VISIBILITY AND VISUAL CONNECTIONS ON THE ISLAND OF MENORCA
ANALYSIS OF SITES FROM THE TALAYOTIC PERIOD
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1. Introduction

1.1. Landscape Archaeology on the island of Menorca

Even though in Menorca studies on Landscape Archaeology have not experienced an uninterrupted development, several researchers have carried out studies on this field. The pioneering work in Landscape Archaeology on Menorca consisted in a spatial analysis focused on the territorial organization based on the location of taula enclosures (De Alvaro 1983).

During the 90’s several Landscape or Territorial Archaeological studies were carried out in order to analyse the organization of settlements on the island. In this way, Juan (1993) divides the island in territorial units based on geographical features, resulting in an uneven occupation between the North, the Tramuntana region, and the South, the Migjorn region. Moreover, in this study he describes the Talayotic occupation based on some major settlements which are surrounded by a set of secondary ones, associating this fact to the urban function, territorial control and political power of the main settlement.

Another study on this topic was published in the following year, which analyses the municipality of Alaior (García-Argüelles et al. 1994). In this case, a spatial analysis of this area in the South of the island was carried out, which mentions the fact that the municipal limits of the area under study are a current boundary and, thus, had nothing to do with the geography of the territory. The study confirms that during the Talayotic period, the first occupation of the Miocene platform was completed, whereas north of the municipality, within the Tramuntana region, the occupation was limited to settlements located on top of hills for a visual control of the territory. According to this study, there are five types of settlements dating back to this period, depending on the area where they are located. In this way, the inside of ravines and the coastline, less than 50 meters above sea level, were not occupied at all. Between 50- and 80-meters high there are some sites, mostly at the edge of ravines. Settlements in heights more than 80 meters are located close to contour lines with a good visual control, which improves in those settlements that are at an altitude higher than 100 meters, in which a visual control of the SE-SW axis predominates. In altitudes higher than 120 meters, the highest point of the Miocene platform, settlements are in small elevations of the terrain and the higher part of ravines. And, lastly, in the Tramuntana zone settlements are located on top of small hills. This study also states that settlements with only one talayot are in areas with a good visual control of the territory.

The next work dealing with the prehistoric occupation of Menorca, which uses an updated version of the archaeological inventory map of the island, was the first study using Geographical Information Systems (GIS). This study states that approximately in 1,100 BC the population would be scattered in settlements with talayots surrounded by other population clusters. The situation would have changed around 650 cal. BCE, when evidence of a certain concentration of the population in the large settlements with taula sanctuary is attested, whereas most of the talayots and tower-shaped structures were either abandoned or reused (Gornés et al 2004).

Lastly, there is a long-term study about the occupation of the island of Menorca which ranges from prehistoric times until the 19th century, and focuses on delimiting occupation densities, settlement patterns and location preferences. In this way, a clear
preference for the Miocene platform over the Tramuntana region is attested until the 19th century, when new technologies allowed for the drainage of the northern region. Likewise, it stresses that the settlement pattern shows some continuity over this long period, which is specially assembled in the southern half of the island (De Cet et al. 2012).

Recently some studies have widened this perspective towards a symbolic dimension of landscape (Gornés 2016).

The most recent studies with a landscape focus suggest that the settlement pattern of the Talayotic period meant the configuration of a closed space which was organised from the monumental architecture and centred and organised from the settlement itself, from which a complex visibility network was designed. The constructive monumentality is understood as an element for the social cohesion of the group, as an identifying factor of the group with the landscape and to shape a political landscape throughout the entire territory of the community.

1.2. Theoretical framework
The occupation and use of the territory by the Talayotic communities of Menorca was not merely utilitarian, since landscape was also given a symbolic dimension. As is common in all societies, functional and symbolic aspects are inextricably connected in such a way the second unite, justify and legitimate the first, as do the social organization linked to them. In the case of Menorca, the humanization of landscape through the monumental architecture would be an example of what Criado (2012) describes as a conscious will to exhibit, visualize through space, a social and cultural model. The most recent studies with a landscape approach, suggest that the settlement pattern during the Talayotic period meant the creation of a closed space which was organised by the monumental architecture and gathered and structured from the settlement itself, from which a complex visibility network was formed. The constructive monumentality is understood as an element of social cohesion for the community, of identification of the group with the landscape and as a way to form a political landscape throughout the entire territory of the community (Galmés 2018).

The theoretical framework used in this study follows the approach started by A. Galmés (2015) with respect to the focus in two main variables: the visual control exerted on the space and the architectural monumentality as a means to endow this space with semantics. In this way, the study of the visibility patterns and the relation between these and the movement through the territory are the starting point to make an attempt to shed some light on the social and political conception of the Talayotic communities.

In Menorca some spatial and territorial studies have been conducted (García-Argüelles et al. 1994; De Alvaro 1983; Juan 1993; Gornés et al 2004, De Cet et al. 2012) which focus on settlement patterns and resource catchment. Recently, some studies have widened this approach to endow landscape with a symbolic meaning (Gornés 2016).

In this way, an attempt has been made to study landscape as a socio-cultural product, that is to say: it is an analysis of the schemes of rationality that orient and determine the perception and conception of territory by the communities that inhabit it (Criado
This idea suggests the search for strategies that allow for interpreting landscape not just from its materiality but uniting this with its ideal or imaginary meaning (Criado 1993:42). Thus, the idea of landscape that is under consideration considers that it is not just a space, a portion of land, since territory becomes landscape when it is experienced by people. Space acquires sense when it is inhabited, that is to say; when a network of actions, experiences and memories are intertwined on it (Ingold 1993; 2011).

Architecture is one of the formulae used by humans to endow space with meaning, since architecture is the deliberate creation of a space, making it tangible, visible and sensitive (Tilley 1994). Contrary to natural spaces, to which social meanings can be given; architecture needs human implication to exist, what makes it a reference point within the experience and sense of a landscape (Tilley 2004:78). In this sense, the Prehistory of the Balearic Islands is characterised by the monumentality of its constructions, which have been a constant referent for its inhabitants. The term monumental usually refers to large constructions made with a huge effort, regardless their chronology and function (Trigger 1990). However, when we consider that a building exceeds its practical dimensions, we are judging it from a modern perspective. For this reason, we believe monumentality should be defined as constructions of large proportions made to survive the passing of time (Criado 1991:92); or in other words: it implies that human communities make themselves intentionally, notably and permanently visible in a given space (Parcero 2005:13). Thus, monuments are enduring constructions where to perform a set of practices that serve as a repository of memory (Bradley 1993).

In this way, we have to keep in mind that landscape is also formed as “an anonymous sculptural form already fashioned by human agency, never completed, and constantly being added to, and the relationship between people and it is a constant dialectic and a process of structuration: the landscape is both a medium for and outcome of action and previous stories of action. In practice, landscapes are experienced in daily activities” (Tilley 1994:23).

This quotidian experience of landscape prevents us from considering it complete, as it is always under construction (Ingold 1993:162). In this sense, the occupation of a space, a territory, is not only done through settlement patterns, fixed entities in the space, but also through movement through that space (Parcero et al. 2009).

As a result of this movement, landscape tells, or is in itself, a story (Ingold 1993:153); it is a way to create a shared experience, of explaining a narration, of fixing a community. Landscape accumulates personal, collective and mythical stories, all of which are remembered through the movement across it (Santos-Granero 2004). In this way, it is formed as a changing social space which is created from human experience and interaction (Tilley 1994:10). Thus, it becomes something messy, complex and chaotic, where each of its components gets mixed with the rest (Ingold 1993:54). Therefore, we must find a way to work with the disorder of landscape to better understand if what we see in a specific moment is a conjunction of actions and past times which are intermingled in the present (González Ruibal 2006).

Therefore, the analysis of the social construction of landscape through architecture, and the ways to order, conceive and perceive the social network articulated in it, has
been one of the key factors to define the limits of the properties which form part of Talayotic Menorca.

2. Methodology

Tools integrated in a Geographical Information System (GIS) have been used in the analysis of the territorial occupation. The analyses conducted are divided in two main categories. Firstly, location of settlements and the role of monumental architecture and, secondly, the connection and control that architecture generates through the landscape. These have been compiled with ArcGis 10.4 and using the Digital Model of the Terrain of Instituto Geográfico Nacional (National Geographical Institute, IGN), both at 25m and 5m resolutions.

The location of settlements has been compared and contrasted with the inherent visualisation areas of the island. To do so, a total viewshed of Menorca has been compiled in order to show which zones are geographically more visible, after which the location of prehistoric settlements has been compared. To do so, a viewshed is created for each territorial location, for which a limit of 6,880 metres has been established, which is the maximum distance of human visual acuity in ideal conditions of light and contrast. Moreover, in certain cases, by using the method designed by Gillings (2015), a calculation has been done to determine from which positions of the territory a larger space can be observed, something carried out by doing the opposite task of the former analysis. Lastly, a Kernel density analysis has been carried out, following the guidance of De Cet et al. (2012), for the funerary sites, both in caves and hypogea, and talayots, to spot the differences between the two.

Furthermore, viewsheds and patterns of direct visual connection or intervisibility have been studied to analyse the connection and control that this architecture creates through the landscape. In this way, viewsheds are obtained through the calculation of the visible area from a certain place, having in mind the topography of the terrain, which determines the angle of vision with respect to each portion of land (Wheatley 1995; Llobera 2003; Conolly & Lake 2006, pp. 225-233). Moreover, the intervisibility among settlements is the direct visual connection among them (Wheatley 1995), the study of which let us see how the different architectural stations across a territory relate to the rest. QGIS software has been used to carry out this analysis. It should be noted that talayots whose preserved height is not known have been given a hypothetical height of 3 metres.
Total viewshed.

Both approaches are based on the visibility study thoroughly carried out in archaeological research (Wheatley, Gillings 2000; Lake, Woodman 2003). However, we must keep in mind that, even though visual incentives are the ones that can be constantly seen through time (Llobera 2007), we are not taking into account factors such as vegetation, the interaction of sight with the rest of the senses (Frieman, Gillings 2007; Hamilakis 2013), or social or cultural factors which make us fix our sight to one direction or another. Moreover, the potential visibility from a given place will always depend on the environmental conditions of a certain moment, and it is subject to the limitations of the human eye (Shang, Bishop 2000).

To interpret the complexity of intervisibility networks among settlements, the use of methodologies for the analysis of networks is suggested, for which Visone software (2016) has been used (Weidele 2017). These, which have been widely used in Archaeology (Brughmans et al. 2016) have only recently been applied to the analysis if visual networks. In these analyses, and to simplify the analytics, only the visual connections over a distance of 2 km have been considered, which allows for a close intervisibility among settlements. Visual networks have been analysed, paying special attention to the centrality of each settlement, or nodes that form them. The centrality measure in the analysis gives a ranking of its nodes. The index of betweenness is defined as the number of times a node works as a bridge in the shortest way between two other nodes. In this way, this rate allows us to detect which nodes of the visual network are important stops in the connections of the network, as well as to see bottlenecks in this. In this case, the connection among nodes, or settlements, has been considered to be stronger when the distance between them is short, something
which also depends on the number of visual connections between them.

The information about settlements has been basically sought in the inventory of Historical and Cultural Heritage of the Spatial Data Infrastructure (IDE) of the Insular Government of Menorca (Consell Insular de Menorca).

Location of talayots currently documented on the island
Burial sites on the island of Menorca

Location of burial sites with respect to total viewshed
Kernel density of burial sites (caves and hypogea)

Kernel density of the talayots on the island
A complex and complementary aspect is the delimitation of land areas likely used for agriculture and animal husbandry in the various settlements. V. M. Fernández and G. Ruiz Zapatero (1984: 59) define the zone of exploitation of a settlement as the area which is directly accessible to the common exploitation of its inhabitants. According to the most-used convention, this one would extend up to a maximum distance of one hour by foot from the dwelling place, which would be around 5 km surrounding it (Dennell 1978; Fernández and Zapatero 1984: 60). Larger distances reduce efficiency, since the time consumed in moving to the resource catchment point increases. This calculation has been later on nuanced in order to introduce the orographic factor (Bailey and Davidson 1983; García Sanjuán 2005: 205-206; Mayoral 1984; Pignant y Crotti 1984), even though the mild orography of Menorca would not possibly affect this in a significant way. Evidently, these are hypothetical lands of exploitation, but they can be used as a parameter to explore this field (Diloli 1998: 297), acceptable to do a general approach of the areas which would have been directly controlled/exploited by the settlements. Undoubtedly, if the needs of a community were met by the exploitation of a minor area, its inhabitants would have had to use useful zones closer to the settlement, as long as there was not any other determinant.

In the case of Menorca during the Talayotic period, capturing the parameter of 5 km around each settlement of all the areas allows us for visualising the massive superposition of the several hypothetical territories of exploitation. In fact, the territory of each of settlement includes, in most of the cases, the rest of population centres. If each settlement would have had an autonomous functioning, this arrangement would have possibly met the development of strong tensions, as the result of competence for the access to farming and pasture lands.

Both the close approximation among settlements and the almost total superposition of the respective hypothetical territories of exploitation seem to indicate that settlements did not work as autonomous entities, but were integrated in structures, where in some cases, such as in Son Catlar and Torre d’en Galmés, a hierarchy existed. In this sense, the integration of all settlements in the same territorial and political entity, either if they were hierarchically organised or if they were egalitarian, would avoid, or at least alleviate, the emergence of conflicts deriving from competition for the exploitation of the territory.
3. Zones under study

3.1. Southwestern area of the island

3.1.1. General description of the zone
This area is located on the Miocene platform that covers the entire southern half of the island, characterised by a geological permeable substratum which prevents from the retention of rainwater in the surface and makes the soil be suitable for agricultural practices. Thus, it is a zone with a great potential for agriculture and animal husbandry which, even nowadays, is home to the majority of exploitations on the island. It is also home to the flattest zones on the island, even though its mild relief was a decisive factor for the location of human settlements and funerary spaces during prehistoric times, as will be described in the following pages.

3.1.2. Occupation of the territory in the Talayotic period
Despite the mild relief, all the area is formed as a large zone with important visualisation platforms within the total viewshed of the island. Son Catlar is located on one of them, being the most distinguishable settlement of the zone, with an extension of 4.5 hectares. It is located about 3 km away from the southern coast of the island and 4 km away from its western coast. It preserves a nine-hundred-metre defence outer wall which is currently under research. Three talayots are preserved at the northern, southern and eastern parts of the site, as well as the largest known taula enclosure, which was excavated by F. Hernández in 1923. These three talayots have an intense visual control both at a short and a long distance, which extends to the sea. The talayots probably worked as an identifying mark of the settlement, which could have been spotted from the distance.

Near the coast, roughly 3.5 km southeast of Son Catlar and, consequently, within the limits of its potential exploitation surroundings, there is an important humid zone (Es Prat de Son Saura). Even though the available information indicates that hunting and fishing had practically no impact on the economy of Talayotic communities (Anglada et al. 2017b), humid zones can provide important vegetal materials. In this way, reeds or common reed grass were used during the Bronze Age in the Western Mediterranean to make ropes and threads (e. g. Maestre et al. 2001) and in the construction of roofs (e. g. Rivera et al. 1994), respectively. Moreover, humid zones are suitable for pasturing during summer. In this point it is important to mention that in samples taken from these contexts, the abundance of taxonomic groups typically found in areas altered from the Bronze Age onwards (for instance, plantains, collard greens or asphodels) shows the use of humid zones and their surroundings for the development of agro-pastoral activities (Burjachs et al., 2017; Servera-Vives et al., 2018). This specific humid zone is nourished by a torrent that follows a north-south direction (Canal de ses Abelles).
South of Son Catlar, and just 500 metres away from it, there is another large circular talayot and other remains in Son Pau settlement (IDE – SPA01 – 000573), which presents a visual control directed towards Artrutx cape. South of it there is a group of settlements, of which it is worth mentioning Son Saura Vell settlement (IDE – SSV01 – 000639), where four talayots, circular houses and other indeterminate structures can be seen. These four talayots share an extremely similar visual control, but they are located in pairs very close to each other, for which the profile of the settlement could have been very distinctive. The entire area to the southeast, towards Artrutx cape, can be seen very clearly from them. 780 metres to the east, there is Sa Cova settlement (IDE – CVA01 – 000353), which presents a talayot with abutted constructions including a possible hypostyle room, as well as circular houses and other indeterminate structures. Not only has this settlement an intense visual control towards the southwestern coast, but it also has certain visibility towards the northeast of the island, at the other side of the Canal de Ses Abelles ravine.
Relation among settlements in the southeast area and total viewshed

West of Son Saura Vell settlement, there are the settlements of Son Tari Vell (IDE – STV01 – 000662), settlement which is now lost and where a talayot was located; Son Marquet (IDE – SMQ – 000544), with the remains of a circular talayot with abutted constructions, as well as a hypogeeum; Son Marc (IDE – SMC01 – 000519), a Talayotic settlement with two talayots and other constructions, in addition to a talayot (IDE – SMC02 – 000520) that lies very close to it, which once formed part of the same settlement, and which was partially destroyed to fill the humid zones of Son Xoriguer. This group of sites presents an important visual control in the area from Son Catlar to Artrutx cape.

Another alignment of sites is documented near the coast, which is distributed in a parallel axis to it. The westernmost settlements are Son Olivar de Baix (IDE – SOB01 – 000556), a Talayotic settlement with one talayot presenting two superimposed bodies and an access ramp; and Son Olivar (IDE – SOO03 – 003890), which has the remains of a settlement with one apse-shaped talayot (IDE – SOO01 – 000568). These settlements are located on a large visualisation platform within the total viewshed of the island. They present a great visual control over the entire southwest area, surrounding Artrutx cape. There is another talayot towards the direction to the cape: Son Olivar Nou (IDE – SON01 – 000566), with a circular layout and abutted structures. It has a visual control both towards the internal triangle and towards the southern coast.

By following the alignment of sites which lies parallel to the coast, we can find Son Xoriguer Vell (IDE – SXO01 – 000682), which has a circular talayot; So na Parets Vives (IDE – SPV01 – 000584), with a talayot that preserves a height of 3 metres; Son
Vell (IDE – SVE01 – 000672), which has two talayots with abutted constructions; and Son Saura Nou (IDE – SSN01 – 000615), which is a Talayotic settlement that presents a degraded state of preservation due to modern farming activities. These settlements visually control the inland area, creating a triangle towards the Son Catlar area, as well as towards the maritime area to the South, at a half distance.

If we go back to the area surrounding Son Catlar, to the northeast, the settlements of Parella Vella (IDE – PRV01 – 000420), with remains of a talayot; and Sant Domingo (IDE – SDO01 – 000467), with another talayot which was destroyed during the Spanish Civil War, when an anti-aircraft battery was mounted on it; both present a visual control that extends both across the northwest triangle and inland at a long distance. Moreover, east of Son Catlar, the settlements of Son Alzina (IDE – SAZ01 – 000446), a site with a possible talayot ad a hypogeum; and Son Piris (IDE – SPI01 – 000576), with a talayot and indeterminate structures, extend their visual control towards the other end of Canal de Ses Abelles ravine. North of Son Catlar there are other sites which are located in areas with a high visibility within the total viewshed of the island. In this way, from west to east, the settlement of Son Vivó (IDE – SVV01 – 000677), with a large talayot and a possible hypostyle hall; Santa Rosa (IDE – SRS01 – 000596), a Talayotic settlement with two or three circular talayots and other structures including the remains of an outer wall, a hypostyle hall, circular houses and a group of hypogea; Lloc des Pou (IDE – LLP01 – 000384), with two circular talayots, which are affected by vegetation, and a group of artificial caves and a possible sanctuary; Sant Joan Gran (IDE – SJG01 – 000498), with a large circular talayot that does not preserve its complete perimeter. Moreover, Son Tica (IDE – STC01 – 000649), with a possible talayot and indeterminate structures; Morvedre Nou (IDE – MON01 – 000402), a very degraded settlement that still has a talayot or fortified hill, as well as a possible outer wall and a group of artificial caves; and Son Piris (IDE – SPI05 – 000580), a settlement with a possible talayot and two hypostyle halls and an artificial cave. They all have a visual control of the southeast triangle of the island, also connecting with the inland area to the North. Lastly, the northernmost point of this group is formed by the settlements of Sa Trinitat (IDE – TRI01 – 000741), located on a wide visualisation area, which currently preserves a Talayotic settlement with a talayot that has a chamber inside. This has an exceptional visual control of the entire western
area of the island, connecting the area of Son Catlar to the South, with all the area north of Ciutadella.

This group of settlements forms an interesting visual connectivity network in which, in 72% of the cases, talayots have to be at least 3 meters high. The southern talayot of Son Catlar has the highest index of betweeness, forming a large bottleneck in the connectivity network and followed by the two other talayots of the site. These divide two distinguishable networks. Firstly, the settlements that are located north of Son Catlar form an intervisibility network in which Son Alzina and Lloc des Pou are the settlements with the highest visual connectivity. Secondly, to the South, the area of Son Bou Vell – Son Marc creates the zone with the highest connectivity within the area; whereas the settlements located to the South are distributed in two groups which are divided into the eastern settlements and the western ones in the coastal area. In this way, we see how Son Catlar forms the axis of this visual connectivity network, since the settlements that are less than 3 km away, both to the North and to the coast, which are divided in groups as can be seen in the map, are distributed in small axes, taking advantage of the areas with a high visibility.
Intervisibility among settlements in the area surrounding Son Catlar

Analysis of visual connection hierarchy, which also shows the index of betweenness (area of nodes)
Regarding funerary spaces, the ones in the area surrounding Son Catlar are found inland, at a distance of approximately 500 metres away from the settlements, mostly in the northern half of the studied visual network. In the southern half, there is a concentration of them in Canal de Ses Abelles ravine, which leads into Es Prat de Son Saura wetland. Furthermore, two interesting clusters are located in the coast, one to the South, surrounding Son Vell cove; and another to the West, near Cala Blanca. Both have a certain degree of visualisation of the maritime space, especially the southern area.

Relation between talayots and funerary sites in caves and hypogea in the area of Son Catlar

Naveta de Es Tudons is located roughly 3 km east of the city of Ciutadella, North of the zone defined at the start of this section. It is a funerary monument dating back to the Middle and Late Bronze Age (1400 – 1000 BC). This funerary naveta, which has an elongated layout with a pointy apse and a flat façade, was excavated by L. Pericot and M. Ll. Serra in 1960. These researchers documented an internal partition into two levels and the inhumation of a minimum number of 100 individuals of all ages and both sexes (Naveta des Tudons, Talayotic Menorca, CIME).
The Es Tudons funerary naveta is located in a shallow depression in the terrain. However, if we compare this location with the total visibility surrounding the monument, one can notice that it is located in a spot slightly more visible than its surroundings at a short distance. Notwithstanding, visibility from this monument over its surroundings is scarce and highly fragmented, which indicates that the place where it lies does not present a significant territorial control. It is only at a very short distance from the monument when this can be seen throughout the territory, although in a fragmented way.
Visibility from Naveta de Es Tudons

Relation between Naveta de Es Tudons and the total viewshed.
The funerary naveta is located in a visual valley, an area with less visibility than its surroundings which could have been a visual corridor, flanked by two areas at the East and the West, both of them presenting more visibility.

*Location of the visible area from each cell in the Naveta de Es Tudons area.*
3.2. Zone of ravines in the centre and southern part of the island

3.2.1. General description of the zone
This zone is also located on the Miocene platform that covers the entire southern half of the island. Generally, the geology of this area is characterised by soils suitable for agriculture, although its rough relief, with several ravines very close to each other, does not favour the existence of large zones with a great agricultural potential. The area is delimited to the West by Torre Vella ravine, to the East by Son Boter ravine and to the South by the coastline. The two ravines that define the area are, undoubtedly, markers in the organisation of the territory already in the Talayotic period. The Es Prat de Son Bou wetland lies southeast of this area. As has already been said in section 3.1.2., wetlands were, without any doubt, zones for the exploitation of several resources.

3.2.2. Land occupation during the Talayotic period
The zone located between the Torre Vella and the Son Boter ravines have a large quantity of Talayotic settlements, even though there is not a large central one as happens in AREA 3.1, where Son Catlar is the main one, and AREA 3.3 with Torre d’en Galmés. Thus, the available data indicate that this territory would have been controlled by the inhabitants of several medium-sized settlements including Sant Agustí and Binicodrell de Darrera.

The Talayotic settlement of Sant Agustí is located in a somewhat central position in the area, at the eastern edge of the Binigaús ravine, whereas roughly 1,8 km away to the East there is the ravine formed by the Son Boter torrent, at the edge of which there lies the Talayotic settlement of Binicodrell de Baix (BCB). Both geographical features delimit the two ends of Sant Tomàs beach.

Relation between settlements in the area of Sant Agustí and total viewshed
The site of Sant Agustí (SAG) has two talayots, one circular and truncate-shaped that preserves an internal chamber covered by a roof of flat stone slabs, which are sustained by two polylithic columns (Sant Agustí, Talayotic Menorca, CIME). The uniqueness of this building lies in the fact that it preserves wooden beams with a C14 date of 1,100 – 1,200 cal BC, whose wood has been identified to belong to wild olive tree (Anglada et al. en premsa), which matches the long tradition in the use of this wood for constructive elements in the islands (Picornell – Gelabert and Dufraisse 2018) (IDE – SAG02 – 001327). The second talayot has a solid structure based on concentric rings and has a diameter of 18.2m (Sant Agustí, Talayotic Menorca, CIME).

Roughly 890 metres north of Sant Agustí, there is another settlement that bears the same name (IDE – SAG01 – 001326), which has a possible talayot that uses part of the natural rock of the ravine.

The territory in which it is located is delimited, as has already been mentioned, by two ravines: Torrent de Son Boter and Binigaús, apart from the depression in which the Sant Tomàs road (Me-18) is located, towards the centre of this area. In this area there are several Talayotic settlements which are interconnected through visual networks. In this way, the two talayots at Sant Agustí (IDE – SAG02 – 001327) present very similar viewsheds, which, even though they are fragmented due to the ravines that mark the territory, allow for a direct visual connection with other settlements. In this way, the settlement of Sant Tomàs (IDE – STO03 – 001360) lies 1 km east of it, and it has a circular talayot and remains of abutted constructions. Likewise, this settlement has a fragmented visibility due to the orography of the area, although its central position makes possible for it to have a visual control of the space between ravines.

600 metres north of the settlement of Sant Agustí, at the other side of the ravine, there are three talayots known as Binigaús Vell talayots, with a distance of about 500 metres from one another. This is the settlement of Binigaús Vell (IDE – BGV02 – 001277), with a small circular-shaped fortified hill. There is another settlement (IDE – BGV11 – 001286) that lies close to the edge of the Binigaús ravine, which has indeterminate structures that could have belonged to a talayot or a hypostyle hall. Moreover, close to the houses of this state there is a talayot (IDE – BGV01 – 001276), which uses the natural bedrock in its base, and other indeterminate structures. These three sites have a very fragmented visibility due to the orography of the area but, despite this, they have a certain degree of visibility over the territory they occupy and are visually connected with the settlement of Sant Agustí (IDE – SAG02 – 001327).

West of the area of Binigaús and at the other side of Torrevella ravine, there is the site of Nova d’en Jordi Marc (IDE – TNJ01 – 001366), where there is a circular talayot and other structures including a hypostyle hall. There is a fragmented visibility from this spot, but, nonetheless, it connects with areas of Binigaús, as well as the area of Sant Agustí, which is less than 1 km away. The settlement of Torre Vella d’en Jordi Marc (IDE – TVJ03 – 001378) has a hypogea necropolis which is found to the North and following the same line west of Torrevella ravine, as well as a possible talayot and a Talayotic house. From this space visibility expands to the North, even though it has a certain degree of vision over the Binigaús area.

The settlements of Binicondrell de Darrera or de Dalt and Es Mestall lie just south of the town of Es Migjorn Gran. The area of Binicondrell de Darrera (IDE – BCD01 – 001254) presents a large Talayotic settlement that preserves two large talayots and
two other possible ones now in ruins. The two large talayots share a very similar visibility, which is oriented much more to the North, which could be a possible limit for the visual network created in this area under study. However, they also have visual connections with the area of Sant Agustí and the area where the settlements of Santa Mònica are located. Moreover, the settlement of Es Mestall (IDE – MES01 – 001316), only 360 metres away, has a circular talayot with an entrance and a central chamber. In this case, the visibility from the settlement, even though it is mostly focused to the North, is also notable towards the Binigaús and Santa Mònica areas.

The settlements of Santa Clara and Santa Mònica lie east of Binigaús ravine. The settlement of Santa Clara (IDE – SCL01 – 001339) has one circular talayot with abutted structures from which a fragmented visibility is obtained, but it connects with the area of Sant Agustí. The settlements of Santa Mònica (IDE – SMO01 – 001343) have a large area with presence of Talayotic structures including a truncate-shaped circular talayot; whereas roughly 800 metres to the east, there is another cluster of structures (IDE – SMO02 – 01344) including a possible talayot. Both hold a highly fragmented visibility, but, despite this, they visually connect with the Santa Clara and Binicodrell de Darrera zones.

To the South and near the settlement of Sant Tomàs, in the limit of Torrent de Son Boter ravine, there is Binicondrell de Baix (IDE – BCB01 – 001250), which is a settlement with a circular talayot with abutted constructions and a taula enclosure. It has a visibility that allows it to connect with Sant Tomàs and San Agustí areas. 560 metres away from it in a straight line, but with the ravine in the middle, there is the settlement of Daia Nou or Santa Victòria (IDE – DEN01 – 000080) with a Talayotic construction on top of a crag, which has a visual connection with the Santa Mònica and Sant Tomàs areas, as well as with the Sant Agustí and Binicodrell de Baix (IDE – BCB02 – 001251) areas at the other side of the ravine at a larger distance. The latter one is located in the southernmost part of the area and has a hypostyle hall.

All these talayots form a narrow visual network in which, in 78.8% of the cases, talayots should be at least 3 metres high, whereas in the remaining 21.2% connections can be established with lower monuments. Within this network, the talayot of Sant Agustí (IDE – SAG01 – 001326), located in the northern part of the settlement, is the one that has the highest number of visual connections, followed by the talayot of Binigaus Vell (IDE – BGV01 – 001276), which is lies close to the houses of this farmstead, and the one at Es Mestall (IDE – MES01 – 001316).
Intervisibility between the settlements in the area surrounding Sant Agustí

Hierarchy of direct visual connections and index of betweenness (depending on the area of nodes)
Cumulative visual control from the talayots of the settlement of Sant Agustí (upper left) and viewshed from the talayots of Santa Clara (upper right), Sant Tomàs (bottom left) and Binigaús Vell (bottom right)
The settlement of San Agustí (IDE – SAG01 – 001326) presents the highest index of betweenness (Brughmans et al. 2017: 34), that is to say; it is the site that works more than any other as a connector among other settlements. It is followed by the settlements of Santa Mònica (IDE – SMO01 – 001343) and Sant Tomàs (IDE – STO03 – 001360). If we have a look at the group in the network, we can see that it is divided in two groups, with Sant Tomàs settlement being the one which connects both groups in the network, as well as Binicondrell de Baix (IDE – BCB01 – 001250). Geographically, this division in the network also coincides with the division given by Torrent of Son Boter ravine. In this way, settlements that form bottlenecks in this network are the talayots of San Agustí, Santa Mònica, Binigaus Vell and Sant Tomàs. If we keep in mind the centrality of these settlements in the network, we can notice how they are located at the centre of the area under study and connect with the other side of Binigaús ravine.

The talayot of Sant Agustí, which is the central point with the highest connectivity in the network, uses a high position in the land since it is located on top of a small elevation at the edge of the ravine, from which it obtains an extremely fragmented visual control, even though it has a certain degree of coherence at a short distance range of 1 km, in which many other settlements are grouped. These close connections form this centrality within the analysis of the network.

Lastly, when observing the location of the settlements within the total viewshed of the island, we notice that the zone is characterised by presenting small elevations from where to get a high visibility, whereas the rest of the area is visually fragmented as we have seen in the visibilities from the settlements, in small visual valleys. The talayots are located in these areas with a higher visual control, having a certain degree of pre-eminence over an extremely fragmented visual area.

Funerary spaces are usually located in the depressions. There are several funerary caves, which remain outside the visibility area of the settlements, which are located in the two ravines that delimit the area. Cova des Coloms, located in the Binigaús ravine and at a short distance from Sant Agustí, outstands among all these caves. Cova des Coloms is a karstic cave, like the majority of natural caves in Menorca, which was formed due to the circulation of underground water currents which eroded the calcareous rock. This cave outstands among the rest due to its large dimensions: roughly 25 metres high and 110 metres wide. French prehistorian Émile Cartailhac (1892) already mentioned this cave in his work about the Balearics. At the back of the cave there are the remains of a cyclopean wall, where little natural light strikes the inside of the cave. Between 1914 and 1915 several excavations were conducted inside the cave, where some artefacts were found which indicate that it was used in the Talayotic period as a funerary space. Some of these artefacts included two bronze ox horns. It seems the dimensions of the cave have endowed it with a special importance already in the Talayotic period.
Relation between talayots and funerary sites in caves and hypogea in the Sant Agustí area.
3.3. Zone between the Llucalari and Calan Porter ravines

3.3.1. General description of the zone

As in the previous case, this zone lies on a Miocene platform that covers the entire southern half of the island. As much of this southern area, the territory abounds with ravines, even though in this case there is a large platform with a soft relief between two important ravines: Es Bec (to the West) and Calan Porter (to the East).

3.3.2. Occupation of the territory in the Talayotic period

The settlement of Torre d’en Galmés lies in a somewhat central position within this area, on top of a small elevation which is approximately 100 metres above sea level. It is one of the largest settlements on the island with more than 4 hectares of extension and has a long occupation from the early Bonze Age (c. 1600 BC) to the Medieval period. It is located on top of a hill and has three talayots which are very close to one another, which endows the settlement with a distinctive profile. The first talayot, which lies to the East, has a circular layout and two small entrances that give access to a corridor, now collapsed; the talayot at the centre is the largest and was built by layers of stone rings and has an entrance to an oval chamber in its top; whereas the third one, oval and truncate-shaped, has an entrance in its top and is connected to the central talayot by a wall. Moreover, the settlement abounds with structures including many circular houses, a taula enclosure, a water-recollection system ad four funerary hypogea. The platform defined by the ravines extends up to a maximum distance of 3.4km from the settlement, which is the visibility limit with a 20/20 vision (Ogburn 2006).

Relation among settlements in the area of Torre d’en Galmés and total viewshed
The three talayots have practically an identical visibility, all of them controlling the whole area. Approximately 2 km surrounding Torre d’en Galmés, there is a group of settlements that reach the other side of the Cala en Porter ravine. In this way, to the West there is Sant Jaume (IDE – SJM01 – 000144), which has one talayot, an outer wall and indeterminate structures. This settlement lies roughly 500 metres away from the coast and has a visibility which is specially focused on the maritime space, covering the entire area of Son Bou beaches and, despite its visibility being limited inland, it visually connects with the talayots of Torre d’en Galmés. The settlement of Torre Solí Vell (IDE – TSV01 – 000184) lies a little more inland and closer to Calescoves, and preserves a circular talayot with an entrance and a corridor oriented to the South. Visibility from this site is mostly focused on the Calescoves area and the coast (even though, as is frequent, it is not focused on the funerary spaces, since they remain hidden). To the East and between this site and Torre d’en Galmés, there is the settlement of Binialmesc (IDE – BAM01 – 000013), which has several remains including a talayot which, despite its fragmented visibility, connects with Torre d’en Galmés and all the western area surrounding this settlement.
Visual control from the settlements of Binifamís (upper left), Sant Jaume (bottom left), Binisegarra (bottom right) and cumulative visibility form the talayots of Binigemor (upper right)
A little more to the North there is the settlement of Llucassaladent (IDE – LLS01 – 000103), which comprises a large archaeological area which has a possible talayot. It has a visibility specially directed to the northern area and connects both with the settlement of Binialmesc (BAM01) and Torre d’en Galmés, as well as Binifamís, located in the limit with the Cala en Porter ravine. This settlement (IDE – BFA01 – 000018) is poorly preserved and has a very fragmented visibility, but it connects, nonetheless, the area of Torre d’en Galmés with the area of Torralba d’en Salort. In this way, at the other side of the Cala en Porter ravine there are, to the North, the settlements of Sa Mola (IDE – SAM07 – 000123), with a circular talayot; Sa Beguda or Tanques d’en Contestí (IDE – BEG01 – 000016), with a talayot close to the Maó-Ciutadella road; and Son Magnar (IDE – SMA01 – 000147), with a talayot now lost. Even though the two first sites have a very fragmented visibility, they connect the areas of Torre d’en Galmés and Torralba d’en Salort.

A little more to the South there is the settlement of Binigemor (IDE – BNG01 – 000041), with two talayots: the larger one with a staircase and built from concentric circles, and the smaller one located near the ravine. Both have a very fragmented visibility, although they possibly connect the talayots of Torre d’en Galmés, Torralba d’en Salort and So Na Caçana.

Lastly, the area closer to the sea is home to the settlements of Binisegarra (IDE – BNS02 – 000048), with a circular talayot with abutted constructions; Torre Vella (IDE – TVE01 – 000189), which is a small settlement with one talayot; and Sant Llorenç (IDE – SLR), which has not come down to us. These three sites control the space between Torre d’en Galmés and the coast, and they can also see the area So Na Caçana at the distance.

Intervisibility among settlements in the area of Torre d’en Galmés
Visual connection network with the area of nodes in proportion to the number of visual connections.
Analysis of the hierarchy of the visual connections in the area of Torre d'en Galmés

By analysis the visual network among settlements, we can see that Torre d'en Galmés, Binigemor and Llucassaladent have the higher number of visual connections. These three settlements form connection nodes in the visual network and also have a high percentage in the index of betweenness. They connect different parts of the network, Llucassaladent connecting the area of Torre d'en Galmés with the northernmost settlements; whereas Binigemor connects the area of Torre d'en Galmés with the area of Torralba d'en Salort and So Na Caçana.

This visual network presents an interesting hierarchy, with the settlement of Torre d'en Galmés as the central node, whereas the surrounding settlements are distributed forming clusters depending on the number of visual connections and the distance at which they are located. The furthest away sites form Torre d'en Galmés are located at the edges of the defined area of the network, and they could connect with other parts of the visual network that are outside this area under study. However, within the complexity of this hierarchy, its higher settlements, after Torre d'en Galmés, are Llucassaladent and Binigemor, for the same reasons we have seen before.
If we pay attention to the location of these three settlements within the total viewshed of the island, we detect that they are located in high visibility platforms which are slightly more intense than the others where other talayots are located in their surroundings. Moreover, an intense area with high visibility is located close to the coast, which could provide with an interesting visibility area.

Relation among talayots and funerary sites in caves and hypogea in the area of Torre d’en Galmés
3.4.1. Southeast area of the island

3.4.1. General area description
Just as with the previous three areas, this one is located on the Miocene platform on the south of the island, where most of the population lived during the talayotic era. This area in particular shows a gentle relief, with ravines of lesser importance than the ones on the central area on the southern part of the island. This area is delimited by the Cala en Porter ravine to the west; by the border between the Miocene platform and the older geological materials to the north, which form other types of soil and a more mountainous terrain; by the natural harbor of Mahon to the northeast and to the south and the east by the coastline.

3.4.2. Land use patterns during the talayotic era.

As will be seen later, a pattern similar to AREAS 1 and 3 is not documented on this area of the island, with a central settlement and other smaller sized settlements around it. The structure is also different from the one in AREA 2, even though we also document a high density of settlements. In this case, the intervisibility network seems to articulate around an east-west axis. If we focus on the largest settlements, this network facilitates the connection between Trepucó (on the eastern side) with Torralba d’en Salort (on the western side).

The site of Torralba d’en Salort (IDE – TOR02 – 003378) is one of the best-known sites on the island. In addition to the best-preserved taula precinct on the island, it also has two circular-shaped talayots, a hypostyle chamber and
several artificial burial caves (Fernández-Miranda 2009). The largest-sized talayot, with a circular floor plan and truncated-cone in shape, stands at the settlement’s highest point and has several buildings attached to it. The other talayot, excavated in the 70s by Manuel Fernández Miranda and William Waldren is set close to the taula precint. This talayot, with only part of the outer wall left, was built over an older structure, a probable Middle Bronze Age dwelling with the latest recorded evidence of habitation in the 13th century BC (Fernández-Miranda 2009).

This settlement is located on a low elevation and provides a visual control which, however fragmented, connects with the area of Torralba Gran at short distance and with the settlements of Cotaina d’en Carreras, Binigemor and Torrellissar at mid distance. As seen above, these settlements connect with the areas of Torre d’en Galmés and So Na Caçana. However, most of the visibility from this talayot focuses towards the area to the north of the settlement. On the other hand, the smallest-sized talayot, despite connecting at mid distance with some of these settlements, e.g. Binigemor or Cotaina d’en Carreras, affords a higher short distance visual control around the surrounding area of the settlement. Visual control afforded from the talayots in this settlement is very fragmented due to the landscape on this part of the island. As seen in the total viewshed of the island, this area is characterized by a large number of small visual valleys, while the talayots are located in areas with higher visibility.

![Relationship between the Torralba d'en Salort settlement and total viewshed of the island.](image)

Close by, at about 720m towards the south, we find Torralba Gran (IDE – TGR01 – 003853), a small settlement with two talayots, one of them with
undefined floor plan and some buildings attached to it. These talayots provide visual control focused on the area closer to them. However, they are a relevant visual connector within the mid-distance network, about 1.5 and 2km around. At short distance, at about 500m, we find Son Seguí (IDE <t1/>– SSG01 – 000164), a site with remains of an undetermined cyclopean structure, classified as a talayot by Mascaró Pasarius. This structure affords a short distance visual control, although it connects with the area of Binigemor and Torrellissar towards the south.

As shown, the visual connectors are located towards the south, e.g. Binigemor or Torrellissar, while towards the east we find the area of Cotaina d’en Carreras which, as seen above, is an important visual connector between this area, the one at So Na Caçana and the visual network further to the east, e.g. Talatí de Dalt. However, the settlements at Torralba show a visual control that expands toward the north, a more rugged area. We find in this area a cluster of settlements e.g. Son Olives (IDE – SOL01 – 000158) a settlement with a circular-shaped talayot with a probable passageway in the southern sector and a taula precinct; Biniac Nou (IDE – BNN01 – 000046), with a probable talayot, very much deteriorated; Llumena d’en Nicoulau (IDE – LLM01 – 000094), an archaeological site with a burial necropolis and a probable talayot; or Es Morlans (IDE – MOR1 – 000108) a settlement with two circular-shaped talayots, in different stages of preservation as well as a hypogeum and other undefined buildings. This network of settlements visually controls the area between Torralba d’en Salort and the more rugged area to the north.

*Cumulative visibility from the Torralba d’en Salort talayots.*
Direct visual connections in the Torralba d’en Salort area.

Following viewnet analysis, the area around Torralba is a main connectivity center within the network, being the talayots the elements that accumulate a greater number of visual connections, followed by the connectors at Cotaina d’en Carreras or Torrellissar Vell. However, this network fragment presents an important connectivity, especially at mid distance with an average of 11 visual connections. On the other hand, the settlements of Torralba d’en Salort, Torralba Gran and Cotaina d’en Carreras show a higher index of betweenness and are, therefore, the bottleneck nodes in the connections within the area. The viewnet on the area, despite being intensive, is especially relevant at mid distance, between 1.2 and 2.4km. Thus, it is probable that this visual connectivity experience would be less intense. However, we spot an interesting connectivity area between the areas of Torralba and Cotaina d’en Carreras.
Visual connection network with the node area proportional to number of visual connections.

Visual connection network with the node area proportional to index of betweenness
When analyzing the hierarchical configuration of this viewnet segment, we see how the settlements of Torralba and Cotaina d’en Carreras make up the central area, while the settlements on the area further north make up another narrow set of connections. On the other hand, the area to the south, with Torrellissar Vell, harbors another visual connectivity area.

Hierarchy analysis of visual connections in the area of Torralba and node sizes proportional to the index of betweenness.
Relationship between the talayots and the cave and hypogea burial sites in the area of Torralba d’en Salort.

The site of So Na Caçana (IDE – SNC01 – 000152), located at about 3 km to the south of Torralba d’en Salort, is an exceptional site as it is the only known settlement with more than one taula precinct, as well as having two unorthodox-type talayots. Hence, it is thought to be a settlement-shrine due to having houses within. In addition, it has two talayots apart from the two taula precincts. The first and larger one in size is quadrangular at the base and there are walls attached to it. Moreover, electromagnetic prospecting carried out in the 1980s, revealed a chamber inside (Plantalamor 1991). On the other hand, the second talayot, smaller in size, also has an inner chamber and an eccentric floor plan instead of circular and a concave façade (Plantalamor 1991).

This singular site is located at about 2.7 km from the coast, alongside the ravine that ends in Calescoves. It is located on a high visibility area, in relation to the total viewshed of the island and it is very close to two other areas of importance with visibility peaks where the settlements of Torrellissar Vell and Biniedrís are located. The two talayots at So Na Caçana present a similarly fragmented visual control but it connects with visual platforms in the surrounding area, where the Torrellissar Vell area and further away Binigaus stand out.

Hence, and very close to So Na Caçana, at about 650m to the north, we localize the Torrellissar Vell (IDE – TLL01 – 000180) settlement, where two talayots are documented as well as a taula precinct with a covered passageway leading to it. This settlement is located at an important visualization space with respect to the total viewshed of the island, with very similar visual control from both. This settlement connects with the area of Binigemor and Torralba Gran, and also towards the coast, towards the Binisegarra area.
Towards the west, to the Cala en Porter ravine, we find the already mentioned talayots of Binigaus that connect this area with the Torre d’en Galmés area. In this area we also find the settlements of Torralbenc Vell (IDE – TBV01 – 000176), at just 1.2km from So Na Caçana, as well as Binigemor (1.2km) and Torrellissar Vell (1.1km). In this large archaeological area, of about two hectares, we find a talayot, a taula precinct and at least ten talayotic houses as well as some burial structures. The talayot has a circular floor plan and a cone-shaped body and is small in size. Visual control from this talayot is substantially intense at short distance and connects with the settlements in the surrounding area, which, as seen above, create a narrow range visual network.

Descending to the Cala en Porter area, we localize the two talayots with the same name. Hence, we document a settlement (IDE – CLP01 – 000062), with a circular floor plan and 4.15m in height and a taula precinct. The visual control afforded from the settlement is fragmented but it connects with the settlements of Torralbenc Vell and Binigemor, as well as with the ones at So Na Caçana and Torrellissar Vell and the Binisegarra area, on the other side of the ravine of Calescoves. On the other hand, at 500m towards the coast, we localize another talayot (IDE – CLP02 – 000063) with a circular floor plan but with two sides at an angle, and with a preserved height of 2.3m and a perimeter of 30.5m. This talayot presents a very similar visual control to the previous talayot.

To the south of So Na Caçana, at about 850m, we localize the talayots of Biniedris de Dal (IDE – BIN01 – 000029), with a circular-shaped talayot with a passageway, and another talayot (IDE – BIN02 – 000030) among other structures. Despite fragmented visibility, these talayots present a high number of connections, e.g. with the areas of Cala en Porter or Cotaina d’en Carreras, as well as with the area around So Na Caçana. Further to the west, the settlement of Binicalaf Vell (IDE – BCV01 – 000986) has a large cone-shaped talayot with a circular floor plan and 8m in height, excavated in 1978. A 15th century medieval building was documented on the upper part, thus showing subsequent reoccupation of these sites. The site has two other talayots, as well as other undetermined structures. Its height affords an important visual control over the territory at both sides of Ses Penyes ravine, while connecting at long distance with settlements such as Cotaina d’en Carreras. Close by, in the residential area of Binixiquer there is a peculiar talayot, Binixiquer Vell (IDE – BXV01 – 000996), stepped and with a rectangular floor plan, made of two superimposed bodies. Both sides of the Ses Penyes ravine can be seen from the talayot as well as the area under study, such as the settlements of Cotaina d’en Carreras.
Cumulative visibility from So Na Caçana talayots (above left), and visual control from the eastern talayot of Binicalaf Vell (above right), and the talayots of Cala en Porter (below left) and Torralbenc Vell (below right).
In the area of Cotaina, several structures have been documented, a talayot (IDE – COT03 – 000079), a hypogeal necropolis, as well as a large talayotic settlement with an oval floor plan talayot and a taula precinct (IDE – COT01 – 000077). This precinct visually connects the area of Binigemor with the area of Torralba.

![Map of visual connections in the area of So Na Caçana.](image)

**Direct visual connections in the area of So Na Caçana.**

When analyzing this fragment of the network, we see that the settlements of Torrellissar Vell, So Na Caçana and Cotaina d’en Carreras are the ones with the highest number of visual connections. In the first two cases, the talayots are located at the center of the research area, with settlements surrounding them, as seen above, at a distance of less than 2km. Therefore, visual connection is quite intense, in addition to the fact that these settlements are located in an area close by and, hence, probably have a certain path network connection. On the other hand, the Cotaina d’en Carreras talayot is located to the north of this small area and connects with the Torralba area, and thus becomes a "bottleneck" node in the visual network. In addition, as the settlements are very close to one another, the number of visual connections is very high, having 55% of the settlements in this network fragment at least 10 visual connections.

On the other hand, considering the index of betweenness we see how the Cotaina d’en Carreras talayots are visual bottlenecks. They are located at edge of this network fragment but have a high number of visual connections and play an important role as great connectors at mid distance. This also seen in the hierarchy among settlements. Even though the central group comprises the area around So Na Caçana, Biniedris, Torralbenc Vell and Torrellissar Vell, the Cotaina d’en Carreras settlement is an important mid-distance connectivity node.
Visual connection network with the node area proportional to number of visual connections.

Visual connection network with the node area proportional to index of betweenness
Visual connection hierarchy analysis in the So Na Caçana area
Relationship between the talayots and the cave and hypogea burial sites in the So Na Caçana area.

The talayotic settlement of Talatí de Dalt (IDE- TDD – 001067) is one of the most iconic settlements on the island. The settlement has a relevant set of covered enclosures and a taula precint with a broken leaning pilaster propped against the capital slab. The first one, partially collapsed on its eastern side, is one of the best known tallest talayots and it is surrounded by remains of indeterminate structures attached to it. Little remains of the original height of the second talayot, a lot smaller and set to the north of the first one and at the external boundaries of the settlement and with an attached building on the eastern side (Sintes 2015: 113-114).

This settlement is set on a gentle slope that creates a small visualization area when taking into consideration the total viewshed of the island. The central talayot shows a fragmented visual control, which is, nevertheless, coherent at short distance. It also connects with several settlements located around it, at a distance of about 1.5km. At the same time and considering that it shows a higher elevation at three meters, the height of the talayot would allow longer distance connections. Therefore, assuming a height of five meters, the visual control is intense at mid distance and it sets up a visual connectivity area on the surrounding area of the settlement, which would extend to the ravine of Ses Penyes and to the south of Maó’s bay.
Cumulative visibility from the Talatí de Dalt talayots

On the other hand, the smaller sized talayot shows a visual control mainly centered in its nearby area, although it extends, in a fragmented way, along the eastern margin of Ses Penyes ravine. A talayot with attached structures is located close by, just 500m to the southeast of the settlement, and it shows a visual control very much directed towards the southern area. Very close to the northern area of Talatí, just 670m away, we localize the settlement of Algendaret Nou (IDE – ADN01 – 000965) with a circular-shaped talayot with three preserved rows as well as a group of indeterminate structures. It enjoys an important visual control at short distance while connecting, at the same time, with the Binialet Nou area at mid distance.

The documented settlement of Binimaimut (IDE – BMU01 – 000991) —towards the southwest— is an extended talayotic village with two preserved talayots and a taula precint in addition to other buildings. A hypogeeum necropolis is also documented. The hypogeea present a visual control especially centered on the two-kilometer surrounding area, connecting with the settlements of Talatí de Dalt, Massuptà, Torrellonet Vell or Binicalaf Vell. Slightly to the south, the talayots of Binixaquer Nou (IDE – BXN02 – 000995), with a small talayotic building close to a hypogeea necropolis and the talayots of Binixiquer de Sa Torre (IDE – BXS02 – 000999), with the remains of a very degraded settlement with only half of a 3.5m height talayot with attached structures. They are located on both sides of the head of the ravine of Ses Penyes, which ends in the area of Es Canutells. They both present a visual control which extends to the south —to both sides of the ravine— that connects to the settlement of Binicalaf Vell (IDE – BCV01 – 000986), with a big talayot, as mentioned above, that visually controls both sides of the ravine.
Retracing our steps to the vicinity of Talatí de Dalt, towards the west at about a 1.7km distance, we find the settlement of Binifaell Vell (IDE – BFE01 – 000990) with a circular-shaped talayot with two truncated-cone bodies, set on a rocky hill overlooking a small ravine. This talayot connects visually with a cluster of settlements to the north, among which we find the settlement of Biniaiet Vell (IDE – BTV01 – 000981), as well as the area of Talatí and Massuptà Amagat towards the southeast. The settlement of Biniaiet Vell (IDE – BTV01 – 000981), very much damaged due to stone extraction for road construction— with an important cluster of houses in addition to three talayots. The first talayot is documented at the highest point. A second one circular in shape with two attached houses and a third, to the north, with a square floor plan and rounded corners. This talayot is set on an elevated area that creates a visual platform that allows for an important short- and mid-distance visual control, mainly towards the area between these settlements and the more mountainous area to the north, as well as towards the south, on the eastern side of the ravine of Ses Penyes. Other settlements are located around this talayot. For example the one at Sant Vicent d’Alcaidús (IDE – SVA01 – 000169), with a cluster of houses as well as a hypogea necropolis, and the one at Biniai Vell (IDE – BVE01 – 000980), a settlement with the remains of a probable talayot at the top of a hill and with a long distance visual control which extends to the north and reaches the settlements around Sa Torreta de Tramuntana.

![Cumulative visibility from the Biniaiet Vell talayots](image)

Further to the west of this network we find the settlements close to the Torralba d’en Salort area, e.g. Alcaidús d’en Fàbregues (IDE - ALF02 – 003220), with a rock-cut cave necropolis as well as a small 2.9m circular-shaped talayot or the one at Sant
Rafael (IDE – SRA01 – 000166) and the one at Rafal Rubí (IDE – RRU02 – 000115) — both with remains of a probable talayot and some indeterminate structures. We can also mention the settlement of Cotaina d’en Carreras.

Towards the southeast of Talatí, we locate the site of Torellonet Vell (IDE – TOV01 – 001068) with remains of an important talayotic settlement, very deteriorated due to the construction of a road but with remains of two talayots as well as the remains of a talayotic house and a water collection system. The largest sized talayot, truncated cone in shape and built with small-sized stones, has an upper platform which makes it easily identifiable. The talayot was excavated between 1981 and 1982. However, the artifacts recovered related to a later reutilization in the Roman period. Therefore, the original use of the chamber is unknown (Plantalamor 1991). The second talayot — smaller in size and with attached chambers — is documented at 450m from the former. The viewshed from both monuments is very similar. Visibility tends to concentrate towards the east, mainly within the area of the settlement of Biniaiet Vell. However, the height of the truncated cone talayot provides an outstanding visual control over the area at short-, mid- and long distance, connecting visually both the Talatí de Dalt area as well as the settlements located in the area further to the east of the island, e.g. Cornia Nou o Trepucó. Additionally, this settlement is located on a small elevation which provides an important area of visualization within the total viewshed of the island. Furthermore, taking the visual network into consideration, this bottle-neck shaped settlement functions as a connector around the Talatí area with an important area of visual connectivity, within which the settlement of Cornia Nou stands out.

Cumulative visibility from the Torellonet Vell talayots

El settlement of Cornia Nou (IDE – CUN01 – 001013) is located on an elevation, a
limestone quarry used as quarry for the construction of the settlement. This settlement is remarkable for its large solid oval-shaped talayot, about 10m in height. It has several rooms attached to it and, from the one located on the eastern side, a central passageway leads to a flight of stairs that lead to the upper platform of the talayot. This attached building has already been excavated and has been interpreted as the focus of production within the settlement. (Anglada et al 2014). Seventy meters away there is another unusual talayot, made up of two bodies that create a passageway in between that provides access to a fortified hill limited by a wall on the southern and western side, while the northern side is set on a natural gradient. The archaeological excavation documented material from the Late Talayotic period, time when it was reused as a dwelling. However, this reutilization did not allow the recording of what the structure was originally used for (Anglada et al 2014). The area has also a set of hypogea.

The large talayot of Cornia Nou, due to its height and its position on a gently elevated area, enjoys a special visualization within the total viewshed. Furthermore, its height allows for an important visual control towards the east side, with a mid- and long-distance view of the majority of the settlements in the area. Some of these most outstanding settlements are Sa Cudia Cremada, less than one km away and Trepuçó, at about three km distance, i.e. approximately the boundaries proposed by Ogburn (2006) for a visibility with 20/20 vision. However, towards the west, its visual control does not expand further than the Torellonet Vell area, located at 1km distance. Therefore, we can infer that this talayot at Torellonet Vell would be the one which would articulate the visual network between this area and all the visual connections.
already discussed around Talatí de Dalt. At approximately the same distance from the settlement of Torelló, where Cornia Nou is located but towards the southeast, the today lost settlement of Son Seguí used to be located on the present-day airport boundaries.

On the other hand, located at scarcely 800m towards the east of the site of Cornia Nou, we find the settlement of Sa Cudia Cremada (IDE – CCV02 – 001012), with two circular floor plan talayots. The one located on the western side has an entrance way at its base, while the second talayot is documented to the northern side of the settlement. In addition, this site has a taula precinct—with ongoing excavations—as well as a burial hypogaeum (Anglada, Bravo & Riudavets 2017). A third building (IDE – CCV01 – 001011) is located close by, at about 200m. It could either relate to a burial naveta or a talayot. With a rectangular floor plan, it has an inner oval-shaped chamber with rounded corners. These talayots are located on a small visualization area within the total viewshed. Therefore, both talayots show similar visual control, mainly focused towards the north in short distance area. At mid-distance, despite being very fragmented, it connects with the areas of Cornia Nou, Torelló Vell, Malbüger or Llucmaçanes Gran.

Cumulative visibility from the Sa Cudia Cremada talayots

In the surrounding area of Sa Cudia Cremada, at about 500m, we locate the settlement of Llucamaçanet Vell (IDE – LLC01 – 001031), with the remains of a large 7m high talayot. About 13m in diameter, it has an entrance with passageway which leads to an inner chamber. A burial hypogaeum is located nearby. This talayot, located on an important visualization area, shows an interesting short distance all round visual control, while at less than 1km to the south it connects with the Llucmaçanes Gran
area. This settlement (IDE – LLG01 – 001029), nowadays almost inexistent, had two talayots as well as other structures and hypogea. On the other side, towards the east, the talayot of Llucamaçanet Vell connects with the talayot of Es Vergeret (IDE – VER01 – 001077), located at about 300m. This is a talayot higher than 3m, built with big stones and with a probable inner chamber, which extends its visual control to the east, where the settlement of Malbúger (IDE – MBG01 – 001040) is located. This settlement constitutes a large archaeological area, badly affected by the construction of the aerodrome of Sant Lluís. However, in 1818, Ramis documented four talayots in the area in addition to a taula precinct. Nowadays only a few remains are left and a talayot still stands.

Finally, located further to the east and connecting with this area, we find the large settlement of Trepucó, one of the largest on the island. It had three talayots, of which two are still standing. The central talayot is the widest on the Balearic Islands and it is built on a rocky outcrop. Solid in style, with a sort of doorway documented —nowadays walled up—, in addition to a slightly apsidal-shaped room. This talayot shows an intricate history of reuse as a French military battery was built in its perimeter in 1781. It was built during the war between King Charles III and the English, who ruled the island at that time. The aim of the military encampment was to take control of the castle of San Felipe. To this aim, in addition to this defensive construction, two canons were placed on the top of the talayot (Sintes 2015:102). A second talayot is also documented. It had an inner passageway that lead to the upper part, nowadays collapsed (Sintes 2015:102). The settlement has an important taula precinct excavated
in 1930 by Margaret Murray as well as an interesting cluster of talayotic houses (Sintes 2015:98-99). As mentioned above, this settlement is located on a rocky hill top that creates a small visualization area. The highest talayot has a visual control especially intense at short distance. However, at mid distance, it connects visually with the area of Sa Cudia Cremada, as well as with a whole series of sites at a distance between 1 and 2 km to the east.

Cumulative viewshed from the Trepucó talayots

Among them, we can mention the site of Trebalúger (IDE – TRE01 – 001423). This talayot has a façade with an entrance at the top and a structure attached halfway up. At the top, we find an oval platform which was reused around 1924 as an allotment garden. The excavation of the talayot, which took place between 1988 and 1989 under the supervision of L. Plantalamor uncovered a house that predated its construction, dated around 1350-1100 BC. Therefore, the construction of the talayot would have taken place at a later time and would be one of the oldest examples of this type of structures. The place is an interesting visualization space within the total viewshed of the island. It allows for an important visual control, especially intense at short distance and, however fragmented at mid distance, connects with the area of Trepucó and could connect, at long distance, with the area of Sa Cudia Cremada.

The whole area constitutes an interesting visual network where the highest number of visual connections tends to concentrate on the settlements of Sa Cudia Cremada, Torellonet Vell, Talatí de Dalt, Llucmaçanes Gran, Biniaiet Nou and Cornia Nou. If we consider its index of betweenness, i.e. the times they form visual bridges between two other settlements, we see how—to a greater or lesser extent—they all work as visual bridges. The settlement of Torellonet Vell outstands especially since it becomes the one that connects two different areas, as can be clearly seen on the intervisibility map.
Visual network with nodes proportional to index of betweenness
Thus, if we divide the area under analysis in two halves, we can see how around Talatí de Dalt we have an interesting hierarchy of settlements which divides again itself in the connection between Talatí and Torellonet Vell. In the connections around Talatí de Dalt, we see how the settlements of Binimaimut and Biniaiet Vell become connectivity links and units within the hierarchy. Therefore, the settlement of Biniaiet Vell is a connector with the abovementioned talayots located at the periphery of the area subject of research at Torralba d'en Salort while the settlement of Binimaimut connects with the settlements located towards the south, on both sides of Ses Penyes ravine. We also see how site of Torellonet Vell is the axis that connects two areas, the one laid out around Talatí and the cluster of settlements further to the east.

Hierarchy analysis of direct visual connections in the area surrounding Talatí de Dalt, Torellonet Vell, Cornia Nou and Sa Cudia Cremada, with nodes proportional to the index of betweenness.

On the other hand, taking into consideration just the settlements laid out from Torellonet Vell towards the east, we see how the area of Sa Cudia Cremada and Llucmaçanes creates a high-connectivity cluster together with Cornia Nou, and then again, configures a connection area around it. On the one hand, the settlements distributed towards the area of Torellonet Vell and to the south; on the other hand, the set of connections towards the area of Trepucó, a bottleneck area in itself that connects to the area further to the east.
Finally, if we consider the hierarchy of visual connections among all these settlements located along the axis to the south of Mahon harbor, we see how they configure two different groups, being the Torellonet Vell settlement the one that acts as a bottleneck node in the visual connections between the two groups.

Direct visual connection hierarchy analysis between the areas of Trepucó and Torelló
Direct visual connection network to the south of Mahon harbor.

Relationship between the talayots and the cave and hypogea burial sites in the area to the south of Mahon harbor.
Located at the end of this area, to the southwest and along the coastline, the burial site of Calescoves presents high occupancy rates from the period before the development of the talayotic culture well into Roman times. It practically comprises the whole talayotic period (Veny 1982). On this site we find natural caves with cyclopean walls in use during the proto-talayotic era as well as around forty rock-hewn caves of the same period, smaller in size. In addition, about forty caves hewn out of the rock during the post-talayotic era—more easily accessible—and with rectangular entrances and high ceilings. They also have pilasters attached to the wall and even courtyards hewn out of the rock. They are documented inside the two ravines that slope down to Calescoves but mainly on the cliffside around the cove. Visibility analysis of the area shows how ravines, due to land relief, are areas with little visualization. The structures located on coastal cliffs, despite having high visual control over the sea, are not visible from inland. Burial sites, therefore, would not be highly visible and were not located in areas of special visual control. Location would be influenced by different factors other than special visual control and connectivity.

Relationship between burial caves at Calescoves and total viewshed.

During the post-talayotic era this cove became one of the main harbors on the island for the incoming goods from overseas (Veny 1982). The natural entryway of the goods into the island's hinterland follows the ravine, which leads to the highly densely populated area around So Na Caçana, Torralba d'en Salort, etc.

Located to the north of this area, the site of Rafal Rubí, with two burial navetas separated about 90m from each other, close to the road that connects Maó and Ciutadella. These navetas are located halfway between the Torralba d'en Salort and Talati de Dalt settlements. They are 2.3 km from the first one and 2.5 km from the second one.
The northern Rafal Rubí naveta is an apsidal floor plan construction with two inner chambers. It was excavated and restored in 1977 by G. Rosselló Bordoy (Gornés 2016: 77). The southern naveta, with also an elongated floor plan, is one of the best-preserved navetas on the island together with the naveta of Es Tudons. Excavated and restored between 1968 and 1969 by M. Luisa Serra Belabre y G. Rosselló Bordoy, the archaeological excavation enabled the documentation of the upper floor (Gornés 2016: 78).

They are both situated in a flat area —as navetas mostly are— and do not have a significant height in relation with the surrounding area. Neither are they located on a markedly visually prominent space. Both localizations share practically the same viewshed. It is mainly centered in the area closer to the buildings, which shows that visualization of the structures would have been important at short but not at long distance.

![Visibility from the Rafal Rubí navetas](image-url)
Cumulative visibility from the Rafal Rubí navetas

Count of area visible from each cell in the Rafal Rubí navetas area.

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3.5. Northeast area of the island

3.5.1. General area description
This area is located on a region with a geological substrate completely different from the rest. It is situated on the northern part of the island, a lot less populated during the talayotic era due to its being less appropriate, in theory, for farming. The south and southwest boundaries are defined by the wetlands of Es Grau and the Santa Catalina torrent, which flows into this coastal lagoon. The Albufera des Grau is the most important wetland on the island and the available data show that during the talayotic era —well before drainage and canalization works on large expanses of land in the north of the island— this wetland was integrated in a mosaic-like landscape, with an alternation of wetlands and low elevations. Another element worth highlighting in this area is the En Colom island, which has one of the few copper ore deposits on the island and where we find evidence of mining during prehistoric times (Hunt et al., 2014).

3.5.2. Land use patterns during the talayotic era.
The area of Sa Torreta de Tramuntana is located half way on the Tramuntana area of the island, i.e. on its northern half, and more specifically in the area which nowadays covers the Albufera des Grau Natural Park. The Sa Torreta de Tramuntana settlement (IDE – TTT01 – 001073) has a talayot, a taula precinct —excavated in 1931 by Margaret Murray— and several houses. The talayot, with an oval shaped floor plan, consists of two superimposed sections of different sizes giving it the appearance of a step monument with an unexcavated room at the top (Sintes 2015:139). If we consider its position with respect to the total viewshed, the settlement is located at the edge of an important visualization area, overlooking the sea, which allows a mid distance visual control of the latter. Less than 1km away it connects with the settlements of Morella Vell, Morellet and Torreblanca.

Morella Vell (IDE – MRL01 – 001046) is a talayotic settlement with remains of circular houses and some caves. In 2005, a talayot was identified after vegetation clearing. Located on the slope of the so-called Figueral des Galliner rock, the talayot makes use of the rocky wall. On the other hand, towards the coast, Morellet (IDE – MRT01 – 001047) has a circular floor plan talayot with a doorway on the southern side and with an important control over the coastline. Close to the wetland, the Torreblanca settlement (IDE – TBL03 – 001088) is a settlement with a probable talayot as well as other buildings covered by vegetation. This settlement connects visually with two settlements located further inland, Tordonell (IDE – TRD01 – 001076), a talayotic settlement on top of which the posterior farm houses were built. There are still remains of a circular shaped talayot and close by there is a burial cave (IDE – TRD02 – 001087); and Es Banyul (IDE – BAY04 – 000973), a talayotic settlement over a rocky promontory, with the still visible remains of a talayot. They both present a visual control directed towards the coastline. However, they do not reach it and they visually connect with Sa Torreta de Tramuntana and the settlements around it.
Relationship between the Sa Torreta de Tramuntana area and total viewshed of the island.

In this case, the distance limit within the visual network has extended to 4km in order to include the settlements located further inland, set on hilly areas. Thus, a chain of five talayots is documented on the highest and more visible parts of the short promontories that characterize this area away from the coast. We find—along the east-west axis—the settlements of Puigmenor Vell (IDE – PMV01 – 000109), with the remains of a probable talayot; Egipte (IDE – EGT01 – 000086), a talayotic settlement on a hill with a circular floor plan talayot, with a passageway and a preserved height of 2.35m; Binixems de Darrera (IDE – BXD01 – 000052), a talayotic settlement with the remains of a square shaped talayot with rounded corners, and at about 500m, the remains of a very degraded talayot (IDE – BXD02 – 000053); and Estància de Sant Pere (IDE – ESP01 – 000088), with a talayotic settlement standing over a hill, with a circular-shaped talayot. These settlements present a fragmented visual control. However, they connect the area around Sa Torreta de Tramuntana with the settlements located further inland.

As can be seen, having a lesser number of settlements means having a simpler visual network, where Torreta de Tramuntana, Morella Vell and Egipte are the settlements with a higher number of connections, while the rest is laid out around them.
Viewshed from the Sa Torreta de Tramuntana talayot

Visibility from the Es Banyul (left) and Morellet (right) talayots.
Intervisibility among settlements in the Sa Torreta de Tramuntana area
Hierarchy analysis of visual connections in the Sa Torreta de Tramuntana area and nodes proportional to the index of betweenness.

Worth highlighting is the absence of evidence of talayotic settlements on the En Colom islet, despite evidence of mining activities during prehistoric times. However, the Morellet settlement is located less than 2 km from the islet, in a setting closer to the coastline (500m) than is usual in talayotic settlements. On the other hand, the settlement has an appreciable visual domain over the islet.
Relationship between the talayots and the cave and hypogea burial sites in the Sa Torreta de Tramuntana area
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