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THE PLAGUE AND THE PARTHENON: CRUSADE, CLIMATE CHANGE AND DISEASE IN THE EARLY MODERN MEDITERRANEAN

by

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ABSTRACT

The present study examines the role epidemic diseases, specifically malaria and bubonic plague, played on the course of the Morean War (1684-1699). The Morean War was a major offensive by Christian powers, led by the Venetian Republic, against Ottoman controlled Greece. Christian victories during the war were widely celebrated across western Europe, but even in victory Christian forces took severe casualties from multiple disease outbreaks. First, this study seeks to explain the terrestrial and maritime networks the war was fought over, and how those networks either led the opposing forces into regions of endemic disease (malaria), or how they allowed other diseases (bubonic plague), to be distributed around the region. Furthermore, this demonstrates the impact of epidemic events on the Christian armies and the subsequent prosecution of the war, and that epidemic disease was a major catalyst behind demographic change in the Peloponnese, the principal theater of conflict.

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DEDICATION

I dedicate this work to my dear wife, Janet, and our daughters, Ella and Lillian, for their love and support while I completed this work. They endured the hours I spent away from home in coursework and in research, being drug across the nation and the world to archives and relevant sites, and listening to my complaints about getting this thesis written.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

LIST OF ABBREVIATIONS

DEM	Digital Elevation Model
LIA	Little Ice Age
OWDA	*Old World Drought Atlas*
PDSI	Palmer Drought Severity Index

CHAPTER I - INTRODUCTION

On January 10th, 1690, a flotilla slipped into the Venetian lagoon via the Malamacco channel, the southernmost access to the maritime republic. A wide array of shipping entered the lagoons daily, but this was not the usual traffic of merchant vessels arriving on the Rialto from Alexandria, Marseille, or London; rather it was a fleet of Venetian warships returning home victorious over the infidel Turks, with the elected leader of the Republic, Doge Francesco Morosini, commanding. Over the previous five years, Morosini and the Venetian fleet, aided by numerous Christian allies and mercenaries, decisively defeated the Turkish forces and pushed them out of the Morea, the Peloponnese region of southern Greece. The Christian forces were victorious in sieges of the major ports of the region, including Methoni, Koroni, Navarino and Nauplion, as well as defeating Turkish field armies in set-piece battles at Kalamata, Argos, and Patras. The most dramatic turn of the war occurred at Athens in September 1687, when Venetian mortar-rounds struck the Ottoman gunpowder store within the Parthenon, one of the Seven Wonders of the classical world. The subsequent detonation levelled the core of the structure, leaving a shell of a building with only a hint at its ancient grandeur (Mommsen 1941, 544-546). This litany of Christian victories only ended with the unsuccessful siege of Negroponte in the summer of 1688, but that setback paled in comparison to the new “Kingdom of the Morea” now incorporated into the Venetian *Stato da Mar*, or overseas empire.

Morosini and his fleet returned home unambiguously victorious over the Turks, a major shift in Venetian fortunes. The Venetian Republic had suffered numerous defeats at the hands of the encroaching Ottomans over the previous two centuries, which had gradually eroded their seaborne empire in the Aegean and Ionian seas. Morosini, the Venetian commander, earned his military reputation during the most recent iteration of these conflicts, the War of Candia (1645-1669), in which Venice lost control of Crete after a protracted war of attrition (Setton 1991,104-206). The Morean War provided Venice an opportunity to satisfy the irredentist impulse to restore their empire to its former glory. The success of the campaign elicited an enthusiastic response at home, as evidenced by Morosini's election as Doge while still on campaign in 1688, and the conferral of the victory title *Peloponnesiacus* upon him by a euphoric Senate.

The return of Morosini and his fleet fits into this celebratory scheme, as it was nothing less than a triumphal cruise. As the fleet made its way home up the Venetian-controlled Adriatic in the fall of 1689 it was greeted at each port by escorts of local vessels, cannon-salutes, and jubilant celebrations ashore (Locatelli 1691, II:253-270). Ill winds slowed the progress of the fleet, but the delay allowed the preparation of a more elaborate welcome at home. The events of January 10-11th, 1690 were a full-blown triumphal entry into the city, modelled directly on Roman antecedents. Upon entering the lagoon Morosini received the welcome of the entire Venetian Senate, the Knights of San Marco, and all the grandees of the Republic. The next morning, he sailed from the monastery of S. Nicolo di Lido aboard the *Bucintoro*, the ceremonial galley of the Doge, accompanied by ships bearing banners and tapestries portraying his victories, prisoners, and spoils of war. The civic populace joined the triumphal procession in their *gondolas* and *sandalos*, to the point that "all the inhabitants of Venice were upon the seas." (Locatelli 1691, II.271). On arrival at the *Arsenale*, Venice's military shipyard, Morosini found a triumphal arch built in classical styling, flanked by images of both Neptune and the Blessed Virgin, mixing Christian and Greco-Roman triumphal religious symbols (Locatelli 1691, II:275). While originally constructed in paper mâché, a permanent arch was built within a year, and two classical lions taken from Piraeus, port of Athens, flanked the arch as trophies of Venice's military glory. The lions remain there still.

The Venetians heavily publicized their successes during the Morean War, and much of Christian Europe, whether Catholic or Protestant, consumed news of Turkish defeats with great enthusiasm. Morosini and other Christian commanders wrote short accounts of critical sieges and battles, known as *relazioni*, which were quickly published as pamphlets and widely translated and disseminated throughout Europe (Moronsini 1685; Corner 1687). Printing houses capitalized on the public fascination with the conflict by commissioning histories of the war and biographies of Morosini, including one by Morosini's secretary, Alessandro Locatelli (1691), as well as Niccola Beregani (1698) and Antonio Arrighi (1748). By far the most popular work concerning the war was *Memorie istoriografiche de' regni della Morea, Negroponte e littorali fin' á Salonichi*, written by the Venetian friar and cartographer Vincenzo Coronelli (1687). As a blend of geography with contemporary military history, the *Memorie istorigrafiche* included a textual narrative of the conflict accompanied by Coronelli's own highly detailed maps and plates. The work was immediately translated into multiple languages and mass produced, with surviving copies of the book found in the library of John Adams, and many of the plates feature in the extensive military map collection of King George III.

The historical image of the Morean War presented in contemporary and later materials is one of unmitigated Christian triumph over a tyrannical, infidel Empire, and the various Christian commanders, from Morosini to his German mercenary commanders, Maximilian Wilhelm von Brunswick and Otto von Konigsmarck, appear in these accounts as heroes of Christendom and their respective nations. Yet this triumphalism obscures the horrendous toll the war took on combatants and non-combatants caught up in the conflict. A careful reading of the battlefield reports, coupled with extensive census records and maps produced in the decade following the end of major combat, show devastating mortality rates among the soldiery and extensive depopulation of the Peloponnese. Despite the celebratory attitude displayed by the victors, the Morean War was won at a shocking cost, and left the so-called “Kingdom of the Morea” a desolate landscape.

The epidemic spread of disease among Venetian forces, their allies, and their Turkish opponents is an aspect of this conflict, that, while noted by both historians and geographers, has not been properly considered as a central aspect of the campaign. Disease ravaged the opposing forces, beginning with a malaria outbreak at Corfu in 1684, and continuing with intermittent bouts of malaria and plague through the end of major combat operations at Negroponte in 1688 (Setton 1991, 290-91). As the Venetian fleet and its mercenary army moved from siege to siege, disease followed, devastating the army, and hampering military operations. As an illustration, out of 3,350 Saxon mercenaries who joined the Venetians in 1685, only 800 remained during the siege of Athens two years later (Setton 1991, 299). In fact, the Venetians eventually abandoned Athens altogether, not due to Turkish military opposition, but because of continued outbreaks of plague (Setton 1991, 341). Indeed, the Venetians remained cognizant of the threat of disease in the Morea even as they feted Morosini; the Doge and his fleet were forced to undergo the *quarantia*¸ 40 days of quarantine, at Split before the final leg of their journey, and they sent ahead sworn documentation asserting the absence of plague amongst them.

The Morean War significantly impacted the human geography of the Peloponnese. Much evidence exists for a major demographic decline in the Morea subsequent to the Morean War, with large numbers of villages abandoned in the 18th and 19th centuries (Wagstaff 1978, 297-98). The mechanism behind these abandonments is debated, though it is notable that disease, as prevalent as it is in the sources, has not been discussed as a potential cause. Within this study I seek to answer the following interrelated research questions:

1. What environmental and geopolitical factors shaped the movement of people and goods in the Eastern Mediterranean, and how did these movements impact conflicts in the region? In other words, what networks did the Venetians and Ottomans fight over, and how did these networks impact disease occurrence and mobility?
2. What diseases did Christian forces encounter during the campaign and how did the subsequent epidemics shape the course of the conflict? How did the make-up of the Christian armies exacerbate morbidity and mortality during these epidemics?
3. How can GIS modeling be used to better understand disease risk within the Ottoman world?

4. How did this conflict and its attendant epidemics change the human geography of the Morea? Can we model these changes in the landscape using GIS programming and methodologies?

The goal of these research questions is to explain the complex interplay of disease, climate fluctuations coinciding with the 17th century and warfare in changing the human landscape of the Morea during and subsequent to this conflict, and in turn, how this changed the fate of two empires. Chapter II examines the environmental factors that shaped networks of trade and power projection in the Eastern Mediterranean. Control of these networks was the impetus behind the Morean War, yet these networks also influenced the propagation of disease among the opposing forces. Chapter III analyzes the risk of endemic malaria within the combat zones of the Morean War, and how malaria was an especially deadly pathogen to the Christian forces deployed to the Morea in 1684-1686, and again in the fall of 1688. Chapter IV discusses the appearance of bubonic plague in the combat theater in 1687-1688, and will provide GIS modelling of plague risk in Ottoman Greece, the Balkans, and Anatolia, and propose a more complex understanding of plague movement across landscapes. Chapter V examines the role of malaria in the costliest battle of the war, the Siege of Negroponte. Finally, Chapter VI utilizes post-war Venetian cadastral texts and maps to consider the impact the war and its attendant epidemics had on the human landscape of the Morea.

CHAPTER II - THE GEOGRAPHY OF MARITIME EMPIRES IN THE EASTERN MEDITERRANEAN

The city-state of Venice was born of the sea and survived by the sea, so it is no surprise that over the centuries the Venetians would create a seaborne network of critical ports connecting them to the trade entrepôts of the eastern Mediterranean. These ports further linked them to the caravan networks of the Balkans, Anatolia, and the Near East. The maritime and terrestrial networks of the Eastern Mediterranean are crucial to understanding the role of endemic and epidemic disease during the Morean War. The networks Venice and the Ottomans struggled over brought them into direct contact with endemic diseases in the region, as well as providing efficient networks (sea lanes and roads) and vectors (fleets, armies, and refugees) for the epidemic spread of some diseases.

Yet this *Stato da Mar*, literally an "empire upon the seas", did not take shape in the short term, or without physical constraints; rather it evolved organically in the face of numerous contingent factors, including the maritime space it was built upon. Therefore, we must examine the *Stato da Mar* considering the maritime geography and climatology of the Adriatic, Ionian, and Aegean Seas. In what ways did the annual wind patterns of the region shape sailing patterns? How did the availability of safe anchorages further shape the trade lanes? How did sailing practices and technologies limit the range of choices sailing masters made when embarking on a journey in this region? How did this maritime network allow access to the land-based trade networks of Southeastern Europe and the Near East? The *Stato da Mar* was also created within a temporal framework, requiring us to acknowledge the contingent geopolitical events that created this empire, focusing on the imperial cruise of Doge Pietro II Orseolo down the Adriatic in 1000, and the Fourth Crusade of 1202-1204. Each of these episodes involved intentional, proactive measures by Venetian authorities to conquer or otherwise impose their will on spaces critical to the maintenance of their trade lanes, and when we compare these "imperial moments" with the maritime geography, we gain a clearer understanding of the *Stato da Mar*.

Seafaring in the Eastern Mediterranean

All nautical travel is constrained by natural forces, but premodern sailors, lacking precise navigational aid, meteorological information, and mechanized engines, were at the mercy of environmental factors more so than their modern brethren. The movement of sailing vessels is limited by three basic environmental factors: currents, tides, and winds. In addition, certain technical factors further burdened premodern mariners, including the lack of precise navigational aids, the limits of contemporary naval architecture in the face of bad weather, and the need to revictual frequently to support the high manpower needs of shipping. Indeed, these geographic and technological issues impacted sailors globally, but the exact manner they played out varied from region to region with geographical conditions. How did these factors effect ships and their crews in the Eastern Mediterranean, and in turn, how did these factors shape the maritime networks these sailors created?

Currents and Tides

The movement of water, either in the form of surface currents or in tidal action, can either aid or inhibit ship movement depending upon direction and/or timing. In the Mediterranean Sea all currents, both surface and subsurface, move in a counterclockwise manner. This implies the currents would help east-to-west sailing along the northern shores of the Mediterranean, and west-to-east sailing on the southern littoral. Sailing in the opposite direction would appear to hinder movement pattern. Yet this is not the case, as Mediterranean currents are negligible. The Mediterranean is largely cut-off from the warm-water circulation patterns of the larger oceans, which generate higher current speeds. For example, the North Atlantic Current which brings the warm equatorial waters towards Europe can average up to 6 knots (kt) (11kph). The current speed in the Mediterranean averages no more than 1 kt (1.85kph), with some localized occurrences of 1.5 kt (Pryor 1989; Thompson and Thompson, 2017). Such a low current speed has little bearing on sailing practices.

Tidal action is also an important variable for captains to consider, especially when approaching a safe harbor. The tide cycle can help or hinder a ship during ingress or egress from an anchorage. Some small harbors or bays may be unusable as an anchorage at low tide, even leaving a vessel aground. But tidal action is barely present in the Mediterranean, again a result of the Mediterranean's enclosed nature. In most Mediterranean ports, the mean difference between high and low tide is less than 1m, with little practical impact to sailing practice, although high tide coupled with seasonal *sirocco* winds (see below) accounts for tides of higher than 1.8 m in the Venetian lagoons, which is now responsible for growing frequency of *acqua alta* flooding in the lagoons (Pryor, 1989; Thompson and Thompson, 2017).

Wind Patterns

The annual cycle of wind patterns in the Mediterranean influences sailing practice far more than any other environmental factor. Wind behavior, including wind speed, direction, and frequency is of paramount concern to the pilot of any vessel. Mediterranean wind patterns are well documented through both modern data collection as well as historical attestations of pilots and travelers extending back into Greco-Roman antiquity. In fact, the historical information we possess suggests no real change in wind patterns in the Mediterranean throughout recorded history (Murray 1987). The winds Venetian sailors utilized in the 10th , 13th, or 17th centuries are the same as we experience today.

To understand the importance of wind patterns, we must understand how sailors use them in the first place. As long as a wind is blowing, a vessel can find a way to harness wind power, even if the wind is blowing against the direction of travel. By tacking, or gybing the sails from port to starboard in a zig-zag pattern, any sailing vessel can utilize the wind to move in a 270-degree arc. A ship cannot sail directly against the wind, or within 45 degrees either side of said wind direction, but any pilot can make use of a wide latitude of wind direction to make headway (Rousmaniere and Smith, 2014). Yet having the wind as close to dead astern, or “windward”, as possible is advantageous to any sailing ship, both in terms of providing greater speed and maneuverability.

Mediterranean winds follow certain basic patterns. First, the Mediterranean is known for calm surface winds, especially when compared to the high windspeeds of the North Atlantic or Central Pacific, especially during the late spring and summer months (May – September). Windspeed is rarely above 20 kts during these months. Gale force winds (above 30 kts) are more common from late October through April, and during the medieval and early modern period few captains risked their vessels during this time of year (Heikell and Heikell, 2019; Pryor, 1988).

Wind direction also follows predictable annual patterns. Copernicus, the European Union’s online compendium of climate data, shows the mean annual wind direction of theEastern Mediterranean between 1993 and 2016 is overwhelmingly northerly, either north-northeast or north-northwest winds. The data confirms the textual accounts of pilots and travelers from any time in the last 2500 years (Simoncelli et. al., 2016). The Greeks referred to these as *etesian* winds, while the early modern Turks call them *meltemi*, a term in common usage among sailors today (Heikell and Heikell, 2019). From time-to-time, these northerlies turn to gale-force winds known as the *bora*, occurring with greater frequency during the winter months, further limiting maritime traffic in that season (Cesini, Morelli and Parmiggiani, 2004). Yet generally the winds are calm, and any vessel departing from the northern shore of the Mediterranean would possess the “weather gauge”, the greater freedom of speed and movement afforded by having the wind astern. John Pryor (1988) asserts that European powers of the Mediterranean possessed great military and commercial advantages simply by sailing from windward.

In-shore sailing practices

Pre-modern mariners sailed according to several common practices dictated by natural and technological limitations. Taken all together these limiting factors resulted in a near-universal preference for in-shore sailing or sailing within sight of the shoreline. In-shore channels, or waterways found between landmasses, such as between islands or islands and the mainland, were even more desirable. Why was this the case?

One reason was ease of navigation. Ancient and medieval sailors lacked even the most basic navigation tools, such as a compass, astrolabe, or accurate timepieces. Proper navigational charts were non-existent until the appearance of portolan charts in the 13th century, and these were still tied to visual landmarks (Campbell, 1987). Even after the invention and proliferation of better navigational technology, the enclosed nature of the Mediterranean meant that sailors were never far from land in the first place. So coastal landmarks, especially hilly and mountainous landscapes, acted as the primary waypoints for pre-modern sailors (Pryor 1988). This is reflected by the portolan charts utilized by late medieval/early modern sailors. These charts used rhumb lines to show relative direction towards clearly identifiable coastal landmarks as a way of finding appropriate harbors (Astengo, 2007). Medieval portolans evolved into “pilots”, printed guides to local ports first appearing in the 17th century, which combined portolan charts annotated with soundings and narrative descriptions of ports and headlands, as well as sketched silhouettes of landmarks and port entrances (Seller 1753). Modern pilots, utilizing up-to-date nautical charts and GPS data, still include visual sketches of coastlines so that mariners can navigate by landscape, especially as they approach anchorages (Heikell and Heikell, 2019; Thompson and Thompson, 2014).

Proximity to shorelines also enhances sailing efficiency. The daily cycle of heating and cooling of land and sea produces sea winds, steady winds blowing from sea to shore, during daylight hours. Sea winds are prevalent from 8:00am to 4:00pm most days. The cycle reverses with nighttime cooling, with land winds heading out to sea after sundown. This daily wind cycle can add to the prevailing surface winds, or even provide mobility in periods of otherwise calm winds. In-shore channels provide an even greater sea/land wind cycle, as landmasses are on both sides of the channel (Rousmaniere and Smith 2014). The Adriatic Sea possesses several in-shore channels, including the

Kvarner and Velebit Channels that act as daily wind funnels, pushing shipping to the south with relative ease (Marelic 2016).

Sailing vessels also required frequent resupply in the pre-modern era. Fuel was obviously not an issue, but the heavy manpower needs of a large sailing ship or war galley necessitated significant provisions of foodstuffs and fresh water. Space was at a premium in any sailing vessel, and food and water stores took up a great deal of space. Most medieval and early modern cargo ships needed a minimum of 50 sailors, while war galleys were especially manpower intensive, with at least 200 oarsmen and marines on board to properly mobilize the vessel (Lane, 1934). And this only accounts for the working crew. Merchant vessels frequently carried dozens of passengers, especially those ships plying the pilgrimage route to the Holy Land. Pryor (1988) calculates that most medieval ships would run out of fresh water long before food supplies, and on average needed to replenish their water stores every 3 days. The need for frequent stops further kept shipping near coastal sources of resupply.

The principal factor keeping mariners close in-shore was safety from storms and squalls. Compared to the world oceans, the Mediterranean is calm, but bad weather is still the bane of mariners, as evidenced by the innumerable shipwrecks recorded throughout the Mediterranean. The winter months experience frequent high-wind *bora* and *sirocco* events that could snap masts or capsize vessels (Marelic 2016). Even during the calm of the summer sailing season, thunderstorms and squall lines are known to appear with rapid onset. Galleys and galleasses, noted for their long hulls but low freeboard, were easily swamped by even the smallest of storms (Lane 1934). The localized high winds produced in such storms also threaten shipping with the dangers of a "lee shore", a straight coastline perpendicular to the wind direction. A storm can easily push a ship directly aground on the rocks, shoals, or beaches that make up the lee shore (Rousmaniere and Smith, 2014).

The Dalmatian coast of the Adriatic Sea, the Ionian Sea, and the Aegean Sea all exhibit complex maritime environments well suited for maritime traffic. Wind speed and direction, numerous in-shore channels and the multitude of safe harbors together create an ideal setting for maritime trade lanes. The Adriatic Sea best illustrates this. Wind direction and speed is largely uniform across the entire sea, yet the historical trade lanes are all located on the northeast coastline along Istria and the Dalmatian coastline of Croatia and Montenegro. Pilots avoided the Italian coastline on the southwestern side of the sea almost universally. Even ships setting out from major Italian ports like Ravenna, Ancona, or Bari sailed across the Adriatic to the Dalmatian coastline and only then proceeded south to the wider Mediterranean world (Faracic, 2014). The network of over 200 safe anchorages on the Croatian mainland and in the Dalmatian islands, coupled with multiple in-shore channels between island groupings creates a near-ideal maritime route. By comparison the Italian coastline to the southwest possesses fewer than 50 ports, most of which feature artificial moles and other structures built in the 19th and 20th centuries (Thompson and Thompson 2014). Only Ravenna, Ancona, Bari, and Otranto stand out as natural deep-water ports, so most of the Italian coastline is considered a lee shore.

The Ionian Sea features in-shore channels between the Ionian islands (Corfu, Lefkada, Kephalonia and Zakynthos) and the mainland, with safe harbor facilities inside the channels themselves. The principal sailing routes avoid the western side of the islands and all travel down the in-shore channels (Heikell and Heikell 2019). South of the Peloponnese the prescribed route hews near to the Messenian Cape at Methoni, Cape Matapan, and Cape Malea. Routes diverge from Cape Malea, with one moving eastward toward the north coast of Crete and on to Rhodes and the Levant, and the other going northeast to Athens and beyond. The northeastern route continues as an in-shore channel through the Euboean Gulf, the calm channel between Evia (Venetian Negroponte) and the Greek mainland. There are no ports on the west coast of Evia, and with prevailing northeasterly winds this becomes a lee shore, so the eastern channel was preferred in antiquity and is still advised by modern pilots (Pryor 1988; Heikell and Heikell 2019). Upon exiting the Euboean Gulf, ships can move directly north to Thessalonika or northeast to the Dardanelles and Istanbul.

The geography and climatology of the eastern Mediterranean creates a natural maritime network that can be exploited commercially, politically, and militarily, and can set the stage for geopolitical competition over control of that network. The Venetian Republic of the medieval and early modern period, itself a commercial, maritime state, sought to control the trade routes that were their economic lifeblood. To do so meant regulating, in some form or fashion, the network of ports in the region and in-shore channels that connected them. Gradually the Venetians did just that, forming the *Stato da Mar*, which reached its greatest extent at the end of the 15th century (**Map 1**).

Forging the Stato da Mar: Venetian Imperialism from the 10th to 15th centuries.

Venice’s ties to the sea comes from its very origins. Small fishing settlements existed in the marshes and lagoons at the mouth of the Po River valley from antiquity, but large populations only migrated to the area due to warfare. The Lombard invasion of 568 CE radically altered the political landscape of northern Italy. The sheer violence of the

Lombards forced large number of refugees from various cities in northwestern Italy into the marshes. The Roman populace of Altino fled to Torcello, that of Padua to Malamacco, Concordia to Caorle, Oderzo to Heraclea, Treviso out to Chioggia, and Aquileia to Grado (Giovanni Diacono, 1999; Madden, 2013; Hodgson, 1901). These nascent refugee communities maintained their cultural and political allegiance to the Byzantine Empire centered on Istanbul, and ocean-going trade in the eastern Mediterranean quickly became the main economic driver within the lagoons. The *Translatio Sancti Marci*, the legendary tale of the arrival of the relics of St. Mark in Venice in 829, speaks of Venetian merchants visiting Alexandria, where they stole the body of the Evangelist to boost the religious prestige of their society (McCleary, 1931). The historicity of this tale is debatable, but the notion that Venetian merchants would have conducted business in Egypt is believable and belies a historic reality. Alexandria was not the only entrepôt that attracted Venetian merchants. Trade with Istanbul predictably grew into the central feature of the Venetian economy, culminating in a critical trade agreement in 992 that gave Venetians preferential trade status within the Byzantine Empire (Hodgson, 1901; Lane, 1973). This agreement encouraged further growth of trade between Venice and the imperial capital (Borsari 1988).

The Imperial Expedition of Pietro II Orseolo

Solidifying trade relations with Istanbul provided the impetus for Doge Pietro II Orseolo's campaign to dominate the Adriatic Sea. The many ports along the Dalmatian coast served as potential safe harbors, but they were also trade rivals. Both Poreč and Pula on the Istrian coast, a day's sail from Venice, possessed large deep-water ports and substantial populations. Zadar, in the very center of the Dalmatian coast, was able to control trade lanes to the north and south. Split, founded as the retirement villa of the Emperor Diocletian (284-305), held the seat of an archbishop, a rival for ecclesiastical supremacy over Dalmatia against Venice's own Patriarch. Adriatic ports also provided haven for pirate bands. Slavic pirates operated out of the Neretva River basin in southern Dalmatia, and they were joined by Latin-speaking pirates from the nearby island ports of Korčula and Lastovo. These pirate havens sat astride the major trade routes and exacted a significant economic toll on shipping in the region. Venetian domination of the Adriatic was not preordained, and there were many rivals and impediments to Venetian power.

On the Feast of the Ascension (May 9) 1000 CE, just as the sailing season opened, Doge Pietro II led a fleet of warships out of the lagoons and towards the northeast coast of the Adriatic. The ostensible purpose of the expedition was to reduce the threat of the Neretva pirates. The previous year embassies from Zadar and the other Dalmatian cities came to Venice seeking aid against this common threat (Giovanni Diacono, 1999, IV.30). The pirate threat provided Orseolo the opportunity to not only eliminate a danger to Venetian shipping, but to impose Venetian hegemony on the major ports of the Adriatic. Public expressions of piety by the Doge and his fleet were a major aspect of the campaign. Orseolo received the banner of St. Mark from the Bishop of Castello (Venice) as the fleet departed and stopped at Grado to accept a similar banner of St. Hermagoras from the Patriarch of Grado. The banners signified the supernatural aid of the patron saints of Venice, but also implied the saints' favor over and above the patrons of the Dalmatian cities they sailed to defend.

Orseolo first stopped at Porěc, where he and his armed bodyguard went ashore to venerate the relics of St. Maura in the cathedral there, and the next night he slept in the monastery of St. Andrew at Pula (Giovanni Diacono, 1999, IV.31). Again, piety coupled with a show of power. The Doge honored local patron saints, while practically demonstrating his ability to enter these cities at will with an armed force. These were acts of religious and political submission to Venice. After a brief stop at Ossero, the fleet made for Zadar, the most important port of the Dalmatian coastline. Zadar opened its gates to Orseolo, and he was also greeted by the bishops of Krk and Rab, who had travelled there specifically to pledge their loyalty to the Venetian leader (Giovanni Diacono, 1999, IV.31).

Zadar became a forward-operating base for Orseolo. He received intelligence that a group of Neretvan nobles were returning home from a merchant trip to southern Italy and armed with this information he dispatched 10 vessels to intercept them. This force overtook the Neretvans off the island of Sušac, and 40 prisoners of noble birth were taken prisoner to Trogir. The Neretvan leadership immediately dispatched an embassy to Orseolo, who released most of the prisoners in return for oaths of submission from the Neretvan leaders, but retained 6 prisoners as hostages (Giovanni Diacono, 1999, IV.31).

The Neretvan pirates were subdued with little bloodshed, but the island bases of Korčula and Lastovo remained unchecked. The Venetian fleet sailed on to Trogir and then Split, where Orseolo received the submission of those cities, as well as that of Dubrovnik further to the south. He then sailed to Korčula, and in the face of overwhelming force the city swiftly submitted, but nearby Lastovo did not, resulting in a short siege. After the city’s water supplies were cut, the populace surrendered and the walls of Lastovo were demolished to prevent future rebellion (Giovanni Diacono, 1999, IV.32). With his mission complete Orseolo and his fleet returned home, following the same route by which they came.

Orseolo's expedition of 1000 CE did not create an empire in the classic sense. The Venetians did not install governors or garrisons in the cities they visited, nor did they impose direct taxes. Rather this was an exercise in force-projection. By assembling a significant war-fleet and sailing down the main trade routes, visiting each city and demanding entrance to them by the Doge and his bodyguard, the Venetians established the power they were capable of wielding if necessary. The limited violence of the campaign, including capture of the Neretvan nobility and the siege of Lastovo, further enhanced the image of a powerful Venice, capable and willing to wield their military might down the Adriatic. Venice successfully achieved dominance over the Adriatic by acting dominant over the Adriatic. This would remain the status quo for many centuries.

The Fourth Crusade and the Forging of a Seaborne Empire

The 11th century saw Venetian trade with the Byzantine Empire grow considerably. Istanbul remained the source of many luxury items that made their way across Asia via the Silk Road and Byzantine Greece provided a wide array of agricultural products for Western European markets. Other Italian maritime cities joined the Byzantine trade as well, including Genoa, Pisa, Amalfi, and Ancona, but none were as successful as Venice. Venetian success stemmed from its long-standing alliance with Byzantium, which took on new significance in the late 11th century. The Norman warlord Robert Guiscard, who already controlled southern Italy, invaded Greece in the 1080s and threatening to topple the Byzantine Empire in its entirety. The threat to the Venetian economy was twofold. It would end the long-standing and lucrative alliance with the Byzantines, yet it would also present a larger geopolitical challenge. If Byzantium fell to Guiscard, he would then control both the Italian and Greek coastlines at the opening of the Adriatic, including the Ionian Islands and mainland ports of the western Greece. This would give Guiscard a chokehold on the trade lanes into and out of the Adriatic Sea, a strategic disaster for Venice.

Consequently, the Venetians offered significant naval aid to the Byzantines against the Normans, though at great cost. The Normans ambushed and destroyed a Venetian fleet at Corfu in 1084, leaving thousands of sailors dead and many more imprisoned for a long period (Madden 2013). Despite this grim setback for the Venetians, the Normans ultimately failed in their campaign, and the Byzantine Empire survived. In return for their military aid, Emperor Alexius I Comnenus bestowed an imperial *chrysobull*, or “golden bull” on the Venetians in 1082. The new treaty granted sweeping economic advantages for Venetian merchants operating within the Empire, most notably exemption from all customs duties. This effectively placed Venetian merchants at an advantage over native Byzantine merchants, who were still subject to taxes and customs imposts (Borsari, 1988; Nicovich, 2009).

Trade within the Byzantine Empire was already critical to the Venetian economy, yet the *chrysobull* of 1082 further intertwined the fate of the two states. The 12th century saw dramatic growth of Venetian power at the economic expense of the Byzantines, and as a result, tension arose between the erstwhile allies. When Emperor John II Comnenus revoked the *chrysobull* in 1118, the Venetians raided the Byzantine coastline until he restored it. In March 1171 Manuel I Comnenus orchestrated the mass arrest of more than 10,000 Venetian merchants and their households within the Empire, all on the same day, severing ties with the Republic for the next decade (Madden 2013). Despite these violent episodes the two powers generally continued their symbiotic relationship.

The Fourth Crusade (1202-1204 CE) represented the chaotic culmination of these East-West tensions and inadvertently sparked the creation of a true Venetian seaborne empire. The crusade was initially called by Pope Innocent III to retake Jerusalem from the hands of the Ayyubid Sultanate, which had taken the holy city from Christian hands in 1187. The intended target of the crusade was the Ayyubid base of power in Egypt, and as such the Pope had recruited the Republic of Venice, led by its nonagenarian Doge Enrico Dandolo, to supply the naval transport for the planned campaign. Crusaders, most of whom were of French origin, were instructed to make their way to Venice to join the combined army and fleet of the crusade (Queller and Madden, 1997).

A series of unanticipated events waylaid the crusade. The Venetian Republic suspended all overseas trade in 1202 CE in order to assemble or construct an enormous fleet of more than 400 cargo ships, horse transports and war galleys, with the contractual understanding that the assembling French crusaders would provide funding for this fleet upon their arrival at Venice. But by the winter of 1202, the entire crusade seemed bound to collapse. Fewer than half the expected 35,000 crusaders appeared, and the crusade verged on the edge of financial ruin, and with it the entire Venetian economy. The insolvency of the Fourth Crusade set it on a wild series of half-measures intended to save the crusade but instead culminated in the conquest of Christian Istanbul rather than Muslim Alexandria (Queller and Madden, 1997).

To forestall the collapse of the crusade, in late 1202 the Venetians suggested the crusader army aid Venice in reasserting their authority over Dalmatia. Zadar had repudiated Venetian control several decades before and the crusading army was a welcome addition to any Venetian fleet sent against the city. The diversion to Zadar allowed the Venetians to justify a forbearance on the money the crusaders owed them, as well as regaining full control of the Adriatic coastline. In short order the combined crusader/Venetian force seized Zadar and razed the city to the ground, although there was much controversy concerning a Christian crusade sacking a Christian city (Villehardouin, 2008; Queller and Madden, 1997). Thus, the Republic retained its control of the Adriatic trade routes.

Yet the crusade still possessed no solution to its financial problems. The crusade sailed on to Corfu with dwindling hopes of a solution when a solution appeared. Alexius Angelus, the son of a deposed and imprisoned Byzantine Emperor, arrived at Corfu promising to pay the crusaders' debts and even join the crusade himself if they would help restore him and his family to the Byzantine throne. As this was the only option available, the crusaders agreed, and the Fourth Crusade set sail for Istanbul. In April 1203, the crusaders successfully placed prince Alexius on the throne as Emperor Alexius IV with relative ease, but Alexius soon discovered that the imperial treasury was bare, leaving no money to fulfill his lavish promises to the crusade. The next year saw increasing tensions between the crusade, the emperor, and the larger Byzantine populace. The result was a crusader assault on Istanbul in April 1204, capturing the city and, in theory, the entire Empire (Villehardouin, 2008; Queller and Madden, 1997).

Just prior to the final assault on Istanbul the crusader and Venetian leadership met to determine the outcome of a successful attack. The division of the Empire was the principal subject; who would get what loot and what lands? The resulting treaty, the

Partitio terrarium imperii Romaniae, paid off the debt owed to the Venetian Republic by the crusaders and gave them half of any remaining monetary spoils. But it also gave them their choice of 3/8ths of the lands of the Byzantine Empire (Tafel and Thomas, 1856). It is rare that an imperial power can determine the shape of their empire at one sitting; most empires develop over long periods and are formed through many unforeseen, contingent events. In this instance the Venetians had an unprecedented opportunity to shape a seaborne empire at one stroke

The choices made in the *Partitio terrarium imperii Romaniae* are telling. The foremost prize named therein was a vast trading quarter in Istanbul itself, comprising nearly a quarter of the city along the shorefront of the Golden Horn, the prime shipyard facilities in the region (Tafel and Thomas, 1856; Janin, 1964). The Venetians then chose a series of port cities along the northern coastline of the Sea of Marmara and the Dardanelles, including Perinthus, Theodosiopolis, Rodosto and Gallipoli. These ports were common waystations for ships heading through the straits to Istanbul, and Venetian presence here also indicated its naval dominance of the final leg of the route.

Venice next laid claim to the ports of Oreos and Karystos, located respectively at the northernmost and southernmost points of Negroponte. The bulk of Negroponte was assigned to Boniface of Montferrat, a major Crusader warlord, but the Venetians needed ports governing the Euboean Gulf between Negroponte and the Greek mainland, the safest in-shore channel in the Aegean Sea. With these ports the Venetians effectively controlled ingress and egress from the channel, a major strategic advantage. Further south they also claimed rights to the western half of the Peloponnese. This encompassed

Methoni and Koroni at the tip of the Messenian peninsula, where the Ionian Sea turned eastward into the Aegean proper, as well as Navarino Bay, a large and safe anchorage.

The Venetians also sought control of the entire littoral of the Ionian Sea. They demanded all ancient Epirus, which included much of modern Albania and northwestern Greece. This claim encompassed mainland anchorages at Lepanto on the Ionian Gulf, Preveza on the Gulf of Arta, and Vlorë and Durazzo further north in Albania. The treaty also granted Venice the key Ionian islands, including Zakynthos, Kephalonia, Lefkada, and Corfu (Tafel and Thomas, 1856). Control of the Ionian islands, together with the mainland ports, established control of the safer in-shore channel that ran down the eastern side of these islands, creating a kind of maritime chokepoint that governed access to the Adriatic Sea. Indeed, the Venetians came to know Corfu as the “door of the Republic”, vital not only for forward control of the sea-lanes but also as a defensive bulwark for Venice itself (Longnon ,1964).

The *Partitio terrarium imperii Romaniae* granted the Venetian Republic the right to seize the enumerated territories; conquering and controlling these regions was another matter. The Venetians failed to conquer some of the lands they claimed, yet were able to seize other areas not named in the *Partitio*. Much of Epirus and the western Peloponnese remained beyond Venetian control, though the major ports, like Methoni and Koroni, were taken quickly and held for centuries. In addition, the Venetians negotiated the purchase of Crete from Boniface of Montferrat in 1205, securing ports vital to east-west shipping towards Anatolia and the Holy Land. They also established a power-sharing agreement with crusader lords on Negroponte, further securing Venetian control of the ports along the Evia channel, as opposed to crusader sovereignty over the rural territories. Venice eventually gained full control of the island by 1390 CE (Thiriet, 1959).

The Fourth Crusade, at one historical juncture, granted Venice maritime dominance in the northeast quadrant of the Mediterranean. In short order, Venice seized control of the major in-shore channels preferred by mariners, including the one passing through the Ionian islands and the important maritime juncture at the Evia channel. The Dardanelles and the approaches to Istanbul also were under the watchful eye of the Republic. Rarely in the history of empires has a state gained such considerable strategic dominance at one blow.

The Rise of the Ottomans and the Twilight of a Seaborne Empire

The Republic maintained its seaborne empire and dominance of the eastern trade lanes with little interruption for more than 250 years. The rise of the Ottoman Empire over Anatolia and portions of the Balkans radically changed the geopolitical situation in the Mediterranean in the late-15th century. The fall of Istanbul in May 1453 signaled the rise of a new imperial power in the region, and in swift succession the Ottomans began dismantling the *Stato da Mar*. Sultan Mehmet II, conqueror of Istanbul, led a major force to Negroponte in 1470, seizing the city and butchering the defenders after a difficult siege. This robbed the Republic of control of the strategic Euboean Gulf. In 1499 Ottoman forces struck into the Ionian Sea, defeating two Venetian fleets off the Messenian peninsula, and capturing Methoni, Koroni, and Lefkada. The Ottomans besieged Kephalonia and Naupaktos, but both strongholds held out. Despite these small victories Venice clearly no longer possessed a monopoly over the Ionian trade lanes (Lane 1974; Madden 2013).

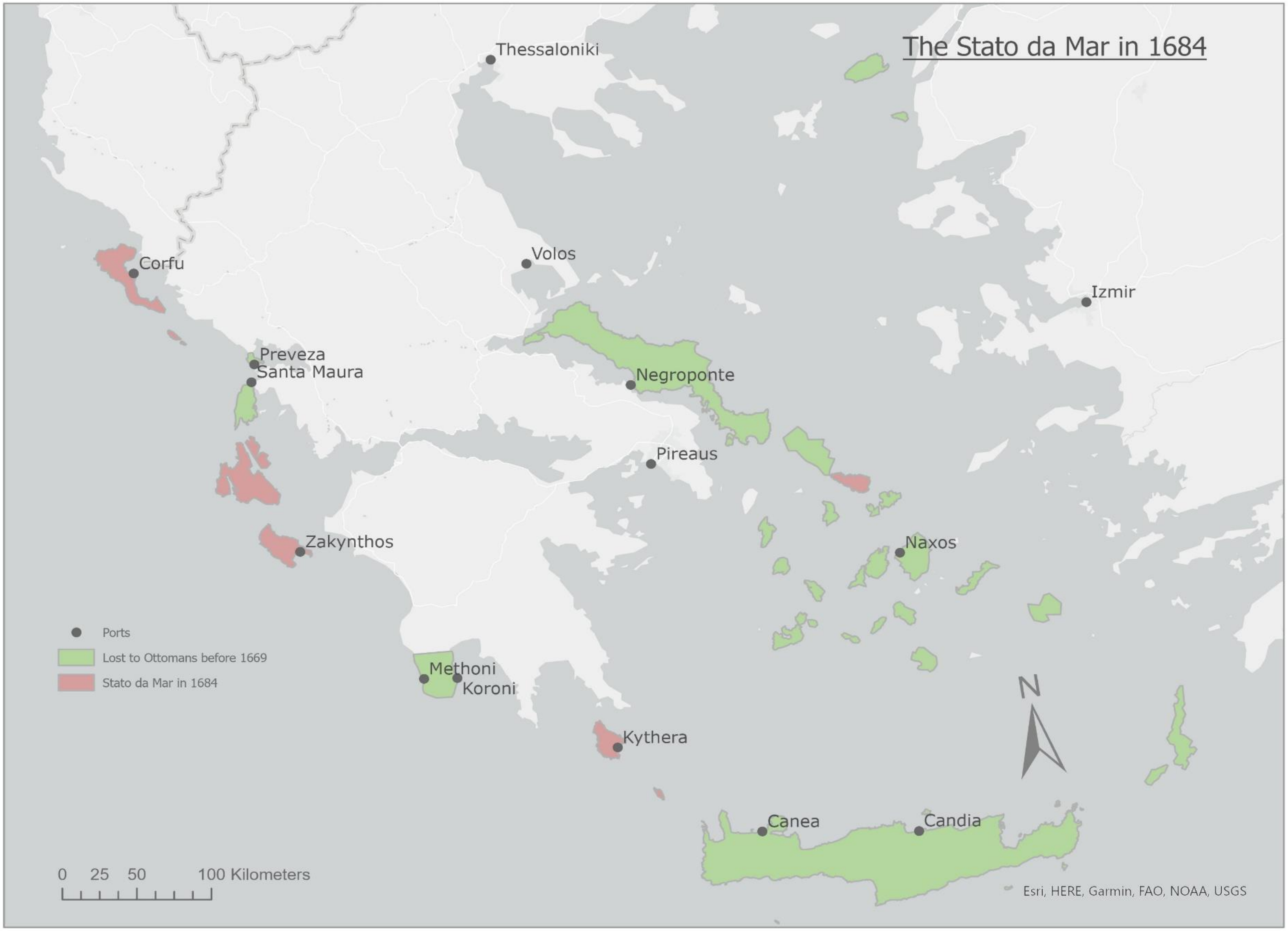
The Republic spent much of the 16th and early 17th centuries trying to adapt their mercantile empire to the new geopolitical realities of the Mediterranean World. There was no doubt that the Ottoman Empire was the juggernaut of the region, and the Venetians preferred to negotiate and maintain as much of their trade as possible. Venice waged war against the Ottomans in exceptional circumstances, such as joining the Holy League of 1570-71 that resulted in the Battle of Lepanto in 1571, (Lane 1974; Madden 2013). However, the simple reality was that Venice, no longer holding a monopoly over the eastern trade-lanes, was in a weak position vis-à-vis the Ottoman Empire, and peace with the Turks was more expedient that constant warfare (Setton, 1991).

The long peace ended in 1645, when Sultan Murad IV invaded Venetian Crete and began the siege of Candia, the principal maritime base on the island. Thus began the War of Candia (1645-1669), a kind of twilight struggle between two weakening states. The court of Sultan Murad was beset by internal dissension, and the Venetian Republic's economic power dwindled in face of a shift in trade towards the Atlantic. Although the ostensible cause of the war involved reciprocal bouts of piracy, the reality is that domestic political weakness pushed both states towards a long war (Lane 1974; Setton 1991). The War of Candia became a war of attrition with numerous major naval battles across the Aegean and tens of thousands of mercenaries and other levies deployed to Crete. Bouts of plague killed far more soldiers and sailors than combat, and eventually the Republic was forced to cut its losses, surrendering Candia and all of Crete to the Turks in 1669 (Anderson 1952). But given the close-run nature of the war, the Venetians harbored very real hopes of restoring their empire in the near term. The Ottoman Empire, despite its eventual victory in Crete, seemed vulnerable, and the Venetian Republic looked for an opportunity to exploit any Turkish weakness to their advantage. As we will see in Chapter Three, the Morean War would be born of just such opportunism.

Visualizing Trade Networks in the Eastern Mediterranean

The maritime imperialism that provoked the Venetian-Ottoman Wars of the 15th to 18th centuries centered upon control of a network of clearly delineated trade routes. These networks are significant to the current study not only because of the military struggle over them, but because these networks also existed alongside reservoirs of **endemic** disease and enabled the spread of **epidemic** disease. Armies and fleets moving along the network moved from areas of relative health into areas rife with a particular set of endemic maladies, and in some cases carried said diseases along with them as they moved down the network, creating an epidemic. By utilizing network analysis tools built into ArcGIS Pro 2.9, we can conceptualize these networks and quantify the most critical nodes and connections between them. In turn this allows us to visualize the movement of not only everyday trade, but that of armies, foodstuffs, ammunition, and refugees, as well as various forms of pestilence.

The network analysis had 2 stages. The first stage involved constructing a network dataset within the ArcGIS Pro Link Chart tool, consisting of nodes (cities and ports) and the vertices (overland or oversea routes) connecting them. The locations of principal roadways through Ottoman Anatolia and Rumelia have changed little, if at all, since classical antiquity, so the overland networks were compiled utilizing the Barrington Atlas of the Greco-Roman World (Talbert 2000), as well as the maps produced by the *Expédition Scientifique de Moree* (Guizot 1855). Nodes were identified as major urban



Map 1. *The Venetian Stato da Mar c. 1684.*

centers along the caravan routes, and they were linked according to their physical location and proximity along the known road networks.

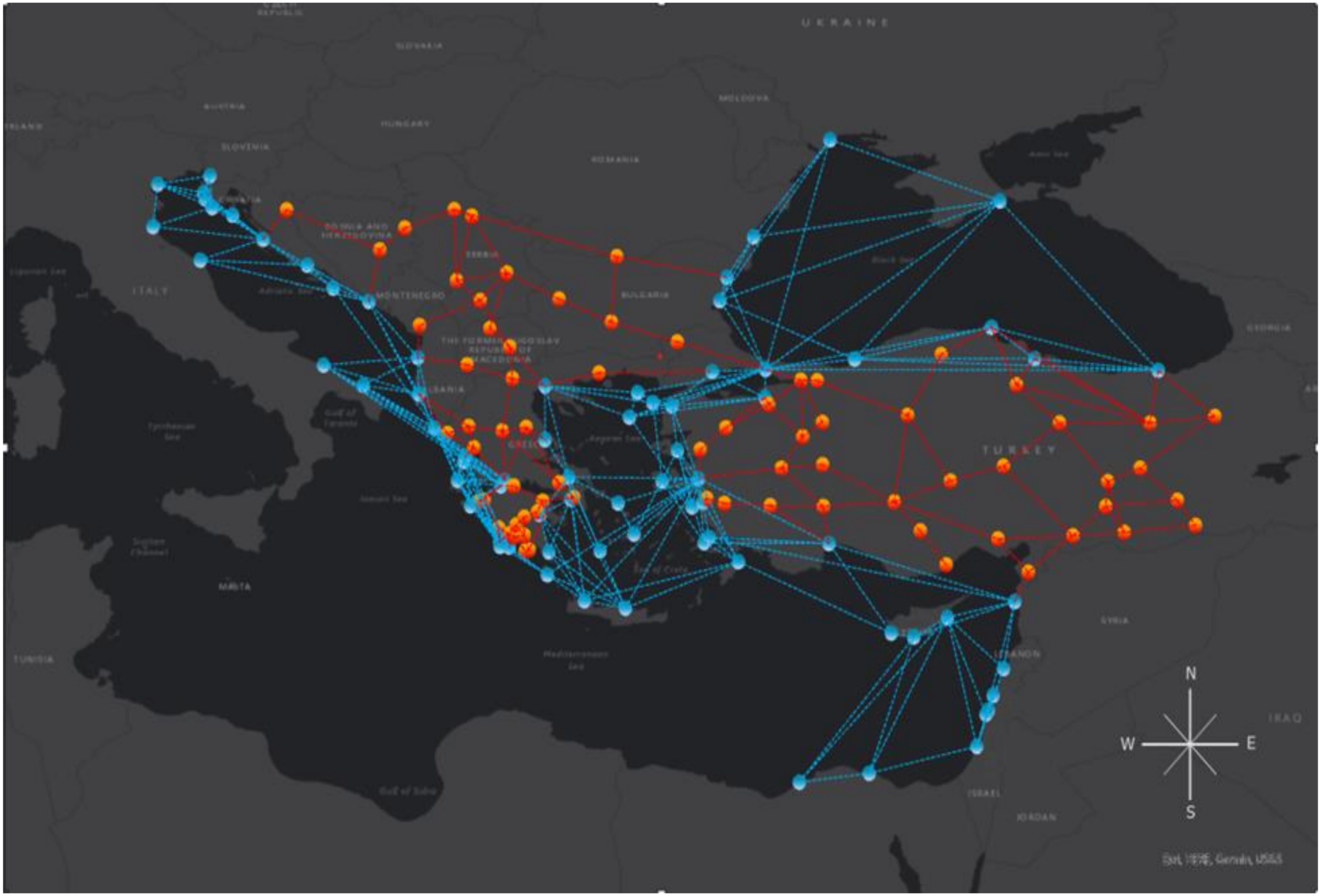
Identifying nodes along the maritime network proved more difficult. Theoretically a sailing vessel could proceed directly to its ultimate destination without stopping at intervening ports, yet due to various environmental and human factors this is not how ship-pilots operated in the period between the 15th and 18th centuries. Navigational hazards, avoidance of storms or military threats, ill-winds, local trade opportunities, and the need for revictualling all forced captains to stop at ports frequently, often every several days. Within these variables the complex coastlines of Adriatic, Ionian and Aegean Seas offered innumerable bays, inlets, and safe in-shore channels as potential anchorages (Heikell and Heikell 2019; Thompson and Thompson 2014). The wide availability of safe harbors, as well as the technical ability to sail past such harbors under ideal sea-keeping conditions, potentially complicates creating a suitable link network. For example, a ship leaving Venice and sailing down the Adriatic had the option of several Istrian ports for a first night's anchorage, including the major ports of Poreč, Rovinj and Pula, and the smaller harbors at Umag or Novigrad. From the Istrian coastline they could stop over at the Oser anchorage or proceed directly to Zadar. Indeed, captains and pilots had numerous options available to them in their navigational planning.

Despite these complexities, a standard network of sea-lanes and ports is discernible. Certain ports, due to geographic, environmental, and geopolitical conditions, were more frequently utilized than others, and this is readily apparent in pre-modern and modern sources (Pryor 1989, 18-21; Marelic 2016, 228). Pilgrimage accounts from the

15th to 17th century record a standard route from Venice to the Levantine coastline, with remarkably similar itineraries between them (Faracic 2014, 40-45).

Early modern portolan charts specifically list the major ports of a region (Ash 2007; Astengo 2007), while contemporary pilots, notably that of Jonathan Sellers (1753), describe in detail the major sea-lanes and the preferred harbor facilities throughout the region. Modern scholarship on trade in the Eastern Mediterranean confirms the economic patterns found in these sources (Borsari 1988; Thiriet 1959). The seaborne link network is substantially more complex than that of the overland routes, but still provides clear patterns for analysis.

The resulting conceptualized network (Map 2) interlinks the road network (red) with the sea-lanes (blue) via port cities. The completed network was then analyzed using the Link Analysis Toolbox in ArcGIS Pro 2.9. Centrality Analysis is the most relevant method to employ in this study, as it is specifically designed to identify the most important or influential nodes within a particular network (ESRI 2020). Two distinct types of centrality tools were applied here, starting with Degree Centrality, which simply calculates the number of immediate connections a node has to the rest of the network, indicating the potential impact a single node may have on the network. The Betweenness Centrality tool was also used, calculating how often each node in the network is on the shortest path between all other nodes in the network. A high betweenness score suggests that a particular node acts as a bridge or chokepoint, having greater influence within the overall network.



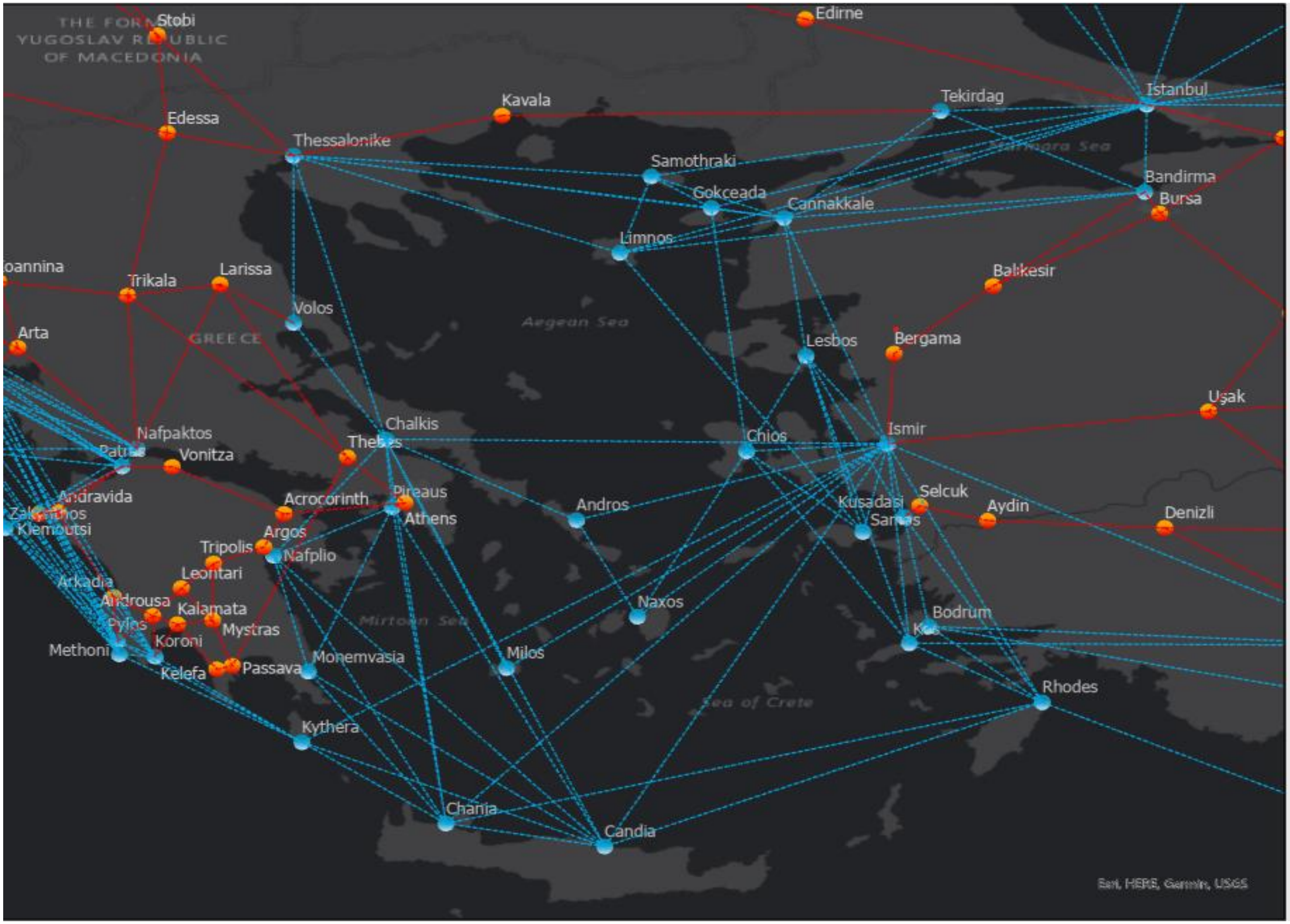
Map 2. *Networks in the Eastern Mediterranean, showing land route/nodes (red) and maritime routes/nodes (blue).*

Table 1. *Degree Centrality*

Node	Degree Centrality
Ismir	17
Istanbul	15
Corfu	15
Patras	11
Zadar	10
Pylos	10
Nafpaktos	10
Koroni	10
Thessalonike	9
Preveza	9
Kephalonia	9
Negroponte	9
Cannakkale	9
Zakynthos	8
Methoni	8
Lefkada	8
Dubrovnik	8
Chania	8
Candia	8
Vlore	7

Table 2. *Betweenness Centrality*

Node	Betweeness Score
Ismir	1
Kythera	0.65642
Istanbul	0.59595
Corfu	0.44913
Antalya	0.42025
Cannakkale	0.41529
Latakia	0.35185
Thessalonike	0.33579
Koroni	0.28688
Dubrovnik	0.27303
Zadar	0.24393
Pylos	0.23822
Usak	0.17287
Konya	0.166
Edessa	0.16033
Methoni	0.14974
Negroponte	0.14963
Trabzon	0.14001
Sinop	0.13719
Antakya	0.13352



Map 3. *Detail of Aegean Networks and their connections to Anatolia, Greece, and the Peloponnese.*

Several distinct patterns emerge. Both the Degree Centrality (*Table 1*) and Betweenness Centrality (*Table 2*) analyses place Izmir in the top spot, with 17 direct connections at a betweenness score of 1. Izmir is a critical port on the west coast of Anatolia, dominating the sea-lanes of the eastern Aegean and providing direct access to the fertile valleys and urban centers of Anatolia (Frangakis-Syrett 2001, 110). Istanbul comes in third, with 15 direct connections and a "betweenness" score of 0.59595, reflecting its placement at the juncture of Europe and Asia by land and the maritime intersection of the Black and Aegean Seas. Thessaloniki has fewer direct connections (9) but scores a high "betweenness" score (0.33579), demonstrating its access to the Aegean and the Balkan hinterlands. Indeed, Izmir, Istanbul and Thessaloniki are each highly influential as port cities linking inland centers with the maritime network. Koroni, Methoni, and Pylos in the southwestern Peloponnese and Antalya in southwest Anatolia illustrate this same principle on a lesser scale, acting as more localized intersections between land and sea.

The island port of Corfu is an example of a key node located solely on the maritime network. The entire island, nestled parallel to the Balkan mainland, provides a wide anchorage on a safe in-shore channel, with access to both the Adriatic and Ionian portions of the maritime network. With 15 direct connections and a "betweenness" score of 0.44913, control of Corfu provided immediate access to the Ionian islands, the Gulf of Arta, the Gulf of Lepanto, as well as entry into the Adriatic and its cluster of ports. Corfu truly was the "door of the Venetian Republic" and immensely important to Venetian imperial strategy (Gertwagen 2007, 183). Similarly, Negroponte controls movement through the Gulf of Evia, the in-shore channel between the island of Evia and Attica on the Greek mainland. This route was long preferred as a north-south course from Crete into the eastern Aegean due to the placid waters of the narrow, protected channel (Heikell & Heikell 2018, 333-334). The small island of Kythera, with fewer direct connections (6) still scored second on the “betweenness” scale (0.65642) as it straddles the transition from the Ionian to the Aegean Sea, and virtually all maritime traffic had to pass near this small island, as it served as the only safe harbor between the Peloponnese and the ports of Crete. In fact, Venetian ambassadors returning from various eastern locales often quarantined on Kythera prior to their return to the Rialto, indicating that the island served as an essential chokepoint in disease surveillance and control (Locatelli 1691, I: 50).

Centrality Analysis provides a useful mechanism to quantify the relative influence of various nodes along geopolitical networks in the Eastern Mediterranean. However, there are limitations, as it is impossible to mathematically measure any number of political, military, economic and cultural factors that influenced the decision making of travelers on the network. A prominent example is the relative importance/influence of Istanbul vs. Izmir. Per the Centrality Analysis, Izmir is the most influential node in the network dataset, and its overall importance as a port is confirmed by contemporary sources (Seller 1753, 75; Rycaut 1667). Yet did Izmir overshadow Istanbul as a network node in actual practice, as implied by the current analysis? Istanbul, as the imperial capital of successive empires, exerted a kind of gravitational force upon the empire it ruled and even beyond, attracting all manner of people and goods to the city due to its political, economic, and cultural significance. The sheer size of its population (700,000) entailed extensive importation of food and other commodities, and the imperial elite who ruled from there consumed large quantities of luxury items. Furthermore, Istanbul was the hub of the Ottoman military machine, with all arsenals, foundries, shipyards, warehouses, and barracks centralized at or in the immediate vicinity of the capital. This concentration of military industries entailed a funneling of vast amounts of supplies and manpower to Istanbul itself, and virtually all Ottoman military expeditions set out from there (Imber, 2009). These compounding factors enhance the centrality of Istanbul in a way that cannot be modeled within the bounds of current Link Analysis tools. As we will demonstrate, Istanbul proved to be the primary distributor of bubonic plague, in addition to its role in distributing goods and projecting military power.

Mediterranean Climatology and the Impact of the “Little Ice Age”

In December 1684, not long after combat operations in the Morea War commenced, the Republic of Venice concluded a mercenary contract with Ernst August, Duke of Brunswick-Lunberg in northern Germany, for the hire of 2400 musketeers. Meant to supplement Venetian forces, this force of professional soldiers, commanded by the duke’s youngest son, Maximilian Wilhelm, immediately began the long march to Venice for the 1685 campaigning season (Finlay,1877; Setton, 1991). What is most striking is that this contingent set off in the middle of an especially extreme winter. The winter of 1684-1685 saw extreme cold weather extending across northern and into southern Europe, freezing the Thames River at London and the lagoons at Venice alike (Camuffo et. al., 2019). It seems reckless for a mercenary force to march through this winter and cross the Alpine passes, even for a considerable sum of money.

In fact, by 1684 such an extreme winter was not unusual, and the German mercenaries were used to contending with all manner of poor weather, as they lived in the period scholars now refer to as the *Little Ice Age*. The Little Ice Age (hereafter LIA) refers to a long-term period of global cooling, beginning c. 1350 CE and continuing intermittently through c. 1850 CE. The cooling period reached its nadir in the mid-17th century, resulting in expanding glaciers, denser oceanic ice packs, and cooler growing seasons across the globe. Scholars posit several interconnected causal factors behind this climatic change, including diminished solar radiation, changes in the axial tilt of the planet, increased solar veiling due to volcanic activity, and/or changes to oceanic circulation (Matthews and Briffa, 2005). Regardless of the specific causes, this cooling pattern and its 17th century nadir is well established in both contemporary documents and in current scientific scholarship.

The global cooling minimum historically coincides with the *Iron Century*, a designation contemporary to the period denoting wide-spread, long-term conflict across Europe, the Near East, East Asia, and the New World (White, 2011; Parker, 2013). The many rebellions and large-scale wars of the period have attracted a great deal of attention from historians, but recently scholars have probed the possible links between a cooling climate and these various conflicts. Is there an historical nexus of climate change, famine, and epidemics, with wide-spread violence? The correlation between these heightened societal stressors and subsequent warfare seems obvious but demonstrating the causal links among such complex factors proves difficult.

The Morean War, and the epidemics attendant to it, played out in the distinct climatological environment of the Eastern Mediterranean, classified as a *Mediterranean hot-summer climate* (Csa) according to the current Köppen climate classification system. (Berg et. al., 2018). The *Csa* coding generally refers to a region with average monthly temperatures above 22^{o} C in the summer, and monthly averages between 0^{o} and 18^{o} C in the winter. Precipitation in the summers is negligible, mirroring arid or semi-arid environments, with most rainfall occurring in the fall, winter, and early spring (Kotteck et. al., 2006). Consequently, the agriculture of the region adapted to these climatological norms, centering around the *Mediterranean Triad* of *durum* wheat, olive groves and viticulture. The Triad was supplemented by other grain crops (millet and barley), as well as legumes and squash.

While each of these crops is well adapted for arid summers, they still require a level of moisture for germination and growth and remain susceptible to drought conditions. This is especially true of *durum* wheat, the principal source of complex carbohydrates in the Mediterranean diet. Typically, two crops of *durum* were planted annually, in the spring and summer. Given the arid nature of the region, stored moisture in the soil, a holdover of the rainy season, sustained these crops during dry periods. Winter wheat relies on summer and fall rains for sustenance, while spring wheat depends on winter rains. Hence drought conditions, even those outside of the normal growing season, have a direct impact on soil moisture and in turn crop yields (Saadi et. al, 2015; Yang et. al., 2019). Repeated annual seasons of drought could impact other crops as well. Olive trees, notoriously long-lived and difficult to kill, suffer extensive internal dry rot and gas embolisms during recurring cycles of drought, damaging or killing the tree and significantly reducing olive yields (Trambley et. al., 2020).

The historical and scientific evidence we possess strongly indicates a repeated cycle of colder, wetter winters coupled with summer droughts in both the Balkans and Anatolia during the LIA, and especially during the 1680s. Military affairs dominate the written sources, especially the various historical chronicles of the period, yet a careful review of a wider array of sources, including personal letters, diplomatic reports, and legal documents exposes less glamorous details of the period, including significant weather events. Mrgic's recent work (2018) demonstrates the importance of such historical documents. Working with a variety of detailed sources from civic institutions in Serbia and religious houses on the Dalmatia coast, he uncovers numerous accounts of extreme weather conditions during the 17th century. Several common patterns appear in these sources. First, extremely cold winters froze even large rivers like the Danube for some weeks. Harsh winters were invariably followed by heavy spring floods, likely the result of heavy snow-packs melting in the Carpathians and the Dinaric Alps. Finally, the summers were hot and extremely dry. These scenarios present themselves frequently during the 17th century, but are especially pronounced in the 1680s, which coincides with the Morean War. Mrgic notes that the various writers were cognizant of the additional societal impacts meteorological events brought, especially to agriculture. Floods swept away freshly planted fields and droughts withered crops long before harvest, and the resulting famine conditions disrupted normal social and political life. Reports of brigands in the countryside and revolts against local authorities abound in these sources, all a direct result of the collapse of agriculture (Mrgic, 2018). This in addition to the large, state-sponsored armies passing through and fighting within these very regions.

Scientific evidence confirms the historical sources. A palynological study from the lower Sava valley in Serbia, corresponding to one of Mrgic's documentary study areas, clearly shows a pattern of frequent erosions caused by recurrent flooding coupled with periods of severe drought. The abandonment of farmland is evident, likely a consequence of both the environmental stressors and frequent warfare moving through the region (Kulkarni et. al., 2018). Sediment cores taken from the lagoon of Butrint, a Venetian port located along the Ionian Sea in modern Albania, provide further evidence of heavy winter rains and spring run-off from substantial snow-packs. Heavy clastic build-up in the lagoon indicates extensive fluvial action from the surrounding watershed (Morellon et. al., 2016).

Similar climatological impacts are seen in Italy. Research conducted around the Sicilian town of Pergusa shows drought conditions for the LIA period, though not to the degree found in the Balkans (Sadori, 2016). It is notable that major socio-political upheaval occurred in the region in the 17th century, possibly indicating greater climate change in the region than is currently in evidence (Parker, 2013). A study focusing on communities in the Central Italian highlands shows a mixture of heavy winter rains coupled with extreme summer aridity. However, the response of the local population was substantially different; rather than succumbing to the environmental stressors, they adapted. The local populace engineered various hydraulic technologies to move water from highland catchments to irrigate the upland valleys (Mensing, 2016). Climate change does not condemn a society to inevitable chaos.

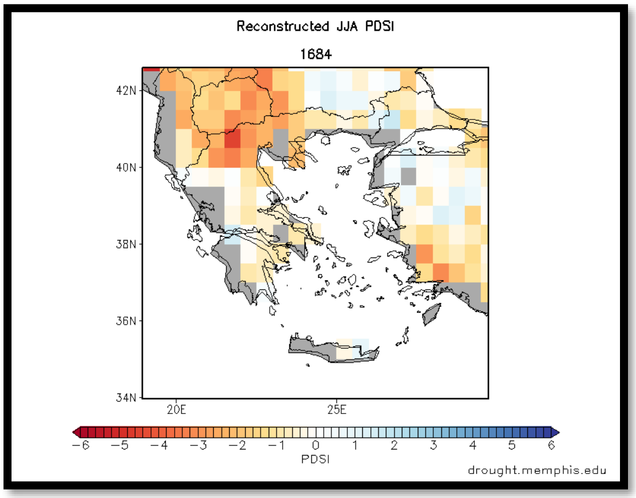
The LIA is further evidenced in Greece, the epicenter of the Morean War. One major study reconstructs premodern sea-surface temperatures (SSTs) for the Northeastern Aegean Sea using multiproxy evidence, including seabed sediment cores, pollen core samples from the nearby Rhodope mountains, speleothem deposits from Anatolian and Thracian caves, and lake sediment cores from Anatolia. The high-resolution seabed core, taken offshore from Mount Athos (Greece), provides decade-level data, with the other proxies used as verification. The study concludes that the period from 1600 to 1750 AD saw a +/- 1.5 degree Celsius drop in SST, a direct correlation to the LIA (Gogou et. al., 2016). This study shows the drop in temperature, but not what wider environmental effects lower temperatures caused. Quaternary evidence from Stymphalia in the Peloponnese provides a localized answer. The lake-core evidence from this highland lake shows periods of alternating humidity and aridity across several millennia, as well as changes to local agriculture. In the LIA period the lake completely dried up and palynological evidence indicates diminished agriculture in the region, quite like other evidence from the Balkans noted above (Seguin et. al., 2019).

The Balkan Peninsula clearly experienced significant cooling in the LIA period; multiproxy evidence indicates extremely cold, wet winters, heavy spring floods, and drought-ridden summers. The Old World Drought Map (OWDA) further confirms that the region suffered major environment change (Cook, et. al., 2020). The OWDA uses dendrochronological data to reconstruct a *Palmer Drought Sensitivity Index*, or PDSI for Europe, North Africa, and the Near East across the past 2000 years. These PDSI scores reflect a supply-and-demand model, combining local precipitation supply with the needs of local soils, allowing for a common model applicable to many different landscapes, local climates, and soil types. The resulting PDSI map for the Balkans shows severe drought across the region during the very years major combat was taking place in Greece, 1684-1688, further indication of the impact of the LIA (**Maps 4a-4e**).

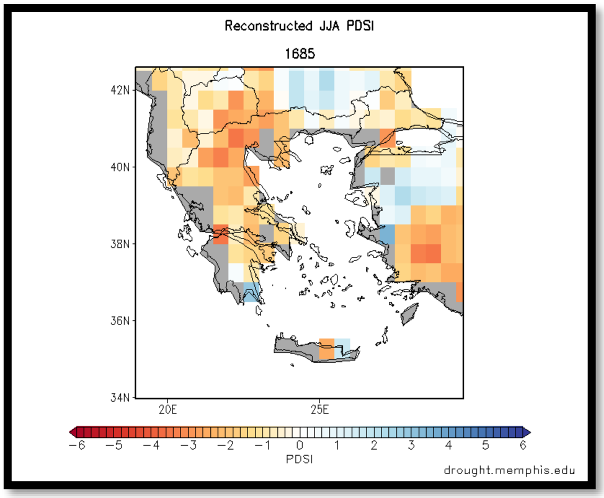
Ottoman Anatolia exhibits climate trends like those in the Balkans. As noted above, Anatolia was the lifeblood of the Ottoman military machine, providing the conscript manpower that filled the ranks of the army and navy, timber for naval stores, and meat and grain to feed the troops. These critical elements all funneled towards the center of the empire, Istanbul itself (White, 2011). The imperial capital served as the center of the Sultan's power. From the Topkapi Palace, the Sultan and his court exercised control over an extensive bureaucracy that harnessed these resources into a series of military barracks and state-owned factories, foundries, and arsenals. This centralized control was not only meant for efficiency, but for loyalty; under the watchful eye of the Sultan and his court, the military forces of the empire were less likely to revolt, at least in theory (Imber, 2009).

However, this centralized system of military procurement suffered from inherent weaknesses. First, by relying on resources from one region, the Ottoman leadership ran serious risks if those resources failed to materialize. They had no fallback source. These risks were further exacerbated by Istanbul being the sole logistical hub. All the supply routes funneled to the capital, and even if the needed men and material existed, they had to travel across a limited number of precarious routes to get to the depots of Istanbul. Without alternate destinations, the blocking of any of these roads, bridges or mountain passes could spell disaster for the Sultan (White, 2011). Finally, by concentrating all of these resources in Istanbul, disease could spread more easily. Men and rodents, effectively mobile biological hazards, moved along the same routes and concentrated at the same destination, creating the perfect environment for epidemic transmission of a variety of diseases (Varlik, 2015).

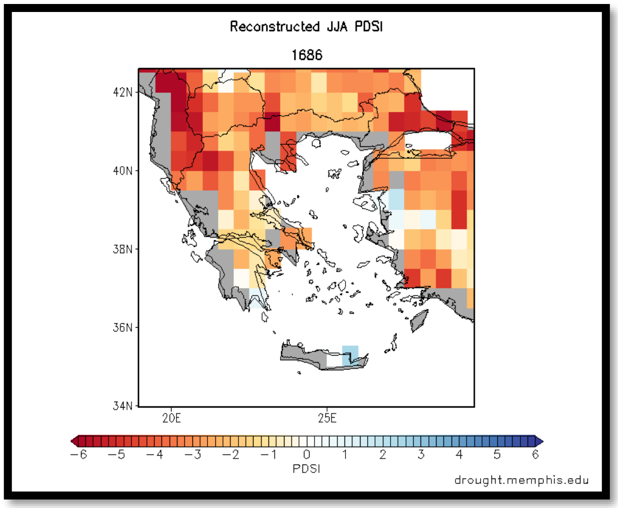
These weaknesses became apparent in the 17th century. There were repeated instances of rebellion in the Anatolia countryside throughout the century, known to contemporaries as the *Celali* Rebellions. *Celali* were bands of landless young men in



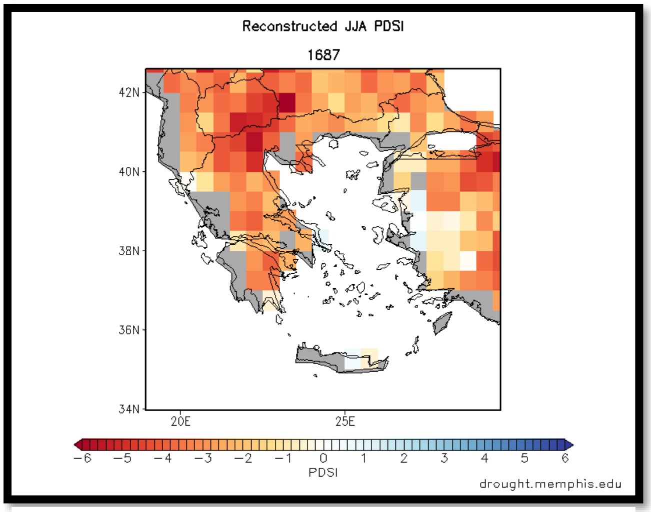
Map 4a. *Drought PDSI for Aegean Basin 1684*



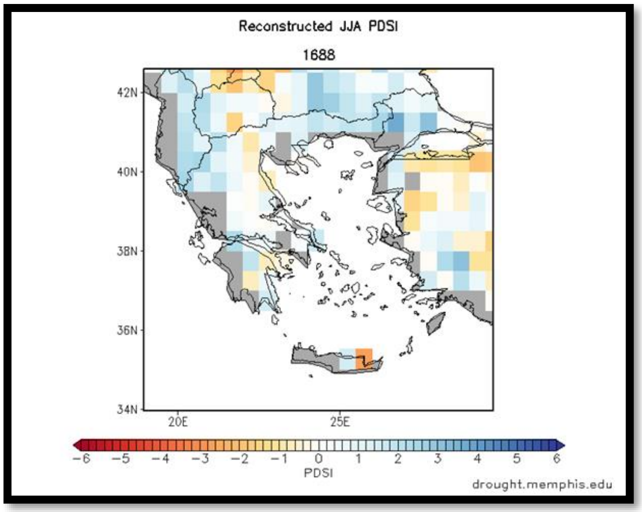
Map 4b. *Drought PDSI for Aegean Basin 1685*



Map 4c. *Drought PDSI for Aegean Basin 1686*



Map 4d. *Drought PDSI for Aegean Basin 1687*



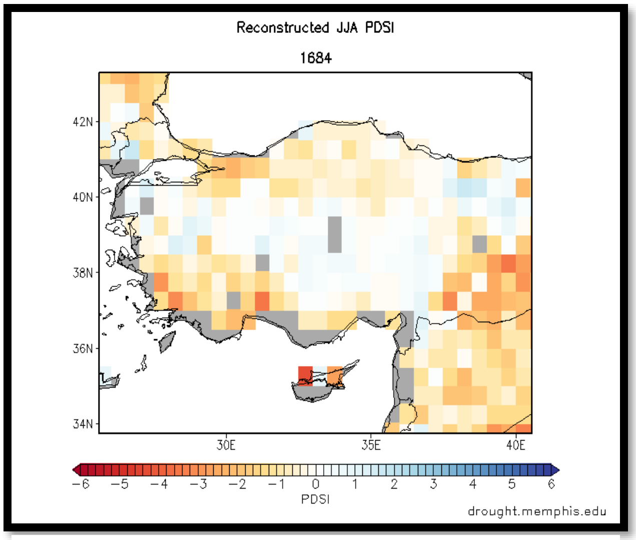
Map 4e. *Drought PDSI for Aegean Basin 1688*

rural areas of Anatolia that rose in rebellion against the Ottoman imperial government, often with the encouragement of Sufi mystic-preachers. While scholars have often noted the rebellions and their religious undercurrents, they have failed to fully explain why so many landless, disenfranchised males existed to rebel in the first place. Sam White's work (2011), influenced heavily by that of Geoffrey Parker (2013), focuses on the collapse of agriculture in Anatolia due to the LIA, which consequently left many young men without a livelihood. These environmental factors, coupled with apocalyptic religious fervor, created a potent mix for rebellion. This serves as an example of how climate impacts social, economic, and political life.

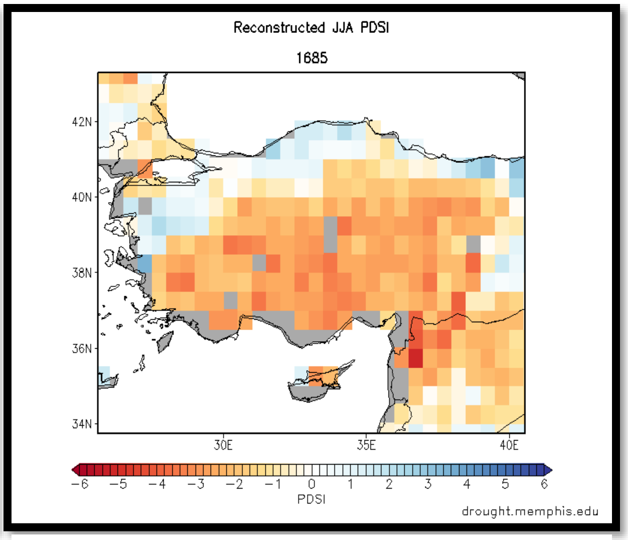
As in the case of the Balkans, scientific evidence corresponds closely with traditional historical evidence. Several sediment-core studies, examining pollen and isotope data, provide good evidence of LIA impacts across Anatolia. Two such studies located in NW Anatolia, one at Lake Cubuk (Ocakoglu et. al., 2015) and another at Lake Iznik (Ulgen et. al., 2012), show similar results. In both cases the advent of the LIA in the region circa 1600 CE coincides with greater aridity, with the water level of both lakes decreasing and local vegetation changing. Vegetation shifted away from cereal crops towards shrubbery and pine forests, indicative of diminished agriculture. Another lake core study from Cappadocia in central Anatolia showed no major disruptions during the period of the LIA. This may indicate a lack of major change to agricultural output in this region, but it cannot be said to apply to all of Anatolia (England and Haldon, 2012). But there were major climate impacts in Cappadocia. Altin and Kayas' (2020) recent work utilizes high-resolution DEM and topographic data to study snowpack and glacial formation during the LIA in the mountainous regions of Cappadocia. The authors note that many of the major supply routes funneling foodstuffs towards Istanbul converged in the Cappadocian highlands, and expanding glaciers had a direct impact on various mountain passes. They identify several moraines, ridges of sedimentary rock formed by glacial movement, in critical highland valleys, that date to the LIA. In a world with pre-modern transportation infrastructure, the movement of people and good was definitively impacted by shifts in long-term weather patterns.

As with the Balkan example, Anatolia experienced significant cooling during the LIA, resulting in heavier winter precipitation and more arid summers. Data from the Old-World Drought Map (Cook et. al., 2020) bears this out again (**Maps 5a-5e**). Societal upheaval in the form of the *Celali* Rebellions aligns closely to increasing environmental stressors resulting from the LIA. Furthermore, the spread of bubonic plague can be tied to environmental change. Nukhet Varlik's work on disease in early-modern Anatolia (2015) identifies near-constant outbreaks of bubonic plague in the region. Rodents, the principal carriers of the plague, have a symbiotic relationship with human societies, feeding off human food supplies. Disruptions to agriculture not only disrupt human societies, but rodent colonies as well, and as groups of humans move, either as soldiers, rebels or refugees, rodents and their plague-bearing fleas follow with them. It seems likely that Ottoman armies moving out of Anatolia into the Morea to fight the Venetian invasion carried the plague there with them.

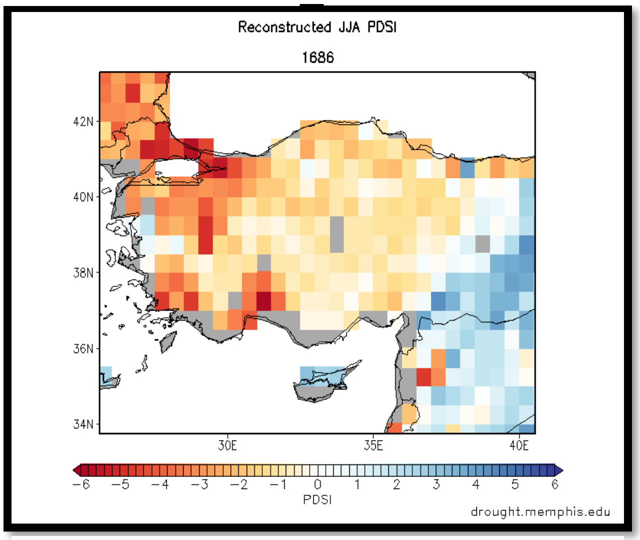
Given the historical and scientific evidence that we possess, we can make several broad conclusions with confidence. First, the Little Ice Age had a demonstrable impact on the climate of the Northeast Mediterranean. The general climate trends include a drop in temperature, with more extensive winters. The colder temperatures were accompanied



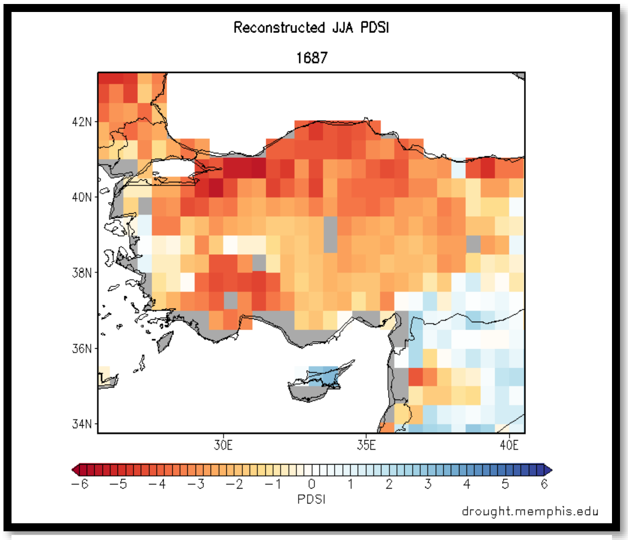
Map 5a. *Drought PDSI for Anatolia 1684*



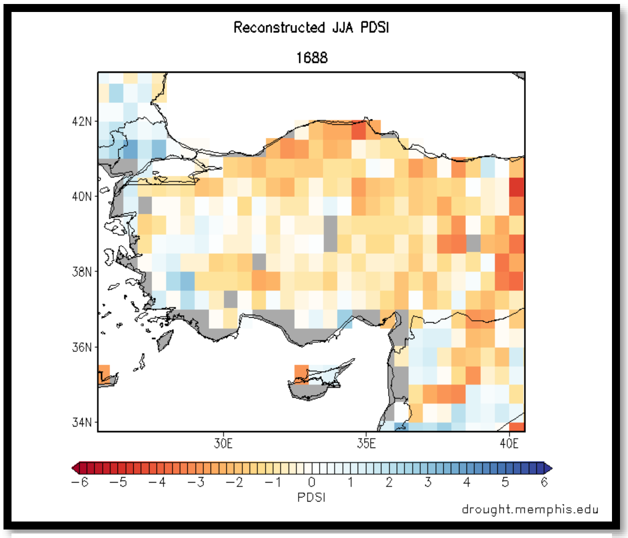
Map 5b. *Drought PDSI for Anatolia 1685*



Map 5c. *Drought PDSI for Anatolia 1686*



Map 5d. *Drought PDSI for Anatolia 1687*



Map 5e. *Drought PDSI for Anatolia 1688*

by heavier winter precipitation, thicker snow-packs, and expanding glaciation. This resulted in more extreme spring floods in various river valleys. Summers saw widespread and long-term drought conditions. Various proxy evidence, especially pollen cores and isotope data, show degradation of human agriculture, both in cereal crops and in viticulture (Kulkarni et. al., 2018). As noted, the scientific data corresponds closely with historical accounts of extreme weather events and the growth of societal chaos (Camuffo et. al., 2019). This is especially true of the 1680s when the Morean War was underway.

The coincidence of major climate change with famine, pestilence, revolution, and warfare is well known to scholars (Appleby, 1980; Iyigun, Nunn and Qian, 2017; Rosenzweig and Marston, 2018). The general connection between environmental stressors and the subsequent breakdown of human societies is obvious, yet there remain questions as to exactly how these breakdowns came about. For example, Sam White's work (2011) on the *Celali* Rebellions in Anatolia makes a clear connection between climate change and revolution. But these rebellions had a strong element of Sufi mysticism. How did environmental stressors impact religious ideology? Another question raised is why did major, state-on-state warfare continue to take place, and even accelerate, in periods of inclement weather and epidemic disease? Disease was the major cause of death in all wars of the 17th century (Parker, 2013), including the Morean War (Setton, 1991), and this was a known factor to the military commanders in the field and the governments they served. It seems counterintuitive to continue fighting in the midst of multiple natural disasters, yet the various powers of Europe and the Near East never considered ceasing or even pausing their military operations. To what degree did inclement weather and epidemic disease impact military decisions, if at all? What, if any, measures were taken to mitigate the impact of disease and weather on the armies, and were these measures effective in any way? These specific questions are relevant, especially in a world where we now face both climate change, pandemic disease, and simmering geopolitical tensions.

Conclusion: Chapter II

As we have seen, the Eastern Mediterranean environment of the 17th century was characterized by intricate networks connecting urban centers across both land and sea, allowing for the movement of people and goods, as well as the projection of imperial power. Control of these networks was a principal cause of imperial conflict in the early modern period, especially between the Venetian Republic and the Ottoman Turks. These networks were both the catalyst for warfare as well as the landscape upon which these wars were fought. It is also notable that some nodes in these networks exerted more influence than others. By utilizing Centrality Analysis tools, we can conceptualize the relative importance of some nodes over others, and perhaps understand an individual node’s role in distributing people, goods, and for the purposes of this study, disease across the larger network.

These networks existed within a changing environment. There is no doubt that the LIA produced long-term effects across the globe (Parker, 2013; White, 2017), but there is considerable scientific and historical evidence for immediate climate impacts on the Eastern Mediterranean during the period of the Morean War. Extremely cold, wet winters coupled with repeated severe summer droughts throughout the period of the war undoubtedly damaged agriculture in the region, as evidenced in numerous palynological studies. In turn this placed considerable stress local populaces, compounding upon the effects of warfare in the area. But did climate change also exacerbate the epidemic spread of disease? Did heavy winter rains and spring run-offs expand colonies of malarial mosquitos? Did severe droughts push rodent populations, a known plague reservoir, from their normal habitats towards human populations and the networks they operated on? The following chapters will address these specific questions in the temporal context of the Morean War.

CHAPTER III - "THE CLIMATE OF THE EAST" :MALARIA AND THE MOREAN WAR

The Great Turkish War and Venice

The Morean War was precipitated by another major confrontation between Christian powers and the Ottoman Empire in Central Europe, the so-called "Great Turkish War" (1683-1699). In the summer of 1683 Kara Mustafa Pasha, Grand Vizier of Sultan Mehmet IV, besieged Vienna with a force in excess of 150,000 men, threatening much of central Europe and the integrity of both the Holy Roman Empire and the Kingdom of Poland. After a protracted siege, a coalition army of Christian powers, led by Jan III Sobieski of Poland, moved to relieve the city, and on September 12th, 1683, inflicted a stinging defeat on the Ottomans before the walls of Vienna. The stunning Christian victory at Vienna began a series of Ottoman defeats in the Balkan peninsula. Christian contemporaries viewed the dramatic victory against overwhelming odds as a sign of divine favor against the infidel Turks. Pope Innocent XI, buoyed by the Christian victory, encouraged the Venetians to join the Poles and the Empire in a new Holy League, in hope that a Venetian campaign in Ottoman Greece would divert Turkish troops away from the main theater of war in the upper Danube basin (Setton, 1991). Conversely, with the bulk of Ottoman forces engaged further to the north, the time seemed ripe for Venice to reconquer its lost possessions in the Ionian and Aegean Seas.

After a vigorous debate in the Venetian Senate (Garzoni 1707, 45-51), the Republic joined the Holy League in March 1684, and immediately set about preparing for war. The Senate elected Francesco Morosini, a veteran commander during the War of Candia, as Captain-General. Morosini set sail from Venice on June 10th, gathering further ships, troops and supplies from the various Adriatic ports of the *Stato da Mar* as his fleet passed by. By June 24th, the fleet anchored at Corfu, where Morosini rendezvoused with allied naval forces contributed by the Papacy and the Knights of Malta (Locatelli 1691, I:13-16). The decision was taken to fully secure Venetian control of the Ionian Sea by seizing Lefkada and the mainland ports of Preveza and Vontisa on the Gulf of Arta. Both the Lefkada lagoon and the nearby Gulf were important anchorages in the region, and Turkish pirates were known to sortie from these bases in their strikes against Christian shipping (Setton 1991, 252; Locatelli 1691, I:65). Morosini wished to avoid leaving hostile forces along his main supply lines, and he had reason to believe that the Christian populace of the region was prepared to revolt and support his campaign. The fortress of Santa Maura, guarding the channel leading into the Lefkada lagoon, was chosen as the first target in July 1684 (Locatelli 1681, I: 25). After a two-week siege, the garrison surrendered on August 6th, and subsequently many Greek chieftains nearby on the mainland rebelled against their Turkish overlords. With the aid of these local irregulars Morosini moved to besiege Preveza and Vontisa, which both capitulated by the end of September (Locatelli 1691, I: 59-69). In short order, Christian forces secured several strategic ports which could act as bases for further operations. As well, each of these conquests returned long-lost possessions to the *Stato da Mar*, satisfying the revanchist fervor driving the Venetian campaign. All in all, the Morean War was off to a good start for Venice and its Christian allies.

Yet disease was already taking its toll on Morosini’s force. Shortly after the arrival of the fleet at Corfu in early July 1684, Locatelli reports that over 700 soldiers fell sick from “that disease ordinary to the Climate of the East”, and he specifically notes that it was the “new Levy”, previously unexposed to this “climate” that took ill. Of the 700 sick, they were “doubly decimated through death” (*doppiamente decimati*), meaning that they suffered a 20% mortality rate, or approximately 140 deaths (Locatelli 1691, I:28-29; Garzoni 1707, 66). The siege of S. Maura saw 127 Christians killed in action, but more than 1,700 soldiers and sailors fell sick and were sent to Corfu for recuperation (Pinzelli 2020, 74). Several weeks later, during the siege of Preveza, oarsmen on the Papal galleys were struck by the same malady, with over 400 stricken and 60 dying (Locatelli 1691, I:67). While common soldiers and sailors made up the bulk of the sick, the officer corps was not immune. The veteran Sergeant-Major Niccolo Bentio and Colonel Pietro Gabbrielli succumbed in October 1684, followed by Colonel Gio. Battista Sopini Bergamesco in early November (Locatelli 1691, I:85-89; Garzoni 1707, 66). Conte di Strassolo, overall commander of Christian ground forces, took ill at Preveza in October, and along with many other sick soldiers was sent to Corfu to convalesce from the “mutation of the air”. His illness, like that of many others, lingered for months, and he died on 8 January 1685 (Locatelli 1691, I:93; Garzoni 1707. 89).

What was this illness endemic to the “Climate of the East”? Identifying the specific pathogen behind pre-modern epidemics is fraught with difficulty, as our principal data often consists solely of written accounts of eyewitnesses. Given their relative lack of epidemiological knowledge and scientific methodology, pre-modern descriptions can be vague and filled with obvious errors and mistaken assumptions, at least to the modern scientific eye. Glaring errors, such as blaming diseases on miasmas and vapors emanating from swamps, often lead scholars to erroneously discount written accounts entirely (Cunha 2004, 30; Aberth 2021, 237-49). The condescending assumption is often that ancient ignorance on some matters renders all such accounts useless as evidence. Yet the advent of genomic DNA sequencing of ancient remains shows that, most often, pre-modern descriptions align closely to modern scientific conclusions. This type of genomic testing has confirmed that the Black Death was, indeed, bubonic plague, and that the “Plague of Athens” described by Thucydides was typhoid (Aberth 2021, 237; Papagrigorakis et. al. 2006, 210). The present study asserts that, despite some distortions stemming from a lack of medical science, our sources are thoroughly capable of describing the main symptoms and course of the diseases they encountered, and in turn can provide a relatively accurate taxonomy of disease. In short, we can discern what diseases impacted ancient peoples from these descriptions, at least in most cases.

Malaria: Epidemiology, Immunity, and Environment

Locatelli’s reference to the “Climate of the East” (*Clima di Levante*) is undoubtably malaria. Malaria refers to a class of infectious, vector-borne protozoa of the genus *Plasmodium*. Thousands of distinct species exist within the larger genus, but only 4 species are known to infect humans: *P. falciparum, P. malariae, P. ovale* and *P. vivax*. Female mosquitos of the genus *Anopheles* serve as the disease vector, transmitting sporozoites through their blood meal into an inoculated host. Once in the human blood stream, the sporozoites infect the liver, quickly establishing themselves in hepatocyte cells and spreading back into the blood stream, where they feed off hemoglobin within red bloods cells as trophozoites, further circulating throughout the host. This rapid spread (within 48 hours of infection) triggers the body’s immune response, resulting in the fevers that characterize all malarial species (WHO 2015, CDC 2021). The cyclical nature of high fever followed by chills is a result of periodic growth and release of successive waves of trophozoites into the blood stream, creating distinguishable patterns of *tertian* fevers (peaking every 48 hours) or *quartan* fevers (peaking every 72 hours), according to the individual malarial species. In the case of *P. vivax* and *P. ovale* sporozoites may become hypnozoites, clusters of dormant *plasmodia* that can cause recurring symptoms for months or years after the initial infection (Carter and Mendis 2002, 566). Further symptoms include body aches, vomiting and diarrhea, and severe anemia caused by the destruction of red blood cells can produce a jaundiced skin-tone. *P. falciparum* and *P. vivax* are the principal cause of mortality in malarial infections, both resulting in high *tertian* fever-cycles which, in turn, can lead to cerebral syndrome, coma, and death (Baird 2013, 48). Common comorbidities include lingering upper respiratory infections and repeated bouts of diarrhea, and malarial anemia often becomes chronic. Each of these comorbidities further exacerbates the overall mortality rate over the course of many months after the initial infection (Etiabe et. al. 2015, 25; Papaioannou et. al., 2019a).

Repeated malarial infections can produce varying levels of immunity. As an example, one or two inoculations of *P. falciparum* is often sufficient to immunize against life-threatening onset of future infections, and repeated inoculations may eliminate symptoms entirely (Carter and Mendis 2002, 566). Yet such immunity is specific to the individual species of *plasmodia*; immunity to *P. vivax* does not confer any immunity to *P. ovale*, for example (Carter and Mendis 2002, 567). Furthermore, the rapid reproduction of sporozoite cells within each host results in the speedy mutation of individual strains, meaning that immunity to one strain of *P. falciparum* found a specific location may not confer any protection against a strain of *P. falciparum* found in a different locale

(Sallares 2002, 37). The lack of exposure to malarial infection results in a high disparity in morbidity and mortality between immune/non-immune populations, as evidenced by the high proportion of children (age 0-5) dying in regions of endemic malaria today, as opposed to older populations who are largely immune from severe symptoms. Historic data clearly shows that non-immune travelers into a region of endemic malaria, especially areas where *P. falciparum* or *P. vivax* dominate, suffer exceedingly high mortality rates, ranging anywhere from 10% to 50% (Alles, Mendis and Carter 1998, 371). French soldiers stationed in North Africa in the early 19th century consistently exhibited a 30% mortality rate prior to widespread use of high dose quinine regimes (Sallares 2002, 35). This wide range of non-immune mortality rates is a consequence of disparate local conditions, including variations in malarial species or strain, as well as the density of local *Anopheles* populations. The issue of immunity is a critical issue in understanding the impact of malaria on the Morean War, as a large portion of the Christian combatants originated from regions with little or no malarial exposure, and they were frequently moved from one combat zone to another, increasing the likelihood of encountering multiple different strains.

Risk of malarial infection is directly tied to its host vector, the *Anopheles* mosquito, and the environments in which these species thrive. Malaria in Greece, whether *P. falciparum* or *P. vivax*, is primarily spread by *Anopheles sacharovi*, a highly adaptable species with a proclivity for anthropophilic feeding. *A. sacharovi* may breed in any gathering of stagnant water, including brackish waters up to 20% salinity, and warm waters up to 38-40^{o} C. They tend to feed in early evening hours, and rest either indoors or in other sheltered areas, including caves, under overhangs, pits, or in heavy shrubbery/forestation (Sinka et. al. 2010). In the Mediterranean, *A. sacharovi* concentrate in coastal salt marshes and lowland plains, and while it can be found at elevations up to 1100m, it overwhelmingly prefers wetter, low-lying regions (Hanafi-Boyd et. al. 2019, 10). Mosquitos are generally weak flyers and highly susceptible to any wind action, so local disparities in infection rates between marshy lowlands and adjacent hilly areas is a demonstrable correlation, apparent in written sources from antiquity onward (Sallares 2002, 57-60). Additionally, malarial infections display a seasonal character, based upon the life cycle of *A. sacharovi*. The deadliest infections, mostly associated with *P. falciparum* and *A. sacharovi*, break out in late July and continue through August and September. Since malaria does not kill quickly, mortality rates tend to lag, with deaths attributable to the disease spiking as late as October and November (Sallares 2002, 62).

Mosquitos, and the diseases they carry, are also highly sensitive to changes in climate. Numerous studies from sub-Saharan Africa show a boost in mosquito populations and attending malarial infections 6-8 weeks following major rain events during warmer periods, as heavier precipitation increases the number of wetland breeding sites for mosquito larvae (Diouf et. al. 2020; Githeko et. al. 2000). At the other extreme, drought conditions also appear to correlate to higher malarial risk. Droughts reduce the number of predators feeding on mosquito colonies, and the reduction of moving bodies of water into smaller, stagnant pools creates many more suitable breeding grounds and intensifies larval production in those locales (Paul et. al. 2017; Kvit 2017). Drought conditions also increase anthropophilic feeding by various mosquito species, as they become dehydrated and must feed more frequently to compensate, resulting in increased infection rates in immediate populations (Hagan et. al. 2018).

P. falciparum and *P. vivax* spread into the Mediterranean world as early as the 5th century B.C. and became endemic to all of Southern Europe in short order (Sallares, Bouwman and Anderung 2004). The Ionian Islands, the Gulf of Arta, and any lowland region (below 500m) were known reservoirs of endemic malaria down to the official eradication of the disease in 1974 (Retief and Cilliers 2004, 130; Kousoulis et. Al. 2015; Browning 2021). In recent decades small outbreaks of *P. vivax* have reappeared in previously endemic regions of Greece, a result of climate change and the increased mobility of migrant populations in the Mediterranean (Kousoulis et. Al., 2012; Sudre et. Al., 2013, 784). Endemic malaria is repeatedly noted in the accounts of 19th century explorers, geographers, and medical personnel. The French physician and diplomat, Ferdinand Pouqueville, passed through the Morea as a prisoner of the Turks in 1799-1800, and he describes the Argolid valley as filled with "quartan fevers", and the jaundiced complexion of the local populace, a sign of repeated bouts of malaria (Pouqueville 1806, 73). At the same time, French troops garrisoning Corfu and nearby Butrint suffered repeated malarial attacks (Hernandez 2019, 393-95). The British explorer W.M. Leake, traveling in 1805, noted the fertile, yet largely empty, marshy lowlands of Elis in the northwestern Peloponnese, and largely ascribed their desolate nature to the "unhealthy air", or malarial capacity, of the region (Leake 1830, I:1-3). Later in his work, Leake repeatedly advises that travelers should not risk visiting **any** of the Morean lowlands in the summer months, specifically due to the local risk of malaria (Leake 1830, II:20 & III:171).

The Irish military surgeon John Hennen leaves the most detailed description of malaria in the Ionian islands. Stationed in British-occupied Corfu in 1821, Hennen keenly observed the correlation of environment and epidemic in his postxhumously-published work, *Sketches of the Medical Topography of the Mediterranean* (1830). Hennen still ascribed to the ancient (and incorrect) *miasma* theory that pestilential fever was caused by the "exhalations" of wetlands. While his generation incorrectly identified the cause of malarial outbreaks, they were correct in the correlation between wetlands and greater malarial risk. Hennen describes ports, warehouses and barracks located closer to the port of Corfu, surrounded by marshes, as having a greater incidence of malaria (145-152). He regarded the fortress of Butrint, surrounded by saltmarsh, as "one of the most pestiferous mashes in all of Greece", and the garrison was rotated out of the fort every two days to lessen the risk of infection (152). At Zakynthos soldiers housed at the "mole barracks" alongside the port suffered repeated bouts of disease, while those based in the fortress on the acropolis above remained healthy (335). The same was true of the local populace; those who lived in the hills avoided contracting malaria until they came to the lowlands (328). In any case, Hennen regards the Ionian islands as an enzootic focus of malaria, much like the Greek mainland.

Hennen further distinguishes between types and impact of malarial fevers; intermittent fevers are divided among *quotidian* (every 24 hours), *tertian* (every 48 hours) and *quartan* (every 72 hours), while the term remittent is used in cases where the fevers fluctuate in intensity but do not completely subside (219). This follows the obsolete clinical taxonomy used prior to the mid-20th century, in which the more severe *P. falciparum* was usually classified as remittent or as a "malignant" tertiary fever, while *P. vivax* and *P. ovale* were treated as "benign" tertiary fevers. *P. malariae* was generally associated with quartan fevers (Baird 2013, 39). These classifications are ambiguous, a consequence of a lack of diagnostic technology. *P. vivax*, long thought to be less severe than *P. falciparum*, has been shown to exhibit remittent fevers in some cases, and has a fatality profile similar to *P. falciparum* (Baird 2013, 48-50). Hennen's own work bears out these differences. Over seven years (1815-1821) the Corfu garrison suffered 5721 soldiers hospitalized with some form of fever. Of these, 3299 were "common fevers", low-level fevers likely associated with any number of ordinary, and generally non-life-threatening, viral or bacterial infections. The remaining were all the remittent or intermittent categories, likely associated with some form of malaria. The remittent category was by far the largest, with 1400 admitted patients, of whom 119 perished, a mortality rate of 8.5%. On Zakynthos, the highest mortality rate was again found in remittent fevers, of 7% (Hennen 1830, 335).

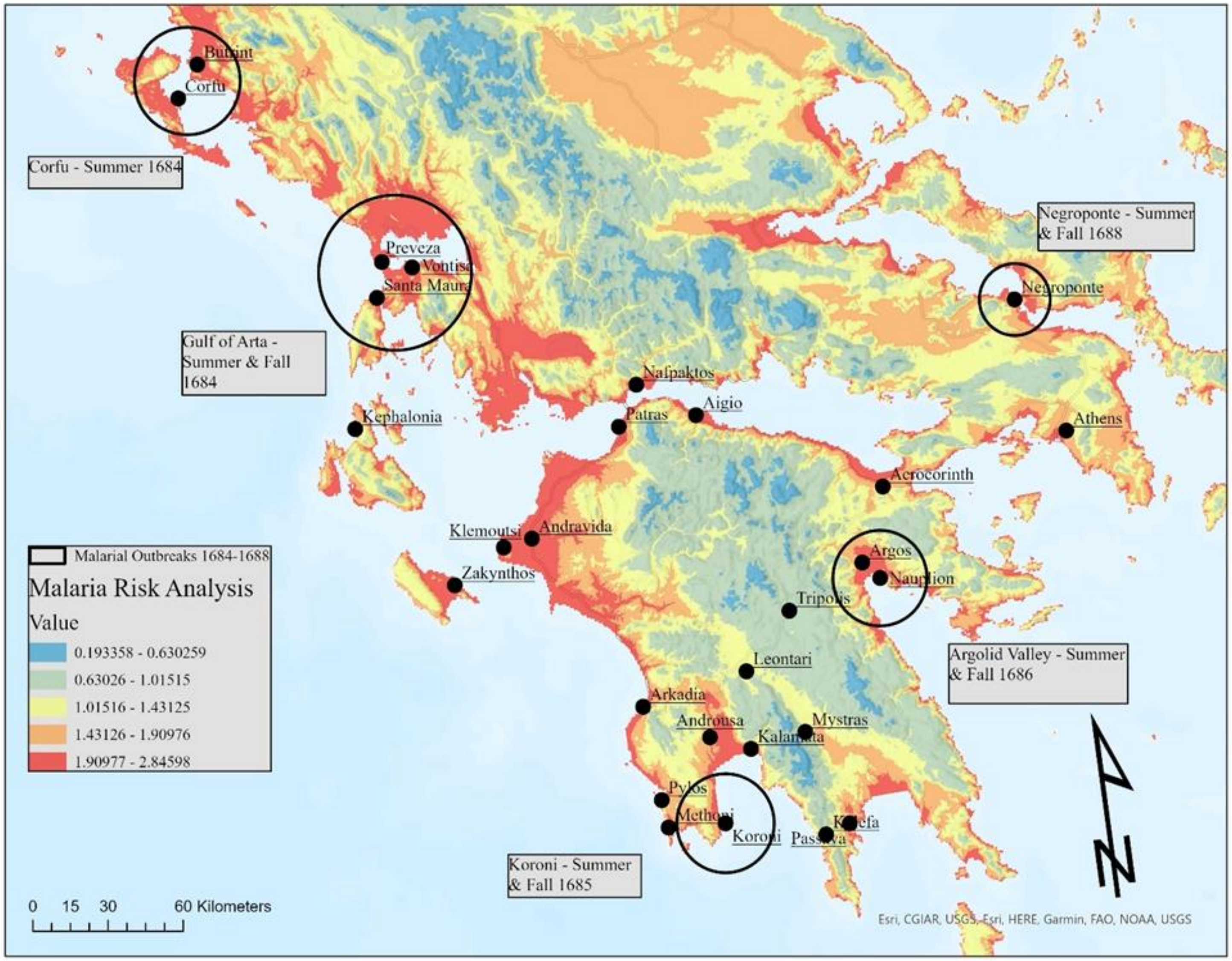
Both the historical sources and current scientific evidence agree that malaria, especially in the form of *P. falciparum* known to dominate the Greek landscape, possesses 3 dominate features. First, spatially malarial risk is strongest in wet, lowland regions, especially those along the coasts, reflecting the principal breeding grounds for the main vector, *A. sacharovi*. This coincides with the temporal characteristic; *A. sacharovi* tends to breed best in the summer months, from July into October, leading to greater malarial transmission in those months. Climate change, notably drought condition, can intensify both the spatial and temporal characteristics of malarial outbreaks. Finally, the relative immunity of the inoculated human host plays a significant role in determining morbidity and mortality within a given population. Each of these features will play a major role in the epidemic outbreak of malaria among Christian forces engaged in the Morean War and the subsequent high mortality rate among infected troops.

GIS Modeling of Malarial Risk in Greece

The spatial distribution of malaria in Greece is well attested in early modern sources, yet they can only supply general impressions; current GIS modeling bears out these accounts and allows us to actively quantify and visualize malarial risk. A recent study by Daniel Browning produced a validated model of malarial risk for several regions of the Mediterranean world. The model combines rescaled risk layers representing elevation, temperature, slope, precipitation, and wetness data, all to create a cumulative risk layer displaying malarial risk on a scale of 0 (low) to 3 (high) (Browning 2021a, 71-73). The resulting risk map was validated using the Torelli map of Italian malarial zones (Torelli 1882; Browning 2021a, 71). Browning has expanded his model to include all of Greece and provided the model to this author (Browning 2021b). This model is presented here overlaid with the major malaria outbreaks of the Morean War (**Map 6**).

This model confirms much of what the historical sources say; malaria risk prevails in coastal lowlands, which combine the wetness of coastal marshes and alluvial plains with hot summer temperatures, an ideal breeding ground for *A. sacharovi*. As noted in **Map 6,** this kind of coastal malarial risk coincides with the main ports of the Ionian Sea and the Peloponnese, critical nodes in the very maritime network being contested during the Morean War. Venetian forces moving along the network repeatedly entered landscapes of endemic malarial risk and waged successive, long sieges in these high-risk zones. The temporal element of these sieges further heightened this risk, as they all occurred between July and October each succeeding year of the conflict. These hot, dry months were prime for military action, yet they correlate to the period of highest *A. sacharovi* propagation. The drought conditions prevalent in the Greece in the 1680s likely intensified mosquito populations and their propensity for anthropophilic feeding, heightening the overall hazard. So Venetian forces settled into sieges in the highest risk landscapes at the highest risk time of year for malarial infection. Furthermore, a substantial proportion of the soldiers brought to the Morea by the Venetians were new to the region and lacking any natural immunity to local malarial strains, making the army uniquely vulnerable to malarial infection on a wide scale. The Morean War provided the perfect combination of spatial, temporal, and human factors to inflict repeated malarial epidemics on the Venetians and their allied forces.

This deadly combination of factors reveals itself from the outset of the war in 1684. The Venetian base at Corfu sits within a “red zone” of malarial risk, as noted both by the Malarial Risk Model (**Map 6**) and by the Hennen’s work in the 1820s (Hennen 1830). It is unsurprising that the “new levy” sickened upon their arrival in July 1864 and that the mortality rate rose to approximately 20%. Subsequent attacks on S. Maura, Preveza, and Vonitza in August and September 1684 similarly exposed the Venetian fleet to high-risk malarial spaces. These portscontrolled access to the Gulf of Arta, the largest anchorage on the Ionian Sea. The Gulf was ringed with extensive saltmarshes and was known for its miasmic fevers, so a high infection rate with a significant number of mortality events is to be expected. Yet these early malarial outbreaks pale in comparison to the mass-mortality events that would strike Venetian-led armies in subsequent years.



Map 6. *Malarial Risk Analysis for Greece with known Malarial outbreaks, 1684-1688. Risk analysis layer courtesy Daniel C. Browning, Jr. (2021).*

Mercenaries and Malaria in the Peloponnese, 1685-86.

In June 1685 the first of 2400 Hanoverian musketeers arrived in theater at an advanced base at Dragomestre, along the Epirote coast. This would be the first of several waves of Hanoverian, Hessian and Saxon infantry hired by the Venetian Senate and brought from their homes in Northern Germany to supplement the Republic's forces. This need for mercenaries was fueled by both quantitative and qualitative deficiencies in the Venetian military. As a maritime power Venice projected its power on the high seas, and possessed only limited infantry reserves as a consequence. The Republic's ground forces largely consisted of *Schiavoni*, Slavic irregulars drawn from Istria and Dalmatia, and some Greeks from the Ionian islands. In order to wage a land campaign in Greece the Republic needed many more infantry capable of conducting sieges and engaging large Ottoman field armies (Setton 1991, 292). The German mercenaries they procured were among the best trained and equipped forces in Europe at the time. The Hanoverian forces arriving at Dragomestre consisted solely of musket-armed infantry; they abandoned pikemen in favor of the socket bayonet for defense against Turkish cavalry, one of the first militaries in Europe to make this pivotal shift (Black 1994, 39).

The ethnographic make-up of the mercenary forces deployed to Greece is a critical factor in understanding the role of malaria during the Morean War. While highly capable soldiers, these northern Germans possessed no acquired immunity to any species or strain of malaria. The forces used in the 1684 campaign in the Gulf of Arta largely consisted of Italian, Southern Slavic, and other inhabitants of Mediterranean climates, and only a minority were previously unexposed to the "climate of the East" noted by Locatelli. Conversely, the German mercenaries brought to Greece from 1685 onward were overwhelmingly vulnerable, meaning that any outbreak among them would swiftly reach epidemic proportions and inflict a high mortality rate. High hospitalization rates and death tolls among the ranks of elite, professional soldiers not only created a manpower shortage but a diminished the overall quality of the army, requiring the further recruitment of more mercenary regiments from Germany. In turn, new German recruits exhibited the same epidemiological vulnerabilities as the soldiers they replaced. These factors created a recurring loop of recruitment, infection, epidemic, mortality, and new recruitment to make up losses.

The Siege of Koroni

The muster of Christian forces at Dragomestre in June 1685 saw the Hanoverian regiments joined by contingents from Florence (300), Dalmatia (1000), the Papal States (400), the Knights of Malta (1000), along with Venetian infantry (1600) and sailors (1500) (Schwenke 1854, 24-25). This gave the Captain-General, Francesco Morosini, an army of 10,000 effectives to use in the 1685 campaign. The immediate target was the Messenian peninsula in the southwest Peloponnese, dominated by the ports of Methoni on the west and Koroni on the east. Before their loss to the Turks in 1500 the two ports were known as the "eyes of the Republic", as they dominated the maritime transition between the Aegean and Ionian Seas (**Map 3**). The importance of these ports in maritime networks is reflected in Koroni's Betweeness Centrality score (.30103), putting it in 10th place out of 148 nodes in the network (**Table 2**). After sailing to the island of Sapienza off Methoni, Morosini and his officers decided to attack Koroni first. The immediate concern was supporting local Greek rebels in the Mani peninsula opposite Koroni, as well as isolating the rest of the Messenian peninsula from Ottoman reinforcements. By June

25th infantry disembarked under the walls of Koroni and commenced building siegeworks (Locatelli 1691, I: 125; Andrews 2006, 11).

The struggle for Koroni was a classic early modern siege. Sitting on a headland jutting out into the sea, the Christian army cut off Koroni with a circumvallation trench across the neck of the promontory, and proceeded to build zig-zagged assault trenches snaking towards the walls. A Turkish relief force arrived on July 7th, forcing Morosini to order the construction of countervailing fortifications facing outward towards the Turkish camp, and the siege devolved into a series of sorties and counter-sorties against the opposing trenches. At dawn on August 7th Morosini launched a surprise attack on the Ottoman camp, routing the Turks and seizing their supplies. The Turkish defeat gave Venetian engineers the respite they needed to complete a mine under the fortress walls, and on August 11th, a breach was blown open in the city defenses. Despite a Turkish attempt to surrender, Christian forces assaulted Koroni and sacked the city, leaving 1500 dead from among the garrison and the populace (Andrews 2006, 12-13). The dead were subsequently tossed into the sea (Locatelli 1691, I:151). Turkish forces continued attempts to dislodge the Christian forces from the region, but a set-piece battle at Kalamata on September 14th resulted in a stinging Ottoman defeat and retreat from the region. This secured the Christian hold on Koroni and allowed Greek rebels in the nearby Mani peninsula to eject local Turkish garrisons (Pinzelli 2020, 93).

Despite the very real violence of these clashes, disease proved a much greater danger than Turkish artillery or musketry. By July 16th the Hanoverian regiments reported an epidemic beginning in their ranks, with 60 sick with fever and dysentery. Of these, 19 (30%) died within weeks (Schwenke 1854, 32). By August 3rd, more than 400 were sick, with 150 dead, and more than 1000 were ill by August 11th (Schwenke 1854, 42). In late August, Locatelli describes a "grave malady" afflicting the officer corps, and by September 17th the "very dangerous illness" striking the force required extra medical staff to be called from the Ionian islands (Locatelli 1691, I: 158, 167). Just as in the previous summer, many of the sick were removed from the combat theater and sent to convalesce in hospital at Zakynthos, though mortality continued at a high rate. Of the 772 Hanoverian sent to Zakynthos in late September, 193 (33%) died by October 10th and some level of mortality continued among them through the fall and early winter. Hanoverian records from January 10th, 1686 show that, of the 2400 mercenaries on hand for the 1685 campaign, 992 had perished. Of these, 256 fell in combat, while 736 succumbed to illness (Schwenke 1854, 58). This places the overall mortality rate at 39%, with disease mortality at 31%.

Determining the mechanism behind the epidemic at Koroni poses some difficulties. The contemporary sources only provide a single vague reference to specific symptoms, high fever, and dysentery (Schwenke 1854, 32), which are common indicators of several diseases, including *P. falciparum* as well as typhoid fever (*S. typhi*), a bacterium in the *Salmonella* family. In fact, due to this overlap in symptoms it can be difficult to properly diagnose malaria from typhoid, even for modern medical practitioners (Cunha 2005). And typhoid is a real possibility in context of the Morean War. Typhoid is water borne, spreading via human fecal matter into contaminated food and drinking water, and is a known danger in densely populated, unsanitary conditions (Amicizia et. al. 2019, 271), such as siege camps like that at Koroni. Furthermore, typhoid is known to have been present in Greece as early as the Peloponnesian War of the

5th century BC. Recent aDNA evidence demonstrates that the “Plague of Athens” described by Thucydides in 430 BCE was indeed typhoid (Papagrigorkoris 2006).

However, given the limited nature of our evidence, as well as what we know about malarial risk in Greece, malaria is still the most likely culprit behind the high mortality at Koroni. First, Koroni sits firmly in the highest risk category of the Malarial Risk Analysis (**Map 6**). The local geography and climate are at high risk for *A. sacharovi* populations, and the LIA-induced drought conditions present in 1685 (**Map 4b**) further heightened that risk. The timing of the epidemic, beginning in July and continuing into September and October, directly correlates to the period of prime *A. sacharovi* reproduction. Indeed, the siege of Koroni took place at the worst time of year, in one of the worst places, for malarial risk. Finally, the rate of morbidity and mortality among the Hanoverian is exactly what we would expect from a non-immune population being exposed to a malarial environment. Considered together the evidence points to malaria as the major killer at Koroni.

The campaign of 1686: Pylos, Methoni and Nauplion.

The winter of 1685-86 allowed Morosini to rest and recuperate his remaining forces, while the Venetian Senate hired more mercenaries from Germany to make up the loses from the previous season. The reinforcements included additional Hanoverian mercenaries to replace loses in the original three regiments, as well as add a fourth regiment of musketeers commanded by the Raugraf zu Pfalz. Some 1500 Saxon infantry were recruited as well, and other members of the Holy League contributed larger contingents. New recruitment produced in a substantially larger force for the 1686 campaign, allowing a muster of 10,800 combat troops on Zakynthos at the end of May

1686 (Schwenke 1854, 72). A new ground commander also arrived in theater, the experienced Swedish general Otto Wilhelm von Königsmarck, accompanied by his wife Charlotta and her retinue. The Königsmarck household included Charlotta's close friend, Anna Akerhjelm, whose letters and diary comprise one of the major eyewitness resources for the subsequent campaigns (Akerhjelm 1854).

Morosini's proximate goal was to secure the western Messenian peninsula. On June 2, 1686, Königsmarck's troops landed below *Old Navarino*, the medieval fortress guarding the northern entrance to Navarino Bay. The small, ill-equipped garrison surrendered the next day when their water supply was cut by the besieging forces, and in return they were allowed to sail to Alexandria with their families (Locatelli 1691, I:212). A siege of the much stronger fortress at *New Navarino* (modern Pylos) commenced immediately, and after Königsmarck routed a relief force and Christian artillery ignited the fortress's gunpowder store, the remaining Turks capitulated on June 14th. As at Old Navarino, the surviving Turks evacuated to Tripoli in North Africa (Locatelli 1691, I:211-212). These successes left all of Navarino Bay in Christian hands.

Methoni was the only remaining Turkish strongpoint on the Messenian peninsula. The Christian siege began on June 22nd, and the Turkish commander refused several of Morosini's calls to surrender. He was encouraged to resist by Methoni's strong fortifications and the presence of major relief force in the region. Turkish cavalry raided through much of the countryside, hoping to entice Venetian forces out of their siege camp for a battle in the open field (Locatelli 1691, I:232). That strategy, while devastating to the local countryside, failed to distract Morosini and Königsmarck, and the Turkish garrison surrendered on July 7th, and the 4000 Turks within followed those of Navarino to

Libya (Locatelli 1691, I:236). With both Methoni and Koroni returned to their dominion, Venice had regained strategic control of the juncture of the Ionian and Aegean Seas.

The capitulation of three fortresses in quick succession meant relatively few combat losses for the Christian army. Yet disease continued to take a toll, especially among the new recruits. By June 16th, 584 Hanoverian soldiers had fallen ill, out of 3219 total effectives, with 45 dying as a result. Of these, 267, including 24 of the dead, belonged to the newly arrived "Raugraf" Regiment, meaning that 45% of the sick soldiers had no previous contact with malaria, and thus no possible immunity (Schwenke 1854, 83). This one regiment suffered twice the rate of illness as the other three regiments, which were mostly made up of veterans of the previous campaign. The mortality rate as of June 16th remained low compared to the previous year, at 7% overall, and 8.9% in the "Raugraf" Regiment. However, the lower mortality rate may be explained by the presence of a less severe malarial species in the region of Methoni, such as *P. vivax*, or by the relatively short window of infection to date. The report of June 16th was just under 3 weeks into the campaign, and malarial deaths tend to lag weeks or months behind initial infection. Regardless, this particular outbreak did not significantly hamper military operations.

The presence of an energetic new ground commander, the swift successes in Messenia, and the relatively few loses suffered thus far, all encouraged Morosini to act boldly. In late July 1686 Morosini sailed with a large force to attack Nauplion, the capital of the Ottoman Morea and gateway to the fertile Argolid valley. Königsmarck and his ground forces landed at nearby Port Tolon, and within hours seized the Palamidi hill overlooking Nauplion. Gun batteries on the heights began the bombardment of the city, while the main Christian army encamped on the plain below and began digging mines and assault trenches (Andrews 2006, 90). Ismail Pasha, the Ottoman governor of the Morea, moved quickly to relieve Nauplion with a force of 7000 cavalry and infantry. Königsmarck countered this move aggressively, confronting the Ottoman force on the plains below Argos on August 7th, and after a sharp clash forced the Turks to retreat. Ottoman cavalry continued attacks against the Christian camp for the next several weeks, while the garrison of Nauplion sortied against the encroaching siegeworks frequently (Locatelli 1691, I:247). Ismail Pasha attempted a surprise nighttime attack on the Christian camp on August 27th, but being forewarned by the local Greek populace, Königsmarck met the assault with his full army, killing 1400 Turks in return for only 300 Christian dead and wounded (Pinzelli 2020, 117). Nauplion surrendered on August 29th, and the 9000 Turkish residents took ship to the Ottoman-held Island of Tenedos (Locatelli 1691, I:269). The capture of Nauplion concluded an exceptional campaigning season for the Venetians and their allies, with four major fortresses falling in under three months, and with few combat losses, even against significant Turkish opposition.

Yet again, as noted by a contemporary historian, disease "killed more than the scimitars of the Turks" (Beregnani 1698, II:89). As at Methoni the previous year, the siege of Nauplion took place in a high-risk malarial zone (Map 6) at the very time of year of peak mosquito breeding. The Argolid valley is one of the largest agricultural plains in the Peloponnese, with numerous watercourses flowing through the valley and into the Argolic Gulf. As noted above (p. 61), malaria was a known risk in the Argolid, as directly observed by European travelers, and the local Greek populace bore the telltale jaundiced complexion of survivors of repeated malarial infections. Furthermore, the summer of

1686 saw more intense drought conditions in Greece than the previous year (**Map 4c**), further heightening the risk of infection within the valley. Garzoni specifically notes the hot, dry weather at Nauplion as an anecdotal factor in the spread of the epidemic (Garzoni 1707, 100).

Just as the battle for Nauplion reached its final phase at the end of August 1686, a malarial epidemic wreaked havoc among the Christian army. A muster of the Hanoverian regiments just before the battle of August 27th showed only 1551 soldiers fit for duty; the remaining 1200 were listed as sick and wounded, or 43% of the entire force (Schwenke 1854, 112). Zorzi Emo, commissary officer for the entire army, reported 178 deaths by disease throughout the force the last week of August. The situation vastly worsened in the first half of September, with 4018 sick and 1073 dead, meaning more that 50% of the army had been infected, with a mortality rate of 21%. (Pinzelli 2020, 345).

The officer corps suffered as much as the rank-and-file. Barbaro Brigadino, commander of the *Condennati* Regiment, died on August 25th, along with the nobleman Bernardo Visconti, followed on the 28th by Girolamo Ghirardi and Francesco Loredan (Locatelli I: 265-6). Stefano Gregorovich and Giovanni Bernardo Topau, both infantry officers, succumbed in mid-September (Locatelli 1691:276). In all Locatelli lists 9 Venetian officers who died in the fall of 1686 from this epidemic. Many others grew ill and recovered; Daniel Dolfin, commander of one of the naval flotillas, became gravely ill for several weeks, while Lorenzo Venier is reported to have been "resurrected from his illness". The Captain-General's own brother, Lorenzo Morosini, died after long illness on December 31st (Locatelli 1691, I:271).

Königsmarck's household was especially hard-hit, as noted in the letters and diary of Anna Akerhjelm. His 27 year-old nephew, Karl Johann von Königsmarck, died on August 27th after experiencing a "fiery fever" (Akerhjelm 1854, 227). Over the next several weeks much of the household fell ill, including Count Königsmarck and his wife Charlotta, who were attended by a surgeon from one of the Saxon regiments. They both suffered fevers from September 18th to October 6th, according to Akerhjelm's diary, before recovering, as did several maids (Akerhjelm 1854, 257-259). Many others were not so fortunate. Three members of Karl Johann's retinue died shortly after him, as well as several staff officers, valets, and the Count's baker and confectioner (Akerhjelm 1854, 227-229). As expected, illness and deaths continued to lag well behind the period of initial infection, a result of various comorbidities attendant to malaria. Several of Akerhjelm's fellow ladies-in-waiting remained sick into December, exhibiting *tertian* fevers in several cases (Akerhjelm 1854, 231) Much of the army, including all of the sick, embarked for winter quarters and convalescence at Zakynthos at the end of October. Due to ill winds and heavy rains the trip took 6 weeks, not arriving at Zakynthos until December 15th. In the interim, 90 more Hanoverian soldiers died, as well as Herr Fabricius, Königsmarck's Lutheran chaplain (Schwenke 1854, 124; Akerhjelm 1854, 259).

From a military standpoint the 1686 campaign was stunningly successful. Morosini and Königsmarck pursued an aggressive strategy, besieging multiple well-fortified, supplied, and garrisoned strongpoints, all while mobile Turkish armies constantly threatened their siege lines. In each case the Christian army routed relief forces and forced the capitulation of the besieged garrison, all with very few combat casualties. These successes testify to the able leadership of commanders like Königsmarck, as well as the tactical skill of the highly trained German mercenaries they led. But the environment proved a much greater challenge to the Christian forces, especially at Nauplion. The German infantry from Hanover and Saxony, especially those new to the theater, lacked any natural immunity to malarial infection. Even those Hanoverian veterans of the previous summer, as well as the rest of the army, possessed no immunity from any malarial strain specific the Argolid plain. Heavy drought, evident in the dendrochronology of the region, exacerbated the already high malarial risk of the region, all at the worst time of year for mosquito propagation. The toll is best illustrated by the muster records of the Hanoverian regiments; of the 3219 soldiers and 150 servants present at Zakynthos on May 23rd, only 2058 remained at the end of December 1686, with a loss of 1300 soldiers/servants and 58 officers (Schwenke 1854, 124). Unfortunately for the survivors, the new year and new campaign season held a different epidemic in store.

CHAPTER IV – PLAGUE AND THE PARTHENON: BUBONIC PLAGUE IN THE MOREA, 1687-1688

Winter quarters provided Morosini and Königsmarck the opportunity to convalesce the survivors of the previous year, recruit and marshal new forces, and plan their next strategic moves. As well, they were concerned with countering frequent Turkish cavalry raids into Venetian-held areas of the Morea, which burned local villages and forcibly evacuated many Greeks from the Morea into Turkish controlled regions of Greece, a kind of ethnic cleansing (Locatelli 1691, I: 297; Beregnani 1698, 256). Whatever the commanders initially planned, they were upended by the appearance of bubonic plague in the Morea and the wider Aegean in Spring 1687. Local Greek chieftains warned Morosini that the plague recurred in the Morea every 10 years, and that they were due for a return visit from the disease (Locatelli 1691, I:300). In March 1687, the plague appeared within the Venetian fleet, as diagnosed by Venetian medical personnel. The *Protomedicus* Draga, chief medical officer of the Venetian contingent, examined several infected individuals and described symptoms, including “buboes of the groin” which “make the sick die quickly and make the healthy sick” (Locatelli 1691, I: 301). Draga immediately submitted his findings to Morosini, who dispatched the report directly to Venice. The war effort took a decidedly new turn with the arrival of this deadly contagion.

Morosini and his medical staff had every reason to fear the appearance of plague, as the Venetians had long experience with it. Like so many other major European trade centers, Venice suffered from repeated recurrences of plague, in 1478, 1528 and 1555. Prolonged epidemics struck in 1575-77 and again in 1630-1631, and each of these events killed as many as 50,000 Venetians out of a populace of 160,000 to 190,000, which amounted to one quarter to one third of the citizenry (Martin 2022, 6; Setton 1991, 105). As a consequence, the Republic developed an extensive heath system, the *Magistrato alla Sanità*, empowered by the Senate with a full raft of health laws, to conduct disease surveillance throughout the *Stato da Mar*, enact quarantine procedures, and manage *lazarettos* at Venice and other Venetian-held ports. The Venetian Senate also patronized the medical profession, subsidizing the premier medical school at nearby Padua and engaging the services of the best medical personnel in Europe. These medical humanists, such as Girolamo Mercuriale, produced numerous treatises on the causes and treatment of plague (Mercuriale 2022). The Venetian health establishment was confident enough in its knowledge of plague that during the War of Candia (1644-1669), they unsuccessfully attempted to weaponize a "quintessence of the plague" to infect Turkish forces deployed in Crete (Thassalinou et. al. 2015, 2149).

Bubonic Plague: Epidemiology, Mortality and Environment

Bubonic plague is a vector-borne, zoonotic disease caused by the bacterium *Yersinia pestis*, which is primarily carried and transmitted through various species of fleas and lice, including Oriental rat flea, *Xenopsylla cheopis*, and the human flea (*Pulex irritans*). In turn, infected flea populations can infest a wide variety of mammalian species, but rodent species are the most common enzootic plague reservoirs and source of epizootic transmission into human populations. Infected fleas, especially *X. cheopis*, suffer from a blockage of their intestinal tract, resulting in regurgitation of the *Y. pestis* bacterium. Regurgitated bacteria are thereby transmitted to an inoculated host when the flea feeds (Abbot and Rocke 2012, 5). The foregut blockage, which prevents blood meal from reaching the insect's stomach, encourages frequent feeding, as the flea is literally starving, and thus heightens transmission potential (Aberth 2021, 2-3).

Morbidity and Mortality

Once within a human host, *Y. pestis* bacteria spread via the lymphatic system, first infecting lymph nodes closest to the point of inoculation, then spreading to nodes in the groin and neck. This results in visible *buboes*, swellings or carbuncles, which characterize bubonic plague. The infection brings about high fevers, chills, body aches, and ultimately causes multi-system organ failure and death within 3 to 5 days from the onset of symptoms. It is common for the bacteria to break into the lungs, creating pneumonic plague, allowing for human-to-human transmission via sputum. Pneumonic plague is even more deadly, with death occurring within 2 to 3 days, due to the respiratory distress it causes. Septicemic plague, an infection of the bloodstream, can kill even more swiftly, in less than 24 hours, owing to septic shock. The bodily fluids of the victims of septicemic plague are particularly dangerous to those who handle them. Overall mortality rates in modern plague events are between 60% and 80% for bubonic plague, while primary pneumonic or septicemic infections are universally fatal without immediate antibiotic treatment (Aberth 2021, 6-7).

Y. pestis is the pathogen responsible for all three plague Pandemics; the First Pandemic (the *Justinianic Plague*) striking the Mediterranean World and Europe from 541 to 549, with subsequent regional recurrences into the 8th century, the Second Pandemic (the *Black Death*) crossing Afro-Eurasia from 1346 to 1353, with frequent reappearances up to the early 19th century, and the Third Pandemic began in central China in 1854, spreading globally with outbreaks through the 1920s (Abbot and Roche

2012, 2; Aberth 2021, 8-9). Though it is difficult to accurately quantify pre-modern death tolls and mortality rates, each of these pandemics ravaged global populations, killing millions and often reducing impacted populations by as much as 50%.

Despite numerous historical accounts accurately describing clinical symptomology and epidemiology of *Y. pestis*, some scholars have aggressively denied plague as the causative agent behind these pandemics. Multiple aDNA studies of plague burials, however, decisively confirm *Y. pestis* as the causative agent behind all of these pandemics, to the point that all other possible explanations have been silenced (Little 2012; Sarris 2021). Furthermore, aDNA sequencing has allowed scholars to look back into the evolutionary history of the plague with incredible precision. Monica Green's seminal work on the phylogenetic history of plague shows that both the Second and Third Pandemic, as well as all current strains of *Y. pestis*, trace back of an evolutionary "big bang" event occurring in the 13th century in the Tian Shan Mountains, along the borders of China, Kyrgyzstan, and Kazakhstan (Green 2021, 1611-1614).

Endemic Environments and Transmission via rodents.

Plague transmission is closely tied to the behavior of rodent populations. Endemic reservoirs/foci of sylvatic plague historically have existed among various rodent colonies in highland forests and grasslands. Within these colonies, the pathogen circulates at a low level, allowing the disease to survive without killing off its host population. Identifiable foci exist today in several places. The Tian Shan mountains of China/Kyrgyzstan and the Quighan-Tibetan Plateau both support colonies of plague-infested rodents, notably the native marmot (*Marmota baibacina*) of the region (Sariyeva et. al. 2019; Qian et. al. 2014). Given that the "big bang" described by Green (2021, 1614) took place in this area, finding endemic plague here is unsurprising. The Third Pandemic of the late 19th/early 20th century, spreading via global trade lanes, established plague reservoirs in previously untouched locales, including the Four Corners region of the American Southwest, the Ituri rainforest of Congo and Uganda, and the central highlands of Madagascar (Abbot and Rocke 2012, 16; Eisen et. al. 2007; Lofty 2015; Andrianaivoarimanana 2019). Despite the global distribution of these plague foci, the geographic commonality between all of them is the prevalence of elevation (500m – 2300m) and landcover (forest and grasslands) among the preferred environments for host rodent colonies.

The epizootic leap from endemic disease in a rodent population to an epidemic/pandemic outbreak among human populations is a consequence of both human and rodent behavior. Many rodents, especially the Black Rat (*Rattus rattus*), are commensal species that establish symbiotic relationships with human communities. Human societies, through their agricultural output and waste, provide ready sources of food for rodents, and given the furtive nature of these species the size of their colonies is often underestimated by several orders of magnitude. In simple terms, human settlements attract rodent colonies, and these colonies are large (up to 6000 per square mile), whether they are observable or not (McCormick 2003, 14). *R. rattus*, as well as many other rodents, adapt well to new environments and climates, and demonstrate considerable mobility, travelling along with their human companions by land and sea. The inherent mobility of rodent species and the fleas they carry, along with their commensal relationship with human communities, is a critical aspect of the spread of bubonic plague. As humans move, the rats and their fleas move with them.

Moreover, rodent populations are just as susceptible to environmental change as humans. Any change to food supply can cause rodent populations to act in abnormal ways. The *trophic cascade* model has been observed in numerous species of rodents, wherein heavier spring rains result in the growth of more vegetation. Increased food resources lead to a boom in rodent populations, in turn leading to greater incidence of plague transmission, as repeatedly observed in the American Southwest (Abbot and Rocke, 2012, 40-41; Gage et. al. 2007, 443-444). Conversely drought also raises the risk of epizootic plague; rodents weakened by hunger and/or dehydration often attract twice the fleas they would normally, a result of their weakened ability to fend off flea infestations (Eads et. al. 2016). *X. cheopis* tolerates drought conditions well, being able to go 100 days without feeding (Gage 2005), so drought does not impede plague transmission, and likely encourages it. The oscillation between wet winters and drought-ridden summers characteristic of the LIA may have created a kind of push-and-pull effect on rodent/flea populations, in which wet conditions in early spring allowed for a trophic cascade and a rise in rodent populations, while the summer droughts killed off these rodents, forcing their fleas to find new host colonies (Schmid et. al. 2015, 3024).

Disruptions to infected rodent colonies, such as those caused by climate shifts, become *amplification events* that push rodents/fleas away from their endemic environments and towards new hosts. This is how *Y. pestis* jumps from highland plague reservoirs towards commensal species like *R. rattus*. Indeed, scholars now suggest that periodic climate change in the Old World plague reservoirs of Central Asia was the catalyst for both the First and Second Pandemics. Extreme vulcanism in the 530s and 540s and the colder temperatures that followed likely sparked the First Pandemic, while the climate fluctuations of the LIA repeatedly pushed plague outwards from its natural foci (Harper 2017, 251-255; Schmid et. al. 2015, 3025).

Plague in the Ottoman World, 1346-1841

To understand how bubonic plague impacted the Morean War, we must recognize how the plague effected the Ottoman Empire at large, especially those landscapes most closely connected to the Morea. Simply put, the Black Death that entered the Ottoman world in 1343 never truly ended, but continuously circulated throughout the Empire and its hinterlands for the next five centuries, reappearing in various locales repeatedly. The complex maritime and terrestrial networks crossing the Ottoman world, as described in Chapter II, and the ships, caravans and armies that moved along them, were conduits of plague transmission. Rather than bringing people into regions of endemic disease, as with malaria, these networks distributed plague to every corner of the Empire.

Nükhet Varlık identifies three distinct phases of plague movement across the Ottoman landscape. First, an initial period (1346-1517) occurred in which the late-Byzantine and Ottoman world was integrated into a large European network of plague. Plague flowed into the Ottoman Empire largely from the west, with Venice as a an especially dangerous plague node in the late-15th century (Varlik 2015, 135-137). The Ottoman conquest of Mamluk Egypt in 1517, which doubled the size of the Empire, radically shifted trade networks towards Egypt and the Arabian Sea. The large grain shipments subsequently coming out of the Nile valley became a new source of plague transmission to Istanbul and Anatolian ports along the way (Varlik 2015, 167). The final phase developed after 1570, as the Ottomans reached a kind of imperial maturity. The growing cities of central Anatolia, like Kayseri and Konya, developed even closer links to Istanbul, with most foodstuffs, trade goods and manpower from these regions filtering towards the imperial metropolis. But just as Istanbul was the center of political and economic power, drawing all towards it, it was also the center of plague distribution, drawing plague from various foci within the Empire and beyond, and then pumping *Y. pestis* back along the network (Varlik 2015, 174-181). This final phase continued until the final plague epidemics of the mid-19th century.

Mapping Plague in the Ottoman Heartland

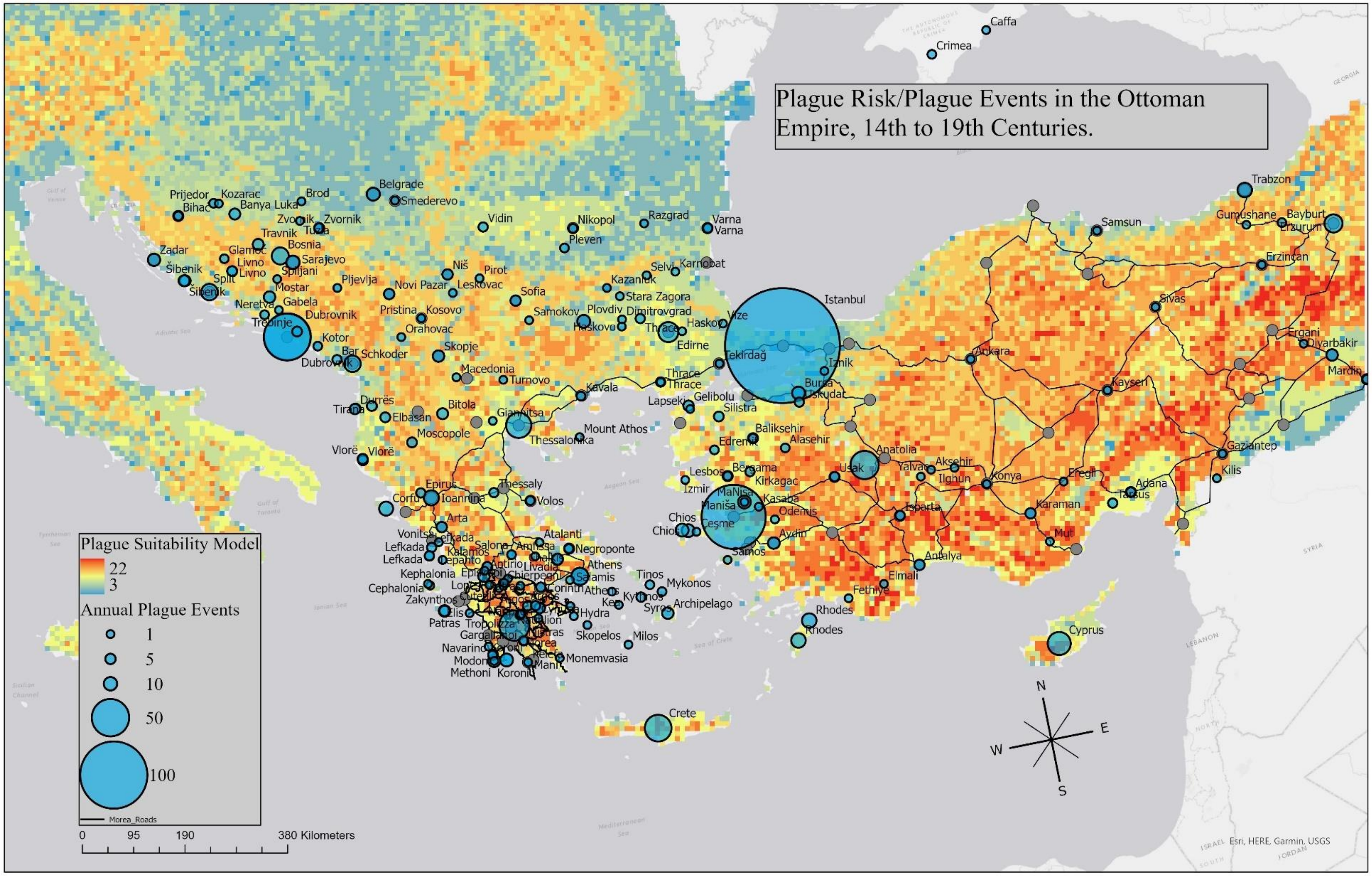
Varlik's three-phase *schema* is sensible, but she fails to utilize contemporary GIS mapping techniques to support her argument. The maps supplied in her work are vague, using only basic arrows to show routes and direction of plague movements in each of the larger phases she describes (Varlik 2015, 134, 137, 161, 188). This is only a step beyond the infamous Carpentier map of the Black Death in Europe, 1347-1350 (Carpentier 1962). This map presents bubonic plague progressing through Europe in wide-spanning annual waves, looping over Europe from south to north as a slow-moving tsunami of disease. Diseases do not spread in such a linear fashion. As John Aberth notes, epidemic disease tends to spread metastatically, jumping over one spot to appear in another place further away, only to return to those places skipped over at a later time (Aberth 2021, 30). This better reflects human behavior, as merchants and their accompanying rodents may pass by one town or port, favoring another place entirely. Varlik's maps, while accurately depicting a basic form of plague transmission, still fail to communicate the complexity of plague in the Ottoman world.

Identifying plague reservoirs within the Ottoman orbit is critical to understanding plague movements. Some scholars uncritically assert that no plague reservoirs existed within Ottoman Anatolia or the Balkans; rather they claim plague emanated out of the Caucasus and simply progressed through Ottoman trade centers and networks (Schmid et. al. 2015, 3021; White 2011. 86). Varlik (2015, 105-112) argues for the existence of plague foci in the Anatolian highlands, particularly the Taurus mountains to the south of the Anatolian plateau. The highland elevations, forested landcover and the presence of native rodents (the Anatolian ground squirrel, *Spermophilus xanthoprymnus*) all indicate an environment perfect for sustaining reservoirs of plague (Varlik 2015, 105-112). Yet even Varlik is relying purely on anecdotal evidence, making no attempt to quantify the likelihood of plague reservoirs in the region.

This study produced an analytical map (**Map 7**) detailing the environmental suitability for possible plague foci within Ottoman Anatolia and the Balkans, overlaid with known plague outbreaks in the region from 1346 to 1841. The Plague Suitability Model uses criteria drawn from current plague risk modelling in the American Southwest (Abbot and Rocke 2012, 16; Eisen et. al. 2007), the Tibetan Plateau (Sariyeva et. al. 2019; Qian et. al. 2014), and Madagascar (Andrianaivoarimanana 2019), including elevation, landcover, and spring/summer average daily temperatures. No such information is available for the 17th century, so modern data are used as a proxy. Digital elevation data (DEM) were derived from the 30m *EU-DEM v. 1.1* dataset (Copernicus Land Monitoring Service 2021a) and was reclassified following the risk analysis found in Gage et. al. (2007), with the highest risk score (5) given to elevations from 1300m to 2300m. Elevation ranges from 500-1300m and 2300-3000m still show significant risk (4), while elevations below 500m, capable but unlikely to host plague foci, are given a lower score (2). Elevations above 3000m host few or no rodents, and thus are given the lowest score (1). The *CORINE Landcover 2018* dataset (Copernicus Land Monitoring Service 2021b) were reclassified to give the highest scores to forested landscapes (5), grasslands (4) and agricultural plots (4). Lower scores (0 or 1) were given to wetlands and urban developments. Spring and summer temperature was added as a criterion, since flea reproduction is largely governed by warm climates (Abbot and Rocke 2012, 41). Monthly averaged temperature data for May to September was supplied by the Copernicus Climate Change Service (2021), and reclassified to reflect optimal flea populations, with 26°C to 36°C receiving the highest rank (5). Degree ranges above and below this threshold were ranked lower (0 to 2). The model then weights the reclassified datasets according to the studies noted above, with elevation multiplied by 2, landcover by 1.5, and temperature by 1. The sum of the weighted scores produced the final analysis raster.

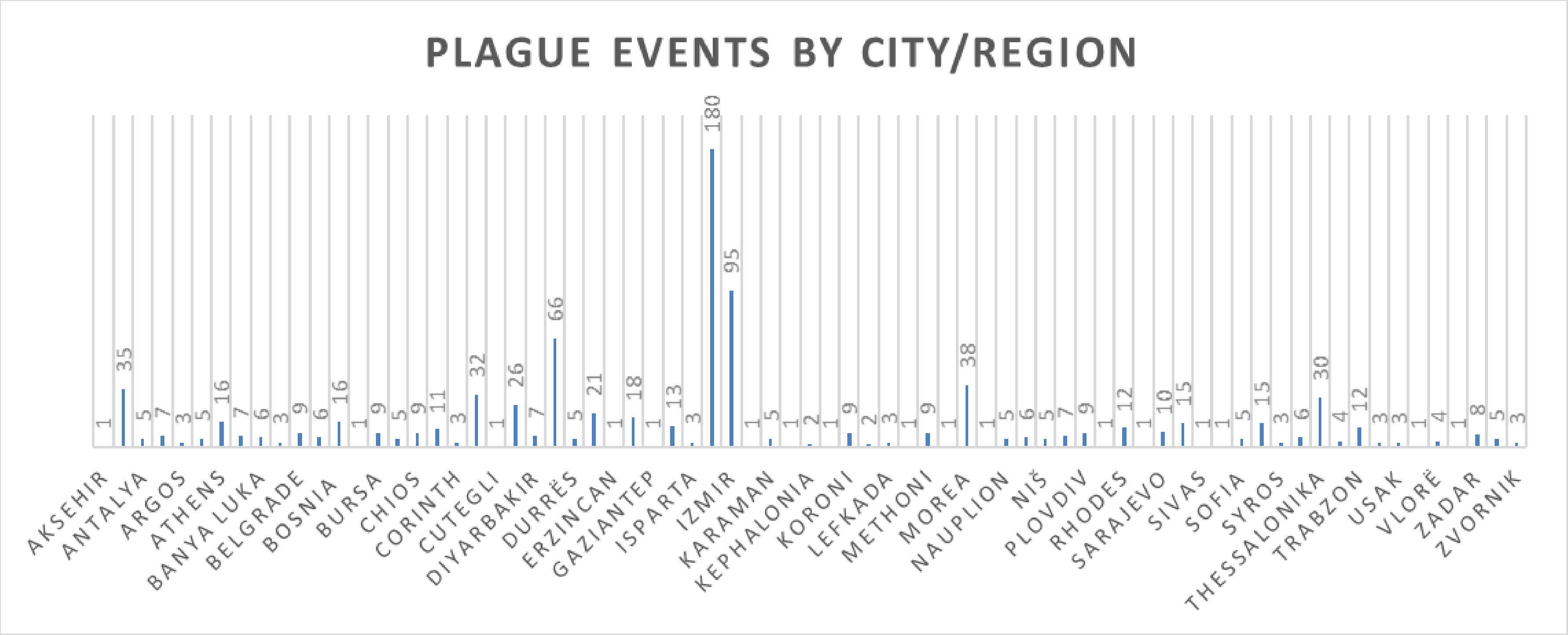
In order to compare identifiable plague reservoirs with known plague occurrences, a dataset was compiled from the major plague studies of the Ottoman Empire, including Varlik's work noted above (2015), Daniel Panzac's *La peste dans l'Empire ottoman, 1700-1850* (1985), and Jacques Biraben's *Les hommes et la peste en France et dans les pays européens et méditerranéens* (1975). Additional data was added from several more focused studies (Setton 1991; White 2011; Tsiamis et. al. 2011), as well as new primary source materials used in this study (Locatelli 1691; Laborde 1854). The dataset resulted in more than 1000 plague events across the Ottoman Balkans and Anatolia over five centuries. The dataset was then imported into ArcGIS, displayed as graduated symbols by event count, and overlaid over the Plague Suitability Model, creating **Map 7.**

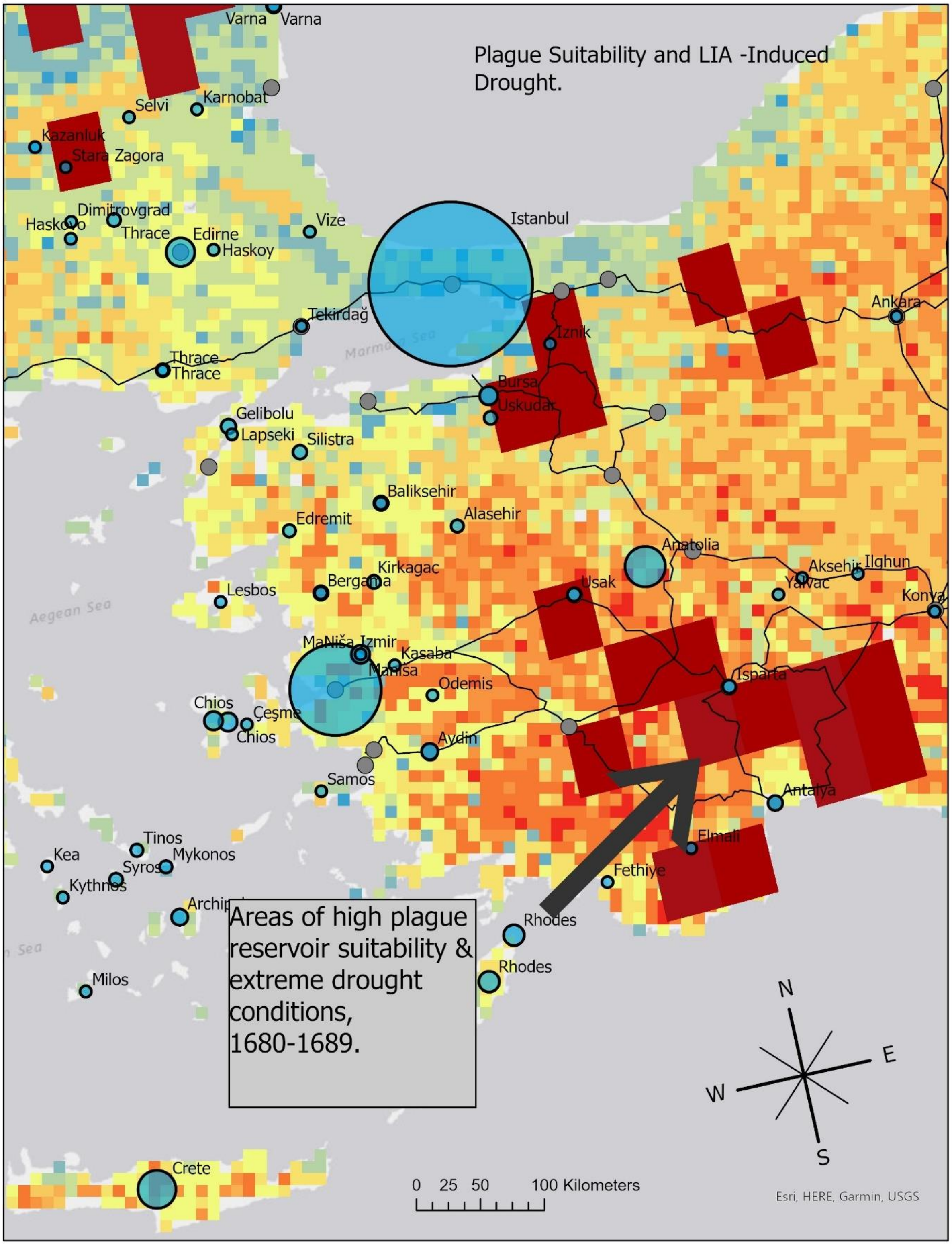
The results are striking. First, while it is clear that much of the study area scores high on the Suitability Model scale, the highest scores are clearly in the Taurus Mountains crossing southern Anatolia. Here, proper elevation combines with a forested landscape, the perfect breeding ground for local rodent species, the fleas they carried, and *Y. pestis*, bearing out the anecdotal evidence cited by Varlik (2015, 105-112). These high-scoring areas are also located near caravan routes that connect many of the trade centers of the Empire; this is especially true in Southwestern Anatolia, where caravan routes feed towards Istanbul to the north, as well as the port of Izmir on the western coastline. The importance of possible plague foci in southwest Anatolia is further heightened when LIA induced drought is considered. PDSI data from the Old-World Drought Atlas, averaged for the 1680-1689 decade, were reclassified on a scale of 8 to 0, with the positive numbers indicating a negative PDSI score, or drought. The resulting raster output was multiplied by the Plague Suitability Model to emphasize possible plague reservoirs most heavily impacted by drought conditions. This may indicate where rodent colonies, with environments disrupted by drought, dispersed and sought out new, more hospitable settings, transmitting plague in the process.



Map 7: *Plague Suitability Model in context of known plague events, 1346-1841.*

Table 3: *Plague Events by Ottoman City or Region, 1343-1841*.





Map 8: *Plague Suitability in context of Little Ice Age droughts.*

Again, southwest Anatolia stands out (*Map 8*), particularly the mountains of ancient Pamphylia, between Isparta and Antalya. This area is in close proximity to major trade routes in central Anatolia that funneled men and material toward Istanbul, as well as routes directed towards the ports of western Anatolia. This suitability model demonstrates that plague reservoirs likely existed in southwest Anatolia, near the trade network that interconnected the wider Ottoman world, heightening the risk of plague being transmitted along that network. Furthermore, the presence of LIA-induced drought exacerbated these risks considerable, likely disrupting rodent populations and helping to further push plague into the very bloodstream of the Empire.

The concentration of plague events fits well with these patterns. Varlik's assertion that Istanbul acted as a redistribution center for bubonic plague is undoubtedly correct; the Ottoman capital experienced plague epidemics 180 years out of the period, including 44 years out of the 17th century. In the lead-up to the Morean War, Istanbul hosted plague outbreaks annually from 1670-1679, and again in 1685-1686. Yet Izmir should not be underestimated as source of plague transmission; no less than 95 plague outbreaks are recorded in Izmir, with 8 of those in the latter half of the 17th century, and 47 outbreaks in the 18th century. This further illustrates Izmir's network centrality noted in Chapter II (**Table 1** and **Table 2**). In the 17th and 18th century, Izmir was the major gateway to the goods of Anatolia for both British and French merchants (Rycaut 1667; Raveux 2019), and it was a key port on the route from Ottoman Egypt to Istanbul. It is no surprise that, in addition to manpower and goods, bubonic plague would flow from its Anatolian reservoirs towards both Istanbul and Izmir, and from these centers transmitting around the rest of the Ottoman orbit. The epidemic events we see in western Anatolia are significant, with 97 epidemics recorded in the region excepting Izmir; together with Izmir the number of recorded epidemics is 192. Yet even these high numbers are an undercount. The available sources we possess for western and central Anatolia largely consist of the reports of French and British diplomats and travelers in Istanbul and Izmir, and what reports we get about the Anatolian interior are vague and spotty. It seems probable that more detailed data exists in the vast array of unpublished Turkish archival material yet to be studied. Regardless, the data we possess points to significant reservoirs of plague in western Anatolia, which in turn spread the disease to the wider trade networks through Istanbul and Izmir.

To the west, plague events appear most frequently in regions or trade nodes with the most centrality. Thessaloniki, with 9 direct connections in the link analysis and a betweenness score in the top ten overall of .33, experienced 30 recorded plague outbreaks. The Adriatic port of Dubrovnik, with 8 connections and .27 on the betweenness scale, suffered 66 bouts of plague. Chania and Candia on Crete each scored .0756 on the betweenness scale, but each have 8 direct connections, explaining the 32 epidemics occurring there. But the Morea, intersecting the Ionian and Aegean worlds, took significant damage over time from plague episodes. A total of 93 plague outbreaks are recorded for the Peloponnese at large, including 38 references to plague generically listed in “Morea”, but with a significant number of outbreaks at the major ports, including 5 at Nauplion and 7 at Patras. Methoni and Koroni have the highest centrality scores in the Peloponnese, with Koroni having 10 direct connections and a .286 betweenness score, and Methoni having 8 connections and a .149 betweenness score. In turn, Koroni experienced 9 stretches of bubonic plague, with Methoni suffering 8 bouts with the disease. As with Anatolia, there are many lacunae in our source materials, especially for the Peloponnesian interior, and these numbers only give us a glimpse at the extent of bubonic plague in the area. Yet we can see that the more important cities within the network, especially ports that connected the maritime network to the hinterlands, suffered the greatest exposure to *Y. pestis*. Plague in the Morean War, 1687-1688

Disease Vector

The appearance of bubonic plague in the Venetian fleet in early 1687 fits into the wider circulation patterns of plague around the Ottoman Aegean. Identifying the exact disease vector sparking this plague outbreak proves difficult. Several Venetian accounts blame the epidemic on a French merchant vessel carrying supplies from the Cyclades to the Christian fleet at Nauplion (Contarini 1710, 701; Garzoni 1701, 195). The island of Paros had recently fallen to a Venetian task force, and Turkish provisions captured there were forwarded on to support the Morean campaign. The captured supplies originated from Istanbul, the great plague center, and it was presumed that the disease quickly spread to the Venetian fleet (Locatelli 1691, I: 301; Beregnani 1698, 256). This explanation is certainly plausible, but it does not tell the complete story. The warnings from local Greek headmen to Morosini that plague was immanent suggests that plague had already appeared among the civilian populace of the Morea (Locatelli 1691, I: 300). Likewise, Contarini describes the plague hitting rural villages first, followed by urban centers, and only then did it spread into the army's camp and the fleet (Contarini 1710, 701).

These differing accounts are not mutually exclusive, but rather suggest multi-vector transmission of plague contagion. We know that plague occurred in Istanbul in

1685 and 1686, at the very time that Ottoman armies, fleets and supply columns congregated there prior to deployment to the Morea. New troops also moved in from more remote plague reservoirs. More than 3000 Turkish reinforcements arrived in early 1687 at Negroponte from Cairo, where plague had raged the year before (Beregnani 1698, 263). Subsequent military and logistical movements likely spread plague via multiple different routes across the network. Finding plague in captured foodstuffs in the Cyclades, or spreading from village to village in the rural Morea as Turkish armies passed by, all at the same time, should be expected. Trying to isolate a single disease vector for a local epidemic displays a simplistic conception of epidemic disease. Instead, plague transmission to and within the Morea was as complex as the networks in which it took place.

Spring 1687 Outbreak

The extent of plague in the Morea in the spring of 1687 is evident in Locatelli's recounting. Medical personnel identified plague victims on multiple ships at Nauplion and reports from garrison commanders at Methoni and Koroni confirmed plague within their fortress walls (Locatelli 1691, I: 301). Extensive raids by Turkish cavalry into the Messenian peninsula and the Argolid valley exacerbated the situation by devastating villages and field, disrupting agriculture and forcing the local populace to flee, all compounding the dispersal of rats, fleas, and plague *bacilli* (Beregnani 1698, 261-263).

The command response to the growing plague crisis was swift, dictated by the extensive institutional experience the Venetian medical establishment possessed concerning plague. This was a markedly different response than what we saw in the previous malarial epidemics; in those cases, the only recourse taken was to remove the sick to better climates. With the arrival of plague, more specific and extensive measures were taken. The medical staff led by *Protomedicus* Drago instituted procedures to cleanse the fleet of plague *miasma*, including fumigating the ships, washing the decks and sailors' bedding in vinegar, and using various perfumes to drive away pathogenic odors. These actions, divorced from any true epidemiology of plague, did nothing to stop it. More effective measures involved control of movement, with all commerce between ships immediately forbidden, and those infected or suspected of infection separated from the healthy (Locatelli 1691, I:303). Lorenzo Venier, commander of the Venetian squadron in the Cyclades, placed the infected into several fishing vessels, while those "suspected" of plague, sick but with no visible buboes, were shifted over to small sloop (Locatelli 1691, I:305). Morosini ordered a lazaretto established on the island of Sapienza opposite Methoni, with separate quarantine facilities for the infected and the suspected (Locatelli 1691, I: 306). Rudimentary contact-tracing also was instituted. When an African slave on the *San Giuseppe* fell ill, officers who recently sailed in his company were removed to a ship for the "suspected" (Locatelli 1691, I: 316).

The epidemic immediately forestalled plans for the 1687 campaign season. The extensive loses of the previous year necessitated new recruitment from Germany, netting 4000 Hessian and 2000 more Hanoverian soldiers (Garzoni 1707, 195). Morosini planned to rendezvous with the new recruits, as well as reinforcements from the Knights of Malta and the Duchy of Tuscany, at Porto Glimnio on southern Lefkada in early June. The planned conjunction of forces failed to materialize on time, as the Maltese commander General d'Herbesteim refused to unite with Morosini, and instead diverted his force to support operations in the Adriatic (Beregnani 1698, 285). The Tuscan force simply returned to their home port of Livorno upon hearing of plague in Morosini's fleet (Beregnani 1698, 288). For his part, Morosini sailed for Glimnio, only to have several ships turn back to Koroni as plague cases appeared onboard. Even after arrival at Lefkada cases continued to appear, with more ships isolated from the rest of the fleet. Ships with "suspected" cases quarantined off the nearby island of Kalamos, with all movement between ships forbidden on penalty of death (Locatelli 1691, I: 320). In addition, as new troops arrived on Lefkada, Morosini forbade any contact between them and veteran units, even those that had no plague cases, in order to prevent spreading the disease to the reinforcements.

The extended quarantine lifted on July 20th, celebrated with a muster of the reunited army before Morosini and Königsmarck, and the *Te Deum* was sung in thanksgiving for deliverance from *Il contagio* (Locatelli 1691, I:328). The final death toll from the spring of 1687 plague epidemic is unclear, but we know that it compounded heavily upon the malarial losses from the previous year. Zorzi Emo recorded 14300 soldiers at Porto Glimnio on May 27th, 1686 (Pinzelli 2021, 104 n.1). A year later, on July 25th, 1687, Emo tallied 7983 deaths among soldiers and 793 deaths in the fleet, totaling 8776 deaths, which constituted a 61% attrition rate (Pinzelli 2021, 345). This annual death toll encompassed both the malarial epidemic at Nauplion from July to October 1686 as well as the bubonic plague outbreak of spring of 1687, in addition to combat actions at Navarino, Methoni, Argos, and Nauplion. It is notable that foreign troops, primarily Germans, accounted for 58% of the dead among ground forces, well above the mortality rate for the Venetian contingent (41%) (Pinzelli 2021, 345). We can attribute this divergence in mortality rates, in part, to the lack of malarial exposure among the German regiments.

Fall 1687 to Spring 1688

Despite heavy losses from disease the previous year, the influx of newly recruited reinforcements gave Morosini a large and highly capable force for his delayed 1687 campaign season. On July 22nd Morosini landed a force of 14,000 Christian soldiers near Patras, the principal port of the northern Peloponnese. Two days later Königsmarck led this army against entrenched Turkish positions just below the fortress walls, routing the last remaining Ottoman field army in the Morea (Finlay 1877, 183). Consequently, remaining Turkish forces abandoned the Peloponnese, withdrawing into Attica. The great fortress at Acrocorinth, overlooking the Isthmus of Corinth and guarding entrance to the Peloponnese, was burned and abandoned by its garrison on August 7th. Maniot irregulars forced the surrender of several inland towns, including Mistras and Karytaina. Only the rocky bastion of Monemvasia held out against Christian forces, not succumbing until 1690 (Andrews 2006, 160). The Morea seemed firmly in Venetian hands, and these final conquests prompted the Venetian Senate to grant Morosini the triumphal title *Peloponnasiacus* (Locatelli 1691, I:353).

A war council made up of Morosini, Königsmarck, Brunswick, and the other main officers met at Acrocorinth on September 17th to discuss their next move. Despite reservations about its military utility, Morosini agreed to launch an immediate attack on Athens, just across the Saronic Gulf from Corinth. Within days a force of 9880 infantry and 871 cavalry landed at Porto Lione, the port of Athens, and moved inland to besiege the Turkish garrison fortified on the Acropolis. The initial bombardment was hampered by incompetent gunnery and frequent Turkish cavalry raids emanating out of the Ottoman base at Thebes (Mommsen 1941). The siege turned on September 26th, when a Venetian mortar round struck the Parthenon, the 5th century BCE temple and one of the wonders of the ancient world. Over the millennia the Parthenon had successively been a pagan temple, a Christian church, and a mosque, but on this particular day it was also a gunpowder store, and the explosion ignited by the mortar round gutted the ancient structure and killed 300 soldiers of the garrison. This explosion and the failure of another Turkish cavalry sortie the next day precipitated the surrender of the garrison. Athens and its remaining antiquities fell into Christian hands.

The abbreviated 1687 campaign seemed to result in striking successes, with the Morea firmly under Venetian control and Turkish forces on their back foot. Yet despite these real successes, Morosini faced numerous challenges as winter loomed. Turkish cavalry continued to raid into Attica, taking slaves from among the local Greek populace and ravaging the countryside. Corsairs operating around Kythera intercepted supplies meant to feed the Christian army at Athens, and payroll issues caused unrest and desertion among the German mercenaries (Locatelli 1691, II:10-11). But the specter of plague overshadowed all of these concerns. The minutes of the war council held on October 2, 1687 are dominated by reports of plague. The Turkish populace of Mistras could not be expelled from the region for fear of further spreading the disease. More concerning were new outbreaks reported in central and northern Peloponnese, including at Tropolizza, Trikkala, and at Kalavryta and a cluster of nearby villages on the slopes of Mount Panachaikon. The dispersal of plague across the breadth of the Morea, even into mountain villages, deeply concerned the Venetian command staff. Morosini blamed the widespread interactions of the local peasantry for transmission of the plague, a direct consequence of war-induced refugee movements. Morosini ordered local Greek headmen to shut down all trade and other commerce across the peninsula, though the efficacy of this prohibition is debatable (Laborde 1854, 166-67).

By early November rumors of plague in the Turkish camp at Thebes reached Morosini, and he rightly feared that the contagion would reach his own winter camp at Athens. He immediately ordered a cessation of all trade between the Athenian populace and nearby villages, even though this worsened his own supply situation (Locatelli 1691, II: 13). This only delayed the inevitable, and on Christmas Day plague deaths were reported in Athens. Morosini ordered the houses of the victims burned and a *lazaretto* set up (Locatelli 1691, II: 34). In a dispatch to the Senate on January 2nd, 1688, Morosini reported plague outbreaks throughout Venetian held territory, including Patras, Castel Tornese, Naupaktos, and Koroni. Ottoman Greece fared no better, with plague still haunting Thebes, but also northward to Negroponte, the Bay of Talanda, Volos, and the island of Skopelos, all of which sat along maritime supply routes to Istanbul (Laborde 1854, 180-181). Shortly thereafter cases appeared among refugees on the islands of Salamis and Aegina, and the plague "rekindled" at Navarino and Koroni (Locatelli 1691, II:39). The situation in Athens continued to deteriorate; in addition to a growing plague epidemic and repeated Turkish raids, heavy snows and strong northerly *bora* winds prevented supply vessels from approaching Porto Lione, severely limiting the stock of *biscotti* for the troops (Locatelli 1691, II: 42-43).

Athens proved too exposed to both Turkish raids and to plague transmission from the countryside, and in March 1688 Morosini ordered the evacuation of the city, including both the army and the civilian populace. Plague continued to spread, and strict quarantine procedures were put in place. No land-to-ship or ship-to-ship commerce was permitted before the actual evacuation took place, in order to limit transmission and allow for the identification of the infect. No new vessels could enter Porto Lione, again limiting the possibility of infecting newcomers. A new *lazaretto* was established at Kalamos, a rocky island just off Porto Glimnio on Lefkada, an isolated spot far from the epicenter of the plague epidemic yet close of a ready source of supply (Locatelli 1691, II:48-49). The final evacuation took place April 8-10, with Athenian civilians sent to Aegina, Corinth and Vonitsa to repopulate abandoned villages, and the Christian army sailed across the Saronic Gulf to Porto Poro. The sick were sent onward to the Kalamos lazaretto, while the remaining troops were carefully separated into small, squad level groupings to limit infection and ease contact-tracing. Over 100 soldiers grew sick and died within days. For the next 6 weeks numerous soldiers and officers perished at Porto Poro, at Kalamos, and aboard ships in transit. The final death toll for late 1687 into the spring of 1688 totaled 1000 soldiers and 500 sailors (Locatelli 1691, II: 53-58).

Conclusion: The Passing of the Plague Wave

The strict quarantine imposed at Porto Poro and at the Kalamos *lazaretto* proved effective. At the height of the epidemic in April 1688, 60 to 70 soldiers fell ill each day, with 30 dying (Pinzelli 202, 141-142). By early May, the epidemic burned itself out, and the only reported sick remained at Kalamos, allowing Morosini to prepare his next operation (Locatelli 1691, II:57). Several salient features stand out about the 1687-1688 plague epidemic. First, the overall response of the Venetian commanders to the appearance of plague differed markedly from the malarial outbreaks in previous campaign seasons. Malarial infections were simply attributed to the “climate of the east”, effectively blaming local landscapes of the areas they were fighting over. This explanation, while imprecise, is not entirely unfounded. As we have already noted malarial epidemics were a function of the geography of the Morean battlespace. Without any detailed knowledge of the epidemiology of malaria, the only thing Morosini and his commanders knew to do was remove the sick to better climates.

The reaction to plague differed greatly. The medical staff led by *Protomedicus* Draga was primed to combat plague by previous Venetian epidemics, and was forewarned about the impending epidemic by local Greeks. When plague appeared, it was swiftly diagnosed and long-standing protocols were immediately enacted. Given the lack of an epidemiological understanding of bubonic plague, some of these protocols failed to have any meaningful effect. Ventilation and fumigation measures, based upon the classical *miasma* theory of disease transmission, proved useless in combatting an epizootic bacterium. Extensive quarantine measures, however, including prohibiting contact between vessels, separating encamped soldiers into smaller groups, and identifying the sick and placing them in *lazarettos*, directly impeded the movement of plague, especially the pneumonic version of the disease. These measures were not perfect by any means. Rodents and their infected fleas still circulated within military camps. But isolating the sick from the healthy clearly limited the spread of the disease, allowing the epidemic to burn itself out. The use of rudimentary contact tracing and preventing newly arrived recruits from mixing with those who already exposed further limited disease transmission. While overall knowledge of plague epidemiology was deficient, the methods used were effective to a great degree. Given that bubonic plague carries a 60-80% case mortality rate, the only effective means of staving off large death tolls is preventing infection in the first place. The loss of 1500 soldiers and sailors in the spring of 1688 is remarkably low, especially compared to the much higher death tolls from previous malarial outbreaks. This is testament to at least limited efficacy of Venetian plague procedures.

CHAPTER V – MALARIA REDUX: THE SIEGE OF NEGROPONTE AND THE END OF THE MOREAN WAR.

Once freed from quarantine, the Christian army struck out towards a crucial strategic target, Negroponte (modern Chalkis). Negroponte sits on the eastern coast of the island of Evia, midway up the Euboean Gulf, where the gulf narrows to a channel less than a kilometer wide. The channel is easily spanned by a bridge connecting the island to the Greek mainland, which also allows control of the channel. Venice held Negroponte and Evia as a critical part of the *Stato da Mar* until Mehmet II besieged the city in 1470. Retaking Negroponte would satisfy a revanchist impulse on the part of the Venetian state, as well as reclaim a vital base along a strategic corridor. Negroponte scores in the top 10 in the both the Degree Centrality Analysis (**Table 1**) with 9 connections, and in the Between Centrality Analysis (**Table 2**), with a score of .42675.

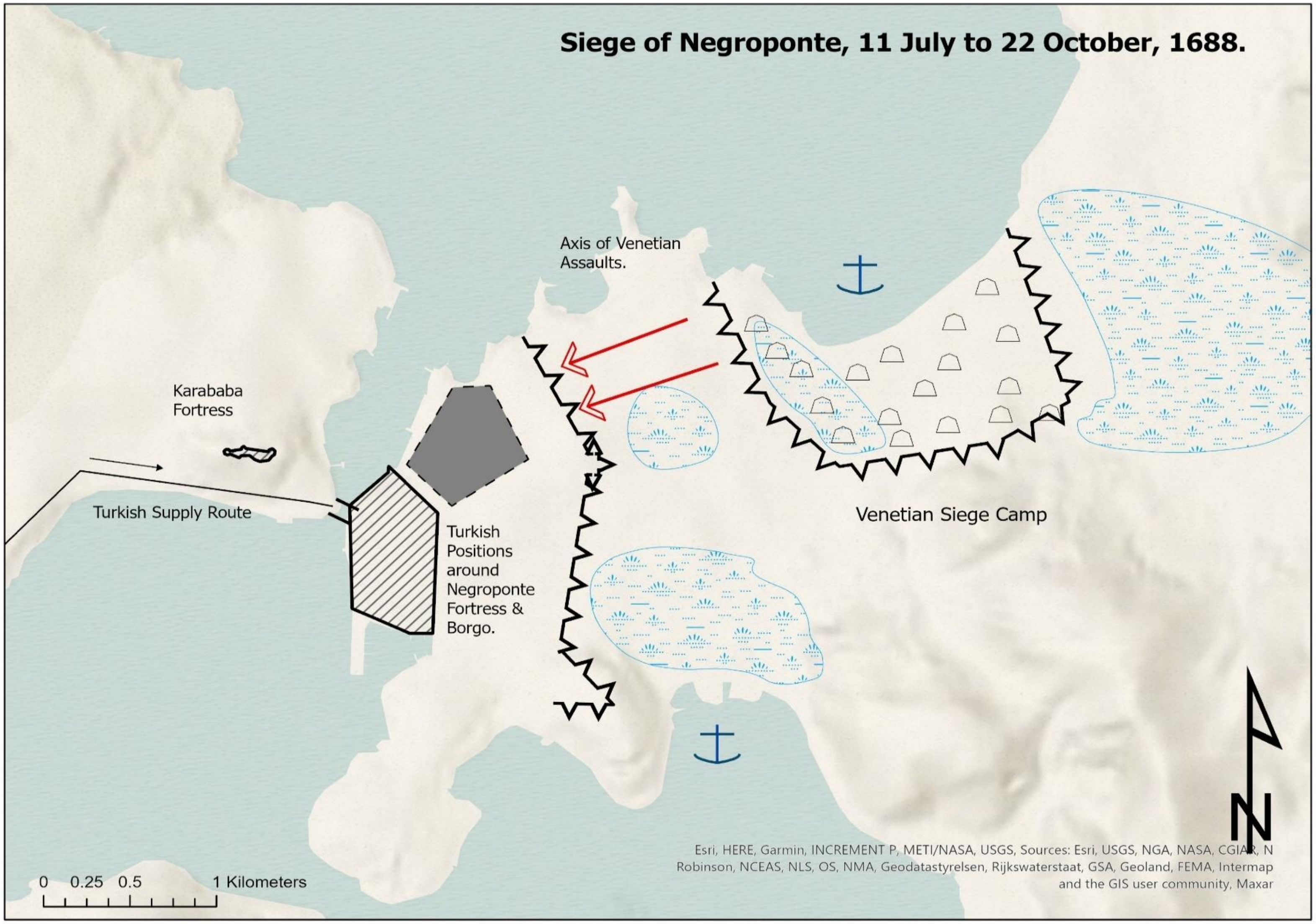
By the end of June, Morosini began assembling his forces, including veterans released from quarantine on Kalamos and Porto Poro, and new recruits arriving from Venice and other members of the Holy League. This included another regiment of 1200 Hanoverians and nearly 1200 Swiss mercenaries. Additional Maltese forces and Albanian irregulars brought the overall force to between 13,000 and 14,000 effectives, the largest Christian force yet assembled (Schwenke 1854, 164; Pinzelli 2021, 143). However, the Turks expected an attack on Negroponte, and built extensive outer works on the eastern approaches to the city, as well as Karababa Fortress on the Greek mainland, just above the critical bridge. A sizeable garrison of at least 6000 soldiers manned the Turkish defenses (Andrews 2006, 183-184).

The Siege of Negroponte: July to October 1688

Morosini, recently elected Doge of Venice *in absentia*, landed much of his infantry on July 11th, 1688, just south of Negroponte. The troops trekked the several miles through "woods and swamps" to begin digging siege lines east of the city (Pinzelli 2021, 145). By attacking Negroponte from the east, Morosini committed several tactical errors that shaped the subsequent campaign. Königsmarck unsuccessfully argued that the army should land on the mainland and attack Karababa first, severing Negroponte from sources of resupply and reinforcement. More importantly, establishing siege lines and camps east of Negroponte placed the Christian army firmly in a malaria-ridden bog. A contemporary map of the siege, produced at the behest of Francesco Grimani, a Venetian officer, clearly depicts numerous marshes and swamps east of Negroponte, on the very ground the Venetians built their camp and siege trenches. A reconstruction of the Grimani map presented here (**Map 9**) shows marshy ground within the walls of the Venetian camp, as well as a large swamp directly to the east. Additionally, the main siege trenches approaching the Turkish works moved through a swampy bog. Predictably Negroponte and its surroundings score in the redzone of the Malarial Risk Analysis (Map 6), and the siege took place in the prime months for mosquito propagation. The summer of 1688 exhibited severe drought conditions (Map 8), further intensifying malarial risk. These spatial and temporal factors, along with the arrival of fresh, and non-immune, reinforcements from northern Europe, set the stage for a major epidemic.

The siege of Negroponte was the most violent and costly clash of the entire war. Both the Christians and the Turks heavily fortified their earthworks and deployed dozens of artillery pieces, and the battle revolved around artillery duels, sorties, and counter-sorties, resulting in high combat casualties in the trenches. Among those dying in battle were Girolamo Garzoni, brother of a later historian of the war, and Father Antonio d'Asiago, Morosini's own chaplain, slain by a Turkish cannonball (Locatelli 1691, II: 115; Garzoni 1707, 259). However savage the combat, disease again proved a more efficient killer. Malaria stalked the Christian camp, striking down soldiers in the thousands within weeks of the start of the siege. As many as 2000 soldiers were sickened by the beginning of August, with those serving in the marshy trenches bearing the brunt of infection (Locatelli 1691, II:106). The newly recruited regiments, as at Koroni and at Nauplion, suffered high rates of infection and mortality. Anna Akerhjelm, Locatelli, and Garzoni all note that the Maltese contingent fell ill first, followed closely by the latest Hanoverian, Hessian, and Swiss mercenaries to arrive in theater (Akerhjelm 1854, 247; Locatelli 1691, II: 104; Garzoni 1707, 256).

The officer corps suffered heavily as well. Locatelli identifies a number of Venetian officers struck down by malaria; Henrico Filippo fell sick by August 1st and the Prince of Turin took ill on August 8th (107-108), while Scipone Gaspardo, Matteo Bon and Prince Palatine Degrace all died by August 15th (108-110). Aurelio Marcello died on September 5th (121) and Matteo Quirini succumbed by October 5th. Morosini himself fell sick with intermittent fevers in early October. *Protomedicus* Draga treated the Doge personally, while Morosini went to confession and Mass, seeking the help of the "celestial doctor", in addition to his earthly one (Locatelli 1691, II:158). The Venetians and their Christian allies relied on both contemporary medical science as well as Divine Providence in combatting the epidemic.



Map 9: Reconstruction of the Grimani Map of the Siege of Negroponte, 1688 (Andrews 2006, Plate XXXV)

The most prominent victim of the malarial epidemic at Negroponte was Königsmarck. Despite surviving a malarial infection at Nauplion 2 years previously, the general began to suffer severe fevers by early August, likely due to a differing species or strain of malaria found around Negroponte. Anna Akerhjelm was infected as well, along with many others in Königsmarck's household; Johann Roloff, their quartermaster, died within 3 days of extreme fever (Akerhjelm 1854, 249). Anna recovered, but her diary entries and letters record the progression of Königsmarck's illness. From late July into early August the general had high fevers for 11 days straight, relenting on August 4th, though he remained fatigued to the point of being unable to walk without assistance (Akerhjelm 1854, 249, 277). Königsmarck was forced to convalesce aboard ship, away from the dangerous *miasmas* of the swamps, but he did have the vessel pulled to within sight of the battlelines to watch assaults on the Turkish works. On August 22nd the general rejoined the army ashore to much fanfare, but by the 24th his fevers returned, evidence of the harsh recrudescence often occurring in *P. falicparum* infections (Akerhjelm 1854, 277). Anna then describes the classic progression of the disease; "The fever, which held him without relenting from August 30 to September 13, was renewed every day at different times." (Akerhjelm 1854, 253). The high fevers recurring on a daily, or *quotidian* basis are the tell-tale sign of *P. falciparum.* Otto von Königsmarck, the victorious commander at Argos, Nauplion, Patras, and Athens, died of malaria on September 15th, 1688 (Akerhjelm 1854, 283).

The vast number of soldiers and officers struck down by malaria hampered siege efforts considerably. In late August, 4000 German, Swiss and Venetian reinforcements arrived, allowing for new assaults on the outer Turkish works. The assault of August

22nd breached the Turkish lines, and their subsequent retreat behind the walls of Negroponte turned into a rout. Over 1500 Turks were killed, but 700 Christians fell in the assault as well (Cappelletti 1854, 66; Andrews 2006, 184). The battle lines then centered on the medieval walls of Negroponte itself, but September 1688 saw the efficacy of the Venetian army further reduced by disease, with thousands of troops sidelined in the hospital. Many soldiers deserted, while others fled the trenches for the relative safety of the fleet, forcing Morosini to forbid anyone leaving the camp on penalty of death (Locatelli 1691, II:126). The Maltese contingent, having lost 400 soldiers and 24 knights, sailed for home, followed by the Florentines; between desertion, departures, and disease, Morosini's forces were reduced to 4000 effective troops by October 1st (Pinzelli 2021, 150). Despite the gravity of the situation, Christian forces doggedly continued their assaults on the walls, with their efforts focusing on a weakened tower at the northwest corner of the city. After landing sailors from the fleet as reinforcements, Morosini ordered one last assault on October 12th. The vulnerable northwest tower was briefly taken and a breach formed, but a Turkish counterattack routed Christian forces and inflicted terrible casualties, with over 1000 Christians killed. Morosini began a withdrawal the next day, completing the evacuation of his remaining troops as well as 6000 Evian Greeks from Negroponte by October 22nd (Locatelli 1691, II: 143; Cappelletti 1854, 67).

The Butcher's Bill: Negroponte and the War at Large

The failed siege of Negroponte marks the climax of the Morean War. The conflict would not officially end until the Peace of Karlowitz in January 1699, but the pace of combat operations in the Aegean slowed significantly after Negroponte.

Monemvasia, the last Turkish holdout in the Peloponnese, surrendered in August 1690, and Domenico Mocenigo lead an abortive attempt to take Canea on Crete in the summer of 1692. Several fortresses in Dalmatia fell to Venetian forces, and Turkish raids into the Morea continued into the late 1690s, but the days of major combat largely ended in 1688. Doge Morosini, aged and sick, attempted to revive the war effort by taking direct command of the Venetian fleet in 1693. While he bolstered the defense of the Morea, little else was achieved, and Morosini died at Nauplion on January 6, 1694 (Setton 1991, 386-388).

Mortality at Negroponte, 1688

Negroponte was a devastating experience for all involved. Paolo Nani, a Venetian commissary officer, reported to the Senate on November 30, 1688 a loss of 6136 soldiers, with another 2016 sick and injured. Nani bitterly remarked that most of the sick subsequently succumbed due to the inattentiveness of their officers, indicating that his fatality count was provisional at best. As with the previous campaigns, the coming and going of various contingents makes establishing accurate numbers impossible, but the approximate tally we possess shows 13,500 soldiers initially landed at Negroponte, with 4000 reinforcements in August, a total of 17,500 effectives during the siege. Following Nani's figures, the overall mortality rate was between 35% (6126 dead) and 45% (8162 dead and subsequent fatalities) (Pinzelli 2021, 259). A mortality rate of +/- 40% is evidenced by the experience of the Hanoverian regiment serving at Negroponte. Of the 63 serving officers, 26 died at Negroponte, resulting in a mortality of 41%. Only 1 of the 26 casualties is listed as killed-in-action, and the remainder have no cause of death noted, so we cannot reliably assert how many died of disease. Yet it is clear that a majority of deaths at Negroponte stemmed from malarial infection, and that it spared neither the musketeer in the trenches nor the general in the command tent.

Mortality for the entire war, 1684-1689

The overall death toll/mortality rate for the entire Morean War is similarly difficult to tally, again due to the imperfect accounting of commissary officers and the perpetually fluid nature of Christian forces. The most detailed numbers come from the muster rolls of the German regiments hired by the Venetian Senate. As noted above, these soldiers represented some of the best infantry in all of Europe, but they were uniquely susceptible to malarial infections present in their Mediterranean battlespaces. Exposure to malaria without any acquired immunity, coupled with the plague epidemic of 1687-1688, repeated exposure to drought conditions, and multiple high-intensity military operations led to the devastation of these German forces. The mortality rates (**Table 4**) exhibited by the various German units is stark with an overall rate of 60%, with some regiments exhibiting death rates 75% - 82%. Losses may have been lower in an individual battle or campaign, like the 40% fatality rate at Negroponte, but over the course of a multi-year campaign casualty rates crept upward. More exposure to disease, the repeated risks of combat, and secondary infections exacerbated by the physicals stressors of the campaign killed a larger proportion of soldiers over an extended period. While the exact number of casualties remains unknown, it is clear that the majority of German mercenaries deployed to Greece 1684-1689 died on campaign, and that disease was the principal killer.

Table 4: *Mortality Rate among German Mercenaries, 1684-1689*. (Wilson 1998, 78).

German State	Total serving	Losses	Mortality Rate
Bayreuth	2000	1500	75%
Waldek	1000	Unknown	Unknown
Wolfenbutel	1210	910	75%
Württemberg	4532	2769	61%
Saxony	3000	2239	75%
Hessen-Kessel	1000	820	82%
Hanover	5600	3000	54%
Sachsen-Meiningen	100	Unknown	Unknown
Total	**18442**	**11238**	**61%**

CHAPTER VI – LANDSCAPE CHANGE IN THE MOREA, 1684-1700

In January 1691 Giacomo Corner, submitted his *relazione,* or official report, on his stint as *Provveditor General in Morea*¸ governor of the newly conquered region. While describing the Morean landscape, Corner eloquently noted "her [the Morea] beauty languished upon my arrival, amid the paroxysm of the contagion that barbarously reigned, and the wounds opened by the contingencies of war." (Corner 1691, 296). Corner's immediate successor, Tadeo Gradenigo, decried the general destitution of the Morea (Gradenigo 1692, 238) while Andrea Molin was even more specific, calling attention to the large number of abandoned villages and the wide dispersal of the population across the countryside (Molin 1693, 432-434). Indeed, all of the *Provedditori* of the Morea from 1691 to 1715 describe large-scale depopulation of the region, with ghost villages dotting the landscape, and alleviating the population shortage was central to their official duties (Topping 1972, 71). The Venetian government needed the Morea to produce agricultural goods for trade, and in turn, taxable income. The *relazioni,* as well as the highly detailed cadastral surveys and maps produced by Venetian officials, all revolve around making the Morea produce greater quantities of commodities like grain, wine, olive oil, cheese, leather, and silk. Yet the overall fertility of the Peloponnese was never in question; the problem was a lack of manpower to exploit the agricultural resources of the region.

Warfare can change landscapes in a variety of ways, from disruption to the rhythms of agriculture and industry, to destruction of infrastructure, to shifts in the demographic make-up of the human populace. We should reasonably expect the Morean War to have changed the landscape of the Peloponnese in some way, but identifying those changes and the complex mechanisms behind them is difficult. However, the extensive Venetian cadastral records produced immediately following the war allow us to reconstruct many of these changes within a GIS-enabled environment. Of course, these sources have limitations, but we can still identify the degree to which the population fell, where it fell, and identify possible catalysts behind the demographic shifts.

Quantifying and Geo-locating Population Change in the Morea, 1684-1690

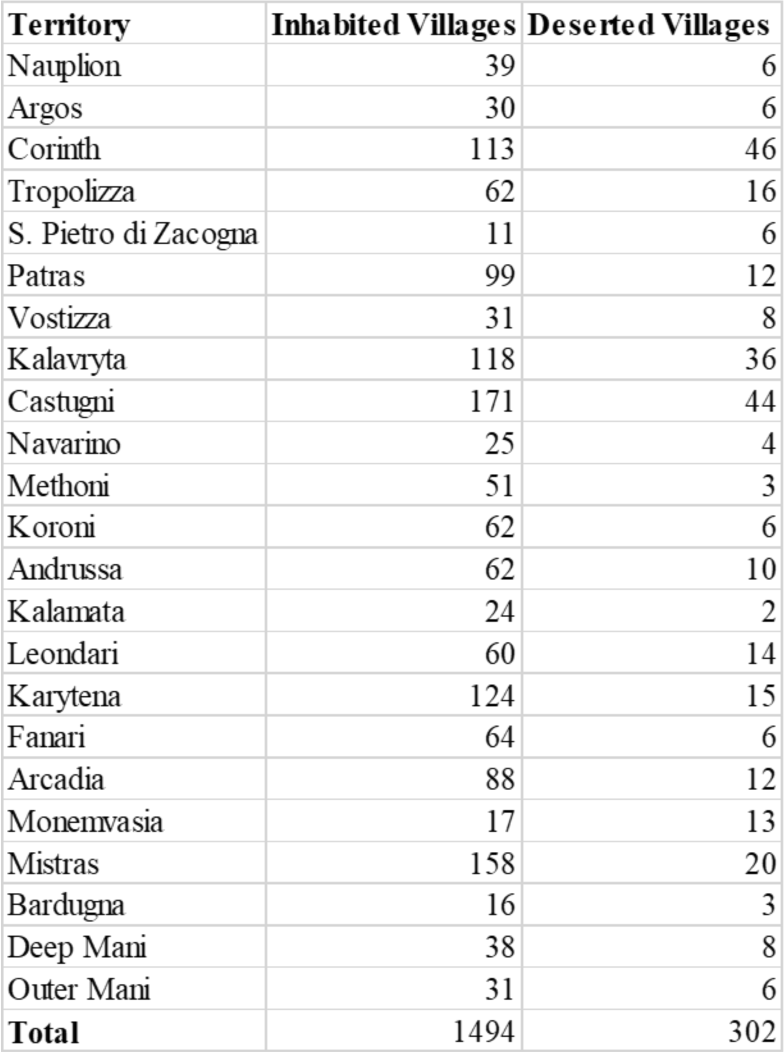
Early modern states, including both the Venetian Republic and the Ottoman Empire, developed many of the tools of modern bureaucratic government, especially with regard to taxation. Cadastral surveys proliferated across the early modern Mediterranean to provide tax officials with detailed information on property ownership or tenancy, land valuation, and potential tax burden. These records also provide valuable demographic data, giving modern historians and geographers a snapshot of what a specific property looked like at a given time Actual cadastral methods differed between states, but they often collected data on number of households, agricultural products, livestock, slaves, and any other taxable property or chattel. By comparing such records, we can observe population shifts over time.

An Ottoman census completed circa 1530, during the dynamic reign of Suleiman the Magnificent, counts the population according to individual hearths (households), and categorizes these according to religion, as non-Muslim families paid the *jizyah* head-tax, and Christian families were potentially liable for the *devşirme*, the levy of young men for service in the Janissary Corps. The 1530 census shows the Ottoman Morea possessing 50,541 total hearths, with 1065 Muslim, 464 Jewish, and 49,412 Christian households (Barkan 1957, 32). This census data allows for a population estimate; Barkan argued for a coefficient of 5, resulting in an approximate population of 250,000, while Topping uses more detailed figures from a later Venetian census to support a coefficient of 4, which renders a population of around 200,000 (Topping 1972, 70). Therefore, we can reasonably contend that the Peloponnese in the early 16th century supported a populace of 200,000 to 250,000.

The situation in the Morea by the late-17th century was markedly different. Giacomo Corner's work as *Provveditor* in 1689-1690 took place as major combat ceased in the Morea, save for occasional Turkish cavalry raids. His description of the Peloponnesian countryside noted above is stark; the Morea suffered terribly from the intertwined forces of plague and warfare. Corner's population count reflects these forces, tallying only 86,468 persons of all ages and sexes on the peninsula, excepting the regions of Maina and Corinth, on which he possessed no information (Corner 1691, 301). Working alongside Corner were three *catastico sindaci*, officials proceeding with a detailed cadastral survey. Their final report, presented to the Senate in May 1691, found 97,118 souls across the Morea, only excluding the remote Maina peninsula, thus fitting closely with Corner's report (Molin 1691, 214; Topping 1972, 71). Whatever numerical discrepancies, the population of the Morea had fallen by more than half since the census of 1530.

This severe drop in population is evidenced by the many abandoned villages dotting the Peloponnesian landscape. Each of the Provveditori from 1689-1699 describe many ghost towns throughout the Morea, but the numbers are only quantified under Francesco Grimani, Provveditori Generale from 1699-1701. Grimani's cadaster extensively details all the Venetian Morea, down to the level of individual villages, either inhabited or abandoned. The cadastral count of inhabited versus abandoned villages appears repeatedly in discussion of the Morea, including Pacifico (1704), von Ranke (1878), and more recently by both Topping (1972) and Wagstaff (1978).

Table 5: *Village Abandonment per the Grimani Survey, 1701.* (von Ranke 1878, 361).

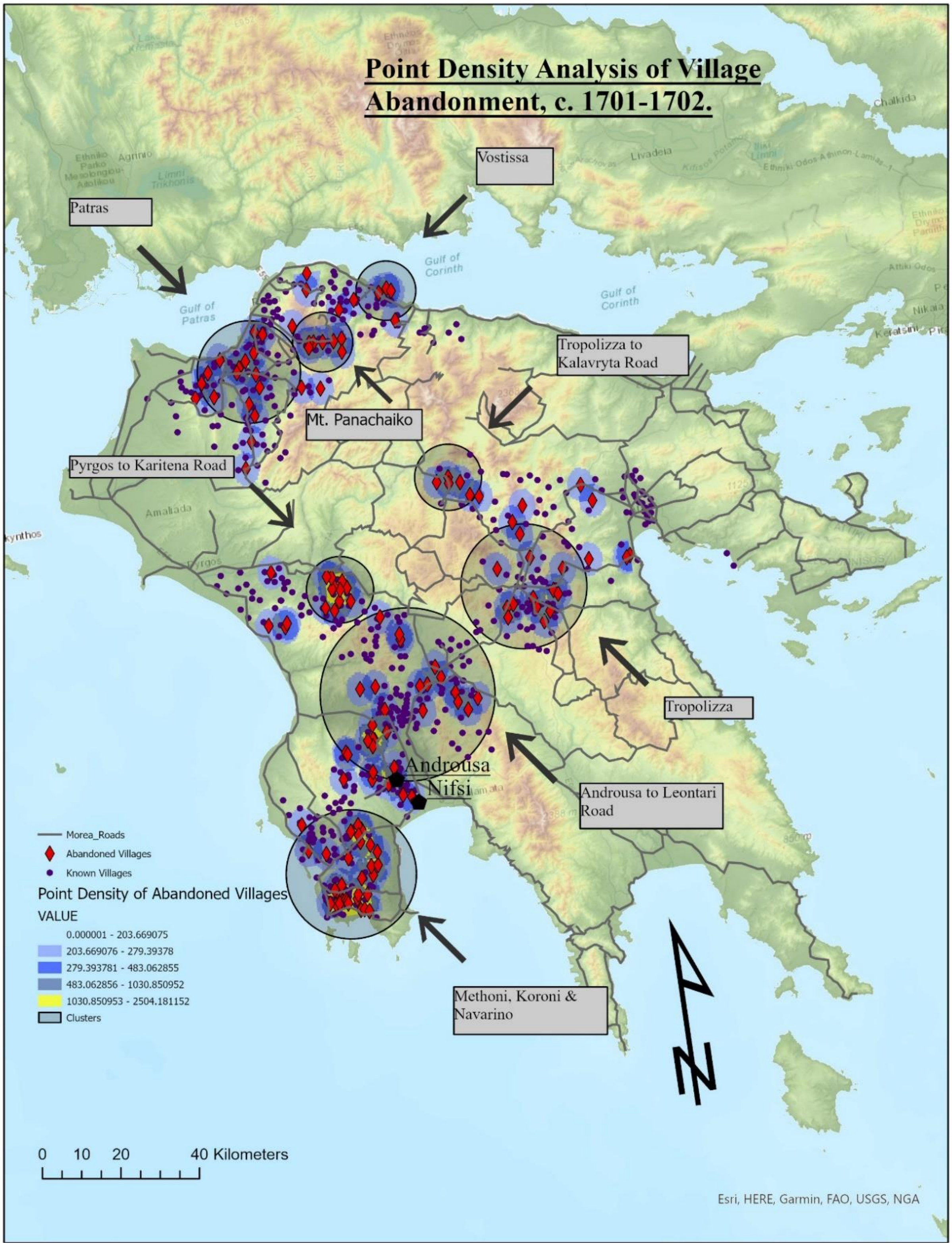


Territory	**Inhabited Villages**	**Deserted Villages**
Nauplion	39	6
Argos	30	6
Corinth	113	46
Tropolizza	62	16
S. Pietro di Zacogna	11	6
Patras	99	12
Vostizza	31	8
Kalavryta	118	36
Castugni	171	44
Navarino	25	4
Methoni	51	3
Koroni	62	6
Andrussa	62	10
Kalamata	24	2
Leondari	60	14
Karytena	124	15
Fanari	64	6
Arcadia	88	12
Monemvasia	17	13
Mistras	158	20
Bardugna	16	3
Deep Mani	38	8
Outer Mani	31	6
Total	1494	302

The Grimani survey shows a total of 1796 villages in the Peloponnese, with 302 of them abandoned, or 16.8%. The cadaster breaks down the number of inhabited/abandoned villages per Venetian district, and Wagstaff attempts a kind of spatial analysis based upon the mean number of abandoned towns per district (Wagstaff 1978, 297-299). Using this method, he finds a significantly greater mean number of abandoned villages across the northern Peloponnese, from Corinth in the northeast to Castugni in the northwest. Excepting Corinth these areas remained beyond most of the fighting in the Morea War, and regions that experienced major combat, notably the Messenian peninsula, allowing Wagstaff to conclude that much of the village abandonment occurred prior to the war, not because of it (Wagstaff 1978, 305).

However, major weaknesses exist in Wagstaff's argument. First, the cadaster constrains Wagstaff to use the Venetian district boundaries, which are of unequal size and population densities. For example, the districts of Castugni, Kalavryta and Corinth are substantially larger than those of Navarino, Methoni and Koroni in the southwest. This exemplifies the Modifiable Areal Unit Problem (MAUP), in which uneven spatial divisions can distort the data. More importantly, major discrepancies exist between the cadastral totals and the maps produced by Grimani's cartographer, Francesco Van Dyke. A number of these maps survive, along with their attached catalogs, and they explicitly mark abandoned villages as *distrutta*, or destroyed (Katsiarda-Hering 2018). For purposes of this study a table was created from these maps, with the villages geolocated with X-Y coordinates and classified as inhabited or abandoned. Point features were created from the X-Y data in ArcGIS Pro 2.9, and road features were derived from the *Expédition Scientifque de Moree Tome I (Atlas)* (Guizot 1855). A DEM layer was created from EU-Copernicus data (Copernicus Land Monitoring Service 2021a), and the feature layers were overlaid upon it. A Point Density Analysis was performed on the abandoned villages, resulting in **Map 10**. A Global Moran's I analysis for autocorrelation showed significant clustering, with a z-score of 14.77765.

The surviving maps do not cover the entire Peloponnese, unlike the detailed cadasters referenced by von Ranke, Wagstaff and Topping, but they provide far more precise geographic placement. The resulting analysis generally correlates with the cadastral evidence; of the 717 villages appearing on the maps, 139 are labelled as *distrutta*, destroyed or derelict. This produces an abandonment rate of 19.3%, only 2.4 percentage points off the overall cadastral rate of 16.3%, a discrepancy easily explained by the *lacunae* in the map coverage. The analysis significantly differs on the geographic distribution of abandoned sites. The Point Density Analysis identifies several significant clusters of village ruins in the central and southwestern Peloponnese, in stark contrast to Wagstaff's analysis. Proximity to major roads is a near universal attribute of all the abandoned villages, with none of them sitting more than 5km from any roadway. But several clusters exist near major crossroads, notably around Tropolizza, the central crossroads within the Morea, and along the Androusa-Leontari roadway, what acted as a regional nexus in the southwest portion of the peninsula. Separate clusters appear on connecting roads, including a small cluster on the north-south path between Tropolizza and Kalavryta, and a highly intense cluster along the road connecting Karitena to Prygos on the Ionian coast. A similar concentration appears around Vostissa in the northeast. Each of these roads and the nexus points along them would have witnessed considerably military movements during the war,



Map 10**:** *Point Density Analysis of Village Abandonment using the Grimani Maps*.

especially as Turkish forces used interior lines of communication. Refugees would have moved along them as well.

Several other clusters, while along the road network, stand out for other reasons. The cluster of abandoned villages to the southwest of Patras, in the Northern Peloponnese, sit near the site of the Battle of Patras in July 1687. The most intense concentration of deserted villages appears on the Messenian Peninsula in the southwest, which experienced 4 major sieges in 1685 and 1686, at Koroni, Old Navarion, New Navarino and Methoni. Finding the ruins of so many villages in proximity to major combat zones is expected, but other factors may be relevant as well. The most unusual cluster is found on the southern slopes of Mount Panachiako near Patras. Seven deserted villages appear in this remote area, which is accessed by a single road that dead-ends on the mountain itself, and the ghost towns all sit above 1000m, the only ruins found at that height in the entire study area.

Establishing a causal relationship between village abandonment and the ravages of the Morean War seems like a simple matter. However, significant declines in population and widespread abandonment of entire settlements rarely takes place overnight, and evidence suggests that the process of depopulation was long standing by the Morean War. Numerous European travelers noted the general emptiness of the Morea in the 17th century, including the English writer Bernard Randolph, who wandered the Morea in the later 1670s, just prior to the war (Randolph 1683). Venetian officials noted that the *devşirme*, the levy of Christian boys, fell heavily on Peloponnesian communities, and frequent revolts by the Maniots and other Greeks resulted in many deaths and encouraged emigration to safer areas (Topping 1972. 70-71).

Yet whatever long-term forces influenced depopulation in the Peloponnese, the ravages of the Morean War undoubtedly intensified the process. The Point Density Analysis reflects patterns expected during a conflict, with clusters of deserted villages near areas of major combat actions and along the route of armies, supply trains, and refugee movements. The contemporary sources bear this out, detailing various forms of violence and chaos inflicted upon the civilian populace of the Peloponnese, including ethnic cleansing perpetrated by both Christian and Turkish forces, and the spread of bubonic plague across the Morea landscape, which was heavily exacerbated by the war.

Ethnic Cleansing in the Morean War

The Morean War occurred for a variety of political, economic, and military reasons, but the religious character of the war is undeniable. This is not to say that religion caused the war, but once ignited the participants viewed the struggle through the long-standing lens of Christian-Muslim holy war, and this effected the course of the conflict. For the Venetians and their Christian allies this meant that Muslim Turks, including civilians, had to be removed from newly conquered territories and that local Christians, even those long under Turkish rule, were regarded as allies. On the same account the Turks saw the Greek Christians of the Peloponnese, the overwhelming majority of the population, as untrustworthy and a potential fifth column. Ethno-religious categorization of local populaces played a major part in the strategies of the opposing powers. For instance, the decision to besiege Koroni in 1685 was heavily influenced by the need to support the Greek Christians of the Mani peninsula, just across the Messenian Gulf from Koroni. Likewise, the Ottomans populated the major cities of the Peloponnese with Turkish Muslims, in a large part to secure them as fortified points that dominated a largely Christian countryside (Randolph 1683, 15). In these circumstances ethnic cleansing, in various forms, became a strategic took for the opposing powers.

Siege warfare and ethnic cleansing: the Venetian policy

From the beginning of the war Venetian policy called for the removal of Muslims from newly conquered cities. Siege warfare relied on a simple, cold-blooded calculus; if the defenders capitulated, even after a heated defense of the walls, they could negotiate terms and expect some kind of reasonable treatment. At a minimum this meant the surviving garrison and populace kept their lives and, most often their freedom and some of their chattel. Conversely, if the city resisted to the point an assault on the walls was necessary, with the severe casualties it would entail on the attacking troops, then the garrison and inhabitants forfeited their lives and goods. The Venetians utilized this bloody equation quite effectively throughout the Morean War. Morosini consistently offered simple terms of surrender to Turkish garrisons, in which Muslims retained their lives and freedom, Christian slaves held by the Turks were freed, and *Mori*, or black slaves, were relinquished to the Venetian conquerors.

However, Muslims could not remain in the Peloponnese unless they converted to Christianity. The evacuation of Muslims populations from Morean urban centers to other parts of the Ottoman Empire played a major role in depopulating the region. The small garrison of Old Navarino, capitulating in early June 1686, sailed to Alexandria, to be followed later that month by 3000 Turkish citizens of New Navarino, who sailed to Libya (Locatelli 1691 I: 203, 224-25). The garrison of Methoni surrendered on July 10, 1686, and 4000 Muslims evacuated the city for North Africa (Locatelli 1691, I:236). The extended siege of Nauplion in August 1686 ended with a Turkish surrender, and Morosini granted the Muslim population 10 days to leave the city with their belongings, though he granted Jewish families the right to stay, in return for an annual subsidy to the Venetian government (Locatelli 1691, I: 269). The 3500 Turks who survived the devastating explosion of the Parthenon accepted Morosini's terms in late September 1687, sailing to Izmir five days later (Locatelli 1691, II: 5; Morosini et. al., 1688, 40). Some of the Muslim garrison of Chlemoutsi fortress, in the far western Peloponnese, agreed to evacuate to Izmir, but 150 soldiers chose to convert to Christianity and remain in the Morea (Locatelli 1691, 341). Such conversions were not uncommon, as some Turkish landowners hoped to retain their properties. Michiel's cadaster of 1691 records 3577 Turkish converts to Christianity (Michel 1691, 214).

Not all these sieges ended so peacefully. The siege of Koroni (1685) witnessed some of the most savage combat of the entire conflict, only topped by the later experience at Negroponte. At one point the Venetian contingent found itself sandwiched between the walls of Koroni and a Turkish relief force, a siege-within-a-siege that resulted in numerous sorties and counter-sorties against opposing trenches. On August 11, 1685, having repelled the relief army, Christian engineers detonated a mine under the walls of the city, opening a breach. The Turkish garrison immediately raised the flag of surrender, but as officers negotiated terms a cannon went off within the fortress. Though likely an accidental shot, this event scuttled the surrender and caused Christian forces to surge into the city, putting it to a brutal sack. Some 1500 of the garrison and their families were killed, with their corpses cast into the sea (Locatelli 1691, I: 151; Andrews 2006, 12-13).

The Muslim population of Mistras suffered genocidal violence after they peacefully surrendered, though in unusual circumstances. Mistras, a fortress-town looming over the Vale of Sparta, resisted a siege by Maniot Greeks throughout the spring and summer of 1687, only yielding after all Turkish armies had evacuated the Peloponnese. Angered by the prolonged siege and with no threat of a Turkish relief force, Morosini refused to grant the populace his normal terms. Rather, he threatened to enslave all able-bodied men between 17 and 50, unless they paid a ransom of 200,000 *reales.* Unable to pay the heavy sum, the Turkish chiefs counter-offered that they would leave all their possessions in exchange for their freedom. Morosini initially agreed, but the appearance of plague at Mistras in Fall 1687 forced him to order a quarantine of the city. During the winter the Muslims sequestered at Mistras proved uncontrollable, with many breaking quarantine to flee into the countryside, and others threatening to re-fortify the city against the Christian army. Morosini, losing whatever patience he possessed, ordered the Turks of Mistras to be seized, and he savagely enacted his earlier threats. Over 300 children were removed from their families and baptized, 700 able bodied men enslaved and sent to the Venetian galleys, and the remaining women and children deposited on the desolate shores of Attica, where they were fodder for plague, banditry, or starvation (Andrews 2006, 159-161). Even contemporary Christian historians decried Morosini’s savagery in this instance (Locatelli 1691, II:46; Garzoni 1707, 263).

Razzia: Turkish raids on Greek Christian territories.

Turkish strategy in the Morea, apart from repelling Venetian forces, centered upon suppressing any local Greek support for the invaders. The Christian populace of the Morea, as well as other parts of Greek, frequently rebelled against their Ottoman overlords, especially when offered the support of foreign powers. Therefore, local Ottoman commanders instinctively ordered attacks on Greek villages. When Morosini's fleet entered the Gulf of Arta in 1684 he immediately made contact with sympathetic Greek warlords. Subsequently 800 Ottoman cavalry ravaged villages around the edge of the Gulf (Locatelli 1691, I: 85). At the same moment Ismail Pasha, expecting a rebellion among the Maniot warlords, began reducing the villages of the region (Locatelli 1691, I: 101). As combat in the Morea intensified, so did Turkish attacks on Greek villages. The Messenian peninsula, which experienced 4 major sieges in 1685-1686, suffered especially harsh raids. Ottoman forces withdrawing from their failed relief of Koroni burned villages and took slaves in late 1685 (Locatelli 1691, I:153). The next year the approaches to Navarino suffered visits from Turkish cavalry, while Ottoman forces based at Nifsi raided the countryside right up to the Venetian siegeworks are Methoni (Locatelli 1691, I:236). The heavy combat inflicted upon the Messenian peninsula in a relatively short period likely explains the intense cluster of abandoned villages present in **Map 10,** most of which are in the immediate environs of Methoni.

The Venetian landing at Nauplion sparked Turkish raids throughout the Argolid valley in the late summer of 1686 (Locatelli 1691, I:247), and by early 1687, as the Ottoman hold on the Peloponnese continued to weaken, punitive raids transformed into full-scale ethnic cleansing. Ottoman forces operating out of Corinth began enforced removal of Greeks from the Peloponnese to the Morea, specifically to depopulate the landscape (Locatelli 1691, I:297-300). This was a human "scorched earth" strategy, intended to denude agricultural lands of necessary labor. Even while the coastal centers fell one-by-one to Morosini's forces, Turkish cavalry ranged far and wide across the

Peloponnese, striking as far as the vicinity of Koroni, where they cut the aqueduct supplying the fortress (Locatell 1691, I:308). Muslim forces continued scouring the Peloponnese even after region fell, with light cavalry skirting Venetian defenses at Corinth and devastating the region in 1690 and 1692 (Gradenigo 1692. 244, 425).

Bubonic Plague and the Morea

The bubonic plague epidemics within the Christian army in the spring of 1687 and again in the winter and spring of 1688 did not occur in isolation. Plague had struck the Peloponnese as recently as 1661 and 1674, and was generally circulating throughout the Ottoman world (Biraben 1975, Annex IV). Yet the combination of warfare with an epidemic outbreak created an especially dangerous situation. Warfare entails various mobilities, including the movement of armies, supply trains, and refugees. In turn, war also impacts the living environment of commensal species, such as the rodents living among human habitations. Disruptions in the human habitat immediately effects rodent colonies, and as humans move, rodents must move as well. The depopulation of cities removes food resources from urban rodent colonies, while the interruption of normal agriculture life brought on by conflict disturbs rural rodents. The effects of multi-year drought throughout the Morea further intensified these disruptions (**Map 4a** to **Map 4e**). Once bubonic plague enters an environment of dynamic mobility, as exists in an active theater of warfare, widespread outbreaks of the pathogen are certain to follow.

From 1687 through 1689, bubonic plague circulated across the Morean landscape, and beyond into Attica and Rumelia (**Table 6**). The major urban centers, especially the coastal cities, suffered extensive outbreaks, but the contagion spread widely in the interior as well. Morosini blamed much of the rural circulation of plague in late 1687 on

Table 6: *Known Plague Outbreaks during the Morean War*

Known Plague Event	Month/Year	Source
Methoni	Spring 1687	Loc. I:301-303
Koroni	Spring 1687	Loc. I:301-303
Nauplion	Spring 1687	Loc. I:301-303
S. Maura	Spring 1687	Loc. I:320-25
New Navarino	Spring 1687	Loc. I:320-25
New Navarino	Fall 1687	Loc. I:340
Methoni	Fall 1687	Loc. I:340
Mistras	Winter 1687/88	Loc.I:350-53/Loc.II:40
Patras	Winter 1687/88	Laborde Doc. Ined. 180-81
Castel Tornese	Winter 1687/88	Laborde Doc. Ined. 180-81
Lepanto	Winter 1687/88	Laborde Doc. Ined. 180-81
Talanda	Winter 1687/88	Laborde Doc. Ined. 180-81
Thebes	Winter 1687/88	Laborde Doc. Ined. 180-81
Koroni	Spring 1688	Loc. II:40
Thebes	Spring 1688	Loc. II:13
Athens	Spring 1688	Loc. II:34
Salamis	Spring 1688	Loc. II:39
Negroponte	Spring 1688	Loc. II:39
Volos	Spring 1688	Loc. II:39
Kelefa	Spring 1688	Loc. II:40
Porto Poro	Spring 1688	Loc. II:53; Aker. 233-4;275
Milos	Spring 1688	Loc. II:58
Trikala	Fall 1687-Spring 1688	
Tropolizza	Fall 1687-Spring 1688	Laborde Doc. Ined. 166-67
Kalavryta	Fall 1687-Spring 1688	Laborde Doc. Ined. 166-67
Lopesi	Fall 1687-Spring 1688	Laborde Doc. Ined. 166-67
Episkopi	Fall 1687-Spring 1688	Laborde Doc. Ined. 166-67
Chierpegni	Fall 1687-Spring 1688	Laborde Doc. Ined. 166-67
Rogas	Fall 1687-Spring 1688	Laborde Doc. Ined. 166-67
Cutegli	Fall 1687-Spring 1688	Laborde Doc. Ined. 166-67
Corinth	Spring 1689	Loc. II:158
Lepanto	Spring 1689	Loc. II:158
Amfissa	Spring 1689	Loc. II:158
Argos	Spring 1689	Loc. II: 166
Tropolizza	Spring 1689	Loc. II:222

peasants moving in mass around the region, likely reflecting refugee movements (Laborde 1854, 167-168). The movement of Turkish armies and Greek irregulars, refugee columns fleeing the effects of war, as well as everyday commerce, all aided the transmission of plague to every corner of the peninsula. An accounting of plague deaths among the Morean peasantry does not exist, but in light of the high mortality rate from plague infections (60-80%), there is little doubt that a large number of civilians perished.

War, Plague, and the Abandonment of Settlements

The Peloponnese likely experienced a long-term demographic decline in the decades leading up to the Morean War, but the war itself served as a watershed event that greatly intensified these trends. The spatial distribution of abandoned villages recorded in the war's aftermath correlates to the kind of patterns we would expect from a war coupled with a plague epidemic (**Map 10**). The main clusters of abandoned villages occur in immediate proximity of major nodes along Morea roadways, such as Tropolizza, Leondari, and Androusa, or directly along major roads, as on the Prygos-Karitena road or the path between Tropolizza and Karitena. Similar hot spots exist on the coastal roads near Patras and Vostizza. These roadways and crossroads were heavily trafficked by Turkish forces moving along the internal lines of communication in the region, and these are the areas most likely to experience raids, massacres, and forced removal. By the same token these were also the areas most exposed to plague transmission, with the contagion potentially carried by all who passed by. In most cases we should not attribute the abandonment of particular villages to either or war or plague, but to a combination of the two. In this instance violent action coupled with plague to create synergistic effects along the major transit corridors, resulting in the patterns we see in the data.

There are several potential outliers. As noted, the most intense cluster of abandoned villages appears on the Messenian peninsula in the rough triangle between Navarino, Methoni, and Koroni. This region experienced 4 major sieges with a 12-month period, as well as the movement of Turkish relief armies and cavalry raids. The existence of so many destroyed villages, often within sight of the fortress walls, implies a violent cause. But as noted in **Table 6**, all three of these major ports experienced repeated plague outbreaks, and it seems unlikely that quarantine measures prevented the pathogen from spreading into the hinterlands. Plague may have played a role in the demise of these villages, though warfare remains the most important catalyst. In contrast, the cluster of abandoned villages on the slopes of Mt. Panachaiko is most attributable to plague. The villages sit at altitudes above 1000m, along a dead-end road that curves around the mountain. This is a remote, inaccessible region unlikely to be targeted by Ottoman raiders, especially when more easily reached targets existed along the coastal plains. In addition, plague is known to have spread in the area. The Christian war council of October 2nd, 1687, specifically lists several plague-ridden villages in the highlands around Mt. Panakaicho, including Lopesi, Episkopi, Cutegli, Chierpegni, and Rogas. Girolamo Corner, when conducting his cadastral survey, noted that he saw no living soul in these very highlands (Miller 1921, 418). Under these circumstances it makes sense to identify plague as the principal cause of the abandonment of these remote villages.

Conclusion: Repopulating the Morea

Venetian goals in the Morean War centered on regaining control of the maritime networks dominating the Eastern Mediterranean, and acquiring new agricultural lands to economically exploit. They accomplished both of these goals, but with the severe caveat that the lands conquered suffered major damage, especially in terms of its human landscape. Agriculture relies directly on human labor, so Morea lands were useless without the manpower to tend the fields, pastures, and orchards. With this in mind the Venetian leadership set in motion a number of strategies to repopulate the Morea and mitigate the damage future wars or plague outbreaks to the region.

Morosini and his officers, keenly aware of the population loss, leveraged the ethno-religious fault lines in Greece to their advantage. In the late summer of 1687, as Turkish forces evacuated the Peloponnese, the Venetians made contact with sympathetic Greek leaders in Rumelia, on the north side of the Ionian Gulf. Under the leadership of Philotheus, a local Orthodox bishop, a large contingent of Greeks emigrated from Rumelia on Venetian galleys and were settled in Vostissa (Locatelli 1691, I:345; Michiel 1691, 212). The evacuation of Athens the next spring allowed Morosini to settle some on the island of Aegina, and many more around Corinth (Locatelli 1691, II: 50). A similar population transfer occurred following the withdrawal from Negroponte in late 1688, with 6000 Evian Greeks fleeing for the Christian controlled Morea (Locatelli 1691, II: 143; Cappelletti 1854, 67).

The policy of enticing Greek Christians to emigrate from Ottoman-held territories continued under the Venetian *Provveditori*. Tadeo Gradenigo reported the arrival of Greeks from Thebes and Livadia in Rumelia, Candiots from Crete, and some *Bulgari*, Slavic Christians of unknown provenance. The emigres were granted abandoned houses, fields, and vineyards, which the Morea possessed in large numbers (Gradenigo 1692, 238). In many villages the Venetian cadasters record separately *famiglie del Paese* (native peasants) as well as *famiglie detto Rumeliotte* (Rumeliot emigres), reflecting the redistribution of abandoned properties (Grimani 1700, f.21v). Ironically, by inviting Greek Christians out of Ottoman territory the Venetians engaged in a kind reverse ethnic-cleansing. This process of resettlement succeeded to the point that by 1701, Francesco Grimani counted a population of 176,844 persons in the Morea. Noting the secretive and superstitious nature of the Greek people, Grimani regarded this as an undercount, and he believed that the *Regno di Morea* housed more than 200,000 souls, effectively recovering the population to its 1530 levels (Grimani 1701, 454).

Grimani, a veteran of the Morean campaigns and well aware of the forces that depopulated the Morea, took proactive measures to prevent future mass mortality events. Having witnessed the high death tolls among the German mercenaries during the war due to “insalubrious airs”, Grimani took pains to only recruit garrison troops “immune to the mortality of the fatal air” (Grimani 1701, 460-462). In response to the potential reappearance of plague, Grimani ordered the construction of *lazarettos* at the major fortresses. At Corinth he converted the ruins of the classical amphitheater into a *lazaretto* at small expense, and Patras a warehouse by the harbor served a similar purpose. An old harem outside the walls of Pylos assumed this new role, but at Methoni and Monemvasia Grimani could not identify any appropriate structures for the purpose (Grimani 1701, 489-490).

Preventing further Turkish raids was also a serious concern. Morosini earlier proposed rebuilding the *Hexamilion*, a late-Roman defensive wall built across the Isthmus of Corinth, and his engineers and cartographers even supplied detailed plans for such a project (Katsiarda-Hering 2018, Billa 134). This project never made much headway, and under the *Provveditori* the concern shifted to repairing and maintaining the major urban fortifications. The walls of Koroni were especially concerning, considering the huge breach blown in its walls during the siege in 1685. Antonio Molin, *Provveditore* in 1692, failed to close the breach due to a lack of available manpower in the city. In his *relazione* to the Senate he proposed that future governors halt resettlement in the countryside and focus repopulating Koroni, at least until the repairs were completed (Molin 1693, 439-440). The governors also recruited significant numbers of dragoons, or heavy cavalry, as garrison troops rather than infantry, as a direct counter to the possibility of Turkish raids.

The Venetian governors clearly understood the damage done to the Morean landscape by the war, and they took considerable measures to reverse the depopulation. They also proactively tried to forestall the ravages of future epidemics and conflicts, though how effective these measures were is unclear. Certainly, the resettlement program initiated under Morosini and continuing under the *Provveditori* was a success, with the population rebounding to levels not recorded since the 16th century. Yet, did a repopulated landscape equal a profitable one for the Republic? The governors all complained that the *Regno* produced lower profits than anticipated. Viticulture and olive groves produced the greatest profit on the open market, and thus the *Provveditori* encouraged converting fields into vineyards and orchards. Local Greeks resisted turning away from cereal product, and government exactions on barley and pastureland was required to support the dragoons of the garrison and their horses, further hampering economic growth (Topping 1972, 76). So, the Morean War was not as profitable as the Venetians hoped, but at least in the short-term they held the region.

CHAPTER VII – CONCLUSION

General Conclusions

It is well known that war and disease coincide. There is a reason these forces are personified as two of the Four Horsemen of the Apocalypse depicted in the New Testament (Rev. 6). Indeed, disease is known to be the primary killer in virtually all wars across human history prior to the 20th century. Only the recent advent of automatic weapons, rapid-fire artillery, aerial bombardment, and the other weapons of mass murder has changed the principal cause of death to combat wounds rather than pestilence. Yet knowing that disease and war intertwine does not explain why that is the case, or how these forces specifically interact. This thesis acts as a case study of how armies on campaign encounter various diseases, suffer from them, and spread them across war-torn landscapes.

The Morean War took place within a discernible web of sea lanes and roads, and the war was fought over control of this network. This system acted as a conduit of trade and allowed the projection of political power, but it also contained endemic diseases within it and transmitted epidemic disease along it. Thus, the armies and fleets fighting to control the network risked entering reservoirs of endemic disease. Most battles of the war took place at critical nexus points within the matrix, including Santa Maura, Preveza, Methoni, Koroni, Nauplion, and Negroponte, all of which sat within lowland coastal regions exhibiting high risk for malarial infection. This level of risk is evident within the Browning Malarial Risk Analysis Model (**Map 6**), and closely aligns with first-hand accounts of travelers in the region from the 17th to 19th centuries, as well as the testimony of Morean War veterans. The timing of the major battles also contributed to higher death tolls; most major combat actions took place in July to September each year of the war, coinciding with the highest period of mosquito propagation.

The unique make-up of Christian armies deployed to the Peloponnese further exacerbated malarial mortality rates. The various German mercenaries hired to fight the Turks were among the best trained and best equipped soldiers in Europe, and they played a major role in defeating Turkish field armies and fortifications. Yet lacking any natural immunity to malarial infection, the German soldiers died in droves, which hampered the war effort. The high mortality forced the Venetians to recruit thousands more German infantry each year, creating a repeating cycle of recruitment, deployment, illness, and mass mortality. One of the reasons that all the major combat during took place in the high summer, the worst malarial months, was due to the need to wait on the arrival of these reinforcements.

The plague epidemics of 1687-1689 further validates the role of network analysis in understanding disease. It is well established that bubonic plague circulated throughout the Ottoman Empire from the 14th to the mid-19th century, and some general patterns of that circulation have been identified by Nukhet Varlik (2015). However, plague transmission within the Ottoman orbit was far more complex than what is described in current scholarship. The creation of a Plague Suitability Model allows us to identify possible reservoirs of endemic plague, which confirms southern/southwestern Anatolia as a likely incubator of bubonic plague. By combining layers of known plague events, Ottoman caravan networks, and the Plague Suitability Model (**Map 7**) we can see how bubonic plague periodically emanated out of southern Anatolia into the larger Ottoman network. Once circulating throughout the network, the most important nodes, Istanbul and Izmir, acted as distribution centers, transmitting plague to secondary and tertiary centers. The Morea, a secondary node at the maritime crossroads of the Aegean and Ionian seas, saw frequent plague outbreaks due to its direct contacts with the primary transmission points. Warfare, entailing the movement of armies, supply trains and refugees, exacerbated possible disease spread, as is evident during the Morean War.

The Morean War occurred during one of the worst decades of the Little Ice Age, a period of global cooling. In Greece and Anatolia, the LIA impacted precipitation, with heavy rains and snows during exceptionally cold winters, but with severe droughts evidenced in the summers. Drought conditions directly affect disease, usually by intensifying epidemic outbreaks. Malarial risk tends to increase during droughts, as mosquito populations cluster around remaining wetland habitats, and dehydration encourages more frequent anthropophilic feeding. Similarly, drought disrupts environments that host colonies of plague infected rodents, encouraging them to move seeking food resources. By combining the PDSI data from the Old-World Drought Atlas (OWDA) with the Plague Suitability Model, we can see that the worst drought effects of the 1680s coincide with areas highly suitable in maintaining endemic plague, especially in southwestern Anatolia (**Map 8**). Thus, drought likely intensified plague outbreaks and made them more frequent. This further suggests that this region was critical in circulating plague in the Ottoman world.

The Morean landscape suffered heavily during the war, with hundreds of abandoned settlements dotting the countryside in its aftermath. While this phenomenon has been studied previously, scholars have not utilized the full range of sources available, including the maps produced by the Grimani cadastral survey of 1701 (Katsiarda-Hering, 2018). These maps allow us to map village desertion in the Peloponnese with geographic precision, and by applying Point Density Analysis to these data, we can identify patterns of abandonment on the landscape. While the Peloponnese experienced a long-term demographic decline over the century previous to the Morean War, the pattern of destruction seen in this analysis suggests more immediate causes. Both Christian and Turkish forces perpetrated acts of mass murder and ethnic cleansing during the war, and did so as matters of policy, not happenstance. At the same time war entails the movement of armies and their logistical trains across landscapes, while violence encourages the flight of refugees. The disruptions inherent to a war zone, along with the mass movement of men and livestock, allows for greater transmission of disease, especially bubonic plague. The patterns of abandonment seen in this study, with deserted villages clustered near major roadways, crossroads, and near major battle sites, strongly implies that the war and its attendant plague outbreak were the proximate cause.

Future Study

The present study opens new avenues for continued research. While the Grimani cadastral maps provided relatively high-resolution data for village abandonment, only a portion of those maps were available for this study, leaving many *lacuna*. The full cadastral survey, *Archivio Grimani ai Servi*, survives in the State Archives of Venice. In its complete form the survey includes detailed written descriptions of every village in the Morea, both inhabited and deserted, and specifically accounts for recent immigrants to the peninsula. Extended research in the archive, when feasible, will allow for a complete accounting of village abandonment in the Morea, as well as establishing patterns of immigration designed to fill the demographic void.

The Plague Suitability Model (**Map 7**) produced here is well grounded in current research on modern plague reservoirs, yet much work remains. One of the major weaknesses of the model is the dearth of information on plague outbreaks in immediate proximity to the disease reservoirs in southern/southwestern Anatolia. Epidemic outbreaks certainly occurred in these areas, yet the sources we possess, mostly European observers, only witness these plague events as they move toward the major trade nodes, including Istanbul and Izmir. Filling in this *lacuna* requires further archival work in the unpublished records of various European diplomats, notably the British consuls at Izmir in the late 17th and early 18th centuries. These records are accessible in the Levant Company holdings of the National Archives of the United Kingdom.

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