

Original Study

Scott Kirk*

Sicilian Castles and Coastal Towers:

Signaling a Shift in Trade Networks, Territorial Organization, and Defensive Strategies in Post-Medieval Sicily

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Abstract: While much attention has been paid to the development of castles as the hallmark architectural symbol of the Middle Ages, less attention has been given to the changes in European defensive strategies that occurred between the 15th and 17th centuries. It was at this time when the modern nations of Europe began to take form, as sea-based trade between distant nations took precedence over land-based trade routes. This paper examines how this transformation manifested in the defensive structures of Sicily, Italy, where the hilltop castles of the Middle Ages gradually gave way to a more cohesive network of coastal towers around the island. Putting this transition in its historical context, presenting an anthropological model from which to view this transition, and using geospatial methods to track these changes, the results of this study indicate that as defensive towers began to dominate the Sicilian coast around the 16th century, their command over the environment was no greater than that of the feudal castles which were still in use. Yet, unlike the castles of feudal lords, these towers represented an island-wide system of defense and the beginning of an adherence to a more centralized power structure then seen previously.

Keywords: Sicily; GIS; post-Medieval; trade; defense

1 Introduction

The need to defend oneself is something that can be seen in the material culture of people around the world going back thousands of years (see Keeley 1997, Keeley, Fontana, & Quick 2007, Toy 2006 [1955], Webster 1976). Medieval fortifications – especially castles – and their early modern counterparts are examples that most people can recognize based on their depictions in the popular media. Yet, while these fortifications were undoubtedly designed for defensive purposes, fantastic renditions of their use in battle fail to demonstrate how Medieval and Early Modern European fortifications changed over time, as well as how they related to their surroundings, their historical context, and the societies that built them. Using Sicily as a case study, this paper illustrates the relationship between fortification and society; analyzing the transformation that occurred in the placement and visual focus of the island's defenses between the 11th and 19th centuries. It is here postulated that: 1) localized political power, associated with inwardly focused castles, slowly diminished in Sicily as a network of state-sponsored coastal defenses began to appear, and 2) that this transformation in political power and defensive strategy was almost certainly related to socio-economic change caused by a) pressures from Ottoman presence in the Mediterranean, b) the arrival of new, Atlantic and Northern European powers, c) a reorientation in both overland and maritime trade routes, and d) the increased threat of piracy.

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***Corresponding author: Scott Kirk**, The University of New Mexico, Department of Anthropology, MSC01-1040, Anthropology 1, Albuquerque, NM 87109 USA, E-mail: kirks@unm.edu

2 The Building of Fortifications and Analytical Framework

In the late 15th and early 16th centuries, the Early Modern rulers¹ of Europe began to transform the defenses of their landholdings to prepare for and accommodate new, innovative weapons and battle tactics. Fortifications built during this time began to incorporate cannons and cannon ports into their designs, their walls were lower and angled to deflect cannon fire, and they began to align themselves around national boundaries and major port cities (Anderson 1970, Kaufmann & Kaufmann 2001, Hogg 1981). In the Spanish imperial landholdings of the 16th century – particularly in the Mediterranean – defensive towers were also employed to protect coastal assets² (see Clements 1999, Giannattasio, Grillo & Murru 2016, Hogg 1981, Maurici 1985, Maurici, Fresina & Militello 2008, Mazzarella & Zanca 1985). These changes in fortification design, type, and placement have traditionally been seen as a direct result of the introduction of gunpowder to the European theater of war. And yet, while this explanation makes sense for the functional changes in fortification design and type, it does not necessarily account for changes in placement.

To better understand this aspect of defensive strategy, one needs to look beyond the new developments in the practices of war to the socio-economic realities of the 15th – 18th centuries. It was at this time when the empires of Europe – specifically, but not limited to, Britain, Spain, Portugal, and the Netherlands – began to increasingly rely on maritime power; first through Portuguese and Spanish attempts to subvert Islamic trade routes (see Barta 2005, Hamdani 1981, Hess 1978), and then with the direct introduction of Northern European powers into the Mediterranean³ (see Abulafia 2013⁴, Fusaro 2012, Munro 1999). As maritime trade has always been vital to Sicily's economy,⁵ one would expect that the changes wrought by these developments would have been negligible in their effect on the island's defensive strategies. Yet, it was not until the 15th, and more realistically the 16th, century that the material remains of an island-wide system of coastal defenses can be seen taking shape and coalescing in a meaningful and comprehensive way. This paper seeks to understand why that is.

Taking both a historical and an anthropological/archaeological approach, I begin this investigation by commenting on the socio-political and historical context in which this transition occurred, before discussing a more anthropological framework from which to understand it. I then present a geospatial model showing a shift in the placement of defensive structures and employ a series of cumulative viewshed analyses to examine the relative proportions of the island visible on a century by century basis from castles and coastal towers respectively. Finally, I conclude with a brief case study illustrating what the average castle and tower was focused on in the 16th century and discuss what these foci may indicate.

3 Important Historical Themes

Set against the backdrop of larger socio-political and economic change, a minimum of five important and loosely interconnected historical themes must be addressed before contemplating why a transition from localized, inland defense, to centralized, coastal defense occurred. These themes are: 1) the potential presence of earlier coastal and state-sponsored defenses, 2) Spanish control over the island of Sicily and its ongoing war with the Ottoman empire, 3) changes in who and what was appearing in the Mediterranean, 4) documented changes in both maritime and overland trade routes and 5) the continued, and in some cases

¹ Including any member of the elite class in a position of power over a general populous (e.g. kings, viceroys, dukes, etc.).

² This is a practice that the British would later adopt in the 18th century with the Martello Towers seen all around the empire (Clements 1999).

³ Note that goods from Northern Europe had been arriving from land based trade routes through Gaul (discussed later) for centuries before that.

⁴ Abulafia's (2013) *The Great Sea* is referenced extensively in this paper for two reasons: 1) because of its comprehensive overview of Mediterranean history, and 2) because it was the last thing the author read before making revisions to this paper.

⁵ For a better understanding of the point of view used here, discussions of Mediterranean trade in the Middle Ages which have influenced the author include: Abulafia (2013), Davis-Secord (2010), Epstein (1992, 1989), Hodges and Whitehouse (1983), Hodges (1982), Kapitaikin (2013), McCormick (2001), Vaccaro (2013), and Wickham (2009, 2005, 2004).

increased, threat of piracy to the island of Sicily.⁶ As the historical underpinnings of this transformation have been widely published on,⁷ and are only one of several components to this analysis, this section will be brief and, at times, truncated by necessity in order to focus on the more quantitative and theoretical aspects of this research.

3.1 Early Attempts at Coastal and State-Sponsored Defenses

The use of coastal defenses for the protection of small segments of Sicily goes back much further than the defensive towers of the Early Modern era. Being a land rich in agricultural potential, Sicilian grain was traded in the Aegean and other parts of the Mediterranean since the time of Classical Greece (Austin & Vidal-Naquet 1977, Basile 1941, De Angelis 2000, Morris 2004, Stika, Heiss, & Zach 2008). With references to the use of signal fires being common in the stories of the ancient Greeks (Tracy 1986), it is not surprising that vague references to such fires on Sicily seem to go back to the Greek colonization of the island (Maurici 1985, Ortisi & Rizza 1995). However, these were not the island's only defenses. Large scale fortifications, such as the *Castello Euriallo* outside of Syracuse (see Bonacini & Castorina 2017, Mauceri 1939), also appeared on the landscape around Greek settlements by the 5th and 6th centuries BC (see also Karlsson 1989).

That being said, it was not until the Medieval period that any serious attempt to systematically fortify the entire island can be seen in the historical or archaeological record.⁸ With the arrival of the Norman and subsequent Swabian rulers of Sicily between the 11th and 13th centuries AD, a system of state-owned and sponsored castles⁹ were established in order to exert control over the island (Bresc & Maurici 2009, Kirk 2016, Tuzzolino 2001). Yet, in spite of their initial success against Sicily's Muslim inhabitants, this centralized system of defense did not last in the way that the Norman and Swabian kings had likely envisioned.

After the Sicilian Vespers of the 13th century, the island eventually fell under the rule of the Aragonese, ending the independence of the Kingdom of Sicily and ushering in an era of foreign subjugation (see Abulafia 2013, Epstein 1992, Smith 1968).¹⁰ It was during this time that the nobility of Sicily gradually began to take control of, and add to, the island's many castles in order to solidify their own feudal domination (Gomez 2007, Smith 1968). This maneuver effectively diminished the power of the once strong, centralized Sicilian government in favor of a more localized power structure that benefited the aristocracy.¹¹ For the entirety of the 14th century, no truly systematic, state-sponsored system of defense can be said to have existed on the island, and castles were mainly used as noble residences offering protection only to the elite classes. It was not until the 15th century, when the major cities of the island began to build coastal defenses for their own protection and the defense of the individual assets of the nobility (Maurici 1985), that Sicily once again began to establish a more centralized system of defense.

3.2 Spain and the Ottomans

Passing through the Kingdom of Aragon, Sicily became part of the fledgling Spanish empire around the turn of the 15th century (Smith 1968). The island was thereafter at the physical center of the conflict between

⁶ Note that these are not the only potential themes which one could evaluate. The interplay between the internal political dynamics of feudal Sicily and the imperial power structure of Spain could rightly be considered another theme, but this is a topic best suited for a different paper. Likewise, population growth in the 15th century (see Epstein 1992) also has the potential to have played a major role in the reorientation of Sicily's defenses.

⁷ For more background information on the history of Sicily and the Mediterranean at this time see: Abulafia (2013), Epstein (1992), Goodwin (2015), Hess (1978), Smith (1968), and Wickham (2009, 2005). For more historical information on the coastal towers of Sicily see: Mazzearella and Zanca (1985) as well as the Maurici et al. (2008) three volume treatise on the matter.

⁸ Though Roman fortifications did exist, they cannot be called systematic to the same extent as either later Norman and Swabian castles or the Early Modern towers that this paper focuses on.

⁹ Many of these castles were built upon earlier Islamic fortifications. However, due to the fractured political state of the island during the Norman conquest (see Metcalfe 2009, Smith 1968) it is unlikely that they formed any kind of network.

¹⁰ It should be acknowledged that this greatly simplifies matters. For a better understanding of what this really entailed refer to the references listed.

¹¹ This is not to say that Sicily is unique in this regard, only that this is how the events played out on the island.

the Spanish and the Ottoman Turks (Bono 2008).¹² Though Sicily's economy had thrived earlier in the Middle Ages (Davis-Secord 2010), prolonged fighting and civil war robbed it of much of the economic power it previously held (Epstein 1992, Smith 1968). Spanish/Ottoman conflict further diminished the island's economic importance as, after centuries of profiting from the exchange of grain with North Africa, the Spanish crown mandated that Sicily cease this trade following the Ottoman conquest of North Africa (Smith 1968). Cut off from potential trade partners, Sicily was no longer the economic center of trade that it had once been, and much of the grain that it had profited so heavily from was rerouted towards the Spanish empire (Smith 1968).¹³

Economic exchange between Spain and Sicily has been regarded as relatively one sided, with Spain caring little about the Sicilian economy (Smith 1968). Yet, as part of the Spanish empire, investment in defenses were made¹⁴ (Maurici 1985, Maurici et al. 2008, Mazzarella & Zanca 1985, Smith 1968). The 15th and 16th centuries saw a new, invigorated period of fortification building in Sicily (Bono 2008, Maurici 1985, Mazzarella & Zanca 1985), characterized by the construction of large fortifications around major port cities,¹⁵ with smaller coastal towers filling in the shoreline between them. This construction was not all part of a singular push to systematically fortify the island, but rather a series of phases attempting to improve upon the defenses already in place using a number of different architectural designs (Maurici 1985, Maurici et al. 2008, Mazzarella & Zanca 1985, Smith 1968).

The first phase of construction for these new defenses began in the 15th century, when coastal towers started to appear in association with major port cities (Bono 2008, Maurici 1985, Mazzarella & Zanca 1985). These towers were primarily funded by local elites for the protection of their own investments (Maurici 1985), leaving much of the Sicilian coastline vulnerable. To remedy this, the Spanish Viceroy Juan de Vega commenced another phase of tower building in the middle part of the 16th century, but it was not until the last part of that century when a final push to create a true, systematic network of coastal defenses was made following Camillo Camilliani's inspection of the island's coastal defenses (Bono 2008, Maurici 1985, Mazzarella, Zanca 1985).

While it is not appropriate to link this investment in Sicilian defenses to a single catalyst, fear of Muslim/Ottoman attack on Sicily would have likely been sufficient enough motivation to mobilize the resources needed to reorient the island's defenses towards the coast. As the two biggest powers in the Mediterranean during the 15th and 16th centuries, Spain and the Ottomans rarely engaged in full scale battle with each other.¹⁶ In lieu of all-out war, both empires typically encouraged corsairs to attack the interests and landholdings of their opposition in their stead (Hess 1978, Mazzarella & Zanca 1985). While it is likely that this was partly due to the prohibitively high costs which both sides would have accrued in the event of all-out war, both empires had other reasons to avoid battle as well.

By the end of the 16th century Spain's interests began to fall more firmly outside of the Mediterranean, as the empire began to focus on the extraction of resources from the New World (Goodwin 2015, Hess 1978, Marks 2007, Smith 1968). In contrast, the Ottomans were still confined to the Middle Sea due to their failure to take the Atlantic coast of North Africa and the prolonged, multi-front conflicts they were involved with in Persia and the Balkans (Abulafia 2013, Hamdani 1981). Following the Spanish into the Atlantic was simply not a viable option for them. Yet, despite having the advantage of being part of the trans-Atlantic trade, Spain was having difficulties of its own in terms of both finance and holding on to the empire it had built for itself (Abulafia 2013; Davis-Secord 2010; Goodwin 2015; Smith 1968, Trasselli 1974). Though these difficulties may have been less apparent to the Ottomans, they did allow for the British and Dutch to begin edging in on Spanish trade and territories in both the New and Old Worlds.

¹² Spanish/Ottoman conflict in the Mediterranean is a complicated topic that deserves a more comprehensive treatment than the author can provide here. For a better understanding, see Abulafia (2013), Goodwin (2015), Hamdani (1981), and Hess (1978).

¹³ This by no means crashed the Sicilian economy (see Epstein 1992).

¹⁴ In many cases, however, these defenses were paid for by the people of Sicily at the behest of Spain.

¹⁵ These were not unlike many of the Early Modern fortifications that can still be seen around the Caribbean today.

¹⁶ That is not to say that they never did engage in any sort of confrontation. The Battle of Lepanto is the most famous example. Nonetheless, the situation in the 15th and 16th century Mediterranean may have resembled—to use a modern analogy—more of a cold war much like the Russians and Americans faced for the better part of the 20th century.

3.3 Changes in Who and What Entered the Mediterranean

As early as the 15th century, Northern European merchants from England and the Low Countries¹⁷ began to take the oceanic route down around the Iberian Peninsula and into the Mediterranean (Abulafia 2013; Munro 1999).¹⁸ These merchants were relatively few in number and did not represent a significant force until the 17th century (Abulafia 2013, Fusaro 2012, Munro 1999). In exchange for the high-quality textiles that they brought with them¹⁹ and slaves from North Africa, Late Medieval Sicily exported mainly agricultural goods in the form of “grain, cheese, livestock, [tuna], silk, and sugar” (Epstein 1992, p. 270);²⁰ an arrangement that has struck some scholars as being very colonial in nature (Abulafia 2013, Epstein 1992, 1989).

In many ways, the interpretation of this exchange as a colonial relationship is valid, having a number of similarities with the colonial relationships between Britain, Spain and their New World landholdings. Indeed, in a parallel to what was going on in the Americas, the labor force used to extract agricultural products from Sicily was, in part, made up of Islamic and North African slaves (see Epstein 1992).²¹ Similarly, what made these changes in who was entering the Mediterranean and what was being traded possible was the same thing that made the colonization of the Americas possible, new designs for ship building seen in the caravels and carracks of the Atlantic empires (Abulafia 2013, Hamdani 1981, Munro 1999). Not only were these ships nearly impervious to attack from the galley ships of Muslim corsairs and the Ottoman empire (Abulafia 2013, Munro 1999), but they allowed for the Spanish and Portuguese to bring goods back from all around the world (Hamdani 1981), bypassing the old Islamic trade routes that the Ottomans were developing a stranglehold over.

3.4 Changes in Trade Routes

In order to examine how trade routes changed between the 15th and 17th centuries, one must first understand that these changes were taking place at three different levels: 1) over the European continent, 2) within the Mediterranean, and 3) at a localized level. Many of the changes in trade routes across the European continent can be seen as only tangentially related to what was going on in the Mediterranean. Beginning in the 15th century, Britain and the Low Countries began to rely more heavily on maritime exchange with the Mediterranean (Abulafia 2013), bypassing previously used land routes and taking products directly to their final destination by way of sea (Munro 1999).²² Motivations for trade between Northern Europe and the Mediterranean were mostly economic, with changes in trade routes caused by the political underpinnings of the time.²³ In contrast to the picture that emerges for the changing relationship between Northern Europe and the Mediterranean, changes in trade within the Mediterranean must be seen within a much greater depth of time.

By the 9th century AD, the Mediterranean was on the brink of a new trade cycle (Wickham 2004). Fueled by Islamic expansion, it was not long before the great Northern Italian port cities of Venice and Genoa, amongst others, began to break in on the exchange (Abulafia 2013, Wickham 2004). For Italy, participation in

¹⁷ The Low Countries are usually defined as what is now Belgium and the Netherlands but sometimes includes Denmark as well.

¹⁸ This is not the first time that Northern Europeans had done this. The Vikings were doing the same thing roughly 1500 years prior, although their motivations for doing so were much different.

¹⁹ These textiles had been arriving in the Mediterranean by way of land routes through Gaul since as early as the 13th century (Munro 1999). Additionally, other goods were also coming from Northern Italy, Spain, North Africa, and Portugal as well (Abulafia 2013, Barta 2005, Epstein 1992, 1989).

²⁰ Over time, this exchange seems to have become more specialized, with the 17th century British navy trading to specifically obtain the bulk of the island's lemons for their sailors to help prevent scurvy (Abulafia 2013).

²¹ These same slaves would also be brought to the New World by the Spanish as galley rowers (Wheat 2010), further implying that the colonial relationship between Spain and Sicily was not wholly different than it was between, say, Spain and Cuba.

²² This shift in how Northern European goods reached the Mediterranean was not linear, and the ebb and flow of goods between Northern Europe and the Mediterranean by land and by sea has been well documented by Munro (1999).

²³ During the Hundred Years War, for instance, overland trade from Northern Europe to the Mediterranean was rerouted through Germany to avoid the battlefields of France (Munro 1999).

Eastern Mediterranean trade with Islamic people was not a problem. But, during the 14th and 15th centuries, both Spain and Portugal – growing maritime powers in the Mediterranean – sought to bypass traditional, Islamic trade routes into the Indian Ocean.²⁴ With these imperial forces focused on the Atlantic in order to shut Islamic traders out of the increasingly interconnected European economy, and the introduction of Northern European vessels into the Mediterranean, the “Middle Sea” slowly began to become just one of many important economic hubs for the Atlantic powers of Europe (Abulafia 2013, Barata 2005, Hamdani 1981, Hess 1978, Marks 2007).

The effects of this transformation on Sicily can largely be characterized by a break with Roman/Medieval continuity in overland trade routes between major cities and the coast seen prior to the 16th century, and an increased focus on maritime activities following that. While the topography of Sicily has created a certain amount of continuity between both ancient and modern roadways, a big difference between the two lies in the use of more coastal routes in the Early Modern era (Trasselli 1974). Before the 16th century, both Roman and Medieval trade routes were found mainly on the interior of the island, linking many of Sicily’s major cities (Arcifa 1997, Trasselli 1974), but largely existing for transporting grain from the interior to the coast (Trasselli 1974).²⁵

In a previous paper (Kirk 2016), I have argued that the castles of Sicily constructed between the 9th and 16th centuries were conspicuously placed along old Roman trade routes,²⁶ with the continued use of these roads symbolic of continuity in economic practices and the construction of castles representing a breakdown in the centralized power structure of the Roman empire (cf. Kirk 2016).²⁷ By the same logic, the 16th century construction of new fortifications and trade routes along the coast may indicate that socio-economic change was underway in the form of lessening feudal/localized control over the island and an increased focus on both the sea and the island as a more centralized entity onto itself.

3.5 Piracy and Identity

The last historical theme that must be addressed before moving on to discuss the theoretical and methodological aspects of this paper is the continued, and potentially increased threat of piracy to the people of Sicily at the onset of the Early Modern era between the 15th and 17th centuries. While in the broad scheme of things, the discovery of the New World forever altered the course of European history, on a more local scale in a place such as Sicily – where maritime and long-distance trade stemming back to the Bronze Age had played such a vital role to the islands development (see Abulafia 2013, D’Agata 2000, de Navarro 1925) – the effects of an increased focus on the ocean by Europe’s Atlantic front would have seemed negligible to the everyday inhabitants of the island. However, with new people and new goods coming in from the Atlantic world, and the need for slaves to supply labor, the threat of piracy that had been prevalent for much of the island’s history was likely made worse.

As anyone who has read the multitude of fantastic tales about the Mediterranean in the Early Modern era knows, the Middle Sea, and specifically the Italian and Sicilian coasts, has long been a home to pirates. Indeed, Sicily features prominently in stories such as Dumas’s famous *Count of Monte Cristo*, and Reyerson (2012) has discussed many more tales of piracy, stretching back even further in time than Dumas’s narrative.

²⁴ This desire can best be understood as a continuation of crusader mentality in Portugal and Spain after having fought a bitter war for more than half a century to take back the Iberian Peninsula from Muslim powers (Hamdani 1981).

²⁵ Overland routes around Sicily were recorded by the Arab geographer *al-Idrisi* during the reign of the Norman King Roger II (Arcifa 1997, Idrisi et al. 1999, Metcalfe 2009). Based on Idrisi’s description, many of the same routes that were traversed by the geographer appear similar to those still in use today. This is, of course, within a certain debatable margin of error. I believe that this margin is far more negligible than Arcifa (1997), who presents a drastically different picture for what Sicilian overland routes may have looked like based on the presence of monasteries and Hospitaller strongholds. Trasselli’s (1974) depiction of overland routes is fairly middling between these two extremes with his work partially focusing on the constraining effects of topography.

²⁶ This assessment was based on the significant overlap between Roman and Medieval settlements seen in Wilson (1985, 1990).

²⁷ The argument being made was that the distribution of power and the division of land were what allowed for economic practices to continue in the face of a power vacuum (Kirk 2016).

All the stories Reyerson (2012) relays seem to share the same common theme that Dumas used in his own work: that of flexible and changing identities in the Early Modern Mediterranean. Based on works of literary fiction written at the time, it seems, one could go from almost any walk of life to piracy and back again without much difficulty. And, to some extent, this makes sense.

Exacerbated by 1) an influx of Spanish Muslims entering North Africa after the *Reconquista* (Abulafia 2013, Gosse 2007),²⁸ and 2) privateering put in motion by both the Spanish and Ottoman empires (Hess 1978, Mazzarella & Zanca 1985), the ranks of the Barbary corsairs seem to have swelled in the 16th century. Once established, extinguishing the threat of pirates becomes notoriously hard to accomplish in part due to the hydrarchic nature of sea based economies such as those discussed in Linebaugh and Rediker (2001). Pirates, after all, cannot be seen as a unified group, and negotiations for peace, possible with an empire such as that of the Ottomans, are not so easily undertaken. Therefore, it is here argued that an increased threat of piracy, rather than a threat of Ottoman invasion, lead to the complete reorientation of Sicily's defenses. Strengthening this argument is the notion that, by the close of the 16th century, most of the conflict between Spain and the Ottomans had already played out (Abulafia 2013).

When looking at the increase in coastal defenses undertaken during the Early Modern era,²⁹ it seems that a majority of coastal towers were constructed after the period when they would have been most useful against the Ottomans. While hostilities between the two empires continued long after the climactic Battle of Lepanto, it would have been unlikely that the Ottomans could have mustered the forces for a full-scale invasion of Spanish Sicily over a century after the battle when Camilliani was recommending further elaboration of the island's network of defensive structures along the coast. Of course, this is not to say that the construction of coastal towers was not due to either a tradition of Ottoman aggression or in preparation of an Ottoman revitalization.

In discussing both law and trade arrangements, Lopez and Raymond (2001 [1955], p. 6) state that "When a formula or expression first appears in a notarial instrument, it usually means that it has long been used in unwritten custom." Similarly, the constructions of the 17th and 18th century coastal towers of Sicily may represent a lag in the formalization of an informal behavior which served to warn the inhabitants of the island's interior about impending Ottoman aggression. However, even if this were the case, and the Early Modern towers of Sicily were the material formalization of informal signal fires, the system seen through the construction of these towers would have been equally as useful in warning the residents of Sicily against pirate attacks as they were in warning against Ottoman invasion. Furthermore, such a large-scale building project would have been a rather inexplicable investment if it was indeed only constructed for defense against the waning power of the Ottomans in the face of ongoing pirate raids which were a cause of concern for many Sicilians. Not only did the inhabitants of the island's coastal territories have to worry about loss of life and livelihood due to pirate attacks, but they also had to worry about being captured and sold into slavery as well (Davis 2004, Maurici 1985). Therefore, it would seem more likely that any early warning system put in place for the Ottomans would have either been in place before the Spanish/Ottoman conflict or at least served the dual purpose of warning against pirate attack as well.

4 Theoretical Perspectives: Localized vs. Centralized Power Structures

While the coastal towers of Sicily and other parts of the Spanish Mediterranean had similarities in construction to the early fortifications of the Middle Ages, where a tower was typically constructed as part of a large, walled enclosure (Creighton 2012), there is one important difference between the defensive structures of the two time periods that needs to be addressed. This difference lies in how they were used strategically. Early Modern coastal towers were not always designed to be defensive in and of themselves,

²⁸ These were often individuals who had lost wealth that had been acquired over generations lived in Muslim Spain and who had an intimate knowledge of Spanish trade routes (Abulafia 2013, Gosse 2007).

²⁹ Discussed in greater detail within the results section.

but were instead made to act as part of a network that could send rapid, line-of-sight messages about incoming invasion to one another via smoke signals (Mazzarella & Zanca 1985, Santoro 1985). As part of a network, these towers were more often than not state – or sometimes city – sponsored defenses, contrasting with the castles of the High Middle Ages which were more often privately owned by noble families starting around the 14th century.³⁰ Well studied in a historical sense, the development of coastal towers in Sicily has been covered by numerous scholars such as Mazzarella and Zanca (1985), Mazzamuto (1986), Maurici (1985), Maurici et al. (2008), Ortisi and Rizza (1995), and Santoro (1985), to name a few. Here, I suggest a more theoretical and anthropological model which focuses on behavioral patterns, as opposed to a strictly historical narrative, for an alternative, yet complimentary, understanding of the transition from inland castles to coastal towers.

Building off the Corporate-Network Strategy mode – otherwise known as Dual Processual Theory – presented in Blanton et al. (1996) and Feinman (2001),³¹ I propose to use a simplified version of this work to examine how political structure and economy relate to the construction of defenses. Within this simplified model, henceforth referred to as the Socio-Economic Expansion-Contraction (SEEC) Model, I suggest that two non-mutually exclusive power structures tend to emerge in most societies, a localized one and a centralized one (Figure 1). Typically, a localized power structure will have political power distributed over a dispersed set of leaders or groups competing against each other from land that they, themselves, own, while a centralized power structure will have political power focused on a centralized leadership governing over a unified territory. Localized power structures will be individualizing and self-aggrandizing (much like the Blanton et al. [1996] network strategy) while centralized power structures will seek to incorporate all those people whom they govern into the power structure (much like the Blanton et al. [1996] corporate strategy). These two power structures will typically exist side by side within the same political arena (as is the case for the Corporate-Network Strategy Model), but there are certain rare examples of societies that favor one form of power structure over another.³²

<u>Localized Power Structure</u>	<u>Centralized Power Structure</u>
Power Distributed	Power Centralized
Dispersed Leadership	Centralized Leadership
Individualizing Power	Encorporating Power
Parcelled Land	Unified Territory
Intergroup Competition	Intergroup Cooperation
Examples: Vikings, Pirates, Taifa states	Examples: <i>Pax-Romana</i> , 1950s America, Teotihuacan

Figure 1. Figure showing the characteristics of localized and centralized power structures with examples of societies that embody them. While these examples serve a purpose, it should be noted that they are extreme examples and typically both power structures will exist within the same society as is the case for late Medieval/Early Modern Sicily.

³⁰ This somewhat conflicts with an earlier statement made that the Normans and Swabians used castles as a state-sponsored and networked means of defense. To be clear, the statement used in the above text refers to castles in general, and specifically the castles of the later Middle Ages, which were often family owned.

³¹ While typically used more prominently in Mesoamerica, Corporate-Network Strategy models have been used in European contexts by Small (2009) as well as Englehardt and Nagle (2011) to describe and understand societies in the ancient Aegean.

³² Examples include Vikings, Caribbean pirates, and the Taifa states of Spain favoring localized power structures, in contrast to the Roman empire during the *Pax Romana*, 1950s America, and Teotihuacan favoring centralized power structures.

A useful example of how these power structures materialize can be seen in a generic description of the medieval kingdoms in Europe, where feudal lords competed against each other for localized political power under an overarching centralized monarchy. These centralized monarchies would typically wax and wane in the amount of power they actually held over the course of the Medieval and Early Modern periods. As castles can be seen to function as economic hubs placed along trade routes where tolls could be extracted (Kirk 2016; Painter 1956), they would serve to embody the localized power structure.³³ Lords and barons residing in these structures could grow monstrously rich at the expense of both the state and the lower classes, a scenario which was almost certainly the case in Sicily after the Sicilian Vespers (see Smith 1968).

Of course, this behavior – which was by no means unique to Sicily in the 14th and 15th centuries and can be seen mirrored in the rise of pirate lords along the Barbary Coast – creates an imbalance towards a more localized power structure. Since the SEEC Model suggests that the extreme favoring of one power structure over another is relatively rare, it should be expected that this imbalance would correct itself over time with the growth of a state-based system of political control. This, I argue, can be seen in territorial reorganization characterized by the creation of a system of coastal towers in the 16th and 17th centuries around the Spanish Mediterranean. Thus, while the elites of the 14th and 15th centuries began to control the more traditional symbols of power (i.e. castles) in Sicily to protect their own assets, the 15th–17th century response from the state (i.e. Spain) was to set up a system of defense which, when broken apart to its constituent components might not have seemed very impressive, when taken as a network would have sent a strong message to both the people of the island and outsiders: that Sicily was capable of pulling itself together for its own defense.³⁴

5 Methods

While similar studies have examined the interconnectivity of castles and towers as defensive networks to test their effectiveness (see Kay & Sly [2001] for an example looking at Medieval English beacons, McManama-Kearin [2013] for an example looking at the role of visibility between early Anglo-Norman castles in Ireland, and Smith & Cochrane [2011] for an example looking at Fijian strongholds), it is already known from historical documents that the system of coastal towers implemented in Sicily was not nearly as successful as was initially hoped (Mazzarella & Zanca 1985). Piracy, despite any attempt to thwart it, continued to plague the island for reasons that have been covered above. Therefore, as the historical record already calls into question the effectiveness of this scheme, emphasis of this study focuses more on the actual process of transition and the economic, social, and political implications surrounding it without paying much attention to how the system was actually used. To that end, this study uses geospatial analyses to examine 1) the type and number of defensive structures built during each century over the past millennium from the 11th through the 19th centuries, 2) where these structures appeared on the landscape during that time, and 3) what the cumulative visual focus of each type of structure (i.e. all castles vs. all towers) was during each century.

Each of the above listed analyses was made to determine how the placement of defensive structures changed over time, with more inland placement and visual focus on overland trade routes indicative of a localized power structure, and more coastal placement and visual focus on the Mediterranean indicative of a centralized power structure.³⁵ Research began by obtaining the dates of construction and abandonment, in addition to latitude and longitude,³⁶ for a nearly complete and unbiased sample of Sicily's Medieval

³³ In Sicily, this idea is complicated due to the use of Norman and Swabian state-owned castles between the 11th and 13th centuries (Bresc & Maurici 2009, Kirk 2016).

³⁴ Whether or not either Spain or the major population centers of Sicily had the force to back up this message is an altogether different matter, and it is unlikely that by this point in history the armies of Sicily would have been able to do much to protect themselves against a full-scale invasion (Abulafia 2013).

³⁵ This assumption is made based on the SEEC model.

³⁶ Dates of construction and abandonment were largely taken from Kirk (2016), Maurici et al. (2008), and Tuzzolino (2001). Latitude and longitude was acquired using place names and maps from the aforementioned sources, finding each structure on Google Earth, and copying the data over to an excel spreadsheet before importing it into ArcMap as a shapefile.

and Early Modern defensive structures (i.e. castles [including fortifications of Renaissance design] and towers).³⁷ Since the exact location of a small number of castles and towers was not precisely known, an estimate for their location was made based on previous research, topography in satellite photos, and suggested placements (see Kirk 2016, Maurici et al. 2008). This was only done for those structures whose relative location was fairly well known under the assumption that the total sample size would be large enough to correct for any error caused by these estimates in the final results.

To determine how many of each type of structure was in use during each century, I used the data collected on the construction, abandonment, and geospatial positioning of all structures in use during each century between the 11th and the 19th to create a series of shapefiles. These shapefiles allowed for these structures to be plotted onto a series of ASTER GDEMs (a product of METI & NASA) representative of each of the centuries this study focuses on and auto calculated the number of castles and towers in use during each century based on attributes recorded during the data collection process. Calculations for how many castles and towers appeared near the coast were done using a buffer analysis searching for data points within a certain distance of the Sicilian coast during each century. Once all structures were plotted, a series of viewshed analyses were derived using the ASTER GDEMs to determine 1) how much area was visible from each structure, 2) what parts of the island were visible from them, 3) how many other defensive structures were in each viewshed, and 4) the cumulative effect of these viewsheds.

ASTER GDEMs are designated research grade – implying that they should only be used for more academic and theoretical undertakings – due to certain systematic errors (ASTER Validation Team 2009, Hirt, Filmer & Featherstone 2010). Though there are issues with the accuracy of these data (see Hirt et al. 2010, Zhao et al. 2011), I chose to use it for five reasons. First, ASTER GDEMs have a relatively high horizontal resolution of 1 arc second (~30m x 30m pixel size). Second, they have a relatively high accuracy in mountainous areas analogous to large parts of Sicily (see Zhao et al. 2011). Third, they provide a free, easy to access data set allowing for the results of this study to be replicated by interested researchers at no cost. Fourth, being free and widely available for most of the world, the use of ASTER GDEMs allows for comparative studies to be made between various different regions in Europe and the Mediterranean by providing a standard data set. And fifth, for the scale and cumulative nature of this analysis, and for the research questions being asked, it was believed that a finer detailed resolution DEM – which would increase the time needed to process each viewshed – was not needed.³⁸

Archaeological use of viewshed analysis typically explores the visual organization of features across a landscape to examine human decision-making in regards to structure location (Kay & Sly 2001, Wheatly 2000). For this study, a viewshed was produced for every defensive structure and then combined for each type of structure in use during each century over the past millennium to determine where the cumulative focus was (i.e. overland trade routes, coastal areas, mountain passes, waterways, etc.). Each viewshed used an offset of 3 meters (similar to Seifried 2015) to represent a conservative minimum height for defensive structures of 1.5 meters with an additional 1.5 meters added for the height of anyone standing on top of it. A standard measure was used in this study because the exact height for many of the structures could not be determined with the dataset available and, for those where height was known, it was unknown if the structure height was the same for the entire occupational history of the building, or if it changed throughout different construction episodes. Viewsheds produced for this study focused entirely on visible landmass with no data collected on how much of the sea someone standing on top of one of these structures could potentially see.

With each viewshed plotted onto the series of maps for Sicily representing each century in question, along with the positions of each defensive structure, it was possible to assess where defensive structures appeared and were utilized on a century by century basis and what areas of the island were under surveillance by all castles – using a standardized red color for their viewsheds – and all towers – using

³⁷ Estimated to be around 80–90%.

³⁸ Viewsheds discussed below using a 10m DEM from Tarquini et al. (2007) took 2–4x longer to run than they did on the ASTER GDEM. This adds up to a lot of time without much benefit due to the cumulative nature of this study. Had this study focused on individual structures, the 10m DEM would have been greatly preferable.

a standardized green color for their viewsheds. This focus on the cumulative area under surveillance by a system of defensive structures is not necessarily unlike other more traditional analyses, such as that of Roubis (2009). In that work, the cumulative viewsheds of defensive structures for the area around Torre di Satriano, on the Italian mainland, were analyzed as a way of seeing how these structures interacted with known and hypothetical (derived from least cost path analysis) roads. However, my study goes beyond this regional focus to examine how the geospatial and visual focus of defensive structures changed on a gross scale over a millennium.

Using the results of these viewshed analyses, estimates for the average area a typical viewshed covered in each century and the average number of other defensive structures visible in each viewshed were evaluated to determine if there was a sharp decrease or increase in landmass under surveillance through time. Changes detected here could then be seen in relation to historical events. Seifried (2015, p. 46) has postulated that preparations for war, or defense against piracy as the case may be here, often led to “a heightened potential for physical and visual connections.” Thus, one would expect that as Sicily was dragged into the Spanish war against the Ottomans, the population began to grow, and pirate raids increased, the defensive structures of Sicily would have a greater potential viewsheds with more structures visible from them.

Numbers for the average area under surveillance by each type of structure in each century and the average number of structures in each viewshed for a particular type of structure need to be taken with a bit of caution, as viewshed analyses are not without certain problems and limitations. In addition to changes in the environment over time (i.e. vegetation height, shifts in hydrology, landslides, etc.), lack of consideration for atmospheric conditions (i.e. decreased visibility due to pollution in modern cities), the ability of the observer to actually resolve what they are seeing, and the absence of detailed features are all known problems (Llobera 2010). More specific to this study, using a central point for calculating the viewshed of an entire structure, particularly in regards to castles, also proves to be problematic as it doesn't account for the sheer scale of each structure or the ability to move around within it for a better view. While these problems do represent valid concerns, for the purposes of model construction aimed at determining the cumulative focus of a number of structures, they are not insurmountable. Therefore, it is important to realize that the strength in this analysis lies in the cumulative nature of its heuristic model; and that while it attempts to show how much of the island could be seen by the collective system of castles and/or towers running across Sicily, it cannot be used to represent what each individual castle and tower was focused on.

6 Results

Examining the development of the Sicilian tower system along the coast over the last millennium (Figures 2–10), it is clear that the construction of this network was a relatively slow process with what was likely a great many false starts. Since signal fires were used to warn of invasion deep into antiquity, it is possible that more coastal defenses were in place earlier than is currently known, and that the system of defense examined here may have been overlain on top of a much older foundation. However, this is conjecture. Regardless of whether these structures were built to replace earlier, more informal signal fires or not, what is known from available data based on the historical record, archaeological work, and material culture is that the earliest coastal towers associated with the beginnings of an Island-wide defensive network do not begin to appear prior to the 15th century (Figure 6). As historical data has suggested, these early examples seem to be associated with the island's major port cities and therefore likely do indicate that they were constructed in order to safeguard the assets of an elite class becoming increasingly concerned with maritime exchange (cf. Maurici 1985).

11th Century

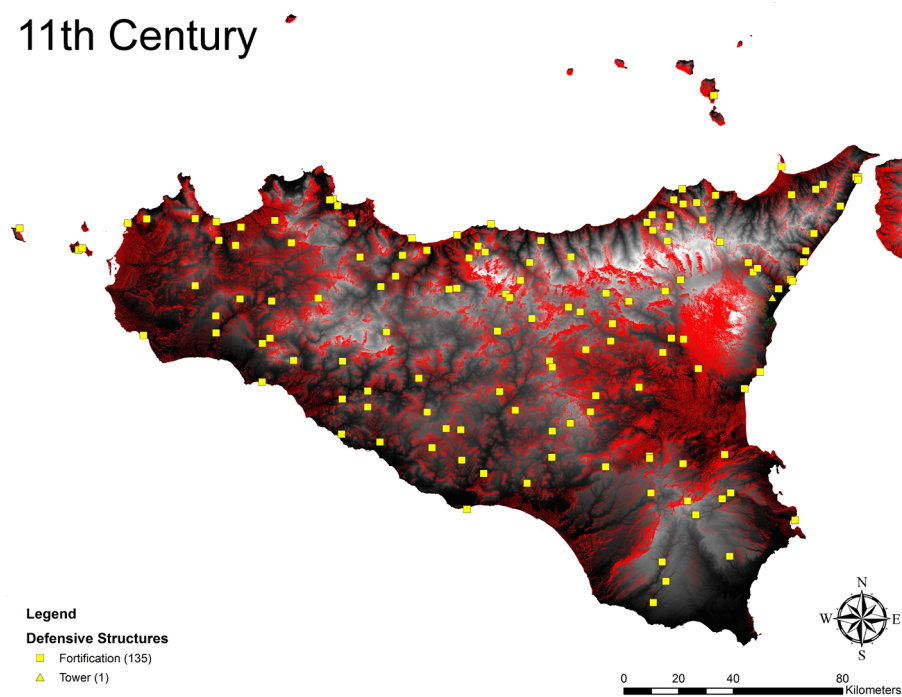


Figure 2. Figure showing the distribution of defensive structures and their viewsheds in the 11th century. Fortifications are represented by squares and the area they have surveillance over is in red whereas towers are represented by triangles and the area they have surveillance over is in green. Image derived from an ASTER GDEM (a product of NASA and METI).

12th Century

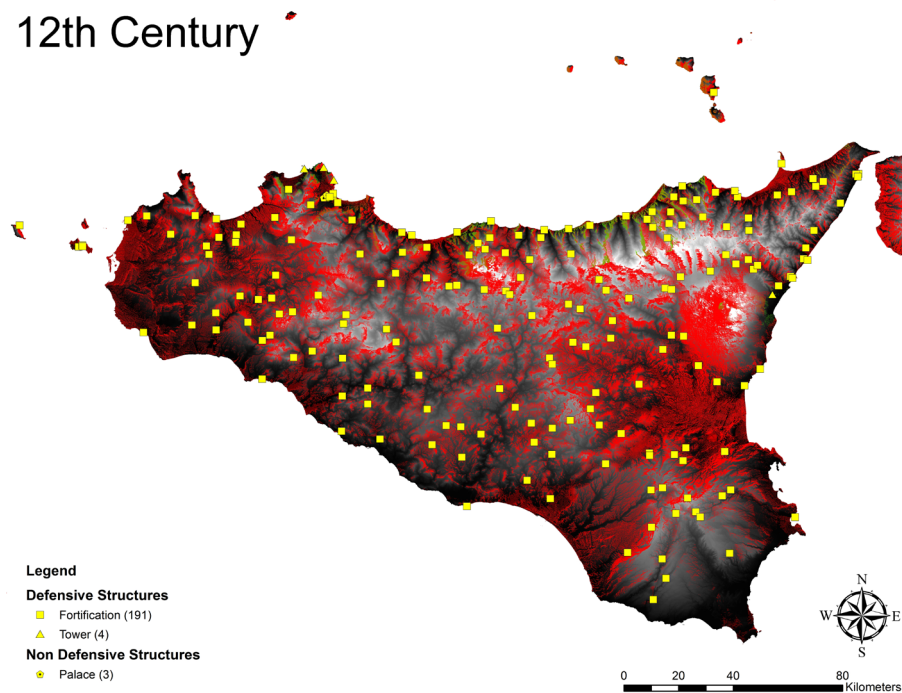


Figure 3. Figure showing the distribution of defensive structures and their viewsheds in the 12th century. Fortifications are represented by squares and the area they have surveillance over is in red whereas towers are represented by triangles and the area they have surveillance over is in green. Also included are palaces represented by hexagons. Image derived from an ASTER GDEM (a product of NASA and METI).

13th Century

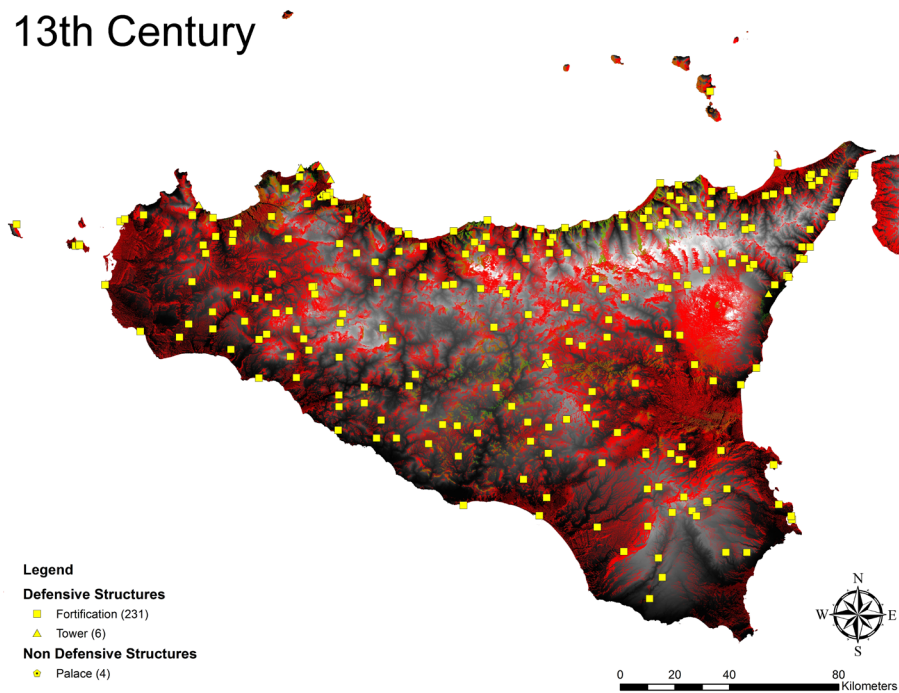


Figure 4. Figure showing the distribution of defensive structures and their viewsheds in the 13th century. Fortifications are represented by squares and the area they have surveillance over is in red whereas towers are represented by triangles and the area they have surveillance over is in green. Also included are palaces represented by hexagons. Image derived from an ASTER GDEM (a product of NASA and METI).

14th Century

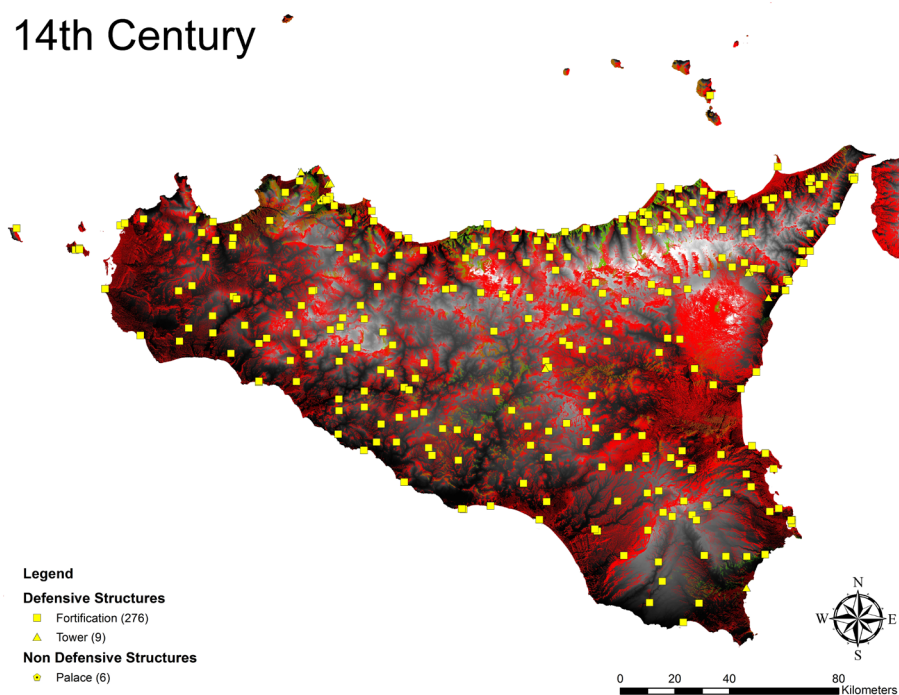


Figure 5. Figure showing the distribution of defensive structures and their viewsheds in the 14th century. Fortifications are represented by squares and the area they have surveillance over is in red whereas towers are represented by triangles and the area they have surveillance over is in green. Also included are palaces represented by hexagons. Image derived from an ASTER GDEM (a product of NASA and METI).

15th Century

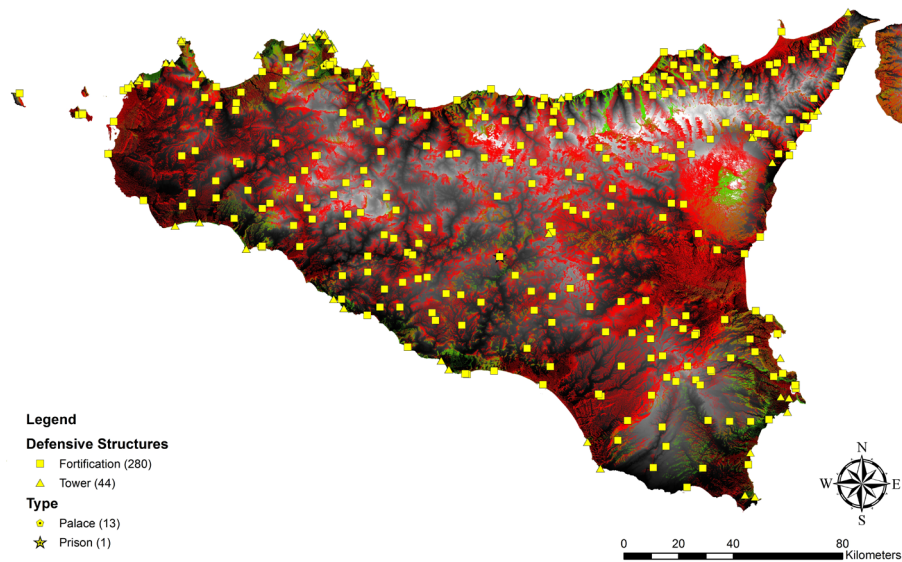


Figure 6. Figure showing the distribution of defensive structures and their viewsheds in the 15th century. Fortifications are represented by squares and the area they have surveillance over is in green. Also included are, palaces represented by hexagons, and prisons represented by a star. Image derived from an ASTER GDEM (a product of NASA and METI).

16th Century

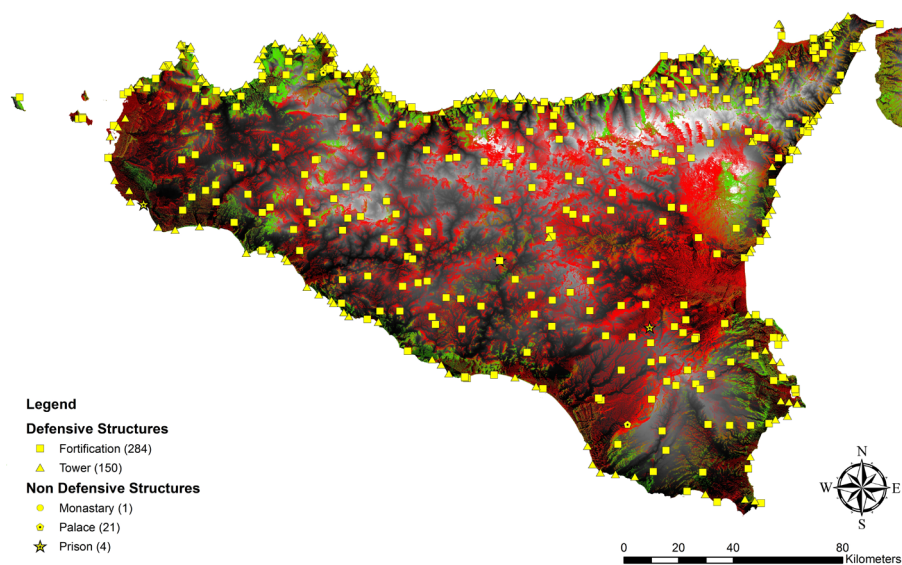


Figure 7. Figure showing the distribution of defensive structures and their viewsheds in the 16th century. Fortifications are represented by squares and the area they have surveillance over is in red whereas towers are represented by triangles and the area they have surveillance over is in green. As one can see through this picture, there is a growing trend in the use of coastal towers along the coast and a growing focus on the exterior of the island. Also included are church buildings represented by circles, palaces represented by hexagons, and prisons represented by a star. Image derived from an ASTER GDEM (a product of NASA and METI).

17th Century

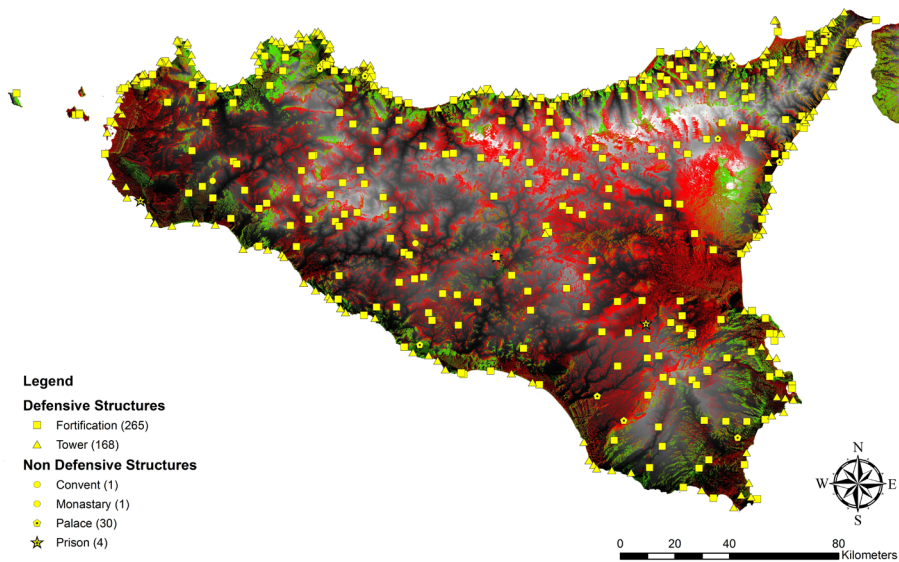


Figure 8. Figure showing the distribution of defensive structures and their viewsheds in the 17th century. Fortifications are represented by squares and the area they have surveillance over is in red whereas towers are represented by triangles and the area they have surveillance over is in green. Also included are church buildings represented by circles, palaces represented by hexagons, and prisons represented by a star. Image derived from an ASTER GDEM (a product of NASA and METI).

18th Century

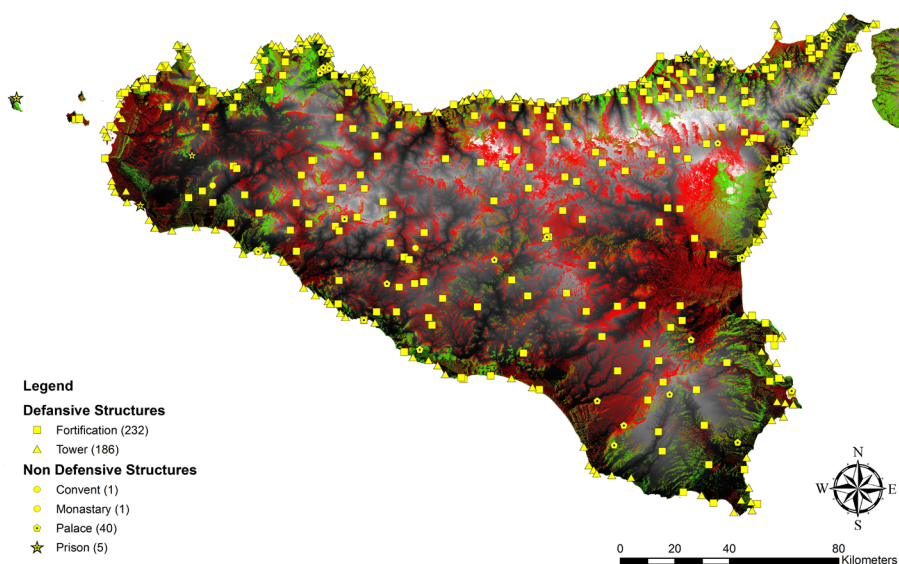


Figure 9. Figure showing the distribution of defensive structures and their viewsheds in the 18th century. Fortifications are represented by squares and the area they have surveillance over is in red whereas towers are represented by triangles and the area they have surveillance over is in green. Also included are church buildings represented by circles, palaces represented by hexagons, and prisons represented by a star. Image derived from an ASTER GDEM (a product of NASA and METI).

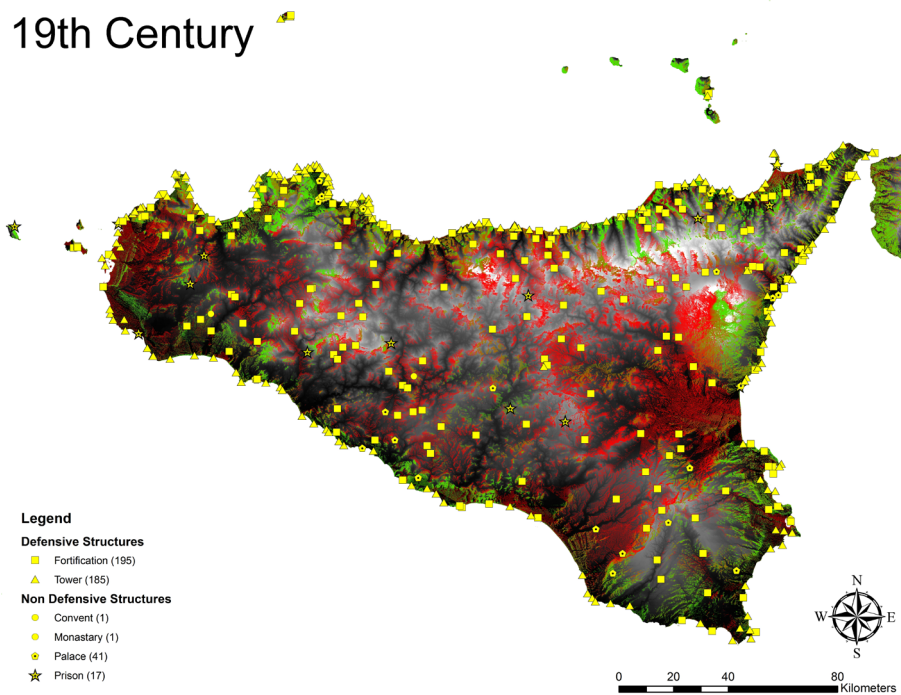


Figure 10. Figure showing the distribution of defensive structures and their viewsheds in the 19th century. Fortifications are represented by squares and the area they have surveillance over is in red whereas towers are represented by triangles and the area they have surveillance over is in green. Also included are church buildings represented by circles, palaces represented by hexagons, and prisons represented by a star. Image derived from an ASTER GDEM (a product of NASA and METI).

While the extent to which these early examples represent a network can be called into question, the towers of the 15th century show an undeniable shift in where defensive structures were being placed. Thus, while potentially not yet associated with a more centralized power structure, it does seem that the defensive strategy employed by many of the island's cities begin to align with each other in an increased focus on preventing sea-based raids. Investment in this strategy grew over time, and by the 16th century (Figure 7) a true island-wide system of defense fixated on coastal surveillance can be seen coming into fruition.³⁹ This fluorescence is here seen as representative of a revolution in both territorial organization and defensive strategy, signaling a shift away from the more localized power structures and defensive practices characterized by the larger castles of the Middle Ages towards a more centrally organized one.

Concurrent with this shift in defensive strategies, it seems that a number of overland coastal roads begin to develop as well (see Trasselli 1974). The reason for this might be simple, for instance, a larger number of people needed access to the coast. However, seen alongside the construction of a more outwardly focused defensive strategy, one might interpret this development as representative of wider socio-political changes. For instance, coastal routes could be used to more easily transport both troops and supplies between cities, they could be seen as linking together the burgeoning new network of towers, or they could be seen as allowing for more of the island's inhabitants to make their living off of the sea. Whatever the case may be, the increase in both defensive structures and roads along the coast do seem to align with the growing importance of a more maritime based economy.

From the 16th century on, the viewsheds of towers, and indeed the towers themselves to some extent, can be seen as forming a nearly unbreakable chain around the island throughout the remainder of the time discussed in this study (Figures 8–10). It was not until the invention of the telegraph, which made

³⁹ Many of these 16th century towers were built at the end of the century based on designs and suggestions put forth by the Tuscan architect Camillo Camilliani (Mazzarella & Zanca 1985, Maurici 1985). As this analysis was done on a century by century basis, knowledge of this is obscured by the coarse resolution of the study.

rapid-fire communication between two points not only possible but undetectable to the outside observer, that the towers of the Early Modern era were no longer considered necessary and a majority of them were abandoned (Mazzarella & Zanca 1985). Thus, in many ways, the reason for these towers becomes rather self-explanatory when discussing why they were abandoned, they served as a sort of communication network as much as a system for defense. Perhaps more interesting than the question of why they developed, however, is what they tell us when compared to the defensive structures that came before them (i.e. castles).

Already by the 12th–14th centuries (Figures 3–5), much of the coastal territory of Sicily was already under surveillance by the 191 (12th century) – 276 (14th century) known and well documented castles on the island. As anyone who has toured a number of these castles knows, many of them had some way of communicating between each other, primarily through the use of large hearths constructed to send smoke signals much like the towers of the Early Modern era. As many of these structures were still inhabited during the 15th–18th centuries, one has to question why coastal towers were even needed since they essentially served as a redundancy. Indeed, this is clearly visible in Figures 2–9 where the overlap in red (castle) and green (tower) viewsheds mix to create a murky brown color covering certain portions of the coast. And furthermore, in some areas that do not prominently display this redundancy between castles and towers, the viewsheds of the towers themselves proved to be so redundant as to mask out the underlying visibility of castles.

Three explanations immediately spring to mind as for why this redundancy between castles and towers could be. First, viewsheds indicate what is possible to see from a location, not what is possible to resolve (cf. Llobera 2010). Therefore, redundancies could be caused by the need for higher resolution in early detection of sea based attacks. Second, these redundancies may also indicate that certain areas of the Sicilian coast were prioritized for surveillance more than others. This explanation fits with historical data suggesting that towers were used to prevent pirates and smugglers from hiding in and operating out of Sicily's many inlets (Maurici 1985, Maurici et al. 2008, Mazzarella & Zanca 1985). Finally, a third explanation may be seen in light of the theoretical framework taken by this study. Here, I would suggest that the redundancy in these viewsheds could partially be seen as caused by a newer, more centralized power structure exerting itself over the localized one already in place. Regardless of the cause, the construction of coastal towers does not represent a dramatic shift in attention away from inland trade routes and towards the coast, but rather a heightened focus on it.

This heightened focus can be further observed in Table 1 where, using a buffer analysis to examine the number of defensive features found along the coast, one can see that between the 16th–18th centuries when the number of defensive structures along the coast rose, the total number of defensive structures in use began to fall. The tipping point in the orientation of defenses from overland routes and harbors to larger stretches of coast seems to be in the 16th century when the number of seaside defensive structures more than doubles while the total number of defensive structures in use does not. With this being the case, one can begin to insinuate that there seems to be a growing need for the defense of the island as a whole, rather than the protection of individual pieces of overland trade routes that the construction of Medieval castles seemed to represent.

Table 1. Table showing the number of defensive structures within a certain set of distances from the Sicilian coast. Note a clear break in the trend during the 16th century as the number of coastal structures doubles without the number of total structures doubling.

Number of Defensive Structures Along the Coast						
Century	.25km	.5km	.75km	1km	2km	Total Structures Island Wide
11th C	12	19	21	22	29	136
12th C	18	29	32	34	42	195
13th C	24	37	40	43	53	237
14th C	35	50	55	59	70	285
15th C	65	84	91	97	109	324
16th C	141	177	195	203	225	434
17th C	156	191	209	217	239	433
18th C	172	208	224	232	253	418
19th C	170	203	219	226	247	380

Yet, while more defensive structures were being built during each of the centuries examined here, the average area under surveillance by each type of structure (Table 2) does not appreciably change over time, especially between the 16th and 18th centuries. Interestingly, two trends occur. First, the average area under surveillance by a typical castle diminished over time, fitting with the findings of Kirk (2016) which showed that the average elevation and prominence of a castle over the landscape diminished over time. Second, towers were typically built to observe a larger area of land than castles. This difference in visible area between inland castles and coastal towers is likely a result of Sicily's rugged topography. Since coastal towers were often built on rocky outcrops jutting into the Mediterranean, their viewsheds are not obscured by terrain, and so a greater area of coastal land is visible from these vantage points than from that of the average castle whose view was often obscured by surrounding mountains.

Table 2. Table showing total average area of all viewsheds, the average area of viewsheds for castles, and the average area of viewsheds for towers by century.

Average Area Covered by Viewsheds in KM2			
Century	Total Averages	Castles Averages	Towers Averages
11th C	222.49	223.18	128.12
12th C	215.55	211.23	421.81
13th C	200.28	193.99	442.50
14th C	198.95	192.17	406.83
15th C	198.59	191.35	244.68
16th C	206.27	189.42	238.06
17th C	200.81	181.63	230.96
18th C	203.93	179.64	234.09
19th C	207.43	176.33	240.05

In much the same way, an average coastal tower was also typically able to see more of the island's other defensive structures than their inland counterparts (Table 3), and as the total number of structures in use over the island increased, so did the number of structures visible from the average castle and/or tower in almost every century with the exception of the 17th. Therefore, regardless of structure type, I argue that communication between two points was an important factor moving forward through time, and that both castles and towers can be seen as important communication nodes. However, it needs to be stressed that the results presented here are a model representing a conservative estimate for all area visible from castles and towers if they work together. Not all values recorded as inputs for the average likely represent the on-the-ground reality of the situation, past or present, and it is unlikely that all castles and towers would serve to operate within the same network.

Table 3. Table showing the average number of structures in each viewshed for castles and towers by century.

Average Number of Defensive Structures Visible in Each Viewshed			
Century	Total Averages	Castles Averages	Towers Averages
11th C	1.8	1.8	1.0
12th C	2.5	2.5	4.8
13th C	2.7	2.6	5.8
14th C	3.1	3.0	6.6
15th C	3.5	3.3	5.3
16th C	5.2	4.4	6.9
17th C	5.2	4.1	6.8
18th C	5.7	4.4	7.4
19th C	5.7	4.3	7.2

7 16th Century Case Studies

While cumulative viewsheds can tell us a great deal about the focus of a certain type of structure, it is important to acknowledge their limitations. Using cumulative viewsheds obscures what individual structures can see and fails to allow for an understanding of how these structures may have interacted with the specifics of their environment. To counteract this bias, two case studies, that of the Castle at Pollina and that of the Torre del Re, are presented (Figure 11). Both are located in Palermo Province and were selected because their viewsheds contained the average number of structures visible in the viewsheds of castles and towers for the 16th century (i.e. Pollina had 4 other defensive structures visible from it and the Torre del Re had 7 other defensive structures visible from it). The 16th century was chosen for this analysis because it was the century when the network of coastal towers can first be seen.⁴⁰

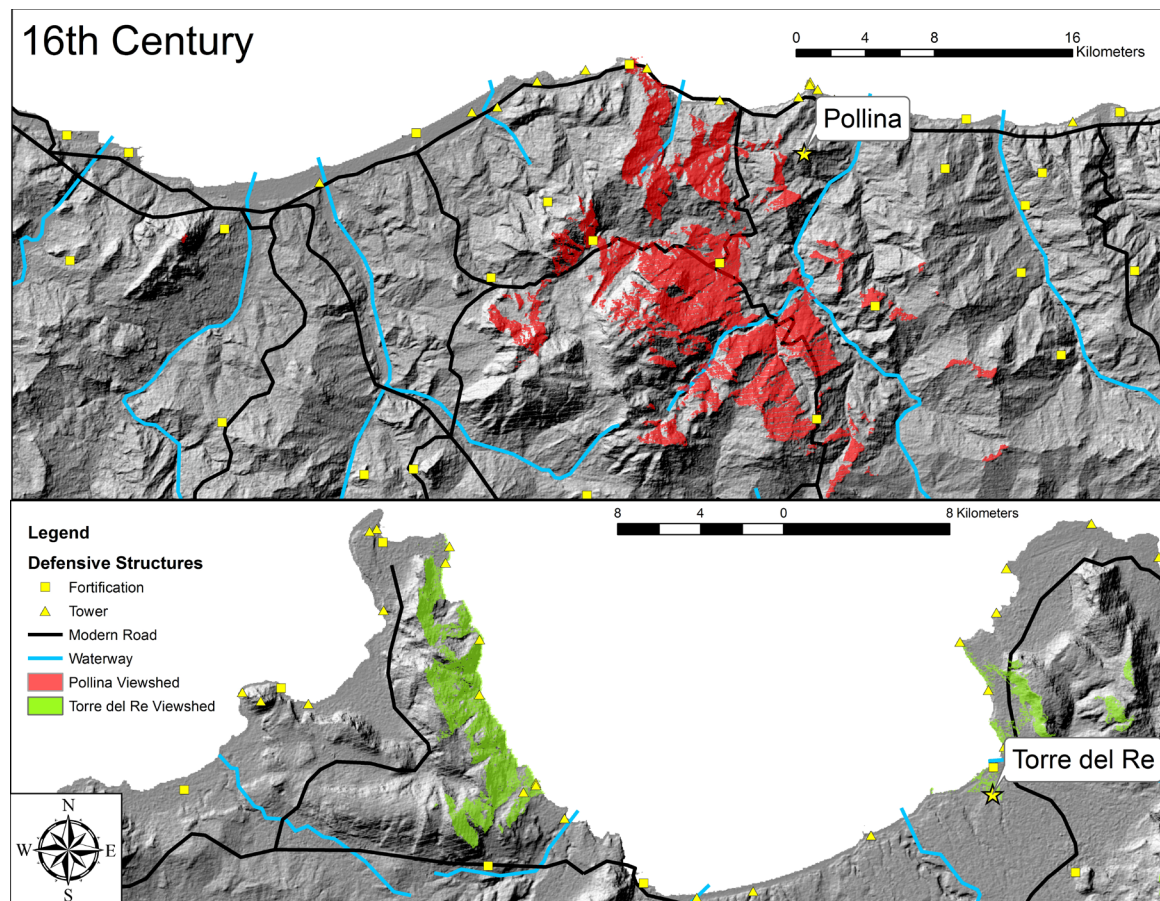


Figure 11. Figure showing the viewshed of the Castle of Pollina (top) and the Torre del Re (bottom) in the 16th century. Viewsheds derived from an ASTER GDEM (a product of NASA and METI). Modern roads and waterways from Hijmans et al. (2012).

Starting with the castle at Pollina, it is easy to see that the structure was designed primarily for keeping both the mountain pass and waterway directly to the south and west of it under surveillance, with only a minimal amount of coastal territory visible within its viewshed. As is to be expected, other defensive structures seen from Pollina largely consist of other castles, with only one tower seen within its viewshed. Nonetheless, it

⁴⁰ Modern roadways and waterways (from Hijmans, Guarino & Mathur [2012] who use the Digital Chart of the World for their source data) have been added to figures 11 and 12 to help orient the reader. Note that these do not perfectly match the projection of the DEM used and the author is aware of this.

is possible to see the coast from the castle, and furthermore, anyone who has been to the castle can likely tell that the area within this viewshed is a very conservative estimate. Indeed, the waterway directly to the east of the castle can also be observed in modern times, which means that the castle had command over much more of the waterway and roadway than the viewshed produced using the ASTER GDEM would imply. Furthermore, the use of smoke signals would also likely make many more of the coastal towers found near Pollina valuable to the castle's defenses, as one does not need to directly see one of these structures to be warned of incoming danger by smoke.

In contrast to this, the landmass contained within the viewshed of the Torre del Re consists mostly of coastal territory. Very little of the roadways and waterways included on this map can be seen from the tower, and focus here centers mostly on the coast opposite the tower rather than the territory immediately around the structure. Other defensive structures within the tower's viewshed are mainly other towers, strengthening the idea that these coastal defenses were built to act as a network signaling danger to each other. Given this, it is easy to see that the focus of the Torre del Re seems to be almost entirely directed towards the water, and specifically towards the bay the tower is found within, with little concentration on the interior of the island or surrounding castles still inhabited by feudal lords.

As both the castle at Pollina and the Torre del Re represent what is typical for the castles and towers of the 16th century, a clear division in focal points exist between the two different types of structures; castle locations emphasize visibility on interior trade routes and waterways with little interest on the coast, while what is visible from towers remains primarily focused on the sea – specifically Sicily's many bays and inlets. Nonetheless, similarities exist as well. Close proximity to other defensive structures in both networks⁴¹ allowed for messages to be carried by horse as well as smoke signals. Roadways connecting major cities are known to have existed in the Middle Ages (see Arcifa 1997), and it is likely that roadways dating back to the Roman era connected many of the castles of Sicily throughout much of the Middle Ages (see Kirk 2016). As coastal towers become more common, it is interesting to note that coastal roads become more common as well (see Trasselli 1974), even though they would have likely been less effective at carrying simplistic messages – such as impending attack – than smoke signals. Nonetheless, the development of coastal routes does seem to indicate that as the use of smoke signals changed from inter-castle to inter-tower communications, so too did the routes linking defensive structures together.

To validate data produced by the viewsheds using the ASTER GDEMs, viewsheds were also run for the castle at Pollina and the Torre del Re using the 10m DEM of Tarquini et al. (2007) (Figure 12) to ensure that a major difference in foci between two different digital elevation models could not be observed.⁴² Qualitative assessment of each structure's viewshed revealed that the viewsheds produced by both DEMs cover roughly the same area, with points for each structures on the 10m DEM having slightly more cover to the east. Quantitatively, there is more of a difference. Using an ASTER GDEM, the Castle of Pollina has an area in its viewshed of 524 km² while the viewshed produced by the 10m DEM put forth by Tarquini et al. (2007) covers an area of only 367 km² (70% of the area covered by the ASTER GDEM viewshed). This represents a major difference with the ASTER GDEM allowing for more land to be visible. However, with the Torre del Re, the opposite is true, and the ASTER GDEM covers only 31 km² while the 10m DEM from Tarquini et al (2007) covers an area of 42 km² (135% of what the ASTER GDEM viewshed covered).

These differences in area are, without a doubt, wildly different results; but as the focus of this paper has been on the shift away from a more inland focus of trade routes towards the coast, both figures demonstrate the relative area under surveillance appears to be rather similar. While more work can be done to assess the specific area under surveillance by certain structures, and better averages for area covered by the viewsheds of each structure can be obtained, the results of this study, which qualitatively assessed the focus of each viewshed and used averages to put forth ordinal data for changes seen on a century by century basis, would not appreciably change.

⁴¹ The term network is being used here in the conventional sense and not an analytical one.

⁴² A discussion of the accuracy of this DEM can be seen in Tarquini et al (2012).

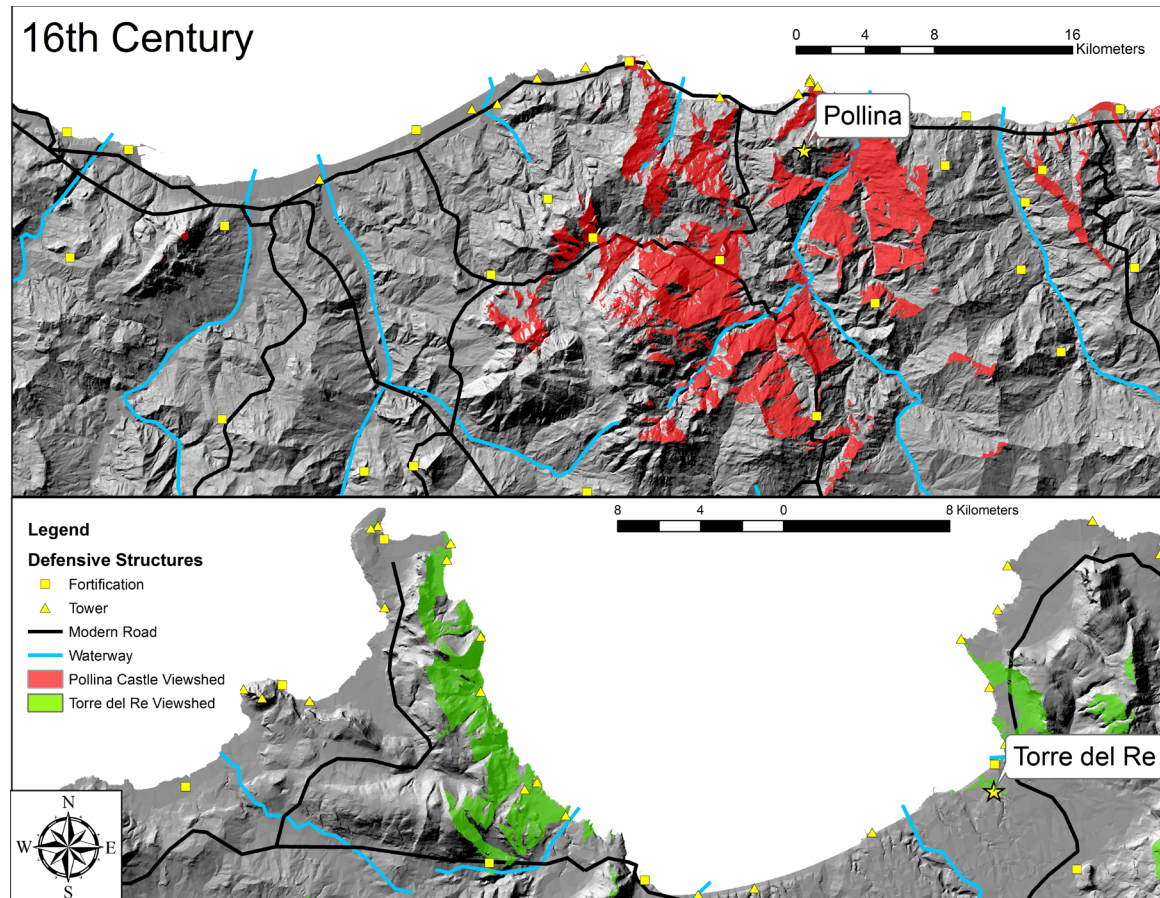


Figure 12. Figure showing the viewshed of the Castle of Pollina (top) and the Torre del Re (bottom) in the 16th century. Viewsheds derived from the Tarquini et al. (2007) 10m DEM of Sicily. Modern roads and waterways from Hijmans et al. (2012).

8 Discussion

The Mediterranean of the 15th–17th centuries is often characterized by the clashing of the Spanish and Ottoman empires, the introduction of new people and goods into the Middle Sea, shifting trade networks, and the continued presence of piracy threatening regional stability. These events likely created great uncertainty, and lead to a need for changes in the structure of political power and more solidarity in defensive strategy across the Mediterranean. Focusing on Sicily, the results of this study's geospatial analysis show that, following the 16th century, a fundamental shift occurred in the defensive strategy of the island; one that created a pan-Sicilian network of coastal defenses that slowly began to overshadow the more interior defenses of the island's Medieval castles.

Here, I have suggested a more theoretical approach to the understanding of this transition from inland castles to coastal towers than has previously been undertaken. I postulate that the appearance of defensive towers along the island's coast represents a rebalancing of Sicily's political power structure in favor of a more centralized one. After centuries of political power – and by extension the island's defenses in the form of Medieval castles – resting in the hands of a more localized elite class (i.e. feudal lords), making the defense of the Sicilian coastline more difficult, the Spanish viceroys of Sicily, in collaboration with wealthy land owners and the Sicilian Parliament, ordered a more centralized system of defense to protect Sicily's more vulnerable areas (Maurici 1985, Smith 1968). This reorientation – seen in the number of defensive structures built along coast in relation to the total number of defensive structures built at the time (Table 1) and the reorientation of visual focus for these structures (Figures 2–10) – occurred precisely at a time when

long-distance, intercontinental maritime trade was becoming increasingly important and attacks from sea based threats were becoming more and more common (Abulafia 2013, Fusaro 2012, Maurici 1985, Maurici et al. 2008, Mazzarella & Zanca 1985, Munro 1999, Smith 1968).

Whether large extents of the Sicilian coastline were vulnerable before this time, or whether the system of defenses already in place during the 14th and early 15th centuries was simply not working, can be debated. As has already been stated, it is interesting to see (in Figures 3–4) that much of Sicily's coastline was already under the surveillance of more interior castles by the 13th century, and this continued to be the case when the coastal towers of the 16th century (Figure 7) were built. This overlap in viewshed between inland castles and coastal towers reinforces the argument made here that the reason for the construction of coastal defenses likely falls outside of functional need and is instead due to changes in political, social, and economic realities. Thus, it appears that external pressure associated with warfare, piracy, the arrival of previously marginal foreign powers, and the opening of the Mediterranean to new and far-flung trade routes created the need for a more centralized power structure to offset that of the localized one which the feudal lords of the island had exploited prior to the 16th century.

What the network of coastal towers established in the Early Modern era succeeded in doing was to unite the island in a common goal, at least on a symbolic level. These structures created a system of defense that could be seen by the residents of Sicily and visitors to the island alike. This front helped to rebalance political power in Sicily, reinforcing a more centralized power structure which would operate side by side with the localized one used by feudal elites until the 19th century. One parallel in how this system of coastal towers united the island can be seen with how the royal post-horse routes of Early Modern England and Wales helped to unify the United Kingdom at roughly the same time and in much the same way (Brayshay 1991). Both systems allowed for messages to travel between different parts of their respective kingdoms at speeds that are thought to be unprecedented before their development. Unlike the case in England, however, unity would not be fully achieved in Sicily until it joined with the Italian mainland during Garibaldi's 19th century revolution. Nonetheless, the defensive towers of coastal Sicily likely still represent a first, early step towards the creation of a more cohesive, centralized government capable of defending itself and administering to its own maritime needs in a time of changing socio-economic practices.

9 Closing Remarks

As this study currently stands, the assessment presented here is only semi-quantitative. For a more truly quantitative analysis of this transition, an examination of total area focused on the coast⁴³ would serve to better justify the interpretations made here. As with all things, however, this falls victim to the law of diminishing returns, and I consider Figures 2–10 sufficient to indicate the assertions made in this paper. Similarly, due to the conservative nature of this study, error was assessed qualitatively with no rigorous tests made to determine what the exact margins might be.⁴⁴ In this regard, this study may have benefited from randomly testing an entire subset of structures using the Turquini et al. (2007) 10m DEM and/or viewsheds computed in Google Earth for comparison. Systematic ground-truthing would have also been a viable option for accuracy assessment. But again, due to the cumulative nature of this study, it was believed that these extraneous measures were not necessary for the validation of this study.

While questions remain regarding the shift from inland castles to coastal towers, one thing seems clear: this transition seems to reflect changes in both political structure and how trade was conducted within the Mediterranean. If it is possible to link economy with defensive strategy, then one can see the castles of Sicily being built along preexisting Roman trade routes for the continued protection of a more classical economic system under a localized power structure. When things begin to change in the 15th and 16th centuries and

⁴³ Derived by clipping all viewsheds to the visible area within .25km of the coast and summing the values.

⁴⁴ In some cases, error was assessed based on personal experience with the author having visited roughly 13% of the more than 600 total structures used in this study. Typically, viewsheds tended to stretch a little further than is possible to resolve (a known problem with computerized viewshed analyses) with fewer defensive structures within them (potentially due to no offset being used for the structures found within the viewshed).

defenses were reoriented to focus on the coast, one can only assume that a similar reason exists for this reorientation; that the construction of a new, centralized system of defensive structures along the coast signals an increase in maritime activities around the island.

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