



# Marine salt production in the Roman world: The *salinae* and their ownership

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## ABSTRACT

While we have abundant archaeological evidence for the salting establishments that once operated in the Roman world salting fish (and meat), archaeological evidence for salt works is rarer; yet in antiquity salt was essential not only in food preservation but in many other production processes. The few known cases of Roman salt works investigated archaeologically (e.g., those at O Areal near Vigo or at Caunos in Turkey) offer some information on the physical infrastructure for salt production. However, the issue of ownership – whether marine salt works in the late republican and imperial periods were always a state monopoly – remains unclear. This article presents the available archaeological evidence for Roman marine salt works and argues that in the late Republic and during the first two centuries of the Empire state ownership was not the norm for marine salt pans, but rather the exception. The capillary diffusion of fish-salting workshops is a good indicator that salt could be freely acquired in the quantities needed for this activity, presumably at a fair price. This is in stark contrast compared to later historical period when salt was certainly a state monopoly.

## 1. Introduction

*ergo, Hercules, vita humanior sine sale non quit degere, adeoque necessarium elementum est uti transierit intellectus ad voluptates animi quoque nimias*, Plin., *HN* 31.88

‘Therefore, Heaven knows, a civilized life is impossible without salt and so necessary is this basic substance that its name is applied metaphorically even to intense mental pleasures’ (Transl. W.H.S. Jones, Loeb edn).

With these words the encyclopaedist author Piny the Elder, in the section of the *Naturalis Historia* devoted to salt, its uses, and production, emphasized the importance of salt to various aspects of daily life.<sup>1</sup> In the modern developed world, the average person would probably more readily associate salt with the idea that its dietary use needs to be reduced, since it can contribute to various health issues typical of *homo modernus sedentarius*. Few, however, may realize that salt’s utility reaches outside the kitchen and the seasoning of food, as various industrial and production processes use salt.

In the pre-modern world, salt was a very important commodity,

essential to life. First, in the lack of refrigeration, there were just a few methods available to preserve food; salting and preservation in brine, together with smoking and drying (of meat, fish, and some types of fruit), were the main procedures used to prolong the shelf life of many foods. How to prepare a good brine to preserve meat, fish, or to pickle cheese was standard knowledge in any household and very important in the daily running of a farm; we find such instructions clearly spelled out in Cato’s agricultural manual (Cato, *Agr.* 88.2). In addition, salt was also central to animal husbandry and the production of cheese, not to mention a range of other uses, for instance in medicine, leather working, metallurgy, wool washing, and purple dye making. Even the perfume-making industry required salt: Theophrastus in his work *On Odours* reports the requirements for the manufacture of rose perfume:

τῷ ῥοδίνῳ δ’ ἐμβάλλονται καὶ ἄλες πολλοὶ καὶ τοῦτ’ ἴδιον παρὰ τᾶλλα, διὸ καὶ πλείστη ἀπουσία γίνεται· μίγνυται γὰρ εἰς τὸν ἀμφορέα δύο μέδιμνοι, Theophr., *On Odours* 5.25

‘Into rose-perfume moreover is put a quantity of salt: this treatment is peculiar to that perfume, and involves a great deal of waste, twenty-

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<sup>1</sup> On salt as an essential addition to food as enhancer of taste, see Plut. *Mor.* 668 d-f (in which what salt does to make food palatable is compared to the role of hope in life and of light in making colours visible) and *Mor.* 685a-b (in which salt is seen playing a role as useful as those of light, water, and the seasons). Both passages are referenced in Carusi (2016), 337–338.

three gallons of salt being put to eight gallons and a half of the perfume' (Transl. A. Hort, Loeb edn).<sup>2</sup>

Salt deposits and the possibility to extract salt were not available in every location. Communities away from the coast, and hence from the sea, if they lacked deposits of rock salt or salty springs, were forced to establish trade links with areas where salt was produced. The Via Salaria that from the Forum Boarium in Rome reached the region of Sabina, derived its name from the fact that the salt produced at the mouth of the Tiber was transported on it towards inland regions, where it was much sought for animal husbandry (see e.g., Plin., *HN* 31.89). Rome had salt warehouses on the northern slope of the Aventine (as inferred from the toponym *Salinae*; *LTUR*, s.v. *Salinae*) from an early date and the close connection between salt and cattle was well embodied there: the Forum Boarium, from where the Via Salaria started, was the cattle market of Rome and the area of the city where the cult of Hercules—a god with an association with both animal husbandry and salt—was predominant (Torelli, 1993, 2006).

Salt had a vital role in Roman religious life too. Ancient texts like Pliny's remark that one thing that proved the absolute importance of salt to the daily life of people and the well-functioning of the Roman state was the fact that no sacrifice could be performed without the *mola salsa*. This was a mixture of spelt groats and brine prepared by the Vestal Virgins and, sprinkled on the sacrificial victims, was used by priests and magistrates when performing sacrifices in any of the *sacra publica* cults (Cic., *Div.* 2.37; Brill's *New Pauly*, s.v. *mola salsa*). Thus, salt was an essential ingredient in the performance of rituals that ensured the correct interaction with the divine and the right equilibrium between the human and divine spheres.

## 2. Materials: types of salt and salt works

As far as the Roman world is concerned, different sources of salt were exploited: marine salt; mine salt; and salt extracted from brackish springs and lakes. Coastal lagoonal environments were particularly important to salt production and since the ancient Mediterranean environment had many more coastal lagoons than it does nowadays, possibly covering an area equal to c. 6500 square km,<sup>3</sup> there were many locations offering the right natural conditions for salt works.

The very early stages of Rome's history are linked with salt production in a lagoonal environment: control of the *salinae*—salt works—located, possibly since prehistory, at the mouth of the Tiber on the right bank of the river may have been central to the war conflict between Rome and Veii and to Rome's growth as military power (Giovannini, 1985, 2001). Rome's own historiographical tradition attributed to the king Ancus Marcius the establishment of these *salinae* when the colony of Ostia was founded in 620 BC; an alternative version instead credited Ancus Marcius with securing the control of the salt works from the Veientans (e.g., Liv. 1.33.9; Dion. Hal. 3.41.3). Therefore, Rome's dependency on, and control of, these salt works is fixed in the very early stages of the city's history. The mythical king of Rome would also have given a benefaction—Pliny the Elder calls it a *congiarium*—to the people of Rome consisting in six thousand *modii* of salt (Plin., *HN* 31.89), thus enshrining in this legendary anecdote two essential aspects characterizing ancient Roman life throughout its history: the usefulness and desirability of salt, and the *congiaria*, that is the public distributions of food (later in the empire, of money) to the Roman *populus* which had such an essential socio-political role.

<sup>2</sup> The use of salt in this manufacturing process was to prevent decay, as explained by Discorides 2.53.

<sup>3</sup> Many coastal lagoons were drained in the large reclamation projects to create new agricultural land which took place in the early twentieth century. Horden and Purcell (2000), 192.

Recent archaeological investigations were carried out at Piscina Torta near Ostia (Alessandri et al., 2024), a site characterized by an extensive and dense scatter of reddish-brown pottery sherds believed to be containers used in the salt extraction process known as *briquetage* (see below). In antiquity Piscina Torta was on the edge of a lagoon connected to the sea, which may have functioned also as a port. Most of the pottery material identified dates to the period going from the second half of the 7th century BC to the 6th, so the time when city states like Rome were growing. The chronological and typological study of the pottery and its spatial distribution suggests that in the Late Iron Age this site possibly engaged also in the preservation and trade of foodstuffs (the pottery forms identified were both open and closed shapes), for example salted fish (Alessandri et al., 2024, 4.3). The important conclusion of this study is that there seem to be a clear link between the emergence and growth of the early-Tyrrhenian city states in Central Italy in the later Iron Age and Archaic period and the control of protoindustrial areas dedicated to salt and food production. Such a scenario would explain the importance given to the control of the salt-making sites at the mouth of the Tiber in Rome's own historiographic accounts.

In the imperial era Pliny the Elder discusses in some detail marine salt making and the different properties of the salt produced in different geographic regions: the sea salt from Cyprus is reputed to be among the best, the ones from Tarentum and from Phrygia are 'useful for the eyes', the salt from Cappadocia gives a particular gloss to the skin, the salt from Caunos has medical properties, and so forth (Plin., *HN* 31.41; 31.99; Moinier, 1985). Pliny is not the only imperial-age author to report on the reputation certain types of salt had; the salt produced at Tragasai (mod. Tuzla) in the Troad from the evaporation of salty hot spring water, for instance, is praised as the best salt by the physician Galen (Gal., *SMT* 12.372 [Kühn]).<sup>4</sup> Although probably Pliny derived much of his information from Theophrastus' lost treatise *On salts, niter and alum*,<sup>5</sup> his attention to reporting for his Roman audience the different regional salts and their properties implies that these different types of salt were traded also outside the immediate region of production and, especially in the case of salts with medicinal properties or other very specific qualities, that they could be acquired in Rome and presumably in other large urban centres of the empire.

The extraction of marine salt is a laborious process and involves several stages. Salty water (on average 1 kg of seawater contains 35 g of salt: Webb, 2023, section 5.3) is channelled to shallow evaporation basins, with sluices placed along the channels, so that the flow of water can be blocked, and the water in the basins is allowed to evaporate during the hot summer months. If the slope of the terrain cannot be relied upon to let the water move in the channels by gravity, water lifting devices need to be used. Different types of water lifting devices were known and used in antiquity and a passage from Vitruvius' treatise *De Architectura* mentions salt works among the applications for the *tympanum*, that is, the waterwheel with a compartmental body powered by people treading on the rim.<sup>6</sup>

<sup>4</sup> Ath., *Deip.* 3.73 reports that anyone had been free to collect this salt but then Lysimachus had imposed a tax on it and the salt disappeared; when, surprised by this phenomenon, Lysimachus abolished the tax, the salt came back. The Turkish name, meaning 'the place where salt is produced', shows the continued exploitation of these salty hot springs until modern times. When Tchihatcheff visited the area in the nineteenth century, many small basins had been cut in the plain around Tuzla to let the water evaporate; in one gorge a very hot water jet, 1.57 m long, erupted from the side of the mountain. He remarks that the abundance of salty springs in the plain could give a huge quantity of salt, much more than the 18,000/20,000 kg per year they were producing at the time because 'l'état d'enfance où se trouve l'industrie dans toute l'Asie Mineure, cette source de richesse a été à paine entamée': Tchihatcheff (1853), 336, with illustration of the water jet.

<sup>5</sup> This work by Theophrastus is mentioned by Diogenes Laertius, *Vit. Phil.* 5.42.

<sup>6</sup> Vit., *de arch.* 10.4.1-2: *ita hortis ad irrigandum vel salinis ad temperandum praebetur aquae multitudo*. On water-lifting devices, see Wilson (2008).

When brine starts to form in the first evaporation basin(s), the marine water is moved into a shallower one and so forth, until eventually the evaporation of water is complete and salt crystals are formed. While the evaporation relied on the strength of the sun, this is only half of the salt making process: purification is needed, because sea salt also contains sulphate of magnesium, salts of iron, calcium, and other ‘impurities’ that must be removed. In modern salt making, the purification process can occur by harvesting or by clarification. Harvesting was probably the method used in the Roman world. With the harvesting method, when during evaporation a black mud forms (this is a substance that oxidizes when exposed to the air, giving off hydrogen sulphide), the salt harvester proceeds to remove the salt from the basins, separating it from the muddy substance. The skill of a good salt harvester is to remove fine white salt without disturbing the black mud formed at the bottom of the pans.

Salt-extraction methods used in antiquity did not always rely on complex procedures and permanent infrastructure. A very old salt-extraction method, which was probably still used in the Roman period in some areas, consisted in using fire to evaporate the water and crystallize the salt; this is the so-called *briquetage* technique and had been widely used since prehistoric times, particularly in northern Europe, where climatic conditions make the solar evaporation of sea water or brackish water more difficult to obtain (Weller, 2015, 71–73; Harding, 2021, 17–19; 30–54). In areas characterized by high sea tides and large sandy beaches, it was also possible to extract the salt from the sand by a process called lixiviation. In locations with high sea tides seawater evaporates quickly because of the action of wind and sun, and salt crystals form on the upper layers of sand. These crystals are mostly sodium chloride, as other salts would precipitate to the lower layers of sand. These layers were gathered and washed with fresh water to dissolve the salt, and the water was then collected in containers and artificially heated up by fire. It has been suggested that this was the method used to produce the salt needed for the Roman fish-salting operations based at Cotta and Tahadart, on the Atlantic facade of Morocco (Hesnard, 1998).

### 2.1. Archaeological evidence for marine salt works

Roman marine salt works have been identified in a few geographic areas of the Roman world either based on written sources or, more rarely, archaeological remains. The most famous marine salt works of Rome were the *salinae* located at the mouth of the Tiber, where extensive lagoons existed in antiquity. Most of the evidence pertaining to these famous salt works is, however, either literary or documentary. A well-known inscription of the Severan period refers to these salt works with the name *Campus salinarum romanarum*, a name that probably survived in the medieval toponym ‘Campus Maior’.<sup>7</sup> This text also mentions *saccarii salarii*, that is, the porters who transported in sacks the salt produced in the *salinae*. Terracotta statuettes depicting male figures with a sack on their shoulders are indeed known from the Ostia-Portus area, depictions of the porters that were central to the hauling of goods, not just salt, that passed through this major hub (Martelli, 2013). In recent years some archaeological traces of these *salinae* have come to light, and better data on the ancient environment in this area and how it changed through time have become available.<sup>8</sup> The archaeological remains of the actual Roman salt works are fragmentary. The area in antiquity occupied by the lagoon which later, reduced in size, came to be known as the Stagno di Maccarese, changed drastically with the reclamation works carried out in the

late nineteenth and early twentieth centuries.<sup>9</sup> These interventions completely dried up the Stagno di Maccarese and either destroyed or obliterated any traces of pre-Roman and Roman settlements. Archaeological excavations carried out at Vignole-Interporto have uncovered a large hydraulic structure, dated to the first half of the first century AD (Grossi et al., 2015). This consisted in a dam built using 1439 amphorae and four channels intersecting each other almost at 90° angles. The other remains, multiple cuts of channels of different shapes and sizes found in the clay-silty sediments are difficult to interpret (Grossi et al., 2015, 87; 90–92).<sup>10</sup> The amphorae are Dressel 6a, 6b, and 20 and were cut in half before driving the toe into the ground. The row of amphorae, at places a double row, was buttressed by a mound on the ‘exterior’ side and by wooden posts (preserved in places) from the inside. Oriented north-south, it is about 1 km long, and is perpendicularly intercepted by two masonry channels set 300 m apart. The elevation this barrier of amphorae had in comparison with the contemporaneous ground level, its orientation, and general topographical setting in relation to the other features dated to the Roman period have led the excavators to interpret this as a dam and support of a walkway for the Roman salt works<sup>11</sup>; the channels would have been the adductors for the water coming from the salty lagoon. Traces of grooves for sluices are also reported in two of these channels (Grossi et al., 2015, 94). A slight inclination from west to east was noted from the start of the amphora dam to the end of two of the masonry channels, presumably to allow the water to flow. Large areas delimited by channels (e.g., 202 × 300 m) were also identified, but these were not the shallow basins communicating with each other one would expect in a *salina*. Such set up is clearly described in written sources such as Pliny the Elder, Manilius, Rutilius Namatianus, the medieval author Agricola, and corroborated by early modern and modern parallels. However, the investigation at Vignole-Interporto did not locate clearly defined interconnected basins. As we shall see also for the site of O Areal in Spain, even in the case of well-defined shallow basins, we do not have openings or channels connecting them to each other, and this is very puzzling. Nonetheless, the features uncovered at Vignole-Interporto are most plausibly explained as a highly efficient infrastructure to convey water from the sea into an enclosed area for the purpose of salt extraction through evaporation. The infrastructure included ‘channels, flood zones and well-defined openings allowing for the regulation of water flow’, and a general hypothesis on the functioning of the system was also advanced, postulating that this installation produced unrefined sea salt (Grossi et al., 2015, 96; 97).

While the physical evidence for the salt works is very fragmentary and insufficient to give precise details on the characteristics of the infrastructure for the various stages of salt production, studies on the skeletal remains from a Roman imperial necropolis located in the area have revealed information on the individuals that worked in the *salinae* and their (generally poor) health conditions.<sup>12</sup> The studies carried out on the skeletons from the necropolis of Castel Malnome confirm that the individuals here buried in very simple tombs had been engaged in demanding physical activity and repeated movements creating stresses on the upper body, the forearms, lower limbs, etc. These stresses are compatible with work in salt pans (e.g., the harvesting of salt and the carrying of heavy loads) (Catalano et al., 2010).

<sup>7</sup> CIL XIV suppl. 4285 = ILS.6178 = : B 321, to be dated between AD 197 and 209. *Conductores salinarum romanarum* are also attested in a dedication to Neptune dating to AD 135 discovered in 2003 in emergency excavations on the right bank of the Tiber: Cébeillac-Gervasoni and Morelli (2014).

<sup>8</sup> Keay et al., (2005), esp. the chapter by Arnoldus-Huyzendveld on the geomorphology.

<sup>9</sup> For the reconstruction of the palaeoenvironment see Grossi et al., (2015), 84–87 with previous bibliography and Di Rita, Celant, Magri (2010).

<sup>10</sup> Excavations have found also remains of wooden posts and planks related to the creation of partitions in the lagoons for fish farming/fishing in the Middle Ages. By this period, the saltworks had moved to the other side of the Stagno di Maccarese.

<sup>11</sup> Cf. the retaining wall made with two rows of superimposed Roman amphorae discovered in the modern salt works on the island of S. Fernando in Cadiz, attributed to the Roman *salina*: Marzano (2013), 128.

<sup>12</sup> The necropolis, which measures c. 3000 m<sup>2</sup>, is near Ponte Galeria, in proximity of the Via Portuense.

For other archaeological evidence for salt works we need to look outside of Italy. The discovery at Caunos in southern Turkey and the investigations carried out at O Areal in north-western Spain have highlighted the surface extension that ancient marine salt works featuring shallow basins for water evaporation could have.<sup>13</sup> The importance in antiquity of salt production at Caunos is well attested in the literary and documentary record (e.g., Plin., *HN* 31.99; *I. Caunos* 35.1 B 8). The archaeological evidence, so far still published in preliminary fashion, consists of forty-eight circular shallow basins, divided into four groups by three long, rectangular canals or basins presenting a curved profile at one end and blocked on the sea side by two low walls (Atik, 2008). No connection between the individual circular basins, and between these, the ‘canals’, and the sea, is evident and the general dating for the construction of the complex, the first century BC, is based on construction technique (S. Atik, pers. comm.).

The site of O Areal in Vigo (Galicia, Spain) presents a different typology and construction technique from Caunos’ saltwork complex. At O Areal several shallow rectangular basins of varying sizes with a base of compacted impermeable clay and separated by rows of stones have been found. From the location of the various remains, it seems that the Roman *salina*, established in the mid-first century AD, covered an area of c. 8.5 ha (Curras, 2017, 330). Water from a nearby coastal lagoon identified by geoarchaeological studies would have entered first the larger basins along the shore and then moved to the smaller ones where crystallization would have been completed (Curras, 2017, 331–333). Some aspects of the working of this installation remain, however, unclear, most importantly the salty water intake and how the progressively evaporated water moved from one basin to the other. Indeed, the rectangular basins do not seem to have any openings to allow the flow of water from one evaporation basin to the next and the gradient reported does not always seem to conform to the movement the water should have followed. One would expect openings controlled by sluices, a simple technology well attested in other Roman contexts, but this does not seem to have been the case. With the large installations of Caunos and O Areal lacking clear channels connecting the basins, are we to suppose that the water was moved by hand, possibly employing water lifting devices like the Archimedean screws mentioned by Cassiodorus when talking of the inhabitants of Altinum and their saltworks? (Cassiod., *Var.* 12.24.6).

While secure archaeological evidence for Roman marine salt works is not very abundant, we know from literary or documentary evidence of many coastal areas where salt was produced: the Republican salt works at Minturnae in southern Latium, known from first-century BC epigraphic evidence attesting slaves of a *societas salinatorum* or those at Caralis in Sardinia; the *salinae Herculeae* near Herculaneum and Pompeii, mentioned in literary texts; the fifth-century AD *salinae* part of the maritime villa estate of Albinus at Vada Volterra in Etruria, which Rutilius Numatianus mentions in his poem; or the salt works at Priene in Asia Minor, attested in a honorific inscription.<sup>14</sup> There are, however, many other locations that, in spite of not having identified archaeological traces of Roman salt-works or not being mentioned in the written sources about salt production, are extremely likely to have been exploited for salt production in the Roman period and even before the

<sup>13</sup> Marzano (2013), 126–129 for archaeological evidence for other possible Roman salt works.

<sup>14</sup> Minturnae: *CIL* I<sup>2</sup>. 2691, 2693, 2698, 2703; Caralis: *CIL* 10.7856, *IG* 14.608, *CIS* I.143 and Pennacchietti (2002) trilingual inscription in Latin, Greek and Punic mentioning, in the Latin text, a *salari(orum) soc(iorum) s(ervus)* and in the Greek ὁ ἐπὶ τῶν ἁλῶν (=the superintended of the salt works), dating to either the second or the first century BC; *Salinae Herculeae*: eg. Columella, *Rust.* 10.135–6 (probably the *Salinienses* attested in Pompeii in an electoral context are the inhabitants of the *pagus* of the *salinatores* working in these salt works: *CIL* IV.128; De Carlo, 2007); Albinus’ villa: *Rut. Namat.* 475–90, possibly this villa is to be identified with the villa excavated at S. Vincenzino, near Cecina, see Marzano (2007), Catalogue T24; Priene: *I. Priene* 111.

Romans. Indeed, at these locations, fish salting or purple-dye production, activities requiring abundant salt, are attested either from literary sources or from archaeological data for classical antiquity.

It has been suggested that the territorial and commercial integration achieved in the Roman empire together with the supposed state monopoly on salt caused a general shift from mine salt to marine salt, but this seems unwarranted to me (Saile, 2013). Salt was an essential substance, but that does not mean that it was such a high-priced commodity that shipments in bulk could absorb the cost of long-distance transport (especially over land and difficult terrain). There is a brief reference in Plutarch’s *Table Talks*, in the discussion on why salt is said to be ‘divine’, to ‘ships transporting salt’, but since it is generic and does not specify any place or time period, it is difficult to take it as indication that transmarine bulk shipments of salt occurred as regular part of long-distance trade.<sup>15</sup>

The scattered references we have about the price of salt in the Roman world show that its price was low (Carusi, 2008, 162–165; 2016, 345). For instance, a papyrus from Tebtunis in Egypt dated to AD 47 (*P. Mich.* 5.245), a document of the local association of salt merchants, gives as the minimum price for good quality salt (ἄλς καλός), 2 *obols* and 4 *chalci* per *metron* (a *metron* is c. 3.9 L). To put this price in perspective, in the same town of Tebtunis a document of AD 46 gives 10 *obols* as the price for thirty eggs and 2 *obols* as the cost of two loaves of bread.<sup>16</sup> For a later period and an area of the empire far from the Mediterranean, a writing tablet dating to AD 111 from Vindolanda in Britain records the purchase of 85 *pondera* of salt (c. 27.83 kg or 23.2 L)<sup>17</sup> for probably 12 *asses*; in the same tablet 100 nails for military boots have a price of 2 *asses*, whereas 1 *metretes* (c. 54 L) of Celtic beer costs 8 *asses*.<sup>18</sup> In this case the price of salt, when compared with the other items, seems more expensive than in the Egyptian example. The maximum price for salt given in Diocletian’s Price Edict of AD 301 is 100 *denarii* for 1 *modius castrensis* (c. 11.6 L) (*Ed. Diocl.* 3.8–9). This is the same price the Edict (at 5.6) gives for the purchase of 100 oysters. It can be plausibly assumed that only ‘specialty’ salts, largely used in medicine, would be traded over very long distances. For the demand on ‘normal’ salt, local sources were used whenever it was possible; for the settlements along the seashores this local source was the sea. Both the archaeological and written evidence suggest that in the Roman world salt was produced whenever such production was feasible, on both small and large scale, regardless of the type of salt.

### 3. Salt and the economy: some considerations

Salt in the Roman world seems to have been more widely and readily available than in later historical period when a strict control on the extraction and trade of salt was enforced and when the many custom barriers of politically fragmented Europe added much to the final cost of

<sup>15</sup> Plut., *Mor.* 685d; the passage argues that salt contributes to generation because of its stimulating effect on copulation, even claiming that ‘Ships carrying salt breed an infinite number of rats, because, according to some authorities, the females conceive without coition by licking the salt’ (Transl. H.B. Hoffleit, Loeb edn). Bresson (2007), 184 takes this passage as an indication that salt was traded in large quantities.

<sup>16</sup> *P. Mich.* 2.123. Some decades later, in AD 78, the daily wage for ploughmen as given in *P. Lond.* 131 was 5 *obols/day*.

<sup>17</sup> Assuming a density of 1.2 kg/l; conversions from Stockinger (2015), Table 1.

<sup>18</sup> *TVII* 186: the quantity of salt purchased by a soldier is clear, but the line with the price is lacunose, only *II* is readable; the tablet editors suggest 12 *asses*.

salt for consumers.<sup>19</sup> The result of this historical situation was that in Medieval and Renaissance Europe salt became a precious substance, a natural resource whose control helped to create great commercial empires and over which wars were fought. The case of Venice in the Middle Ages and her increasing commercial power across the Adriatic and the whole Mediterranean is a case in point. The extensive lagoons around Venice were most suitable for salt production and fish farming. Salt production in the area in antiquity is attested by an oft-quoted passage in Cassiodorus' *Variarum* that mentions the salt works of Altinum and the importance they had in the local economy (Cass., *Var.* 12.24.6).

From the twelfth century onwards, Venice started to adopt a series of policies aiming at controlling the trade in salt, while steadily increasing her direct control over many salt production areas; at the end, not only did Venice control all salt production along the whole Adriatic, but also in Sicily, Sardinia, Crete, and Cyprus. The war fought between Venice and Ferrara in 1482–1484 had among its causes the fact that Ferrara, reacting to Venice's monopoly on the salt trade, had started to produce salt near Comacchio. In some cases, the culinary taste of entire regions changed because of the strict control on salt production and trade, and such differentiations continue to this day. In parts of central Italy, where during the Middle Ages bread started to be made without salt because the cost of this commodity reserved its use to more essential applications, we still find today that the local bread is made without salt. This example concerns dietary habits, but the existence of state monopolies on salt has had in the past more profound consequences, affecting regional economies and the degree to which certain artisanal and industrial activities could grow and spread. It is sufficient to consider the consequences, in the nineteenth century, of the imposition by the British rule of a salt tax and declaration that sea-salt making activities such as those traditionally practised in the village of Dandi in India were illegal. The Salt March that started Gandhi's non-violent protest and civil disobedience movement against the British rule in India in 1930 was so successful in getting the general population involved precisely because it targeted a restriction that had been affecting everyone and which went beyond culinary use.

The matter of state control on key natural resources is of great importance in the contemporary world and was of great importance in antiquity. It has sometimes been said that, like in the case of modern European states, also in ancient Rome marine salt was a state monopoly. The Roman state would have leased out the exploitation of *salinae* to business partnerships—the *societates*. The evidence provided by the Republican inscriptions from Minturnae and Caralis, attesting to slaves of *societates* exploiting the salt works has been read in this sense and cited in support of a general monopoly the Roman state would have had on salt (e.g., Llamazares Martín, 2020, 17). There are indeed several passages in the legal sources which refer to salt works owned by the *populus Romanus* and managed through *societates publicanorum*,<sup>20</sup> and important salt works such as the one at the mouth of the Tiber were indeed owned by the *populus Romanus*, i.e., the state. However, the issue

is whether state ownership was the norm across the whole Roman world. As observed by Ørsted (1998, 26), attestations of *societates* involved in the exploitation of salt works does not necessarily imply ownership by the Roman state; it could also refer to *salinae* owned by individual cities, a very likely scenario particularly in the case of the Greek city-states but by no means limited to them, or it could even refer to private entrepreneurship.

The case of the tax on the salt trade that the censor M. Livius Salinator (as he was known after introducing the tax) established in 204 BC almost at the end of the Second Punic War does not necessarily prove the state monopoly over salt or state ownership of all the *salinae* (Liv. 29.37.3; Ørsted, 1998, 21–22 on this point). Government control, at least on the right to trade in salt and on the price of salt existed in Roman Egypt, a continuation of earlier practices. The Egyptian case is an anomalous situation in the light of the working of market forces: the state exercised control over the price of salt but at the same time it auctioned the right to sell it. Normally individuals bidding for this kind of contracts had the incentive to do so because of the gains they could make from selling the product at an advantageous price, so the fact that the government set the price for salt should not have encouraged interests in acquiring the right to trade in salt.<sup>21</sup>

There were certainly various instances of marine salt works that were owned by the *populus Romanus* and leased out to *societates* for their exploitation, such as the *salinae* of the kingdom of Pergamum in Asia Minor or those near Carthago Nova in the Iberian Peninsula. In the former case, when king Attalus III left his reign to the Roman people in his will in 133 BC, all royal properties became public property of the Roman people, including salt works. A passage in Cicero's *pro lege Manilia*, listing the areas in which the *publicani* had slaves engaged in production activities and expressly mentioning *salinae* confirms that among the properties formerly of the king of Pergamum there were also salt works, now leased by the Roman state to *societates publicanorum*.<sup>22</sup> The case of Carthago Nova was probably similar: it is believed that the extensive salt works became property of the Roman state after Scipio's conquest of the town during the conflict with Carthage and that an appositely-created *societas* had later leased their management, subsequently branching out to include also the production of processed fish: the famous *garum sociorum*.<sup>23</sup>

The discussion on the legal status and ownership of marine salt works in the Roman period has proceeded hand in hand with the discussion about the juridical status of the sea, state control of marine fishing rights, and the eventual existence of a legal concept comparable with the modern idea of territorial waters (Marzano, 2013, 235–267; on marine fishing rights and the juridical status of the sea in the Greek world: Lytle, 2012). The sea and the seashore in Roman legal thought were placed in the same category as the air. As specified in the *Digest*, they fell under the *ius gentium*, meaning that anyone, regardless of citizenship status, could freely make use of them and could not be kept in private ownership:

<sup>19</sup> In the Roman empire internal customs duties (*portoria*) were levied on the major traffic-routes, and often several provinces formed a single custom district in which the duty was raised at a uniform rate (often, as in Gaul, 2.5 per cent of the value of the goods). The political unity of the Roman empire meant that internally there was a significant smaller number of customs frontiers compared to medieval or early modern Europe. On Roman customs duties the De Laet's 1949 study remains fundamental.

<sup>20</sup> E.g., Dig. 39.4.13 pr.: *et hi, qui salinas et cretifodinas et metalla habent, publicanorum loco sunt.* ('However, people who have salt-works, chalk-pits, and mines also count as *publicani*'); Dig. 50.16.17.1: *publica vectigalia intellegere debemus ex quibus vectigal fiscus capit; quale est vectigal portus, vel venalium rerum, item salinarum et metallorum et picariarum* (it is unclear whether the word should read *piscariarum* or *picariarum*, see Marzano, 2013, 249–250) ('We must also regard as 'public' those taxes from which the imperial treasury derives revenue, such as a harbour tax or a tax on salt works, mines and pitch (?) factories'). Cf. also Dig. 3.4.1; 28.5.60.1.

<sup>21</sup> Forbes (1965), 178. For the associations of salt traders, see, e.g., P.Mich. 5.245 attesting a group of salt traders at Tebtunis in the Faiyum and dating to the reign of Claudius.

<sup>22</sup> Leg. Man. 16: *Cum publicani familias maximas quas in salinis habent, quas in agris, quas in portoribus atque in custodiis magno periculo se habere arbitrentur?* ('When the *publicani* believe they can keep only with great risk the large slave manpower they have in the salt works, in the fields, in the ports, and in the sentry posts?').

<sup>23</sup> Étienne and Mayet (2002: 19–26) have suggested that the *garum sociorum* produced in the Carthago Nova area referred to a *societas* that started with salt extraction and later included fish processing among its business activities. Carthago Nova had very favourable conditions for fish processing: the salt pans and bountiful lagoonal and marine fisheries, which ensured fishing whole year round.

*litorum quoque usus publicus iuris gentium est, sicut ipsius maris ... Proprietas autem eorum potest intellegi nullius esse, sed eiusdem iuris esse, cuius et mare et quae subiacent mari, terra vel harena, Inst., II.1.5*

‘The law of all peoples gives the public a similar right to use the seashore, and the sea itself ... The right view is that ownership of these shores is vested to no one at all. Their legal position is the same as that of the sea and the land or sand under the sea’ (Trans. Birks and McLeod, 1987, with modifications).

To think that the Roman state had a general monopoly on fishing rights and on marine salt production is not supported by the evidence, nor can one consider the legal status of the shoreline as affecting the legal status of marine salt works. In fact, Roman jurists define the shore (*litus*) as the maximum portion of shoreline reached by the waves in winter: *Litus publicum est eatenus, qua maxime fluctus exaestuatur* (Dig. 50.16.112). Marine salt works were not located on the *litus* reached by the waves, but a bit more inland, and therefore could be held as private property by communities or individuals,<sup>24</sup> and be leased out privately for their exploitation.

Indeed, there is evidence for *salinae* owned by towns and for *salinae* owned by private individuals,<sup>25</sup> as there is evidence that controlling the extraction of salt was economically so important that salt works could be sources of litigation. In the first century BC, an individual named Krates was the recipient of an honorific decree passed by the *polis* of Priene (I. Priene 111). What deeds did this Krates accomplish to deserve the honour? He had taken on a *societas publicanorum* apparently specializing in the exploitation of salt works, since the Greek inscription refers to it with the name *halonai*; this *societas* had tried to claim the right to the local salt works against the temple of Athena Polias. 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 these salt works and intermediated with the governor of Asia. The text reports that while awaiting for the senate’s deliberation on the matter (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),<sup>26</sup> Krates had intervened twice with the provincial governor, successfully convincing him to leave the salt works under the city’s control and management.<sup>27</sup> Krates’ actions were probably not simply dictated by the desire to defend his town’s interests in consideration of the public post he had covered: the inscription specifies that he had invested in these salt works and thus must have had a stake in them (I. Priene 111, l. 113: τὰς κατασκευασθείσας ὑφ’ ἑαυτοῦ ἄλλεας = ‘the salt works equipped by himself’).

Besides the *salinae* at the mouth of the Tiber and Pergamum’s salt works, the other attestations unquestionably pertaining to public *salinae* of the Roman people refer to salt mines and not to marine *salinae*. These are the three epigraphic attestations of *conductores pasculi et salinarum* from the province of Dacia (CIL, 3.1209, 1363; AE, 1937.141). It is worth noting here the combination under the same management of pastureland, and hence animal husbandry, and salt mines.<sup>28</sup>

Nonetheless, compared with the attestations of Roman salt-works, either literary or archaeological, references to the juridical status of

specific salt works and to their modes of exploitation remain rare. This fact might indicate that in most cases, both in the Greek classical world and in the Roman Empire, the norm was rather for marine salt pans to be privately owned, and that only in some cases did direct control by the Roman state occur.

Indeed, there is a striking difference, judging from the evidence available to us, between the availability of salt for a range of manufacturing and artisanal processes that one can see in the Roman world and the case of medieval Europe or even more recent times, when there certainly was state control on salt. This is a salient distinction to be made and it explains the capillary diffusion of those production activities that needed salt as one of their main and necessary ‘ingredients’. The widely attested fish-salting workshops and ‘factories’, and the purple dye producing sites that can be found along the coasts of many regions of the Roman world obviously required large quantities of salt to make salted fish, fish sauces and pastes, and the precious purple dye. I am not here interested in proposing a quantification of the salt needs of these manufacturing activities,<sup>29</sup> but rather I wish to emphasise that Roman fish-salting establishments of varying sizes are to be found almost everywhere one has looked for them. This picture suggests that salt was readily available to this type of food-processing activity and that the idea of a state monopoly on marine salt works and control of its production, even if by leasing out the management to private individuals, is highly unlikely. The territorial distribution of these workshops is revealing of how common fish salting was; the fact that we have large sites and also very small, isolated workshops, shows that both big and small manufacturers could access the abundant salt they needed regularly and at a convenient price.

This is a very different situation from what recorded for different areas of the Mediterranean in the modern era, when the inability to acquire sufficient quantities of salt significantly hampered the fishing industry. Take the case of the Adriatic fisheries in the nineteenth century. As observed in 1883 by George Luis Faber, the British vice-consul to the Austro-Hungarian Empire resident in Rijeka-Fiume, inability to access enough salt due to the state monopoly had a significantly adverse impact on the Adriatic fisheries:

‘One of the great drawbacks to development is also the State monopoly of salt. The fishermen are, it is true, allowed a certain quantity of salt at reduced prices, but not sufficient, and very often they fall short of their supply. Thus, when large hauls of mackerel, pilchard, etc. are made, so that they cannot be consumed in their fresh state... the fish has often to be thrown away from want of a sufficient quantity of salt’ (Faber, 1883, 45).

The monopoly on salt imposed by the Austro-Hungarian empire meant that once the salt the fishermen could acquire at a set price had been exhausted, additional salt could not be obtained at a price that was competitive enough to make the processing and preservation of the abundant fish catches a worthwhile endeavour. It was the same in Greece, in places such as the Argolic Gulf. According to Apostolides, who lived and wrote in the same period as Faber, in the late nineteenth century no salting operation took place in conjunction with tuna fishing in the area and the fishermen were forced to try and deliver the entire catch fresh (Apostolides, 1883, 39–40). In this case too one of the causes limiting the possible growth of the fishing sector was the limited capability of these individuals to acquire salt.

The situation exemplified by the case of the nineteenth-century Adriatic and Argolid fisheries was the result of three main elements: the limited availability of salt, which was at that time a state monopoly, at a sufficiently low price to make salting economically feasible; no connections between fishermen and those who might have had the

<sup>24</sup> In other words, they were considered *res privatae in patrimonio*.

<sup>25</sup> In addition to the known example referred to in Rutilius Namatianus’ poem, see also Dig. 33.2.32.2.2 about a testamentary legacy a wife received from her husband comprising the usufruct of farms, houses, estates, and salt works (... *usum fructum fundorum et salinarum*).

<sup>26</sup> Wallace (2014) on this inscription and other examples of resistance to the *publicani*’s claims on *ager publicus*.

<sup>27</sup> Krates mediated with two different governor of Asia and must have had a very good social network to be able to do so; on the importance of establishing personal relations with provincial governors in the towns’ strategies to defend their rights from the claims of the *publicani* see Marzano (2020).

<sup>28</sup> Another inscription from Dacia attests a *conductor salinarum* at Mucia: CIL 3.13.63.

<sup>29</sup> For quantification attempts see Carusi (2008), 152–153; 2015, and brief discussion in Marzano (2013), 136–138. For the quantity of salt used in experimental archaeology studying the manufacture of ancient fish saucers, see Driad (2014).

means to start a salting operation; and no access to distribution channels. From what we know of the Roman fish-salting industry, the situation was very different: even small and medium-sized producers had access to the resources needed for production and commercialization of the product, such as salt and amphorae, and to a wide network of distribution channels. These workshops were, obviously costly, and as fish was fished from the sea, so too must salt have been extracted locally.

I focus here on giving the example of the fish-salting industry as an indicator of the demands, geographic diffusion of salt extraction in the Roman world, and accessibility of the product, simply because the many fish-salting establishments of Roman date, featuring batteries of masonry salting vats, are very visible archaeologically. However, as mentioned at the start of this article, salt had multiple uses in antiquity. We ought to equally posit that activities such as production of cured meat or of leather, which, being connected to animal husbandry, often took place in more inland areas, had access to the salt they needed, whether this was coming from rock salt deposits, from brackish lakes, or it was marine salt transported from the coast. For example, the several meat-processing establishments attested at Augusta Raurica (mod. Augst) clearly needed, and had access to, abundant salt provisions<sup>30</sup>; similar considerations can be made for other areas of the Roman world.

#### 4. Conclusions

Salt was a precious resource because its use was not limited to making food more palatable: it was an indispensable substance that allowed the preservation of food, animal husbandry, cheese making, and a variety of artisanal processes, from wool washing to leather processing. As has been suggested for Rome's development, the fortune of individual cities may have rested on the availability of nearby salt resources and the ability to control them. In the Roman world, different types of salt resources were exploited: marine salt, rock salt, and salt from salty lakes and springs. Although the details of the juridical status of marine salt works are not completely clear, the idea that the Roman state had a monopoly on marine salt works is questionable and rests on few exceptional cases of salt works that had a considerable strategic and economic value, such as the *salinae* at the mouth of the Tiber. Even if one does not agree that the conflict between Rome and Veii was centred around control of this important natural resource, in my view control of the salt pans significantly contributed to Rome's political and economic growth. But to assume, from this or Pergamum's case, a general state monopoly across the Roman world forces the evidence. Rather, private ownership, whether by individuals, towns, or temples, seems to have been the norm. The production of preserved fish or meat by salting on a semi-industrial scale in many locations and different regions of the Roman empire logically suggests that large quantities of salt were available locally or that they could be easily acquired at moderate cost. In addition, the army presence, particularly along the German *limes*, with its needs in salt and in products that were made using substantial quantities of salt, must have further stimulated salt production and trade (Davis, 1971; Groot, 2016; Groot and Deschler-Erb, 2015).

I have contrasted this scenario with the severe limitations the modern state monopolies on salt caused to the development and growth of local and regional economies, such as the fisheries of the nineteenth-century Adriatic. The anecdote Athenaeus reports on the salty spring at Tragasai ceasing to have any salt once Lysimachus levied a tax on salt production (see footnote 5), and then promptly containing salt again once the tax was abolished, should be seen as signifying the realization that this specific salt was no longer commercially viable if subject to taxation. Demand for it had collapsed, halting salt extraction operations

<sup>30</sup> The source of salt for this industry is not secure, maybe the local deposits in places such as Kaiseraugst and Schweizerhalle or more distant sources such as Franche-Comté: Stockinger (2015), 191. However, the installations could also have been smokehouses; on the evidence see Schatzmann (2013), 214.

(in the story, the salt 'disappears') but once the added cost was repealed, the salt had a market again and production could resume (the salt 'returns'). In the first half of the nineteenth century, salt produced at this same location, transported probably by camel to the inland site of Balikesri located c. 176 km away, was sold 80% more than at the place of production (Tchihatcheff, 1853, 336). It is easy to see how a new tax could have suddenly changed the supply-demand equilibrium. In the Roman imperial period, the territorial unity of Rome's vast empire and the lower presence of custom barriers in comparison to later historical periods meant that salt could continue to play its central role in the life and work of the population. Several regions of the Roman empire experienced considerable levels of growth of various commercial activities because salt was available; as Pliny wrote, salt was a *necessarium elementum*.

#### CRedit authorship contribution statement

**Annalisa Marzano:** Conceptualization, Methodology, Investigation, Writing – original draft, Visualization.

#### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

#### Data availability

No data was used for the research described in the article.

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