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New Approaches to Seaborne Commerce in the Roman Empire

Panel 5.17

Thomas Schmidts
Martina Seifert (Eds.)

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Edited by

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PREFACE

On behalf of the 'Associazione Internazionale di Archeologia Classica (AIAC)' the 19th International Congress of Classical Archaeology took place in Cologne and Bonn from 22 to 26 May 2018. It was jointly organized by the two Archaeological Institutes of the Universities of Cologne and Bonn, and the primary theme of the congress was 'Archaeology and Economy in the Ancient World'. In fact, economic aspects permeate all areas of public and private life in ancient societies, whether in urban development, religion, art, housing, or in death.

Research on ancient economies has long played a significant role in ancient history. Increasingly in the last decades, awareness has grown in archaeology that the material culture of ancient societies offers excellent opportunities for studying the structure, performance, and dynamics of ancient economic systems and economic processes. Therefore, the main objective of this congress was to understand economy as a central element of classical societies and to analyze its interaction with ecological, political, social, religious, and cultural factors. The theme of the congress was addressed to all disciplines that deal with the Greco-Roman civilization and their neighbouring cultures from the Aegean Bronze Age to the end of Late Antiquity.

The participation of more than 1.200 scholars from more than 40 countries demonstrates the great response to the topic of the congress. Altogether, more than 900 papers in 128 panels were presented, as were more than 110 posters. The publication of the congress is in two stages: larger panels are initially presented as independent volumes, such as this publication. Finally, at the end of the editing process, all contributions will be published in a joint conference volume.

We would like to take this opportunity to thank all participants and helpers of the congress who made it such a great success. Its realization would not have been possible without the generous support of many institutions, whom we would like to thank once again: the Universities of Bonn and Cologne, the Archaeological Society of Cologne, the Archaeology Foundation of Cologne, the Gerda Henkel Foundation, the Fritz Thyssen Foundation, the Sal. Oppenheim Foundation, the German Research Foundation (DFG), the German Academic Exchange Service (DAAD), the Romano-Germanic Museum Cologne and the LVR-LandesMuseum Bonn. Finally, our thanks go to all colleagues and panel organizers who were involved in the editing and printing process.

Bonn/Cologne, in August 2019

Martin Bentz & Michael Heinzelmann

A Bird's-eye View: the Legal Side of Imperial Seaborne Commerce

Emilia Mataix Ferrándiz

Nowadays, Roman sea trade has been studied considering different sources of evidence, such as pottery, and through diverse theoretical approaches, such as new institutional economics or network analysis. All these methods have their strengths and limitations, as for example, the systematic study of amphorae limits the understanding of commerce just for specific areas or products. In addition, even if different authors have used Roman legal texts as describing some features of commerce, they have not considered the legal framework surrounding the different procedures involved in trade. Overall, one of the problems of the archaeological methods when studying sea trade is to focus mainly on the materials and not on the subjects interacting with them.

My work inside the ERC project Portus Limen is based on the study of the epigraphy of merchandise (e.g. amphorae, barrels, etc.), which reflects the commercial cycle in which the artefact was involved since it was bought (e.g. kilns, workshops) and until it arrived to a destination (e.g. port, market). These inscriptions, which reflect data such as product, merchant or quantity, shape a record and provide essential information about the agreements of sale and transport by sea performed by the parties involved in trade. Consequently, with the help of these inscriptions and other sources as legal or iconographic, I reconstructed a model of the procedures of distribution to understand the itinerary followed by merchandise setting sail from one port to other. The activities described not only depict the activity of the ports of the Mediterranean, since, when considering other regions of the Roman world, a number of these distribution stages can be identified in the different sources, materials and port structures. There were, therefore, geographical variations in the implementation of these procedures, but overall these activities happened throughout the Roman world. This model has been created considering all the elements that can be present at any port (e.g. warehouses, docks), and their locations (e.g. mouth of a river, implying transhipping in some occasions). This means that not just the enormous structures of the main Mediterranean ports, such as Portus, fit inside this model. Ports had contrasting structures built according to their function, to the features of the land or the city to which these ports were associated. However, we can gather something common from all of them: the procedures taking place to sell, control, transport and store the cargoes, setting sail and arriving there. In that way, the use of the model of the cycle of procedures of ports enables us to understand their peculiar features with the help of a common framework.

This paper aims to describe a model of the procedures taking place from a port of departure to a port of destination, considering the model described before. That model allows appreciating landscape as a place where procedures performed in trade and their legal framework were controlled and protected by the law of the Empire and other local

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legal systems being also applied (e.g. Hellenistic, Jewish). This research intends to study the commercial activities taking place in these sites, linked to both the infrastructures and materials associated. This method can be included under the umbrella of the field of "juridical archaeology", as it proceeds beyond the legal text and begins to investigate explanations and causal connections between reconstructed facts, the material remains and their outcome in the excavated site. Juridical archaeology focuses on archaeological sites where legal activities took place (e.g. contracts, control by the authorities of the empire, trials, taxation) and it attempts to analyse and explain the causal links between the legal facts reconstructed through the material remains. The analysis of the procedures performed in these sites, and in the places where the goods are distributed, will help to understand not just the distribution but also the risks and charges assumed by the merchants and the shippers. Consequently, this approach considers trade from a bird's-eye view, focusing on the people involved in the transactions performed along the shores and understanding those as interacting activities between individuals, imperial and provincial authorities.

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The Inscribed Seaborne Commerce

Thomas Schmidts

Ship Cargoes are an excellent source for the economic history of the ancient world: They are closed finds; often with a large number of relevant finds which represent a combination of different groups of merchandises. Additionally, a good state of preservation often simplifies the typological classification of the finds as well as the quantification of the cargoes.

However, the scientific potential of this group of sources does not yet seem to have been exhausted. Studies which are focused on individual cargo residues allow analyse on the reconstruction of trade journeys. However, they have to be questioned with regard to their value for a broader view on the economy. A comparative perspective emerges by looking at wreck finds over a long period of time. All studies refer to the statistics published by A. J. Parker based on his catalogue where the wreck finds are broken down by centuries.[1] However, it seems that these summarising observations that are problematic. This could be explained by A. Wilson in a contribution which critically examined the chronological basis of Parker's statistics and the various factors that were influencing the statistics of the wrecks.[2] In his article he rightly draws attention to problematic economic-historical conclusions from such statistics.[3] Apart from the question which the frequency of wreck finds indicates economic cycles there are further problems for interpretations in behalf of aspects of economic history. Amphorae as the as by far the most common type of finds were container of good – especially foodstuffs – have a significant impact on the assessment of the cargoes. The certainty with which chronology, origin and content can be determined is, however, very different and also depends on the level of experience of involved researcher. If the mentioned points in particular are uncertain, an interpretation of the economic background seems to be problematic. The possibility of reusing amphorae aggravates the difficulties of an interpretation.[4]

The Significance of the Inscriptions

Without relativizing the problems described above, however, I try to harness the unquestionably great potential of cargoes for economic history. It is obvious that the problems regarding the classification of amphorae also apply to the finds ashore. However, some groups of finds are better represented in shipwrecks than ashore. This applies, for example, to the metal bars which origin and dating can often be interpreted on basis of the combinations of finds. For a better understanding of maritime trade, the focus in the following is on remains of cargo with all kinds of inscriptions.[5] These objects are more significant than those without labelling and they are also easier to interpret. In contrast to amphorae for which an advanced typology depends on a specialist, the

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interpretation of stamps or graffiti is often easier. Also, they are often published quite well. They can inform us about producers, products and different qualities, and also sometimes about the dealer or the owner of the goods. So, conclusions can be drawn about the composition of the freight and the export areas. Inscriptions can also provide information about the ship owner or skipper, the crew and the origin of the ship. The potential of these sources can thus be clearly determined. It is possible to reconstruct details of the seaborne commerce which would otherwise remain hidden. The localization of target export areas in detail allows conclusions to be drawn about distribution channels and the ports which could have been the final destinations of the ships. Ultimately, a shipload is the result of contracts between ship owners and merchants. The graffiti and stamps could be used to reconstruct parts of them. An interpretation of the epigraphic material with regard to the legal basis of maritime trade would also be possible. É. Mataix Fernándiz discusses this aspect in her contribution. However, focusing on labelled charge residues also limits the interpretation: They generally represent only a more or less small proportion of the cargo which might restricts or even prevent the possibilities of quantification.[6]

Groups of finds and chronology

Inscriptions and stamps can be found on a variety of objects of different material (fig. 1). The labelled objects provide information especially about the cargo, less about the possession of the crew and travellers. Only in a few individual cases information about the

Group	Objects	S	G	T
Containers	Amphorae, dolia	×	×	×
Fine Wares	e.g. Terra Sigillata	×	×	
Coarse Wares	e.g. Mortaria	×	×	
Lamps	Lamps		×	
Metal Objects	Weights and balances, bronze vessels, furniture, statues	×	×	
Resources	Ingots (lead, copper, tin, sulphur, iron)	×	×	
Building materials	Brick and tile, ashlar	×	×	
Parts of ships and equipment	Timber, anchors, pumps		×	

Fig. 1: Inscribed objects from shipwrecks (S = stamps, G = graffiti, T = tituli picti).

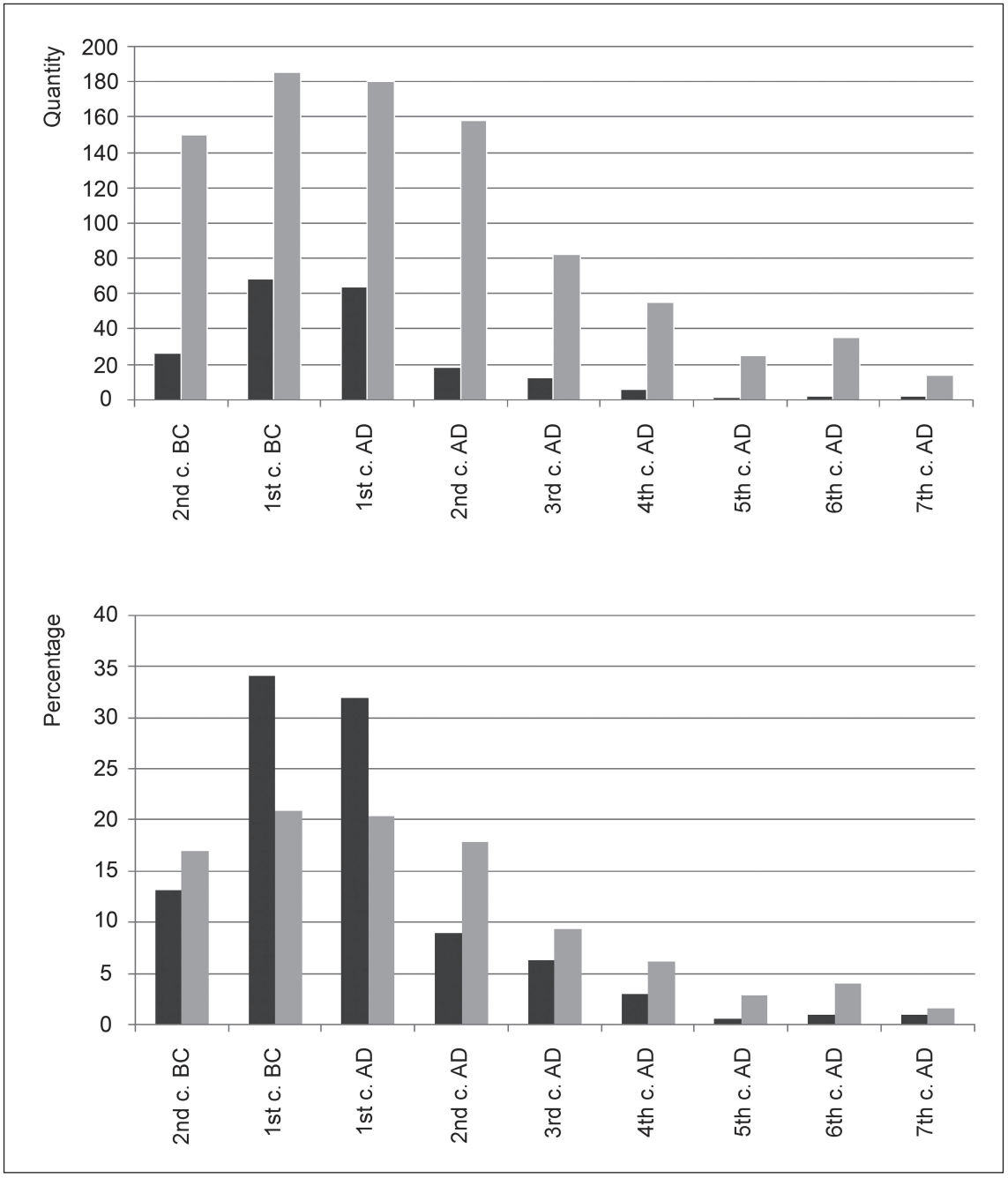

Fig. 2: Shipwrecks from the 2nd century BC to the 7th century AD with inscriptions (dark grey) compared to the entire stock of wrecks (light grey; based on Parker 2008, 187 fig. 12). Above: quantity; below: percentage.

ship itself is given. The chronological distribution can currently only be based on the number of wrecks for which inscriptions are published. It concerns 199 wrecks from the period from the 2nd century BC to the 7th century AD.[7] Their percentage distribution over the centuries roughly corresponds to the total number of wreck finds published by Parker with a peak in the 1st century BC and 1st century AD (fig. 2).[8] However, it is noticeable that the inscriptions are overrepresented in wrecks of the 2nd and 1st century BC and otherwise underrepresented. Whether the deviations can only be explained by a general trend in the labelling of goods, has to be investigated in the future. At least for late antiquity this would not be surprising. The relevant wrecks are located almost exclusively in the western Mediterranean, while the Adriatic and eastern Mediterranean are under-represented. On the one hand, this can be explained by a lower rate of labelled ceramics from the eastern provinces of the Roman empire; on the other hand, a relatively low state of publications would also have to be taken into account.

Case Studies

The following examples presented here should give an impression of the value of epigraphic material for the understanding of maritime trade in the Roman Empire. Their selection is not representative of the group of shipwrecks. The focus is on stamps and graffiti on pottery. Lead and other metal ingots are another important group which will not be discussed in detail here. They are also inscribed frequently.[9]

The wreck of La Madrague des Giens discovered east of Marseille off the coast of southern France is remarkable in many aspects. The ship itself with a reconstructed length of approx. 40 m and a cargo capacity of at least 400 t belongs to the largest class of antique merchant vessels, which have been discovered yet. 2364 amphorae were documented of a cargo which is estimated of more than 6,000 amphorae. These are mainly Italian wine amphorae of the Dressel 1b type, dated to the third quarter of the 1st century BC.[10]

On the basis of the epigraphic evidence, the origin, presumed ownership and loading procedures could be reconstructed by A. Hesnard.[11] The amphora stamps testify that the amphorae were produced at several sites in the Fondi plain in southern Latium. This area was famous for its white wines, especially *Caecubum* and *Fundanum*. Seals on Pozzulan mortar that were applied to the corks as amphora closures show that several wineries were involved in delivering the contents. Three series of amphorae can be classified as the main charge, a further series as a secondary charge. In one series of amphorae of the main charge, the presumed owner of the vineyard, P. Veveius Papus, was also the producer of the amphorae. Due to the anepigraphic seals, the other suppliers can be distinguished, but not named. But, the combination of manufacturer stamps and seal enables the reconstruction of different groups. The assumption that one long-distance trader (or a consortium) was the owner of the main cargo is based on the arbitrary dis-

tribution of the seals within the shipwreck. The secondary cargo included amphorae of the Dressel 1b type with different stamps and seals as well as further amphorae, partly from the Eastern Mediterranean. Less clear than the amphorae are three lead ingots, whose stamps point to an origin from Hispania. A classification as a merchandise on the way from Lazio to Southern Gaul did not seem to make much sense. Therefore, they were interpreted as part of the on-board equipment, namely material for maintaining the ship.[12]

Without a doubt, the remains of the cargo from the wreck of La Madrague de Giens are certainly an excellent example. The quantity and quality of stamps, graffiti is extraordinary as well as the conservation conditions and, last but not least, the state of research and publication. This example illustrates the knowledge potential that stamps and graffiti offer.

The Dramont A wreck which sunk near Fréjus also dates in the third quarter of the 1st century B.C. and its cargo consists almost of Italian wine amphorae of the type Dressel 1b. The name Sextus Arrius, son of Marcus, appeared several times on the seals and also on a lead anchor stick.[13] So it seems clear that Sextus Arrius, who transported the wine he had bought himself to Gaul, was the *navicularius* and merchant in one person. Also, the name Lucius Lentulus is mentioned on the amphora stamps (L. Lentulus P. f.). It is probably identical to L. Cornelius Lentulus Crus who was an owner of a large estate from Minturnae and consul of the year 49 BC.[14]

The wreck Cala Culip IV was discovered off the northern Spanish coast not far from Narbonne. It was a relatively small vehicle of approx. 9 m length which can be interpreted as a coaster. The cargo consists almost entirely of fine ceramics, mainly terra sigillata: 814 terra sigillata vessels were decorated and 1947 decorated. They come exclusively from the pottery centre La Graufesenque in southern Gaul. The research on the decorated vessels by X. Nieto and A. M. Puig led to a date between 75 and 85 AD with a probable limitation to the period 78–82. About 40 different potters could be identified by the stamps. The stamps of Iucundus III, which were frequently found in the cargo, are mainly distributed in the western Mediterranean and at the Atlantic coast (fig. 3). Within this area the maximum radius of action of vessels such as the Cala Culip IV should be sought with Narbonne as port of departure. Its cargo also included stamps on some amphorae of the Dressel 20 type and mortaria.[15]

The wreck St. Gervais 3 that was found in the Rhône estuary dates to the middle of the 2nd century AD. 34 of the at least 43 Hispanic oil amphorae of the type Dressel 20 had stamps of three different types. Furthermore, brush inscriptions (*tituli picti*) were visible on 18 of them due to good conservation conditions. Comparable *tituli picti* are otherwise known especially from Monte Testaccio in Rome. According to a standardised scheme, weight indications, names (producers, traders), the places of delivery and control notes are shown. The evaluation of the tituli picti by B. Liou and J.-M. Gassend indicates four groups, for each of which a separate merchant could be assigned (fig. 4). In two of these groups production and bottling of the oil amphora were conducted by

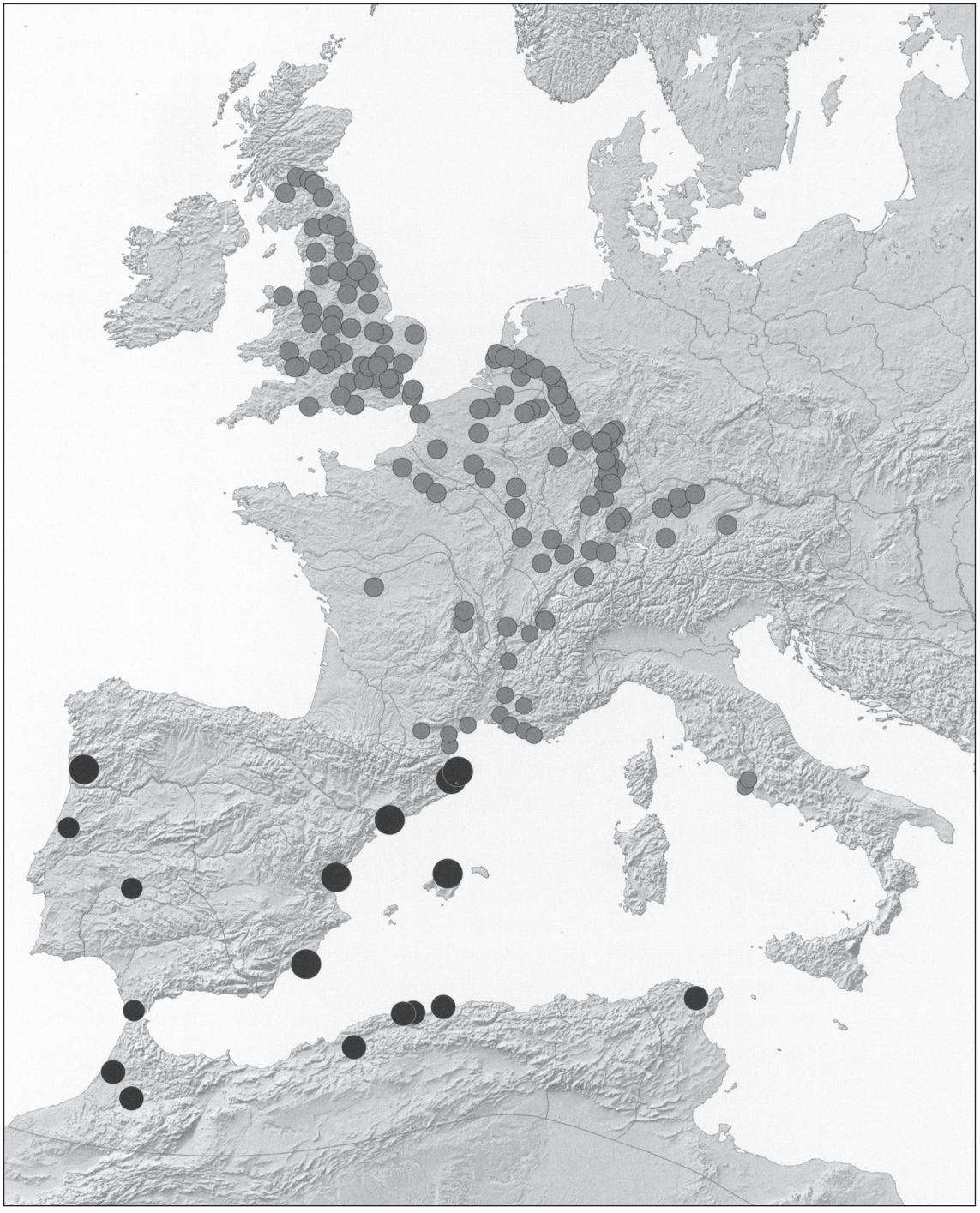

Fig. 3: Distribution of Terra Sigillata with stamps of Iucundus III. The size of the dot is according to the quantity. The colours indicate high percentage (black) or low percentage (grey) of Iucundus III within the Terra Sigillata spectra (after Mees 2011, 195 fig. 180).

		Nos 9, 10, 11, 12	Nos 1, 2, 3, 4, 5, 6, 7, 8	Nos 14, 15	N° 16
1er niveau : *production de l'huile*	propriété	*(fundus) Veturianus*	*(fundus) Charisianus*	*callecr.?*	?
	propriétaire	*Pontianus*	*Aelia Aeliana*	*Aelia Marciana*	?
2e niveau : *production de l'amphore et conditionnement*	estampille	Q I A L	L. S. A. R.	L. S. A. R.	–
	ponderator	*Martialis*	*Anicetus*	*Anicetus*	?
3e niveau : *commercialisation*	*acceptor*	*Herac(lius, -litus ?)*	*Primus*	*oni..?*	?
	mercator	*L. Antonius Epaphroditus*	*L. Antonius Epaphroditus*	*Antonii Melissus et Peregrinus*	*Q.Vinisius Serenus*
Localisation géographique		*Malpica Astigi*			*Astigi*

Fig. 4: Synopsis of tituli piciti on Dressel 20 amphorae from the shipwreck Saint Gervais 3 (after Liou – Gassend 1990, 208).

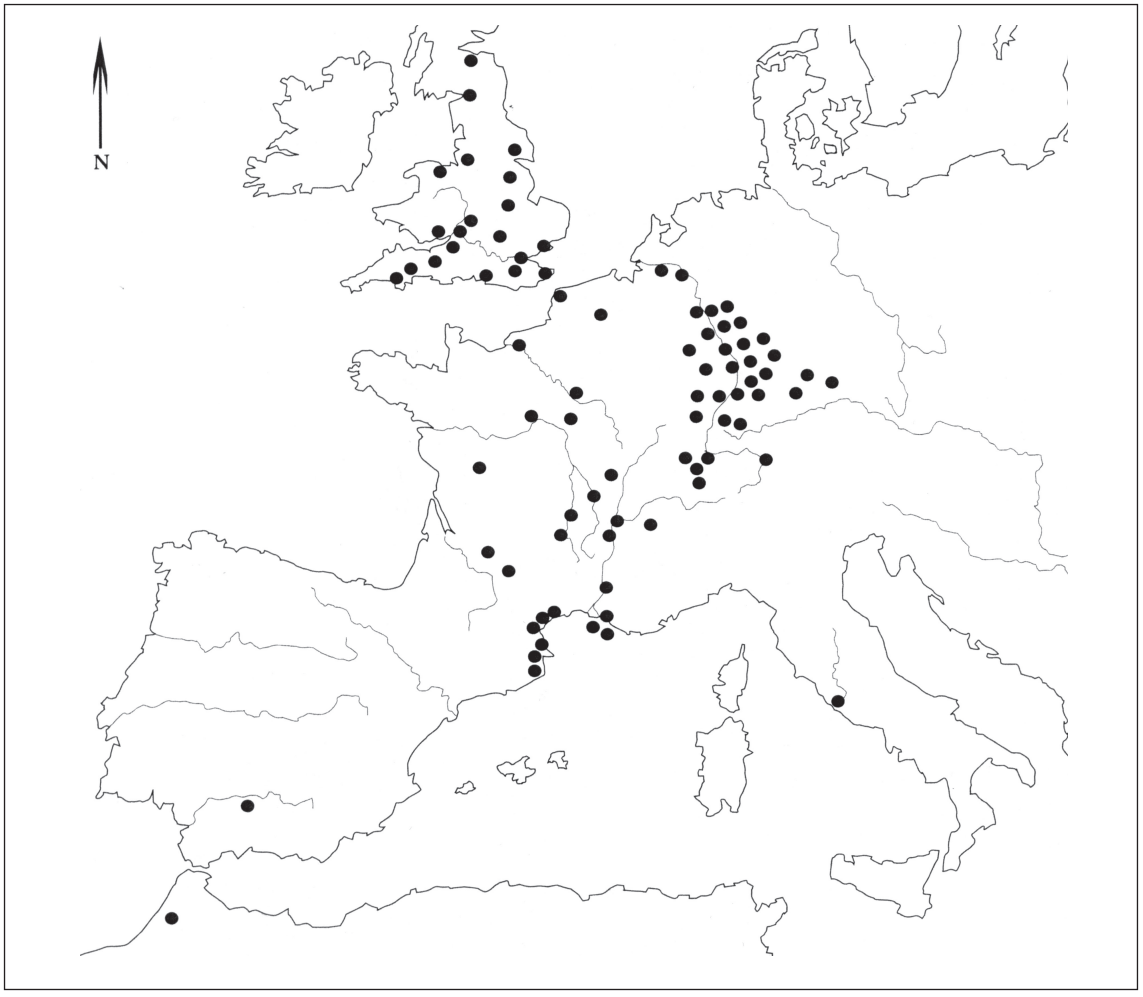

Fig. 5: The distribution of stamps on Dressel 20 amphorae found in the cargo of the Saint Gervais 3 shipwreck (after Étienne/Mayet 2004, 211 fig. 58).

one manufacturer. The instructive map published by R. Etienne and F. Mayet (fig. 5) illustrates the distribution of the stamps found in the wreck. They are often found in the interior of Gaul and in the Limes region. This characterises the potential export areas. The cargo also contained fish sauce and wine amphorae from Gaul and Hispania with *tituli picti* relating mainly to the quality or age of the products.[16]

From the 3rd century AD onwards, the amount of evidence for goods with stamps or graffiti on the ship's cargo has decreased considerably (see above). The use of stamps in particular became relatively rare in Late Antiquity. However, graffiti and brush inscriptions can still be found, especially in the eastern Mediterranean. The early 7th century (terminus post quem 625/626) wreck A of Yassi Ada, discovered off the south-western Turkish coast, is chronologically at the period that is observed in this article. The cargo of the freighter consisted mainly of amphorae of the types LRA1 and LRA 2. The 116 graffiti convey monograms of Names as well as information on the content or quality of the amphora contents. In addition, the graffiti indicates the reuse of amphorae by overwriting. Single might could refer to dates within the reign of Emperor Heraklios. Christian symbols also appear, which hints to the church as new actors in maritime trade.[17] In this context, an important piece of evidence is the chased inscription on a steelyard, which was also part of the wreck's inventory: ΓΕΟΡΓΙΟΥ ΡΡΕΣΒUΤΕΡΟΥ ΝΑΥΚΛΕΡΟΥ. It shows that the scales belonged to the *naukleros* Georgios. The term presbyteros is either to be interpreted in the sense of "the elder" or identifies Georgios as a cleric, which seems to make sense in the context of the already mentioned graffiti and further objects.[18]

Conclusion

Based on a first review of the relevant literature, inscribed objects could be proved for about 200 shipwrecks from the period from the 2nd century B.C. to the 7th century AD These are stamps, graffiti and brush inscriptions (*tituli picti*) on various objects: Pottery fine and coarse ware, amphorae and dolia, lamps, metal ingots and various metal objects. A small and special group of testimonies consists of graffiti on parts or equipment of the ships. The inscribed objects are mostly parts of the cargo, more rarely the crew's possessions. They provide information e.g. on types of goods, producers, places and people involved in trade. The advantage compared to unlabelled goods is the detailed information that can contribute to the reconstruction of maritime trade. However, this usually concerns only a small part of the cargoes, so that a quantification based on the inscribed objects is hardly possible. The chronological distribution of wrecks with inscribed objects shows, similar to the wrecks in general, a peak in the 2nd and 1st century BC. Spatially the western Mediterranean area is the core area, probably due to the epigraphic habit and the state of research. The potential of future research could be a deeper understanding of the networks on which maritime trade was founded.

Notes

[1] Parker 1992, 8–9 on the statistic of the wrecks; also with more data Parker 2008, 187

[2] Wilson 2011; cf. Wilson 2009, 219–229 and the contribution of M. Reinfeld in this volume.

[3] Wilson 2011, 33 n. 2 gives an overview of publications based on Parker statistics.

[4] Beltrame et al. 2011 with the example of wreck 1 of Grado.

[5] This article is based on preliminary work for a research project that aims a systematic record of inscriptions from shipwrecks in future. The statements are based on an initial review of published graffiti and stamps, mainly those which are mentioned by Parker 1994. – Edmondson 2014 about the importance of epigraphic evidence for the valuation of the ancient economy.

[6] Wilson 2009 describes the possibilities of quantification based on archaeological sources.

[7] For the wrecks which were dated in a range of two centuries, a value of 0.5 was assumed for each of the centuries.

[8] Wilson 2009, 33–39 discusses the problems of the wreck statistics according to Parker and the changes when considering different parameters and data.

[9] Brown 2011 on lead ignots from ship wrecks. As Rothenhöfer 2018, 74 noted a "Corpus of Roman Lead Ingots" should be published soon.

[10] Tchernia et. al. 1978 with detailed information on the ship and its cargo.

[11] So Hesnard 2012 which is a modified version of the previous material template: Hesnard 1978 with pl. XIV–XVI.

[12] Laubenheimer 1978 with reference to the ingots of the wreck of Mahdia.

[13] Parker 1992, 165–166 no. 371. – Hesnard – Gianfrotta 1986, 397. 411 Nr 8.6 (seal) and 396–405 (generally on the function of the seals)

[14] Tchernia 2016, 16.

[15] Parker 1992, 157–158 no. 347. – Decorated vessels: Nieto – Puig 2001; cf. also the datasets of Cala Culip IV in: <https://www1.rgzm.de/samian/home/frames.htm> (15. 11. 2021). – Mees 2011, 192 and 194–195 fig. 179–180 on the distribution of Iucundus III stamps.

[16] Liou – Gassend 1990 (catalogue of tituli picti). – Parker 1992, 373–374 no. 1002. – Étienne – Mayet 2004, 210–211 with fig. 58; 234–236.

[17] On wreck and cargo: Bass – van Doorninck 1982; Parker 1992, 454–455 no. 1239; van Doorninck 2015. – Detailed information on the graffiti and their allocation to individual amphora types: van Doorninck 1989, 247–253 and with further remarks van Doorninck 2015, 207; cf. also van Alfen 1996, 201–202.

[18] van Dooninck 2015, 205–206. – Bass – van Doorninck 1982, 212–213 no. 4 and 215 fig. 10–12 (steelyard with inscription).

Image Credits

Fig. 1: T. Schmidts. – Fig. 2: T. Schmidts, auf based on Parker 2008, 187 Fig. 12. – Fig. 3: after Mees 2011, 195 Fig. 180. – Fig. 4: after Liou – Gassend 1990, 208. – Fig. 5: after Étienne – Mayet 2004, 211 Fig. 58.

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Maritime Trade in the Adriatic Sea

Sebastian Adlung – Julia Daum – Martina Seifert

The project "The Adriatic Communication Area: Functional Characteristics of Port Cities and their Facilities on the Italian and Dalmatian Coast during the Roman Imperial Period" focuses on port cities, port facilities and traffic route relations of the coastal areas of the Adriatic Sea (fig. 1). A special view is on networks and mobility of Roman settlers involved in trade and economy. The study started with the analysis of merchant families in the ancient Adriatic region. According to previous research, many of them show relationships to Rome, Spain or Africa being involved in trade activities in Pannonia, Dacia and across the Alps. The paper presented concentrated on questions with regard to trans-Adriatic trade networks revealing the background of their actors as well as economic needs and infrastructures.

The trans-Adriatic trade reflects the settlement history of the region. Already in the 7th century BC. there was the foundation of trading posts and colonies of Greek cities on the islands and in the coastal areas of the Adriatic. The protection of the western and eastern Italic coasts played an important role in the following periods, since the controlled access to the sea and the protection of the trade routes enabled sea transport.

In the course of the First Illyrian War (229–228 B.C.) Roman military fleets crossed the Adriatic Sea to contain the pirates. The raids apparently affected mainly the trade along the Strait of Otranto and the Latin colony of Brundisium. The reasons for the war were certainly complex. Many Greek coastal cities were allies of Rome and as a result, Epidamnos (from now on Dyrrhachium), Apollonia and Korkyra came under Roman protection. For a long time, the dominant view of research was an impoverishment of the local population as the cause of the piracy, now the situation evaluated as an economic conflict of a wealthy population with Rome. The takeover of Illyrian territories brought the Romans not only coastal control and properties, but also the control of overseas ports that were very important for later Roman maritime trade.

It was not until the Augustan period that the last great Pannonian-Dalmatian uprising was put down and Dalmatia was established as a province. According to the narrative established by Wilkes, many settlers with Italic roots settled in the province in this period, they established *villae maritimae* on the numerous islands off the coast and there are traces for an intensive maritime trade in the Adriatic. Former scholarship assumed that the Adriatic Sea had a separating effect in the Republican period, but from the Augustean phase onwards the two Adriatic coasts got in closer contact by merchant activities and probably, the merchants and the settlers as well perceived the Adriatic Sea as a communication space.

At the time of pre-Roman and Roman settlement, cattle breeding and wool production were the most important branches of production in Dalmatia and Liburnia. Especially in the settlements in the hinterland many cowbells and sheep shears were documented. Due to the karst landscape, there were only a few areas suitable for ag-

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riculture, especially farming. With the settlement of the Romans, the cultivation of wine and olives increased, especially in the coastal areas and on the islands. Near fertile areas, the settlers built numerous *villae,* which, if possible, had infrastructures for the loading of goods. Strabon mentions the innumerable ports and landing places along the Dalmatian coast. Other major economic activities include forestry and mining. The main source of lumber was the region of nowadays Bosnia and from the area south of the Velebit massif. Among the products made from it were wooden barrels. Mining was probably one of the most important economic reasons for the expansion of the Romans. Several written sources mentioned Dalmatia as the land of gold. The mining of silver, iron and copper is also attested. The mining areas were mainly located in the region of today's southern and central Bosnia and Herzegovina. Central roads connected them with Salona, Narona and Epidaurum. In the east, roads as well as rivers reached the Danube system. Roman roads met ports mainly at Salona, but also at Narona, Senji and Epidaurum.

Due the Dinaric Alps which are a karst mountain range running from north to south through the whole province, the transport infrastructure is difficult. With their more than 1000 m high peaks, rugged slopes and many caves, they form a natural barrier between the coast and the hinterland. Accordingly, the larger settlements are located – with a few exceptions – on the Adriatic coast or along the Sava and Danube rivers. According to the findings, there seemed to exist a very intensive local trade in coastal goods, with some ports playing a central role in trans-Adriatic and supraregional trade. The most important and probably largest port was Salona. It was located in the so-called Bay of Castles, on the eastern shore of the Jadro estuary, between the trading colonies of Tragurium and Epidaurum. Salona was located exactly at an interface between the hinterland and the coast. This seems to have been the decisive factor for its establishment, since from a maritime point of view there would have been better harbor locations along the coast with today's Split. The colony Salona probably established in the period of Julius Caesar.

An only slightly younger colony with an important port was Iader, today's Zadar. The colony situated between the Velebit massif and the Ravni Kotari plain. In the times of Augustus, Iader served as a naval base in the fight against piracy. There was a junction to the north-south route from here, but there was no road to the distant hinterland. The Roman reached the hinterland via Senji in the north or via Salona or via Epidaurum in the south. The close connection of Iader with Aenona and the Italic Pisaurum was already topic in a former article. Hereafter, the focus is on persons with evidence to have been active in trade and/or navigation during the Roman period.

According to Broekaert, several names linked to trans-Adriatic trade, each associated in a different way with the port of Salona. These include members of the Ancharii, who are attested through about 120 individuals in the provinces with a focus in several port settlements along the Tyrrhenian coast between Tarquinia and Salerno in Etruria and Latium et Campania. Thus, the Ancharii show a connection on a political-religious level

in two cities. However, there is no direct evidence of presence in the hinterland or in Pannonia and Dacia.

The Canii had contacts to Pannonia and Dacia, e.g. the released negotiator Titus Canius Titi Libertus Cinnamus was buried in Sopron in Pannonia superior. With a little more than 50 individuals, the Canii probably were part of a network with nodes in the eastern provinces of Pannonia and Dacia. Canii also appear more frequently in Aquileia, Salona and in Ostia.

Obviously, the evidence reveal two different family entanglements and probably trade networks here. The Ancharii seem to be specialized in trade between the two Adriatic coasts, with a focus in Pisaurum. Members of the Ancharii also settled along the so-called communication routes between Rome and the Adriatic coast. The Canii, on the other hand, moved much further away from the Adriatic Sea in the course of time. Salona and Aquileia served apparently rather as intermediate station for the long-distance trade in the direction of the East. Possibly, the evidence allows the interpretation that Salona and Aquileia functioned as central distribution points for the northern and eastern Adriatic coast. Epidaurum, with its optimal connections to the mining regions, also appears in these networks. For the western Adriatic coast, such a node could not be determined yet. In ancient written sources the role of Ancona for the Roman troop

Fig. 1: Map of all places mentioned in the text with ports and landing sites

movements is mentioned several times, e.g. in the conflicts with the Illyrians between the years 178–163 B.C., but does not reflect the epigraphic analyses so far. However, connections from Salona and Iader to Pisaurum are attested. The topographical situation may be the decisive factor here: Ancona is situated at the end of a chain of hills, at an approximately 10 km long junction of the north-south connection running parallel to the coast, whereas Pisaurum is situated directly on this coastal road. For the Roman army, Ancona was a strategically favorable location, while for civilian trade, Pisaurum offered optimal connections by sea and land.

Further investigations will have to focus on the flow of goods and the distribution of individual products. The preliminary evaluation of the pottery finds at Aenona, for example, show the flow of goods between the Adriatic and the Aegean.

Image Credit

Fig. 1: Map by Sebastian Adlung and Debora Oswald

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The Colours of Pompeii

Pascal Warnking

It is often claimed that without the standard intermodal shipping container and without container ships modern globalisation would have been unthinkable. Likewise, without the development of sea-going ships, the connecting of the Mediterranean world in antiquity would not have taken place to the extent it did. To understand the ancient world, one must understand ancient seafaring and its sea routes. Not only people and goods travelled on ships, but also knowledge and ideas. This is exemplified by a special commodity: pigments for wall paint.

In the late republic the exchange across the Mediterranean reached its peak, only to be surpassed in modern times. Thanks to free access to distant regions and the discovery of new sea routes, for example to India, goods became available in large quantities that had previously been offered either not at all in Rome and Italy or only in small quantities at very high prices. Just as these goods became available, purchasing power increased as well. So did the demands of the Roman upper class. This process of change is still visible today on the walls of Pompeii. The development of the different styles of mural painting from the First Pompeian Style to the Forth Pompeian Style tells the story of the trade in colour pigments. Starting with the four colours black, white, red, and yellow in the First Style the colourfulness developed with the availability of the corresponding colour pigments. Pliny describes the change and laments this luxury, which he views as exaggerated. With the colour pigments, fashions and new aesthetic views were imported on the growing fleet of trade ships, aesthetics which Pliny considered un-Roman.

The names of the colours mentioned in Plin. NH 35.30 hint at their distant origin: Armenia, India, Syria, Sinope and, in the case of one special white, Paraetonium in Egypt. This white was expensive in Pompeii, but of superb quality. In fact, Selim Augusti identified as many as four distinctly different qualities of white from the stands of the pigment dealers at the forum in Pompeii. But on which routes did the chalk of the Paraetonium white and the other pigments from distant regions reach the Bay of Naples? That they must have been imported on the main trade routes as additional cargo can be deducted from the fact that with the intensification of trade, prices fell: The price of blue decreased by 90% within a few decades. Green also became relatively cheap. The practice to carry additional cargo on the large grain freighters that travelled back from Egypt is well attested. However, Paraetonium lies not on the route around Cyprus, which is often considered to have been the main route from Alexandria to Italy.

A new research approach at the University of Trier used the navigation software *Expedition* to simulate ancient sea routes, determining their course and likely duration. The research results have been published in detail. About 50,000 voyages on different routes were simulated with *Expedition.* The results show the fastest and the most reliable routes ancient skippers could sail. For some routes, the outcome is surprising, among them for the best return route from Alexandria to Italy. The winds favoured the journey

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to Alexandria but made the return more difficult for the square-rigged ancient ships: The direct route was blocked by physics. It has been widely assumed that the way back to Italy passed east of Cyprus, always staying close to the coast. The software *Expedition* suggests a different route for ancient ships: from Alexandria, first a short distance west to about 27° 30' East, exactly to where Paraetonium is situated. From Paraetonium then on a north-northeasterly course directly across the open sea to Lycia. On this course the ancient cities of Patara and Myra can be reached safely and quickly considering the wind regime in this part of the Mediterranean. Archaeologists have excavated large granaries in both cities and a lighthouse in Patara. These finds fit well into the picture painted by the results of the computer simulation. Also, it is no longer surprising that Paul switched to a grain freighter in Myra of all places. Finally, we can now believe Ach. Tat. 5.15; 17.1, which speaks of a sailing time of five days from Alexandria to Ephesus. The fastest route from Alexandria to Italy ran right past Paraetonium. The colours of Pompeii thus not only give us an indication of the general development of Roman maritime trade, but also reflect the course of the sea routes that this trade took.

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Le navi antiche di Pisa: Breve introduzione al contesto archeologico

Gloriana Pace

Già dalle prime immagini della scoperta archeologica avvenuta nel Dicembre 1998, all'interno del perimetro della stazione ferroviaria di Pisa San Rossore, a poche centinaia di metri dalla più famosa piazza della città, apparve senza ombra di dubbio che i ritrovamenti del «cantiere delle navi» erano senz'altro eccezionali: le imbarcazioni e i loro carichi, che vennero sorpresi dalla furia delle acque nell'entroterra pisano, per circa otto secoli, quando ormai si dovevano ritenere al sicuro dai rischi delle traversate marine, non solo ci hanno tramandato, nel loro eccezionale stato di conservazione, arredi, strumenti, carichi, strutture, sartiame, nonché vestiti e oggetti personali di marinai e passeggeri; tutti i reperti, travolti da alluvioni che intaccavano e rimescolavano anche i depositi vicini, una volta sprofondati nel loro letto di fango, sono stati sottoposti a correnti fluviali, mulinelli, gorghi, altre alluvioni, che li hanno trasportati, rimescolati, spostati, creando una interessante casistica di movimenti post-deposizionali.

L'approdo fluviale nel sistema portuale pisano e la centuriazione

Il ritrovamento delle navi romane si localizza all'interno della pianura pisana caratterizzata dalla presenza di un corso fluviale, che scorreva in senso Est-Ovest, e che arrivava direttamente al mare, ovvero andava a confluire nell'Arno poco più a valle: si trattava forse dell'*Auser* o dell'*Auserculus,* una delle ramificazioni meridionali del fiume *Auser* – Serchio, che costeggiava l'abitato di Pisa a Nord, e che, esattamente nell'area dell'attuale stazione ferroviaria di Pisa San Rossore, formava un'ansa in cui sboccava un canale artificiale, probabilmente realizzato in concomitanza della centuriazione romana di Pisa (fine II–I sec. a. C.); la spalletta meridionale del canale doveva essere rinforzata con blocchi di pietra di medie dimensioni.

I depositi che inglobavano le imbarcazioni, sulla base della stratigrafia geologica e archeologica, sono stati generati dalle esondazioni del fiume Arno, quindi da depositi alluvionali provenienti da Sud, che hanno scavalcato la riva dell'invaso, facendone avanzare la sponda meridionale.

Il preservarsi dei depositi è dovuto essenzialmente al progressivo spostamento verso Nord del corso fluviale; mentre sul lato meridionale è stato possibile individuare una serie di sponde; esse non sono tuttavia riconoscibili sul versante settentrionale, perché erose dallo spostamento stesso del fiume.

Sebbene siano state rinvenute alcune strutture di sistemazione della riva fluviale e alcune forse di attracco, non è possibile, allo stato attuale, interpretare il contesto come

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porto. Si tratta, con molta probabilità, di un braccio di corso d'acqua prossimo alla città, quindi soggetto a intenso traffico fluviale, che attraversava un'area suburbana centuriata, per lo più agricola, percorsa da una fitta rete di canalizzazioni e che presentava alcuni apprestamenti privati di attracco relativi alle fattorie circostanti.

Le fasi archeologiche identificate e i relitti

La più antica testimonianza all'interno del contesto archeologico è costituita da un complesso di strutture rurali situate lungo la riva meridionale del fiume: una serie di pali lignei appuntiti infissi nella sabbia della riva, sul limite dello scavo, delimita la parte terminale di due probabili capanne, mentre una massicciata di pietre e una palificata contengono la linea di riva. I materiali associati alle strutture sembrano attestare una frequentazione compresa tra VI e V sec. a. C.

La fase II (prima metà II sec. a. C.) si colloca dopo un periodo di avanzamento della linea di riva, con lo spostamento verso Nord del corso fluviale. La prima alluvione attestata è infatti databile, grazie al relitto e al contesto che la caratterizza, agli inizi del II sec. a. C.: un relitto di medie dimensioni (cosiddetta nave «ellenistica»), con un carico di prodotti provenienti dall'Italia meridionale e dalla Spagna, sembra essersi arenato contro la riva distruggendosi completamente e riversando in un'area piuttosto ristretta carico e suppellettili di bordo.

Intorno alla prima metà del I sec. a. C. (fase III) si registra un consistente spostamento verso Nord della linea di riva e una sostanziale variazione dell'ambiente naturale: si assiste alla scomparsa di tracce vegetali connesse con gli alberi di alto fusto e alla contestuale comparsa di pollini di graminacee e di erbacee. L'interpretazione corrente è quella di un massiccio disboscamento connesso alle attività di centuriazione e la trasformazione dell'area in senso agricolo.

Una possibile alluvione potrebbe essere testimoniata dai resti di carico di *dolia* di una nave non ancora identificata (nave M, esterna all'area di scavo) rinvenuti in vari punti del fondale fluviale.

Un leggero avanzamento della linea di riva verso settentrione si registra nuovamente in età augustea (fase IV: 0–15 d. C.); l'incrocio tra il canale centuriale e il corso fluviale, in seguito a una ben databile alluvione, intrappola sul fondale e lungo la riva una barca a remi di medie dimensioni (la nave C o *Alkedo,* dal nome inciso su uno dei banchi dei rematori), una nave da carico di medie dimensioni (nave B) e un barcone a fondo piatto (nave G).

Un moderato avanzamento della linea di riva si definisce in seguito a una alluvione (fase V: prima metà II sec. d. C.) che coinvolge alcune imbarcazioni minori (barchino a fondo piatto H, *lintres* o barca fluviale F), la nave A (una nave oneraria di circa 30 m, localizzata sul confine settentrionale dello scavo, arenata sul limite del corso d'acqua) e forse il barcone fluviale P.

L'alluvione di età adrianea (fase V) forse coinvolge anche una nave esterna all'area di scavo.

In un periodo di tempo piuttosto ristretto (fase VII: seconda metà del III sec. d.C.) si concentrano una serie di drastici cambiamenti dell'assetto fluviale con diverse fasi alluvionali.

L'intera area di scavo al momento non fornisce dati utili a indicare gli eventi del periodo compreso tra la fine del III e il IV sec. d.C. (fase VIII): tronchi e legni semilavorati trasportati dalla corrente e incagliatisi, testimoniano anche un uso del corso d'acqua come veicolo di trasporto del legname.

Tra il IV e gli inizi del V sec. d.C. (fase IX; è tuttavia in corso una revisione della stratigrafia e dei materiali archeologici pertinenti a questa fase da parte della collega T. Tescione), un'alluvione coinvolge una barca fluviale a fondo piatto (nave I), in legno di quercia e un'imbarcazione analoga di dimensioni minori (nave Q); è inoltre verosimile il naufragio di una imbarcazione da carico esterna all'area di scavo (nave L), il cui carico viene trasportato dalla corrente. In questo periodo il braccio settentrionale del canale centuriale è da considerarsi ostruito.

Intorno agli inizi del V sec. d.C. si assiste a un periodo di stasi fluviale (fasi X–XI) che restituisce solo scarsi depositi limosi e pochi materiali; a questo periodo di stasi segue un'alluvione che coinvolge una nave presumibilmente da carico, esterna all'area di scavo (nave O), testimoniata da un gruppo di *spatheia* trasportati dalla corrente.

Nel VI sec. d.C. (fase XII) si data un'alluvione di consistente entità, che travolge e capovolge un barcone fluviale (nave D) trainato con il suo carico di sabbia. L'ostruzione del braccio settentrionale del canale centuriale è a questo punto sicuramente completa.

L'ultima fase di attività fluviale, databile nel VII sec. d.C., è testimoniata dai depositi di scorrimento lento, indice di una relativa tranquillità della corrente; un deposito di limi e argille, privo di materiale archeologico, testimonia il definitivo spostamento dell'asse fluviale più a Nord, al di fuori dell'area occupata dal cantiere.

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The Maritime Trade Network of Lycia in the Context of Mediterranean Merchant Shipping – a Bottom-up Approach to the Ancient Economy

Michaela Reinfeld

At least since the discovery of the Bronze Age shipwrecks of Cape Gelidonya and Cape Uluburun, the Lycian coast has been recognized as an important interface of the Mediterranean trade routes and has become the focus of scientific interest. From the Hellenistic period, the Lycian cities connected by a dense network of harbors at both the local level and with the entire Mediterranean world.

Field archaeological research and the results of underwater archaeology show a flourishing trade from the Hellenistic to the Byzantine period. This paper gives an overview of the role of individual port facilities in the Lycian trading network and of trade relations, which can be reconstructed using the underwater archaeological findings. Based on certain parameters, it raises the question whether individual port facilities were particularly predestined for international trade and whether the results of field archaeology reflect the underwater archaeological findings. Modifications of the maritime network, which are accompanied by changes in political, religious or economic factors, will also be discussed. Finally, regional trends that can be observed on the Lycian coast are placed in an overall Mediterranean context.

Shipwrecks and Amphorae as Indicators of Trading Activities

Since the publication of Parker's often quoted catalogue of the ancient shipwrecks of the Mediterranean and the Roman provinces,[1] the importance of the book for Roman economic history has been repeatedly emphasized and questioned at the same time.[2] A major focus was on the statistical distribution of shipwrecks through the centuries, from the Bronze Age to the Byzantine period. In particular, the increase of shipwrecks at the end of the Roman Republic and in the Roman Imperial period, as well as the changes in the Byzantine period were discussed under historical and archaeological aspects. On the one hand, the shipwrecks that could be detected archaeologically mainly consisted of amphorae, roof tiles and other goods, which are well preserved in underwater archaeological contexts. Ships with a cargo of organic materials, such as grains or textiles, or wooden warships are very difficult or even impossible to detect in the archaeological record. On the other hand, the transport of wine from Italy to Gaul, as well as the supply of Rome boosted the economy and thus shipping in the Roman Empire. Reasons for the obvious decline of shipping in late antiquity arise, among other things, in the imperial crisis of the 3rd century, the division of the Roman Empire at the end of the 4th century and the emergence of wooden barrels as transport containers.[3]

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Wooden barrels and ancient ship hulls belong to the organic materials that are rarely preserved in underwater sites. Already Sealey has stressed that even in the 1st century BC, in addition to amphorae, the use of wooden barrels for wine trade was common in the western Mediterranean.[4] In the East, wine, oil and fish sauce were still usually transported in amphorae.

When interpreting trading activities based on shipwrecks, it must always be kept in mind that the available data are dependent on and influenced by numerous factors. These include the type of cargo (amphorae or barrels, inorganic or organic products), the route of the ship (coast or open sea, hazard zones and busy trade routes), technological advances in shipbuilding and the accessibility of the site (depth, tourist development of the coast, divers, etc.). Nonetheless, shipwrecks and their cargo, which often consists of commercial amphorae, offer great potential for the reconstruction of Mediterranean trading networks. Especially in comparison to the results of harbor excavations, they provide information on the nature, duration and intensity of trade relations.

The Big Picture versus Regional Developments

Meanwhile, the publication of Parker's catalogue goes back almost 30 years and the discovery of a new, previously unknown shipwreck is reported almost weekly. Current projects, such as the Oxford Roman Economy Project, The Digital Atlas of Roman and Medieval Civilizations or the research of the author are engaged in updating the catalogue and include more than 2000 entries now (fig. 1, 2).[5] Notably, we have the highest wreck density along the southern coast of France, on the Italian west coast and along the Croatian coast. Not surprisingly, these countries are also traditionally among the popular holiday destinations for seaside holidays and divers. In contrast, we still have major research gaps in large parts of the eastern Mediterranean and along almost the entire North African coast.

Due an increasing amount of data and improved visualization, we can see slight changes in the histogram of the chronological distribution of shipwrecks in the Mediterranean (fig. 3).[6] The most striking difference is the peak of shipwrecks in the 1st century AD in contrast to Parker's histogram, which has a maximum value in the 1st century BC. For the illustration of the chronological distribution of shipwrecks through the centuries, Parker still uses the midpoints of the dating periods of the wrecks. This means that wrecks that are dated over several centuries are not displayed evenly over several centuries in the graph. Instead, the mean value was used, which is one of the biggest criticisms of Parker's analysis.[7] An improved presentation already suggested by Wilson[8] contains the even distribution of the dating period over the histogram. The visualization method used here is based on Boolean values, which characterize a date as "true" or "false" ("1" or "0") in the predetermined time intervals (here 100 years).[9] It resembles the aoristic analysis but refrains from weighting the dating probabilities.

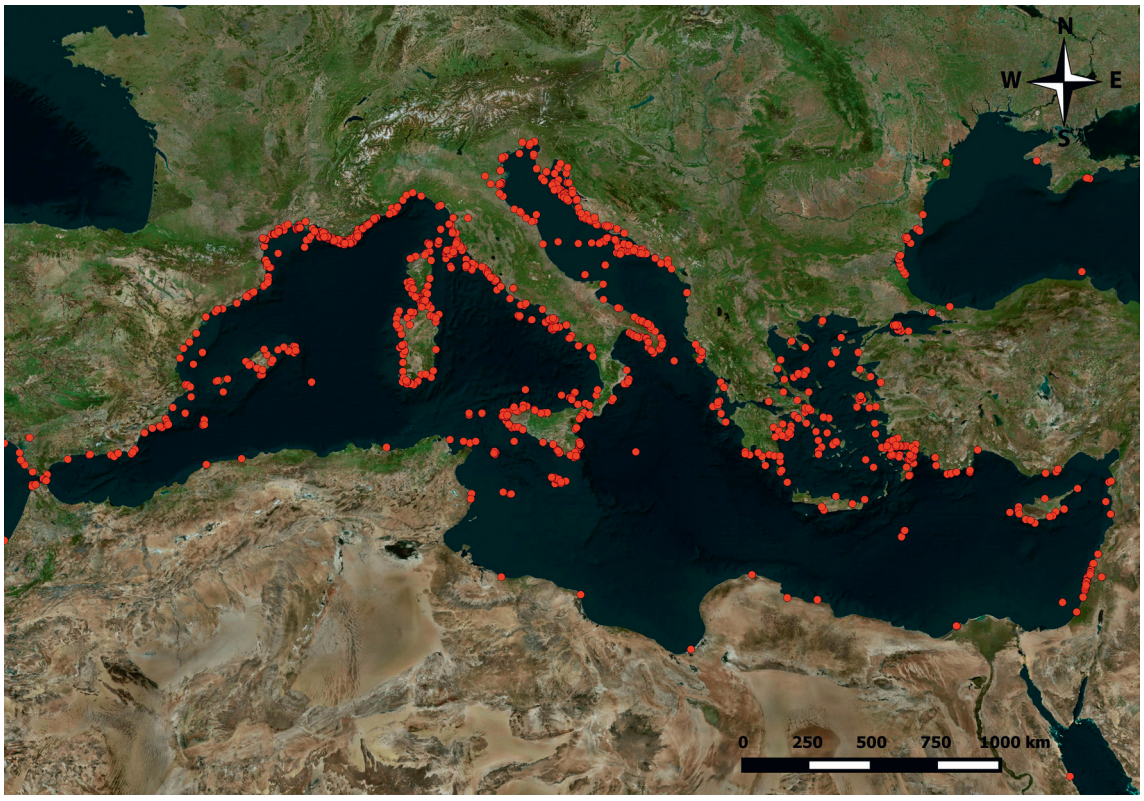

Fig. 1: Map of ancient shipwrecks in the Mediterranean and Roman Provinces.

Furthermore, the large discrepancy in the available data volume for the western and eastern Mediterranean shows that regional studies for understanding maritime human activities are essential (fig. 4). On the one hand, we have much more data available for the western Mediterranean than for the eastern Mediterranean, on the other hand, these data differ greatly both in their quantity and in their quality. This becomes apparent, for example, in a comparison between Croatia and Turkey (fig. 5). The 131 shipwrecks along the Croatian coast show a similar chronological distribution to our graph of shipwrecks of the entire Mediterranean. Again, we have a tremendous increase in wrecks in the 1st century AD. In contrast, the 122 wrecks on the Turkish coast show a very different distribution with peaks in the 1st century BC, the 6th century and at the end of the first millennium.

Thanks to the increasing importance of maritime archaeology, the establishment of new research institutions, the organization of large-scale deep sea and coastal surveys or NGOs involved in the underwater archaeological exploration of coastal and inland waters, more and more data for microregions and landscapes are slowly becoming available.[10]

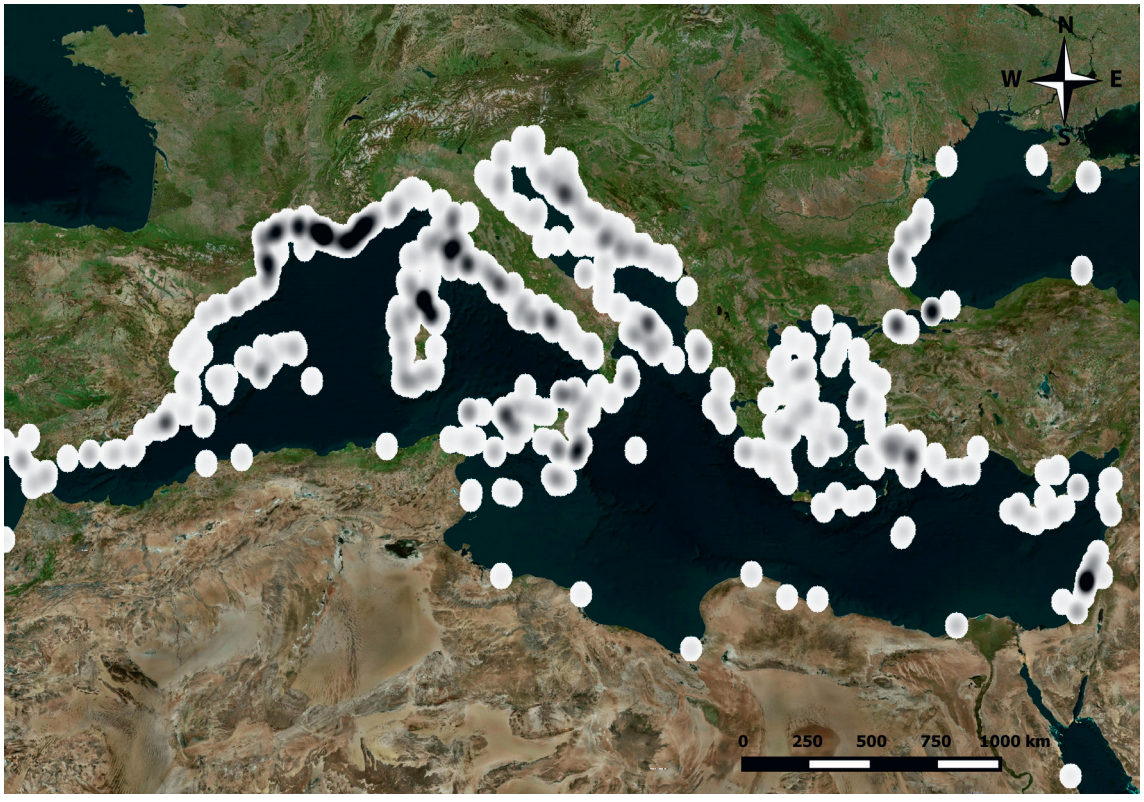

Fig. 2: Density map of ancient shipwrecks in the Mediterranean and Roman Provinces. Dark areas indicate a very high, light areas a low wreck density.

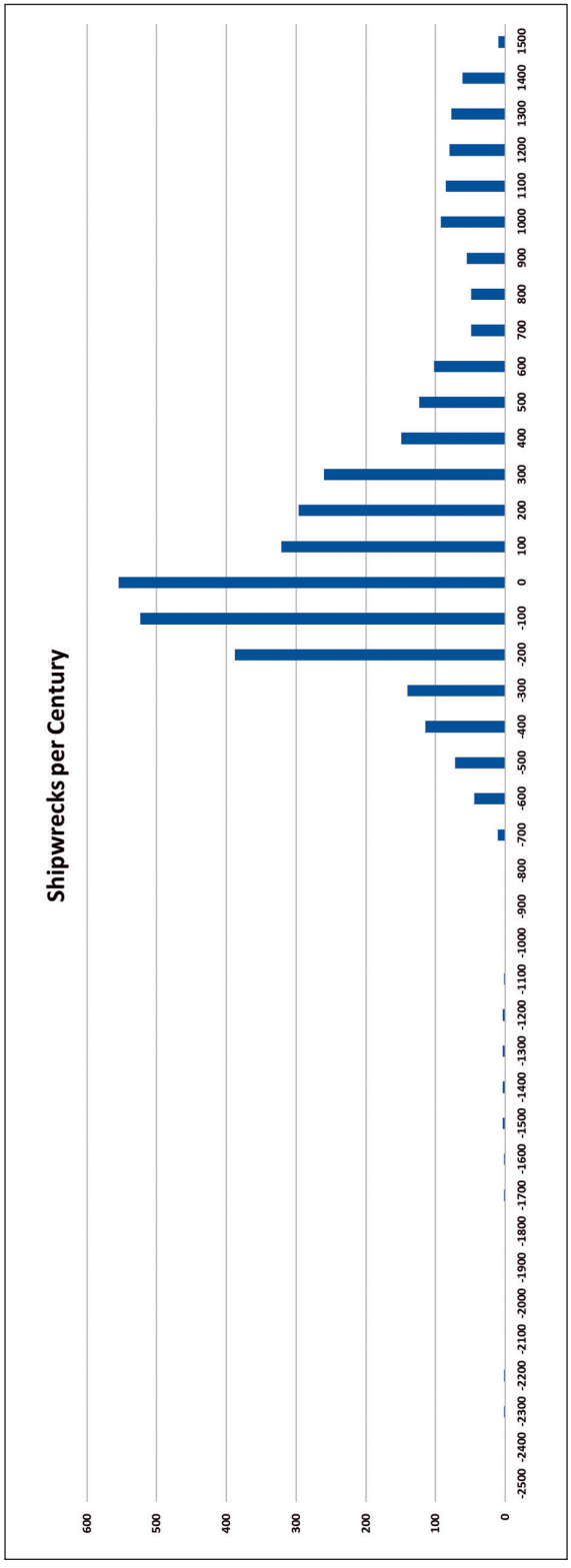

Fig. 3: Histogram of ancient shipwrecks in the Mediterranean and Roman Provinces.

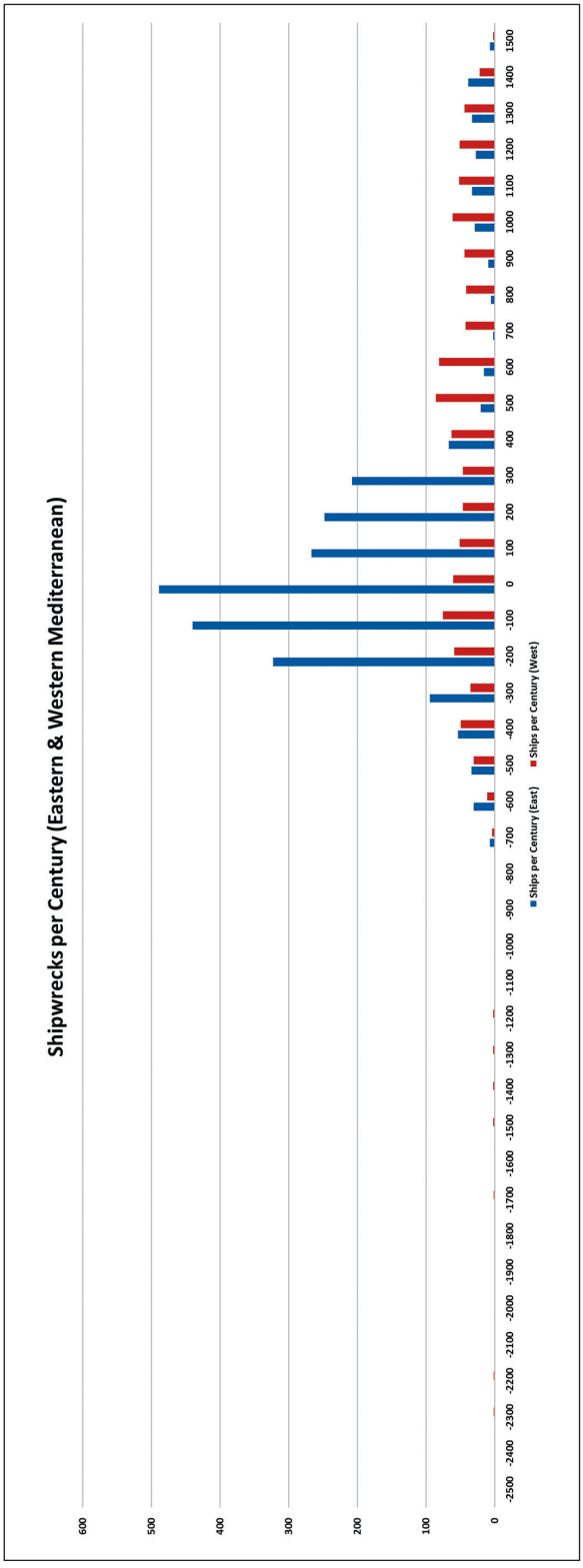

Fig. 4: Ancient shipwrecks of the western and eastern Mediterranean in comparison.

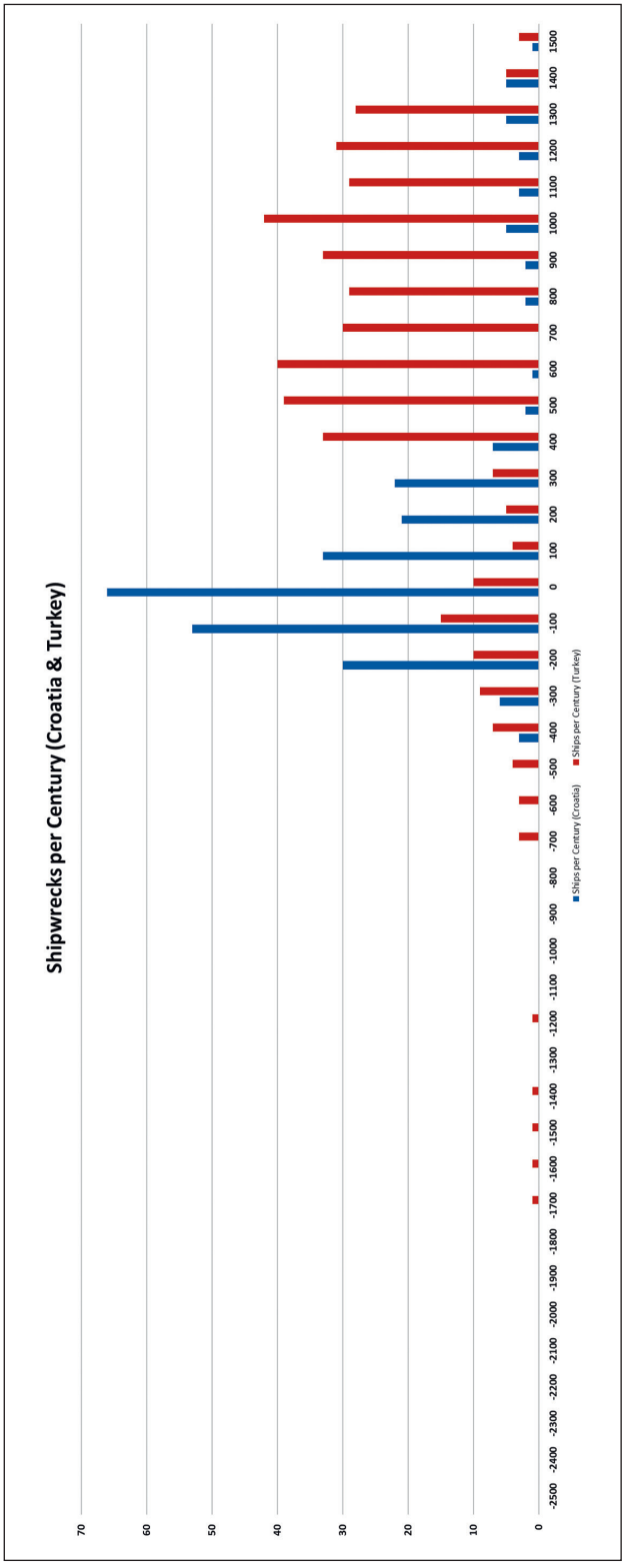

Fig. 5: Ancient shipwrecks of Croatia and Turkey in comparison.

Seafaring and Trade along the Lycian Coast

In particular, the Lycian coast of Turkey is suitable for a study of the trading networks based on shipwrecks, as at least since the discovery of the Bronze Age shipwrecks of Cape Gelidonya and Cape Uluburun the Lycian coast has been recognized as an important interface of Mediterranean trade routes. Above all, the geographic location and topographical conditions underline the importance of the seaborne trade connections. Foothills of the Tauros form the Lycian Peninsula and provide natural harbors in many places. Strabo already describes Lycia as "rugged and hard to travel but is exceedingly well supplied with harbors and inhabited by decent people".[11] Therefore, an investigation of the underwater archaeological sites makes sense only in the context of a consideration of the Lycian harbors.

As the most important harbors of the Hellenistic period, Telmessos, Patara, Antiphellos, Teimiussa, Andriake, Korykos (Olympos) and Phaselis were probably involved in the Mediterranean long-distance trade network.[12] Literary sources, inscriptions and papyri demonstrate the importance of Lycia for the Mediterranean trade network and shipping routes. An important economic factor was the trade in cedar and cypress wood, which was obtained in the Lycian hinterland until modern times. Other natural products included olive oil, fish products, herbal oils, Lycian ham, goat hair for ropes, chalk and glance coal, as well as panthers and gazelles for the Roman amphitheaters. The Lycian seaport Patara was known for the production of gilded sandals and medical tools. Purple dye was sought-after throughout the Roman world for the production of precious textiles and was won from sea snails from the harbour cities Aperlae and Andriake. Particularly large sponges are found in great numbers off the Lycian coast, and sponge divers, who have been active here since Antiquity, have found numerous shipwrecks too. In particular, the sponges from the area of the seaport of Antiphellos were considered to have had a healing effect.[13] Unfortunately, the popular Lycian exports known from the written sources are no longer preserved in the archaeological record.[14] In contrast, the transport containers for liquids, fruits, nuts and other products, the commercial amphorae, are better preserved.

Only a few excavations and research projects dedicated to the maritime trade history of the Lycian harbor cities have taken place to this day. A notable exception is the seaport of Patara, whose trading networks were exemplary analyzed by Erkan Dündar, based on amphorae from the Archaic to the end of the Hellenistic period.[15] As one of the major harbors along the Lycian coast, Patara maintained trade relations with the entire eastern Mediterranean and was a hub for the Xanthos Valley, as well as the surrounding harbors and landing places. In the Archaic period, Patara established trade contacts in the eastern Aegean, to the Ionian mainland and to Corinth or Corcyra. Obviously, the Persian conquest of Lycia had a positive impact on both the economy and trade, as well as the cultural and artistic development of the region. Sporadic contacts with Cyprus may indicate that Patara, and probably all of Lycia, covered its olive oil needs

mainly through local cultivation.[16] The Classical period is characterized by the appearance of the Lycian amphora, a new type, which was probably used for the transport of olive oil. The continuation of trade links with Greece and new relations in the northern Aegean indicate closer contacts with the region, which probably resulted from the at least short membership in the Delian League. In the Hellenistic period, under Ptolemaic and Rhodian domination, Patara experienced a veritable economic boom, building trade relations with the northern and South-East Aegean and the Anatolian mainland. More contacts with Cyprus, which also appears as a wine producer, suggest that Cyprus covered the increased demand for wine imports, too.[17] Fortunately, underwater archaeological surveys supplement the good archaeological field research at Patara now.[18]

Underwater Archaeological Research in Front of the Seaport Antiphellos (Kaş)

Quite different to Patara is the situation in the harbor city Antiphellos, modern Kaş (fig. 6). Here, a relatively well-explored underwater coastal region coincides with a harbor city whose ancient remains were destroyed by modern building activities, and the pottery finds are still awaiting publication.[19] Numerous dangerous rocky islands and reefs surround the harbor city. This is in contrast to the much more important harbor city of Patara, which could be reached easily by ship. Due to the popularity of diving tourism and intense underwater archaeological exploration of the coastal region, numerous ancient sites are already known off the coast of Antiphellos.[20]

Since 2007, the Turkish Underwater Research Group SAD ("Sualtı Araştırmaları Derneği") carried out systematic surveys on the 60 km wide coastal stretch between Kalkan and Kekova.[21] A total number of 32 scattered underwater archaeological sites,

Fig. 6: Modern Kaş with its offshore islands and reefs.

dating from Classical Antiquity to modern times, have been documented in the project Underwater Cultural Heritage of Turkey ("Türkiye Sualtı Kültür Mirası"). The results of the underwater archaeological surveys complement and extend the research results of terrestrial archaeology. In particular, they help in the investigation of maritime trade routes and the ports involved.[22]

Careful analysis by the author of all available published and unpublished information resulted in a dataset of 80 ancient shipwrecks found along the Lycian coast (fig. 7). The analysis was complicated by the fact that alleged new finds of shipwrecks were already known and even published, so that imprecise information about the location of the site and missing references could successfully conceal any duplications.[23] In addition, single finds of amphorae or even anchorages were defined as shipwrecks. However, these can be considered rather as an indication of the presence of ships and trade relations, and not as evidence of a shipwreck. The chronological distribution of shipwrecks by century shows an increase in shipping activities in the 1st century BC, which is most likely related to trade connections with Rhodes and the Aegean. In the 5th and 6th century AD, shipping activities reach their peak. This corresponds to the period after the division of the Roman Empire and the foundation of Constantinople as the new capital of the Eastern Roman Empire. A connection between these two developments is not unlikely, because the increased demand for food, daily and luxury goods of the new capital Constantinople, could only be covered by maritime trade.

High concentrations, which is from some five to more than ten shipwrecks, can be found in the areas of Cape Gelidonya, Andriake, Antiphellos and Patara (fig. 8). A relationship between the shipwrecks and the nearest harbor city can only be assumed based on the proximity of the site to the harbor or, in the case of Patara, due to similar assemblages. Based on the wreck sites off the Lycian coast, some conclusions can be drawn about the Mediterranean trading networks of the Lycian harbors.[24] From the Archaic period to the end of the Rhodian supremacy in Lycia, the trade relations of the Lycian ports correspond approximately to the observations made by Erkan Dündar on the transport amphorae from Patara. In the Hellenistic period, under Ptolemaic and Rhodian supremacy, Patara and the other Lycian seaports experienced an economic boom. However, this development can also be seen after the incorporation of Lycia into the Roman Empire.

On the one hand, established shipping routes to the Aegean that already existed remained. On the other hand, trade ties with the western Mediterranean, Italy and the Iberian Peninsula, as well as with Egypt and the Black Sea, prove economic prosperity until the beginning of Late Antiquity. Only then, with the division of the Roman Empire and the rise of Christianity, do the trade contacts of the Lycian harbors focus on the eastern Mediterranean, the Aegean, Cilicia, Cyprus and the Palestinian coast again.[25]

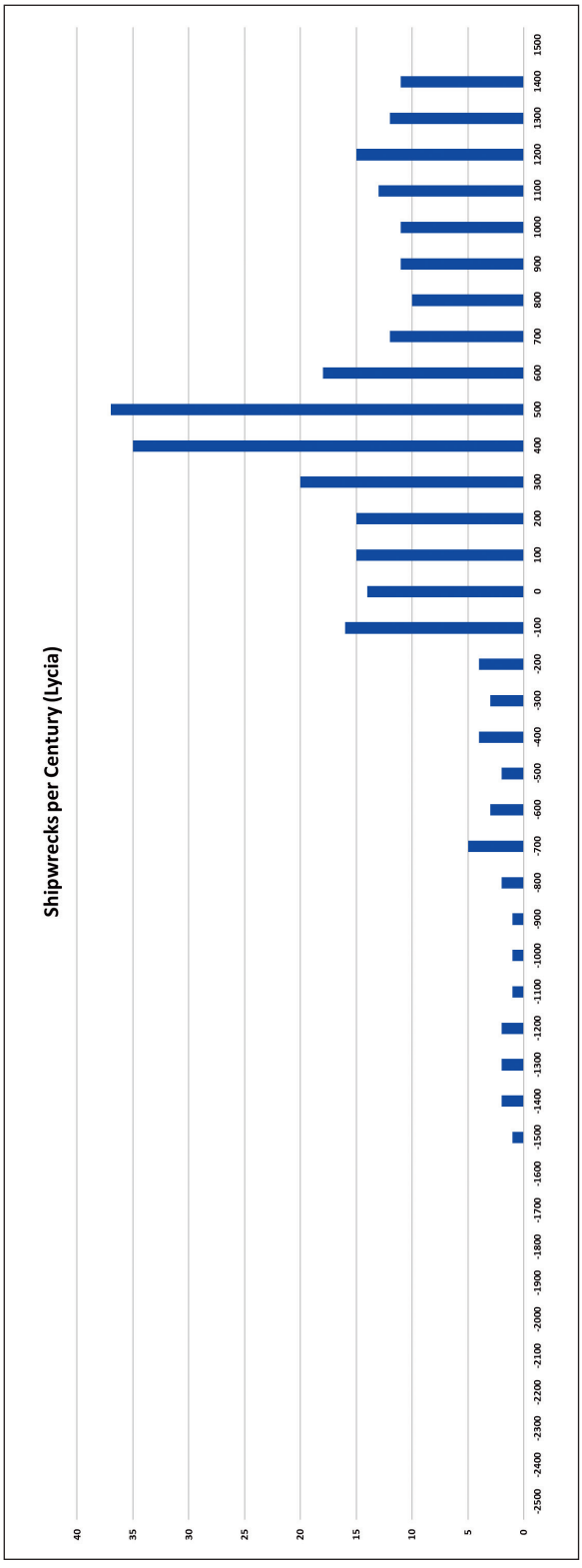

Fig. 7: Histogram of ancient shipwrecks off the Lycian coast.

Fig. 8: Density map of ancient shipwrecks off the Lycian coast.

The Maritime Trade Network of Lycia

From the Archaic to the Byzantine period, the Lycian maritime trade network focused on the eastern Mediterranean, especially the Aegean and the Anatolian mainland. By the integration of Lycia into the Roman Empire, this network expanded into the western Mediterranean and the Black Sea. Place names in the Black Sea region and grave inscriptions testify that these contacts were not only sporadic. Lycian traders who ventured the long and dangerous journey to the shores of the Black Sea were able to gain both financial wealth and social status, as well as hold political functions.[26] Wilhite described this type of trading network as a "small-world network", which is characterized by the connection of local markets by a few traders or crossover agents. By connecting local markets with distant local markets through new trade routes, individual long-distance traders, the crossover agents, can generate great wealth. These traders are not only members of their local trader group, they also become part of another trader group that serves the distant market.[27] The grave inscription of the ship owner and trader Eudemos from Olympos suggests the close connection of individual Lycian traders to distant local markets. The close relationship between Eudemos and the seaport Kalchedon, at

the entrance to the Bosporos, is characterized by honors, perhaps even the granting of citizenship.[28]

With the division of the Roman Empire and the rise of Christianity, a political, cultural and religious transformation took place, which also influenced Lycia's maritime trade network and caused a change in the maritime shipping routes. The trade relations of the Lycian harbor cities were now again limited to the eastern Mediterranean, but had a strong focus on the Palestinian coast, from where the 'holy wine' was imported.[29]

Conclusion

The Lycian coast was involved in the maritime trading network of the Mediterranean early. Therefore, it is even more interesting to reconstruct the history of seafaring using shipwrecks and terrestrial excavations in harbors. The chronological distribution of shipwrecks along the Lycian coast shows a special development that can only be explained by the historical events and political transitions in the eastern Mediterranean. In addition, the chronological distribution of the wrecks of the Lycian coast, or of the entire eastern Mediterranean, differs distinctively from the chronological distribution of the western Mediterranean or individual coastal areas (e.g. Croatia).

The small number of shipwrecks from the eastern Mediterranean in comparison to the western Mediterranean also leads to a concealment of maritime history in the East. Regional studies, such as the example of Lycia, enable a reconstruction of the maritime and trade history of micro-regions and, in addition, contribute to the understandin overall Mediterranean developments.

Acknowledgements

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Notes

[1] Parker 1992.

[2] Critical remarks: Whittaker 1989, 537–539; Gibbins 2001, 273–283 and Wilson 2009, 219–226. Parker also advises caution in interpreting shipwrecks as a proxy for maritime trade: Parker 2011, 445.

[3] Parker 1992, 8 f.; Wilson 2009, 219–226.

[4] Sealey 1985, 125–126.

[5] McCormick 2012; McCormick et al. 2013; Strauss 2013; McCormick et al. 2017.
[6] cf. Parker 1992, 549 fig. 3.
[7] Parker 1992, 8; Wilson 2009, 222.
[8] Wilson 2009, 222. Wilson uses the aoristic analysis without naming it as such. The aoristic analysis determines the probability (as a fraction of 1 or 100%) of the occurrence of an event over a certain period. For an explanation of the methodology, see: Ratcliffe 2000; Ratcliffe 2002; Johnson 2004 and Mischka 2004.
[9] Nakoinz 2012; Kennedy – Hahn 2017, 73–78.
[10] An important project is the Shipwreck Inventory Project of Turkey, led by Harun Özdaş – Özdaş – Kızıldağ 2017, 108–109.
[11] Strab. geogr. 14, 3, 2; cf. Jones 1960, 312–313.
[12] Brandt – Kolb 2005, 101.
[13] For agricultural production in the Yavu Highlands see: Kolb 2008, 310–313; Dündar 2017, 383. For the production of purple dye in Aperlae: Hohlfelder – Vann 1998; Hohlfelder – Vann 2000 and Hohlfelder 2011. A list of all Lycian commercial products with the corresponding ancient written sources can be found at Brandt – Kolb 2005, 100–101.
[14] An exception are the purple snails, which were detected in large heaps in the seaport Aperlae (literature above). For Andriake, the production of purple is evidenced by the excavation of murex workshops dating back to the middle of the 6th century AD. See: Çevik – Bulut 2011, 62–63; Akyürek 2016, 475. 485 fig. 9.
[15] Dündar 2014; Dündar 2017.
[16] See above for the export hits of the Lycian coast.
[17] Dündar 2017, 77–79. 377–390.
[18] Özdaş – Kızıldağ 2014, 284–288.
[19] At least, the stamped handles of the Rhodian transport amphorae of the 2nd century BC from the Hellenistic temple of Antiphellos are fortunately published by Erkan Dündar. The amphora handles were found as part of the excavations of the Archaeological Museum of Antalya in 2012. See: Dündar 2017, 389.
[20] Reinfeld – Varinlioğlu 2012.
[21] Varinlioğlu 2011; Varinlioğlu 2014.
[22] A complete evaluation of the underwater archaeological sites is part of the dissertation project of the author. See also: Reinfeld 2017.
[23] A problem that can also be seen in the shipwreck databases of Parker, Strauss and McCormick. Nonetheless, the occasional errors do not change the overall picture.
[24] The two Late Bronze Age wrecks of Uluburun and Cape Gelidonya were not included in this analysis because they cannot be associated with the Lycian harbour cities.
[25] A now outdated presentation can be found in: Reinfeld 2017.
[26] Adak – Atvur 1997, 11–27.
[27] Wilhite 2001, 54–63.
[28] Adak – Atvur 1997, 20.
[29] Riley 1975, 30; Claude 1985, 81–82; Kislinger 1999, 144–147; Kingsley 2001, 45. 56–58; Reinfeld 2017, 142–143.

Image Credits

Fig. 1: Map by M. Reinfeld, based on the data of: Parker 1992; Strauss 2013; McCormick et al. 2013 and McCormick et al. 2017. – Fig. 2: Map by M. Reinfeld, based on the data of: Parker 1992; Strauss 2013; McCormick et al. 2013 and McCormick et al. 2017. – Fig. 3: Histogram by M. Reinfeld, based on the data of: Parker 1992; Strauss 2013; McCormick et al. 2013 and McCormick et al. 2017. – Fig. 4: Comparison by M. Reinfeld, based on the data of: Parker 1992; Strauss 2013; McCormick et al. 2013 and McCormick et al. 2017. – Fig. 5: Comparison by M. Reinfeld, based on the data of: Parker 1992; Strauss 2013; McCormick et al. 2013 and McCormick et al. 2017. – Fig. 6: Photo by M. Reinfeld. – Fig. 7: Histogram by M. Reinfeld. – Fig. 8: Map by M. Reinfeld.

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Seaborne Trade and Field Trials with Roman Vessels on Rhine, Moselle and Danube

Christoph Schäfer

As Alan Bowman and Andrew Wilson have shown, new impulses and further insights into the character and nature of the ancient economy can be achieved primarily through quantification.[1] With regard to Roman long-distance trade, however, valid data on the efficiency and resilience of the trade routes are a necessary prerequisite for quantifying analyses. Only on such a basis can new insights be gained into the transaction costs and potential of individual trade goods. One important aspect of this is the oil trade with Roman Germania. As shown by the absolute dominance in the archeological record of oil amphorae of the Dressel 20-type with an approximate capacity of about 70 kg, Olive oil for the German provinces originated almost exclusively in the *Baetica.*[2]

A first indication of the order of magnitude of the annual oil deliveries is provided by the Roman military. José Remesal-Rodríguez assumes an annual consumption of 1,370 oil-filled Dressel 20-amphorae per legion. Th. Kissel has calculated a supply requirement of 11,500 amphorae for the 50,000 strong army in Britain.[3] For the German provinces, this means that the legions and auxiliary units on the Rhine border alone would have had an annual oil requirement of approximately 23,000 amphorae.[4]

The route via the Rhône, Saône and Moselle rivers is considered one of the main routes for trade traffic and the supply of the military camps and civil settlements on the Rhine.[5] From the Saône, goods had to be transported by cart over land to the Moselle.[6] With regard to the road link between Chalon-sur-Saône and the Moselle, the generally postulated route crosses the Plateau-de-Langres, which would have involved a distance of almost 240 km for the shortest route with Épinal as the destination.[7] However, the main road from Langres to Metz meets the Moselle 6 km upstream from Pont-à-Mousson at Scarponna (Dieulouard), at which point the river was already navigable. The distance via Langres to Pont-à-Mousson would have been over 270 km, the connection to Metz a good 300 km.[8] With regard to the relation of sea, river and land transport, it is necessary to calculate with the main route and thus a distance of 300 km. There was an alternative to the Rhône-Saône-Moselle route: the sea route via the Atlantic, across the Bay of Biscay to the mouth of the Rhine and then, after a single transhipment, up the Rhine.

Atlantic route

Total distance:	3010 km
Distance between Gades and Rhine estuary (across Bay of Biscay):	2480 km
Distance travelled upriver on Rhine until Mogontiacum[9]:	530 km
Instances of reloading or transshipping:	1

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Rhône-Saône route
Overland transport Chalon-sur-Saône-Metz (1780:303:803)

Total distance:	2886 km
Distance between Gades and Rhône estuary in Arelate:	1780 km
Distance of overland transport between Chalon-sur-Saône and Metz:	303 km
Distance of river transport (Rhône, Saône, Moselle, Rhine[10]):	803 km
Instances of reloading or transshipping:	3[11]

In order to be able to estimate the journey times approximately, data from reconstructed Roman military ships of the Oberstimm 1 (*Victoria*) and Mainz A (*Lusoria Rhenana*) types, which were recorded with an electronic nautical measuring system, were used. Even in the age of GPS, it is not enough to measure the journey of a ship over ground. In order to obtain valid data, the displacement of the vessel due to current and wind (drift) must be deducted from the GPS results. Unfortunately, tests with the first full scale reconstruction of a Roman merchant ship (*Bissula*) on the Moselle, to be conducted by the University of Trier, are still in their infancy. However, in the course of the experiments with the three reconstructions of ancient military ships mentioned above, similar sailing characteristics could be investigated and approximate results gained.

Fig. 1: Field tests with the *Victoria* (Oberstimm 1)

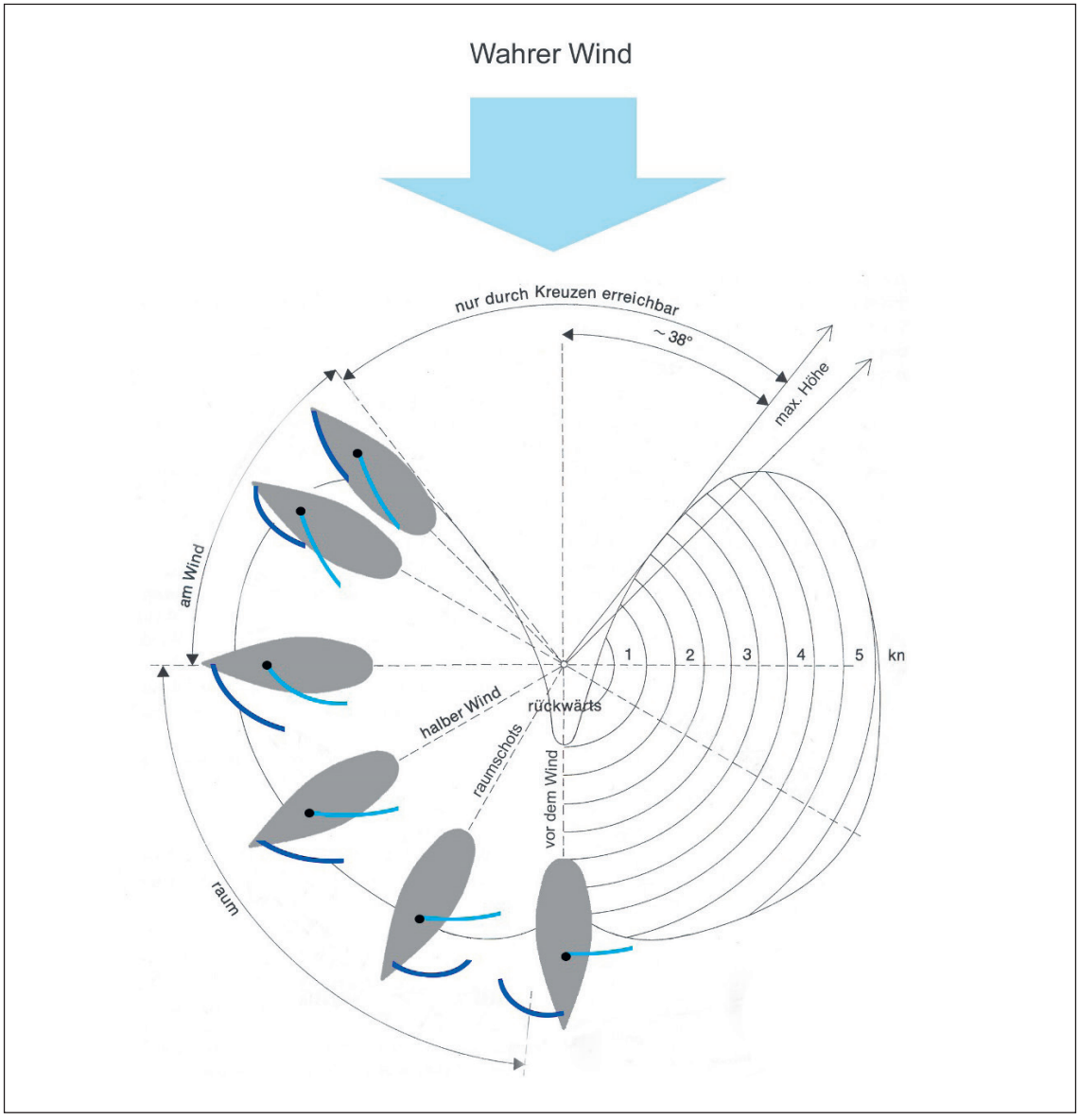

Fig. 2: Polar plot of a modern sailing yacht

For this purpose, astrophysicists from the University of Hamburg and the Harvard-Smithsonian Center of Astrophysics have developed and adapted the NX-2 measuring suite manufactured by Silva-Nexus. Originally developed for the America's Cup, the adaptation of this combination of hardware and software allowed for an accurate measurement of Roman ship reconstructions' performances and the drift-adjusted values for direction and speed under sail could be determined.[12] The sailing characteristics of any given ship is typically represented as a polar plot; the preceding example (fig. 2) is from a modern sailing yacht.

For the Oberstimm 1-type vessel, dated around 100 AD, such a plot looks as in fig. 3.

Investigations have shown that, taking into account the occurrence of drift due to current and wind, the square sail, which was typical of antiquity and also predominant in the Middle Ages, can be sailed not only downwind or bulkheaded, but also on a half-wind course and even slightly upwind.

On the basis of the sailing data and taking into account today's wind conditions, which largely correspond to those of the Roman Empire, the following calculations can be made.[13]

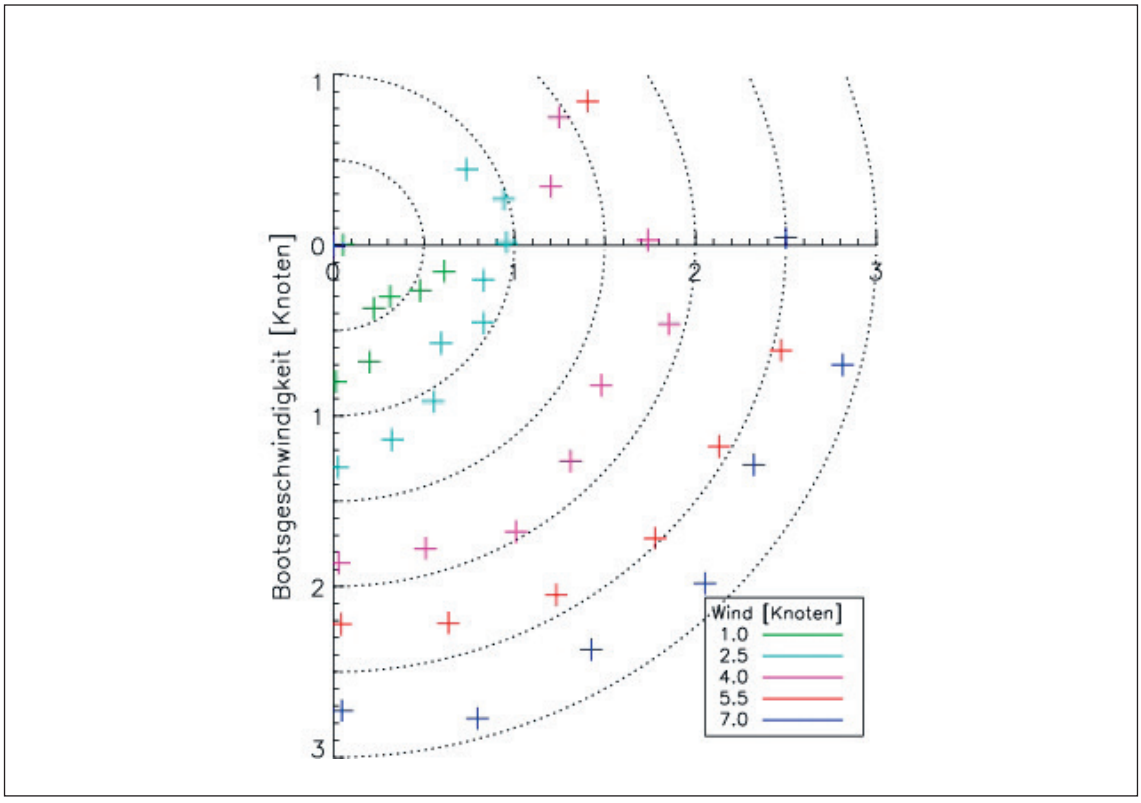

Fig. 3: Polar plot of Oberstimm 1 (late 1st/early 2nd c. AD)

Atlantic route (3010 km in total)

Time travelled	42.5–57 days
Travel time by sea (Gades-Rhine estuary)	16.5–22 days
Travel time by river (upriver to Mainz)	26–35 days
Instances of reloading or transshipping:	1

Rhône-Saône route (2886 km in total, via Plateau de Langres)

Time travelled	74–103.5 days
Travel time by sea (Gades-Rhône estuary)	15–20 days
Travel time by river (Rhône, Saône, Moselle)	40–53,5 days
Travel time overland (Chalon-sur-Saône-Metz)	19–30 days
Instances of reloading or transshipping:	3[14]

On the basis of data from early modern vessels and experience of field-testing a 1:2 scale replica of a 1st/2nd c. Roman scow, towing times and the time required for land transport were calculated approximately. For antiquity, a daily distance of about 15–20 km travelled seems realistic. For overland transport by cart, 10–16 km are estimated with a full load.[15]

Fig. 4: Towing field tests on the Moselle river

The journey across the Atlantic was therefore almost twice as fast as the transport via the inland route. Quite apart from that, it was also considerably cheaper. In addition, the Atlantic route required only one instance of transshipping, instead of three or four. Nevertheless, both routes were used, as is shown by the finds of numerous scows on the Lower Rhine and the rich epigraphic evidence for professional river shippers (*nautae*).[16] Profit maximization was by no means the sole determining factor in the decision to choose the trade route. Social relations, the possibility of carrying out part of the trade on the route and still making a profit despite the higher costs, all this made the Rhône route attractive to some traders. Thus, the patterns of action of the actors on the Rhône route, which cannot be explained rationally alone, fit perfectly into the theoretical approach of modern transportation cost economics.[17]

Notes

[1] Bowman – Wilson 2009

[2] Remesal-Rodríguez 1983, bes. 93.; Kissel 1995, 218.

[3] Remesal-Rodríguez 1986, 76 f; Kissel 1995, 218.

[4] See Wolters 1990, 204–206 u. 239–241. for troops stationed in Germany.

[5] Rougé 1966, 93–95.

[6] Campbell 2012, 271. Campbell mentions Metz (Divodurum) and Trier (Augusta Treverorum) as important intermediary trading

[7] For overland transport of, e.g., wine from Chalon-sur-Saône via the Plateau-de-Langres to Belgica and the German provinces, see Krier 1981, 34 f.

[8] On the direct connection between Langres and Metz, see Wierschowski 1995, 149.

[9] For towing on the middle Rhine, cf. Sauerbrei 1991, 65–67.; for the Moselle, see Binsfeld 1977, 3–5.

[10] The detailed calculation is: 269 km (Rhône) + 142 km (Saône) + 298 km (Moselle) + 94 km (Rhine) = 803 km in total.

[11] I.e.: transshipping at Arelate to switch to river craft; reloading onto carts at Chalon-sur-Saône; reloading onto river barges on the upper Moselle.

[12] Schäfer 2008, 70–72. Ch. Schäfer; Schäfer – Wagener 2011 99–101.; Günther – Wawrzyn 2008a, 118–120.; Günther – Wawrzyn 2008b 111–113.

[13] For a more complete version of this argument and the following calculations, see Schäfer 2016, 233–240.

[14] See above n. 10.

[15] Cf. Schäfer 2016, 238 f.

[16] Schmidts 2011, 14.

[17] See e.g. Welfens 2006, bes. 17.; Richter – Furobotn 2010, 267–269.

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Seaborne commerce in the Roman Empire is characterised by a remarkable efficiency for the pre-modern world. From Egypt to Britain, trade connections can be proven on the basis of archaeological finds. The range of these activities includes the Mediterranean, the Black Sea and parts of the north-eastern Atlantic. Important reference points for the assessment of Roman merchant shipping are ports, ships and cargo remains. Due to the large number of known shipwrecks and ports, archaeology in particular can contribute to a better understanding of maritime trade.
The contributions address various aspects of the "seaborne commerce" with a broad methodological spectrum. In addition to wreck finds, the relevance of inscriptions on amphorae and other cargo remains are considered as well as the formation of networks, the reconstruction of ship routes and the performance of ancient watercraft based on experiments.

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