FASTI ONLINE DOCUMENTS & RESEARCH

The Journal of Fasti Online (ISSN 1828-3179) ● Published by the Associazione Internazionale di Archeologia Classica ● Palazzo Altemps, Via Sant'Appolinare 8 – 00186 Roma ● Tel. / Fax: ++39.06.67.98.798 ● http://www.aiac.org; http://www.fastionline.org

Fluvial Archaeology in Italy. Methods and First Results for the Study of a Roman Shipwreck Area

Massimo Capulli

The Stella River (Udine, Italy) was in antiquity one of the most important watercourses of the Friuli Venezia Giulia Region, its relevance residing in that it connected the populations living in the foothills of the Alps to the ones living near the Adriatic coast. The Anaxum Project (named after the Roman appellation for the river), a partnership between the Department of Humanities and Cultural Heritage of the University of Udine and the local Archaeological Superintendency, aims to reconstruct the history of the Stella River basin focusing on human-landscape relationships through time.

This article describes the part of the project focused on the study of a Roman shipwreck area; in particular, the relationship between the remains of a barge and a spread of archaeological material, which without a break stretches north of the hull for tens of meters.

The aim was to find out if this material could be part of the cargo of the same wreck, to assess the original dimensions of the boat, as well as to ascertain the dynamics of the sinking and post-depositional events. Thanks to the methodology used during the underwater archaeological research, it was possible to establish in the whole area investigated the homogeneous presence of tegulae *(roof tiles) equal to those that were part of the known cargo of the ship; the presence of the same producer names on the* tegulae *stamps provides the most solid proof that the spread of archaeological material is linked with the barge.*

However, it seems unlikely that all of the tegulae *recovered were on the same boat. In accordance with the stowage scheme observed, the boat could not be laden with more than 55* tegulae *per linear meter. This means that even if we do not consider the fact that we have partial data (many tiles are still on the river bottom), at its widest part the vessel would have been over 13 meters to accommodate all recovered tiles.*

At present, one explanation could be that this archaeological site represents a convoy and that a second vessel might have been involved in the sinking.

Keywords:

Shipwreck, Site formation processes, Method, Underwater archaeology, Research design, River

Introduction

The Stella river, the ancient *Anaxum* of Pliny[1], is the most important artery of groundwater-fed river in the Friuli Venezia Giulia region (Fig. 1) and puts the middle and lower plains in contact with the Marano lagoon and therefore the northern Adriatic[2]. Generated mainly from an underground strata of water, it is characterized by a water flow that is roughly steady in every season, unlike the other great rivers of this region such as the Ta-

[1] PLINY, *NH*, III, 126.
[2] CAPULLI 2014a: 20-25.

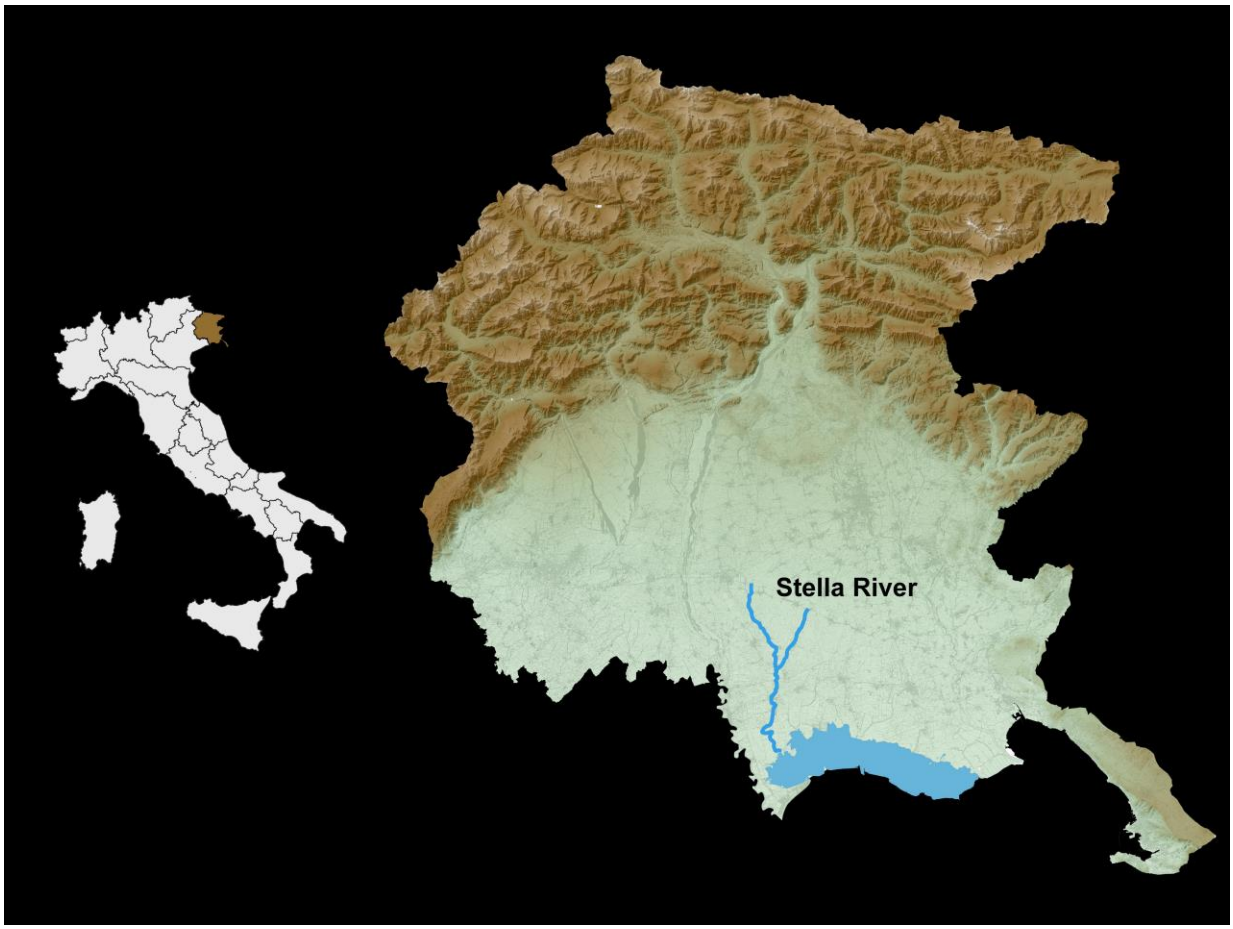

Fig. 1. Stella River localization (created by Fabio Case).

gliamento or the Isonzo, which instead have a torrential flow regime[3]. This characteristic has made the Stella a privileged waterway in every era, since it is one of the most northerly points of the entire Mediterranean sea that is always navigable.

In the Roman era, it was part of the Aquileia transmarine system[4]. In fact, in ancient times, before flowing into the Northern Adriatic, it intersected both the consular *Via Annia*[5], and the route within the lagoon that connected Aquileia to Ravenna[6]. The latter consisted of an articulated system of waterways (rivers, canals and lagoons) that offered the advantage, when compared to the coeval marine route[7], of being able to be used *cum venti saevientibus mare fuerit clausum*, as Cassiodorus reports[8].

The river has preserved many traces of this rich past since the Neolithic period[9], which is attested by artifacts recovered duringt underwater surveys such as a Middle Bronze Age sword[10] or a stamped ingot from the Roman period[11], and by underwater archaeological campaigns promoted by the Archaeological Superintendency. This is the case of the Stella 1 shipwreck, which underwent an excavation at the end of the 90s that ended with the recovery of part of the cargo that rested on the hull[12].

[3] FONTANA 2009: 288-289.
[4] CAPULLI 2010: 89-107.
[5] GALLIAZZO 1994: 139; GALLIAZZO 1995: 536-547.
[6] UGGERI 1990: 175-196.
[7] CAPULLI 2013: 18-23.
[8] CASSIODORUS, *Variarum libri*, XII, 24.
[9] FERRARI, PESSINA 1996: 81-92; PESSINA 2006: 279-301; FONTANA, PESSINA 2011: 137-144.
[10] BRESSAN 1997: 446-450.
[11] VITRI *et al.* 1994: 290-291; CAPULLI 2017a: 217.
[12] VITRI *et al.* 1999: 435-440; CAPULLI 2018: 303-316.

Anaxum Project

Considering the potential of this river, the idea of creating an "Archaeology of Waters" project was born, which in a river context should be understood as the study of what has been preserved over time of the activity promoted by humans on the river, in the river, and around the river: whenever the river has been the reason of the choices settled or productive. Thus, in 2011, the Anaxum Project – Archaeology and History of a River Landscape – of the University of Udine and in collaboration with the Superintendence, began with the primary objective of studying the archaeological landscape of the Stella River on the basis of existing documentation, non-invasive methods of investigation, and targeted archaeological excavations. Other scientific institutions have contributed to the project since the beginning: Texas A&M University[13] and the Institute of Nautical Archaeology[14], specialized in naval archaeology, as well as the Department of Geosciences of the University of Padua, for the geomorphological aspect, and the Department of Mathematics and Geosciences of the University of Trieste, for geophysical exploration.

The "engine" of the Anaxum Project is therefore an interdisciplinary research group that experiments and develops innovative techniques in the field of fluvial archaeology, to be exported to other watercourses[15], while using the Stella River as a laboratory for the training of underwater archaeologists in a problematic environment and presenting different types of material evidence[16].

The research was carried out in the stretch of river between the municipalities of Palazzolo dello Stella and Precenicco concerned the Via Annia Bridge, the shipwreck of Precenicco, and the Stella 1 site (Fig. 2).

Fig. 2. Anaxum Project research area (created by Massimo Capulli; background Image © 2019 Google).

[13] FOZZATI *et al.* 2012: 17-19.
[14] CAPULLI, CASTRO 2012: 15.
[15] BARTOLI *et al.* 2012: E1-E9; CAPULLI *et al.* 2013: 185-198.
[16] CAPULLI 2014b: 13-16; CAPULLI 2015: 26-31.

The site of the Via Annia Bridge, discovered in 1981[17], is located about 80 meters downstream of the bridge of Highway 14 near the city of Palazzolo dello Stella and consists of five structures made of *sesquipedali Norditalici* brick[18], in the variant of 28x43x6 cm, bound by mortar, with elements of stone blocks. Radiometric dating, carried out on five samples taken from the foundations of the structures, returned a date for the structure of the second half of the 2nd c. B.C., which is consistent with the historical sources relating to the construction of the *Via Annia*, variously dated to 153 B.C.[19] or 128 B.C.[20]. During the last few years, a boost to research has been possible thanks to the three-dimensional photogrammetric survey of some of the structures of the bridge with the Computer Vision (Structure from Motion) technique, as the strong current makes it particularly difficult to apply direct survey techniques here.

The shipwreck of Precenicco, exposed in 2012 during civil works a few meters from the west bank of the Stella River, is the remnant of a hull dated to the 12th-13th c. A.D. by C14 analysis. It is a flat bottom boat without a keel, but presents curved sides and a smooth turn of the bilge, atypical in riverboats. Moreover its internal structure, with alternating L-shaped floor timbers and only one futtock per frame, is a singularity, both for Italy and for the rest of Europe[21]. The salvage excavation lasted just over a month at the end of the summer in 2014, but it is currently in a vat still awaiting restoration.

Stella 1: the shipwreck area

The first excavations of the Stella 1 shipwreck site in 1998 and 1999 did not conduct a detailed study of the hull and instead focused mainly on the cargo[22], which consisted almost entirely of building materials, *tegulae* (flat tiles with raised edges), in particular of which 17 have stamps[23]. As part of the Anaxum project, the hull was brought to light again and then measured, as well as analyzed for its technical construction[24].

In this sector, the river channel is U-shaped and is incised for about 6 m in the clayey silty deposits of the last glacial maximum[25]. At the bottom of the riverbed, the erosive action of the stream exposed a horizon of peat with a thickness of almost 10 cm, which is partly overed by a thin discontinuous layer of fine gravels. This also partly covers the archaeological remains and corresponds to the residual lag layer moved by the stream. The Stella River is fed by springs of groundwater originating in the alluvial plain; thus, it transports only the sediments it eventually erodes from along the banks and the bottom of the channel.

The wreck

The boat, dated to the end of the 1st c. A.D., lies at a depth of between 4.6 and 5.6 m along the east bank of the river, and is oriented almost perfectly N-S, thus forming an angle of about 45° with the axis of the river. The wreck is a flat-bottomed barge[26] with a maximum width of just over 2 meters, a measurement that should be similar to that of the original boat, while the length has been preserved to only 5 m (Fig. 3). Unfortunately, neither the bow nor the stern of the boat have been preserved, but the closing curvature of the bottom at the western end suggests it is close to one of the ends. From a construction point of view, the hull is part of the tradition of sewn boats[27], built according to the load-bearing shell construction system[28], where the assembly of the planking is joined by ligatures of vegetable fibres, here passed through circular holes and blocked by truncated conical pegs[29].

[17] FOZZATI, CAPULLI 2014: 147-52.
[18] RIGHINI 1990: 257-296.
[19] GRILLI 1979: 242-43.
[20] BOSIO 1991: 68-81; BANDELLI 1998: 151-152.
[21] CAPULLI 2017b: 131-34; CAPULLI 2019: 77-85.
[22] VITRI *et al*. 2003, 324-338.
[23] *M. Albius Macrus* (2 *tegulae*), *M. Albius Rufus* (2 *tegulae*), *L. Epidius Theodorus* (8 *tegulae*), *C. Oppius Agathopus* (1 *tegula*), *C. Titius Hermerotis* (2 *tegulae*), *Valeriae Magnae Epidian* (2 *tegulae*).
[24] CAPULLI, CASTRO 2014, 35-41; CASTRO, CAPULLI 2017, 425-430.
[25] *LGM*; cf. FONTANA 2006: 92-100.
[26] *Fluviatiles naves, ad superanda vada stagnorum apte planis alveis fabricates* (Livius, X, 2)
[27] CAPULLI *et al.* 2014: 215-218.
[28] POMEY, BOETTO 2019: 5-15.
[29] CASTRO, CAPULLI 2016: 30.

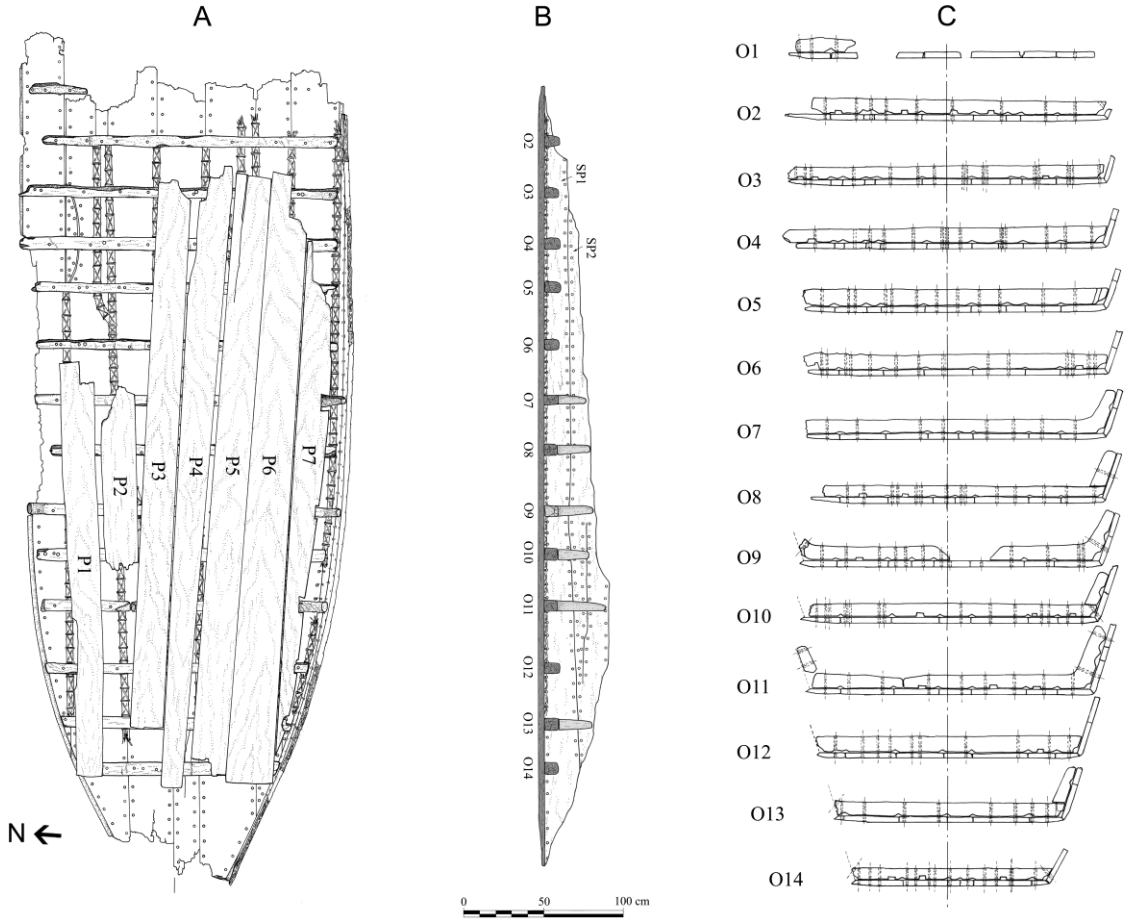

Fig. 3. a) Plan view of the Stella 1 wreck; b) longitudinal view with side planks; c) section view of the floor timbers with short arms (created by Filipe Castro and Kotaro Yamafune).

Comparing the structural data, the result of the survey conducted within the Anaxum project, with those relating to the load *in situ* where the stowage system was observed at the end of the 1990s[30], some hypotheses can be advanced. In fact, even if the depth of the hold angle is unknown, if we consider that the tiles stacked on the floor were about 60 cm h., it is presumable that the sides of the boat were about 70/80 cm, thus creating an angle of about 75° with the vertical, and therefore resulting in a draught between 25 and 50 cm. From a load capacity point of view, this means that in the widest part of the boat (known), it would respectively have received a buoyancy thrust of 500-1000 kg per meter of length (unknown).

Objectives

Starting from these observations, the presence of a large amount of materials on the riverbottom, despite the recoveries of the 90's, posed a legitimate question about the nature of this deposit. Based on previous excavation reports, we believed that the entire load had been recovered, or at least that there were only residual elements in the river. However, from the very first dive, it became clear that there was a vast area of dispersion of artifacts. After the nautical study of the hull, we decided to investigate this area, which without a break stretched north of the hull for tens of meters.

[30] Figure 2 in VITRI *et al.* 2003: 327; here Fig. 7.

The aim was to find out if this material could be part of the cargo of the same wreck and to assess the original dimensions of the boat, as well as to ascertain the dynamics of the sinking and post-depositional events.

Methodology

After a first survey aimed at establishing the boundaries of the entire area, which had a maximum size of about 8x60 m, it was decided, for reasons of simplicity and safety, to materialize the work area by squares of 2 by 2 meters.

This is a classic method in underwater environments, where it is more difficult to follow the layers by extension. But in a river it is also a practical necessity. There is always water in motion with a current that varies depending on the tide. If there is low tide in the nearby lagoon, the river runs so fast that it is absolutely impossible to dive: the current literally tears off a diver's mask. The other way around, when the tide is high, the river slows down and produces optimal conditions for diving. However, the height and hour of the tides, in accordance with the moon calendar, change every day. This means that underwater activity must be planned day by day and only in the short time-window that the tide allows.

The square system is also useful for underwater navigation. Poor visibility, between 0 and 150 cm, never allows an overview of the whole site and requires divers with a high sense of orientation as well as the ability to store portions of the site to be reassembled in a mental photomosaic.

The fixed squares were carried out through helicoidal stakes, screwed in the bottom and georeferenced, and cords, while a metal movable square, divided into 25 sub-squares of 40 cm sides, was used during the excavation of each fixed unit.

From an operational point of view, we had identified a baseline, located about four meters north of the hull, from which to begin with the recovery of the most reliable deposit. This was due to the fact that during the 1990s excavations the finds were selectively recovered and some of the heavier objects (large fragments of tiles) were moved and used to secure the geotextile coverfor the hull. We then divided our 8 meter "starting line" into four lanes (2 meters each) called A, B, C, and D moving from the center of the river to the bank. Each alphabetical lane was then numbered every 2 meters, starting from number one, as you move away from the shipwreck (Fig. 4).

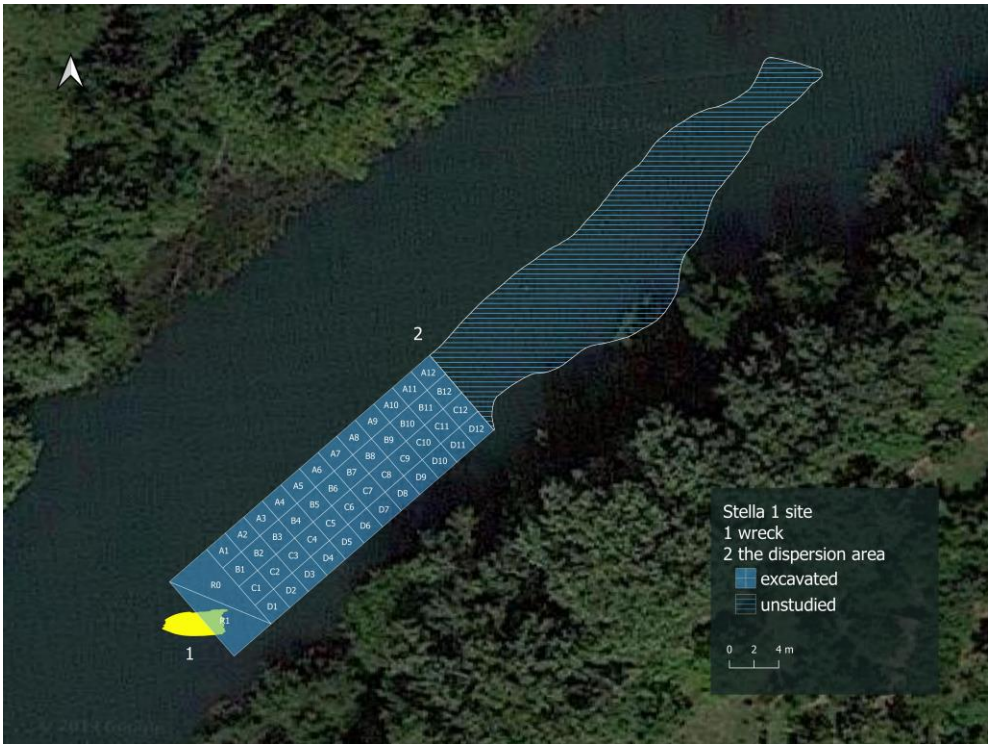

Fig. 4. Dispersion area (created by Fabio Case; background Image © 2019 Google).

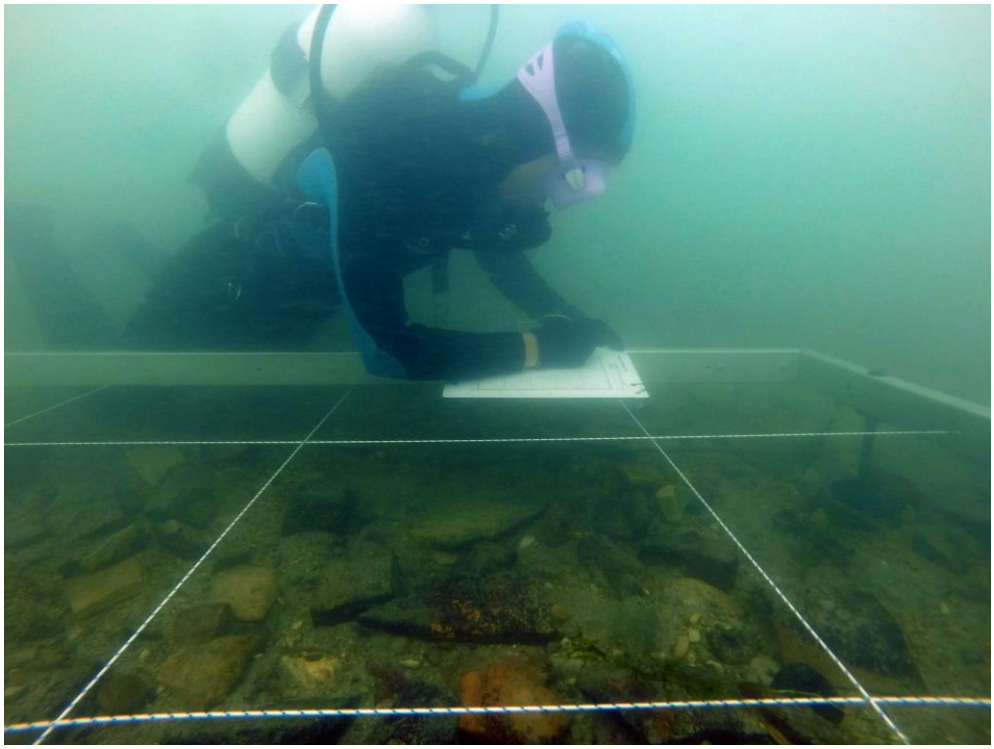

Fig. 5. Underwater recordings (picture by Massimo Capulli).

The underwater operations for each square can be summarized as follows: hand cleaning and excavation with a water dredge, planimetric drawing of artifacts *in situ*, and complete recovery of archaeological material. The divers (all university students: from BA to PhD) had at their disposal a slate on which was placed a transparent plastic sheet with a grid printed on it and a series of plastic bags and pre-numbered tags. Thus, during the recording, they could draw the artifacts, record the tag number on the sheet, then tag and bag the artifacts immediately after documentation (Fig. 5). This operation concerned only the diagnostic findings - handles, hems, tips, etc.- while other non-diagnostic materials, such as broken bricks, *tegulae,* and *imbrices* (curved roof tiles), were recovered without discrete tag numbers.

Once on the surface, all the material were washed, divided into different typological classes, and then independently weighed.

This allowed us to have both the partial weight of each single class of material and obviously the overall weight for each single square and the entire area under investigation. Since the weight data is very important to calculate the size of the boat, in addition to this work, at a later stage, materials in the small area between the "zero line" and the hull were also recovered. This have been called “R” zone and it measured 8 x 4 meters.

Results

Following this methodology, we have excavated forty-eight squares to date, to which must be added the space between the zero line and the hull, for a total of 224 square meters.

The amount of archaeological material already recovered is 9753.4 kg, but the weight varies a lot from square to square, ranging from 14.8 kg (A1) up to 447.8 kg (C6). If the outliers are excluded, 32 of 48 squares have a narrower range between 121 kg and 284 kg.

However there is no regular increase or decrease of material, moving away from or approaching the hull. On the contrary, there are squares with a lot of material close to those that have little. However it should be emphasized that the material from Lane A, that is in the middle of the river, weighs 1524 kg while that coming from the other three lanes (B, C, D) weighs respectively 2566 kg, 2211 kg, and 2358 kg.

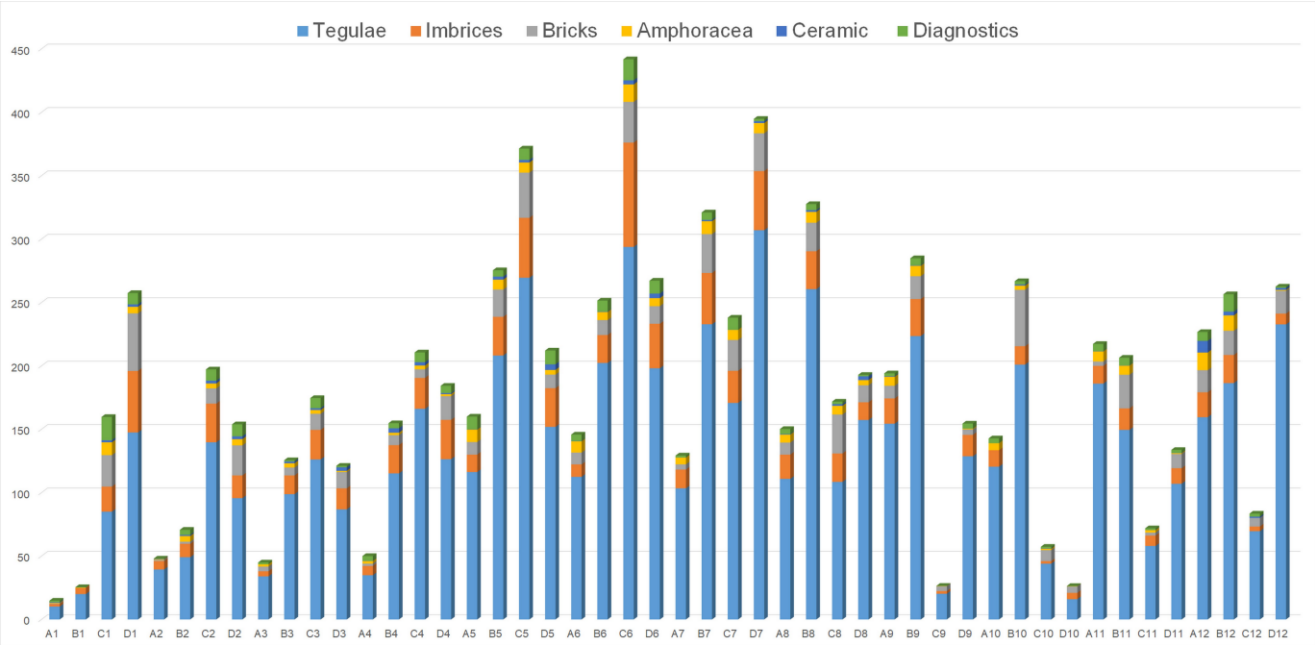

Fig. 6. Weight distribution of archaeological materials (created by Massimo Capulli).

From the typological point of view, nearly three-quarters (74%) of the archaeological material recovered is made up of *tegulae* (7200.5 kg) (Fig. 6). Other construction materials make up a lesser extent of the material, including *imbrices* at 12% (1140.6 kg) and bricks at 7% (kg 732,1), with only a small part from pottery at 4% (365.2 kg) or other artifacts at 3% (315 kg).

It is interesting to note that there is no zoning; in fact, each excavated square presents the same materials and mostly the percentages are roughly equal. The *tegulae* represent always the largest part, ranging from 53% (C1) up to 89% (D12), but if the extremes are excluded, 41 of 48 squares have a narrower range between 65% and 85%.

But the most interesting thing about the *tegulae* are the ones that have the stamp preserved. In the dispersion area, there were 33 stamped tiles found from 16 different squares, attributable to eight different productions[31]. Of these, six names are the same ones found on tiles recovered in the 90s.

Discussion

The amount of archaeological material already recovered, just under 10 tons from 224 m^2 (43.5 kg / m^2), clashes with the small size of the Stella 1 wreck. Also complicating the analysis of this site are the typological heterogeneity of the finds and the chronology that has come to be outlined. Indeed there are not only building materials, that can be dated to the 1st c. A.D., as ascertained up to now[32], such as for example *tegulae* with stamps, but also considerable quantities of amphorae (including Lamboglia 2, Dressel 2-4, Dressel 6A, Dressel 6B, Forlimpopoli and Africana), fine ceramics, coarse ware and coins, some of which securely date no earlier than the 2nd c. A.D.

Considering only the *tegulae*, the total weight of the recovered fragments is currently 7200 kg. Knowing that the standard weight per unit is normally equal to or greater than 12 kg, a minimum number of *tegulae* can be estimated at no less than 600 tiles. But if we consider that 120 roughly intact *tegulae* were recovered in the 1990s, we must say that the total number could have been no less than 720 *tegulae*, here on average 59 cm long, 43 cm wide and 7 cm thick.

[31] *M. Albius Macrus* (4 *tegulae*), *M. Albius Rufus* (7 *tegulae*), *L. Epidius Theodorus* (2 *tegulae*), *C. Titius Hermerotis* (4 *tegulae*), *Valeriae Magnae Epidian* (7 *tegulae*), *Cai (et) Marci Epidiorum* (4 *tegulae*), *L. Statii Iusti* (2 *tegulae*).
[32] VITRI *et al.* 2003: 331.

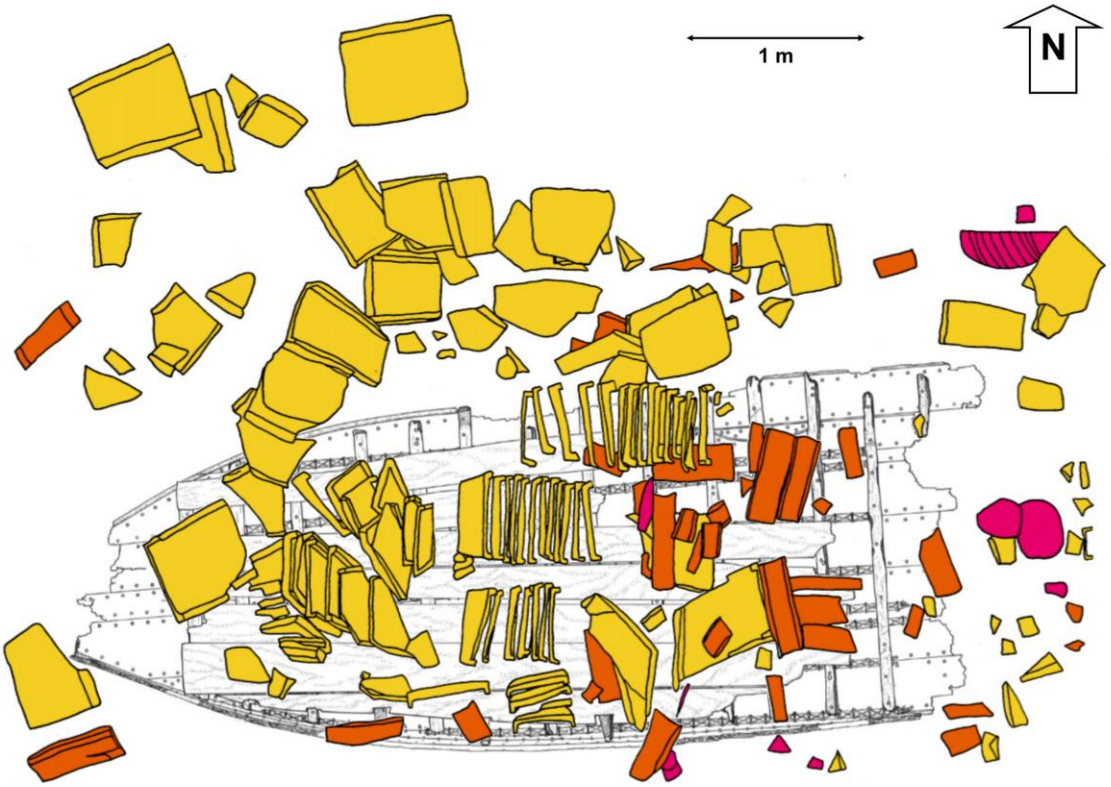

Fig. 7. Stella 1 wreck: hull and cargo in situ *based on excavations in the 1990s (created by Marta Marcolina).*

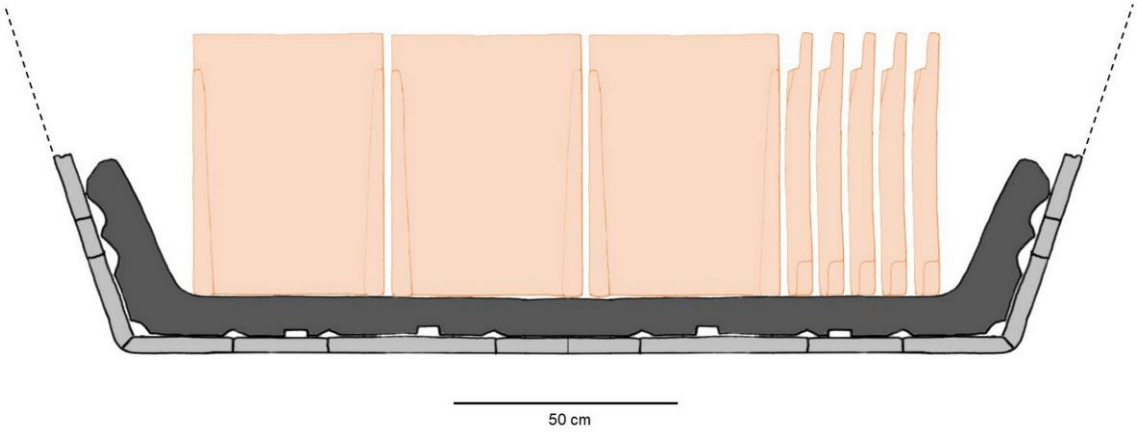

Fig. 8. Tegulae *stowage system (created by Massimo Capulli).*

The stowage scheme can be observed in the planimetry of the '90 excavations (Fig. 7), which shows in the widest part three *tegulae* transversal to the shipline and five parallel (Fig. 8).
So the boat could not have been laden with more than 55 *tegulae* per linear meter (each *tegula* measures on average 59 cm l., 43 cm w. and 7 cm th.). This means that even if we do not consider the fact that we have partial data (many tiles are still on the river bottom) and that the boat was also carrying all the other goods, of which the weight is another 2553 kg, the boat at its widest part had to be over 13 m just for the *tegulae*.

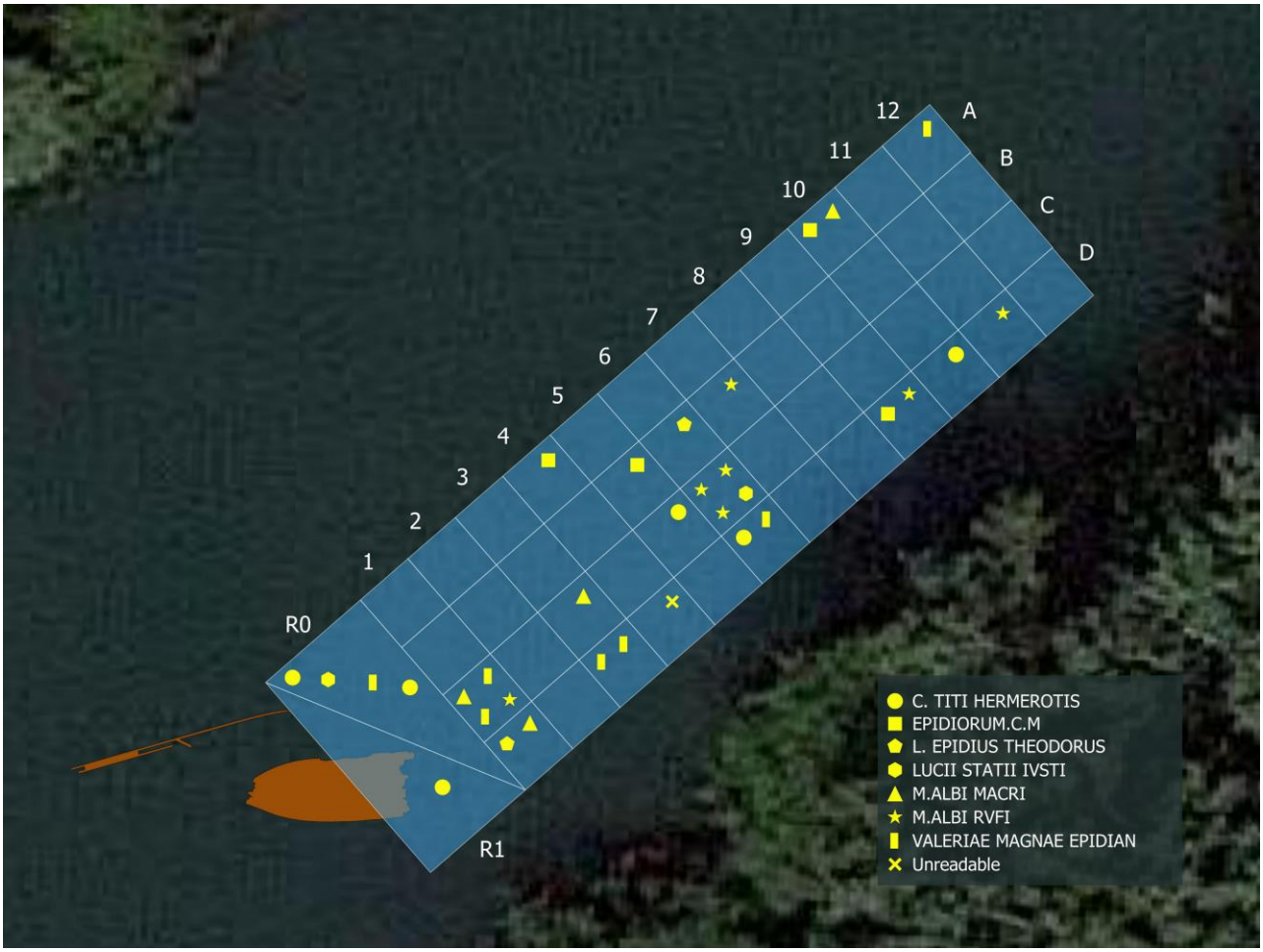

Fig. 9. The stamps distribution into the research area (created by Fabio Case; background Image © 2019 Google).

Conclusions

The homogeneous presence of the *tegulae* equal to those that were part of the ship's known cargo in the whole area investigated to date would already be good evidence of the depositional unity of this area with the shipwreck. But above all, the stamps provide the most solid proof. Six of the eight producer names found are the same as those found on the tiles recovered in the 1990s, and some of these are in the farthest excavated squares from the hull (D11, A12), about 30 m. away (Fig. 9).

This does not mean that it is a one-to-one relationship. The materials recovered from the wreck are the same as ones recovered from the contiguous area, but the materials recovered from shipwreck area may not have been on this boat.

The dimensions of a boat able to carry all this material, without considering that we have yet to recover artifacts from about half of the total area, should be so large as to make it non-functional, as it would have a length-width ratio of over 10 to 2.

If we consider the shape of the wreck[33], that the barge is not symmetrical and the widest beam is close to the end of the preserved length, there is a (small) possibility that this barge may have transported everything.

One alternative explanation could be that it was part of a convoy and that a second vessel might have been involved in the sinking. This also must have occurred much further north, as the material area is north of the hull and the current in a river is always unidirectional.

[33] CASTRO, CAPULLI 2016: 33.

Fig. 10. Connections of the Stella 1 shipwreck (created by Massimo Capulli; background Image © 2019 Google).

At some point about eighty meters from the current wreck site, the sinking must have begun where one, or more likely two, boats began to lose their cargo, which spread out across the riverbed, until at least one finally sank at the end of the process. If a second boat was part of the shipwreck event, it may have not been completely sunk but only overturned. In this case, it could have been taken away by the current or recovered by sailors in some way.

Even more uncertain is the cause; we can think of a wrong maneuver and/or bad stowage of the load, but we are in the field of hypotheses that are currently groundless.

But where the barge came from and where it was supposed to go. The great majority of the *tegulae* with these stamps are widely attested along the river, as well as in the rest of the region, and the production centers seem to have been identified along the river Stella. This is the case of the furnace in Casali Pedrina site, that is just 5 km from the shipwreck as the crow flies[34]. The presence of clay sources, the abundance of water, the existence of large woods, made the Stella basin one of the most important ceramics production centers of Aquileia area. The land routes and especially the navigable ones have favoured the distribution of these artifacts throughout the Adriatic Sea. At the moment, we do not know if the transshipment of the cargo into ships suitable for seagoing navigation took place at the harbour of Aquileia[35] through the river Natissa or at the mouth of the river Stella, perhaps near the lagoon island of Bioni (Fig. 10), where are several Roman archaeological evidences and it also looks like a port of call[36].

[34] MAGGI 1998: 82-112; CARRE, ZACCARIA 1989: 358-361.
[35] *Nona inter claras Aquileia cieberis urbes, Itala ad Illyricos obiecta colonia montes, moenibus et portu celeberrima* (Ausonius, *Ordo urbium nobilium*, 9).
[36] AURIEMMA, MAGGI 2012: 7-24.

Acknowledgements

The author would like to thank Simonetta Bonomi and Luigi Fozzati (Superintendency of the Friuli Venezia Giulia region); Filippe Castro (Texas A&M University); Alessandro Fontana (University of Padova); Stefano Magnani, Dario Innocenti and Fabio Case (University of Udine); Staci Willis (Houston Community College).

Massimo Capulli
Department of Humanities and Cultural Heritage - University of Udine (Italy)
Vicolo Florio 2/B - 33100 Udine
E-mail: massimo.capulli@uniud.it

REFERENCES

AURIEMMA R., MAGGI P., 2012, "L'archeologia sommersa. Vecchie e nuove scoperte nella laguna di Marano", in *la bassa* 65: 7-24.

BANDELLI G., 1998, "La penetrazione romana e il controllo del territorio", in G. SENA CHIESA (ed.), *Tesori della Postumia: archeologia e storia intorno a una grande strada romana alle radici dell'Europa,* catalogo della mostra, Milano: 147-155.

BARTOLI D., CAPULLI M., HOLTE P., 2012, "Creating a GIS for the Underwater Research Project ANAXUM: the Stella 1 Shipwreck", in L. FOZZATI, V. ROBERTO (eds.), *The New Technologies for Aquileia,* Proceedings of the 2nd Workshop on The New Technologies for Aquileia; Aquileia Italy, June 25, 2012, Aachen: E1-E9.

BOSIO L., 1991, *Le strade romane della Venetia e dell'Histria*, Padova.

BRESSAN F., 1997, "Progetto DAFNE: Palazzolo-Precenico. Rinvenimenti subacquei nel fiume Stella", in *Aquileia Nostra* (Notiziario Archeologico) 68: 446-450.

CAPULLI M., 2010, "Il mare di Aquileia. I traffici commerciali e il controllo militare dell'alto Adriatico", in L. FOZZATI (Ed.), *Aquileia, Patrimonio dell'Umanità*, Udine: 89-107.

CAPULLI M., 2013, "Ships of Aquileia. Underwater Archaeological Research for the Study of Marine and Inside Routes in the Upper Adriatic Sea", in *Skyllis* 13: 18-23.

CAPULLI M., 2014a, "Waterlands. The Eco-historical Landscape of the Stella River", in *Skyllis* 14: 20-25.

CAPULLI M., 2014b, "Progetto ANAXUM. Studio di un paesaggio archeologico fluviale", in *l'Archeologo Subacqueo* 20, 2 (59): 13-16.

CAPULLI M., 2015, "ANAXUM Project. Archeologia e Storia di un Paesaggio Fluviale", in *Storie di uomini e di acque. La nuova frontiera dell'archeologia fluviale,* Atti del Convegno; Aquileia, 24-25 febbraio 2012, Udine: 26-31.

CAPULLI M., 2017a, "Lingotto bollato", in *Made in Roma and Aquileia, Marchi di produzione e di possesso nella società antica,* Catalogo della mostra di Aquileia, Roma: 217.

CAPULLI M., 2017b, "The Precenicco Shipwreck. An 11th–13th-century Vessel from the River Stella", in J. LITWIN (Ed.), *Baltic and Beyond. Change and Continuity in Shipbuilding,* Proceedings of the Fourteenth International Symposium on Boat and Ship Archaeology, Gdańsk 2015, Gdansk: 131-134.

CAPULLI M., 2018, "Anaxum Project, Archeologia e storia di un paesaggio fluviale: ricerca e didattica", in M. CAPULLI (Ed.), *Il patrimonio culturale sommerso: ricerche e proposte per il futuro dell'archeologia subacquea in Italia*, Udine: 303-316.

CAPULLI M., 2019, "Il relitto di Precenicco (XI-XIII d.C.): lettura dello scafo e osservazioni sull'uso dei madieri asimmetrici alternati", in A. ASTA, G. CANIATO, D. GNOLA, S. MEDAS (eds.), *NAVIS – Rassegna di studi di archeologia, etnologia e storia navale* 6, Atti del III Convegno Nazionale; Cesenatico, 13-14 aprile 2016, Padova: 77-85.

CAPULLI M., CASTRO F., 2012, "ANAXUM Project", in *The INA Quarterly* 39 (3-4): 15.

CAPULLI M., CASTRO F., 2014, "Navi cucite di epoca romana: il caso del relitto Stella 1", in A. ASTA, G. CANIATO, D. GNOLA, S. MEDAS (eds.), *NAVIS – Rassegna di studi di archeologia, etnologia e storia navale* 5, Atti del II Convegno Nazionale; Cesenatico, 13-14 aprile 2012, Padova: 35-41.

CAPULLI M., PIPAN M., MOCNIK A., 2013, “Progetto ANAXUM. Studio di un paesaggio archeologico fluviale e sviluppo di tecniche geofisiche integrate”, in L. BOTARELLI, D. LA MONICA (eds.), *Conoscenza e tutela del patrimonio sommerso,* Atti del Convegno Scuola Normale Superiore; Pisa 11 dicembre 2012, Roma: 185-198.

CAPULLI M., WILLIS S., ASTA A., 2014, “Il progetto Sutiles nel quadro delle attività di tutela e conoscenza delle tecniche di costruzione navale antica. Il caso del Veneto”, in *NAVe – Notiziario di Archeologia del Veneto* 3: 215-218.

CARRE M-B., ZACCARIA C., 1989, “Casali Pedrina, Comune di Teor. Scavi 1988”, in Aquileia nostra 60: 358-361.

CASTRO F., CAPULLI M., 2016, “A Preliminary Report of Recording the Stella 1 Roman River Barge, Italy”, in *International Journal Nautical Archaeology* 45.1: 29-41.

CASTRO F., CAPULLI M., 2017, “The Stella 1 Shipwreck. A Roman Barge in the Upper-Adriatic Region (Udine, Italy)”, in J. GAWRONSKI, A. VON HOLK, J. SCHOKKENBROEK (eds.), *Ships and Maritime Landscape,* Proceedings of the Thirteenth International Symposium on Boat and Ship Archaeology, Amsterdam 2012, Eelde: 425-430.

FERRARI A., PESSINA A., 1996, “L’insediamento di Piancada (UD)”, in A. FERRARI, A. PESSINA (eds.), *Sammardenchia e i primi agricoltori del Friuli*, Tavagnacco: 81-92.

FONTANA A., 2009, “Meandri abbandonati del Fiume Stella presso Titiano”, in F. CUCCHI, F. FINOCCHIARO, G. MUSCIO (Eds.), *Geositi del Friuli Venezia Giulia*, Trieste: 288-289.

FONTANA A., MONEGATO G., DEVOTO S., ZAVAGNO E., BURLA I., CUCCHI F., 2014, “Geomorphological Evolution of an Alpine Fluvioglacial System at the LGM Decay: the Cormor Type Megafan (NE Italy)”, in *Geomorphology* 204: 136-153.

FONTANA A., PESSINA A., 2011, “Early Farming Landscapes in the Friuli Plain (NE Italy)”, in G. PIZZIOLO, L. SARTI (Eds.), *Hidden Landscapes of Mediterranean Europe. Cultural and Methodological Biases in Pre- and protohistoric Landscape Studies,* Proceedings of the international meeting, Siena 2007, Oxford: 137-144.

FOZZATI F., CAPULLI M., 2014, “L’archeologia delle acque di Luisa Bertacchi: la sensibilità di una studiosa che ha precorso i tempi”, in *Aquileia Nostra* 85: 147-152.

FOZZATI F., CAPULLI M., CASTRO F., 2012, “The Stella 1 Shipwreck, Udine, Italy”, in *CMAC News & Reports* 3-2: 17-19.

GALLIAZZO V., 1994, *I ponti romani. Catalogo generale*, Dosson.

GALLIAZZO V., 1995, *Esperienze preromane, storia, analisi architettonica e tipologica, ornamenti, rapporti con l'urbanistica, significato*, Dosson.

GRILLI A., 1979, “Aquileia: il sistema viario romano”, in *Antichità Altoadriatiche* 15, 1: 242-243.

MAGGI P., 1998, *Presenze romane nel territorio del Medio Friuli*, 5. Teor, Udine.

PESSINA A., 2006, “Nuovi dati sugli aspetti culturali del primo Neolitico in Friuli e sui rapporti con l’Adriatico orientale”, in A. PESSINA, P. VISENTINI (eds.), *Preistoria dell’Italia settentrionale. Studi in ricordo di Bernardino Bagolini,* Atti del Convegno Internazionale; Udine 23-24 settembre 2005, Udine: 279-301.

POMEY P., BOETTO G., 2019, “Ancient Mediterranean Sewn-Boat Traditions”, in *International Journal of Nautical Archaeology* 48.1: 5-15.

RIGHINI V., 1990, “Materiali e tecniche da costruzione in età preromana e romana”, in G. SUSINI (ed.), *Storia di Ravenna I, L’Evo antico*, Venezia: 257-296.

UGGERI G., 1990, “Aspetti archeologici della navigazione interna nella Cisalpina”, in *Antichità Altoadriatiche* 36: 175-196.

VITRI S., GOMEZEL C., PRENC F., 1994, “Un lingotto di piombo con il bollo dal fiume Stella”, in *Aquileia Nostra* 65: 290-291.

VITRI S., BRESSAN F., MAGGI P., 1999, “Fiume Stella. Scavo subacqueo e protezione del relitto «Stella 1». Interventi 1998-1999”, in *Aquileia Nostra* 70: 435-440.

VITRI S., BRESSAN F., MAGGI P., DELL'AMICO P., MARTINELLI N., PIGNATELLI O., ROTTOLI M., 2003, “Il relitto romano del fiume Stella (Ud)”, in F. LENZI (ed.), *L'Archeologia dell'Adriatico dalla Preistoria al Medioevo,* Atti del Convegno Internazionale; Ravenna 7-9 giugno 2001, Roma: 324-338.