

Chapter 7

Coastal lagoons, shifting environments, and control of natural resources

Annalisa Marzano

Abstract

Lagoons and wetlands are environments that offer very valuable natural resources and as such have been exploited by humans since early times. This paper touches on the important role lagoons had in the Roman era not only in the production of salt but also for large-scale fishing and fish salting. It then focuses on cases of territorial disputes concerning lagoonal areas that involved local authorities against Roman tax farmers. It is argued that the reasons for these disputes were on the one hand the economically important resources offered by wetlands and on the other the morphological changes to which lagoons are prone, which could modify the interface between lagoon and sea. This mattered because in Roman law the sea and coastal lagoons had different status regarding ownership.

Keywords

Lagoons; territorial disputes; lagoonal fisheries; Roman aquaculture; Histria; Ephesus

Introduction

In their seminal book *The Corrupting Sea*, Horden and Purcell state that in antiquity probably as much as 6,500 km² of Mediterranean coastline were occupied by lagoons and wetlands (Horden and Purcell 2000: 192). These environments provided a range of resources—salt, fishing, fowling, grazing, canes utilized in agriculture—not to mention their use as sheltered anchorage and harbours (Felici 2016). Indeed, before the advancements in building engineering allowing for the construction of moles and breakwaters, coastal lagoons, with their sheltered environments, have been often used as harbour basins (Morhange *et al.* 2015; Sanchez and Jézegou 2016). In the case of ancient Rome, a famous instance concerns the use by Octavian/Augustus of the complex lake Avernus and the lagoon of Lucrinus as seat for the Portus Iulius, the base for the military fleet. Two canals were dug, one to connect the Avernus with the Lucrinus, and the other between the Lucrinus and the sea (Cass. Dio 48.50). The fleet was then moved to Misenum, possibly due to the silting of the Lucrinus (cf. Strabo 5.4.6; Reddé 1986: 164–71, 186–97 on Portus Iulius and Misenum; Scognamiglio 2006: 65). Earlier in Rome's history, at the time of the foundation of the colony of Ostia in the 4th century BC, the nearby lagoon was connected to the sea and had a depth of between 3.5m and 4.5m below ancient sea level, thus suggesting that it might have been used as a sheltered anchorage (Vittori *et al.* 2015).

While marshland with stagnant water can be an insalubrious environment—malaria was indeed endemic in many Mediterranean areas until modern times—the level of biodiversity in coastal lagoons and wetlands is extremely high (Mitsch *et al.* 2015). The large land reclamation projects launched in the late 19th and early 20th century to bring more land under cultivation have profoundly modified the coastal landscapes of many Mediterranean countries. To give an example, since 1920, about 60% of Greece's wetlands have disappeared; these areas used to be among the most ichthyofaunally diverse in Europe (Mylona 2018).

Lagoons have been settled and exploited since the Bronze Age at least (Cattani and Boccuccia 2018, for Late Bronze Age exploitation of the lagoons of Adriatic Italy). While current research has been focussing on the reconstruction of the ancient environment and *chaîne opératoire* of lagoonal salt-making sites (Alessandri *et al.* 2019; Di Rita *et al.* 2010; Grossi *et al.* 2015; Sevink *et al.* 2021),¹ lagoons and wetlands are by and large still considered as relatively marginal environments in both archaeological and historical studies of the Roman era.² Yet, the abundant archaeological evidence pertaining to the geographic distribution and activity of Roman fish-salting sites does not only attest to the importance of large-scale fishing in the sea for pelagic migratory fish such as tuna and mackerel, but also to the role the exploitation of lagoonal fisheries had for the fish-salting business. If we take the case of three centres that produced a high volume of fish salted products and commercialized it far and wide in the Roman world—Troia in Portugal and Gades and Cartago Nova in Spain—in all three cases the natural environment where these centres stood was characterized by wetlands and coastal lagoons. Gades, with its position near the Straits of Gibraltar, through which schools of migratory fish would periodically enter and exit moving between the Atlantic and the spawning grounds in the Mediterranean, could target both marine and lagoonal fisheries. Since the Punic era, Gades' economy flourished thanks to the exploitation of the local fisheries and to its strategic location in respect to the routes for the trade in sought-after metals such as tin. Troia, where at least 25 fish-salting Roman workshops of varying size are known, stood on the sandy peninsula that separates the estuary of the Sado River from the Atlantic. Possibly, in the Roman period this was a series of islands rather than a peninsula. Surrounding the Sado estuary were wetlands, which must have provided the large quantities of salt needed for the fish salting activity. Salt production in the Sado estuary is attested from the 13th century onwards; the area produced large quantity of salt, also allowing for export to other places in Europe (Marzano 2013: 126). This area offered, and still does, bountiful fishing, having access to the estuary, the wetlands/lagoons, and the sea. Finally, Carthago Nova was near the Mar Menor, a large coastal lagoon which today measures c.135 km² and has a coastal length of 70km but which seems to have been larger in antiquity. Even today, with overexploitation of fish stocks, high pollution, and other anthropic negative impacts, the lagoon is rich in fish: in August 2021, tonnes of dead fish washed up on the shores of the Mar Menor, a disaster caused by a combination of high pollution (largely from agricultural runoffs) and low oxygen levels due to the high temperature of the water.³

Lagoons and their exploitation

The ancient literary sources make some references to abundant fishing that regularly took place in lagoons and to the economic importance of lagoonal fisheries. For example, Pliny the Elder, when talking of a peculiar fishing collaboration between humans and dolphins in the lagoon of Lattes (Stagnum Latera) in the south of France indicates that the amount of grey mullets that seasonally migrated from the lagoon to the sea were such that simply placing nets to block them at the entrance of the lagoon was not an option: the nets could not sustain the huge weight of the multitude of fish (Plin., *HN* 9.29–32). Changing geographic context and moving to the Bay of Naples, we have Servius' comment to the *Georgics* of Virgil which reports on the economic importance of fishing in the Lucrinus. Servius reports that when, following a sea storm, the opening between the Lucrinus and sea had been blocked, thus preventing the fish from entering the lagoon, those who had leased the fishing rights from the Roman state (the *redemptores*) appealed directly to the senate to ask for extraordinary works to connect the lagoon to the sea again. That the *redemptores* turned directly to the senate and that the senate listened

¹ See also the Salt & Power Project based at the University of Groningen (<https://www.rug.nl/research/groningen-institute-of-archaeology/research/salt-and-power/>).

² The trend is shifting as attested by the papers in this volume and ongoing research projects focussing on lagoons in antiquity, including the recently launched project 'Coastal lagoons and their hidden cultural heritage: the exploitation of lagoonal environments in Roman Italy', which sees the author of this paper as PI and D. Cottica as Co-I. The project is funded by the EU under the PRIN PNRR 2022 funding call (grant P2022WLSJN_001).

³ BBC 2021.

to them indicates that the revenues that both parties got from fishing and fish-farming activity in the Lucrinus were considerable (Serv. *Ad Georg.* 2.161).

The discovery some years ago of a cargo of small terracotta vessels on board the Arles-Rhône 3 shipwreck has provided the ichthyofaunal confirmation that lagoonal fisheries were a source of fish for the fish-salting industry. The content of several of the vessels, which were still sealed, was analysed, revealing that it was some kind of fish paste made with several types of very young fish such as sprats, sardines, mackerels, and twait shards (Djaoui, Piquès, Botte 2014). The age of the fish suggests they were captured in a lagoon, since all these species tend to spend time in lagoons at juvenile stage to find nutrients and shelter from larger predators.

Lagoonal fishing and fish farming would also provide fish to be consumed fresh. Fish farming in enclosures built in coastal lagoons is attested in texts and archaeology. C. Sergius Orata, the alleged inventor of baths with hypocaust and the entrepreneur who started oyster farming in the Lucrinus, is also said to have farmed gilthead in artificial enclosures he built in this lagoon (see, e.g., about oyster farming, Cic., *Hort.* 67–71; Plin., *HN* 9.168–9; Varro, *Rust.* 3.3.10 and Val. Max. 9.1.1 on Orata's fish farming). At Cosa, in the lake of Burano (in fact, a coastal lagoon), remains of two masonry-built Roman fish tanks for fish farming were identified by the archaeological team lead by Marguerite McCann, in addition to channels aimed at regulating the flow of water in the lagoon and facilitating the migration of fish in and out of the lagoon (McCann and Bourgeois 1987). Even in the case of intensive fish farming, lagoons seem to have been key environments, not only for the development of the practice, as I have argued some years ago (Marzano 2013: 219–223), but also in the case of monumental manifestations combining the practical needs of pisciculture with architectural display. There are some grand structures for aquaculture equipped with outdoor *triclinia* and marble architectural elements suggesting elite conspicuous consumption situated in lagoonal environments. At Lac-de-Capelles, Port-la-Nautique in Narbonne an impressive early 1st-century AD circular fishpond with central dining area equipped with a small rectangular tank to keep oysters alive was excavated; in antiquity the structure stood in the middle of a lagoon (Carayon *et al.* 2016).

Lagoons and legal disputes

When discussing lagoons and their usage in the Roman world, it is worth considering what their juridical regime was. As an internal body of water, a lagoon could be held as private property (*res in patrimonio*). This property could belong to an individual, a civic community, or an entity like a sanctuary. With Rome's territorial expansion, some lagoons had been declared property of the Roman people, and their exploitation was leased out by the censors, as was the case for the Lucrinus. If a lagoon was owned by someone, the revenues coming from its exploitation belonged to this individual.

There are some cases of disputes concerning the control of lagoons and of the natural resources they contained, which attest to the economic importance of these environments but also to the fact that defining boundaries between sea and the lagoon, and the lagoon and land, and assessing any tax or dues could be a challenging business. By their nature, lagoonal environments are prone to continuous, and at times sudden, geomorphological changes, as in the story related by Servius of the occlusion of the Lucrinus' opening to the sea after a storm. We have few attestations for cases of litigation concerning lagoonal environments and their resources, seeing on one side local communities or sanctuaries and on the other the Roman tax farmers. I will discuss three examples which show, on the one hand, the financial importance of these environments and their various resources, and on the other the fact that in the case of fishing, often the reason for the disputes was the problem in determining the origin of the fish (caught in the sea or the lagoon?) because of the shifting 'boundaries' between sea and lagoon.

The first case I wish to discuss concerns Priene in Asia Minor. Today the site of Priene is landlocked due to the progradation of the Büyük Menderes (Maiandros) delta which over the centuries has caused the Latmian Gulf to silt up. Geoarchaeological investigations have determined that when Priene was founded anew around 350 BC, the bay at the foot of the eastern side of its promontory had already turned into a coastal freshwater lake (Brückner 2003; on progradation of the Küçük Menderes (Kaystros) delta see Brückner *et al.* 2005). Geological corings have revealed that in the area of Priene a lagoonal environment existed until the beginning of the Roman Imperial era (Brückner *et al.* 2003: 51). The salt works of Priene mentioned in a 1st-century BC inscription might have been located in proximity of the freshwater lake, since freshwater is needed in salt making. The inscription, a honorific decree passed by the polis of Priene, attests a dispute that occurred between a *societas publicanorum* and the temple of Athena Polias concerning the control of the salt works (*I. Priene* 111). A certain Krates, who had held for four years the position of superintendent of the town's sacred properties, legally defended the temple's ownership rights to the salt pans against a *societas publicanorum* that apparently specialized in the extraction of salt or the management of salt-works, since the Greek text refers to them as *halonai*. Krates, while waiting for the senate's deliberation on the matter,⁴ intervened twice with the governor of Asia, successfully convincing him to leave the salt works under the city's control. It appears that Krates had invested in these salt works himself, so his actions were not simply dictated by a sense of civic duty. Indeed, the inscription specifies that these were 'the salt works equipped by himself' (i.e., by Krates), thus he must have had a stake in them (see *I. Priene* 111, line 113).

The second example of dispute concerning control of the natural resources offered by lagoonal environments comes also from Asia Minor and concerns Ephesus and its famous sanctuary to Artemis, the Artemision. Strabo reports that:

"next to the mouth of the Cayster is a lake called Selinusia, formed by the overflowing of the sea. It is followed by another, which communicates with this. They afford large revenue ... then the tax-farmer seized upon the tribute by force, and converted it to their own use..." (Strabo 14.1.26).

The Selinusia as described by Strabo was clearly a brackish coastal lagoon. The dispute between the Roman tax farmers (*publicani*) and the Artemision concerned the revenues derived from this lagoon, in all likelihood fishing and salt making.⁵ As reported by Strabo, the historic right of the sanctuary to this lagoon and its resources was removed under Hellenistic rule, when these revenues were destined to the royal coffers, but with the Roman rule the Artemision's rights had been restored.⁶ As in the case of Priene, one leading citizen of Ephesus, Artemidoros, took upon himself to oppose the *publicani* and appeal directly to the senate; he led a successful embassy to Rome and the rights of the sanctuary were restored (Purpura 2009).

Lastly, there is the case of the dispute between the town of Histria in the Danube Delta and the *publicani*, which I have discussed recently (Marzano 2020). In this case we know of the dispute and the length to which both parties went in trying to secure a favourable outcome for themselves from an extraordinary epigraphic dossier comprising inscriptions in Greek and Latin. The inscriptions, made sometime in the late 2nd century AD, reproduce eight letters spanning from AD 47 to AD 100 at least (but one Latin document, mentioning Laberius Maximus, is later in date, possibly to be dated under Marcus Aurelius or the Severi). The letters by Julio-Claudian governors are addressed to the 'archons, council, and demos of the Histrians' and all concern the Histrians' rights to fishing in the Lake Halmyris (a salt-water

⁴ In disputes such as these, involving *publicani* and the eventual status of a property as belonging to the Roman people, the senate was the body called to adjudicate.

⁵ On the connection between the cult of Artemis Ephesias and salt, see Carusi 2008: 85 and *I. Ephesos* Ia 14, line 19.

⁶ Possibly this event refers to the years after the peace of Apamea in 188 BC, when Ephesus was subject to the Attalid kingdom and as such had been willed to the Roman people by Attalus III with the rest of the kingdom of Pergamum.

lagoon, maybe the modern Lake Razelm) and to taking wood from Peuce, an island in the Danube Delta. From the texts, it appears that the governors' letters were prompted by embassies sent by the town of Histria, eager to get their rights reconfirmed each time there was a change of provincial governor. The dispute started when the *publicanus* for the customs district of the *Ripae Thraciae* had asked that the tolls from Lake Halmyris and Peuce be given to him in accordance with his tax-farming contract. In AD 100 the legate Manius Laberius Maximus rejected the *publicanus*' request recognizing Histria's rights. Key part of this final ruling was the survey and official demarcation of the territorial boundaries of the town of Histria which was carried out under the legate Laberius Maximus. Recognition of the town's rights to the lagoon and island from where they took torch wood was essential for the town, since fishing and fish salting appears to have been the pillars of the local economy. One of the texts declares that "your ambassadors affirmed, and the prefect Asiaticus said so too, that the revenue there from salted fish is just about the city's only revenue" (Epistle of Sabinus to the Histrians, c. AD 56, see Oliver 1965, translated text n.3); this view is confirmed by abundant archaeological finds of fishing weights, hooks, and fish bones from excavations of the ancient site of Histria (Ardeleanu 2016: 314). The "torch wood" mentioned in the epigraphic texts, so a resinous wood, is also likely to refer to fishing and fish salting: the wood might have been used to fish at night by fire, a known technique in both antiquity and modern times, and as fuel for the likely amphora kilns which produced vessels for the salted products (Lytle 2018; Marzano 2020: 281).

When these inscriptions, located in different parts of the Danube Delta, evidently in key positions along the territorial boundaries of Histria, were discovered in 1914, they initially prompted several scholars to believe that the *publicani portorii* also assessed taxes on fishing rights and timber collection at the mouth of the Danube, and this in turn was used to suggest that the Roman state exerted a monopoly on fishing rights. Later, it was suggested that what was under dispute were not the fishing rights themselves, but the Histrians' right to *transport* fish and wood from the lagoon and the island of Peuce without paying customs dues (De Laet 1949: 205–208). Since Histria and its territory stood to the south of the southern bank of the Danube, and the northern border of the province of Moesia ran along the southern bank as far as the sea, it was postulated that the Histrians had to pass at least one Roman customs station when travelling to and from the rich fisheries and Peuce island. Alternatively, it has been suggested that Histria's case would have rested on a territorial claim on the lagoons at the mouths of the Danube, which gave the town the right to lease fishing rights and/or to tax fishermen enjoying their use (Schwarz 2001: 377–381).

Be as it may, the new survey of the territory was vital because, in my opinion, this dispute centred on two interconnected issues. The Histrians claimed rights of ownership on the Halmyris lagoon at the mouth of the Danube, which meant that the town could lease the exploitation of this lagoon and receive revenues or, more unlikely, exploit it directly. The Histrians also had the right to take and transport the torch wood from Peuce without paying customs tolls, which became particularly relevant when the Roman custom frontier of the *ripae Thraciae* was created. Since the possible revenues in question were substantial, the tax-farmers must have argued that the Halmyris lagoon and Peuce island did not belong to the Histrians, but to the Roman people and that therefore they could demand payment of the leases. The *publicani* could also argue, as far as crossing the customs frontier and *portoria* are concerned, that the fish being transported had not been fished in the Halmyris, but in the sea and that therefore payment of a toll on the fish as an import tax was due. In fact, fish and molluscs fished from the sea were subject to the payment of *portoria* if they entered a port or passed through a customs frontier. It is because of this that, for example, at Caunos in Asia Minor (another locality with lagoons and wetlands and renowned in antiquity for the salt to which medical properties were attributed) in the 1st and 2nd century AD the inscription giving the list of import-export tolls displayed at the customs house was next to an inscription dealing with fishing and fish. Therefore, the Histrians had

to do two things: first prove that the town had territorial rights to the areas in question, rights which had been confirmed through the decades by the various Roman provincial governors. To this end, the various official communications sent to the town by the Roman legates were used, reproduced in the set of inscriptions; these letters must have been kept in the town's archives. Then the Istrians had to 'prove' that the fish they transported was coming from the lagoons they owned, not from other sections of the Danube Delta or the sea. Hence, to resolve the dispute the exact definition of the boundaries between the Halmyris and surrounding territory was necessary, as was necessary defining the exact boundaries of the custom district assigned to the tax farmer who had initiated the litigation. It is therefore apparent that the legate's decision to carry out a land survey and definition of the boundaries was key to reaching the resolution. These boundaries had to be surveyed again because a complex environment as the Danube's Delta was not static; it had certainly changed over time (Bivolaru and Morhange 2025; Purpura 2009).

A similar resolution comprising re-survey of territorial boundaries in order to define and reaffirm property rights was very likely needed also in the above-mentioned case of Ephesus. The Artemidorus who led the embassy to the Roman senate to defend the Artemision's right to the lagoon was a geographer and this is probably significant, as pointed out by Purpura years ago. Archaeological evidence attests that a land survey to delimit the area that belonged to the sanctuary was carried out under Augustus, an indication of the need to regularly re-survey the territorial boundaries due to the changing morphology of the Selinus lagoon (SEG 39.1175; Içten and Engelmann 1998, 83).

Conclusions

Coastal lagoons were natural environments which offered a range of important natural resources and as such have attracted human settlement since at least the Bronze Age. In the case of fishing and salt production, we have both textual and archaeological evidence for the exploitation of lagoons in the Roman era. For some towns, being able to draw on both marine and lagoonal fisheries was the key factor that made the local fish-salting activity a commercial success and on which the local economy rested. The discovery a few years ago of many sealed small vessels on board a shipwreck excavated in the Rhone River indicating the content was a fish paste made with juvenile fish caught in a lagoon is an important archaeological confirmation of the role lagoonal fisheries could have in the fish-salting industry. Even in the case of fish farming, a practice which reached notable levels of sophistication in the Roman period, lagoons seem to have been the 'incubators' for learning and developing skills, ideas, and practices that later found their application in the manmade marine structures for pisciculture (Marzano 2023).

The importance of the natural resources the lagoons offered is confirmed by the few cases of disputes between local communities and Roman tax farmers. These disputes, which focussed on who had the rights to the exploitation of the lagoons, fundamentally stemmed from two issues: 1) who had the right of ownership, which in cases of lagoons that over time had repeatedly changed ownership between state entities (e.g., Hellenistic kingdoms, the Roman state) and local communities or temples, could be complicated to ascertain; and 2) the exact definition of the limits of the lagoon and of where the limits between lagoon and sea stood. I have argued that the continuously evolving morphology of coastal lagoon was at the core of the well documented disputes involving the towns of Ephesus and Histria and the Roman tax farmers. I have also argued that the revenues involved were substantial enough to prompt, on the one hand, the Roman tax farmers to try and claim rights to exact taxation or control leases on lagoons that in fact should not have been subjected to their farming contracts, and on the other the communities or sanctuaries to strenuously defend their rights, even going to the great length of sending embassies to Rome.

Bibliography

- Alessandri, L. *et al.* 2019. Salt or fish (or salted fish)? The Bronze Age specialised sites along the Tyrrhenian coast of Central Italy: New insights from Caprolace settlement. *PLoS One* 14.
- Ardeleanu, C. 2016. Fishing in the Lower Danube and its floodplain from the earliest times to the twentieth century, in T. Bekker-Nielsen and R. Gertwagen (eds) *The Inland Seas: Towards an Ecohistory of the Mediterranean and the Black Sea*: 309–340. Stuttgart: Franz Steiner.
- BBC 2021. Mar Menor: Tonnes of dead fish wash up on Spanish lagoon's shores. (24 August 2021, <https://www.bbc.com/news/world-europe-58311105>). Viewed 30 May 2023.
- Bivolaru, A., Morhange, C., 2025. Micro-ecologies and economic strategies in Antiquity: unravelling landscape exploitation in Razelm-Golovița lagoons through geoarchaeology. *Archaeofauna S.I* (in press).
- Brückner, H. 2003. Delta evolution and culture. Aspects of geoarchaeological research in Miletos and Priene, in G. A., Wagner, E. Pernicka, and H. P. Uerpmann (eds) *Troia and the Troad: Scientific approaches* (Natural Science in Archaeology): 121-142. Berlin, Heidelberg, New York: Springer.
- Brückner, H., Müller, K. H. Müllenhoff, M. Uncu, L. 2003. Modelling coastal change in space and time: The example of the Büyük Menderes delta plain in Turkey, in *GIS Coast, Research Publication, 4: Final Conference Project IGCP 437: Coastal Environmental Change During Sea-Level Highstands*: 51-52. (available at http://www.igcp437finalconference.unisalento.it/AbstractBook/Bruckner51_52.pdf)
- Brückner, H., A. Vött, A. Schriever, and M. Handl. 2005. Holocene delta progradation in the eastern Mediterranean – case studies in their historical context. *Méditerranée* 1.2: 95-106.
- Carayon, N., Flaux, C., Sanchez, C., Piquès, G., *et al.* 2016. Le vivier augustéen du Lac-de-Capelles à Port-la-Nautique (Narbonne). *Revue archéologique de Narbonnaise. Les ports dans l'espace méditerranéen antique, Narbonne et les systèmes portuaires fluvio-lagunaires* (supplément 44): 87-97.
- Carusi, C. 2008. *Il sale nel mondo Greco (VI a.C. -III d.C.): Luoghi di produzione, circolazione commerciale, regimi di sfruttamento nel contesto del Mediterraneo antico*. Bari: Edipuglia.
- Cattani, M., Boccuccia, P. 2018. Nuove prospettive di ricerca per l'età del Bronzo nelle terre del Delta padano, in M. Cesarano, M.C. Vallicelli, and L. Zamboni (eds) *Antichi romani e romanità nelle terre del delta del Po*: 101–114. Bologna: Ante Quem.
- De Laet, S. 1949. *Portorium: Étude sur l'organisation douanière chez les romains, surtout à l'époque du haut-empire*. Bruges: De Tempel.
- Di Rita, F. *et al.* 2010. Holocene environmental instability in the wetland north of the Tiber delta (Rome, Italy): sea-lake-man interactions, *Journal of Paleolimnology* 44: 51-67.
- Djaoui, D., G. Piquès, E. Botte. 2014. Nouvelles données sur les pots dits “a garum” du Latium, d'après les découvertes subaquatiques du Rhône (Arles), in E. Botte and V. Leitch (eds) *Fish and Ships. Production and Commerce of 'Salsamenta' during Antiquity: Production et commerce des 'salsamenta' durant l'Antiquité. Actes de l'atelier doctoral, Rome 18-22 juin 2012*. Bibliothèque d'Archéologie Méditerranéenne et Africaine 17: 175–98. Aix-en-Provence: Publications du Centre Camille Jullian.
- Felici, E. 2016. *Nos flumina arcemus, derigimus, avertimus. Canali, lagune, spiagge e porti nel Mediterraneo antico*. Bari: Edipuglia.
- Grossi, M.C. *et al.* 2015. A complex relationship between human and natural landscape: a multidisciplinary approach to the study of the roman saltworks in “Le Vignole- Interporto” (Maccarese, Fiumicino–Roma), in O. Weller, R. Brigand (eds) *Archaeology of Salt: Approaching an Invisible Past*: 83–101. Leiden: Sidestone Press.
- Horden, P. and Purcell, N. 2000. *The Corrupting Sea*. London: Wiley Blackwell.
- İçten, C., and Engelmann, H. 1998. Inschriften aus Ephesos und Kolophon. *Zeitschrift für Papyrologie und Epigraphik* 120: 83–91.
- Lytle, E. 2018. Fishing with fire: Technology, economy and two Greek inscriptions. *Historia. Zeitschrift für Alte Geschichte* 67.1: 61–102.

- Marzano, A. 2013. *Harvesting the Sea. The Exploitation of Marine Resources in the Roman Mediterranean*. Oxford: Oxford University Press.
- Marzano, A. 2020. A Story of Land and Water: Control, Capital, and Investment in Large-Scale Fishing and Fish-Salting Operations, in P. Erdkamp and K. Verboven (eds) *Capital, Investment, and Innovation in the Roman World: 275-306*. Oxford: Oxford University Press.
- Marzano, A. 2023. Lo sfruttamento delle lagune costiere nel mondo romano. *Rivista di Archeologia* 47, 73-84.
- McCann, A. M., Bourgeois J. (eds) 1987. *The Roman Port and Fishery of Cosa: A Center of Ancient Trade*. Princeton: Princeton University Press.
- Mitsch W.J. et al. 2015. Ecosystem services of wetlands. *Int. Journal of Biodiversity Science, Ecosystem Services & Management* 11.1: 1-4
- Morhange, C., et al. 2015. Dynamiques Géomorphologiques et Typologie Géoarchéologique des Ports Antiques en Contextes Lagunaires. *Quaternaire* 26.2: 117-139.
- Mylona, D. 2018. Fish Processing in the Mediterranean: Varying Traditions, Technologies and Scales of Production with Particular Reference to the Eastern Mediterranean, in D. Mylona and R. Nicholson (eds) *The Bountiful Sea: Fish Processing and Consumption in Mediterranean Antiquity. Proceedings of the International Conference Held at Oxford, 6-8 September 2017. Journal of Maritime Archaeology Special Issue* 13.3: 419-436.
- Oliver, J. H. 1965. Texts A and B of the Horrothesia Dossier at Istros. *Greek, Roman and Byzantine Studies* 6: 143-156.
- Purpura, G. 2009. Il geografo Artemidoro e la dogana dell'Asia, available at <https://sites.unipa.it/dipstdir/pub/purpura/PUBBLICAZIONI%20DICEMBRE%202008/il%20geografo%20Artemidoro%20e%20la%20dogana%20dell%27Asia.pdf> . Last accessed 11 June 2023.
- Reddé, M. (1986). *Mare Nostrum: Les Infrastructures, le dispositif et l'histoire de la marine militaire sous l'empire romain* (BEFAR 260). Rome: École Française de Rome.
- Sanchez, C. and M. P. Jézégou (eds). 2016. *Les ports dans l'espace Méditerranéen antique. Narbonne et les systèmes portuaires fluvio-lagunaires. Actes du colloque international tenu à Montpellier du 22 au 24 mai 2014*. (Révue Archéologique Narbonnaise Supplément 44). Montpellier-Lattes: Éditions de l'Association de la Revue archéologique de Narbonnaise.
- Schwarz, H. 2001. *Soll oder Haben? Die Finanzwirtschaft kleinasiatischer Städte in der Römischen Kaiserzeit am Beispiel von Bithynien, Lykien und Ephesos (29 v. Chr.-284 n. Chr.)*. Bonn: Habelt.
- Scognamiglio, E. 2006. Archeologia subacquea a Miseno (Campi Flegrei). *Archaeologia Maritima Mediterranea. An International Journal on Underwater Archaeology* 3: 65-78.
- Sevink, J., De Neef, W., Alessandri, L., et al., 2021. Protohistoric briquetage at Puntone (Tuscany, Italy): principles and processes of an industry, based on the leaching of saline lagoonal sediments. *Geoarchaeology* 36.1: 54-71.
- Vittori, C., Mazzini, I., Salomon, F., et al. 2015. Palaeoenvironmental evolution of the ancient lagoon of Ostia Antica (Tiber delta, Italy). *Journal of Archaeological Science* 54: 374-384.