

The climatic conditions of Delos and the Cyclades follow the pattern of the Mediterranean climate, with generally sunny and dry weather and occasional rainstorms.⁴⁷⁶ A main characteristic is the strong winds blowing nearly all year long.⁴⁷⁷ Prevailing winds are northern and north-western and in the summer they take the form of the etesians or

meltemia. The former blow constantly from mid-May to mid-September, abruptly reaching up to 7-8 Beaufort and are both a favourable wind as well as a potential hazard for sailing, often rendering even the narrowest straits impassable.⁴⁷⁸ Southern winds, although rare and

⁴⁷⁴ Duchêne et al. 2001, 14-29.

⁴⁷⁵ Gallois 1910, Figs.26, 28-31, 38.

⁴⁷⁶ Desruelles 2004, 48-54; Beresford 2013, 54-6.

⁴⁷⁷ Dalongeville & Renault-Miskovsky 1993, 16-7; Chabas 1997; Beresford 2013, 63-90.

⁴⁷⁸ Iliopoulos 1952; Maheras 1979; Morton 2001, 85-97; Constantakopoulou 2007, 24-5.

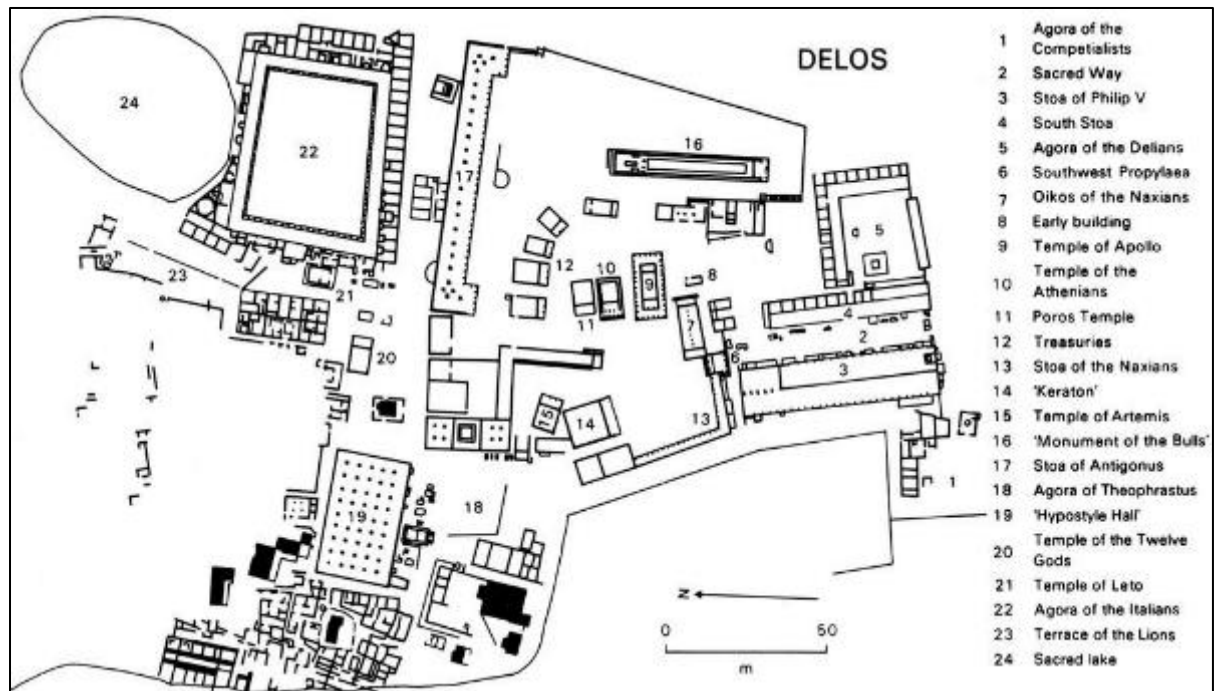


Fig.3.4. Plan of the sanctuary area of ancient Delos, with the names of the main buildings (<https://www.flickr.com/photos/toutlunivers/21703075818>).

relatively mild, usually occurring in Spring and Autumn, can also be hazardous, blowing unexpectedly and preventing ships from leaving protected harbours.⁴⁷⁹

The main factor of change on the coasts of Delos is the rise of the sea level of about 2.2 m since the Hellenistic period, as confirmed by geoarchaeological research on the coastal beachrock formations.⁴⁸⁰ With no major subsidence or uplift observed on Delos the only drastic change on the coast has been caused by the erosion and collapse of the rocky areas, especially around the Northern District and Skardanas bay. Another factor of anthropogenic change is the presence of rubble from the collapsed ancient structures. In Skardanas bay such rubble was accumulated by the constant and strong wave action in the middle of the bay, creating a steep ridge (**Figs.3.23-6**), whereas in the Main Harbour rubble was deliberately placed there in the early 20th-century in order to create the large jetty and a smaller one on top of the "Great Mole" (**Figs.3.6-7**).⁴⁸¹ Similar rubble concentrations have also covered the beach of the Merchant Harbour, but, according to aerial photographs, they

⁴⁷⁹ Morton 2001, 121-3; Arnaud 2005, 16-23.

⁴⁸⁰ Duchêne et al. 1995; Desruelles et al. 2004; Dalongeville et al. 2007.

⁴⁸¹ It is noteworthy that the small rubble jetty is clearly moving towards the south, pushed by the prevailing northern waves and currents and obstructing various features surveyed in the early 20th century (**Fig.3.5**), as shown by a comparison between old and recent plans and photographs (Duchêne et al. 2001, Doc.VIII, Pl.XXVI; Moretti et al. 2015, pl.5).

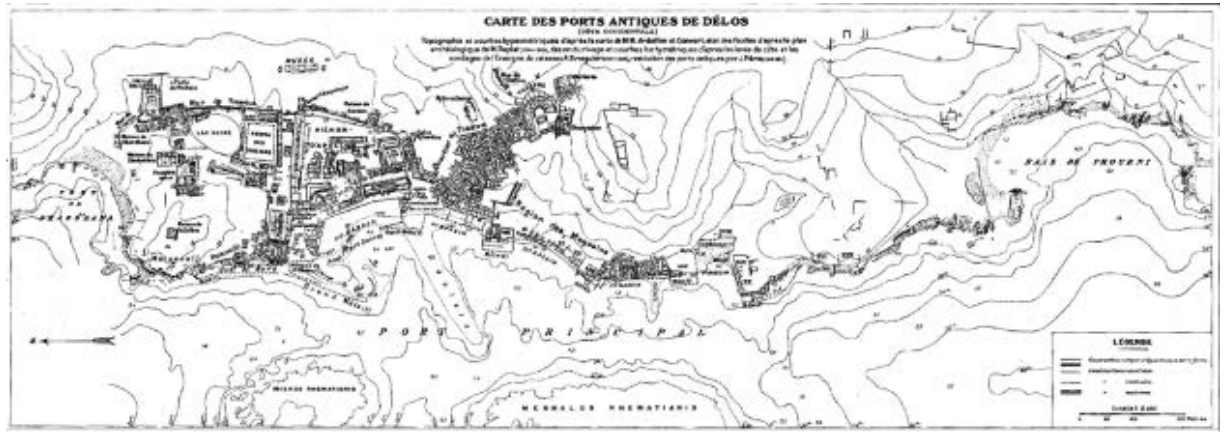


Fig.3.5. The western harbours of ancient Delos. The plan has included the ancient structures, the shoreline, as well as the bathymetric contours of the area (Pâris 1916, Pl.I-IV).

are limited to the shore (Figs.3.5 & 18).⁴⁸² The bathymetry and photographs also indicate the areas where debris was piled up by the excavators, especially in front of the “Magasin à la baignoire” where it formed a narrow jetty.⁴⁸³

One final factor of change is siltation. Due to the dryness of the island, inland siltation is limited and sediments arriving at the sea are dispersed by waves and currents. Siltation is mostly anthropogenic and is caused both by a series of ancient sewers, many leading to the Main Harbour⁴⁸⁴ as well as by the presence of the ancient “Great Mole” and the modern rubble jetty, which have created a vortex-like phenomenon, trapping and recycling sediments within the harbour’s basin.⁴⁸⁵ The thickness of the sediments covering the crystallite basement in antiquity is difficult to establish. Recent sondages and trenches have shown that these do not present a coherent stratigraphy and are largely disturbed, whereas no traces of dredging have been documented by geomorphological studies or written sources. Thanks to these studies the depth of the stable crystalline basement was established, which shows the maximum depth the harbour basin could have reached, even if dredging was employed.⁴⁸⁶

⁴⁸² Desruelles et al. 2007, 237.

⁴⁸³ Pâris 1916, Pl.I-IV.

⁴⁸⁴ Desruelles 2004, Fig.115.

⁴⁸⁵ Dalongeville et al. 2007, fig.8; Desruelles et al. 2007, Fig.5.

⁴⁸⁶ Desruelles & Hasenohr 2018, 44. The use of bathymetric evidence without the consideration of the siltation problems in the Main Harbour made a recent geological study recreate the basin as a totally silted area in antiquity (Mourtzas 2011, Fig.12).



Fig.3.6. The Main Harbour seen from the summit of Kynthos. Rhenia at the back (photograph by the author).

3.1.2. The harbours of Delos and their reconstruction

The main source of information for the reconstruction of the Delian harbours is on the one hand the series of meticulous surveys of the island by the EFA⁴⁸⁷ and on the other the detailed bathymetric surveys conducted by the French navy around 1900 (**Fig.3.5**).⁴⁸⁸ The latter preserved precious information on the configuration of the Delian coast, especially of the Main Harbour, that is largely obscured today by the modern rubble piers and the accumulation of sand and excavation debris.

Main harbour

Delos' Main Harbour, often called the "Sacred Harbour",⁴⁸⁹ is today a shallow, sandy cove

⁴⁸⁷ Especially the "Atlas of Delos", the most up-to-date and accurate survey of the island and its antiquities; Moretti et al. 2015.

⁴⁸⁸ Bringuier's and Dardinier's bathymetry, published by Pâris 1916, Pl.I-IV and Duchêne et al. 2001, Document I-VIII.

⁴⁸⁹ The term "Sacred Harbour" ("Port Sacré") was introduced by the first excavators because the Main Harbour was considered to have been used mainly by the ancient pilgrims arriving to the nearby sanctuary, in contrast to the Merchant Harbour (Ardaillon 1896; Déonna 1948, 46). Although the term is still used, especially in French literature, it is not attested in any ancient source and, as shown by recent studies, the Main Harbour had an equally important commercial character (Moretti et al. 2012; Moretti & Fincker 2016). Thus the term Main Harbour is preferred here (for the earlier use of the term see Zarmakoupi 2013a and 2013b).



Fig.3.7. Aerial photograph of Delos' Main Harbour (©EFA).



Fig.3.8. Plan of Delos' Main Harbour as it is today (©EFA).

measuring approximately 100 x 100 m, facing westwards and extending between the remains of the “Great Mole”, the modern rubble jetty and the sandy beach in front of the sanctuary (**Figs.3.4-7**). The ancient harbour basin has been heavily silted and the area between the beach and the sanctuary is now covered by a marsh. The only ancient structure protecting the Main Harbour from the prevailing winds and currents was the “Great Mole”, the large rubble breakwater, almost totally submerged today (**Figs.3.7-8**).⁴⁹⁰ The whole structure measures approximately 200 x 100 m, covering an area of 12,500 m² and reaches a height of about 5 m above the sea bottom at its west end.⁴⁹¹ It is crowned by a curved retaining wall at its northern and western sides, made of roughly hewn or unworked granite boulders, some of nearly megalithic size.⁴⁹²

⁴⁹⁰ Pâris 1916, 20.

⁴⁹¹ Pâris 1916, Pl.I-IV.

⁴⁹² A wall parallel to the mole but at a distance of about 30 m from it towards the harbour basin has been documented in the old plans (marked B in Pâris 1916, Pl.I-IV), but is today totally covered by a small rubble ridge. Its original form and function remain obscure and it is even questionable if the old surveyors documented an actual wall there or just a rubble accumulation.

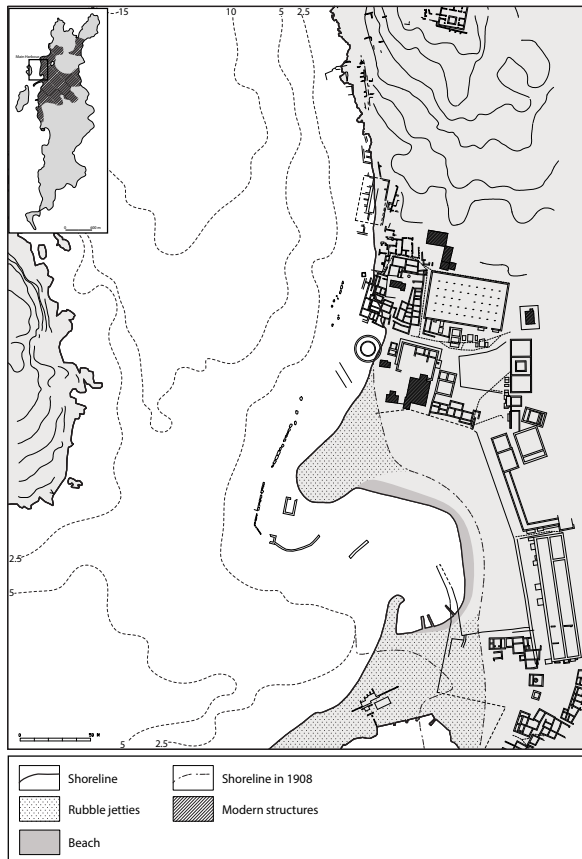


Fig.3.9. Plan of Delo's Main Harbour as it is today, with bathymetry contours and the shoreline before the creation of the modern jetties (drawing by the author Based on Pâris 1916, Pl.I-IV and Duchêne et al. 2001, Doc.VIII).



Fig.3.10. Plan of the northern part of the Main Harbour with indications of various structures mentioned in the text (plan by Moretti et al. 2012, Fig.14 with names in blue added by the author).

According to the Ardaillon's and Dardinier's plans, a rectangular structure with a dividing wall was located at the southern end of the mole and it has been interpreted as a lighthouse.⁴⁹³ Its shape and size, however, suggest that it was probably a small temple (*ναῖσκος*), similar in dimensions to the one standing in front of the Hypostyle Hall (**Fig.3.9**).⁴⁹⁴ If the "Great Mole" is identified with the *χῶμα* mentioned in the inscriptions of the sanctuary, then it is the earliest structure of the Main Harbour, built before 345 BCE.⁴⁹⁵ As for the quays and buildings erected on top of it, these can be broadly dated in the Hellenistic and Roman period, most likely before the destruction of the city in the 1st century BCE. An interesting feature is located at the point where the mole meets the shore, where the submerged remains of what appears to be a channel or a 'trench' are preserved (**Fig.3.10**). The structure runs almost perpendicular to the course of the mole and can be followed for

⁴⁹³ Ardaillon 1896, 432-3, Pl.II; Cayeux 1907, Fig.1.

⁴⁹⁴ Leroux 1909, Pl.I.

⁴⁹⁵ ID 104-4; Hellmann 1980.

about 15 m; it includes two parallel walls at a distance of 6.5 m built with small stones.⁴⁹⁶ The remains are too poor to allow for any safe interpretation of the structure. It could have been a channel, allowing the circulation of seawater to avoid siltation, a method known from other ancient harbours (Apollonia, Tyre, Sidon),⁴⁹⁷ or a slipway housing a galley (its width corresponds to the width of several ancient shipsheds).⁴⁹⁸

The inner face of the “Great Mole” and the northern part of the Main Harbour preserves no other structures and it seems that it was originally a simple beach, opened towards the Agora of Theophrastos (**Fig.3.10**).⁴⁹⁹ The former was a flat spacious area related with merchant activities, as establishments like the Hypostyle Hall, the *κύκλος* (circle) auctioning enclosure,⁵⁰⁰ and the small sanctuary of Poseidon *Ναυκλάριος*, patron of ship commanders, show.⁵⁰¹ Inscriptions of the 3rd-2nd century BCE also refer to the area as the *ἀπόβασις*, the main landing space of the sanctuary, leading to the sanctuary’s north-western entrance.⁵⁰²

⁴⁹⁶ Duchêne et al. 2001, Plan Ib.

⁴⁹⁷ Blackman 1982b, 199.

⁴⁹⁸ Blackman & Rankov 2013, 94-5.

⁴⁹⁹ Moretti & al. 2012, Figs.14-5. The Agora of Theophrastos took its name from the *ἐπιμελητής τῆς νήσου* (island’s superintendent) who, in 126/5 BCE, created it by reclamation, according to the inscription of his statue base, erected in the middle of the agora (*ID* 1645; Durrbach 1921, 160-5). “Θεόφραστος [Ηρ]α[κ]λ[εΐτου] Ἀχαρν[έ]α, ἐπιμελητὴν Δήλου γενόμενον/καὶ κατασκευάσαντα τὴν ἀγορὰν καὶ τὰ χώματα περιβαλόντα τῷ λιμένι,/ Ἀθηναίων οἱ κατοικοῦντες ἐν Δήλῳ καὶ οἱ ἔμποροι καὶ οἱ ναύκληροι/καὶ Ῥωμαίων καὶ τῶν ἄλλων ξένων οἱ παρεπιδημοῦντες, ἀρετῆς/ ἔνεκεν καὶ καλοκάγαθίας καὶ τῆς εἰς ἑαυ[το]ῦς εὐεργεσίας ἀνέθηκαν” (*ID* 1645).

⁵⁰⁰ Leroux 1909; Moretti et al. 2012; Moretti & Fincker 2016, 107-8. *ID* 1835. The commercial use of the *κύκλος* is attested by its form as well as by the inscription relating it with an Athenian market inspector: “Σωκράτης Σωκράτους Κηφισιεὺς ἀγορανομήσας Ἀπόλλωνι καὶ Ἑρμῇ” (*ID* 1835).

⁵⁰¹ *ID* 2483; Moretti & Fincker 2016, 98. Both agoras flanking the Main Harbour, the Agora of Theophrastos and the Agora of the Competaliasts were largely covered in the 2nd century CE by smaller buildings, probably of commercial character (Pâris 1916, 29; Hasenohr 2002, 101).

⁵⁰² *ID* 144 I, 117-8; *ID* 119A I, 23; *IG*, XI.I, 2, 161A I, 114-5; Duchêne et al. 2001, 144-7; Étienne 2018b, 62-3, 82.

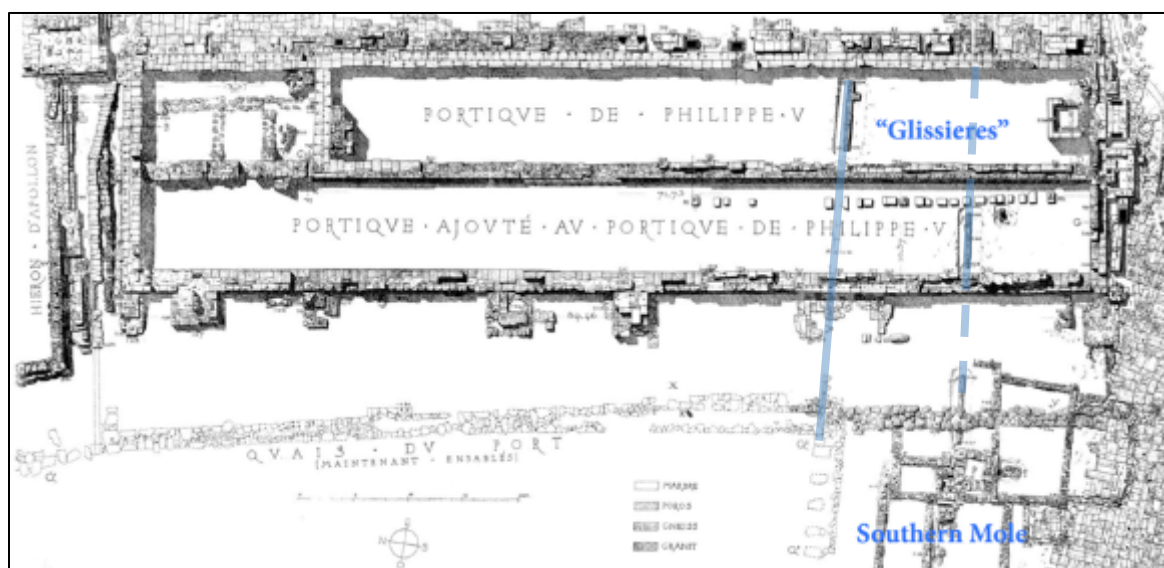


Fig.3.11. Plan of the area of the portico of Phillip with indications of structures mentioned in the text. A hypothetical continuation of the “glissieres” has also been marked (Vallois 1923, Pl.I).

At the harbour’s eastern bank a long retaining wall (0.8-2 m wide) runs parallel to the sanctuary’s structures and Phillip’s Portico, marking the easternmost limit of the basin (**Fig.3.7**).⁵⁰³ Its thicker southern part operated also as a retaining wall for the Portico of Phillip, and supported a paved terrace adorned with a series of statues and other votives (**Figs.3.11**).⁵⁰⁴ In this area the ὄρος boundary stone with the inscription documenting the “galleys’ cove” was found.⁵⁰⁵ A final feature of the same area is the two parallel constructions, conventionally named *glissieres* (slipways) by the excavators that predated the quay and Phillip’s Portico (**Figs.3.11 & 13A**).⁵⁰⁶ The simple, one-course structures were most probably curbs, delineating a procession road leading to the sea and used before Phillip’s Portico was built (their spacing matches the width of the later δρόμος procession road of the sanctuary) or some kind of enclosure, possibly for the hauling of galleys (a width of c.12 m, enough for two triremes, is provided between the two structures).

The quays of the Main Harbour ended at the Southern Mole, a wide trapezoidal structure, measuring approximately 50 x 70 m, of which only the northern retaining wall was preserved and is now totally covered by debris (**Fig.3.7**). The mole’s width can be inferred by the slab pavement of the Agora of the Competaliasts, whose continuation the mole

⁵⁰³ Vallois 1923, Fig.3, Pl.I; Fraisse & Hellmann 1979, Pl.I.

⁵⁰⁴ Pâris 1916, Fig.25.

⁵⁰⁵ “ὄρος ὀρμου μακρῶν πλοίων” (ID 2556).

⁵⁰⁶ Vallois 1923, Figs.25-6.

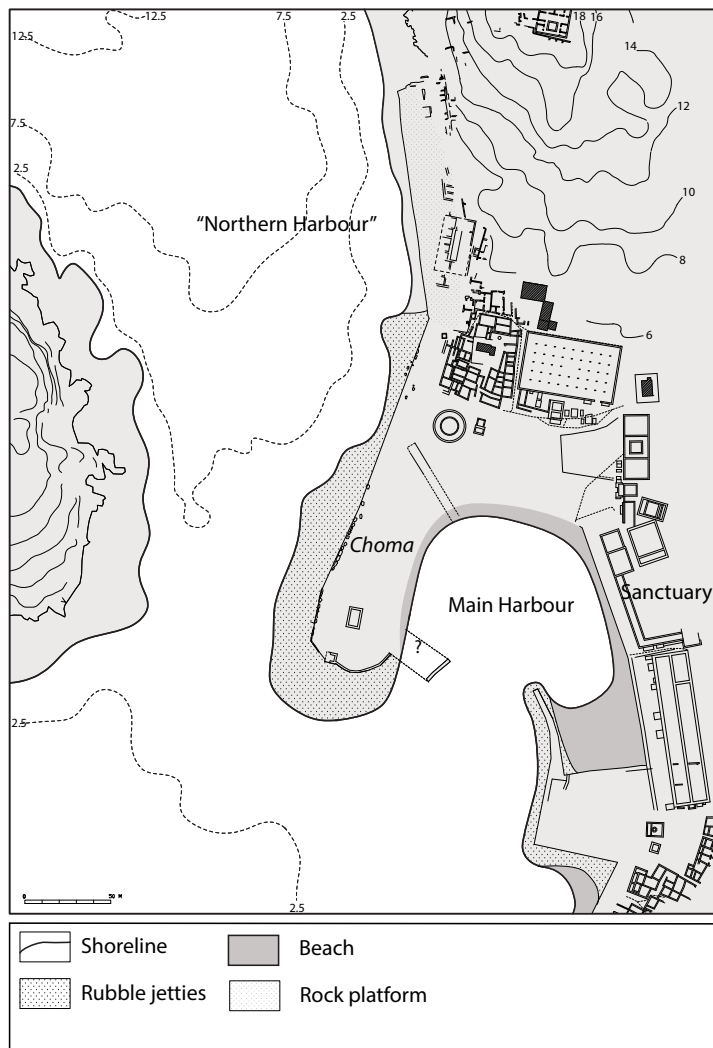


Fig.3.12. *Reconstruction of the form the Main Harbour of Delos had during the late Hellenistic period (drawing by the author).*

formed.⁵⁰⁷ At its north-western end a narrow, wedge-shaped jetty extended for about 40 m towards the north (**Fig.3.12**). The jetty protected the harbour's southern half from south and south-western winds but could also act like a groyne, preventing seaward sedimentation. Sondages at the Agora of the Competalists showed that the agora and the mole were founded on a simple landfill on a seaside marsh between 167 and 125 BCE (**Fig.3.13B**).⁵⁰⁸

There have been several reconstructions of the Main Harbour. The first was suggested by Pâris (**Fig.3.5**) and reproduced by Papageorgiou-Venetas.⁵⁰⁹ The rise of sea level was not taken into

account and all seaside remains were interpreted as a continuous line of quays, jetties and basins; even the wide area covered by the "Great Mole" was reconstructed as a narrow breakwater, following the course of the mole's retaining wall still visible outside the water. As we already saw, the rise of the sea level has been proved beyond doubt in Delos and such a reconstruction cannot be correct. A second reconstruction has been suggested by geologists⁵¹⁰ and, although acknowledging the rise of sea level, it presented a totally silted and practically non-existent basin.

⁵⁰⁷ Duchêne et al. 2001, Doc.VIII. The agora conventionally took the name of one of the religious brotherhoods of the islands, many dedicatory inscriptions of which were discovered there; alternatively and for the same reason it has also been called Agora of the Hermaistes.

⁵⁰⁸ Hasenohr 2004, 890-901; Desruelles et al. 2007, Fig.3-5; Desruelles & Hasenohr 2018, 42.

⁵⁰⁹ Pâris 1916, Pl.I-IV; Papageorgiou-Venetas 1981, Fig.81.

⁵¹⁰ Desruelles et al. 2007, Fig.5; Mourtzas 2011, Fig.12.

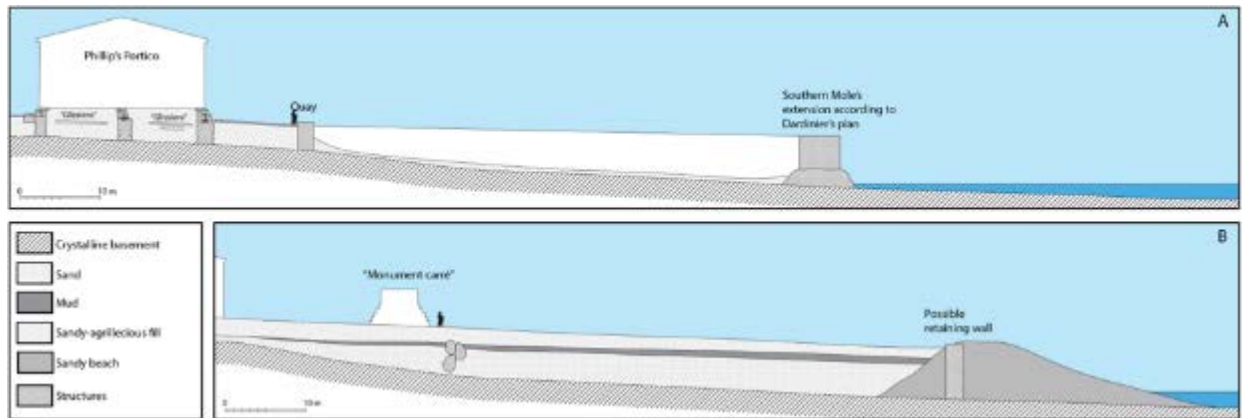


Fig.3.13. Cross-sections of the Main Harbour's southern area as it is believed to have been around 100 BCE. A: Cross-section to the west of Phillip's Portico according to Vallois (1923, Pl.I) and Desruelles et al. (2007, Fig.5). B: Cross-section of the Agora of the Competaliasts and of the Southern Mole according to Desruelles et al. 2007 (Fig.5; drawings by the author).

A third, more credible, to my view, reconstruction was suggested by Moretti, Fincker and Chankowski (**Fig.3.10**).⁵¹¹ According to this the Main Harbour was never totally silted, although it was much smaller than what was suggested by Pâris (**Fig.3.12**). Due to the shallowness of the crystalline basement in antiquity, measured recently by electric resistivity surveys,⁵¹² the centre of the basin could have originally had a depth of about 1 m that became 1.5 m towards the basin's entrance, depending on the amount of sediment accumulated (**Fig.3.13A**). The sedimentation rates of the basin in antiquity are unknown and there is no evidence of any dredging operations in the harbour. The fact, however, that no structure was ever erected there, even during the Imperial period, when large parts of the harbour agoras were covered by buildings, strongly indicates that the area was never totally silted or reclaimed but that it remained a very shallow, sandy bay, with a depth of 1 to 0.5 m. The basin's northern limit must have been a few metres south of the Agora of Theophrastos, as suggested by Moretti et al. (**Fig.3.10**).⁵¹³ Finally, the part of the "Great Mole" protruding from the water was at least 50 m wide, with a zone of about 20 m between the sea and the mole's retaining wall to its west and south façade (**Figs.3.12 & 42**).

Towards the east and according to the geological data collected by sondages at the Agora of the Competaliasts (**Fig.3.13**) the ancient shore was 20 to 30 m to the west of the

⁵¹¹ Moretti et al. 2012, Fig.14.

⁵¹² Desruelles & Hasenohr 2018, 42.

⁵¹³ Plans published by Gabriel Leroux in 1909 (Fig.2) and by Desruelles & Hasenohr (2018, Pl.10.1), show a line of what the author describe as a "rock fill" (*enrochement*) marking the end of the harbour. This line does not appear in any other plan of the period nor is reported by Pâris (1916). The recent electric resistivity prospection in the area (Desruelles & Hasenohr 2018, 43) showed no trace of any such structure and it is likely that Leroux misinterpreted the unexcavated walls as a rocky shore or a quay.



Fig.3.14. Aerial photograph of Delos' Northern Harbour (@EFA with names added by the author).



Fig.3.15. Delos' Northern Harbour seen from the north (photograph by the author).

quays.⁵¹⁴ Concerning the Southern Mole its original form can only be reconstructed thanks to the few remains documented by Dardinier (**Fig.3.12**).⁵¹⁵ A narrow strip of beach or rubble probably divided it from the sea. The area enclosed between the quays, the Southern Mole and the latter's extension towards the north probably formed a wide beach, ideal for the beaching or hauling of vessels where most probably where the galley cove was located.

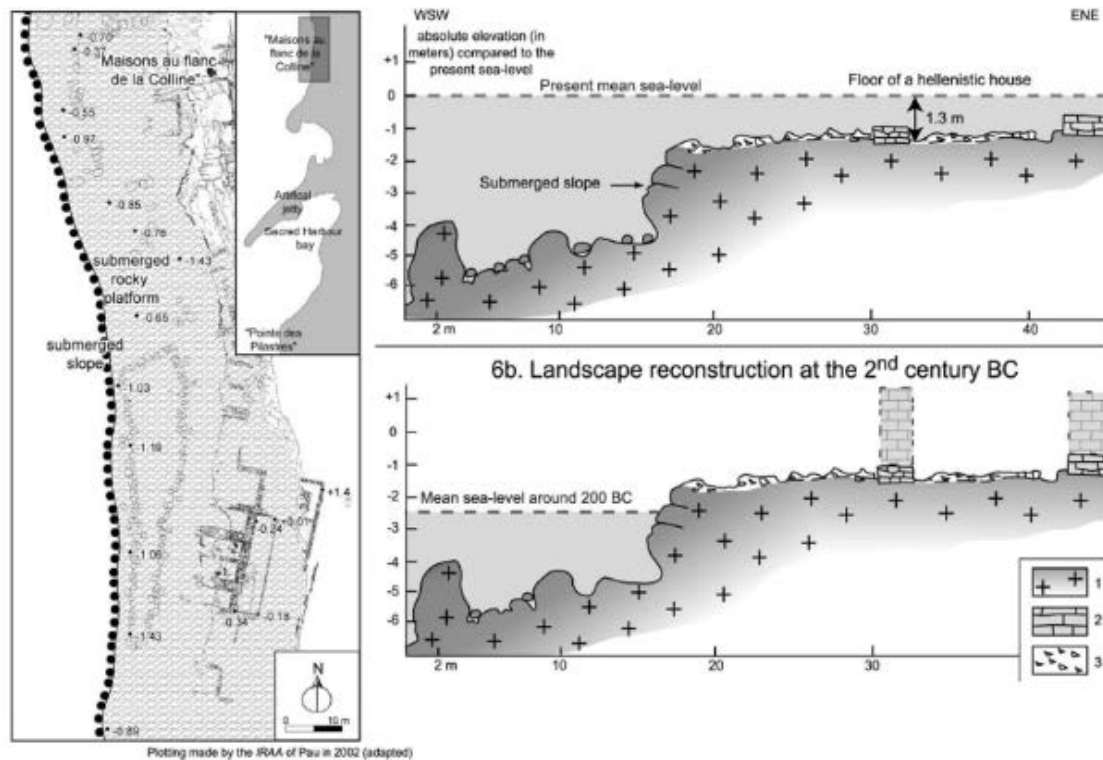
Northern harbour

The area conventionally named Northern Harbour stretches from the "Great Mole" towards the north for approximately 150 m (**Figs.3.14-5**) and was originally a simple open shoreline formed by a natural platform that is today submerged. This feature was 8-9 m wide and in antiquity stood c.1 m above the sea level. The rocky, steep seabed in front of the platform originally had a depth of 2-3 m (**Fig.3.16**). This natural platform had the form of a quay or a promenade, whilst its northern end was reinforced by granite boulders, forming a trapezoidal terrace.⁵¹⁶ The buildings facing the natural quay or esplanade were luxurious houses and the whole area was mainly a habitation zone, compared to the picturesque

⁵¹⁴ Desruelles et al. 2007, Fig.3.

⁵¹⁵ Duchêne et al. 2001, Document VIII.

⁵¹⁶ Duchêne et al. 2001, 67, Doc. XXXV.2, Plan I; Desruelles et al. 2007, 237, Fig.6.



'small Venice' quarter of modern Mykonos, developed around the end of the 2nd century BCE.⁵¹⁷ No breakwater was ever built to shelter the Northern Harbour and no remains of any mooring stones or commercial buildings have been found on the shore.

Merchant harbour

The seafront of this area was dominated not by religious or other official edifices but by large commercial buildings that included a series of warehouses or shops (named “magasins” by the excavators) open towards the sea; it has thus been conventionally named Merchant Harbour.⁵¹⁸ The remains of the seaside buildings are today partly submerged, whilst the shallower part of the seabed is covered with posidonia and rubble (**Figs.3.17-20**).⁵¹⁹ The shore becomes steeper and rockier south of the Dioskourion sanctuary and there are no visible remains of any quays or other buildings on the shore there, although the area was inhabited in antiquity. Two large rectangular buildings stood on most likely reclaimed land at the end of Triarius’ Wall and at the “Pointe des pillastres” (pilaster point; **Fig.3.22**).

⁵¹⁷ Bruneau 1981, 112-6; Duchêne et al. 2001, 73-8, 67; Plans II-III.

⁵¹⁸ Jardé 1906, 644; Karvonis 2008, 200-5; Malmay & Karvonis 2016, 176.

⁵¹⁹ The depth contour line closer to the shore (Pâris 1916, Pl.I-IV) appears somehow distorted but this is most probably due to the presence of the debris from the excavations and is not related to any structure or rock formation (**Fig.3.5**).



Fig.3.17. *The shore of Delos' Merchant Harbour in front of the warehouses of Group ε (photograph by K. Bouras).*

Similar establishments covered the whole coast towards the south, two of which were fully excavated, the “Magasin à la baignoire” and the “Magasin des colonnes”.⁵²⁰ The layout of the coastal buildings of the Merchant Harbour confirms their use as commercial facilities in direct relationship with the seafront.⁵²¹ A narrow (2-3 m wide) quay is preserved, running along nearly the whole shore and constructed of large granite slabs (**Fig.3.20**), next to which a series of conical bollard or marking stones are placed at a distance of 1 m to the west (**Fig.3.21**; Pâris mentions seven lying at various distances).⁵²² Their simple form and lack of any use marks indicates that these were never used for the berthing of ships. The Merchant Harbour is associated with the expansion of the city towards the south after 166 BCE, as excavation data have verified.⁵²³

⁵²⁰ Jardé 1906, 632-64.

⁵²¹ Karvonis 2008, 204; Malmay & Karvonis 2016.

⁵²² Pâris 1916, 38-9.

⁵²³ Duchêne et al. 2001, 104-6; Trümper 2002, 192-6; Karvonis 2008, 167-169. Although initially the whole coastal area of the Theatre Quarter was considered to have been founded on extensive reclamation (Cayeux 1911, Pl.2; Charmonard 1922, 69; Bruneau 1981, 1-7-12, Fig.3), the identification of an archaic building south of the Agora of the Competaliasts (Moretti 1998) showed that reclamation was much more limited, especially in comparison to the extensive quarrying and leveling of the natural bedrock required for the construction of the great southern buildings (Malmay & Karvonis 2016, 169-70).

The Merchant Harbour of Delos during the late Hellenistic period had a very simple



Fig.3.18. Aerial photograph of Delos' Merchant Harbour (©EFA with names added by the author).



Fig.3.19. Plan of Delos' Merchant Harbour as it is today (©EFA).



Fig.3.20. The quays and the possible mooring stones in front of Group ε of the Merchant Harbour warehouses with indications of the warehouses' façade, the quay and the mooring or marking stones (Malmay & Karvonis 2016, Fig.5).



Fig.3.21. Mooring or marking stone from Delos' Merchant Harbour (Duchêne et al. 2001, Pl.LI.1).

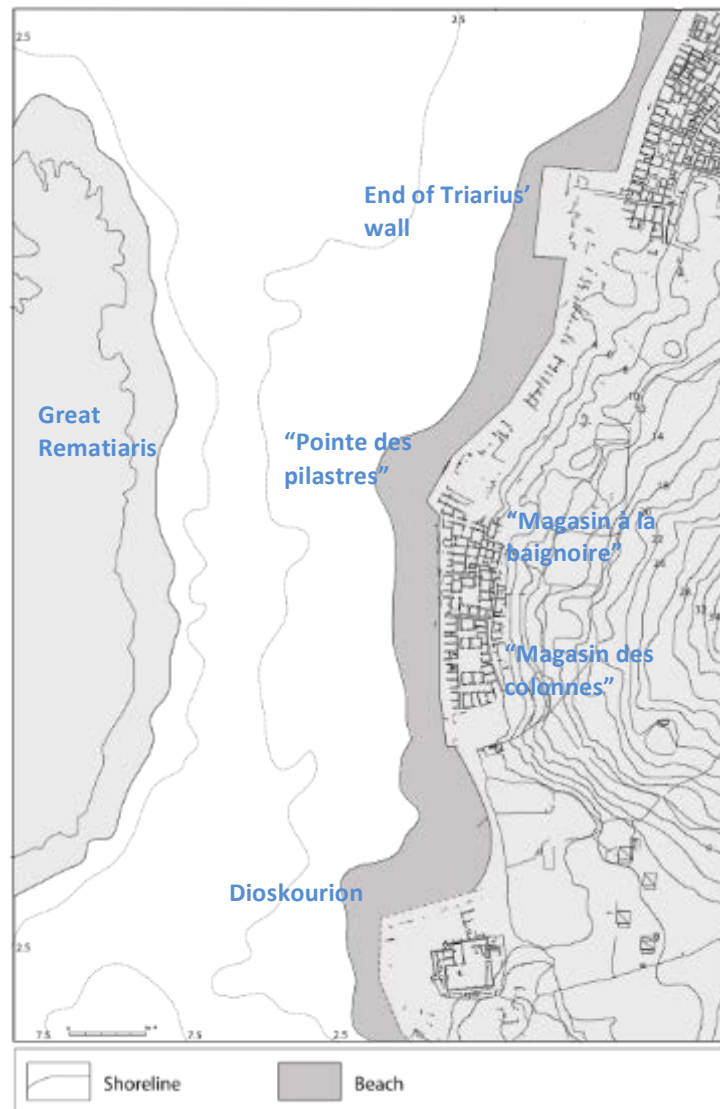


Fig.3.22. *Reconstruction of the form the Merchant Harbour of Delos had during the late Hellenistic period (drawing by the author).*

form, quite similar to its modern one. According to recent geological surveys the harbour was a continuous sandy beach, at least 600 m long and approximately 20 m wide. The quays operated mainly as retaining walls for a road running along the “magasins” on the shore. The beach had a gentle slope towards Great Rematiaris (**Fig.3.22**).⁵²⁴ No further harbour works have been found in the area and, with the possible exception of wooden jetties that have left no traces, it is almost certain that none existed.

⁵²⁴ Desruelles & al. 2007, 237, Fig.7.

Skardanas bay

Skardanas bay is located to the north of the Main and Northern Harbours. It has a width of 185 m and faces northwest (**Fig.3.2**). It is flanked by rocky cliffs and on its east side leads to a small triangular plain, probably a result of inland siltation (**Fig.3.23**). The modern beach is covered by rubble from the collapsed ancient buildings, piled up into a high, steep ridge by the strong wave action (**Fig.3.24**). The rubble slopes down to a depth of c.5 m at a distance of 22 m from the shore in the middle of the bay; beyond that a less steep sandy seabed continues towards the open sea (**Figs.3.24-5**).⁵²⁵ The whole area forms part of the Northern District of Delos, an extension of the city dated in the



Fig.3.23. Skardanas bay from the north (photograph by the author).



Fig.3.24. Aerial photograph of Skardanas bay (©EFA).

last quarter of the 2nd century BCE.⁵²⁶ One single building is located, half-submerged and partly preserved, in the bay's best-protected northern end.⁵²⁷ It is divided into rectangular rooms and preserves what seems to be a quay around it, resembling the commercial buildings of the Merchant Harbour.⁵²⁸ No further harbour work has been identified in the bay.

⁵²⁵ Papageorgiou-Venetas 1981, Fig.84.

⁵²⁶ Bruneau 1968, 670-1.

⁵²⁷ Duchêne et al. 2001, Pl.LVIII-LXIII, Plans VII-VIII; Zarmakoupi & Athanasoula 2017.

⁵²⁸ Pâris 1916, 62; Bruneau 1987, 328; Duchêne et al. 2001, 119-22. The building's walls continue inland and preserve painted stucco decoration, indicating a possible domestic use of at least part of it.



Fig.3.25. Plan of Skardanas bay as it is today (drawing by the author based on Papageorgiou-Venetas 1981, Fig.84 with additions concerning the submerged building from Duchêne et al. 2001, Plan VII-VIII, Plans VII-VIII).

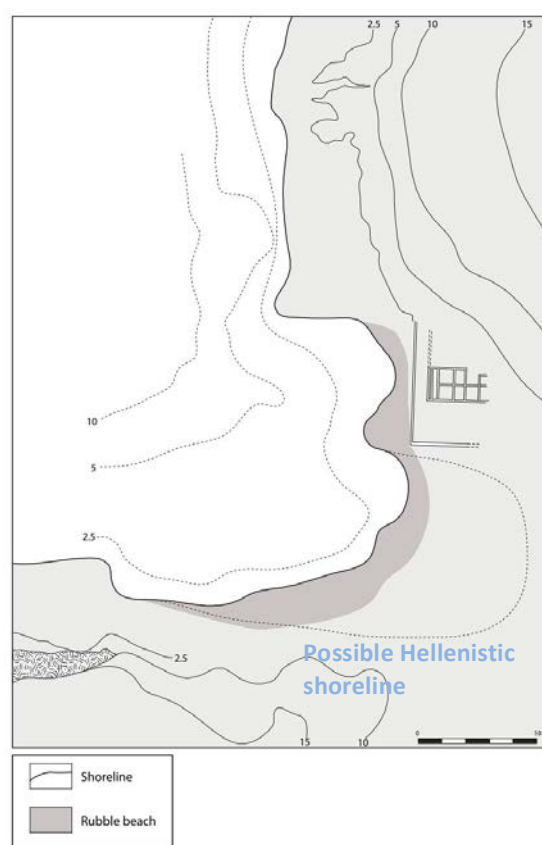


Fig.3.26. Reconstruction of the form Skardanas bay had during the late Hellenistic period. The reconstruction is based on the bathymetric and geographical data provided in Fig.3.25 with a line indicating a possible ancient shoreline extended towards the east (drawing by the author).

The steep rubble ridge of Skardanas has covered the central part of the bay and it is difficult to establish the shore's original course and bathymetry in this area (Fig.3.25). No ancient structure has been located between the modern beach and the "Maison de Skardana" towards the east (Fig.3.26).⁵²⁹ It is thus possible that the ancient coastline was located in this area but this has not yet been confirmed by field research. The centre of the bay had a relatively large depth (up to 5 m) and no substantial sediments or rock formations appear to be present. Finally, according to the bathymetry, a small rocky promontory originally protected the bay from the north.⁵³⁰

⁵²⁹ Bruneau & Ducat 2005, 240.

⁵³⁰ Papageorgiou-Venetas in his plan of Skardanas (1981, Fig.84) reconstructed an artificial protective mole to the north and a long straight quay at its middle. No remains of such structures are visible at all on the coast, nor in aerial photographs (see the photographs available on line by the EFA in <https://sig-delos.efa.gr/index.php?SIG=Delos>).



Fig.3.27. The bay of Gourni seen from the south (photograph by the author).



Fig.3.28. Aerial photograph of Gourni bay (©EFA).

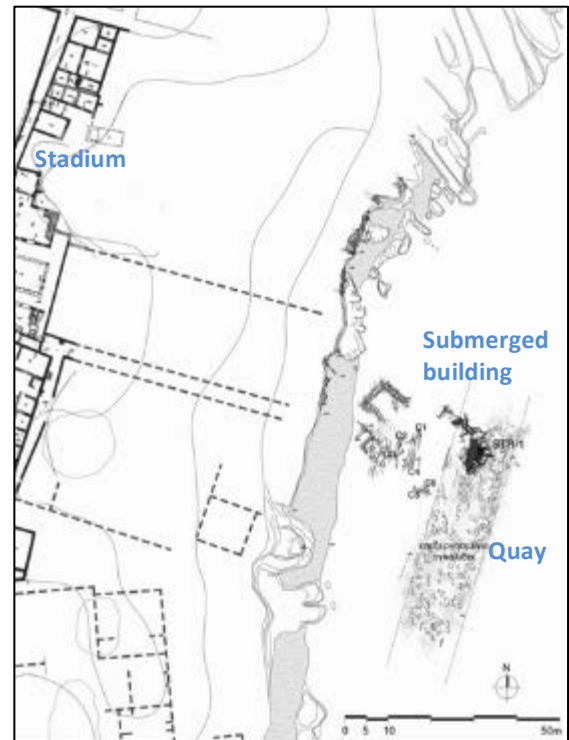


Fig.3.29. Plan of Gourni bay. The plan includes the results of the recent underwater survey of the harbour, including the quay and the submerged building (Zarmakoupi 2015, Fig.132).

Gourna

Gourna bay served as the harbour of the Stadium District (**Fig.3.3**). The area was inhabited most likely just after the extended renovation of the stadium and the construction of the gymnasium in the last decade of the 2nd century BCE and was abandoned after the destructions of 88/69 BCE.⁵³¹ The harbour is a small cove with a natural pebble beach, facing Mykonos towards the east and barely protected by a small rocky promontory to the north (**Figs.3.2 & 27**). The beach is narrow and rock formations disrupt it (**Fig.3.28**).⁵³² The coast is exposed to waves and drift, which have contributed to the

erosion of most ancient shoreline remains. The recent underwater investigation, however, revealed that a wide quay, built with large stone plinths existed there (**Figs.3.28 & 29**): the submerged structure has a width of 15 m and a preserved length of 50 m, but is unfortunately in a bad state of preservation.⁵³³ Immediately to the west the remains of a submerged building are located. Thanks to the discovery of embedded ceramic vessels it has been interpreted either as a tavern, or as a textile dyeing workshop.⁵³⁴ No remains of any commercial buildings have been identified in the surrounding area. It has also been suggested by Bruneau that a series of rectangular structures on the small low Sykia cape to the south belong to ancient lighthouse facilities but the remains are insufficient to confirm this.⁵³⁵

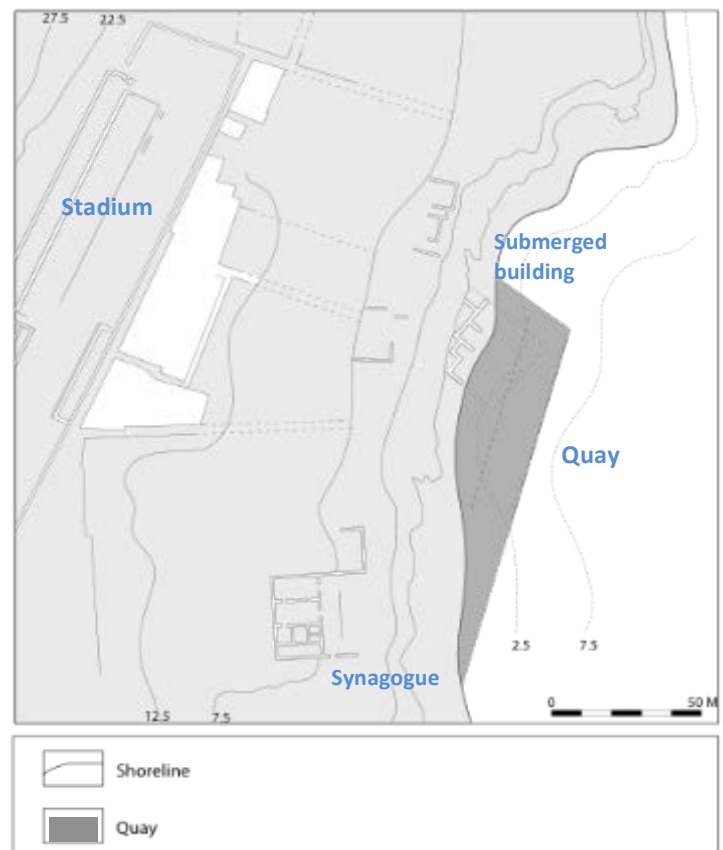


Fig.3.30. Reconstruction of the form Gourna bay had in antiquity. The remains of the quay have been tentatively reconstructed at the structure's northern and southern ends (drawing by the author).

⁵³¹ Zarmakoupi 2013a, 22.

⁵³² Papageorgiou-Venetas 1981, Fig.85.

⁵³³ Zarmakoupi 2015, 124-6; Zarmakoupi & Athanasoula 2018, 98, Fig.10.

⁵³⁴ Zarmakoupi & Athanasoula 2018, 95-7.

⁵³⁵ Bruneau 1979, 102-3; Bresson 2016, 91.

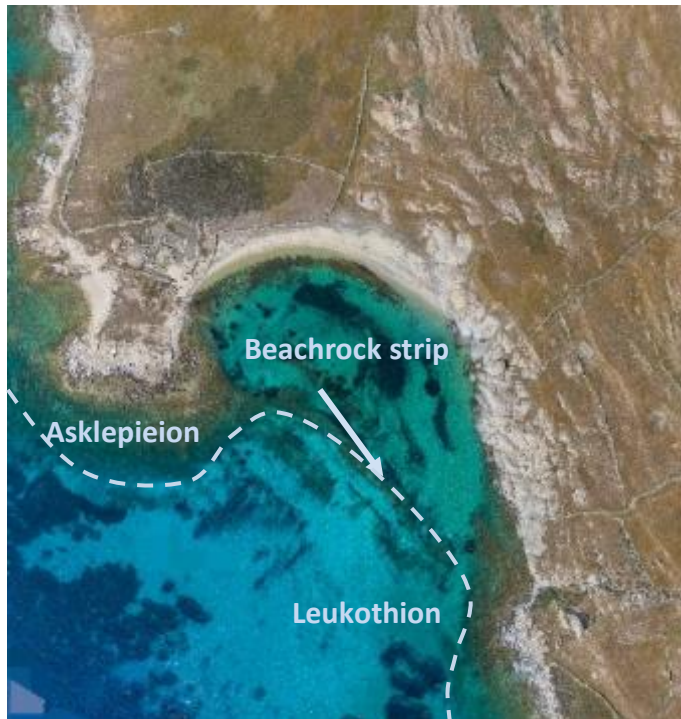


Fig.3.31. Aerial photograph of Fourni bay. The dashed line follows the course of the Hellenistic beach (©EFA with names added by the author).

Gourna presents a very simple configuration concerning its reconstruction. No substantial sedimentation or rubble remains are evident in the exposed and relatively deep bay and, according to aerial photographs (**Fig.3.28**), a large part of the seabed is covered by rock formations and not sand. According to the bathymetry the ancient beach was at a distance of about ten metres to the east of the modern one (**Fig.3.30**). The ashlar quay is well delineated on its seaward façade but not at its northern and southern ends.

According to the bathymetric data of the bay, the quay was founded at a depth of 2-5 m from the ancient sea level.⁵³⁶

Fourni bay

The bay of Fourni is located at the southern end of the Hellenistic city. It faces south-west and measures c.300 x 200 m. A shallow sandy beach extends at the bay's middle (**Fig.3.31**). It is protected from the west by a rocky promontory on which the ancient Asklepieion stood. Another small sanctuary, presumably the Leukothion,⁵³⁷ is located on the opposite shore. No ancient harbour works or other structures have been recorded on land or underwater.⁵³⁸ According to the bathymetry, but also to the presence of a long strip of beachrock,⁵³⁹ the

⁵³⁶ Papageorgiou-Venetas 1981, Fig.85.

⁵³⁷ Robert 1952, 107-19; Fig.38.

⁵³⁸ At the bay's southern side there is deep rock cut on the shore, measuring c.20 x 40 m (Cayeux 1911, 202, Fig.104). The position and dimension of this cut could indicate that it is an ancient slipway, but further research is needed to ascertain whether it is natural or manmade.

⁵³⁹ Beachrock formations were created during periods of geological stability, by the cementation of sandy sediments in the intertidal zone (Dalongeville et al. 2007, 26).

ancient shore was located 70-75 m to the southwest of the modern beach. The depth of the beachrock (2.2-3 m) agrees with the rise of sea level since Classical-Hellenistic times.⁵⁴⁰

Rhenia

The island of Rhenia could have also functioned as an extension of the harbours of Delos, being firmly under the control of the Delians since the 6th century BCE.⁵⁴¹ Located very close to Delos and with many coves and beaches, the island offered various good anchorages, as also indicated by the fact that even today sailing ships often seek shelter there (**Fig.3.1**). Remains of a breakwater with a cylindrical bollard stone or column have been reported by Negrís at the bay south of the Lazaretto peninsula.⁵⁴² The date of these structures remains unfortunately unknown, as well as the extent and type of the settlements on Rhenia and the role Rhenia could have played as a harbour (the archaeological research on the island has focused on its extended cemeteries and Hercules' sanctuary, as well as on the local farms).⁵⁴³ The Delos Underwater Project, which has also included research on the coasts of Rhenia, will hopefully provide more data on the island's harbours.

3.1.3. Ships and cargoes in the harbours of Hellenistic Delos

The thriving commercial centre of Hellenistic and Roman Delos received a large number of ships of various kinds every year. Indirect evidence, such as the series of shipping taxes the local authorities imposed during the period of independence,⁵⁴⁴ the presence of a multitude of foreigners on the island,⁵⁴⁵ the numerous mariners' funeral stelae from Rhenia⁵⁴⁶ and the documentation of Delos as the archetypal port-of-trade of the whole Mediterranean by a

⁵⁴⁰ Kent 1948; Desruelles et al. 2009, Figs.4D & 10.

⁵⁴¹ The tyrant of Samos Polycrates, after taking control of Rhenia, had offered it to the sanctuary of Apollo in Delos and had also symbolically tied the two islands with a chain. See Thuc.3.104.1.

⁵⁴² Negrís 1904b, 344-7, Figs.1 & 2. Cf. Desruelles et al. 2004, 15, Fig.6.

⁵⁴³ Le Dinahet-Couilloud 1974; Charre et al. 1993. The existence of a settlement on Rhenia is attested by Hypereides' in one of his fragments around 340 BCE (F70 Jensen= *BNJ* 401b F5a), which refers to a quarrel over the murder of Aeolian pilgrims somewhere between the two islands; the fragment on the one hand mentions a city (πόλις) but on the other underlines the lack of a harbour and a market on the island.

⁵⁴⁴ Beyond the main tariff on the costs of the merchandize exchanged (the πεντηκοστή, "fiftieth" tax; *IG*, XII, 161A, 26; Vélissaropoulos 1980, 208), harbour taxes included dues on the use of the harbour (τοῦ λιμένος; *ID* 353A, 28; *ID* 354, 25; *IG*, XII, 287A, 39; Homolle 1882, 67), of the capstans (στροφεῖα; *ID* 138B, 8), of the hauling facilities (όλκοι; *ID* 353A, 29-30; *ID* 354, 26, 29) as well as the παραγώγιον ship passage tax (*IG* XII, 163A, 24; Vélissaropoulos 1980, 215). Another due (τῶν αἰρεσίων) was probably related to the use of cranes or of public space for the placement of cargoes (*ID* 353A, 33; *ID* 354, 29; cf. Vial 1984, 231, n.207).

⁵⁴⁵ Hatzfeld 1912; Tréheux 1992.

⁵⁴⁶ Le Dinahet-Couilloud 1974

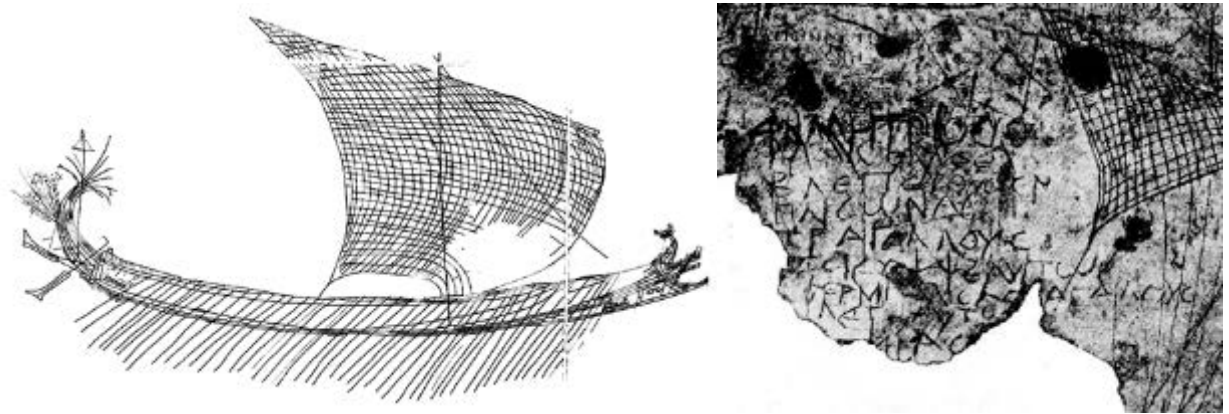


Fig.3.32. Graffiti from the House of Dionysus, Theatre Quarter, Delos. Left: drawing of a galley graffiti (Basch 1987, Fig.739). Right: photograph of a graffiti inscription (Chamonard 1906, Fig.20).

series of ancient authors⁵⁴⁷ clearly paint the picture of a very busy harbour in terms of ship traffic.

But what was the actual number and tonnage of ships visiting the island and using its harbours? Shipwreck finds could provide the most direct information about these ships, but data is for the time being scarce: six ancient shipwrecks have been recently located around the island by the Delos Underwater Project but have not yet been published.⁵⁴⁸ No further finds related to ships, like anchors or sounding weights, have been reported from the seas around the island either.⁵⁴⁹ Ship iconography, despite the importance of seamanship and trade for Hellenistic Delos, is surprisingly poor. Maritime subjects (anchors, tridents, dolphins), illustrating the relationship of the locals with the sea, are common in the mosaics discovered but no image of any ship survives.⁵⁵⁰ The numerous ship graffiti carved on the walls of private and public buildings form a richer, yet problematic source of information (Fig.3.32).⁵⁵¹ They were most probably created by crews and passengers of ships passing Delos and may portray the actual vessels on which they sailed. As graffiti, however, these images are not only subjected to the conventions of pictorial art (see 1.4.3), but they are also impossible to date with precision. The configuration of the ships, especially the galleys (rams, square brailed sails, side rudders, curved sterns forming an ἄφλαστον), as well as the

⁵⁴⁷ Paus.3.23.3–6; Plin.Nat.34.9; Lucilius, *Satires*, cited in Paulus, *ex Festo* 88.4; Cic.Q.Rosc.133. Cf. Zarmakoupi 2013b, §3-4

⁵⁴⁸ Zarmakoupi & Athanasoula 2017.

⁵⁴⁹ The dedication of iron and stone stock anchors in the sanctuary of Apollo has been documented by 2nd-century BCE inscriptions, but none has been found (*ID* 443, Bb 92; *ID* 443, Bb 95; *ID* 1417, A col.I, line 167; cf. Votruba 2014, 87, n.164)

⁵⁵⁰ Déonna 1948, 114-5; Bruneau 1972, 89.

⁵⁵¹ Chamonard 1906, 549-53, Figs.17-20; Basch 1973; Basch 1987, 350, 371-85, Figs. 737-9, 804.

form of the letters carved next to them,⁵⁵² show that they were definitely created in antiquity, but it is impossible to confirm whether that happened before the destructions of 88/69 BCE or afterwards. The number of galleys depicted, as well as the height some of them were carved (about 2 m above the original floors) suggest that they were drawn by the crews of Triarius' naval fleet, who reoccupied the island after 69 BCE and were billeted in the half-destroyed houses, where rubble allowed them to reach high on the walls.⁵⁵³ Merchantmen are also portrayed, but their sketchy rendering does not allow any conclusions to be drawn about the exact type and size of the vessels depicted, nor about their dating.

A series of Hellenistic and Roman funeral stelae reliefs from the cemeteries of Rhenia also preserves various images of ships, related to sailors and marines lost in shipwrecks and sea battles, most of them dating to the late Hellenistic period (**Fig.3.33**).⁵⁵⁴ Both merchantmen and galleys appear. Unfortunately the ships portrayed are too stylised and without rigging in order to fit the limited space of the reliefs, thus offering little information on their actual size and typology.

Inscriptions provide some evidence about the tonnage of ships visiting the island in relationship to donations of grain to the sanctuary and the city (**Table 2.4**): around 250 BCE Dionysos from Byzantium sold 500 μέδιμνοι (20 tons) of grain at a very low price to the Delians and in 179 BCE Massinissa, the king of Numidia, donated 2,900 μέδιμνοι (115 tons) of grain to the sanctuary.⁵⁵⁵ In the first case the quantity of grain corresponds to the cargo of a single vessel of small capacity, much like the Kyrenia ship which sank a few decades earlier⁵⁵⁶ and in the second to a middle capacity ship, both common merchantmen of the period (**Table 2.1**). Nevertheless, these cargoes cannot be representative of the tonnage or the number of ships serving the island at least concerning the import of grain, since they were irregular donations related mostly to diplomacy.

The local consumption of grain could have been an indicator of a minimum number and tonnage of ships that would visit the island annually. The population of Delos is considered to have risen from 9,000 in the early 2nd century BCE to 20,000 inhabitants or

⁵⁵² Chamonard 1906, Fig.20.

⁵⁵³ van Berchem 1962, 313, n.4.

⁵⁵⁴ Le Dinahet-Couilloud 1974, 171-5, 243-54, Pls.65-70.

⁵⁵⁵ *IG* XI.4.627; *ID* 442A 100-105; Reger 1994, 111-6.

⁵⁵⁶ Steffy 1994, 42-59.



Fig.3.33. Late Hellenistic funerary stelae from Rhenia with ship depictions (*La Dinahet-Couilloud* 1974, nos.343 & 357).

even more in the early 1st century BCE,⁵⁵⁷ but there is little evidence to support these numbers. Epigraphic data suggest a more modest number of 6,000 inhabitants before the city's destruction,⁵⁵⁸ although to this unknown numbers of non-permanent inhabitants, enslaved people and foreigners should be added. But even if one takes into account the higher estimates concerning the local population and the scenario that all grain was imported via the sea, no more than 12 ships of medium capacity (160 tons) would be required for the population in the early 2nd century BCE and 26 for the population at the end of the same century (in analogy to the numbers of ships required for the annual provisioning of Classical Athens or Imperial Rome).⁵⁵⁹ Furthermore, it is very unlikely that all grain in Delos was imported. Delos and Rhenia were intensively cultivated during antiquity and so local production could easily cover the largest part, if not all, of the local needs, as argued by Gary Reger.⁵⁶⁰ More grain could have been imported from adjacent islands like Mykonos or

⁵⁵⁷ Le Dinahet-Couilloud 1974, 307-35; Rauh 1993, 27; Reger 1994, 51.

⁵⁵⁸ Zarmakoupi 2018b, 31.

⁵⁵⁹ Isager & Hansen 1975, 62; Brandt 2005, 28-9.

⁵⁶⁰ Reger 1994, 99-101. Cf. Raptopoulos 2014, 40.

Tenos too. The extensive pasturing of animals verified by inscriptions on Delos, Rhenia and Mykonos should be added. Dairy products as well as live animals could be easily imported to Delos from these islands and help the sustenance of the islanders as well as of the pilgrims and travellers.⁵⁶¹ It is unknown whether the island possessed a local fleet for such small-haul trade. Some ships would have naturally been operated by the inhabitants, but beyond the existence of a shipyard, attested by a 209/8 BCE inscription, no further data is provided.⁵⁶² The construction of ships on the small, arid island would have also been difficult, since necessary timber would have to be imported or recycled.

Another type of ship that frequented the harbours of Delos was galleys. The island, thanks to the venerated sanctuary of Apollo, was a clearly ‘demilitarised’ zone⁵⁶³ and there is no reference to any military establishment being built before Triarius’ wall was erected in 69 BCE.⁵⁶⁴ Naval fleets did, however, regularly visit the island for provisioning,⁵⁶⁵ whilst numerous galleys carrying emissaries and offerings sailed there every year during the religious festivals (the *θεωρεΐαι* missions).⁵⁶⁶ Hellenistic galley fleets comprised of ships of every kind, from triremes to ‘eights’ or even larger ships,⁵⁶⁷ but galleys employed in emissary missions like the *θεωρεΐαι* in Delos were generally smaller vessels like triremes and, at least in the case of Athens in the 4th century BCE, a small triakonter (30-oared ship).⁵⁶⁸ Despite the fact that galleys could not carry any substantial commercial cargo, they played a vital role in the operation of the harbour, on the one hand as parts of politically important religious and diplomatic missions and on the other thanks to their large crews. The presence of hundreds of sailors, oarsmen and marines on the island (a Hellenistic galley crew could number up to 500),⁵⁶⁹ in need of provisioning, recreation, rest and pilgrimage would be highly beneficial for the local markets and business, as well as for the sanctuary, especially since all

⁵⁶¹ The accounts of the *hieropoioi* mention the leasing of sheep, cow and pig sheds to individuals, as well as the operation of private pasturing estates (*IG*, XI.2 287A 143-74; *IG*, XI.2 154A 41; *ID* 452 & *ID* 467). There is also a mention to the right to pasture for the area of the Isthmos of Mykonos (*ID* 353A 28-36). Cf. Constantakopoulou 2017, 171-81; 2020.

⁵⁶² *ID* 363, 1.41; Duchène et al. 2001, 143.

⁵⁶³ Reger 1994, 28. “Delos was then a Greek market, and seemed to offer security to traders on account of the god; but as the place was unfortified and the inhabitants unarmed, Menophanes, an officer of Mithridates, attacked it with a fleet, to show his contempt for the god, or acting on the orders of Mithridates” (Paus.2.23.3).

⁵⁶⁴ Reger 1994, 26-9; Maillot & Fincker 2015-16.

⁵⁶⁵ Duchène et al. 2001, 154-5.

⁵⁶⁶ Déonna 1948, 119-20.

⁵⁶⁷ Casson 1971, 97-147; Morrison & Coates 1996, 255-77.

⁵⁶⁸ Jordan 1975, 160-1.

⁵⁶⁹ Morrison & Coates 1996, Appendix D.

crewmembers were free men receiving proper salaries that they could be spent on goods, services, or offerings to the gods.⁵⁷⁰ The visit of naval fleets remained, however, with the exception of the more regular *θεωρείαι* missions, uneven and depended on the occasional warfare and troop movement in the Aegean.

Concerning the types of cargoes that reached the harbours of Delos, the proverb documented by Strabo *ἔμπορε, κατάπλευσον, ἐξελοῦ, πάντα πέπραται* (*merchant, sail in, unload your ship, everything has been sold*)⁵⁷¹ illustrates the great demand for merchandize of all types in the local market, which guaranteed that goods were sold as soon as they reached the island. One of the main bulk cargoes exchanged was grain. Apart from the grain imported to cover the local needs (see above) Delos became the main centre for grain trade, especially after the establishment of the *ἀτέλεια* tax exemption in 166 BCE, as attested by the sanctuary's inscriptions.⁵⁷² Other victuals were also exchanged, as the large number of imported merchant amphorae indicates. The variety of forms and provenances (both from the East as well as from the West) reflects also the cosmopolitan character of the local market.⁵⁷³ It is, however, unlikely that all the bulk cargoes arriving at Delos were fully unloaded to be sold. The island never acquired the extensive storage facilities of other important harbours like Roman Ostia and Portus,⁵⁷⁴ whereas the numerous commercial spaces scattered all around the urban fabric of Delos had multiple functions as shops, storage spaces or workshops, their roles often alternating, especially during the last years of the Delian prosperity.⁵⁷⁵ The island has been compared to modern London or Hong Kong by Duchêne and Zarmakoupi,⁵⁷⁶ due to its operation not as a merchandize depot but as an *entrepôt* where bulk goods were sold in its markets but were not unloaded or stored there. Transferring only part of the cargo, the *δείγμα* or 'sample', for exhibition and inspection on

⁵⁷⁰ Both the demilitarized character of Delo and the importance of galley crews for the local economy are shown in an incident reported by Livy (44.29.1-2): during the First Macedonian War (214-205 BCE) three Roman quinqueremes arrived in Delos where they met with forty enemy Macedonian vessels (most likely light galleys) and five quinqueremes from Pergamon. Due to the sanctity of the island the numerous crewmembers "went about together in the city and the temple in the peaceful security of a locality sacred and inviolate". On the beneficial or detrimental role of military troops in local economies of the Hellenistic period see Reger 2007, 478-9.

⁵⁷¹ Str.14.5.2.

⁵⁷² IG, XI, 4, 1055 & 1025; IG, XI, 4, 666; IG, XI, 4, 627; cf. Durrbach 1921, nos.46, 4, 50; Larsen 1938, 350-1; Reger 1994, 116-26.

⁵⁷³ Grace 1952; Empereur 1983; Raptopoulos 2014, 41-51.

⁵⁷⁴ Keay 2010, 13; Zarmakoupi 2013b, §7.

⁵⁷⁵ Karvonis 2008; Zarmakoupi 2018a; 2018b, 35-6

⁵⁷⁶ Duchêne 1993, 125; Zarmakoupi 2013b, §7; 2018b, 33-4.

land was common in ancient Greece and this was probably the case in Delos too.⁵⁷⁷ On one occasion the practice of selling wood on ships has been documented by a 3rd-century BCE inscription, but inscriptions remain generally tacit on this subject.⁵⁷⁸

A more complicated 'cargo' was enslaved people. Strabo's report of 10,000 of them auctioned every day on Delos, although most probably an exaggeration,⁵⁷⁹ underlines the importance of this trade for the prosperity of the island. Delos lacks, however, any infrastructures to house large numbers of enslaved people inevitably arriving from the sea.⁵⁸⁰ This leads to the conclusion that they remained on board the ships that brought them there and were transported by boat in small groups to be swiftly auctioned (most likely in the *κύκλος* auctioning establishment in the Agora of Theophrastos) and then returned to the ships.⁵⁸¹ Security must have been an issue, but there were few places for the fugitives to hide on the small island and escape through the sea was nearly impossible.⁵⁸²

Another important cargo handled in the harbours of Delos was construction material. Although a large part of the needs of the sanctuary, as well as of the developing city, was covered by the local stone sources, wood and high-quality marble, the latter necessary for the embellishment of monuments and the local sculpture workshops, had to be imported.⁵⁸³ Inscriptions testify the presence of members of the Roman stone merchant family of the Cossutii on Delos, who could reasonably have been active in the provisioning of marble for the island too.⁵⁸⁴ Delian marble was also quarried and used locally, but there is no evidence for any export, probably due to its small quantity and mediocre quality.⁵⁸⁵ A single marble quarry has been located at the island's eastern shore (**Fig.3.2**).⁵⁸⁶

⁵⁷⁷ Bresson 2016, 309-13. Alain Bresson has also argued, based on few written sources, on the operation of another type of *δείγμα* practice, in which all cargoes were unloaded, evaluated and exhibited for selling, with taxes paid both for the cargo arriving as well as for the unsold cargo returning to the ship (Bresson 2008, 101-5; Arnaud 2011b, 67). Even, however, if such a practice was common in at least some of the Hellenistic and Roman harbours of the Aegean, there is no evidence to support its use in any of the case study harbours.

⁵⁷⁸ *ID* 509; Larsen 1938, 352-3. The term *δείγμα* as a practice or as a market space is not documented in any Delian inscription, although several suggestions have been made for its possible location (Vallois 1944, 65-6).

⁵⁷⁹ "Delos was at no great distance, a large and rich market, capable of receiving and transporting, when sold, the same day, ten thousand slaves" (Str.14.5.2). Cf. Scheidel 1996.

⁵⁸⁰ Trümper 2009, 34-9.

⁵⁸¹ Zarmakoupi 2018b, 34.

⁵⁸² Only one revolt of enslaved people is reported for Delos around the end of the 2nd century BCE. According to Diodorus Siculus (34.19) the revolt was swiftly and violently oppressed by the local inhabitants.

⁵⁸³ Meiggs 1982, 352-3; Karvonis 2008, 174-5, 209-10.

⁵⁸⁴ *ID* 1738; *ID* 1739; *IG* XII.5.1049; Roussel & Launey 1937, no.1738-9, 1767; Russell 2013a, 205.

⁵⁸⁵ Cayeux 1911, 10, 82, Fig.57; Vallois 1944, 8-9.

⁵⁸⁶ Fraisse & Koželj 1991.

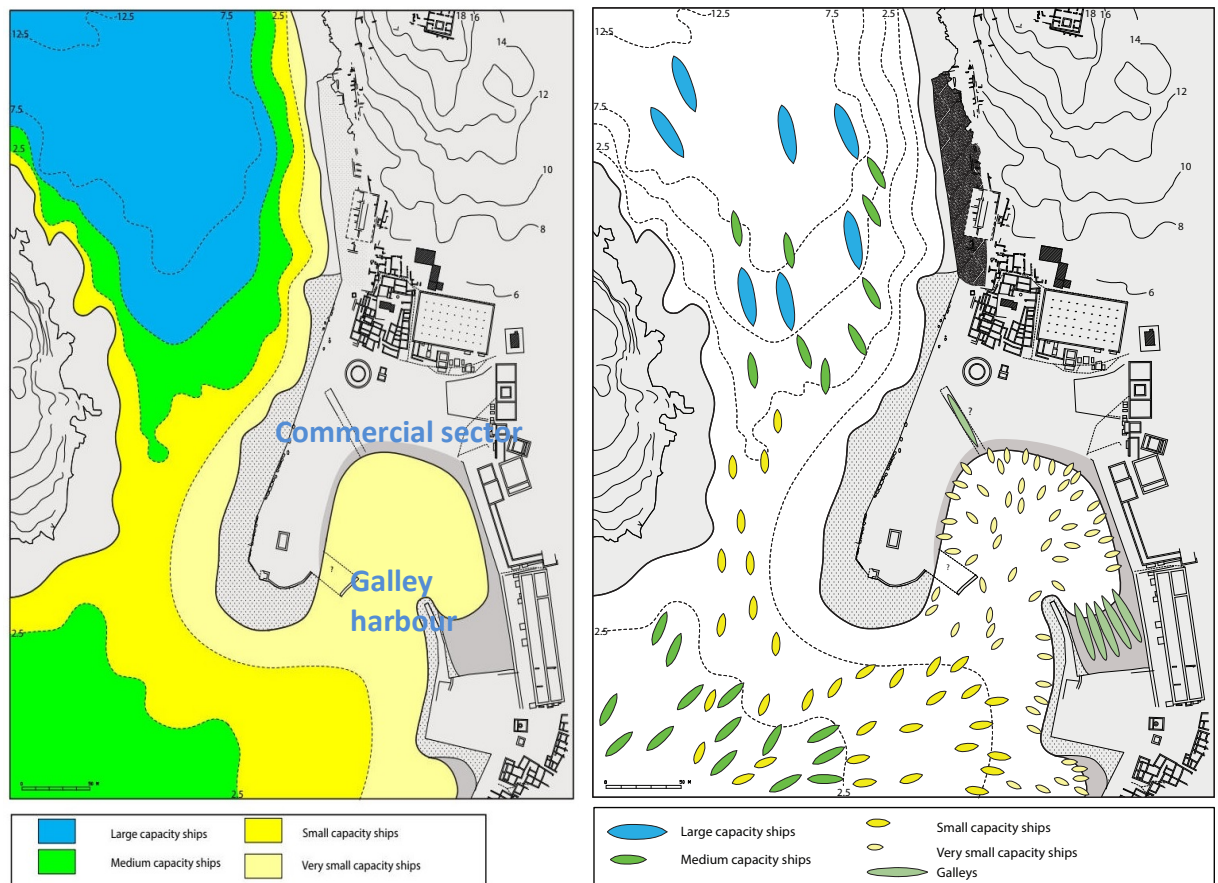


Fig.6.34. Reconstruction of the use of Delos' Main and Northern Harbours according to the draught (left) and the estimated number (right) of ships and the harbour's depth. The contour line closer to the shore marks the area approachable by very small capacity ships and it has been tentatively reconstructed (drawing by the author).

Finally, the local workshops produced and exported a variety of goods. Archaeological finds and written evidence confirm the production of purple-dye, perfumes, marble and bronze sculptures, bronze vessels, glass, furniture, musical instruments, and terracotta figurines.⁵⁸⁷ Local products were luxurious and expensive and thus important for the local economy, but they were not bulk goods and could be easily transported as secondary cargoes amongst the main cargoes of the merchantmen of the period.⁵⁸⁸

3.1.4. The capacity and operation of the harbours

Delos was served by a series of harbours or anchorages, operating in parallel with each other. Each harbour presented a different configuration, had a different capacity and use

⁵⁸⁷ Pliny (*Nat.*34.9) and Cicero (*S.Rosc.*133) praise the quality of Delian bronzes. On the various local workshops and industries discovered during excavations see Rauh 1993, 44-68, Brunet 1998, Karvonis 2008 and Zarmakoupi 2013b, n.7.

⁵⁸⁸ Zarmakoupi 2018b, 36.

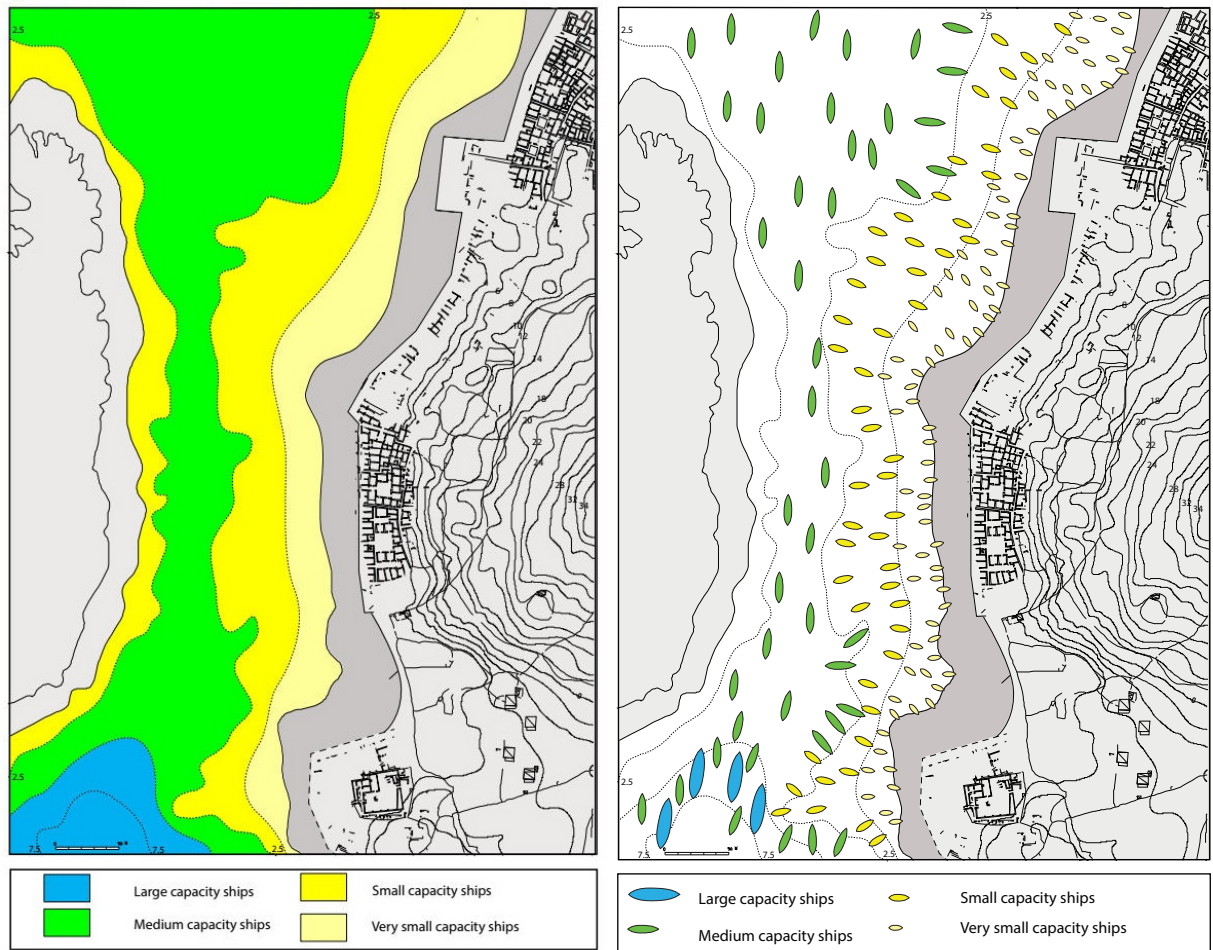


Fig.3.35. Reconstruction of the use of Delos' Merchant Harbour according to the draught (left) and the estimated number (right) of ships and the harbour's depth (drawing by the author).

and was served not only the island in general but also the different districts of the prosperous Hellenistic city.

Ship capacity and methods of using the harbours

Delos' only enclosed anchorage, the Main Harbour, originally covered an area of 1,500 to 2,000 m². According to the minimum space ships of different sizes would take (see **Table 2.2**), the harbour could be used by 3-7 ships of great capacity, 6-12 ships of medium capacity, 8-28 ships of small capacity or 23-125 ships of very small capacity (not simultaneously). But these numbers are misleading for the simple reason that the depth of the harbour's basin was not adequate to allow every ship to enter (**Fig.3.34**). Due to the presence of the crystalline basement rock, the basin could have hardly been deeper than 1 m at its centre, becoming even shallower along the sandy coast (see **3.1.1-2**). Therefore, only ships of very small capacity could enter it and even they could not approach the quays, which stood much higher than the ancient sea level and were divided from them by a zone

or earth, sand or rubble. It is much more reasonable to suggest that a maximum of about 40 very small capacity ships could operate within the Main Harbour without obstructing each other's movement. Galleys, especially the lighter procession vessels of the *θεωρίαι* missions, like the triakonter employed by the Athenians,⁵⁸⁹ could easily enter the harbour and approach the coast, although, due to their length, they required more space for manoeuvres and this is why part of the harbour was demarcated as the "galley cove", probably located at the harbour's southern half. 4-5 regular galleys of the period (triremes, 'fours' or 'fives') could fit in the cove of the galley harbour (see below **3.1.5**).

The Northern Harbour was much deeper than the Main Harbour and theoretically allowed even ships of medium capacity to approach its long, natural quay and berth directly onto it (**Figs.3.16 & 34**).⁵⁹⁰ A maximum of 12 ships of medium capacity, 20 ships of small capacity or 35 ships of very small capacity could berth stem-first on the rocky natural quay. Nonetheless, the quay was totally exposed to the northern winds and currents and it is unlikely that a beach was located there in antiquity, with nothing to prevent sand shifting by the strong waves and shore drift. It is therefore not surprising that no mooring stones or storage facilities were found on the coast. Thanks to the depth of the sea and the steepness of the seabed ships of even large capacity could anchor very close to the rocky shore, but if their anchor cables were severed, they would drift in the shallows between the "Great Mole" and Small Rematiaris or crash on the rocky platform or on the rubble jetty to the south, as Aelius Aristides eloquently describes in the account of his adventures on Delos.⁵⁹¹ The existence of the platform was neither favourable for lighters, which were equally exposed to the strong winds and could not take advantage of a beach to be hauled onto. Any possible use of the harbour would thus have to be done in very calm weather but it is unlikely that any cargoes would be handled there.

The Merchant Harbour was the largest harbour of Delos (**Fig.3.35**). The long and wide beach stretching between the Agora of the Competaliasts and the Dioskourion was protected from the northern and western winds and swell by the moles of the Main Harbour and by the two islets and it remains until today a relatively calm area. The channel between Great Rematiaris and Delos was narrower (150-250 m) in antiquity and covered an area of

⁵⁸⁹ Jordan 1975, 160-1.

⁵⁹⁰ Desruelles et al. 2007, Fig.6.

⁵⁹¹ "...other ships in the harbour were thrown on land and other fell against each other and crashed" (Ael.Ar. Sacred *Tales* D.32; translated by the author).

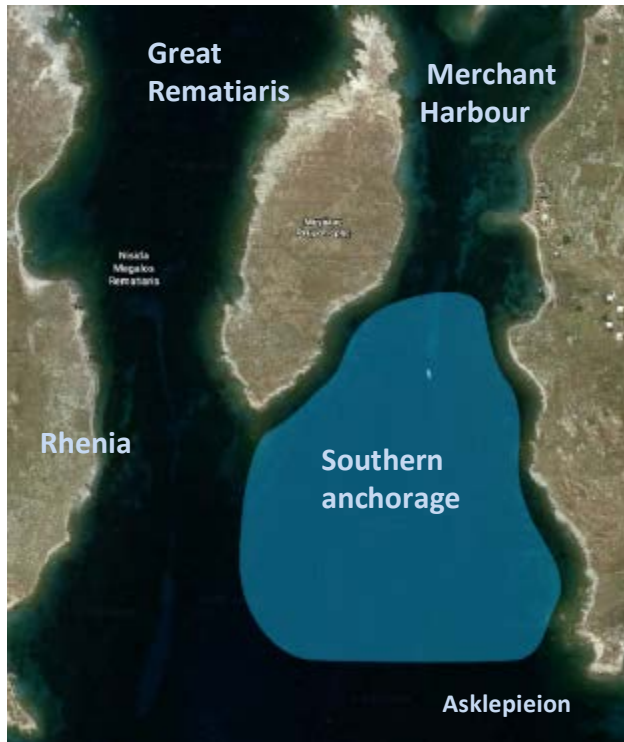


Fig.3.36. The estimated extent of Delos Merchant Harbour's Southern Anchorage (source of photograph: Google Earth).

7,000 m². It had a maximum depth of only 3 m, which meant that no ships of large capacity could enter it. Ships of medium capacity could approach the coast at a distance of about 30-50 m and ships of small capacity at a distance of 20 m (**Fig.3.40**). According to the harbour's dimensions, 25-56 ships of medium capacity, 40-100 ships of small capacity and 111-437 ships of very small capacity could be accommodated there. These numbers, as in the case of the Main Harbour, correspond to a theoretical maximum capacity of the harbour area and much fewer ships would be able to

use this area, especially due to the need to allow the movement along the harbours and anchorages of the western coast. More realistic numbers would have thus been 15 ships of medium, 30 ships of small and 100 ships of very small capacity using the harbour at the same time. Ships would also need to keep a safety distance from the rocky shore of Great Rematiaris islet.

The Merchant Harbour was easily approachable from the southern half of the channel between Rhenia and Delos, an area that also the old nautical maps of Delos and Rhenia indicate as a good anchorage.⁵⁹² The whole area, that can be considered a part or an annexe of the Merchant Harbour, covers a space of 175,000 m² (from Great Rematiaris to the southernmost ends of Delos and Rhenia), but most probably only the best protected, north-eastern part of it was used, covering 23,000 m² from Rematiaris to the Asklepieion peninsula (**Fig.3.36**). This area gave ships of every size ample depth and space to anchor and manoeuvre and easily sail away towards the south by taking advantage of the prevailing northern winds: 38-82 ships of great, 85-184 ships of medium, 131-368 ships of small and 365-1,437 ships of very small capacity could be accommodated there. Thanks to the depth of

⁵⁹² Gallois 1910, Figs.26, 28-31, 38.

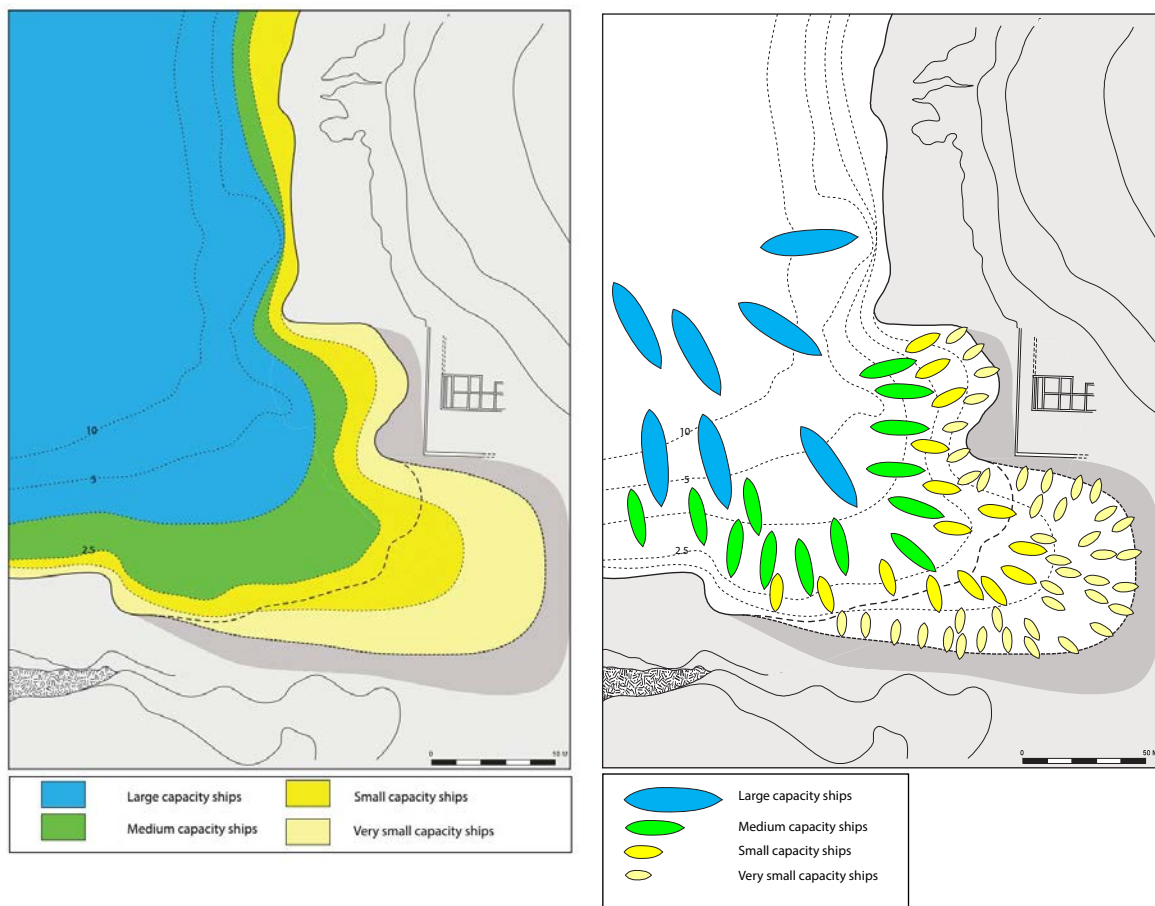


Fig.3.37. Reconstruction of the use of Skardanas harbour according to the draught (left) and estimated number of ships (right) and the harbour's depth. The depth contours and the limit of the shore at the bay's centre have been tentatively reconstructed (drawing by the author).

the sea and the availability of space, such large numbers of ships could easily anchor there, although it very unlikely that so many ships were ever present in Delos simultaneously. A considerable drawback of the anchorage for the long-term sheltering of vessels was that in case of a southern wind there was not an equally large anchorage to shelter the ships from the area. In such case ships would probably have to disperse in various smaller anchorages of Delos and possibly of Rhenia too.

Skardanas was a small harbour and covered an area of about 1,000 m² but in contrast to the Main Harbour large part of the bay originally had a depth of more than 2 m and allowed space for about 5 medium or 2-4 large capacity ships (**Fig.3.37**). As for the harbour's eastern side, it most probably consisted of a sandy beach (now covered by the rubble ridge), which allowed lighters and other small ships to approach it and beach themselves on it, unloading their cargoes there. The bay had a serious disadvantage: it remained totally exposed to the prevailing winds, with no natural or human-made features to sufficiently protect it, apart from the small northern promontory that could only partly protect the bay

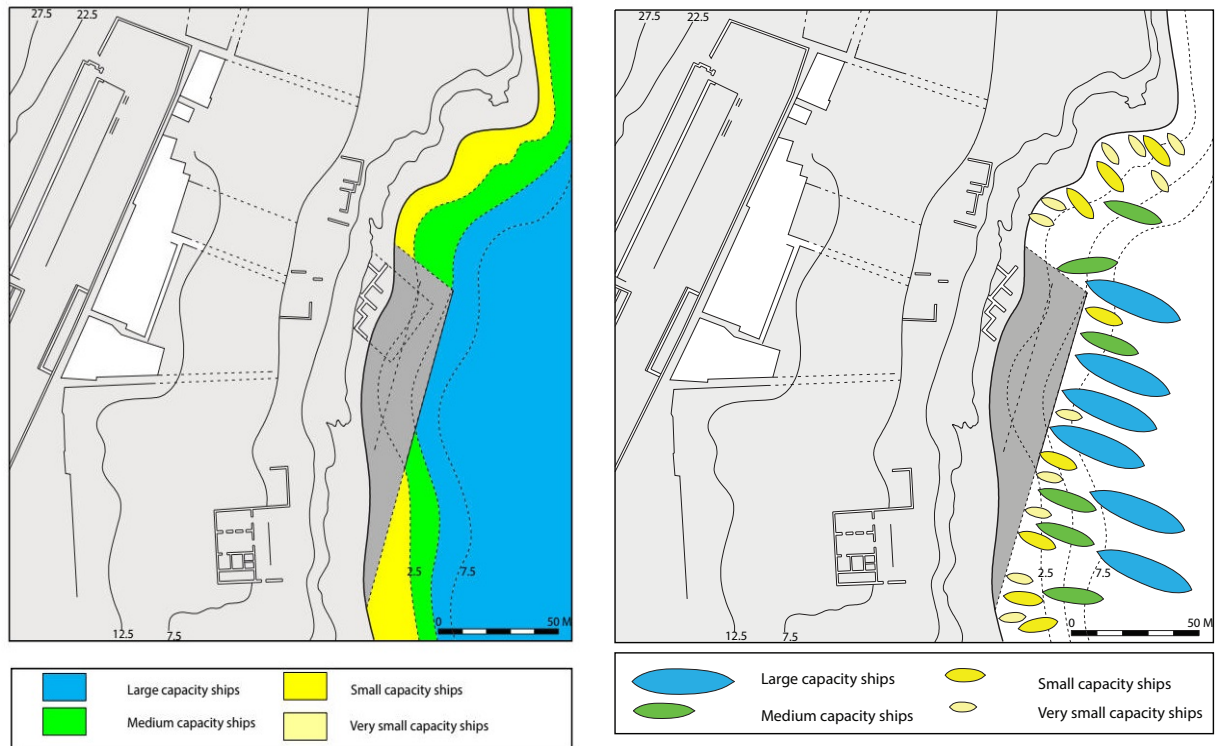


Fig.3.38. Reconstruction of the use of Gourni harbour according to the draught (left) and estimated number (right) of ships and the harbour's depth (drawing by the author).

from that direction. Thanks to the bay's depth and according to the refraction principle, waves would easily rise high and crash on the shore without anything to stop them. Nevertheless, the construction of the building at the bay's most protected north-east corner shows that it was used at least as an auxiliary or district harbour when conditions were favourable.⁵⁹³ Ships could anchor there until their cargoes or parts of their cargoes were unloaded and then seek shelter in the Merchant Harbour and in the spacious Southern Anchorage. Had the ancient beach been further to the east, as suggested in **Fig.3.37**, that would give more space for ships of very small capacity, but it is doubtful whether it could increase the capacity of the harbour concerning small and medium capacity ships. Skardanas could have functioned as a regional harbour too, facilitating the commerce and provisioning of the Northern District, one of the richest urban districts of Delos, as attested by the luxurious houses excavated nearby.⁵⁹⁴

Gourni was another deep, open harbour and offered ample space for the approach and anchoring of various ships (**Fig.3.38**). Provided the ancient shoreline was similar to the modern one, a 75-m long beach stretched there (at least before the construction of the

⁵⁹³ Zarmakoupi & Athanassoula 2017.

⁵⁹⁴ Bruneau et al. 1970; Siebert 2001; Zarmakoupi 2013b, §17.

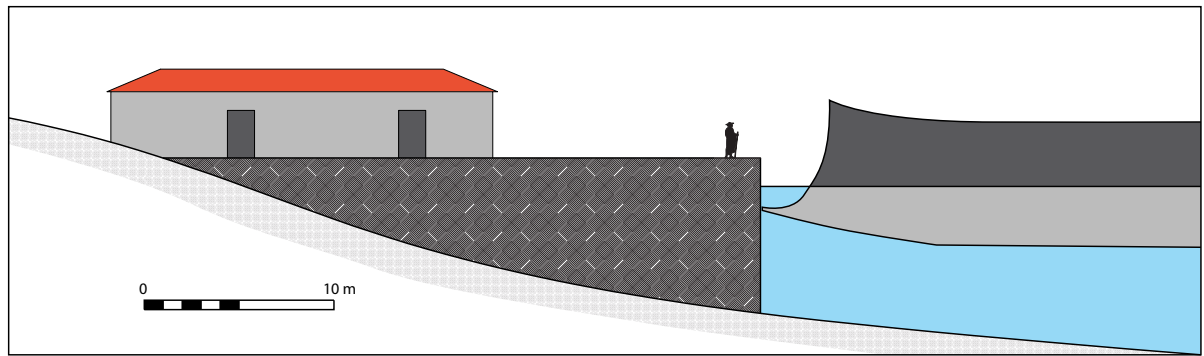


Fig.3.39. Conjectural reconstruction of the Gourná quay at Delos, based on the latest underwater finds (drawing by the author).

quay), which would offer space for about 7 large capacity ships, 10 medium capacity ships, 15 small capacity ships or 18 very small capacity ships. Only ships of small capacity, of course, would be able to come very close to the shore. The steep shore and narrow beach would hardly leave enough space for hauling anything more than lighters out of the water. Due to the absence of any enclosure towards the east and the sea's adequate depth, the number of ships that could anchor at Gourná cannot be determined. Being an open anchorage, it presented fewer problems concerning ship movement and handling, but it remained an exposed bay and ships would have needed to keep a distance from the predominantly rocky coast. A unique characteristic of the site was however the stone quay. The 50-m long structure, according to the data supplied by the recent underwater investigations (**Fig.3.30**) and the depth of the sea in front of it,⁵⁹⁵ could accommodate 4-5 ships of large capacity, 6 ships of medium capacity, 10 ships of small capacity or 12 ships of very small capacity, berthed stem-first (**Fig.3.38**).

The last harbour or, more precisely, anchorage of Delos was Fourni bay (**Fig.3.31**). The sandy cove was probably not one of Delos' commercial harbours, since the city never expanded much towards the south and there are no remains of any harbour installations or commercial buildings there. Nevertheless, fishing boats and lighters could have easily used the bay, which offered beaching space for 40-50 ships of very small capacity.⁵⁹⁶

⁵⁹⁵ Papageorgiou-Venetas 1981, Fig.85; Duchêne et al. 2001, Doc.VI; Zarmakoupi & Athanasoula 2018, Fig.1

⁵⁹⁶ Christy Constantakopoulou (2017, 76) has reasonably suggested that the bay could have operated as a departing point for boats carrying the women about to give birth or the people about to die to Rhenia, according to the strict law that no birth or death should take place on the Apollo's island, especially considering that the bay is just next to the Asklepieion sanctuary. This remains, however, a hypothesis, since there is no evidence to support it.

Considering the methods that could be employed by ships in the harbours of Delos, it appears that docking was not a common one. As already noted, all types of quay structures, with the exception of the Gournas quay, were originally erected on dry land and were separated from the water by a zone of rubble, rock or beach, preventing any ship from berthing directly on them (**Fig.3.13**). Wooden quays and jetties could have been very helpful, but there is no archaeological or written evidence of their existence in Delos. The lack of timber on the arid island could explain this although large amounts of wood were being imported to Delos to be used in buildings and they could as well have been used or reused for harbour works and shipyard slipways.⁵⁹⁷ Docking at a distance from the quays could have also been employed, but no mooring stone has been found in situ in the harbours of the island and it is very unlikely that both the cylindrical boundary stones with the rectangular sockets discovered in the Main Harbour (**Fig.3.45**) or the stones placed in a row along the beach of the Merchant Harbour were used as such (**Fig.3.21**). In both cases these stones lack any wear marks or proper holes for the attachment of ropes. In the case of the Main Harbour the association of the stones with boundary inscriptions, the sockets and their location at the harbour's southern cove suggests a use as fencing stones delineating the galley harbour (see below **3.1.5**). In the case of the Merchant Harbour it appears they most likely served to mark the spaces allocated for specific merchants, lighters or cargoes on the beach and not to attach ships.⁵⁹⁸

The Gournas quay remains the only harbour structure, which allowed the berthing of ships of even large capacity (**Figs.3.38 & 39**). The greatest problem there, however, was the exposure of the harbour to the open sea. Even if ships of considerable size could dock on the stone quay, they remained unprotected from the drift, waves and abrupt changes of the weather conditions of the Cyclades. Therefore, it seems much more plausible that the Gournas quay served for the swift loading and unloading of vessels, as well as for their provisioning and not for their long-term berthing.⁵⁹⁹ Ships would most likely cast their anchors in the open and be ready to move to more protected nearby areas or even other islands (Rhenia, Mykonos) if conditions became unfavourable.

⁵⁹⁷ Meiggs 1982, 352-3; Blackman 2008b, 649.

⁵⁹⁸ Malmay & Karvoni 2016, 170.

⁵⁹⁹ Zarmakoupi 2015, 126.

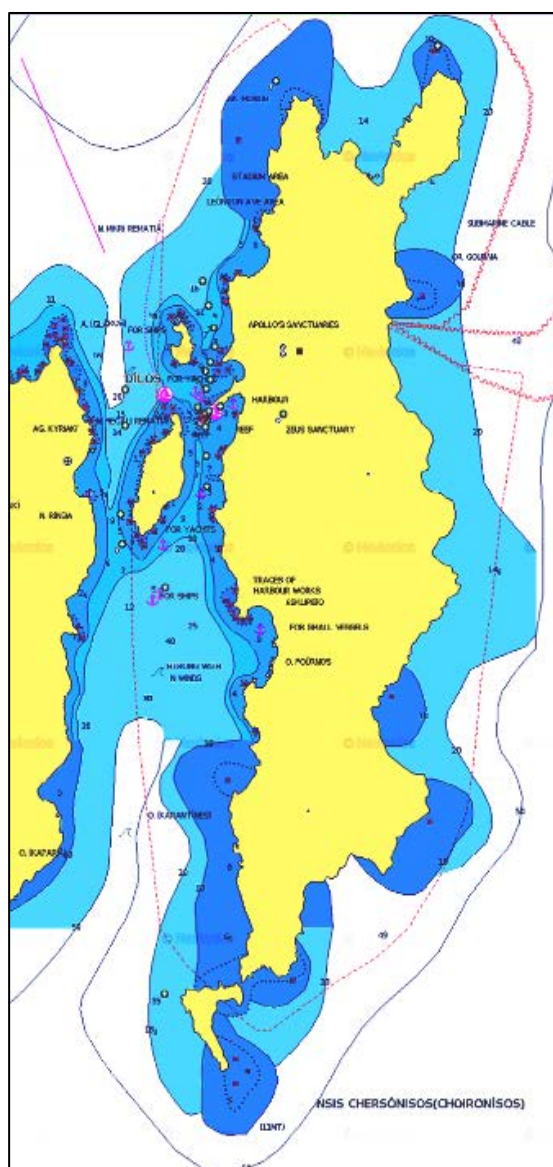


Fig.3.40. Modern nautical map of Delos (webapp.navionics.com).

The seas around Delos were generally ideal for anchoring and this was most probably the method most used by most ancient ship commanders. The sea is deep enough, whereas there is no indication that dangerous reefs and shoals were located beyond specific areas near the coasts in antiquity too (mainly Cheronnisi to the south or the Kako Akrotiri to the south; **Fig.3.40**). The best area for anchoring would naturally be the Main Harbour, thanks to the protection offered by the two moles, but its small depth made it unapproachable for the seagoing vessels of the time, as already discussed, whilst its small size would the handling of even small capacity vessels tedious. The safest and most spacious location for ships to anchor would have been the Southern Anchorage, an area preferred by sailing ships even today (**Figs.3.36 & 40**). This area not only offered ample space and depth of the anchoring of great numbers of ships of every kind but was also easily approachable by

lighters from the beaches of the Merchant Harbour, Fourni and Rhenia (**Fig.3.1**). Anchoring would have also been practiced in the other harbours of Delos. Skardanas offered enough depth for large and medium capacity ships, as well as a low shore on which lighters could make their landing and transport merchandize into commercial buildings, like the one located at the bay's northern side (**Fig.3.26**). What Skardanas lacked was any protection against the prevailing winds and currents, which the bay directly faced and which could be disastrous for the ships stationed there, especially when anchored close to the rocky shores. The same probably happened in Gournas, with the difference that ships could have waited for calm days, swiftly unload their cargoes directly on the quay and then move to more



Fig.3.41. The beaches used by the ancient harbours of Delos (source: Google Earth with shaded areas and names added by the author).

convenient anchorages. This “selective coastal tramping”, as described by Zarmakoupi,⁶⁰⁰ i.e. the relocation of ships between various anchorages according to the weather and the needs of each ship and cargo, must have therefore been common in the handling of ships in Hellenistic Delos. As we saw in **Chapter 2**, the ships of the period were well equipped and their crews agile enough in order to tackle diverse

winds and to make the best out of every friendly or hostile coastal environment. The operation of different anchorages by a ‘merchant-friendly’ harbour city like Delos would allow ships both to approach it from different directions as well as to shelter themselves from the unstable winds of the Aegean.⁶⁰¹

Delos offered many sandy shores for ships to successfully employ beaching, many easily accessible by the city’s urban fabric and commercial infrastructure (**Fig.3.41**). The Main Harbour was ideal for beaching ships of very small capacity thanks to the sand accumulated there. The “Great Mole” could not serve beaching mainly because of the rubble used for its construction (**Fig.3.42**). Most of the ships would likely beach at the harbour’s northern part, next to the Agora of Theophrastos, one of the city’s main markets. This coast was a wide and shallow sandy beach opening directly towards a big flat square, which covered an area of up to 1,500 m² (**Fig.3.10**).⁶⁰² Lighters could unload the cargoes of ships anchored in the open or near the harbour’s entrance and directly present them for sale in the agora, the *κύκλος* auctioning enclosure, or even inside the Hypostyle Hall.⁶⁰³ It is unlikely that larger ships would use the harbour for beaching, even when long-term maintenance was needed. Their size and draught would have made their operation difficult and the open, wide beach of the

⁶⁰⁰ Zarmakoupi 2018b, 37-8.

⁶⁰¹ Zarmakoupi 2018b, 38.

⁶⁰² Moretti & Fincker 2016, 98.

⁶⁰³ Leroux 1913, 255; Moretti et al. 2012, Fig.15; Moretti & Fincker 2016, 108.

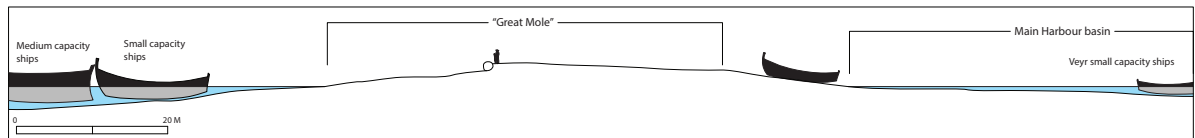


Fig.3.42. Cross-section of the “Great Mole” in antiquity (drawing by the author).

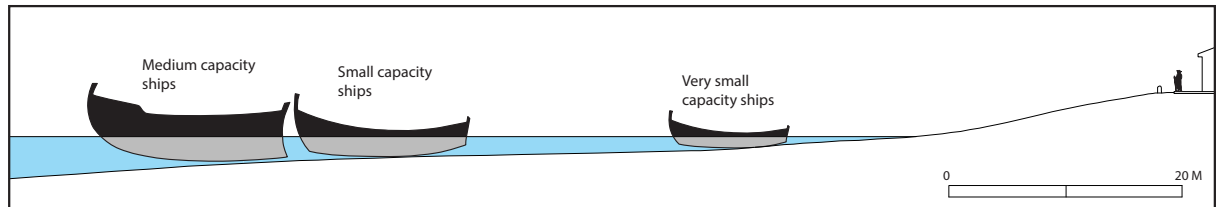


Fig.3.43. Cross-section of the Delos’ Merchant Harbour in antiquity (drawing by the author).

Merchant Harbour would have been much better for such a task. The small draught of galleys allowed them to operate much easier in the basin and the Main Harbour also accommodated the “galley cove”, the special sector reserved for oared vessels (see below).

The second large beaching area was the Merchant Harbour (**Figs.3.22, 35 & 43**). The long and wide beach allowed the easy draught beaching of ships of medium and small capacity and the hauling out of the water of lighters (**Fig.3.43**). The mild inclination of the seabed protected the shore by depleting the force of the incoming waves, whereas the Main Harbour’s moles also diminished wave strength and shore drift. As we saw above, the boundary stones in front of the quays were probably related to the loading and unloading of vessels, marking the exact area assigned to the cargo of each merchantman or to each lighter (**Fig.3.21**),⁶⁰⁴ in a thorough organisation of space in connection with the series of warehouses or shops lined up on the shore. The city’s shipyard, mentioned in written sources, most likely operated in the same area (see below). The beaching of boats and lighters must have also been practiced at Skardanas and Fourni bays. In Gourná, the shore is steeper than in the other harbours and, if the ancient configuration of the bay is similar to the modern one, beaches were quite narrow and rockier and not fit for the beaching of anything more than a few small boats (**Fig.3.27-30**). The small width of the bay’s beaches could have caused the construction of the stone quay that would, in any case, have obstructed much of the beaching space there.

One final important aspect of beaching on Delos was the operation of an organised shipyard for the construction and maintenance of ships. This is well attested in the

⁶⁰⁴ Malmay & Karvonis 2016, 170-1.

inscriptions that report one shipyard in the proximity of a house owned by the sanctuary.⁶⁰⁵ Public capstans (*στροφεῖα*) and slipways (*όλκοι*; one on Delos and one on Mykonos) were also operated in the 3rd-century BCE as inscriptions concerning the taxes related to their use verify.⁶⁰⁶ The imposition of taxes on such facilities is a clear indication that these served all ships passing from the harbour and not only the local ones, and contributed to the income of the sanctuary, at the same time making Delos a 'friendlier' place for mariners, who knew that they would find there the means they needed to repair their ships. Although there is no data on where the island's shipyard was, this was possibly located in the Merchant Harbour, where there was enough space for the easy operation of such an establishment.

Approachability and circulation

The harbours and in general the coasts of Delos presented various issues concerning the approach of ships. Beginning with large capacity vessels, these could enter neither the Main nor the Merchant Harbour, due to the shallowness of the coastal areas (**Fig.3.34**). In the case of the Northern Harbour they could anchor at a distance of about 50 m from the shore. Skardanas, being deeper at its centre, allowed the approach of such vessels but, again, no closer than 40-50 m to the shore. It was only Gournas, which, thanks to its depth and the existence of the ashlar quay, would allow ships of large, medium and small capacity to use it by directly berthing on the quay (**Figs.3.38-9**). Ships of medium capacity could approach closer to the shore in every case but could neither enter the Main Harbour, nor navigate between Small Rematiaris and Delos. In the Merchant Harbour they could approach the beach at a distance of about 30 to 40 m (**Fig.3.34**) and in Skardanas and Gournas at a distance of 15-20 m (**Figs.3.37-8**). In theory ships of medium capacity could also dock on the natural quay of the Northern Harbour, but, as already discussed, it is very doubtful that this was feasible and safe. An additional problem must have been the lack of space around the Main Harbour. The passage between the Rematiaris' islets and Delos' rocky coast and "Great Mole" was considerably narrower in antiquity because of the difference in sea level and it is doubtful whether any medium capacity merchantman would attempt to cross it without the

⁶⁰⁵ *ID* 363, 1.41. Cf. Duchène et al. 2001, 143.

⁶⁰⁶ *ID* 138B, 8 *ID* 353A, 29-30; *ID* 354, 26, 29. Cf. Velissaropoulos 1980, 208, 215. The term *όλκος* could also refer to the operation of hauling of ships over an isthmus, as it happened at the Isthmus of Corinth, but in the case of Delos and Mykonos this corresponds to a simple slipway (Bruneau 1970, 184; Raepsaet 1993, 248-249).

use of tugboats (**Figs.3.12 & 34**). Small capacity ships could approach even closer to the shore (10-20 m in the Merchant Harbour, Skardanas and Gournas) and draught beach on it, the ones with a draught of 1-1.5 m might also be unloaded by porters. They still could not enter the Main Harbour basin beyond its entrance area between the two moles. They could, nevertheless, navigate easily around all harbours and between the Rematiaris islets. It was only very small capacity vessels that could enter the Main Harbour and approach every beach of the island. Finally galleys could also approach the coast at a distance similar to the small or even the very small capacity ships, according to their draught (**Table 2.1**), which would be even smaller when they disembarked their whole crew and rigging.

3.1.5. The handling of ships and cargoes

Much like the capacity of the harbours of Delos, the methods by which ships and their cargoes were handled was variable and depended both on the nature of each harbour, as well as on the nature of each cargo.

The handling of cargoes

In terms of the ability to handle various cargoes the harbours of Delos presented a rather complicated image. As analysed above, the draught beaching of ships of small capacity and the use of lighters were the main methods that could inevitably be employed. Taking into account the average width of service ships as known through archaeological finds (**Tables 2.1 & 2; Appendix I, Table 4**) and assigning 4 m for each vessel we get the following numbers: the northern half of the Main Harbour, with a beach of about 200 m, could serve about 50 lighters at the same time. If each lighter could carry a cargo of 8 to 10 tons, then a maximum of 400 to 500 tons could reach the Main Harbour simultaneously. The small size and draught of the lighters would allow a fast unloading directly on the beach, although the precise time needed would depend on the number of lighters and porters employed.⁶⁰⁷ According to Brandt's calculations⁶⁰⁸ and assigning an average of five porters, each carrying 40 kilograms, to each vessel, it would take them less than an hour to unload each lighter. Similarly, the

⁶⁰⁷ Porters (*ῥωμοφόροι*, *σακκοφόροι* or *saccarii*, literally sack-bearers) are mentioned in an Egyptian papyrus (P. 11652 C R Kol. XXII) and several inscriptions (Mataix Ferrándiz 2018, 96; Feuser 2020, 65). These workers would have beyond doubt played a very important role in the commercial life of harbours, but texts are vague concerning the exact ways they loaded and unloaded vessels.

⁶⁰⁸ Brandt 2005, 35-6.

much longer beach of the Merchant Harbour could accommodate about 150 lighters of the same dimensions, unloading a total of 1,200-1,500 tons. Skardanas had a similar capacity with the Main Harbour, with a beach about 200 m long. Thus, in theory, a total of 2,000-2,500 tons of cargo could be unloaded at the harbours of the western shore of Delos at the same time and in a few hours.

These numbers are, nevertheless, totally theoretical and the logistics involved must have been much more complex. If the whole of the available beaches of Delos' western harbours were taken by draught-beached ships of small capacity, there would have been no space for any other ships or boats to use them. The amount of cargo each lighter could carry was only a fraction of the cargo of a medium-capacity merchantman and it would have taken a single lighter at least ten trips to unload the whole cargo. As for the number of lighters, 250 vessels is an excessive number for Delos. Not only would they require more than 1,000 people to operate them (if a minimum of 5 crewmembers and porters is assigned to each), but also they would have little space to move and to store the cargoes transported on land. Further, the harbours of Delos were used not only by grain freighters but for a variety of other vessels like passenger boats, galleys, fishing boats and small vessels sailing to Rhenia and the other nearby islands. It is more likely that fewer lighters operated in the local harbours and that they worked along with the merchantmen's own boats, unloading only portions of the cargoes on land. As noted above, it is very possible that only part of each ship's cargo would have been transported to Delos, even with the help of the ship's own boat, exhibited in the open in the commercial buildings and "magasins" or auctioned in the *κύκλος* and then returned to the ships to be taken wherever the buyer wanted. A constant and intense traffic of boats would then have been the case in Delos and enough space would have been left free for their movement.

The only harbour where ships could apparently berth on an artificial mole was Gourni. Compared to the other harbours of Delos, Gourni offered a unique opportunity to ships of considerable size to unload or load cargoes without the costly and time-consuming intervention of lighters, whereas the existence of a spacious, stable quay would allow the operation of lifting devices too. According to Brandt's calculations,⁶⁰⁹ it would take a team of 15 porters 5 days to empty a 150-ton merchantman on such a quay. If merchantmen could

⁶⁰⁹ Brandt 2005, 35-6.

unload their entire cargoes at Gournā and according to the numbers of various ships the quay could accommodate, that would result in more than 1,000 tons of cargo being unloaded on the quay. It should, however, be noted that no commercial buildings were identified on the shore of Gournā harbour and the building standing right next to the quay was probably a tavern or a workshop (**Fig.3.30**). Any merchandise would most likely have had to be distributed in the storage and commercial spaces of the surrounding houses,⁶¹⁰ or be transported to the city agoras. The latter would have, however, been a problem for large and cumbersome cargoes, due to the poor road network of Delos.⁶¹¹ Finally, the exposure of the harbour to the open sea would have made docking a potentially dangerous task (see above). It is therefore much more plausible that Gournā served for the temporary berthing and provisioning of ships, as suggested by Zarmakoupi,⁶¹² and not the handling of substantial cargoes.

An important feature of the Delian harbour landscape related to the handling of cargoes is the association of the series of coastal “magasins” of the Merchant Harbour with the ships and cargoes handled on the island (**Fig.3.44**). The fact that these spaces were oriented towards the open beach indicates a direct relationship with the cargoes arriving there, but their actual capacity, provided each space was actually used to store goods, was very limited: even the largest ones could accommodate a maximum of 100 m³ or 35 tons of cargo.⁶¹³ In the case that bulk goods like grain were stored there piled on the floor their capacity would not exceed 73 metric tons, in analogy to the later *horrea* warehouses of Ostia.⁶¹⁴ Such quantities would match the total tonnage of ships of small capacity only, larger ships requiring more than one unit to unload all their cargo. However, the “magasins” could have actually been shops in which only parts of cargoes were temporarily stored and exhibited, according to the *δείγμα* practice. In this case there would have been no need for larger warehouses, but only enough space to allow the easy transportation of small quantities of goods to and from the sea and the circulation of clients. Unfortunately, the

⁶¹⁰ Zarmakoupi 2013a; 2013b.

⁶¹¹ Jardé 1905, 35-6.

⁶¹² Zarmakoupi 2015, 126.

⁶¹³ Karvonis 2008, 185.

⁶¹⁴ Boetto et al. 2016. The main problem in storing bulk goods like grain inside enclosed spaces would have been the need to leave space for the entrance and movement inside them and the natural tendency of any such material to roll down and cover the floor. None of the warehouses of Delos or Ostia were proper granaries or silos accessible from their roof and only a fraction of their space could be used for the storage of grain or other similar goods.

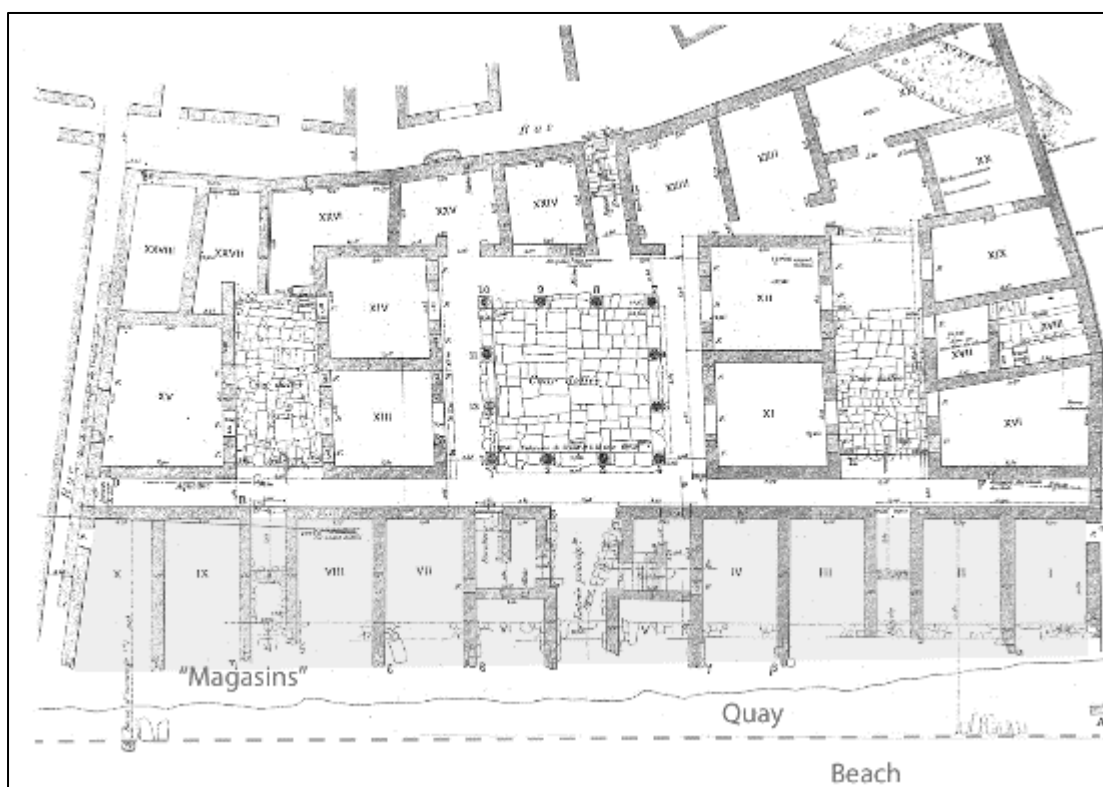


Fig.3.44. Plan of the “Magan de colonnes” building with the “magasins” facing the sea and the ancient quay highlighted by the author (Jardé 1906).

actual use of these spaces, damaged by the rising sea level and excavated with 19th-century standards, cannot be confirmed by any archaeological finds.

One last aspect of cargo handling in Delos concerned the import and possible export of building material. Although large quantities of such materials were imported for the needs of the rapidly growing Hellenistic city and the lavish sanctuary, it is difficult to establish where and how this operation took place. As we saw in **Chapter 2**, stone carriers required specific harbour works and cranes to unload their cargoes. Such structures most likely never existed in the harbours of Delos, with the possible exception of the Gournay quay. The island’s inscriptions only mention the placement of building material on the $\chi\omega\mu\alpha$ ⁶¹⁵ and the existence of a tax possibly related to lifting devices ($\tau\omega\nu \alpha\iota\pi\epsilon\sigma\iota\omega\nu$).⁶¹⁶ It is quite possible that the transportation of building material was done with special arrangements and equipment being set up each time a specific ship had to unload such a cargo. Simple shear-leg cranes, made from reused timber or even from ship masts and other equipment (capstans, pulleys, ropes) could be set up in the most convenient places and then

⁶¹⁵ ID 104-4; Hellmann 1980.

⁶¹⁶ ID 353A, 33; ID 354, 29; Vial 1984, 231, n.207.

dismounted, leaving no trace in the archaeological record, or in the archives of the sanctuary.⁶¹⁷ And although construction activity in Hellenistic and Roman Delos was truly ardent, building material would not arrive regularly, but whenever needed for specific projects so it would make little sense for local authorities to build and maintain a *statio marmorum* whose use would have been costly and irregular (see also 2.5.2). Gournà harbour, according to our present knowledge, could accommodate large stone carriers and the operation of cranes but was too far from the sanctuary and the transportation of marble blocks and other similar material would have been difficult, also considering the island's poor road network (see above).

A final aspect of stone and marble transportation on Delos was the transport of local marble from the quarries located at the island's eastern shore that was used, along with other imported material, in the local buildings (Fig.3.3).⁶¹⁸ The configuration of the rocky coast next to them allowed loading directly on ships or even rafts with the use of cranes and traces of their sockets have been identified on the shore.⁶¹⁹ Gournà harbour, located very close, even if it could not operate for the unloading and handling of this material (see above), could have operated as a provisioning station for ships and mariners dealing with the local quarries (Zarmakoupi 2015, 126).

The galley harbour, its location and operation

Galley regularly visited Hellenistic Delos, either as parts of religious missions (*θεωρίαι*) or as naval fleets for provisioning and rest (see above 3.1.3). Thanks to their small draught they could use almost all of Delos' harbours and either approach the shore at a small distance by draught beaching or be partly or totally hauled out of the water. The sandy beaches of the Main and Merchant Harbours, Skardanas and Fourni were ideal places for galleys to be beached and sheltered. The authorities, however, made sure to divide the galley harbour from the commercial harbours of the island, as the *ὄρος* delineating the "galley cove" of the Main Harbour clearly shows.⁶²⁰ This was probably done for security reasons, as well as to guarantee that galleys would not interfere with the rest of the harbour traffic and vice versa. One of the possible bollard stones was most likely not a mooring stone but part of an

⁶¹⁷ Landels 1978, 84-5, Fig.26.

⁶¹⁸ Chamonard 1922-24, 233-6; Vallois 1966, 70.

⁶¹⁹ Fraisse & Koželj 1991, Figs.2 & 15.

⁶²⁰ Roussel 1916, 299, n.3; Dûchene et al. 2001, 153-4.

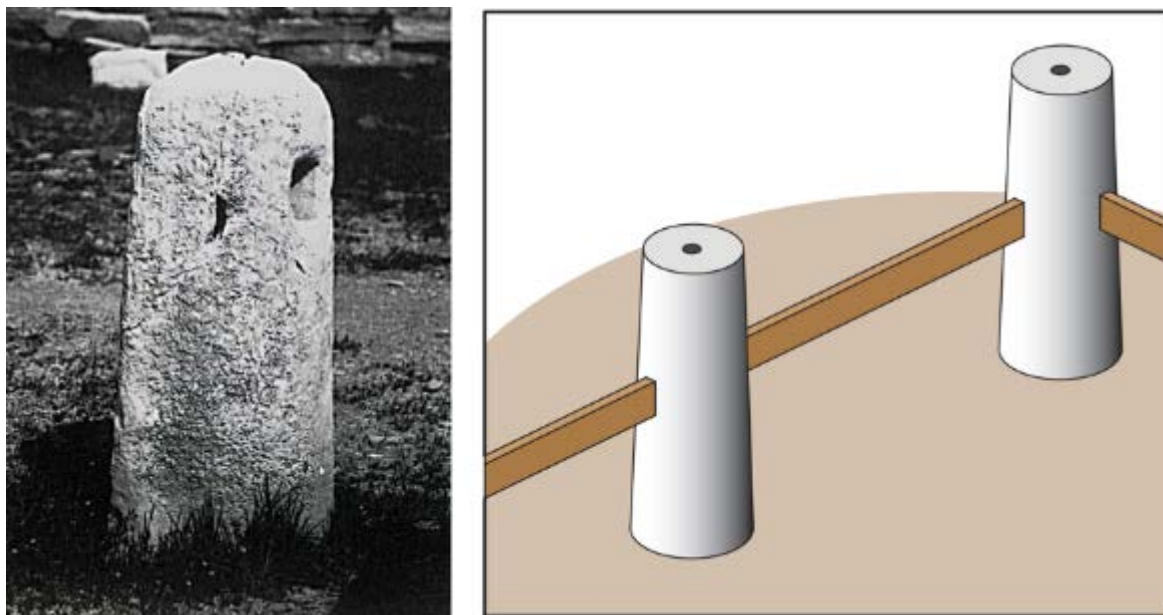


Fig.3.45. One of the mooring or boundary stones of Delos' Main Harbour located today in the area of Phillip's Portico. Left: photograph of the stone as published by Duchêne et al. (2001, Pl.XXXI.2). Right: reconstruction of the stone as part of an enclosure (drawing by the author).

enclosure fence (κλείθρα),⁶²¹ placed around the galley harbour (**Fig.3.45**).⁶²² The discovery of the stone close to Phillip's Portico, in the area where also the ὄρος was reportedly found, indicates that the galley harbour was located in the Main Harbour's southern half, on the beach in front of the portico and north of the Southern Mole.⁶²³ The sandy area enclosed between the quays, the Southern Mole and the wedge-shaped small jetty to the west (the former's length corresponds to the maximum length of a Hellenistic warship; **Table 2.3**), would be ideal for galleys to be hauled on land (**Fig.3.34**). There is no further indication of any other arrangement for the accommodation of galleys and it seems that the galley harbour was a simple beach with wooden slipways and possibly a capstan, like the ones mentioned in the sanctuary's inscriptions (see **1.1.6**). As we already saw, the "glissieres" underneath Phillip's Portico could tentatively be identified with an earlier galley enclosure (**Fig.3.11**) but this remains a hypothesis.

Other locations or establishments for galleys could have existed on the island.⁶²⁴ A 2nd-century BCE inscription documents the diminutive νεωρίδιον (small dockyard or ship

⁶²¹ The term κλείθρα appears as a means to fence the military arsenal of Hellenistic Kos, allowing the communication only with the shipyard: "τῶν νεωρίων τῶν [κα]/τεσκε[υασμ]ένων τοῖς κλείθοις δι[α]λείπων εἴσοδο[ν]/ ἐκ τῶν ναυπαγίων" (IG, XII, 4, 1, 302, 42-4; cf. Blackman & Rankov 2013, 363).

⁶²² Duchêne et al. 2001, Pl.XXI.2.

⁶²³ Zarmakoupi & Athanassoula 2018, 93.

⁶²⁴ The νεώριον (shipshed or slipway) mentioned in several inscriptions (ID 1403; SEG 16.451; SEG 37.692; SEG 39.711; SEG 43.1272) has been identified not with any operational galley shipshed but with the "Bulls' Monument" ("Monument des taureux"), the impressive building at the north half of the sanctuary's

shed) in relation to some houses owned by the sanctuary, but does not clarify its precise function nor location.⁶²⁵ The use of a diminutive term indicates its use by a small ship. There is a possibility that the former could refer to the ‘trench’ at the eastern end of the “Great Mole” (**Fig.3.12**). The structure could have been a simple slipway, cut through the high mole to allow the right inclination for ship hauling, accommodating a single galley used by the sanctuary or the galley that each year arrived from Athens with offers for Apollo.⁶²⁶ Archaeological and epigraphic data is, however, too limited to support this hypothesis and the actual function of this structure remains obscure. Furthermore, although the term *νεώριον* from which *νεωρίδιον* derives mainly describes galley dockyards,⁶²⁷ it could as well denote a regular small shipyard used by any kind of ship visiting the island.

enclosure that housed a sacred galley or several galley parts used as trophies dedicated to Apollo (**Fig.3.4, n.16**; Couchoud & Svoronos 1921; Vallois 1944, 33-7, 279-80; Fraisse & Llinas 1995, 417-21).

⁶²⁵ *ID* 1417B ii 118.119.

⁶²⁶ Roussel 1916, 207.

⁶²⁷ Blackman & Rankov 2013, 16.

3.3. Kenchreai

The third case study of my research is the harbour of Kenchreai, which was Corinth's gateway towards the Aegean and the East (Fig.3.74). Kenchreai became an important harbour settlement after its reconstruction by the Romans in 44 BCE, in what was part of an organised effort not only to replace the already declined Delos, but also to stimulate trade in Roman Greece by reviving Corinth as a merchant hub on the crossroad of the Isthmus.⁷²⁷

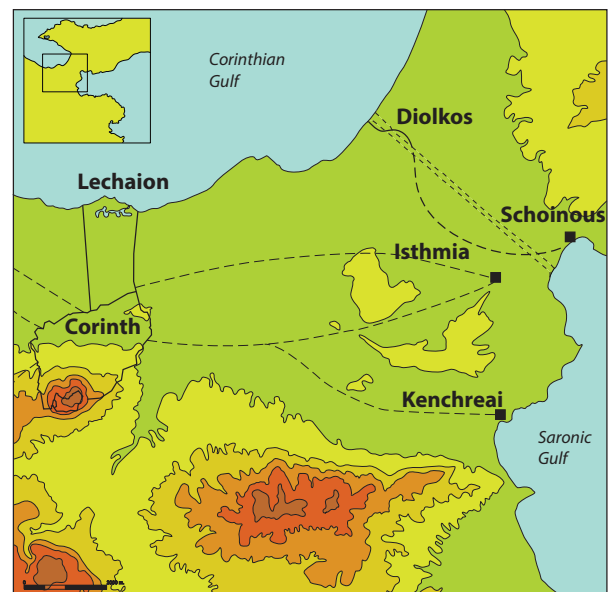


Fig.3.74. Map of Corinthia and of the Isthmus area (drawing by the author).

Kenchreai's ancient harbour has been studied by a meticulous pioneering survey and excavation by the Universities of Indiana and Chicago that took place between 1963 and 1968.⁷²⁸ Thanks to the results of this thorough and fruitful research published in a series of volumes,⁷²⁹ as well as more recent excavations on land⁷³⁰ and various geophysical surveys,⁷³¹ we have a clear and precise image both of the ancient harbour as well as of a large part of the settlement that thrived there during the Roman Imperial period.⁷³² Despite the rich information collected and published, harbour operation and ship and cargo handling was never properly studied. This is a very important gap in scholarship that my study covers in the following pages.

⁷²⁷ Rostovtzeff 1926, 65.

⁷²⁸ Scranton et al. 1978, xvii-xxi. The site of Kenchreai's harbour is for the first time briefly mentioned by Gerster in 1884. Georgiades (1907, 5, Pl.II) published the first plan of Kenchreai's shore, including the "Baths of Helen" promontory to the south, but failed to locate the Southern Mole, whereas the Northern Mole was documented as a simple wall. Fowler & Stillwell (1932, 71-5, Figs.36-42) gave a much more detailed account of the site, although they did not publish any plan of the submerged structures.

⁷²⁹ Scranton et al. 1976; Scranton et al. 1978; Adamschek 1979; Williams 1981; Stern & Thimme 2007.

⁷³⁰ Wilson Cummer 1981; Rife et al. 2007; Korka & Rife 2013; Heath et al. 2015.

⁷³¹ Stiros 2001; Rothaus et al. 2008; Koukouvelas et al. 2017.

⁷³² Kenchreai's ancient harbour and settlement has been largely undisturbed by modern development and is today a protected and monitored archaeological site. The main destruction in the archaeological site has been caused by the modern highway leading from the Isthmus to Epidaurus and of several houses built mostly at the site's western half and not on the harbour's shore. The modern beach is a popular destination for swimmers and holidaymakers during the summer months. Further damage on the cemetery has been done by the construction of coastal fortifications by the German forces in World War II on the Koutsongila ridge, where also modern looting has been constant (Rife et al. 2007, 146; Alexiou et al. 2008).



Fig.3.75. *The harbour of Kenchreai seen from the north (photograph by the author).*

3.3.1. Geomorphology and climatic conditions

Kenchreai is located on the east coast of Corinthia, 10 km east of the centre of ancient Corinth and 4 km south of the important sanctuary of Poseidon at Isthmia (**Fig.3.74**). The site faces southeast towards the Saronic Gulf and the island of Aegina. The harbour, around which the ancient city was developed, is located at the end of a small triangular plain, formed by alluvial deposits (**Figs.3.75-7**).⁷³³ To the north and west the plain is surrounded by high marine terraces or spurs (the inland, central and seaward spurs as conventionally named by the excavators of the 1960's) of yellow to white marls, typical in Corinthia.⁷³⁴ The seaward spur, which is steeper and reaches closer to the coast, originally formed a small rocky cape, but the soft rocks have been heavily eroded by the sea and only small parts survive underwater, forming the natural foundation of the Northern Mole.⁷³⁵ A similar, but smaller cape originally formed the base of the Southern Mole. A long beachrock strip is located on the shore north of the Northern Mole (**Fig.3.77**).⁷³⁶

The ancient harbour is today a deep, sandy cove (**Fig.3.76**). The beach is relatively narrow (5-7 m) and there are no rivers or streams ending there. This, as well as the protection from coastal sand shifting from the Northern Mole, renders the site "silt-free",

⁷³³ Stillwell et al. 1976, 446.

⁷³⁴ Scranton et al. 1978, 1-5.

⁷³⁵ Scranton et al. 1978, 17.

⁷³⁶ Kolaiti & Mourtzas 2016, Fig.3.



Fig.3.76. *Satellite photograph of Kenchreai harbour (source: Google Earth).*

with minimum siltation rates.⁷³⁷ The seabed progressively slopes towards the entrance of the harbour where it reaches a depth of 22 m. The inclination is steeper around the rubble moles. No underwater rocks or reefs are to be found inside and around the harbour and the seabed is covered by fine sand and posidonia fields.

Although several major seismic sources surround Kenchreai,⁷³⁸ their slip-rates are very low and, beyond the typical 2 m rise of the sea-level since the 1st century CE and some coastal erosion, little seems to have changed in the area.⁷³⁹ Local subsidence and erosion, however, appears to have heavily affected the artificial moles, as they slope towards the sea with their ends 4-15 m underneath the modern sea-level.⁷⁴⁰

⁷³⁷ The excavators observed that it took years for exposed excavation trenches to be backfilled by sand (Hohlfelder 1985, 84), whereas the trenches of Lechaion would be filled in a few hours when the weather picked up (author's personal observation). The minimum siltation of Kenchreai has been partly caused by the construction of the modern coastal road that blocked the small stream at the bays' northern half (Alexiou et al. 2008, 5, Fig.5).

⁷³⁸ The Kenchreai, Loutraki and Agios Vasileios faults.

⁷³⁹ Flemming et al. 1973, 4-5. Kolaiti & Mourtzas (2016, 76) suggested a 3.25-m sea-level rise at Kenchreai since the 1st century CE. They based their argument on the lower elevation of the compact beachrock formation that embedded one of the ancient quays or retaining walls at the harbour's northern end. They did not, however, provide any dating evidence for the beachrock or the wall and seem to ignore the possibility of heavy subsidence and erosion of the whole coast.

⁷⁴⁰ Although a major subsidence event is considered by Stiros (2001, 559) to have been caused by the great earthquake of 375 CE that destroyed great part of the ancient city, Rothaus et al. (2008) have suggested that subsidence was gradual and should not be linked to any particular seismic event.

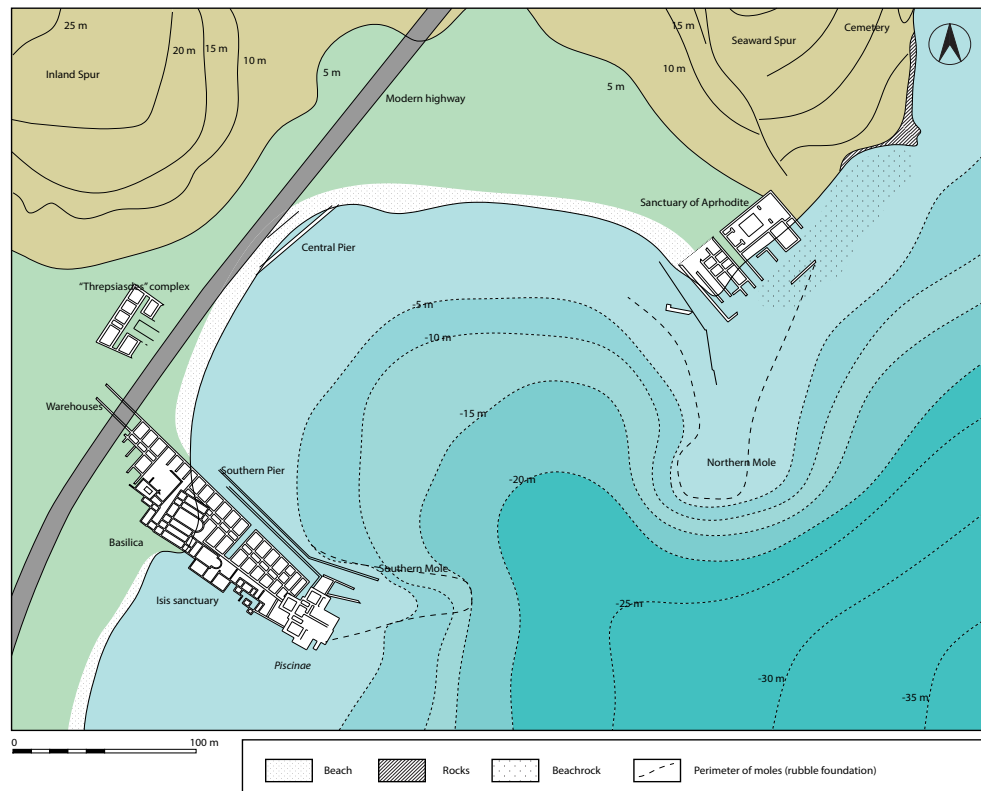


Fig.3.77. Plan of Kenchreai harbour as it is today. The plan is based on the maps of the ancient remains and topography published by Scranton et al. 1978 and the plan of the “Threpsiades” complex published by Heath et al. 2015, Fig.2 (drawing by the author).

The climatic conditions of Kenchreai and of western Corinthia follow the pattern of the Aegean climate, with generally sunny and dry weather and occasional rainstorms.⁷⁴¹ Prevailing winds are northern and strong etesians blow in the summer.⁷⁴² Thanks to its orientation, Kenchreai harbour offers substantial protection from the north and north-western winds. It remains open to the currents and winds from the east and south-east, which, are, however, rare.⁷⁴³ The area, according to the Mediterranean Pilot, is not considered a very safe harbour today, due to the lack of protective works and the easiness with which winds might change, especially in the summer months.⁷⁴⁴

⁷⁴¹ Desruelles 2004, 48-54; Beresford 2013, 54-6.

⁷⁴² Iliopoulos 1952; Maheras 1979.

⁷⁴³ Alexiou et al. 2008, 4.

⁷⁴⁴ Mediterranean Pilot IV, 56.



Fig.3.78. Corinthian coin of the Antonine period with a representation of Kenchreai harbour (Hohlfelder 1970, Pl.80a).

3.3.2. The harbour of Kenchreai and its reconstruction

Most of the data concerning the harbour's construction, geography and bathymetry comes from the meticulous and inclusive project of the 1960's.⁷⁴⁵ During that project the whole bay was mapped and excavations were carried out in several areas, mostly around the Northern and Southern Moles, as well as on land. Later geological studies also addressed the relative sea-level rise since antiquity, as well as the seismicity of the surrounding region and confirmed the moderate dynamics of the geological environment.⁷⁴⁶ Historical sources give little evidence for the original configuration of the site: according to Pseudo-Skylax Kenchreai was a fortified site around 330 BCE⁷⁴⁷ and to Dio Chrysostom and Apuleius it was a busy cosmopolitan harbour in the 1st and 2nd centuries CE.⁷⁴⁸ Pausanias describes the site in his account of Corinthia but mentions only briefly the sanctuaries of Asclepius, Isis and Aphrodite, as well as Poseidon's statue on the waterfront, without any reference to the harbour or the settlement.⁷⁴⁹ Inscriptions are also generally missing from the site (with the exception of the cemetery), most of them having been reused as building material in later buildings like the nearby early Medieval Isthmus wall.

Iconography offers some unique clues on the appearance of the ancient harbour, which was portrayed in a series of Corinthian coins of the Antonine period (**Fig.3.78**).⁷⁵⁰ The

⁷⁴⁵ Scranton et al. 1978.

⁷⁴⁶ Flemming et al. 1973, 4-5; Kolaiti & Mourtzas 2016, 75-7; Koukouvelas et al. 2017.

⁷⁴⁷ "And after Epidaurus is the Corinthians' territory [the one] towards the dawn, and a fort, Kenchreai, and the Isthmus, where is a sanctuary of Poseidon" (Pseudo-Skylax, *Periplus* 55).

⁷⁴⁸ "For you accorded me this honour, not as to one of the many who each year put in at Cenchreae as traders or pilgrims or envoys or passing travellers, but as to a cherished friend, who at last, after a long absence, puts in an appearance" (Dio.Chr.37.8); "Gallop[ing] six full miles fast as I could, I soon reached Cenchreae, which everyone knows is a famous slice of Corinthian territory on the Saronic Gulf, washed by the waters of the Aegean. There the port is safe for shipping and always crowded with people, so I avoided the harbour and chose a secluded stretch of shore" (Apul.Met.10.35).

⁷⁴⁹ "In Cenchreae are a temple and a stone statue of Aphrodite, after it on the mole running into the sea a bronze image of Poseidon, and at the other end of the harbor sanctuaries of Asclepius and of Isis" (Paus.2.2.3).

⁷⁵⁰ Imhoof-Blummer & Gardner 1885, xii Nr.11, Pl.D, LX; Price & Trell 1977, Fig.146; Blackman 1982a, Fig.1G.

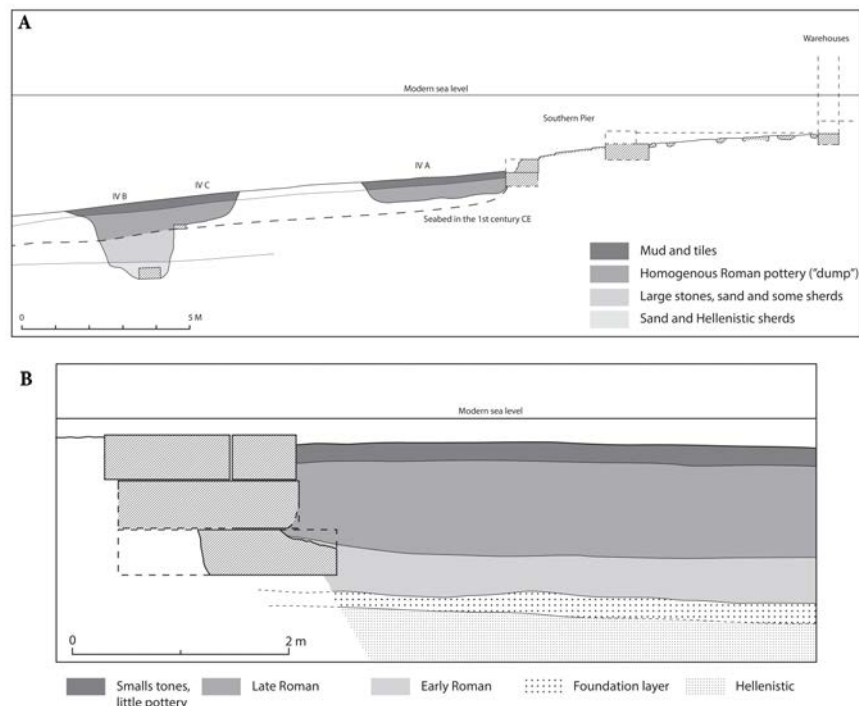


Fig.3.79. *Stratigraphic cross-sections in the harbour basin of Kenchreai. A: Southern Pier. B: Central Quay (drawings by the author based on Scranton et al. 1978, Pls.13 & 22).*

coins show a semi-circular harbour cove, with continuous porticoes or warehouses and temple-like buildings at each end. Ships under sail indicate the sea, whereas a statue of the patron deity Poseidon or Isis (depending on the coin) appears standing at the middle of the bay. Although the coins are not inscribed with the name of Kenchreai but simply with the acronym CLICOR, which identifies them with the Corinthian mint of the Imperial period, the configuration of the image with the continuous colonnade or warehouse entrances, as well as the presence of the statue of Poseidon, probably the one mentioned by Pausanias, strongly indicates that this is a representation of the harbour of Kenchreai.⁷⁵¹ The image is unfortunately very abbreviated to convey anything but a generic image of a Roman harbour.⁷⁵² In any case however the choice of depicting the harbour on the local coins in the 2nd century CE underlines its importance for the local economy and society.

Kenchreai harbour presents a rather simple configuration. It consists of a single deep oval basin protected at its northern and southern sides by massive rubble jetties (**Figs.3.80**). It should be noted here that, although natural siltation has been minimal in the area of the harbour, the underwater excavations revealed, in front of the Southern Pier, a 0.9-m thick

⁷⁵¹ Hohlfelder 1970; Scranton et al. 1978, 148-9.

⁷⁵² Blackman 1982a, 82.

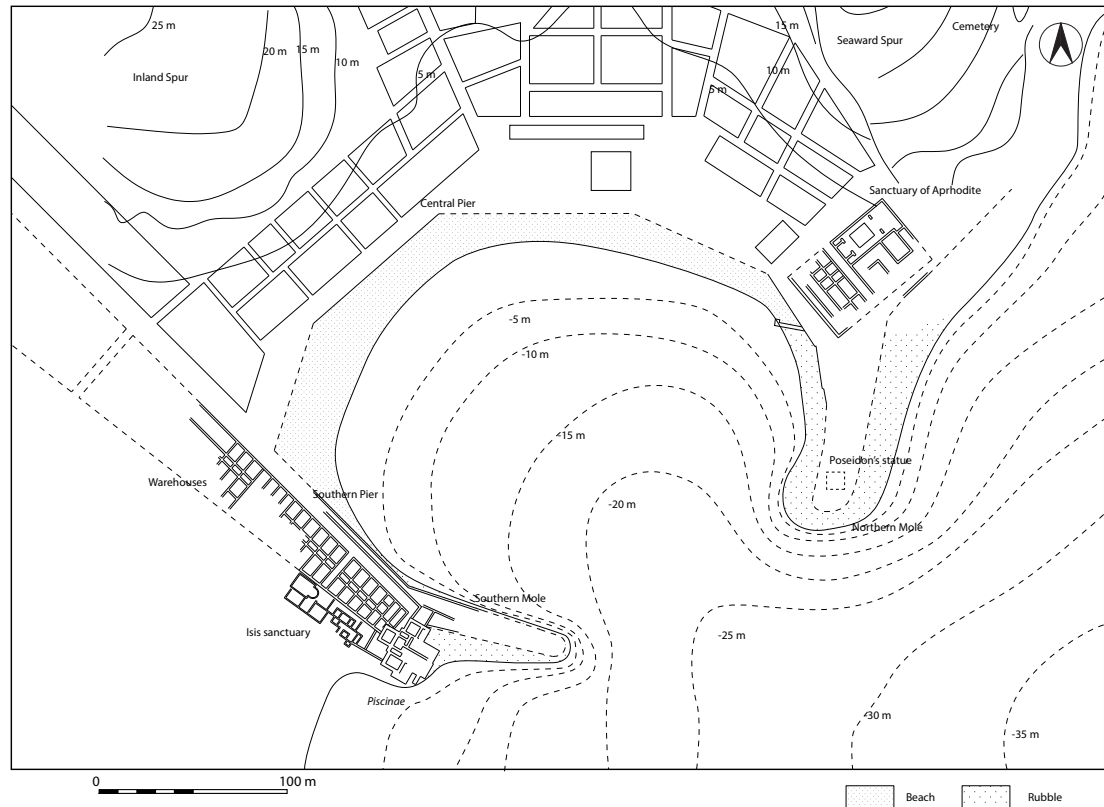


Fig.3.80. Reconstruction of the harbour and city of Kenchreai in the 2nd century CE. Plan based on the maps and plans published by Scranton et al. 1978. The urban planning also follows the suggestion of the same publication, which is based on trenches excavated in the whole area. A minor alteration to the city plan has been added, following the data supplied by the “Threpsiades building” excavation (Heath et al. 2015) (drawing by the author).

layer that belonged to a filling created from debris and broken pottery material (conventionally called the “dump” by the excavators; **Fig.3.79A**). The filling was accumulated from cleaning the nearby warehouses or from discarding debris material from ships stationed there. The same layer was also found in the middle of the bay, but with a smaller thickness (0.45 m; **Fig.3.79B**).⁷⁵³ According to datable pottery and coins recovered it was created between the 1st and the 3rd century CE and it appears that constant use of the harbour in the first centuries CE made it somewhat shallower, especially since no dredging operations have been identified in the well-established stratigraphic sequence, nor are attested in any written source.

⁷⁵³ In the middle of the bay and at a distance of about 25 m from the quay several concentrations of what appears to be dumped ballast stones was reported by the excavators (Scranton et al. 1978, 37, Fig.21). Although it is plausible that ships would discard their ballast when necessary inside the harbour, these concentrations were found at a depth of no more than 2 m, at the area where the ancient beach was roughly located and could have also belonged to reclamation efforts.

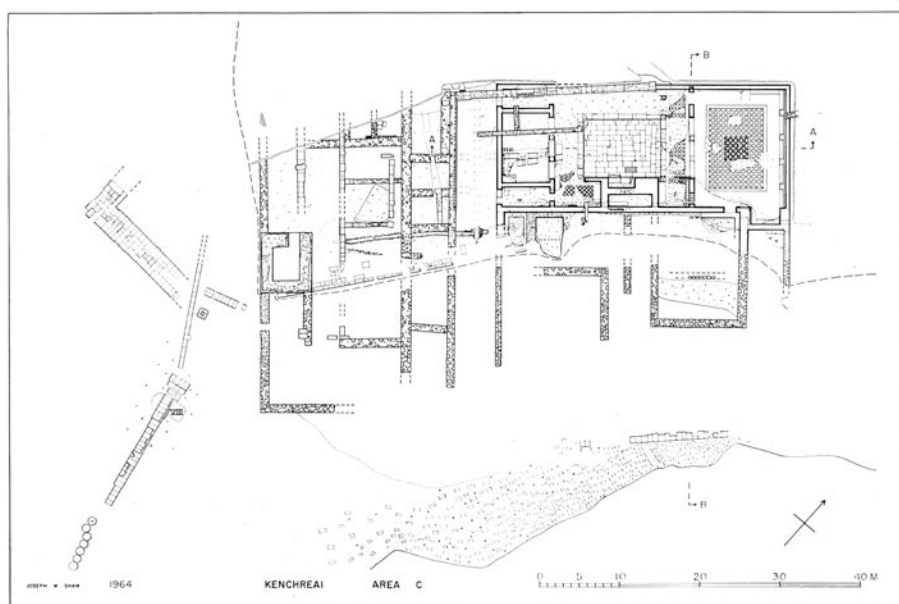


Fig.3.81. Plan of the ancient buildings excavated at Kenchreai harbour's northern side, next to the Northern Mole. The quays of the mole are visible, as well as the early medieval tower at the building's southern end (source: ASCSA).

The harbour comprised of a single ovoid basin that covered an area of about 32,000 m² and had a shoreline of about 800 m.⁷⁵⁴ The basin had a relatively steep seabed, reaching a depth of 5 m at a distance of about 50 m at the bay's centre and more

than 20 m at its entrance (**Fig.3.80**). The main harbour works were the two great moles, today totally submerged. Both have a similar configuration: the Northern Mole is a trapezoidal rubble foundation with a length of about 140 m and a width of about 36 m at its southern end, becoming much wider (about 100 m) as it reaches the coast. The mole slopes to a depth of 4.8 m at its southern end and it seems that it did not support any substantial structures apart from a pavement created with loosely placed flat ashlar blocks at its southern end.⁷⁵⁵ A trapezoidal or triangular ashlar quay originally crowned the rubble foundation, its remains surviving at the mole's northern end.⁷⁵⁶ North of the mole a large

⁷⁵⁴ Scranton et al. 1978, 14.

⁷⁵⁵ Scranton et al. 1978, 18. The pavement does not seem to have been part of a foundation for a lighthouse or any other edifice. This area probably was where Poseidon's statue was erected, since Pausanias (2.2.3) describes it as standing on the embankment or jetty of the sea (*ἐπὶ τῷ ἐρύματι τῷ διὰ τῆς θαλάσσης*).

⁷⁵⁶ Remains of a retaining wall, comprising of a single row of ashlar limestone and including several reused column drums, have been found at the mole's northern half, facing towards the basin. A similar wall is preserved at the mole's north-eastern corner, at a depth of 2 m and it has been suggested by the excavators that it supported a coastal road leading towards the north where the main cemetery of the settlement was located (Scranton et al. 1978, 22; Rife et al. 2007). At the mole's northwest end the remains of the retaining walls turn towards the west, following the course of the shore. Several ashlar walls have been located at the same area but their function and dating remains obscure.

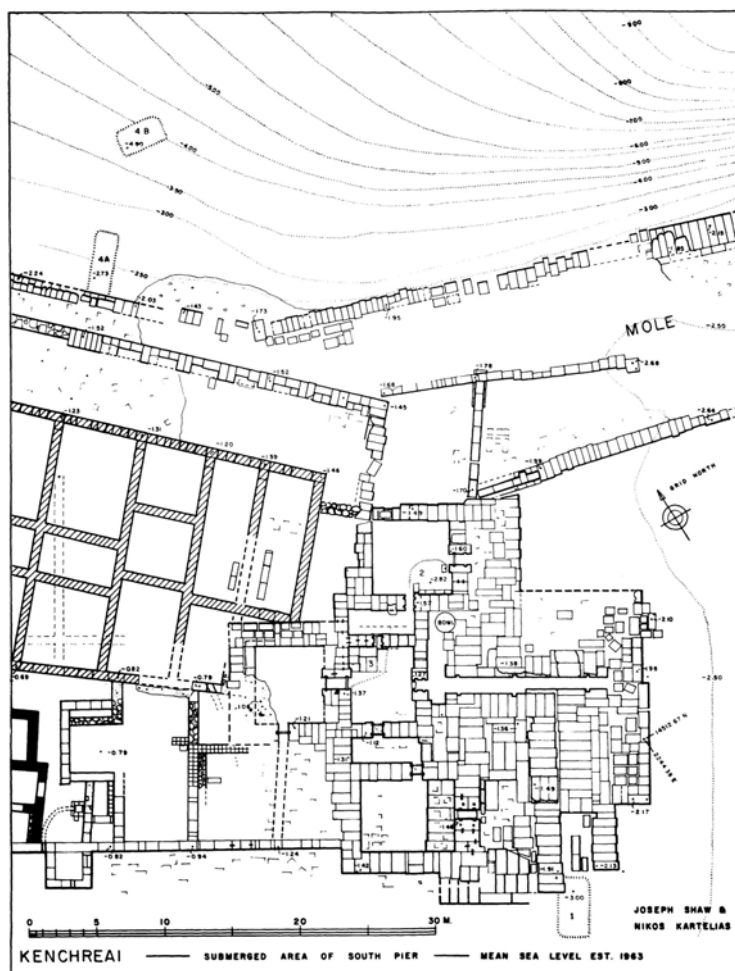


Fig.3.82. Plan of the ancient remains excavated and documented in the area of the Southern Mole and Pier (Shaw 1967, Fig.3).

cover a total area of about 22,100 m² (Figs.3.80 & 82; Scranton et al. 1978, 17). The mole measures 130 x 25 m. Similar to the Northern Mole, it suffered considerable subsidence and erosion and its seaward end lies today at a depth of 10-15 m. The mole supported a low quay comprising of three ashlar walls that survive at its western end (Fig.3.82). The middle one stood slightly higher than the northern one, probably to allow for the better draining of

rectangular building complex was excavated and was identified with the sanctuary of Aphrodite, mentioned by Pausanias (Fig.3.81).⁷⁵⁷ Limited remains show that the sanctuary was operating already in the Hellenistic period.⁷⁵⁸ In Roman times two buildings were erected, both with central peristyles and facing the harbour through a colonnaded portico.⁷⁵⁹ The organisation of the buildings has little in common with the warehouses of the Southern Pier of the harbour (see below) and served either as dwellings or as worship spaces.⁷⁶⁰

The submerged remains of the Southern Mole and Pier

⁷⁵⁷ Scranton et al. 1978, 79-90.

⁷⁵⁸ Very few remains can be dated before the Roman period: these are located at the area's western half and belong to buttress or bench walls of what seems to be enclosures. In Hellenistic times the two-room "pillar building" was erected, surrounded by what appears to be an enclosure wall or a platform. It would be interesting to see the building as an early harbour facility standing on a wide dock or platform, the remains are, however, very poor and the building was most probably related to the cult of Aphrodite.

⁷⁵⁹ The buildings witnessed many changes and re-organisations and survived the destructions of the late-4th century CE when a tower or lighthouse was built at its southern corner, its impressive remains standing until today.

⁷⁶⁰ The layout of the buildings at the northern side of the harbour resembles domestic spaces. This has led the excavators to interpret them not as temples but as *oeci* of worship (Scranton et al. 1978, 88-90).

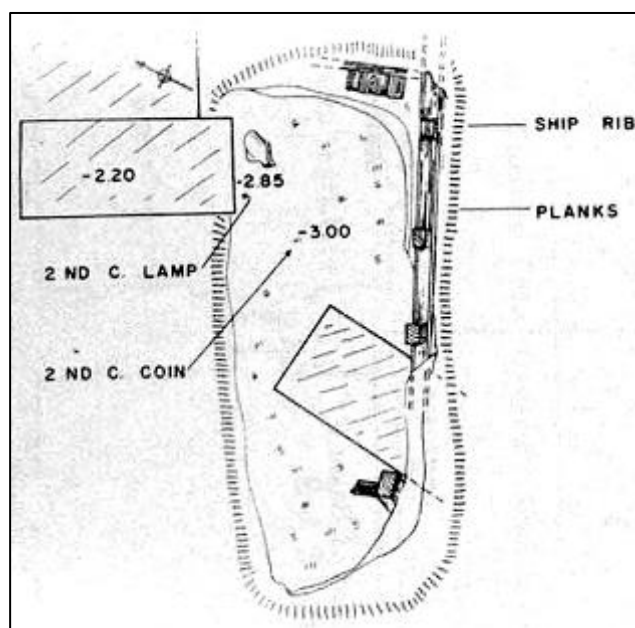


Fig.3.83. The wooden remains of a shipwreck or a wooden pier structure at the area of the Southern Pier (Shaw 1967, Fig.4I).

water and spray (Fig.3.79A). The Southern Mole was a continuation of the Southern Pier, which can be traced for about 70 m from the mole but it appears to have originally extended for c.100 m, up to the point where it turned towards the north, following the curve of the shore (Fig.3.80). Two stratigraphic trenches opened in the area north of the pier showed the existence of the “dump” layer.⁷⁶¹ A unique find in front of the Southern Pier was the remains of a ship or a wooden structure (Fig.3.38).⁷⁶²

Although the excavators concluded that this was a small ship lost or scuttled during the construction of the pier, no curvature was observed on its remains and it is possible that it was originally part of a caisson or pile construction erected next to the ashlar quay, possibly in the 2nd or 3rd century CE.⁷⁶³ No other wooden remains were located elsewhere in the harbour.

⁷⁶¹ Scranton et al. 1978, 133-8. In the northern trench (Trench IVB-C) and a depth of 5.15-6 m a large ashlar block not in situ and resting in a pre-Roman layer was identified as part of the Hellenistic harbour (Scranton et al. 1978, 133-8). Nevertheless there is no indication that the block was in situ.

⁷⁶² Scranton et al. 1978, 132-3. The remains, with only their upper part exposed due to the hardness of the debris around it, appears to have preserved the frames of a ship and part of its shell in two parts. Bronze clenched nails secured the frames to the planking. Unfortunately no parts of the wood were removed nor any photographs published and the only documentation of the find is in one plan of the trench (Scranton et al. 1978, Fig.15.I).

⁷⁶³ No remains of any maritime concrete were reported during the excavation, but it is possible that they remained unnoticed by the excavators due to the compactness and hardness of the surrounding filling.

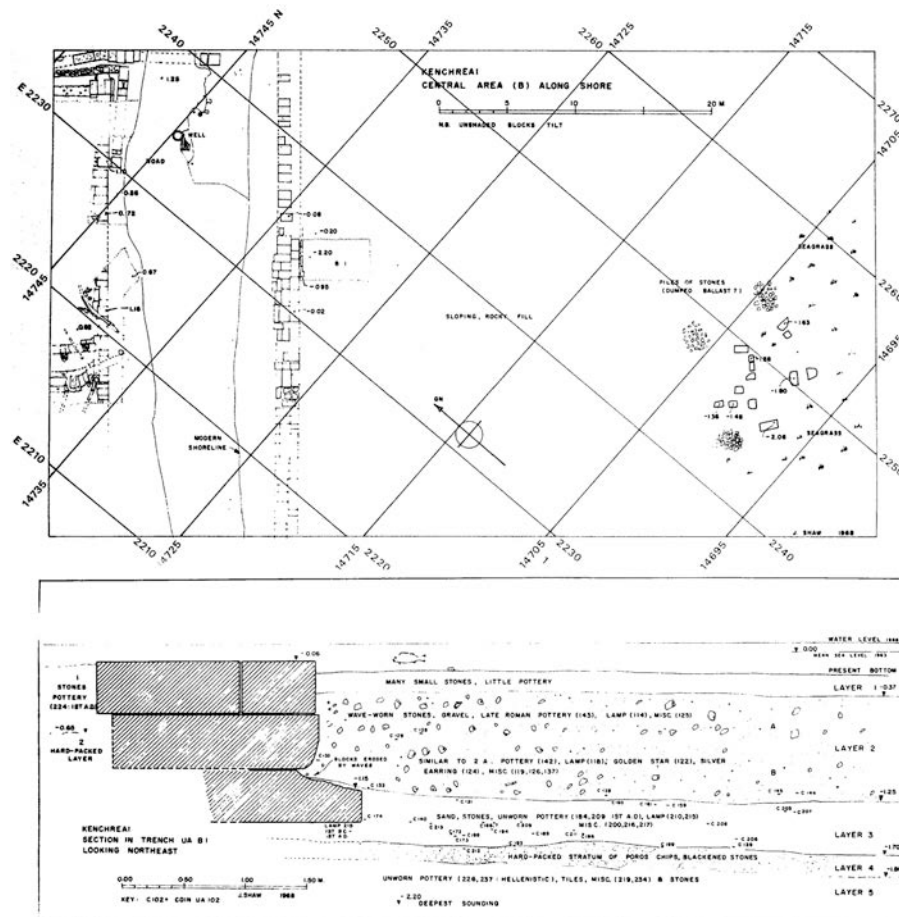


Fig.3.84. Excavation plan of the Central Quay of Kenchreai (top) and cross-section of the trench in front of the quay (bottom; Scranton et al. 1978, Figs.21-2).

Several buildings stood at the Southern Mole's western end (**Fig.3.82**). The first was the large *piscinae* (fish tanks) complex, an impressive structure, built with large limestone and porous blocks, covering an area of 615 m² and comprising of at least six basins, connected with channels.⁷⁶⁴ Right next to the *piscinae* the long series of warehouses (*horrea* or *tabernae*) began. The complex was originally more than 175 m long, as shown by test trenches on land, and had a trapezoidal plan following the orientation of the pier and the urban grid of the city. Each warehouse was about 5.2 m wide and divided into two or three rooms open towards the seafront. As indicated by the overall plan and construction method, they were built simultaneously.⁷⁶⁵ Other structures were located behind the warehouses, amongst which an apsidal building, embellished with marble revetments, identified with the

⁷⁶⁴ Scranton et al. 1978, 25-33. Kolaiti & Mourtzas (2016, 76) have criticized the view that the complex was a fishpond, basing their arguments on the sea level, which they consider it was 3.25 m lower than today in the 1st century CE and have suggested that the structure could have been the hypocaust of a bath.

⁷⁶⁵ Scranton et al. 1978, 39-46.

sanctuary of Isis mentioned by Pausanias.⁷⁶⁶ The north-western end of the southern pier was marked by the “Threpsiades’ building”,⁷⁶⁷ a peristyle edifice, probably of commercial use, dated to late antiquity. The building firmly followed the urban planning of the rest of the city and of the quay esplanade (**Figs.3.77**).

Finally, the middle of the bay was also equipped with an ashlar quay that ran along the shore, of which 40 m was excavated, along with some remains of the buildings that stood beyond it. The quay consisted of a three-course retaining wall (**Fig.3.84**). According to the stratigraphy it was built on natural soil about 2 m above the early Roman sea level. Thanks to the abundance of small finds, especially coins, the quay can be dated in the middle of the 1st century CE.⁷⁶⁸ Trenches opened on the shore behind the quay showed that a series of buildings stood there, parallel to the waterfront and belonged, most probably, to private houses.

It is unlikely that the harbour was marked by a lighthouse in antiquity. There are no remains of any such structure and none is depicted on the 2nd-century CE coins. Ships arriving from the east could easily locate it by using the high and steep Onia ridge that lies to its south (**Figs.3.74-5**) and the Acrocorinth, which lies at a distance of about 5 km behind it and is visible from the open sea. Other possible landmarks would have been the bronze statue of Poseidon described by Pausanias and depicted on coins as standing on the shore or on one of the moles⁷⁶⁹ or some of the large funerary monuments from the Northern Ridge cemetery.⁷⁷⁰

Thanks to the systematic excavation and the abundant material recovered, a chronology for the development of the harbour was established. Although the site is

⁷⁶⁶ Paus.2.2.3; Scranton et al. 1978, 53-78. The sanctuary built just after the completion of the warehouses, received many renovations and changes during the Roman period and was most probably destroyed in the earthquakes of the late 4th century CE, to be replaced later by a 6th-century Christian basilica. No ancient remains are to be located south of the abovementioned buildings, but only a wide shallow coastal zone filled with debris and scattered ancient finds most probably belonged to ancient reclamation and originally supported buildings of the Roman and the early Byzantine period.

⁷⁶⁷ Heath et al. 2015. The building, named after the lot’s modern owner, was not excavated by the Kenchreai first research project but was revealed during salvage excavations conducted by the Greek Archaeological Service in 1976. The excavation was resumed in 2014 and concluded by the American Excavations at Kenchreai.

⁷⁶⁸ A thin compact layer with a few Hellenistic sherds located at a depth of 1.70-1.80 m from the modern seabed belonged most probably to the coast of Hellenistic times, but no architectural finds were reported there.

⁷⁶⁹ The statue has been tentatively reconstructed as standing on the end of the Northern Mole in **Fig.3.80**.

⁷⁷⁰ Wilson Cummer 1971; Korka & Rife 2013, Fig.8.

mentioned by Pseudo-Skylax in the second half of the 4th century BCE,⁷⁷¹ the use of the harbour in the pre-Roman period is attested only by some pottery and scattered ashlar walls, not related with any harbour works.⁷⁷² The great majority of the harbour structures, including the moles, quays and warehouse complex, belong to the Roman period, from the re-establishment of Corinth by the Romans in 44 BCE and until the end of the 1st century CE.⁷⁷³ The long duration of this building phase indicates that the harbour works of Kenchreai took several decades to be concluded and this is probably the reason why Strabo, in the early 1st century CE, mentions the site as just a *κώμη*, small town or village.⁷⁷⁴ Towards the end of the 1st century CE the *piscinae* complex is dated. The complex was used (if used at all) for a very short period before it was backfilled and became part of the quay. Limited works were executed in the 2nd century CE, including the pavement at the end of the Northern Mole. No other harbour work was added in any later period. The moles were submerged, either abruptly or gradually, by 400 CE. The city continued to be inhabited and the harbour used, with a watchtower at the northern building, a basilica on the southern mole and the “Threpsiades’ building” being erected before the site’s final abandonment towards the end of the 6th century.⁷⁷⁵

The simple configuration of the harbour of Kenchreai allows a rather straightforward reconstruction of its original form in antiquity. The coast was a sandy beach, with a width from 15 m at the basin’s northern end to 44 m its centre. The ashlar quays stood well above the ancient sea level, as the elevation of the remains at the harbour’s centre and Northern Mole indicate, thus they operated mainly as retaining walls and not as docks. The situation was slightly different at the area of the Southern Mole, where, due to the nature of the rubble foundation, the inclination was much steeper and the quay was built nearly in contact with the sea (**Fig.3.88**).⁷⁷⁶ Although, according to the thickness of the “dump”, the south-

⁷⁷¹ Pseudo-Skylax, *Periplus* 55.

⁷⁷² Scranton et al. 1978, 87. The total lack of any pre-Roman tombs in the thoroughly surveyed area also indicates that no important settlement existed at Kenchreai before the end of the 1st century BCE (Rife et al. 2007, Fig.2).

⁷⁷³ Scranton et al. 1978, 37.

⁷⁷⁴ “Lechæum is the commencement of the coast on one side; and on the other, Cenchreæ, a village with a harbour, distant from the city about 70 stadia. The latter serves for the trade with Asia, and Lechæum for that with Italy” (Strab.8.6.22).

⁷⁷⁵ Stiros 2001, 559; Rothaus et al. 2008.

⁷⁷⁶ According to the cross-sections supplied by the excavators, the Southern Pier was founded at a depth of more than 2.5 m and was under sea level during the 1st century CE. However, beyond the fact that constructing such a well-defined ashlar wall would have been impossible under water, the whole of the

western area of the harbour was up to one metre deeper in the 1st century CE, it is difficult to establish for how long this depth was maintained before debris was accumulated and what its extent was. Not surprisingly, the thickness of this layer was greatest in front of the warehouse complex where ship and cargo traffic was likely most intense.

3.3.3. Ships and cargoes in the harbour of Kenchreai

Kenchreai was Corinth's main gateway towards the Aegean and the eastern Mediterranean. The importance of the trade with the east is shown through a series of finds in the city. A steady inflow of eastern pottery, including many transport amphorae, is evident throughout the Hellenistic and the Interim Period.⁷⁷⁷ With the creation of the Roman colony in 44 BCE these imports continue, although the early colonial elite of Corinth appears to have formed commercial links with Asia Minor.⁷⁷⁸ An additional eastern import was building material, as suggested by the use of Prokonessian marble at the Great Bath of the Lechaion road in the 2nd century CE.⁷⁷⁹ Written sources clearly document Kenchreai as an important harbour in the 1st and 2nd century CE and a thriving commercial centre (Dio Chrysostom and Apuleius, see above). It was also where Saint Paul set sail for Syria in 52 CE, after founding the local Christian community.⁷⁸⁰

harbour's southern structures are located much lower than the structures at the centre and the north part of the harbour and it is very likely that the area has suffered considerable erosion or subsidence.

⁷⁷⁷ Salmon 1984, 144; Lawall 2006; James 2010, 220.

⁷⁷⁸ Slane 1989; 2000; Spawforth 1996.

⁷⁷⁹ Biers 1985, 3; Concannon 2017, 75.

⁷⁸⁰ "Paul, having stayed after this yet many days, took his leave of the brothers, and sailed from there for Syria, with Priscilla and Aquila with him. He shaved his head in Cenchreae, for he had a vow" (*Acts* 18.18); "I commend to you Phoebe, our sister, who is a servant of the assembly that is at Cenchreae, that you receive her in the Lord, in a way worthy of the saints, and that you assist her in whatever matter she may need from you, for she herself also has been a helper of many, and of my own self" (*Rom.* 16.1-2).

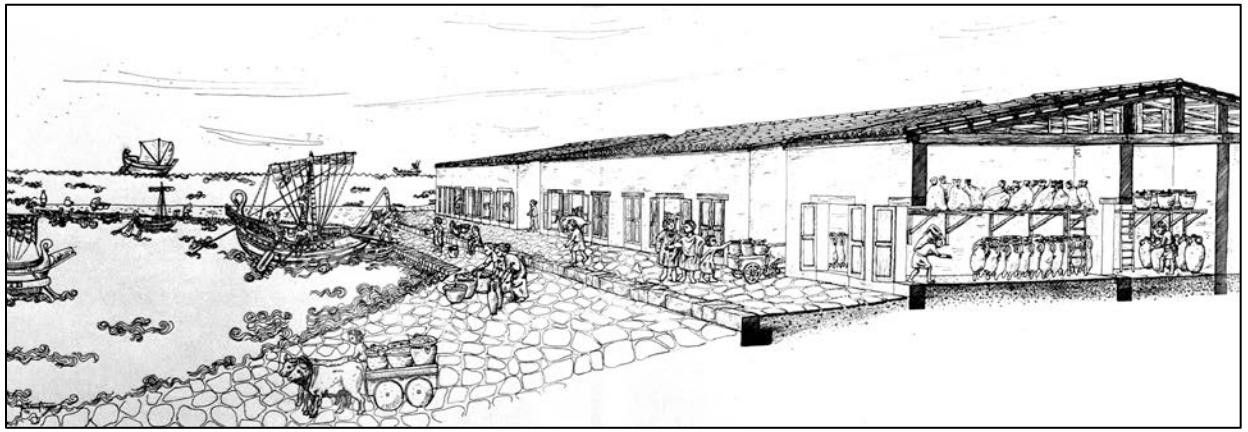


Fig.3.85. Artistic reconstruction and cross-section of Kenchreai's Southern Mole and Pier and warehouse complex (Scranton et al. 1978, front piece).

Despite the importance of Kenchreai as a commercial harbour, archaeological and epigraphic data do not point towards it being a cosmopolitan and multicultural harbour like Delos. The extended remains of the city cemeteries of the 1st and 2nd centuries CE, as well as personal names documented in funeral inscriptions, reveal a homogenous society comprised mainly of Italians and Greeks.⁷⁸¹ Although Italian merchants and freemen from Delos did move to the Peloponnese before or after the destructions of 88/69 BCE, none of them appears to have been active at Kenchreai or Corinthia in general.⁷⁸² The worship of foreign deities like Isis in Kenchreai is equally not unusual, since it was already common amongst the Mediterranean populations before the Roman conquest and not an actual sign of the presence of foreigners. What tomb finds do reveal, however, is the existence of a wealthy elite, whose income would have largely come from the exploitation of the harbour through trade and the serving of the multitude of passing mariners, travellers and pilgrims, as described by Dio Chrysostom.⁷⁸³ Roman Kenchreai was most probably established as part of the Roman colony of Corinth with a Roman-Greek population that took over the profitable management of the busy harbour. The harbour never had the exceptional circumstances of Roman Delos (a free port and an important cult centre) and thus never attracted foreign settlers at least in any great numbers. But the role of Corinth as a commercial, religious and cultural centre of Roman Greece and the thorough planning of Kenchreai underlines the importance of the harbour city as a centre of trade and commerce even without the presence of a multinational population.

⁷⁸¹ Rife et al. (2007, 176) and Korka & Rife (2013, 293) suggested that Roman Kenchreai was a multinational city, but fail to give any evidence for it, beyond the existence of an Italian and a Greek community in the city. In only one occasion the name of a Greco-Roman athlete from Sardeis as well as a Roman veteran is mentioned in an inscription from Kenchreai (Rizakis et al. 2001, 334, no.338).

⁷⁸² van Berchem 1962; Rizakis et al. 2004, 418, no.639.

⁷⁸³ Dio.Chr.37.8. Cf. Rife et al. 2007, 175.

Direct evidence related to the actual numbers, tonnage and types of ships frequenting Hellenistic and Roman Kenchreai is very scarce. No ancient shipwrecks have been reported from the seas around the harbour. Nevertheless, the sheer size of the warehouses excavated in the harbour's southern area (they covered an area of at least 4,500 m²) clearly shows a thoroughly organised effort to accommodate and control large quantities of goods in what appears to have been a public building. The thorough cleaning of the warehouses was what created the thick "dump" layer in the sea in front of them (see also below **3.3.5**).

Although it is difficult to ascertain the tonnage and nature of the merchandize arriving and leaving Kenchreai, several clues point towards bulk cargoes. The large warehouse complex facing the seafront would be ideal for the long or short-term storage of bulk goods like grain, olive oil or wine that were exported and imported. Unlike Lechaion, Kenchreai could have operated as a stop for ships on their trip from east to west or from north to south and vice versa. With the harbour facing the east, where substantial part of grain provisioning came from, it would make perfect sense for bulk grain cargoes to be handled at Kenchreai and either diverted towards Corinth for local consumption and reshipment through Lechaion, or sold and transferred to other ships in the harbour itself. Local agricultural products would also be exported from Kenchreai, although their exact amount cannot be estimated. Fine and coarse pottery must have likewise been traded in large quantities, as the amount of pottery sherds discovered in the "dump" indicates. Furthermore, Kenchreai was a maritime city with a considerable population,⁷⁸⁴ equipped with a local market serving the city itself, Corinthia and Peloponnese in general as well as the provisioning of passing ships, their crews and passengers.

The harbour must have also operated as the end of the land road for the transshipment of goods from the Saronic to the Corinthian gulf. Like Lechaion, the harbour is not located close to the diolkos tramway, but at a distance of about 4 km from its eastern end. The connection with the diolkos remains problematic, since no direct road appears to have lead to the ancient track way but instead the main roads from Kenchreai led either directly to Corinth or to Isthmia (**Fig.3.74**). It is very possible that by the Roman Imperial

⁷⁸⁴ It is very difficult to calculate the population Roman Kenchreai had, during its years of prosperity, since only a portion of the ancient city has been excavated and it remains unknown which part of the urban area was actually inhabited or taken by warehouses like the ones excavated at the city's southern end.

period the *δίολκος* was already out of use (at least for merchant ships and their cargoes), which made the authorities establish the harbour of Kenchreai at this specific point and not closer to the Isthmus. But even without the use of the diolkos Kenchreai and its deep and well-sheltered harbour still stood at one of the ends of the important and busy land route connecting the Saronic and the Corinthian gulf and facilitated the development of Corinth into the wealthy commercial centre that “held the keys” of the Peloponnese, as Strabo cleverly points out.⁷⁸⁵

As noted above, marble from the east was most likely imported through the harbour of Kenchreai.⁷⁸⁶ A similar cargo that must have been exported from Kenchreai was the local stone. An extended ancient quarry of oolitic limestone has been detected to the northwest of the ancient city.⁷⁸⁷ The export of this type of stone to places on the eastern coast of Peloponnese like Epidaurus has been documented in inscriptions and it is almost certain that this would have been done via the sea, since ship transportation was more convenient and cheaper in antiquity.⁷⁸⁸ Unfortunately, no archaeological or written evidence testify the exact ways stone cargoes were shipped from and to Kenchreai.⁷⁸⁹

There are no ship images surviving from the harbour of Kenchreai. The stylised miniature depictions on the coins (**Fig.3.78**) can give no actual information on the type of ships reaching the harbour.⁷⁹⁰ The discovery of a possible shipwreck next to the Southern Pier could be an indication for the form and size of ships frequenting the harbour, but the information provided by the excavators gives little evidence about it. Shipbuilding activities have not been attested at Kenchreai either, despite the north-eastern Peloponnese having access to extended forests that could have provided good shipbuilding timber and the wide beach at the centre of the bay could have easily been used for the construction and repair of

⁷⁸⁵ Strab.8.6.20.

⁷⁸⁶ A variety of stones and glass was used for the 4th-century CE *opus sectile* panels from Kenchreai and other similar works from Corinth. The analysis undertaken by the excavators, however, did not provide any data on their provenance (Scranton et al. 1976, 252; Oliver 2001).

⁷⁸⁷ Scranton et al. 1978, 8, 79; Hayward 2003, 28-9.

⁷⁸⁸ Hayward 2003, 31; Russell 2013a, 110-40.

⁷⁸⁹ The on-going study of the extended local limestone quarries will hopefully provide new evidence on the transport and export of the stone through the harbours of Corinthia (Hayward pers. com.).

⁷⁹⁰ The images of several sailing ships have been preserved on the 4th-century CE glass panels found at Kenchreai (Scranton et al. 1976, Dr.XVI-XVII, Figs.89-102). These images belong, however, to an idealistic ‘sacro-idyllic’ rendering of a monumental seaside or riverside city related, according to some, with the cult of Isis (Scranton et al. 1976, 267-9), that cannot be in any way considered a representation of Roman Kenchreai (of which the panels are much later) and are too stylized to provide any further information on the form and size of these ships (Bruneau 1981, 116-8).

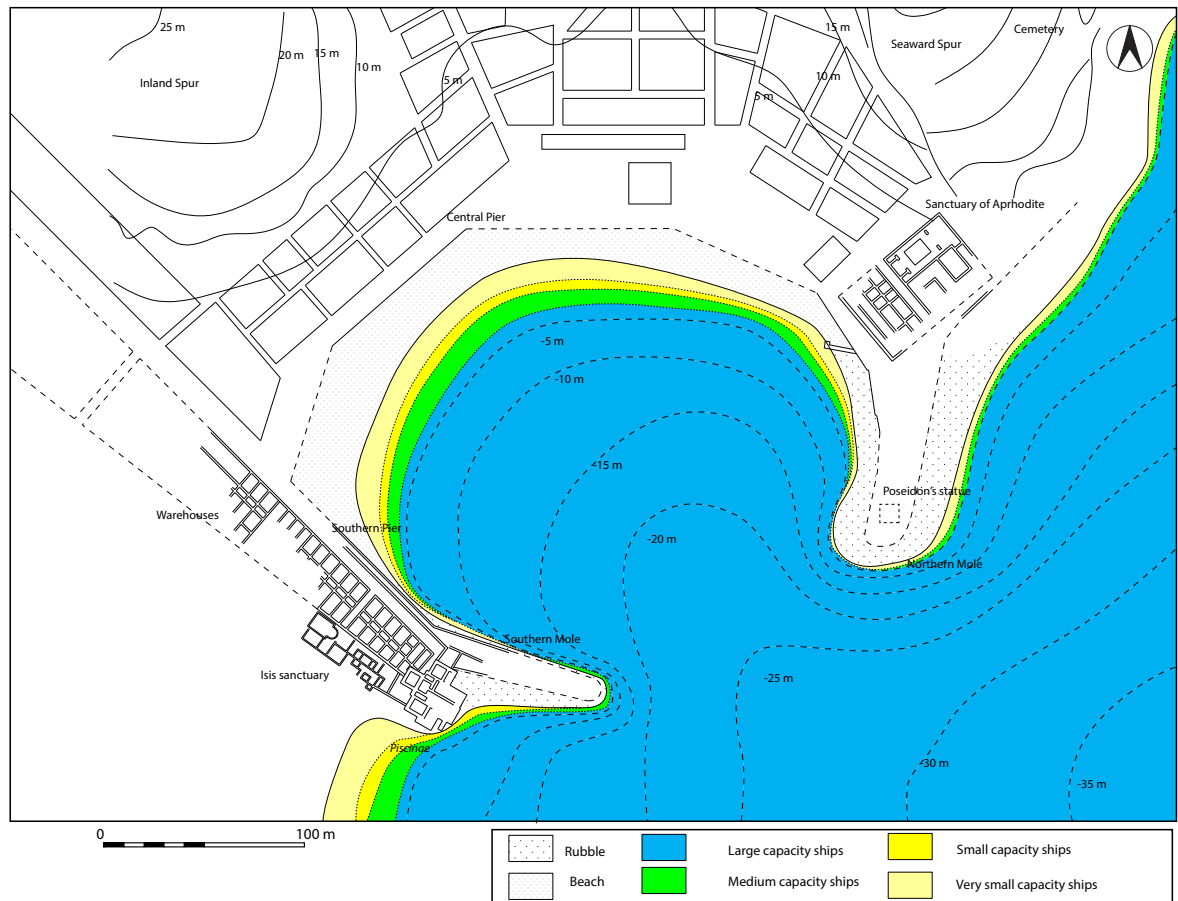


Fig.3.86. Reconstruction of the harbour of Lechaion with colour indications of the various areas approachable by ships of various capacities (drawing by the author).

ships. Finally, there is no evidence to any military use of Kenchreai.⁷⁹¹ No shipsheds have been located in the harbour and there are no references to any naval unit being stationed there or using it as a base, even during the Hellenistic period when Corinth still maintained a naval fleet.

3.3.4. The capacity and operation of the harbour

The ancient harbour of Kenchreai presents a quite simple and coherent configuration, with a deep, although relatively small basin protected by wide and strong rubble breakwaters and surrounded by continuous ashlar piers. As will be discussed below, the basin offered ample

⁷⁹¹ Little has survived from Kenchreai's defences. Pseudo-Skylax's mentions a fort at Kenchreai in the 4th century BCE (*Periplus* 55, but no archaeological remains of such an establishment have yet been located. Some poor remains of walls on the Seaward Spur have been tentatively interpreted as parts of a fortification wall by Scranton et al. (1978, 6-7) and Rife et al. (2007, 160), but the site might as well have been left unfortified during the Roman period.

space and depth for the accommodation and circulation of various types of ships, combining a sandy beach with steeper rubble jetties and deep quays.

Harbour capacity and methods of using the harbours

According to the reconstruction of the Kenchreai basin (**Fig.3.86**), it could accommodate ships of even great capacity, but cannot be considered a very big harbour in terms of its size. The basin originally covered an area of about 32,000 m² and, according to the bathymetry, a maximum of 45-95 ships of large, 100-230 ships of medium, 180-455 ships of small or 500-2,000 ships of very small capacity could be accommodated in it. These numbers would have been slightly higher, especially for ships of large and medium capacity, if we add 0.4-9 m of depth to the basin, at its south-western part where the “dump” layer was created. It is, however, questionable whether this would have made a big difference to the overall capacity of the harbour and for a long period, especially since it appears that the “dump” layer began to be created as soon as the Roman harbour started operating in the 1st century

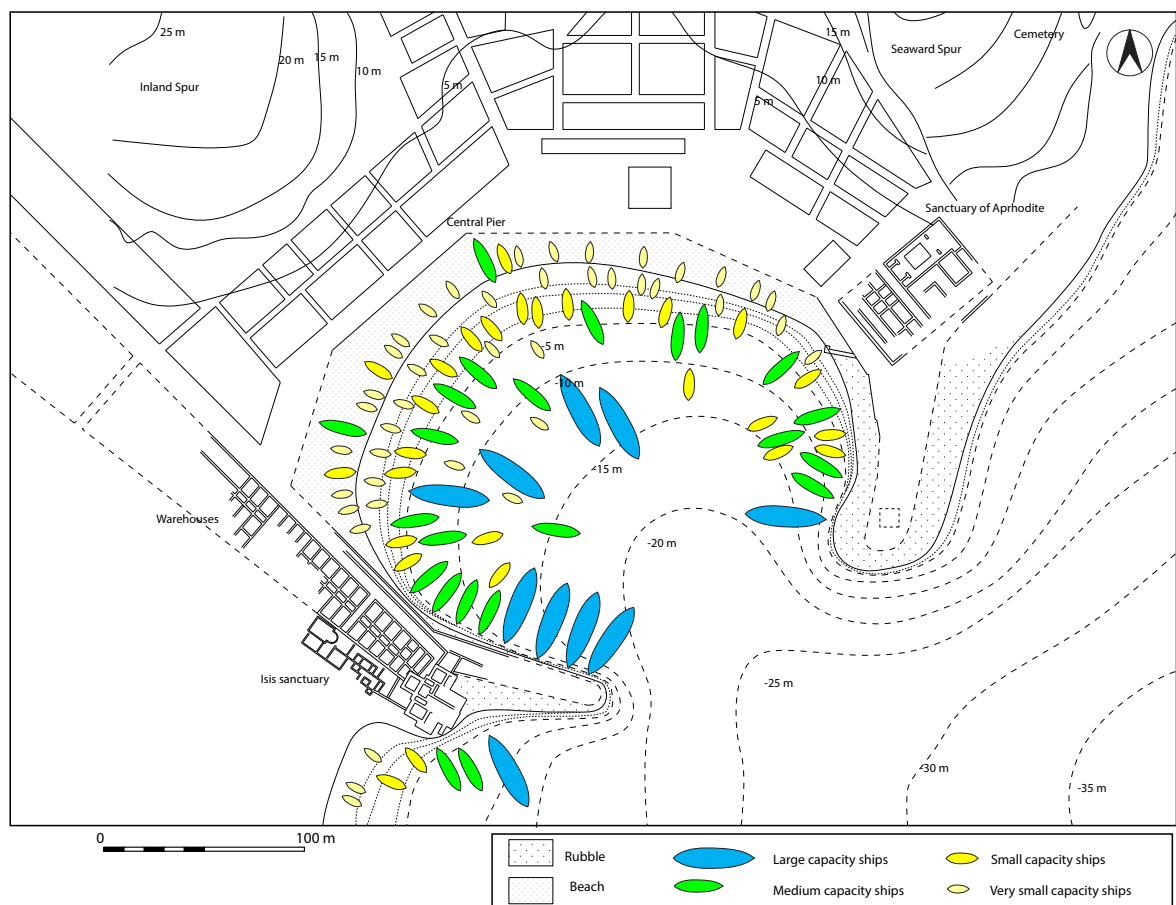


Fig.3.87. Reconstruction of the harbour of Lechaion with indications of its possible use by ships of different size (drawing by the author).

CE and was limited only to the harbour's south-western corner. As with the other case studies examined, the actual numbers of ships inside the harbour must have been much smaller, since enough space would have to be left for safety reasons and for the circulation of any kind of vessel. According to the reconstruction suggested in **Figs.3.86 & 87**, a maximum of about 10 ships of large, 20 ships of medium, 25 ships of small and 30 ships of very small capacity could be simultaneously accommodated inside the harbour basin. It is very likely that only about five large capacity ships could enter the harbour and anchor there without causing considerable trouble in vessel circulation (see below).

Anchoring was a method that could be easily employed in the harbour of Kenchreai. The basin was deep enough and unobstructed by any natural or artificial features and could accommodate large and small ships even at a close distance to the moles (**Figs.3.87**). A potential drawback would have been the soft, sandy seabed, which could cause anchors to drag during storms or gales, but the harbour was well sheltered by the two moles and only if the wind was southeast, a rear occurrence in the region, would it push ships towards the shore. But even if ships were uncontrollably dragged towards the bay's centre they did not run the danger of crashing on stone structures or rocks since the area was covered by a wide sandy beach. Thanks to the steepness of the rubble moles, ships could anchor very close to them for better protection and easily load/unload their cargoes using lighters. Anchoring close to the moles would have, nevertheless, been potentially hazardous, due to the presence of the rubble foundation, so ships would have to keep a safe distance and be firmly secured with multiple anchors.⁷⁹²

⁷⁹² The meticulous survey of the harbour did not locate any ancient anchors. This, however, should not be surprising, since the survey and excavation was focused on the shallower areas where ships would not use anchors, but any lost would also have been largely covered by the "dump" layer.

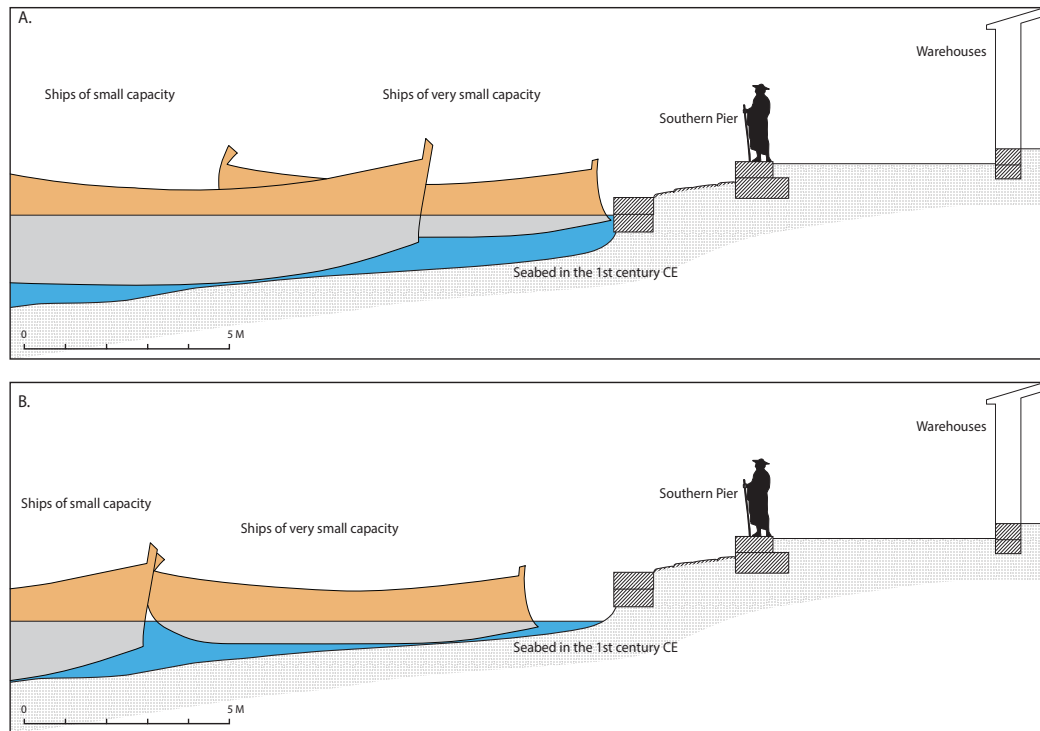


Fig.3.88. The two different reconstructions of the Southern Pier, with indications of the ships that could approach it. A: Reconstruction of the height of the pier and the depth of the sea bottom according to the suggestion of Scranton et al. 1978, Pl.13. B: Reconstruction of the height of the pier and the depth of the sea bottom according to the hypothesis that the pier was at the same height as the Central quay (drawings by the author based on Scranton's plan).

The beach of Kenchreai, stretching between the two artificial moles, offered adequate space for the beaching of a number of vessels (**Fig.3.80**). The 335-m long, sandy and uninterrupted beach at the centre of the bay allowed a maximum of 22-40 ships of large, 37-47 ships of middle, 47-57 ships of small or 74-167 ships of very small capacity to be beached along it. The sandy seabed and lack of reefs, shoals or beachrock formations made the approach and draught beaching even easier. Through this cargoes unloaded from ships and lighters could easily reach the low quay and the 10-m wide seaside esplanade and be stored in the city warehouses (**Figs.3.85-6**) or transported to other storage spaces in the city, or even to Corinth and Lechaion. The area was protected by the northern ridge and the two great moles from winds and spray (see below) and loading and unloading lighters and small capacity ships would have been easy. This would also greatly assist the handling of cargoes from ships of large capacity, which could, as noted above, anchor in the deep bay and at a close distance to the beach and employ lighters. It is unlikely that beaching was practiced around the moles, since the steep inclination of the rubble foundations would have

prevented the accumulation of sand and the hard material used for their construction was totally impractical for beaching.

Finally, thanks to the relatively great depth and steepness of the seabed in front of the Southern Mole, a number of ships might have also used the structure as a dock. The mole, however, has been severely distorted by subsidence and erosion and it is therefore difficult to ascertain how many ships and of what capacity could dock there. The length of the mole from the beach was about 120 m and could theoretically accommodate 8-15 ships of large, 13-17 ships of medium, 17-24 ships of small or 26-60 ships of very small capacity. It is unlikely that ships of large or medium capacity could approach the quay at the shallower western end and only its eastern end could possibly allow some to dock on it, depending on the width and slope of the rubble foundation (**Fig.3.87**). No mooring devices have been located anywhere in the harbour. The external (southern) façade of the mole could not probably accommodate any ships beyond vessels of very small capacity since, according to the bathymetry, was too shallow and exposed. The Northern Mole was less steep and a strip of beach or rubble most probably divided the quay from the sea, not allowing the docking of any ship there, but its state of preservation is not good enough to ascertain its original form and function.

The moles could have also facilitated the loading and unloading of heavier cargoes like stone and marble. Thanks to the steepness of the rubble foundation and the existence of the ashlar quays, which formed a wide and stable platform, there was enough space to set and operate even large cranes in order to unload/load heavy cargoes from the ships docked at the moles. The wide quays were also connected with the seaside esplanade running along the bay and the road network of the city and its hinterland, allowing the easy transportation of such cargoes.

Finally, the long sandy beach extending to the south of Kenchreai's city and harbour could also have operated as an auxiliary harbour, mostly for smaller ships. The straight beach, although not very well protected from the sea, offered ample space for the beaching of small vessels or the operation of a shipyard. No buildings have been located on the shore, however, and the existence of a seaside necropolis show that the area was clearly outside the limits of the ancient city.⁷⁹³

⁷⁹³ Rife et al. 2007, Fig.2.

Approachability and circulation

The single basin of the harbour of Kenchreai was a very convenient place for the approach and circulation of vessels. It had a 140-m wide and more than 20-m deep opening, allowing ships of every size to easily enter (**Fig.3.86**). At the basin's centre ships of great capacity could approach the shore at a distance of 30 m, ships of medium capacity at a distance of 20 m and ships of small capacity at a distance of 10 m (**Fig.3.89**). Around the moles, thanks to the steepness of the rubble foundations, ships of large and medium capacity could approach the shore at a distance of about 5 m and ships of small capacity at a distance of 2-3 m, although these numbers are speculative, due to the poor preservation of the moles' original height and form (see above).

The circulation of ships in and around the harbour must have been very easy. With the sea being deep enough and without any islets, reefs or shoals to hinder ship movement, mariners could safely navigate the coast and enter the harbour directly through its wide and deep entrance. Inside the basin, with deep waters reaching very close to the shore (**Fig.3.89**), circulation was equally easy and ships could be accommodated either in the shallower middle of the basin or next to the moles and navigate without considerable problems, provided traffic was not too dense or that it was cautiously controlled by the harbour authorities. However, the harbour, while adequately deep, was not spacious enough to allow the accommodation and circulation of a great number of large capacity ships. Only few vessels with a length of 30-40 m would have enough space to manoeuvre inside the basin without hindering the anchoring and circulation of other smaller ships (**Fig.3.87**). In case of increased ship traffic, such ships would have probably anchored in the open sea outside the harbour.

3.3.5. The handling of ships and cargoes

Kenchreai can be considered, in a way, a 'model' harbour. Combining the qualities of a sandy beach, a deep basin, a well-sheltered anchorage and a thoroughly organized urban settlement with substantial storage facilities. It was a harbour fit for the efficient traffic of

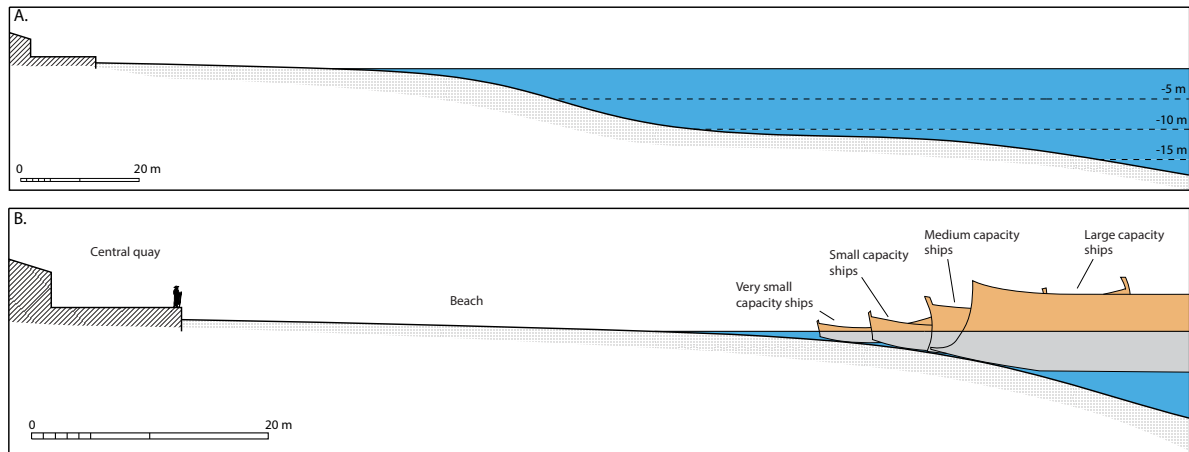


Fig.3.89. Cross-sections of Kenchreai's Central Quay as it was in antiquity. A: Cross-section of the whole harbour, according to the bathymetry supplied by Scranton et al. 1978 and with the subtraction of 2 m of water. B: Cross-section of the beach in front of the Central Quay, according to the stratigraphy trench (Fig.3.84) and with the addition of ships of different size (drawing by the author).

ships and cargoes and could serve both large numbers of ships of every capacity, as well as large quantities of bulk cargoes and travellers, as described by Dio Chrysostom.⁷⁹⁴

Protection and exposure

Kenchreai was one of the best-protected harbour sites of the Aegean, thanks to the selection of the site and the creation of the two moles. These were simultaneously constructed and under the same scheme of urban planning and created a very safe basin facing south-east and protected from the prevailing northern winds and shore swell by the Northern Mole and from the potentially dangerous southern winds by the Southern Mole. The size of the moles and their sturdy construction indicates that they not only created spacious esplanades on top of them but were high and wide enough to protect the basin from waves, winds and spray. The width of the rubble foundations also depleted the force of waves before reaching the quays (the refraction principle) and secured the structures' stability.⁷⁹⁵

The main problem concerning adverse sea conditions in Kenchreai harbour must have been its exposure towards the southeast. Although winds from this direction are not common in the region, they could be destructive for the ships in the harbour, which would either have to be secured well with anchors and cables, beach themselves within the basin

⁷⁹⁴ D.Chr.37.8.

⁷⁹⁵ King 1972, 96-8; Morton 2001, 31-3.

or move to the open sea.⁷⁹⁶ With written evidence being scarce it is difficult to verify if Kenchreai harbour was ever afflicted by any sudden storm like the one that brought chaos in the harbour of Delos in the 2nd century CE and is described so vividly by Aelius Aristides.⁷⁹⁷ The “dump” layer and the concentrations of ballast stones discovered within the harbour basin could be indications of lost ships, but they could have equally been remains of discarded broken pottery and ballast lost during transportation or dumped as ships were cleared from deficient material.⁷⁹⁸ The intense and uninterrupted use of the harbour indicates that Kenchreai remained a safe and comfortable anchorage for ships between the 1st and the 3rd century CE and it seems that it was the earthquakes of the 4th century CE or a gradual subsidence that caused the destruction of the great moles and left the basin unprotected, leading to the final decline of the harbour and the city.⁷⁹⁹

The handling of cargoes

Several suggestions can be made concerning the handling of cargoes within the harbour of Kenchreai. If the beach was used by lighters only for unloading bigger ships, then something between 600 and 1,670 tons (by considering that 74-167 lighters could use the beach, each carrying 8-10 tons of cargo) could be landed on each lighter trip simultaneously. More cargoes could be unloaded on the moles, especially the Southern one, and it would not be irrational to suggest an extra 500-1,000 tons, depending on the size of the ships they could dock there or the lighters that could use them. These numbers, of course, represent the maximum that the harbour could handle in the ideal scenario that the highest possible number of ships and lighters would be accommodated there. But whatever the amount of merchandise reaching the shore was, how could it have been handled afterwards?

In contrast to Lechaion, Kenchreai has revealed large part of its harbour infrastructures, which also include the massive warehouse complex, covering an area of more than 4,500 m². The fact that Kenchreai could be used, thanks to its location, both as a terminal harbour for ships supplying Corinth and the Peloponnesian hinterland, as well as a stop where cargoes were transhipped, is mirrored in the construction of these warehouses.

⁷⁹⁶ Hohlfelder 1985, 84.

⁷⁹⁷ Ael.Ar. *Sacred Tales*, D.32–7.

⁷⁹⁸ According to the distance of the ballast stone concentrations from the ancient quay (**Fig.6.11**) the area was most probably on the ancient shoreline or even on dry land in antiquity and thus it is unlikely that it was a place where ships could anchor and drop their ballast in the sea.

⁷⁹⁹ Stiros 1981; Rothaus et al. 2008.

These were thoroughly planned in parallel units of 77 to 190 m², divided into 2-4 spaces and present a unique configuration compared to other Roman warehouse facilities.⁸⁰⁰ These spaces are much larger than the earlier shoreline “magasins” of Delos (19-27 m²)⁸⁰¹ and preserve no traces of any change of use or reorganization. Furthermore, the warehouses of Kenchreai do not belong to buildings that could accommodate any other functions like the peristyle commercial buildings of Delos. Their orientation and layout leaves little doubt that goods were carried there directly from the sea, either from ships docked on the Southern Mole and Pier or from lighters unloading larger vessels anchored in the harbour basin. The warehouses offered ample space for a great amount of bulk cargoes: with an estimated height of about 3 m they could accommodate at least 10,000 tons of merchandize of any kind (amphorae or piled grain), although whether they would ever be filled with such a great amount of goods is unknown. In any case their presence, as well as the thick “dump” layer of discarded pottery in front of them, underlines the intensity of cargo handling in the harbour, at least in the 1st and 2nd century CE. The relatively great distance between Kenchreai and Corinth (11 km, about three times greater than the distance from Corinth to Lechaion), probably contributed to the need to store goods in the harbour before a means of transportation was available in order to move them to Corinth and Lechaion.⁸⁰²

A local market must have also existed in Kenchreai, covering the needs of the substantial settlement of the Roman period, as well as of the rural hinterland. The excavations did not reveal formal agora, although an open space at the bay’s centre probably operated as such (**Fig.3.80**).⁸⁰³ Notwithstanding the city’s development, mirrored also in the number of the surrounding cemeteries,⁸⁰⁴ the local population was small and only a limited fraction of the goods reaching the city would have been sold and consumed there, with the majority being diverted towards the metropolis or being reshipped. An important consumer of goods at Kenchreai must have been the crews and passengers of passing ships,

⁸⁰⁰ The elongated and divided layout of each of Kenchreai’s storage units is not observed neither in the earlier Delian commercial establishments (Karvonis 2008, 200-11), nor in the later warehouses of Ostia (Gros 2001, 115, 121), although the latter’s elongated plan is closer to the Kenchreai establishments. Similar two or three-partite warehouses or shops have been found at Miletus and Marseilles (Hellmann 2010, Figs.380 & 397; Feuser 2020, 45-41, Abbs.11, 13-4). In the case of Miletus they formed part of the ancient peristyle agora and in the case of Marseilles they were a simple row of warehouses or shops.

⁸⁰¹ Malmay & Karvonis 2016, 174.

⁸⁰² Salmon 1984, 31.

⁸⁰³ Scranton et al. 1978, 49-50, Fig.5.

⁸⁰⁴ Rife et al. 2007, Fig.3.

whom the harbour city would serve on their way from north to south, east to west, or towards Corinth. These would have required provisioning, but also wood, rope, and other materials for the maintenance of ships. This “nautical economy”⁸⁰⁵ must have greatly contributed to the development of the ancient harbour.

3.3.6. Construction technology and planning

Thanks to the extended excavation and study of Kenchreai the development of the harbour and the technology employed can be properly highlighted. A main characteristic of the whole establishment is a certain degree of conservatism in relationship to the technology employed.⁸⁰⁶ Although, as proven by the excavations, harbour works coincide with the Augustan and Flavian period, the years that maritime concrete technology became common in the Mediterranean, no concrete was used in any of the harbour structures.⁸⁰⁷ The moles, as well as the quays and even the *piscinae* were built according to the ‘Greek’ tradition with ashlar quays and buildings erected on simple rubble foundations.⁸⁰⁸ In such a well-planned new harbour city, where considerable effort was invested in order to create a comfortable and well-protected anchorage, the choice not to use the most advanced technology of the period appears puzzling. Could this indicate negligence or backwardness by the authorities, particularly in a period where other harbours in the east, like Caesarea Maritima and Alexandria, were being equipped with massive concrete structures?

Such a comparison between Kenchreai and other contemporary harbours is misleading. Kenchreai appears to have been more of a practical, working harbour, thoroughly serving the needs of the newly founded Roman colony of Corinth and of Roman Greece in general, but not acting as a political statement of the imperial power and a lavish maritime façade of a city, like a series of other harbours in the Roman Mediterranean did.⁸⁰⁹ Although the reconstruction of Corinth was initiated by Julius Caesar,⁸¹⁰ imperial patronage in the following century was relatively limited and considered a new centuriation scheme under Vespasian and the construction of the city’s aqueduct by Hadrian and not the city’s

⁸⁰⁵ Gibbins 2001, 294-5.

⁸⁰⁶ Hohlfelder 1985.

⁸⁰⁷ Brandon et al. 2021, 223-30.

⁸⁰⁸ Rickman 1996; Blackman 2008b, 643-7.

⁸⁰⁹ Arnaud 2015a; Feuser 2020, 306-11.

⁸¹⁰ App.*Pun.*20.136; Plut.*Caes.*57.5; Dio Cassius 43.50.3-5.

harbours.⁸¹¹ Concerning Kenchreai in particular excavation finds show that its construction was slow and lasted for nearly a century.⁸¹² It appears that local funds and engineers were employed for the creation of the harbour and the introduction of the state-of-the-art maritime concrete technology, requiring also the import of building material, was too complicated and costly. The builders followed the known and very simple method of creating a rubble foundation and building above it, a method less monumental but much cheaper and practical. The result was an establishment that operated much more as a highly efficient commercial station and much less as a monumental *ora maritima* (sea or maritime coast) of a city.⁸¹³ The amount of pottery discovered in the “dump” deposit shows that the arrangement of the harbour was very successful and served the transportation of large amounts of merchandise from and towards the harbour for at least two centuries, before it was rendered unfit for use in the 4th century CE.

3.4. Conclusions

The study of the harbours of Delos, Lechaion and Kenchreai in relationship to ship capacity and handling reveals a diversified and complicated image. Hellenistic Delos was an integrated *emporion* not defined by walls and borders but by its long *ora maritima*,⁸¹⁴ its several harbours operating in a parallel way, supplementing each other and being part of the dense urban fabric of the city.⁸¹⁵ The function of Delos as an establishment where transit and retail trade were the norm⁸¹⁶ is confirmed by the study of the ways ships and their cargoes could be handled in its harbours. Delos was, in a way, a port-of-trade without a port. The local authorities or foreign benefactors of the holy island focused on creating and embellishing the public space around the harbours, including lavish monuments and commercial facilities, but not the harbour infrastructure *per se*, which remained surprisingly poor, limited to a single mole and a line of quays, basically operating as retaining walls. This, however, did not prevent Delos from expanding its commercial activities, the majority of

⁸¹¹ Kent 1966, no.82; Romano 264-6; Paus.2.3.5 & 8.22.3.

⁸¹² Hohlfelder 1985, 84-5.

⁸¹³ The term was introduced by the 4th-century CE Roman author Avienius as the title of his geographical poem that drew information from much older texts, namely the 6th century BCE Massaliote Periplus. Cf. Purcell 1996, 273, n.32.

⁸¹⁴ Purcell 1996, 274.

⁸¹⁵ Zarmakoupi 2018a; 2018b.

⁸¹⁶ Duchêne 1993, 125; Zarmakoupi 2018b, 33-4.

which related to seaborne trade, and becoming τὸ κοινὸν Ἑλλήνων ἐμπόριον (the common market of Greece).⁸¹⁷ Merchants and mariners did not hesitate to approach the island by employing other methods beyond docking and seeking shelter inside a protected harbour. Anchoring in the open and using lighters, beaching and selectively taking advantage of every natural feature that could provide protection and essentially avoiding the entanglement of enclosed anchorages were employed. The practice of transporting only a small part of bulk cargoes on land and the need for ships to sail swiftly without delay, having already sold their cargoes in the busy market could also explain the lack of harbour facilities.

Lechaion on the other hand, beyond its evident great size, was a rather problematic harbour in terms of protection and depth. The Hellenistic harbour was no more than an open sandy beach and a narrow estuary, prone to constant silting. The Roman harbour, although improved by the impressive moles/groynes, remained basically an open shore where most ships had to either anchor in the open or enter the narrow and shallow meanders of the Inner Harbour. The important harbour was adorned with the monumental ashlar moles and possibly a lighthouse too, but, despite their evident size and sturdiness, the moles' role in the sheltering and docking of ships remained marginal. Furthermore, there is nothing to suggest that any important buildings were erected on the exposed coast and that the maritime façade of Lechaion was accordingly not an organised market with commercial facilities like Delos or Kenchreai. However, the rapid development of Roman Corinth into one of the richest cities of Roman Greece with special links with the west through Lechaion⁸¹⁸ indicates that the harbour served its purpose well and that its simplicity was balanced by its geographical position and proximity to the city. The openness and the lack of natural limitations, especially at Lechaion's Outer Harbour, allowed the accommodation of a great number of ships that were not obstructed by natural or artificial features in their movement.

Kenchreai was much closer to the image of an 'ideal' harbour described by Vitruvius (5.12.7) as well as to the modern idea of a 'good' harbour than Delos and Lechaion, with a firmly defined, deep and enclosed basin combined with substantial protective works and at the same time with continuous quays and large, well-organized storage facilities, all within the framework of a thoroughly planned urban space. The method employed for the

⁸¹⁷ Paus.8.33.2.

⁸¹⁸ Salmon 1984, 139-52; Chaniotis 2018, 313-4.

construction of the harbour was relatively simple, yet adequate and successful: in a natural bay, protected from the prevailing winds by its orientation and small promontories, two great moles were constructed with the simplest and cheapest method available, i.e. by the accumulation of stone rubble on the seabed and the subsequent construction of a continuous ashlar quay on dry land. Extended storage facilities were carefully planned and erected to accommodate large amounts of merchandise. The harbour could thus be defined as an impressive and substantial, yet not a monumental space. But this lack of monumentality and the application of less advanced technology did not mean that the harbour did not operate successfully. Archaeological data clearly show that Kenchreai became a busy commercial centre and flourished as a harbour city between the 1st and the 3rd century CE, serving the overseas trade of Corinth and of Roman Greece. In other words functionality was Kenchreai's main asset. The 'mundane' and less impressive planning of the harbour compared to other monumental contemporary harbours should not be taken as a sign of backwardness but as a sign of practicality and efficiency, according to which simple, pre-existing and well-known methods were employed to create a safe anchorage, at the same time taking advantage of the natural configuration of the area. The main limitation of the harbour of Kenchreai - its relatively small size - was dictated by its geographical configuration and thus the harbour must have been unable to accommodate many large capacity ships, which in turn would have to anchor in the open and use lighters.



4. Discussion: harbours in context

The basic methodological premise of this study is, as often underlined in the previous pages, the combined analysis of ships and seamanship vis-à-vis harbours of the Hellenistic and Roman Aegean. The results from this analysis were presented in the last two chapters: first the typology, size, draught and tonnage of ships, as well as the different possible methods of handling them and their cargoes were examined. This was followed by the reconstruction of the form of the three case study harbours and of their capacity to receive and handle ships and their cargoes and the scrutiny of the methods that could be employed for this. Through these tasks the actual possibilities and limitations of these harbours in relation to ship and cargo traffic were demonstrated and their variability as natural and human spaces was underlined. Now a broader, comparative analysis of the case studies as well as of other related harbour sites and a contextualization of their function and role within the wider contemporary Mediterranean world will be undertaken. In the following pages the data collected and generated in the previous chapters will be incorporated in a more inclusive discussion on ship capacity and the operation of contemporary harbours, the technology employed in their construction, issues of patronage and planning, their role as connecting hinterlands and forelands and finally their development during the period discussed.

4.1. Harbour size, configuration and ship capacity

The fundamental characteristic concerning the function of Hellenistic and Roman harbours is their general configuration and layout, features that fundamentally dictate the harbours' capacity in terms of ship accommodation.

Type/capacity	Harbour	Area covered
<i>Exceptionally large harbours</i>	Alexandria (Great Harbour)	2,200,000 m ²
	Portus (Claudian basin)	2,000,000 m ²
	Puteoli (outer basin)	1,350,000 m ²
	Piraeus (Kantharos)	800,000 m ²
	Puteoli (inner basin)	600,000 m ²
<i>Large harbours</i>	Antium	300,000 m ²
	Marseilles	285,000 m ²
	Ephesus (Roman harbour)	250,000 m ²
	Halicarnassus	225,000 m ²
	Portus (Trajanic basin)	223,000 m ²
	Puteoli (Portus Baianus)	200,000 m ²
	Mytilene (northern harbour)	193,000 m ²
	Ephesus (Hellenistic harbour)	190,000 m ²
	Patara (outer harbour)	180,000 m ²
	Centumcellae (outer harbour)	118,000 m ²
	Lechaion (inner & outer harbour)	93.500-164,000 m ²
	Rhodes (commercial harbour)	100,000 m ²
	Myndos (eastern harbour)	100,000 m ²
	Knidos (commercial harbour)	100,000 m ²
<i>Medium harbours</i>	Iasos	97,000 m ²
	Kos	90,000 m ²
	Mytilene (southern harbour)	88,000 m ²
	Frejus	85,000 m ²
	Lepcis Magna	85,000 m ²
	Caesarea Maritima	80,000 m ²
	Samos	66,000 m ²
	Amathus	58,000 m ²
	Carthage (commercial harbour)	56,000 m ²
<i>Small harbours</i>	Pompeiiopolis	44,000 m ²
	Chersonissos	42,000 m ²
	Alexandria Troas (inner harbour)	45,000 m ²
	Side	36,000 m ²
	Delos (all harbours)	34,000 m ²
	Elaia (enclosed harbour)	33,000 m ²
	Kenchreai	32,000 m ²
	Centumcellae (inner harbour/Darsena)	31,000 m ²
	Patara (inner harbour)	28,000 m ²
	Miletus (Lion Harbour)	27,000 m ²
	Alexandria Troas (outer harbour)	24,000 m ²
	Ostia	20,000 m ²
	Thasos (commercial harbour)	25,000 m ²
	Miletus (Theatre Harbour)	13,000 m ²
	Phalasarna (outer and inner harbour)	5,000 m ²

Table 4.1: Approximate size of various Hellenistic and Roman harbours of the Mediterranean.

Beginning with the issue of size, **Table 4.1** documents the size of various harbours in

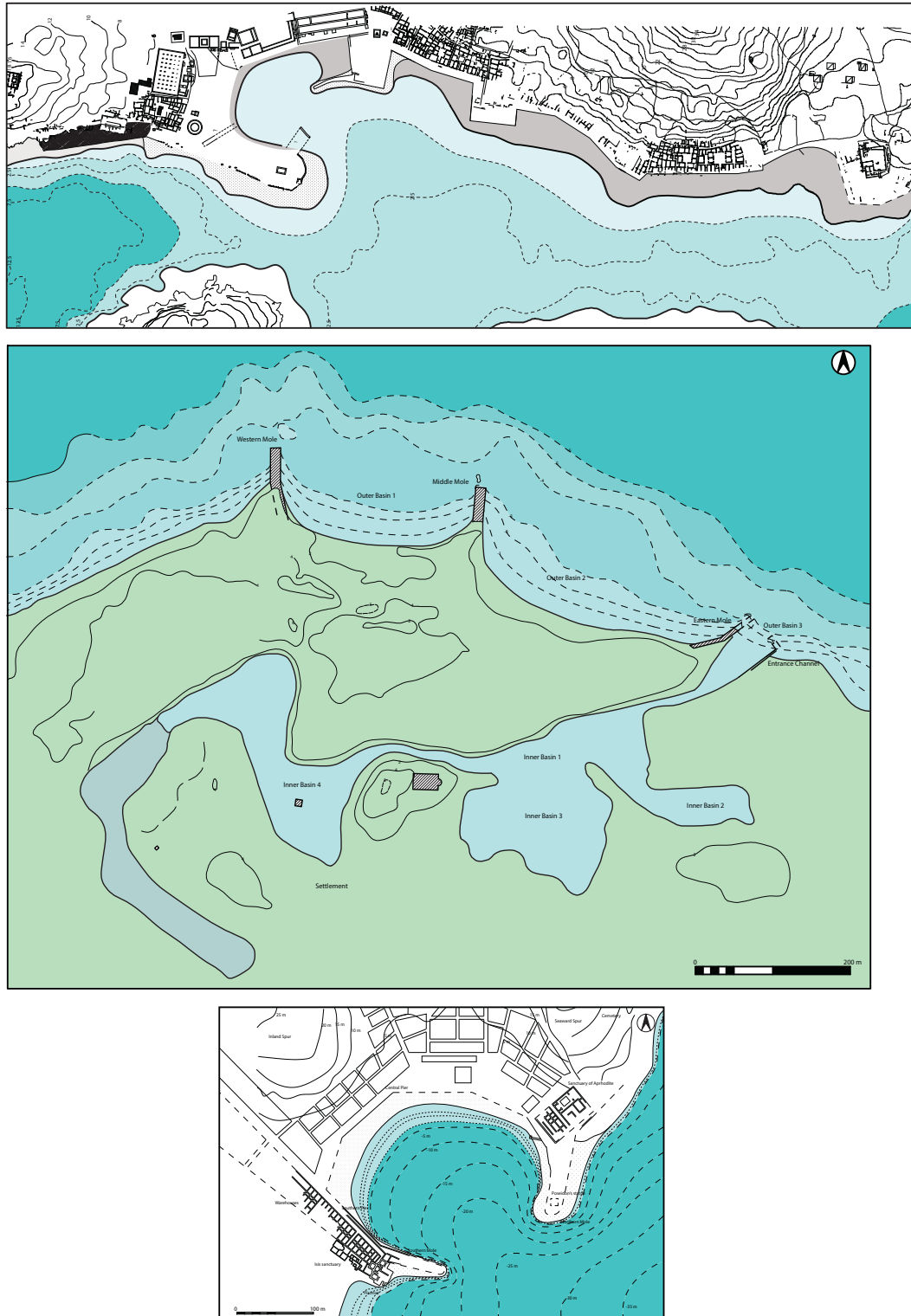


Fig.4.1. Comparative plans of the three case study harbours as they were in antiquity and placed in the same scale (top: Delos' Main and Merchant Harbours, middle: Lechaion, bottom: Kenchreai (drawing by the author).

the Hellenistic and Roman Mediterranean, as these are known through archaeological and geomorphological research, including the three case studies. The former appear in **Fig.4.1** in

a comparative plan of the harbours in the same scale (for Delos only the Main and Merchant Harbours are included). According to the data collected the size of these harbours varies greatly, depending on the one hand on the exclusive natural configuration of each site and on the other on the spatial limitations it posed, as well as the existence and extent of harbour works. Through the comparative study of these features a series of conclusions is reached.

Concerning typology, ancient sources give no evidence for any nomenclature of harbours based on their size and capacity and it is quite possible that, much

like the case of ship categorization (see 2.1), none ever existed. Harbours are regularly but vaguely mentioned as ‘good’, especially by geographers like Strabo,⁸¹⁹ but their actual size or capacity is never stated. A division that is suggested here is that harbours with a size of up to 50,000 m² can be considered small, harbours between 50,000 and 100,000 m² medium and harbours above 100,000 m² large, with the exceptionally large harbours being above 500,000 m² (Table 4.1). This division remains largely conventional due to the aforementioned lack of written evidence. It nevertheless highlights a significant distinction between the large, terminal harbours serving the trade of bulk cargoes like grain and thus

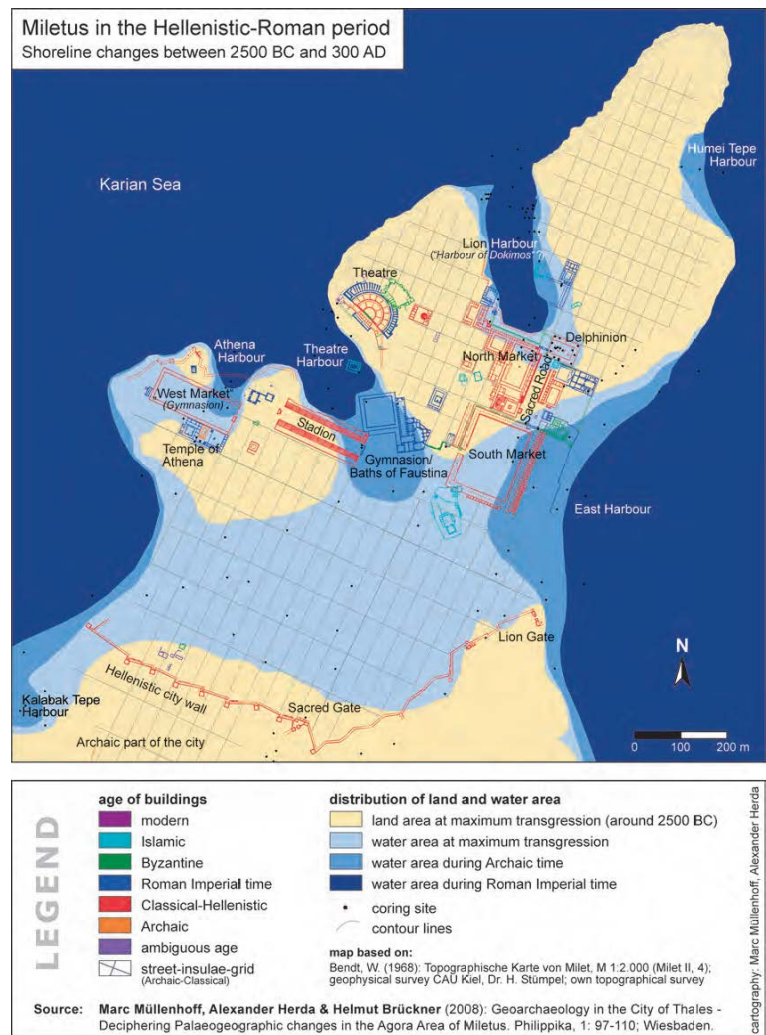


Fig.4.2. The evolution of the ancient harbours of Miletus (Brückner et al. 2014, Fig.10).

⁸¹⁹ The term εὐλίμενος (with a good harbour) is commonly used by Strabo to describe a good harbour, in contrast to the term ἀλίμενος (harbourless): e.g. “Ἦν δὲ πόλις εὐλίμενος ἡ Πύρασος” (9.5.14); “Πόλεις δ’ ἐπὶ θαλάττῃ μὲν τῶν Λατίνων εἰσὶ τὰ τε Ὠστια, πόλις ἀλίμενος διὰ τὴν πρόσχωσιν ἣν ὁ Τίβερης παρασκευάζει πληρούμενος ἐκ πολλῶν ποταμῶν” (5.3.5); “Δεύτερον δὲ τὸ ἀλίμενον κατὰ τὸ πλεῖστον καὶ τὸ τοὺς ὄντας λιμένας μεγάλους εἶναι καὶ θαυμαστοὺς” (6.4.1). A rarer term is the adjective ἀγχιβαθής (very deep), used by Pausanias when he describes the harbour of Larymna in Boeotia: “λιμὴν δὲ σφισὶν ἔστιν ἀγχιβαθής” (9.23.7).

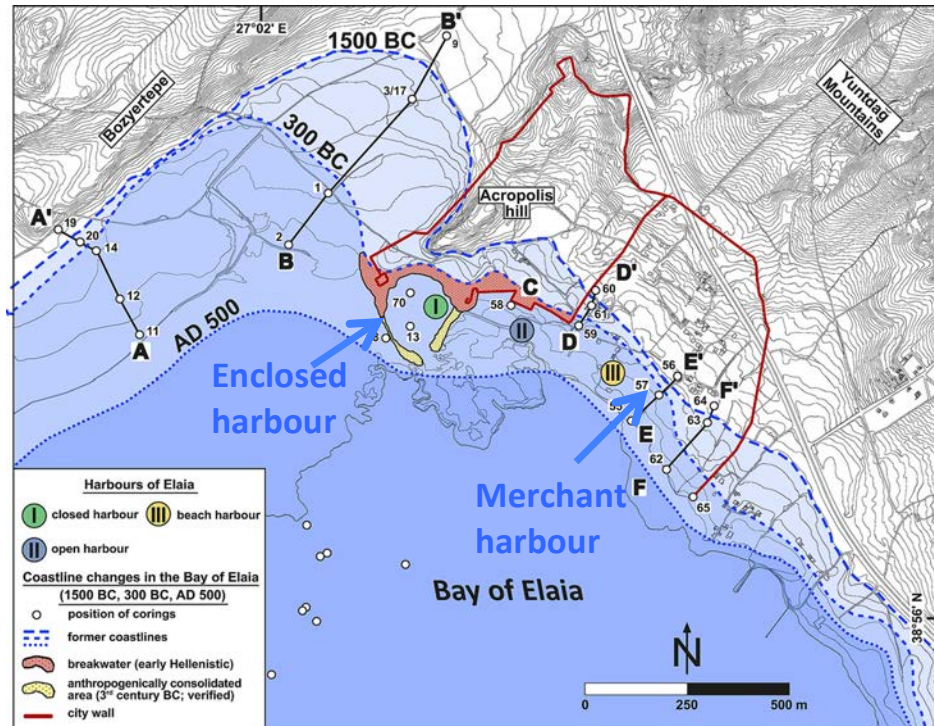


Fig.4.3. The ancient harbour and coastline evolution of Elaia (Seeliger et al. 2018, Fig.9).

playing a greater role in long-haul networks and receiving more attention in terms of funding and harbour works (e.g. Alexandria, Portus) and the smaller, ‘secondary’ harbours serving minor networks and populations (e.g. Miletus, Elaia) or even local urban districts (e.g. Delos). The interplay and relationship between these different types of harbours will be discussed in the following pages.

Local geomorphology greatly influenced harbour size. Many harbours of the Aegean islands and of the coasts of mainland Greece, where the natural fragmentation of the rocky shoreline is common and there are few large rivers with extended estuaries or lagoons, have a very limited size and few exceptions go above 100,000 m² (Piraeus, Lechaion, Rhodes). In Asia Minor, on the other hand, a series of natural estuaries allowed the operation of large harbours (Ephesus, Patara’s Outer Harbour) alongside smaller ones (Elaia, Miletus’ Lion Harbour, Side). Finally, areas that offer few naturally protected anchorages but were related with extended, fertile hinterlands and large populations (Levant, Italy, Northern Africa; the “harbourless” regions described by Strabo) were equipped with some large, artificially enhanced harbours (Lepcis Magna, Alexandria, Caesarea Maritima, Portus, Puteoli).

Concerning the three case study harbours, these present great variability concerning their size, as well as their fragmentation into numerous basins and anchorages (**Fig.4.1**). In the case of Delos each independent harbour/anchorage did not exceed the size of 26,000 m²

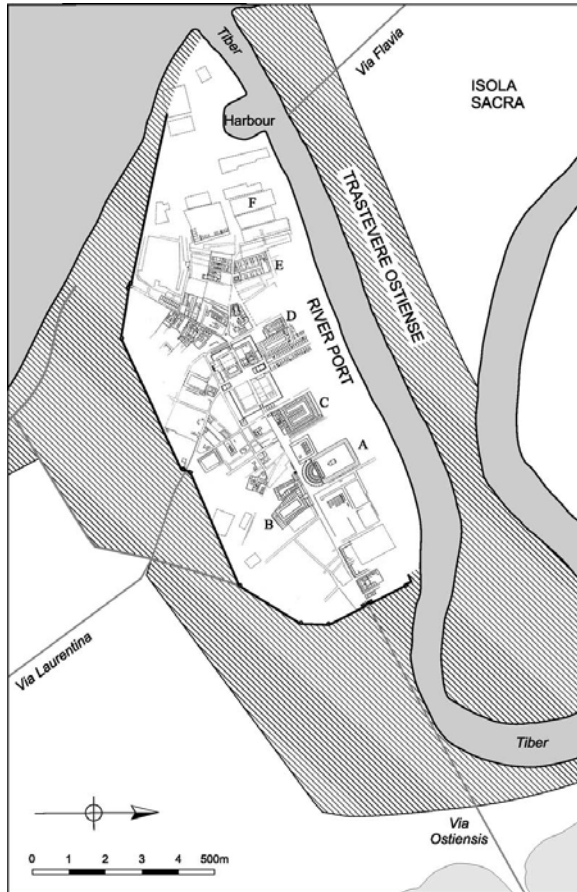


Fig.4.4. Plan of the city and the harbour of ancient Ostia. The shading represents suburban settlement area revealed by the recent geophysical survey (Keay 2012b, Fig.2.6)

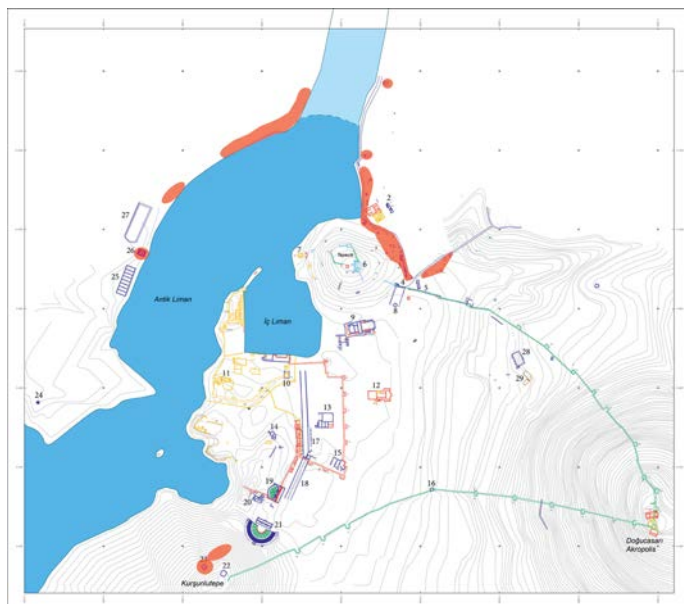


Fig.4.5. Plan of the city and the harbours of ancient Patara (Koçak 2019, Fig.2).

(Southern Anchorage) and some even covered areas as small as 600 m² (Gourna), making the whole island a rather small integrated harbour, even when all anchorages and harbours are combined (c.34,000 m²). Lechaion, on the other hand, is the largest of the three case studies and one of the largest harbours of the Aegean in general, thanks to the combination of the spacious Inner and Outer Harbours (93-164,000 m²). Kenchreai is the only case study with a simple, single harbour basin, its size determined by the two natural promontories, enhanced by the rubble moles (c.34,000 m²). It is noteworthy that, although Kenchreai and Delos harbours have a very similar size, their configuration is totally different, with Delos being a series of mostly open basins and anchorages and Kenchreai a single, well-sheltered and deep one. This different configuration greatly influenced the capacity and operation of these harbours, as will be shown below.

Seen in a wider perspective certain similarities concerning the size and configuration of the harbours

studied here and other harbours around the Mediterranean can be noted. Starting with

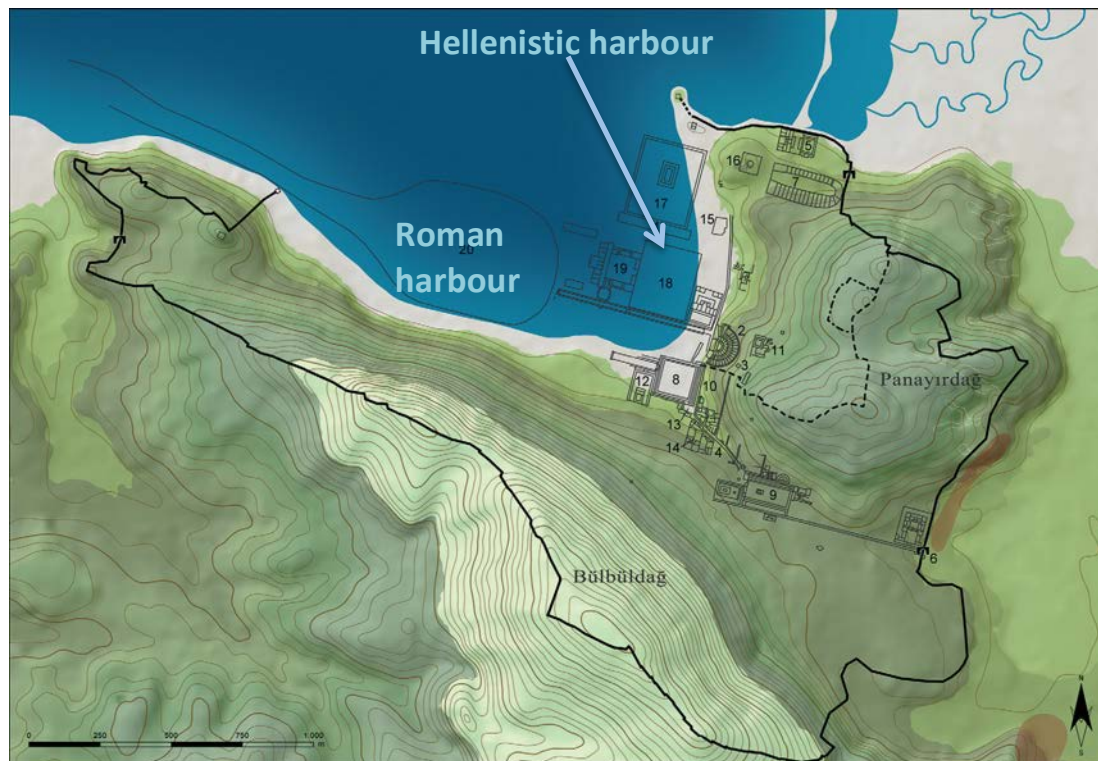


Fig.4.6. Plan of the city and consecutive harbours of Hellenistic-Roman Ephesus (the names of the harbours added by the author; Landstätter 2016, Abb.22).

Delos, it presents similarities with the harbours of Miletus (**Figs.3.3 & 4.2**). Both cities were served by several natural harbours and anchorages dispersed around their urban fabric. These were related to various quarters or acted as auxiliary harbours to the main one (in the case of Miletus the Lion's Harbour).⁸²⁰ Much like in Delos, there were few harbour works in Miletus,⁸²¹ whereas the wide and open beaches outside the city's walls were also used by ships (the Kalabak Tepe and the Humei Tepe harbours).⁸²² Another similar site is Elaia, the harbour of Hellenistic Pergamon, where an enclosed artificial and fortified harbour of 33,000 m² operated next to an open one, the former little more than a straight shallow beach, much like Delos' Merchant Harbour and most likely serving the commercial needs of the city (**Fig.4.3**).⁸²³ Multiple harbours also operated in Rhodes, where the natural bays of the city's northern coast were enhanced by long moles and protected by fortifications, creating a massive harbour complex (the combination of the harbours of Hellenistic Rhodes could

⁸²⁰ Brückner et al. 2014; Feuser 2020, 31-3.

⁸²¹ Recent geoarchaeological surveys showed that an artificial mole, on which also the lions' statues stood, protected the entrance to the Lion's Harbour, leaving a 20-30 m-wide entrance (Brückner et al. 2014, 82-3). The exact dating, however, as well as the original form of the structure remains largely unknown.

⁸²² Brückner et al. 2014, 91-2. In the case of the Humei Tepe harbour the presence of gates in the city wall and commercial buildings facing them indicate important harbour activities.

⁸²³ Pirson 2014; Seeliger et al. 2018.

reach of up to 400,000 m²).⁸²⁴ Rhodes' harbour was, nevertheless, much larger and better organized than Delos or Miletus, equipped with substantial harbour works and a large military harbour. Unfortunately due to later development and constant use, the operation of the Hellenistic and Roman harbours of Rhodes, especially concerning their commercial use, remains largely unknown.⁸²⁵ In general the harbours of Delos, Miletus, Elaia and Rhodes, despite their differences, had all taken advantage of every natural feature (bays, beaches, promontories) and had used, enhanced or created multiple anchorages, which had allowed their successful operation as thriving centres of commerce and shipping.

Lechaion comprises a very particular case study, due to the combination of the two different harbours and remains a rather rare case, even when compared with other estuary harbours like Ostia (**Fig.4.4**), Patara (**Fig.4.5**), Utica, or Roman Ephesus (**Fig.4.6**). In Ostia the river harbour had the form of a simple wider meander, extended and maintained deep by copious dredging,⁸²⁶ whereas in Patara the outer harbour was a spacious delta gulf that was gradually blocked by seaward siltation and tsunami action but never totally silted.⁸²⁷ The harbour of Utica was also a large delta bay similarly blocked by inland siltation, gradually turning into a peatland.⁸²⁸ The harbour of Roman Ephesus, on the other hand, despite being an enclosed basin communicating with the sea through a narrow channel, quite like Lechaion's Inner Harbour, was not an actual part of an estuary but a coastal 'dead-end' marshland, barely kept operable by copiously dredging the communication channel and the basin.⁸²⁹ Lechaion's Inner Harbour was also kept in operation thanks to dredging, but its configuration changed little through the centuries and was never actually blocked by natural causes.

⁸²⁴ Blackman 1999; Filimonos-Tsopotou 2004, 46-70.

⁸²⁵ Manousou-Della 2009.

⁸²⁶ Salomon et al. 2016.

⁸²⁷ Ünlü et al. 2014; Koçak 2019.

⁸²⁸ Delile et al. 2015b, 301-2, Fig.7.

⁸²⁹ Kraft et al. 2011, 32; Steksal 2014; Feuser 2020, 115-6, Abb.51.



Fig.4.7. Plans of the harbours of Halicarnassus (left; Özdaş & Kızıldağ 2019, Fig.1d) and Kos (right; Bouras 2014, Fig.2).

Evidently the harbour that had the simplest and most common configuration was Kenchreai (**Fig.3.80**). The single-basin, naturally protected, deep, sandy cove was a common occurrence in many harbours of the Aegean and Asia Minor, like Halicarnassus, Kos, Samos or Mytilene (**Fig.4.7**).⁸³⁰ This is clearly due to the similar geomorphology of the coasts of the Aegean, where such coves are found everywhere. Contrary to the abovementioned harbours Kenchreai belongs, however, to the small harbours of this type (**Table 4.1**) and never extended beyond the two natural promontories, which were enhanced by the two rubble moles.

In terms of depth the case study harbours present a similar variability as their size and form. Harbour basins range from areas more than 20 m deep (Delos' Southern Anchorage and Kenchreai) to extremely shallow ones (Delos' Main Harbour, Lechaion's Inner Harbour). Siltation was the major factor of such depth fluctuations and even of size change in Delos and Lechaion, as well as in many other contemporary harbours like Ostia, Marseilles, Ephesus, Utica or Lepcis Magna.⁸³¹ As a local phenomenon, however, siltation presented great regional variations, whereas the application of costly and complicated dredging was uneven.⁸³² Concerning the case studies in Delos, siltation appears to have affected the Main Harbour⁸³³ and not the other ones, since they were open to constant currents and waves that prevented the accumulation of land and sea sediments on the

⁸³⁰ Simossi 1991; Bouras 2016, 308-9; Theodoulou 2017; Özdaş & Kızıldağ 2019.

⁸³¹ Mohrange & Marriner 2010; Wilson 2011b, 51; Delile et al. 2015b.

⁸³² Giaime et al. 2019.

⁸³³ Desruelles 2004, Fig.115; Dalongeville et al. 2007, fig.8; Desruelles et al. 2007, Fig.5; Desruelles & Hasenohr 2018, 44.

coast. Similarly, at Kenchreai sedimentation remained minimal, as observed during the excavations of the harbour basin, most likely thanks to the thorough selection of the site and the careful planning of the moles.⁸³⁴ Lechaion is the harbour most afflicted by seaward and inland siltation, its depth constantly changing, both in the Outer, as well as the Inner Harbour.⁸³⁵ The latter witnessed a steady depletion of its depth by the



Fig.4.8. *Tufa substratum scouring marks from the Roman dredging operations at the harbour of Naples (Morhange & Marriner 2010, Fig.4A)*

constant accumulation of inland silt, leading to a gradual abandonment of some basins and the substantial dredging of others in the 4th century CE, as shown by archaeological, geophysical and written evidence (see **3.2**).⁸³⁶

Although, as noted above, siltation and the subsequent dredging have been major factors of change in many Mediterranean harbours like Utica, Ostia or Ephesus (where the open-shore Hellenistic harbour had rather swiftly become an enclosed basin; **Fig.4.6**), it is difficult to compare the actual rate of change between different harbours, mainly due to the lack of precise data concerning each harbour's original depth. Some observations can, however, be made. In harbours where siltation was minimal thanks to the nature of the area's geomorphology (e.g. in Mytilene, Kos and Halicarnassus, ancient harbour basins that are still operating today with minor changes; **Fig.4.7**) and where harbour works did not operate as 'sand traps', depth must have remained relatively stable, as the case was at Kenchreai and Gournai. Many other harbours, however, especially in Italy and Asia Minor, were connected with estuaries creating a dramatic inflow of sediments, much like what happened in Lechaion, and requiring dredging to operate.⁸³⁷ In Portus and Ostia (**Figs.2.20 & 4.4**) coring has shown that the basins and the canals were kept up to 6-8 m deep by constant and extensive dredging, in order to allow the accommodation even of exceptionally large

⁸³⁴ Hohlfelder 1985, 84.

⁸³⁵ Repousis et al. 2015.

⁸³⁶ *JG*, IV, 209 (cf. Kent 1966, 164, Pl.42; Rizakis et al. 2001, 315-6). Kolaiti et al. 2017, 116; Güngör & Lovén 2018, 43, Fig.5; Riddick et al. 2021.

⁸³⁷ Despite the fact written sources clearly document the common application of dredging (Blackman 2008b, 662-3; Wilson 2011b, 51), its results unfortunately seldom appear in geoarchaeological surveys.

ships there.⁸³⁸ Such drastic and costly dredging operations are justified by the need to keep the harbour operable and thus secure the provisioning of the capital and its hinterland and must have required the generous funding of the imperial environment. In Marseilles and Naples, on the other hand, dredging appears to have only affected the coastal zone by using simpler methods and to have been limited to a depth of 30-50 cm (**Fig.4.8**).⁸³⁹ This would have facilitated the approach of small capacity ships and lighters to the quays but not of any larger vessels. In other harbours such as Miletus or Elaia geophysical research showed no traces of dredging whatsoever. Especially in Elaia the enclosed harbour originally had a depth of just 2.5 m and the open harbour a depth of 1.5 m and both were silted by the end of antiquity.⁸⁴⁰ Finally, in harbours like Ephesus and Side, where dredging has been confirmed by written sources, no corresponding evidence has yet been retrieved by geophysical surveys and excavations to verify the extent and method of dredging.⁸⁴¹ In general, the harbour environment of Hellenistic and Roman harbours appears to have been a very unstable and constantly changing one and dredging was not always a choice, probably due to its cost. Ships must have therefore developed various alternative methods to use them, as we will see.

The capacity of the case study harbours to accommodate ships corresponds directly to their size and depth and their changes, with minor oscillations. The similar dimensions and depth of Delos (if the use of the larger and deeper Southern Anchorage is also included) and Kenchreai gave them an equally similar ship capacity, as illustrated in **Table 4.2**. Lechaion, on the other hand, despite its great size, remained a predominantly shallow harbour, even if one considers the scenario that the Outer Harbour was originally deeper

	Large capacity	Medium capacity	Small capacity	Vary small capacity
<i>Delos</i>	47-86	125-240	219-496	567-2,062
<i>Lechaion</i>	54-114	205-545	455-1,144	1,510-8,712
<i>Kenchreai</i>	49-95	100-230	180-455	500-2,000

Table 4.2: Comparative estimated capacity of the three case study harbours in terms of maximum and minimum number of anchored ships they could accommodate.

⁸³⁸ Boetto 2010, Fig.11; Salomon et al. 2016, Figs.5 & 8.

⁸³⁹ Hesnard 1994, 209-10; Giampaola et al. 2005, 60; Giaime et al. 2019, 145.

⁸⁴⁰ Seeliger et al. 2018, 10-1.

⁸⁴¹ On the dredging of Ephesus see Tac.*Ann.*16.23 and *IvE*, VII.1, 3071. On Side see Stillwell et al. 1976, 835.

and fairly protected from coastal siltation. With the Outer Harbour being exposed and constantly influenced by strong and unpredictable siltation its ability to accommodate large to medium capacity vessels was significantly limited. It was ships of small and very small capacity that could easily approach areas of any depth and, more importantly, enter the well-protected waters of the Inner Harbour. Kenchreai presented the best conditions for ship accommodation, thanks to the basin's great depth and thus had a slightly improved capacity to accommodate ships of large capacity (3.5% compared to a 2.9% of Delos and a 1% of Lechaion).

The actual capacity, however, of the harbours discussed here, as well of all contemporary harbours was a much more complicated issue, related not only to size and depth but also to the needs for circulation and handling of ships and cargoes and the actual presence of large numbers of seagoing ships there. A major factor that would make ships avoid entering certain basins would have been the availability of other, possibly less protected but easier to approach, spaces in close proximity. In the case of Delos the small and exposed 'secondary' harbours of Skardanas and Gournas gave ships the possibility to tramp between them (see below) and avoid using potentially dangerous narrow passages such as the channel between the Rematiaris islets and the coast. This allowed mariners to bypass the tedious handling of merchantmen within basins, especially the Main Harbour that served other types of ships too like lighters and galleys. Such a possibility was theoretically offered also by Lechaion's Outer Harbour, but the latter was shallow and almost totally exposed and anchoring there would have little difference than anchoring in the open sea, groynes offering little protection from western winds and coastal drift. The much better protected Inner Harbour, although it could accommodate very large numbers of ships (at least of small and very small capacity ones), had the disadvantage of being fragmented into smaller basins divided by narrow channels. Contrary to other estuary harbours like Ostia and Roman Ephesus (**Figs.4.4 & 6**), which basically consisted of large, single basins, the circulation of any kind of ship in the numerous basins and channels of Lechaion's Inner Harbour, which also most likely had variable depths due to different sedimentation rates, would have been complicated and would have to be regulated and assisted by the harbour authorities. It would nevertheless be ideal for all smaller ships that could easily find shelter there. Finally, Kenchreai's capacity must have also been affected by the need to allow the movement of ships from and towards the deep but single harbour entrance and to regulate

their stationing in the basin. The harbour's main problem would have been the need to arrange ships of medium and large capacity in a rather small basin and close to each other.

Harbours had a maximum or theoretical capacity and a functional one. Although the number and tonnage of ships using a harbour simultaneously is difficult to calculate due to the seasonal fluctuations of ship traffic as well as of the harbour's depth (see **2.1.4**), a rule of thumb can be suggested and has already been used in the preceding discussion over the case study harbours: by allowing enough space for ships to move, anchor and maintain safety distances from each other and from the coast, I would propose that the actual capacity of harbours would be roughly half their notional maximum one (i.e. the total number of ships that could fit or rather be cramped inside harbour basins in very close proximity, allowing no space for circulation and manoeuvring), at least concerning seagoing vessels. This is based on roughly multiplying the space occupied by a ship in square metres (**Table 2.2**) by two, a space allowing just enough room for ship handling and circulation and representing a maximum functional capacity of basins as ship havens. However, in certain cases we should not exclude the possibility that ships would have anchored in harbour basins or berthed on docks lined next to each other, whenever conditions imposed that, as seen in the ships of the harbour of Olbia in Sardinia (**Fig.2.21**)⁸⁴² and as would happen in some early modern harbours too.⁸⁴³ Such practices would potentially raise overall harbour capacity when needed, provided there was proper management by the harbour authorities. Whether mariners would nevertheless venture into complicated manoeuvres instead of taking their chances with anchoring in the open is doubtful. Both methods could have been employed but for different purposes: berthing inside a harbour and close to quays and other vessels was ideal for long-term protection or maintenance whereas anchoring in the open remained the best choice for stopovers and for ships generally spending less time in any given harbour. The use of harbour facilities was also, as documented in various inscriptions, subject to fees and taxes and it would be another reason why ship captains would avoid it if possible.

But in order for ships to be accommodated by any harbour these had to be actually present there. This was subject to three main factors, the sailing season, the need to exchange goods and the location of harbours on specific commercial routes. Ship traffic in

⁸⁴² D' Oriano 2002, 1255-7, Fig.5; D' Oriano & Riccardi 2004, 89-90.

⁸⁴³ Delano Smith 1979, 365.

the ancient Mediterranean peaked in the summer months, thanks to better weather conditions and favourable winds and it would be more likely during these months to find most of the merchantmen visiting various harbours.⁸⁴⁴ To this ship traffic galleys should be added, since these were the exact months they could operate more successfully.⁸⁴⁵ Recent studies have suggested that the sailing season was much longer than previously thought and even in harbours with intense activity ship arrivals could have occurred during a longer period (April-October) or even during winter, especially in areas where harbour networks existed (e.g. central Italy and Southern France).⁸⁴⁶ Shorter trips to nearby destinations would also be feasible, especially for smaller ships, easier to man and handle too (e.g. between the islands of the Aegean or along the coasts of Asia Minor and Italy).⁸⁴⁷

Equally significant concerning ship traffic in harbours was the provisioning of cities and their hinterland: large urban or rural populations (e.g. Rome) would have naturally required more imports in terms of foodstuff than small ones (e.g. the inhabitants of many Aegean islands), provided their needs could not be covered by the local production. Consequently, more or larger ships carrying them would have frequented the harbours serving such territories. Similarly, an extended hinterland would have generated more agricultural products to be exported and thus more ships would have to be employed, although this would have been common mostly in areas with surplus production like Egypt or Northern Africa. Local provisioning needs would have also temporarily increased when army forces were present, or even when large numbers of workers and enslaved people were employed in construction works, additionally requiring the import of building materials.⁸⁴⁸ Finally wealthy local elites could have contributed to the import or export of products, both as consumers (especially of luxury foodstuff), as well as producers who invested their resources and stimulated local production (e.g. the Capuan families who

⁸⁴⁴ Arnaud 2005, 16-23.

⁸⁴⁵ Pryor 1995, 210-1.

⁸⁴⁶ Beresford 2013, 12-3; Robinson et al. 2020, 117-9.

⁸⁴⁷ Xenophon gives a vivid description of the intense ship traffic of small capacity ferries and fishing boats moving between the islands of the Aegean around 390 BCE: "(Teleutias) captured great numbers of fishing craft and ferryboats full of people as they were sailing in from the islands" (*Hel.*5.1.23).

⁸⁴⁸ The mobility of specialised craftsmen as well as enslaved people employed in great building projects was common in antiquity, as written evidence show (Burford 1965, 22, 31-3). Although local population could supply personnel for such projects this does not mean that local artisans would abandon their stable work for occasional projects and contractors would regularly seek for workforce abroad. Skilled or unskilled workers and enslaved people would naturally raise the needs of local markets for provisioning. For an example of the costs and personnel employed in a large building project of the Roman period see Janet DeLaine's study on the logistics of the construction of the Baths of Caracalla in Rome (DeLaine 1997, 219-22).

possessed large estates in Crete and exported their products to Italy during the Augustan period).⁸⁴⁹

Despite, however, the constant needs of cities, especially the larger, 'consumer' ones like Rome, Corinth or Ephesus⁸⁵⁰ for imported grain and other victuals, it should not be taken for granted that all of their needs were covered via sea transportation. 'Secondary', smaller or short-haul networks would have also supplied cities in a great extent,⁸⁵¹ whereas the local hinterland played also an important role, improving the cities' self-sufficiency. Even very small islands like Delos could still cover large part of their needs by local production.⁸⁵² In the case of imperial Rome, on which more evidence is available, even if we consider the unlikely scenario that all victualing was done via Portus, it has been calculated that the annual needs of the city would have required an average of about 1,807 ships of 150 tons each⁸⁵³ that could be easily accommodated at the same time in the 2,000,000 m² of the Claudian basin of Portus. The harbour offered enough space for more than 3,000 large capacity ships, without including the nearby harbours of Ostia, Centumcellae and Puteoli,⁸⁵⁴ but it is very doubtful that such numbers of ships were ever simultaneously present there. This most likely reflects Tacitus' report that 200 commercial grain carriers were sunk in the same harbour by the sudden storm of 62 CE.⁸⁵⁵ The incident is described as devastating, indicating that the majority of the grain fleet was present and lost. If this is true, then the actual number of cargo vessels accommodated even in the largest harbours of the period was only a small fraction of their maximum capacity. The festive arrival of the Alexandria grain fleet in the beginning of each summer in Puteoli (see also **2.1.4**),⁸⁵⁶ although a politically important event, displaying to everyone that the government had secured the grain for the year, should not be taken as proof that all grain ships arrived at once and that all came from Egypt.⁸⁵⁷ The fact that the destruction of the ships in Portus and a contemporary fire in the harbour of Rome did not trigger famine and civic unrest shows not only the efficient crisis

⁸⁴⁹ Gianfrotta 2011, 191-2.

⁸⁵⁰ Morley 2007, 577; Temin 2013.

⁸⁵¹ Hopkins 1983, 94-6.

⁸⁵² Rathbone 1983, 46; Reger 1994, 51-3.

⁸⁵³ Brandt 2005, 34.

⁸⁵⁴ Schörle 2011, 97-9; Keay 2012b.

⁸⁵⁵ Tac.*Ann.*15.18.

⁸⁵⁶ Sen.*Ep.*77.1-2.

⁸⁵⁷ Keay 2010.

management reflexes of the Roman administration but also the existence of alternative sources of provisioning.

Furthermore, the fact that ships did visit certain harbours for provisioning and rest or to have their cargoes sold without unloading them (the *δείγμα* practice), does not mean that they would have necessarily used local harbours and not briefly anchor in the open sea to save time and avoid entanglement in secluded spaces (see below). Even in terminal harbours like Antioch, Alexandria or Rome, there is no indication that these would ever reach the limits of their capacities in terms of ship numbers. As described above, in such harbours which bordered large and fertile hinterlands like Latium and Egypt local production and victuals were transported also via land routes, rivers, and canals.⁸⁵⁸ Finally harbours located on specific commercial routes would be more likely to be visited by merchantmen, which would either use the local markets and/or make necessary stops for provisioning or rest.⁸⁵⁹ Thus the actual ship traffic of all harbours would have been fluctuating and dependable on a series of periodical or unforeseen local conditions.

4.2. The methods of using the harbours

As we saw in **Chapter 2** ships of the Hellenistic and Roman period were quite advanced and well equipped and their crews agile enough to use a variety of methods when they approached coasts and harbours (docking, beaching and anchoring in the open). Further assistance could be offered by the application of towing, sounding and piloting. How did these methods, however, fit into the context of the case study harbours as well as other contemporary harbours of the Mediterranean?

Docking, a method widely diffused in modern ship handling, was not an operation easily employable in the harbours studied here, for the simple reason that, according to our current knowledge, there were very few docks able to accommodate seagoing ships berthed directly on them (see also **2.5.1**). In Delos the long quays around the Main, Merchant and Skardanas harbours, were built on dry land and were separated from the sea by a strip of sand or rubble and could not be used for docking. The island's only actual dock was in most probability the Gournas quay, erected in a depth of more than 5 metres, allowing even ships of large capacity to berth there (**Fig.4.9, top**). In Lechaion it was the two moles of the Outer

⁸⁵⁸ Boetto 2016; Archibald 2016; Moreno Escobar 2021.

⁸⁵⁹ Malkin et al. 2009; Malkin 2011; Bouras 2016.

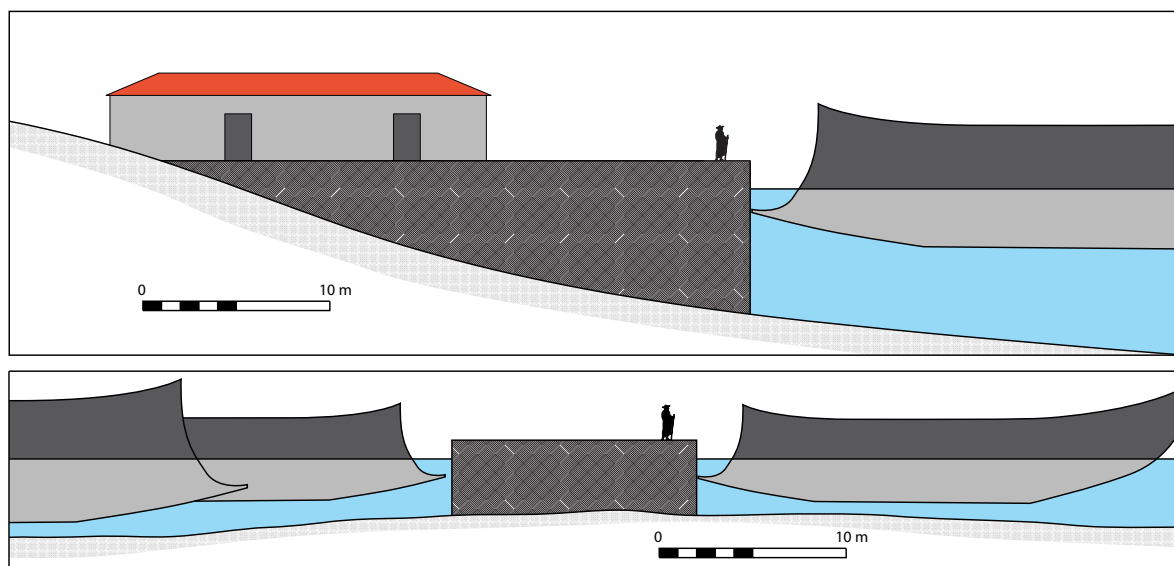


Fig.4.9. Schematic plans of the possible use of Delos' Gourná quay (top) and of Lechaion's moles (bottom) by ships of medium and large capacity (drawing by the author).

Harbour that could operate as docks. Built, most likely, by casting blocks from the surface, they had, at least in the early period of their use, adequate depth around their seaward ends to accommodate ships of even large capacity (**Fig.4.9, bottom**). Kenchreai does not seem to have ever been equipped with any proper dock of any kind, although docking might have been employable at the ends of the moles, thanks to the steepness of the rubble foundation and the depth of the seabed there (**Fig.3.80**).

Even if docking were employable at the abovementioned sites, these would have been hardly favourable places for ships since they were totally exposed to the sea (Gourná, Lechaion) and in the case of Kenchreai too close to the harbour's entrance, which had to remain free to allow ship circulation. Any change of wind could potentially cause docked ships, especially laden, bulky freighters, to crash against the ashlar walls or on the rubble foundation of the moles if their anchor cables were severed. Although experienced mariners must have been adept in reading the weather and securing their vessels accordingly, the unpredictable weather conditions in the Mediterranean and especially in the Aegean⁸⁶⁰ could easily endanger vessels, as the destruction of the ships in Portus in 62 CE and in Delos around 150 CE shows (see **2.5.1**). Keeping the vessels secured by employing tackles and anchors and maintaining safe distances would have been an additional nuisance to mariners. The alternative method of berthing at a small distance from the docks, with anchors securing

⁸⁶⁰ Beresford 2013, 63-90.

the seaward end of the ships, a practice that was probably employed in the harbour of Lepcis Magna (**Fig.2.29**) and is described by Appian for 2nd-century BCE Carthage,⁸⁶¹ appears a more practical solution. Nevertheless in none of the case study harbours, have any proper mooring stones or even wooden posts been discovered, despite their thorough investigations on land and underwater.

It should however not be taken for granted that docking was not practiced at all in the harbours studied here, as well as in other contemporary harbours. The common use of gangplanks on the ships of the period (see **2.4.2**) shows that berthing on docks of some kind was something ships would regularly do. The Gourná quay was most probably constructed to serve such a purpose (**Figs.3.30 & 4.9**), especially for ships arriving from the east and serving as the harbour of the Stadium District, an important quarter of late Hellenistic Delos.⁸⁶² However, the fact that no mooring stones were discovered around the structure indicates that ships would not dock there for long, but that they would spend short periods there before moving to safer anchorages. They could also easily move to a small distance in the open sea where they would cast their anchors and avoid the danger of crashing against the quay or the rocky shore of the island. Such 'short-term' docking would fit perfectly with the operation of Delos as a retail centre where cargoes were sold with only parts of them being unloaded, as well as a transit harbour and a necessary re-victualing station of ships and their crews and passengers.⁸⁶³ The situation would have been similar at the great moles of Lechaion, but their distance from the shore and the local settlement would have made the circulation of cargoes and people difficult. Furthermore and contrary to Gourná, where the island of Delos offered some protection, Lechaion's moles had no protection whatsoever from the prevailing northern winds and even if ships used them for short periods they would have had to move to the open or to other anchorages when weather picked up. But even though the docking facilities in Delos and Lechaion offered limited protection and could accommodate relatively few ships (**Table 4.3**), the possibility of unloading/loading cargoes easily and fast from proper docks would have been very important for at least some ships, even if they would have to be relocated in case of bad weather.

⁸⁶¹ App.*Pun.*14.96; von Gerkan 1933, 40, Fig.5.

⁸⁶² Zarmakoupi 2013a.

⁸⁶³ Zarmakoupi 2015, 126; 2018b, 34.

	Large capacity	Medium capacity	Small capacity	Very small capacity
<i>Delos Gournà</i>	7	10	15	18
<i>Lechaion Western Mole</i>	3-6	8-10	14-20	20-50
<i>Lechaion Middle Mole</i>	3-6	8-10	14-20	20-50

Table 4.3: *Estimated maximum docking capacity of the harbours of Delos and Lechaion.*

Docking seems to have been equally rare and difficult in other harbours where maritime concrete was not employed. With most quays built at a distance from the water due to the rubble foundations or the natural inclination of the shore even the presence of numerous and often large mooring stones should not be related with the direct berthing of ships (e.g. the mooring stones of Lepcis Magna; **Fig.2.30**). Apart from the possibility of docking at a distance from the quays described above, a ‘middle’ solution might have been the use of rudimentary quays, which would allow the provisional berthing of ships without being costly, complicated structures. A ‘provisional’ quay was built in Elaia’s closed harbour in the 3rd century BCE by dumping boulders and rubble in the middle of the bay’s shore (**Fig.4.3**).⁸⁶⁴ Such quays would most likely not serve ships of large capacity, but could be favourable for smaller ones, provided mariners employed berthing and sounding carefully. Wooden jetties could have also been also employed for docking and iconography and finds verify this in several sites (Marseilles, Pisa, Naples), but they remain unknown in the archaeological record of the Aegean and the Levant (see **2.5.1**). Although we cannot assume that such structures were not used at all in the area, their absence from the archaeological and written sources does not allow any further assumptions to be made on their role and function in the harbours discussed here.

⁸⁶⁴ Seeliger et al. 2013, 79.

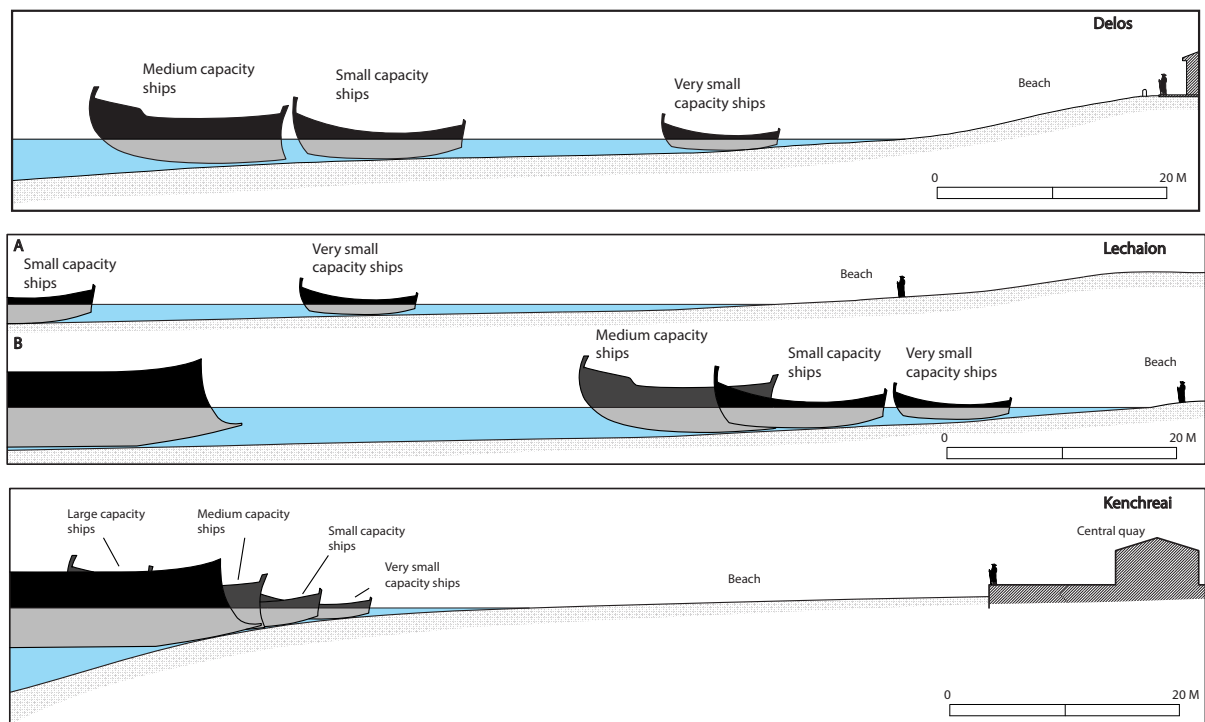


Fig.4.10. Schematic reconstruction of the ways beaching could be employed in the case study harbours. In Lechaion the two scenarios concerning the Outer Harbour's depth are shown (drawing by the author).

Contrary to docking, beaching (including draught beaching and hauling on land) could be easily employed in nearly all harbours, since they all are located in areas with long, sandy beaches (**Fig.4.10**). In the case of Delos the late Hellenistic city had actually expanded exactly towards coastal areas with beaches, even if these were not adequately sheltered for the accommodation of ships (Merchant Harbour, Skardanas, Gournas).⁸⁶⁵ In Lechaion the harbour was organised along an open long sandy beach, despite the fact that no natural protection existed, whereas Kenchreai was also developed on a natural beach.

Beaching was, however, a fairly difficult method of accommodating and serving larger cargo ships. As shown in **2.5.1**, draught-beached ships of large, medium and partly of small capacity, would not allow porters to approach them in water and carry cargoes due to the water's depth (**Fig.2.37**). Draught beaching any kind of loaded ship could also cause them to get stranded if anchors were not employed correctly or if weather changed abruptly. Hauling any loaded ship on land would also be practically impossible due to their weight and danger of damage, whereas even unloaded ships would require substantial infrastructures and enough labour force, animals or machinery. Gangplanks that appear to be used in similar

⁸⁶⁵ Bruneau 1968, 633-71.

environments in contemporary iconography could improve things, but only slightly, due to the mild inclination of the seabed along beaches, and would be much more useful on steeper river banks, rocky shores or artificial jetties and moles. The beaches, present in all three case study harbours, would, however, be essential for the operation of shipyards. Such establishments unfortunately have left nearly no trace in the archaeological record of the case study harbours. The only source for the operation of designated shipyards is the 3rd-century BCE inscriptions of Delos that document the hauling and capstan use taxes, as well as the existence of a single shipyard on the island.⁸⁶⁶

The role of beaches would have been crucial in the operation of harbours for another important reason. What sandy beaches would offer was a ‘friendly’ coast for lighters, which, thanks to their small draught and lightness, even when loaded, could approach the coast, swiftly unload/load cargoes and, if needed, be hauled on land for protection. Even when a beach was not sheltered by harbour works or natural features, its small depth depleted the incoming waves,⁸⁶⁷ helping the safe beaching of ships and the transportation of goods on land. The existence of high docks or piers, useful for larger vessels and an asset of the harbour’s monumentality, would have had a negative impact on lighters and porters that would need very low or stepped structures, similar to the long quays of Kenchreai (**Fig.3.85 & 38**). This is most probably the way Delos’ Merchant Harbour and Skardanas operated, with the quay being nothing more than a low retaining wall, not hindering the communication between the beach and the city (**Fig.4.20**). Other harbours were similar: in Elaia a long, open and shallow beach was incorporated into the maritime façade of the city, most of it not divided from the urban area by any coastal fortification wall (**Fig.4.3**).⁸⁶⁸ In Miletus a series of gates were opened on the sea wall to allow the communication between the open beach and the commercial buildings in the “Humei Tepe Harbour” (**Fig.4.2**).⁸⁶⁹ In Pompeiopolis, next to the monumental, enclosed harbour, a simple, open quay extended too.⁸⁷⁰ Finally, the harbour of Hellenistic Ephesus appears to have been little more than a continuous open

⁸⁶⁶ ID 138B, 8; ID 353A, 29-30; ID 354, 26, 29; ID 363, 1.41; cf. Duchène et al. 2001, 143.

⁸⁶⁷ Morton 2001, 31-3.

⁸⁶⁸ Feuser et al. 2018, 99.

⁸⁶⁹ Brückner et al. 2014, 92; Thurn pes.com.

⁸⁷⁰ Brandon et al. 2021, Figs.4.53-4.

beach along the seafront of the city before any quays were built around the much smaller Roman harbour.⁸⁷¹

The prevailing, more easily employable and useful method of using Hellenistic and Roman harbours was anchoring in the open and employing lighters. Such practices leave little to no solid evidence and their operation is too mundane to be included in ancient literature and inscriptions but based on the study of the configuration of ancient harbours, the form and function of seagoing ships, as well as the nature of trade of the period, I have reached the conclusion that it was the most convenient method to use harbours. As shown above, the case study harbours were not equipped with adequate and sufficiently protected docking facilities and beaching would not benefit cargo vessels of a draught of more than 1 m. What mariners of the period were left with was carefully anchoring their ships in deeper water and employing lighters to transport cargoes and people. Such a practice is indirectly documented by Demosthenes and more explicitly by Strabo (see 2.5.1), whereas the operation of the *lenuncularii* and the *codicarii* trade unions with their numerous members in 2nd-century Rome and Ostia highlights the importance and usefulness of such a practice.⁸⁷²

Anchoring in the open and using lighters should not, however, be seen as a 'lesser of two evils', a practice employed only because there was no better one. Its benefits were substantial. First of all, it kept ships outside secluded harbour basins, where circulation and anchoring would have been difficult due to the number of ships that had to be accommodated, but also due to the unpredictable depth fluctuations. Keeping a distance from harbour basins, as well as from shallow beaches, would be an equally sane choice for ships passing from these harbours and using them as provisioning/maintenance stations or even to unload/load whole cargoes. Many harbours also operated as *entrepôts* where ships would unload only small portions of their goods to be exhibited on land and auctioned and then continue their routes to their final destinations,⁸⁷³ their sojourn there being limited to a few days, as Strabo eloquently describes the ship traffic at the harbours of Delos.⁸⁷⁴ It would thus make little sense for passing ships to go to the trouble of entering secluded basins for

⁸⁷¹ Feuser 2020, Abb.45.

⁸⁷² Dem.35.28; Strab.5.3.5. Cf. Casson 1965; Theiss 2017.

⁸⁷³ Bresson 2016, 308-13.

⁸⁷⁴ Strabo's account of Delos ("Merchant, come into port, discharge your freight-everything is sold." 14.5.2), although a proverbial, generalized description, clearly demonstrates the widespread notion of the operation of an *entrepôt* harbour where demand was so high and constant that it took very little time for cargoes to be sold and reshipped.

such short periods of time. The inclusion of open beaches in harbours like Delos, Elaia and Lechaion (see above), which were ideal for lighters unloading/loading ships anchored in the open, is another indication of the importance this method had in creating a favourable environment for ships and mariners.

A further asset of anchoring and using lighters was that it could be employed in every harbour environment ships would encounter in their travels. Many important harbours often being heavily and unexpectedly affected by siltation (Lechaion, Elaia, Ephesus, Side, Ostia) or by natural disasters and failure of their harbour works (Claudian Portus, Caesarea Maritima), which would not stop their operation but would possibly make it more difficult for mariners. Furthermore, secondary 'opportunistic' harbours were very often nothing more than an open sandy bay.⁸⁷⁵ Ships and their crews would need to be versatile and resourceful in order to make the best out of every condition. Larger merchantmen operating in long-haul networks would have to use less protected harbours, even if these did not serve important markets.⁸⁷⁶ Bad weather, damage or political instability, warfare and piracy would force mariners to seek shelter in any site available.⁸⁷⁷ Vessels operating in smaller, short-haul, 'secondary' networks and regularly tramping between harbours in order to trade goods in smaller quantities would also frequent the same sites regularly and most likely in great numbers. To this constant mobility of ships and goods the transportation of people, these being seasonal workers, artisans, adventurers, pilgrims or geographers and tourists like Strabo or Pausanias, should be added. Versatility of sea voyages and trade is reflected in the evolution of ships and their equipment in the period discussed: the widespread use of the foresail and the mizzen, the gangplank and the ship's boat, as well as the use of many anchors of various types point towards practices that allowed ships to take advantage of every coastal environment to their benefit (see **2.4**). Anchoring in the open and using lighters would have been the easier, faster and safer way of using almost all harbours of the period.

Towing and piloting, as examined in **2.5.1**, are two auxiliary practices that would have been very useful in the harbours studied. Towing would be ideal when entering narrow passages like the channel between the Rematiaris islets and Delos or the ones connecting

⁸⁷⁵ Delano Smith 1979, 327-8; Leidwanger 2013.

⁸⁷⁶ Lucian describes how the giant grain freighter *Isis* had to find shelter to Piraeus due to adversary winds, despite the fact that the harbour was not on its course (Luc.*Nav.*5.9).

⁸⁷⁷ Gambin 2012, 148-50.

Lechaion's Inner Harbour with the sea as well as its basins to each other. Other contemporary harbours like Roman Ephesus⁸⁷⁸ or the canal network of Portus⁸⁷⁹ presented similar challenges to mariners. The poor documentation of such a practice is probably due to the fact that most seagoing ships would use their own boats and not employ local boatmen (see Philostratus' reference to the ship using her own boat to leave the harbour of Smyrna)⁸⁸⁰ whereas the whole process would have been too mundane to be commemorated in inscriptions or historical accounts. Piloting, on the other hand, although extremely useful for ships crossing dangerous straights or entering unknown harbours or estuaries, is only documented twice in written sources (Synesius' Letters and the *Periplous Maris Erythraei*; see **2.1.2**).⁸⁸¹ It is difficult to interpret the lack of a practice widely employed in more recent years,⁸⁸² especially in the larger harbours of the period, which were regularly used by ships of considerable tonnage. The answer might lie again in the common use of the ships' boats, in this case as pilots and sounding vessels and the Rimini mosaic most likely depicts such a practice (**Fig.2.39**). This multipurpose function of the ships' boats once again agrees with the whole perception of ship handling in relation to harbours during the period studied: ships and crews could and would operate quite independently, adjusting themselves to every condition and making the best out of it.

A very important aspect of ship and cargo handling in harbours during the period discussed concerned stone carriers. As described in **2.2.2**, stone and marble cargoes, being both cumbersome and heavy, required the docking of ships on their sides on quays wide and sturdy enough to accommodate cranes, their operators and the blocks transported. The use of lighters or rafts would have been feasible only for small blocks but not for larger ones that required heavy-duty machines, which could not be set and operated on ships afloat. However, in none of the harbours studied in detail here, as well as in the great majority of other contemporary harbours have any proper facilities for such operations been discovered nor is mentioned in texts. In Delos only the sturdy and spacious Gournay quay could be used by stone carriers but no remains have been found there to confirm that, whereas the distance from the city centre and the poor local road network strongly indicate that the quay

⁸⁷⁸ Kraft et al. 2011, Fig.5.

⁸⁷⁹ Casson 1965; Boetto 2010; 2016; Moreno Escobar 2021.

⁸⁸⁰ Philostr. VA 4.9.

⁸⁸¹ Syn.Ep.4.28-9; *Periplous Maris Erythraei* §44.

⁸⁸² Cunliffe 2001.

was not used as a *statio marmorum*, at least for imported stone, although it could be related with the operation of the local quarry located nearby.⁸⁸³ Similarly in Lechaion the solid and wide ashlar moles could have been used for the loading and unloading of stone and marble cargoes, but their almost total exposure to the prevailing winds would have made such operations very difficult and potentially dangerous. As for Kenchreai, it remains doubtful whether any large capacity stone carriers could have berthed sideways on the moles without being too exposed and running the danger of crashing on the rubble foundations and the ashlar quays. The *statio marmorum* has been identified only in Portus and Rome and not by any special configuration of the harbour works there, but by the presence of marble *spolia* and debris.⁸⁸⁴ In the case of Roman Ephesus an inscription reveals that stone cargoes were handled within the city's harbour, they do not, however, clarify either the existence of a special location nor the methods used for such operations.⁸⁸⁵ It appears that it was only very specific harbours, serving urban centres with uniquely high demands in building material like Rome that were ever equipped with a harbour sector specialized in the handling of such cargoes.

The pressing needs of the growing cities of the period in building material verify that such trade was extremely important and active in most harbours but a significant aspect of this trade was its 'irregularity' (see also **2.2.2**).⁸⁸⁶ Contrary to ships carrying foodstuff that had to timely arrive to harbours in order to support the local populations (e.g. the Alexandria grain fleet provisioning Rome and Latium) or to secure the export of surplus local production, stone/marble cargoes were organized around the needs of specific building projects. The movement of stone cargoes would depend on the needs of each project and the availability of funds (for example the Apollo of Clarus temple for which the cargo of the Kizilburun shipwreck was to be used was being constructed for more than three centuries).⁸⁸⁷ This view is further strengthened by the fact that there is nothing to confirm that stone carrier ships were vessels specially built for this form of trade but that they were

⁸⁸³ Zarmakoupi 2015, 126.

⁸⁸⁴ Keay 2012b, 38-9, 47.

⁸⁸⁵ Bouras 2009. The fragmentary Ephesus inscription can be reconstructed as follows: "So I order those who import wood and those who import stone not to place the wood there nor to saw the stone blocks there; for the former damage the piles built for the protection of the quays with their weight and the later undermine the depth of the basin with the emery produced and retain the current; both render the shore unusable" (*IvE* 23; translated by the author).

⁸⁸⁶ Russell 2013a, 129-31.

⁸⁸⁷ Carlson & Aylward 2010, 151.

regular merchantmen doubling as stone carriers each time they were commissioned for such cargoes (see **2.5.2**). Thus, with stone carriers arriving in harbours in significant numbers but not regularly, the need to create special sectors for them must have been secondary and harbour authorities must have been more concerned with the handling of these cargoes on land, as the inscriptions from Delos (see **3.1**) and Ephesus (see above) on the handling of building material in specific areas testify. The only feasible, as well as more convenient, solution would have been the construction of temporary wooden quays or the beaching of vessels as close to the shore as possible, even if that meant that ships would be stranded until they could be emptied and floated back to the open sea. If wooden jetties were purposely constructed for such operations without any care for future use and, quite likely, with recycled timber (especially in regions where good quality wood was scarce like the Cyclades), it is not surprising that none has survived. On the other hand and although deliberately stranding ships would have been a troublesome and delicate procedure, it would be supported both by the great funds invested in monumental architecture,⁸⁸⁸ as well as by the large numbers of workers available in such constructions sites. Ship commanders would have to each time balance the necessity of unloading their cargoes and the potential dangers and decide whether to employ such a method or not.

One last important issue related to the use of harbours by ships was the organisation of the sea space. There are no clues on any actual restrictions imposed on ships from entering harbours in written sources, with the exception of secluded military harbours or the harbours of royal palaces, thoroughly guarded for security reasons.⁸⁸⁹ Nevertheless, an effort to regulate and tax the accommodation of ships inside harbours is evident in several written sources. According to the Digest each ship commander had to present to harbour authorities a declaration he had prepared upon departure from his homeport concerning the quantity and quality of state supply victuals he carried. The declaration was acknowledged and returned and this allowed him to depart the harbour.⁸⁹⁰ In Delos, before the establishment of the free port, inscription document the harbour fees paid to the sanctuary

⁸⁸⁸ On the high costs of temple construction in ancient Greece see Burford 1965.

⁸⁸⁹ Blackman & Rankov 2013, 210-30; Feuser 2020, 312-5.

⁸⁹⁰ *Dig.*48.11.7.2 & 50.16.106; cf. Mataix Ferrándiz 2018, 89. Although two Roman inscriptions document the necessity of official permits for ships to leave harbours, these could be related with the *annona* networks and not with all ship traffic.

by every visigin ship.⁸⁹¹ In Ephesus a fragmentary inscription prevents incoming ships from obstructing the harbour basin.⁸⁹² In Alexandria, according to Strabo and papyric evidence, a special permit (*lettera dimissoria*) would have to be obtained in order to allow any merchant ship to leave the harbour.⁸⁹³ This data comes from some of the busiest harbours of the period and, in the case of the Digest, concern the *annona*. It is difficult to ascertain whether similar laws were being applied in all harbours of the period and in which manner. It is possible that some harbours, according to the local needs, had a more rigid policy in harbour space organization and taxation and other not.

What is also evident is the effort to regulate the use of beaches. The Thasos harbour inscription clearly demarcates two beaches that were reserved for the hauling of ships above 80 and above 130 tons respectively,⁸⁹⁴ whereas the *horos* inscription of Delos' Main Harbour assigns a special "cove" for the use of galleys.⁸⁹⁵ In both cases these spaces are related to beaches where ships of importance due to their tonnage (Thasos) or ceremonial function (Delos) could be hauled or draught beached. The focus on the beaching of ships is probably related to the fact that this was the only operation that could be fully controlled by the local authorities, requiring the use of both public space as well as infrastructures (slipways, capstans etc.) and personnel.

4.3. Technology, funding, patronage and planning

By the Roman imperial period a series of different methods of harbour construction had developed in the Mediterranean: stone-cut harbours, rubble jetties with ashlar quays built upon them, ashlar moles erected by casting blocks from the surface on the seabed, wooden jetties and quays and finally maritime concrete.⁸⁹⁶ The builders of the case study harbours had used, however, only two, rubble foundations supporting stone quays (Delos' Main Harbour, Kenchreai) and casting ashlar blocks from the surface (Delos' Gournai, Lechaion). In the case of Delos the choice of these two building methods can be explained by the date of the harbour works that precede the destructions of 88 and 69 BCE, just before the

⁸⁹¹ ID 353A, 28; ID 354, 25; IG, XII, 287A, 39; Homolle 1882, 67.

⁸⁹² "It is necessary that the harbour that welcomes all those who come from all directions not to be crowded (by ships)" (IvE 23; translated by the author).

⁸⁹³ Strab.2.3.5; P.Oxy.X.1271; BGU 1.27. Cf. Mataix Ferrándiz 2018, 89.

⁸⁹⁴ IG, XII Suppl. 348; Launey 1933, 394-401; Blackman 1995, 75-9.

⁸⁹⁵ ID 2556; Roussel 1916, 299, n.3; Dûchene et al. 2001, 153-4.

⁸⁹⁶ Rickman 1988, 285.



Fig.4.11. Map of the harbour sites where the ROMACONS project took concrete cores (black dots; drawing by the author based on Brandon et al. 2014, Fig.3.2).

technology of maritime concrete was introduced from Italy to the rest of the Mediterranean by the Romans.⁸⁹⁷ In Lechaion and Kenchreai, however, both extensively rebuilt during the Augustan and Flavian period, exactly when maritime concrete was becoming common, there are no traces of such technology. Nevertheless this should not be seen as something unusual. A closer look to the diffusion of maritime concrete technology in the early Roman harbours of the Mediterranean shows that it is quite uneven (**Fig.4.11**).⁸⁹⁸ With the exception of several harbours in central Italy, which were closer to the sources of material for the creation of maritime concrete (Campanian pozzolana) as well as to imperial Roman patronage and funding,⁸⁹⁹ there are areas in which the new technology was never introduced. In the Aegean it is only Chersonissos in Crete where moles were built with the use of maritime concrete, whereas in Alexandria Troas, Kyme or Pompeiopolis where concrete was used, it remains doubtful whether this was employed underwater or just used to fill ashlar enclosing walls built above sea-level.⁹⁰⁰ Even in some of the most important and monumental harbours of Asia Minor, which were greatly developed during the Roman Imperial Period, like Ephesus or Miletus, no such technology was ever introduced.⁹⁰¹ The

⁸⁹⁷ Brandon et al. 2021, 233.

⁸⁹⁸ Despite the large number of Mediterranean harbours where concrete has been employed (Brandon et al. 2021, 121-40), the actual use of maritime concrete is not so widespread. The results of the ROMACONS project showed that many of them were not actually built with maritime concrete, whereas most were not thoroughly tested as actual maritime concrete structures within the framework of the project.

⁸⁹⁹ Robinson et al. 2020, 105-7.

⁹⁰⁰ Esposito et al. 2002, 30, Tav.X; Feuser 2009, Beil.3; 2011, 261-5, Fig.15; Brandon et al. 2021, 89-101.

⁹⁰¹ Feuser 2020, 126, Abb.58.

same stands for the lavish Severan harbour of Lepcis Magna, where concrete was used only on dry land as filling, encased within ashlar walls.⁹⁰²

Most of the harbour works of the period consisted of simple rubble or ashlar moles and jetties crowned with more or less monumental ashlar quays and other buildings such as lighthouses, fortifications and temples). The survival and prevalence of this ‘obsolete’ method (the rubble moles of Samos and Klazomenai/Liman Tepe dates back to the 6th century BCE)⁹⁰³ was not, however, a sign of backwardness or shortage of funds. Despite its disadvantages, which mainly considered the large amounts of material used and the inability of ships to actually dock on structures of that type, the method created sturdy moles, barely affected by wave and drift action, that guaranteed the safety of the ships they protected and were also large enough to allow for additional structures to be erected on them. The longevity of these moles was another considerable asset (it is characteristic that the “Great Mole” of Delos and the moles of Kenchreai continue to protect the basins even though submerged), compared to new, not tested technologies like maritime concrete (see below). A further issue would have been the tendency of vernacular constructors and craftsmen as well as of administrators to prefer methods already known to them instead of experimenting with new ones, which, in the case of maritime concrete, were also technically complicated (related to the “path dependence” theory of technological innovation).⁹⁰⁴ Finally, maritime concrete was both a complex as well as an expensive product.⁹⁰⁵ The investment of resources in creating concrete harbours would make much more sense in areas without many natural harbours like the Tyrrhenian coast of Italy, the Levant and Northern Africa,⁹⁰⁶ or at the ends of great commercial networks like Rome and Alexandria in which it was much more likely large numbers of ships of considerable size and draught would operate. It is therefore not surprising that in areas like the Aegean harbours continued to be built with the traditional methods, even in sites like Delos where funding was abundant.

A note should be made here about the use of ashlar blocks cast above the surface of

⁹⁰² Bartoccini 1958, 28-9, Figs.1-3.

⁹⁰³ Hdt.3.60; Tölle-Kastenbein 1976; Votruba et al. 2016, 672.

⁹⁰⁴ Frier & Kehoe 2007, 137. The idea of “path dependence” in economics relates to the resistance of things to change due to financial implications or to the reservation of policymakers (Liebowitz & Margolis 2001). This can be reasonably applied to the harbour construction technologies that perpetuate older methods that are cheaper, more convenient and already operational within the pre-existing commercial networks.

⁹⁰⁵ Brandon et al. 2021, 223-35.

⁹⁰⁶ Wilson 2011b, 49; Robinson et al. 2020.

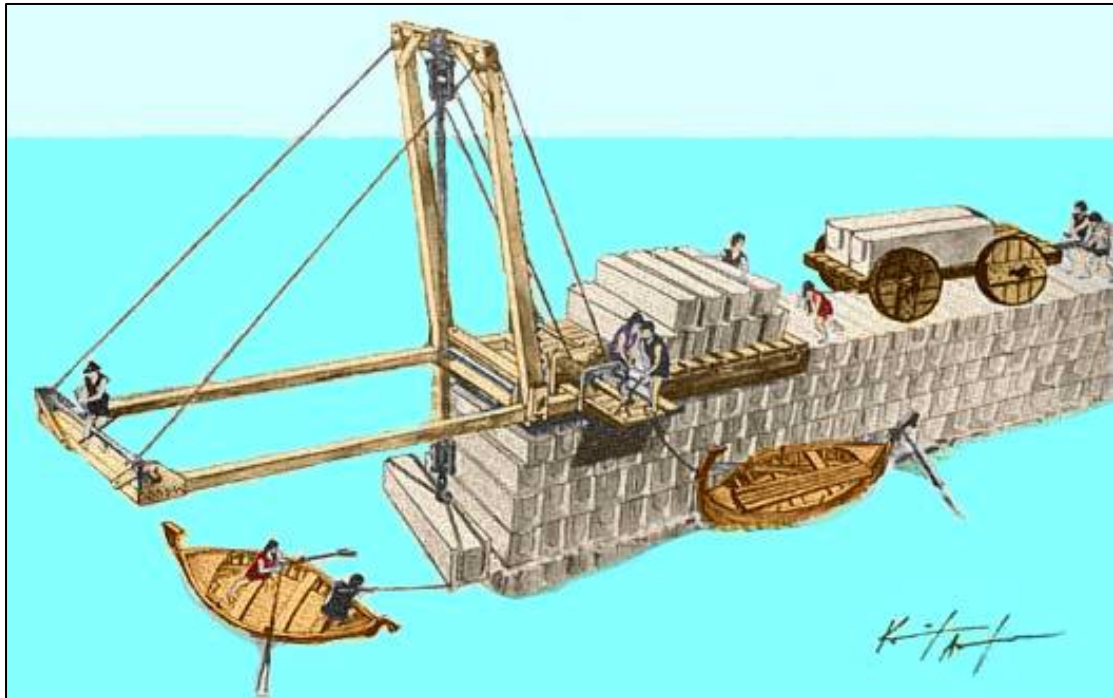


Fig.4.12. Artistic reconstruction of the method employed for the construction of the ashlar mole of Amathus harbour (<http://www.hellenicaworld.com/Greece/Technology/en/Ports.html>).

the water in Delos' Gourni and Lechaion's Outer Harbour. The method remains a rather rare one, documented with finds from the aforementioned sites, Amathus' military harbour (Fig.4.12), probably Kyme and Pompeiopolis and by written sources in the Trajanic harbour of Centumcellae.⁹⁰⁷ Its application in these sites is inferred by the depth these areas had in antiquity, a depth that did not allow structures to be erected above sea level, as well as the lack of any joints on the blocks. This method would potentially create very sturdy and compact moles (the preservation of the Lechaion moles, despite their long-term exposure to violent waves, clearly shows that) without the use of joints (the weight of the blocks was adequate to maintain the integrity of the structure), whereas it could also be used in deeper areas, creating sturdy docks with adequate depth for ships of any size. It did, nevertheless, require the supply of considerable amounts of well-hewn stones, as well as elaborate lifting devices and a thorough preparation of the seabed. It is difficult to assert whether the

⁹⁰⁷ Esposito et al. 2002, Fig.27; Brandon et al. 2021, 94-101; Empereur & Koželj 2017. The free-standing breakwater of Centumcellae is described as having been built by casting ashlar blocks from the surface by Pliny the Younger: "The island has been artificially constructed, and is not a natural formation, for a broad barge brings up a number of immense stones, which are thrown into the water, one on top of the other, and these are kept in position by their own weight, and gradually become built up into a sort of breakwater.... Subsequently concrete will be added to the stones, to give it the appearance of a natural island as time goes on" (Ep.6.31.16-7). Unfortunately the exact nature of the construction method remains unknown, since no archaeological data exist on the breakwater that has been rebuilt many times throughout the centuries and is still in use today (Quilici 1993).

method was experimental and this is the reason why it was not so widely employed. The success of the method is variable: in the case of Delos it remains unclear for how long the poorly preserved Gournay quay was used and how,⁹⁰⁸ in the case of Amathus the harbour was most probably never completed, whereas in Lechaion the transformation of the two great moles into small capes by the accumulation of sediment is a proof of their sturdiness and longevity.

A very interesting aspect of the case study harbours is the sheer number of actual harbour works. In late Hellenistic Delos, despite the importance of the island as a commercial centre and the amount of ship traffic it served, harbour works remained surprisingly limited to the two moles of the Main Harbour and the Gournay quay (the series of coastal quays are not included, since, as we saw, they served as retaining walls and not as actual quays). The harbours of Delos were thus left without any considerable artificial protection and most of the resources of the local authorities were invested in commercial infrastructures on land (see below). This was not, however, due to negligence but due to the nature of the ship and cargo traffic in the island. As shown in **3.1**, Delos was an open, free harbour, an *entrepôt* in which merchantmen would remain for short periods, anchored in the open, as merchants conducted their transactions in the local markets before sailing away to their final destinations, whereas the city's provisioning needs would be covered largely by short-haul networks and local production. The practical usefulness of constructing new, expensive enclosed basins becomes questionable. Furthermore, the silting of the Main Harbour, experienced already since antiquity, would have made the Delian authorities think twice before creating another similar basin that would likely be rapidly silted too.⁹⁰⁹ It could be argued that there was not enough time for the construction of new harbour works within the period of great prosperity (between 166 and 88/69 BCE). Nevertheless, the intense construction activities on land, including commercial buildings of great size (e.g. the Hypostyle Hall), as well as the rapid expansion of the city towards almost every available direction, strongly indicates that it was a conscious choice not to capitalize more harbour works but focus on different commercial infrastructures. Lechaion was a similar case where despite the considerable resources invested in the erection of the monumental

⁹⁰⁸ The poor preservation of Gournay's quay might have been due to hasty construction, whereas the possibility that it remained unfinished before the island's destruction in 88/69 BCE should not be excluded.

⁹⁰⁹ Dalongeville et al. 2007, fig.8; Desruelles et al. 2007, Fig.5.

moles/groynes and the Entrance Channel a choice not to create enclosed basins was most likely made. Although there was enough time to create, even at a slow pace, at least one enclosed basin on the coast, that would be able to accommodate larger vessels and to operate as a monumental façade of Corinth's western gateway, as was the case in Kenchreai, this never happened.

In all case studies the harbour works chosen were related to functionality rather to the creation of a predominantly monumental establishment and that was most likely not an exception to the rule. Already in antiquity it must have become evident that substantial harbour works did not guarantee the operation of harbours and often generated more problems than the harbour administrators could handle: Claudian Portus was unable to prevent the destruction of 200 ships in 62 CE, Caesarea Maritima's collapsed concrete moles and quays had rendered the harbour largely unusable by the end of the 1st century CE,⁹¹⁰ Ephesus' harbour works under Hadrian had actually accelerated and not prevented the siltation of the basin,⁹¹¹ whereas Side's dredging was a proverbially Sisyphean task.⁹¹² Better planning did, however, secure the operation of harbours, with a parallel economy in resources: in Kenchreai the harbour basin became an excellent anchorage with minimum siltation, whereas in Lechaion the groynes served their purpose well, depleting incoming silt and waves and maintaining the Entrance Channel open even in later periods. This was a more 'down to earth' approach to the problems of harbour operation, where specific targets were set and cautious investments were then planned and materialised.

Whichever choices harbour constructors made, the importance of funding and patronage was essential. In the case of Delos, as the inscriptions document, funding came directly from the sanctuary's treasury and large sums were repeatedly invested for nearly a century in the creation and maintenance of the moles and agoras around the Main Harbour.⁹¹³ In the cases of Lechaion and Kenchreai it is almost certain that their renovation was part of the extended reconstruction program of Corinth and the reorganisation of the countryside by the Roman state that began under Julius Caesar and continued until the end of the 1st century CE.⁹¹⁴ With the high cost of harbour construction and maintenance being

⁹¹⁰ Reinhardt & Raban 1999, 814; Brandon et al. 2021, 79-81; Goodman-Tchernov & Austin 2015, 452-3.

⁹¹¹ Kraft et al. 2011; Feuser 2020, Abb.51, 115-6.

⁹¹² Wilson 2011b, 51.

⁹¹³ *ID* 355, 12; *ID* 399 A, 44-8. Cf. Bruneau 1981, 110-1.

⁹¹⁴ Paus.2.3.5 & 8.22.3. Kent 1966, np.82; Engels 1990, 207; Romano 2010; Pawlak 2013, 155.

something only state authorities and very high ranking officials could cover (there is meagre evidence for civilians funding the construction and/or maintenance in any Hellenistic and Roman harbour),⁹¹⁵ harbours would also play a vital role in the complicated interplay of patronage and euergetism, especially during the Roman imperial period.⁹¹⁶ The creation or enhancement of harbour facilities was a task that could directly improve the public image of high-ranking officers, who were regularly commemorated for their services by the local communities (Theophrastos in Delos, Flavius Hermogenes in Lechaion, Soranus and Iulianus in Ephesus).⁹¹⁷

But this kind of patronage could also have a negative impact on the life of harbours, since euergetism was delivered according to specific political conditions, which dictated the selective funding of certain cities and projects and not others. The construction of Kenchreai seems to have been such a case. As indicated by excavation finds it took more than a century for the harbour works to be concluded,⁹¹⁸ despite the fact that these were neither too extended nor technically complicated, in comparison to other contemporary harbours like Caesarea Maritima or Claudian Portus. This was probably due to the lack of adequate funding from the local authorities, which also had to rebuild the entire city of Corinth, repopulate and re-organise its territory through centuriation, as well as to the accidental or deliberate lack of imperial patronage. The same probably happened in Lechaion, although the precise duration of the construction of the harbour works is still unknown. Local authorities were left to their own devices to build, embellish and operate these harbours and had to choose the most convenient methods, avoiding the creation of impressive, but of little practical use, monuments and focusing on functionality. The high cost of extensive harbour works was also, as other large building projects, “beyond the pocket of even the

⁹¹⁵ The only civilian confirmed by written sources to have funded harbour works is the Ephesian sophist and benefactor T.Flavius Damianus, who had constructed “artificial islands” and had cleared all harbour coves from siltation (Philostr.VS, 2.23; cf. Feuser 2020, 312). However, it is clear from the text that the sophist did that in the lands he had under his possession and not at the city’s harbour. A similar case was Marcus Aemilius Lepidus who, in 179 BCE, constructed a breakwater in Terracina using state funds but allegedly to serve his own private estates in the region (Liv.40.51.21; cf. Robinson et al. 2020, 106).

⁹¹⁶ Arnaud 2015a.

⁹¹⁷ Tac.*Ann.*16.23. Homolle 1884, 123; Rizakis et al. 2001, 315-6; Wilson 2011b, 51.

⁹¹⁸ Hohlfelder 1985, 84-5.

wealthiest individuals”,⁹¹⁹ whereas antagonism and political opportunism must have also played their role.⁹²⁰

Interestingly enough the approach of the Delian authorities towards their harbours was similar, although the sanctuary was one of the wealthier in the Mediterranean.⁹²¹ Conditions in Delos were, however, quite distinctive when compared to other harbours of the Aegean. As we saw above the island remained basically a port-of-trade in which transient ships would not spend much time. The sanctuary affirmed its importance in a more visible manner by creating luxurious monuments, often under the patronage of powerful foreign rulers like Antigonos Gonatas or Philip V, as well as public facilities to serve merchants and pilgrims on land (Hypostyle Hall, the two harbour agoras, the Agora of the Italians) but not in the sea.⁹²² Another possible reason also for the fact that Delian authorities did not invest their resources in creating monumental harbours was the establishment of the free port in 166 BCE.⁹²³ This would have prevented the Delians from imposing taxes on the ships using the harbour and would have thus weakened their resources and their interest to create a more appealing harbour environment by investing large amounts of money in expensive harbour works. Ships and merchants would have used the free port either way, thanks to its geographical position, lack of tolls and the existence of an thriving market and city that could provide religious, provisioning and recreation facilities to ship crews and passengers and Delians could take advantage of this without the creation of a protected artificial harbour.⁹²⁴

The creation of harbour networks is another important aspect of harbour construction and operation. Historical sources do not explicitly document any organised state plan to create a network of all commercial harbours, even in the Roman Imperial period, when the unification of the Mediterranean was completed, although considerable

⁹¹⁹ See the estimates for the building costs of Caracalla's baths in Rome (DeLaine 1997, 222).

⁹²⁰ In Roman Corinth there seem to have been adequate private sponsors for the construction of monuments (e.g. Marcus Antonius Mulesius, who, along with other, had rebuilt the temple of Asclepius; Kent 1966, no.311; Rizakis et al. 2001, 262; cf. Pawlak 2013, 155), but no individual is related with harbour work. In the same area there must have also been friction and antagonism between the colonists of the city and the inhabitants of the surrounding countryside (Pawlak 2013, 157-8).

⁹²¹ Shipley 2000, 130.

⁹²² It remains an interesting hypothesis whether more harbour works would have been erected in Delos under direct Roman rule and imperial patronage, had the island escaped the destructions of the 1st century BCE.

⁹²³ Rauh 1993, 2-3, 7-8.

⁹²⁴ See also the similar case of the Roman harbour of Berenike Troglodytica on the coasts of the Red Sea (Kotarba-Morley 2015, 284-6).

efforts were repeatedly undertaken for the stimulation of trade. These included the construction of new harbours or the institution of tax exemptions concerning either individual harbours like Delos or ships serving the *annona* grain supply system⁹²⁵ Political necessity and even a public demonstration of a ruler's piety towards his hometown, also dictated the creation of lavish harbours like the Ptolemaic Alexandria, Caesarea Maritima and Lepcis Magna too.⁹²⁶ The success of such endeavours was in any case questionable: in the case of Amathus the military harbour was never finished,⁹²⁷ whereas in the cases of the Claudian Portus and Caesarea Maritima the harbours very quickly faced considerable problems and required large-scale repairs and extensions (see above).

An effort to create harbour networks in a local level is, nevertheless, more evident. Such is the case of Southern France and of the Tyrrhenian coast of Central Italy where a series of harbours were gradually either created or enhanced under Roman rule (especially in the 1st century CE) in order to serve the rising needs of trade with the west.⁹²⁸ The same was, most likely, the case with Northern Africa in the Antonine period and the commercial development of these areas, as well as the fall of the number of shipwrecks dated in that period indicate the beneficial impact such networks had in the local economy.⁹²⁹ In the Aegean, however, it is difficult to ascertain the creation of similar harbour networks in this way. Despite the fact that many harbours had received state funding and were under the patronage of rulers or high-ranking officers (e.g. Ephesus, Lechaion) written and archaeological evidence do not point towards an organized effort to create harbour networks but to the improvement of pre-existing harbours *ad hoc*, each time serving different commercial and/or political needs. This, however, should not be considered a sign of negligence, but of adaptation to the local conditions. With a multitude of harbours and adjacent urban centres pre-existing in the region, especially in Ionia, with many natural anchorages allowing the safe accommodation of ships and with coasts and islands being at short distances to each other, the creation of harbour networks 'from scratch' was quite unnecessary. What must have been more important was the improvement and embellishment of specific harbours to serve specific commercial needs (e.g. storage

⁹²⁵ Rougé 1966, 460-5; Gruen 1984, 299; Rauh 1993, 2-3 Morley 2007, 585-6.

⁹²⁶ Holum & Hohlfelder 1988, 73; McKenzie 2007, 41-7; Feuser 2020, 204-24.

⁹²⁷ Empereur & Koželj 2017.

⁹²⁸ Schörle 2011; Robinson et al. 2020, Figs.2-4.

⁹²⁹ Morel 2007, 505; Wilson 2011b, 49-51, Fig.2.25; Robinson et al. 2020, 103-4.

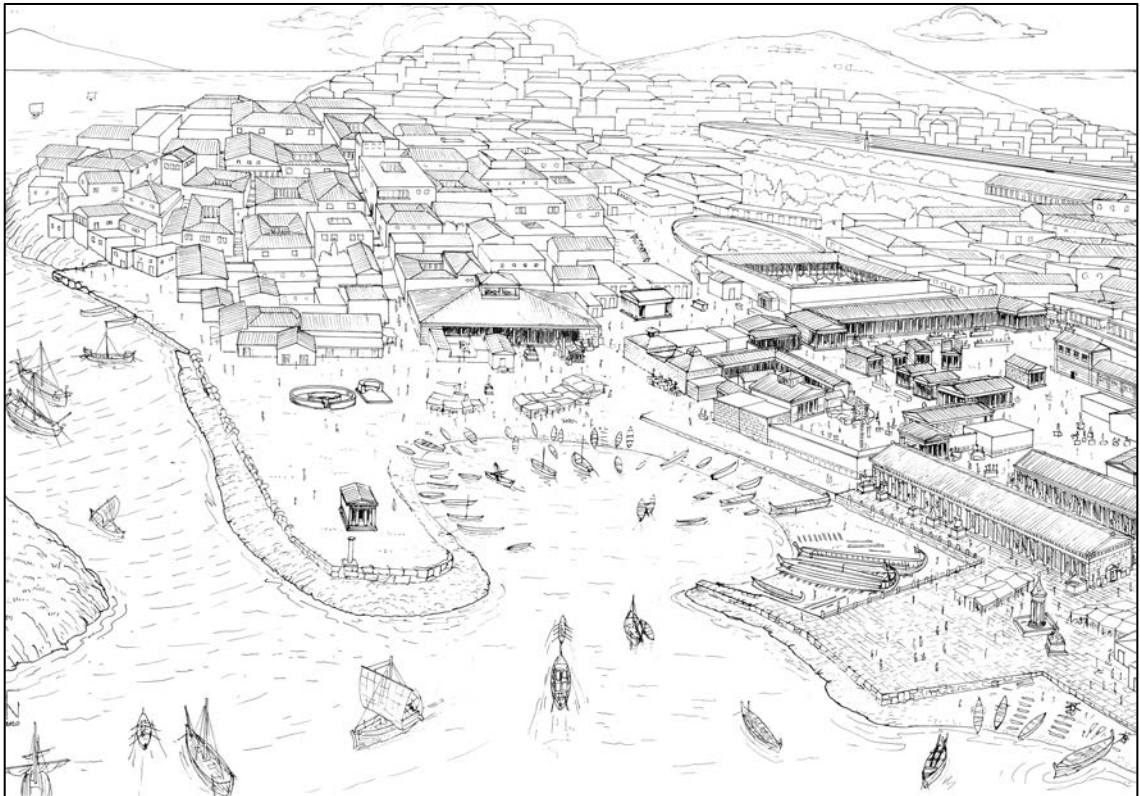


Fig.4.13. Artistic reconstruction of Delos' Main Harbour during the late Hellenistic period (drawing by the author).

infrastructure related to the *annona* grain provisioning scheme), as well as political necessities.

What different harbours did share, however, was the application and diffusion of common technologies. These were employed among various sites, with none being limited to any geographical region, something hardly surprising in the unified Hellenistic and Roman Mediterranean world, where a “maritime *koine*” had developed through commerce and interaction.⁹³⁰ Whether the construction of harbours was undertaken by specialised itinerant architects and engineers (some possibly serving in the armies of the period)⁹³¹ and their working crews or whether local specialists were employed is unknown and surviving written sources, such as Vitruvius, give no clues about it. Nevertheless, creating harbour works by casting rubble from the surface was a rather simple and not as technically advanced task as

⁹³⁰ Horden & Purcell 2000, 396.

⁹³¹ Brandon et al. 2021, 232. The large centuriation projects in various areas of the Roman Mediterranean amongst which Lechaion and Kenchreai were related with the settlement of veteran legionaries. Although it would make sense for army engineers to be responsible for the local harbour works too, information is very poor. A Latin tomb inscription documents the employment of a *caementarius* concreting engineer in the Misenum fleet (1st-2nd century CE; *CIL* 10.3414) but it is not stated whether he was employed in harbour construction (Brandon et al. 2021, 35-6).

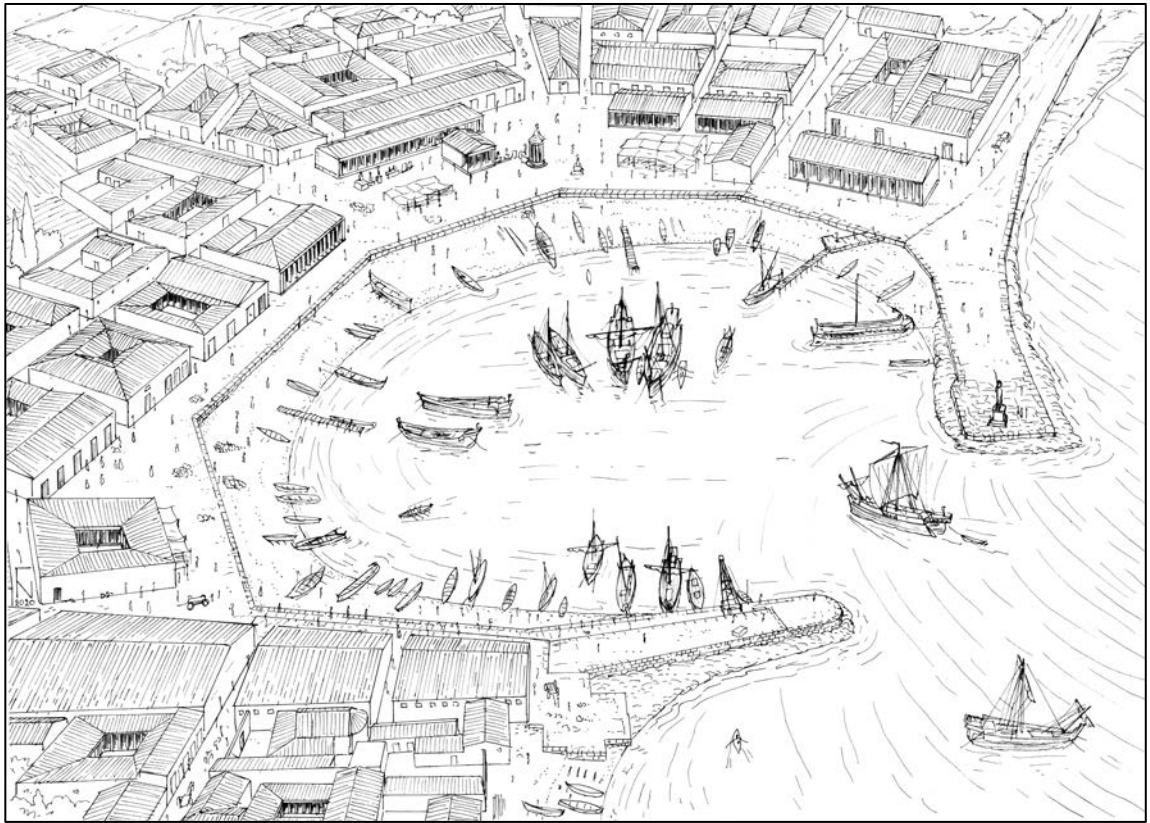


Fig.4.14. *Artistic reconstruction of the harbour of Kenchreai during the Roman period (drawing by the author).*

the use of maritime concrete (**Fig.4.11**). The latter required not only the technical skill and experience to make the proper concrete, but also the import of volcanic pumiceous material in large quantities (the ROMACONS project proved that only Campanian material was used)⁹³² and the erection of elaborate and costly wooden moulds (caissons). The cost and complexity of this method is most probably what made it less favourable amongst harbour builders, especially in the Aegean, and is why it remained restricted to the larger, more lavish harbours built under the patronage of ambitious rulers like Herod or the Roman emperors.

4.4. Harbour organisation, networks, hinterlands and forelands

A harbour's fundamental mission and function, as underlined many times throughout this study, is to accommodate and serve ships and cargoes and is essentially interweaved with its role as commercial centre, meeting place, part of urban environments and exchange networks as well as maritime façade of cities, regions or whole states. A reciprocal

⁹³² Brandon et al. 2021, 233.

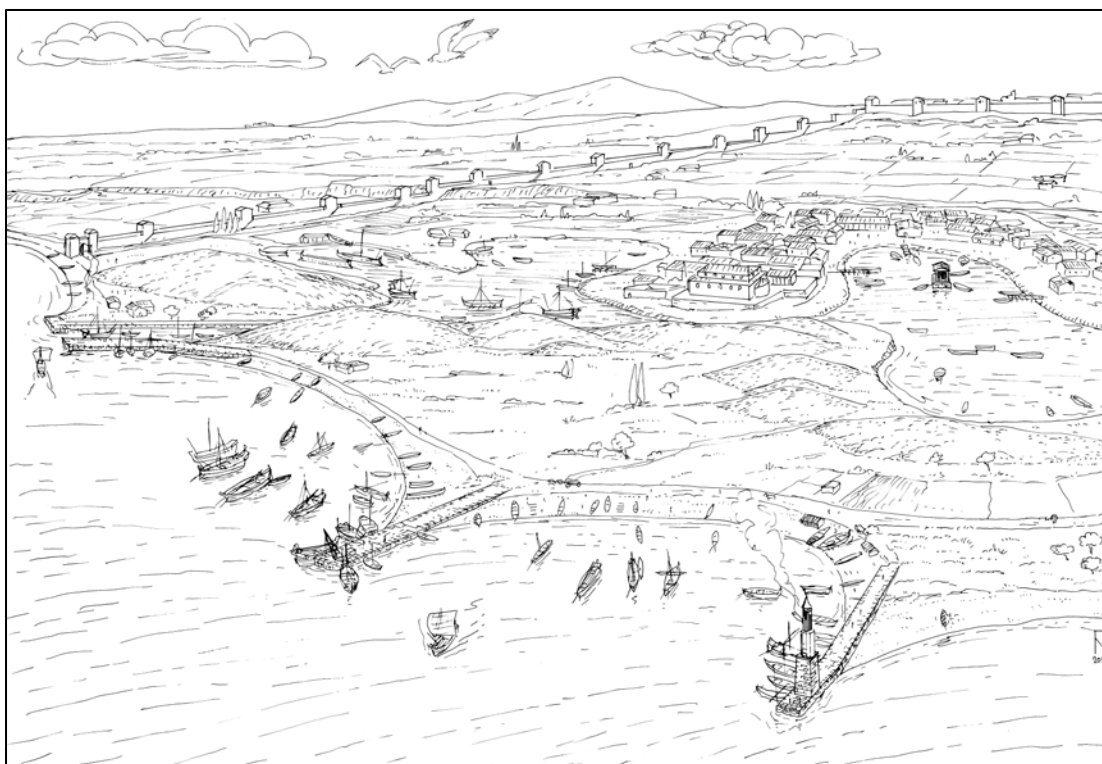


Fig.4.15. *Artistic reconstruction of the harbour of Lechaion during the Roman period (drawing by the author).*

relationship had developed between the two main aspects of harbour creation, development and operation during the period studied, both concerning the case study harbours as well as other contemporary ones.

A basic aspect of the commercial and urban role of harbours concerns the organization of the spaces around them. In Delos the need for adequate room for the handling of cargoes and the operation of markers led authorities to invest their resources in the creation of the two agoras, as well as of the quays/retaining walls around the Main Harbour basin (**Figs.3.10, 4.13 & 16**), along the Merchant Harbour (**Fig.4.20**) and probably Skardanas too (**Fig.3.26**), and to thoroughly make sure these spaces were left free of buildings (at least during the period of prosperity).⁹³³ Similarly in Kenchreai a wide esplanade was created around the harbour quays, with more spacious areas located in front of the warehouse complex and at the bay's centre, where the city's agora was most likely located (**Fig.4.14 & 17**). The organisation of spacious agoras next to harbour basins is also attested in almost all contemporary harbours like Ephesus, Miletus, Kos, Lepcis Magna and Alexandria

⁹³³ Although several buildings covered the two agoras of Delos' Main Harbour during the Roman period, as the city was reduced in a segment of its Hellenistic size by the Triarius fortification, space was still left free in the two harbour agoras, which most likely continued to operate as commercial markets (Pâris 1916, 29; Hasenohr 2002, Fig.12).

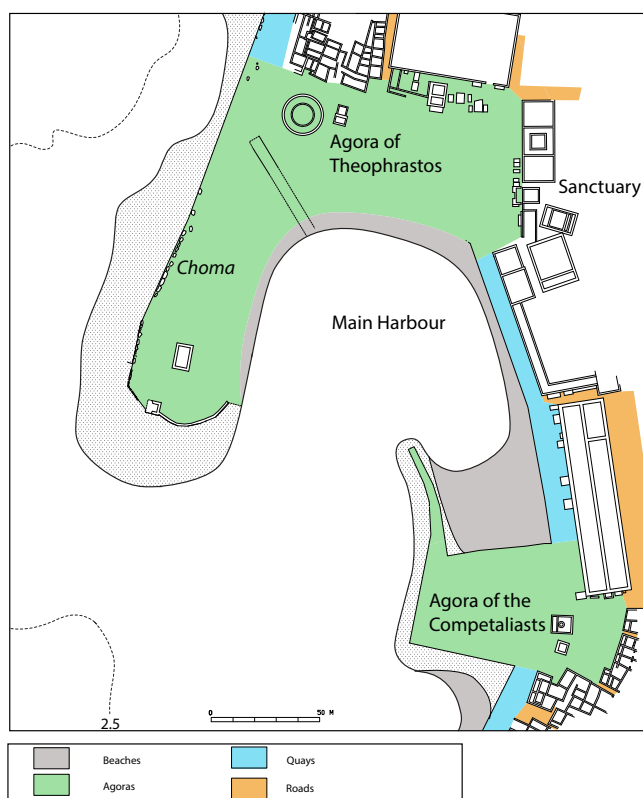


Fig.4.16. Plan of Delos' Main Harbour with colour indications of the use of its surrounding open spaces (drawing by the author).

organised settlement or market: no commercial or other buildings were located on the exposed shore and it is very probable that the actual agora of the settlement was organised south of the Inner Harbour, where the Roman civic basilica was also located (**Fig.4.15**).

Public spaces around harbours were of varying sizes, from relatively small agoras, not exceeding 1,000 m² (Delos, Kenchreai) to vast, monumental areas (Miletus, Ephesus, Kos; **Figs.4.2, 6 & 7**), their size related to the needs and resources of each harbour and harbour city. They accommodated sanctuaries, altars and temples, essential for the religious life of the mariners and visitors, especially the ones related to the sea: the sanctuary of Poseidon *Ναυκλᾶριος* in the agora of Theophrastos in Delos (see **3.1.2**) and the sanctuaries of Isis and Aphrodite in Kenchreai (see **3.3.2**) were all dedicated to patron deities of mariners and travellers. Similar important establishments were the sanctuaries of Aphrodite and Hercules in Kos, the “Felsspaltempel” (Crevice temple, most probably of Aphrodite) at Ephesus or the Delphinion at Miletus.⁹³⁶

Troas (**Figs.4.2, 4.6 & 4.7**).⁹³⁴ This configuration directly reflects the operation of harbours as commercial centres and the need for cargoes, either as a whole or partially to be unloaded on free spaces around them, exhibited, sold and with some being returned to the ships to continue their journeys.⁹³⁵ Specialised cargoes like enslaved people and building material also required adequate space and commercial facilities and the most convenient choice for them were the areas closer to the harbour basins or coasts. Lechaion is the only harbour where it is doubtful that the coast was ever part of any

⁹³⁴ Feuser 2020, 252-65.

⁹³⁵ Arnaud 2011, 67.

⁹³⁶ Kleiner 1968, 33-5; Bouras 2014, 673-4, Fig.2; Ladstätter 2016, 257-60.

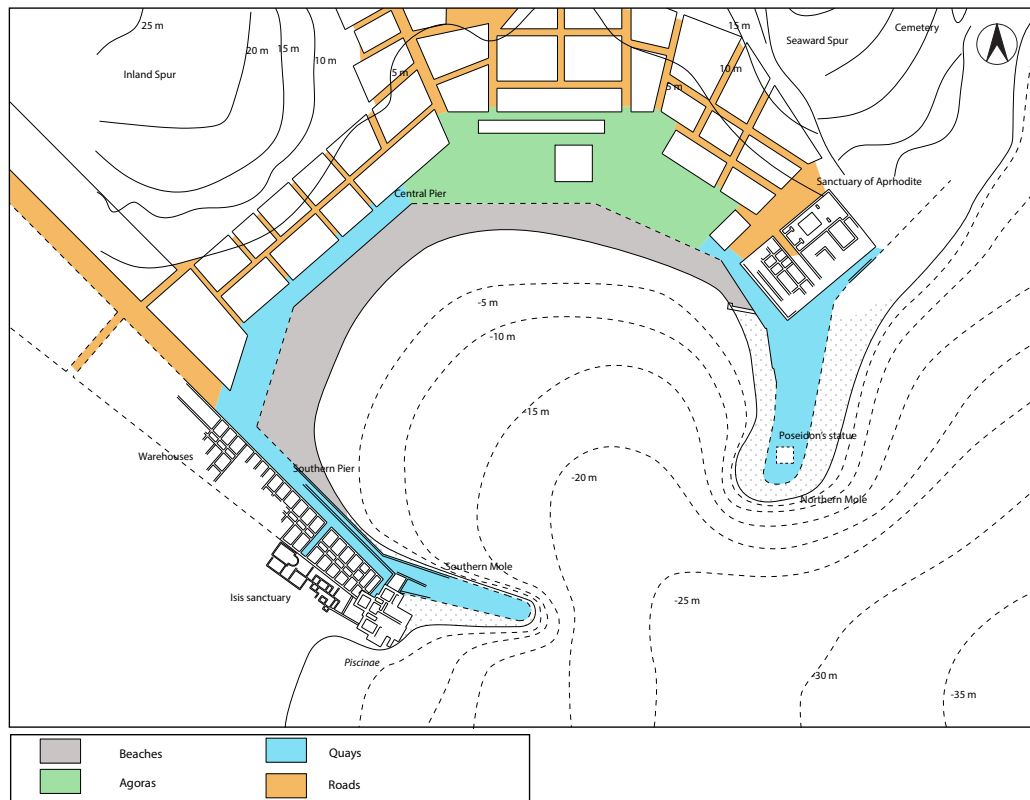


Fig.4.17. Plan of Kenchreai's harbour with colour indications of the use of its surrounding open spaces (Drawing by the author).

What harbour spaces also needed was a connection with their hinterlands. A hinterland could range from the extended tracks of land providing the harbour with export products and raw material and a market for imported goods to just an island or the city the harbour served.⁹³⁷ In the case of Lechaion and Kenchreai both harbours were related to an extended, fertile hinterland and a large metropolis, communicating through a network of roads, which were greatly improved during the Roman period through centuriation (Figs.4.17-8).⁹³⁸ These road networks also allowed the transportation of goods over the Isthmus from one harbour to the other and could even extend further south and west, expanding the hinterland of the Corinthian harbours to large parts of Peloponnese too. The possible connection with such an extensive hinterland is reflected in the large warehouse complex of Kenchreai where great quantities of local production goods or of imports were waiting to be distributed or exported. Similar extended hinterlands existed, thanks to geophysical and political conditions, for the harbours of Asia Minor or of Northern Africa and it was thanks to these networks that many of these harbours developed during the Roman

⁹³⁷ Rougé 1966, 121; Karmon 1985, 2-5; Horden & Purcell 2000, 392.

⁹³⁸ Romano 1993, Colour Fig.7.

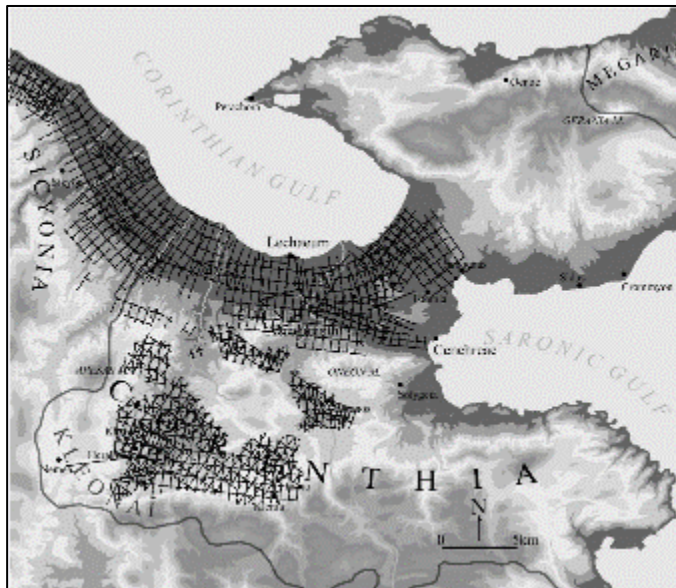


Fig.4.18. The centuriation and road grid system of Corinthia and Sicyonia after its completion in the 1st century CE (Romano 2010, Fig.10).

period.⁹³⁹ Such networks could also be greatly improved by the use of navigable rivers and canals, as happened in Alexandria and Portus/Ostia something, however, not feasible in Lechaion and Kenchreai.⁹⁴⁰

Delos presented a totally different configuration to Corinthia concerning the role of the island's hinterland and foreland. The harbour's direct hinterland consisted of a tiny island and a single city. Delos possessed, however, unique dynamics

as a commercial centre, being a cosmopolitan *entrepôt* or *emporion*, the "common market of Greece",⁹⁴¹ especially after the establishment of the free port in 166 BCE. Thus, in a way, the actual hinterland of the harbour extended beyond the geographical limits of the island and reached wherever the commercial links of the city extended to.⁹⁴² At the same time and in a unique way this hinterland was also the harbour's foreland.

⁹³⁹ Wilson 2011b, 49-50; Külzer 2019.

⁹⁴⁰ Khalil 2010; Keay 2012, 48-9; Boetto 2016; Belov 2020.

⁹⁴¹ Paus.8.33.2.

⁹⁴² Roussel 1916, 301.

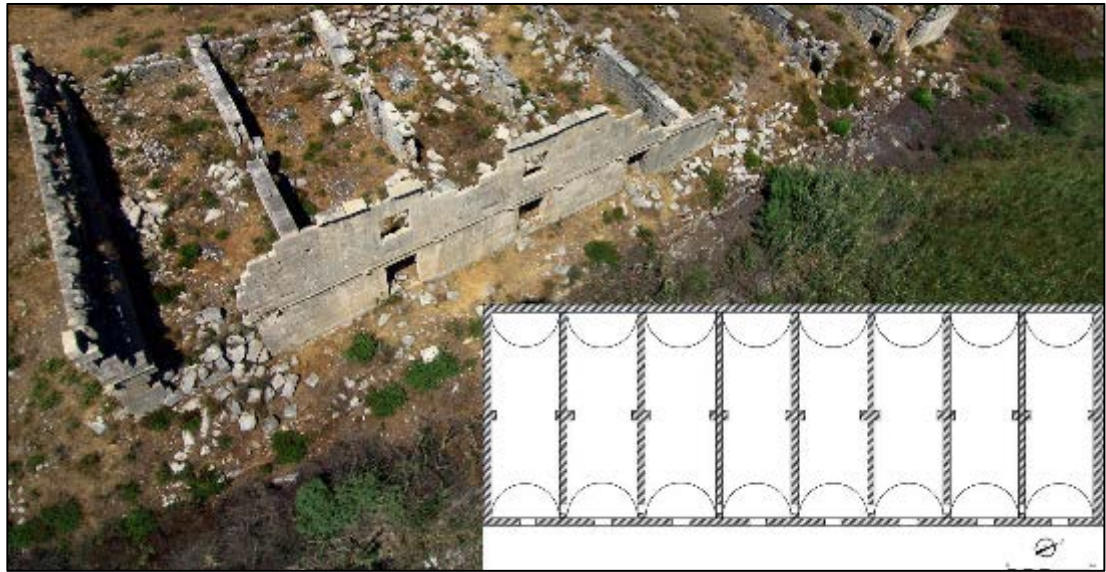


Fig.4.19. Aerial photograph and plan of the Hadrianic horrea of Patara (Koçak 2019, Fig.4).

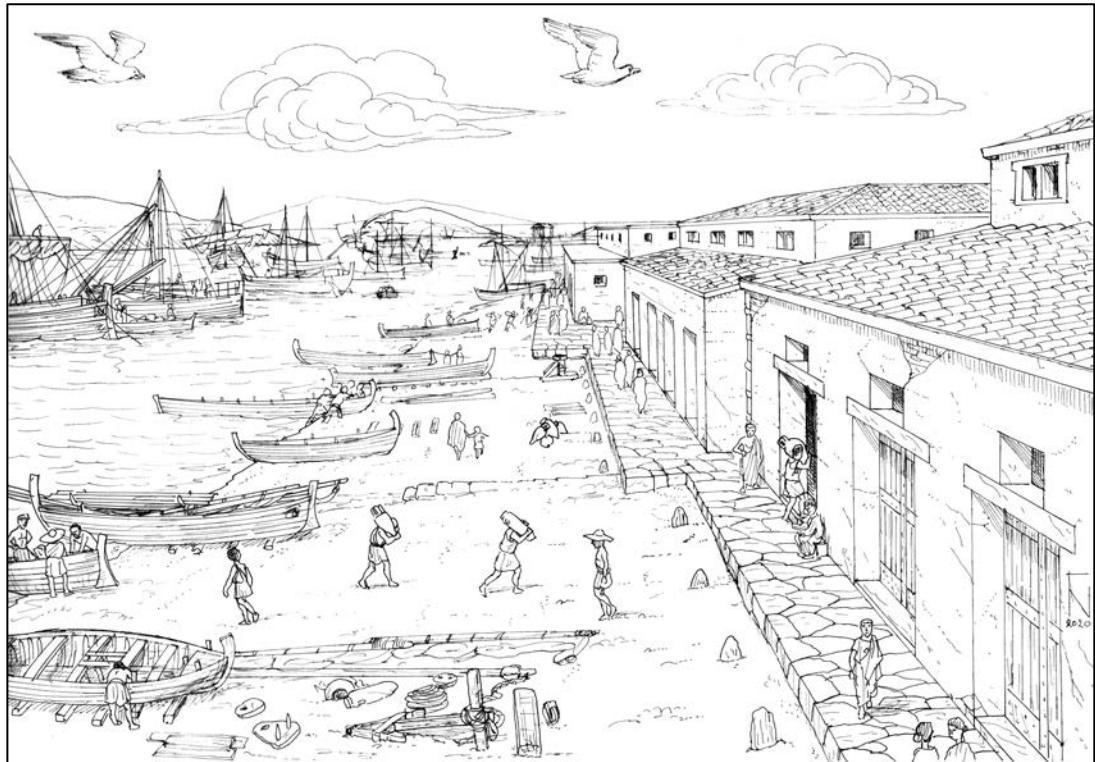


Fig.4.20. Artistic reconstruction of Delos' Merchant Harbour (drawing by the author).

Interestingly enough the Delian harbours, well-connected with the outer world, were not equally connected with the island's urban and rural hinterland: as correctly pointed out by Auguste Jardé, communication from the sea towards the seafront and vice versa was easy, but not further inland, within the urban fabric of the city.⁹⁴³ Delos remained a

⁹⁴³ Jardé 1905, 35-6.

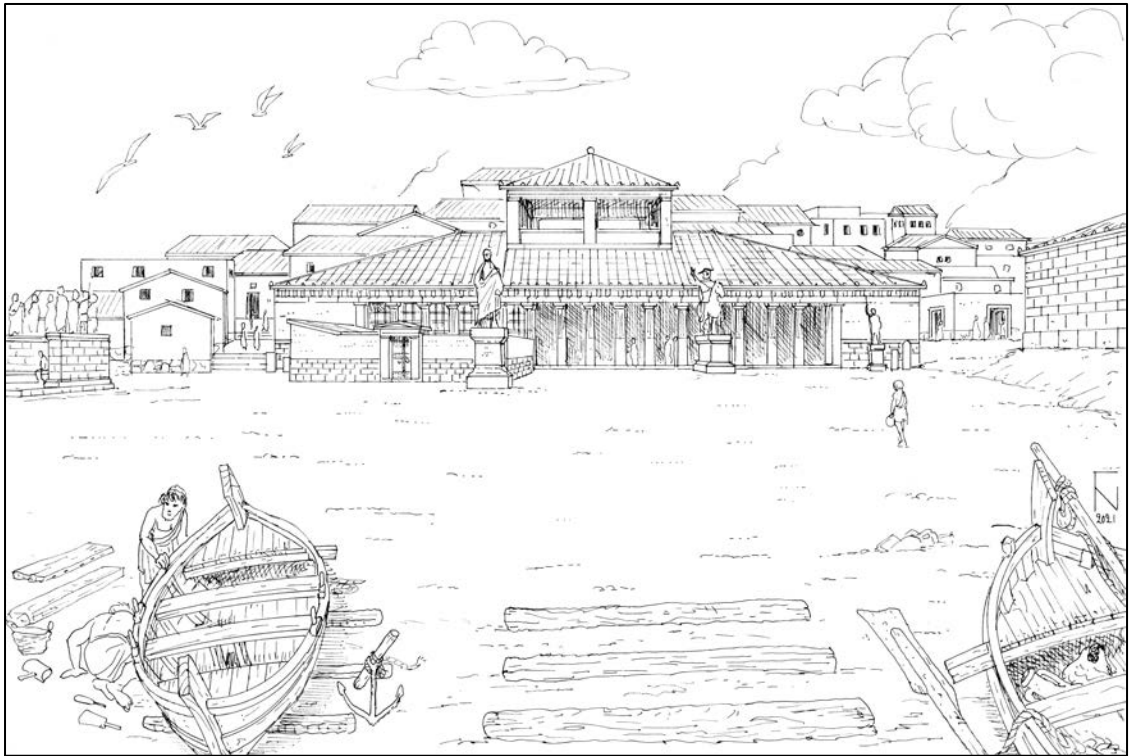


Fig.4.21. Artistic reconstruction of the agora of Theophrastos, Delos, as seen from the sea and as it would have looked in the early 1st century BCE (drawing by the author).

settlement with a poor road network, even around the harbours (**Fig.4.16**). This, however, should be something studied within the perspective of the commercial activity of Delos, which, on the one hand, focused on the retail and transit trade of goods and enslaved people without cargoes being fully unloaded from the ships or accommodated on land and, on the other, was interweaved with micro-scale commercial and productive activities, fragmented within the household network of the city.⁹⁴⁴ There was no need for substantial cargoes to be transported inland and the population could support its needs and industries through the steady supply of small quantities of goods from the busy harbours and from local production.⁹⁴⁵ Delos' own production, which included mainly luxury items (artwork, furniture, perfumes), was limited in volume, easy to handle and required little transportation space on ships.⁹⁴⁶

Another important feature of the harbour environment was storage facilities, serving the short as well as the long-term storage of goods. Warehouses in direct relationship with the seafront are found in Delos (the “magasins”; **Fig.4.20**) and Kenchreai (the great

⁹⁴⁴ Duchêne 1993; Karvonis 2008; Zarmakoupi 2018a; 2018b, 33-4.

⁹⁴⁵ Reger 1994, 99.

⁹⁴⁶ Zarmakoupi 2018b, 36.

warehouse complex), as well as in many other contemporary harbours like Portus (the vast Trajanic warehouse complexes), Caesarea Maritima (a series of spacious warehouses around the harbour) or Patara (“Hadrian’s *horrea*”; **Fig.4.19**).⁹⁴⁷ The extent and monumentality of such establishments was subject to specific conditions and ranged from large and well-organised, often prodigious complexes arranged around the harbours (Portus, Ostia, Kenchreai, Lepcis Magna, Ephesus, Patara)⁹⁴⁸ to relatively limited establishments, others attached to commercial porticoes (Miletus) and examples included within commercial buildings probably belonging to private owners or corporations (Delos, Elaia). A rather clear chronological division can be noted here: larger warehouse complexes are found in harbours that were developed after the Roman conquest, whereas less extended, multi-functional commercial buildings or simple rows of warehouses/stores predate them and belong to Hellenistic building traditions. These two organization schemes reflect two different realities in the commercial operation of harbours. The explicitly organized warehouses of the Roman Empire are related to the state administration of the bulk trade of victuals, mostly grain, that were to provision the ‘mega-cities’ of the period through various commercial networks or to sustain the border armies after the Severan period (the *annona* and the *annona militaris* respectively).⁹⁴⁹ Warehouses and/or shops of the Hellenistic period were smaller, simpler in plan and often dispersed in the urban fabric of cities (e.g. Delos). This corresponds to a more ‘free’ and versatile trade in which individual merchants played a key role, cargoes were more diverse and somehow smaller and where state intervention was limited.⁹⁵⁰

Along with their functional role for the storage and distribution of goods harbours were also monuments themselves and were related with the way both locals as well as travellers experienced them as built spaces.⁹⁵¹ Various ‘degrees’ and forms of monumentality existed. In Delos the southern part of the Main Harbour, related both with

⁹⁴⁷ Rickman 1971, Fig.31; Keay 2010, 12-4; Rizos 2015, 294-6, Figs.7-9; Feuser 2020, 277-80.

⁹⁴⁸ It has been argued that the larger *horrea* complexes of Asia Minor and the Levant (Caesarea Maritima, Myra, Andriake, Myra, Patara, Maximianopolis, Korasion) were built and operated as parts of the *annona militaris* army supply system of the late Roman Empire (Rizos 2015). Nevertheless the dating of several of the buildings before the establishment of the system around 200 CE (e.g. the Hadrianic *horrea* at Patara; Rickman 1971, 140-4) and epigraphic data (Rizos 2015, 289-90) point towards a mixed function both for individual merchants or *collegia* as well as for the collection and shipment of the *annona* taxes (Rizos 2015, 288-9). In both cases the monumentality of these buildings clearly shows the interest of the authorities to thoroughly organise harbour space and local markets.

⁹⁴⁹ Brandt 2005; Keay 2010; Rizos 2015.

⁹⁵⁰ Archibald 2005, 7; Morley 2007, 571.

⁹⁵¹ MacDonald 1986, 262.

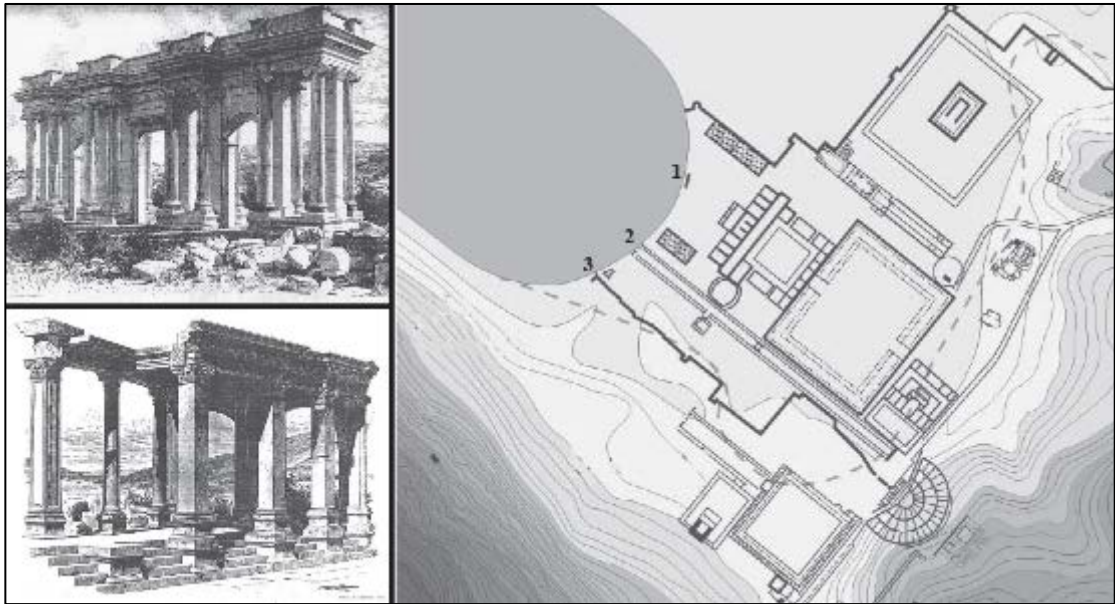


Fig.4.22. The Roman harbour area of Ephesus (right) with artistic reconstructions of the two monumental gateways leading towards the harbour basin (left; indicated by the numbers 2 and 3 on the other plan (Bouras 2012, Fig.2).

the sanctuary's entrance as well as with the "galley cove" and the Agora of the Competalists, was equipped with quays/retaining walls, paved and adorned with the great portico of Philip, statues and lavish votive monuments like the "Monument Carré" and the Tholos (**Fig.4.13**). The harbour's northern part, on the other hand, presented a more modest appearance, its main focal points being the large but austere Hypostyle Hall and the simple κύκλος auctioning establishment. There were fewer votives, which never obstructed the centre of the Agora of Theophrastos that was also left unpaved (**Fig.4.21**). Both agoras had a commercial function but there was a clear effort to create a lavish maritime façade in the agora of the Competalists and to establish a more functional market space in the Agora of Theophrastos. Kenchreai, on the other hand, despite its thorough organization and planning as a harbour city, presented a rather non-monumental maritime façade, dominated by simple warehouses and dwellings and even the sanctuaries flanking the harbour had the form of simple enclosed *oeci* establishments (**Fig.4.14**; Scranton et al. 1978, 88-9). Monuments and votives were most likely concentrated at the harbour's centre where the city's agora was located, but neither excavations, nor iconography attest to any impressive architectural configuration. Lechaion was, according to our present knowledge, the least monumental harbour of the three case studies, with no large buildings, sanctuaries or statues adorning its shore (with the possible exception of the lighthouse) and with the settlement's centre located at a certain distance from the shore (**Fig.4.15**).

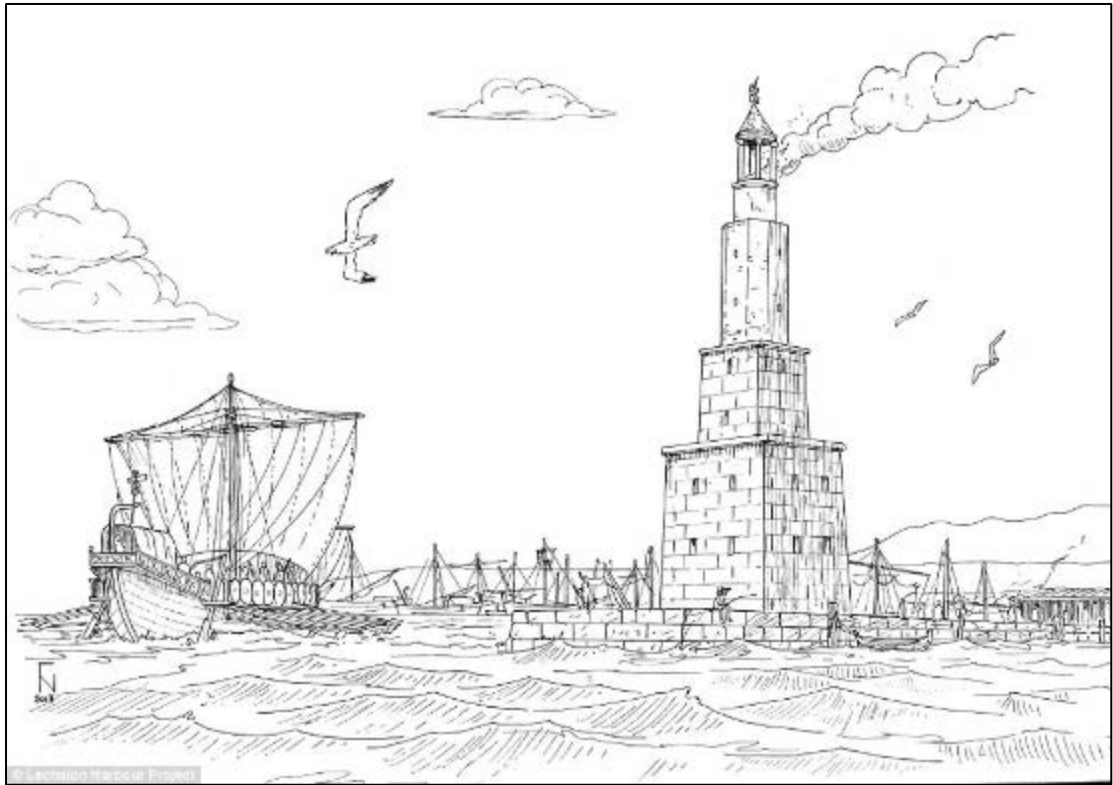


Fig.4.23. A hypothetical reconstruction of Lechaion's lighthouse (drawing by the author in Güngör & Lovén 2018, Fig.6).

Hellenistic and Roman harbours like Ephesus, Miletus and Kos also presented monumental maritime façades adorned with impressive buildings possibly of limited practical but of great symbolic usefulness.⁹⁵² Towards the end of the Antonine period and mainly in the area of Ionia and the Eastern Aegean but also in Lepcis Magna a series of porticoes, temples, arches and gateways, the former either placed at the end of colonnaded streets (Rhodes, Kos, Miletus) or standing free (Ephesus; **Fig.4.22**) became the landmarks and gateways of harbours, serving at the same time as a façade of the city towards the sea as well as of the harbour itself towards the hinterland.⁹⁵³ In contrast to this the series of imposing, multi-storeyed warehouses constituting the maritime façade of harbours like Portus and Ostia remained functional structures despite their monumentality. This rather excessive harbour scenography most likely reflects the development of cities under the active patronage and control of the Roman emperors.⁹⁵⁴ Similar projects were, at least to our present knowledge, not materialized in harbours of mainland Greece like Lechaion and Kenchreai where imperial patronage was either absent or took other forms (see above).

⁹⁵² Feuser 2020, 323-30.

⁹⁵³ Bouras 2012; 2014; Feuser 2020, 258-65.

⁹⁵⁴ Arnaud 2015a, 64-5.

Lighthouses were also very important landmarks in the harbours of the period.⁹⁵⁵ These served both symbolic as well as practical functions and it is not surprising that they become the main symbols of harbours in the iconography of the imperial period, especially in coinage.⁹⁵⁶ They were not only substantial structures able to immediately convey political and symbolic messages dictated by their builders/funders, but also remained relatively simple, tower-like edifices, much easier to build than the technically complicated moles and quays of any kind.⁹⁵⁷ Their construction, however, still depended on local conditions and patronage. Next to massive lighthouses like the ones of Alexandria (**Fig.1.7**), Portus or Lepcis Magna, much smaller structures operated, like the lighthouses of Thasos or Patara,⁹⁵⁸ whereas even important harbours like Delos or Kenchreai seem to have never had any lighthouse at all. Lechaion, most probably due to the lack of other landmarks on the flat coast, was equipped with the lighthouse depicted on Corinthian imperial coins (**Figs.3.52, 4.15 & 23**).

But lighthouses were not the only landmarks of harbours. Other buildings and monuments formed important parts of their maritime façade. In the case of Delos the entrance to the Main Harbour was marked by the small temple that most probably stood on the “Great Mole” (**Fig.4.13**), whereas in Kenchreai the main harbour landmark was Poseidon’s statue (possibly a colossal one), mentioned by Pausanias (**Fig.4.14**), and quite likely some of the large funerary monuments standing on the Northern Ridge above the harbour.⁹⁵⁹ In Miletus the entrance to the main harbour was marked by the two lion statues,⁹⁶⁰ whereas the ships tramping between the various harbours could also use the Hellenistic temple erected on the Humeitepe hill, just above the seafront.⁹⁶¹ In Hellenistic Ephesus a small temple marked the harbour’s northern end, standing on a cliff and facing the open sea (the “Crevice temple”; **Fig.4.6**).⁹⁶² Two votive temples also adorned the moles of Lepcis Magna, paired with the impressive lighthouse and guard tower.⁹⁶³ Such edifices had multiple functions as cult places, landmarks and parts of the cities’ maritime façade and

⁹⁵⁵ Giardina 2010; Robinson et al. 2020, 106-7.

⁹⁵⁶ Boyce 1958, Pl.14; Rosen et al. 2011, Fig.2.

⁹⁵⁷ Feuser 2020, 237-40.

⁹⁵⁸ Koželj & Wurch- Koželj 1991; Koçak 2019, Fig.3; Feuser 2020, Abb.124.

⁹⁵⁹ Paus.2.2.3; Wilson Cummer 1971.

⁹⁶⁰ Brückner et al. 2014, Fig.7; Feuser 2020, 32-3, Abb.9.

⁹⁶¹ Feuser 2020, 50.

⁹⁶² Ladstätter 2016, 257-60.

⁹⁶³ Bartoccini 1958, Tav.XXV, LXVII-VIII.

were almost certainly built in specific sites to serve all these purposes.

A common operational attribute of the harbours studied here, as well as of the majority of the other Hellenistic and Roman harbours of the Aegean, was that they were almost exclusively commercial ones, with no naval bases operating there (with the exception of the Classical-Hellenistic naval arsenal of Lechaion, of which, however, almost nothing is known; see **3.2.6**). Nevertheless, in the case of Delos, due to the religious and political importance of the island, the accommodation of galleys serving the *θεωρίαι* religious embassies were vital for the operation of the harbour and thus the “galley cove” was demarcated and used inside the Main Harbour (see **3.1.5**). This ‘blending’ of commercial and naval harbours might appear peculiar at first sight, since military harbours have been strictly divided in most of the Classical and Hellenistic harbours of the Mediterranean (e.g. Aegina, Piraeus’ Zea and Mounychia, Rhodes, Carthage) with the creation of well-organized and fortified shipshed complexes.⁹⁶⁴ But in harbours like Kos, Marseilles or Piraeus’ Kantharos shipsheds were included within the limits of commercial harbour basins, probably due to the lack of enough space in arsenals or of a second harbour to be used as a military one.

A final aspect of the architecture and planning of the harbours of the period was that the lavishness of the monuments around them was not always related with impressive harbour works. In Delos, Kenchreai, Ephesus or Miletus the monuments surrounding harbour basins were set above simple, low quays that allowed the easy circulation of people and merchandize from the shallow beaches of the harbours towards the local agoras and warehouse (Delos, Miletus; **Figs.4.2 & 13**). This approach highlights both the basic methods of using a harbour described above (anchoring in the open and using lighters), as well as the choice of harbour builders and local authorities to avoid the investment in expensive and quays of uncertain usefulness and to prefer the more secure and much more impressive land monuments. The combination of monumental quays with an equally monumental maritime façade can be observed in a few harbours like Puteoli and Portus, with the extensive use of maritime concrete, as well as in Lepcis Magna, where the magnificent ashlar quay with the staircases and the huge mooring stones supported monumental two-storey porticoes (**Fig.2.30**).⁹⁶⁵

⁹⁶⁴ Blackman & Rankov 2013, 210-30; Bouras 2014.

⁹⁶⁵ Bartoccini 1958.

Finally, the harbours discussed in this study had very specific positions within wider commercial networks. Despite their importance the three case study sites were not terminal harbours like Alexandria, Portus or Lepcis Magna, i.e. harbours from which bulk cargoes were exported and which served extended hinterlands and/or large urban populations like Rome. They operated as important stations for ships operating on long-haul networks, such as the grain freighters moving from Egypt or the Black Sea towards Italy, as well as outlets of specific regions like Corinthia towards the sea and the outer world. Delos had a very important position, thanks to its geographical location at the middle of the Archipelago in almost all networks crossing the Aegean Sea⁹⁶⁶ and for this reason, as well as its religious importance, it was a popular stop for ships, mariners and travellers, becoming also a unique clearinghouse for the commerce of grain. In general all three harbours stood in the middle of the long-haul networks of the period. Many ships would frequent them regularly but would not spend long periods of time there to load/unload whole cargoes since the local needs could be covered by local production and short-haul networks and, even in the case of Delos, transactions would take place without the whole cargo being unloaded on the shore. How then did the position of the three harbours in these networks affect their form and operation?

As we have already seen, less ship traffic meant a smaller pressure on the local authorities to enhance and enlarge harbours in order to receive greater numbers of ships, especially of greater tonnage and draught. Fewer ships also meant fewer taxes that could be invested in the construction of bigger harbours. Instead, with harbours being essential stops for the provisioning and maintenance of ships and for the rest and entertainment of their crews and passengers, resources were invested, as we have seen, in the creation of land infrastructure. This included repair facilities for ships (the shipyard, capstan and slipway of Delos), market facilities where the exchange of goods could be facilitated (agoras, warehouses, auctioning sites), sanctuaries where crews and passengers could practice their religious duties (especially for deities like Poseidon and Isis, patrons of mariners) and a wide range of establishments like inns, taverns, shops and brothels where visitors could seek rest, food, and entertainment. These “parameters of attractiveness” of the “Sailortowns” were

⁹⁶⁶ Rostovtzeff 1941, 1263; Bouras 2016, Fig.1.

very important aspects of the lives of the harbours of the period and essential factors of their prosperity or demise.⁹⁶⁷

It should, nevertheless, be stressed that, despite the fact that the three case studies never reached the importance of terminal harbours like the ones mentioned above and were never as big or elaborate as them, they still remained very important parts of short-haul, local networks of commerce and seamanship. Delos was the centre of the commercial as well as the religious and political networks of the Cyclades,⁹⁶⁸ whereas Lechaion and Kenchreai served the whole of Corinthia and most likely large parts of the Peloponnese.⁹⁶⁹ The details of the operation of these harbours within these networks and of the networks themselves in general evade us, due to the lack of written evidence, but future research could bring new evidence, particularly archaeological, to highlight this.

4.5. From Hellenistic to Roman harbours

It is beyond the scope and possibilities of this study to trace the evolution of all harbours of the Hellenistic and Roman Mediterranean, since that would require the scrutiny of many more case studies than the three ones selected, but certain useful observations can be made concerning at least the three case studies.

A quite straightforward evolution can be observed, from the less elaborate, mostly natural Hellenistic harbour of Delos to the sophisticated Roman harbours of Lechaion and Kenchreai. Delos was never equipped with any substantial harbours works, (protective structures and docking facilities), nor was any dredging ever undertaken there, despite the island's impressive urban and financial development and the funding of various grandiose projects on it. In contrast the bigger and more elaborate harbour works of Lechaion and Kenchreai, the dredging of Lechaion's Inner Harbour, as well as the establishment of the well-organised harbour city of Kenchreai showed a substantial effort to create and maintain more monumental, protected and 'user-friendly' harbour environments. Although the two harbours of Corinth never acquired the unique monumentality of Delos, in terms of actual harbour works in the sea they overshadowed the great city. Was, however, this discrepancy a result of an evolution or of different and very specific local conditions?

⁹⁶⁷ On the term "parameters of attractiveness" see Kotarba-Morley 2015, 287-9. On "Sailortowns" see Hugill 1967, xviii (cf. Reger 2016).

⁹⁶⁸ Reger 1994, 51-3; Constantakopoulou 2007, 25-6.

⁹⁶⁹ Rougé 1966, 131-2; Chaniotis 2018, 313-4.

The development of Lechaion and Kenchreai was related to initiatives of the Roman authorities to not only lavishly rebuild the destroyed Corinth and equip it with two suitable harbours, stimulating commerce in the area and boosting financial development in general, but also to create a 'façade maritime' that would serve political purposes, albeit, as we saw above, this never reached the grandeur of other contemporary harbours. This was made possible after the establishment of the full control of Corinthia and of the Peloponnese by the Romans and served the pressing need to reorganise a devastated region and restore its infrastructures. Delos on the other hand had developed during a period when the Romans had not yet gained full control of the Aegean and would take other measures to stimulate trade and counteract the monopolies of Rhodes, such as the establishment of a free port.⁹⁷⁰ The political and commercial conditions of the period did not permit, nor favour the creation of a new, monumental harbour like Lechaion and Kenchreai, which were established in the period of the principate, as well as like other harbours of the Aegean and of Ionia in particular (see 4.4). Furthermore, the use of harbours as political statements by the Roman state was not yet developed to the degree that would grow during the aforementioned period, when the scenography of harbours became a vital part of political propaganda.⁹⁷¹

Beyond, however, the evident advance in harbour works and organisation between Delos and the two other case study harbours, it is quite difficult to affirm a linear evolution between the three harbours. In terms of construction technology employed little would change, all three harbours having been built with the 'Greek' method without the use of maritime concrete and their main difference being the application of dredging (see 4.3) and the improved organization of the urban space around them (see 4.4). Despite similarities in their use by ships (anchoring in the open and using lighters), each case study followed a very specific evolution, which corresponded to equally specific local conditions. These conditions, although following the general tendencies in the development of Mediterranean economy, trade and urbanism, were still firmly attached to local environments and needs, which they had to sufficiently serve in the most convenient way. Harbours, as seen through the examination of the case study ones, remained largely independent units, following individual courses and each time presenting a unique configuration.

⁹⁷⁰ Casson 1984, 76; Chaniotis 2018, 180.

⁹⁷¹ Ugolini 2020, 132-3, 170-1.

4.6. Ship and harbour technology and development

Another important aspect of harbour operation is the relationship of their development in terms of organisation and technology with the development of contemporary ships and vice versa. In other words, was it the construction of larger and better ships that caused the development of more advanced harbours, or the existence of such harbours brought the construction of ships of greater tonnage and improved seaworthiness?

Concerning the early Hellenistic period it is difficult to trace the relationship between ship and harbour technology. On the one hand data on hull size and shapes is meagre, with few shipwrecks excavated and written sources in general documenting ships of relatively small size with few exceptions (the *Syracusia* or the large poyleremes; see **2.3.1**). On the other hand harbours appear to have remained simple and small (Delos, Lechaion), with few exceptions related mostly with land infrastructure (e.g. the lighthouse of Alexandria) and military installations (e.g. Rhodes, Carthage), whereas the known cases of dredging (e.g. Naples) were limited to a small depth that could not affect the accommodation of large capacity ships much (see **4.1**, **Fig.4.8**). Much more evidence comes from the Late Republican period with the appearance of the first ships of great tonnage like the early-1st century BCE *myriophoroi* (see **2.3.2**). This evidently predates the construction of the elaborate concrete harbours of the 1st century CE and could have been a major factor for their development. Nevertheless, there are substantial problems in such an interpretation. The boom in ship size of the period is not only geographically limited (southern Gaul),⁹⁷² but also appears to have no continuation. By the 1st century CE shipwreck evidence points towards a predominance of ships of small and medium tonnage, despite the fact that trade in the Roman Mediterranean increased in volume considerably.⁹⁷³ Ships remain of the same size even in the following century, when large and deep harbours continued to be built and maintained (see **2.3.3**). Although certain ships of exceptional size like the *Isis* travel the Mediterranean these remain rarities and exceptions to the rule.⁹⁷⁴

But this does not mean that it was harbours that triggered the construction of larger and more elaborate ships either. The appearance of the first large capacity ships and *myriophoroi* in the early 1st century BCE does not follow any advance in harbour

⁹⁷² Nantet 2016, 122.

⁹⁷³ Oleson & Hohlfelder 2011, 816-9.

⁹⁷⁴ *Luc.Nav.* 5-9. Casson 1971, 186-8; Houston 1987.

construction, whereas, as noted above, the elaborate harbours of the 1st and 2nd centuries CE are not followed by any considerable rise in ship tonnage. Furthermore, as mentioned already, the development of new, larger, deeper and more monumental harbours is uneven and greatly affected by political interplay and specific local conditions.

This lack of a direct connection of shipbuilding with harbour technology should not, however, be seen as proof that harbours and ships developed independently to each other. As we saw above the advance in ship technology was triggered by their need to carry larger cargoes and be able to sail with safety and to use every different coastal environment, not depending on the existence and the configuration of harbours. On the other hand harbours were built not only according to the ship traffic they would handle, which comprised mainly of medium and small capacity vessels, but also to meet the specific local conditions and needs (networks, markets, hinterlands, population etc.). Furthermore middle range harbours like the case study ones, although serving large numbers of ships operating on long-haul networks, only accommodated the few vessels that served the local needs, with most ships remaining anchored in the open. Thus the rise in ship tonnage and numbers affected mostly the terminal harbours like Portus where great numbers of ships, often of large tonnage, had to be accommodated and load/unload whole cargoes. Such harbours were affected by the development of ships and were enhanced in order to receive ships of great draught and size, as well as their cargoes.

4.7. Conclusions

In the previous two chapters the configuration and operation of the case study harbours vis-à-vis ship and cargo handling was analysed, both as individual sites as well as in comparison with each other and contemporary harbours elsewhere in the Mediterranean. Several important conclusions were reached, revealing a reality of similarities as well as differences amongst the Hellenistic and Roman harbours of the Aegean.

The case study harbours, as well as other contemporary ones, presented a great degree of variability, which critically influenced their ability to accommodate ships and handle cargoes: there were deep coves along with very shallow, nearly swamp-like, basins, the former greatly hampering the capacity of these harbours to receive ships of medium and large capacity. Size also varied greatly, from extended anchorages to very small basins with

corresponding possibilities concerning their capacity to accommodate ships. The inclusion of multiple basins and anchorages into the same harbours or harbour systems, often serving different urban districts, was also known (Delos). Protection varied from naturally or artificially well-sheltered coves and enclosed estuaries to almost totally exposed anchorages and open coasts. Most harbours were sheltered by relatively few structures, limited to protective rubble and ashlar moles and groynes (Delos, Lechaion). Coastal quays were rather common, however, they were built on dry land and ships could not berth directly on them and operated basically as retaining walls for roads or other public spaces (Delos, Kenchreai). Another shared feature was the existence of long sandy shorelines, ideal for the easy employment of beaching. The technology employed in the construction of the case study harbours was quite simple, consisting of the 'Greek' tradition of building moles with the accumulation of rubble (Delos' Main Harbour, Kenchreai) or, more rarely, by lowering ashlar blocks from the surface directly on the seabed (Delos' Gourni, Lechaion). The advanced technology of maritime concrete was not introduced to any of the case study sites during the period investigated and it in general remained rare in the Aegean and the Eastern Mediterranean. Compared to the relative poverty of harbour works, land infrastructures were much more developed, including spacious agoras, monumental porticoes, extended storage facilities and religious buildings, linked with the urban fabric of the adjoining harbour cities (Delos, Kenchreai). The monumentality and extent of these structures was, however, subjected to different local conditions and varied greatly from lavish establishments to nearly empty beaches (Lechaion).

Due to the lack of deep protected areas and docking facilities, the best method for ships to use the majority of harbours was anchoring in the open and employing lighters. This not only allowed the use of every harbour and anchorage mariners encountered, even when harbour works and infrastructures were absent, but also permitted ships to sail from/to these harbours more easily and avoid secluded basins and passages where circulation would have been tedious and potentially dangerous. The existence of sandy beaches in almost all harbours of the region indicates that beaching was also common for the unloading/loading of draught-beached vessels, although unfit for large and medium capacity ones, which porters could not approach due to their draught. These areas also allowed the establishment of shipyards, vital for the maintenance of ships, and were ideal for the beaching of lighters, serving, through the low sandy coasts, the easy transportation of cargoes from and towards

coastal commercial establishments. Docking was inevitably very limited, since most merchantmen could not approach quays erected on rubble moles without the danger of being damaged or running aground due to the inclination of the foundations and their draught. Ashlar or concrete docks with enough depth in front of them were rare and, at least in the case study harbours, exposed to the open sea, whereas, as noted above, maritime concrete remained largely unknown in the region. Docks were very likely limited to the important terminal harbours of the period like Alexandria and Portus where ships would have to inevitably unload or load whole cargoes. Such facilities would have, nonetheless, been vital in the trade of specialised heavy cargoes like building material, especially marble, or large containers (*dolia*), both requiring heavy duty lifting devices or siphons that could only be operated from solid docks. Docking facilities were, however, never established in harbours beyond Rome and Portus despite the amount of stone and marble cargoes handled there for local use or export/import. This was most likely due to the irregularity of the arrival of stone cargoes and the cost of the construction and operation of specialised facilities. Each time such cargoes had to be moved temporary facilities, most likely from wood, were erected and then demolished, whereas draught beaching could also be employed.

Urban and rural hinterlands and forelands had a reciprocal relationship with the ship and cargo traffic harbours administered. The spaces around harbour basins were commonly equipped with all the necessary commercial infrastructures (agoras, porticoes, storage facilities) in various degrees of monumentality but always related to the commercial traffic and ready to receive and deliver goods and people from and to the sea. This made harbour spaces even more appealing to mariners and merchants, who would find there a favourable environment for commercial transactions and storage of goods, but also for rest, recreation and worship. Rural hinterlands also played an important role as production and consumption centres, largely dictating the form and quantity of ship and cargo traffic. Nevertheless, important harbours could develop and operate even in sites with a practically non-existent hinterland like Delos, which became a port-of-trade, with almost the whole of the Mediterranean being its hinterland and foreland at the same time.

The relative simplicity in harbour works, small size and presence of more elaborate infrastructure on land in the harbours studied is related closely with their position in contemporary commercial networks. Despite their importance in regional networks (Lechaion, Kenchreai) and operation as clearinghouses and markets (at least in the case of

Delos), the three case study harbours were not terminal harbours where large numbers of ships would unload and load whole cargoes, but were used as stops by these ships, serving their maintenance and offering rest and recreation for their crews and passengers. This caused ships to spend short little time there and did not put pressure on the harbour authorities for the creation of elaborate and large harbours. Instead, they invested on land infrastructure related both to the local needs as well as to accommodate the needs of the visitors.



5. Conclusions and epilogue

The primary aim of this study was to understand Hellenistic and Roman harbours of the Aegean in respect to the handling of ships and cargoes within them. This was achieved by approaching three case study sites (Delos, Lechaion and Kenchreai) according to the ways these were used and experienced by contemporary sailors, with special focus on their interaction and dependability with ship and cargo traffic. A new methodology was devised and applied based on the combined study of ships and seamanship and the harbours' natural and anthropogenic configuration, a task that constituted the thesis' secondary aim. The typology, draught, size and equipment of ships vis-à-vis the original form and organisation of harbours was analysed and different scenarios concerning the case study harbours were created.

5.1. New understandings of Hellenistic and Roman harbours

According to the scrutiny of the evidence and the reconstructions of the case study harbours, these were rarely ideal places for the sheltering and handling of large numbers of merchantmen of medium and large capacity. Several harbour basins were not large enough to receive any substantial number of vessels (Delos' Main and Merchant Harbours, Kenchreai), whereas the whole harbour area of each site could also be fragmented into separate smaller basins and anchorages (Delos, Lechaion). More importantly, most basins did not offer adequate depth for the approach of ships of medium or large tonnage (Delos' Main and Merchant Harbour, Lechaion), some being heavily affected by coastal or inland sedimentation (Delos' Main Harbour, Lechaion), with dredging employed only in one case (Lechaion's Inner Harbour). The operational or functional ship capacity of harbours, i.e. the number of ships they could accommodate with safety and without hindering their circulation, was also inevitably reduced, most likely to half compared to their absolute maximum capacity, i.e. the total number of vessels that could be crammed within them, by the need to maintain space for circulation, manoeuvring and safety between vessels. Furthermore, with the exception of Delos' Main Harbour and Kenchreai, harbours were not adequately protected by natural or artificial features (see below), often being exposed to strong winds and waves (Delos' Skardanas and Gournas, Lechaion's Outer Harbour). In

general the majority of basins could accommodate large numbers of small and very small capacity ships (with a draught of 1.5 metres or less) but not of large ones, which could not enter these areas, nor to approach the shore due to their draught.

Harbour works were simple, limited in numbers and in a way 'out-dated' in terms of technology, following the long 'Greek' tradition of rubble moles with ashlar quays built above water level (Delos' "Great Mole", Kenchreai). These quays were common but were built on dry land and thus operated basically as retaining walls for buildings, roads and other public spaces and not as actual docks (Delos, Kenchreai). The advanced technology of maritime concrete introduced by the Romans was never employed in any of the case study harbours during the period studied and was rarely used in the Aegean and the Levant in general. The creation of moles and quays in deep water by sinking ashlar blocks directly onto the seabed, a less common method known from sites like Amathus and from written sources, was most likely employed in two cases (Delos' Gournai and Lechaion's moles/groynes). In both sites, however, these structures were dangerously exposed to the open sea, undermining the safety of ships berthed there, whereas in the case of Gournai the poor preservation of the quay indicates it was possibly a short-lived establishment. Wooden piers are not documented in any of the case study sites or in any other contemporary harbour of the Aegean, although they are known from the western Mediterranean (Naples, Marseilles) and from iconography.

Contrary to the simplicity and relative poverty of harbour works in the sea, the land infrastructure of the harbours studied, as well as in many other contemporary examples, was significantly richer and more elaborate. These were developed via the creation of well-planned urban centres (Kenchreai), spacious agoras and impressive buildings of monumental and/or commercial character, embellished with works of art and votives (Delos). Only in the case of Lechaion was the maritime façade matched by the simplicity of harbour works, being, according to our present knowledge, devoid of any monuments, with any infrastructure located further inland.

The exposure, small depth, and overall simplicity in terms of human intervention of the harbours studied did not prevent their successful use by mariners and their ships, as seen through their development as important commercial and urban centres like Delos and Kenchreai. Evidence suggests mariners resourcefully exploited contemporary advantages in ship construction and equipment (curved cutwaters, boarding planks, ships' boats, different

types of sails and anchor etc.) and could use every diverse and often hostile harbour environment they encountered, not relying on the existence of artificially or naturally protected anchorages. According to the archaeological remains that confirm the lack of docking facilities and the shallowness of many harbour basins and coasts (see above), but also to other sources like texts and iconography, mariners must have predominantly anchored ships in the open and employed lighters for the transportation of merchandise from/towards land or other ships. This method could be applied in any coastal environment and greatly facilitated the use of various harbours by preventing the entanglement of vessels in small and shallow basins, lagoons, or estuaries where they ran the danger of being stranded or damaged. It also allowed mariners to avoid the fees imposed by local authorities for the use of harbour space and facilities. Further, it was ideal for busy harbours like Delos and Lechaion that had to accommodate substantial ship traffic but offered few protected and deep anchorages.

Beaching (in the form of hauling ships on land or draught beaching them) could also be easily employed in the case study harbours since all of them, as well as other contemporary examples (e.g. Hellenistic Ephesus, Miletus, Elaia), were organised around long sandy beaches. This method was, due to the draught of loaded ships and the small depth of the sea along the beaches, mainly useful for small capacity ships and lighters, which could approach the coast, unload/load cargoes in shallow water and also be hauled out of the water, if needed, for protection. Nevertheless, the 'friendly' space of sandy beaches was still important for the operation of larger merchantmen since it was the ideal location for the lighters employed for the transportation of their cargoes to and from the coast and the commercial facilities on land. Finally, beaches were the areas where shipyards operated, essential for the necessary maintenance of all ships using harbours, as well as for the construction of new ones (for example the shipyard of Delos, known from written evidence, or Marseilles and Olbia, discovered by excavations).

Docking must have been rare, because of the lack of proper facilities (only the ashlar quay of Delos' Gourni and the moles/groynes of Lechaion could potentially operate as docks but left ships dangerously exposed to the sea) and reserved for ships carrying special cargoes like large containers (*dolia*) or stone and marble that required direct berthing on docks for the operation of siphons and lifting devices. The existence of multiple basins, anchorages and beaching areas dispersed around coastal cities, a characteristic of numerous harbour

sites of the period (e.g. Delos, Lechaion, Miletus, Rhodes, Elaia) allowed mariners to choose between different areas for their vessels according to weather conditions, space availability or the local needs of different urban areas (the “selective coastal tramping”).⁹⁷⁵ In general the configuration of the case study sites, as well as of other harbours of the period, points towards mobility and adaptability as the main characteristics of their use, with mariners most likely avoiding secluded basins when this was not necessary and opting for open anchorages and beaches.

Contextualising the sites studied within their contemporary world, a diverse and complicated image appears, related to the different configuration and capacity of each site as well as to the different commercial networks, hinterlands, and urban centres each of them served. A tendency towards simplicity and a thorough management of resources is evident. As seen through the remains of the case study sites as well as of other contemporary harbours their constructors and administrators relied on less monumental but already tested, cheaper and simpler technologies (e.g. rubble moles at Delos, Kenchreai, Lepcis Magna or Thapsus and, less frequently, the casting of ashlar blocks from the surface at Delos’ Gourni, Lechaion, Amathus and Centumcellae). The advanced technology of maritime concrete, despite the fact it allowed the construction of a harbour in any coastal environment and depth, was more expensive, complicated and of unknown longevity compared to other less sophisticated technologies. It thus remained, with a single verified exception (Chersonissos) rare in the Roman Aegean. The choice of simpler methods in harbour construction and operation directly reflects the flexibility and resourcefulness in the use of harbours described above. Conscious efforts were made to create simple but functional and ‘merchant-friendly’ spaces on land instead of impressive but technically complicated structures in the sea.

The relationship between ship and harbour technology is another important issue researched in this thesis, with the main question being whether it was the development of ships and their technology that caused the development of harbours or the opposite. By the Roman period both ship as well as harbour technology made great progress in the Mediterranean, as seen through shipwreck and harbour archaeology,⁹⁷⁶ but, according to my study this relationship was quite complex and not as straightforward as one would expect.

⁹⁷⁵ Zarmakoupi 2018b, 37-8.

⁹⁷⁶ Nantet 2016, 223.

The creation of larger and more elaborate ships in the Hellenistic and the late Republican period (e.g. the large polyremes and the *myriophoroi* carriers) preceded the construction of more monumental and complicated harbours built after the establishment of the *pax romana*. Nevertheless shipwreck evidence show a drastic fall in the number of large-capacity merchantmen in the 1st century CE, the period when some of the most advanced artificial harbours were built in the Mediterranean, thanks to the wide employment of maritime concrete began. Similarly, the creation of several larger and deeper harbours during the period of the principate did not trigger the development of larger ships in general, as shipwreck and written evidence show. The majority of merchantmen in the Roman Imperial Period remained ships of small and medium tonnage with few exceptions. This, however, should not be seen as a paradox. What the study of ships and their capabilities of the period studied showed was their ability to successfully operate in every different environment, using a variety of methods and taking full advantage of the possibilities offered by the advance of seafaring technology (see above). Ship traffic was thus not dependent so much on the existence of deep and protected harbour basins, but on the various networks these ships had to serve, the cargoes they had to carry and the profit that could be gained by merchants and mariners (see below). Although harbour administrators had every reason to make their harbours friendly places for ships, people and cargoes, this depended largely, as we saw above, on uneven patronage and funding, whereas it was considered more important to create cheaper land infrastructures than more expensive and often short-lived harbour works in the sea.

Directly related to the tonnage and number of ships visiting the case study harbours as well as other harbours of the period is their position and operation within various commercial networks. According to the evidence related to ship and cargo handling in the three case studies these were not the termini of sea routes, located at the end of long-haul networks, like Portus or Alexandria.⁹⁷⁷ They were mainly middle harbours, serving as regional trade centres (Lechaion, Kenchreai), necessary stops for the victualing and maintenance of ships serving long-haul networks and, in the case of Delos, as clearing-houses and free ports.⁹⁷⁸ This is reflected in the absence of substantial harbour works and in the presence of commercial infrastructure on land, as well as in their use by ships that,

⁹⁷⁷ Rostovtzeff 1941, 1263; Keay 2010, 11; Schörle 2011, 93.

⁹⁷⁸ Bresson 2016, 308-13; Zarmakoupi 2018a.

according to my study, spent short periods anchored in the open and not unloading all of their cargo. Having to accommodate much fewer ships and cargoes than the terminal harbours of the period the case study harbours received less attention from high-ranking state authorities who funded other harbours in order to enhance both their functional (through dredging or the construction of maritime concrete moles and quays) as well as their symbolic operation (through adorning them with imposing buildings and votives; see below). Nevertheless, the three case study harbours remained extremely important operating as stops for ships travelling in long-haul networks, clearing houses, commercial hubs for the local communities and parts of local harbour networks, as well as developing into important settlements with their own life and history.⁹⁷⁹

There was not a single type of 'model harbour', neither as a natural and/or constructed space, nor as a centre of commerce and seamanship. Small and shallow harbours with few protective works (e.g. Delos, Lechaion) coexisted successfully alongside large, well-protected and monumental establishments (e.g. Kenchreai, Portus, Ephesus). Specialization in the use of harbours was most likely minimal and basically involved galleys and stone carriers. In the case of galleys, security and special infrastructure was important for their accommodation (even when these consisted of non-combatant, emissary vessels like in Delos), whereas in the case of stone carriers the practical requirements and technical implications of the handling of their cargoes (weight, space for the operation of cranes, experienced personnel) caused the creation of special harbour sectors (the *statio marmorum*) and the imposition of rules on the handling of such cargoes (e.g. the Ephesus' decrees). The existence of stone-handling sectors is, however, documented in only two of the most important harbours of the period (Portus, Rome) and most basins and coasts indiscriminately must have served ships of all kinds, sizes, and cargoes, provided they could approach them.

Despite the relative simplicity of harbour works, monumentality remained an essential component of the harbours studied. It served the creation of a 'coastal scenography' that would demonstrate to the people who visited harbours but also to the local inhabitants state authority and patronage. This was, nevertheless, expressed, especially in the Aegean, mostly through less technically complicated and more visible buildings on

⁹⁷⁹ Horden & Purcell 2000, 393; Archibald 2005, 1; Robinson et al. 2020.

land and not through costly and less apparent structures in the sea (for example the lavish harbour fronts of Delos, Miletus and Ephesus that were equipped with very little infrastructure in the sea). The creation and maintenance of large, monumental harbours required substantial funds that could only be delivered by high state officials and rulers. This patronage was uneven and depended on various circumstances and political interplay, targeting sites serving the long-haul networks that provided grain for capitals and other important cities, especially during the Roman period (e.g. Alexandria, Caesarea Maritima, Portus, Lepcis Magna). When such funding was not available local authorities had to build and operate harbours according to their own finances and to choose the most cost-effective methods. Such practices of constructing, maintaining, and administering harbours relate closely with the ways harbours were used by ships (see above) and largely contradict the idea of the state-controlled ‘great trade’ of the Hellenistic and Roman period and the high degree of commercial specialization⁹⁸⁰ in favour of a more free and versatile seaborne commerce, often of regional and short-haul character.⁹⁸¹

The results reached and the arguments developed within this study are associated with the wider on-going discussion on the harbours of the period, especially concerning their diverse urban development schemes,⁹⁸² the necessity of their connection with hinterlands, forelands and commercial networks⁹⁸³ and the application of various types of technology and the different ‘degrees’ of monumentality.⁹⁸⁴ But my study’s main contribution to scholarship is that it introduces seamanship into the discussion regarding Hellenistic and Roman harbours of the Aegean and the Mediterranean in general by developing and applying a new methodology. Building upon previous scholarship that saw harbours as multi-functional centres of commerce and interaction where ships played a crucial role,⁹⁸⁵ it sheds light on harbours’ primary (and largely neglected by scholarship) function – the handling of ships and cargoes. It reaches, for the first time, conclusions based on solid data rather than on theoretical models and assumptions, concerning the actual practicalities, possibilities and drawbacks of the operation of harbours as ship havens. Finally, and very importantly, since this thesis’ methodology was based on hard, measurable data that can be retrieved in

⁹⁸⁰ Rougé 1966, 71-3; Pomey 2011, 48-9.

⁹⁸¹ Hopkins 1983, 94-6; Lawall 2005, 202; Mataix Ferrándiz 2018, 204-7.

⁹⁸² Zarmakoupi 2018b; Feuser 2020.

⁹⁸³ Keay & Paroli 2011; Leidwanger 2013; Schörle 2011; Wilson et al. 2013.

⁹⁸⁴ Morhange & Marriner 2010; Oleson & Hohlefeldler 2011, 814-9; Arnaud 2015a.

⁹⁸⁵ Keay 2012a; Boetto 2010; 2016; Feuser 2020.

harbours of any region and period, it formed a new research tool for harbours of other time periods, as well as of other geographical regions around the world (see below).

5.2. A new methodology

The second most important contribution of this study to scholarship is the creation and application of a new methodology that integrated ship and seamanship archaeology with harbours. This was considered necessary since previous scholarship had never approached harbours in such close relationship with the practical issues of ship and cargo handling and had neither used reconstructions as methodological tools but basically as means of mere visualisation. Taking advantage of my skills as an illustrator as well as of my first-hand experience of two of the case study sites (Delos and Lechaion) I demonstrated the potential of such a methodology to function as an analytical tool as well as to give answers to questions concerning ships and harbours of the Hellenistic and Roman antiquity.

My methodology and its basic principles provide a platform for further research that can expand to other harbours of the Aegean and the Mediterranean, including not only specific sites but also harbour groups. By applying this new methodology, future research can target harbour operation both within regional, as well as within wider commercial networks, exploring different patterns of exchange and economy, based on the combined study of harbour configuration and seamanship. The results of such studies can provide important measurable and comparable evidence on the actual harbour operation and capacity. This evidence can be then integrated within the ongoing debates over the realities of both ancient harbours as well as of the ancient economy and commerce, especially since the study of the former has been largely based on quantitative methods, similar to the ones used in this thesis. Such a broader perspective will greatly improve the understanding of the ancient economy and commerce through the study of harbours as centres of exchange and seamanship, but also their evolution concerning organization, technology and function, both issues purposely not explored extensively here, due to the focus on three very specific case studies.

Despite the successful application of the methodology of this research that showed its possibilities to open up new paths in the study of ancient harbours, there is always potential for development and improvement. Further applications of this methodology can

include not only more harbour sites of the same as well as of other periods, including the corresponding study of contemporary ships, seamanship and commerce, but also of the inclusion of more datasets (e.g. ship and cargo registries, shipwrecks inside harbours, imports and exports) and of new tools for the collection and analysis of information as well as of illustration and harbour reconstructions.

5.3. Epilogue

The results of my work showed that many Hellenistic and Roman harbours of the Aegean, despite the development of seaborne trade and progress in harbour construction, remained relatively simple and open and could not accommodate and offer protection to great numbers of medium and large capacity merchantmen. Contemporary mariners were able, however, to conveniently use these harbours by applying various different methods (docking, anchoring in the open, beaching) according to each harbour environment and infrastructure and to avoid the use of secluded basins. This confirms that some of the busiest harbours of the period (e.g. Delos) operated largely as *entrepôts*, with limited infrastructure since only parts of cargoes were transferred on land and ships used them for small periods of time,⁹⁸⁶ whereas monumental establishments like Portus, Caesarea Maritima and Ephesus operated side-by-side with simpler harbours and anchorages like Lechaion and Kenchreai. But, more importantly, my study explored in depth the different “harbour realities”⁹⁸⁷ that resulted from the use of different types of ships, different cargoes and in different environments, each harbour being unique in its way of operation and organisation, but all sharing and fulfilling their primary aim to serve ships and cargoes in the most convenient and lucrative manner.

⁹⁸⁶ Delano Smith 1979, 327 and Zarmakoupi 2018a.

⁹⁸⁷ Reger 2016.



Appendixes

Appendix I: tables

Categories		Name/shipwreck	Date	Capacity (t)	Length (m)	Beam (m)	Height from keel to deck (m)	Draught (m)	References
Exceptionally large cargo ships		<i>Syracusia</i> *	240 BCE	1,700	?	?	?	?	Ath.5.37, 5.206-9
	Alexandrian ships	<i>Isis</i> *	2 nd century CE	1,200	53	14	7	4.5	Luc.Nav. 5-9
Large cargo ships (<i>myriophoroi</i>) 10,000 amphorae 50,000 <i>modii</i> 350-500 tons		Madrague de Giens	70-65 BCE	350-390	40	9	4.5	3.5-3.7	Pomey 1982
		Albenga	Early 1 st century BCE	350-390	40	10-12	4-5	3.5-4	Lamboglia 1971; 1970-71
	Nile kerkouros ⁹⁸⁸		171 BCE	450	?	?	?	?	Casson 1971, 163-7
Large capacity 5,000 amphorae 30,000 <i>modii</i> 150-350 tons		Mahdia	100-75 BCE	230-250	40.6	13.8	5	3.5	Hellenkemper Salies et al. 1994
		Spargi	120-100 BCE	200-300?	35	8-10	c.4-5	c.3	Gianfrotta & Pomey 1981, 339
		Antikythera	80-70 BCE	200-300?	30-40?	10-14?		2-4?	Bouyia 2012
	Stone-carrier	Punta del Francese	30-100 CE	265-275					Galasso 1997, 129-32
		Antirrhodos, Alexandria	Late-1 st century BCE- Early 1 st century CE	250-260	30-31	10.5-11	3.5-3.7	c.2.5	Sandrin et al. 2013
		Saint-Tropez	2 nd century CE	200 plus					Pomey & Tchernia 1978, 234
	Stone-carrier	Torre Sgarata	Late-2 nd century CE	170-250					Pomey & Tchernia 1978, 234
		Marzamemi I	3 rd century CE	200 plus	21-32	7-8		c.2-3	Pomey & Tchernia 1978, 234
	Nile Kerkouros*		171 BCE	225-275					P.Theb.856

Table 1. A comparative table of large capacity ships of the Hellenistic and early Roman period of the Mediterranean (asterisks indicate ships known only through written sources).

⁹⁸⁸ The asterisk (*) indicates ships known only through written sources.

Categories		Name	Date	Capacity (t)	Length (m)	Beam (m)	Height from keel to deck (m)	Draught (m)	References
Medium capacity 3,000 amphorae 20,000 modii 75-150 tons		<i>Syracusia's kerkouros*</i>	c.240 BCE	78	?	?	?	?	Ath.208f
		Grain ship at Pompeii*	c.70 CE	100	?	?	?	?	CIL IV 9591
		Ship measured by Hero*	1 st century CE	144	24	4.5	?	c.2	Hero, <i>Stereometrica</i> I.53
		Ship measured by Hero*	1 st century CE	95	16.5	4	2.3	c.1.5	Hero, <i>Stereometrica</i> II.50
		Bourse de Marseille	190-220 CE	130/150	22/23	9 (6)	3	2.2-2.3	Gassend 1982
	Stone-carrier	Kizilburun	125-25 BCE	90	15-20	4.5-5	1.5-2	c.1-1.5	Littlefield 2012
	Stone-carrier	Porto Nuovo	Early 1 st century CE	c.138					Bernard et al. 1998
		Titan	Mid-1 st century BCE	c.130	25	6-8		c.2	Taillez 1971
		Pisa A	2 nd century CE		25-30				Comune di Pisa 2001, 54; Kyprouli 2012, 28
		St.Gervais 3	148-150 CE	81	17.54	7.4	2.8	2.36	Liou et al. 1990

Table 2. A comparative table of middle capacity ships of the Hellenistic and early Roman period of the Mediterranean.

Categories		Name	Date	Capacity (t)	Length (m)	Beam (m)	Height from keel to deck (m)	Draught (m)	References
Small capacity 1,000 amphorae 10,000 <i>modii</i> 15-75 tons		Tre Senghe	30-20 BCE	40-45	20-24	5		c.2	Volpe 1989, 554
		Dramont A	1 st century BCE		25	7		c.2.5	Santamaria 1975, 196
	Nile <i>kerkouros</i> *		2 nd century BCE	c.60-70	20.6	3.2		c.2	Casson 1971, 163-6
	<i>Naves caudicaria</i>	Fiumicino 1	4 th -5 th century CE	50	17.18	5.59	2.26	1.40	Boetto 2006
	<i>Naves caudicaria</i>	Fiumicino 2	4 th -5 th century CE	70	19.18	6.27	2.53	1.57	Boetto 2006
		Port-Vendres I	Late 3 rd -early 4 th century CE	69	17.50	8	1.95	1.89	Rival 1991, Pl.95
	Dolia shipwreck	Diano Marina	Mid-1 st century CE	66	20-22	6	2.3	c.1.5	Pallarés 1991; Marlier 2008, 158-9
	Dolia shipwreck	La Giraglia	20 CE	64	20	6.7	2.1	c.1.5	Marlier 2008, 158
	Dolia shipwreck	Ouest Giraglia 2	Mid-1 st century CE	<70	c.22	c.7	c.2	c.1.5	Cibecchini et al. 2017
	Dolia shipwreck	Grand Ribaud D	End of 1 st century BCE	50	18	6	2.1	c.1.5	Hesnard et al. 1988
	Dolia shipwreck	Ladispoli	Late 1 st century BCE-early 1 st century CE	45-50	18	6	2.1	c.1.5	D' Atri & Gianfrotta 1986; Carre 1993
		Grado I	Mid-2 nd century CE	c.25	16.5	5.9		c.1.4	Beltrame & Gaddi 2007, 144; 2013
	Stone-carrier	Dramont I	50-75 CE	23					Joncheray & Joncheray 1997; Joncheray 1998
		Ashkelon Roman	2 nd -1 st century BCE	?	15-25				Galili et al. 2010, 125-45.
		Naples A	Late 1 st -early 3 rd century CE	15/20?	11.77?	3.32?	0.88?		Boetto 2005; Boetto et al. 2009
		Kyrenia	310-300 BCE	22	14.4	4.4		c.1.1	Steffy 1994, 42-59
		Serçe Limanı	280-275 BCE	20	c.14	c.4		c.1	Pulak et al. 1987
		Cavalière	100 BCE	27	12.98	4.6	1.53	c.1.2	Charlin et al. 1978
		Chretienne C	2 nd century BCE	15	15-16	5.5-6		c.1.5	Joncheray 1975
		Carry-le-Rouet	2 nd -1 st century BCE	27	13	4.6			Long 1988, 22-7
		Grand Congloué B	2 nd -1 st century BCE	?	23				Benoit 1961
		Miladou	2 nd -1 st century BCE	?	15				Dumontier & Joncheray 1991, 109-74; Long & Ximenes 1988, 159-83
		Laurons 2	2 nd century CE		15	5		c.1.2	Gassend et al. 1984, 75-105
		Conque de Salins	2 nd century BCE	?	15	2.2			Roquette et al. 2004, 35-8.
		Apollonia	2 nd -1 st century BCE	?	15				Laronde 1987, 322-30
	Stone-carrier	Izmetište	100-150 CE	30-40					Jurišić 2000, 65
	Stone-carrier	Margarina	1 st century CE	30-40					Jurišić 2000, 69
	Stone-carrier	Marseillan Beauséjour	50-100 CE	c.24					Bernard 2009
	Stone-carrier	Meloria C	30-160 CE	c.50					Bargaliotti 2002
		Pisa (Hellenistic ship)	2 nd century BCE	42	14	4.5			Bonino 2003, 183-221
		Planier III	50 BCE		14?	3.2?			Liou 1973

Table 3. A comparative table of small capacity ships of the Hellenistic and early Roman period of the Mediterranean.

Categories		Name	Date	Capacity (t)	Length (m)	Beam (m)	Height from keel to deck (m)	Draught (m)	References
Very small capacity (less than 15 tons)	Nile <i>phaselion</i> *		3rd century BCE	5					Casson 1971, 168, n.59
	Nile <i>kydaron</i> *		1 st -3 rd century CE	3 ¾					Casson 1971, 330
		Naples B	Late 1 st -early 3 rd century CE	10/15?	8?	2?			Boetto 2005; Boetto et al. 2009
	<i>Horeia</i> -type ship	Naples C	Late 1 st -early 3 rd century CE	21/8.5 ⁹⁸⁹	13.5	4	2	c.1.2	Boetto 2005; Boetto et al. 2009; Boetto & Poveda 2014
	<i>Horeia</i> -type ship	Toulon 1	Late 1 st century CE	10/15?	8.5?	3.1?	0.35-45?		Boetto 2009, 291-4
	<i>Horeia</i> -type ship	Toulon 2	Late 1 st century CE	10	6.3?	2.2?	0.35-45?		Boetto 2009, 291-4
	<i>Horeia</i> -type ship	Ostia, Isola Sacra I	Late 2 nd -early 3 rd century CE		12?	4.88?			Boetto et al. 2017
		Herculaneum	1 st century CE		8.6	2.2		c.0.5	Steffy 1985; 1994, 67-71
		Kinneret	1 st century CE		9	2.5		c.0.5	Steffy 1994, 65-7
		Pisa B	7 CE		9.5	4.3			Comune di Pisa 2001, 54; Kyprouli 2012, 29
	Oared vessel (<i>akatos</i> ?)	Pisa C	1 st century BCE-1 st century CE		14	3			Kyprouli 2012, 30
	Small boat (<i>lembos</i> ?)	Pisa F	117-138 CE		8.18	1	1	c.0.5	Kyprouli 2012

Table 4. A comparative table of very small capacity ships of the Hellenistic and early Roman period of the Mediterranean.

⁹⁸⁹ 21 tons if the ship was a sailing ship and 8.5 if the ship was had mixed propulsion of sail and oars (Boetto & Poveda 2014).

Type	Length	Beam	Area covered
Trireme	40 m	5.6 m	148 m ²
Early “five”	45 m	6.4 m	234 m ²
“Four”	37 m	5.6 m	170 m ²
“Five”	45 m	7.0 m	238 m ²
“Six”	47 m	7.5 m	268 m ²
“Seven”	47 m	7.5 m	268 m ²
“Five”	45 m	8.2 m	256 m ²
Liburnian	20 m	3.9 m	60 m ²
Hemiolia	24 m	4.3 m	65 m ²
Trihemiolia	35 m	5.8 m	140 m ²
Marsala Punic galley (liburnian?)	35 m	4.8 m	168 m ²

Table 5. A comparative table of the approximate area that would have been covered by various sizes of Hellenistic and Roman galleys of the Mediterranean. The area covered by these ships is based on the overall length and beam that were suggested by Morrison and Coates (1996, Appendix D).

Appendix II: written sources

List of publications and translations⁹⁹⁰

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⁹⁹⁰ All translations have been taken from the publications listed, unless indicated otherwise.

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Texts

Achilles Tatius, Leucippe and Clitophon

3.4.1. "Ενθα δὴ τις ἀπὸ τῆς νεῶς νεανίσκος εὐρωστος λαμβάνεται τοῦ κάλῳ καὶ ἐφέλκεται τὴν ἐφορκίδα, καὶ ἦν ἐγγὺς ἤδη τοῦ σκάφους, ἠύτρεπιζετο δὲ ἕκαστος ὡς εἰ πελάσειε πηδήσων ἐς αὐτήν.

Acts

18.1-17. Μετὰ ταῦτα χωρισθεὶς ἐκ τῶν Ἀθηναίων ἦλθεν εἰς Κόρινθον. ... Γαλλίωνος δὲ ἀνθυπάτου ὄντος τῆς Ἀχαΐας κατεπέστησαν οἱ Ἰουδαῖοι ὁμοθυμαδὸν τῷ Παύλῳ καὶ ἤγαγον αὐτὸν ἐπὶ τὸ βῆμα, λέγοντες ὅτι Παρὰ τὸν νόμον ἀναπείθει οὗτος τοὺς ἀνθρώπους σέβεσθαι τὸν θεόν. Μέλλοντος δὲ τοῦ Παύλου ἀνοίγειν τὸ στόμα εἶπεν ὁ Γαλλίων πρὸς τοὺς Ἰουδαίους Εἰ μὲν ἦν ἀδίκημά τι ἢ ῥαδιούργημα πονηρόν, ὧ Ἰουδαῖοι, κατὰ λόγον ἂν ἀνεσχόμεν ὑμῶν· εἰ δὲ ζητήματά ἐστὶν περὶ λόγου καὶ ὀνομάτων καὶ νόμου τοῦ καθ' ὑμᾶς, ὁψεσθε αὐτοί· κριτὴς ἐγὼ τούτων οὐ βούλομαι εἶναι. καὶ ἀπήλασεν αὐτοὺς ἀπὸ τοῦ βήματος.

18.18. Ὁ δὲ Παῦλος ἔτι προσμείνας ἡμέρας ἱκανὰς τοῖς ἀδελφοῖς ἀποταξάμενος ἐξέπλει εἰς τὴν Συρίαν, καὶ σὺν αὐτῷ Πρίσκιλλα καὶ Ἀκύλας, κειράμενος ἐν Κενχρεαῖς τὴν κεφαλὴν, εἶχεν γὰρ εὐχήν.

27.29-32. Φοβούμενοί τε μή που κατὰ τραχεῖς τόπους ἐκπέσωμεν ἐκ πρύμνης ῥίψαντες ἀγκύρας τέσσαρας ἠύχοντο ἡμέραν γενέσθαι. Τῶν δὲ ναυτῶν ζητούντων φυγεῖν ἐκ τοῦ πλοίου καὶ χαλασάντων τὴν σκάφην εἰς τὴν θάλασσαν προφάσει ὡς ἐκ πύργου ἀγκύρας μελλόντων ἐκτείνειν, εἶπεν ὁ Παῦλος τῷ ἑκατοντάρχῃ καὶ τοῖς στρατιώταις Ἐὰν μὴ οὗτοι μείνωσιν ἐν τῷ πλοίῳ, ὑμεῖς σωθῆναι οὐ δύνασθε. Τότε ἀπέκοψαν οἱ στρατιῶται τὰ σχοινία τῆς σκάφης καὶ εἶσαν αὐτὴν ἐκπεσεῖν.

Aelius Aristides, Sacred Tales (translated by the author)

D.32-37. Ὡς γὰρ ἐξέβην εἰς τὴν Δῆλον, ἀχθεσθεὶς τῷ κυβερνήτῃ, ταραχῶδει τε ὄντι καὶ ὑπεναντία τοῖς ἀνέμοις πλέοντι, καὶ οἷον ἀροῦντι τὸ πέλαγος, εὐθύς ὄρκῳ καταλαμβάνω ἢ μὴν μῆτε ἐκπλεύσεσθαι δυοῖν ἡμερῶν, ἀλλ' εἰ φίλον αὐτῷ, πλείτω, ἔφην, ἐφ' αὐτοῦ. Κἀγὼ μὲν τῷ θεῷ θύσας καὶ διατρίψας ὅσον οἷός τ' ἦν περὶ τὸ ἱερόν, εἰσελθὼν εἰς τὸ δωματίον καὶ προειπὼν τοῖς οἰκέταις, ἂν ἀφίκηται τις ἐκ πλοίου, χαίρειν κελεύειν, ἀνεπαυόμην ἐν τῷ λιμένι τῶν δηλίων. Οἱ δ' ἦκον οἶνω βεβαρηότες οἱ ναῦται περὶ πρῶτον ὕπνον σχεδόν, καὶ προστάντες ἔκοπτον τὴν θύραν, καὶ ἐκέλευον ἐξίεναι καὶ χρῆσθαι πλῶ· καὶ γὰρ εἶναι θαυμαστὸν οἷον. Ἀποκριναμένων δὲ τῶν παίδων ὅτι ληροῖεν καὶ οὐδ' ἂν εἴ τι γίγνοιτο κινησοίμην, ἀπιόντες ὥχοντο πρὸς ὀργὴν, ὡς δὴ μεγάλων στερόμενοι. Ἀλεκτρυόνων τε ὥδαί πλησίον ἦσαν, καὶ καταρρήγνυται σκηπτὸς ἐξάσιος, καὶ ἡ θάλαττα ἡλαύνετο λαίλαπι ἀγρία καὶ πάντα ἐπεκλύζετο, καὶ τὰ πλοιάρια τὰ ἐν τῷ λιμένι τὰ μὲν εἰς τὴν γῆν ἐξέπιπτε, τὰ δ' ἀλλήλοις ἐνέπιπτε καὶ συνετρίβετο· ἡ δ' ὀλκάς ἡ κομίζουσα ἡμᾶς ἀπορραγέντων τῶν καλωδίων ἐκυλινδεῖτο ἄνω καὶ κάτω, καὶ μόλις σὺν βοῇ πολλῇ καὶ ταραχῇ τῶν ναυτῶν διασώζεται· καὶ ἐπιγίγνεται ὕδωρ ἐξ οὐρανοῦ πολὺ καὶ λάθρον, καὶ ἐν τῇ νήσῳ θόρυβος ἦν ὥσπερ ἐν νηί.

Aelius Aristides, Orations

3.21-3. Τεκμαίρομαι δὲ τοῖς τε ἄλλοις καὶ ὅτι πᾶσαν τὴν πανταχόθεν θάλατταν ἐπέστρεψε δεῦρο, πύλας ἐκατέρωθεν ἐπιθεὶς καὶ ἀναπετάσας αὐτῇ τὸν ἰσθμὸν τοῦτον καλούμενον, πρὸς τε ἔω καὶ πρὸς ἐσπέραν ὁμοίως, συγκλείσας τε ἅμα, ὡς μὴ ἐπιμίγνυντο, οὐ πολλῷ τινι μέτρῳ γῆς, ἀλλ' οἷον αὐλῶνι στενῷ, καὶ νόμον θεὸς καὶ τάξας ἐπ' αὐταῖς φυλάττειν τὰ ἐαυτῆς ὅρια ἐκάστην, καὶ ἀναπετάσας πάλιν καὶ δοὺς πολλήν τινα τὴν πρόσω εὐρυχωρίαν ἐκάστη, θεαμάτων ἀπάντων ὅποσα ἐν γῇ παραδοξότατόν τε ὁμοῦ καὶ ἡδιστόν, εἰσπλεῖν τε καὶ ἐκπλεῖν ἐν τῷ αὐτῷ ἐξ οὐρίων ἐκάστους, καὶ ὑπὸ τοὺς αὐτοὺς ἀνέμους ἀναγωγὰς τε καὶ καταγωγὰς γίνεσθαι ἐν μόνῃ τῶν πασῶν τῇ γῇ ταύτῃ καὶ τῇ θαλάττῃ· πάντα τε δεῦρο φοιτᾶν τὰ πανταχόθεν κατὰ τε γῆν καὶ κατὰ θάλατταν, καὶ τοῦτ' εἶναι ὑφ' οὗ καὶ ἐκ παλαιότητος ἀφνειὸν τε ὕμνηται χωρίον ὑπὸ τῶν ποιητῶν, ἅμα μὲν διὰ τὸ πλῆθος τῶν παρόντων ἀγαθῶν, ἅμα δὲ καὶ διὰ τὴν ὑπάρχουσαν εὐδαιμονίαν ἐν αὐτῷ. Ἔστι γὰρ οἷον ἀγορά τις καὶ αὐλὴ κοινὴ τῶν Ἑλλήνων καὶ πανήγυρις, οὐχ ἦν διὰ δυοῖν ἐτοῖν συμπληροῖ αὐτῇ τὸ Ἑλληνικόν, καθάπερ ἡ παροῦσα αὕτη, ἀλλ' ἦν διὰ παντὸς ἔτους καὶ καθ' ἡμέραν ἐκάστην.

Aeschylus, Suppliant Maidens

764-9. Οὔτοι ταχεῖα ναυτικοῦ στρατοῦ στολή, / οὐδ' ὄρμος, οὗ δέ τ' πεισμάτων σωτήρια/ ἐς γῆν ἐνεγκεῖν, οὐδ' ἐν ἀγκυρουχαίαις/ Θαρσοῦσι ναῶν ποιμένες παραυτίκα, / ἄλλως τε καὶ μολόντες ἀλίμενον χθόνα/ ἐς νύκτ' ἀποστείχοντος ἡλίου.

Appian, The Punic Wars

14.96. Οἱ δὲ λιμένες ἐς ἀλλήλους διεπλέοντο, καὶ ἔσπλους ἐκ πελάγους ἐς αὐτοὺς ἦν ἐς εὖρος ποδῶν ἑβδομήκοντα, ὃν ἀλύσεσιν ἀπέκλειον σιδηραῖς. ὁ μὲν δὴ πρῶτος ἐμπόροις ἀνεῖτο, καὶ πείσματα ἦν ἐν αὐτῷ πυκνὰ καὶ ποικίλα: τοῦ δ' ἐντὸς ἐν μέσῳ νῆσος ἦν, καὶ κρηπῖσι μεγάλαις ἢ τε νῆσος καὶ ὁ λιμὴν διείληπτο. Νεωρίων τε ἔγεμον αἱ κρηπῖδες αἰδεές ναῦς διακοσίας καὶ εἴκοσι πεποιημένων, καὶ ταμειῶν ἐπὶ τοῖς νεωρίοις ἐς τριηρετικά σκεύη. Κίονες δ' ἐκάστου νεωσοίκου προὔχον Ἰωνικοὶ δύο, ἐς εἰκόνα στοᾶς τὴν ὄψιν τοῦτε λιμένος καὶ τῆς νήσου περιφέροντες. Ἐπὶ δὲ τῆς νήσου σκηνὴ ἐπεποιήτο τῷ ναυάρχῳ, ὅθεν ἔδει καὶ τὸν σαλπικτὴν σημαίνειν, καὶ τὸν κήρυκα προλέγειν, καὶ τὸν ναύαρχον ἐφορᾶν. Ἐκεῖτο δ' ἡ νῆσος κατὰ τὸν ἔσπλουν, καὶ ἀνετέτατο ἰσχυρῶς, ἵνα ὃ τε ναύαρχος τὰ ἐκ πελάγους πάντα ἐφορᾷ, καὶ τοῖς ἐπιπλεύουσιν ἀφανὴς ἢ τῶν ἔνδον ἢ ὅψις ἢ ἀκριβής. Οὐ μὴν οὐδὲ τοῖς ἐσπλεύσασιν ἐμπόροις εὐθύς ἦν τὰ νεώρια σύνοπτα: τεῖχος τε γὰρ αὐτοῖς διπλοῦν περιέκειτο, καὶ πύλαι, αἱ τοὺς ἐμπόρους ἀπὸ τοῦ πρώτου λιμένος ἐς τὴν πόλιν ἐσέφερον οὐ διερχομένους τὰ νεώρια.

20.136. Καὶ μετ' οὐ πολὺ τῶν ἀπόρων αὐτὸν ἐς Ῥώμην ἐπανελθόντα περὶ γῆς παρακαλούντων, συνέτασεν ὡς ἡέμψων τοὺς μὲν ἐς τὴν Καρχηδόνα τοὺς δ' ἐς Κόρινθον.

Appian, The Civil Wars

5.89. ...τὰς ναῦς ἐκατέρωθεν ἀγκύραις ἔκ τε τοῦ πελάγους καὶ ἀπὸ τῆς γῆς διεκράτουν καὶ κοντοῖς ἐξεώθουν ἀπ' ἀλλήλων.

Appian, The Mithridatic Wars

5.28. Καὶ ὁ μὲν ἐπὶ τοῖσδε ἦν, κατὰ δὲ τὴν Ἑλλάδα τοιάδε ἐγίνετο. Ἀρχέλαος ἐπιπλεύσας καὶ σίτῳ καὶ στόλῳ πολλῷ, Δῆλόν τε ἀφισταμένην ἀπὸ Ἀθηναίων καὶ ἄλλα χωρία ἐχειρώσατο βίᾳ καὶ κράτει. κτείνας δ' ἐν αὐτοῖς δισμυρίους ἄνδρας, ὧν οἱ πλεόνες ἦσαν Ἰταλοί, τὰ χωρία προσεποιεῖτο τοῖς Ἀθηναίοις: καὶ ἀπὸ τοῦδε αὐτοὺς, καὶ τὰ ἄλλα κομπάζων περὶ τοῦ Μιθριδάτου καὶ ἐς μέγα ἐπαίρων, ἐς φιλίαν ὑπηγάγετο.

Apuleius, Metamorphoses

10.18. *Sed prius est ut vobis, quod initio facere debueram, vel nunc saltem referam, quis iste vel unde fuerit. Thiasus (hoc enim nomine meus nuncupabatur dominus) oriundus patria Corintho, quod caput est totius Achaiae provinciae, ut eius prosapia atque dignitas postulabat, gradatim permensis honoribus quinquennali magistratu fuerat destinatus, et ut splendori capessendorum responderet fascium, munus gladiatorum tridui spectaculi pollicitus latius munificentiam suam porrigebat.*

10.35. *... sexque totis passuum milibus perneciter confectis Cenchreas pervado, quod oppidum audit quidem nobilissimae coloniae Corinthiensium, alluitur autem Aegaeo et Saronico mari: inibi portus etiam tutissimum navium receptaculum magno frequentatur populo. Vitatis ergo turbulis et electo secreto litore prope ipsas fluctuum aspergines in quodam mollissimo harenae gremio lassum corpus porrectus refoveo: nam et ultimam diei metam curriculum solis deflexerat, et vespernae me quieti traditum dulcis somnus oppresserat.*

Aristophanes, Knights

542-4. Ταῦτ' ὀρρωδῶν διέτριβεν αἰεὶ, καὶ πρὸς τούτοισιν ἔφασκεν/ ἐρέτην χρῆναι πρῶτα γενέσθαι πρὶν πηδαλίοις ἐπιχειρεῖν,/ κᾷτ' ἐντεῦθεν πρωρατεῦσαι καὶ τοὺς ἀνέμους διαθρῆσαι,/ κᾷτα κυβερνᾶν αὐτὸν ἑαυτῷ.

Athenaeus, The Learned Banqueters

5.37. Ἐπεὶ δὲ περὶ νεῶν κατασκευῆς εἰρήκαμεν, φέρ' εἵπωμεν ἀκοῆς γάρ ἐστιν ἄξια καὶ τὰ ὑπὸ τοῦ Φιλοπάτορος βασιλέως κατεσκευασμένα σκάφη. Περὶ ὧν ὁ αὐτοσκαλλίξινος ἱστορεῖ ἐν τῷ πρώτῳ περὶ Ἀλεξανδρείας οὕτως λέγων ' τὴν τεσσαρακοντῆρη ναῦν κατεσκεύασεν ὁ φιλοπάτωρ τὸ μῆκος ἔχουσαν

διακοσίων ὀγδοήκονταπηχῶν, ὅκτῳ δὲ καὶ τριάκοντα ἀπὸ παρόδου ἐπὶ πάροδον, ὕψος δὲ ἕως ἀκροστολίου τεσσαράκοντα ὅκτῳ πηχῶν, ἀπὸ δὲ τῶν πυρμνητικῶν ἀφλάστων ἐπὶ τὸ πρὸς τῇ θαλάσσημέρος αὐτῆς τρεῖς πρὸς τοῖς πεντήκοντα πήχεις, πηδάλια δ' εἶχε τέτταρα τριακονταπήχη, κώπας δὲ θρανδικὰς ὅκτῳ καὶ τριάκοντα πηχῶν τὰς μεγίστας, αἱ διὰ τὸ μόλυβδον ἔχειν ἐν τοῖς ἐγχειριδίοις καὶ γεγονέναι λίαν εἶσω βαρεῖται κατὰ τὴν ζύγῳσιν εὐήρεις ὑπῆρχον ἐπὶ τῇ σφραγίδι, δίπρωρος δ' ἐγεγόνει καὶ δίπρωρος καὶ ἔμβολα εἶχεν ἑπτὰ: τούτων ἐν μὲν ἡγούμενον, τὰ δ' ὑποστέλλοντα, τινὰ δὲ κατὰ τὰς ἐπιπλάδας. Ὑποζώματα δὲ ἐλάμβανε δώδεκα: ἐξακοσίων δ' ἦν ἕκαστον πηχῶν, εὐρυθμος δ' ἦν καθ' ὑπερβολήν. Θαυμαστός δ' ἦν καὶ ὁ ἄλλος κόσμος τῆς νεώς: ζῶα μὲν γὰρ εἶχεν οὐκ ἐλάττω δώδεκα πηχῶν κατὰ πρύμναν τε καὶ κατὰ πρῶραν, καὶ πᾶς τόπος αὐτῆς κηρογραφία κατεπεποίκιλτο, τὸ δ' ἐγκωπον ἅπαν μέχρι τῆς τρόπεως κισσίνην φυλλάδα καὶ θύρσους εἶχε πέριξ, πολὺς δ' ἦν καὶ ὁ τῶν ὄπλων κόσμος, ἀνεπλήρου δὲ πάντα τὰ προσδεόμενα τῆς νεώς μέρη. Γενομένης δὲ ἀναπείρας ἐδέξατο ἐρέτας πλείους τῶν τετρακισχιλίων, εἰς δὲ τὰς ὑπηρεσίας τετρακοσίους: εἰς δὲ τὸ κατάστρωμα ἐπιβάτας τρισχιλίου ἀποδέοντες ἑκατὸν καὶ πεντήκοντα: καὶ χωρὶς ὑπὸ τὰ ζύγια πλῆθος ἀνθρώπων ἕτερον ἐπισιτισμοῦ, τε οὐκ ὀλίγον. Καθεικλύσθη δὲ τὴν μὲν ἀρχὴν ἀπὸ ἐσχαρίου τινός, ὃ φασὶ παγῆναι πεντήκοντα πλοίων πεντηρικῶν ξυλεία, ὑπὸ δὲ ὄχλου μετὰ βοῆς καὶ σαλπίγγων κατήγετο. Ὑστερον δὲ τῶν ἀπὸ Φοινίκης τις ἐπενόησε τὴν καθολκὴν, τάφρον ὑποσπασάμενος ἴσθη τῇ νηὶ κατὰ μήκος, ἣν πλησίον τοῦ λιμένος ὤρυξε. Τὰ αὐτὰ δὲ τοὺς θεμελίους κατωκοδόμησε λίθῳ στερεῶ πρὸς πέντε πήχεις τὸ βάθος, καὶ διὰ τούτων φάλαγγας ἐπικαρσίας κατὰ πλάτος τῆς τάφρου διώσας συνεχεῖς τετράπηχυν εἰς βάθος τόπον ἀπολειπούσας. Καὶ ποιήσας εἴσρουν ἀπὸ τῆς θαλάσσης ἐνέπλησεν αὐτῆς πάντα τὸν ὀρυχθέντα τόπον, εἰς ὀνράδιως ὑπὸ τῶν τυχόντων ἀνδρῶν εἰσήγαγε τὴν ναῦν., τὸ ἀνοιχθὲν κατ' ἀρχὰς ἐμφράξαντας μετεξαντλήσαι πάλιν τὴν θάλασσαν ὀργάνοις. Τούτου δὲ γενομένου ἐδρασθῆναι τὸ πλοῖον ἀσφαλῶς ἐπὶ τῶν προειρημένων φαλάγγων.

4.173b-c. Πάντων ἀκούων διότι παρασίτῳ τόπος οὗτος τρία μόνος ἀγαθὰ κεκτῆσθαι δοκεῖ, εὖοψον ἀγοράν, παντοδαπὰν οὐκ οὐκ ὄχλον, αὐτοὺς παρασίτους τοῦ θεοῦ τοὺς Δηλίου

5.206d-209. ...Ἱέρων δὲ ὁ Συρακοσίων βασιλεὺς, ὁ πάντα Ῥωμαίοις φίλος, ἐσπουδάκει μὲν καὶ περὶ ἱερῶν καὶ γυμνασίων κατασκευάς, ἦν δὲ καὶ περὶ ναυπηγίας φιλότιμος, πλοῖα σιτηγὰ κατασκευαζόμενος, ὧν ἐνὸς τῆς κατασκευῆς μνησθήσομαι. Εἰς ὕλην μὲν ξύλῳσιν ἐκ τῆς Αἴτνης παρεσκεύαστο ἐξήκοντα τετρηρικῶν σκαφῶν πλῆθος ἐξεργάσασθαι δυναμένην. Ὡς δὲ ταῦτα ἡτοιμάσατο γόμφους τε καὶ ἐγκοιλία καὶ σταμῖνας καὶ τὴν εἰς τὴν ἄλλην χρειαὴν ὕλην τὴν μὲν ἐξ Ἰταλίας, τὴν δ' ἐκ Σικελίας, εἰς δὲ σχοινία λευκέαν μὲν ἐξ Ἰβηρίας, κάρναβιν δὲ καὶ πίτταν ἐκ τοῦ Ῥοδανοῦ ποταμοῦ καὶ τὰλλα πάντα τὰ χρειώδη πολλαχόθεν. Συνήγαγε δὲ καὶ ναυπηγούς καὶ τοὺς ἄλλους τεχνίτας καὶ καταστήσας ἐκ πάντων Ἀρχιάν τὸν Κορίνθιον ἀρχιτέκτονα παρεκάλεσε προθύμως ἐπιλαβέσθαι τῆς κατασκευῆς, προσκαρτερῶν καὶ αὐτὸς τὰς ἡμέρας, τὸ μὲν οὖν ἥμισυ τοῦ παντός τῆς νεώς ἐν μηνσὶν ἐξ ἐξεργάσατο... Καὶ ταῖς ἐκ μολίβου ποιηθείσας κεραμίσις ἀεὶ καθ' ὃ ναυπηγηθεῖ μέρος περιλαμβάνετο, ὡς ἂν τριακοσίων ὄντων τῶν τὴν ὕλην ἐργαζομένων τεχνιτῶν χωρὶς τῶν ὑπηρετούντων, τοῦτο μὲν οὖν τὸ μέρος εἰς τὴν θάλασσαν καθέλκειν προσετέτακτο, τὴν λοιπὴν κατασκευὴν ἴν' ἐκεῖ λαμβάνη. Ὡς δὲ περὶ τὸν καθελκυσμὸν αὐτοῦτὸν εἰς τὴν θάλασσαν πολλὴ ζήτησις ἦν, Ἀρχιμήδης ὁ μηχανικὸς μόνος αὐτὸ κατήγαγε δι' ὀλίγων σωματῶν, κατασκευάσας γὰρ ἔλικα τὸ τηλικούτον σκάφος εἰς τὴν θάλασσαν κατήγαγε. Πρῶτος δ' Ἀρχιμήδης εὗρε τὴν τῆς ἔλικος κατασκευὴν, ὡς δὲ καὶ τὰ λοιπὰ μέρη τῆς νεώς ἐν ἄλλοις ἐξ μηνσὶ κατεσκευάσθη καὶ τοῖς χαλκοῖς ἥλοις πᾶσα περιελήφθη, ὧν οἱ πολλοὶ δεκάμνοοι ἦσαν, οἱ δ' ἄλλοι τούτων ἡμιόλιοι - διὰ τρυπάνων δ' ἦσαν οὗτοι ἡρμοσμένοι τοὺς σταμῖνας συνέχοντες: μολυβδίναις δὲ κεραμίσις ἐπεστεγνοῦντο πρὸς τὸ ξύλον, ὑποτιθεμένων ὀθονίων μετὰ πίττης - ὡς οὖν τὴν ἐκτὸς ἐπιφάνειαν ἐξεργάσατο, τὴν ἐντὸς διασκευῆν ἐξέπονεῖτο.

Ἦν δὲ ἡ ναὺς τῇ μὲν κατασκευῇ εἰκόσορος, τριπάρωδος δέ: τὴν μὲν κατωτάτῳ ἔχων ἐπὶ τὸν γόμον, ἐφ' ἣν διὰ κλιμάκων πυκνῶν ἢ κατὰβασις ἐγένετο: ἡ δ' ἐτέρα τοῖς εἰς τὰς διαίτας βουλομένοις εἰσιέναι ἐμεμηχάνητο: μεθ' ἣν ἡ τελευταία τοῖς ἐν τοῖς ὅπλοις τεταγμένοις. Ἦσαν δὲ τῆς μέσης παρόδου παρ' ἑκάτερον τῶν τοίχων δαίται τετράκλινοι τοῖς ἀνδράσι, τριάκοντα τὸ πλῆθος, ἡ δὲ ναυκληρικὴ δαίτα κλινῶν μὲν ἦν πεντεκαίδεκα, θαλάμους δὲ τρεῖς εἶχε τρικλίνους, ὧν ἦν τὸ κατὰ τὴν πρύμναν ὀπτανεῖον. Ταῦτα δὲ πάντα δάπεδον εἶχεν ἐν ἀβακίσκοις συγκείμενον ἐκ παντοίων λίθων, ἐν οἷς ἦν κατεσκευασμένοις πᾶς ὁ περὶ τὴν Ἰλιάδα μῦθος θαυμασίως ταῖς τε κατασκευαῖς καὶ ταῖς ὀροφαῖς, καὶ θυρώμασι δὲ πάντα ἦν ταῦτα πεπονημένα. Κατὰ δὲ τὴν ἀνωτάτῳ πάροδον γυμνάσιον ἦν καὶ περίπατοι σύμμετρον ἔχοντες τὴν

κατασκευὴν τῷ τοῦ πλοίου μεγέθει, ἐν οἷς κῆποι παντοῖοι θαυμασίως ἦσαν ὑπερβάλλοντες ταῖς φυτεαῖς, διὰ κεραμίδων μολυβδινῶν κατεστεγνυμένων ἄρδευόμενοι, ἔτι δὲ σκηναὶ κιττοῦ λευκοῦ καὶ ἀμπέλων, ὧν αἱ ῥίζαι τὴν τροφήν ἐν πίθοις εἶχον γῆς πεπληρωμένοις, τὴν αὐτὴν ἄρδουσιν λαμβάνουσαι καθάπερ καὶ οἱ κῆποι, αὗται δὲ αἱ σκηναὶ συνεσκίαζον τοὺς περιπάτους, ἐξῆς δὲ τούτων Ἀφροδίσιον κατεσκεύαστο τρίκλινον, δάπεδον ἔχον ἐκ λίθων ἀχατῶν τε καὶ ἄλλων χαριεστάτων ὅσοι κατὰ τὴν νῆσον ἦσαν· τοὺς τοίχους δ' εἶχε καὶ τὴν ὀροφὴν κυπαρίττου, τὰς δὲ θύρας ἐλέφαντος καὶ θύουγραφαῖς δὲ καὶ ἀγάλασιν, ἔτι δὲ ποτηρίων κατασκευαῖς ὑπερβαλλόντως κατεσκεύαστο.

Τούτου δ' ἐφεξῆς σχολαστήριον ὑπῆρχε πεντάκλινον, ἐκ πύξου τοὺς τοίχους καὶ τὰ θυρώματα κατεσκευασμένον, βιβλιοθήκην ἔχον ἐν αὐτῷ, κατὰ δὲ τὴν ὀροφὴν πόλον ἐκ τοῦ κατὰ τὴν Ἀχραδίνην ἀπομεμιμημένον ἡλιοτροπίου, ἦν δὲ καὶ θαλανεῖον τρίκλινον πυρίας χαλκᾶς ἔχον τρεῖς καὶ λουτήρα πέντε μετρητὰς δεχόμενον ποικίλον τοῦ ταυρομενίτου λίθου, κατεσκεύαστο δὲ καὶ οἰκήματα πλείω τοῖς ἐπιβάταις καὶ τοῖς τὰς ἀντλίας φυλάττουσι. Χωρὶς δὲ τούτων ἵππων ἦσαν ἐκατέρου τῶν τοίχων δέκα· κατὰ δὲ τούτους ἡ τροφή τοῖς ἵπποις ἔκειτο καὶ τῶν ἀναβατῶν καὶ τῶν παιδῶν τὰ σκεύη, ἦν δὲ καὶ ὑδροθήκη κατὰ τὴν πρῶραν κλειστή, δισχιλίους μετρητὰς δεχομένη, ἐκ σανίδων καὶ πίττης καὶ ὀθονίων κατεσκευασμένη. Παρὰ δὲ ταύτην κατεσκεύαστο διὰ μολιβδώματος καὶ σανίδων κλειστὸν ἰχθυοτροφεῖον· τοῦτο δ' ἦν πληρὲς θαλάττης, ἐν ᾧ πολλοὶ ἰχθύες ἐνετρέφοντο. Ὑπῆρχον δὲ καὶ τῶν τοίχων ἐκατέρωθεν τρόποι προεωσμένοι, διάστημα σύμμετρον ἔχοντες· ἐφ' ὧν κατεσκευασμένοι ἦσαν ξυλοθήκαι καὶ κρίβανοι καὶ ὀπτανεῖα καὶ μύλοι καὶ πλείους ἕτεραι διακοναί. Ἀτλαντές τε περιέτρεχον τὴν ναῦν ἐκτὸς ἐξαπήχεις, οἳ τοὺς ὄγκους ὑπειλήφεσαν τοὺς ἀνωτάτω καὶ τὸ τρίγλυφον, πάντες ἐν διαστήματι συμμέτρῳ βεβῶτες. Ἡ δὲ ναὺς πᾶσα οἰκείαις γραφαῖς ἐπεπόνητο. Πύργοι τε ἦσαν ἐν αὐτῇ ὅκτω σύμμετροι τὸ μέγεθος τοῖς τῆς νεῶς ὄγκοις· δύο μὲν κατὰ πρῶμναν, οἱ δ' ἴσοι κατὰ πρῶραν, οἱ λοιποὶ δὲ κατὰ μέσσην ναῦν. Τούτων δὲ ἐκάστῳ παρεδέδεντο κεραῖαι β', ἐφ' ὧν κατεσκεύαστο φατνώματα, δι' ὧν ἠφίεντο λίθοι πρὸς τοὺς ὑποπλέοντας τῶν πολεμίων, ἐπὶ δὲ τῶν πύργων ἕκαστον ἀνέβαινον τέτταρες μὲν καθωπλισμένοι νεανίσκοι, δύο δὲ τοξόται. Πᾶν δὲ τὸ ἐντὸς τῶν πύργων λίθων καὶ βελῶν πληρὲς ἦν. Τείχος δὲ ἐπάλξεις ἔχον καὶ καταστρώματα διὰ νεῶς ἐπὶ κυλινδάντων κατεσκεύαστο· ἐφ' οὗ λιθοβόλος ἐφειστήκει, τριτάλαντον λίθον ἀφ' αὐτοῦ ἀφίεις καὶ δωδεκάπηχυ βέλος, τοῦτο δὲ τὸ μηχανήμα κατεσκεύασεν Ἀρχιμήδης, ἐκάτερον δὲ τῶν βελῶν ἔβαλλεν ἐπίστάδιον. Μετὰ δὲ ταῦτα παραρρύματα ἐκ τροπῶν παχέων συγκείμενα διὰ ἀλύσεων χαλκῶν κρεμάμενα, τριῶν δὲ ἰστῶν ὑπαρχόντων ἐξ ἐκάστου κεραῖαι λιθοφόροι ἐξήρτηντο β', ἐξ ὧν ἄρπαγές τε καὶ πλίνθοι μολίβου πρὸς τοὺς ἐπιτιθεμένους ἠφίεντο. Ἦν δὲ καὶ χάραξ κύκλῳ τῆς νεῶς σιδηροῦς πρὸς τοὺς ἐπιχειροῦντας ἀναβαίνειν κόρακές τε σιδηροῖ κύκλῳ τῆς νεῶς, οἳ δι' ὀργάνων ἀφιέμενοι τὰ τῶν ἐναντίων ἐκράτουν σκάφη καὶ παρέβαλλον εἰς πληγὴν. Ἐκατέρῳ δὲ τῶν τοίχων ἐξήκοντα νεανίσκοι πανοπλίας ἔχοντες ἐφειστήκεσαν καὶ τούτοις ἴσοι περί τε τοὺς ἰστούς καὶ τὰς λιθοφόρους κεραίας, ἦσαν δὲ καὶ κατὰ τοὺς ἰστούς ἐν τοῖς καρχησίοις οὔσι χαλκοῖς ἐπὶ μὲν τοῦ πρώτου τρεῖς ἄνδρες, εἴθ' ἐξῆς καθ' ἓνα λειπόμενοι τούτοις δ' ἐν πλεκτοῖς γυργάθοις διὰ τροχιλίων εἰς τὰ θωράκια λίθοι παρεβάλλοντο καὶ βέλη διὰ τῶν παιδῶν, ἄγκυραι δὲ ἦσαν ξύλιναι μὲν τέτταρες, σιδηραῖ δ' ὅκτω. Τῶν δὲ ἰστῶν ὁ μὲν δεύτερος καὶ τρίτος εὐρέθησαν εὐχερῶς, δυσχερῶς δὲ ὁ πρῶτος εὐρέθη ἐν τοῖς ὅρεσι τῆς Βρεττίας ὑπὸ συβώτου ἀνδρός· κατήγαγε δ' αὐτόν ἐπὶ θάλατταν Φιλέας ὁ Ταυρομενίτης μηχανικός, ἡ δὲ ἀντλία καίπερ βάθος ὑπερβάλλον ἔχουσα δι' ἐνὸς ἀνδρός ἐξηντλεῖτο διὰ κοχλίου, Ἀρχιμήδους ἐξευρόντος. Ὄνομα δ' ἦν τῇ νηὶ Συρακοσία· ὅτε δ' αὐτὴν ἐξέπεμπεν Ἰέρων, Ἀλεξανδρίδα αὐτὴν μετωνόμασεν. Ἐφὸλκία δ' ἦσαν αὐτῇ τὸ μὲν πρῶτον κέρκουρος τρισχίλια τάλαντα δέχεσθαι δυνάμενος· πᾶς δ' ἦν οὗτος ἐπὶ κωπος. Μεθ' ὃν χίλια πεντακόσια βαστάζουσαι ἀλιάδες τε καὶ σκάφαι πλείους. Ὀχλος δ' ἦν οὐκ ἐλάττων..., μετὰ τοὺς προειρημένους ἄλλοι τε ἐξακόσιοι παρὰ τὴν πρῶραν ἐπιτηροῦντες τὰ παραγγελλόμενα, τῶν δὲ κατὰ ναῦν ἀδικημάτων δικαστήριον καθειστήκει ναύκληρος, κυβερνήτης καὶ πρῳεὺς, οἷπερ ἐδίκαζον κατὰ τοὺς Συρακοσίων νόμους. Σίτου δὲ ἐνεβάλλοντο εἰς τὴν ναῦν μυριάδας ἕξ, ταρίχων δὲ σικελικῶν κεράμια μύρια, ἐρεῶν τάλαντα δισμύρια, καὶ ἕτερα δὲ φορτία δισμύρια. Χωρὶς δὲ τούτων ὁ ἐπισιτισμὸς ἦν τῶν ἐμπλεόντων. Ὁ δ' Ἰέρων ἐπεὶ πάντας τοὺς λιμένας ἤκουεν τοὺς μὲν ὡς οὐ δύνατοί εἰσι τὴν ναῦν δέχεσθαι, τοὺς δὲ καὶ ἐπικινδύνους ὑπάρχειν, διέγνω δῶρον αὐτὴν ἀποστεῖλαι Πτολεμαίῳ τῷ βασιλεῖ εἰς Ἀλεξάνδρειαν καὶ γὰρ ἦν σπάνις σίτου κατὰ τὴν Αἴγυπτον. Καὶ οὕτως ἐποίησε, καὶ ἡ ναὺς κατήχη εἰς τὴν Ἀλεξάνδρειαν, ἔνθα καὶ ἐνεωλκήθη.

Automedon, Anthologia Graeca

10.23. Νικήτης ὀλίγοις μὲν ἐπὶ προτόνοισιν, ἀήτης/ οἷάτε, πρηεῖς ἄρχεται ἐκ μελέτης;/ ἀλλ' ὅταν ἐμπνεύσῃ, κατὰ δ' ἰστίᾳ πάντα φέρεται,/ λαίφεα πακτώσας, μέσσα θέει πελάγη,/ ναῦς ἄτε μυριόφορτος, ἔως ἐπὶ τέρματα μύθων/ ἔλθῃ ἀκυμάντους † ἔμπροσθεν εἰς λιμένας.

Caesar, Commentaries on the Civil War

3.23.2. *Hic repentino adventu naves onerarias quasdam nactus incendit et unam frumento onustam abduxit magnumque nostris terrorem iniecit, et noctu militibus ac sagittariis in terra expositis praesidium equitum deiecit et adeo loci opportunitate profecit, uti ad Pompeium litteras mitteret, naves reliquas, si vellet, subduci etrefici iuberet; sua classe auxilia sese Caesaris prohibitorium.*

3.29.2-3. *Expositis omnibus copiis Antonius, quarum erat summa veteranarum trium legionum uniusque tironum et equitum dccc, plerasque naves in Italiam remittit ad reliquos milites equitesque transportandos, pontones, quod est genus navium Gallicarum, Lissi relinquit, hoc consilio, ut si forte Pompeius vacuam existimans Italiam eo traiecisset exercitum, quae opinio erat edita in vulgus, aliquam Caesar ad insequendum facultatem haberet, nuntiosque ad eum celeriter mittit, quibus regionibus exercitum exposuisset et quid militum transvexisset.*

3.96.4. *Neque ibi constitit, sed eadem celeritate paucos suos ex fuga nactus nocturno itinere non intermisso comitatu equitum xxx ad mare pervenit navemque frumentariam conscendit, saepe, ut dicebatur, querens tantum se opinionem fefellisse, ut a quo genere hominum victoriam sperasset, ab eo initio fugae facto paene proditus videretur.*

Caesar, Gallic War

3.13.5. *...ancorae pro funibus ferreis catenis revinctae*

Callimachus, Hymn to Delos

300-1. Ἀστερίη θυόεσσα, σὲ μὲν περὶ τ' ἀμφὶ τε νῆσοι/ κύκλον ἐποίησαντο καὶ ὥς χορὸν ἀμφεβάλοντο·

Cicero, Letters to Atticus

16.6.1. *Ego adhuc (pervenī enim Vibonem ad Siccā) magis commode quam strenue navigavi; remis enim magnam partem, prodromi nulli. Illud satis opportune, duo sinus fuerunt quos tramitti oporteret, Paestanus et Vibonensis. Utrumque pedibus aequis tramisimus. Veni igitur ad Siccā octavo die e Pompeiano, cum unum diem Veliae constitissem; ubi quidem fui sane libenter apud Thalnam nostrum nec potui accipi, illo absente praesertim, liberalius. Viii Kal. Igitur ad Siccā. Ibi tamquam domi meae scilicet. Itaque obdixi posterum diem. Sed putabam, cum Regium venissem, fore ut illic “δολιχὸν πλόον ὁρμαίνοντες” cogitarem corbitane Patras an actuariolis ad Leucopetram Tarentinorum atque inde Corcyram et, si oneraria, statimne freto an Syracusis. Hac super re scribam ad te Regio.*

Cicero, The Letters to his Friends

12.15. *Quam indignitatem deminutionemque non solum iuris nostri sed etiam maiestatis imperi populi que Romani idcirco tulimus quod interceptis litteris cognoramus Dolabellam, si desperasset de Syria Aegyptoque, quod necesse erat fieri, in navis cum omnibus suis latronibus atque omni pecunia conscendere esse paratum Italiamque petere; id circo etiam navis onerarias, quarum minor nulla erat duum milium amphorum, contractas in Lycia a classe eius obsideri.*

Cicero, For Sextus Roscius of Ameria

133. *Alter tibi descendit de Palatio et aedibus suis; habet animi causa rus amoenum et suburbanum, plura praeterea praedia neque tamen ullum nisi praeclarum et propinquum. Domus referta vasis Corinthiis et Deliacis, in quibus est authepsa illa quam tanto pretio nuper mercatus est ut qui praetereuntes quid praeco enumeraret audiebant fundum venire arbitrentur.*

Cicero, On the Nature of Gods

3.91. *Portenta enim ab utrisque et flagitia dicuntur. Neque enim quem hipponactis iambus laeserat aut qui erat archilochi versu vulneratus a deo immissum dolorem non conceptum a se ipso continebat, nec cum aegisthi libidinem aut cum paridis videmus a deo causam requirimus, cum culpa paene vocem audiamus, nec ego multorum aegrorum salutem non ab hippocrate potius quam ab aesculapio datam iudico, nec lacedaemoniorum disciplinam dicam umquam ab apolline potius spartae quam a lycurgo datam. Critolaus inquam evertit corinthum, carthaginem asdrubal; hi duo illos oculos orae maritumae effoderunt, non iratus aliqui, quem omnino irasci posse negatis, deus.*

Cicero, De Republica

2.7. *Est autem maritimis urbibus etiam quaedam corruptela ac demutatio morum; admiscuntur enim novis sermonibus ac disciplinis et inportantur non merces solum adventiciae, sed etiam mores, ut nihil possit in patriis institutis manere integrum. Iam qui incolunt eas urbes, non haerent in suis sedibus, sed volucris semper spe et cogitatione rapiuntur a domo longius, atque etiam cum manent corpore, animo tamen exulant et vagantur. Nec vero ulla res magis labefactatam diu et Carthaginem et Corinthum pervertit aliquando quam hic error ac dissipatio civium, quod mercandi cupiditate et navigandi et agrorum et armorum cultum reliquerant.*

Cicero, Tusculanae Disputationes

3.53. *Quod ita esse dies declarat, quae procedens ita mitigat, ut isdem malis manentibus non modo leniatur aegritudo, sed in plerisque tollatur. Karthaginienses¹ multi Romae servierunt, Macedones rege Perse capto; vidi etiam in Peloponneso, cum essem adulescens, quosdam Corinthios. hi poterant omnes eadem illa de Andromacha² deplorare: "haec omnia vidi ...", sed iam³ decantaverant fortasse. eo enim erant voltu, oratione, omni reliquo motu et statu, ut eos Argivos aut Sicyonios⁴ diceretis, magisque me moverant Corinthi subito aspectae⁶ parietinae quam ipsos Corinthios, quorum animis diuturna cogitatio callum vetustatis obduxerat.*

Ctesias, On India

6. ... τὸ δὲ ὕψος ὅσον μυριοφόρου νεὼς ἰστός...

Demosthenes

35.28. Ὁ δὲ πάντων δεινότατον διεπράξατο Λάκριτος οὐτοσί, δεῖ ὑμᾶς ἀκοῦσαι: οὗτος γὰρ ἦν ὅπαντα ταῦτα διοικῶν. Ἐπειδὴ γὰρ ἀφίκοντο δεῦρο, εἰς μὲν τὸ ὑμέτερον ἐμπόριον οὐ καταπλέουσιν, εἰς φωρῶν δὲ λιμένα ὁρμίζονται, ὅς ἐστιν ἔξω τῶν σημείων τοῦ ὑμετέρου ἐμπορίου, καὶ ἔστιν ὁμοῖον εἰς φωρῶν λιμένα ὁρμίσασθαι, ὥσπερ ἂν εἴ τις εἰς Αἰγίναν ἢ εἰς Μέγαρα ὁρμίσαιτο: ἔξεστι γὰρ ἀποπλεῖν ἐκ τοῦ λιμένος τούτου ὅποι ἂν τις βούληται καὶ ὀπηνίκε' ἂν δοκῇ αὐτῷ.

50.20. ...ὁ δὲ στρατηγὸς Τιμόμαχος, ἀφικομένων ὡς αὐτὸν πρέσβειων Μαρωνιτῶν καὶ δεομένων αὐτοῖς τὰ πλοῖα παραπέμψαι τὰ σιτηγὰ, προσέταξεν ἡμῖν τοῖς τριηράρχοις ἀναδησαμένοις τὰ πλοῖα ἔλκειν εἰς Μαρώνειαν, πλοῦν καὶ πολὺν καὶ πελάγιον.

50.22. Παραταξαμένων δὲ Μαρωνιτῶν ἡμῖν ταῖς ναυσὶν ὑπὲρ τοῦ χωρίου τούτου καὶ μελλόντων ναυμαχῆσαι, καὶ τῶν στρατιωτῶν ἀπειρηκότων, πλοῦν πολὺν πεπλευκότων καὶ πλοῖα ἐλκόντων ἐκ Θάσου εἰς Στῆρυν, ἔτι δὲ χειμῶνος ὄντος καὶ τοῦ χωρίου ἀλιμένου, καὶ ἐκβῆναι οὐκ ὄν οὐδὲ δειπνοποιήσασθαι πολεμίας τῆς χώρας οὔσης καὶ περικαθημένων κύκλῳ τὸ τεῖχος καὶ ξένων μισθοφόρων καὶ βαρβάρων προσοίκων, ἀναγκαῖον ἦν ἐπ' ἀγκύρας ἀποσαλεύειν τὴν νύκτα μετεώρους, ἀσίτους καὶ ἀγρύπνους, φυλαττομένους μὴ τῆς νυκτὸς ἡμῖν ἐπιθῶνται αἱ Μαρωνιτῶν τριήρεις.

Digest

47.2.5. ... Quid deinde si nave vinaria (ut sunt multae, in quas vinum effunditur), quid dicemus de eo, qui vinum hausit?

49.15.2. *Navibus longis atque onerariis propter belli usum postliminium est, non piscatoriis aut si quas actuarias voluptatis causa paraverunt.*

48.11.7.2. *Illud quoque cavetur, ne in acceptum feratur opus publicum faciendum, frumentum publice dandum praebendum adprehendendum, sarta tecta tuenda, antequam perfecta probata praestita lege erunt.*

50.16.106. *"Dimissoriae litterae" dicuntur, quae volgo apostoli dicuntur. Dimissoriae autem dictae, quod causa ad eum qui appellatus est dimittitur.*

Dio Cassius, Roman History

42.2.3. Μετ' ὀλίγων ἔφυγε. Καὶ ἐς μὲν τὴν πόλιν οὐκ ἐσῆλθε καίτοι τῶν Λαρισσαίων ἐσκαλούντων, φοβηθεὶς μὴ τινα αἰτίαν ἐκ τούτου ὀφλωσιν· ἀλλ' ἐκείνους μὲν τῷ κρατοῦντι προσχωρῆσαι ἐκέλευσεν, αὐτὸς δὲ τὰ τε ἐπιτήδεια λαβὼν καὶ ἐπὶ τὴν θάλασσαν καταβάς ἐς Λέσβον ὁλκάδι πρὸς τε τὴν γυναιῖκα τὴν Κορνηλίαν καὶ πρὸς τὸν υἱὸν.

43.50.3-5. Τούτοις τε οὖν ἐσεμνύνετο, καὶ ὅτι καὶ τὴν Καρχηδόνα τὴν τε Κόρινθον ἀνέστησεν. Πολλὰς μὲν γὰρ καὶ ἄλλας ἐν τῇ Ἰταλίᾳ καὶ ἔξω πόλεις τὰς μὲν ἀνωκοδόμησε, τὰς δὲ καὶ ἐκ καινῆς κατεστήσατο· ἀλλὰ τοῦτο μὲν καὶ ἄλλοις τισὶν ἐπέπρακτο, τὴν δὲ δὴ Κόρινθον τὴν τε Καρχηδόνα, πόλεις ἀρχαίας λαμπρὰς ἐπισήμους ἀπολωλυίας, ἧ μὲν ἀποικίας Ῥωμαίων ἐνόμισεν, ἀπώκισεν, ἧ δὲ τοῖς ἀρχαίοις ὀνόμασιν ἐτίμησεν, ἀπέδωκεν τῇ μνήμῃ τῶν ἐνοικησάντων ποτὲ αὐτάς, μηδὲν διὰ τὴν ἐκείνων ἔχθραν τοῖς χωρίοις τοῖς μηδὲν σφας ἀδικήσασι μνησικακήσας.

55.27.3. Ἐκεῖνά τε οὖν αὐτοῖς προσέταξε, καὶ τὸ μῆτε περαιοῦσθαί ποι ἄλλοσε, μῆτε πλοῖα πλείω φορτικοῦ τε ἐνὸς χιλιοφόρου καὶ κωπήρων δύο κεκτῆσθαι, μῆτε δούλοις ἢ καὶ ἀπελευθέροις ὑπὲρ εἴκοσι χρῆσθαι, μῆτ' οὐσίαν ὑπὲρ δώδεκα καὶ ἡμίσειαν μυριάδα ἔχειν, τιμωρηθῆσεσθαι καὶ αὐτοὺς ἐκείνους καὶ τοὺς ἄλλους τοὺς τι παρὰ ταῦτα συμπράξαντάς σφισιν ἐπαπειλήσας.

Dio Chrysostom, Discourses

37.8. Ἡμᾶς δὲ δις ἐπιδημήσαντας οὕτως ἀσμένως ἐπέιδετε ὥστε μάλιστα μὲν ἐπειρᾶσθαι κατέχειν, ὀρῶντες δὲ ἀδύνατον ὄν, ἀλλὰ γε τὴν εἰκὴ τοῦ σώματος ἐποίησασθε καὶ ταύτην φέροντες ἀνεθήκατε εἰς τὰ βιβλία, εἰς προεδρίαν, οὗ μάλιστα ἂν ᾤεσθε τοὺς νέους προκαλέσασθαι τῶν αὐτῶν ἡμῖν ἐπιτηδευμάτων ἔχεσθαι. Οὐ γὰρ ὡς ἓνα τῶν πολλῶν καὶ κατ' ἐνιαυτὸν καταιρόντων εἰς Κεγχρεὰς ἔμπορον ἢ θεωρὸν ἢ πρεσβευτὴν ἢ διερχόμενον, ἀλλ' ὡς μόλις διὰ μακρῶν χρόνων ἀγαπητὸν ἐπιφαινόμενον, οὕτως ἐτίμησατε.

Diodorus, Historical Library

14.86.3. Καὶ οἱ μὲν φυγάδες μετὰ Λακεδαιμονίων καὶ τῶν συμμάχων ἐπὶ τὸ Λέχαιον καὶ τὸν ναύσταθμον ἐπελθόντες νυκτὸς κατὰ κράτος εἶλαν.

32.4.5. Οὗτοι δὲ σχεδὸν τὴν ἀρχὴν πάσης τῆς οἰκουμένης ἔχοντες ταύτην ἡσφαλίσαντο φόβῳ καὶ τῇ τῶν ἐπιφανεστάτων πόλεων ἀπωλείᾳ. Κόρινθον γὰρ κατέσκαψαν καὶ τοὺς κατὰ τὴν Μακεδονίαν ἐρριζοτόμησαν, οἷον τὸν Περσέα, καὶ Καρχηδόνα κατέσκαψαν καὶ ἐν Κελτιβηρίᾳ τὴν Νομαντίαν, καὶ πολλοὺς κατεπλήξαντο.

20.47.1-2. Ὁ δὲ Δημήτριος παραπλεύσας εἰς Κιλικίαν κάκεῖθεν ναῦς καὶ στρατιώτας προσλαβόμενος διέπλευσεν εἰς τὴν Κύπρον ἔχων πεζοὺς μὲν μυρίους πεντακισχιλίους, ἵππεῖς δὲ τετρακοσίους, ναῦς δὲ ταχυναυτούσας μὲν τριήρεις πλείους τῶν ἑκατὸν δέκα, τῶν δὲ βαρυτέρων στρατιωτῶν πεντήκοντα καὶ τρεῖς καὶ πόρια τῶν παντοδαπῶν ἱκανὰ τῷ πλήθει τῶν ἱππέων τε καὶ πεζῶν. Καὶ τὸ μὲν πρῶτον κατεστρατοπέδευσεν ἐν τῇ παραλίᾳ τῆς Καρπασίας καὶ νεωλκήσας τὰ σκάφη χάρακι καὶ τάφρῳ βαθεῖα τὴν παρεμβολὴν ὠχύρωσεν· ἔπειτα τοῖς πλησιοχώροις προσβολὰς ποιησάμενος εἶλε κατὰ κράτος Οὐρανίαν καὶ Καρπασίαν, τῶν δὲ νεῶν τὴν ἱκανὴν φυλακὴν ἀπολιπὼν ἀνέζευξε μετὰ τῆς δυνάμεως ἐπὶ τὴν Σαλαμίνα.

34.19. Οὗ διαβοηθέντος κατὰ τε Ῥώμην δούλων ἀπόστασις ἑκατὸν πεντήκοντα συνομοσάντων ἀνήπτετο, καὶ κατὰ τὴν Ἀττικὴν ὑπὲρ χιλίων, ἐν τε Δήλῳ καὶ κατ' ἄλλους πολλοὺς τόπους· οὐς τάχει τε τῆς βοηθείας καὶ τῇ σφοδρᾷ κολάσει τῆς τιμωρίας οἱ καθ' ἕκαστον ἐπιμεληταὶ τῶν κοινῶν θᾶπτον ἡφάνισαν, σωφρονίσαντες καὶ τὸ ἄλλο ὅσον ἦν ἐπὶ ἀποστάσει μετέωρον.

32.27.1-2. Ὅτι περὶ τῆς Κορίνθου καὶ οἱ ποιηταὶ προειρηκότες ἦσαν Κόρινθος ἄστρον οὐκ ἄσημον Ἑλλάδος. Αὕτη πρὸς κατάπληξιν τῶν μεταγενεστέρων ὑπὸ τῶν κρατούντων ἡφανίσθη. Οὐ μόνον δὲ κατὰ τὸν τῆς

καταστροφῆς καιρὸν ἢ πόλις ἔτυχε παρὰ τοῖς ὁρῶσι μεγάλης συμπαθείας, ἀλλὰ καὶ κατὰ τοὺς ὕστερον χρόνους εἰς ἔδαφος κατερριμμένη πολὺν ἐποίει τοῖς ἀεὶ θεωροῦσιν αὐτὴν ἔλεον. Οὐδεὶς γὰρ τῶν παροδευόντων αὐτὴν παρῆλθεν ἄδακρυς, καίπερ ὁρῶν λείψανα βραχέα τῆς περὶ αὐτὴν γεγεννημένης εὐδαιμονίας τε καὶ δόξης. Διὸ καὶ κατὰ τοὺς τῆς παλαιᾶς ἡλικίας καιροῦς, διεληλυθότων χρόνων σχεδὸν ἑκατόν, θεασάμενος αὐτὴν Γάιος Ἰούλιος Καῖσαρ ὁ διὰ τὰς πράξεις ὀνομασθεὶς θεὸς ταύτην ἀνέστησεν. Ἐναντία γὰρ πάθη συνεῖχε τὰς ψυχὰς τῶν ἀνθρώπων ἐλπίδι σωτηρίας καὶ προσδοκίαις τῆς ἀπωλείας.

32.27.3. Ὅτι κατὰ τοὺς τῆς παλαιᾶς ἡλικίας καιροῦς, διεληλυθότων σχεδὸν ἐτῶν ἑκατόν, θεασάμενος τὴν Κόρινθον Γάιος Ἰούλιος Καῖσαρ ὁ διὰ τὰς πράξεις ὀνομασθεὶς θεὸς εἰς τοιαύτην ἦλθε συμπάθειαν καὶ φιλοδοξίαν ὥστε μετὰ πολλῆς σπουδῆς πάλιν αὐτὴν ἀναστήσαι. Διόπερ τὸν ἄνδρα τοῦτον καὶ τὴν ὑπερβολὴν τῆς περὶ αὐτὸν ἐπικεικίας δίκαιόν ἐστι μεγάλης ἀποδοχῆς ἀξιοῦσθαι καὶ διὰ τῆς ἱστορίας ἀπονέμειν αὐτῷ τὸν αἰώνιον τῆς χρηστότητος ἔπαινον.

Dionysius Calliphontis Filii, Description of Greece

108-11. ... Ἐντεῦθεν ἀρχὴ τῆς Πελοποννήσου...Λιμὴν χωστὸς ὑπόκειται καὶ Λέχαιον λεγομένη πόλις.

Dionysius of Hallicarnasus, Roman Antiquities

3.44.3. Αἱ μὲν οὖν ἐπὶ κωποὶ νῆες ὀπηλίκαι ποτ' ἂν οὔσαι τύχῃσι καὶ τῶν ὀλκάδων αἱ μέχρι τρισχιλιοφόρων εἰσάγουσί τε διὰ τοῦ στόματος αὐτοῦ καὶ μέχρι τῆς Ῥώμης εἰρεσίᾳ καὶ ῥύμασι παρελκόμεναι κομίζονται, αἱ δὲ μείζους πρὸ τοῦ στόματος ἐπ' ἀγκυρῶν σαλεύουσαι ταῖς ποταμηγοῖς ἀπογεμίζονται τε καὶ ἀντιφορτίζονται σκάφαις.

Ennius, Commentary on the Aeneid of Vergil

2.326. *Quidam 'texamus' proprie dictum tradunt, quia loca in quibus naves fiunt, Graece ναυπήγια, latine textrina dici: Ennius dicit "idem campus habet textrinum navibus longis": navalia enim non esse ναυπήγια, sed νεώρια.*

Euripides, Cyclops

505. ...σκάφος ὀλκάς ὥς γεμισθεῖς...

Ezekiel

27.29. Καὶ καταβήσονται ἀπὸ τῶν πλοίων πάντες οἱ κωπηλάται καὶ οἱ ἐπιβάται καὶ οἱ πρωρεῖς τῆς θαλάσσης ἐπὶ τὴν γῆν στήσονται.

Gaius, Institutiones

32c. *Item edicto Claudii Latini ius Quiritium consecuntur, si navem marinam aedificaverint, quae non minus quam decem milia modiorum frumenti capiat, eaque navis vel quae in eius locum substituta sit, sex annis frumentum Romam portaverit.*

Galen, Of the compounding of remedies in relation with their genera

13.829. Στυπτηρίας, ἰοῦ Κορινθίου, μίλτου Σινωπίδος, κοτύλης μέτρῳ τὸ ἴσον ἀναλάμβανε ὄξει.

Herodotus, Histories

1.163.2. ... ἐναυτίλλοντο δὲ οὐ στρογγύλῃσι νηυσὶ ἀλλὰ πεντηκόντεροις.

3.60. Ἐμήκυνα δὲ περὶ Σαμίων μᾶλλον, ὅτι σφί τρία ἐστὶ μέγιστα ἀπάντων Ἑλλήνων ἐξεργασμένα, ὁρεὸς τε ὑψηλοῦ ἐς πεντήκοντα καὶ ἑκατὸν ὀργυῖας, τούτου ὄρυγμα κάτωθεν ἀρξάμενον, ἀμφίστομον. Τὸ μὲν μῆκος τοῦ ὀρύγματος ἐπτὰ στάδιοι εἰσὶ, τὸ δὲ ὕψος καὶ εὖρος ὀκτὼ ἑκάτερον πόδες. Διὰ παντὸς δὲ αὐτοῦ ἄλλο ὄρυγμα εἰκοσίπηχυ βάθος ὀρώρεται, τρίπουν δὲ τὸ εὖρος, δι' οὗ τὸ ὕδωρ ὀχετευόμενον διὰ τῶν σωλήνων παραγίνεται ἐς τὴν πόλιν ἀγόμενον ἀπὸ μεγάλης πηγῆς. Ἀρχιτέκτων δὲ τοῦ ὀρύγματος τούτου ἐγένετο Μεγαρεὺς Εὐπαλῖνος Ναυστρόφου. Τοῦτο μὲν δὴ ἐν τῶν τριῶν ἐστὶ, δεύτερον δὲ περὶ λιμένα χῶμα ἐν θαλάσῃ, βάθος καὶ εἴκοσι ὀργυιῶν: μῆκος δὲ τοῦ χώματος μέζον δύο σταδίων. Τρίτον δὲ σφί ἐξεργασταὶ

νηὸς μέγιστος πάντων νηῶν τῶν ἡμεῖς ἴδμεν: τοῦ ἀρχιτέκτων πρῶτος ἐγένετο Ῥοῖκος Φιλέω ἐπιχώριος. Τούτων εἵνεκεν μάλλον τι περὶ Σαμίων ἐμήκυνα.

3.135.2. ...πρὸς δὲ ἐς τὰ δῶρα ὀλκάδα οἱ ἔφη συμβαλέεσθαι πλήσας ἀγαθῶν παντοίων, τὴν ἅμα οἱ πλεύσεσθαι.

Hero, Stereometrica (translated by the author)

I.53. Πλοῖον ου το μήκος πηχῶν κδ, η δε βάσις πηχῶν στ η δε κάτω βάσις πηχῶν δ· ευρεῖν, πόσα κεράμια χωρεῖ. Ποιεῖ οὕτως· την βάσιν ἐπὶ την βάσιν· γίνονται κδ. Ταῦτα πάλιν ἐπὶ τα κδ του μήκους· γίνονται φος. Τούτων αἰ το γ' γίνονται ροβ. Ταῦτα σύνθες μετὰ των φος· γίνονται ψξη· ἀπερ εἰσὶ κεράμια. Χωρεῖ το κεράμιον μοδίους ι. Γίνονται μόδιοι στχπ. Τοσούτους μοδίους χωρεῖ το πλοῖον.

II. 51. Ἐστω πλοῖον, και ἐχέτω [μήκος] ἀπὸ κορύμβου εἰς κόρυμβον το μεν μήκος ποδῶν ν, το δε πλάτος ποδῶν ιβ και το βάθος ποδῶν ζ. Ποιεῖ οὕτως· τα ν ἐπὶ τα ιβ· γίνονται χ. Ταῦτα ποιῶ ἐπὶ το βάθος, ἐπὶ τους ζ' γίνονται ,δς. Ταῦτα ποιῶ δι' ὅλου ἐξάκι· γίνονται β,ες. Τοσούτους μοδίους χωρήσει το πλοῖον.

II. 52. Πλοῖον μετρήσωμεν, ου το μήκος πηχῶν μη, η δε ἐμβασις πηχῶν δ και η διάβασις πρῶρας πηχῶν στ, η δε ἄνω βάσις πρύμνης και πτέρνης πηχῶν η και η βάσις μέση πηχῶν θ· ευρεῖν, πόσους μοδίους χωρεῖ. Ποιεῖ οὕτως· σύνθες πρῶραν και πρύμναν· γίνονται ιδ. Τούτων το L· γίνονται ζ. Τούτοις πρόσθες την διάβασιν της μέσης· ομοῦ γίνονται πήχεις ιστ. Τούτων το L· γίνονται η· τούτους ποιῶ ἐπὶ την βάσιν, ἐπὶ τους δ πήχεις· γίνονται πήχεις λβ. Ἐπὶ το μήκος, ἐπὶ τους μη πήχεις· γίνονται πήχεις ,αφλς. Ο δε πήχυς χωρεῖ Ἰταλικούς μόδιους ιβ L· γίνονται μόδιοι M,θς. Τοσούτους μοδίους χωρήσει το πλοῖον.

Hero, De mensuris

17. Πλοῖον μετρήσωμεν οὕτως· ἔστω πλοῖον ἔχον το μήκος πηχῶν μ, πλάτος πηχῶν ιβ, τό δε βάθος πηχῶν δ· ευρεῖν πόσων μοδίων ἐστὶ το ποῖον. Ποιεῖ οὕτως· πολυπλασίασον το μήκος ἐπὶ το πλάτος· γίνονται πήχεις υπ' τούτους πολυπλασίασον δεκάκις και τα γενόμενα πάλιν παλλαπλασίασον ἐπὶ τους δ πήχεις του βάθους· και ευρήσεις χωρὺν το πλοῖον μοδίους α, θς Ἰταλικούς. Εἴαν δε τις [εἰς] καστρησίους εἰποι μοδίους, ἀνάλυσον τους μοδίους εἰς ξέστρας και ψήφισον τον μόδιον του σίτου κατὰ κδ ξέστας· γίνονται σίτου μόδιοι μυριάδες β, δτκ. Ο πούς δέχεται σίτου μοδίους β.

18. Ἄλλη μέτρησις πλοίου. Πλοῖον μετρήσωμεν οὕτως, εἴαν ἔχη πήχεις μ το μήκος, η δε διάμετρος της πρῶρας πήχεις ζ, πρύμνης πήχεις στ, κοιλίας πήχεις η, ὕψος πήχεις δ· σύνθες τους στ και τους η· γίνονται ιδ· ων το ἡμισυ· γίνονται ζ. Τούτους ἐπὶ το βάθος· γίνονται πήχεις κη· τούτους ἐπὶ το μήκος· γίνονται πήχεις ,αρκ. Ο πήχυς χωρεῖ ἀρτάβας γ· γίνονται ἀρτάβα, γτκ. Ἐχει η ἀρτάβα μοδίους βδ·... Ο πήχυς χωρεῖ μοδίους ι Ἰταλικούς, μοδίους ιγ...

Homer, Iliad

2.570. ... ἀφνειὸν τε Κόρινθον ἐϋκτιμένας τε Κλεωνάς...

Horace, Odes

I.4.1-4. Soluitur acris hiems grata vice veris et Favoni/ Trahuntque siccas machinae carinas,/ Ac neque iam stabulis gaudet pecus aut arator igni/ Nec prata canis albicant pruinis.

Josephus, The Jewish War

1.409. Μεταξὺ γὰρ Δώρων καὶ Ἰόππης, ὧν ἡ πόλις μέση κεῖται, πᾶσαν εἶναι συμβέβηκεν τὴν παράλιον ἀλίμενον, ὥς πάντα τὸν τὴν Φοινίκην ἐπ' Αἰγύπτου παραπλέοντα σαλεύειν ἐν πελάγει διὰ τὴν ἐκ λιθὸς ἀπειλὴν, ᾧ καὶ μετρίως ἐπαυρίζοντι τηλικούτον ἐπεγείρεται κύμα πρὸς ταῖς πέτραις, ὥστε τὴν ὑποστροφὴν τοῦ κύματος ἐπὶ πλεῖστον ἐξαγριοῦν τὴν θάλασσαν.

4.5.10. Δυσπρόσιτος δὲ λιμὴν ναυσὶ καὶ κατ' εἰρήνην Ἀλεξανδρείας· στενὸς τε γὰρ εἶσπλους καὶ πέτραις ὑφάλοις τὸν ἐπ' εὐθὺ καμπτόμενος δρόμον. Καὶ τὸ μὲν ἀριστερόν αὐτοῦ μέρος πέφρακται χειροκμήτοις σκέλεσιν, ἐν δεξιᾷ δὲ ἡ προσαγορευομένη Φάρος νῆσος πρόκειται, πύργον ἔχουσα μέγιστον ἐκπυρσεύοντα τοῖς καταπλέουσιν ἐπίτριακοσίους σταδίους, ὥς ἐν νυκτὶ πόρρωθεν ὀρμίζονται πρὸς τὴν δυσχέρειαν τοῦ κατάπλου. Περὶ ταύτην τὴν νῆσον καταβέβληται χειροποίητα τεῖχη μέγιστα, προσαρασσόμενον δὲ τούτοις τὸ πέλαγος καὶ τοῖς ἄντικρυς ἔρκεσιν ἀμφαγνυμένον ἐκτραχύνει τὸν πόρον καὶ σφαλερὰν διὰ στενοῦ τὴν

εἴσοδον ἀπεργάζεται. Ὁ μέντοι γε λιμὴν ἀσφαλέστατος ἔνδον καὶ τριάκοντα σταδίων τὸ μέγεθος, εἰς ὃν τά τε λείποντα τῇ χώρᾳ πρὸς εὐδαιμονίαν κατάγεται καὶ τὰ περισσεύοντα τῶν ἐπιχωρίων ἀγαθῶν εἰς πᾶσαν χωρίζεται τὴν οἰκουμένην.

Josephus, Jewish Antiquities

15.333-4. Κεῖται μὲν γὰρ ἡ πόλις ἐν τῇ Φοινίκῃ κατὰ τὸν εἰς Αἴγυπτον παράπλουν Ἰόππης μεταξύ καὶ Δώρων, πολισμάτια ταῦτ' ἐστὶν παράλια δύσσορμα διὰ τὰς κατὰ λίβα προσβολάς, αἱ αἰεὶ τὰς ἐκ τοῦ πόντου θῖνας ἐπὶ τὴν ἥονα σύρουσαι καταγωγὴν οὐ διδόασιν, ἀλλ' ἔστιν ἀναγκαῖον ἀποσαλεύειν τὰ πολλὰ τοὺς ἐμπόρους ἐπ' ἀγκύρας. Τοῦτο τὸ δυσδιάθετον τῆς χώρας διορθούμενος καὶ περιγράψας τὸν κύκλον τοῦ λιμένος ἐφ' ὅσον ἦν αὐτάρκες πρὸς τῇ χέρσῳ μεγάλοις στόλοις ἐνορμεῖσθαι λιθούς ὑπερμεγέθεις καθίει εἰς τὸ βάθος εἰς ὀργυιὰς εἴκοσι. Πεντήκοντα ποδῶν ἦσαν οἱ πλείους τὸ μῆκος καὶ πλάτος οὐκ ἔλαττον δεκαοκτῶ, βάθος δὲ ἐννέα, τούτων δὲ οἱ μὲν μείζους οἱ δὲ ἐλάττους.

Livy, The History of Rome,

21.63.3. *Invisus etiam patribus ob novam legem, quam Q. Claudius tribunus plebis adversus senatum atque uno patrum adiuvante C. Flaminius tulerat, ne quis senator cuive senator pater fuisset maritimam navem, quae plus quam trecentarum amphorarum esset, haberet. Id satis habitum ad fructus ex agris vectandos; quaestus omnis patribus indecorus visus.*

25.11.18. *Haec oratio non spem modo effectus sed ingentem etiam ducis admirationem fecit. Contracta extemplo undique plaustra iuncta quae inter se et machinae ad subducendas naues admotae munitumque inter quo faciliora plaustra minorque moles in transitu esset.*

29.25.11. *Lumina in navibus singula rostratae, bina onerariae haberent.*

40.51.2. *Opera ex pecunia attributa divisaque inter se haec fecerunt. Lepidus molem ad Tarracinam, ingratum opus, quod praedia habebat ibi privatamque publicae rei impensam inseruera.*

44.29.1-2. *Dum haec geruntur, legati Romani, C. Popilius et C. Decimius et C. Hostilius, a Chalcide profecti tribus quinquere mis Delum cum venissent, lembos ibi Macedonum quadraginta et quinque regis Eumenis quinquere mis invenerunt. Sanctitas templi insulaeque inviolatos praestabat omnes. Itaque permixti Romanique et Macedones et Eumenis navales socii in templo indutias religione loci praebente versabantur.*

Periochae, 52. Qui omni Achaia in deditionem accepta Corinthon ex S. C. diruit, quia ibi legati Romani uiolati erant. Thebae quoque et Chalcis, quae auxilio fuerant, dirutae. Ipse L. Mummius abstinentissimum uirum egit, nec quicquam ex his operibus ornamentisque quae praediuves Corinthos habuit in domum eius peruenit.

Lucian, Navigium

5-9. Σάμπρος: ...Ἀλλὰ μεταξύ λόγων, ἡλικὴ ναῦς, εἴκοσι καὶ ἑκατὸν πήχεων ἔλεγε τὸ μῆκος ὁ ναυπηγός, εὖρος δὲ ὑπὲρ τὸ τέταρτον μάλιστα τούτου, καὶ ἀπὸ τοῦ καταστρώματος ἐς τὸν πυθμένα, ἥ βαθύτατον κατὰ τὸν ἄντλον, ἐννέα πρὸς τοῖς εἴκοσι. Τὰ δ' ἄλλα ἡλικὸς μὲν ὁ ἰστός, ὅσῃν δὲ ἀνέχει τὴν κεραίαν, οἷω καὶ προτόνῳ κέχρηται καὶ συνέχεται, ὡς δὲ ἡ πρύμνα μὲν ἐπανεστήκεν ἡρέμα καμπύλῃ χρυσοῦν χηνίσκον ἐπικειμένη, καταντικρὺ δὲ ἀνάλογον ἡ πρῶρα ὕπερβέθηκεν ἐς τὸ πρόσω ἀπομηκνυμένη, τὴν ἐπώνυμον τῆς νεὸς θεὸν ἔχουσα τὴν Ἰσιν ἐκατέρωθεν: ὁ μὲν γὰρ ἄλλος κόσμος, αἱ γραφαὶ καὶ τοῦ ἰστίου τὸ παράσειον πυραυγές, πρὸ τούτων αἱ ἄγκυραι καὶ στροφεῖα καὶ περιαγωγεῖς καὶ αἱ κατὰ τὴν πρύμναν οἰκῆσεις θαυμάσια πάντα μοι ἔδοξε. Καὶ τὸ τῶν ναυτῶν πλῆθος στρατοπέδῳ ἄν τις εἰκάσειεν. Ἐλέγετο δὲ καὶ τοσοῦτον ἄγειν σῖτον, ὡς ἱκανὸν εἶναι πᾶσι τοῖς ἐν τῇ Ἀττικῇ ἐνιαύσιον πρὸς τροφήν. Κάκεῖνα πάντα μικρός τις ἀνθρωπίσκος γέρων ἤδη ἔσωζεν ὑπὸ λεπτῇ κάμακι τὰ τηλικαῦτα πηδάλια περιστρέφων: ἐδείχθη γὰρ μοι ἀναφαλαντίας τις, οὖλος, Ἥρων, οἶμαι, τοῦνομα.

Τιμόλαος: Θαυμάσιος τὴν τέχνην, ὡς ἔφασκον οἱ ἐμπλέοντες, καὶ τὰ θαλάττια σοφὸς ὑπὲρ τὸν Πρωτέα. Ἠκούσατε δὲ ὅπως δεῦρο κατήγαγε τὸ πλοῖον, οἷα ἔπαθον πλέοντες ἢ ὡς ὁ ἀστήρ αὐτοὺς ἔσωσεν;

Λυκῖνος: Οὐκ, ὦ Τιμόλαε, ἀλλὰ νῦν ἡδέως ἂν ἀκούσαιμεν.

Τιμόλαος: Ὁ ναύκληρος αὐτὸς διηγείτό μοι, χρηστὸς ἀνὴρ καὶ προσομιλῆσαι δεξιός. Ἐφη δὲ ἀπὸ τῆς Φάρου ἀπάραντας οὐ πάνυ θιαίῳ πνεύματι ἐβδομαίους ἰδεῖν τὸν Ἀκάμαντα, εἴτα ζεφύρου ἀντιπνεύσαντος ἀπενεχθῆναι πλαγίους ἄχρι Σιδῶνος, ἐκεῖθεν δὲ χειμῶνι μεγάλῳ περιπεσόντας δεκάτῃ ἐπὶ Χελιδονέας διὰ

τοῦ Αὐλῶνος ἐλθεῖν, ἔνθα δὴ παρὰ μικρὸν ὑποβρυχίους δῦναι ἅπαντας. Οἷδα δέ ποτε καὶ αὐτὸς παραπλεύσας Χελιδονέας ἠλίκον ἐν τῷ τόπῳ ἀνίσταται τὸ κῦμα, καὶ μάλιστα περὶ τὸν λίβα, ὁπότεν ἐπιλάβῃ καὶ τοῦ νότου· κατ' ἐκεῖνο γὰρ δὴ συμβαίνει μερίζεσθαι τὸ Παμφύλιον ἀπὸ τῆς Λυκιακῆς θαλάττης, καὶ ὁ κλύδων ἅτε ἀπὸ πολλῶν ῥευμάτων περὶ τῷ ἀκρωτηρίῳ σχιζόμενος - ἀπόξυροι δέ εἰσι πέτραι καὶ ὀξεῖαι παραπηγόμεναι τῷ κλύσματι - καὶ φοβερωτάτην ποιεῖ τὴν κυματωγὴν καὶ τὸν ἥχον μέγαν, καὶ τὸ κῦμα πολλάκις αὐτῷ ἰσομέγεθες τῷ σκοπέλῳ. Τοιαῦτα καὶ σφᾶς καταλαβεῖν ἔφασκεν ὁ ναύκληρος ἔτι καὶ νυκτὸς οὔσης καὶ ζόφου ἀκριβοῦς· ἀλλὰ πρὸς τὴν οἰμωγὴν αὐτῶν ἐπικλασθέντας τοὺς θεοὺς πῦρ τε ἀναδείξαι ἀπὸ τῆς Λυκίας, ὡς γνωρίσαι τὸν τόπον ἐκεῖνον, καὶ τινα λαμπρὸν ἀστέρα Διοσκούρων τὸν ἕτερον ἐπικαθίσαι τῷ καρχησίῳ καὶ κατευθῆναι τὴν ναῦν ἐπὶ τὰ λαῖα ἐς τὸ πέλαγος ἥδη τῷ κρημνῷ προσφερομένην· τούντεῦθεν δὲ ἅπαξ τῆς ὁρθῆς ἐκπεσόντας διὰ τοῦ Αἰγαίου πλεύσαντας ἑβδομηκοστῇ ἀπ' Αἰγύπτου ἡμέρᾳ πρὸς ἀντίους τοὺς ἐτήσιος πλαγιάζοντας ἐς Πειραιᾶ χθὲς καθορμίσασθαι τοσοῦτον ἀποσυρέντας ἐς τὸ κάτω, οὓς ἔδει τὴν Κρήτην δεξιὰν λαβόντας ὑπὲρ τὴν Μαλέαν πλεύσαντας ἥδη εἶναι ἐν Ἰταλίᾳ.

Lucian, Fugitivi

13. Ἔδοξε δὴ σκοπουμένοις τὴν ὑστάτην ἄγκυραν, ἣν ἱερὰν οἱ ναυτιλλόμενοι φασιν, καθιέναι, καὶ ἐπὶ τὴν βελτίστην ἀπόνοιαν ὁρμήσαντες...

Lucian, Jupiter Tragoedus

51. Οὐκοῦν ἐπεὶ τῆς νεῶς τὸ παράδειγμα, οὐ πάνυ σοὶ ἰσχυρὸν ἔδοξεν εἶναι, ἄκουσον ἤδη τὴν ἱερὰν, φασίν, ἄγκυραν καὶ ἣν οὐδεμιᾷ μηχανῇ ἀπορρήξεις.

Lucian, Lexiphanes

15. Ἀλλὰ σὺ τὸ ὅμοιον εἰργάσω με ὥσπερ εἶ τις ὀλκάδα τριάρμενον ἐν οὐρίῳ πλέουσας, ἐμπεπνευματωμένου τοῦ ἀκατίου, εὐφοροῦσάν τε καὶ ἀκροκυματοῦσαν, ἔκτοράς τινας ἀμφιστόμους καὶ ἰσχάδας σιδηρᾶς ἀφείς καὶ ναυσιπέδας ἀναχαιτίζοι τοῦ δρόμου τὸ ρόθιον, φθόνῳ τῆς εὐηνεμίας

Lucian, Pseudologista

27. ...μικροῦ γοῦν φασιν ἀποπνιγῆναί σε ναύτη τινὶ τῶν τριαρμένων ἐντυχόντα, ὃς ἐμπεσὼν ἀπέφραξέ σοι τὸ στόμα.

Lucilius, Satires

118. 'Minorem Delum' Puteolos esse.

Memnon, History of Heraclea

8.5. Ἦσαν δ' ἐν αὐταῖς ἄλλαι τε καὶ τῆς Ἡρακλείας αἱ μετάπεμπτοι, ἐξήρεις τε καὶ πεντήρεις καὶ ἄφρακτοι καὶ ὀκτῆρης μία ἡ Λεοντοφόρος καλουμένη, μεγέθους ἔνεκα καὶ κάλλους ἤκουσα εἰς θαῦμα· ἐν ταύτῃ γὰρ ῥ' ἐμὲ ἄνδρες ἕκαστον στοῖχον ἤρεττον, ὥς ὡ' ἐκ θατέρου μέρους γενέσθαι, ἐξ ἐκατέρων δὲ χιλίους καὶ χ'. οἱ δὲ ἀπὸ τῶν καταστροφμάτων μαχησόμενοι χίλιοι καὶ ς', καὶ κυβερνῆται β'.

Lycurgus, Against Leocrates

1.26. Καὶ οἱ μὲν πατέρες ὑμῶν τὴν Ἀθηναῖαν ὡς τὴν χώραν εἰληχυῖα ὁμώνυμον αὐτῇ τὴν πατρίδα προσηγόρευον Ἀθήνας, ἵν' οἱ τιμῶντες τὴν θεὸν τὴν ὁμώνυμον αὐτῇ πόλιν μὴ ἐγκαταλίπωσι· Λεωκράτης δ' οὔτε νομίμων οὔτε πατρίδος οὔθ' ἱερῶν φροντίσας τὸ καθ' ἑαυτὸν ἐξαγωγίμων ὑμῖν καὶ τὴν παρὰ τῶν θεῶν βοήθειαν ἐποίησε. Καὶ οὐκ ἐξήρκεσεν αὐτῷ τοσαῦτα καὶ τηλικαῦτα τὴν πόλιν ἀδικῆσαι, ἀλλ' οἰκῶν ἐν Μεγάροις, οἷς παρ' ὑμῶν ἐξεκομίσατο χρήμασιν ἀφορμῇ χρώμενος, ἐκ τῆς Ἠλείου παρὰ Κλεοπάτρας εἰς Λευκάδα ἐσιτήγει καὶ ἐκεῖθεν εἰς Κόρινθον.

Pacuvius, Medus

231. <'Tonsillam' ait> esse Verrius palum dolatum <in acumen et> cuspidē praeferatū, ut existimat, . . . quem configi in litore navis religandae causa.

Pausanias, Description of Greece

2.1.2. Κόρινθον δὲ οἰκοῦσι Κορινθίων μὲν οὐδεὶς ἔτι τῶν ἀρχαίων, ἔποικοι δὲ ἀποσταλέντες ὑπὸ Ῥωμαίων. αἴτιον δὲ τὸ συνέδριον τὸ Ἀχαιῶν: συντελοῦντες γὰρ ἐς αὐτὸ καὶ οἱ Κορίνθιοι μετέσχον τοῦ πολέμου τοῦ πρὸς Ῥωμαίους, ὃν Κριτόλαος στρατηγεῖν Ἀχαιῶν ἀποδειχθεὶς παρεσκεύασε γενέσθαι τοὺς τε Ἀχαιοὺς ἀναπείσας ἀποστῆναι καὶ τῶν ἔξω Πελοποννήσου τοὺς πολλούς. Ῥωμαῖοι δὲ ὡς ἐκράτησαν τῷ πολέμῳ, παρείλοντο μὲν καὶ τῶν ἄλλων Ἑλλήνων τὰ ὅπλα καὶ τεῖχη περιεῖλον ὅσαι τετειχισμένοι πόλεις ἦσαν: Κόρινθον δὲ ἀνάστατον Μομμίου ποιήσαντος τοῦ τότε ἡγουμένου τῶν ἐπὶ στρατοπέδου Ῥωμαίων, ὕστερον λέγουσιν ἀνοικίσαι Καίσαρα, ὃς πολιτείαν ἐν Ῥώμῃ πρῶτος τὴν ἐφ' ἡμῶν κατεστήσατο: ἀνοικίσαι δὲ καὶ Καρχηδόνα ἐπὶ τῆς ἀρχῆς τῆς αὐτοῦ.

2.2.3. Κορινθίοις δὲ τοῖς ἐπινείοις τὰ ὀνόματα Λέχης καὶ Κεγχρίας ἔδοσαν, Ποσειδῶνος εἶναι καὶ Πειρήνης τῆς Ἀχελῷου λεγόμενοι: πεποιῆται δὲ ἐν Ῥοίαις μεγάλαις Οἰβάλου θυγατέρα εἶναι Πειρήνην. Ἔστι δὲ ἐν Λεχαίῳ μὲν Ποσειδῶνος ἱερὸν καὶ ἄγαλμα χαλκοῦν, τὴν δὲ ἐς Κεγχρέας ἰόντων ἐξ ἰσθμοῦ ναὸς Ἀρτέμιδος καὶ ξόανον ἀρχαῖον. Ἐν δὲ Κεγχρέαις Ἀφροδίτης τέ ἐστι ναὸς καὶ ἄγαλμα λίθου, μετὰ δὲ αὐτὸν ἐπὶ τῷ ἐρύματι τῷ διὰ τῆς θαλάσσης Ποσειδῶνος χαλκοῦν, κατὰ δὲ τὸ ἕτερον πέρας τοῦ λιμένος Ἀσκληπιοῦ καὶ Ἰσίδος ἱερά. Κεγχρεῶν δὲ ἀπαντικρὺ τὸ Ἑλένης ἐστὶ λουτρόν: ὕδωρ ἐς θάλασσαν ἐκ πέτρας ῥεῖ πολὺ καὶ ἀλμυρὸν ὕδατι ὅμοιον ἀρχομένῳ θερμαίνεσθαι.

3.23.3-6. ...τὸ γὰρ τοῦ Ἀπόλλωνος ξόανον, ὃ νῦν ἐστὶν ἐνταῦθα, ἐν Δήλῳ ποτὲ ἴδρυτο. Τῆς γὰρ Δήλου τότε ἐμπορίου τοῖς Ἑλλήσιν οὔσης καὶ ἄδειαν τοῖς ἐργαζομένοις διὰ τὸν θεὸν δοκούσης παρέχειν, Μηνοφάνης Μιθριδάτου στρατηγὸς εἶτε αὐτὸς ὑπερφρονήσας εἶτε καὶ ὑπὸ Μιθριδάτου προστεταγμένον - ἀνθρώπῳ γὰρ ἀφορῶντι ἐς κέρδος τὰ θεῖα ὕστερα λημμάτων -, οὗτος οὖν ὁ Μηνοφάνης, ἅτε οὔσης ἀτειχίστου τῆς Δήλου καὶ ὅπλα οὐ κεκτημένων τῶν ἀνδρῶν, τριήρεσιν ἐσπλεύσας ἐφόνευσε μὲν τοὺς ἐπιδημοῦντας τῶν ξένων, ἐφόνευσε δὲ αὐτοὺς τοὺς Δηλίου: κατασύρας δὲ πολλὰ μὲν ἐμπόρων χρήματα, πάντα δὲ τὰ ἀναθήματα, προσεξανδραποδισάμενος δὲ καὶ γυναικας καὶ τέκνα, καὶ αὐτὴν ἐς ἔδαφος κατέβαλε τὴν Δήλον. Ἄτε δὲ πορθουμένης τε καὶ ἀρπαζομένης, τῶν τις βαρβάρων ὑπὸ ὕβρεως τὸ ξόανον τοῦτο ἀπέρριψεν ἐς τὴν θάλασσαν: ὑπολαβὼν δὲ ὁ κλύδων ἐνταῦθα τῆς Βοιωτῶν ἀπήνεγκε, καὶ τὸ χωρίον διὰ τοῦτο Ἐπιδήλιον ὀνομάζουσι. Τὸ μέντοι μήνιμα τὸ ἐκ τοῦ θεοῦ διέφυγεν οὔτε Μηνοφάνης οὔτε αὐτὸς Μιθριδάτης: ἀλλὰ Μηνοφάνην μὲν παραυτίκα, ὡς ἀνήγετο ἐρημώσας τὴν Δήλον, λοχήσαντες ναυσὶν οἱ διαπεφευγότες τῶν ἐμπόρων καταδύουσι, Μιθριδάτην δὲ ὕστερον τούτων ἠνάγκασεν ὁ θεὸς αὐτόχειρα αὐτοῦ καταστῆναι, τῆς τε ἀρχῆς οἱ καθηρημένης καὶ ἐλαυνόμενον πανταχόθεν ὑπὸ Ῥωμαίων: εἰσὶ δὲ οἱ φασιν αὐτὸν παρά του τῶν μισθοφόρων θάνατον βίαιον ἐν μέρει χάριτος εὐρασθαι.

8.12.1. Ἀρκάδων δὲ ἐν τοῖς δρυμοῖς εἰσὶν αἱ δρυὲς διάφοροι, καὶ τὰς μὲν πλατυφύλλους αὐτῶν, τὰς δὲ φηγοὺς καλοῦσιν: αἱ τρίται δὲ ἀραιὸν τὸν φλοιὸν καὶ οὕτω δὴ τι παρέχονται κοῦφον, ὥστε ἀπ' αὐτοῦ καὶ ἐν θαλάσῃ ποιοῦνται σημεῖα ἀγκύραις καὶ δικτύοις: ταύτης τῆς δρυὸς τὸν φλοιὸν ἄλλοι τε Ἰώνων καὶ Ἑρμησιάναξ ὁ τὰ ἐλεγεία ποιήσας φελλὸν ὀνομάζουσιν.

8.22.3. Ἔστιν ἐν τῇ Στυμφαλίων πηγῇ, καὶ ἀπὸ ταύτης ὕδωρ βασιλεὺς Ἀδριανὸς Κορινθίοις ἤγαγεν ἐς τὴν πόλιν.

8.33.2. Μυκῆναι μὲν γε, τοῦ πρὸς Ἰλίῳ πολέμου τοῖς Ἑλλήσιν ἡγησαμένη, καὶ Νῆνος, ἔνθα ἦν Ἀσσυρίοις βασιλεία, καὶ Βοιωτῖαι Θῆβαι προστῆναι τοῦ Ἑλληνικοῦ ποτε ἀξιοθεῖσαι, αἱ μὲν ἡρῆμονται πανώλεθροι, τὸ δὲ ὄνομα τῶν Θηβῶν ἐς ἀκρόπολιν μόνην καὶ οἰκήτορας καταβέβηκεν οὐ πολλούς. Τὰ δὲ ὑπερηρκότα πλούτῳ τὸ ἀρχαῖον, Θῆβαι τε αἱ Αἰγύπτιοι καὶ ὁ Μινύης Ὀρχομενὸς καὶ ἡ Δήλος τὸ κοινὸν Ἑλλήνων ἐμπόριον, αἱ μὲν ἀνδρὸς ἰδιώτου μέσου δυνάμει χρημάτων καταδέουσιν ἐς εὐδαιμονίαν, ἡ Δήλος δὲ, ἀφελόντι τοὺς ἀφικνουμένους παρ' Ἀθηναίων ἐς τοῦ ἱεροῦ τὴν φρουράν, Δηλίων γε ἔνεκα ἔρημός ἐστιν ἀνθρώπων.

9.23.7. Λιμὴν δὲ σφισὶν ἐστὶν ἀγκιβαθῆς, καὶ τὰ ὄρη τὰ ὑπὲρ τὴν πόλιν ὧν παρέχεται θήραν ἀγρίων.

Petronius, Satyricon

117.12. "Quid vos" inquit "iumentum me putatisse aut lapidariam navem? Hominis operas locavi, non caballi. Nec minus liber sum quam vos, etiam si pauperempater me reliquit."

76. "Ceterum, quemadmodum di volunt, dominus in domo factus sum, et ecce cepi ipsimi cerebellum. Quid multa? Coheredem me Caesari fecit, et accepi patrimonium laticlavium. Nemini tamen nihil satis est. Concupivi negotiari. Ne multis vos morer, quinque naves aedificavi, oneravi vinum - et tune erat contra

aurum - misi Romam. Putares me hociussisse: omnes naves naufragarunt, factum, non fabula. Uno die Neptunus trecenties sestertium devoravit. Putatis medefecisse? Non mehercules mi haec iactura gusti fuit, tanquam nihil facti. Alteras feci maiores et meliores et feliciores, ut nemo non me virum fortem diceret. Scitis, magna navis magnam fortitudinem habet. Oneravi rursus vinum, lardum, fabam, sepladium, mancipia. Hoc loco Fortunata rem piam fecit; omne enim aurum suum, omnia vestimentavendit et mi centum aureos in manu posuit. Hoc fuit peculii mei fermentum. Cito fit, quod di volunt. Unocursu centies sestertium corrotundavi. Statim redemi fundos omnes, qui patroni mei fuerant. Aedifico domum, venalicia coemo iumenta; quicquid tangebam, crescebat tanquam favus. Postquam coepi plus habere, quam totapatria mea habet, manum de tabula: sustuli me de negotiatione et coepi liberos faenerare. Et sane nolentem menegotium meum agere exhortavit mathematicus, qui venerat forte in coloniam nostram, Graeculio, Serapa nomine, consiliator deorum. Hic mihi dixit etiam ea, quae oblitus eram; ab acia et acu mi omnia exposuit; intestinas meas noverat; tantum quod mihi non dixerat, quid pridie cenaveram. Putasses illum semper mecum habitasse.”

Periplus Maris Erythraei

44. Τούτου χάριν περί αὐτὸν τὸν εἰσπλουν βασιλικοὶ ἀλιεῖς ἐντόπιοι πληρώμασι μακρῶν πλοίων, ἃ λέγεται τράππαγα καὶ κότυμβα, πρὸς ἀπάντησιν ἐξέρχονται μέχρι τῆς Συραστρηνῆς, ἀφ’ ὧν ὁδηγεῖται τὰ πλοῖα μέχρι Βαρυγάζων. Κλίνουσι γὰρ εὐθύς ἀπὸ τοῦ στόματος τοῦ κόλπου διὰ τενάγη τοῖς πληρώμασι καὶ ῥυμουλκοῦσιν αὐτὰ σταθμοῖς ἤδη τεταγμένοις, ἀρχομένης μὲν τῆς πλήμης αἶροντες, ἱσταμένης δὲ διορμίζοντες κατὰ τινὰς ὅρμους καὶ κυθρίνους. Οἱ δὲ κύθρινοι τόποι εἰσὶ τοῦ ποταμοῦ βαθύτεροι μέχρι Βαρυγάζων· ἀπέχει γὰρ ἀπὸ τοῦ στόματος ἄνω παρὰ τὸν ποταμὸν κειμένη ὡς σταδίῳν τριακοσίων.

Philo of Alexandria, De Opificio Mundi

38.1. πελάγη βαθύτατα οὐ βραχεΐαις ὀλκάσιν, ἀλλὰ μυριοφόροις ναυσὶν ἐμπλεόμενα.

Philo of Alexandria, De Plantatione Noe

6.1. ...μυριαγωγὰ σκάφη θρίθοντα φόρτω...

Philo of Alexandria, De aeternitate mundi

26.2. ...ὅση δὲ χέρσος θαλαττωθεῖσα μυριοφόροις ναυσὶν ἐμπλεῖται.

Philo of Alexandria, Against Flacus

155.1-3. Περαιωσάμενος δὲ τὸν Ἰόνιον κόλπον ἔπλει τὴν ἄχρι Κορίνθου θάλατταν, ταῖς παράλοις τῶν ἐν Πελοποννήσῳ πόλεων θέα γινόμενος κατὰ πύστιν τῆς αἰφνιδίου μεταβολῆς· ὁπότε γὰρ ἀποβαίῃ τῆς νεώς, συνέθεον οἱ μὲν μοχθηροὶ τὰς φύσεις ἐθελοκακοῦντες, οἱ δ’ ἄλλοι συναλγήσοντες, οἷς ἔθος ταῖς ἐτέρων τύχαις σωφρονίζεσθαι. Διελθὼν δ’ ἀπὸ Λεχαίου τὸν Ἰσθμὸν εἰς τὴν ἀντιπέραν θάλατταν καὶ καταβάς εἰς Κεγχρεάς, τὸ Κορίνθιον ἐπίνειον, ἀναγκάζεται πρὸς τῶν φυλάκων ἀναχώρησιν οὐδ’ ἡντιναοῦν ἐνδιδόντων εὐθύς ἐπιβάς βραχεΐας ὀλκάδος ἀνάγεσθαι καὶ πνεύματος ἐναντίου καταρραγέντος μυρία ταλαιπωρηθεῖς μόλις ἄχρι τοῦ Πειραιῶς κατασύρεται.

Philostratus, The Life of Apollonius of Tyana

4.9. Καὶ ἅμα διῶν ταῦτα ναῦν εἶδε τῶν τριαρμένων ἐκπλέουσιν καὶ τοὺς ναύτας ἄλλον ἄλλως ἐς τὸ ἀνάγεσθαι αὐτὴν πράττοντας. Ἐπιστρέφων οὖν τοὺς παρόντας ὁρᾷτε· εἶπε ‘τὸν τῆς νεώς δῆμον, ὡς οἱ μὲν τὰς ἐφολκίδας ἐμβεθήκασιν ἐρετικοὶ ὄντες, οἱ δ’ ἀγκύρας ἀνιμῶσι τε καὶ ἀναρτῶσιν, οἱ δὲ ὑπέχουσι τὰ ἱστία τῷ ἀνέμῳ, οἱ δὲ ἐκπρύμνης τε καὶ πρῶρας προορῶσιν; εἰ δὲ ἐν τούτων εἷς ἐλλείψει τι τῶν ἑαυτοῦ ἔργων ἢ ἀμαθῶς τῆς ναυτικῆς ἄψεται, πονήρως πλεουσοῦνται καὶ ὁ χειμὼν αὐτοῖς δόξουσιν: εἰ δὲ φιλοτιμήσονται πρὸς ἑαυτοὺς καὶ στασιάζουσιν κακίων ἕτερος ἐτέρου δόξαι, καλοὶ μὲν ὅρμοι τῇ νηὶ ταύτῃ, μεστὰ δὲ εὐδίας τε καὶ εὐπλοίας πάντα, Ποσειδῶν δὲ Ἀσφάλειος ἡ περὶ αὐτοῖς εὐβουλία δόξει.

4.32....εἰ δὲ ἡ ἐμπορία πρὸς τὰ χρεᾶ μὴ ἀναφέροίτο, μεταβάντες ἐς τὰ ἐφόλκια προσαράττουσι τὰς ναῦς...

8.14. ... στέλλεται τε ἡ ναῦς ἥδη: ξυμβάλλομαι δ’ αὐτὸ τῇ τῶν ἐμπλεόντων βοῇ καὶ οἷς περὶ τὴν ἀναίρεσιν τῶν ἀγκυρῶν πράττουσιν.

Philostratus, Lives of the Sophists

2.23. Πλούτου δὲ ἐπίδειξιν τῷ ἀνδρὶ τούτῳ κάκεῖνα εἶχεν: πρῶτα μὲν ἡ γῆ πᾶσα, ὁπόσῃν ἐκέκτητο, ἐκπεφυτευμένη [p. 108] δένδρεσι καρπίμοις τε καὶ εὐσκίοις, ἐν δὲ τοῖς ἐπὶ θαλάττῃ καὶ νῆσοι χειροποίητοι καὶ λιμένων προχώσεις βεβαιοῦσαι τοὺς ὅρμους καταιρούσαις τε καὶ ἀφιεῖσαις ὀλκάσιν...

Plautus, Casina

778. *Novi ego illas ambestrices: corbitam cibi.*

Plautus, Poenulus

3.1.40. *Obsecro hercle, operam celocem hanc mihi, ne corbitam date...*

Pliny the Younger, Letters

6.31.16-7. *In ore portus insula assurgit, quae illatum vento mare obiacens frangat, tutumque ab utroque latere decursum navibus praestet. Assurgit autem arte visenda: ingentia saxa latissima navis provehit contra; haec alia super alia deiecta ipso pondere manent ac sensim quodam velut aggere construuntur. Eminent iam et apparet saxeum dorsum impactosque fluctus in immensum elidit et tollit; vastus illic fragor canumque circa mare. Saxi deinde pilae adicientur quae procedente tempore enatam insulam imitentur.*

Pliny the Elder, Natural History

16.19. *Suberi minima arbor, glans pessima, rara, cortex tantum in fructu, praecrassus ac renascens atque etiam in denos pedes undique explanatus. Usus eius ancoralibus maxime navium piscantiumque tragulis et cadorum obturamentis, praeterea in hiberno feminarum calceatu.*

16.34. *Usus eius ancoralibus maxime navium, piscantiumque tragulis, et cadorum obturamentis.*

16.192. *Mirum apud antiquos primo Punico bello classem Duilli imperatoris ab arbore LX die navigavisse, contra vero Hieronem regem CCXX naves effectas diebus XLV tradit L. Piso. Secundo quoque Punico Scipionis classis XL die a securi navigavit. Tantum tempestivitas etiam in rapida celeritate pollet.*

34.3. *Ex illa autem antiqua gloria corinthium maxime laudatur. Hoc casus miscuit corintho, cum caperetur, incensa, mireque circa id multorum adfectatio furit, quippe cum tradatur non alia de causa verrem, quem M. Cicero damnaverat, proscriptum cum eo ab antonio, quoniam corinthis cessurum se ei negavisset.*

34.6. *Nec pudet tribunorum militarium salariis emere, cum ipsum nomen a candelarum lumine inpositum appareat. Accessio candelabri talis fuit theonis iussu praeconis clesippus fullo gibber et praeterea et alio foedus aspectu, emente id gegania. Eadem ostentante in convivio empti ludibrii causa nudatus atque inprudens libidinis receptus in torum, mox in testamentum, praedives numinum vice illud candelabrum coluit et hanc corinthis fabulam adiecit, vindicatis tamen moribus nobili sepulchro, per quod aeterna supra terras geganiae dedecoris memoria duraret. Sed cum esse nulla corinthia candelabra constet, nomen id praecipue in his celebratur, quoniam mummi victoria corinthum quidem diruit, sed e compluribus achaiae oppidis simul aera dispersit.*

34.9. *Antiquissima aeris gloria Deliaci fuit, mercatus in Delo celebrante toto orbe, et ideo cura officinis*

Plutarch, Pompei

40.5. Ὑστερον δὲ Ῥωμαίοις τοῦτο δὴ τὸ καλὸν καὶ περιβόητον ἀνιστὰς θεάτρον, ὥσπερ ἐφόλκιόν τι, παρετεκλήνατο λαμπροτέραν οἰκίαν ἐκείνης, ἀνεπίφθονον δὲ καὶ ταύτην, ὥστε τὸν γενόμενον δεσπότην αὐτῆς μετὰ Πομπηίου εἰσελθόντα θαυμάζειν καὶ πυνθάνεσθαι ποῦ Πομπηίου Μάγνος ἐδείπνει.

Plutarch, Caesar

57.5. Τὴν δ' εὖνοιαν ὡς κάλλιστον ἅμα καὶ βεβαιότατον ἑαυτῷ περιβαλλόμενος φυλακῆριον, αὖθις ἀνελάμβανε τὸν δῆμον ἐσιτιάσει καὶ σιτηρεσίοις, τὸ δὲ στρατιωτικὸν ἀποικίαις, ὧν ἐπιφανέσταται Καρχηδὼν καὶ Κόρινθος ἦσαν, αἷς καὶ πρότερον τὴν ἄλωσιν καὶ τότε τὴν ἀνάληψιν ἅμα καὶ κατὰ τὸν αὐτὸν χρόνον ἀμφοτέραις γενέσθαι συνέτυχε.

Plutarch, De Pythiae Oraculis

2. Ἐπέραινον οἱ περιηγηταὶ τὰ συντεταγμένα, μηδὲν ἡμῶν φροντίσαντες δεηθέντων ἐπιτεμεῖν τὰς ῥήσεις καὶ τὰ πολλὰ τῶν ἐπιγραμμάτων. Τὸν δὲ ξένον ἢ μὲν ἰδέα καὶ τὸ τεχνικὸν τῶν ἀνδριάντων μετρίως προσήγετο, πολλῶν καὶ καλῶν ἔργων ὡς ἔοικε θεατὴν γεγεννημένον ἐθαύμαζε δὲ τοῦ χαλκοῦ τὸ ἀνθηρὸν ὡς οὐ πίνῃ προσεοικὸς οὐδ' ἰῶ, βαφῇ δὲ κυάνου στίλβοντος, ὥστε καὶ παῖξαι τι πρὸς; τοὺς ναυάρχους 'ἀπ' ἐκείνων γὰρ ἦρκεται τῆς θέας' οἷον ἀτεχνῶς θαλαττίους τῇ χροᾷ καὶ θυθίους ἐστῶτας. Ἄρ' οὖν ἔφη 'κρᾶσις τις ἦν καὶ φάρμαξις τῶν πάλαι τεχνιτῶν περὶ τὸν χαλκόν,' ὥσπερ ἡ λεγομένη τῶν ξιφῶν στόμωσις ἥς ἐκλιπούσης ἐκεχειρίαν ἔσχεν ἔργων πολεμικῶν ὁ χαλκός,' τὸν μὲν γὰρ Κορίνθιον οὐ τέχνη ἀλλὰ συντυχία τῆς χροᾶς λαβεῖν τὸ κάλλος, ἐπινειμαμένου πυρὸς οἰκίαν ἔχουσάν τι χρυσοῦ καὶ ἀργύρου, πλεῖστον δὲ χαλκὸν ἀποκείμενον: ὧν συγχυθέντων καὶ συντακέντων, ὄνομα τοῦ χαλκοῦ τῷ μείζονι τὸ πλεῖθος παρέσχε. Ὁ δὲ Θέων ὑπολαβὼν 'ἄλλον' ἔφη 'λόγον ἡμεῖς ἀκηκόαμεν πανουργέστερον: ὡς ἀνὴρ ἐν Κορίνθῳ χαλκοτύπος, ἐπιτυχὼν θήκη χρυσίου ἐχούσῃ πολὺ καὶ δεδοικῶς φανερός γενέσθαι, κατὰ μικρὸν ἀποκόπτων καὶ ὑπομιννὺς ἀτρέμα τῷ χαλκῷ, θαυμαστὴν λαμβάνοντι κρᾶσιν, ἐπίπρασκε πολλοῦ διὰ τὴν χροᾶν καὶ τὸ κάλλος ἀγαπώμενον. Ἀλλὰ καὶ ταῦτα ἀκαεῖνα μῦθός εἰσιν: ἦν δὲ τις ὡς ἔοικε μῖξις καὶ ἄρτυσις, ὥς που καὶ νῦν ἀνακεραννύντες ἀργύρῳ χρυσὸν ἰδίαν τινὰ καὶ περιττὴν ἐμοὶ δὲ φαινομένην νοσῶδη χλωρότητα καὶ φθορὰν ἀκαλλῇ παρέχουσι.'

Plutarch, Moralia

146.2. Παρεσκευάκει μὲν γὰρ οὐκ ἐν τῇ πόλει τὴν ὑποδοχὴν ὁ Περίανδρος, ἀλλ' ἐν τῷ περὶ τὸ Λέχαιον ἐστιατορίῳ παρὰ τὸ τῆς Ἀφροδίτης ἱερόν, ἥς ἦν καὶ ἡ θυσία. Μετὰ γὰρ τὸν ἔρωτα τῆς μητρὸς αὐτοῦ προεμένης τὸν βίον ἐκουσίως, οὐ τεθυκῶς τῇ Ἀφροδίτῃ τότε πρῶτον ἐκ τινων ἐνυπνίων τῆς Μελίσσης ὥρμησε τιμᾶν καὶ θεραπεύειν τὴν θεόν. Τῶν δὲ κεκλημένων ἐκάστῳ συνωρίς ἱκανῶς κεκοσμημένη προσήχθη: καὶ γὰρ ὥρα θέρους ἦν, καὶ τὴν ὁδὸν ἄπασαν ὑπὸ πλήθους ἀμαξῶν καὶ ἀνθρώπων ἄχρι θαλάττης κονιορτὸς καὶ θόρυβος κατεῖχεν. Ὁ μέντοι Θαλῆς τὸ ζεῦγος ἐπὶ ταῖς θύραις ἰδὼν καὶ μειδιάσας ἀφῆκεν. Ἐβαδίζομεν οὖν ἐκτραπόμενοι διὰ τῶν χωρίων, καθ' ἡσυχίαν...

148.2-3. Ἐν τοιοῦτοις λόγοις γενόμενοι κατὰ τὴν ὁδὸν ἀφικόμεθα πρὸς τὴν οἰκίαν, καὶ λούσασθαι μὲν ὁ Θαλῆς οὐκ ἠθέλησεν, ἀληλιμμένοι γὰρ ἦμεν: ἐπιὼν δὲ τοὺς τε δρόμους ἐθεᾶτο καὶ τὰς παλαιίστρας καὶ τὸ ἄλσος τὸ παρὰ τὴν θάλασσαν ἱκανῶς διακεκοσμημένον, ὑπ' οὐδενὸς ἐκπληττόμενος τῶν τοιούτων, ἀλλ' ὅπως μὴ καταφρονεῖν δοκοίη μηδ' ὑπερορᾶν τοῦ Περιάνδρου τῆς φιλοτιμίας. Τῶν δ' ἄλλων τὸν ἀλειψάμενον: ἢ λουσάμενον οἱ θεράποντες εἰσῆγον εἰς τὸν ἀνδρῶνα διὰ τῆς στοᾶς.

Plutarch, Caius Marcius Coriolanus

32.1. Ἐπανελθόντων δὲ τῶν πρέσβειων ἀκούσασα ἡ βουλή, καθάπερ ἐν χειμῶνι πολλῷ καὶ κλύδωνι τῆς πόλεως, ἄρασα τὴν ἀφ' ἱερᾶς ἀφῆκεν.

Plutarch, Quaestiones Convivales

8.9. Πόθεν γε δὴ σώματι νόσημα καινὸν ἢ πάθος ὀψίγονον, ἰδίαν μὲν ὥσπερ ἡ ψυχὴ κινήσεως ἀρχὴν οἴκοθεν οὐκ ἔχοντι, συνημμένῳ δὲ κοινᾷς πρὸς τὴν φύσιν αἰτίαις καὶ κεκραμένῳ κρᾶσιν, ἥς καὶ τὸ ἀόριστον ἐντὸς ὄρων πλανᾶται, καθάπερ πλοῖον ἐν περιδρόμῳ σαλεῖται...

Pollux, Onomasticon

1.93. Ἔστι δὲ ἐν τῇ νηὶ ἰστός, ἰστοδόκη, κεραία, σχοινία, κάλοι, πρότονοι, καλῶδια, πείσματα, ἀπόγυα, ἐπίγυα, πρυμνήσια· ἐγχωρεῖ γὰρ τῷ ὀνόματι χρῆσθαι, κἂν ἦ ποιητικόν. Ἄγκυραι ἀμφίβολοι, ἀμφίστομοι, ἑτερόστομοι· καὶ ἄγκυρα ἱερά, ἥ χωρὶς ἀνάγκης οὐ χρῶνται. Ἀποβάθρα καὶ διαβάθρα, ἦν σκάλαν καλοῦσιν. Οἱ δὲ στίχοι τῶν κωπῶν ταρσώματα καλοῦνται. Δέρρεις, διφθέραι. Ἔστι δὲ τις καὶ μηχανὴ καὶ τροχὸς καὶ τροχιλία, καὶ δι' ὧν οἱ κάλοι διεύρονται, κρίκοι· τὸ γὰρ κίρκοι ποιητικόν, ἴδιον δὲ τὸ κύκλοι. Εἴτα θρανεῖα, ὑπηρέσιον, ἔρματα, καὶ ἡρματισμέμη ναῦς καὶ ἀνερμάτιστος, κοντός, κάδος, ἀντλία, ἱμονία. Τὰ δὲ σύμπαντα σκευὴ ὅπλα καλεῖται. Καὶ ὁ Ξενοφῶν 'σκευὴ κρεμαστὰ' καὶ 'ξύλινα,' Δημοσθένης δὲ καὶ ἀποτριβὴν σκευῶν ὠνόμασεν.

5.16.3. Παμμένης μετὰ Θηβαίων κρατῆσαι βουλόμενος τοῦ Σικυωνίων λιμένος αὐτὸς μὲν κατὰ γῆν παρεσκευάζετο προσβαλεῖν, πλοῖον δὲ στρογγύλον πληρώσας ὀπλιτῶν ἔπεμψεν.

1.22. Οἱ δὲ Ῥωμαῖοι μετὰ ταῦτα συνεγγίσαντες τοῖς κατὰ τὴν Σικελίαν τόποις καὶ συνέντες τὸ γεγονός σύμπτωμα περὶ τὸν Γνάιον παραυτίκα μὲν διεπέμποντο πρὸς Γάιον Βίλιον τὸν ἡγούμενον τῆς πεζῆς δυνάμεως καὶ τοῦτον ἀνέμενον, ἅμα δ' ἀκούοντες οὐ μακρὰν εἶναι τὸν τῶν πολεμίων στόλον ἐγίνοντο πρὸς παρασκευὴν τοῦ ναυμαχεῖν. Ὅντων δὲ τῶν πλοίων φαύλων ταῖς κατασκευαῖς καὶ δυσκινήτων, ὑποτίθεται τις αὐτοῖς βοήθημα πρὸς τὴν μάχην τοὺς ἐπικληθέντας μετὰ ταῦτα κόρακας ὧν συνέβαινε τὴν κατασκευὴν εἶναι τοιαύτην. Στύλος ἐν πρῶρρα στρογγύλος εἰσθήκει, μῆκος μὲν ὀργυιῶν τεττάρων, κατὰ δὲ τὸ πλάτος τριῶν παλαιστῶν ἔχων τὴν διάμετρον. Οὗτος αὐτὸς μὲν ἐπὶ τῆς κορυφῆς τροχιλίαν εἶχεν, περιετίθετο δ' αὐτῷ κλίμαξ ἐπικαρσίαις σανίσι καθηλωμένη, πλάτος μὲν ποδῶν τεττάρων, τὸ δὲ μῆκος ἑξ ὀργυιῶν. Τὸ δὲ τρῆμα τοῦ σανιδώματος ἦν παράμηνες καὶ περιέβαινε περὶ τὸν στῦλον μετὰ τὰς πρώτας εὐθέως τῆς κλίμακος δὴ ὀργυιάς. Εἶχεν δὲ καὶ δρύφακτον αὕτη παρ' ἑκατέραν τὴν ἐπιμήκη πλευρὰν εἰς γόνυ τὸ βάθος. Ἐπὶ δὲ τοῦ πέρατος αὐτοῦ προσήρμοστο σιδηροῦν οἶον ὑπερον ἀπωξυσμένον, ἔχον δακτύλιον ἐπὶ τῆς κορυφῆς, ὡς τὸ ὅλον φαίνεσθαι παραπλήσιον ταῖς σιτοποιικαῖς μηχανήσεσιν. Εἰς δὲ τοῦτον τὸν δακτύλιον ἐνεδέδετο κάλως, ᾧ κατὰ τὰς ἐμβολὰς τῶν πλοίων ἐξαίροντες τοὺς κόρακας διὰ τῆς ἐν τῷ στύλῳ τροχιλίας ἀφίεσαν ἐπὶ τὸ κατάστρωμα τῆς ἀλλοτρίας νεὼς ποτὲ μὲν κατὰ πρῶρραν, ποτὲ δ' ἀντιπεριάγοντες τὰς ἐκ τῶν πλαγιῶν προσπιπτούσας ἐμβολὰς. Ὅτε δὲ ταῖς σανίσι τῶν καταστρωμάτων ἐμπαγέντες οἱ κόρακες ὁμοῦ συνδήσαιεν τὰς ναῦς, εἰ μὲν πλάγαι παραβάλοιεν ἀλλήλαις, πανταχόθεν ἐπεπῆδων, εἰ δὲ κατὰ πρῶρραν, δι' αὐτοῦ τοῦ κόρακος ἐπὶ δύο συνεχεῖς ἐποιοῦντο τὴν ἔφοδον: ὧν οἱ μὲν ἡγούμενοι τὴν κατὰ πρόσωπον ἐπιφάνειαν ἐσκέπαζον ταῖς τῶν θυρεῶν προβολαῖς, οἱ δ' ἐπόμενοι τὰς ἐκ τῶν πλαγιῶν ἡσφάλιζον πλευρὰς ὑπὲρ τὸν δρύφακτον ὑπερτιθέμενοι τὰς ἴτυς τῶν ὅπλων.

5.2.4-6. Κριθέντων δὲ τούτων, ἡθροίζε τὰς τε τῶν Ἀχαιῶν νῆας καὶ τὰς σφετέρας εἰς τὸ Λέχαιον, καὶ συνεχεῖς ποιοῦμενος ἀναπείρας ἐγύμναζε τοὺς φαλαγγίτας καὶ συνεΐτιζε ταῖς εἰρεσίαις, προθύμως αὐτῷ πρὸς τὸ παραγγελλόμενον συνυπακούοντων τῶν Μακεδόνων: πρὸς τε γὰρ τοὺς ἐν γῇ κινδύνους ἐκ παρατάξεως γενναιότατοι πρὸς τε τὰς κατὰ θάλατταν ἐκ τοῦ καιροῦ χρείας ἐτοιμότατοι, λειτουργοὶ γε μὴν περὶ τὰς ταφρεῖας καὶ χαρακοποιίας καὶ πᾶσαν τὴν τοιαύτην ταλαιπωρίαν φιλοπονώτατοί τινες, οἷους Ἡσίοδος παρεισάγει τοὺς Αἰακίδας,

5.25.4. Τούτων δὲ συμβαινόντων, καὶ τῆς πόλεως ὅλης ἐν θορύβῳ καὶ ταραχῇ καθεστῶσης, ἀκούσας ὁ Φίλιππος, ἦκε μετὰ σπουδῆς ἐκ τοῦ Λεχαίου θέων εἰς τὴν πόλιν.

5.18.8-9. Ἀναχθεῖς γὰρ ἐκ μέσης Αἰτωλίας, καθάπερ ἐπάνω προεῖπον, καὶ διανύσας ἐν νυκτὶ τὸν Ἀμβρακικὸν κόλπον, εἰς Λευκάδα κατῆρε. Δύο δὲ μείνας ἡμέρας ἐνταῦθα, τῇ τρίτῃ ποιησάμενος ὑπὸ τὴν ἐωθινήν τὸν ἀνάπλου, δευτεραῖος πορθήσας ἅμα τὴν τῶν Αἰτωλῶν παραλίαν ἐν Λεχαίῳ καθωρμίσθη.

5.24.12. Αὐτὸς δὲ καταβάς εἰς τὸ Λέχαιον ἐγίνετο περὶ πλοῦν, ἔχων τινὰς πράξεις ὀλοσχερεστέρας ἐν τοῖς περὶ Φωκίδα τόποις.

30.20. Ὅτι οἱ Ἀθηναῖοι παρεγένοντο πρεσβεύοντες τὸ μὲν πρῶτον ὑπὲρ τῆς Ἀλιαρτίων σωτηρίας, παρακουόμενοι δὲ περὶ τούτου τοῦ μέρους ἐκ μεταθέσεως διελέγοντο περὶ Δήλου καὶ Λήμνου καὶ τῆς τῶν Ἀλιαρτίων χώρας, εἰς ἑαυτοὺς ἐξαιτούμενοι τὴν κτῆσιν: εἶχον γὰρ διττὰς ἐντολάς. Οἷς περὶ μὲν τῶν κατὰ Δῆλον καὶ Λῆμνον οὐκ ἂν τις ἐπιτιμήσειε διὰ τὸ καὶ πρότερον ἀντιπεποιῆσθαι τῶν νήσων τούτων, περὶ δὲ τῆς τῶν Ἀλιαρτίων χώρας εἰκότως ἂν τις καταμέμψαιτο. Τὸ γὰρ πόλιν σχεδὸν ἀρχαιοτάτην τῶν κατὰ τὴν Βοιωτίαν ἐπταικυῖαν μὴ συνεπανορθοῦν κατὰ πάντα τρόπον, τὸ δ' ἐναντίον ἐξαλείφειν, ἀφαιρουμένους καὶ τὰς εἰς τὸ μέλλον ἐλπίδας τῶν ἡκληρηκότων, δῆλον ὡς οὐδενὶ μὲν ἂν δόξαι τῶν Ἑλλήνων καθήκειν, ἥκιστα δὲ τῶν ἄλλων Ἀθηναίοις. Τὸ γὰρ τὴν μὲν ἰδίαν πατρίδα κοινὴν ποιεῖν ἅπασιν, τὰς δὲ τῶν ἄλλων ἀναιρεῖν, οὐδαμῶς οἰκεῖον ἂν φανείη τοῦ τῆς πόλεως ἥθους. Πλὴν ἢ γε σύγκλητος καὶ τὴν Δῆλον αὐτοῖς ἔδωκε καὶ τὴν Λῆμνον καὶ τὴν τῶν Ἀλιαρτίων χώραν. καὶ τὰ μὲν κατὰ τοὺς Ἀθηναίους τοιαύτην ἔσχε διάθεσιν.

Pseudo-Scylax, Periplous

55. Μετὰ δὲ Ἐπίδουρον ἡ Κορινθίων χώρα ἐστὶ... πρὸς ἡῶ, καὶ τείχος Κεγχρείας, καὶ ἰσθμός, οὗ ἱερὸν Ποσειδῶνος.

Quintilian, Institutio Oratoria

4.2.41. *In portum veni, navem prospexi, quanti veheret interrogavi, de pretio convenit, conscendi, sublatae sunt ancorae, solvimus oram, profecti sumus.*

Romans

16.1.2. *Commendo autem vobis Phoebem sororem nostram quae est in ministerio ecclesiae quae est Cenchris.*

Scaevola, Digest

50.5.3. *His, qui naves marinas fabricaverunt et ad annonam populi romani praefuerint non minores quinquaginta milium modiorum aut plures singulas non minores decem milium modiorum, donec hae naves navigant aut aliae in earum locum, muneris publici vacatio praestatur ob navem. Senatores autem hanc vacationem habere non possunt, quod nec habere illis navem ex lege iulia repetundarum licet.*

Scriptores Historiae Augusta, Commodus

17.7. *Classem Africanam instituit, quae subsidio esset, se forte Alexandrina frumenta cessassent. Ridicule etiam Carthaginem Alexandriam Commodianam togatam appellavit, cum classem quoque Africanam Commodianam Herculeam appellasset.*

Scriptores Historiae Augusta, Gordiani Tres

29.2. *Misitheus tantum ubique, quantum diximus, habuerat 1 conditorum ut vacillare dispositio Romana non posset; verum artibus Philippi primum naves frumentariae sunt aversae, deinde in ea loca deducti sunt*

Seneca, Moral Essays

13.4. *Hoc quoque quaerentibus remittamus, quis Romanis primus persuaserit navem conscendere. Claudius is fuit, Caudex ob hoc ipsum appellatus, quia plurium tabularum contextus caudex apud antiquos vocatur, unde publicae tabulae codices dicuntur et naves nunc quoque ex antiqua consuetudine, quae commeatus per Tiberim subvehunt, codicariae vocantur.*

Seneca, Letters

77.1-2. *Subito nobis hodie Alexandrinae naves apparuerunt, quae praemitti solent et nuntiare secuturae classis adventum; tabellarias vocant. Gratus illarum Campaniae aspectus est; omnis in pilis Puteolorum turba consistit et ex ipso genere velorum Alexandrinas quamvis in magna turba navium intellegit. Solis enim licet siparum intendere, quod in alto omnes habent naves. Nulla enim res aequae adiuvat cursum quam summapars veli; illinc maxime navis urgetur. Itaque quotiens ventus increbruit maiorque est quam expedit, antemna summittitur; minus habet virium flatus ex humili. Cum intravere Capreas et promunturium, ex quo alta procelloso speculatur vertice Pallas, ceterae velo iubentur esse contentae; siparum Alexandrinarum insigne est.*

95.7. *Atqui gubernatorem facit ille, qui praecipit: sic move gubernaculum, sic vela summitte, sic secundo vento utere, sic adverso resiste, sic dubium communemque tibi vindica*

Strabo, Geography

1.1.16. *Τῷ μαθεῖν δὲ τῆς χώρας τὴν φύσιν καὶ ζώων καὶ φυτῶν ιδέας προσθεῖναι δεῖ καὶ τὰ τῆς θαλάττης· ἀμφίβιοι γὰρ τρόπον τινὰ ἐσμεν καὶ οὐ μᾶλλον χερσαῖοι ἢ θαλάττιοι.*

2.3.5. *Ἄλλ' οὐδ' ἐξὸν ἦν ἄνευ προστάγματος ἐξ Ἀλεξανδρείας ἀνάγεσθαι, καὶ ταῦτα νενοσφισμένῳ βασιλικὰ χρήματα. Οὐδέ γε λαθεῖν ἐκπλεύσαντα ἐνεδέχeto τοσαύτη φρουρὰ κεκλεισμένου τοῦ λιμένος καὶ*

τῶν ἄλλων ἐξόδων, ὅσῃν καὶ νῦν ἔτι διαμένουσιν ἔγνωμεν ἡμεῖς ἐπιδημοῦντες τῇ Ἀλεξανδρείᾳ πολὺν χρόνον, καίτοι τὰ νῦν πολὺ ἀνεῖται, Ῥωμαίων ἐχόντων· αἱ βασιλικά δὲ φρουραὶ πολὺ ἦσαν πικρότεραι.

3.3.1. Ὁ δὲ Τάγος καὶ τὸ πλάτος ἔχει τοῦ στόματος εἴκοσί που σταδίων καὶ τὸ βάθος μέγα, ὥστε μυριαγωγαῖς ἀναπλεῖσθαι.

5.3.5. Πόλεις δ' ἐπὶ θαλάττῃ μὲν τῶν Λατίνων εἰσὶ τὰ τε Ὡστια, πόλις ἀλίμενος διὰ τὴν πρόσχωσιν ἣν ὁ Τίβερις παρασκευάζει πληρούμενος ἐκ πολλῶν ποταμῶν· παρακινδύνως μὲν οὖν ὁρμίζονται μετέωρα ἐν τῷ σάλῳ τὰ ναυκλήρια, τὸ μὲντοι λυσιτελὲς νικᾷ· καὶ γὰρ ἡ τῶν ὑπηρετικῶν σκαφῶν εὐπορία τῶν ἐκδεχομένων τὰ φορτία καὶ ἀντιφορτιζόντων ταχὺν ποιεῖ τὸν ἀπόπλουον πρὶν ἢ τοῦ ποταμοῦ ἄψασθαι, καὶ μέρους ἀποκουφισθέντος εἰσπλεῖ καὶ ἀνάγεται μέχρι τῆς Ῥώμης, σταδίου ἐκατὸν ἐνενήκοντα.

6.4.1. Τοσαύτῃ μὲν δὴ καὶ τοιαύτῃ τις ἡ Ἰταλία. Πολλὰ δ' εἰρηκότων, τὰ μέγιστα νῦν ἐπισημανοῦμεθα, ὅφ' ὧν εἰς τοσοῦτον ὕψος ἐξήρθησαν Ῥωμαῖοι. Ἐν μὲν ὅτι νήσου δίκην ἀσφαλῶς φρουρεῖται τοῖς πελάγεσι κύκλῳ πλην ὀλίγων μερῶν, ἃ καὶ αὐτὰ τετελείσθαι τοῖς ὅρεσι δυσβάτοις οὔσι. Δεύτερον δὲ τὸ ἀλίμενον κατὰ τὸ πλεῖστον καὶ τὸ τοὺς ὄντας λιμένας μεγάλους εἶναι καὶ θαυμαστούς, ὧν τὸ μὲν πρὸς τὰς ἐξωθεν ἐπιχειρήσεις χρήσιμον, τὸ δὲ πρὸς τὰς ἀντεπιχειρήσεις καὶ τὴν τῶν ἐμποριῶν ἀφθονίαν συνεργόν.

8.6.20-3. Ὁ δὲ Κόρινθος ἀφνειὸς μὲν λέγεται διὰ τὸ ἐμπόριον, ἐπὶ τῷ Ἰσθμῷ κείμενος καὶ δυεῖν λιμένων ὧν κύριος, ὧν ὁ μὲν τῆς Ἀσίας ὁ δὲ τῆς Ἰταλίας ἐγγύς ἐστι ... Καὶ ῥαδίας ποιεῖ τὰς ἐκατέρωθεν ἀμοιβὰς τῶν φορτίων πρὸς ἀλλήλους τοῖς τοσοῦτον ἀφεστῶσιν. Ἦν δ' ὥσπερ ὁ πορθμὸς οὐκ εὐπλοὺς ὁ κατὰ τὴν Σικελίαν τὸ παλαιόν, οὕτω καὶ τὰ πελάγη καὶ μάλιστα τὸ ὑπὲρ Μαλεῶν διὰ τὰς ἀντιπνοίας· ὅφ' οὗ καὶ παροιμιάζονται “Μαλέας δὲκάμψας ἐπιλάθου τῶν οἴκαδε.” Ἀγαπητὸν οὖν ἐκατέροις ἦν τοῖς τε ἐκ τῆς Ἰταλίας καὶ ἐκ τῆς Ἀσίας ἐμπόροις, ἀφεῖσι τὸν περὶ Μαλέας πλοῦν, κατάγεσθαι τὸν φόρτον αὐτόθι· καὶ πεζῇ δὲ τῶν ἐκκομιζομένων ἐκ τῆς Πελοποννήσου καὶ τῶν εἰσαγομένων ἔπιπτε τὰ τέλη τοῖς τὰ κλειῖθρα ἔχουσι.

Ἀρχὴ δὲ τῆς παραλίας ἐκατέρας τῆς μὲν τὸ Λέχαιον τῆς δὲ Κεγχρεαὶ κόμη καὶ λιμὴν ἀπέχων τῆς πόλεως ὅσον ἐβδομήκοντα σταδίους· τούτῳ μὲν οὖν χρῶνται πρὸς τοὺς ἐκ τῆς Ἀσίας πρὸς δὲ τοὺς ἐκ τῆς Ἰταλίας τῷ Λεχαίῳ. Τὸ δὲ Λέχαιον ὑποπέπτωκε τῇ πόλει κατοικίαν ἔχον οὐ πολλήν· σκέλη δὲ καθεῖλκυται σταδίων περὶ δώδεκα ἐκατέρωθεν τῆς ὁδοῦ τῆς ἐπὶ τὸ Λέχαιον. Ἐντεῦθεν δὲ παρεκτείνουσα ἡ ἡὼν μέχρι Παγῶν τῆς μεγαρίδος κλύζεται μὲν ὑπὸ τοῦ Κορινθιακοῦ κόλπου, κοίλῃ δ' ἐστὶ καὶ ποιεῖ τὸν δίολκον πρὸς τὴν ἐτέραν ἢ ὀνατὴν κατὰ Σχοινοῦντα πλησίον ὄντα τῶν Κεγχρεῶν. Ἐν δὲ τῷ μεταξὺ τοῦ Λεχαίου καὶ Παγῶν τὸ τῆς Ἀκραιας μαντεῖον Ἦρας ὑπῆρχε τὸ παλαιόν, καὶ αἱ Ὀλμιαί τὸ ποιοῦν ἀκρωτήριον τὸν κόλπον ἐν ᾧ ἢ τε Οἰνὸν καὶ Παγαί, τὸ μὲν τῶν Μεγαρέων φρούριον ἢ δὲ Οἰνὸν τῶν Κορινθίων. Ἀπὸ δὲ τῶν Κεγχρεῶν ὁ Σχοινοῦς, καθ' ὃν τὸ στενὸν τοῦ διόλκου· ἔπειθ' ἡ Κρομμυωνία. Πρόκειται δὲ τῆς ἡόνος ταύτης ὃ τε Σαρωνικὸς κόλπος καὶ ὁ Ἐλευσινιακός, τρόπον τινὰ ὁ αὐτὸς ὧν, συνεχῆς τῷ Ἑρμιονικῷ....

Κορίνθιοι δ' ὑπὸ Φιλίππῳ ὄντες ἐκείνῳ τε συνεφιλονέικησαν καὶ ἰδίᾳ πρὸς Ῥωμαίους ὑπεροπτικῶς εἶχον, ὥστε τινὲς καὶ τῶν πρέσβειων παριόντων τὴν οἰκίαν αὐτῶν ἐθάρρησαν καταντλήσαι βόρβορον. ἀντὶ τούτων μὲν οὖν καὶ ἄλλων ὧν ἐξήμαρτον ἔτισαν δίκας αὐτίκα· πεμφθείσης γὰρ ἀξιολόγου στρατιᾶς, αὐτὴ τε κατέσκαπτο ὑπὸ Λευκίου Μομμίου καὶ ἄλλα μέχρι Μακεδονίας ὑπὸ Ῥωμαίοις ἐγένετο, ἐν ἄλλοις ἄλλων πεμπομένων στρατηγῶν· τὴν δὲ χώραν ἔσχον Σικυώνιοι τὴν πλείστην τῆς Κορινθίας.

9.5.14. Ἦν δὲ πόλις εὐλίμενος ἢ Πύρασος ἐν δυσὶ σταδίοις, ἔχουσα Δήμητρος ἄλσος καὶ ἱερὸν ἅγιον, διέχουσα Θηβῶν σταδίους εἴκοσι.

10.5.4. Τὴν μὲν οὖν Δῆλον ἔνδοξον γενομένην οὕτως ἔτι μᾶλλον ἠὔξησε κατασκαφεῖσα ὑπὸ Ῥωμαίων Κόρινθος· ἐκεῖσε γὰρ μετεχώρησαν οἱ ἔμποροι, καὶ τῆς ἀτελείας τοῦ ἱεροῦ προκαλουμένης αὐτοὺς καὶ τῆς εὐκαιρίας τοῦ λιμένος· ἐν καλῷ γὰρ κεῖται τοῖς ἐκ τῆς Ἰταλίας καὶ τῆς Ἑλλάδος εἰς τὴν Ἀσίαν πλέουσιν· ἢ τε πανήγυρις ἐμπορικὸν τι πρᾶγμα ἐστὶ, καὶ συνήθεις ἦσαν αὐτῇ καὶ Ῥωμαῖοι τῶν ἄλλων μάλιστα, καὶ ὅτε συνειστέκει ἡ Κόρινθος· Ἀθηναῖοι τε λαβόντες τὴν νῆσον καὶ τῶν ἱερῶν ἅμα καὶ τῶν ἐμπόρων ἐπεμελοῦντο ἱκανῶς· ἐπελθόντες δ' οἱ τοῦ Μιθριδάτου στρατηγοὶ καὶ ὁ ἀποστήσας τύραννος αὐτὴν διελυμήναντο πάντα, καὶ παρέλαβον ἐρήμην οἱ Ῥωμαῖοι πάλιν τὴν νῆσον, ἀναχωρήσαντος εἰς τὴν οἰκίαν τοῦ βασιλέως, καὶ διετέλεσε μέχρι νῦν ἐνδεῶς πράττουσα. Ἐχουσι δ' αὐτὴν Ἀθηναῖοι.

12.8.11. Ἔστι δὲ νῆσος ἐν τῇ Προποντίδι ἢ Κύζικος συναπτομένη γεφύραις δυσὶ πρὸς τὴν ἡπειρον, ἀρετῇ μὲν κρατίστη μεγέθει δὲ ὅσον πεντακοσίων σταδίων τὴν περίμετρον· ἔχει δὲ ὁμώνυμον πόλιν πρὸς αὐταῖς ταῖς γεφύραις καὶ λιμένας δύο κλειστοὺς καὶ νεωσοίκους πλείους τῶν διακοσίων

14.1.24. Ἐχει δ' ἡ πόλις καὶ νεώρια καὶ λιμένα: βραχύστομον δ' ἐποίησαν οἱ ἀρχιτέκτονες, συνεξαπατηθέντες τῷ κελεύσαντι βασιλεῖ. Οὗτος δ' ἦν Ἄτταλος ὁ Φιλάδελφος: οἰηθεὶς γὰρ οὗτος βαθὺν τὸν εἵσπλουν ὀλκάσι μεγάλαις ἔσεσθαι καὶ αὐτὸν τὸν λιμένα τεναγώδη ὄντα πρότερον διὰ τὰς ἐκ τοῦ Καῦστρου προχώσεις, ἐὰν παραβληθῇ χῶμα τῷ στόματι πλατεῖ τελέως ὄντι, ἐκέλευσε γενέσθαι τὸ χῶμα. Συνέβη δὲ τούναντίον: ἐντὸς γὰρ ἡ χοῦς εἰργομένη τεναγίζειν μᾶλλον ἐποίησε τὸν λιμένα σύμπαντα μέχρι τοῦ στόματος: πρότερον δ' ἱκανῶς αἱ πλημμυρίδες καὶ ἡ παλίρροια τοῦ πελάγους ἀφήρει τὴν χοῦν καὶ ἀνέσπα πρὸς τὸ ἐκτός. Ὁ μὲν οὖν λιμὴν τοιοῦτος: ἡ δὲ πόλις τῇ πρὸς τὰ ἄλλα εὐκαιρίᾳ τῶν τόπων αὖξεται καθ' ἐκάστην ἡμέραν, ἐμπόριον οὔσα μέγιστον τῶν κατὰ τὴν Ἀσίαν τὴν ἐντὸς τοῦ Ταύρου.

14.5.2. Ἡ δὲ τῶν ἀνδραπόδων ἐξαγωγή προῦκαλεῖτο μάλιστα εἰς τὰς κακουργίας ἐπικερδεστάτη γενομένη: καὶ γὰρ ἠλίσκοντο ῥαδίως, καὶ τὸ ἐμπόριον οὐ παντελῶς ἄπωθεν ἦν μέγα καὶ πολυχρήματον, ἡ Δῆλος, δυναμένη μυριάδας ἀνδραπόδων αὐθημερόν καὶ δέξασθαι καὶ ἀποπέμψαι, ὥστε καὶ παροιμίαν γενέσθαι διὰ τοῦτο ἔμπορε, κατάπλευσον, ἐξελοῦ, πάντα πέπραται. Αἴτιον δ' ὅτι πλούσιοι γενόμενοι Ῥωμαῖοι μετὰ τὴν Καρχηδόνας καὶ Κορίνθου κατασκαφὴν οἰκετείαις ἐχρῶντο πολλαῖς: ὀρῶντες δὲ τὴν εὐπέτειαν οἱ λησταὶ ταύτην ἐξήνθησαν ἀθρόως, αὐτοὶ καὶ ληζόμενοι καὶ σωματεμποροῦντες.

17.1.9. Ἔστι δ' ἐν τῷ μεγάλῳ λιμένι κατὰ μὲν τὸν εἵσπλουν ἐν δεξιᾷ ἡ νῆσος καὶ ὁ πύργος ὁ Φάρος, κατὰ δὲ τὴν ἐτέραν χεῖρα αἱ τε χοιράδες καὶ ἡ Λοχιάς ἄκρα ἔχουσα βασιλείον. Εἰσπλεύσαντι δ' ἐν ἀριστερᾷ ἐστὶ συνεχὴ τοῖς ἐν τῇ Λοχιάδι τὰ ἐνδοτέρῳ βασιλεία, πολλὰς καὶ ποικίλας ἔχοντα διαίτας καὶ ἄλση: τούτοις δ' ὑπόκειται ὁ τε ὀρυκτὸς λιμὴν καὶ κλειστός, ἴδιος τῶν βασιλέων, καὶ ἡ Ἀντίρροδος νησίον προκείμενον τοῦ ὀρυκτοῦ λιμένος, βασιλείον ἅμα καὶ λιμένιον ἔχον: ἐκάλεσαν δ' οὕτως ὡς ἂν τῇ Ῥόδῳ ἐνάμιλλον. ὑπέρκειται δὲ τούτου τὸ θέατρον: εἴτα τὸ Ποσειδῖον, ἀγκῶν τις ἀπὸ τοῦ ἐμπορίου καλουμένου προπεπτωκώς, ἔχων ἱερὸν Ποσειδῶνος: ὧς προσθεὶς χῶμα Ἀντώνιος ἔτι μᾶλλον προνεῦον εἰς μέσον τὸν λιμένα ἐπὶ τῷ ἄκρῳ κατεσκεύασε δίαιταν βασιλικὴν ἣν Τιμώνιον προσηγόρευσε. Τοῦτο δ' ἔπραξε τὸ τελευταῖον, ἥνικα προλειφθεὶς ὑπὸ τῶν φίλων ἀπῆρεν εἰς Ἀλεξάνδρειαν μετὰ τὴν ἐν Ἀκτίῳ κακοπραγίαν, Τιμώνιον αὐτῷ κρίνας τὸν λοιπὸν βίον, ὃν διάζειν ἔμελλεν ἔρημος τῶν τοσούτων φίλων. Εἴτα τὸ Καισάρειον καὶ τὸ ἐμπόριον καὶ ἀποστάσεις, καὶ μετὰ ταῦτα τὰ νεώρια μέχρι τοῦ ἐπτασταδίου. ταῦτα μὲν τὰ περὶ τὸν μέγαν λιμένα.

17.3.14. Καὶ Καρχηδὼν δὲ ἐπὶ χερρονήσου τινὸς ἰδρυται, περιγραφούσης κύκλον τριακοσίων ἐξήκοντα σταδίων ἔχοντα τεῖχος, οὗ τὸ ἐξηκονταστάδιον μῆκος αὐτὸς ὁ αὐχὴν ἐπέχει, καθῆκον ἀπὸ θαλάττης ἐπὶ θάλατταν, ὅπου τοῖς Καρχηδονίοις ἦσαν αἱ τῶν ἐλεφάντων στάσεις, τόπος εὐρυχωρής. Κατὰ μέσην δὲ τὴν πόλιν ἡ ἀκρόπολις ἣν ἐκάλουν Βύρσαν, ὀφρὺς ἱκανῶς ὀρθία, κύκλῳ περιοικουμένη, κατὰ δὲ τὴν κορυφὴν ἔχουσα Ἀσκληπιεῖον, ὅπερ κατὰ τὴν ἄλωσιν ἡ γυνὴ τοῦ Ἀσδρούβα συνέπρησεν αὐτῇ. Ὑπόκεινται δὲ τῇ ἀκροπόλει οἱ τε λιμένες καὶ ὁ Κῶθων, νησίον περιφερὲς εὐρίπῳ περιεχόμενον, ἔχοντι νεωσοίκους ἐκατέρωθεν κύκλῳ.

Suetonius, Claudius

18-19. *Nam et negotiatoribus certa lucra proposuit suscepto in se damno, si cui quid per tempestates accidisset, et naves mercaturae causa fabricantibus magna commoda constituit pro condicione cuiusque: civi vacationem legis Papiae Poppaeae, Latino ius Quiritium, feminis ius Illi liberorum; quae constituta hodieque servantur.*

Synesius, Letter 4

22. Φθάνει δὲ ἡμέρα, καὶ ὀρῶμεν τὸν ἥλιον, ὡς οὐκ οἶδα εἴ ποτε ἦδιον. Το δὲ πνεῦμα ῥᾶον ἐγίνετο τῆς ἀλέας ἐπιδιδούσης, καὶ ἡ δρόσος ἐξισταμένη παρεῖχε ἡμῖν κεχρησθαι τοῖς καλωδίοις, καὶ τὸ ἰστίον μεταχειρίζεσθαι. Ὑπαλλάττειν μὲν οὖν ἰστίον ἕτερον νόθον οὐκ εἵχομεν· ἠνεχυρίαστο γάρ. Ἀνελαμβάνομεν δὲ αὐτὸ, καθάπερ τῶν χιτῶνων τοὺς κόλπους· καὶ πρὶν ὥρας εἶναι τέτταρας, ἀποβαίνομεν οἱ τεθνάναι προσδοκῆσαντες, ἐν ἐσχατιᾷ τινὶ πανέρημῳ· καὶ οὔτε πόλις, οὔτε ἀγρόν ἐχούση γείτονα, σταδίους ἐκατόν που|πρὸς τοῖς τριάκοντα κατόπιν ἀγροῦ.

23. Ἡ μὲν οὖν ναῦς ἐσάλευεν ἐπὶ μετεώρου (λιμὴν γὰρ ὁ τόπος οὐκ ἦν) καὶ ἐσάλευεν ἐπ' ἀγκύρας μιᾶς. Ἡ ἑτέρα γὰρ ἀπηπόλητο, τρίτην δὲ ἄγκυραν Ἀμάραντος οὐκ ἐκτῆσατο.

28. Ἦδη δὲ ὑποφαινομένης ἡμέρας, κατασεῖει τις ἄνθρωπος χωρικῶς ἐσταλμένος, καὶ δείκνυσι τῇ χειρὶ τόπους ὑπόπτους, καὶ ἐτέρους οὓς ἔδει θαρρῆσαι. Καὶ τέλος μόνος ἦλθεν ἐπὶ κελητίου δισκάλμου· ὅπερ ἐξάψας τοῦ πλοίου, μεταχειρίζεται τὸ πηδάλιον. Ὁ δὲ Σύρος ἄσμενος ἐξέστη τῆς προεδρίας. Ἀναλύσας δὲ σταδίους οὐ πλείους, ἢ πεντήκοντα, τὴν τε ναῦν ἐνορμίζει λιμενισκίῳ χαρίεντι (Ἀζάριον οἶμαι καλοῦσιν αὐτὸν), καὶ ἡμᾶς ἐπὶ τῆς ἡϊόνος ἀπεβίβασε, σωτὴρ καὶ δαίμων ἀγαθὸς ἀποκαλούμενος.

29. Καὶ μετὰ μικρὸν ἑτέραν ὀλκάδα εἰσήλασε, καὶ μάλα ἄλλην, καὶ πρὶν ἐσπέραν εἶναι, πέντε γεγόναμεν ὑπὸ τοῦ θεσπεσίου πρεσβύτου περισωθεῖσαι φορτίδες, πρᾶγμα ἐναντιώτατον τῷ Ναυπλίῳ ποιοῦντος....

Synesius, Letter 148

6. Οἶσθα γὰρ ὡς ἐγὼ καὶ φιλοσοφῶν ποτε ἅμα ὑμῖν ἐθεασάμην τὸ χρῆμα τοῦτο τὴν θάλασσαν, καὶ πρὸς Φάρω, καὶ πρὸς Κανώβω, τὴν μεγάλην λίμνην τὴν ἀλμηράν. Καὶ εἴλκετο ναῦς, καὶ ἀνήγετο πρὸς οὖρον αὕτη, κώπαις ἐκείνη.

Tacitus, Annales

15.18. At Romae tropaea de Parthis arcusque medio Capitolini montis sistebantur, decreta ab senatu in tegro adhuc bello neque tum omissa, dum aspectui consulitur spreta conscientia. Quin et dissimulandis rerum externarum curis Nero frumentum plebis vetustate corruptum in Tiberim iecit quo securitatem annonae sustentaret. Cuius pretio nihil additum est, quamvis ducentas ferme navis portu in ipso violentia tempestatis et centum alias Tiberi subvectas fortuitus ignis absumpsisset. Tres dein consularis, L. Pisonem, Ducenium Geminum, Pompeium Paulinum vectigalibus publicis praeposuit, cum insectatione priorum principum qui gravitate sumptuum iustos redditus antissent: se annum sexcenties sestertium rei publicae largiri.

16.23. At Baram Soranum iam sibi Ostorius Sabinus eques Romanus poposcera reum ex proconsulatu Asiae, in quo offensiones principis auxit iustitia atque industria, et quia portui Ephesiorum aperiendo curam insumpserat vimque civitatis Pergamena prohibentis Acratum, Caesaris libertum, statuas et picturas evehere inultam omiserat. Sed crimini dabatur amicitia Plauti et ambitio conciliandae provinciae ad spes novas. Tempus damnationi delectum, quo Tiridates accipiendi Armeniae regno adventabat, ut ad externa rumoribus intestinum scelus obscuraretur, an ut magnitudinem imperatoriam caede insignium virorum quasi regio facinore ostentaret.

Theophrastus, Inquiry into Plans

5.7.1. ...τὰς μὲν γὰρ τριήρεις καὶ τὰ μακρὰ πλοῖα ἐλάτινα ποιοῦσι διὰ κουφότητα, τὰ δὲ στρογγύλα πεύκινα διὰ τὸ ἀσαπές...

5.7.2. ...τὴν δὲ τρόπιν τριήρει μὲν δρυῖνην, ἵνα ἀντέχη πρὸς τὰς νεωλκίας, ταῖς δὲ ὀλκάσι πευκίνην· ὑποτιθέασι δ' ἔτι καὶ δρυῖνην ἐπὶ νεωλκῶσι, ταῖς δ' ἐλάττοσιν ὀξύνην· καὶ ὅλως ἐκ τούτου τὸ χέλυσμα.

Thucydides, History of the Peloponnesian War

1.13.2-5. Πρῶτοι δὲ Κορίνθιοι λέγονται ἐγγύτατα τοῦ νῦν τρόπου μεταχειρίσαι τὰ περὶ τὰς ναῦς, καὶ τριήρεισιν Κορίνθω πρῶτον τῆς Ἑλλάδος ναυπηγηθῆναι. Φαίνεται δὲ καὶ Σαμίους Ἀμεινοκλῆς Κορίνθιος ναυπηγὸς ναῦς ποιήσας τέσσαρας· ἔτη δ' ἐστὶ μάλιστα τριακόσια ἐς τὴν τελευταίαν τοῦδε τοῦ πολέμου ὅτε Ἀμεινοκλῆς Σαμίους ἦλθεν. Ναυμαχία τε παλαιτάτη ὣν ἴσμεν γίγνεται Κορινθίων πρὸς Κερκυραίου· ἔτη δὲ μάλιστα καὶ ταύτῃ ἐξήκοντα καὶ διακόσια ἐστὶ μέχρι τοῦ αὐτοῦ χρόνου. Οἰκοῦντες γὰρ τὴν πόλιν οἱ Κορίνθιοι ἐπὶ τοῦ Ἰσθμοῦ αἰεὶ δὴ ποτε ἐμπόριον εἶχον, τῶν Ἑλλήνων τὸ πάλαι κατὰ γῆν τὰ πλείω ἢ κατὰ θάλασσαν, τῶν τε ἐντὸς Πελοποννήσου καὶ τῶν ἔξω, διὰ τῆς ἐκείνων παρ' ἀλλήλους ἐπιμισγόντων, χρήμασι τε δυνατοὶ ἦσαν, ὡς καὶ τοῖς παλαιοῖς ποιηταῖς δεδῆλωται· ἀφνειὸν γὰρ ἐπωνόμασαν τὸ χωρίον. Ἐπειδὴ τε οἱ Ἕλληνες μᾶλλον ἐπλωζον, τὰς ναῦς κτησάμενοι τὸ ληστικὸν καθήρουν, καὶ ἐμπόριον παρέχοντες ἀμφοτέρωθεν δυνατὴν ἔσχον χρημάτων προσόδω τὴν πόλιν.

6.44.1. Τοσαύτῃ ἢ πρώτῃ παρασκευῇ πρὸς τὸν πόλεμον διέπλει. τούτοις δὲ τὰ ἐπιτήδεια ἄγουσαι ὀλκάδες μὲν τριάκοντα σιταγωγαί, καὶ τοὺς σιτοποιοὺς ἔχουσαι καὶ λιθολόγους καὶ τέκτονας καὶ ὅσα ἐς τειχισμόν

ἐργαλεῖα, πλοῖα δὲ ἑκατόν, ἃ ἐξ ἀνάγκης μετὰ τῶν ὀλκάδων ξυνέπλει: πολλὰ δὲ καὶ ἄλλα πλοῖα καὶ ὀλκάδες ἐκούσιοι ξυνηκολούθουν τῇ στρατιᾷ ἐμπορίας ἔνεκα: ἃ τότε πάντα ἐκ τῆς Κερκύρας ξυνδιέβαλλε τὸν Ἰόνιον κόλπον.

3.104.2. ... Ἀπέχει δὲ ἡ Ῥήνεια τῆς Δήλου οὕτως ὀλίγον ὥστε Πολυκράτης ὁ Σαμίων τύραννος ἰσχύσας τινὰ χρόνον ναυτικῶ καὶ τῶν τε ἄλλων νήσων ἄρξας καὶ τὴν Ῥήνειαν ἐλὼν ἀνέθηκε τῷ Ἀπόλλωνι τῷ Δηλίῳ ἀλύσει δῆσας πρὸς τὴν Δήλον. Καὶ τὴν πεντετηρίδα τότε πρῶτον μετὰ τὴν κάθαρσιν ἐποίησαν οἱ Ἀθηναῖοι τὰ Δήλια.

7.7.3. Πρέσβεις τε ἄλλοι τῶν Συρακοσίων καὶ Κορινθίων ἐς Λακεδαίμονα καὶ Κόρινθον ἀπεστάλησαν, ὅπως στρατιὰ ἔτι περαιωθῇ τρόπῳ ᾧ ἂν ἐν ὀλκάσιν ἢ πλοίοις ἢ ἄλλως ὅπως ἂν προχωρῇ, ὡς καὶ τῶν Ἀθηναίων ἐπιμεταπεμπομένων.

7.25.6. ...προσαγαγόντες γὰρ ναῦν μυριοφόρον αὐτοῖς οἱ Ἀθηναῖοι, πύργους τε ξυλίνους ἔχουσιν καὶ παραφράγματα, ...

Vergil, Aeneid

5.208. *Consurgunt nautae et magno clamore morantur, / ferratasque trudes et acuta cuspidē contos/expediunt, fractosque legunt in gurgite remos.*

Vitruvius, The Ten Books on Architecture

5.12.1-2. *De opportunitate autem portuum non est praetermittendum sed, quibus rationibus tueantur naves in his ab tempestatibus, explicandum. Hi autem naturaliter si sint bene positi habeant quae acroteria sive promunturia procurrentia, ex quibus introrsus curvaturae sive versurae ex locinatura fuerint conformatae, maximas utilitates videntur habere. Circum enim porticus sive navalia sunt faciendae sive ex porticibus aditus ad emporia, turresque ex utraque parte conlocandae, ex quibus catenae traduci per machinas possint. Sin autem non naturalem locum neque idoneum ad tuendas ab tempestatibus naves habuerimus, ita videtur esse faciendum, uti, si nullum flumen in his locis impederit sed erit ex una parte statio, tunc ex altera parte structuris sive aggeribus expediatur progressus, et ita conformandae portuum conclusiones. Eae autem structurae, quae in aqua sunt futurae, videntur sic esse faciendae, uti portetur pulvis a regionibus, quae sunt a Cumis continuatae ad promunturium Minervae, isque misceatur, uti in mortario duo ad unum respondeant.*

5.12.7. *His perfectis navaliorum ea erit ratio, ut constituentur spectantia maxime ad septentrionem; nam meridianae regiones propter aestus cariem, tineam, teredines reliquaque bestiarum nocentium genera procreant alendoque conservant. Eaque aedificia minime sunt materianda propter incendia. De magnitudinibus autem finitio nulla debet esse, sed faciunda ad maximum navium modum, uti, etsi maiores naves subductae fuerint, habeant cum laxamento ibi conlocationem. Quae necessaria ad utilitatem in civitatibus publicorum locorum succurrere mihi potuerunt, quemadmodum constituentur et perficiantur, in hoc volumine scripsi; privatorum autem aedificiorum utilitates et eorum symmetrias insequenti volumine ratiocinabor.*

10.2.8-10. *Est autem aliud genus machinae satis artificiosum et ad usum celeritatis expeditum, sed in eo dare operam non possunt nisi periti. Est enim tignum, quod erigitur et distenditur retinaculis quadrifariam. Sub retinaculo chelonia duo figuntur, troclea funibus supra chelonia religatur, sub troclea regula longa circiter pedes duos, lata digitos sex, crassa quattuor supponitur. Trocleae ternos ordines orbiculorum in latitudine habentes conlocantur. Ita tres ductarii funes in summa machina religantur. Deinde referuntur ad imam trocleam et traiciuntur ex interiore parte per eius orbiculos summos. Deinde referuntur ad superiorem trocleam et traiciuntur ab exteriori parte. Cum descenderint ad imum, ex interiore parte et per secundos orbiculos traducuntur in extremum et referuntur in summum ad orbiculos secundos; traieci redeunt ad imum et ab imo referuntur ad caput; traieci per summos redeunt ad machinam imam. In radice autem machinae conlocatur tertia troclea; eam autem Graeci ἐπάγοντα, nostri artemonem appellant. Ea troclea religatur ad trocleae radicem habens orbiculos tres, per quos traieci funes traduntur hominibus ad ducendum. Ita tres ordines hominum ducentes sine ergata celeriter onus ad summum perducunt. Hoc genus machinae polyspaston appellatur, quod multis orbiculorum circumflectionibus et facilitatem summam praestat et celeritatem. Una autem statutio tigni hanc habet utilitatem, quod ante quantum velit et dextra ac sinistra*

ab latere proclinando onus deponere potest. Harum machinationum omnium, quae supra sunt scriptae, rationes non modo ad has res, sed etiam ad onerandas et exonerandas naves sunt paratae, aliae erectae, aliae planae in carchesiis versatilibus conlocatae. Non minus sine tignorum erectionibus in plano etiam eadem ratione et temperatis funibus et trocleis subductiones navium efficiuntur.

Xenophon, Hellenica

4.4.12. Οἱ δὲ Λακεδαιμόνιοι οὐκ ἠπόρουν τίνα ἀποκτείνουσιν: ἔδωκε γὰρ τότε γε ὁ θεὸς αὐτοῖς ἔργον οἷον οὐδ' ἡϋξαντό ποτ' ἄν. Τὸ γὰρ ἐγχειρισθῆναι αὐτοῖς πολεμίων πληθὸς πεφοβημένον, ἐκπεπληγμένον, τὰ γυμνάπαρέχον, ἐπὶ τὸ μάχεσθαι οὐδένα τρεπόμενον, εἰς δὲ τὸ ἀπόλλυσθαι πάντας πάντα ὑπηρετοῦντας, πῶς οὐκ ἄντις θεῖον ἡγήσασαίτο; τότε γοῦν οὕτως ἐν ὀλίγῳ πολλοὶ ἔπεσον ὥστε εἰθισμένοι ὁρᾶν οἱ ἄνθρωποι σωροὺς σίτου, ξύλων, λίθων, τότε ἐθεάσαντο σωροὺς νεκρῶν. Ἀπέθανον δὲ καὶ οἱ ἐν τῷ λιμένι τῶν Βοιωτῶν φύλακες, οἱ μὲν ἐπὶ τῶν τειχεῶν, οἱ δὲ ἐπὶ τὰ τέγη τῶν νεωσοίκων ἀναβάντες.

5.1.23. Ὁ δὲ (Τελευτίας) τὰ μὲν πλοῖα ἀπέστειλεν εἰς Αἴγιναν, καὶ τῶν τριήρων τρεῖς ἢ τέτταρας συναπαγαγεῖν ἐκέλευσε, ταῖς δὲ ἄλλαις παραπλέων παρὰ τὴν Ἀττικὴν, ἅτε ἐκ τοῦ λιμένος πλέων, πολλὰ καὶ ἀλιευτικὰ ἔλαβε καὶ πορθμεῖα ἀνθρώπων μεστά, καταπλέοντα ἀπὸ νήσων. Ἐπὶ δὲ Σούνιον ἐλθὼν καὶ ὀλκάδας γεμούσας τὰς μὲν τινὰς σίτου, τὰς δὲ καὶ ἐμπολῆς, ἔλαβε.



List of references

Abbreviations

AJA	American Journal of Archaeology
AR	Archaeological Reports
BCH	Bulletin de Correspondance Hellénique
BEFAR	Bibliothèque des Écoles Françaises d'Athènes et de Rome
EAD	Exploration Archéologique de Délos
IJNA	International Journal of Nautical Archaeology
JHS	Journal of Hellenic Studies
JRA	Journal of Roman Archaeology
JRS	Journal of Roman Studies
RA	Revue Archéologique
BAR	British Archaeological Reports

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