

LATE ANTIQUE PLAGUE SHIPS:
SIXTH-CENTURY C.E. TRADE ROUTES AND THEIR ROLE IN
TRANSMITTING THE JUSTINIANIC PLAGUE

A Thesis

by

MEKO KOFAHL

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Chair of Committee,	Shelley Wachsmann
Committee Members,	Felipe Vieira de Castro
	Daniel Schwartz
Head of Department,	Cynthia Werner

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ABSTRACT

The major European epidemic of bubonic plague in the sixth century C.E. – named for the ruling Byzantine emperor, Justinian – devastated the empire at the same time that outside pressures in the form of Goths, Vandals, Persians and others were also eroding the territory held by the Byzantines. While far less documentation survives the period between 550-750 C.E. than does for the periods before and after, we do have numerous references to specific plague outbreaks with which it is possible to reconstruct a transmission path and timeline.

The combination of geographical information systems (GIS) tools, literary references, modern archaeological finds and DNA analysis of excavated sixth-century C.E. graves creates an opportunity past researchers of this plague have not had for linking individual outbreaks. Synthesizing this data gives us a more detailed path of transmission than has previously been available and more clearly illustrates the relationships between various cities and countries through which the plague moved during the epidemic.

Although several authors have done outstanding work tracing the path of the plague through specific regions, no prior work has combined all known literary references to the Justinianic plague for the specific purpose of mapping its course. This thesis attempts to do just that by combining the plague outbreak information with trading data, evidence from shipwrecks, ancient road information, archaeological finds, and other materials to present a plausible transmission scenario.

This synthesis reveals, in many cases, a startlingly clear relationship between cities during phases of the epidemic. While epidemiological work has strongly suggested that waterborne transmission was required for the speed of the spread, it is evident when all

available information is mapped. Holes in our information are similarly highlighted, and present opportunities for focused plague-related research and/or excavation.

This thesis presents a fresh look at old data, but also opens the door for new questions and lines of inquiry.

DEDICATION

For Cristiano, always. *Ad astra per aspra*

ACKNOWLEDGMENTS

All scholars who use the vast resources of already-published material stand on the shoulders of giants, and I am no exception. In particular this work benefited from the contributions of very many people, few of whom I can thank personally here.

First, I would like to thank my committee chair, Dr. Wachsmann, and my committee members, Drs. Castro and Schwartz, for their guidance and support throughout the course of this research. Dr. Schwartz in particular pointed me toward a number of Syriac resources I might not have located on my own. I wonder how many other plague sources might exist in as-yet-untranslated materials.

The library staff at Texas A&M University's Evans library, and specifically the team responsible for inter-library loans, made research as painless as possible. I can only imagine how difficult this work would have been without the use of the resources that were readily available to me through this wonderful library. Special mention also needs to be made of the impressive "Digital Atlas of Roman and Medieval Civilizations" website created and maintained by Harvard University; I hope that part of my work will find its way there to enhance an already immensely useful resource.

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CHAPTER I

INTRODUCTION

In the year 541 C.E. a devastating epidemic of plague swept across the Mediterranean, initially carried from port to port by the merchant ships that were the lifeblood of the cities, towns and settlements that survived the fall of Rome. No less virulent than the more-famous 14th century Black Death, estimates suggest that this earlier plague exacted a similar toll: killing 30-50 percent of a population already ravaged by war, famine and natural disasters. Figure 1 shows the extent of the spread: in total, 18 waves of plague overwhelmed Mediterranean countries, only to mysteriously subside around 750 C.E.¹

Named for the Byzantine emperor ruling at the start of the epidemic, this so-called *Justinianic Plague* has received only a fraction of the attention given to the epidemic of the later Black Death, in part due to the relative lack of source material. Within the last ten years, however, important new evidence has been collected that warrants fresh review and a revalidation of our understanding of the paths of transmission. Most analyses of this plague occurrence completely ignore the shipwreck finds from the last few decades, for example, and now that a number of wrecks from between 500-750 C.E. have been found and documented (at least partially) we can attempt to revisit this period from the perspective of the trading vessels, rather than relying primarily on land-based sources. Combined with economic information, trade patterns, and other information, these shipwrecks help elucidate the course of the epidemic as described by the literary sources.

¹ Cohn 2008, 74; Stathakopoulos in Little 2007, 100.

The sixth-century C.E. bubonic plague epidemic arose as a direct result of the creation of a vast trading empire in the Mediterranean and beyond; perhaps ironically, it was Justinian's reconquest of the western Mediterranean that helped ensure smooth trade and travel as well as ensuring a clear path for the spread of the deadly disease. Without Byzantium's newly re-established trading networks and the imperial organization needed to allow trade to flow freely (via economic agreements, standardized money, and trade laws) the critical components of a plague outbreak – rats, fleas, bacterium and sufficient population density – would not have existed in the proportions necessary for an epidemic. Trade is the source of this epidemic, and within trade routes lie the pathway of transmission.

While many people have heard of the bubonic plague (particularly the Black Death outbreak of the 14th century), as much misinformation as fact surrounds this disease, even today. A brief review of the physical symptoms of this disease and its cause, as well as contemporary understanding of its transmission will be useful at the outset. Key to understanding the spread of this deadly bacterium is the awareness of incubation periods, early symptoms, and potential for human-to-human transmission. Additionally, diagnosis of plague events post-mortem is a capability which has entered the archaeologist's toolbox only within the last decade. Since it is now possible to confirm the presence of the plague in human dental pulp – even in skeletons from the sixth century C.E. – it is no longer necessary to rely purely on literary sources for identification of potential plague cemeteries. Fairly routine testing of any remains found roughly within the 500-750 C.E. time period can now reveal plague burials which would never otherwise have entered the historic record. Correlating such cemeteries with other information known about the spread of the disease

can help confirm the presence of trade centers, and, possibly one day soon, the mutation patterns of the disease over time, which would help further refine a timeline for outbreaks.

To start, however, this review of the outbreaks must begin with the literary sources. Even on this point there is some disagreement among the scholars regarding the actual dates of some of the outbreaks: General consensus places the first documented case in the Mediterranean in Pelusium, Egypt in the year 540 or 541 C.E.² There are, of course, numerous “plagues” prior to this event, as the term was often used to describe any odious disease, but we are aided somewhat by the distinctive symptoms of the bubonic plague specifically. Prior ‘plagues’ have likely included outbreaks of dysentery, yellow fever, influenza, typhus and other illnesses, but none of these have the distinctive “buboes” present with the bubonic plague. These painful swellings of the lymph nodes, often occurring in the groin area and normally darkly discolored, appear often and distinctly in the literary record.

Literary sources also provide us with numerous references to trade, which, of course, had been well-established for centuries between the Mediterranean and the Red Sea (a possible introductory passage for the bacteria). So how and why did the bubonic plague arrive when it did? This review of the evidence will consider the possibility that an ancient canal existed between the Red Sea port of Clysma and Pelusium (the closest Mediterranean port city) and that ships moving through this passage were the means for introduction of the plague into the Mediterranean.³ Other scholars have also considered the possibility of animal caravan or cart bringing the disease from an overland road like the Silk Route, although the appearance of the first outbreak in Pelusium makes this theory less likely, in my opinion.⁴

² Procopius, *History of the Wars*, II 22, 6

³ Tsiamis et al. 2009.

⁴ Morelli et al. 2010.

Since there were a number of documented disease epidemics prior to Justinian's rule – suggesting that there existed sufficient population density and trade patterns to sustain epidemics in general – what was special about the sixth century that spawned an outbreak of bubonic plague? While there is not yet consensus, a number of scholars have noted the occurrence of multiple climatic events and numerous earthquakes immediately prior to and during the first outbreak; such events (supported by literary evidence) suggest climatic change that created a window of opportunity for the disease.⁵

Central to most epidemiological studies of the bubonic plague is the identification of the mechanism by which the disease spread: this infected insect or animal which spreads a disease from one host to another is known as the *vector*. During a plague outbreak in China in 1894, the bacteria responsible for the bubonic plague was finally identified, along with its most likely carriers: the flea *Xenopsylla cheopis* and its host of choice, the black rat.⁶ The black rat (*rattus rattus*), known also as the *roof rat* or *ship rat*, is a capable climber and swimmer as well as being host to the plague and the fleas that spread it. One of the problems with black rats as a plague host, however, is their own susceptibility to the disease. Without a sufficiently-large rodent population resident in an urban area, the disease tends to burn itself out before it can become established enough to spread to the human population at-large and become an epidemic. For the major city outbreaks, infected rats arrived in sufficient numbers such that they were able to establish the disease there themselves, or perhaps infected fleas were introduced to an extant rodent population in the city.

Passing from rodents to humans, then possibly from humans to other humans either directly or by “human fleas” (*Pulex irritans*) or lice, this rapidly-progressing disease had the

⁵ Arjava 2005.

⁶ Dennis et al. 1999, 13.

potential to kill too quickly to sustain an outbreak – and periodically, it did just that. A certain population density of humans, fleas, and rodents is necessary to maintain an epidemic of the bubonic plague; once any one group's level falls below a minimum, the disease essentially disappears.⁷ Human-to-human and other transmission scenarios exist, but that occurrence is normally rare compared to regular flea-to-human transmission.⁸ This cyclical recurrence appears with the sixth-century plague episodes.⁹ It reappears seemingly spontaneously on a fairly regular cycle throughout the sixth, seventh and eighth centuries. As both the rat flea (*Xenopsylla cheopis*) and the plague bacterium itself (*Yersinia pestis*) can survive months without feeding, it is possible that these two components waited patiently between episodes for rodent populations to recover. Or, alternatively, ships simply brought more rats. If shiploads of rats were necessary to keep the plague active, this should be apparent in the literary and archaeological record.

With new archaeological evidence, as well as a synthesis of all available known sixth-century literary references and archaeological documentation, it is possible to suggest the exact path of the plague. Using GIS mapping tools to correlate all of this data, I have arrived at a plausible transmission scenario and have identified where areas of uncertainty lie. This may help guide future excavations by others interested in also confirming the spread of this particular plague outbreak by indicating locations likely to have been infected (whether or not they appear elsewhere in the plague record).

The new analysis contained herein does not drastically rewrite our understanding of the Justinianic plague; rather, it clarifies the details the events surrounding it and potentially provides a better understanding of maritime inter-country trade during the sixth-century. It

⁷ Keeling and Gilligan 2000, 2222-4.

⁸ Kool and Weinstein 2005, 1167.

⁹ Biraben and Le Goff 1969, 1492-3.

also reflects the current state of archaeological work on sites from the mid-sixth-century and later, with the intention of providing firmer evidence for the literary references which are general or undated.

CHAPTER II

HISTORICAL CONTEXT

Life in the Byzantine Empire during the sixth century C.E. was markedly different from that under the Roman Empire just two hundred years prior.¹⁰ Despite Justinian's aggressive reconquest of many former Roman territories from Goths and Barbarians (see Figures 2-6 for a progression of control of territories), continuing tensions along the Byzantine Empire's borders meant that some cities had to concern themselves for the first time with defense, fortification, or the purchase of immunity from raids.¹¹ People moved closer to resources to avoid long overland travel, and life generally became more locally-focused and self-sufficient.¹² Rome, the world's most important city for centuries, contained only a tenth of its peak population in the fourth century C.E., for various reasons (sacking, famine and disease among them).¹³ The focus of the empire had shifted to Constantinople, which was now the home of the Emperor and the epicenter for trade due in part to its location on the Bosphorus.

Pressure on the Empire from the East came in the form of the Persian army, initially kept at bay by Justinian with substantial payments in gold.¹⁴ In what is now France, the Merovingians held sway, receiving (at least during one period in the late sixth century)

¹⁰ Morony 2004 provides a thorough summary. More classic works addressing this issue include Jones 1964 and Gibbon 1890.

¹¹ Grierson 1958, 131. Procopius describes such 'immunity' payments by cities to the Persian emperor Chosroes: 2000 lbs of gold from Hierapolis and Beroea, 1000 lbs of gold from Antioch, 1000 lbs of silver from Apamea, 200 lbs of gold from Chalcis, 700 lbs gold total from Edessa.

¹² McCormick 2003, 308.

¹³ McCormick 2003, 322-3.

¹⁴ Grierson 1958, 133. Payments from Justinian to the Persians are numerous, as are gifts (an estimated 1000 lbs of gold to a single ambassador according to Procopius) and an annual tribute.

considerable annual tribute from the Lombards in Italy in order to keep the peace.¹⁵ The Visigoths controlled Spain, and the Vandals ruled Africa – until Justinian’s campaign to reclaim portions of the Western Empire succeeded.¹⁶ The history of Europe is pockmarked by battles over territory, coups and short-lived kingdoms between 500 C.E. and 750 C.E.

John of Biclaro mentions that the Avars 'deceitfully' blockaded the coastline along Thrace and were a great threat to sailing ships.¹⁷ Attacks on merchant vessels, and the fear that resulted, had an effect on trade traffic and drove up transportation costs.¹⁸ As many have noted, however, the presence of pirates generally signifies sufficient maritime traffic to tempt them.

During the late antique period the nature of trade itself appears to have changed as compared to during the Roman empire. Large grain ships continued to supply Byzantine army needs (the *annona*) and the needs of the populaces of Constantinople and Rome (the *annona civica*), but other trade appears to have focused on local or established trade routes with a few partner cities. The archaeological record is difficult to interpret. Shipwrecks are often found with piecemeal cargoes (see Appendix B) but it is impossible to know whether the ship visited each port or whether the goods simply circulated by way of a network of short trips. Large scale *cabotage*, or opportunistic trade, in an uncertain economy with uncertain security seems to have been too risky to undertake for many merchants. Taxes levied on goods at port cities throughout the Mediterranean (and in the Northern countries)

¹⁵ Fredegarius, iv. 45, 143-4. The annual amount was 12,000 gold *solidi*.

¹⁶ Boss 1993, 5-40.

¹⁷ Ferry 1990, 81.

¹⁸ Teall 1959, 95.

and the cargo tolls charged based on the carrying capacity of one's ship further reduced the ability to profit reliably from purely opportunistic trade.¹⁹

The additional requirement for foreign merchants to register (sometimes even to obtain royal permission) in order to trade at controlled cities was certainly not an insignificant burden, and foreign merchants' presence in these cities was generally monitored during their entire stay.²⁰ Dealing with the registration and permission process would clearly have been best dealt with once while establishing a routine trade route, not on an *ad hoc* basis.

Very few documents regarding commerce in Western Europe survive from the Late Antique period (approximately 400-800 C.E.) as compared to the Roman period or later Medieval. For Amalfi and Venice, two prominent trading cities in Italy, there are a *combined* 23 documents dealing with trade and traders prior to 900 AD.²¹ Of a list of extant early-medieval sources dealing with the Frisians (a coastal people who lived in what is now The Netherlands), again only 23 mention merchants or trade – and only five name a specific person.²²

Imperial documents in the form of customs charges and tariff rates exist, but are much more common starting in the eighth century C.E. Trade documentation corresponding to the early years of the Justinianic plague is rare. We do know that farmland was being abandoned as populations shifted and shrank, perhaps setting the stage for the famines that would periodically reappear in the following centuries.²³ This resulted in reduced tax revenue

¹⁹ Middleton 2005, 328 & 333. According to Middleton, the relative standardization of a ten percent tax might be due to reciprocity agreements.

²⁰ Middleton 2005, 318-9.

²¹ McCormick 2001, 15.

²² McCormick 2001, 14.

²³ Jones 1964, 812-23.

for the Imperial government, and led to the creation of hereditary professions, inherited ties to one's land of origin, legal requirements to pay tax on adjacent unoccupied land and other measures designed to reduce the impact of a drastically reduced population³⁸

on the imperial coffers.²⁴

Trade across disputed borders seems not to have been impeded greatly, but, again, the archaeological evidence is not always clear. Many of the late antique amphoras types were in use for a hundred years or more, making subtle distinctions across brief periods nearly impossible. The historical record is of little use in this regard, as well, although we do have some clues (see Chapter V – Trade Routes).

Additionally, religious practices were changing, with widespread adoption of Christianity in the Mediterranean by 600 C.E. (Fig. 7) and the subsequent conquering of a considerable amount of territory by Muslim Arabs around 650 C.E. (Fig. 6). Archaeological finds on shipwrecks throughout Late Antiquity reflect the presence of pagan, Christian and Muslim beliefs.²⁵ In part due to religious beliefs, the disease was believed by the faithful (Justinian included) to be a punishment from God for sins.²⁶

It was into this changeable, dynamic environment that the plague arrived.

²⁴ Procopius, *Secret History*, XXIII.

²⁵ Appendix A is a catalog of shipwreck cargoes from the period of 500-800 C.E.

²⁶ Stathakopoulos in Little 2007, 106.

CHAPTER III

EPIDEMIOLOGY

Despite the notoriety of the fourteenth century's Black Death and the attention paid to that particular bubonic plague epidemic, the disease itself was poorly understood until recently. The bacterium which causes bubonic plague, *Yersinia pestis*, wasn't itself identified until 1894 in the wake of the so-called Hong Kong epidemic.²⁷ Identification of the disease's host and its transmission mechanism took another twenty years.²⁸

The bacterium makes its home in certain species of rats and other animals, some of which are immune to the illness or whose hibernation period slows the advance of the illness and delays death.²⁹ Other plague hosts simply reproduce quickly enough to maintain a population despite regularly losing members to the disease. Many of the "reservoir hosts" of the plague—those animals with which the disease shares some sort of natural equilibrium—are burrowing animals living in close proximity with each other. In a burrow environment animals might not only infect each other directly, but also the parasites living among them, creating a cycle of infection.

Parasites like fleas have an opportunity to jump from animal to animal as needed, even outside a burrow. The relationship between certain fleas and the *Y. pestis* bacterium is unique. When a flea bites an infected animal, the plague bacteria establish themselves in the flea's gut, often creating a biofilm that blocks the passageway to the stomach. When the infected flea then tries to feed, the blockage prevents it from swallowing and forces it to vomit a portion of the bacteria back into the bite wound. Driven to a biting frenzy by

²⁷ Cook 2008, 221.

²⁸ Cook 2008, 222.

²⁹ Pollitzer 1954, 263.

starvation, the fleas become increasingly aggressive. Once their original host has died of the disease, they seek out any nearby living host, biting multiple times once one is found. In this way infected *Xenopsylla cheopis* fleas – which normally prefer rodent hosts who happen to lack immunity to the plague – ended up infesting human communities when those rodents died.³⁰

While the large epidemics of the bubonic plague seem to have materialized nearly out of thin air, *Yersinia pestis* has likely been infecting human societies ever since people set up villages near natural reservoirs of the disease. One such natural focus existed in Central Asia, where indigenous rodents called “tarabagans”—Siberian marmots that can reach an adult length of half a meter and a weight of up to 7.5 kg—were known by the local people to harbor a disease lethal to humans.³¹ These people monitored changes in the rodents’ movement patterns and would evacuate villages if the risk of contact with them became too high.³²

Normally, humans can live relatively close to such plague foci with minimal risk; large areas of the American southwest are home to colonies of plague-harboring prairie dogs, for example, yet only rarely is there a report of plague affecting the human populations living in that area.³³ Worldwide there are over 17 species confirmed as reservoir hosts to plague, that is, populations of creatures within which the disease can sustain itself; the vast majority comprise wild rodents infrequently in contact with man.³⁴

At some point, however, a tarabagan, an infected flea, or perhaps something directly contaminated with bacteria (*Yersinia pestis* can lie dormant for months under the right

³⁰ Dennis 1999, 64-65.

³¹ Kelly 2005, 36-8.

³² Pollitzer 1954, 252.

³³ Dennis 1999, 18-22.

³⁴ Pollitzer 1954, 254-5.

conditions) entered the trading route and arrived in Egypt. There, the bacterium found another natural reservoir in the Nile rat (*Arvicanthis niloticus*) – which, like the tarabagans and prairie dogs, are reservoir hosts for the disease and immune to its effects. Even in infected animals with no signs of illness the disease can be passed on via fleabite.³⁵

Black rats (*rattus rattus*) were possibly first introduced to plague-carrying *X. cheopis* fleas in China (as a native species) but a logical argument has been put forth for introduction in Egypt, where the Nile rat is a natural reservoir for both the flea and the endemic bacteria.³⁶ Urban growth and flooding of the Nile, perhaps combined with other environmental factors, could have put the human-avoiding Nile rat in intimate contact with city-dwelling black rats for the first time (whether they were freshly introduced or not), sharing their fleas and the plague with them.³⁷ However the lethal combination of black rat, *X. cheopis* and *Y. pestis* occurred in 541 C.E., it set in motion events that would impact Europe for the next two hundred years.

The infection of the black rat population was, in effect, the trigger for the human epidemic. For bubonic plague to be introduced to the human population a particular host was necessary: one that tolerated or even sought out human habitation, found food there, was an adept climber (to enter houses and ships) and a strong swimmer (to swim to shore and across rivers). This new host also needed to be themselves susceptible to the disease. Because Nile rats are effectively immune to bubonic plague, their fleas never have reason to leave their rodent hosts; it is precisely because black rats are *not* immune that the fleas must seek out a

³⁵ Pollitzer 1954, 252-3.

³⁶ Panagiotakopulu 2004, 272.

³⁷ Panagiotakopulu 2004, 271.

new host when the stricken one dies.³⁸ The black rat was the perfect vector for spreading *Y. pestis* to the human population.

Once the rat-flea-bacillus connection had been made, especially if it occurred in Egypt, carriage to the Mediterranean would only have been a matter of time. Trade traffic between the Red Sea and the Mediterranean was considerable, particularly after Justinian's reconquest of key strategic assets in the northern Red Sea in 534 C.E. helped ensure the security of merchant ships.³⁹ Transfer to the Mediterranean via the Red Sea port of Clysma has been suggested via an eastern branch of the Nile and Trajan's Canal (*Amnis Traianus*), which would have delivered infected rodents or fleas directly to one of the most important Mediterranean ports of the time: Pelusium.⁴⁰

Flea-infested black rats found ships as comfortable as human houses for refuge, and even with no live rats present, the *X. cheopis* flea can live for several weeks without a host, comfortably lying in wait amongst cargoes and grain for delivery to a new victim.⁴¹ Once aboard, crowded and unsanitary conditions likely led to the disease's spread. Though crews were small paying passengers were often brought on board to augment a voyage's earnings.⁴² Allocated a sleeping space just three cubits by one cubit (about 1.5 m by 0.5 m), passengers in such crowded conditions shared fleas and lice, and would have been at risk of transmitting the pneumonic form of plague through coughing or other bodily fluids.⁴³

³⁸ Panagiotakopulu 2004, 270-1.

³⁹ Panagiotakopulu 2004, 215.

⁴⁰ Tsiamis et al. 2009, 210-1.

⁴¹ Panagiotakopulu 2004, 270.

⁴² Bass and Van Doorninck 1982, 314-5.

⁴³ Ashburner 1909, 59.

Initial plague symptoms resemble the flu, but in some cases the disease progressed so rapidly that as little as two days could pass between apparently perfect health and death.⁴⁴ According to the Rhodian Sea Law and related legal sources, mariners who fell ill before sailing were required to return any pay advances and were replaced, but mariners who fell ill while in the middle of a voyage were at worst paid for the portion of the voyage completed, and in some cases even received their full share.⁴⁵ In other words, there was strong financial incentive for sick men to sail.

At all times during a voyage a portion of a ship's crew was required to remain on board, even during intermediate stops.⁴⁶ Unfortunately, mere proximity of a vessel to shore allows rats to swim to land, and even a small number of crew or passengers carrying infected fleas or lice could have spread them by sleeping ashore. The sale of infected cargo presented additional opportunities for the disease to make landfall.

Whether a sailor had been infected onshore or onboard ultimately made little difference; no one in the mid-sixth century knew what caused the disease and vermin were endemic in port environments, making their way into all corners of a ship. After the 1894 infection of Hong Kong, considerable effort was expended to rid all ships of rats, largely using poisoned gas.⁴⁷ Despite the modern efforts, infected rats were found on vessels on nine different occasions between 1900 and 1904 (during an epidemic).⁴⁸ Even if ancient crews had suspected that rats were anything more than an annoyance, they may well have been unable to do anything about it.

⁴⁴ Jones 2009, 262; Gregory of Tours, *History of the Franks*, V 34. "Those who caught it had a high temperature, with vomiting and severe pains in the small of their back: their heads ached and so did their necks."

⁴⁵ Ashburner 1909, clxix, clxxii-clxxiii. No specific mention is ever made of the plague.

⁴⁶ Ashburner 1909, iii.

⁴⁷ Link 1951, 696.

⁴⁸ Link 1951, 696.

Once the plague cycle had started, it appears to have stopped only when the number of rats fell below the levels needed to sustain an epidemic. Rats could themselves become infected not only by flea bites, but also by eating a portion of any of the infected corpses (rat, human or otherwise) that remained unburied.⁴⁹ Domestic cats catching, killing and eating infected rats can become infected themselves and pass the bubonic plague to humans via bites or, in the case of famine, as contaminated meat.⁵⁰

The course of the disease once a person was infected was quick and painful:

Death was sudden. A wound the shape of a serpent would appear on groin or armpit and the man would be so overcome by the poison as to die on the second or third day. Moreover the power of the poison rendered the victim insensible.⁵¹

Support for fleabites as a major mode of transmission is partially confirmed by the presence of buboes in the groin,⁵² which indicates an initial infection site somewhere on the lower extremities – the most likely place for a flea to jump to when searching for a new host. Armpit buboes can be attributed to both fleas and other sources: cat bites on the hand or arm and upper-body lice bites among them.

In routine cases the bite from an infected flea (or other carrier) becomes regular bubonic plague – which is occasionally survivable even without modern antibiotics – but there are other forms. If untreated, regular bubonic plague can become the septicemic (blood-borne) or pneumonic (air-borne) types.⁵³ These are more easily passed from humans to humans through contact with bodily fluids, similar to transmission of the flu. Other rare types

⁴⁹ Dennis et al. 1999, 11-12.

⁵⁰ Dennis et al. 1999, 33-34.

⁵¹ Gregory of Tours, *History of the Franks*, IV 31.

⁵² In some of the historical accounts the plague is known as ‘inguinal fever.’

⁵³ Monecke, Monecke, and Monecke 2009, 583.

include progressive infections of the brain and skin, often occurring simultaneously with one of the three main types: bubonic, septicemic, or pneumonic.⁵⁴ While a victim of untreated bubonic plague might survive the disease and recover (as Justinian himself did), the chances of an untreated case of pneumonic or septicemic plague resolving itself are virtually zero, as they are today if antibiotics are not administered immediately.⁵⁵ Contracting either of these two types represented a certain death sentence in the sixth century.

The incubation period for the bubonic plague is today between five and seven days, as few as two for the pneumonic type.⁵⁶ Sixth-century accounts seem to suggest that it progressed more rapidly in the past; some accounts cite progression from infection to death in as little as two days for the *regular* type of plague.⁵⁷ Modern documentation of bubonic plague states that after a day of fever, a week of delirium would normally follow, then another week or more of suffering, during which buboes would swell and occasionally burst.⁵⁸

Pneumonic plague is the type that can spread most easily from person to person, much the way the flu is spread (by coughing or sneezing infected droplets into the air).⁵⁹ A single sailor or passenger progressing to this type while on board ship could easily have spread it to the rest of the crew and passengers in the space of a few hours.

...a ship from Spain put in at the port [of Marseilles] with its usual wares and unhappily brought the seed of this disease. And many citizens bought various merchandise from her, and one household in which were eight souls was quickly left

⁵⁴ Centers for Disease Control and Prevention 2012, 1.

⁵⁵ Centers for Disease Control and Prevention 2012, 1.

⁵⁶ Stathakopoulos 2004, 128-9. The Centers for Disease Control (CDC) reports an incubation period of between two and six days.

⁵⁷ Gregory of Tours, *History of the Franks*, IV 31.

⁵⁸ Rosen 2007, 211.

⁵⁹ Centers for Disease Control and Prevention 2012, 1.

vacant, its inmates all dying of this plague. But the fire of the plague did not at once spread through all the houses, but after a definite time like a fire in standing grain it swept the whole city with the flame of disease.⁶⁰

We are not told what the ‘usual wares’ referred to above are, but typical cargoes for that trade route included leather, textiles, and possibly grain.⁶¹ Likewise, due to the description of the spread of the illness it is possible that rats were not the culprit; the cargo itself may have been infested with either fleas or lice that spread the infection to the purchasers and, subsequently, the local rat population.

It is also possible that an infected cargo of grain transmitted the bacteria to new locations. A single rat can contaminate more food than it eats, with the annual consumption of twenty-five rats roughly equivalent to that of one human.⁶² A 1951 experiment showed that for a given quantity of wheat, rats consumed less than 5 percent but fouled over 70 percent in the course of three to seven months.⁶³ Considering how centralized grain distribution was in late antiquity, and how poor their rodent control must have been compared to modern-day practices, the potential for the spread of infection via rodent feces was considerable.⁶⁴

The behavior of the plague epidemic has also been modeled mathematically.⁶⁵ Two important points emerged: first, an explanation for the delay in human infection when the plague is introduced to a new population. Where a rat population already exists, fleas

⁶⁰ Gregory of Tours, *History of the Franks*, IX 22.

⁶¹ See lack of Spanish amphoras exports to Marseilles in Reynolds 1995 and McCormick 2001, 697f (suggesting the ‘usual wares’ were not transported via amphoras). Also see details for the St. Gervais II wreck in Table 8 on page 97.

⁶² McCormick 2003, 3; Sirks 1991, 216-7. Sirks uses the figure of 5 *modii* per month as the figure for the grain ration. This is equivalent to roughly 1 *artaba*, or a little over 29 liters.

⁶³ Barnett 1951, 22.

⁶⁴ McCormick 2003, 3; Dennis et al. 1999, 9 & 11.

⁶⁵ Keeling and Gilligan 2000.

carrying the plague will favor rodent hosts. Only when a sufficient number of rats have been killed by the disease do the fleas become sufficiently desperate to seek out human hosts. Keeling and Gilligan calculate this ‘lag’ period at about four weeks.⁶⁶ From Gregory’s description of the Spanish cargo, we can surmise that the original purchasers of goods were the ones immediately killed by the disease, but that the infected fleas thereafter found rodent hosts and only after this ‘lag’ time was plague able to spread “like a fire in standing grain.”

The second important point from Keeling and Gilligan’s plague model is the possibility to arrive at a sustainable rat-plague equilibrium that does not rely on reintroduction of either rats or plague to trigger a new epidemic. In his example of a “medium-sized town,” an estimated population of 60,000 rats is able to sustain a plague infection for over one hundred years without needing an influx of either new rats or bacillus.⁶⁷ In this model, however, occasional large-scale human outbreaks can be expected about once every ten years.⁶⁸ This number is quite close to the “seven-year cycle” noted by contemporaries of the Justinianic plague, and it might suggest that this equilibrium in the rat-flea population happened quite early in the spread. It also explains why cities likely suffered more than small villages; a certain density of rodents is needed for the equilibrium to occur. Below a certain density, reintroduction of rodents or fleas would almost certainly be necessary to spark a new epidemic.

Proposed rates of mortality for the Justinianic plague range from as low as 20 percent to as high as 70 percent of the entire European population, depending on the source and

⁶⁶ Keeling and Gilligan 2000, 2222.

⁶⁷ For comparison, a 1944 estimation of the rat population in Baltimore, Maryland was 400,000 – or 1 rat for every 2.5 inhabitants. General estimates for cities with modern rodent control methods are normally closer to 1 rat per inhabitant (Pollitzer 1954, 292).

⁶⁸ Keeling and Gilligan 2000, 2224-5.

methodology used.⁶⁹ Whole-population mortality rates for the better-documented Black Death (occurring approximately 1300-1400 C.E.) are estimated at 24 percent.⁷⁰ In a pristine, never-before-afflicted population, death rates for a new disease tend to be higher, and it is likely the Justinianic plague epidemic claimed much more than 25 percent – Procopius claims it was 50 percent throughout the empire.⁷¹ Any epidemiology studies conducted on modern bubonic plague occurrences may not correspond to the sixth-century epidemic for this reason – this phenomenon could explain the unusual speed with which infection and death occurred versus the course of the disease today.

Black rats are present in the archaeological record in Europe from the second century B.C.E. and may have entered Europe much earlier, catching a ride on the ships trading between the rats' southeast Asian homelands and ports on the Red Sea.⁷² These rats, also known as “ship rats,” “wharf rats,” and “house rats” are warmth-loving climbers and capable swimmers; they would have been at home aboard merchant ships, in granaries and in the rafters of sixth-century homes. These black rats together with the *X. cheopis* fleas have been identified as the most effective vectors of the bubonic plague in the 19th century.⁷³ Other animals (rodents, cats, dogs), however, can also carry the *X. cheopis* flea and there is some evidence that person-to-person transmission via the human flea *Pulex irritans* or via body lice might also have occurred.⁷⁴

Camels can contract the disease through contaminated forage; dogs and cats and their fleas, as well as other livestock are susceptible to the plague – carnivores and birds of prey

⁶⁹ Bentley 1998, 249.

⁷⁰ Bentley 1998, 250.

⁷¹ Allen 1979, 11; Procopius, *Secret History*, xviii, 44.

⁷² Armitage 1994, 232.

⁷³ Drancourt and Raoult 2002, 106. They also suggest (107) that during the sixth century C.E. it was more likely that the *Nosopsyllus fasciatus* flea was the carrier.

⁷⁴ Ayyadurai et al. 2010, 892.

generally are not. The latter still plays a role in passing on infected fleas or the bacteria by transporting infected carcasses, residing in infected burrows (as in the case of burrowing owls) or regurgitating infected meals that are later eaten by other animals.⁷⁵ The appearance of plague alongside famines could in part be explained by the eating of undercooked infected rodents by humans when no other foodstuffs were available.⁷⁶ None of these unusual transmission scenarios is described in the literature, but all are possible contributors to the disease's rapid spread.

Body lice might also have been a way of transmitting infection (and virtually everyone had them in those days) or via human fleas (*Pulex irritans*).⁷⁷ As few as 20 infected rodent carriers are needed to spark a human epidemic; tests show that as few as 10 infected body lice can accomplish the same task.⁷⁸ In the case of the 19th-century Indian plague, there is some evidence that wandering groups of *fakirs* might have been responsible for bringing the plague, despite not succumbing themselves to it.⁷⁹ Fleas in general do not like the smell of horses, so perhaps any goods the fakirs were carrying for sale were infected while they remained unmolested by the fleas. The mechanism is not clear—whether they were human carriers, carriers of infected fleas or other infected vermin (like body lice) —they somehow encountered the disease and managed to pass it on without becoming infected themselves.⁸⁰ However these travelling groups managed to spread the disease, it is possible that the same situation occurred on the overland routes in the sixth century C.E.

⁷⁵ Pollitzer 1954, 305-8.

⁷⁶ Dennis et al. 1999, 46.

⁷⁷ Ayyadurai et al. 2010, 892.

⁷⁸ Panagiotakopulu 2004, 272.

⁷⁹ Hankin 1905; Pollitzer 1954, 294.

⁸⁰ Hankin 1905, 2-4.

While there is no evidence for quarantine *per se* – for example, no legal edicts requiring one – attempts were certainly made to mitigate the disease or reduce one’s risk of infection. In one case a group of farmers decided to “give the city [Myra] wide berth [so] we will not die of this disease.”⁸¹ In another instance Bertram of Bordeaux was chastised for bringing plague from abroad.⁸² In the seventh century armed guards protected the unafflicted diocese of Cahors from plague-ridden Provence.⁸³

It was only in 2004 that ancient cases of bubonic plague could be confirmed by DNA testing of human teeth for traces of *Yersinia pestis*, although it had long been considered the cause of the epidemic of the sixth century due to the many unique symptoms described in the historic record.⁸⁴ This test technique has now been applied to a number of sixth-century gravesites, providing the earliest such confirmed cases of the plague.⁸⁵ Ongoing studies are attempting to determine exactly how the plague-causing bacteria, *Yersinia pestis*, its carrier flea *Xenopsylla cheopis* and the host black rat *Rattus rattus* came together to ignite the disease in the human population, and to understand how the ancient version of the bacillus’ DNA has changed over time.

⁸¹ Stathakopoulos 2004, 285.

⁸² Gregory of Tours, *History of the Franks*, VIII 2: “So when Bertram came in the king asked: ‘Who is he?’ For it had been a long time since he had seen him. And he said: ‘This is Bertram bishop of Bordeaux.’ And the king said to him: ‘We thank you for keeping faith as you have with your own family. For I would have you know, beloved father, that you are my kinsman on my mother’s side and you should not have brought a plague from abroad on your own people.’”

⁸³ Gensin 2004, 258.

⁸⁴ Drancourt et al. 2007, 332. See also Wiechmann and Grupe 2005, 48-55 for discussion of experiment. Testing for evidence of plague had been done previously, but Wiechmann 2005 is the earliest confirmed evidence of plague in human skeletons.

⁸⁵ Wiechmann and Grupe 2005, 48.

CHAPTER IV

REVIEW OF LITERATURE

Scholars of the Justinianic plague have fewer historical resources from which to draw than those working on the 14th-century Black Death and later epidemics. While this has typically meant that this sixth-century bubonic plague epidemic has received less scholarly attention than the later ones, recent developments in forensic archaeology, archaeological finds, and the publication of important topical works have spurred new interest in the subject and advanced our understanding of the period.

One of the early modern works dealing with the epidemic of the sixth-century plague predates the identification of the plague bacterium as the cause of the disease in 1894.⁸⁶ This work, *Della Peste e della Pubblica Amministrazione Sanitaria* by A.A. Frari, is typical of many 19th- and early 20th-century works dealing with the bubonic plague in that it combines some descriptive historical background with information on managing the disease when it occurs.⁸⁷ The early 20th-century works by E.H. Hankin and W.J. Simpson are of similar type.⁸⁸

Where Frari's work becomes particularly valuable to researchers of the Justinianic Plague is in its extensive catalog of historical outbreaks and bibliography – included are dozens of 17th-century sources discussing historical plagues, their reach, and their effects along with more ancient sources for the sixth- through eighth-century outbreaks.

While Frari is careful to indicate clear bubonic plague outbreaks in some cases, in others it becomes less clear (particularly after 750 C.E.) what disease is being discussed. An

⁸⁶ Butler 1994, 655.

⁸⁷ The title translates roughly to “On the Plague and Public Health.”

⁸⁸ Hankin 1905; Simpson 1905.

uncritical reading of the listing would lead one to believe that the Justinianic plague never ended, but rather simply continued on until becoming the Black Death. Few modern plague scholars would agree with such a timeline.

Despite these obvious defects, Frari lists plague outbreaks lacking in other secondary sources (specifically an early set of outbreaks in northern Italy), and, unlike many other early plague listings, Frari provides enough bibliographical detail to reference the original source.⁸⁹

More recent work on the plague follows a resurgence of interest in the early medieval period sparked by H. Pirenne and his *Medieval Cities*.⁹⁰ The creation of the Dumbarton Oaks research group in the 1940s spurred new scholarship in the area of early Byzantine history, and the Justinianic plague has been an important topic in that work. In the 1950s G. Ostrogorsky and J. Teall published key works focused on early Byzantine history, paving the way for J.-N. Biraben and J. Le Goff's impressive 1969 article on Justinianic plague transmission.⁹¹ Biraben and Le Goff's article includes a list of outbreak sites, dates, references and maps that were likely comprehensive for their time (for their maps showing the transmission progression, see Figures 8-12) and for which no equally thorough publication of outbreaks has been published before this thesis.⁹² Since this 1969 article was published, however, additional references have become available through discovery or translation and have expanded the number of individual sites that can be specifically named. Additionally, work in ancient mapping has provided us with reference works such as the

⁸⁹ Specific cities and regions mentioned in Frari but not found elsewhere include Insubria, Liguria and Piemonte, three regions in the north of Italy. See Appendix B for full listing of plague outbreaks.

⁹⁰ Pirenne 1925.

⁹¹ Pirenne 1925; Teall 1959; Teall 1965; Teall 1971; Ostrogorsky 1959; Ostrogorsky 1969; Biraben and Le Goff 1969.

⁹² Biraben and Le Goff 1969, 1500-7.

Barrington Atlas which make specific land route reconstruction possible. Biraben's work, while groundbreaking for its day, suffers from the lack of any detail in the Levant, Greece, North Africa and Spain. His infection route proposal also virtually ignores any overland transmission in Asia Minor and is vague in other areas.

The Justinianic plague has captured the attention of a number of scholars from other fields as well. In addition to historians and archaeologists, medieval demographers like J. Russell have contributed greatly to the discussion by combining the scant historical information with modern understanding of the disease's epidemiology. His 1968 work "That Earlier Plague" is one of the first to combine the demographic aspects with the historical data.⁹³

G. Antonelli, A. Cameron and G. Hourani all wrote key works in the 1970s dealing with various topics of Byzantine history, but it wasn't until L. Conrad's works in the 1980s that the topic of plague received serious fresh academic consideration.⁹⁴ Subsequently, the amount of new scholarship on the topic of the Justinianic plague and the history of trade in the early Byzantine/late Roman empire is considerable enough to make naming all involved individual scholars a daunting task. The impact of the Internet on scholarship is clearly notable, however, with a considerable jump in relevant publications starting around the mid 1990s.⁹⁵

More recent scholarship has been more specialized, with a number of scholars approaching the Justinianic plague from the perspective of a certain region. L. Conrad's plague focus is the Near East: he presents source material from Arabic poetry and Syriac

⁹³ Russell 1968.

⁹⁴ Antonelli 1978a & 1978b; Cameron 1979; Hourani 1979; Conrad 1981a, 1981b and 1982.

⁹⁵ Important references in 1990s include McCormick 1998; McNeill 1998; Hodges and Bowen 1998; Maddicott 1997; Whittow 1996; Conrad 1994; Loseby 1992.

sources that other authors neglect. D. Stathakopoulos focuses on the Levant and the spread of the plague through the Eastern Mediterranean, compiling a detailed list of plague outbreaks with dates and explanations – his work suffers from the lack of a map of his transmission scenario, however.⁹⁶ M. McCormick has maintained a broader approach, first with his hefty *Origins of the European Economy*, but most recently with a focus on aspects of the spread of the plague throughout the Mediterranean.⁹⁷

Popular works have introduced the Justinianic Plague to a wider audience; perhaps the most specific of which is W. Rosen's *Justinian's Flea*.⁹⁸ Rosen presents a solid background and includes a single map of his proposed transmission scenario. There is a limit to the amount of detail that can be shown in one map, however, and while Rosen does a good job covering at least three waves of outbreaks, important information is necessarily left out. The description of Marseilles receiving the plague from Spain in 588, for example, is absent even though the infection itself is mentioned.

The same year as W. Rosen's *Flea* publication, L. Little's *Plague and the End of Antiquity* presented scholars with the latest in Justinianic plague research, highlighting the work of numerous scholars.⁹⁹

Perhaps most exciting among some of the recent developments is a test that can definitively confirm the presence of bubonic plague DNA in the dental pulp of ancient skeletons.¹⁰⁰ For archaeologists, the ability to confirm plague in skeletal remains is of particular value and permits us to substantiate literary accounts of the spread of the disease as well as to identify previously unknown and undocumented plague outbreaks. While the

⁹⁶ Stathakopoulos 2002 and 2004.

⁹⁷ McCormick 2003 and 1998.

⁹⁸ Rosen 2007.

⁹⁹ Little 2007.

¹⁰⁰ Wiechmann and Grupe 2005, 48.

technique has only been in use a short time, the following plague burials have already been confirmed with it (Table 1).

CITY	COUNTRY	COMMENTS
Le Clos des Cordeliers (Sens) ¹⁰¹	France	Literary reference to plague in 571 C.E. confirmed via DNA
Aschheim ¹⁰²	Upper Bavaria, Germany	DNA confirmation of plague in an area where there is no literary mention of the disease, dated to second half of sixth century
Vienne ¹⁰³	France	
Castro dei Volsci ¹⁰⁴	Italy	Confirmed sixth-century plague burials
Gerasa ¹⁰⁵	Jordan	Multiple burial, may be seventh-century plague
Venosa (Lucania) ¹⁰⁶	Italy	Mass graves, may be plague from eighth to tenth centuries

Table 1 - List of Archaeological Justinianic Plague Burial Sites

This new forensic evidence joins the body of evidence gathered from contemporary historical accounts and other documentation.

Other efforts are underway to clarify sixth-century trade relationships, demographics, daily life and other aspects. One such effort is the *Digital Atlas of Roman and Medieval Civilization* assembled by M. McCormick and his team using data from published and unpublished sources.¹⁰⁷ This GIS-based interactive map shows locations of churches, cemeteries, roads, cities, shipwrecks and other important features from Roman through late medieval times. While it currently does not allow users to filter by dates, that information has been captured and could be made available at some time in the future. For now, their data spans over 2000 years and it can be tedious, at times, to identify points of interest relative to a specific date range.

¹⁰¹ Castex 2008, 30.

¹⁰² Wiechmann and Grupe 2005, 48.

¹⁰³ Drancourt et al. 2007, 332.

¹⁰⁴ Rubini 2008, 52.

¹⁰⁵ Castex 2008, 39.

¹⁰⁶ Castex 2008, 37-8.

¹⁰⁷ McCormick 2010.

The Ancient Sources

The vast majority of sixth-century history is documented through the government and the church; most individual accounts are from religious figures, although the quality of the sources is highly variable. The Plague Timeline in Appendix C lists the original sources where each specific incident is mentioned and occasionally includes additional notes and detail.

Unfortunately, to read all of the sources in the original language would require mastery of a dozen languages – perhaps one reason such a comprehensive listing of plague outbreaks has not been assembled previously. I have, therefore, relied on one or more translations of each original work. For the most important of these, multiple translations and analyses are usually available and more and more new translations of previously untranslated works become available to scholars every year.

CHAPTER V

TRADE ROUTES

Without an extensive system of trade routes linking Asia with Europe by sea, the critical meeting of black rats, rat fleas and bubonic plague virus might never have occurred in the Mediterranean. Possibly native to Egypt or Ethiopia, the plague bacteria *Y. pestis* lived in harmony with its shy, human-avoiding host the Nile rat *A. niloticus* and posed little threat to the human population.¹⁰⁸ Not until ships sailed from China to the Red Sea did black rats (*R. rattus*) – likely native to India and very comfortable living in close proximity to humans – reach the Mediterranean. After commingling with the local Nile rat population and picking up some of their plague-carrying fleas, the infected black rats eventually reached the granaries at Alexandria and from there they multiplied and were carried throughout the Byzantine Empire.

While trade did not stop in Late Antiquity, by most accounts it was greatly attenuated by ongoing wars, a reduction in population and numerous natural disasters including volcanic activity, earthquakes, famine, floods and disease. Trade was driven in part by these same events, as cargo holds filled with food sailed for hungry markets. Vital goods (especially grain) still flowed, though, as did luxury items, and shipment by water was preferred for most cargo for speed and cost. Romans had been able to ship goods across the Mediterranean for one-sixtieth the cost of overland routes during the height of the Empire, and while transport was more expensive in the sixth-century C.E., it still cost less to ship a bushel of wheat from Palestine to Spain by ship than to send it seventy-five miles overland by cart.¹⁰⁹

¹⁰⁸ Scholars are close to confirming the origin of the bacteria. For now, China is the leading candidate. See Shen et al. 2010.

¹⁰⁹ Rosen 2007, 196.

Still, not everyone had access to a navigable waterway, and great portions of the Byzantine Empire could be reached only by road. Overland transport was conducted via road using donkeys, mules and camels.¹¹⁰ Contrary to popular belief the Roman roads did not fall completely into disrepair in the sixth century.¹¹¹ Justinian engaged in public works to improve road services – bridges, for example – but he is also criticized for closing others, possibly due to the expense of maintaining such a vast network.¹¹² Many formerly-Roman roads lay outside the Emperor’s control, and we have only spotty documentation on the maintenance and condition of those.¹¹³ In addition to road condition, Justinian ordered the maintenance of stations: places where travelers could exchange horses and rest for the night.¹¹⁴ Generally spaced one day’s ride apart, they are mentioned frequently by pilgrims. In one unusually detailed instance, Procopius complains that the closure of a station between Calchedon and Nicomedia forced people to take the sea route in its place.¹¹⁵

Elsewhere, people lamented that Justinian swapped out the stations’ faster horses and substituted less-expensive, but slower, donkeys in the Eastern part of the empire.¹¹⁶ This may have been done to facilitate the transport of goods, as donkeys were better for carrying goods over rough terrain than horses.¹¹⁷

¹¹⁰ Hodges and Bowden 1998, 91.

¹¹¹ Avramea 2002, 59.

¹¹² Avramea 2002, 59.

¹¹³ One of the best references for the condition and improvement of roads during Justinian’s reign is Procopius’ *Buildings (De Aedificiis)*. See also McCormick 2001, 395.

¹¹⁴ Maas 2005, 48.

¹¹⁵ Avramea 2002, 59.

¹¹⁶ Avramea 2002, 59.

¹¹⁷ Avramea 2002, 59.

Procopius documents a number of Justinian's civil works projects in his *Buildings*.¹¹⁸ Customs stations throughout the empire levied tariffs and collected tolls at stations along the way (Fig. 13 for a map of known stations).

Roman customs documentation shows that the daily distance that could be covered by a heavily laden donkey (or other beast of burden) was essentially capped at 15 km – for distances beyond that, the load of the donkey had to be lightened.¹¹⁹ Other sources tell us that travelers rested as much as 1 in 4 days.¹²⁰ Unladen riders appear to have averaged 54 km a day – heavily dependent on season, terrain, the presence of relay stations and other factors, of course.¹²¹ In the best of scenarios overland travel was slow. Progress by road is highly variable and based on road conditions: paving, steepness, and icing all affected the distance that could be anticipated. A day's journey on horseback on one well-maintained state road (the *demosios dromos*) covered about 75 km from one station to the next, but other roads allowed progress of only 25 km per day.¹²² Passengers and pilgrims generally used whatever water transport happened to be going their way, which means that their reported travel times are likely what the voyage took for the merchant vessels which accepted passengers for extra profit.

An average daily ship distance is more difficult to estimate, as it depended greatly on the direction one was sailing, the time of year, the size of the ship, sea conditions, weather, and the exact route taken. One scholar's estimate is between 30 km and 50 km per day, with the range highly dependent on the weather and other factors.¹²³ Overall, normal ship speeds

¹¹⁸ Procopius, *Buildings*.

¹¹⁹ McCormick 2001, 14.

¹²⁰ McCormick 2001, 475.

¹²¹ McCormick 2001, 476.

¹²² Avramea 2002, 59.

¹²³ Avramea 2002, 79.

in antiquity ranged between 3.4 and 6.2 knots in favorable conditions, 1.5 to 3.3 knots in unfavorable.¹²⁴

During the sixth century, up to ninety percent of all Mediterranean cargo was bulk trade in grain (primarily the *annona* and military supplies), olive oil, fish, salt and other foodstuffs, wood, metals, wool and hides.¹²⁵ Once landed, even goods that had traveled the majority of the distance via sea needed to be unloaded and transported via roads. Carts drawn by oxen in tandem were used to transport wheat by monks, but the movement of these teams was slow – less than the walking speed of people.¹²⁶ Camels and donkeys were only slightly faster.

One sixth-century vessel, found at the Italian city of Cefalù off of western Sicily, carried a cargo indicative of a trade route including Antioch, the North Aegean, the Black Sea and Tunisia.¹²⁷ Unfortunately, from the cargo alone it is impossible to know whether the ship visited each place itself, or whether the goods had simply made their way to various ports via other vessels. A voyage documented in 475 C.E., with stops listed, does describe the acquisition of camels in Cyrenaica, then fabrics and silver goods in Alexandria, before next heading for Athens.¹²⁸

An inscribed tariff list from late antique Anazarbus (in modern-day South-Central Turkey) includes the following commodities: rope, nets, silk, tin, lead, slaves, wine, salt, garlic, garum, saffron, fenugreek, gourds, vegetables and other plants, and cattle – the original list included an additional 27 items now lost.¹²⁹ Among the shipwreck remains,

¹²⁴ McCormick 2001, 482. One knot, the naval measurement of ship speed over water, is roughly equivalent to 1.15 miles per hour on land, or 1.85 kilometers per hour.

¹²⁵ Antonelli 1978a, 481-2; Lewis 1978, XII (1-2).

¹²⁶ Avramea 2002, 59.

¹²⁷ Avramea 2002, 80.

¹²⁸ Avramea 2002, 80.

¹²⁹ Mango 2009, 8.

normally only the inorganic cargo would be preserved: tin, lead and empty amphoras. In Berenike (a city on the Red Sea coast of Egypt), evidence of trade with India included textiles, Job's tear, black peppercorns, pottery, teakwood, beads, and semi-precious stones.¹³⁰ A listing of items subject to Alexandrian tariff in Justinian's *Digest* include cinnamon, cassia, long pepper, white pepper, *costus*, spikenard, myrrh, ginger, malabathron, galbanum, and cardamom – all items which would have been considered luxury goods or, in some cases, medicine.¹³¹

These would have represented high-value, low-volume cargo that could have been easily (and profitably) carried on the smaller vessels that were typical of the monasteries and independent merchants in the sixth century C.E. Other high-value cargo included slaves; a single slave sold for a pound of silver, making slaves a very profitable trade, although one that would begin to face pressures in the face of Christian adherents.¹³² While rarely mentioned, passengers also constituted a significant portion of shipping revenue.¹³³ In the Mediterranean it was not unusual that a passenger was also a merchant accompanying a quantity of goods; in ancient times the same Greek word applied to both.¹³⁴

The thirteen or more ships of the patriarchal fleet of Alexandria in 610-20 C.E. carried dried goods, clothing, silver and “other objects of high value” into the Adriatic for a total value of 34 *kentenaria* (3400 lbs gold). This would indicate a value of 16,000 *solidi* per ship, versus the estimated value of 70 *solidi* for the wine carried on the much more modest

¹³⁰ Mango 2009, 346.

¹³¹ Mango 2009, 278.

¹³² McCormick 2001, 756-7.

¹³³ Handley 2011, 107.

¹³⁴ Tzalas 1990, 90-1.

seventh-century C.E. Yassı Ada ship.¹³⁵ The simplest explanation for this disparity is, of course, that the Yassı Ada ship was a local merchant-owned vessel, whereas the Alexandrian ships were engaging in longer-distance government-sponsored or other official trade.

J. Durliat has commented on the six-percent tax on consumer goods that Cagliari was levying between about 582 and 602 C.E.¹³⁶ Unfortunately, we have only the portion of the tariff that includes common goods like wheat, wine, vegetables, livestock, poultry and some building materials in the form of palm fronds for roofing.¹³⁷ No luxury goods are listed, although they may have been included in a piece that is now lost.

Exotic goods made their way to the Franks and other points west, in considerable volume. A grant by Chilperic II, king of the Franks between 715-720 C.E., to the Abbey of Corbie in 716 C.E., was to be given out of the tolls collected at Fos-sur-Mer (Table 2).¹³⁸ For those sent to collect the above, an additional allowance was stipulated, including: 10 pack horses, 10 loaves of white bread, 20 chicks, 1 measure of wine, 2 of ale, 10 pounds of lard and 20 of meat, 12 pounds of *thymelaea* (an herb with medicinal properties), 20 pounds of peas, a goat, 5 chickens, 10 eggs, 2 pounds of olive oil, 1 pound fish sauce (garum), 2 ounces of cinnamon and a quantity of salt, vinegar, vegetables and sufficient wood – plus 15 wagons to transport it all.¹³⁹

¹³⁵ Mango 2009, 8. Van Doorninck 1972 states that the annual average wage was 7 *solidi* during this period, making the 70 *solidi* cargo an expensive venture. As noted, the shipwreck preserves only certain cargo types; valuable smaller cargoes, like spices, may have been on board but simply left no trace.

¹³⁶ Durliat 1982, 10.

¹³⁷ Durliat 1982, 11.

¹³⁸ Adelson 1962, 113-5. Although 716 C.E. is the date of this list, Lady Balthilde (Chilperic's grandmother) had requested the monastery be constructed around 659 C.E. and had been supplying it since its inception – presumably Lady Balthilde had ordered similar grants, although documentation does not survive.

¹³⁹ Adelson 1962, 113-5.

QUANTITY	UNIT	ITEM
10,000	pounds	Oil (for abbey lamps)
30	measures	Garum
30	pounds	Pepper
150	pounds	Cumin
2	pounds	Cloves
1	pound	Cinnamon
2	pounds	Spikenard
30	pounds	<i>Costum</i> (an aromatic herb)
50	pounds	Dates
100	pounds	Figs
100	pounds	Almonds
30	pounds	Pistachios
100	pounds	Olives
50	pounds	<i>Hidrio</i> (a spice?)
150	pounds	Chickpeas
20	pounds	Rice
10	pounds	Golden Pimento
20	--	Oil-Dressed Hides
10	--	Cordova Hides
50	Sheets	Papyrus

Table 2 – Items Granted to the Abbey of Corbie

A good quantity of the materials listed are native to Africa, Egypt, the Levant, and points further east, further underscoring the still-global nature of trade even in Late Antiquity. The source of the Corbie Abbey goods is potentially enlightening for the detail it provides into specific trade goods. Late antique Iran produced rice, apricots and olives, figs, dates and nuts among other agricultural products.¹⁴⁰ Many of these items would have passed through Antioch's port at the end of the overland Silk Road route.¹⁴¹ Papyrus, produced exclusively in Egypt until the 10th century, is one of the few items listed with a precise original source.¹⁴²

St. John the Almsgiver tells of a captain sailing in 620 C.E. from Alexandria to Britain in 20 days who discovered a famine there. He exchanged his cargo of 20,000 bushels

¹⁴⁰ Daryaee 2010, 401.

¹⁴¹ Tate 1991, 42-45.

¹⁴² Basile and di Natale 1996, 5. Sicily started producing papyrus as well around the 10th century.

of [grain] for tin, probably from the mines of Cornwall and Brittany.¹⁴³ Due to the time needed to assemble a shipload of metal, and the potential issues regarding selling it on his return, it is likely that this was a regular, reliable trade cycle.¹⁴⁴

Egypt was essentially Constantinople's granary until 618 C.E. and both Tarraco (modern-day Alicante, Spain) and Marseilles were receiving a majority of their imported amphoras from North Africa.¹⁴⁵

The real question for this study, however, is this: Which of the trade routes actually carried the plague?

¹⁴³ Mango 2009, 306.

¹⁴⁴ Mango 2009, 308.

¹⁴⁵ Kingsley and Decker 2001, 3.

CHAPTER VI

SAILORS AND SHIPS

The average Byzantine merchant ships from the seventh to the eleventh centuries C.E. seem to have been, as one writer describes them, “small, of less than 250 tons deadweight tonnage, powered by a single lateen sail, steered by two steering oars on the stem quarters ... with no deep keel ...”¹⁴⁶ Even that, perhaps, is generously overstating the average ship. A seventh-century writer from Palestine, John Moschus, described two vessels (one of 300 tons and another of 230 tons) as being “unusually large.”¹⁴⁷ The 230 ton ship was so oversized that the apparently-inexperienced shipwright was unable to even launch the vessel. At about the same time, the Byzantine armada—a fleet including 500 merchant ships—comprised vessels ranging between 120 to 200 tons.¹⁴⁸ The *annona* ships carrying the public grain dole and military supplies were not much different from privately-owned merchant vessels; they typically had a capacity of between 2000 and 20,000 hogsheads (or between 15-150 tons).¹⁴⁹

We are not, then, dealing with large ships during the Justinianic plague, for the most part. The general consensus regarding vessels of the sixth century is that merchant ships tended to be small compared to previous centuries; that voyages were limited in distance, with less purely opportunistic trade (*cabotage*) than in prior centuries; and that ships tended to stay close to shore and carried few goods.¹⁵⁰ There is now a substantial body of evidence available in the form of documented shipwrecks; does the old conventional wisdom hold true in the face of this fresh information?

¹⁴⁶ Pryor 1988, 27-8.

¹⁴⁷ Van Doorninck 1972, 139. The 300-ton ship is the largest mentioned in literature of the period.

¹⁴⁸ Van Doorninck 1972, 139.

¹⁴⁹ Hodges and Bowden 1998, 91.

¹⁵⁰ Unger 1980, 21 & 69.

Appendix B contains a compilation of over 250 shipwrecks dating from between 500 C.E. and 750 C.E. The data, unfortunately, have several problems: most of the ships were not fully excavated or studied, and so length/width/cargo information is estimated, if it is provided at all. Date ranges of some published wrecks cover a period of 500-1000 years, making analysis of any sort of trend problematic. As a result, while I have included wrecks that likely overlap the period of 500-750 C.E., it should be noted that it is probable that some of the actual dates of those wrecks fall outside of those dates. Finally, as with most ancient shipwrecks, the home port of most of the vessels listed cannot be determined. Only in some rare cases is the origin of an ancient wreck betrayed by a particular wood type, construction technique or cargo. For purposes of this paper, therefore, only the cargo origin and likely destination are considered if they can be determined or reasonably estimated; the ships are compared as a group without consideration for their possible origin.

One source states that the majority of trading vessels in the Mediterranean at this time (sixth century) measured up to twenty meters in length and carried less than 75 tons: roughly equal to a cargo of 1500 amphoras.¹⁵¹ My survey of the Appendix B wrecks—vessels for which length and width are at least estimated—suggests an even more conservative size. Of the twenty-eight wrecks in Appendix B with available dimension information, more than 60% were less than 15 meters in length (Fig. 14).¹⁵² The seventh-century Yassı Ada vessel, one of the most completely-published from the list, comes in at just over this length at 18 meters.¹⁵³

An additional measure often used to gauge overall ship size and type is the length-to-beam ratio. Wider ships with a ratio of 3:1 or 4:1 are designed to have roomy holds for cargo.

¹⁵¹ Mango 2009, 8.

¹⁵² See details in Appendix B.

¹⁵³ Van Doorninck 1972, 140.

Slimmer ships, with a 5:1 or 6:1 (or greater) ratio are more likely to be rowed vessels: ships designed for speed rather than cargo capacity (such as warships). Of the ships surveyed where length-to-width ratio can be estimated, the majority found have a 3:1 ratio (Fig. 14). The shipwreck evidence will generally be skewed towards preserving merchant vessels because there is no cargo to protect the hull of a warship from wood-eating teredo worms and other destructive forces; when conducting analysis of the dataset, however, identifying those vessels that probably were not merchant ships allows for their exclusion when considering trade.

In addition to smaller-sized ships, merchants often carried less sail than possible for a vessel. This kept speed down to four to six knots with a favorable breeze, but provided increased vessel stability and allowed for a smaller crew.¹⁵⁴

One well-documented example of what was likely a typical ship for the period had a cargo with an estimated value of 70 *solidi* (the value of the 900 amphoras of wine aboard the Yassı Ada circa 626 C.E.).¹⁵⁵ With an estimated sixty tons' cargo capacity and a length-to-width ratio of 4:1, she will serve as a suitable “average merchant ship” for purposes of discussion.

If the public grain shipments (the *annona civica*) from Alexandria to Byzantium and Rome in 618 C.E. were shipped in vessels of 50-ton capacity – similar to the Yassı Ada ship – it would take 620 shiploads per year.¹⁵⁶ If the *annona*, instead, were shipped in vessels the size of those described by John the Almsgiver (ships of approximately 140 tons that were

¹⁵⁴ Unger 1980, 35; crew positions and shares are listed in the Rhodian Sea Law. Archaeological evidence in the form of belt buckles on the Yassı Ada suggests 4 mariners were aboard and that they carried a number of passengers (evidenced by galley wares).

¹⁵⁵ Mango 2009, 8.

¹⁵⁶ Mango 2009,34.

able to transit between Alexandria and Britain), it would still take 221 shiploads.¹⁵⁷ And this for only the state-sponsored grain dole – other state ships carried grain supplies to the army and private merchants carried grain as well for general sale.

In the case of the grain ships, the objective was to make two to three return trips per year between Alexandria and Byzantium.¹⁵⁸ These runs would have taken place mostly during the normal sailing season of March to October.¹⁵⁹ Unfavorable winds and storms in the Mediterranean limit the months that can safely be sailed; coincidentally, this same time frame happens to overlap with the normal fertility period of black rats. This means that, quite possibly, any female rats sneaking aboard a ship were pregnant or shortly would be. Rat litters contain between five and ten babies, with a short gestation period of only one month. Given sufficient food and shelter, it is possible for a single female rat to have four or five litters per year.

Composed around the middle of the seventh century, the *Miracles of St. Artemios* tell of merchants from Chios, Amastris, and Constantinople – together with an African from Carthage and numerous unidentified *nautae* (shipowners) –who sought relief from disease and other afflictions at the shrine of the healer Saint Artemius in Constantinople.¹⁶⁰ Significantly, a merchant from Rhodes asked his family to permit him to remain in the city while he prayed for a miracle. On what seem to have been normal, periodic voyages, his sons twice returned to inquire whether he had yet been cured of his malady. The merchants

¹⁵⁷ Mango 2009, 304.

¹⁵⁸ Maas 2005, 69.

¹⁵⁹ Davis 2009, 65.

¹⁶⁰ Crisafulli and Nesbitt 1997.

mentioned in the *Miracles* generally seem to have owned their own ships, although no mention is made of their size.¹⁶¹

The *Life of Saint Gregorios of Agrigente* describes how the eponymous Saint embarked on a vessel where there was cargo belonging to the bishop of Panormite (modern-day Palermo) of Sicily.¹⁶²

Sixth-Century Shipbuilders

Like other monastic estates, Ganos monastery probably had its own shipbuilders.¹⁶³ A sixth-century tax list from Aphrodito, Egypt shows that two boatbuilders worked there.¹⁶⁴

By 600 C.E. shipbuilding had shifted towards skeleton-building; this method of construction meant far fewer man-hours of expensive labor were needed for the time-consuming carving of tenons and mortise-holes.¹⁶⁵ It is understood in the documented history of medieval technology that developments occurred at least fifty years before the date of the earliest known evidence. Ship design changes span an even greater time, and our timeline is all the more spotty when it is recreated only by ships which happened to sink and then become preserved in some manner or another.¹⁶⁶

Sixth-Century Sailors

There are few references to the lives of sixth-century sailors, and none are autobiographical. The little information available is generally limited to passing comments by historians, and are generally of an anecdotal nature. There are, however, a number of legal

¹⁶¹ Teall 1959, 104.

¹⁶² Tzalas 1990, 60.

¹⁶³ Mango 2009, 151.

¹⁶⁴ Mango 2009, 7.

¹⁶⁵ Pomey et al. 2012, 235-7.

¹⁶⁶ Unger 1980, 22.

documents that mention sailors, and these references combined with other sources can begin to paint a picture of the lives of the sailors, shipowners, and shipwrights of the period.

An Egyptian will dated 583/4 C.E. states that an illiterate sailor (*nautes*) and his wife owned “houses, objects of gold, silver, copper, brass, clothing, cloths and minor objects.”¹⁶⁷ Unfortunately, we are not told whether this particular sailor was wealthier than average (we can presume he was, in order to merit such special mention). Despite illiteracy, it appears that at least this member of a ship’s crew was fairly well-to-do.¹⁶⁸

Another small clue to the station of sailors is the number of epitaphs mentioning the profession. In Handley’s collection of 68 epitaphs mentioning profession, twelve refer to merchants or traders, six to sea-captains (*nauclerus*) and two to sailors.¹⁶⁹ With the cost of epitaphs averaging nearly five *solidi* at a time when an ordinary annual laborer’s wage was likely seven or eight *solidi*, they would have been unaffordable for the average worker.¹⁷⁰ The appearance of sailors at all in this group suggests that, at least for some, it was a well-paid profession, and, of course, even moreso for the captains and merchants.

There are also a number of references to sailors’ lives in the recounting of the miracles of St. Artemios. A typical account:

A certain sailor afflicted by the same disease waited upon the saint for 30 days. Since his shipmates urged him to set sail, he withdrew from the church and set sail. After they had passed beyond Abydos, while they were sailing with a favorable wind, they plainly saw someone wearing a cloak standing by the steersman giving orders... Now

¹⁶⁷ Mango 2009, 6.

¹⁶⁸ Christides in Tzalas 1990, 92.

¹⁶⁹ Handley 2011, 43.

¹⁷⁰ See footnote 135 on page 46. Handley 2011, 43.

the stranger they were staring at made as if to lay hold of the tiller so as to help the pilot, and...trod upon the sick man's testicles.¹⁷¹

This passage in particular is interesting for a number of reasons. First, this particular sailor had the luxury of waiting thirty days for the saint, and his shipmates waited for him; this suggests a position of some power. The steersman/pilot are named specifically, perhaps suggesting that there is a differentiation between regular sailors and those who man the tiller. Finally, the sick man's shipmates 'urge' him to sail, but there does not seem to be a captain-crew relationship between them. Is this the tale of an egalitarian group of sailors working together as crew on one vessel, or are they simply pleading with their captain to resume their voyage? One wonders if they urged all sick crewmembers to forge ahead.

¹⁷¹ Crisafulli and Nesbitt 1997, 103. St. Artemios was the saint of choice for 'male illnesses', particularly those affecting the testicles.

CHAPTER VII

METHODOLOGY AND RESULTS

Several authors have very competently described possible transmission scenarios of the Justinianic plague, and some, like D. Stathakopoulos, even provide a detailed itinerary of the plague's spread within a specific region.¹⁷² Unfortunately, no author has published a full transmission map to the individual city level – something that would be very valuable to archaeologists interested in further examinations of suspected plague cities or gravesites. This may be in part due to the tendency for plague scholars to focus on a certain area or language.

I examine here the transmission path connecting individual cities throughout the entire Mediterranean based on a combination of literary, archaeological, and other scientific evidence. In particular, I have used shipwrecks – an underutilized resource – as a possible diagnostic tool in retracing the plague's travel.

Using ArcGIS, I mapped all Justinianic plague occurrences, period shipwrecks, known roads and other features. Then, using the few specific dates available, I created plausible paths based on overseas or overland routes, as appropriate. In some cases the path is fairly obvious – in the area of the Levant, in particular, the documentation virtually recreates the path itself; in other cases there is very little historical documentation and I was forced to rely more heavily on what we know of Byzantine trade connections and cities.

While Appendix C attempts to list all known Mediterranean outbreaks from 540 C.E. through 750 C.E., my focus while mapping them was in the initial paths of transmission.

¹⁷² See, for example, Little 2007, Rosen 2007, Biraben and Le Goff 1969, and Stathakopoulos 2002 and 2004.

With later outbreaks, it is much harder, if not impossible, to know whether the disease has been reintroduced or has simply ‘flared up’ after a period of dormancy.¹⁷³

In Chapter IV I discussed the transmission path maps from some of the prominent scholars in this subject; I will occasionally refer back to them in this chapter, especially when my conclusions differ significantly from theirs. Generally, works discussing outbreak detail have a particular focus in one region or another, and may completely ignore outbreak information for unrelated areas. In combining all known plague outbreak information, I hoped to eliminate these ‘transmission gaps’ and paint a more complete picture of the spread throughout the entire Mediterranean.

Though all Justinianic plague authors are working with essentially the same ancient sources, the resulting maps vary considerably. Rosen describes a largely land-based transmission route; Keys favors maritime routes.¹⁷⁴ Stathakopoulos includes a detailed transmission scenario in his *Travelling with the Plague*, but includes no map to accompany it (similarly there is no map accompanying his excellent *Famine and Pestilence*).¹⁷⁵

¹⁷³ For detail on how this dormancy period might have worked see Chapter III.

¹⁷⁴ Rosen 2007, Keys 1999.

¹⁷⁵ Stathakopoulos 2002 and 2004.

Due to the speed of transmission, my own approach was essentially water-based, including navigable rivers, and was primarily focused on shipborne transmission of the plague. I included as many individual cities as possible, but when only regions were mentioned (such as Negev or Bithynia), I constructed a plausible transmission path based on known roads or likely water routes. I have also included extension into areas where a plague site has been documented archaeologically, but historical references are missing.

All of the scholars begin their timelines of the plague with Pelusium, the location of the earliest literary mention of the sixth-century plague and a likely entry point to the Mediterranean from either Africa or the Red Sea. Although identifying or confirming the exact point of entry for the plague is beyond the scope of this work, C. Tsiamis and his colleagues make a compelling case for entry via Clysma.¹⁷⁶ My own work begins with the Pelusium outbreak as ground zero for the Justinianic Plague in the Mediterranean.

All sources (primary and secondary) for the details of plague occurrences are found in Appendix C.

¹⁷⁶ Tsiamis et al. 2009, 211.

Levantine Coast

From Pelusium, the course eastward through the Levant is fairly clear with a number of cities specifically named and relatively limited date ranges provided, as compared to other affected regions. The map in Figure 15 lists Levant plague sites, shipwrecks and possible path of transmission.

The plague is first documented in mid-July 541 C.E. in Pelusium by Procopius, appearing in both Gaza and Ashkelon one month later.¹⁷⁷ The clearest route of transmission is initially by water, a distance of 130 miles, with a typical Pelusium-Gaza passage probably taking a day or two.¹⁷⁸ Assuming Keeling and Gilligan's "incubation lag" of one month can be applied, plague must have passed nearly immediately from Pelusium to Gaza and Ashkelon – probably in cargo that was coming from the Red Sea. Ships sailing from Pelusium carried salted food, oil and textiles to Gaza and Syria—the salted food and textiles, in particular, could have harbored plague-carrying rats and fleas.¹⁷⁹ Some vessels then returned to Alexandria, bringing wine from Gaza and Ashkelon; others would have taken the infected Red Sea cargo, plus likely some of the prized Gazan white wine and other merchandise and continued northward along the coast.¹⁸⁰

With Ashkelon and Gaza just 21 kilometers apart, the same ship could easily have delivered rats or infected cargo to both ports as it plied its trade from city to city up the coast, or goods delivered at either location could easily have been transported overland to the other.¹⁸¹ From Gaza, progress of the plague is inland towards Elousa. While Elousa itself is

¹⁷⁷ Procopius, *History of the Wars*, II 22, 6 (I 250).

¹⁷⁸ Stathakopoulos 2002, 103; Tsiamis et al. 2009, 211. Casson 1951, 139. Casson suggests ancient ships' speed, when traveling with the wind, was likely between 4.5 and 6 knots.

¹⁷⁹ Stathakopoulos 2002, 103; Tsiamis et al. 2009, 211.

¹⁸⁰ Kingsley and Decker 2001, 4.

¹⁸¹ McCormick in Laiou 2002, 14.

not mentioned as a city specifically affected, both Eboda and Rehovot are. I believe it is likely that Elousa, also, was affected due to its location on the route between cities, but simply is never specifically mentioned. Neither is Petra mentioned by name, although its vicinity to Eboda suggests that there would have been sufficient traffic through that city to carry the infection that far, particularly given its placement on the major trading road connecting Petra and Amman: The King's Highway.

Based solely on the few available funerary inscriptions related to death by disease during this time period in this area, it initially appears that the Nessana infection occurred prior to that of Rehovot, but as indicated in my map the timeline seems more logical in reverse.¹⁸² I suggest that Nessana was probably affected in November, and that inscription dates do not necessarily reflect the earliest possible occurrence of the epidemic in either area.

From Ashkelon, traffic carrying goods inland delivered the plague to Jerusalem and the surrounding area, which suffered an outbreak in January of 542 C.E.¹⁸³ While there is mention of plague in both Palestine and the hinterlands of Jerusalem during this first wave, we only have a single named city: that of Zora, which is likely affected in the spring of 542.¹⁸⁴ Bostra in Syria is mentioned several times in later waves, and it is plausible that cargo traveled from Jerusalem to Amman, then Bostra and Damascus along the King's Highway, passing very close to Zora and possibly stopping there. Damascus is specifically named in later waves of plague, but there is no evidence that it received infection during the 541-544 C.E. outbreak.

¹⁸² Stathakopoulos 2002, 104.

¹⁸³ Maas 2005, 136; Stathakopolous 2002, 104; Cyril of Scythopolis, *Vita of Kyriakos* 10 (229).

¹⁸⁴ Cyril of Scythopolis, *Vita of Kyriakos* 10 (229); Procopius, *History of the Wars*, II 22 6 (I 250); Evagrius, *Ecclesiastical History*, IV, 29; Stathakopolous 2004, 115; Koder 1995, 13-18.

Along the Levantine coast, from Pelusium to Antioch, flowed a considerable amount of maritime traffic, and it is probable that Caesarea, Dor, Berytus and possibly other cities were infected even though there is no mention of a coastal outbreak between Ashkelon and Antioch. Especially in the case of Dor, a number of shipwrecks excavated and studied from Tantura Lagoon attest to active trade in and out of that harbor.¹⁸⁵ The general outbreaks in Syria and Palestine could easily have been caused by small-scale trade moving up and down the coast, rather than a single, large infected cargo. In the mid-sixth century Syria was likely exporting olive oil through the large port of Antioch, possibly receiving wine and other goods in exchange.¹⁸⁶

Wherever it stops along the way, plague reaches Antioch from the coast in early Summer in 542.¹⁸⁷ It migrates south rather quickly from Antioch to the cities of Apamea, Epiphaneia and Emesa, which also report affliction in the summer of 542.¹⁸⁸ Syria, in general, is reported as suffering plague at this time, although no cities further inland than Emesa are specifically named.

A specific mention by Procopius states that plague killed half the survivors of a major earthquake affecting Antioch, Seleucia, and Anazarbus (along with other cities in Asia Minor).¹⁸⁹ The date of the earthquake is not mentioned, but the sizable one described as occurring in 526 C.E. is a strong candidate.¹⁹⁰ Since Antioch is mentioned elsewhere as receiving plague in 542, I have assumed that Seleucia and the other cities mentioned in this passage were affected nearly simultaneously – Seleucia in particular due to its placement as

¹⁸⁵ Wachsmann 2011.

¹⁸⁶ Tchalenko 1953-8, vol. 435-7; Ward-Perkins in Cameron 2000, 374-5.

¹⁸⁷ Evagrius, *Historia Ecclesiastica*, IV, 29; *Vita* of Simeon Stylites the younger 69 (I 59-60).

¹⁸⁸ John of Ephesos, *Historiae Ecclesiasticae*, II, 304-7; Evagrius, *Historia Ecclesiastica*, IV, 29; Zacharias Rhetor, *Historia Ecclesiastica*, II, 129-30.

¹⁸⁹ Procopius, *Secret History*, XVIII, 44.

¹⁹⁰ Stothers 1999, 714-6.

the coastal gateway to Antioch. Most likely, coastal trade delivered the plague to Anazarbus, then moved on to Myra and Andriake, essentially the westernmost point of a trade circle that returned sailors back to Pelusium or Alexandria.

While the trail of plague throughout the Levant is among the best-documented of any region in the Mediterranean, there are some clear gaps in the record. It is implausible that only Antioch, Ashkelon and Gaza were infected – but where is the evidence of arrival at other cities, especially those known to have prominent ports? Why are so many prominent cities—Petra, Amman, Damascus, Aleppo—mentioned so late in the epidemic, when they are referred to at all?¹⁹¹ I suggest simply a lack of literary documentation is to blame, and believe that these cities were not, as it appears, spared from the disease. Table 3 lists area shipwrecks, indicating that trade was occurring in areas of the region where no plague has been documented. Presumably, at some point in the future an inscription or mass burial will indicate the presence of plague in locations as-yet unknown.

Wine from Gaza-Ashkelon travelled all the way up the coast to Syria and Cilicia.¹⁹² The emperor in Constantinople, Frankish Gaul's royalty, and the populace in both Gaul and North Africa drank these same regional wines.¹⁹³ The *Expositio totius mundi*, a merchant's guidebook to merchandise produced by region, describes wine and oil as major products of Phoenicia, Gaza and Ashkelon.¹⁹⁴

¹⁹¹ Damascus is mentioned specifically in 638 C.E., but was likely to have been affected long before that. Elias of Nisibis, 18, AH (64); Michael the Syrian, II, 419 & 431; Conrad 1984, 187-190.

¹⁹² Kulikowski 2007.

¹⁹³ Lavan 2007, 67.

¹⁹⁴ Lavan 2007, 67; *Expositio totius mundi*, 164, 166.

SITE NAME/ LOCATION	AMPHORAS/CARGO/ROUTE INFO	DATE
Arwad B (2)	Rilled, pear-shaped Byzantine amphoras	500-600 C.E.
Avdimou Bay	Imported LR4 from Ashkelon and Gaza (traces of pitch indicate use with wine) 3 conical millstones	400-600 C.E.
Cape Andreas A (1)	Corinthian-style roof tiles and cover tiles ¹⁹⁵	400-650 C.E.
Cape Andreas B (2)	Riley LR13 amphoras Glass vessels	600-700 C.E.
Cape Andreas C (3)	Riley LR1 & 1A amphoras, lined with resin (most likely carrying wine)	450-650 C.E.
Cape Andreas E (5)	Baluster-shaped amphoras Terracotta sarcophagi	450-650 C.E.
Cape Andreas 6	Corinthian-style roof tiles and cover tiles ¹⁹⁶	1-500 C.E.
Cape Kiti 1	Byzantine amphoras	600-700 C.E.
Cape Zevgari	Exporting 150+ Amphoras (LR1), locally produced for oil, some writings indicating measurements for dry goods	400-600 C.E.
Dor	Amphoras	600-700 C.E.
Dor 1(A)	Exporting: Locally-produced, bag-shaped amphoras, in small quantities and lined with pitch (likely for wine) ¹⁹⁷	600-640 C.E.
Dor 2001/1	Yassı Ada-type amphoras (7th century) “Gaza ware” Cargo of around 80 <i>kurkar</i> (sandstone) blocks (provenance undeterminable, but not from Turkey, Cyprus or Syria. Possibly local). ¹⁹⁸ Byzantine cooking pots	420-540 C.E.

**Table 3 - Shipwrecks in the Levant Region
(for full details on listed shipwrecks, see Appendix B)**

¹⁹⁵ Green 1973, 153.

¹⁹⁶ Green 1973, 157-8.

¹⁹⁷ Kingsley and Raveh 1996, 62.

¹⁹⁸ Mor and Kahanov 2006, 282.

SITE NAME/ LOCATION	AMPHORAS/CARGO/ROUTE INFO	DATE
Dor 4 (D)	Diverse, empty bag-shaped amphoras lined with pitch with grapeseeds embedded (LR4/LR5 from Palestine between Gaza and Ashkelon, typically used to carry wine) ¹⁹⁹ Such bag-shaped amphoras are also described as suitable containers for oil, dried figs and fish sauce. ²⁰⁰ Cyriot ballast stones Some of the amphoras on-board were re-used. ²⁰¹ Carried roof tiles from Cyprus, LR1, LR2, ARS, Keay 42D amphoras	539-621 C.E.
Dor 5(E)	Palestinian LR4 amphoras Persian jar fragments (crew items?) Chalk ballast Gazan amphoras ²⁰²	500-700 C.E.
Dor 6 (F)	Ashlar marble, amphoras. Possibly Proconnesian	600-640 C.E.
Dor 7 (G)	Ashlar blocks, amphoras. Possibly Proconnesian	600-640 C.E.
Dor J	Exporting locally-produced Byzantine bag-shaped LR5 amphoras ²⁰³ Cyprus ceiling planking and birch frames; wood is not local, ship was probably from elsewhere	500-600 C.E.
Dor O (Trench IX)	Masonry, pottery	553-645 C.E.
Dor (Trench IV)	LR5 amphoras	500-700 C.E.
Fondana Amorosa	Amphoras, sounding lead	1-500 C.E.
Israel Wreck	Sixth century pottery	500-600 C.E.
Jezirat Fara'un	Late Roman-Byzantine amphoras. ²⁰⁴ Basalt grinding mills. ²⁰⁵	500-1500 C.E.
Newe Yam 2	Amphoras	300-1500 C.E.

Table 3 Continued
(for full details on listed shipwrecks, see Appendix B)

¹⁹⁹ Kingsley 2003, 88.

²⁰⁰ Kingsley and Raveh 1996, 43.

²⁰¹ Lavan et al. 2007, 70.

²⁰² Kingsley and Raveh 1996, 66-7.

²⁰³ Kingsley and Raveh 1996, 55.

²⁰⁴ Flinder 1977, 131.

²⁰⁵ Flinder 1977, 131.

SITE NAME/ LOCATION	AMPHORAS/CARGO/ROUTE INFO	DATE
Sdot Yam	LR4; Gazan Keay 25 amphoras	400-600 C.E.
Tantura A	LR5 Byzantine bag-shaped amphoras sherds	595 C.E. (415-530 per Wachsmann 2011, 86)
Tantura Arab	Amphoras	700-900 C.E.
Tantura E		550-600 C.E.
Tantura F	30 ceramic items total, 8 of which resemble Yassı Ada-7th century-style one-handled LR1 amphoras Two juglets similar to items found in Egypt 20 storage jars with resinous linings, containing small fish bones (possibly garum). The 20 were likely manufactured in the lower Nile area. Food remnants found on-board: carobs and Nabali olives from Israel. ²⁰⁶	700-759 C.E.
Tantura 9		550 C.E.
Thalassinies Spilies	Byzantine globular amphoras.	500-600 C.E.
Tyre 3		1-500 C.E.
Tyre 7	Glazed pottery, millstones.	500-1500 C.E.

Table 3 Continued

(for full details on listed shipwrecks, see Appendix B)

²⁰⁶ Barkai and Kahanov 2007, 26-7.

Asia Minor to Constantinople

From the Levant the plague moved both eastward and northward overland, and westward via water. Spread of the plague across Asia Minor to Constantinople is diagrammed in the map in Figure 16. Antioch was infected in the early summer of 542; because the capital city Constantinople was beset in the spring – sometime between late March and early April – it arrived at the capital city from elsewhere.²⁰⁷ From exactly which city the Constantinople plague arrived is still open to debate. Myra and its sister port Andriake were affected either “slightly before or slightly after” Constantinople, making it possible that Myra was a stopover point for whatever vessels from the Levant carried the infection to Constantinople.²⁰⁸

The grain shipments from Alexandria in 542 might have been responsible for delivery of the plague to Constantinople, although some scholars feel the early-spring arrival time is incompatible with a grain shipment—the plague is documented as arriving in March (the first actual infections were likely a few weeks earlier), implying that ships would have been sailing through the legal period of “closed seas,” the *Mare Clausum*.²⁰⁹ While private merchants seem to have violated this restriction with some frequency, it seems unlikely that a vessel on an imperial mission would display the same boldness.

One alternate possibility is that a grain convoy (with infection aboard) sailed *before* Alexandria’s recorded infection of mid-September 541, then deposited its grain cargo in Tenedos, an island south of the Bosphoros where Justinian constructed a large granary. From

²⁰⁷ For Antioch see Evagrius, *Ecclesiastical History*, IV, 29 and *Vita* of Simeon Stylites the younger 69 (I 59-60); For Constantinople see *De ostentis*, LX; Procopius, *Secret History*, II 22, 9; II 23, 1-2. 18-19 (I 251, 256, 259); John of Ephesus, *Historiae Ecclesiasticae*, II, 314; Theophanes, *Chronicon*, AM 6034 (222).

²⁰⁸ Stathakopoulos 2004, 286.

²⁰⁹ Casson 1971, 270-2.

there, eventually the grain would have been shipped by small vessel to Constantinople. This would assume a fall delivery of grain to the island, overwinter storage there, then periodic smaller shipments from Tenedos to Constantinople the next year. This is possible, since the granaries were in operation by the “early sixth century” although this particular scenario is speculative.²¹⁰

Another scenario involves trade in items other than grain; a number of traders arrived frequently in the capital with wine or other goods from cities along the Levant. One example, the shipwreck at İskandil Burnu, carried a fairly homogenous cargo of over 300 LR4 and LR5 wine amphoras.²¹¹ At least two others are known: both carrying LR4 or LR5 amphoras, and possibly headed for Constantinople.²¹² Any one of them could have brought the contagion, either in a single voyage or in multiple ships along a multiple-port route—stops in Cyprus and Rhodes en route to the capital were common. In this, as in the grain-trade scenario, Myra could well have been a stopover point, leading to the infection there prior to its arrival in Constantinople.

Finally, in the case of Asia Minor, transmission overland is better documented than transmission via the water routes (Fig. 16). To and from Constantinople there is historical documentation of transmission through the regions of Cilicia, Cappadocia, Mysia, Galatia, and Bithynia. Unfortunately, few specific cities are listed, but I have included those which are mentioned along with likely candidates. Departing from Antioch or another port city, plague could have reached Constantinople over land via any of the routes listed in Figure 16.

Besides the literary references to certain regions, there are other clues which might indicate the travel path of the plague (as an example, see the listing of shipwrecks in Table

²¹⁰ Adkins and Adkins 1994, 214.

²¹¹ Kingsley and Decker 2001, 53.

²¹² The two other wrecks are the one at Kekova Ölüdeniz and at Kizilağac Adası.

4). Among these is the limited number of passes available through the Taurus mountains; between Tarsus and Tyana lay the Cilician Gates mountain pass, the major passage between the southeastern Turkish coast and the interior. Additionally, Constantinople received trade via Antioch from the Silk Road as well as olive oil from Syria.²¹³

Recreating plague transmission paths for Asia Minor beyond the first, major wave is problematic—Constantinople alone endures more than a dozen waves, many of which were likely reignited locally. Once a plague becomes endemic to a region, transmission pathways become far more speculative; it becomes impossible whether a particular outbreak was triggered by a reinfection or a “flare-up” of plague already present.

²¹³ Kingsley 2001, 74.

SITE NAME/LOCATION	AMPHORAS/CARGO/ROUTE INFO	DATE
Ayios Stephanos	Byzantine Riley LR1 and Zemer amphoras	550-650 C.E.
Bozburun LA anchor wreck (Turkey)	Type 1 similar to Yassı Ada Type 4, two other types (one 60 cm beehive-shaped w/ridges; the other 40 cm long, pyriform with short strap handles). Carried anchors similar to those found on Yassı Ada 7th century and the Dramont F wrecks	500-600 C.E.
Datça 1	Byzantine amphoras	400-650 C.E.
Datça 2	Globular baluster-shaped amphoras Well-preserved hull remains	650-725 C.E.
Delphinion (K?)	Byzantine amphoras similar to Riley D 377 Some Riley LR1 (Keay 53)	400-600 C.E.
Glaronissi	Roman amphoras	1-500 C.E.
İskandil Burnu 1	2000+ globular amphoras, Riley LR3, egg-shaped havit, cigar-shaped from Gaza, hourglass shaped from Cyprus/Asia, carrot-shaped Egyptian	575-600 C.E.
Kekova Ölüdeniz (Turkey)	LR5	Byzantine
Kerme Gulf	Ceramic tiles, amphoras, coarseware pottery	300-1200 C.E.
Kizilağac Adası (Turkey)	LR5	Byzantine
Komi 2	Ceramic roof tiles, terracotta pipes, Roman amphoras	1-500 C.E.
Neseber B (2)	Globular amphoras typical of Sixth/Seventh centuries	500-625 C.E.
Pefkos	Byzantine globular amphoras	400-700 C.E.
Pomorje 1	Amphoras	400-600 C.E.
Pomore 2	Ceramic Tiles	400-600 C.E.
Prasso	Riley LR2 Amphoras	400-700 C.E.
Sinop A	Carrot-shaped, Byzantine amphoras, characteristic of Sinop	300-599 C.E.
Sinop B	LR1 and Carrot-shaped, Byzantine amphoras characteristic of Sinop	300-599 C.E.
Sinop C	Carrot-shaped, Byzantine amphoras, characteristic of Sinop	300-599 C.E.
Sinop D	Ancient Jug	410-520 C.E.
Syria	Arab amphoras, ceramic jars	800-900 C.E.
Yassı Ada A (1) (Turkey)	850-900 Riley Type LR1 and Type LR2 amphoras (Aegean and Syrian), 60 metric ton capacity	626 C.E.
Yenikapı 6 (Turkey)	Heavily-pitched shell-built galley	600-700 C.E.

**Table 4 - Shipwrecks in the Asia Minor Region
(for references and additional details see Appendix B)**

Greece and Hinterlands

In sharp contrast to the security of the Greek peninsula during the Roman period, the early Byzantine period left Greece under pressure from the tribes of the Balkans. Procopius notes that, during Justinian's reign, "Huns, Sclaveni and Antae" conducted regular, annual raids.²¹⁴ In Illyricum, Marcellinus documents an attack by Goths, followed most likely by Slavs.²¹⁵

There are few mentions of Greek cities afflicted with plague, a conspicuous absence, considering the region's central location in the circle of trade formed by Constantinople, Italy and the Levant. The map in Figure 17 details possible plague transmission for the earliest wave of plague; a later wave, where Greece is named specifically and extensively, covers the outbreak between 711 and 746 C.E. and can be found in Figure 18.

Much of the archaeological export record for Greece appears in the form of wine and oil amphoras (the locally-produced LR2 type) and household ceramics. From the literary accounts we know that the region produced wheat in surplus, as well, some of which may have been shipped to the Tenedos granary to be stored alongside the shipments from Alexandria.²¹⁶ In addition to wine and oil represented by the presence of LR2 amphoras throughout the Mediterranean, Aegean cooking wares appear in the archaeological records of Alicante and Carthage.²¹⁷ Red Slip Wares were produced in the Aegean up to the seventh century, when they seem to be supplanted by glazed ceramic fineware from Constantinople

²¹⁴ Karagiorgou 2002, 23.

²¹⁵ Karagiorgou 2002, 23.

²¹⁶ Karagiorgou 2002, 167-9.

²¹⁷ Reynolds 1995, 133.

and locally-made coarsewares.²¹⁸ LR2 amphoras are found in significant numbers at military sites in the Balkans, possibly indicating Greece's participation in the military supply lines.²¹⁹

Other likely food exports included figs, almonds, walnuts and medicinal herbs, and the region of Thessaly had been famous since antiquity for horse breeding.²²⁰ Honey, salt, mosaics, marble and glass are also documented, although the quantities that may have been exported between 540 and 750 are unknown.²²¹ A green marble known as *verde antico* enjoyed particular acclaim for its vivid color.²²² This stone, from quarries in Thessaly, makes appearances in the Hagia Sophia (532-537) and the distant St. Sergios at Gaza (circa 536) among other buildings.²²³ Prefabricated architectural pieces of *verde antico* were aboard the Marzamemi church wreck, sunk off the eastern coast of Sicily around 500 while probably *en route* to Libya and likely originating from the Thessalian port of Demetrias.²²⁴ For relative comparison *verde antico* was valued at 150 denarii per square foot, among the five most expensive marbles listed in Diocletian's Price Edict. Proconnesian marble, perhaps better known today (and present on the Marzamemi and some of the Levant Coast wrecks), fetched only 40 denarii.²²⁵

Thessalonika enjoyed an advantageous position for ocean-based trade passing through the Aegean and by way of the *via Egnatia* land route, and housed a customs station during the Byzantine Empire (Fig. 13). While local Macedonian tableware has been found in Thessalonika (indicating local trade), imported finewares from Phocaea (Late Roman C Red Slip), Cyprus (Late Roman D) and Africa (African Red Slip) appear in significant

²¹⁸ Bowden et al. 2003, 285.

²¹⁹ Lavan et al. 2007, 68.

²²⁰ Karagiorgou 2002, 174-5.

²²¹ Karagiorgou 2002, 179.

²²² Karagiorgou 2002, 184.

²²³ Karagiorgou 2002, 188.

²²⁴ Karagiorgou 2002, 189, 194.

²²⁵ Karagiorgou 2002, 193-4.

numbers.²²⁶ African Red Slip from Tunisia is present in Corinth around 585.²²⁷ Palestinian, Gazan, and Akko amphoras all count among the region's finds.²²⁸

Considering the amount of trade that must have passed through Greek cities, the incidence of literary plague mentions is remarkably low – so low that the lack of appearance must almost certainly be due to lack of documentation. The earliest mention of plague in Greece is vague: Procopius mentions only that plague killed half of the survivors of an earthquake that leveled Corinth, Lychnidos, Antioch and other great cities in 526.²²⁹

Kulikowski believes trade relationships with Eastern Greek cities may have been responsible for Spain's 542 infection—in which case Greece, too, would have suffered that year—but Corinth is the only city in Greece named near that date.²³⁰ Nearby Illyricum suffers an outbreak in the spring of 542, further bolstering this idea.²³¹ With the few mentions available, it is impossible to know which of Corinth, Lychnidos and Illyricum were infected first, especially since no cities in Illyricum are named.²³² Similarly, the shipwreck evidence is sparse for this region, but those which have been found and documented are listed in Table 5.

The next documented plague incident in Greece occurs in the summer of 597.²³³ It starts centered around Thessalonika and the surrounding area, then appears in Drizipera in the Avar territory of Thrace (where the advancing Avar army is subsequently annihilated by the disease).²³⁴ Slav armies overran Athens and Corinth around 582, which could perhaps account for the lack of plague documentation between 542 and 597—merchant activity was

²²⁶ Karavieri 2010, 17.

²²⁷ Slane 2005, 266-70.

²²⁸ Slane 2005, 270-1 & 86.

²²⁹ Procopius, *Secret History*, XVIII, 44.

²³⁰ Kulikowski 2007, 151

²³¹ Biraben and Le Goff 1969, 1494

²³² Stathakopoulos 2004, 115.

²³³ Stathakopoulos 2004, 324-5.

²³⁴ Allen 1979, 14; Conrad 1984, 157.

probably disrupted during the invasion—and possibly explains the eventual introduction to the Avar territory in 598.²³⁵ After the 597 episode, Greece seems to enjoy a respite from the epidemic, although this, too, is more likely due to lack of documentation rather than lack of affliction.

The next regional appearance of plague isn't until 729, where it is mentioned as appearing in both Greece and Syria, although no cities are named.²³⁶ The timing of infection is curious: the *Chronicle of Monemvasia* states that the empire lost control of the Peloponnese in 587, only to regain it in the early eighth century – just about the same time that the plague reemerges in the historical record.²³⁷ Evidence suggests that travel was a risky affair in the Balkans during the sixth century: in 591 a letter to the Bishop of Corinth implores him to provide security for a papal messenger's travel to Constantinople.²³⁸ Walled, fortified cities were necessary for the protection of citizens, but became prisons upon invasion, where they could be besieged and cut off from harvests and trade. In one example, the city of Aseumus was able to successfully defend itself from an imperial army in 594, led by its bishop, and protected by strong walls and a decade of experience defending itself against Slavic invaders.²³⁹

Bishop John of Thessalonica, writing the *Miracles of St. Demetrius* in the early seventh century, wrote at a time when the populace desperately needed reassurance of the church in addition to strong city walls to stave off fear of invaders.²⁴⁰ In 688, Justinian II's

²³⁵ Whitby 2000, 728.

²³⁶ Frari 1840, 278.

²³⁷ Whitby 2000, 727.

²³⁸ Whitby 2000, 729.

²³⁹ Whitby 2000, 729.

²⁴⁰ Whitby 2000, 729.

troops were ambushed and suffered heavy losses on the return trip from Thessalonica to Constantinople.²⁴¹

No further mention of Greek plague is made until 746, when a major outbreak in Italy appears to migrate from Rome and Sicily over to Calabria and then to the Greek mainland, archipelago and Peloponnese—eventually arriving anew in Constantinople. Of all the Greek cities which were possibly infected in 746, however, only Monemvasia is specifically named.²⁴²

SITE NAME/ LOCATION	AMPHORAS/CARGO/ROUTE INFO	DATE
Antikythera 2	Large, barrel-like amphoras. Lead stock and anchor collar.	-100-500 C.E.
Cape Sidero 1	Amphoras	1-500 C.E.
Cape Sidero 2	Amphoras	500-1500 C.E.
Kallithea	Byzantine amphoras	500-1500 C.E.
Lixouri	Marble statues, 2 ionic capitals, 4 half-column bases	1-500 C.E.
Methone 2	Ceramic Medieval jars; ballast	500-1500 C.E.
Plitharia	Amphoras	300-800 C.E.
Porto Cheli	Ballast and globular amphoras	500-600 C.E.
Porto Longo	Byzantine amphoras/potsherds	400-650 C.E.
Saliagos	Roman coarseware; ballast	1-500 C.E.
Sapientza	Marble blocks, slabs	1-500 C.E.
Thasos A (1)	LR/Byzantine Amphoras	400-600 C.E.
Zakynthos B (2)	Amphoras	400-700 C.E.

**Table 5 - Shipwrecks in the Region of Greece
(for references and additional details see Appendix B)**

²⁴¹ Whitby 2000, 730.

²⁴² Biraben and Le Goff 1969, 1497; Stathokopolous 2004, 382-4; Simpson 1905, 18 (Simpson states 746-8); Frari 1840, 279 (Frari states 745-7).

Alexandria to North Africa

Because the literary examples for transmission along the Northern African coast are few, here we can only make an educated guess at the full scenario. Even in the case of shipwrecks we have far less information with which to work. Only three cities are mentioned by name: Alexandria, Carthage, and Sufetula. Most times, writers make vague references to “North Africa” or “Libya” only. Figure 19 is a detailed map of known locations and possible transmission path.

Transmission from Pelusium to Alexandria could have happened either overland or by ship (although the *Itinerarium Antonini* describes an overland route only); both scenarios are possible and the eight-week gap between documented outbreaks is not particularly helpful in narrowing down the likely path.²⁴³ The overland route was approximately 320 kilometers; about three solid weeks of travel by pack animal, not counting time to load, unload and sell one’s wares; the same journey by ship would have taken a fraction of the time.²⁴⁴ However it arrived, the first outbreak was recorded as occurring in mid-September 541.²⁴⁵

From Alexandria ships headed in all directions. To the west lay the major port city of Carthage, a consumer of Egyptian wine and other goods. Plague is first attested there in 542 – there is no month provided, but the one-way trip between the two cities is three to four weeks long.²⁴⁶ A September departure from Alexandria westward was probably too close to the end of the sailing season to be attempted; the resumption of trade along that route would

²⁴³ Scheidel and Meeks 2012, path mapped between Alexandria and Pelusium.

²⁴⁴ Stathakopoulos 2002, 103; The *Itinerarium Antonini* describes a pilgrim’s voyage which includes a Pelusium-Alexandria passage. Presumably he took the safest, fastest, cheapest or most common type of transport; it is telling that this portion of the voyage was overland.

²⁴⁵ Stathakopoulos 2004, 113-4; Procopius, *Secret History*, II 22 6 (I 250); Evagrius, *Ecclesiastical History*, IV, 29; Michael the Syrian, *Chronique*, (II) 235-8

²⁴⁶ Udovitch, in Antonelli 1978b, 513.

have been Spring of 542 – possibly as early as March. Allowing for a month of travel plus Keeling and Gilligan’s lag, we could expect plague to have erupted in Carthage around June 542.

Oddly, areas around Carthage are not recorded as suffering infection until considerably later in the year: Spain probably by October of 542, Sicily in December of the same year.²⁴⁷ Kulikowski notes the frequency of trade between Greece and Spain during this period and attributes Spain’s infection to Greece, arguing that it likely arrived earlier than October 542—unfortunately, the literary evidence cannot confirm or refute this theory.²⁴⁸

Cyrene and Berenice, major trading centers on the northern coast of Libya, could have been stopover cities for an Alexandrian trade vessel headed west. This could have put transmission to western Libya at around April-May of 542 – but the earliest literary mention of plague in Libya isn’t until 543. In fact, there are no literary plague references to any specifically-named cities anywhere along the coast between Alexandria and Carthage. Doubtless this is due to a simple lack of documentation, and not a lack of occurrence, since, for example, we have literary evidence of plague in “Libya” and “Africa” but lack individual city names.

That same ship (or another) departing Berenice or Cyrene for Leptis Magna could have delivered the disease during that summer – when it could have reached Sicily by December 542 in an oil shipment and inland by the end of 542 in overland trade. One of the shipwrecks in Table 6 might have been just such a vessel. From Leptis Magna trade in oil also included cities in Spain and France, which could explain Spain’s infection in 542. In that

²⁴⁷ Rosen 2007, 220; Biraben and Le Goff 1969, 1494; Kulikowski in Little, 151; Corippe, *Iohannis seu de bellis Libycis*, 60-62; *Chronicles of Saragoza*, XI/2, 201.

²⁴⁸ Kulikowski in Little 2007, 151

case, no month or city is given, although recent excavations of a mass burial in Valencia may yet provide DNA evidence of the plague's presence there.²⁴⁹

From Carthage, Rome could have received the plague via grain deliveries to Ostia. It would have taken some time for the disease to make its way up the Tiber from the granaries at Ostia, perhaps explaining the relatively late infection date of November 543.

Unfortunately, plague is not specifically attested in Ostia before 570, but ongoing excavations in the area may yet reveal some evidence of its presence. North Africa's exports were popular: grain and olive oil were among the major commodities.²⁵⁰ The warehouses, ships and cargoes of grain served as ideal instruments for the cultivation and dissemination of plague-infested black rats.

SITE NAME/LOCATION	AMPHORAS/CARGO/ROUTE INFO	DATE
Alexandria 1	DR6 amphoras	1-500 C.E.
Cap Magroua	Amphoras	1-500 C.E.
Cherchel 2	Ceramic pottery, well-preserved hull remains	1-500 C.E.
Marsa Lucch	Riley LR8a amphoras	500-650 C.E.
Sidi Ahmad	Marble columns	1-500 C.E.

**Table 6 - Shipwrecks in the Region of North Africa
(for references and additional details see Appendix B)**

²⁴⁹ Kulikowski in Little 2007, 152-3.

²⁵⁰ Morony 2004, 176.

Italian Peninsula

The earliest record of plague on the Italian peninsula is on a funerary inscription at Mazara, a city on the western side of the province of Sicily. The date is December 542, but we are not told from where it arrives.²⁵¹ A number of shipping routes passed through or near to Sicily, but in this case Carthage seems the likely choice, both for vicinity and the fact that it had its own recorded outbreak around the same timeframe (see map in Figure 20).²⁵² The December date seems late for a major grain transport, but short, regional trade between Carthage and Sicily could easily have continued past the “official” closed seas. The disease could also have made its way overland from a more prominent port city, possibly Syracuse or Messina.

The next mention of plague in Italy is in 543, possibly arriving from a contemporaneous outbreak in Illyricum (the region across the Adriatic to the east of Italy).²⁵³ The region of Insubria (probably including Milan, Como and Cremona), Liguria (Genova) and Piemonte are also named as suffering in 543-4, the same time as southern France.²⁵⁴ Either due to simple proximity or, perhaps, a regular trade between Genova and Marseilles, the fates of both southern France and Liguria are often linked via plague outbreaks.

The Italian outbreaks of 543-4 are described in separate sources, which may indicate that the peninsula of Italy was beset from both directions independently. Considering its central position for trade in the Mediterranean, this is not a far-fetched scenario. Shipwreck evidence for the area (shown in Table 7) covers a wide area.

²⁵¹ Stathakopoulos 2004, 115 & 290-1; Inscription in Manganaro 2001, 133.

²⁵² Conrad 1984, 114-5; Corippus, *Johannidos seu de bellis Lbycis libri VIII*, II. 10-13, III.63, VIII.307-9.

²⁵³ Rosen 2007, 260; Biraben and Le Goff 1969, 1494; Jones 2009, 54; Gregory of Tours, *Liber in Gloria martyrum*: I/3, et *Liber vitae Patrum*, VI, 6.

²⁵⁴ Frari 1840, 271-2; *Leonard Aretin*, lib. II.

Rome is recorded as afflicted in November 543, meaning that the plague likely arrived in October – perhaps in grain ships delivering their final load before the end of the season.²⁵⁵ While the sources suggest it arrived from North Africa, given the spread of the plague throughout northern Italy and in the south I find arrival from the mainland to be just as plausible, although currently not possible to prove.²⁵⁶ The presence of confirmed plague in Castro dei Volsci, a small town equidistant from Rome and Naples, provides unequivocal proof that undocumented inland plague transmission occurred – but this particular outbreak cannot yet be tied to a specific literary outbreak.²⁵⁷

Italy enjoyed a respite—at least in the literature—until 559, when Ancona, Ravenna, Grado and Istria are all affected.²⁵⁸ These cities lie on a circular route of trade between Italy (centered on the capital city of Ravenna) and Constantinople: the same ship plying the route could easily have visited all four areas with contaminated goods. Grain trade from Istria and Liguria to Ravenna would also have provided ample opportunity for infected rats to travel throughout the region.²⁵⁹

In 571 Liguria is named, with the plague heading north to the Alemanni and Bavarians.²⁶⁰ Zara is named in 588, along with Italy, as affected regions. No Italian cities are named, but the Ancona-Ravenna-Grado-Istria route recurs multiple times in the record and may have happened again during the Zara outbreak.²⁶¹

After 588 tracing of the plague in Italy becomes much more difficult; the existence of a number of larger cities on the peninsula capable of housing plague reservoirs of their

²⁵⁵ Reynolds 1995, 131.

²⁵⁶ Stathakopoulos 2004, 116.

²⁵⁷ See Table 1 for details on this confirmed outbreak and Figure 20 for the city's location.

²⁵⁸ Rosen 2007, 220; Biraben and Le Goff 1969, 1495; Paul the Deacon, *Historia Langobardum*, IV, 4.

²⁵⁹ Russell 1968, 175-6.

²⁶⁰ Biraben and Le Goff 1969, 1495; Stathakopoulos 2004, 310, 314; Paul the Deacon, *Historia Langobardum*, II 4 (86-7); Marius of Avenches, *Chronicon*, 238; Gregory of Tours, *History of the Franks* (IV 31 (168)).

²⁶¹ Frari 1840, 274; Thom. Archidiac. Spalaten, 193 (3).

own means that it will be virtually impossible to tell whether local outbreaks came from an internal Italian city or were reintroduced from elsewhere. In some interesting cases, however, specific events are noted in the literature alongside an outbreak. Gregory of Tours notes that after the flooding of the Tiber, Rome suffered a devastating plague between mid-January and April of 590 – perhaps because rats living comfortably in the riverside warehouse district were washed out and forced into area homes instead.²⁶²

The last major traceable outbreak occurs between 745-6 across the entire central and southern areas of Italy (Sicily, Calabria, and Rome included) and the entire peninsula of Greece.²⁶³ Unfortunately, the lack of more-specific timing means that the path of this particular outbreak is also untraceable – but with the smallest of archaeological or additional literary finds this mystery will certainly be solved.

SITE NAME/LOCATION	AMPHORAS/CARGO/ROUTE INFO	DATE
Agropoli	Marble	1-500 C.E.
Alghero	Ceramic and bricks	1-500 C.E.
Arenella	Cargo of Metal (Armor/Weapons); Iron Anchor	500-1500 C.E.
Argentario	Dolia	1-500 C.E.
Averno 1	Amphoras	1-500 C.E.
Averno 2	Amphoras	1-500 C.E.
Averno 3	Amphoras	1-500 C.E.
Averno 4	Amphoras	1-500 C.E.
Cabras	Lead ingots	1-500 C.E.

**Table 7 - Shipwrecks in the Italian Peninsular Region
(for references and additional details see Appendix B)**

²⁶² Biraben and Le Goff 1969, 1496; Stathokopolous 2004, 320-1; Gregory of Tours, *History of the Franks*, (X 1 (476-8)); *Liber Pontificalis* LXV (I 309); Gregory the Great, *Dialogues*, III 19, 2-3; IV 18, 2; IV 27, 6; IV 37, 7; IV 40, 3; Paul the Deacon, *Historia Langobardorum* III 23-4 (127-8); Jacobus de Voragine, *Legenda Aurea*, 46, 4 (190-2).

²⁶³ Biraben and Le Goff 1969, 1497; Stathokopolous 2004, 382-4; Simpson 1905, 18 (Simpson states 746-8); Frari 1840, 279 (Frari states 745-7); Theophanes, *Chronicon*, AM 6238 (422-3); Anastase, *Historia Ecclesiastica*, XX, 75; Constantine VII Porphyrogenitus, *de Thematibus*, II, 6; Nicephore le Patriarche: B; Michaelis Glycae, *Annales*; Cedrenos, *Synopsis*, C 6; Zonaras, *Epitome*, XV, 6; Paul Diacre, *Historia Miscella*, XXII.

SITE NAME/LOCATION	AMPHORAS/CARGO/ROUTE INFO	DATE
Capo Cimiti	Marble cipollino columns	1-500 C.E.
Capo Ferrato	Roof tiles, amphoras	1-500 C.E.
Capo di Muro	Pear-shaped amphoras, lead anchor stocks	1-500 C.E.
Capo Graziano 13	N/A	1-500 C.E.
Capo Passero	Roof Tiles and Byzantine Amphoras	400-650 C.E.
Capo Rizzuto	N/A	1-500 C.E.
Capo San Vito	Amphoras, lead-stocked anchor	1-500 C.E.
Cavlena	Marble columns, stone	1-500 C.E.
Cervia	Copper pot, amphora fragments, sounding lead, roof tile, anchor Hull of a lagoon boat	600-700 C.E.
Favone	LR amphoras	1-500 C.E.
Filicudi Porto A	Keay 62 amphoras, Beltran-Lloris 59 wine amphoras from modern Tunisia	475-550 C.E.
Formiche di Grosseto 1, Le	Amphoras, lead anchor stock	1-500 C.E.
Formiche di Grosseto 2, Le	Amphoras	1-500 C.E.
Formiche di Grosseto 3, Le	Amphoras	1-500 C.E.
Golo	Well-preserved hull with mast-step, deck	1-500 C.E.
Grebeni	Ceramic, Roof tiles	1-500 C.E.
Lastovo 1	Amphoras	400-500 C.E.
Lastovo 6	Roman amphoras	1-500 C.E.
Maddalena	N/A	1-500 C.E.
Margarina	Stone blocks, columns	500 C.E.
Marsala 3	N/A	500-1500 C.E.
Marzamemi B (“Church Wreck”)	Proconnesian architectural carved marble	500-540 C.E.
Marzamemi 3	Red Nubian marble column	500 C.E.
Marzamemi J (10)	Undateable Byzantine Amphora sherds	400-600 C.E.
Marzamemi K (11)	Amphoras	400-600 C.E.
Olbia R0	Bronze ship scrap?	400-500 C.E.
Olbia R1	N/A	400-500 C.E.
Olbia R1 Sud	N/A	400-500 C.E.
Olbia R2	This ship, R6 and R15 possibly from same yard.	400-500 C.E.

**Table 7 Continued - Shipwrecks in the Italian Peninsular Region
(for references and additional details see Appendix B)**

SITE NAME/LOCATION	AMPHORAS/CARGO/ROUTE INFO	DATE
Olbia R2 Sud	N/A	400-500 C.E.
Olbia R3	N/A	400-500 C.E.
Olbia R3 Sud (Sardinia, Italy)	N/A	400-500 C.E.
Olbia R6	This ship, R2 and R15 possibly from same yard.	400-500 C.E.
Olbia R7	N/A	400-500 C.E.
Olbia R12	N/A	400-500 C.E.
Olbia R13 – Naval vessel	N/A	400-500 C.E.
Olbia R14	N/A	400-500 C.E.
Olbia R15	This ship, R2 and R6 possibly from same yard.	400-500 C.E.
Olbia RT	Small tender	400-500 C.E.
Opat	Ceramic roof tiles	1-500 C.E.
Palazzolo di Strella	Central part of a large Roman boat found with ceramics, bricks.	1-500 C.E.
Palese	Amphoras	1-500 C.E.
Palizi Marina	Lead sulphur ingots	1-500 C.E.
Pantano Longarini	Cargo capacity of over 300 tons Hull shape similar to Yassı Ada 7 th century wreck	600-650 C.E.
Pantelleria	Late Roman amphoras and Pantellerian wares	400-500 C.E.
Parco di Teodorico	Well-preserved hull remains	400-500 C.E.
Pelosa 1	Glazed pottery	1-500 C.E.
Pelosa 2	Roman pottery	500-1500 C.E.
Pisa D	Oak, wreck had been salvaged or recycled	400-500 C.E.
Pisa H	Flat-bottomed river boat	1-500 C.E.
Plocice	Ceramic roof tiles	1-500 C.E.
Porto Ercole	Dolia	1-500 C.E.
Posillipo	Wooden hull with bronze nails	1-500 C.E.
Praiano	Afr1 and Afr2 amphoras	1-500 C.E.
Punta del Diavolo	Limestone blocks	500-1500 C.E.
Punta Glavina 2	Pear-shaped amphoras	1-500 C.E.
Punta Secca 1	Well-preserved hull remains. 7 th c. Byzantine coin. No other cargo found.	650-700 C.E.
Punta Secca 2	Well-preserved hull remains. No cargo found.	650-700 C.E.
Rocca di San Nicola 2	5 th c. pottery, Late Roman/Byzantine anchors	300-500 C.E.

**Table 7 Continued - Shipwrecks in the Italian Peninsular Region
(for references and additional details see Appendix B)**

SITE NAME/LOCATION	AMPHORAS/CARGO/ROUTE INFO	DATE
Rocca di San Nicola 3	5 th c. pottery, Roman/Byzantine anchors	400-500 C.E.
Sant'Antioco 2	Transport ship carrying stone blocks	1-500 C.E.
Sciacca	N/A	1-500 C.E.
Scoglitti	N/A	1-500 C.E.
Secche di Ugento 3	Globular amphoras	600-700 C.E.
Silba 3	Roof tiles	1-500 C.E.
Silba 4	Glass	500-1500 C.E.
Siracusa 4	Amphoras	1-500 C.E.
Siracusa 3 (C)	Amphoras	400-600 C.E.
Siracusa 2 (B)	Byzantine amphoras	400-600 C.E.
Sulcis	Planking, keel and nails found. No cargo found.	1-500 C.E.
Susak	Roof tiles	1-500 C.E.
Taranto 1 (A)	Millstones	400-650 C.E.
Triscina 3	Spatheia cylindrical amphoras	400-500 C.E.
Vendicari	Riley LR2 Spatheion and Keay 53 Amphoras	375-625 C.E.
Vieste	Ceramic tiles	500-1500 C.E.
Viz 5 (E)	Amphoras	400-600 C.E.
Viz 6	Ceramic tiles	1-500 C.E.
Viz 7	Amphoras	1-500 C.E.
Zapuntel	Ceramic pottery	1-500 C.E.

**Table 7 Continued - Shipwrecks in the Italian Peninsular Region
(for references and additional details see Appendix B)**

The Frankish Kingdoms

Nowhere else in the Mediterranean is transmission of the Justinianic plague by river more strikingly evident than in the area of modern-day France – a region controlled in large part by three kings of the Merovingian dynasty at the time of the first outbreak. The first Frankish outbreak is in 543 C.E. and is recorded primarily by Bishop Gregory of Tours (Fig. 21).²⁶⁴ During this first event, Arles, “various parts of Gaul,” Trèves (Trier) and “southern France” are mentioned – as are Reims and Clermont for their near misses.²⁶⁵ We have no information regarding the timing of the plague within the year 543, but it certainly attacked the coast first, then headed inland. Additionally, Spain, Liguria (northern Italy) and Carthage are all afflicted in the same year or earlier, three areas known for trade with southern France.

For these reasons, it is impossible to know from the literary sources alone from which direction the original infection arrived. Because a later 588 C.E. infection is specifically documented as having arrived at Marseilles from Spain, however, I find it plausible the first infection in France also arrived by ship from Spain after Spain’s infection in late 542 C.E.²⁶⁶ After entering France at Arles, the disease then moved up the Rhône River, turning west through the region of Auvergne and, again according to Gregory, not quite as far as Clermont. The disease also continued north, possibly branching at Langres and heading both northeast and northwest, almost simultaneously. The path quite clearly follows rivers and known major roads, but the mechanism for the plague’s spread is unknown. If a ship carried it, did it deposit infected cargo along the entire route – or was there a warehouse of infected

²⁶⁴ Gregory of Tours, *History of the Franks*, 77 (IV, 5); Gregory of Tours, *Liber in Gloria martyrum*: I/3, et *Liber vitae Patrum*, VI, 6.

²⁶⁵ For Arles, ‘various parts of Gaul,’ and Clermont see Gregory of Tours, *History of the Franks*, (IV, 5) and Gregory of Tours, *Liber in Gloria martyrum*: I/3, et *Liber vitae Patrum*, VI, 6; For Reims see Gregory of Tours, *Liber in Gloria confessorum*, 78; For Trèves see Gregory of Tours, *Liber vitae Patrum*, XVII, 4; For “Southern France” see Gregory of Tours, *History of the Franks*, (IV, 5) and Leonard Aretin, lib. II. In Papon V. II, 260.

²⁶⁶ Gregory of Tours, *History of the Franks*, (IX, 21 and 22).

goods somewhere (at Fos or Marseille, for example) with multiple individuals responsible for bringing it to their far-flung cities?

Gregory tells us that the credit for the disease not reaching Clermont-Ferrand is given to the institution of “Rogation Days” by St. Gall; the disease similarly stopped short of Reims (in the region of modern-day Germany) ‘halted by the relics of St. Remi.’²⁶⁷ Both of these events serve to underscore the lack of understanding of transmission of the disease. Because many believed the plague to be punishment for the sins of humanity, no widespread quarantine was enacted. Further, care of the sick and burial of the dead were considered to be Christian responsibilities, exposing the healthy people who assumed these duties to plague.

Gregory also describes “southern France” as suffering from the plague, but does not name specific cities.²⁶⁸ Narbonne, a major port city west of Marseilles, would be one such possibility; with direct river access to Toulouse, it would also be a point at which the disease could pass into southwest France and possibly northeastern Spain. Narbonne is specifically named later as receiving the plague, but Toulouse is not – this may be due to the two cities being held by rival groups, Visigoths and Franks, or the literature may simply be silent. Marseilles and Avignon are both possible candidates for cities infected in “Southern France” – but Marseilles is specifically named in later waves, and it seems odd that it would escape mention if it were among the afflicted in 543.

The second major wave of plague in France occurs in 563 (Fig. 22), after a flood in Auvergne (unclear whether city or region is intended) sparks an epidemic with a number of major cities along the Rhone affected, including Lyon, Chalon-sur-Saône, Dijon, Clermont,

²⁶⁷ “Rogation Days” were religious days of penitence designed to placate evil spirits and appeal to God for protection (see Reff 2005, 100); Gregory of Tours, *History of the Franks* (IV 5), *Liber in Gloria Martyrum* X (I 3), *Liber Vitae Patrum* X (VI, 6); Gregory of Tours, *Liber in Gloria confessorum*, 78.

²⁶⁸ Gregory of Tours and Brehaut 1916, 77 (IV 5).

and Bourges.²⁶⁹ The ignition of a wave of outbreaks after a flood is curious; as with the flood in Rome in 590, it suggests that a resident population of plague-infected rats were present in the city in considerable numbers, and were kept apart from the local population in normal circumstances. Were the rats living in a warehouse, then displaced by the flooding and forced to seek shelter elsewhere? If so, how do we explain the spread up the river? Is it possible that the “new shelter” the rats found included riverboats and their cargo? Without additional evidence we cannot know.

The 571 outbreak, instead, occurs throughout the interior of France and as far north as Sens, a city close to modern-day Paris.²⁷⁰ The origin of this outbreak is possibly Liguria (likely Genoa), which also suffers an outbreak in 570.²⁷¹ Curiously, no French coastal cities are named in the 570-1 outbreak; J.-N. Biraben and J. Le Goff suggest Marseilles as the point of entry, but do not provide any references to support their assertion.²⁷² Because the earlier Auvergne-initiated plague outbreak required no re-introduction from an outside source, it is possible that it simply reignited from one of the riverside cities listed as afflicted; or an infected cargo passed through a coastal city without sparking an epidemic there. With additional detail on the timing it might be possible to connect the outbreak with an event (such as a harvest or trade fair), but we lack such detail for this particular infection.

References for other waves of plague in France are less specific, but it is clear that a number of eruptions occurred in the 580s and affected cities not named previously:

Narbonne, Albi, Angers, Lorraine, Vienna, Saint-Symphorien-d’Ozon and, for the first time,

²⁶⁹ Simpson 1905, 15

²⁷⁰ For Lyon, Bourges, Chalon-sur-Saone, Dijon, Clermont, Auvergne and Cahors see Gregory of Tours 1974, IV, 5 & 31; *Liber de virtutibus sancti Juliani Brivatensis*, 46 A; Marius of Avenches, XI (passage may be describing another disease) and Gregory of Tours, *Liber vitae Patrum*, IX: de sancto Patroclo. For Sens and Les Clos des Cordelier see Castex 2008, 29. For Marseilles, see Biraben and Le Goff 1969, 1501.

²⁷¹ Biraben and Le Goff 1969, 1495; Stathakopoulos 2004, 310 & 314; Paul the Deacon, *History of the Lombards*, II 4; Marius of Avenches, *Chronica*, 238; Gregory of Tours, *History of the Franks*, IV 31, 168.

²⁷² Biraben and Le Goff 1969, 1501.

Marseilles.²⁷³ Both Viviers and Avignon appear in the record around 590; Tours and Nantes are first mentioned shortly after.²⁷⁴ In some cases, the mention of specific cities may be due to the writer's travels through a particular area; it certainly does not necessarily mean that only these cities were affected. The shipwreck evidence, listed in Table 8, shows very few vessels on the river routes – in this case there is more literary evidence for inland plague than shipwreck evidence along the river routes.

A particularly interesting aspect of the French outbreaks is the confirmation we have in the form of DNA testing.²⁷⁵ No other region has as many confirmed sixth-century plague gravesites (see Table 1 for a listing of confirmed plague sites and Figure 21, where actual DNA-confirmed sites are marked with a yellow dot). One curious aspect of the DNA tests is fact that no plague site attested in the contemporaneous literature has yet turned up a DNA-confirmed sixth-century plague grave.²⁷⁶

²⁷³ For Narbonne, Lorraine, and Albi, see Gregory of Tours 1974, (VI, 14, 33 and VII, 1). For Angers, see Gregory of Tours, *History of the Franks*, IV, 31; VI, 14; IX, 21; X, 23 & 25. For Vienna, Saint-Symphorien-d'Ozon, and Marseilles, see Gregory of Tours 1974, (IX, 21 and 22).

²⁷⁴ For Viviers and Avignon see Gregory of Tours 1974, X, 23. For Tours and Nantes, see Gregory of Tours 1974, X, 30.

²⁷⁵ For Vienne see Parthesius et al. 2005, 332; for Sens and Les Clos des Cordeliers see Castex 2008, 27

²⁷⁶ See Table 1 for all DNA-confirmed plague burials.

SITE NAME/LOCATION	AMPHORAS/CARGO/ROUTE INFO	DATE
Brescou	Basalt millstones	1-500 C.E.
Calanque du Berger	Lead pipe (from pump?)	1-500 C.E.
Carro 1 (A)	Amphoras, lead piece	525-550 C.E.
Chantenay	Roman fineware	1-500 C.E.
Dramont 9	Stone blocks	1-500 C.E.
Grazel 2 (B)	Bronze pots, box, strainer, lamp, fittings (dated by coin finds)	631 C.E.
Palud, La	LR1/LR2/LR5/LR4 amphoras, primary cargo of Tunisian amphoras with smaller consignment of jars from Aegean, Syria and Palestine. Key 62 and 55. Roof tiles and coarseware.	540-600 C.E.
Port Berteau II		599 C.E.
Punta del Milagro	Stone column drums	1-500 C.E.
Saint-Gervais 2	Wheat cargo, Key 8a and spatheia amphoras. N. African TS Chiara D, orange-painted and orange, lead-glazed pottery, grey-ware pitchers, amphoras, 2 Merovingian brooches, barrel, fine eastern ceramic, everyday ceramic 1 LR5 amph, probably galley stores	600-650 C.E.
Saint-Hospice	N/A	1-500 C.E.
Sorres, Les 4	N/A	1-500 C.E.
Sorres, Les 5	N/A	1-500 C.E.
Sorres, Les 6	N/A	1-500 C.E.

**Table 8 - Shipwrecks from the Region of Modern-Day France
(for references and full details see Appendix B)**

Iberian Peninsula

Archaeologists and historians are still gathering data concerning the plague in Visigothic Spain, but there are some tantalizing clues available today. It probably arrives on the peninsula fairly early, in 542 or 543 (Fig. 24).²⁷⁷ M. Kulikowski notes some of the problems with dating the few available original sources, but suggests that October 542 seems a reasonable estimation for the arrival of the plague, shortly after Carthage and North Africa received it.²⁷⁸

In the mid-sixth century the Visigothic Kingdom occupying modern-day Spain had extensive trading ties with Africa, Greece and the Levant. Specifically, trading connections between the East, parts of Spain and the Levant were robust until the 550s and 560s based on the distribution of ceramics.²⁷⁹ In particular, though, amphora-based trade was heavy from Tunisia and the “East” (see Table 9), although this seems to have ended by the 560s by one scholar’s account.²⁸⁰ If it did, it still means that Tunisia is the likely source of any amphora-based plague infection. Therein lies the challenge, however. We have extensive evidence concerning trade in the Mediterranean with Spain, but none that can be conclusively tied to plague. Given the overall quantity of known trade between Spain and Tunisia, however, I think it is fair to assume that infection proceeded from Carthage and North Africa in the summer of 542 to Spain – possibly in October, as Kulikowski suggests.

²⁷⁷ Corippus, *Iohannis seu de bellis Libycis*, 60-62; *Chronicles of Saragoza*, M.G.H., AA., XI/2, 201.

²⁷⁸ Kulikowski 2007, 151.

²⁷⁹ Kulikowski 2007, 151.

²⁸⁰ Kulikowski 2007, 157.

CITY	SOURCE	DATE	PERCENTAGE OF TOTAL
Tarragona ²⁸¹	Tunisia	Mid-late 6th century	75.6 percent
	Eastern Med.	Mid-late 6th century	11.6 percent
Carthago Nova ²⁸²	Tunisia	525-535 C.E.	62.6 percent
	Eastern Med.	525-535 C.E.	22.6 percent
Ampurias ²⁸³	North African	6th century	59.53 percent
	Eastern Med.	6th century	21.43 percent
Benelua ²⁸⁴	Tunisia	Mid-6th century	29.7 percent
	Eastern Med.	Mid-6th century	22.6 percent

Table 9 - Foreign Amphoras Found in Various Spanish Cities

Overall, Spain's Mediterranean trade had shrunk significantly by the 580s.²⁸⁵ The territory of Spain was a contested area – fought over by the Visigoths, Byzantines, Franks and Vandals – possibly affecting trade, and the already-low population likely suffered greatly when the plague of 542 erupted (although the demographic information to confirm this is lacking). Two cities, Albi and Narbonne, are known to have suffered plague in 582 – both were part of the Visigothic territory. Additionally, the 588 C.E. ship that Gregory of Tours claims brought plague to Marseilles probably worked local *cabotage* routes between Catalonia and Narbonne.²⁸⁶ Unfortunately, Gregory does not tell us from where in Spain the infected Marseilles ship hailed, but between 582 and 588 it seems probable that a number of coastal Spanish cities were afflicted.

The only inland city to be mentioned by name, Toledo, is hit at least twice: as early as 580 and again in 693. The peninsula is silent in the literature except for these few mentions; again, likely due to a lack of literature rather than a lack of events.

²⁸¹ Reynolds 2010, 226

²⁸² Reynolds 2010, 226.

²⁸³ Reynolds 2010, 216.

²⁸⁴ Reynolds 2010, 216.

²⁸⁵ Kulikowski 2007, 153.

²⁸⁶ Kulikowski 2007, 153.

Because Spain did not have the density population necessary to support the plague without constant reintroduction, it does offer the potential for a unique epidemiological study. Since each of the four ‘waves’ of plague attested in Spain were introduced independently, if we can identify the source of trade for those time periods, we have a good chance at identifying the source (or sources) of the plague – and vice-versa.²⁸⁷ The shipwreck evidence is scant, unfortunately (see Table 10).

There is currently no archaeological confirmation of plague in Spain, but this may soon change. A series of intramural burials in Valencia have the hallmarks of plague: collective graves, hastily dug, poorly organized, and with no evidence of funerary rites.²⁸⁸ These are dated to the mid-sixth century based on ceramics. A similar (but better-organized) mass burial outside Carthago Nova may be a second such plague burial. One or the other of these sites may soon prove to be the first concrete evidence of plague in Spain ever found.²⁸⁹

While there is not yet archaeological evidence for the presence of plague in Toledo, a series of sermons prepared for the arrival of plague is preserved in a series of Toledan homilies. Possibly created in a just-in-case scenario, it is in any case telling that a series of such materials were readied.²⁹⁰ The church’s leadership in Toledo were clearly aware of the risk and effects of plague and were prepared for the worst when (and if) it ever arrived.

²⁸⁷ Kulikowski 2007, 154-5. Although the timing of the ‘waves’ is problematic, per Kulikowski, the approximate years of affliction are 542, 584 (along with Narbonne and Albi, cities in the Gothic Kingdom), 693 (Toledo), and between 707-709.

²⁸⁸ Kulikowski 2007, 152-3.

²⁸⁹ Kulikowski 2007, 152-3.

²⁹⁰ Kulikowski 2007, 155. Grégoire, *Les homéliaires du Moyen Age*, 161–85, with an edition of the otherwise unpublished sermons at 197–230.

SITE NAME/LOCATION	AMPHORAS/CARGO/ROUTE INFO	DATE
Amoladeras, Las	Lead objects, DR1A amphoras, ceramic tiles	1-500 C.E.
Barbate	Amphoras	1-500 C.E.
Cádiz 5	2 millstones, 4 squared blocks, coarseware, amphoras	1-500 C.E.
Cala de Sant Vincent	Lead-sheathed timbers of Roman ship	1-500 C.E.
Cala Reona	Small amphoras for salted contents, TS Clara D ceramics. Wood and nails as ship gear	400-500 C.E.
Ciudadela	Roman Amphoras	1-500 C.E.
Favaritx	Hundreds of Byzantine bronze objects possibly liturgical en route from Egypt or Syria. Coarseware, amphoras	450-600 C.E.
Gibraltar 1	N/A	1-500 C.E.
Gibraltar 2	N/A	1-500 C.E.
Gibraltar 3	N/A	1-500 C.E.
Grazel 2 (B)	Bronze pots, box, strainer, lamp, fittings (dated by coin finds)	631 C.E.
Hormigas, Las	Keay 35 amphoras	425-550 C.E.
Punta del Milagro	Stone column drums	1-500 C.E.
Valencia	Amphoras; lead anchor stock; bronze nails	1-500 C.E.

**Table 10- Shipwrecks from the Region of Modern-Day Spain
(for references and full details see Appendix B)**

CHAPTER VIII

CONCLUSIONS

As new evidence becomes available – in the form of DNA results, data from Byzantine-period shipwrecks, or new late antique manuscripts – the story of the Justinianic plague will continue to be revised and corrected. Since the early 1900s (and earlier) authors have attempted to reconstruct the paths of this devastating epidemic, and this present work is merely an additional brick on top of an already-substantial foundation of documentation and interpretation.

With a better understanding of the transmission paths of the plague, scholars will be better prepared to make focused decisions regarding archival research and cemetery excavation to close our knowledge gaps in Late Antiquity. And, in my own specialty of nautical archaeology, I hope that shipwrecks from this plague period in particular can be investigated for direct evidence of the disease – perhaps in the form of rat bones, flea remains or plague bacteria; I am currently conducting examination of a cluster of Byzantine-period shipwrecks' bilge mud with just such a goal in mind.²⁹¹

To date, however, no wreck has been found with evidence of the Justinianic Plague aboard in any form – skeletal, medicinal, or faunal. The most likely opportunity to find such evidence probably lies with searches in the Black Sea, a unique body of water which contains an anoxic layer that could preserve a grain ship in its entirety (rats and all) or a skeleton. At least one exceedingly well-preserved vessel from approximately 100 years prior to

²⁹¹ My dissertation work includes analyzing a collection of organic samples from Byzantine wrecks in the Tantara/Dor area of the Levant.

Justinian's plague has been found in this layer, providing some concrete evidence, and a great deal of hope, that an intact vessel from the period might yet be awaiting discovery.²⁹²

On land, the excavation and DNA testing of sixth-century skeletal teeth for presence of the plague virus has already added several new sites to the web of transmission – doubtless more will be added in the near future. Each new data point serves to link the disparate data we have from the literature, refining our understanding of trade, plague transmission, and the social dynamics of the time. And, in time, perhaps such testing will extend to other material goods, just as today it is possible to test amphoras for evidence of oil or wine storage.

With the analytical tools (like GIS) now available to the disciplines of archaeology and history, scholars are creating powerful new tools and databases that make new discoveries possible simply by surfing a few websites – Harvard's DARMC and Stanford's ORBIS are two such powerful tools, and they are only two of a long list that grows every year. Combining individual plague data points with these databases will markedly affect our understanding of trade, politics, borders and demographics in this little-documented period, particularly if done interactively. I have struggled to show, in this 2-dimensional document, information that is effortlessly demonstrable within my GIS application.

It is my earnest hope that this small contribution will prove useful to other researchers of this fascinating topic, and I look forward to the discoveries that are yet to come.

²⁹² Ballard, Hiebert, and Coleman 2001, 607.

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APPENDIX A

FIGURES MENTIONED IN THE TEXT

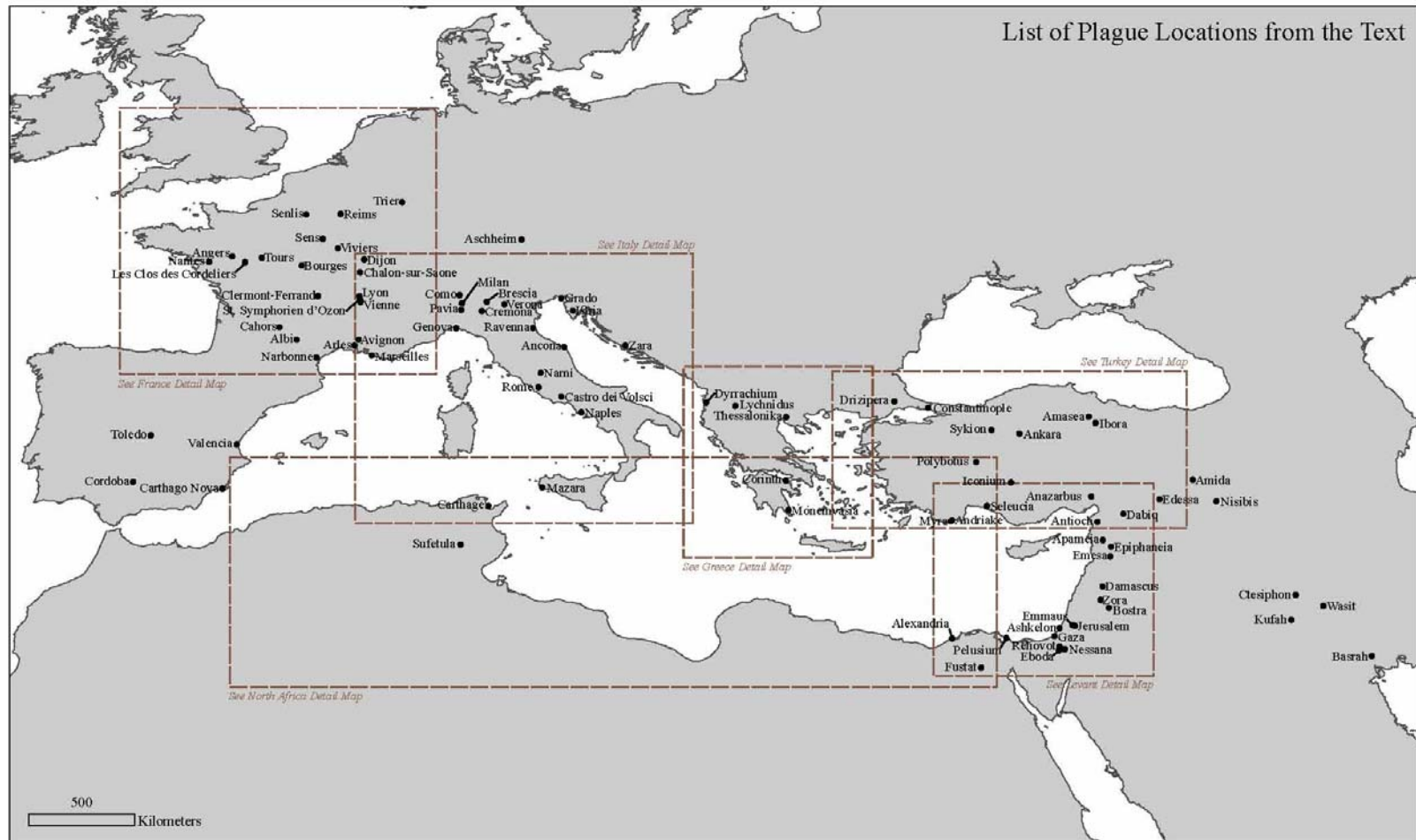


Figure 1 - Map Showing Sites Mentioned in Text, with Detail Sections Highlighted (by Author)

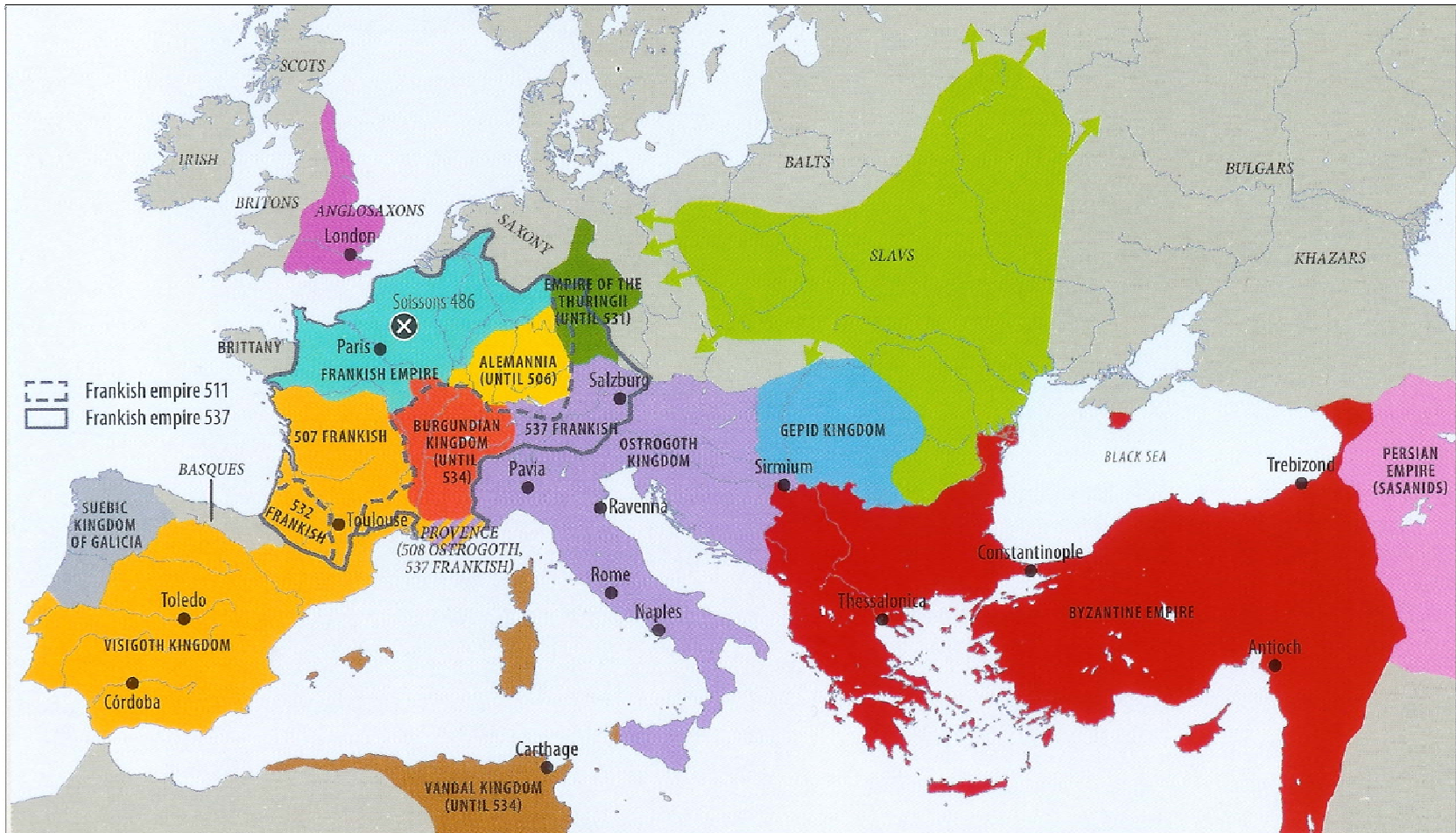


Figure 2 - European Territories between 507-534 C.E. (after Könnemann 2010, 60)

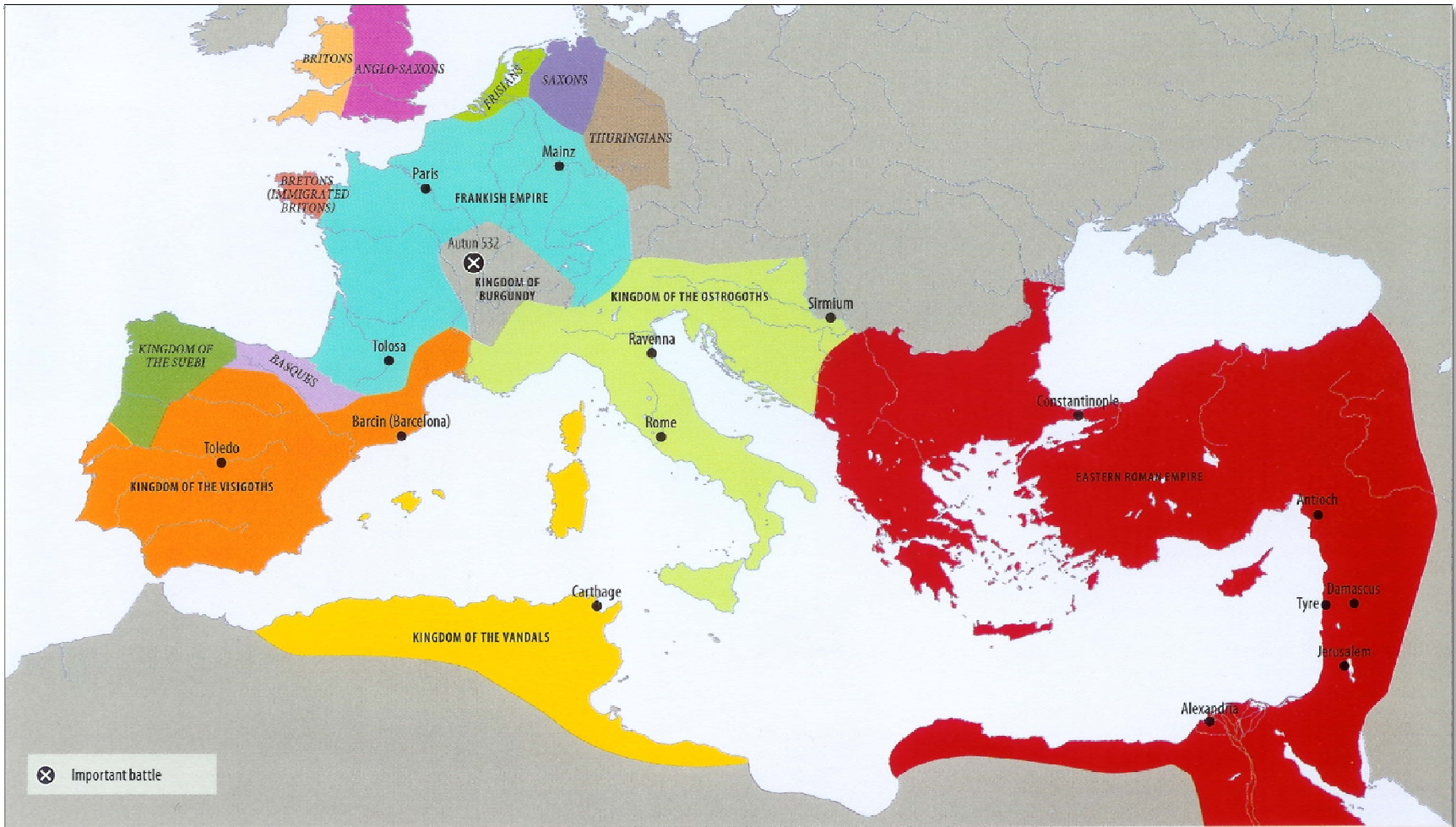


Figure 3 - European Territories in 532 C.E. (During the Battle of Autun) (after Könnemann 2010, 92)

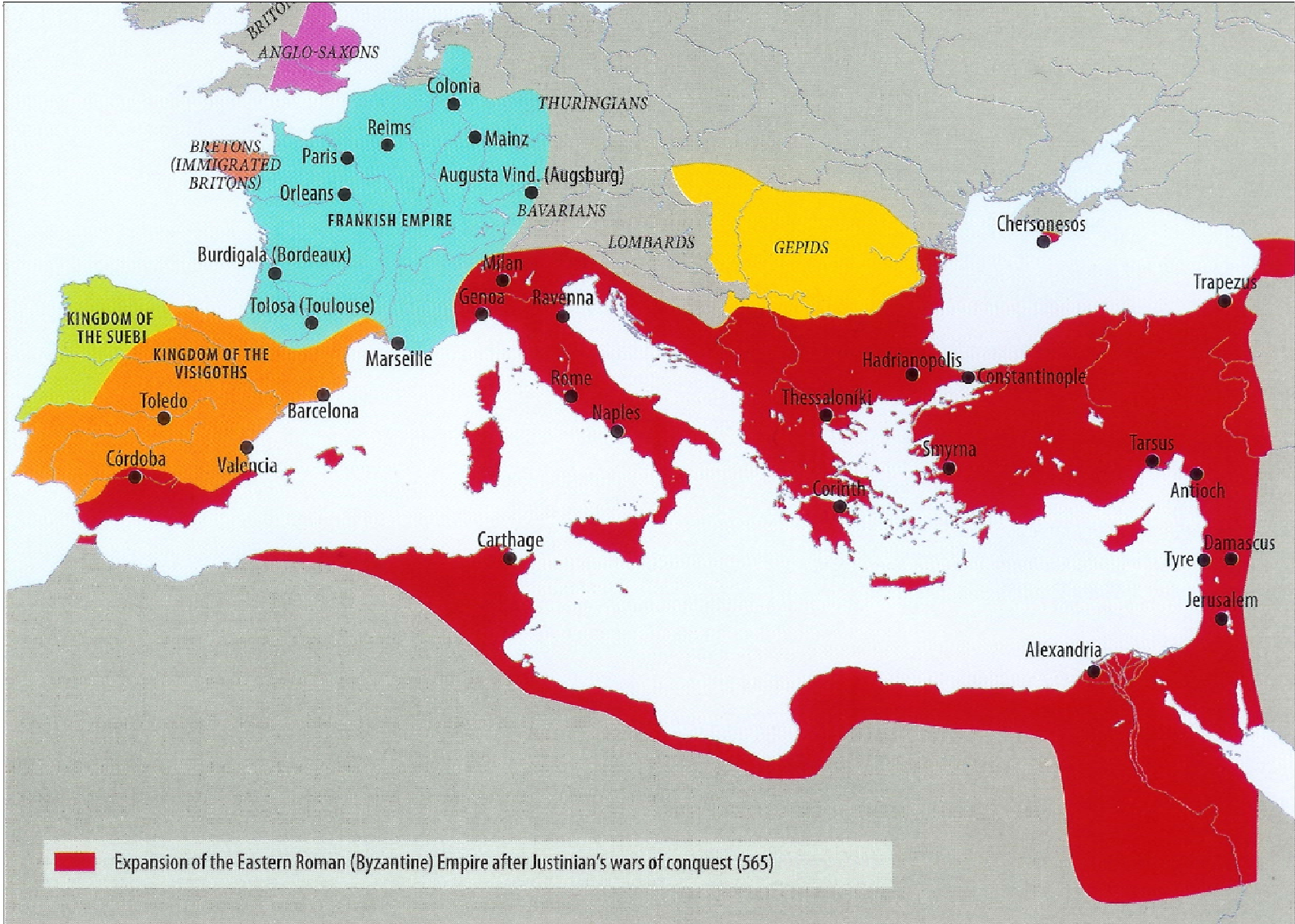


Figure 4 - European Territories in 565, at the Death of Justinian I (after Könemann 2010, 93)

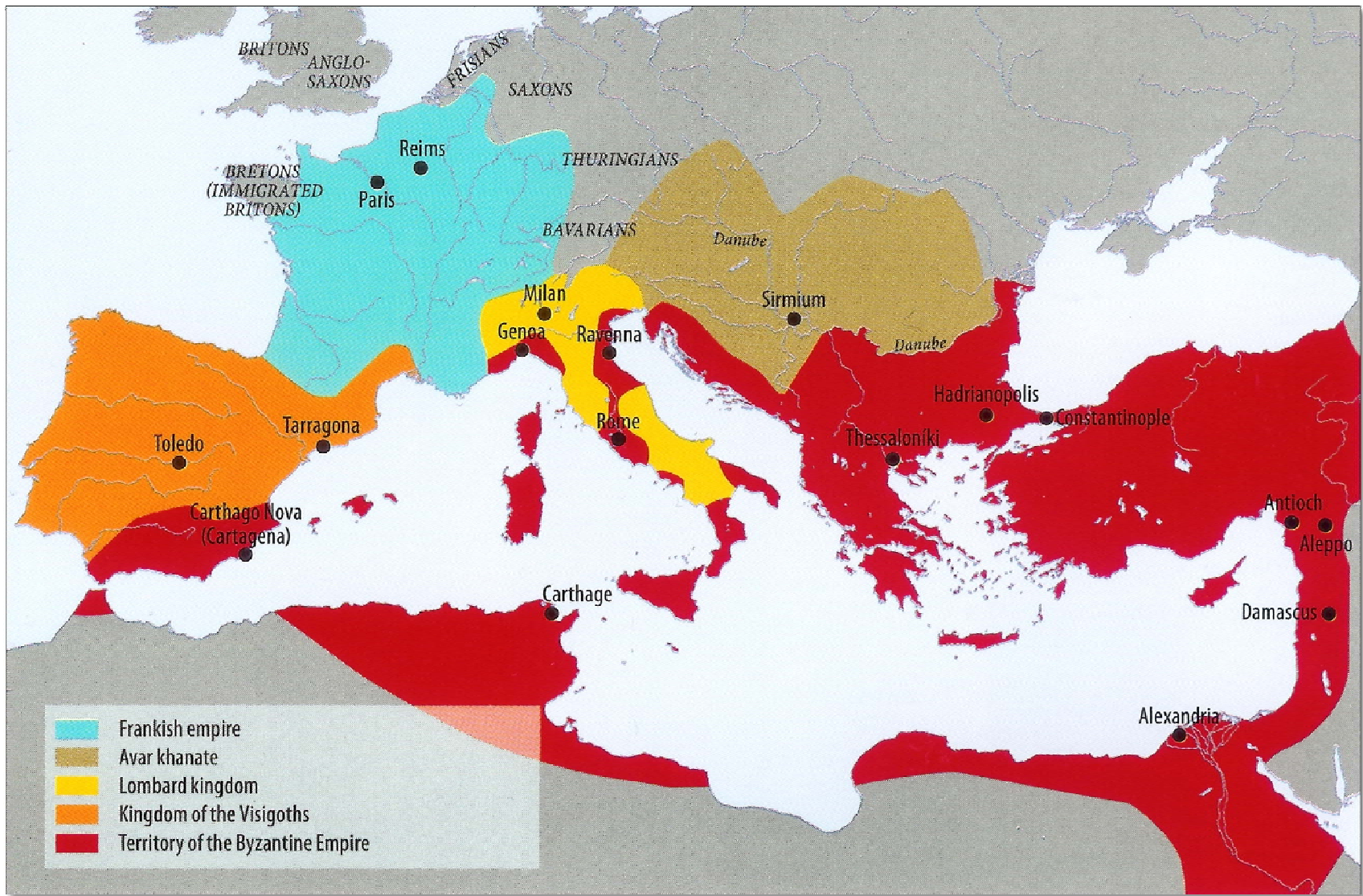


Figure 5 - European Territories in 600 C.E. (after Könemann 2010, 93)

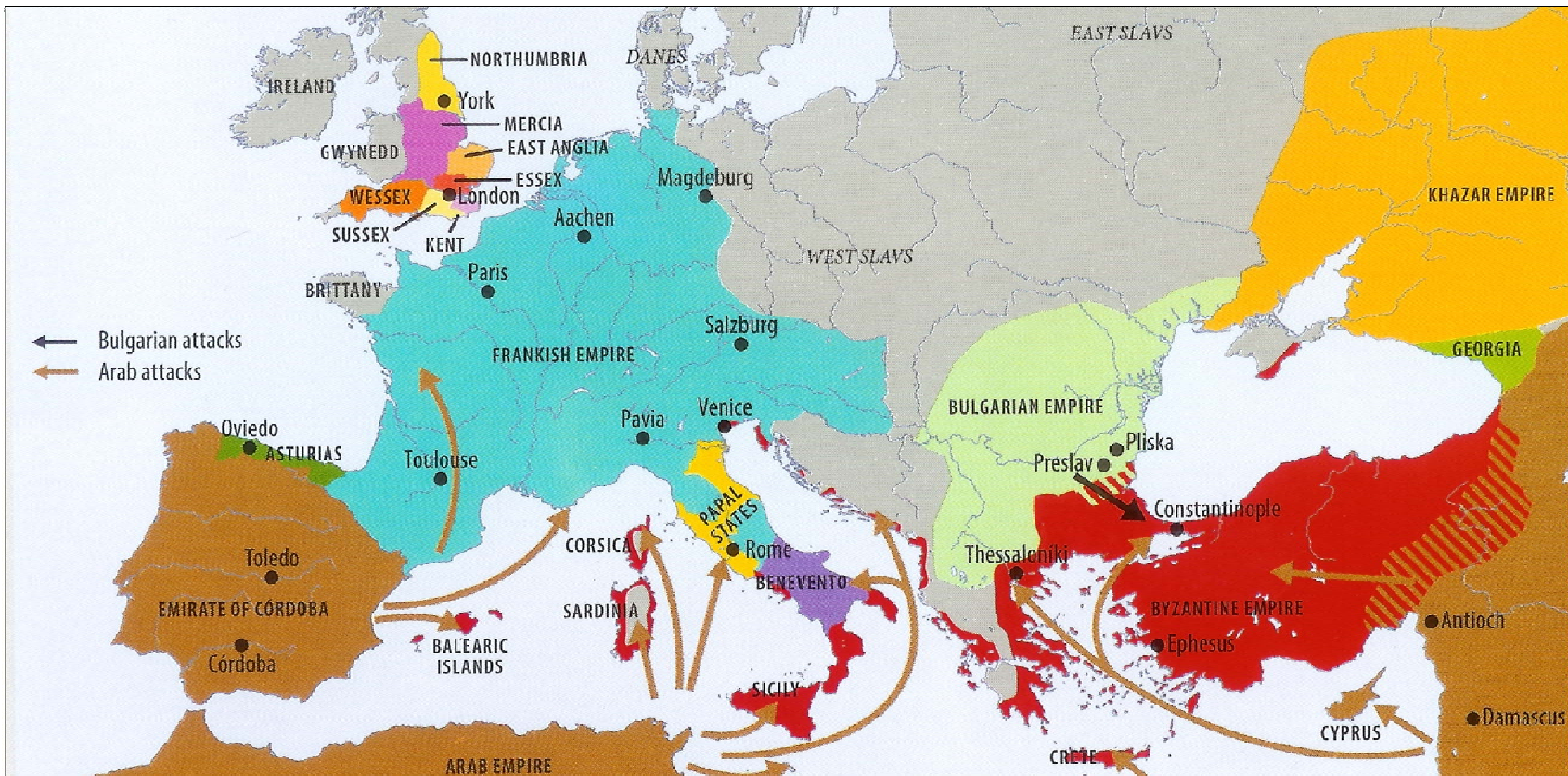


Figure 6 - European Territories between 700-814 C.E. (after Könemann 2010, 60)



Figure 7 - Spread of Christianity around 600 C.E. (after McKay 2010, 100)

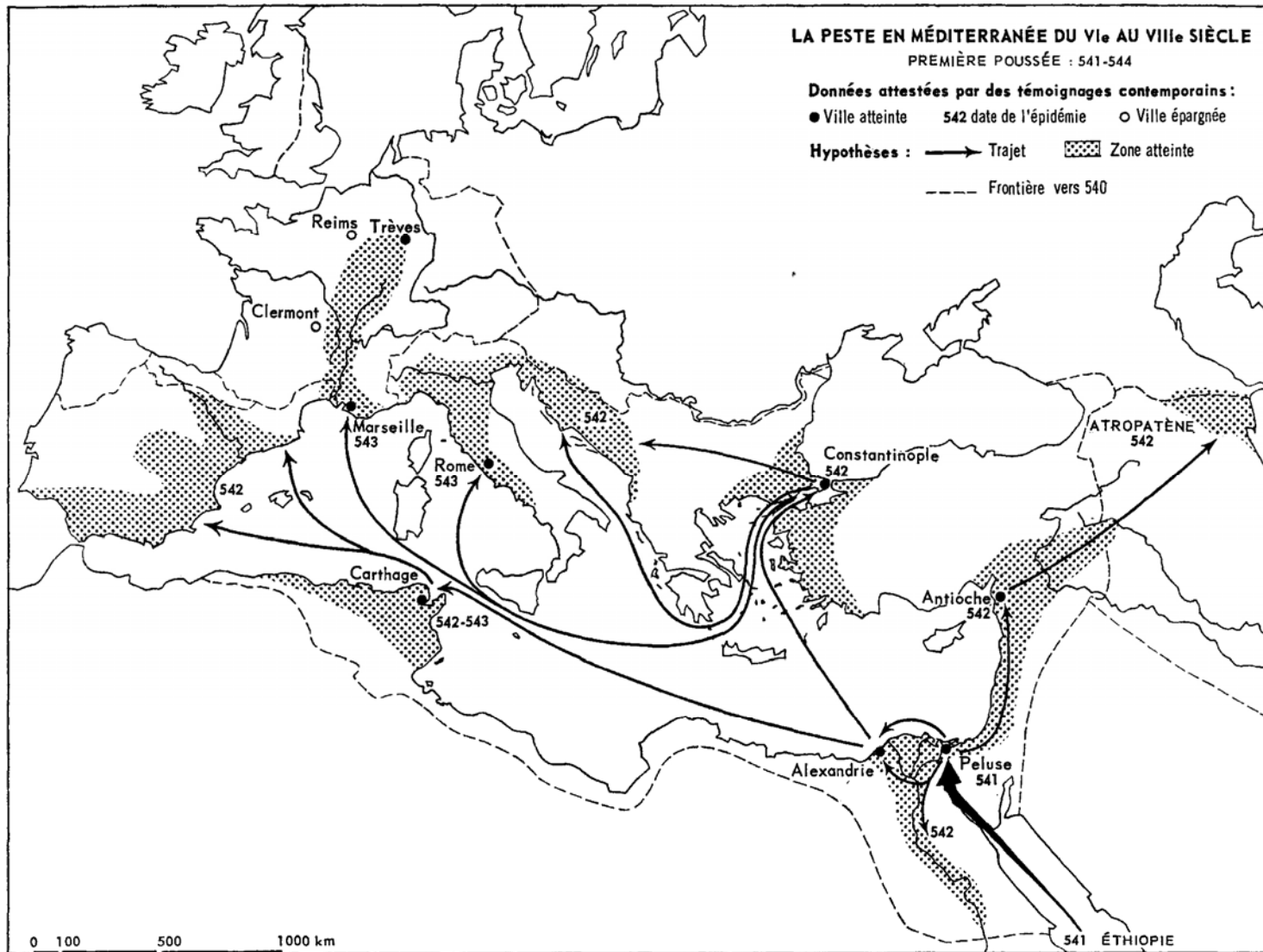


Figure 8 - Spread of the Plague Between 541-544, According to Biraben and Le Goff (1969, 1500)

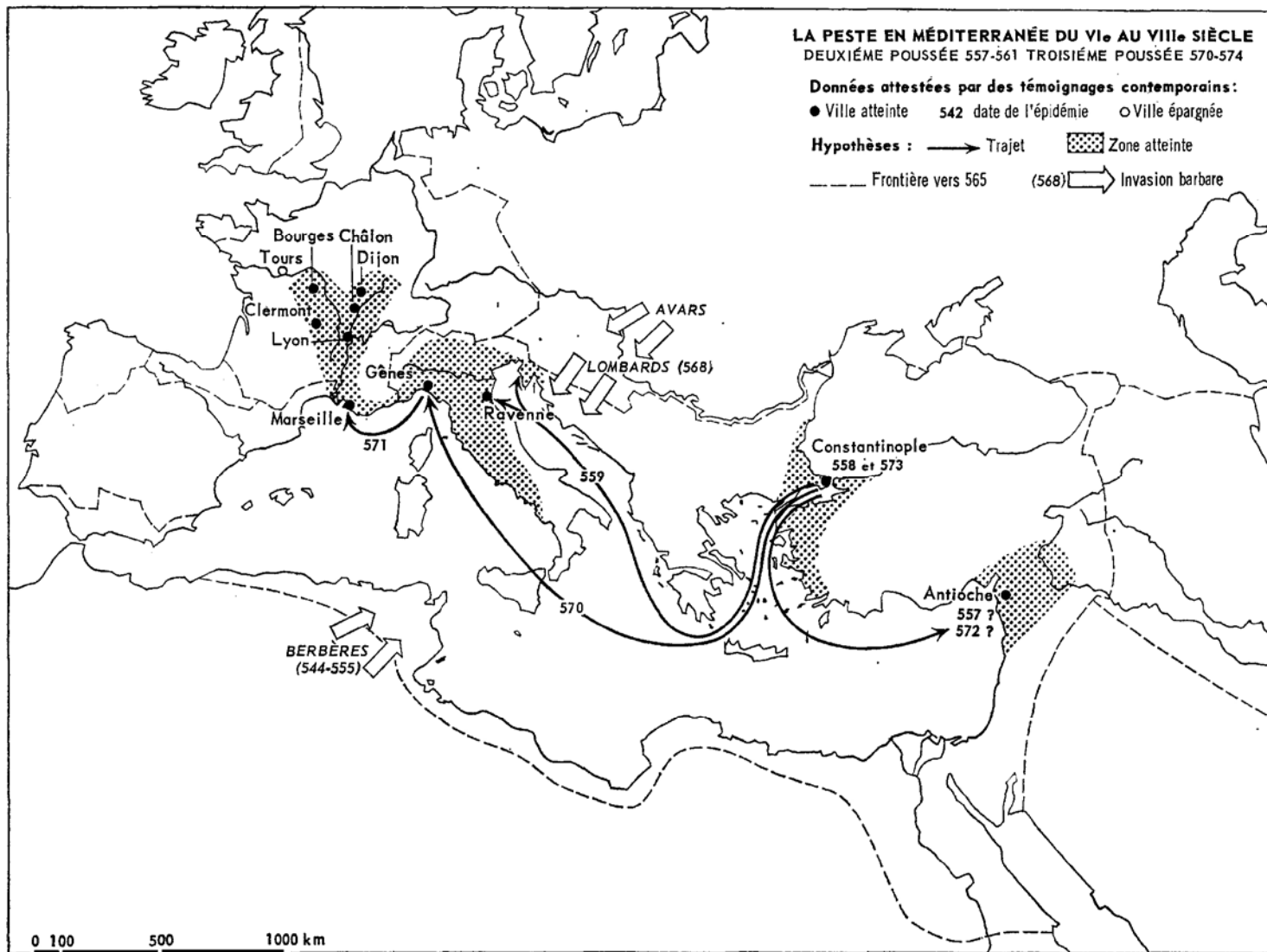


Figure 9 - Spread of the Plague Between 570-574, According to Biraben and Le Goff (1969, 1501)

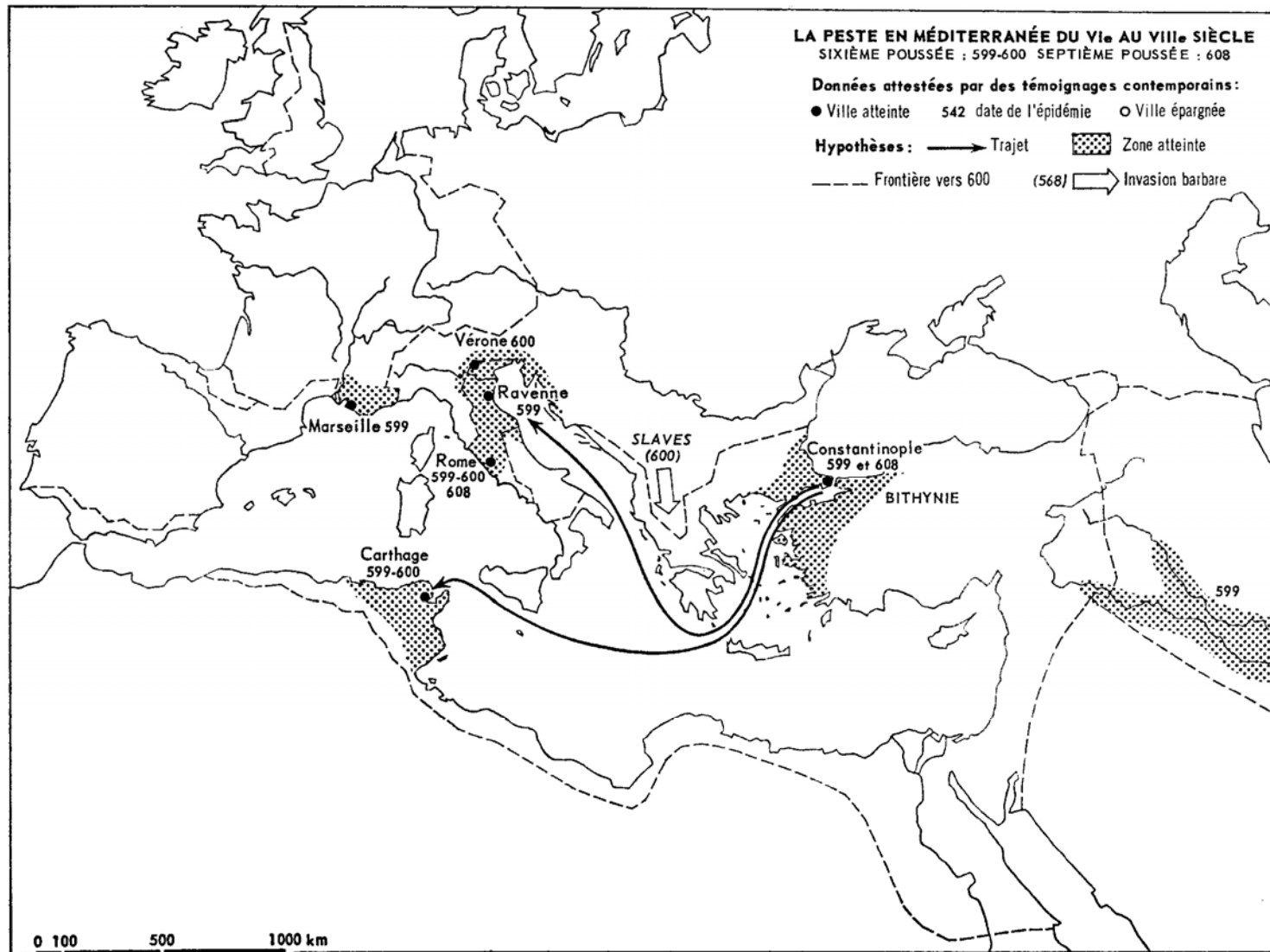


Figure 11 - Spread of the Plague Between 599-608, According to Biraben and Le Goff (1969, 1503)

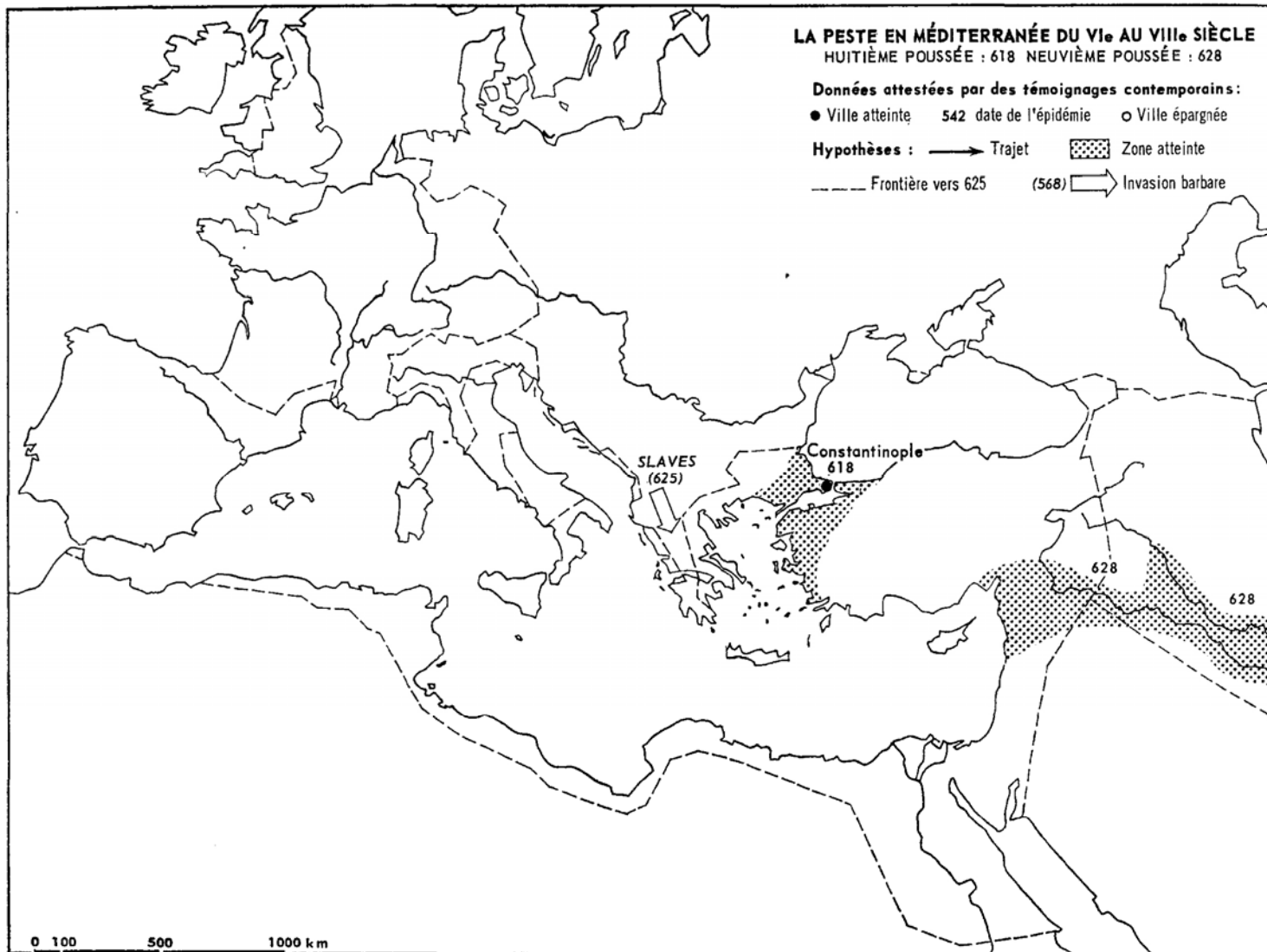


Figure 12 - Spread of the Plague Between 618-628, According to Biraben and Le Goff (1969, 1504)



Figure 13 - Locations of Customs Toll Sites and Common Routes (from Antoniadi 1963, fold-out map)

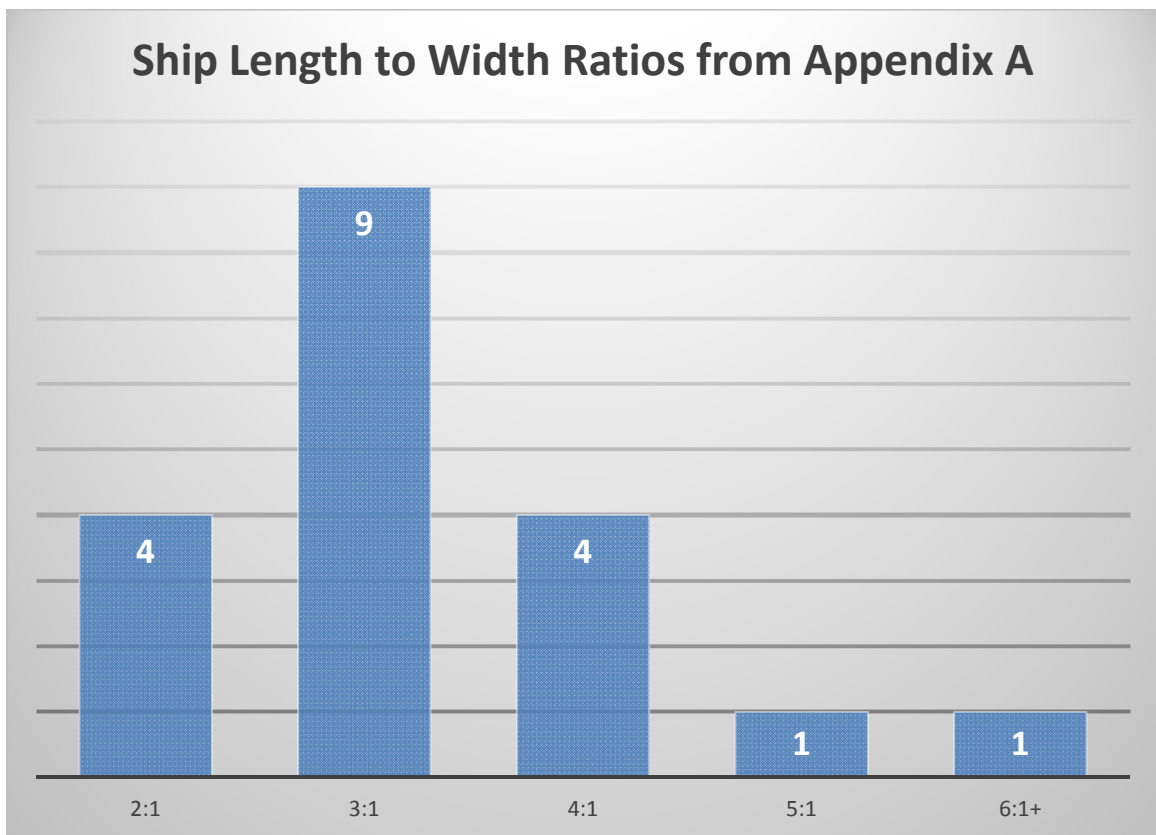
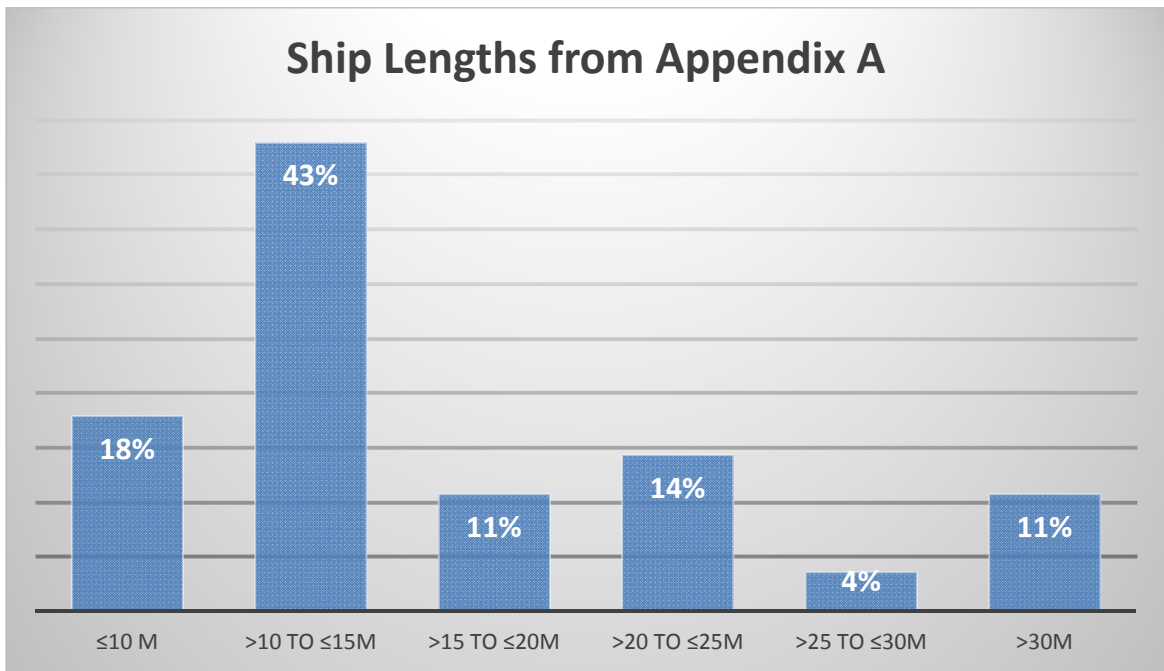


Figure 14 – Size Analyses of Ships from Appendix C



Figure 15 - Path of the Plague through the Levant, 541-544 C.E.

(figures without other attribution are by the Author)



Figure 16 - Path of Plague through Asia Minor, 541-544 C.E.



Figure 17 – Path of Plague across and around Greece, 541-544 C.E.



Figure 18 – Path of Plague around and across Greece, 711-746 C.E.

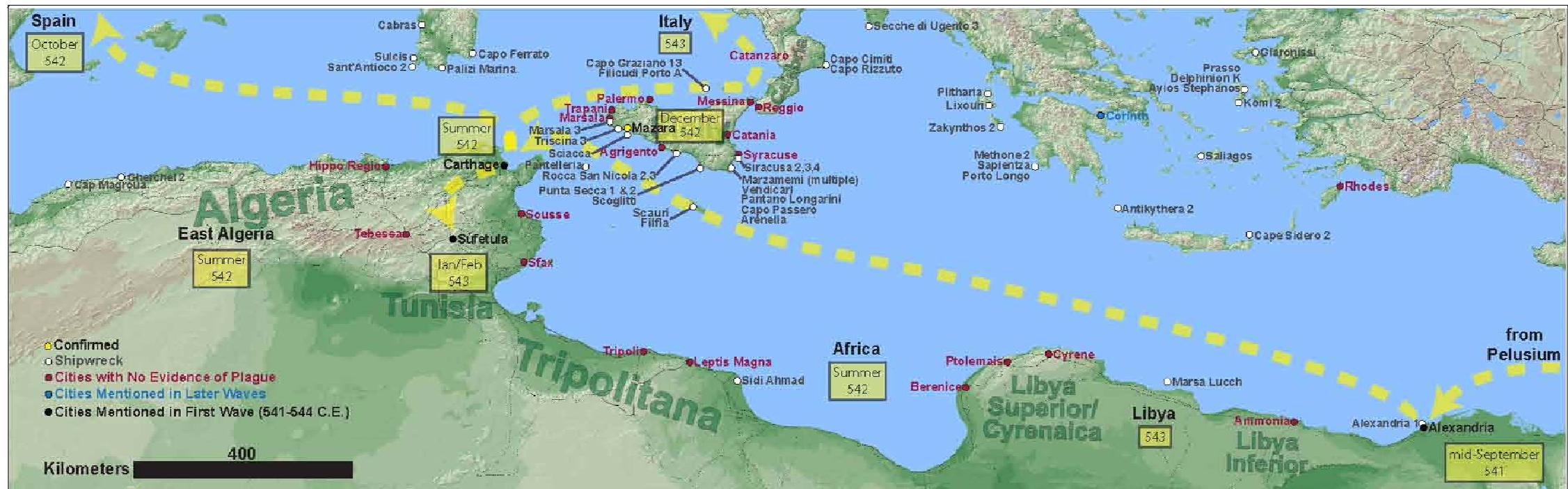


Figure 19 - Path of Plague through North Africa, 541-544 C.E.



Figure 20 - Path of Plague around and across Italy, 541-544 C.E.



Figure 22 - Transmission of Plague through Frankish Kingdoms, 545-565 C.E.



Figure 24 – Path of Plague through Visigothic Kingdom, 541-544 C.E.

APPENDIX B

SHIPWRECKS AND OTHER UNDERWATER EVIDENCE OF TRADE

SITE NAME/ LOCATION	AMPHORAS/CARGO/OTHER GEAR	EST. SHIP LENGTH	EST. SHIP WIDTH	DATE (C.E.)	REFERENCE
Agropoli (Italy)	Marble	N/A	N/A	1-500	McCormick 2010, Ref. No. 18
Alexandria 1 (Egypt)	DR6 amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 31
Alghero (Italy)	Ceramic and bricks	N/A	N/A	1-500	McCormick 2010, Ref. No.34
Altinkum (Turkey)	40 architectural elements including Corinthian column capitals and 25 column bases	N/A	N/A	5th-6th Century	Berlinghieri 2012, 67
Amoladeras, Las (Spain)	Lead objects, DR1A amphoras, ceramic tiles	N/A	N/A	1-500	McCormick 2010, Ref. No. 39
Amrit (Levant Coast)	20 capitals, one column shaft, one impost capital and 16 columns bases manufactured in the workshops of Prokonnesos Island	N/A	N/A	Early Byzantine	Berlinghieri 2012, 66 and 72
Antikythera 2 (Greece)	Large, barrel-like amphoras. Lead stock and anchor collar.	N/A	N/A	-100-500	McCormick 2010, Ref. No. 45
Arenella (Italy)	Cargo of Metal (Armor/Weapons); Iron Anchor	N/A	N/A	500-1500	McCormick 2010, Ref. No. 53
Argentario (Italy)	Dolia	N/A	N/A	1-500	McCormick 2010, Ref. No. 55

SITE NAME/ LOCATION	AMPHORAS/CARGO/OTHER GEAR	EST. SHIP LENGTH	EST. SHIP WIDTH	DATE (C.E.)	REFERENCE
Arwad B (2) (Cyprus)	Rilled, pear-shaped Byzantine amphoras	N/A	N/A	500-600	Frost 1966, 27 Parker 1992, 60 McCormick 2010, Ref. No. 59
Assarca (Eritrea)	Conical Byzantine and Palestinian amphoras	N/A	N/A	300-800	McCormick 2010, No Ref. No.
Avdimou Bay (Cyprus)	LR4 from Ashkelon and Gaza (traces of pitch indicate use with wine), 3 conical millstones, 11 stone anchors.	N/A	N/A	400-600	Leidwanger 2007, 310-12 McCormick 2010, No Ref. No.
Averno 1 (Italy)	Amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 64
Averno 2 (Italy)	Amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 65
Averno 3 (Italy)	Amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 66
Averno 4 (Italy)	Amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 67
Ayios Stephanos (Turkey)	Byzantine Riley LR1 and Zemer amphoras	24 m	12 m	550-650	Garnett & Boardman 1961, 107-12 McCormick 2010, Ref. No. 71
Barbate (Spain)	Amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 91
Bozburun LA anchor wreck (Turkey)	Type 1 similar to Yassı Ada Type 4, two other types (one 60 cm beehive-shaped w/ridges; the other 40 cm long, pyriform with short strap handles). Carried anchors similar to those found on Yassı Ada 7 th c. and the Dramont F wrecks.	9 m	3 m	500-600	McCormick 2010, No Ref. No.

SITE NAME/ LOCATION	AMPHORAS/CARGO/OTHER GEAR	EST. SHIP LENGTH	EST. SHIP WIDTH	DATE (C.E.)	REFERENCE
Brescou (France)	Basalt millstones	N/A	N/A	1-500	McCormick 2010, Ref. No. 114
Cabras (Italy)	Lead ingots	N/A	N/A	1-500	McCormick 2010, Ref. No. 122
Cádiz 5 (Spain)	2 millstones, 4 squared blocks, coarseware, amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 132
Cala de Sant Vincent (Spain)	Lead-sheathed timbers of Roman ship	N/A	N/A	1-500	McCormick 2010, Ref. No. 144
Cala Ustina 2 (Italy)	Pottery fragments, possible sounding lead	N/A	N/A	1-500	McCormick 2010, Ref. No. 156
Calanque du Berger (France)	Lead pipe (from pump?)	N/A	N/A	1-500	McCormick 2010, Ref. No. 159
Cala Reona (Spain)	Small amphoras for salted contents, TS Clara D ceramics. Wood and nails as ship gear	N/A	N/A	400-500	McCormick 2010, No Ref. No.
Cap Magroua (North Africa)	Amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 194
Cape Andreas A (1) (Cyprus)	Roof Tiles	N/A	N/A	400-650	Parker 1992, 108 McCormick 2010, Ref. No. 202
Cape Andreas B (2) (Cyprus)	Riley LR13 amphoras, glass vessels	N/A	N/A	600-700	Parker 1992, 108 McCormick 2010, Ref. No. 203
Cape Andreas C (3) (Cyprus)	Riley LR1 & 1A amphoras	N/A	N/A	450-650	Parker 1992, 108 McCormick 2010, Ref. No. 204
Cape Andreas E (5) (Cyprus)	Baluster-shaped amphoras; terracotta sarcophagi	N/A	N/A	450-650	Parker 1992, 108 McCormick 2010, Ref. No. 206
Cape Andreas 6 (Cyprus)	Ceramic tiles	N/A	N/A	1-500	McCormick 2010 McCormick 2010, Ref. No. 207

SITE NAME/ LOCATION	AMPHORAS/CARGO/OTHER GEAR	EST. SHIP LENGTH	EST. SHIP WIDTH	DATE (C.E.)	REFERENCE
Cape Kiti 1 (Cyprus)	Byzantine amphoras	N/A	N/A	600-700	Parker 1992, 110 McCormick 2010, Ref. No. 212
Cape Sidero 1 (Greece)	Amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 214
Cape Sidero 2 (Greece)	Amphoras	N/A	N/A	500-1500	McCormick 2010, Ref. No. 215
Cape Zevgari (Cyprus)	150+ Amphoras (LR1), locally produced for oil, some writings indicating measurements for dry goods	35 m	15 m	400-600	Leidwanger 2007, 308 McCormick 2010, No Ref. No.
Capo Bianco (Italy)	Around 65 blocks and column shafts	N/A	N/A	5th-6th Century	Berlinghieri 2012, 67 and 72
Capo Cimiti (Italy)	Marble cipollino columns	12 m (site)	6 m (site)	1-500	Royal 2007, 62 Roghi 1961, 55-61 McCormick 2010, Ref. No. 222
Capo di Muro (Italy)	Pear-shaped amphoras, lead anchor stocks	N/A	N/A	1-500	McCormick 2010, Ref. No. 225
Capo Ferrato (Italy)	Roof tiles, amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 228
Capo Graziano 13 (Italy)	Dressel 31, Dressel 26 and other amphora fragments.	N/A	N/A	300-500	Kapitän 1977, 45-6 McCormick 2010, Ref. No. 243
Capo Passero (Italy)	Roof-tiles and Byzantine amphoras	N/A	N/A	400-650	Parker 1992, 121 McCormick 2010, Ref. No. 245
Capo Rizzuto (Italy)	N/A	N/A	N/A	1-500	McCormick 2010, Ref. No. 250
Capo San Vito (Italy)	Amphoras, lead-stocked anchor	N/A	N/A	1-500	McCormick 2010, Ref. No. 252

SITE NAME/ LOCATION	AMPHORAS/CARGO/OTHER GEAR	EST. SHIP LENGTH	EST. SHIP WIDTH	DATE (C.E.)	REFERENCE
Capo Sant'Elia (Italy)	N/A	N/A	N/A	1-500	McCormick 2010, Ref. No. 255
Capo Schisò (Italy)	Roman hand mills	N/A	N/A	1-500	McCormick 2010, Ref. No. 255.01
Capo Taormina (Italy)	37 Green marble columns, 2 blocks; sounding lead; copper bolt	N/A	N/A	1-500	McCormick 2010, Ref. No. 146
Capraia 2 (Italy)	Amphoras and pottery	N/A	N/A	1-500	McCormick 2010, Ref. No. 522
Capraia 4 (Italy)	Marble blocks	N/A	N/A	1-500	McCormick 2010, Ref. No. 505
Carmel (Levant Coast)	Extensive collection of fishing gear	N/A	N/A	665	Galili 2007, 67-76
Carro A (1) (France)	Amphoras, lead piece	N/A	N/A	525-550	Parker 1992, 128 Benoit 1962, 152 McCormick 2010, Ref. No. 268
Cavlena (Croatia)	Marble columns, stone	N/A	N/A	1-500	McCormick 2010, Ref. No. 288
Cefalù (Italy)	Keay-type amphoras 53, 54, 55 and 62; Some amphoras, still sealed and inscribed with contents (Riley LRA 1 = Scorpan VIII B = British Bii); Byzantine oil amphoras (Riley LRA 2 = Scorpan VII A = British Bi); ballast, several iron anchors, galley bricks and frame timbers	35 m	6 m	Mid-Sixth Century	Purpura 1983, 93-105 McCormick 2010, Ref. No. 292
Cervia (Italy)	Copper pot, amphora fragments, sounding lead, roof tile, anchor. Hull of a lagoon boat.	15 m	3 m	600-700	Beltrame 2009, 415 Bonino 1978, 53 McCormick 2010, Ref. No. 293

SITE NAME/ LOCATION	AMPHORAS/CARGO/OTHER GEAR	EST. SHIP LENGTH	EST. SHIP WIDTH	DATE (C.E.)	REFERENCE
Chantenay (France)	Roman fineware	N/A	N/A	1-500	McCormick 2010, Ref. No. 295
Cherchel 2 (North Africa)	Ceramic pottery, well-preserved hull remains	N/A	N/A	1-500	McCormick 2010, Ref. No. 299
Çihli Burnu (Turkey)		N/A	N/A	7th Century	Ginalis 2008, 140 Günsenin in Macrides 2002, 125-136
Ciudadela (Spain)	Roman amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 322.01
Corbella (Italy)	Lead anchor stock	N/A	N/A	1-500	McCormick 2010, Ref. No. 336
Datça A (1) (Turkey)	Byzantine amphoras	N/A	N/A	400-650	Frey 1982, 5 Parker 1992, 159 McCormick 2010, Ref. No. 351
Datça A (2) (Turkey)	Globular baluster-shaped amphoras; well-preserved hull remains	N/A	N/A	650-725	Parker 1992, 159 McCormick 2010, Ref. No. 352
Delphinion (K?) (Turkey)	Byzantine amphoras similar to Riley D 377, some Riley LR1 (Keay 53)	N/A	N/A	400-600	Garnett 1961, 106-11 McCormick 2010, Ref. No. 357
Dor (Levant Coast)	Amphoras; well-preserved ship bottom.	N/A	N/A	600-700	McCormick 2010, Ref. No. 367 Parker 1992, 164
Dor 1 (A) (Levant Coast)	Palestinian amphoras	N/A	N/A	600-640	McCormick 2010, No Ref. No.
Dor 2001/1 (Levant Coast)	Yassi-Ada-type amphoras (7 th century). (Castro states 16m); Byzantine cooking pots	11.5 m	4.5 m	420-540	Blue 2006, 84-8 McCormick 2010, No Ref. No.

SITE NAME/ LOCATION	AMPHORAS/CARGO/OTHER GEAR	EST. SHIP LENGTH	EST. SHIP WIDTH	DATE (C.E.)	REFERENCE
Dor 4 (D) (Levant Coast)	Three single-hole stone anchors. Bag-shaped amphoras (LR4/LR5 from Palestine between Gaza and Ashkelon), extensive ballast (which preserved planking), an iron pick. Made of Cypress. Has trunnels. Carried roof tiles from Cyprus, LR1, LR2, ARS, Keay 42D amphoras.	15 m	N/A	539-621	Mango 2009, 324 Kingsley 2004, 45-73 McCormick 2010, No Ref. No.
Dor 5 (E) (Levant Coast)	Palestinian LR4 amphoras. Persian jar fragments (crew items?). Chalk ballast lead bilge pipe. Gazan amphoras.	N/A	N/A	500-700	Kingsley 1996, 64-65 McCormick 2010, No Ref. No.
Dor 6 (F) (Levant Coast)	Ashlar marble, amphoras; one single-hole stone anchor, hammer head	N/A	N/A	600-640	McCormick 2010, No Ref. No.
Dor 7 (G) (Levant Coast)	Ashlar blocks, amphoras	N/A	N/A	600-640	McCormick 2010, No Ref. No.

SITE NAME/ LOCATION	AMPHORAS/CARGO/OTHER GEAR	EST. SHIP LENGTH	EST. SHIP WIDTH	DATE (C.E.)	REFERENCE
Dor J (Levant Coast)	Byzantine bag-shaped LR5 amphoras, T-shaped iron anchor two daggers four fragmentary amphoras packing material (straw rope coils) lead sounding-weight copper pitcher cypress ceiling planking and birch frames. Wood is not local ship was probably from elsewhere. Wreck has been called Byzantine for its cargo.	12 m	N/A	500-600	McCormick 2010, No Ref. No.
Dor O (Trench IX) (Levant Coast)	Masonry, pottery	N/A	N/A	553-645	McCormick 2010, No Ref. No.
Dor (Trench IV) (Levant Coast)	LR5 amphoras (might be Tantura A, see Kingsley 2002, 4)	N/A	N/A	500-700	McCormick 2010, No Ref. No.
Dramont 9 (France)	Stone blocks	N/A	N/A	1-500	McCormick 2010, Ref. No. 378
Ekinlik (Turkey)	Approximately 17 columns and broken pieces; 15 capitals/bases	N/A	N/A	570	Berlinghieri 2012, 67
Favaritx (Spain)	Hundreds of Byzantine bronze objects possibly liturgical en route from Egypt or Syria. Coarseware, amphoras	N/A	N/A	450-600	Fernández-Maranda 1977, 821-3 Parker 1992, 176 McCormick 2010, Ref. No. 397
Favone (Italy)	LR amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 397.01
Filfla (Malta)	Roman amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 400

SITE NAME/ LOCATION	AMPHORAS/CARGO/OTHER GEAR	EST. SHIP LENGTH	EST. SHIP WIDTH	DATE (C.E.)	REFERENCE
Filicudi Porto A (Italy)	Keay 62 amphoras, Beltran- Lloris 59 wine amphoras from modern Tunisia	N/A	N/A	475-550	Kapitän 1977, 47 Parker 1992, 178 McCormick 2010, Ref. No. 401
Fondana Amorosa (Cyprus)	Amphoras, sounding lead	N/A	N/A	1-500	McCormick 2010, Ref. No. 414
Formiche di Grosseto 1, Le (Italy)	Amphoras, lead anchor stock	N/A	N/A	1-500	McCormick 2010, Ref. No. 419
Formiche di Grosseto 2, Le (Italy)	Amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 420
Formiche di Grosseto 3, Le (Italy)	Amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 421
Gibraltar 1 (Spain)	N/A	N/A	N/A	1-500	McCormick 2010, Ref. No. 444
Gibraltar 2 (Spain)	N/A	N/A	N/A	1-500	McCormick 2010, Ref. No. 445
Gibraltar 3 (Spain)	N/A	N/A	N/A	500-1500	McCormick 2010, Ref. No. 446
Givat Olga (Levant Coast)	LR4	N/A	N/A	6th-7th Century	Kingsley 2002, 52 Kingsley 2004, 47 Ginalis 2008, 139
Glaronissi (Turkey)	Roman amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 455
Golo (Italy)	Well-preserved hull with mast- step, deck	14 m	N/A	1-500	McCormick 2010, Ref. No. 460
Grazel 2 (B) (France)	Bronze pots, box, strainer, lamp, fittings (dated by coin finds)	N/A	N/A	631	Parker 1992, 205 McCormick 2010, Ref. No. 483
Grebeni (Croatia)	Ceramic, Roof tiles	N/A	N/A	1-500	McCormick 2010, Ref. No. 484
Hormigas, Las (Spain)	Keay 35 amphoras	N/A	N/A	425-550	Ginalis 2008, 138 Parker 1992, 212-3

SITE NAME/ LOCATION	AMPHORAS/CARGO/OTHER GEAR	EST. SHIP LENGTH	EST. SHIP WIDTH	DATE (C.E.)	REFERENCE
Hydra (Greece)		N/A	N/A	6th-7th Century	Ginalis 2008, 142
Iassos (Turkey)	Well-preserved hull, few other details	N/A	N/A	300-700	Bass 1974, 337 McCormick 2010, Ref. No. 509
Isis		12 m	N/A		Kingsley 2002, 85-94
Iskandil Burnu 1 (Turkey)	2000+ globular amphoras, Riley LR3, egg-shaped havit, cigar- shaped from Gaza, hourglass shaped from Cyprus/Asia, carrot-shaped Egyptian	20 m	5 m	575-600	Kingsley 2001, 52 Parker 1992, 217 McCormick 2010, Ref. No. 518
Unnamed Wreck (Levant Coast)	Sixth century pottery; ballast	N/A	N/A	500-600	Parker 1992, 220 McCormick 2010, Ref. No. 525
Jezirat Fara'un (Levant Coast)	Byzantine amphoras, possible buried hull under sand	N/A	N/A	500-1500	McCormick 2010, Ref. No. 531.01
Kallithea (Greece)	Byzantine amphoras	N/A	N/A	500-1500	McCormick 2010, Ref. No. 532
Kekova Oludeniz (Turkey)	LR5	N/A	N/A	Byzantine	Ginalis 2008, 88
Kerme Gulf (Turkey)	Ceramic tiles, amphoras, coarseware pottery	N/A	N/A	300-1200	McCormick 2010, Ref. No. 543
Kizilburun (Turkey)	Columns of different sizes, slabs, a column capital, double column. All of white and red unidentified marble.	N/A	N/A	5th-6th Century	Berlinghieri 2012, 67
Kizilagac Adasi (Turkey)	LR5	N/A	N/A	Byzantine	McCormick 2010, Ref. No. 546
Komi 2 (Turkey)	Ceramic roof tiles, terracotta pipes, Roman amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 553
Küçük Ada (Turkey)	Water pipes	N/A	N/A	7th Century	Ginalis 2008, 140 Günsenin in Macrides 2002, 125-36

SITE NAME/ LOCATION	AMPHORAS/CARGO/OTHER GEAR	EST. SHIP LENGTH	EST. SHIP WIDTH	DATE (C.E.)	REFERENCE
Kuyu Burnu (Turkey)	Tile	N/A	N/A	7th Century	Ginalis 2008, 140 Günsenin in Macrides 2002, 125-36
Lastovo 1 (Croatia)	Amphoras	N/A	N/A	400-500	McCormick 2010, Ref. No. 570
Lastovo 6 (Croatia)	Roman amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 575
Lixouri (Greece)	Marble statues, 2 ionic capitals, 4 half-column bases	N/A	N/A	1-500	McCormick 2010, Ref. No. 604
Maddalena (Italy)	N/A	N/A	N/A	1-500	McCormick 2010, Ref. No. 614
Margarina (Croatia)	Stone blocks, columns	N/A	N/A	500	McCormick 2010, Ref. No. 653
Marmaris 1 (Turkey)	Ceramic Byzantine plates	N/A	N/A	700-900	McCormick 2010, Ref. No. 657 Ginalis 2008,140
Marsa Lucch (North Africa)	Riley LR8a amphoras	6 m	2 m	500-650	Parker 1992, 262 McCormick 2010, Ref. No. 660
Marsala 3 (Italy)	N/A	N/A	N/A	500-1500	McCormick 2010, Ref. No. 665
Marsaskala (Malta)	LR1/Large African/Sigillata (dumped cargo in the harbor?)	N/A	N/A	475-525	McCormick 2010, No Ref. No.
Marzamemi B The “Church Wreck” (Italy)	Proconnesian architectural carved marble, Thessalian breccias, and green “verde antico.” 28 columns, 28 bases, 27 capitals, screen slabs, nearly a complete ambo	N/A	N/A	500-540	Kapitän 1969, 122-33 Parker 1992, 267 McCormick 2010, Ref. No. 671 Berlinghieri 2012, 67
Marzamemi 3 (Italy)	Red Nubian marble column	N/A	N/A	500	McCormick 2010, Ref. No. 672
Marzamemi J (10) (Italy)	Undateable Byzantine Amphora sherds	N/A	N/A	400-600	Parker 1992, 269 McCormick 2010, Ref. No. 678
Marzamemi K (11) (Italy)	Amphoras	N/A	N/A	400-600	Parker 1992, 269 McCormick 2010, Ref. No. 679
Methone 2 (Greece)	Ceramic Medieval jars; ballast	N/A	N/A	500-1500	McCormick 2010, Ref. No. 694

SITE NAME/ LOCATION	AMPHORAS/CARGO/OTHER GEAR	EST. SHIP LENGTH	EST. SHIP WIDTH	DATE (C.E.)	REFERENCE
Munxar (Malta)	Spanish-Roman Amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 723
Neseber B (Black Sea)	Globular amphoras typical of Sixth/7 th centuries	N/A	N/A	500-625	Parker 1992, 287 McCormick 2010, Ref. No. 738
Newe Yam 2 (Levant Coast)	Amphoras	N/A	N/A	300-1500	McCormick 2010, Ref. No. 740
Olbia R0 (Italy)	Possible Bronze ship scrap	N/A	N/A	400-500	McCormick 2010, No Ref. No.
Olbia R1 (Italy)		15 m	N/A	400-500	McCormick 2010, No Ref. No.
Olbia R1 Sud (Italy)		N/A	N/A	400-500	McCormick 2010, No Ref. No.
Olbia R2 (Italy)	This ship, R6 and R15 possibly from same yard.	N/A	N/A	400-500	McCormick 2010, No Ref. No.
Olbia R2 Sud (Italy)		N/A	N/A	400-500	McCormick 2010, No Ref. No.
Olbia R3 (Italy)		N/A	N/A	400-500	McCormick 2010, No Ref. No.
Olbia R3 Sud (Italy)		N/A	N/A	400-500	McCormick 2010, No Ref. No.
Olbia R6 (Italy)	This ship, R2 and R15 possibly from same yard.	N/A	N/A	400-500	McCormick 2010, No Ref. No.
Olbia R7 (Italy)		N/A	N/A	400-500	McCormick 2010, No Ref. No.
Olbia R12 (Italy)		N/A	N/A	400-500	McCormick 2010, No Ref. No.
Olbia R13 (Italy)	Naval vessel.	30.35 m	N/A	400-500	Riccardi 2002, 268-9 McCormick 2010, No Ref. No.

SITE NAME/ LOCATION	AMPHORAS/CARGO/OTHER GEAR	EST. SHIP LENGTH	EST. SHIP WIDTH	DATE (C.E.)	REFERENCE
Olbia R14 (Italy)		N/A	N/A	400-500	McCormick 2010, No Ref. No.
Olbia R15 (Italy)	This ship, R2 and R6 possibly from same yard.	N/A	N/A	400-500	McCormick 2010, No Ref. No.
Olbia RT (Italy)	Small tender	4 m	N/A	400-500	McCormick 2010, No Ref. No.
Opat (Croatia)	Ceramic roof tiles	N/A	N/A	1-500	McCormick 2010, Ref. No.764
Orlamonde (Black Sea)	Late Roman and African amphoras	N/A	N/A	300-500	McCormick 2010, No Ref. No.
Palazzolo di Strella (Italy)	Central part of a large Roman boat found with ceramics, bricks.	N/A	N/A	1-500	McCormick 2010, Ref. No. 777
Palese (Italy)	Amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 778
Palinuro (Italy)	Amphoras, hull remains, 2 lead anchor stocks	N/A	N/A	1-500	McCormick 2010, Ref. No. 779
Palizi Marina (Italy)	Lead sulphur ingots	N/A	N/A	1-500	McCormick 2010, Ref. No. 780
Palud, La (France)	LR1/LR2/LR5/LR4 amphoras, primary cargo of Tunisian amphoras with smaller consignment of jars from Aegean, Syria and Palestine. Key 62 and 55. Roof tiles and coarseware.	N/A	N/A	540-600	Kingsley 2001, 52 Parker 1992, 301 Mango 2009, 325 Kingsley 2002, 79 Long and Volpe 1998, 338-9 McCormick 2010, Ref. No. 782

SITE NAME/ LOCATION	AMPHORAS/CARGO/OTHER GEAR	EST. SHIP LENGTH	EST. SHIP WIDTH	DATE (C.E.)	REFERENCE
Pantano Longarini (Italy)	Cargo capacity of over 300 tons. Hull shape similar to Yassı Ada 7 th century wreck. C14 dated to 500 +/-120 and 622 +/- 48.	30 m	N/A	600-650	Throckmorton 1987, 95 Parker 1992, 303 McCormick 2010, Ref. No. 787
Pantelleria (Italy)	Late Roman amphoras and Pantellerian wares	N/A	N/A	400-500	McCormick 2010, Ref. No. 788
Parco di Teodorico (Italy)	Well-preserved hull remains	9 m	3.1 m	400-500	McCormick 2010, No Ref. No.
Pefkos (Turkey)	Byzantine globular amphoras	N/A	N/A	400-700	Parker 1992, 305 McCormick 2010, Ref. No. 795
Pelosa 1 (Italy)	Glazed pottery	N/A	N/A	1-500	McCormick 2010, Ref. No. 798
Pelosa 2 (Italy)	Roman pottery	N/A	N/A	500-1500	McCormick 2010, Ref. No. 799
Petit Rhone, Le (France)	Lead ingots	N/A	N/A	1-500	McCormick 2010, Ref. No. 807
Pian di Spille (Italy)	Keay 25 and 52 amphoras	N/A	N/A	350-500	McCormick 2010, Ref. No. 811
Pisa D (Italy)	Oak, wreck had been salvaged or recycled	14 m	N/A	400-500	McCormick 2010, No Ref. No.
Pisa H (Italy)	Flat-bottomed river boat	N/A	N/A	1-500	McCormick 2010, No Ref. No.
Plitharia (Greece)	Amphoras	N/A	N/A	300-800	McCormick 2010, Ref. No. 836
Plocice (Croatia)	Ceramic roof tiles	N/A	N/A	1-500	McCormick 2010, Ref. No. 837
Pomorje A (1) (Black Sea)	Amphora cargo	N/A	N/A	400-600	Lazarov 1985, 138 McCormick 2010, Ref. No. 860
Pomorje B (2) (Black Sea)	Tile cargo	N/A	N/A	400-600	Lazarov 1985, 138 McCormick 2010, Ref. No. 861

SITE NAME/ LOCATION	AMPHORAS/CARGO/OTHER GEAR	EST. SHIP LENGTH	EST. SHIP WIDTH	DATE (C.E.)	REFERENCE
Pontelagoscuro (Italy)		N/A	N/A	300-1100	McCormick 2010, Ref. No. 864
Port Berteau II (France)		14.3 m	4.8 m	599	Flatman 2007, 99 Rieth 2001, passim
Porto Cheli (Greece)	Ballast and globular amphoras	N/A	N/A	500-600	Parker 1992, 335 McCormick 2010, Ref. No. 884
Porto Ercole (Italy)	Dolia	N/A	N/A	1-500	McCormick 2010, Ref. No. 888.01
Porto Longo (Greece)	Byzantine amphoras/potsherds	N/A	N/A	400-650	Parker 1992, 337 McCormick 2010, Ref. No. 889
Posillipo (Italy)	Wooden hull with bronze nails	N/A	N/A	1-500	McCormick 2010, Ref. No. 896
Praiano (Italy)	Afr1 and Afr2 amphoras.	N/A	N/A	1-500	McCormick 2010, Ref. No. 899
Prasso (Turkey)	Riley LR2 Amphoras	N/A	N/A	400-700	Garnett & Boardman 1961, 107-12 Parker 1992, 341 McCormick 2010, Ref. No. 900
Premuda B (2) (Croatia)	Globular Byzantine amphoras	N/A	N/A	400-600	Brusic 1980, 162 Parker 1992, 341 McCormick 2010, Ref. No. 902
Premuda 3 (Croatia)	Probable medieval ship	N/A	N/A	500-1500	McCormick 2010, Ref. No. 903
Punta Altarella (Italy)	Amphoras and pottery	N/A	N/A	1-500	McCormick 2010, Ref. No. 913
Punta del Diavolo (Italy)	Limestone blocks	N/A	N/A	500-1500	McCormick 2010, Ref. No. 924
Punta del Milagro (Spain)	Stone column drums	N/A	N/A	1-500	McCormick 2010, Ref. No. 926
Punta Glavina 2 (Croatia)	Pear-shaped amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 941

SITE NAME/ LOCATION	AMPHORAS/CARGO/OTHER GEAR	EST. SHIP LENGTH	EST. SHIP WIDTH	DATE (C.E.)	REFERENCE
Punta Nera (Italy)	Amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 948
Punta Secca 1 (Italy)	Well-preserved hull remains. 7 th c. Byzantine coin. No other cargo found.	N/A	N/A	650-700	Parker 1992, 362 McCormick 2010, Ref. No. 967
Punta Secca 2 (Italy)	Well-preserved hull remains. No cargo found.	N/A	N/A	650-700	Parker 1992, 362 McCormick 2010, Ref. No. 968
Ras Achakkar (North Africa)	Amphoras, 'Roman bushel tap'	N/A	N/A	1-500	McCormick 2010, Ref. No. 976
Rocca di San Nicola 2 (Italy)	5 th c. pottery, LR/Byz anchors	N/A	N/A	300-500	McCormick 2010, Ref. No. 990
Rocca di San Nicola 3 (Italy)	5 th c. pottery, LR/Byz anchors	N/A	N/A	400-500	McCormick 2010, Ref. No. 991
Saint-Gervais 2 (France)	Wheat cargo, Keay 8a and spatheia amphoras. N Afr ts chiara D, orange-painted and orange, lead-glazed pottery, grey-ware pitchers, amphoras, 2 Merovingian broaches, barrel, fine eastern ceramic, everyday ceramic 1 LR 5 amph, probably galley stores, acc Kingsley 2002, 79, citg Jézégou 1983, p. 115.	N/A	N/A	600-650	Parker 1992, 372 McCormick 2010, Ref. No. 1001
Saint-Hospice (France)	N/A	N/A	N/A	1-500	McCormick 2010, Ref. No. 1005
Saliagos (Greece)	Roman coarseware; ballast	N/A	N/A	1-500	McCormick 2010, Ref. No. 1016

SITE NAME/ LOCATION	AMPHORAS/CARGO/OTHER GEAR	EST. SHIP LENGTH	EST. SHIP WIDTH	DATE (C.E.)	REFERENCE
San Vito (Italy)	Amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 1025
Sant'Antioco 2 (Italy)	Transport ship carrying stone blocks	N/A	N/A	1-500	McCormick 2010, Ref. No. 1030
Santo Ianni (Italy)	Lead-stocked anchors	N/A	N/A	1-500	McCormick 2010, Ref. No. 1036
Sapientza (Greece)	Marble blocks, slabs	N/A	N/A	1-500	McCormick 2010, Ref. No. 1037
Scauri (Malta)	Mixed, specialized ceramics, including Pantellerian ware.	N/A	N/A	500-700	Bonanno 2008, 32
Sciacca (Italy)	N/A	N/A	N/A	1-500	McCormick 2010, Ref. No. 1047
Scoglitti (Italy)	N/A	N/A	N/A	1-500	McCormick 2010, Ref. No. 1054
Sdot Yam (Levant Coast)	LR4; Gazan Keay 25 amphoras	N/A	N/A	400-600	Raban 1989, 234 McCormick 2010, Ref. No. 1069
Secche di Ugento 3 (Italy)	Globular amphoras	N/A	N/A	600-700	Parker 1992, 397 McCormick 2010, Ref. No. 1068
Sidi Ahmad (North Africa)	Marble columns	N/A	N/A	1-500	McCormick 2010, Ref. No. 1082
Silba 3 (Croatia)	Roof tiles	N/A	N/A	1-500	McCormick 2010, Ref. No. 1086
Silba 4 (Croatia)	Glass	N/A	N/A	500-1500	McCormick 2010, Ref. No. 1087
Sinop A (Turkey)	Carrot-shaped, Byzantine amphoras, characteristic of Sinop	20 m	10 m	300-599	McCormick 2010, No Ref. No.
Sinop B (Turkey)	LR1 and Carrot-shaped, Byzantine amphoras characteristic of Sinop	24 m	12 m	300-599	McCormick 2010, No Ref. No.

SITE NAME/ LOCATION	AMPHORAS/CARGO/OTHER GEAR	EST. SHIP LENGTH	EST. SHIP WIDTH	DATE (C.E.)	REFERENCE
Sinop C (Turkey)	Carrot-shaped, Byzantine amphoras, characteristic of Sinop	N/A	N/A	300-599	McCormick 2010, No Ref. No.
Sinop D (Turkey)	Ancient Jug	13 m	N/A	410-520	McCormick 2010, No Ref. No.
Siracusa 2 (B) (Italy)	Byzantine amphoras	N/A	N/A	400-600	Parker 1992, 406 McCormick 2010, Ref. No. 1092
Siracusa 3 (C) (Italy)	Amphoras	N/A	N/A	400-600	Parker 1992, 406 McCormick 2010, Ref. No. 1093
Siracusa 4 (Italy)	Amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 1094
Skarda 2 (Croatia)	Roof tiles	N/A	N/A	1-500	McCormick 2010, Ref. No. 1097
Sorres 4, Les (France)	N/A	N/A	N/A	1-500	McCormick 2010, Ref. No. 1104
Sorres 5, Les (France)	N/A	N/A	N/A	1-500	McCormick 2010, Ref. No. 1105
Sorres 6, Les (France)	N/A	N/A	N/A	1-500	McCormick 2010, Ref. No. 1106
South Euboea – 2 wrecks (Greece)	N/A	N/A	N/A	6th Century	Ginalis 2008, 139
Sulcis (Italy)	Planking, keel and nails found. No cargo found.	23 m	7 m	1-500	McCormick 2010, Ref. No. 1122
Susak (Croatia)	Roof tiles	N/A	N/A	1-500	McCormick 2010, Ref. No. 1123
Syria (Levant Coast)	Arab Amphoras, ceramic jars	N/A	N/A	800-900	McCormick 2010, Ref. No. 1125
Tantura A (Levant Coast)	(Same as Dor J?) LR5 Byzantine bag-shaped amphoras sherds.	12 m	4 m	415-530	Castro et al. 2008, 352 McCormick 2010, No Ref. No.

SITE NAME/ LOCATION	AMPHORAS/CARGO/OTHER GEAR	EST. SHIP LENGTH	EST. SHIP WIDTH	DATE (C.E.)	REFERENCE
Tantura Arab (Levant Coast)	Amphoras	N/A	N/A	700-900	McCormick 2010, No Ref. No.
Tantura E (Dor) (Levant Coast)	N/A	7.6 m	2.14 m	8th century	Ginalis 2008, 54 McCormick 2010, No Ref. No.
Tantura F (Levant Coast)	20 storage jars, Yassi-Ada-7c.- style one-handed LR1 amphoras	12 m	3.5 m	700-759	McCormick 2010, No Ref. No. Castro et al. 2008, 352
Tantura 9 (Levant Coast)	N/A	N/A	N/A	550	McCormick 2010, No Ref. No.
Taranto 1 (A) (Italy)	Millstones	N/A	N/A	400-650	Parker 1992, 419 McCormick 2010, Ref. No. 1131
Tcerny Nos (Black Sea)	Riley LR8b amphoras	N/A	N/A	375-500	McCormick 2010, Ref. No. 1137
Thalassinies Spilies (Cyprus)	Byzantine globular amphoras	N/A	N/A	500-600	Giangrande & Richards 1985, 161 Parker 1992, 423 McCormick 2010, Ref. No. 1145
Thasos A (1) – (Greece)	LR/Byzantine Amphoras	N/A	N/A	400-600	Bouzek 1982, 136 McCormick 2010, Ref. No. 1146
Torre Flavia 1 (Italy)	Marble columns, lead rings, wood with copper nails	N/A	N/A	1-500	McCormick 2010, Ref. No. 1157
Tours (France)	Gallo-Roman vases	N/A	N/A	1-500	McCormick 2010, Ref. No. 1173
Triscina 3 (Italy)	Spatheia cylindrical amphoras	N/A	N/A	400-500	McCormick 2010, Ref. No. 1179
Tyre 3 (Levant Coast)	N/A	N/A	N/A	1-500	McCormick 2010, Ref. No. 1186
Tyre 7 (Levant Coast)	Glazed pottery, millstones	N/A	N/A	500-1500	McCormick 2010, Ref. No. 1191
Valencia (Spain)	Amphoras; lead anchor stock; bronze nails	N/A	N/A	1-500	McCormick 2010, Ref. No. 1203

SITE NAME/ LOCATION	AMPHORAS/CARGO/OTHER GEAR	EST. SHIP LENGTH	EST. SHIP WIDTH	DATE (C.E.)	REFERENCE
Varna (Black Sea)	LR amphoras	N/A	N/A	300-500	McCormick 2010, Ref. No. 1208
Vendicari (Italy)	Riley LR2 Spatheion and Keay 53 Amphoras	N/A	N/A	375-625	Parker 1981, 330-3 McCormick 2010, Ref. No. 1211
Vieste (Italy)	Ceramic tiles	N/A	N/A	500-1500	McCormick 2010, Ref. No. 1215
Viz 5 (E) (Croatia)	Amphoras	N/A	N/A	400-600	Vrsalovic 1974, 240 McCormick 2010, Ref. No. 1222
Viz 6 (Croatia)	Ceramic tiles	N/A	N/A	1-500	McCormick 2010, Ref. No. 1225
Viz 7 (Croatia)	Amphoras	N/A	N/A	1-500	McCormick 2010, Ref. No. 1226
Xanten Lower Rhine (Netherlands)	Carolingian riverboat	N/A	N/A	600-950	McCormick 2010, No Ref. No.
Yassı Ada A (1) (Turkey)	850-900 Riley Type LR1 and Type LR2 amphoras (Aegean and Syrian), 60 metric ton capacity	20.52 m	5.22 m	626	Parker 1992, 454 Bass 1982, 155-60 McCormick 2010, Ref. No. 1239
Yenikapi 6 (Turkey)	Heavily-pitched shell-built galley	N/A	N/A	600-700	McCormick 2010, No Ref. No.
Zakynthos B (2) (Greece)	Amphoras	N/A	N/A	400-700	Parker 1992, 457 McCormick 2010, Ref. No. 1244
Zapuntel (Croatia)	Ceramic pottery	N/A	N/A	500-1500	McCormick 2010, Ref. No. 1246
Zatoane (Black Sea)	Roman boat with a double wooden pulley-block	N/A	N/A	1-500	McCormick 2010, Ref. No. 1247

APPENDIX C
PLAGUE TIMELINE

DATE	LOCATION	REFERENCE
541	Ethiopia	Biraben and Le Goff 1969, 1500 Original Source: Evagrius Scholasticus, <i>Ecclesiastical History</i> , IV 29
541 (mid-July)	Pelusium (Egypt)	Sthakopoulos 2004, 113; Maas 2005, 136; Biraben and Le Goff 1969, 1494 Original Source: Procopius, <i>History of the Wars</i> , II 22 6 (I 250)
541 (mid-August through December)	Gaza, Ashkelon, Negev (Nessana, Rehovot, Eboda)	Sthakopoulos 2004, 113 and 278; Maas 2005, 136 Original Source: John of Ephesos, <i>Historiae ecclesiasticae fragmenta</i> , E 229
541 (mid-September)	Alexandria, after last grain shipment	Sthakopoulos 2004, 113-4 Original Sources: Procopius, <i>History of the Wars</i> , II 22 6 (I 250) Evagrius Scholasticus, <i>Ecclesiastical History</i> , IV 29 John of Ephesos, <i>Historiae ecclesiasticae fragmenta</i> , E 229 Pseudo-Dionysios of Tel-Mahre, <i>Chronicle, Part III</i> , 77, 80 Michael the Syrian, <i>Chronique</i> , II 235-8
542 (early months, shortly after Negev)	Jerusalem and hinterlands	Maas 2005, 136; Sthakopoulos 2002, 104 Original Sources: Cyril of Scythopolis, <i>Vita of Kyriakos</i> 10 (229)
542	Edessa	Conrad 1981, 107 Original Sources: John of Ephesos, <i>Historiae Ecclesiasticae</i> , II, 304 & 306-307 Pseudo-Zachariah Rhetor, <i>Historia Ecclesiastica</i> , II, 192 Evagrius Scholasticus, <i>Ecclesiastical History</i> , IV 29

DATE	LOCATION	REFERENCE
542	Antioch	Biraben and Le Goff 1969, 1494 Original Source: Evagrius Scholasticus, <i>Ecclesiastical History</i> , IV 29
542 (Spring)	Palestine	Stathakopoulos 2004, 114 Original Sources: Procopius, <i>History of the Wars</i> , II 22 6 (I 250) Evagrius Scholasticus, <i>Ecclesiastical History</i> , IV 29
542 (Spring)	Illyricum	Biraben and Le Goff 1969, 1494 Original Source: Auctarium Marcellini, <i>Chronicon</i> , 543-546
Sometime after the 526 earthquake	Antioch (542), Seleucia, Anazarbus, Iborra, Amasea, Polybotus, Lychnidos, Corinth	Original Source: Procopius, <i>History of the Wars</i> , II 22 6 (I 250)
542 (early Spring and Summer)	Palestine to Mesopotamia, then Cilicia, Mysia, Syria, Iconium, Bithynia, Asia, Galatia, and Cappadocia (between mid-August and late March), Armenia and Adharbayjan	Stathakopoulos 2002, 103 Original Source: John of Ephesos, <i>Historiae Ecclesiasticae</i> , II, 80 & 310 Procopius, <i>History of the Wars</i> , II 24,12 Pseudo-Zachariah Rhetor, <i>Historia Ecclesiastica</i> , II, 192
542 (late March/early April through August – lasts four months)	Constantinople	Stathakopoulos 2004, 114; Maas 2005, 136; Biraben and Le Goff 1969, 1494 Original Sources: Procopius, <i>History of the Wars</i> , II 22, 9; II 23, 1-2 & 18-19 (I 251, 256, 259) John of Ephesos, <i>Historiae Ecclesiasticae Fragmenta</i> , F-G 231-7 Pseudo-Dionysios of Tel-Mahre, <i>Chronicle, Part III</i> , 74-93 Theophanes, <i>Chronographia</i> , AM 6034 (222) John Malalas, <i>Chronographia</i> , 482 Ioannis Laurentii Lydi, <i>Liber de ostentis</i> , 122 (14-15)

DATE	LOCATION	REFERENCE
542 (Spring)	Myra/Andriake (port) - slightly before or after Constantinople	Stathakopoulos 2004, 114; Maas 2005, 136 Original Source: <i>Vita</i> of St. Nicholas of Sion, 52 (40-41)
542-543 (probably Spring 542)	Zora (Azra'a, in the Hawtan)	Stathakopoulos 2004, 115; Stathakopoulos 2002, 104 Original Source: Inscription from Koder 1995, 13-18
542 (early Summer)	Antioch	Maas 2005, 136; Stathakopoulos 2004, 282; Biraben 1969, 1494 Original Sources: Evagrius Scholasticus, <i>Ecclesiastical History</i> , IV 29 <i>Vita</i> of Simeon Stylites the Younger, 69 (I 59-60)
542 (Summer)	Syria (via water); Apameia, Epiphaneia and Emesa	Stathakopoulos 2004, 114; Conrad 1984, 107; Allen 1979, 6 Original Sources: John of Ephesos, <i>Historiae ecclesiasticae</i> , II, 304-7 Evagrius Scholasticus, <i>Ecclesiastical History</i> , IV 29 Pseudo-Zachariah Rhetor, <i>Historia Ecclesiastica</i> , II, 129-30
542 (Summer)	"Africa", including Carthage, Tunisian countryside, the western Mediterranean coast and eastern Algeria	Little 2007, 173; Biraben and Le Goff 1969, 1494 Original Sources: Corippus, <i>Iohannis seu de Bellis Libycis</i> , II (10-13), III (63), VIII (307-9) <i>Chronicles of Saragoza</i> , M.G.H., AA., XI/2, 201
542 (Summer)	Sykeon in Galatia	Maas 2005, 136; Stathakopoulos 2004, 115 & 289 Original Source: <i>Vita</i> of Theodore of Sykeon, I 7-8
542 (Autumn)	Plague strikes the Persian army, they retreat.	Stathakopoulos 2004, 115
542 (Autumn) or 543	Media Atropatene (Azerbaijan)	Maas 2005, 136; Sarris 2002, 171; Biraben and Le Goff 1969, 1494 Original Source: Procopius, <i>History of the Wars</i> , II 22

DATE	LOCATION	REFERENCE
542 (possibly October)	Spain	Rosen 2007, 220; Biraben and Le Goff 1969, 1494; Kulikowski in Little, 151 Original Sources: Corippus, <i>Iohannis seu de Bellis Libycis</i> , III/2, XVI, XVIII <i>Chronicles of Saragoza</i> , XI/2, 201
542 (December)	Sicily (Mazara)	Stathakopoulos 2004, 115 & 290-1 Original Source: Inscription in Manganaro 2001, 133
543 (January-February)	Sufetula, Mainland of Tunisia	Stathakopoulos 2004, 115 Original Source: Auctarium Marcellini, <i>Chronicon</i> , 543-546
543	Arles and ‘various parts of Gaul’; arrives at the limits of Clermont (Auvergne); to stop it St. Gall institutes Rogation days.	Rosen 2007, 260; Biraben and Le Goff 1969, 1494; Jones 2009, 54 Original Sources: Gregory of Tours, <i>History of the Franks</i> , IV 5 Gregory of Tours, <i>Liber in Gloria Martyrum</i> : I/3 Gregory of Tours, <i>Life of the Fathers</i> , VI 6
543	Arriving at the limits of Reims, where the relics of St. Remi halted its advance.	Biraben and Le Goff 1969, 1494 Original Source: Gregory of Tours, <i>Glory of the Confessors</i> , 78, I/2
543	Italy (possibly via Illyricum), Orient, Illyricum	Stathakopoulos 2004, 115 Original Sources: Auctarium Marcellini, <i>Chronicon</i> , 543-546 <i>Chronicorum Caesaraugustanorum Reliquiae</i> , a. 542, XI, 223
543? (Between 525-585)	Trier (Trèves), France	Biraben and Le Goff 1969, 1494 Original Source: Gregory of Tours, <i>Life of the Fathers</i> , XVII, 4
543	Southern France	Stathakopoulos 2004, 116 Original Source: Gregory of Tours, <i>History of the Franks</i> , IV 5
543	Spain	Biraben and Le Goff 1969, 1494 Original Source: <i>Chronicles of Saragoza</i> , XI/2, 201

DATE	LOCATION	REFERENCE
543	Libya	Rosen 2007, 277 Original Source: Victor of Tunnuna, <i>Chronica</i> [no additional details provided in Rosen]
543-544	Italy: specifically Insubria (probably Milan, Como and Cremona plus their environs), Liguria (the Riviera, Genova and Monferrato), a large part of Piemonte and the south of France	Frari 1840, 271-2 Original Source: Leonard Aretin, lib. II. In Papon Chronolog. Historiq. Des Pestes V. II, 260 [Frari cites these two sources, but I was unable to locate either. My closest guess for Papon is listed in Works Cited under Secondary Sources]
543-March 544	Constantinople (in his Novels, Justinian declares the plague ended on March 23, 544)	Biraben and Le Goff 1969, 1494 Original Source: Procopius, <i>History of the Wars</i> , II 22
543-544 (November-February)	Rome (likely arriving from North Africa) – but why not north Italy?	Stathakopoulos 2004, 293 Original Source: <i>Inscriptiones Christianae Urbis Romae septimo seculo antiquiores</i> [see Stathakopoulos for listing of specific inscriptions]
544	Ireland	Maddicott 1997, 10 Original Source: Annals of Tigernach, XVII, 137 & 198
545-7	Mesopotamia (plague and famine)	Rosen 2007, 251; Stathakopoulos 2004, 298 Original Sources: Pseudo-Dionysios of Tel-Mahre, <i>Chronicle, Part III</i> , 102 Pseudo-Zachariah Rhetor, X 14 (II 131) Jacob of Edessa, ad a.860AG (243) Agapios, <i>Kitab al-'unwan</i> , 432
546	Germania devastated by “Lues Inguinaria”	Simpson 1905, 15; Frari 1840, 272 Original Source: Gregory of Tours, <i>Glory of the Confessors</i> , LXXIX
551 or 552	Arles and “Various Parts of Gaul”	Allen 1979, 15; Simpson 1905, 15 Original Source: Gregory of Tours, <i>History of the Franks</i> , IV 5

DATE	LOCATION	REFERENCE
553-554	Constantinople	Allen 1979, 13 Original Source: Evagrius Scholasticus, <i>Ecclesiastical History</i> , IV 29
554 (Autumn)	Remains of the Alemanni army obliterated by 'plague' in Ceneta, Italy as they retreat north after the Battle of Volturnus. Their commander, Leutharis, dies of plague with them. Could be referring to malaria or rabies instead of plague; original reference unclear.	Stathakopoulos 2004, 302 Original Sources: Agathias, <i>The Histories</i> , I, 6; II, 2, 8, 9 Gregory of Tours, <i>History of the Franks</i> , III 32
556	Constantinople	Allen 1979, 15 Original Sources: John Malalas, <i>Chronographia</i> , 482 Theophanes, <i>Chronographia</i> , AM 6038
557-558 (October 1 through September 30)	Amida	Rosen 2007, 252; Stathakopoulos 2004, 304 Original Source: Pseudo-Dionysios of Tel-Mahre, <i>Chronicle, Part III</i> , 107
557-558	Antioch	Biraben and Le Goff 1969, 1494 Original Source: Evagrius Scholasticus, <i>Ecclesiastical History</i> , IV 29
558 (February through July or August)	Constantinople, after earthquake	Biraben and Le Goff 1969, 1494; Stathakopoulos 2004, 304 Original Sources: Agathias, <i>The Histories</i> , V, 9-10 Theophanes, <i>Chronographia</i> , AM 6050 (232) John Malalas, <i>Chronographia</i> , 489 Evagrius Scholasticus, <i>Ecclesiastical History</i> , IV 29 Procopius, <i>History of the Wars</i> , II 23 Agapios, <i>Kitab al-'unwan</i> , 322 Michaelis Glycae, <i>Annales</i> , IV, 270 & 499

DATE	LOCATION	REFERENCE
559	Ancona	Rosen 2007, 220
559-561	Ravenna, Grado and Istria	Biraben and Le Goff 1969, 1495 Original Source: Paul the Deacon, <i>History of the Lombards</i> , IV, 4
560-561	Cilicia, Nisibis, Antioch, Anazarbus, Syria (in April) and Mesopotamia	Maas 2005, 138; Rosen 2007, 252; Stathakopoulos 2004, 307-8; Allen 1979, 13; Conrad 1981, 124-5 Original Sources: Theophanes, <i>Chronographia</i> , 6053 (235) <i>Vita</i> of Symeon Stylites the Younger 126-9 (112-22) <i>Chronicon ad a. 724</i> , 143
563	Auvergne, after a flood, then Clermont, Lyon, Bourges, Chalon, Dijon	Simpson 1905, 15 Original Source: Gregory of Tours, <i>History of the Franks</i> , IV, 31
567-569	Constantinople	Allen 1979, 13 Original Sources: Agaprios, <i>Kitab al-'unwan</i> , 435-7 Michael the Syrian, <i>Chronique</i> , X. 8; II 309 Evagrius Scholasticus, <i>Ecclesiastical History</i> , IV 29
570	Marseilles	Biraben and Le Goff 1969, 1501 Original Source: [None provided in Biraben]
571	Liguria (all over Italy then north, stopping at the border of the Alemanni and Bavarians)	Biraben 1969, 1495; Stathakopoulos 2004, 310 & 314 Original Source: Paul the Deacon, <i>History of the Lombards</i> , II 4 Marius of Avenches, <i>Chronica</i> , ad a. 571 (238) Gregory of Tours, <i>History of the Franks</i> , IV 31, 168
571	Lyon, Bourges, Chalon-sur-Saône, Dijon, Clermont (all of the region of Auvergne, stopping short of Tours), Cahors	Biraben 1969, 1495; Simpson 1905, 15; Stathakopoulos 2004, 314 Original Sources: Gregory of Tours, <i>History of the Franks</i> , IV 5 & 31 Marius of Avenches, <i>Chronica</i> , ad a. 571 (238) Gregory of Tours, <i>Life of the Fathers</i> , IX
571	Sens and Les Clos des Cordelier	Castex 2008, 29

DATE	LOCATION	REFERENCE
573	Antioch	Biraben 1969, 1495 Original Source: Evagrius Scholasticus, <i>Ecclesiastical History</i> , IV 29
573?	Nisibis	Conrad 1984, 135 Original Source: G.S. Assemani, <i>Bibliotheca orientalis</i> , III, I, 72
573-574	Constantinople (plague continues at the accession of Tiberius Caesar, but subsides on his first day), 'Orient'	Allen 1979, 13; Biraben and Le Goff 1969, 1495; Stathakopoulos 2004, 315 Original Sources: Agapios, <i>Kitab al-'unwan</i> , 435-7 Michael the Syrian, <i>Chronique</i> , II 309, IX 28, X 8 John of Biclaro, <i>Chronicle</i> , 67-8
573-588	Clermont-Ferrand, Lyon, Bourges, Chalon-sur-Saone, Dijon	Rosen 2007, 220 & 260 Original Source: Gregory of Tours, <i>History of the Franks</i> , II 31
579	France, after extraordinary flooding	Frari 1840, 273
580	Spain: Carpitanie, region of Toledo	Biraben and Le Goff 1969, 1495 Original Source: Gregory of Tours, <i>History of the Franks</i> , VI 33
580-581	Constantinople	Allen 1979, 13 Original Source: Agapios, <i>Kitab al-'unwan</i> , 438-9
580, 581, 582 (3 events)	Narbonne, other parts of Gaul	Simpson 1905, 15; Jones 2009, 262; Biraben and Le Goff 1969, 1496 Original Source: Gregory of Tours, <i>History of the Franks</i> , VI 14 & 33, VII 1
582	Lorraine	Frari 1840, 273 Original Source: Gregory of Tours, <i>History of the Franks</i> , VI 14 & 33, VII 1
582	Albi	Biraben and Le Goff 1969, 1496; Simpson 1905, 15 Original Source: Gregory of Tours, <i>History of the Franks</i> , VI 14 & 33, VII 1

DATE	LOCATION	REFERENCE
580s/590s	Angers	Bentley 1998, 249 Gregory of Tours, <i>History of the Franks</i> , IV, 31; VI, 14; IX, 21; X, 23 & 25
583-586	Constantinople	Allen 1979, 13 Original Source: Evagrius Scholasticus, <i>Ecclesiastical History</i> , IV 29-32 Agapios, <i>Kitab al-'unwan</i> , 438-9
586-588	Narbonne (586), then south France in 587-88. In 588 Lyon and Italy.	Frari 1840, 273-4
588	Zara (in Dalmatia)	Frari 1840, 274 Original Source: Thom. Archidiac. Spalaten. Hist. Eclesiast. Salonitan. in Addition. pag. 193 (3) [as quoted in Frari, citation unconfirmed]
588-591	Marseilles, infected from Spain (Biraben: travels back up the Rhone Valley Octave (Saint-Symphorien-d'Ozon near Vienna) near Lyon)	Rosen 2007, 220; Allen 1979, 15; Biraben and Le Goff 1969, 1496 Original Source: Gregory of Tours, <i>History of the Franks</i> , IX 21 & 22
590	Antioch	Biraben and Le Goff 1969, 1496 Original Source: Evagrius Scholasticus, <i>Ecclesiastical History</i> , IV 29
590 (mid-January through April)	Rome, after flooding of the Tiber	Biraben and Le Goff 1969, 1496; Stathakopoulos 2004, 320-1 Original Source: Gregory of Tours, <i>History of the Franks</i> , X 1, 476-8 Paul the Deacon, <i>History of the Lombards</i> , III 23-4 (127-8) <i>Liber Pontificalis</i> , LXV (I 309) Gregory the Great, <i>Dialogues</i> , III 19, 2-3; IV 18, 2; IV 27, 6; IV 37, 7; IV 40, 3 Jacobus de Voragine, <i>Legenda Aurea</i> , 46, 4 (190-2)

DATE	LOCATION	REFERENCE
Between 590 and 610, in the Spring	Golan and Hawtan regions (probably including Bostra, al-Qurayya, Beyt Ras, Gedara, Fiq, al-Jabiya, Gasema, al-Khamman, Dar'a, Balas, Sakka, Darayya)	Conrad 1994, 49-50
590?	Viviers, Avignon, both afflicted after heavy rains and flooding	Allen 1979, 15; Biraben and Le Goff 1969, 1496 Original Source: Gregory of Tours, <i>History of the Franks</i> , X 23
590-1?	Marseilles	Allen 1979, 15; Biraben and Le Goff 1969, 1496 Original Source: Gregory of Tours, <i>History of the Franks</i> , X 25
591?	Tours	Allen 1979, 15 Original Source: Gregory of Tours, <i>History of the Franks</i> , X 30
591?	Nantes	Allen 1979, 15 Original Source: Gregory of Tours, <i>History of the Franks</i> , X 30
591-2	Ravenna, Grado, Istria, Narni (probably infected from East)	Biraben and Le Goff 1969, 1496; Stathakopoulos 2004, 323 Original Source: Paul the Deacon, <i>History of the Lombards</i> , IV, 4 (145-6) Gregory the Great, <i>Registrum Epistularum</i> , II 2 (90-1)
592	Antioch	Stathakopoulos 2004, 323-4; Conrad 1984, 154 Original Source: Evagrius Scholasticus, <i>Ecclesiastical History</i> , IV 29
597 (Summer)	Thessalonika and hinterland	Stathakopoulos 2004, 324-5 Original Source: <i>Miracles of St. Demetrios</i> , 29-46 (I 57-82)
598 (Spring, after Easter)	Drizipera (Avar Territory, Turkey)	Maas 2005, 138; Stathakopoulos 2004, 330 Original Source: Theophylact Simocatta, <i>Historiae</i> , VII 15, 2 (271)

DATE	LOCATION	REFERENCE
599	Thrace (wiped out Avar army)	Allen 1979, 14; Conrad 1984, 157 Original Source: Theophylact Simocatta, <i>Historiae</i> , VII, xv, 1-3 Michael the Syrian, <i>Chronique</i> , X 23
599 (after April 2)	Constantinople, Bithynia, Asia Minor (via Bithynia), Syria, Eastern Mediterranean	Stathakopoulos 2004, 331-2; Allen 1979, 14; Biraben and Le Goff 1969, 1496; Maas 2005, 138 Original Source: Theophylact Simocatta, <i>Historiae</i> , VII, xv, 2 Michael the Syrian, <i>Chronique</i> , II 373-4; IV 387; X 23 <i>Chronicon 1234</i> , I, 218 Agapios, <i>Kitab al-'unwan</i> , 325 (date uncertain) Elias of Nisibis, <i>Opus Chronologicum</i> , 911 AG (60) Ḥassān ibn Thābit, <i>Dīwān</i>
599	Marseille and all of Provence	Biraben and Le Goff 1969, 1496; Frari 1840, 276 Original Source: Pseudo-Fredegair, XVIII
599 (Late Spring or Summer, before harvest)	Mesopotamia	Biraben and Le Goff 1969, 1496; Conrad 1981, 157 Original Source: Elias bar Shinaya, <i>Opus Chronologicum</i> , I, 124 Thomas of Marga, <i>The Book of Governors</i> , I, 283
599 or 600	Province of Arles	Biraben and Le Goff 1969, 1496 Original Source: Pseudo-Fredegair, XVIII
599	Nisibis	Original Sources: Elias bar Shinaya, <i>Opus Chronologicum</i> , I, 124
599 or 600	Ravenna and the coast	Biraben and Le Goff 1969, 1496; Stathakopoulos 2004, 333; Maas 2005, 139 Original Source: Paul the Deacon, <i>History of the Lombards</i> , IV 14 (150-1)

DATE	LOCATION	REFERENCE
599 (August)-600 (August)	Carthage and North Africa, Italy (Rome and neighboring cities)	Maas 2005, 139; Biraben and Le Goff 1969, 1496; Stathakopoulos 2004, 332-3 Original Source: Gregory the Great, <i>Register Epistularum</i> , IX 232, X 20 (814-5, 850-1)
600 or 601	Verona and its region	Biraben and Le Goff 1969, 1496; Stathakopoulos 2004, 334 Original Source: Paul the Deacon, <i>History of the Lombards</i> , IV 14 (150-1)
608 (between 602-610)	Constantinople	Biraben and Le Goff 1969, 1496 Original Source: Theophanes, <i>Chronographia</i> , AM 6100 (for year 607) Zonaras, <i>Epitome Historiarum</i> , XIV, 14 Michaelis Glycae, <i>Annales</i> , 510, 18
608	Rome	Sticker 1908-1910, 33
609	Cordoba	Handley 2011, 36 (footnote 105) Original Source: <i>Corpus Inscriptionum Latinarum</i> , II 2/7, 677
609-619	Alexandria	Allen 1979, 14; Stathakopoulos 2004, 345-6; Teall 1959, 100 Original Source: Leontios, <i>Vita of John the Almsgiver</i> , 24 (375) Anonymous, <i>Vita of John the Almsgiver</i> , 37 (52-3)
618	Germania	Frari 1840, 277 Original Source: Georgii Agricola, <i>De Peste</i> , Book III. (Frari quotes this source but I was unable to confirm the exact citation.)
618-619	Constantinople	Biraben and Le Goff 1969, 1497; Stathakopoulos 2004, 342-3 Original Source: Patriarch Nicephoros, <i>Breviarium</i> 8, 12 (48,54) Georgios Monachos, <i>Chronicon</i> , 669 <i>Miracula Sancti Artemii</i> , 34 (52)
622	Egypt	Simpson 1905, 19

DATE	LOCATION	REFERENCE
626 (October)-627 (September)	Palestine	Stathakopoulos 2004, 347 Original Source: Michael the Syrian, <i>Chronique</i> , II 412
627-628	Persia	Stathakopoulos 2004, 348 Original Source: [Arabic sources not specifically named]
628 (Summer or early Fall)	Mesopotamia (Ctesiphon, the Sawad region) – “Plague of Shirawayh”	Rosen 2007, 220; Sarris 2002, 171; Stathakopolous 2004, 348 Original Sources: Ibn Taghrībirdī, <i>Annales</i> , I, 140, 183 [Other Arabic sources quoted in Stathakopolous]
Between 630-655	Marseille and the province of Arles	Biraben and Le Goff 1969, 1497 Original Source: Letters from St. Gall, Bishop of Clermont to Didier, Bishop of Clermont [Source listed in Biraben could not be confirmed]
634	Britain	Allen 1979, 15
638 (Spring)-639 (October)	“Plague of Amwas” Started in Spring 638 in Syria, passed overland. Reached Jerusalem, Emmaus (Amwas), Bostra, Damascus, but not as far as Egypt or Asia Minor.	Allen 1979, 14; Stathakopoulos 2004, 349; Simpson 1905, 15; Conrad 1984, 187-190 Original Sources: Elias of Nisibis, <i>Opus Chronologicum</i> , 18 AH (64) Michael the Syrian, <i>Chronique</i> , II 419 & 431
654 (July to September)	Rome, Pavia	Biraben and Le Goff 1969, 1497 Original Source: Paul the Deacon, <i>History of the Lombards</i> , VI, 5
661-749	“Plague of the Umayyad Caliphate”	Conrad 1984, 247-250
669-670 (February to September)	Kufah (Iraq)	Dols 1974, 378; Stathakopoulos 2004, 353; Conrad 1984, 250 Original Sources: al-Tabari, <i>Ta'rikh</i> , IV, 60 [Other Arabic sources cited in Dols]

DATE	LOCATION	REFERENCE
672-673 (August to September)	Kufah (Iraq), Egypt, Palestine	Dols 1974, 378; Allen 1979, 14; Stathakopoulos 2004, 353 Original Sources: Theophanes, <i>Chronographia</i> , AM 6164 (353) Agapios, <i>Kitab al- 'unwan</i> , 492
674	Syria, Phoenice	Allen 1979, 14; Stathakopoulos 2004, 354 (verify) Original Sources: Agapios, <i>Kitab al- 'unwan</i> , 492 Michael the Syrian, <i>Chronique</i> , II 457
676	Syria	Dols 1974, 379 Original Source: Theophanes, <i>Chronographia</i>
680 (July-September)	Rome, Pavia (Paul the Deacon notes that plague ceases in both cities after altars to St. Sebastian are erected)	Stathakopoulos 2004, 359; Kitzler 2011, 383 Original Sources: <i>Liber Pontificalis</i> , LXXXI 16 (I 350) Paul the Deacon, <i>History of the Lombards</i> , VI 5 (213-4)
684-685	Syria, Bostra	Biraben and Le Goff 1969, 1497; Tholozan 1874, ?
686	Egypt	Dols 1974, 379; Biraben 1969, 1497; Simpson 1905, 19 Beulenpest, d'apres A. Von Kremer
687	Syria, Basrah (Iraq), "The Third Major Plague" or "al-Jarif" per Arab sources	Allen 1979, 14; Stathakopoulos 2004, 360-1 Original Sources: Theophanes, <i>Chronographia</i> , AM 6179 (364) Elias of Nisibis, <i>Opus Chronologicum</i> , 68 AH (72) Michael the Syrian, <i>Chronique</i> , II 474-5 Agapios, <i>Kitab al- 'unwan</i> , 497
689 (Spring)	Basrah (Iraq)	Dols 1974, 379; Stathakopoulos 2004, 362 Original Source: al-Madaini
689-690	Egypt	Stathakopoulos 2004, 363; Conrad 1981, 271-3
693-694	Narbonne	Biraben and Le Goff 1969, 1497; Kulikowski in Little, 153-4 Original Sources: 16th Council of Toledo 17e Concile de Toledé, Mansi, 12, 95

DATE	LOCATION	REFERENCE
697 (4 months)	Constantinople, Syria, Mesopotamia	Allen 1979, 14; Biraben and Le Goff 1969, 1497 Original Source: Theophanes, <i>Chronographia</i> , AM 6190 (370) Kedrenos, <i>Synopsis Historiarum</i>
698	Egypt	Teall 1959, 101
698 (late Spring and Summer)	Constantinople	Magdalino 2000, 213; Stathakopoulos 2004, 364 Original Sources: Theophanes, <i>Chronographia</i> , AM 6190 (370) Patriarch Nicephoros, <i>Breviarium</i> , 41 (98)
698 (Spring-Summer)	Syria	Dols 1974, 379; Stathakopoulos 2004, 363 Original Source: Elias of Nisibis, <i>Opus Chronologicum</i> , 79 AH (74)
699	Fustat	Dols 1974, 379
699	Kufah	Dols 1974, 379
699-700	Iraq, Syria, Mesopotamia	Stathakopoulos 2004, 365 Original Sources: Theophanes, <i>Chronographia</i> , AM 6192 (371) Elias of Nisibis, <i>Opus Chronologicum</i> , 80 AH (74)
700	Constantinople and “the Orient”	Biraben 1969, 1497 Original Sources: Theophanes, <i>Chronographia</i> , AM 6192 (371) Cedrenos, <i>Synopsis</i> , A 2 Leon Grammatikos, <i>Chronographia</i> , 167, 1
704	Egypt	Simpson 1905, 18
704-705	Syria (Serūg region)	Stathakopoulos 2004, 365 Original Sources: <i>Chronicle of Zuqnān</i> , ad a. 1016 AG (148) Michael the Syrian, <i>Chronique</i> , II 480
706 (September- October)	Basrah, Syria, Iraq, Kufa, Wāsīt	Dols 1974, 379; Stathakopoulos 2004, 366 Original Source: [Arabic sources described in Dols]

DATE	LOCATION	REFERENCE
707-709	“Half the population of Spain”	Kulikowski in Little, 154 Original Source: [Arabic sources described in Kulikowski]
709	Brescia and its environs	Frari 1840, 278 Original Source: <i>Chronicon Brixense</i>
711-740	Crete	Stathakopoulos 2004, 367 Original Source: <i>Vita</i> of Andrew of Crete, V 9 (177-8)
713	Syria	Stathakopoulos 2004, 368 Original Sources: Michael the Syrian, <i>Chronique</i> , II 482 <i>A Chronicle of Disasters dated AD 716</i> , ad a. 1024 AG (45-6) <i>Chronicon ad a. 819</i> , ad a. 1024 AG 10 <i>Chronicon ad a. 846</i> , ad a. 1024 AG 176
714-715	Egypt	Stathakopoulos 2004, 369 Original Source: Severos, <i>History of the Patriarchs</i> , XVII, 67-8
716-717	Syria and Iraq	Allen 1979, 14; Dols 1974, 379 Original Source: Theophanes, <i>Chronographia</i> , AM 6218 (404)
718-719	Basrah, Iraq, Syria	Stathakopoulos 2004, 372 Original Source: Arabic Sources described by Stathakopolous but not specifically named
718	Dabiq	Dols 1974, 380
719	Egypt	Simpson 1905, 19
720	Basrah	Dols 1974, 380
724 (Spring)	Egypt	Stathakopoulos 2004, 374; Conrad 1984, 289 Original Source: Arabic Sources described by Stathakopolous

DATE	LOCATION	REFERENCE
725-6	Syria, Mesopotamia	Dols 1974, 380; Stathakopoulos 2004, 374-5 Original Sources: Theophanes, <i>Chronographia</i> , AM 6218 (404) <i>Vita</i> of Wallibald Agapios, <i>Kitab al-'unwan</i> , 506 Elias of Nisibis, <i>Opus Chronologicum</i> , 107 AH (78) <i>Chronicon ad annum 819</i> Michael the Syrian, <i>Chronique</i> , II 491
729	Syria and Greece	Frari 1840, 278
732-735	Syria, Egypt, Palestine, Iraq (especially Wāsīt region)	Dols 1974, 380; Stathakopoulos 2004, 376 Original Sources: Theophanes, <i>Chronographia</i> , AM 6225 (410) Agapios, <i>Kitab al-'unwan</i> , 507
735	Asia Minor	Stathakopoulos 2004, 376-7 Original Source: Agapios, <i>Kitab al-'unwan</i> , 509
740-750	Syria, Damascus, Jordan Valley	Biraben 1969, 1497
743-744 (-768)	Egypt, North Africa	Stathakopoulos 2004, 379-80 Original Source: Severos, <i>History of the Patriarchs</i> , XVIII, 97, 115
744-745	Basrah, Mesopotamia, Syria and Iraq	Dols 1974, 380; Stathakopoulos 2004, 381 Original Sources: <i>Chronicle of Zuqnān</i> , ad a. 1055-56 (168-74) Michael the Syrian, <i>Chronique</i> , II 506 & 508 <i>Chronicon ad annum 1234</i>

DATE	LOCATION	REFERENCE
745-746	Sicily, Calabria, Rome, Monemvasia, the Peloponnese, Continental Greece, Greek Archipelago, Constantinople	Biraben 1969, 1497; Stathakopoulos 2004, 382-4; Simpson 1905, 18 (Simpson states 746-8); Frari 1840, 279 (Frari states 745-7) Original Sources: Theophanes, <i>Chronographia</i> , AM 6238 (422-3) Anastase le Bibliothécaire, <i>Historia Ecclesiastica</i> , XX, 75 Constantine VII Porphyrogenitus, <i>de Thematribus</i> , II, 6 Patriarch Nicephoros, <i>Breviarium</i> , B Michaelis Glycae, <i>Annales</i> Cedrenos, <i>Synopsis</i> , C 6 Zonaras, <i>Epitome Historiarum</i> , XV, 6 Paul Diacre, <i>Historia Miscella</i> , XXII
746	Egypt	Teall 1959, 101
747	Naples	Maas 2005, 138
747-748	Constantinople	Magdalino 219; Stathakopoulos 2004, 384-5 Original Sources: Theophanes, <i>Chronographia</i> , AM 6238 (422-3) Patriarch Nikephoros, <i>Breviarium</i> , 67 (138-40)
748-750	Basrah, Armenia, Syria, Mesopotamia	Dols 1974, 380; Stathakopoulos 2004, 386 Original Source: <i>Chronicle of Zuqnān</i> , ad a. 1061-2 (184-9)
No Date	Vienne, France	Parthesius, Millar, and Jeffery 2005, 332
No Date	Castro dei Volsci, Italy	Rubini 2008, 51-2
No Date	Valencia and Carthago Nova, Spain	Kulikowski, in Little, 152
No Date	Toledo, Spain	Kulikowski, in Little, 161 Original source: Grégoire, <i>Les Homéliers du Moyen Age</i> , 214-17 (The Toledo Homilies)