

SKYLLIS

Zeitschrift für maritime und limnische Archäologie und Kulturgeschichte

19. Jahrgang 2019 Heft 1/2



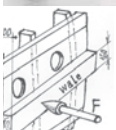
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Titelmotiv

Front view (head) of Ram 8.

*Aus: Sieghard Wagener, A Fatal Crash at the First Punic War.
Investigation of an Ancient Sea Battle by Engineering Methods*

Vorwort

Um den über die letzten Jahre entstandenen Rückstand der Skyllis aufzuholen, erscheint der vorliegende Band 19-1/2, 2019 nicht wie üblich in zwei Teilheften, sondern als Doppelband.

In diesem Band sind Beiträge unterschiedlicher Herkunft versammelt. Die Beiträge von Michael Jones, Yannis Nakas sowie von Miran Erič, Enej Guček Puhar,

Žiga Stopinšek, Aleš Jaklič und Franc Solina gehen auf Vorträge bei der IPR XXIV in Bodrum 2019 zurück. Sieghard Wageners Beitrag entstand aus einem ebenfalls in Bodrum präsentierten Poster, das er in erweiterter Form auf der IPR XXV in Frankfurt vortrug.

Alle übrigen Beiträge entstanden unabhängig von den Tagungen der DEGUWA. Abgerundet wird der

Band durch einen Tagungsbericht zur Unterwasserarchäologie in Bayern sowie eine Rezension.

Generell soll Skyllis künftig nur noch einmal jährlich erscheinen. Da diese Bände entsprechend umfangreicher sein werden, bekommen Sie damit aber genauso viel zu lesen wie bisher. Band 20, 2020 wird Ende dieses Jahres folgen.

Winfried Held

“Gain Overcomes Everything”:

A Mariner's Perspective on the Use of Harbours and Anchorages in the Hellenistic and Roman Mediterranean

Yannis Nakas

Abstract – Contrary to the popular belief, most of the harbours of the late Hellenistic and early Roman Mediterranean were far from hospitable and safe for every ship, notwithstanding the great improvements in harbour construction technology and the great funds employed for their construction and maintenance. Literary and archaeological sources show that, although ships became more numerous and larger, serving an increasingly larger sea traffic within the *pax romana*, many harbours remained shallow and unprotected. Yet, “gain overcomes everything”, as Strabo described the solutions employed by merchants and mariners when using the silted harbour of Ostia. Harbours flourished, becoming important exchange and shipping hubs and serving as contact zones between the outer world and the adjacent metropoleis like Rome, Corinth or Delos. Mariners of the period were versatile and ingeniously used every method available (docking, anchoring, beaching, towing, piloting) to tackle all adverse and variable coastal environments and to secure their profit and safety.

Inhalt – Entgegen der allgemeinen Annahme waren die meisten Häfen des Mittelmeers im späten Hellenismus und der frühen römischen Kaiserzeit weit davon entfernt, gastfreundlich und sicher für jedes Schiff zu sein, trotz der großen Fortschritte in der Hafenbautechnik und der enormen Mittel, die für ihren Bau und ihre Instandhaltung aufgebracht wurden. Literarische und archäologische Quellen zeugen davon, dass viele Häfen flach und ungeschützt blieben, obwohl die Schiffe aufgrund des zunehmenden Seeverkehr innerhalb der *pax romana* zahlreicher und größer wurden. Doch „der Gewinn bezwingt alles“, wie Strabo den Aufwand beschrieb, den die Händler und Seeleute für die Nutzung des versandeten Hafens von Ostia betrieben. Die Häfen blühten, wurden zu bedeutenden Austausch- und Schifffahrtsknotenpunkten und dienten als Kontaktzonen zwischen der Außenwelt und den Metropolen wie Rom, Korinth oder Delos. Die Seefahrer dieser Zeit waren vielseitig begabt und nutzten geschickt jede verfügbare Methode (Anlegen, Ankern, auf den Strand Setzen, Schleppen, Lotsen), um allen widrigen und wechselhaften Gegebenheiten der Küstenlandschaften zu trotzen und so für ihren Profit und ihre Sicherheit zu sorgen.

Harbours have been amongst the most complicated, technologically advanced and monumental structures of humankind. They are also the places where the hinterland encounters the sea, places where networks merge and where people gather to exchange goods but also to experience the outer world¹. But, beyond busy commercial centres, monumental spaces and crowded coastal cities, harbours are fundamentally constructed and operated in order to receive, shelter and serve ships. Thus their configuration and operation should always be studied in accordance with the ships that would frequent them, their size, type and cargo, as well as the different methods they could employ in order to use them.

Ships and seafaring in the Hellenistic and Roman Mediterranean

Shipbuilding and seafaring received a great push during the Hellenistic and Roman period, mainly due to the increasing demands of trade and the establishment of new networks of exchange through the gradual cultural and political unification of the Mediterranean that began with Alexander and peaked with the *pax romana*². This caused the construction of a greater numbers of ships (evident in the increase of shipwrecks in the archaeological record)³, as well as the increase of their size. The growing population of great cities like Rome and Alexandria demanded more im-

* This paper is largely based on the results of the author's ongoing doctoral research on the construction, use and evolution of late Hellenistic and Roman harbours of the Aegean. The research is being carried out at the University of Birmingham under the supervision of Henry Chapman and Gareth Sears. The author would like to warmly thank his supervisors, as well as his previous co-supervisor Martha Zarmakoupi (University of Pennsylvania) for their continuous support, help and precious guidance. The author would also like to thank the good friend and colleague Aylin Güngör for the translation of the paper's abstract in German.

¹ Purcell 1996, 272–273.

² Casson 1974, 115–122; Horden – Purcell 2000, 27.

³ Parker 1992, 89; Wilson 2011, 33–39.



ports of goods and especially victuals like grain and wine and more ships had to be built to serve such networks, since the bulk of grain was carried via the sea. The first ‘mega-freighters’, like the 1,700-ton SYRACUSIA of Hiero and the 1,200-ton ISIS described by Athenaeus (5,206d–209) and Lucian (nav. 5,9) respectively, appear in this period⁴, whereas shipwrecks document the operation of the *myriophoroi*, 10,000-amphorae carriers⁵. Equally important was the trade of marble and stone, which would cover the growing needs of the developing religious and urban centres of the Mediterranean⁶. Larger ships required larger, as well as deeper harbours in order to be sheltered. They also needed better infrastructures like markets, warehouses, and roads in order to unload and load their cargoes, and distribute them locally or tranship them to other destinations.

A closer look, however, to the data related with ship size and construction, reveals that things were much more complicated. The ‘mega-freighters’, of which we only know two and only through written sources, were exceptional ships and their construction and operation required considerable funding, whereas their loss would be devastating for their owners⁷. The *myriophoroi*, although they appear to have been more regular ships for regular bulk cargoes, have only been found in the western Mediterranean and are limited to the 1st century BC, most probably as a local and short-lived type of ship⁸. The majority of the seagoing vessels discovered under water or described by written sources belong to ships of middle and small capacity, with a correspondingly much smaller size and draft (figs. 1, 2)⁹.

The existence of an ‘average’ merchantman has been discussed in the past by various scholars and various suggestions have been made concerning its capacity and size¹⁰. Nevertheless, neither shipwrecks nor written evidence verify the existence of any average commercial ship type with a size regu-

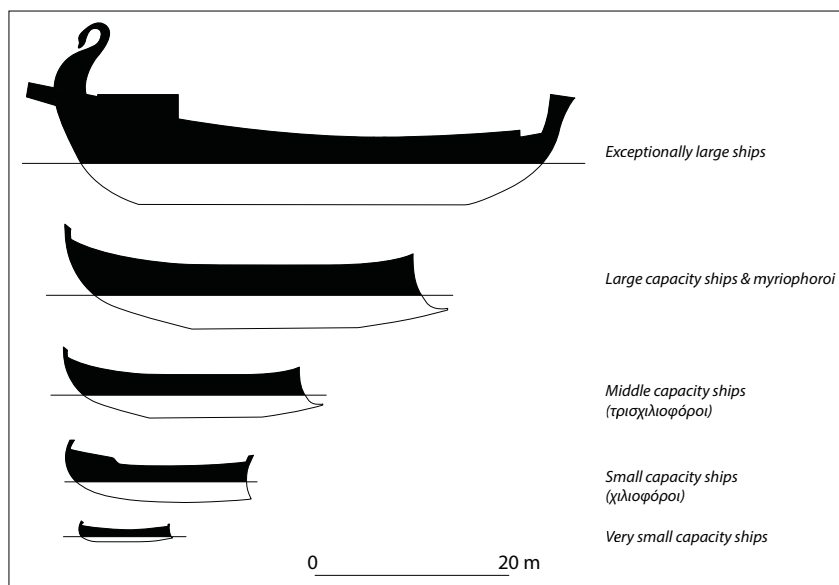


Fig. 1: Pie chart showing the relationship between the numbers of ships of various capacities during the Hellenistic and Roman period in the Mediterranean. The chart is based on shipwrecks that preserve enough remains to reveal their original size and capacity, as well as written sources documenting the size of various ships

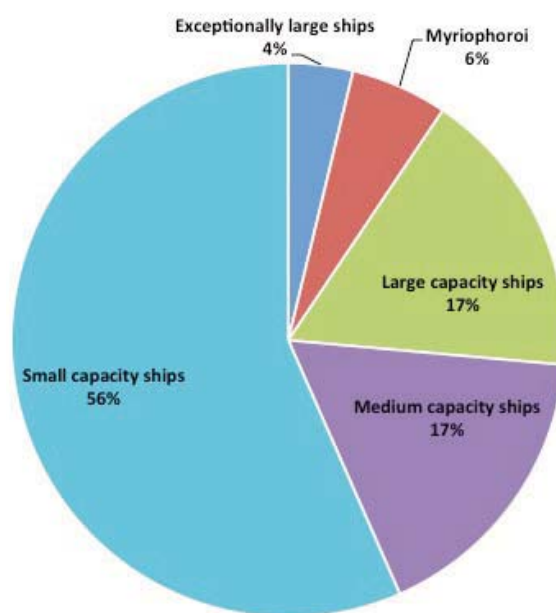


Fig. 2: Map of the ancient Mediterranean harbours where hydraulic concrete has been used and identified by fieldwork (Brandon et al. 2015, fig. 3,2)

lated by the authorities for taxation or construction reasons. Ships of every capacity, from small lighters to gigantic freighters were most probably operating side by side, each serving different networks and areas. The prevalence of smaller ships (fig. 2) can be explained by the construction and operation costs and the greater risk management margins they allowed compared to the large freighters¹¹. An extra advantage of smaller ships would be the ability to approach shallower coasts and rivers, some-

⁴ Casson 1971, 184–188.

⁵ Wallinga 1964; Pomey – Tchernia 1978, 233–237.

⁶ Russell 2013a; 2013b.

⁷ Hopkins 1983, 100–102.

⁸ Nantet 2016, 115–116.

⁹ For a general classification of ancient Mediterranean ships according to their size and capacity see Casson 1971, 171–172; Parker 1992, 89; Boetto 2010, t. 1.

¹⁰ Wallinga 1964, 27; Houston 1988.

¹¹ Hopkins 1983, 100–102.



Fig. 3: An enclosed monumental harbour in a 1st century CE fresco from Stabiae (Votruba 2017, fig. 8)

thing that at least partly balanced their small cargo capacity.

Hellenistic and Roman harbours: a technological revolution?

During the Hellenistic and Roman Imperial periods some of the most impressive harbours were constructed in the Mediterranean¹². The size and grandiose monumentality of harbours like Alexandria, Caesarea Maritima or Portus were unprecedented and marked not only the steep increase in the sea transportation and trade within the unified Mediterranean, but also the use of the harbour space as a symbol of authority and power by the rulers and ruling elites of the time, who invested huge amounts of money in order to embellish the ‘façade maritime’ of their domains and cities¹³. The construction of fully artificial harbours was made possible thanks to the development of sophisticated dredging methods – their extensive use was verified by geoarchaeological researches in various sites of the Mediterranean already since the 4th century BC¹⁴ – as well as to the introduction of maritime concrete in harbour works in the second half of the 1st century BC¹⁵. Maritime concrete allowed, for the first time, builders to successfully construct massive

jetties and piers directly on the seabed inside the water, a method that was much more efficient than the pre-existing ‘Phoenician’ method of quarrying harbours on rocky shores and the ‘Greek’ method of building ashlar moles on rubble foundation outside the water surface¹⁶. The improvement of technology and the need to house growing numbers and sizes of merchantmen caused the construction of massive, artificial harbours like Portus or Caesarea. Thanks to the use of concrete and dredging, harbour basins could be large and deep enough to allow ships of any capacity to dock directly on the quays surrounding them and unload or load their cargoes.

A more thorough scrutiny, however, of the harbours and anchorages of the period paints a different image. The application of maritime concrete is much more limited than one would expect. Apart from Campania, the area where the method was probably invented and first applied, thanks to the availability of material for the construction of the concrete (volcanic pozzolana) and great harbours like Alexandria and Caesarea, maritime concrete harbours are not distributed evenly (fig. 3). Areas like the Adriatic or the Black Sea have not revealed any remains of maritime

concrete. In the case of the Aegean, the actual application of maritime concrete in the period studied has been verified by the meticulous study of the ROMACONS (Roman Maritime Concrete Survey) project only in one site, Chersonesos in Crete¹⁷. Equally uneven is the application of dredging which has been documented by geoarchaeological finds in Italy and the Levant¹⁸ and by texts in Asia Minor¹⁹, but not in harbours like Delos or Kenchreai²⁰, whereas the constant need for copious dredging

¹² Oleson – Hohlfelder 2011, 813. 818–819.

¹³ Horden – Purcell 2000, 126, 393–395; Arnaud 2015.

¹⁴ Morhange – Marriner 2010; Marriner et al. 2014; Salomon et al. 2016.

¹⁵ Brandon et al. 2014, 225–226.

¹⁶ Rickman 1996, 285.

¹⁷ Brandon et al. 2014, 89–93. Although hydraulic concrete has been widely employed in the harbour of Lechaion, recent investigations of the site showed that it could not be dated before the 4th century AD (Güngör – Lovén 2018, 43).

¹⁸ Marriner et al. 2014.

¹⁹ Wilson 2011, 51.

²⁰ The main harbour of Delos was recently surveyed with the application of electric resistivity methods and sondages were also carried out (Desruelles et al. 2007, fig. 3; Desruelles – Hasenohr 2018, 42) and no





Fig. 4: Cross-section of the quays of Leptis Magna (von Gerkan 1933, 40 fig. 5)

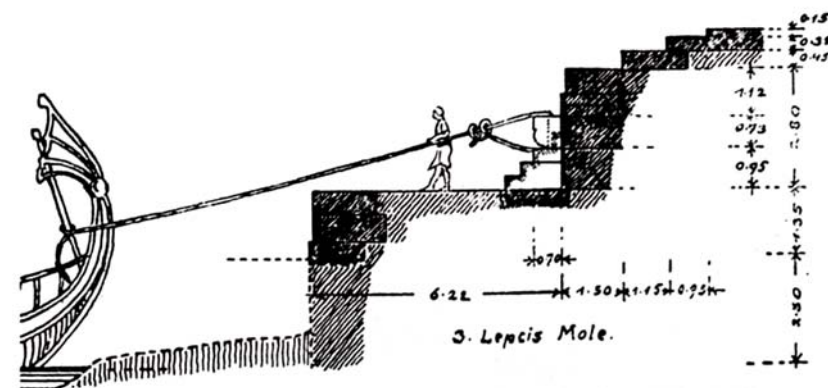


Fig. 5: Various mooring methods that could be employed by Hellenistic and Roman ships. A: Small capacity ship with its bow resting on the foundation of the quay. B: Small capacity ship berthed directly on a maritime concrete quay. C: Large capacity ship with its bow resting on the foundation of the quay. D: Large capacity ship berthed directly on a maritime concrete quay (drawing by the author)

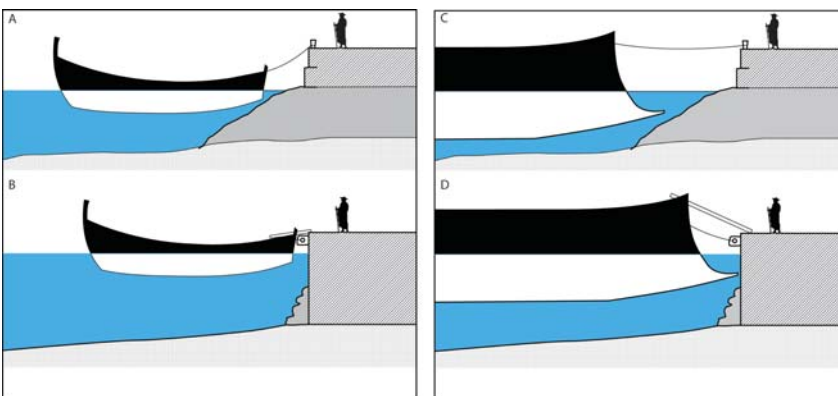


Fig. 6: Plan of the draft beaching possibilities of Hellenistic and Roman ships of various capacities (drawing by the author)

in certain harbours prone to silting would often become proverbial²¹.

Both techniques were apparently expensive and technically demanding and many local communities could not or did not really need to employ them. Some of the most important harbours of the period remained small and shallow. Even after the introduction of maritime concrete a series of harbours continued to be built with ashlar and rubble – e. g. the monumental Leptis Magna had walls constructed on dry land outside the water²² – and often remained unequipped with any quays, being little more than open beaches (the ‘opportunistic harbours’)²³. A series of written sources eloquently highlights the problems of these harbours: Strabo²⁴ and Dionysius of Halicarnassus²⁵ describe as such the small and exposed river harbour of Ostia, which ships avoided to use, preferring to anchor in the open sea. Aelius Aristides²⁶ gives a vivid

traces of any dredging were located. At Kenchreai, the long and meticulous survey and excavation of the Roman harbour (Scranton et al. 1978) revealed no traces of dredging either.

²¹ Bean 1968, 100.

²² von Gerkan 1933, 40 fig. 5; Bartoccini 1958, 28–29 figs. 1–3.

²³ Leidwanger 2013, 223–225.

²⁴ “Of the maritime cities of Latium, one is Ostia. This city has no port, owing to the accumulation of the alluvial deposit brought down by the Tiber, which is swelled by numerous rivers; vessels therefore bring to anchor further out, but not without danger” (Strabo 5,3,5).

²⁵ “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 riverboats” (Dion. Hal. 3,44,4).

²⁶ “It was close to dawn and an amazing storm broke and the sea was shaken by a wild tempest and flooded everything; other ships in the harbour were thrown on land and other 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” (Aelius Aristides, Sacred Tales D32–7).

account of the harbour of Delos, where ships were thrown out of the water by a violent storm. Strabo also frequently uses the term ἀλίμενος (harbourless) for coasts or cities that were not equipped with natural or artificial harbours²⁷. Even the great harbour of Alexandria, although well protected, had a dangerous entrance and ships had to wait outside of it until conditions were favourable, as Flavius Josephus describes²⁸.

The lack of quays where ships could dock and unload their cargo is also reflected in iconography, where there is practically only one representation of such a dock on the Torlonia relief from Ostia²⁹. Even in the Stabiae fresco (fig. 4) with the representation of a monumental, lavish harbour, the artist has chosen to portray ships not berthed on any of the monumental quays and jetties he has drawn, but anchored or draft beached in the middle of the basin³⁰. Although this lacuna in contemporary iconography should not be taken as firm prove for the lack of docking, it is an indication that the popular image of harbours in this specific period did not include docked ships.

Many Hellenistic and Roman harbours, however, were equipped with a series of bollard or mooring stones (e. g. Portus, Leptis Magna, Phalasarina)³¹. Is this then an indication that mooring directly on docks was common? In certain harbours like Portus, where the depth of the Trajanic basin remained great thanks to continuous dredging³², mooring stones would secure ships docked next to the quays. In the case of Leptis Magna, however, and according to the excavators, the ashlar quays were built out of the water and ships had to maintain a distance from the shore (fig. 5).

The mariners of the Hellenistic and Roman Imperial period had thus to deal with a rather difficult situation. Ships of every kind and size had to approach coasts ranging from deep, well-protected coves

and anchorages to totally exposed, sandy or rocky shores, as well as lagoons, estuaries and rivers. Archaeological data show that deep, well-sheltered artificial or natural harbours were by far not the norm in the Mediterranean and were restricted to specific important cities. Even if great harbours like Alexandria and Portus were at the very ends of a specific and very important ship itinerary and were for this reason constantly improved and maintained, ships would still have to use harbours for provisioning, repairs and for shelter when the weather became difficult. And, as we will see, the mariners of the time had developed a variety of techniques to deal with a variety of harbours.

The mariners' solutions

With deep and spacious harbours being few and practically the exception and not the rule in the Hellenistic and Roman Mediterranean, mariners had to be ingenious and inventive in order to travel with safety and guarantee their profit and often their survival. Docking, probably the most convenient and fast way to use a harbour and to load or unload cargoes appears to have been limited to very specific harbours equipped either with concrete quays or with wooden jetties, at least for large capacity ships (fig. 6). Smaller ships could use rubble and ashlar quays with their bows resting on the beach, but that would have been dangerous, due to the hardness of the rubble that could seriously damage the wooden hulls. **Mooring could have also been employed with the use of long cables attached to the shore like the ones reported in the harbour of Carthage by Appian (pun. 14,96), and with the help of buoys.** Ships could pick them up and secure themselves without coming close to the potentially dangerous quays.

Anchoring must have been a much safer solution. The ships of the period, as seen through iconography and shipwrecks were ade-

quately equipped with many anchors of various types and could secure themselves well in the open sea. The practice of anchoring in the open is documented by Demosthenes already in the 4th century BC, and later by Strabo and Josephus³³. Ships would be relatively safe in the open, maintaining a distance from the hazardous shore, but apart from the dangers of losing their anchors and drifting uncontrollably, one of the main drawbacks of this method was the need to employ lighters in order to load and unload cargoes. In the case of Roman Ostia and Portus the application of lighters is well attested by inscriptions:³⁴ a variety of vessels was used to un-load the merchantmen and carry their cargoes to the harbour or directly to Rome. The ships' lifeboats, that regularly appear in written sources and iconography, could also assist the transshipment of the cargoes. The problem was the need to employ enough working hands

²⁷ "A second is that along most of its coast it is harbourless and that the harbours it does have are large and admirable" (Strabo 6,4,1).

²⁸ "The haven also of Alexandria is not entered by the mariners without difficulty, even in times of peace; for the passage inward is narrow, and full of rocks that lie under the water, which oblige the mariners to turn from a straight direction" (Flavius Josephus, bell. 4,5,10); Belov 2015, 55.

²⁹ Basch 1987, figs. 1038. 1044.

³⁰ Votruba 2017, 20 fig. 8.

³¹ Blackman 2008, 651.

³² Salomon et al. 2016.

³³ "You must now hear the most outrageous thing, which this fellow Lacritus has done; for it was he who managed the whole affair. When they arrived here they did not put into your port, but came to anchor in Thieves Harbour, which is outside of the signs marking your port; and to anchor in Thieves Harbour is the same as if one were to anchor in Aegina or Megara; for anyone can sail forth from that harbour to whatever point he wishes and at any moment he pleases" (Demosthenes 35,28); see n. 24. 28.

³⁴ Casson 1965.



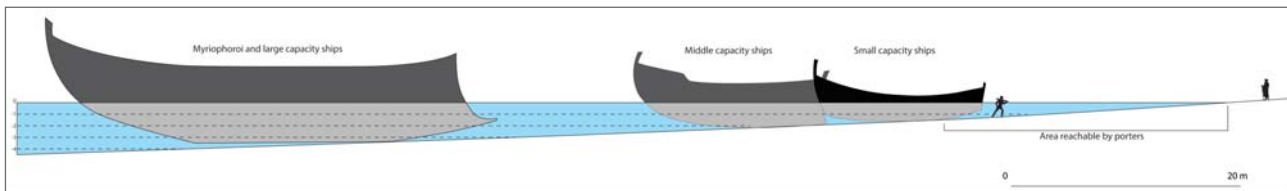


Table 1: A basic typology of Hellenistic and Roman ships concerning their size, capacity and draft, according to shipwreck finds and written sources (drawing by the author)

and boats in order to unload a cargo, especially of ships of great capacity, and it would have taken several days for such an operation, adding to the overall cost of the merchandize.

Beaching was another practice widely employed from antiquity until modern times, particularly in many shallow and sandy harbours of the Mediterranean, and is attested in various iconographical sources³⁵. Hauling, however, any substantial cargo vessel out of the water would have required not only enough working hands which were not always available, but also adequate wooden supports and slipways and possibly capstans. Lighters and boats could have been easily hauled on the shore by their own crew. Draft beaching would have been a much better solution for merchantmen, allowing them to approach the shore safely without being stranded and unload or load their cargo (fig. 7). However, there was a serious drawback on this method: porters could not work in the water when the former was above 1.5 m deep and that would limit this method to ships of small capacity only. The use of gangplanks, evident in the iconography of the early Imperial period, could have helped the situation, but not very much. Therefore wooden jetties or lighters would have had to be employed again in this case.

A 'harbourless' sea?

Although in modern standards the methods described above appear insufficient in comparison to docking, they do not seem to have hindered the development of trade networks and harbour cities dur-

ing the period studied. Delos is a good example of a city whose prosperity was almost totally based on the exchange of goods and whose abrupt and unprecedented transformation into a buzzing harbour city between 166 and 88 BC was neither caused by the creation of a spacious and deep harbour, nor made the local authorities build any substantial harbour works. With the employment of maritime concrete being limited to very specific sites and siltation being a constant threat to some of the most important harbours of the period, e. g. Ephesus³⁶, the construction and operation of a 'good' harbour was not a precondition for the existence of a commercial city. A multitude of smaller natural harbours, usually without any substantial harbour infrastructure operated at the same time, serving various small or large networks.

Was then the Mediterranean a 'harbourless' sea, where ships had to venture constantly around unfriendly coasts? The answer lies in the true meaning of a 'good' harbour in antiquity. As the study of harbours, their depth and size reveals, successful and busy harbours did not have to be deep, large and protected enough, at least in modern standards, to fulfil their mission. Although commercial centres like Delos or Ostia were never truly equipped with large and deep harbours, they managed to develop into buzzing exchange hubs, receiving and administering huge numbers of ships, people and cargoes. Ships were adequately equipped to navigate any coast they would encounter and make the best out of every situation they encountered. The creation of expensive, monumental and large

harbours, whose operational life was, potentially, very short, was often not an option for the local communities. The large, deep and luxurious harbours of the period were therefore the exception and not the rule, in a sea full of hundreds of harbours, anchorages, estuaries, and lagoons that ships had every reason to use according to their needs and circumstances.

Bibliography

- Arnaud 2015
P. Arnaud, The Interplay between Practitioners and Decision-makers for the Selection, Organisation, Utilisation and Maintenance of Ports in the Roman Empire, in: J. Preiser-Kapeller – F. Daim (eds.), Harbours and Maritime Networks as Complex Adaptive Systems, International Workshop Mainz (Mainz 2015) 61–82
- Bartoccini 1958
R. Bartoccini, Il Porto Romano di Leptis Magna, *Bollettino del Centro Studi per la Storia dell' Architettura* 13 (Roma 1958)
- Basch 1987
L. Basch, *Le Musee Imaginaire de la Marine Antique* (Athens 1987)
- Bean 1968
G. E. Bean, *Turkey's Southern Shore: an Archaeological Guide* (London 1968)
- Belov 2015
A. Belov, Navigation within the Great Harbour of Greco-Roman Alexandria, in: S. V. Ivanov – E. G. Tolmacheva (eds.), *And the Earth is Joyous...: Studies in Honour of Galina A. Belova* (Moscow 2015) 45–72
- Blackman 2008
D. J. Blackman, Sea Transport 2: Harbours, in: J. P. Oleson (ed.), *The Oxford Hand-*

³⁵ Votruba 2017.

³⁶ Wilson 2011, 51.

- book of Engineering and Technology in the Classical World (Oxford 2008) 638–670
- Boetto 2010
G. Boetto, *Le port vu de la mer: l'apport de l'archéologie navale à l'étude des ports antiques*, *Bolletino di Archeologia on line I*, volume speciale B B7 (9), 2010, 112–128
- Brandon et al. 2014
C. J. Brandon – R. L. Hohlfelder – M. D. Jackson – J. P. Oleson, *Building for Eternity: The History and Technology of Roman Concrete Engineering in the Sea* (Oxford 2014)
- Casson 1965
L. Casson, *Harbour and River Boats of Ancient Rome*, *JRS* 55, 1965, 31–39
- Casson 1971
L. Casson, *Ships and Seamanship in the Ancient World* (Princeton 1971)
- Casson 1974
L. Casson, *Travel in the Ancient World* (Baltimore 1974)
- Desruelles et al. 2007
S. Desruelles – E. Fouache – R. Dalongeville – K. Pavlopoulos – J.-P. Peulvast – Y. Coquinot – J.-L. Potdevin – C. Hasenohr – M. Brunet – R. Mathieu – E. Nicot, *Sea-level Changes and Shoreline Reconstruction in the Ancient City of Delos (Cyclades, Greece)*, *Geodinamica Acta* 20-4, 2007, 231–239
- Desruelles – Hasenohr 2018
S. Desruelles – C. Hasenohr, *Géomorphologie, hydrologie et littoral du sanctuaire*, in: R. Étienne (ed.), *Le Sanctuaire d'Apollon à Délos, Délos 44* (Athènes 2018) 31–45
- Güngör – Lovén 2018
A. Güngör – B. Lovén, *Fünf Jahre Hafenforschung und Unterwasserarchäologie*, *AW* 2/18, 2018, 39–44
- Hopkins 1983
K. Hopkins, *Models, Ships and Staples*, in: P. Garnsey – C. R. Whittaker (eds.), *Trade and Famine in Classical Antiquity, Proceedings of the Cambridge Philological Society suppl. 8* (Cambridge 1983) 84–109
- Horden – Purcell 2000
P. Horden – N. Purcell, *The Corrupting Sea. A Study of Mediterranean History* (Malden 2000)
- Houston 1988
G. W. Houston, *Ports in Perspective: some comparative materials on Roman merchant ships and ports*, *AJA* 92, 1988, 553–564
- Leidwanger 2013
J. Leidwanger, *Opportunistic Ports and Spaces of Exchange in Late Roman Cyprus*, *Journal of Maritime Archaeology* 8, 2013, 221–243
- Marriner et al. 2014
N. Marriner – C. Morhange – D. Kaniewski – N. Carayon, *Ancient Harbour Infrastructure in the Levant: tracking the birth and rise of new forms of anthropogenic pressure*, *Scientific Reports* 4, 2014, 1–11
- Morhange – Marriner 2010
C. Morhange – N. Marriner, *Mind the (Stratigraphic) Gap: Roman dredging in ancient Mediterranean harbours*, *Bolletino di Archeologia on line*, volume speciale 2010, 23–32
- Nantet 2016
E. Nantet, *Phortia, le tonnage des navires de commerce en Méditerranée, du VIII^e siècle av. l'ère chrétienne au VII^e siècle de l'ère chrétienne* (Rennes 2016)
- Oleson – Hohlfelder 2011
J. P. Oleson – R. L. Hohlfelder, *Ancient Harbours in the Mediterranean*, in: A. Catsambis – B. Ford – D. L. Hamilton (eds.), *The Oxford Handbook of Maritime Archaeology* (Oxford 2011) 809–833
- Parker 1992
A. J. Parker, *Cargoes, Containers and Stowage: the ancient Mediterranean*, *IJNA* 24-2, 1992, 89–100
- Pomey – Tchernia 1978
P. Pomey – A. Tchernia, *Le tonnage maximum des navires de commerce romains*, *Archaeonautica* 2, 1978, 233–251
- Purcell 1996
N. Purcell, *The Ports of Rome: evolution of a façade maritime*, in: A. Gallina Zevi – A. Claridge (eds.), *'Roman Ostia' Revisited. Archaeological and Historical Papers in Memory of Russell Meiggs* (London 1996) 267–279
- Rickman 1996
G. E. Rickman, *Portus in Perspective*, in: A. Gallina Zevi – A. Claridge (eds.), *'Roman Ostia' Revisited. Archaeological and Historical Papers in Memory of Russell Meiggs* (London 1996) 281–291
- Russell 2013a
B. Russell, *The Economics of the Roman Stone Trade* (Oxford 2013)
- Russell 2013b
B. Russell, *Roman and Late-antique Shipwrecks with Stone Cargoes: a new inventory*, *JRA* 26, 2013, 331–361
- Salomon et al. 2016
F. Salomon – S. Keay – N. Carayon – J.-P. Goiran, *The Development and Characteristics of Ancient Harbours. Applying the PADM Chart to the case studies of Ostia and Portus*, *PLoS ONE* 11-9, 2016, 1–23
- Scranton et al. 1978
R. Scranton – J. W. Shaw – L. Ibrahim, *Kenchreai. Eastern Port of Corinth I. Topography and Architecture* (Leiden 1978)
- von Gerkan 1933
A. von Gerkan, *Meershöhen und Hafenanlagen im Altertum*, in: Wilhelm Dörpfeld, *Festschrift zum 80. Geburtstag* (Berlin 1933) 37–42 (reprint in: E. Boehringer (ed.), *Von Antiker Architektur und Topographie. Gesammelte Aufsätze von Armin von Gerkan* [Stuttgart 1959] 139–142)
- Votruba 2017
G. F. Votruba, *Did Vessels Beach in the Ancient Mediterranean? An assessment of the textual and visual evidence*, *The Mariner's Mirror* 103-1, 2017, 7–29
- Wallinga 1964
H. T. Wallinga, *The Unit of Capacity for Ancient Ships*, *Mnemosyne* 4th ser. 17-1, 1964, 1–40
- Wilson 2011
A. Wilson, *Developments in Mediterranean Shipping and Maritime Trade from the Hellenistic Period to AD 1000*, in: D. Robinson – A. Wilson (eds.), *Maritime Archaeology and Ancient Trade in the Mediterranean*, *Oxford Centre for Maritime Archaeology Monographs* 6 (Oxford 2011) 33–59

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