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Continuity and Innovation in Shipbuilding in the North Adriatic between Late Antiquity and the Early Middle Ages

Giulia Boetto

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Le colloque a été organisé sur deux journées et s'est déroulé les 7 et 8 octobre 2023 à Besançon. C'était une occasion pour les doctorants-jeunes chercheurs et les chercheurs confirmés, spécialistes de l'histoire et de l'archéologie de l'Adriatique, d'échanger leurs connaissances et leurs approches de recherche. En adoptant une approche interdisciplinaire, les participants au colloque ont engagé des discussions sur les multiples défis posés par la complexité historique de la région adriatique.

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CONTINUITY AND INNOVATION IN SHIPBUILDING IN THE NORTH ADRIATIC BETWEEN LATE ANTIQUITY AND THE EARLY MIDDLE AGES*

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While several shipwrecks dated to Late Antiquity and the Early Middle Ages have been recorded in the North Adriatic,¹ those sites that have been systematically researched such that an image of the original ship could be drawn up can be counted on the fingers of one hand. Nonetheless, it is possible, using the available data, to draft an initial assessment of our knowledge, which future research will undoubtedly add to.

In this article we have chosen to present only those wrecks that are sufficiently well preserved to provide us with information not only about the structure, form and technical system of the original ship, but also about the construction principles and methods employed by the shipwrights. We have also decided not to restrict our discussion to wrecks of the late period in order that we can better tackle the question of continuity and innovation within shipyards of the North Adriatic region (**fig. 1**).

I- SEWN BOATS OF THE NORTH ADRIATIC

Of the 64 wrecks of sewn boats recorded in the Mediterranean, 27 have been discovered in the North Adriatic. They date from between the end of the Bronze Age/beginning of the Iron Age and the Early Middle Ages.² Two principal traditions

* English translation from French by Colin Clement.

¹ See, for example, Pesić 2013, 2019; Royal 2012, 2015; Zmaić Kralj 2017.

² Pomey, Boetto 2019 with bibliography. Three recent discoveries should be added to these wrecks: a boat found at Poreč/Parenzo in Istria (see *infra*); two planks reused in the Cervia salt pans (3rd to 1st AD, Beltrame 2019a); and a strake washed up on the beach of Grado Lagoon (243-382 AD, Costa, Gaddi 2023) in Italy. Two sewn barges have also been discovered in Slovenia in the Ljubljanica River, a tributary

have been identified based upon the presence of a keel or a flat bottom without keel, and different planking stitch patterns. One tradition, known as “Istro-Liburnian”, developed in two regions of present-day Croatia: Istria and Northern Dalmatia. The other appeared in three regions of present-day Italy: Friuli-Venezia Giulia, Veneto and Emilia-Romagna, between Aquileia and the Po Delta. Before discussing these traditions, however, we should introduce the shipwreck that represents the archetype of the North-Adriatic sewn-boat tradition.

1- Origins

The sewn boat discovered in Zambratija Bay on the north-west of the Istrian Peninsula is the oldest archaeological find of a Mediterranean vessel in which all the elements of the hull (monoxylous bottom, planks, frames) are assembled with vegetal ligatures (**fig. 2**).³

This extended log boat was built between the end of the Bronze Age and the beginning of the Iron Age (end 12th to end 10th century BC) and featured a rounded main section, open sides composed of several flush-laid carvel strakes and a curved longitudinal profile. The axial timber was carved from half of an elm trunk in a manner used for the creation of dugouts. The planks, also of elm, are assembled by means of simple stitching (/// pattern) (**fig. 3.1**) that enclose thin slats of fir placed over the strake edges. The stitches are locked in by pointed pegs. The floor timbers are assembled to the planks by external lashings and waterproofing is ensured by luting inserted between the planks and by a coat of pitch applied to the hull.⁴

of the Drava. These are the Lipe (2nd-1st century BC, Müllner 1892; Salemke 1973; Gaspari 2009, 1998a, 1998b, 2017, 2021, p. 126-127) and Vrinnika 2 wrecks (1st century BC, Gaspari 2017, 2021, p. 126). These discoveries, which are evidence of the influence of Adriatic nautical construction techniques in a continental environment (Boetto, Rousse 2011, 2012; Pomey, Boetto 2019; Gaspari 2021), will not be dealt with in this contribution.

³ Koncani Uhač 2009; Koncani Uhač, Uhač 2012, 2014; Boetto, Koncani Uhač, Uhač 2014, 2017; Boetto 2016, 2024; Koncani Uhač, Boetto, Uhač 2017, 2019.

⁴ The Zambratija wreck was recovered in July 2023 during a joint operation conducted by the Archaeological Museum of Istria and the Centre Camille Jullian (UMR 7299) with the aim of exhibiting the vestiges in a museum dedicated to Istrian nautical heritage to be built in Pula. The dismantling of the wreck provided a unique occasion to examine the construction process and to study instances of repair. Dendrochronological analysis will also provide essential data for determining the construction date and construction techniques, notably on the expansion of the half trunk used to create the monoxylous bottom.

The Zambratija ship is an example of “shell-first” construction in which the monoxylous bottom and the carvel planking, from both the conceptual and structural point of view, fulfil a dominant role in relation to the frames.⁵ The exclusive use of ligatures in the assembly, the specific techniques applied to working the wood, and the waterproofing system all point to a very early date for this craft, which represents, in the current state of research, the archetype of the North Adriatic sewn-boat tradition.

2- Istria and Northern Dalmatia

Two Latin writers, Varro (quoted by Aulus Gellius, XVII, 3, 4) and Verrius Flaccus (in Festus, 508, 33), remark upon the specific nature of Istrian and Liburnian shipbuilding, using the term *serilia naves*⁶ to describe their craft. The many shipwrecks discovered in Istria and Northern Dalmatia have allowed us to define this tradition from an archaeological point of view, to demonstrate its pre-Roman origins and to attest the continuity of the same nautical types into the Imperial period.

It should be stressed that all the craft that have been studied, equipped with a keel and carvel planking assembled with longitudinal and continuous stitches, fall within a “shell first” maritime construction process. Two architectural types have been distinguished: a boat with a mixed propulsion system well adapted for navigation in a sailing space characterised by a heavily indented coastline and by the presence of numerous islands forming archipelagos; and a small sailboat capable of performing greater voyages across the Adriatic.

A- Vessels with mixed propulsion

The first architectural type corresponds to a multi-function coastal craft (light transport, fishing). It consists of two variants, illustrated by the Poreč 1,⁷ Caska 1 and

⁵ Pomey, Rieth 2005, p. 31-33.

⁶ Pomey, Boetto 2019; Boršić, Džino, Radić Rossi 2021.

⁷ Bartolić-Sirotić, Benčić 2021; Boetto *et al.* 2023.

3,⁸ Pula 2⁹ and, probably, Zaton 1¹⁰ and 3¹¹ shipwrecks for the first; and by the Caska 4 shipwreck for the second.¹²

The two variants display shared features. The main section is flat with a rounded turn of the bilge and convex extremities. With a reconstructed length of between 7.5 m (Poreč 1) and approximately 10 m (Caska 1), these craft were of mixed propulsion, using both sail and oar. One notable characteristic is the choice of beech for the planking strakes, which were obtained by radial splitting in a manner attested for the first time in the Mediterranean.¹³ The strakes were assembled by means of three-stranded tresses following a simple longitudinal pattern (///) (fig. 3.2). These ligatures enclosed wadding of compacted fibres placed along the edges of the strakes and were locked in with small tapered pegs made from several different types of conifer, notably fir. Most of the framing is rectangular in section and is composed of floor timbers with crenelated undersides to avoid squashing the stitching. The mast step is simply set directly upon the frames while the ceiling is nailed (fig. 4).¹⁴ Waterproofing is ensured by a thick coat of pitch. It is worth noting that traces of a red, cinnabar-based material were detected on the exterior of the Poreč 1 planking.

The differences between the two variants primarily concern the arrangement of the frames and the assembly system employed to attach them to the planking. In the first variant, the space between the frames measures roughly 40 cm, the futtocks are not

⁸ Čelhar 2008; Radić Rossi 2008, 2010, 2011; Radić Rossi, Boetto 2010, 2011; Boetto, Radić Rossi 2012, 2014, 2017, 2021; Boetto 2016, 2024; Radić Rossi, Boetto 2020; Ferreira Dominguez 2021.

⁹ Boetto 2016, 2024; Boetto, Koncani Uhač, Uhač 2017; Koncani Uhač, Petrović, Sardoz 2017; Essert *et al.* 2018.

¹⁰ Brusić 1968, 1995; Brusić, Domjan 1985; Romanović 2021.

¹¹ Gluščević 2004; Romanović 2021.

¹² The Zaton 2, featuring a tight distance between frames (about 20 cm), might illustrate either a third variant or another type of craft. The use of beech in the manufacture of the planking seems to argue in favour of the initial theory. Radiocarbon dating to 253-99 BC (probability 36.7 %) is not very precise (Brusić 1987, 1995; Brusić, Domjan 1985; Liphshitz, Gluščević 2015; Romanović 2021; Romanović, Krajar, Bronić 2022; Romanović *et al.* [forthcoming]). Furthermore, the reconstitution of a craft equipped with a two-legged mast suggested by Z. Brusić (1995, p. 56) is not very convincing.

¹³ Ferreira Domínguez 2021, p. 207-221; Ferreira Domínguez *et al.* 2021; Boetto *et al.* 2023. This manner of splitting, which brings considerable flexibility and resistance to the planking, is well documented on Viking ships that were built according to “shell-first” principles and processes, as were the sewn boats: Crumlin Pedersen, Olsen 2002, p. 57.

¹⁴ The mast step is only preserved on Poreč 1 and Zaton 3.

attached to the floor timbers, and the transversal timbers are attached to the planking with treenails and the occasional nail (fig. 5.1). In the second variant, of which we know only one architectural example (Caska 4), the floor timbers are widely spaced (80 cm). They are attached to the futtocks by pegged scarf joints, and the ensemble is assembled to the planking solely by means of external lashings (fig. 5.2). We should mention that pieces of woollen cloth are included in the wadding along with the vegetal fibres, which is not the case in the first variant.

The majority of these vessels are dated to between the 1st and the 2nd century AD.¹⁵ On the other hand, the Poreč 1, which belongs to the first variant, is older: its construction dates back to 94-72 BC. This dating confirms not only the pre-Roman origin of the architectural type, but also of the regional “Istro-Liburnian” tradition. Thus, it appears that the two variants should be linked to practices within traditional privately-owned shipyards, rather than to a technical evolution over time.

B- The Pula 1 sailboat

The second architectural type is illustrated by the Pula 1 shipwreck (fig. 6),¹⁶ which is almost contemporary to the Pula 2 (first half of the 2nd century AD). The type corresponds to a cargo-carrying sailboat about 15 m in length with a keel, a flat bottom, and a rounded turn of the bilge. The Pula 1 differs from the mixed propulsion craft described above through its dimensions, a planking made entirely of saw-cut elm, stitching displaying one sole clamping loop (/I/I/I pattern) (fig. 3.3), and the presence of some floor timbers attached by iron bolts to the keel.

3- Between Aquileia and the Po Delta

Current research would suggest that the ancient “Istro-Liburnian” tradition seems already to be a thing of the past by the 2nd century AD, while the wrecks of Santa Maria in Padovetere, Cervia and Pomposa are evidence of the persistence of assembly by ligatures in the North-west Adriatic into Late Antiquity and the Early Middle Ages.

¹⁵ Dating the felling of the beech wood used in the Poreč 1 planking has been established on the basis of dendrochronological analysis and nine AMS radiocarbon dates calibrated using wiggle-matching (Boetto *et al.* 2023).

¹⁶ Boetto 2016; Boetto, Koncani Uhač, Uhač 2017; Essert *et al.* 2018.

These three sewn boats are the last expressions of a construction tradition specific to the sailing space between Aquileia and the Po Delta: the Augustan-era wreck of Comacchio-Valle Ponti is the most spectacular example.

A- Fluvio-maritime ships

The Comacchio-Valle Ponti wreck (Ferrara, Italy) was a fluvio-maritime vessel that ran aground close to shore and rapid silting thereafter ensured the excellent preservation of both cargo and hull (fig. 7).¹⁷ Based on the cargo, the ship dates to the beginning of the Augustan period.¹⁸

According to the reconstitution work of M. Bonino, the Comacchio-Valle Ponti ship was 23 m long and 5.5 m wide.¹⁹ It has a flat bottom and a rounded turn of the bilge. The keel plank is hollowed towards the aft before its assembly to a deadwood knee with a scarf on its upper edge for connecting with the sternpost (not preserved). The carvel planking, made of elm like the keel plank, features a mixed assembly system: the lower part of the hull is sewn following a cross-stitch pattern with clamping turns (IXIX) (fig. 8), whereas pegged tenons are used from the wale upwards. A wadding pad made from vegetal fibres and covered by wool cloth was placed on the strake seams before sewing, and a coat of pitch covered the hull to ensure waterproofing.²⁰ Crenelated frames to avoid damaging the stitching are attached to the planking by both treenails and external lashings made of braids (fig. 9).

In 1956 elements of planking and framing belonging to a sewn boat were found near Cervia (Ravenna, Italy) (fig. 10). The remains, of which only five fragments of planking and seven fragments of frames were preserved, were identified by M. Bonino²¹ and re-examined by C. Beltrame.²² As on the Comacchio wreck, the stitching was threaded through oblique channels perpendicular to the plank edges that end in

¹⁷ Bondesan, Dal Cin, Monari 1990, p. 22. The question as to the Comacchio ship's navigational reach remains open. Several theories have been proposed: coastal trading from Ravenna towards a port located to the north (Aquileia?); or perhaps the inverse.

¹⁸ Boccaccini, Carli, Gelli 1983; Berti 1986, 1990, 2017.

¹⁹ Bonino 1985, 1990.

²⁰ The assembly of the strakes by stitching appears to stop amidships, in an area between two floor timbers. The form of assembly used in this part of the craft has not been ascertained.

²¹ Bonino 1968, 1985.

²² Beltrame 2002a, p. 360, fig. 10-11; 2002b, p. 104; 2009, p. 415, 2019b.

trapezoidal recesses. Small pegs lock the stiches in the channels. Bonino reconstructed the cross-stitch pattern. The frames were treenailed to the planking. An anchor found in association with the vestiges suggests that the wreck dates to the 7th century AD.

Again in 1956, another wreck was discovered at Pomposa in the vicinity of Borgo Caprile, not far from Comacchio (Ferrara, Italy). It has been dated to the medieval era (11th century).²³ The remains were part of a flat-bottomed craft, perhaps with a keel plank and a rounded turn of the bilge. These vestiges were used by Bonino in his analysis of the Cervia wreck because of similar characteristics of the two boats, leading to the suggestion that they were of the same type. Only one piece of waterproofing pad was recovered, while the remains were left *in situ*.²⁴ This fragment clearly shows the imprint of a cross-stitch with clamping turns (IXIX pattern).²⁵ Beltrame²⁶ has questioned the dating to the Middle Ages, and it is not impossible that the two wrecks of Cervia and Pomposa, due to their similar features, might both date to the 7th century AD.

The architecture of the Comacchio, Cervia and Pomposa ships reflect a “shell-first” construction and are characterised by a hull shape at the main frame displaying a continuity between the flat bottom and the turn of the bilge. While the fluvio-maritime nature of the Comacchio ship is certain, that of the Cervia and Pomposa vessels is less so, given the limitations imposed by the documentation.

B- River boats

The Stella 1 wreck, partially preserved over 5×2 m, is an example of a “bottom based”²⁷ river barge, that is, constructed with a flat bottom, no keel and without carved bilge planks. The craft, whose reconstructed length reached around 13 m, sank in the Stella River in the present-day region of Friuli-Venezia Giulia. Its main cargo was tiles

²³ Bonino 1968, 1978.

²⁴ Beltrame 2009, p. 415.

²⁵ Beltrame 2002a, p. 373, fig. 31.

²⁶ Beltrame 2009, p. 415, fig. 11.

²⁷ Regarding “bottom-based” construction, see Pomey, Rieth 2005. Two barges of small dimensions dated to the Roman period (end of 1st-beginning of 2nd century AD) have also been discovered at Corte Cavanella di Loreo (Rovigo, Italy), but only the Corte Cavanella 2, of which only the bottom remains, was recovered and consequently studied: Beltrame 2000, 2002a, p. 360-364; Willis, Capulli 2018.

which indicate a date at the beginning of the 1st century AD²⁸ (fig. 11). The planking is sewn with a cross-stitch pattern and clamping turns (IXIX). Waterproofing pads were placed on the strake seams before sewing, and pegs were used to lock in the stitches. The frames are crenelated and pierced with limber holes to allow well water to flow freely.²⁹

The Santa Maria in Padovetere wreck was discovered a few kilometres to the west of Comacchio (Ferrara, Italy) and is preserved along some 20 m of length: it has been dated to the mid-5th century AD (fig. 12).³⁰ Similar to the Stella 1 barge, the Santa Maria in Padovetere craft is a “bottom-based” construction, without carved bilge planks. The aft end, the only extremity preserved, has a straight sternpost attached to the bottom by a nail. The garboards are joined to the bottom strakes by stitches and iron nails. The sewing pattern is of cross stitches with double clamping turns (IXIX). The ligatures are made of braids enclosing waterproofing pads and are locked in with pegs. The transversal timbers are composed of pairs of L-shaped frames, crenelated to avoid crushing the waterproofing and assembled by means of horizontal nails. Some of them are extended by futtocks. In the upper part the strakes are clinker-built and unpegged tenons can be observed in a limited area near the stern.

This river transport vessel had pointed ends and a total reconstructed length of around 23 m, a maximum width of 5 m, and a height of 1 m amidships and 2.20 m aft. The ship was equipped with a towing mast at the prow and an axial steering oar fixed to the sternpost (fig. 13).

II- MORTISE-AND-TENON BOATS

In addition to sewn boats, a certain number of wrecks of maritime vessels assembled with mortise-and-tenon joints, all equipped with a keel, have been discovered in the North Adriatic. These craft date to between the Roman Republic period and Late Antiquity.

²⁸ Vitri *et al.* 2003.

²⁹ Castro, Capulli 2016, 2017.

³⁰ Beltrame, Costa 2016, 2023; Beltrame *et al.* 2021; Costa, Beltrame 2021.

1- From the Roman Republican to the Imperial period

A- Ilovik-Paržine 1

The Ilovik-Paržine 1 wreck was discovered in 2016 in the Bay of Paržine, to the south of the small island of Ilovik (Croatia).³¹ The ship had an estimated length of 20 to 22 m and carried a cargo of Picenum wine amphorae, thus placing the sinking in the third quarter of the 2nd century BC (roughly 170 BC). There was also a cargo of timber, probably posts, and perhaps clay (fig. 14). The ballast was most likely loaded near Brindisi, one of the major Adriatic ports of the era.³²

Ilovik-Paržine 1 is characterised by an asymmetric longitudinal form, with rounded stern and a straight, slightly concave prow, and by a pinched main frame section (“wine glass section”) (fig. 15.1). The keel has deeply cut rabbets, and the garboards are thicker than the adjoining strakes, displaying a “sculpted” section. Along with the axial timbers, they form a particularly coherent ensemble that has an impact on the design and implementation of the ship’s structure and shape.

The carvel-built planking entirely of elm wood is assembled by means of a dense pattern of pegged tenons. The frames display the typical alternation between floor timbers extended by futtocks and half-frames (fig. 16). All the elements of the transversal framing are independent and are attached to the planking by treenails and occasional nails. None of the floor timbers are bolted to the keel. A fixed and moveable ceiling covered the bilges, and the mast step (not preserved) was set directly upon the frames. A coat of pitch provided protection and waterproofing to the hull.

B- Caska 2

Caska 2 is a small sailboat about 15 m in length that was built between 45 BC and 85 AD. After being filled with stones, it was re-used, as were the sewn boats Caska 1, 3 and 4, to shore up a mooring jetty connected to a grand maritime villa located on Caska Bay of the island of Pag (Croatia) (fig. 17).³³

The craft displays a flat section at the main frame associated with a keel without rabbets or chamfering (fig. 15.2). The carvel planking is assembled by a dense pattern of pegged tenons. The frames are widely spaced (average 47 cm) and attached to the

³¹ Boetto *et al.* (forthcoming).

³² Fournier *et al.* 2024.

³³ Radić Rossi, Boetto 2020; Boetto, Radić Rossi 2021.

planking by treenails. The alternating of floor timbers/futtocks and half frames is not fully respected, with sequences of floor timber and half frame crossing the keel. The keelson/mast step is set directly upon the floor timbers. A fixed hearth structure made of concrete, bricks and tiles placed upon wooden boards is located forwards on the bottom of the boat. The hull has received much repair work and is coated with a thick layer of pitch.

It has been suggested that this working craft is of local, perhaps regional construction and it was used in the same sailing space as the sewn boats of the “Istro-Liburnian” tradition.

C- Trstenic 1

In the same manner as the Caska 2, the Trstenic 1 ship was re-used after being filled with stones to consolidate a coastal structure near Kaštel Sućurac in the Gulf of Kaštela, not far from ancient Salona (Split, Croatia).³⁴

Its reconstructed dimensions would measure roughly 17.5 m in length and 5 m width, with a maximum load of 25 tons. The ship has a flat bottom with keel, a rounded turn of the bilge and slightly flared sides. The carvel planking is assembled with pegged tenons and the tightly-set framing is composed mainly of floor timbers. The keelson/mast step (not preserved) was set directly upon the frames, which are notched on their upper surfaces for this very reason. The hull was protected and waterproofed by a coat of pitch.

The ship, which had been repaired several times before re-use, was built between the mid-1st and the beginning of the 2nd century AD. It was designed to transport heavy cargoes, perhaps limestone blocks from the quarries of the neighbouring island of Brač.

D- Monfalcone

The Monfalcone wreck, discovered near the large Timavo villa (Trieste, Italy), is traditionally dated to the 2nd century AD (fig. 18).³⁵ The preserved dimensions reach

³⁴ Ruff 2020; Ruff *et al.* 2021. Two other re-used boats have recently been discovered at Kaštel Sućurac. Research is ongoing: Radić Rossi, Ruff (forthcoming).

³⁵ Bertacchi 1976; Bertacchi, Bertacchi 1988; Beltrame 2001, p. 437; Capulli 2014. The date has been questioned by R. Auriemma (Auriemma *et al.* 2008, p. 94), since the villa dates to end of the Republican period.

slightly less than 11 m in length and 3.7 m in width: the bottom is flat with a rounded turn of the bilge. The remains are composed of a keel, carvel planking, transversal timbers which are mostly floor timbers and a keelson set upon the frames. The keelson does not show any mast step, but displays several notches to hold stanchions.

The supposition is that this ship was of local construction for local navigation in lagoons and rivers,³⁶ but the architectural type remains undefined.

E- Grado 1

The Grado 1 wreck was discovered off Grado (Italy) in 15 m of water and was the object of several excavation campaigns leading to the recovery of the hull.³⁷ The ship transported salted fish (sardines and mackerel) in approximately 600 re-used amphorae from all around the Mediterranean Basin, some *liquamen* in small amphorae of North Adriatic manufacture, and a barrel holding glass fragments to be recycled.³⁸

The main frame of the Grado ship is flat with a rounded turn of the bilge and slightly flared sides. The vestiges are composed of a keel, carvel planking, some frames, a keelson/mast step set upon two sister keelsons, and a ceiling (fig. 19).

C. Beltrame and D. Gaddi consider that the Grado 1 was built and repaired in the North Adriatic based on the reconstituted dimensions (16.5 m long, 5.9 m wide) and the types of wood used for the keel and garboards (elm), and the repairs (larch). The presence of a double lead pipe directly connected to the sea through a hole in the bottom of the hold also led the two scholars to envisage a curious pumping system that provided water to a fish tank placed on deck.³⁹

2- Late Antiquity

A- Pakoštane

This wreck lies between the two small islands of Veli Školj and Sveta Justina, opposite the town of Pakoštane (Croatia).⁴⁰ The ship was carrying a mixed cargo of

³⁶ Carre, Kovačić, Tassaux 2011, p. 43.

³⁷ Dell'Amico 1997, 2001; Iulia Felix 1999; Beltrame, Gaddi 2005, 2007, 2013b.

³⁸ Auriemma 2000; Carre, Pesavento Mattioli, Belotti 2009.

³⁹ Beltrame, Gaddi, Parizzi 2011. Regarding the pumping system, see Oleson, Stein 2007, and a response by Beltrame, Gaddi 2008.

⁴⁰ Boetto, Marlier, Radić Rossi 2008, 2015; Boetto *et al.* 2012; Radić Rossi, Boetto 2018.

African, Aegean and Sicilian amphorae. The shipboard artefacts included cooking pottery from Pantelleria and fine ware of African manufacture, which date the sinking to between the last quarter of the 4th and the first quarter of the 5th century AD.

The remains of the wreck measure 11 m in length and 7 m in width and consist of carvel planking, some frames and a ceiling (**fig. 20**). The keel, which is not preserved, was attached to some of the floor timbers by bolts. The keelson/mast step, also not preserved, was mounted on two sister keelsons sitting on the frames on either side of the keel. A coat of pitch provided waterproofing to the hull.

The Pakoštane wreck is remarkable for the signs of a large number of repairs to both the planking and the frames. These are evidence of serious overhauls perhaps due to the use of poor-quality wood. This theory would appear to be confirmed by the great variety of wood employed (no less than 21 types) in this merchant sailboat, which would originally have measured between 15 and 20 m in length.

B- Debeljak

This wreck was discovered in Debeljak Bay near the southern tip of the Istrian Peninsula (**fig. 21**).⁴¹ The ship, originally some 17 m length, was carrying a mixed cargo of amphorae, both regional and from Baetica. One single example is of Tuscan production (Empoli). Fine ware of African manufacture dates the sinking to around the end of the 4th-beginning of the 5th century AD.

The transversal section of the wreck displays a slight turn of the garboard strake (**fig. 15.3**) that suggests the Dramont E ship discovered in the south of France and dated to the 5th century AD.⁴² The remains consist of a keel, carvel planking, some frames and part of a ceiling. Some of the floor timbers are pierced by bolts that fixed them to the keel and keelson. This latter is not preserved but rested upon two sister keelsons. A coat of pitch was used to waterproof the hull.

Unlike the Pakoštane ship, the construction was careful with cypress planking throughout and a limited number of different woods for other elements of the hull.

⁴¹ Boetto *et al.* 2022.

⁴² Santamaria 1995; Poveda 2017.

C- Parco di Teodorico, Ravenna

This 5th-century AD wreck was found in the Parco di Teodorico at Ravenna (Italy).⁴³ The vestiges measure 7.22x2.75 m, and the original length of the ship is estimated to have been 9 m.

The vessel's main frame is flat with a rounded turn of the bilge. The remains of the hull consist of the keel, some carvel planking, some frames and a keelson/mast step (**fig. 22**). The strakes are assembled by means widely spaced (80 cm approx.) unpegged tenons: the tenons only fill part of the mortises. The garboards were attached to the keel solely by iron nails. Likewise, assembly with the stempost involved only nails. The framing was largely floor timbers spaced 33 cm apart, some of which were attached to the keel by iron nails. The planking was fixed to the frames by iron nails and trenails. The keelson/mast step was set directly upon the frames. The ceiling was nailed to the frames.

No signs of caulking have been found in the plank seams, and thus waterproofing was only provided by the coat of pitch that covered the hull.

III- CONCLUSIONS

Nautical archaeological research has revealed the great diversity of craft that sailed the North Adriatic in ancient times.

Sewn boats can trace their roots into Early Antiquity and were undoubtedly built in shipyards located in regions close to where the wrecks were discovered. These boats belong to shipbuilding traditions that were developed independently within highly contrasting sailing spaces, where the various communities remained faithful to ancestral know-how while still welcoming technical innovations from outside. Such is the case of the Augustan-era ship of Comacchio-Valle Ponti and of the 5th-century barge of Santa Maria in Padovetere, in which mortise-and-tenon joints were used alongside stitching.⁴⁴

Within the fluvio-maritime, lagoon and riverine environments of the North Adriatic, assembly by stitching persisted into the 5th century (Santa Maria in Padovetere) and possibly beyond (Cervia and Pomposa), while sea-going ships constructed with mortise-and-tenon joints had been present in the Adriatic for several

⁴³ Medas 1999, 2001, 2003; Maioli 2001; Pomey, Kahanov, Rieth 2012, p. 257-258.

⁴⁴ The tenons are pegged at Comacchio-Valle Ponti, while they are unpegged in the Santa Maria in Padovetere ship. It should be remembered that some planking in this latter was clinker-built.

centuries (Ilovik-Paržine 1): some of these may have been built locally (Caska 2, Grado 1, Monfalcone). The reason for this continuity is still debated. Two main theories have been proposed: on the one hand, a technical explanation based on the greater simplicity of using ligatures, which would also have been cheaper than mortise-and-tenon construction;⁴⁵ and, on the other hand, an explanation that links the longevity of stitching on certain types of craft with their adaptation to specific sailing spaces within a socio-technical system characterised by a strong sense of conservatism.⁴⁶ The persistence of assembly by stitching in the Adriatic also seems to indicate indigenous traditions linked to a strong cultural identity.⁴⁷

Such is the case of the Istro-Liburnian tradition, which has been the most precisely defined, given the large number of wrecks discovered in Istria and Northern Dalmatia. This tradition, unlike that of the Po Delta region where evidence of sewn boats is attested until the 7th century, does not appear to continue beyond the 2nd century AD, a period that coincides with the complete Romanisation of Istria and Dalmatia. It is probably from this era that mortise-and-tenon construction begins to supplant the ancestral techniques in the regional shipyards of the Istrians and Liburnian. None the less, in the present state of research, it is difficult to connect the mortise-and-tenon construction of boats to shipyards located in Istria or Dalmatia, particularly sailboats of a certain size like that of Ilovik-Paržine 1.

Indeed, boats built with mortise-and-tenon joints that have been discovered in the North Adriatic reflect architectural types and know-how shared across the Mediterranean. Ilovik-Paržine 1 is of a “Hellenistic”⁴⁸ type, whereas the Grado 1, Pakoštane and Debeljak wrecks display most of the architectural signatures of the “Romano-Imperial” type of the Western Mediterranean.⁴⁹ On the other hand, the

⁴⁵ Beltrame, Gaddi 2013a, p. 303.

⁴⁶ Pomey 1985; Marlier 2002. This explanation returns to the notion of sailing spaces (see Pomey, Rieth 2005, p. 38-41), developed by Ch. Westerdahl (1992, 1994, 2011) using the term “maritime cultural landscape”. According to this concept, there is a close relationship between the architecture and function of a ship, the natural environment in which it develops (sailing space) and the socio-economic context that governs the construction and use.

⁴⁷ Pomey, Boetto 2019, p. 19; Boršić, Džino, Radić Rossi 2021.

⁴⁸ Pomey, Rieth 2005; Pomey 2020.

⁴⁹ Pomey, Rieth 2005; Pomey, Kahanov, Rieth 2012.

Caska 2, Trstenic 1 and Ravenna Parco di Teodorico combine characteristics belonging to these two architectural types.⁵⁰

In concluding this article, we shall come back to the notions of architectural types and of construction principles and methods.⁵¹ In keeping with these concepts, the majority of the maritime and fluvio-maritime boats equipped with an axial timber (keel or keel plank) described in this article, whether sewn or assembled by mortise-and-tenon jointing, are “shell-first” constructions. This expression means that the planking dominates the construction both during the shape conception phase of the structure, and during the construction phase. The shape concept calls for a “longitudinal vision” of the hull volume (plank based), and materially, as regards the hull structure concept, for planking in which the elements are assembled to each other and to the axial timber. The construction process is characterised by the complete or partial mounting of the planking based upon the previously set longitudinal timber, and always before the installation of the framing.

Only the Parco di Teodorico boat in Ravenna stands apart due to its mixed character, both as regards the construction concept and techniques. The shape of this vessel was probably also conceived according to a “longitudinal vision” of the volume, although the frames seem to have guided the structure concept. The construction process is also mixed: the widely spaced unpegged tenons could not guarantee the integrity of the hull, which was, in the end, ensured by the framing. The Parco di Teodorico boat is, therefore, an example of a transitional mixed concept and process, in which the construction is not yet completely “frame-first”.⁵² This latter system will take over in the Mediterranean from the Early Middle Ages.⁵³

Lastly, the flat-bottomed keelless barges, like the wrecks described in this article (Stella 1 and Santa Maria in Padovetere), reflect a completely different construction logic as compared to the maritime and fluvio-maritime ships. On these barges, used for inland shipping, it is the bottom that represents the decisive structure, as regards both the hull conception and construction.⁵⁴ It is noteworthy that such flat-bottomed

⁵⁰ A similar consideration has been proposed for two wrecks discovered in the port of Naples (Napoli A, 1st century, and Napoli B, end of 2nd century): Boetto 2005; Boetto, Poveda 2018.

⁵¹ Pomey 2004; Pomey, Rieth 2005, p. 29-33; Pomey, Kahanov, Rieth 2012, 2013.

⁵² Pomey, Kahanov, Rieth 2012, p. 259.

⁵³ Pomey, Kahanov, Rieth 2012.

⁵⁴ Pomey, Rieth 2005, p. 33 and p. 199-200.

barges are entirely assembled. They do not have carved bilge planks, or internally- or externally-set bottom planks joining the outer plank of the bottom and the first plank of the sides (fig. 23.1-2).⁵⁵ Instead, the flat bottom is composed of an ensemble of strakes assembled by continuous longitudinal stitching, as are the sides. The seam between the bottom and the lower side strakes is flush-laid, with the chamfers of the planking determining the angle of the sides (fig. 23.3). In the case of the *Santa Maria* in Padovetere, tenons and clinker seams are also used, but only in the upper parts of the hull. The extended bottom-based architecture of the Adriatic sewn barges thus reflects original characteristics: built according to a “bottom-based” concept, the process was “shell-first” in that the elements of the bottom are assembled before the positioning of frames.

In sum, the North Adriatic represents a very promising field of research in nautical archaeological studies: the ancient period and the transitional era between the end of Antiquity and the Early Middle Ages remains largely to be deciphered.

⁵⁵ Beaudouin 2001, p. 22.

FIGURES



Figure 1: The ancient Adriatic shipwrecks cited in the article. Shipwrecks of sewn-boats (in red): 1. Zambratija; 2. Poreč 1; 3. Pula 1; 4. Pula 2; 5. Caska 1; 6. Caska 3; 7. Caska 4; 8. Zaton 1; 9. Zaton 2; 10. Zaton 3; 11. Comacchio-Valle Ponti; 12. Cervia; 13. Pomposa; 14. Stella 1; 15. Santa Maria in Padovetere. Shipwrecks of boats with mortise-and-tenons joints (in blue): 16. Ilovik-Paržine 1; 17. Caska 2; 18. Trstenic 1; 19. Monfalcone; 20. Grado 1; 21. Pakoštane; 22. Debeljak; 23. Ravenna Parco di Teodorico.

Credit/source: drawing by V. Dumas, CNRS/CCJ, Adriaboats.



Figure 2: Orthoimage of the Zambratija shipwreck.

Credit/source: photos by Ph. Groscaux, orthoimage by V. Dumas, CNRS/CCJ, Adriaboats.

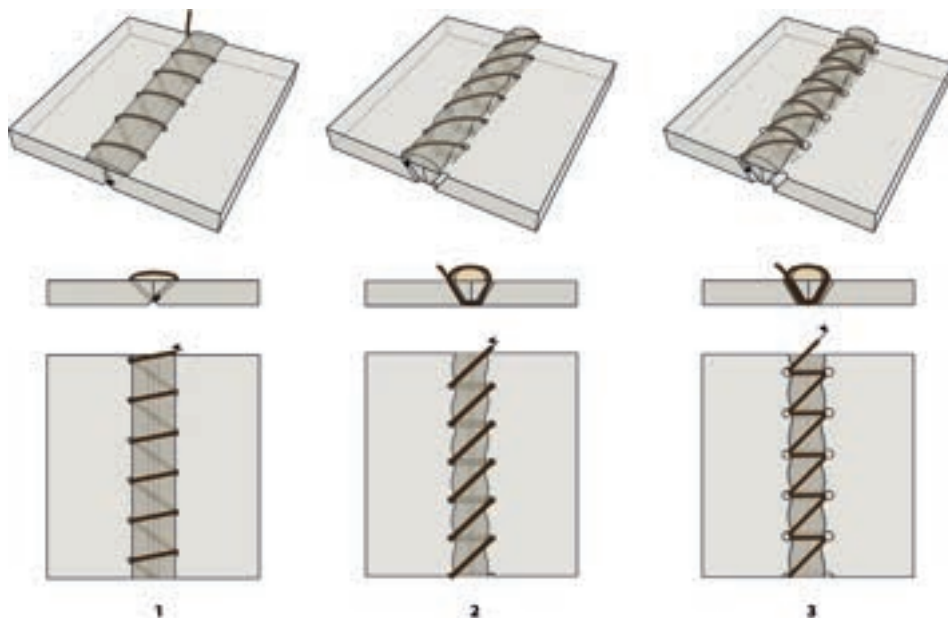


Figure 3: Axonometric illustrations of the sewing systems of: 1. the Zambratija shipwreck; 2. Pula 2; 3. Pula 1.
Credit/source: drawing by P. Poveda, CNRS/CCJ, Adriboats.

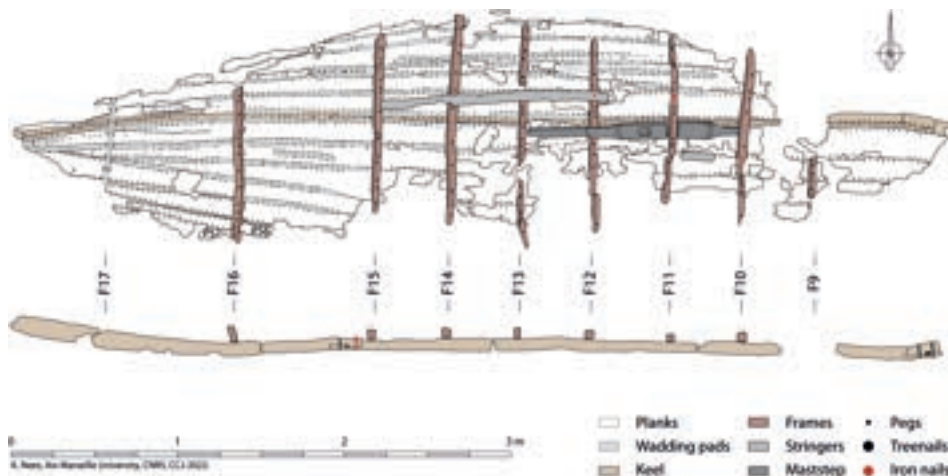


Figure 4: Plan and longitudinal section of the Poreč 1 shipwreck.
Credit/source: drawing by K. Nees, Aix-Marseille Université/CCJ, Adriboats.

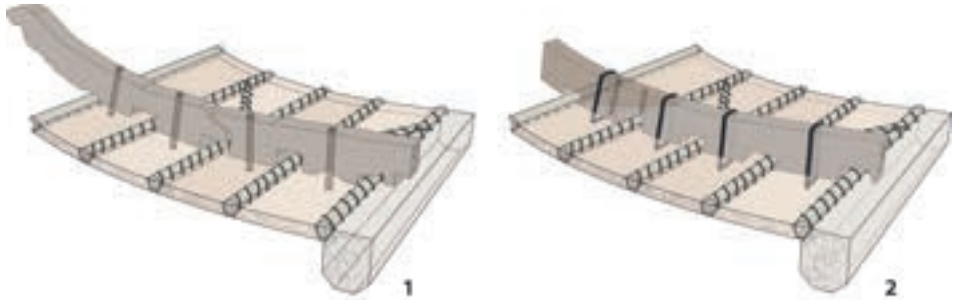


Figure 5: Axonometric illustrations of the two types of assembly systems of the mixed propulsion boats: 1. Treenailed floor-timbers; 2. Lashed frames (floor timbers connected by hook scarf to the futtocks).
Credit/source: drawing by P. Poveda, CNRS/CCJ, Adriboats.



Figure 6: View from the north-east of the Pula 1 shipwreck.
Credit/source: photo by Archaeological Museum of Istria.



Figure 7: Comacchio shipwreck. General view of the hull after the dismantling of the frames for recovery. The transitional timber is visible at the far end of the ship remains.
Credit/source: from Berti 1990, p. 25, fig. 3.



Figure 8: Detail view of the sewing system of the Comacchio shipwreck.
Credit/source: from Berti 1990, p. 30, fig. 4.



Figure 9: Detail view of the external lashing attaching the frames to the planking of the Comacchio shipwreck.
Credit/source: from Berti 1990, p. 31, fig. 10.

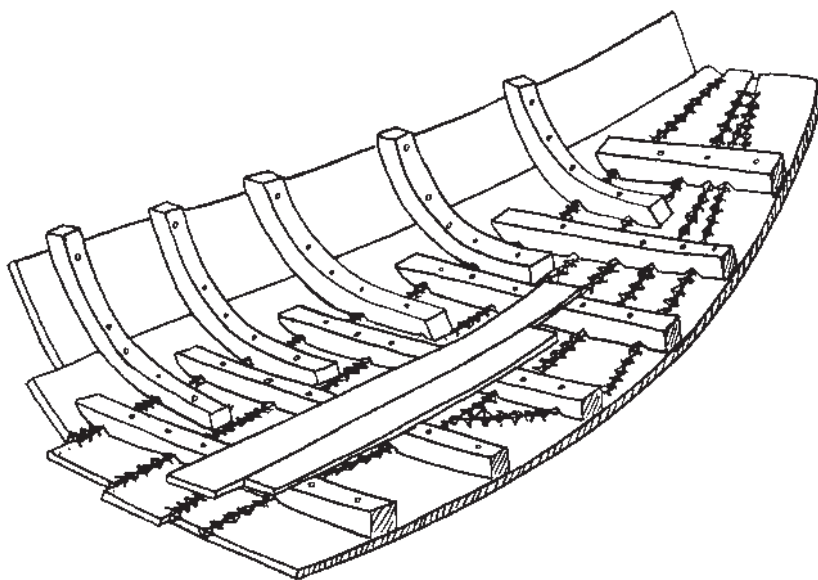


Figure 10: Axonometric reconstruction of the hull of the Cervia shipwreck.
Credit/source: from Bonino 1985, fig. 7.4.

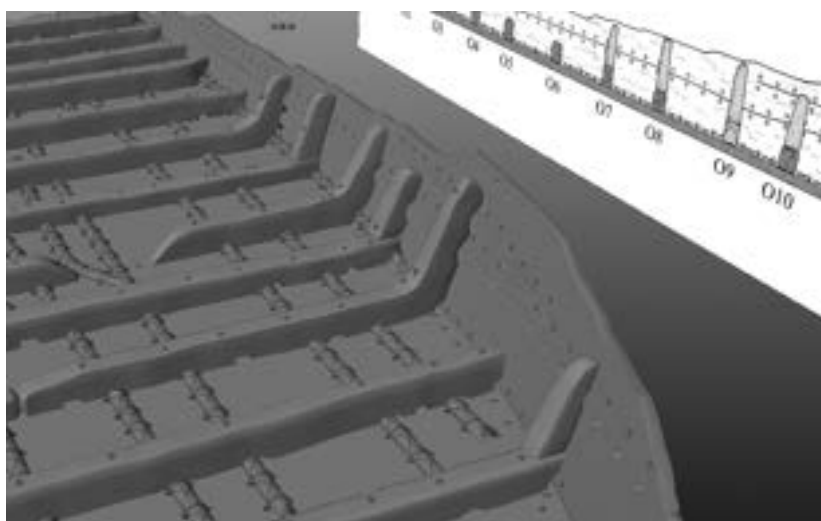


Figure 11: Axonometry of the hull remains of the Stella 1 shipwreck.
Credit/source: drawing by K. Yamafune; from Castro, Capulli, 2016, p. 35, fig. 7.



Figure 12: View of the Santa Maria in Padovetere shipwreck.
Credit/source: photo by C. Beltrame, University of Venice.

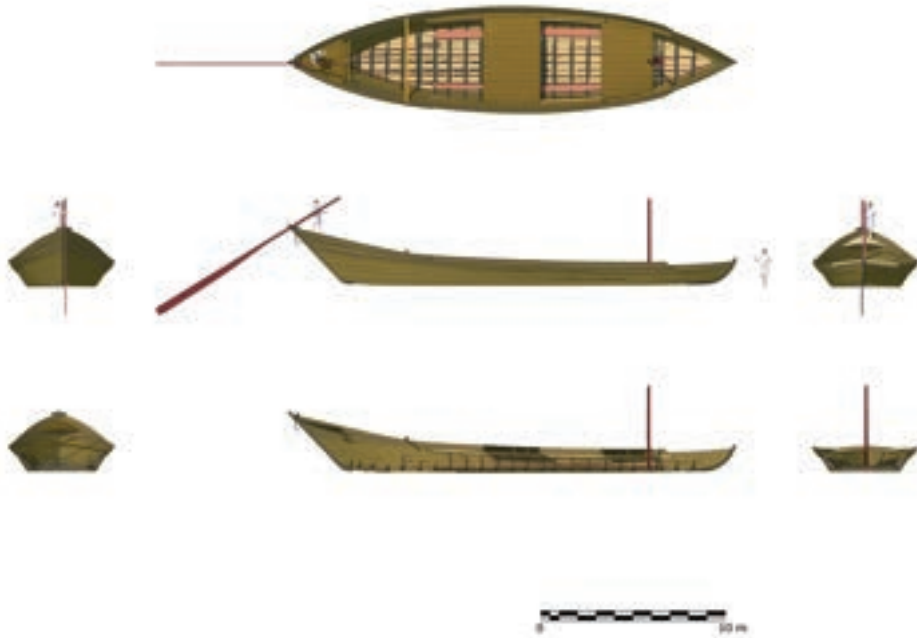


Figure 13: Reconstruction of the Santa Maria in Padovetere barge.
Credit/source: drawing by E. Costa, University of Venice.



Figure 14: View of the stem area with the cargo of timbers of the Ilovik-Paržine 1 shipwreck.
Credit/source: photo by L. Damelet, CNRS/CCJ, Adriboats.

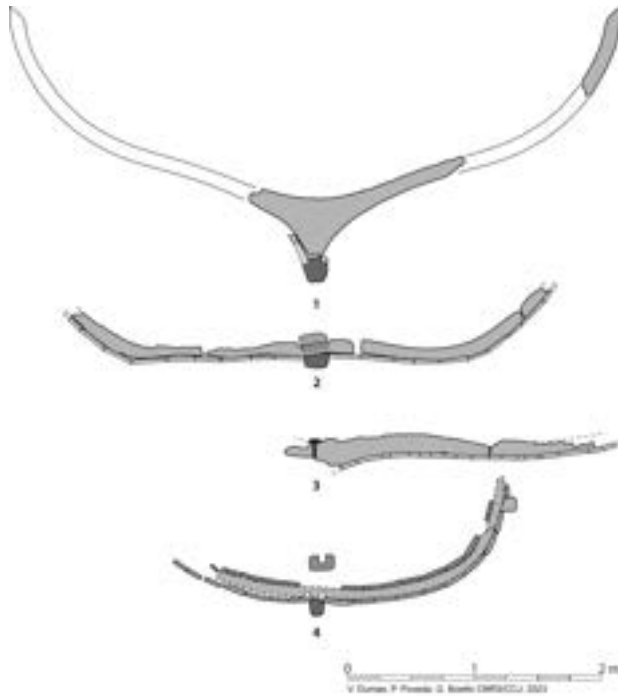


Figure 15: Cross sections of the shipwrecks: 1. Ilovik-Paržine 1; 2. Caska 2; 3. Debeljak; 4. Ravenna Parco Teodorico.
Credit/source: drawing by P. Poveda, V. Dumas, G. Boetto, CNRS/CCJ, Adriboats.



Figure 16: View of the stern of the Ilovik-Paržine 1 shipwreck.
Credit/source: photo by L. Damelet, CNRS/CCJ, Adriboats.

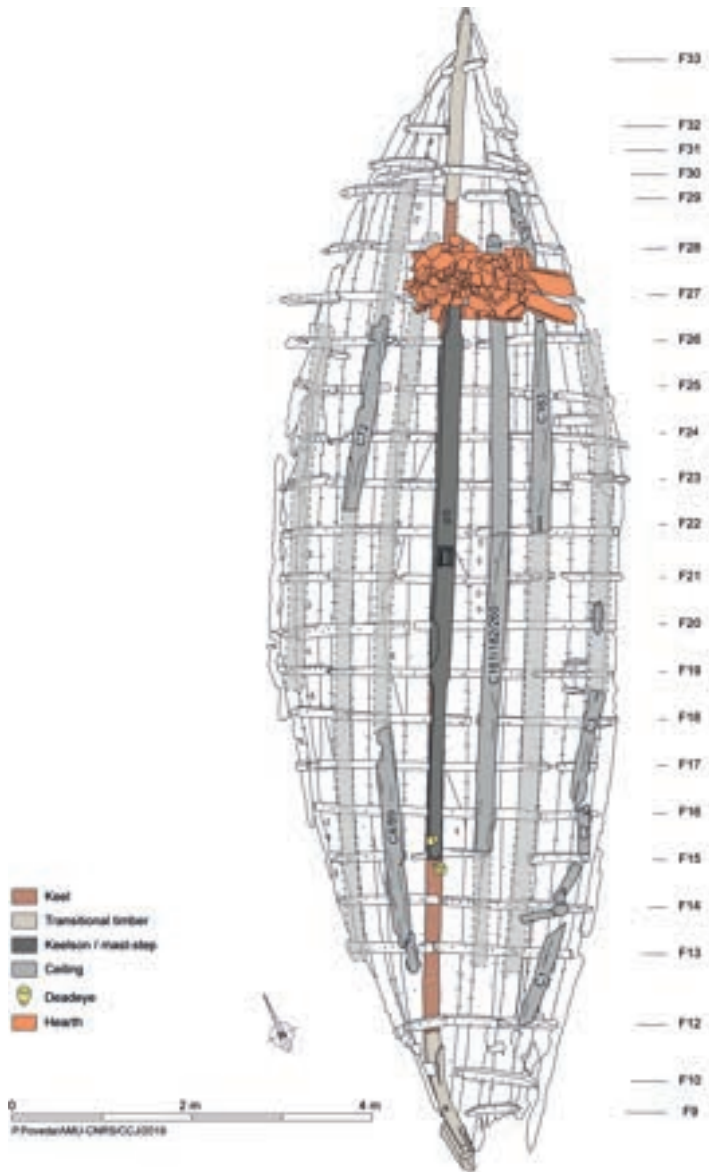


Figure 17: Caska 2 shipwreck. General planimetry.
Credit/source: drawing by P. Poveda, CNRS/CCJ, Adriboats.



Figure 18: View of the Monfalcone shipwreck.
Credit/source: from Capulli 2014, fig. 1.

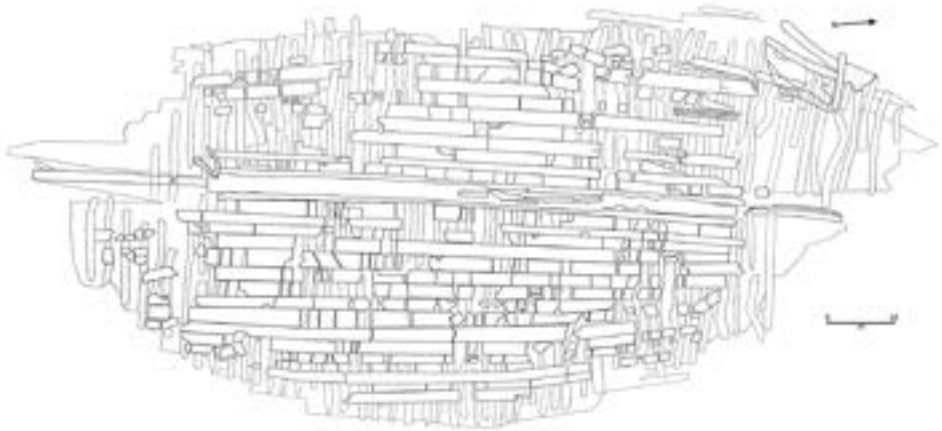


Figure 19: Plan of the Grado 1 shipwreck.
Credit/source: drawing from Beltrame, Gaddi 2008, fig. 5.

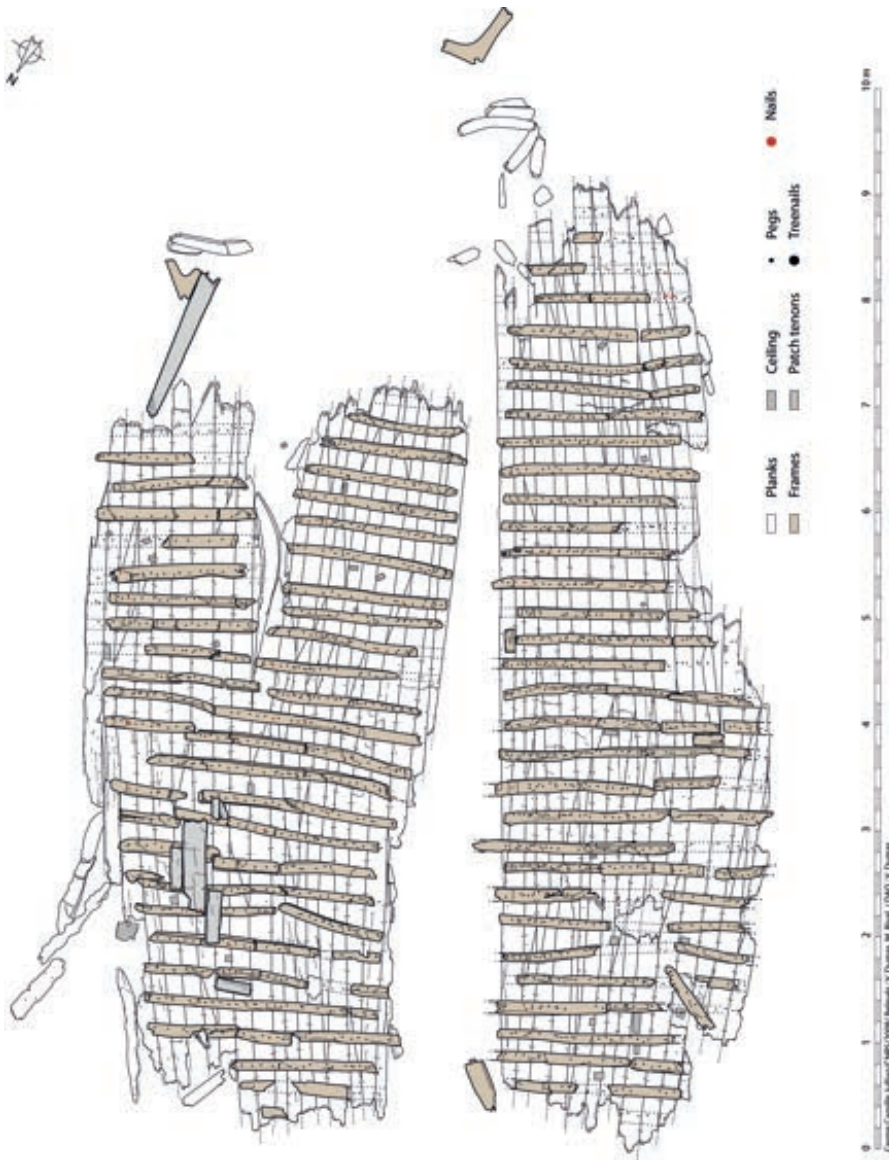


Figure 20: Plan of the Pakoštane shipwreck
Credit/source: drawing by V. Dumas, CNRS/CCJ, AdriaBoats.



Figure 21: Orthoimage of the Debeljak shipwreck.

Credit/source: photos by L. Damelet, orthoimage by V. Dumas, CNRS/CCJ, Adriboats.

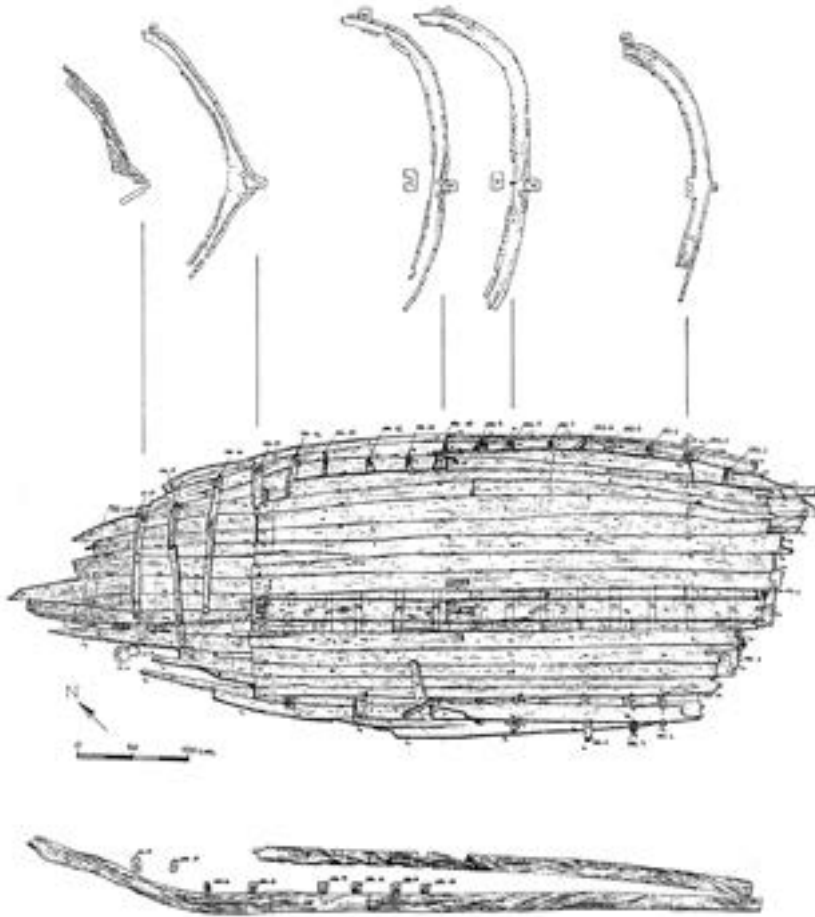


Figure 22: View of the Ravenna Parco di Teodorico shipwreck.
Credit/source: from Medas 2003, fig. 9.2.



Figure 23: Schema of the different arrangements of bottom-based barges without carved bilge planks: 1. Projecting bottom plank; 2. Internally-set bottom plank; 3. Chamfered bottom plank.
Credit/source: drawing by G. Boetto, CNRS/CCJ.

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Résumés

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Continuity and Innovation in Shipbuilding in the North Adriatic Between Late Antiquity and the Early Middle Ages

Abstract: The North Adriatic represents a very promising field of research in nautical archaeological studies, although the ancient period and the transitional era between the end of Antiquity and the Early Middle Ages remain largely to be deciphered. In this article, sufficiently well-preserved wrecks of sewn and mortise-and-tenons boats will be considered in order to tackle the question of continuity and innovation within shipyards of the Adriatic region.

Keywords: North Adriatic, nautical archaeology, mortise-and-tenon boat, sewn boat, continuity, shipbuilding, wreck, innovation.

Continuidad e innovación en la construcción naval del Adriático Norte entre la Antigüedad tardía y la Alta Edad Media

Resumen: El Adriático septentrional representa un campo de investigación muy prometedor en arqueología naval, aunque el periodo antiguo y la época de transición entre la Antigüedad tardía y la Alta Edad Media siguen en gran medida sin descifrar. En este artículo se examinarán pecios suficientemente bien conservados de embarcaciones cosidas y de mortaja y espiga con el fin de abordar la cuestión de la continuidad y la innovación en los astilleros de la región adriática.

Palabras clave: Adriático Norte, arqueología naval, barco de mortaja y espiga, barco cosido, continuidad, construcción naval, pecio, innovación.

Continuité et innovation dans la construction navale en Adriatique du Nord entre l'Antiquité tardive et le haut Moyen Âge

Résumé : Le nord de l'Adriatique représente un champ de recherche très prometteur en matière d'archéologie navale, bien que la période antique et l'ère de transition entre la fin de l'Antiquité

et le haut Moyen Âge restent largement à déchiffrer. Dans cet article, des épaves suffisamment bien conservées de bateaux cousus et à tenons et mortaises seront examinées, afin d'aborder la question de la continuité et de l'innovation au sein des chantiers navals de la région adriatique.

Mots-clés : Adriatique du Nord, archéologie navale, bateau à tenons et mortaises, bateau cousu, continuité, construction navale, épave, innovation.

Quentin COUILLEBAULT, Armelle CHARRIE-DUHAUT, Giulia BOETTO

Caractérisation par analyse chimique des enduits organiques de la coque du bateau cousu *Poreč 1* (Croatie)

Résumé : Sept prélèvements d'enduit d'étanchéité couvrant le bateau cousu du début du 1^{er} siècle avant J.-C. *Poreč 1*, découvert dans le port de la colonie de *Parentium*, actuelle Poreč/Parenzo en Istrie (Croatie), ont été étudiés pour en définir la composition. Les résultats ont été comparés aux analyses effectuées sur les enduits couvrant les parois internes de trois amphores importées découvertes dans le comblement du même port antique. Les analyses par spectroscopie infrarouge à transformée de Fourier (IRTF) ont montré que les enduits de l'embarcation présentent des degrés d'aromatisation différents et un niveau d'oxydation moindre par rapport à ceux présents sur les amphores. L'analyse par chromatographie en phase gazeuse couplée à la spectrométrie de masse (CPG-SM) de deux échantillons, l'un provenant de *Poreč 1* et l'autre d'une des amphores, indique qu'il s'agit de produits dérivés de Pinacées, issus du traitement thermique soit de résine soit de bois de Pinacées. Les enduits des parois d'amphores correspondent à de la poix, un goudron obtenu par chauffage en conditions contrôlées de bois de Pinacées. Pour les enduits de *Poreč 1*, il existe encore un doute sur leur nature précise, goudron ou résine chauffée ?

Mots-clés : Adriatique, amphore, analyse chimique, bateau cousu, CPG-SM, Croatie, IRTF, poix, Poreč.

Characterisation by Chemical Analysis of Organic Coatings on the Hull of the Pre-Roman Sewn Ship *Poreč 1* (Croatia)

Abstract: Seven samples of waterproofing coating covering the early 1st century BC sewn boat *Poreč 1*, discovered in the harbour of the colony of *Parentium*, present-day Poreč/Parenzo in Istria (Croatia), were studied to define their composition. The results were compared with analyses carried out on the coatings covering the inner surfaces of three imported amphorae discovered in the infill of the same ancient port. Analysis by Fourier Transform Infrared Spectroscopy (FTIR) demonstrates that the coatings on the boat have different degrees of aromatisation and a lower level of oxidation than those on the amphorae. Gas chromatography-mass spectrometry (GC-MS) analysis of two samples, one from *Poreč 1* and the other from one of the amphorae, indicates that they are Pinaceae-derived products, obtained by heat treatment of either resin or Pinaceae wood. The coatings of the amphorae correspond to pitch, a tar obtained by heating

Pinaceae wood under controlled conditions. As for the coatings on *Poreč 1*, there is still some doubt as to their precise nature: tar or heated resin?

Keywords: Adriatic, amphora, chemical analysis, sewn-boat, GC-MS, Croatia, FTIR, pitch, Poreč.

Caracterización mediante análisis químico de los revestimientos orgánicos del casco del barco cosido prerromano *Poreč 1* (Croacia)

Resumen: Se estudiaron siete muestras de yeso de sellado que cubrían la embarcación cosida *Poreč 1* de principios del siglo I a.C., descubierta en el puerto del asentamiento de *Parentium*, actual Poreč/Parenzo en Istria (Croacia), para definir su composición. Los resultados se compararon con los análisis efectuados en los revestimientos que cubrían las paredes interiores de tres ánforas importadas descubiertas en el relleno del mismo puerto antiguo. Los análisis por espectroscopia infrarroja con transformada de Fourier (FTIR) mostraron que los revestimientos del barco presentaban diferentes grados de aromatización y un nivel de oxidación inferior al de las ánforas. El análisis por cromatografía de gases-espectrometría de masas (GC-MS) de dos muestras, una de *Poreč 1* y otra de una de las ánforas, indica que se trata de productos derivados de Pinaceae, derivados del tratamiento térmico de resina o de madera de Pinaceae. Los revestimientos de las paredes de las ánforas corresponden a la brea, un alquitrán que se obtiene calentando madera de Pinaceae en condiciones controladas. En el caso de los revestimientos *Poreč 1*, subsisten dudas sobre si se trata de alquitrán o de resina calentada.

Palabras clave: Adriático, ánfora, análisis químico, barco cosido, GC-MS, Croacia, FTIR, brea, Poreč.

Zvonimir FORKER

Ein Beitrag zur Kenntnis der Sarkophage des Brač-Salonitaner Typus an der Ostküste der Adria

Zusammenfassung: Die Sarkophage des Brač-Salonitaner Typus sind anepigraphisch, aus hochwertigem Kalkstein von der Insel Brač hergestellt und sind einfach gestaltet und dekoriert. Das zentrale Ornament ist ein großes Reliefkreuz, das in mehreren Varianten gemeißelt ist. Die Datierung dieser Sarkophage stellt eine Herausforderung dar, da die meisten von ihnen außerhalb eines archäologischen Kontexts gefunden wurden. Folglich wurden sie weitgehend auf die Zeit vom späten 5. bis zum frühen 7. Jahrhundert datiert. Dieser Artikel schlägt eine engere Datierung auf die zweite Hälfte des 6. Jahrhunderts vor und verbindet die Produktion der Sarkophage mit der Rückeroberung durch Justinian. Die Herstellungszentren dieser Sarkophage befanden sich auf der Insel Brač und in Salona, und sie wurden in Richtung der Küstenstädte an beiden Ufern der Adria verteilt. Bei Betrachtung der Karte ihrer Verteilung wird deutlich, dass sie entlang antiker Seehandelsrouten verteilt wurden. Die Sarkophage dieses Typus waren ein hochwertiges und geachtetes Produkt, das seinen Markt auf beiden Seiten der Adria fand. Sarkophage wurden jedoch immer als Luxusgegenstand betrachtet, und das

Vorhandensein der Sarkophage des Brač-Salonitaner Typus zeugt von der wirtschaftlichen Macht von Einzelpersonen sowie ganzen christlichen Gemeinschaften.

Schlüsselwörter: Sarkophage, der Brač-Salonitaner Typus, Merkmale, Chronologie, Verteilung.

A Contribution to the Knowledge of Brač-Salona Type Sarcophagi from the Eastern Adriatic Coast

Abstract: The sarcophagi of the Brač-Salona type are anepigraphic, made of high-quality limestone from Brač island and are simply designed and decorated. The central ornament is a large relief cross carved in several variants. Dating these sarcophagi poses a challenge due to the fact that most of them were found outside of an archaeological context. Consequently, they have been dated widely from the late 5th to the early 7th century. This article proposes a narrower dating to the second half of the 6th century and associates the production of the sarcophagi with the Justinian's reconquest. The manufacturing centres of these sarcophagi were on Brač island and in Salona, and they were distributed towards coastal cities on both the eastern and western shores of the Adriatic. Looking at the map of their distribution, it is evident that they were distributed along ancient maritime trade routes. The sarcophagi of this type were a high-quality and esteemed product that found its market on both sides of the Adriatic. However, sarcophagi were always considered a luxury item, and presence of the sarcophagi of the Brač-Salona type testifies to the economic power of individuals as well as entire Christian communities.

Keywords: sarcophagi, the Brač-Salona type, characteristics, chronology, distribution.

Una contribución al conocimiento de los sarcófagos de tipo Brač-Salona de la costa adriática oriental

Resumen: Los sarcófagos del tipo Brač-Salona son anepígrafos, están hechos de piedra caliza de alta calidad procedente de la isla de Brač y son sencillos en estilo y decoración. El ornamento central es una gran cruz en relieve tallada en varias variantes. La datación de estos sarcófagos plantea un reto debido a que la mayoría de ellos se encontraron fuera de un contexto arqueológico. Por ello, se han datado entre finales del siglo V y principios del VII. Este artículo propone una datación más restringida a la segunda mitad del siglo VI y asocia la producción de los sarcófagos con la reconquista de Justiniano. Los centros de producción de estos sarcófagos se encontraban en la isla de Brač y en Salona, y se distribuían por las ciudades costeras de las orillas oriental y occidental del Adriático. Si se observa el mapa de su distribución, queda claro que se distribuían a lo largo de las antiguas rutas comerciales marítimas. Los sarcófagos de este tipo eran un producto de alta calidad y muy apreciado que encontraba mercado a ambos lados del Adriático. Sin embargo, los sarcófagos siempre se han considerado artículos de lujo, y la

presencia de sarcófagos de tipo Brač-Salona atestigua el poder económico tanto de individuos como de comunidades cristianas enteras.

Palabras clave: sarcófagos, tipo Brač-Salona, características, cronología, comercio.

Une contribution à la connaissance des sarcophages de type Brač-Salone de la côte orientale de l'Adriatique

Résumé : Les sarcophages du type Brač-Salone sont anépigraphes, fabriqués en calcaire de haute qualité de l'île de Brač et sont simples en style et en décor. L'ornement central est une grande croix en relief sculptée en plusieurs variantes. La datation de ces sarcophages pose un défi en raison du fait que la plupart d'entre eux ont été trouvés en dehors d'un contexte archéologique. Par conséquent, ils ont été largement datés entre la fin du V^e et le début du VII^e siècle. Cet article propose une datation plus restreinte à la seconde moitié du VI^e siècle et associe la production des sarcophages à la reconquête de Justinien. Les centres de fabrication de ces sarcophages se trouvaient sur l'île de Brač et à Salone, et ils étaient distribués vers les villes côtières des rives orientale et occidentale de l'Adriatique. En examinant la carte de leur répartition, il est évident qu'ils ont été distribués le long des anciennes routes commerciales maritimes. Les sarcophages de ce type étaient un produit de haute qualité et estimé qui trouvait son marché des deux côtés de l'Adriatique. Cependant, les sarcophages ont toujours été considérés comme des objets de luxe, et la présence des sarcophages de type Brač-Salone témoigne de la puissance économique des individus comme des communautés chrétiennes entières.

Mots-clés : sarcophages, type Brač-Salone, caractéristiques, chronologie, commerce.

Ana-Marija KRNIĆ

Colonie de Salona : approches de l'étude des formes d'habitat de l'Antiquité tardive et du haut Moyen Âge

Résumé : Le présent article porte sur les habitats répandus sur le territoire de la colonie de Salone, dont certains ont vu un procès de transformations continues à l'époque de l'Antiquité tardive, à l'époque paléochrétienne et au haut Moyen Âge. Dans la région de Salone, certaines agglomérations secondaires sont attestées dans les sources (*Tragurium, Epetium, Issa, Oneum, Siculi, Pharos*) tandis que certains sites sont désignés des termes bien différents : villa, habitat groupé, *vicus*, agglomération satellite. L'objectif de cette contribution est tout d'abord de préciser l'emploi des termes et ensuite présenter les critères et méthodes que nous entreprenons dans le

cadre de la recherche en thèse de doctorat et qui nous permettront de classer et d'interpréter les habitats « intercalaire entre villa et chef-lieu de cité ».

Mots-clés : formes d'habitat, agglomérations secondaires, Salone, Antiquité tardive, haut Moyen Âge.

Colony of Salona: Approaches of the Study of Settlement Patterns in Late Antiquity and the Early Middle Ages

Abstract: The subject of this contribution is the settlements in the Salona area, some of which show continuous transformations in Late Antiquity, the Early Christian period and finally in the Early Middle Ages. In the Salona region, a number of “small towns” are attested in the sources (*Tragurium, Epetium, Issa, Oneum, Siculi, Pharos*), while some other important sites are often referred to with quite different terms: villa, grouped settlement, *vicus*, satellite settlement. The aim is firstly to clarify the use of these terms and then to present the criteria and methods that will permit to classify and interpret the settlements whose form can be described as “between villa and urban center”.

Keywords: settlement forms, small towns, Salona, Late Antiquity, Early Middle Ages.

Colonia de Salona: aproximaciones al estudio de las formas de asentamiento en la Antigüedad tardía y la Alta Edad Media

Resumen: En este artículo se examinan los modelos de asentamiento de la zona de Salona, algunos de los cuales experimentaron un proceso de transformación continua en la Antigüedad tardía, el periodo paleocristiano y, por último, en la Alta Edad Media. En la región de Salona, las fuentes atestiguan la existencia de una serie de asentamientos secundarios (*Tragurium, Epetium, Issa, Oneum, Siculi, Pharos*), mientras que los demás emplazamientos principales se designan a menudo con términos muy diferentes: villa, asentamiento agrupado, *vicus*, asentamiento satélite. El objetivo es, en primer lugar, aclarar el uso de estos términos y, a continuación, presentar los criterios y métodos que nos permitirán clasificar e interpretar los asentamientos “entre villa y centro urbano”.

Palabras clave: asentamientos, asentamientos secundarios, Salona, Antigüedad tardía, Alta Edad Media.

Filip LOVRÍĆ

Chapter XXIX of Constantine Porphyrogenitus' *De Administrando Imperio* and the Problems with Living on the Zadar Archipelago in Late Antiquity and Early Middle Ages in the Light of Archaeological and Historical Topography

Abstract: The paper explores the problems related to the inhabitation of the Zadar Archipelago in its older history, primarily focusing on the period of transition from the Late Antiquity to the Early Middle Ages. The research is centred around the chapter XXIX of Constantine Porphyrogenitus' *De Administrando Imperio*—the historical source which is both the most famous, as well as the most controversial one for the islands' inhabitation history.

The paper examines the list of the islands presented at the end of the chapter and analyses it in relation to the historical and archaeological topography of the archipelago in order to address the issue of the abandonment of the island mentioned in the text, as well as to try and identify the nature of the settlements mentioned in it.

Keywords: *De Administrando Imperio*, Zadar Archipelago, Late Antiquity, post-Roman, landscape transformations.

El capítulo XXIX del *De Administrando Imperio* de Constantino Porfirógenita y los problemas de habitabilidad del archipiélago de Zadar en la Antigüedad tardía y la Alta Edad Media a la luz de la topografía arqueológica e histórica

Resumen: El artículo explora los problemas asociados a la ocupación del archipiélago de Zadar durante su historia temprana, centrándose principalmente en el periodo comprendido entre la Antigüedad tardía y la Alta Edad Media. La investigación se centra en el capítulo XXIX del *De Administrando Imperio* de Constantino VII, una fuente histórica que es a la vez la más famosa y la más controvertida para la historia de la ocupación de islas. El artículo examina la lista de islas presentada al final del capítulo y la analiza en relación con la topografía histórica y arqueológica del archipiélago para abordar la cuestión del abandono de la isla mencionada en el texto, así como para intentar identificar la naturaleza de los asentamientos allí mencionados.

Palabras clave: *De Administrando Imperio*, archipiélago de Zadar, Antigüedad tardía, posromano, transformaciones del paisaje.

Le chapitre XXIX du *De Administrando Imperio* de Constantin Porphyrogénète et les problèmes d'occupation de l'archipel de Zadar dans l'Antiquité tardive et au début du Moyen Âge à la lumière de la topographie archéologique et historique

Résumé : L'article explore les problèmes liés à l'occupation de l'archipel de Zadar au cours de son histoire ancienne, en se concentrant principalement sur la période entre l'Antiquité tardive et le début du Moyen Âge. La recherche est centrée sur le chapitre XXIX du *De Administrando Imperio* de Constantin VII – source historique qui est à la fois la plus célèbre et la plus controversée pour l'histoire de l'occupation des îles. L'article examine la liste des îles présentée à la fin du chapitre et l'analyse en relation avec la topographie historique et archéologique de l'archipel, afin d'aborder la question de l'abandon de l'île mentionnée dans le texte, ainsi que d'essayer d'identifier la nature des habitats qui y sont mentionnés.

Mots-clés : *De Administrando Imperio*, archipel de Zadar, Antiquité tardive, post-romain, transformations du paysage.

