

# Notes on water cisterns in Antiquity on the Eastern Adriatic coast

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<https://www.doi.org/10.17234/9789533790343.7>

*Albeit an important factor in all civil and military complexes, the topic of water supply in Antiquity is largely overlooked in Croatia. One of the integral parts in systems governing water supply are water tanks i.e. water cisterns. This paper gives a general overview on water cisterns in Croatia. It includes a list of those known to the author and some general information relevant to each.*

**Key words:** water supply, water cistern, Antiquity, Istria, Dalmatia

## **Introduction\***

**A**s for human life in general, so for every settlement, village, city and military camp, access to a reliable water supply is of vital importance (DNP 12/2 406). The care taken in regard to water supply is especially visible in the Mediterranean, a part of which is the Eastern Adriatic. Naturally, there is a stronger need for water storage in this geographical context. The most common solution to the challenge is the construction of water tanks i.e. water cisterns. The same was true in Antiquity.

I want to emphasize how extremely grateful I am for having been given the opportunity to present this paper in a collection of works honoring the 65th birthday of our professor Mirjana Sanader. During her research in Gardun, Professor Sanader has uncovered, documented and presented a large water cistern found in the context of the Roman legionary camp *Tilurium*. The main goal of this short paper is to determine how much and in what way water cisterns of Antiquity are overall presented in Croatian archaeology. Even though scholars in Croatia have been publishing papers on the subject since the end of the 19th c. (Bulić 1898; Gnirs 1924; Matijašić 1998: 284–291), the topic of water supply in Antiquity and the role cisterns had in it was never systematically observed. The greatest number of these water cisterns in Croatia can be found in Istria, which is where this list begins.

## **Water cisterns on the Eastern Adriatic coast**

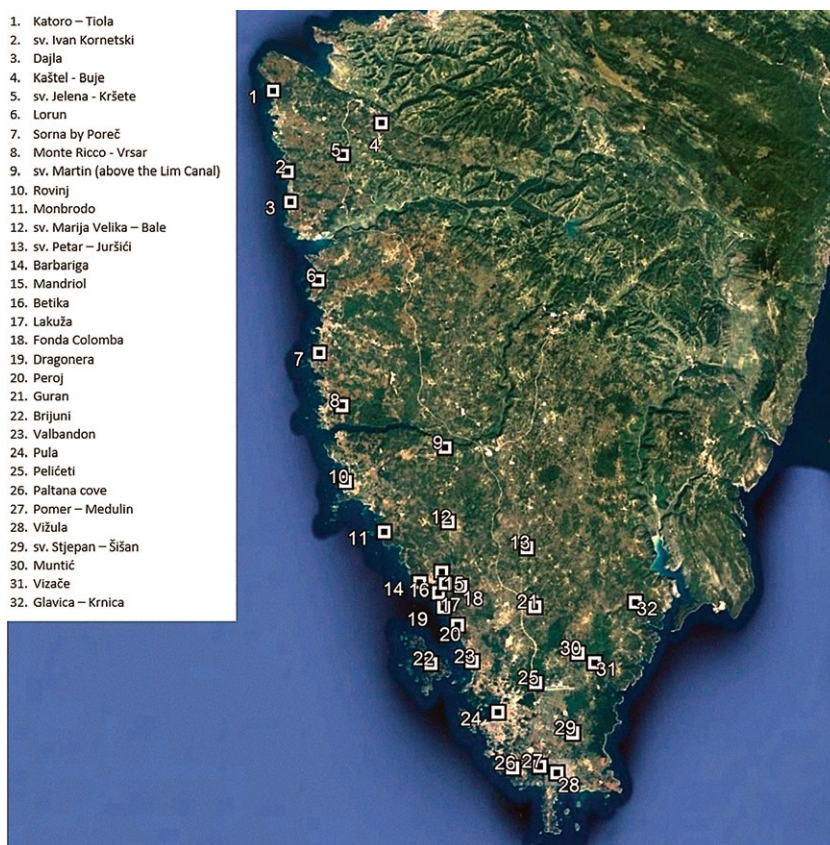
On the territory of Umag, three such tanks are mentioned. One of them is located on the site sv. Ivan Kornetski (Katunarić 2009: 374), the second one on the site Katoro-Tiola (Bošec Ferri & Čučković 2008: 261) and the third one on the site of Dajla (dimensions: 9 x 3 meters) (Gnirs 1924: 150; Matijašić 1998:

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\* This work has been fully supported by Croatian Science Foundation under the project IP-2018-01-4934 „Understanding Roman Borders: the Case of the Eastern Adriatic” (AdriaRom).

288, tab. 3). Close by, one example from the site Kaštel, dated back to Late Antiquity, was documented on the territory of the town of Buje (dimensions: 6.5 x 4 meters) (Milošević 2013: 439). On the site Kršete - sv. Jelena, there are known to be two cisterns. The floor of the larger one is constructed in *opus spicatum*, and it seems to be 8 meters long and 4 meters wide. The smaller one is 3 meters long and wide (Ujčić 2010: 352). In the corners inside of the tank on the site of Lorun (dimensions: 12 x 12 meters, with a maximum preserved height of 2.20 meters) slots, which might have been used for vaulting, are still visible (Kovačić 2005: 142). A water cistern is mentioned to exist in Sorna, near Poreč, and it is documented to be 13 meters long and 7.5 meters wide (Matijašić 1998: 287, tab. 3). On the site of Monte Ricco, near Vrsar, a cistern 7.10 meters long and 16.50 meters wide has been uncovered. In addition, it is 2 meters high, with a small part of the vaulted ceiling being preserved (Buršić-Matijašić & Matijašić 2016: 21). Construction of a cistern from the site of Sv. Martin (above the Lim canal) dates back to the 1st century and the first half of 2nd century (dimensions: 9.8 x 3.8 meters, with a maximum preserved height of 1.8 meters). Its floor is constructed with *opus spicatum* (Percan 2011: 418–420). In the town of Rovinj, on the location of Val Faborso, the existence of a water cistern (dimensions: 10.7 x 3.8 meters, with a maximum preserved height of 3.5 meters) was documented by A. Gnirs (Gnirs 1924: 149; Matijašić 1998: 288, tab. 3). The same author first documented a cistern on the site of Monbrodo (dimensions: 16.2 x 5.7 meters, with a maximum preserved height of 2 meters) (Gnirs 1924: 149; Matijašić 1998: 288, tab. 3). Another water tank was identified during research done on the benedictine church and monastery on the site of sv. Marija Velika in the municipality of Bale (Jurković & Marić 2006b: 240). R. Matijašić mentions the existence of a cistern on the location of sv. Petar in Juršiči (Matijašić 1998: 288, tab. 3). There are known to be two cisterns located in Barbariga. One of them is quite larger than the other (dimensions: 25 x 12.55 meters, with a maximum preserved height of 3 meters) and has an *opus spicatum* floor with visible bases where once stood columns that supported the vault, which divided the three-aisled cistern (Matijašić 1998: 287, tab. 3; Višnjić 2010: 323–327). The other (dimensions: 5 x 4.5 meters) is, supposedly, located in the sea (Gnirs 1924: 150; Matijašić 1998: 287, tab. 3; Višnjić 2010: 326). The existence of three other water cisterns in close proximity to Barbariga is mentioned by scholars. One (dimensions: 30 x 3.5 meters, with a maximum preserved height of 1.8 meters) is located in Mandriol (Matijašić 1998: 287, tab. 3), the second one (dimensions: 24 x 3 meters, with a maximum preserved height of 1.3 meters) on the site of Betika (Gnirs 1924: 149; Matijašić 1998: 288, tab. 3), and the third (dimensions: 18 x 6 meters, with a maximum preserved height of 3 meters) in the Marić cove - Lakuža (Matijašić 1998: 287, tab. 3). The site of Fonda Colomba is mentioned to contain one water cistern (dimensions: 15 x 3 m) (Matijašić 1998: 287, tab. 3). According to its researchers, a cistern from Dragonera can be dated to the time of Emperor Titus (Starac 2006a: 197). In the area of Peroj, there are known to be two cisterns. The larger one (dimensions: 12.4 x 3.2 meters, with a maximum preserved height of 3 meters) can be found on a location called Val Murazzi (Gnirs 1924: 149; Matijašić 1998: 288, tab. 3) and the smaller one (dimensions: 5 x 8 meters) on the location of Velika Šaraja (Matijašić 1998: 287, tab. 3). One water cistern was identified by researchers during work on the St. Cecilia Church on the Guran site in the municipality of Vodnjan (Jurković & Marić 2006a: 206; Jurković *et al.* 2009: 332). At the Verige cove, on the eastern side of the island of Veli Brijun exist three fairly large water tanks and also a smaller one. The largest tank is 37.6 meters long and 3.2 meters wide, whereby its highest preserved point is 3 meters high (Matijašić 1998: 287, tab. 3). The second-largest cistern at the Verige cove is 14.3 meters long, 10.7 meters wide and its highest preserved point is 1.5 meters high (Gnirs 1924: 143; Matijašić 1998: 287, tab. 3) while the third one is 31 meters long and 3.1 meters wide with its highest preserved point being 3 meters high (Matijašić 1998: 287, tab. 3). The smaller cistern is 6 meters long and 5.7 meters wide. Its highest preserved point is 2 meters high (Gnirs 1924: 144; Matijašić 1998: 287, tab. 3). On the same island, at the location called Gradina, there is another, smaller water cistern. It is 14.8 meters long and 2.5 meters wide, while its highest preserved point is 2.5 meters high (Gnirs 1924: 139; Matijašić 1998: 287, tab. 3). Another water cistern is mentioned to exist on the western side of the island, in the Dobrika cove, and is 7.35 meters long and 3.2 meters wide. Its highest preserved point is 3 meters high (Matijašić 1998: 287, tab. 3). The neighboring island of Mali Brijun is mentioned to have one known cistern on a position referred to as sv. Nikola. The object is relatively small. It is 4.2 meters long and 3 meters wide (Gnirs 1924: 150; Matijašić 1998: 287, tab. 3). One water cistern is known to exist in Valbandon. It's 8.7 meters long and 4.6 meters wide (Gnirs 1924: 150; Matijašić 1998: 288, tab. 3). In the area of Pula, two cisterns, which are considered public cisterns by scholars, have been documented. The slightly larger one is 14.5 meters long and 11.5 meters wide. The other is 15 meters long and 9 meters wide, whereby its highest preserved point is 1.75 meters high. R. Matijašić mentions other cisterns in the area of

Pula: Monumenti (dimensions: 3.4 x 5.4 m), two cisterns from the position „casa Petinelli“ (dimensions: 1) 3 x 3.8 meters, with maximum preserved height of 1.85 meters, and 2) 3 x 2.4 meters, with maximum preserved height of 2.8 meters), „viale Carrara“ (dimensions: 3.8 x 3.1 meters, with a maximum preserved height of 1.5 meters), „via Stancovich“ (dimensions: 8.3 x 1.95 meters, with a maximum preserved height of 2 meters). One cistern is known from the sv. Andrija island (dimensions: 5.2 x 3 meters, with a maximum preserved height of 2.5 meters) in Pula (Gnirs 1924: 133–138; Matijašić 1998: 288–289, tab. 3). Furthermore, a larger number of water cisterns were found during recent reconstruction work in the st. Theodor district in Pula. Researchers believe they were part of a wider system (Starac 2006b: 237). Three cisterns have been identified on the site of Peličeti. The largest one (dimensions: 11.58 x 4.13 meters, with a maximum preserved height of 3.10 meters) has a settling tank and 5 limestone monolithic column bases that supported the vault. Several monolithic elements of the cistern were found inside the object, such as the flat roof stone with an opening for grabbing water and a stone pipe for water input. The floor is made in *opus spicatum*. The second cistern in Peličeti (dimensions: 2.98 x 2.04 meters, with a maximum preserved height of 1.15 meters) had a floor in *opus spicatum* and was connected to two small settling pools. The most recent cistern on the site, dated by the small finds, was 4.85 meters long and 3.88 meters wide. The maximum preserved height of the walls was 1.80 meters (Džin 2007: 256–259). A cistern from the Paltana cove is 7.2 meters long and 4 meters wide (Gnirs 1924: 150; Matijašić 1998: 288, tab. 3). In Pomer, near Medulin, there is a cistern with an interesting ground plan in the shape of an irregular L (internal dimensions: 7.60 x 7.06 x 4.72 x 4.57 x 2.65 x 2.48 meters). The tank has two monolithic stone settling tanks whose dimensions are 90 x 90 cm and 85 x 90 cm, respectively. On the floor of the cistern, made in *opus spicatum*, five bases measuring 0.74 x 0.74 meters can be seen. The bases themselves are 1.08 and 1.28 meters apart (Džin 2008: 280–281). Two cisterns seem to be documented in Vižula also in Medulin. The larger one (dimensions: 8.60 x 4.60 meters, with a maximum preserved height of 3.10 meters) was, according to its researchers, probably barrel-vaulted, with the floor done in *opus spicatum*. A stone settling tank was also identified. A monolithic flat roof stone with a circular opening, probably used as an opening for water access, was found as well (Girardi Jurkić & Džin 2007: 281). The smaller cistern (dimensions: 6.50 x 3.20 meters) also has an *opus spicatum* floor and is today partly in the sea (Miholjek 2012a: 432; 2012b: 525–531). Another cistern is present at Šišan (Matijašić 1998: 288, tab. 3). A three-part water tank in Muntić



Map 1: General locations of known water cisterns in Antiquity in Istria and Brijuni (by: D. Bužanić according to Google Earth, 2019).



Map 2: General locations of known water cisterns in Antiquity in Dalmatia and the islands of the Eastern Adriatic (by: D. Bužanić according to Google Earth, 2019).

(dimensions: 5.4 x 6.15 meters + 2 x 1 meter, with a maximum preserved height of 2.25 meters) was documented by R. Matijašić (Matijašić 1998: 286–287, tab. 3). The same author gives measurements for two cisterns from Vizače (dimensions: A\ 2.53 x 2.93 meters, with a maximum preserved height of 2 meters, and B\ 5 x 1.75 meters, with a maximum preserved height of 1.5 meters) (Matijašić 1998: 288, tab. 3). On the location of Glavica near Krnice, there is a 30-meters long cistern, with a maximum preserved height of 1.5 meters (Matijašić 1998: 288, tab. 3).

Another cistern was documented during research on a benedictine monastery and St. Peter church in Osor, on the island of Cres. (Marić *et al.* 2008: 352; 2009: 437). On the Kaštelina site, on the island of Rab, a large water cistern was documented with its rainwater drainage system (Jurković & Marić 2009: 417). A water cistern is mentioned to exist also in Drvišica in the municipality of Karlobag (Glavaš 2014: 440). In Podgrađe (Benkovac), a relatively deep cistern was found in an urban context. It is 3.5 meters long and 3 meters wide, but its walls are 8 meters high. Like a good portion of water cisterns, it was dug into the soil. Originally, the *opus spicatum* floor was completely visible, but at a later time an improvised column was added in the center of the tank in order to hold the stone roof. A flat stone block with a circular opening for grabbing water was found inside it (Perović 2009: 149–160). At Bribirska Glavica, at the location called *nymphaeum*, four Roman cisterns were found, an additional one at the location behind the larger medieval house and an older one, for which scholars believe to be Liburnian, but renovated during the Roman times. In addition to this, one more cistern (dimensions 6.25 x 4.60 m, with maximum preserved height of 2.30 m) was dated to the 1st century and has a mosaic floor made of small white stone cubes (*tesserae*) (Pedišić 2005: 205; 2006: 325; 2007: 363–364). The location Crkvine on the Trbounje site on the territory of Drniš contained a water cistern that was found next to the narthex of a church (Zaninović 2008: 435–437). One possible Roman cistern was found built against a wall of a *villa rustica* in Kaštel Štafilić (Maljković & Nodilo 2010: 598), and another one, at the site Kaštel Štafilić-Resnik, was partially destroyed (Kamenjarin & Šuta 2008: 461). Researchers on the Rižinice site in Solin claim that a water cistern from the site contains a mosaic floor (Gudelj 2014: 574). Another cistern (dimensions: 11 x 7.5 meters, with maximum preserved height of 1 meter) was documented on the territory of the town of Solin by F. Bulić (Bulić 1898: 35–39). At Gardun, a very large cistern was dug into the soil on top of a hill. It had a quadrangular plan, but the southern (19.30 meters) and western (27.95 meters) walls are around 3 meters longer than their opposite northern (16.60

meters) and eastern (24.89 meters) walls. There were rectangular columns inside the cistern, most probably in order to support a roof that has not been preserved to this day (Sanader 2003: 41–54). Excavations in Cista Velika unearthed two cisterns of different sizes. The smaller one was overlaid by the floor of an early Christian church (Maršić *et al.* 2000: 115–128). A surviving water tank can be seen in Supetar on the island of Brač, among the remains of a Roman production complex (Galiot 2011: 729). On the same island, the existence of a larger number of cisterns is mentioned on a Late Antique site Mirje (Kovačić 2006: 372; 2010: 29–32). It seems that two cistern exist as a part of a *villa rustica* on the site Novo Selo – Bunje, on the island of Brač (Jelinčić 2005: 124–126). Another example was documented on the site sv. Petar in Makarska (Tomasović 2012: 621; 2013: 723). One water cistern dated to the Late Antiquity was found during research done on a location called Remetin vrt in Stari Grad on the island of Hvar (Jeličić Radonić & Katić 2014: 614). In the Stonca cove on the island of Vis two water tanks are covered by the sea (Zubčić 2005: 231). A roof of the cistern in Vid by Metković (dimensions: 2.75 x 1.10 meters, with a maximum preserved height of 1.40 meters) was covered with four large stone panels, one of which had a circular opening to allow access to the water supply (Čargo & Piteša 2006: 432). On the site Koludrt in Lumbarda on the island of Korčula, D. Rendić-Miočević confirmed the existence of a large water cistern without a roof and filled with stone debris. The first finds from the cistern were Roman ceramics, but the cistern itself was assumed to be Hellenistic. (Rendić-Miočević 1970: 31–34). New research on the site, conducted under the guidance of H. Potrebić, and publications which are to follow will surely shed new light on it.

## Conclusion

In summary, it can be concluded that at least 81 water cisterns dating back to Antiquity are known from the Croatian part of the Eastern Adriatic. They stretch from northern Istria to southern Dalmatia and the islands. When going through the literature available to me, it was evident that the amount of information about the cisterns varies from paper to paper. Furthermore, there are locations with a larger number of cisterns and the existence of these structures on a couple of sites is sometimes only mentioned. Some papers give the main measurements and state of preservation, while a smaller number provides full information on the structure.

## Abbreviations

|     |                                      |
|-----|--------------------------------------|
| DNP | <i>Der neue Pauly</i>                |
| HAG | <i>Hrvatski arheološki godišnjak</i> |

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