Remote Sensing of the Archaeological Remains of Roman Maritime Villas on the Eastern Adriatic Coast

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Abstract. Roman maritime villas were among the largest Roman villas on the eastern Adriatic coast. They were situated on suitable bays and promontories with panoramic view to the sea and on the maritime routes of the Adriatic. Plans for future archaeological excavations of maritime villas have to be based on remote sensing using aerial photos and satellite images as the non-invasive method of archaeological exploration, recommended by the European Council for Preservation of Cultural Heritage. Up to date, remote sensing has been used on several villa sites, such as Katoro, Brijuni, Murter, Soline Sv. Klement, Sreser and Tiha bay Cavtat. The use of remote sensing on those villas indicated more extensive building complexes than expected. There are 30 known maritime villas on the eastern Adriatic. The level of the present documentation of those villas is insufficient. Some parts of maritime villas are today under the sea level, in shallow water. In such cases, aerial photos are more than useful, especially in preparation of underwater investigations. On the ground, best results are obtained in combination of those methods with geophysical research, including electromagnetic detection of the sites. The classical archaeological excavations were important in order to check the preliminary results.

Keywords. Maritime villas, eastern Adriatic, 1st century BC – 6th century AD, remote sensing.

1. Introduction

Remote sensing has a powerful role in archaeological research and interpretation. The application of the Space Technology and remote sensing aids significantly in identifying and confirming archaeological sites and in documenting their extension and layout. With the classical archaeological excavations, very often, we are not able to explore the whole area of a building, and it is very expensive to do so. As there are some parts of the maritime villas submerged, we have to conduct underwater archaeological investigation together with archaeological excavations. Digital processing analysis of aerial photographs helps us to indicate the areas of archaeological sites which should be explored. The integral land area of maritime villas on the eastern Adriatic coast has not been determined so far. The maritime villas were certainly in the category of luxury Roman villas and they have been situated on the promontories and bays with the most beautiful views to the sea. The extension of the villas’ territory is partially known from limited excavations. Because the whole complexes cannot be archaeologically explored at the moment, other methods of research have to be used as preliminary to classical archaeological explorations. Aerial photographs and orthophotos were analysed by means of computer processing. These explorations indicated that more extensive building complexes exist on all sites. The best results should be obtained in combining those methods with geophysical research, including electromagnetic detection of the sites.
1.1. The historic background and archaeological evidence

The period between Caesar and the Flavian emperors (1st century BC to 1st century AD) witnessed a rapid ascent in economic and political power of the colonial elite in Roman Istria. Originally Italic colonists, those loyal supporters and associates of the Julii, the Antonii, and the Claudii developed economies of scale and through their building programs transformed the city and the countryside. In the wake of recent scholarship and excavations and our own work on the Roman villas, we have undertaken a comparative study of urban and rural architecture to reconstruct the patterns of transformation.

Building activity started with the foundation of the colonies of Tergeste, Pola (both in 46 B.C.) and Parentium (Tiberian period) and the development of villae rusticae in the countryside. The Roman expansion into Noricum and Pannonia coupled with favourable imperial policies stimulated the economy and propelled some families into the senatorial rank. Luxury building began after Augustus annexed Istria to Regio X, 18-12 B.C. The elite were at first shaping the cityscapes in metropolitan style and ideology and then embellishing their country residences. City buildings related to the imperial cult and Roman lifestyle, while some coastal villae rusticae were expanded into villae urbanae and maritimae, in the Campanian fashion. In the next stage, politically mature proprietors, some of them holding highest offices, lavished their attention on their villas. New, post-Augustan architectural designs found their application in maritime villas. City structures were improved and decorated, perhaps due to increasing involvement of freedmen, but innovate architecture did not feature in the cities. The same situation had been on the central and south part of the eastern Adriatic coast in Roman Dalmatia.

Maritime villas were the residences of Roman aristocracy and the centers of their estates on the coast. The political, economic, and ideological conditions were ripe for the birth of this architectural phenomenon on the eastern Adriatic coast during the first century of the Roman Empire. Maritime villas were prestige projects, removed from production sites. The sea became an internal, desired space, embraced by floating porticoes [1]. The topography of the Adriatic coast with rocky promontories and protected bays was conducive to imaginative and exclusive architectural designs, which took off in the Augustan period and lasted during the whole first century.

Agricultural intensification of cash crops, wine and olive oil, and exploitation of stone and salt caused the rapid transformation of the landscape and society, and lead to the great building activities, especially of large maritime villas. Imperial policies and élite economic interests went hand in hand in the development of maritime villas, and they also created economies of scale.

The development of the true maritime villas did not occur until the development of an economy, especially an economy of scale. This is quite clear on the territory of Istria. The economy of scale was based on producing wine and olive oil, which had a wide distribution all over the Roman Empire by maritime routes and Roman roads. The identity and activities of local senatorial landowners are known from literary and documentary sources. The second factor was the growth of political power base first in the community and then, even more importantly, in Rome. Our research in the Adriatic region south of Istria showed a different picture. First, the area had a different political and economic position in the Roman state. It remained the provincial territory of Illyricum, which Augustus removed from the senatorial provinces and established as an imperial province. Villas in the central and southern half of the Adriatic are generally known, both from excavations and publications. Maritime villas of the Early Empire in Dalmatia may belong to high officials sent directly from Rome, rather than to local, Roman elite.

There are numerous Roman villas on Istrian and Dalmatian coast and also on the neighbouring islands, but there are rather few luxury maritime villas. As they are rather rare and the most exclusive Roman sites, we aim our attention to archaeological evidence and aerial photos of those.
villas. We shall discuss the results of remote sensing on twelve villas. They were chosen for their special features or functional significance.


Figure 1: Maritime villas in the eastern Adriatic.
Remote sensing with the aerial photos and electromagnetic detection were carried out on the sites of Katoro, Sorna, Loron, Verige on Brijuni islands, Val Bandon, Vižula, Murter, Stari Trogir, Soline bay on Sv. Klement island, Lumbarda on Korčula island, Polače, and Tiha bay near Cavtat.

Beginning from the north part of the eastern Adriatic, there are known maritime villas on the territory of the Roman colony of Tergeste – 1/ Barcola (today in Italy) and 2/ Simonov zaljev (today in Slovenia). These will be left out of our discussion.

1.2. Part of Roman Histria (today Istra in the republic of Croatia)

The maritime villa on Katoro promontory near Humagum was situated on the low promontory and its architecture reached into two bays on either side. The position is panoramic with vistas on all sides. The site is only partially excavated. Some architectural remains of a high level were found on the top of the promontory - peristyle, a row of rooms, massive terraces, and walls in opus isodomum technique. The building may be dated to the 1st century AD. The baths were located in the north St. Margarita bay, while a large, semicircular fish pond (piscina) with compartments takes up the south bay [2]. A monumental tomb with fine glass jug and pottery dated to the end of the 3rd - 4th century were found near the baths on site of Tiola [3]. At low tides, partial ground plans of new premises with mosaics that frame the southern side of the peninsula occasionally appear. On the aerial photos we see the evidence of walls on both sides of the promontory, and on the part of the villa today under the sea level.

Figure 2: The maritime villa on Katoro promontory - aerial photo and wall painting from Pompeii.

There is also same evidence of a big stone mole north of St Margarita bay and north of Sipar, which protected the whole bay from the north wind.

The maritime villa at Loron, north of Parentium, was spread over two bays, Santa Marina and Cervar, and a promontory between them. In the bay of Cervar-Porat, was located the second largest amphora workshop in Istria, active from the 1st to the 4th century. It also produced terra sigillata and tiles early in the first century. The recent Franco-Croatian excavations on the north side of the bay, at Loron, have uncovered further production installations. A structure with a long row of rooms on the shore and more structures on the slope, one with a hypocaust, have been excavated so far [4]. A maritime villa connected with this production site has been located at Loron, but is awaiting excavation. Walking for over 500 meters along the curving shoreline and on the slopes of the promontory between the bays, one can see evidence of dispersed buildings constructed both at sea
level and on terraces. On the aerial photos it is possible to see a piscina, located at the end of the second bay. Some walls are also visible on the promontory and in Santa Marina Bay.

The maritime villa south of the city of Parentium was situated on a narrow promontory of Sorna. The villa straddles the promontory and its long porticoes open to the wide vistas on all three sides. The axial symmetry of the two peristyle complexes indicates a unified design, not a two-phased development [5]. A large dining room (triclinium) is centrally located at the highest point of the promontory. The light comes from the peristyles on each side. In the east bay, close to the sea, there is the baths complex. The rooms decorated with polychrome mosaics and wall paintings, dated to between the 1st and 2nd century, have been excavated. Here we may truly have an imperial-period villa built for the purpose of otium, the enjoyment of country life. In late antiquity there were changes and additions to the villa. The structure in the lower left corner was added in the 4th century, according to the excavator. In the center of the villa, constructed over the triclinium, a small rectangular building with lateral additions was very likely a church. On the aerial photos more walls are visible on the south side of the promontory, as well as the remains of the port in front of the villa.

The maritime villa in Verige bay on Brijuni islands is the most elaborate maritime villa on the eastern Adriatic. The villa was built in the 1st century and consists of separate functional areas: the residential area built on four terraces; three temples (aediculae) dedicated to Neptune and Venus, third unknown) surrounded with semi-circular porticoes; structure with a nymphaeum; the library; palaestra with baths; and a production area. The whole complex is connected by a system of porticoes and cryptoporticoes along the coast. The complex was surrounded by terraced gardens and the bay had a stone built waterfront flanked by two large moles. It is significant that this villa is the only site where the late republican to early imperial building phases are clear.

The villa has a whole range of long colonnades open to the sea and a peristyle courtyard around which buildings are grouped. A semicircular colonnade follows the shoreline, which had a stone-built waterfront [6]. A rectangular piscina in the bay connects the monumental baths with the production area [7]. Remote sensing and digital processing analysis of aerial photographs have

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Figure 3: The maritime villa on Brijuni islands - aerial photo and overall plan (Gnirs 1908, Begović Dvoržak 1991).
indicated the areas that should be further explored. These include the area in front of the western entrance of the residential building, the area near the large cisterns on the fourth terrace of the same part, the eastern part of the terraced gardens on Dubovac hill near the lateral piers, the area behind the temples, the area behind a large portico on Gradina hill, the area north of the bath and the marginal part of the detached structures on the slopes of Mrtvi Vrh [8]. The archaeological excavation carried out in July 1992 and the two tranches behind the semi-circular portico in the axis of the central temple resulted in discovery of the foundations of a circular structure which, based on the above mentioned results, is thought to be either mausoleum, or the first stage in the building of the circular temple.

Figure 4: The aerial photo of Brijuni islands (Kosinožić, 1992).

The villa in the deep bay of Valbandon was partially excavated early in the 20th century and only new excavation could clear its chronology and the relationship between the two parts on the opposite side of the bay [5]. Imaginative architectural forms and the finds of high-quality decoration, including a floor in opus scutulatum indicate a luxury residence. In the southern complex, almost all the residential areas were decorated with mosaics. Two exedras in the northern part of the bay were decorated with black mosaic with crustae. Behind them lies the northern wing of the residential part. Alongside the mosaics are the remains of decorations of marble slabs in the opus sectile technique. There was evidence that the inner part of the bay was enclosed to form a piscina, which was fed by a creek that flowed into it. The complex is dated to the 1st century AD. There was also some renovation of mosaics in late antiquity [9]. On the aerial photos there is visible silting up of Valbandon Bay. Archaeological excavations should include the entire bay.

East of Banjole, by the present-day town of Medulin, the largest maritime villa in this area, and perhaps the largest one in Istria, occupied most of the promontory of Vižula. The promontory is located in a deep bay, which offers safe anchorage and protection from all winds. The villa had a panoramic position and would have had a visual control of the straits leading into the bay. Since
1995, the remains on the promontory and submerged structures have been surveyed. Several small areas have been excavated. Visible walls stretch for a kilometer along the shores and some are now submerged. Various buildings are arranged at different angles. The whole villa, built on three terraces, covered about 10 hectares [10]. The finds of mosaics, marbles and statuary indicate considerable luxury. Small finds date the complex from the 1st to the 6th century. Some investigated structures showed partitioning in late antiquity, perhaps to house an increased population, possibly military. On the aerial photos we can see remains of harbor structures and a piscina in the bays on both sides of the promontory of Vižula. Also it is visible that the shore had been built around the whole promontory in irregular rectangular shape. On the slope of the hills there is evidence of terraced architecture.

1.3. Roman Dalmatia (today Hrvatsko Primorje and Dalmacija in the republic of Croatia)

The maritime villa on island of Murter is located on the west part of the island under the Gradina hill. The island is close to the mouth of the river Krka (Titus), which flows into the sea not far from the ancient town of Scardona. The Latin name of Murter was Colentum (Pliny, NH III, 140). Villa was situated on a peninsula and it has been only partly excavated [11]. It had a long portico along the shore with a row of rooms (one apsidal) facing the sea, which offered panoramic views. The excavated baths and a large cistern (10 x 5,5 m, 1,8 m high) indicate a luxury villa of the 1st century. The medieval name for this site was Villa Magna. The aerial photos have indicated an even larger site, extending on both sides of the excavated area. Harbor installations and some other parts of the villa were possibly situated in the bay south of the promontory.

The maritime villa in the bay called Stari Trogir was 22 nautical miles west of the colony of Salona and 12 nautical miles west of the town of Tragurion (Trogir). Pliny the Elder mentioned Tragurion as “marmore notum.” The quarry was exploited from the time of the Greek colonization in the 3rd century BC into the Renaissance. The villa may be connected with that activity, but it was also situated in an agricultural area and in an important nautical location. The bay is well protected from all winds and a small island in front of it provides further protection. It is also at a point where ships sailing from Salona up the coast would leave the channel and go into open waters.

The site has been surveyed but never excavated. The remains of a stone quay and a circular structure are visible in the sea [12]. This circular structure of 8 m in diameter may be part of a piscina with a central circle framed by lateral rectangular compartments. Such fishponds are known from maritime villas north and south of Rome, illustrated by Lafon. Most date from the Augustan period. On the beach there are remains of the baths and a large cistern, divided into two compartments. More walls are visible on the slope, as the villa was raised on two terraces, nested in the semicircular shape of the bay. On the aerial photos it is possible to discern in the sea some harbor structures and a big mole, which protected the bay from the south wind.

The maritime villa on the island of Sv. Klement, near the city of Hvar, island of Hvar is located in the bay of Soline on the south side of the island. The remains are located along the shore, on the edge of a fertile field, still under cultivation. Parts of the villa architecture are today submerged, as the sea level rose about 2 m since antiquity. The name of the bay – Soline – indicates the existence of Roman salt works, which have been confirmed in medieval documents. The investigations since 2007 have been directed toward the questions related to the extent, layout, chronology and historical significance of the villa site. The investigated site covers an area of 2500-3000 m2. We can see on the aerial photos that it is also spread over the small hill 32 m high. More structures underground were indicated by the geophysical/magnetometric survey. The first one was conducted by David Monsees in 2007. His report indicated two phases of construction, which also showed in the results and interpretation of Felix Teichner, who in 2010 surveyed an area of 1050 m2. The results of magnetometry and topographic documentation showing the complex of walls, of a different
Two distinctive periods have been observed so far: probably an Early Imperial phase (1st century AD) and a Late Antique phase (4th-6th c.). The archaeological finds from test trenches date from the 2nd/1st BC to 6th c. AD. The aerial photography done in August 2008 revealed submerged remains of four walls of the former salt works in the bay. The salt works were also visible on an archival aerial photo from 1968. Significant findings were made by surface and underwater investigations of the salt works in Soline Bay. The remote sensing documented the layout and distinctive phases of building and settlement of the villa.

Figure 5: The maritime villa in Soline bay on Sv. Klement island near Hvar - aerial photo and overall plan based on the results of archaeological excavations, ortho foto images, results of remote sensing and electromagnetic detection. Probes - a1 to e1 (D. Monsees, F. Teichner, M. Petrić, V. Begović, I. Dubovečak).

The maritime villa at Lumbarda is famous because of its location and masonry. It was located on a promontory, on an elevated, panoramic position between the two bays named Bili Žal and Pržina on the island of Korčula. The site controls sailing in the Pelješac channel and the route to and from Narona on the coast. The site has been surveyed, but not excavated. The layout shows two rectangular buildings (29 x 25 m and 27 x 24 m) connected by a 93 m long, seafront portico 4.66 m wide [13]. One stretch of the exposed wall is built in opus reticulatum, a technique rare in the eastern Adriatic and outside of Italy in general. Xavier Lafon has discussed the rare appearance of this building method in maritime villas in provinces and saw it as an indication of property value and of high position of the original owner in relation to Rome. In Italy, this masonry was always used in monumental villas, mostly in Augustan or the early imperial age. Lafon further quoted Torelli’s argument that provincial use of this opus was for public architecture and that domestic usage was exceptional [1]. We may have at Lumbarda a villa of an equal status to public architecture and built not only by a Roman architect, but also by Roman masons. On the aerial photos we can see that the present roads across the field have outlined the layout of the villa. It also seems like the whole promontory had been compartment on the position of the villa formed the isolated space for villa's exterior.

The maritime villa on the island of Mljet is situated in Polače Bay. The village is now called Polače, from Latin palatium. There were two building phases. The early villa had dispersed buildings and only parts of the baths with mosaics have been investigated [13]. There was a creek flowing into the bay, which would have supplied water to the villa, the baths and perhaps a piscina. The later villa, built in the 5th century, is a compact, two-story cross-shaped building with polygonal corner towers. Its walls are in parts preserved up to 20 meters in height [14]. Underwater finds in the harbor showed the luxury character of the site from the first to the sixth century (Brusić
From the aerial photos we can recognise same structures under the sea on the position of the early imperial villa. On the left side of the bay there are same terraced spaces that may be connected to the villa. The underwater archaeological investigation and excavations on land will probably confirm these facts.

The maritime villa near the Roman colony of Epidaurum is situated in Tiha Bay. The Croatian name Cavtat of this city derived from Latin Civitas. The bay of Epidaurum is protected from the sirocco and the bora and provides good anchorage. Epidaurum was an important port on the shipping line between the Ionian and Adriatic seas and in the trans-Adriatic network.

The site in Tiha Bay has never been excavated and the modern construction has obliterated Roman structures, except some massive walls of a cistern on the site of Donji Obod (Sutivan). An inscription was found there in 1547, which honored Augustus’ legate to Illyricum, P. Cornelius Dolabella [15]. A head and fragments of a statue were also found, perhaps of Dolabella himself. The villa has, therefore, been traditionally attributed to him [16]. Such a villa, and perhaps an estate of Dolabella, would make sense at this location, but more as a strategic asset then an economic one. Some walls and remains of the harbor are visible on the aerial photos, today under the sea level [15].

Figure 6: The maritime villa in Tiha Bay – aerial photo.
2. Conclusion

Maritime villas were opulent estates with architecture spread along the waterfront and on the terraces above it, where the sound of waves reached every room. The structures built at the shoreline in the first century are today partially submerged and provide some indication of the extent to which the sea level has risen since antiquity. The best results in reading the aerial photos are just on the submerged parts of the maritime villas in the shallow sea. The remains of the harbor installations and waterfront structures, such as jetties, piers, stone-built embankments and fishponds (piscinae vivariae) are today under the sea level on the most sites. We can find even porticoes of the villas, sometimes with exedrae and floors covered with mosaics that are today under the sea level. The coast on the eastern side of the Adriatic has sunk about 1.5 to 2 meters since antiquity. Remote sensing and digital processing analysis of aerial photographs have indicated the areas of the maritime villas that should be explored.

On the aerial photos of the maritime villa on Cato ro promontory we see the evidence of piscina vivaria and walls on both sides of the promontory, and on the part of the villa today under the sea level. There is also same evidence of a big stone mole north of St Margarita bay and north of Sipar, which protected the whole bay from the north wind. The maritime villa in Loron – on the aerial photos of the location of Kupanja a piscina vivaria was discovered. In the last few years the underwater investigations of this location verified the remote sensing results and documented the biggest piscina vivaria found on the eastern Adriatic coast (with four pools). The maritime villa on Sorna promontory – the aerial photo indicates the remains of a pier and port. The maritime villa on the Brijuni islands – aerial photos indicate that there are terraced gardens on Gradina Hill and that the explored terraced gardens on Dubovac Hill were larger. Furthermore, it afforded a foothold for research of the walls surrounding the complex, including the entrances and internal communications system, and of the enlarged residential area and new structures built in the temple area. The archaeological excavation carried out in July 1992 and the two test trenches behind the semi-circular portico in the axis of the central temple resulted in discovery of the foundations of a circular structure, which, based on the above mentioned results, is thought to be either a tholos or mausoleum, or the first stage in the building of the circular temple, before the three temples were built. The maritime villa in Val Bandon – aerial photos show the west part of the villa under the sea level in front of the present tourist resort and restaurant. The maritime villa on Vižula promontory – the remains of the architecture all around the peninsula are today under the sea level as well as the remains of the pier. The maritime villa on Murter – architectural remains and the Roman stone built waterfront were found in front of the villa. The maritime villa in Starigrad – the remains of architecture and piscina vivaria in the bay, today under the sea level. The maritime villa in Soline bay, island of Sv. Klement - with the remote sensing the salt works were found in the bay. The combination of the remote sensing results and geophysical research, including electromagnetic detection of the sites brings the plan of two phases of building activities on the villa. The maritime villa in Plumari – the aerial photos show the remains of the walls in the field upon the small hill, which extend to the bay of Pržina and the remains of the built waterfront of the villa. The maritime villa in Polače – The aerial photos show the remains of the port on the position of today’s pier and stone built waterfront built in front of the villa.

Remote sensing by the aerial photographs indicated the more extensive building complexes on all these sites. The best results should be obtained when we combine those methods with geophysical research, including electromagnetic detection of the sites, as we can see on the examples of Brioni islands and Soline, Sv. Klement. The classical archaeological excavations and underwater investigations will be the last and the most important activity to check the preliminary results. For the application of the results it is very important to make correction air shots to keep up with what could be more accurately planned archaeological research.
Using aerial photos in archaeological investigations is a non-aggressive method of archaeological exploration recommended by the European Council for preservation of cultural heritage. The geophysical prospection areas are very helpful. Given the large area encompassed by villas’ activity, this method is a fast and cost-effective means of locating areas worthy of excavation, while also being non-invasive and thus non-destructive. Today, an unusual combination of historical research, traditional archaeology, and application of space technology has demonstrated the existence of much larger sites of the maritime villas, then it was known before. This is very useful in planning the archaeological investigation of the sites. The final result should be an ideal reconstruction of the maritime villas.

Figure 7: The ideal reconstruction of the maritime villa in Verige bay on Brijuni islands.

It can be a part of scientific work or a part of tourist information on the sites. Using data from aerial photographs, recent research has led to unexpected discoveries and innovative interpretations of the maritime villas sites on the eastern Adriatic coast.

References

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