

## Research Article

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# Mapping Changes in Settlement Number and Demography in the South of Israel from the Hellenistic to the Early Islamic Period

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**Abstract:** The south of Israel was lately at the heart of a debate regarding the supposed catastrophic effects of the Late Antique Little Ice Age (LALIA) and the Justinianic plague. The current article aims to contribute to this debate by examining the fluctuations in settlement numbers in the south of modern-day Israel, between the Hellenistic and Early Islamic periods. It will do this by aggregating archaeological survey data, mapping it on ArcGIS and analysing it quantitatively and qualitatively, while comparing it with data from excavations. Through this, it will be shown that a decline in settlements occurred only from the 7th century CE and the damaging effects of the LALIA and the Justinianic plague will be questioned.

**Keywords:** archaeological survey; Negev desert; Early Roman; Late Roman; Byzantine; Early Islamic

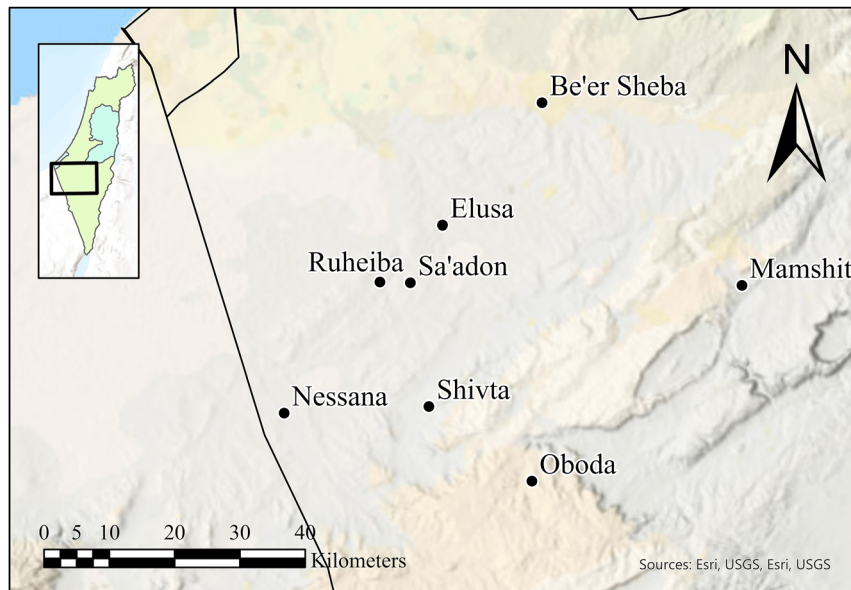
## 1 Introduction

Populating a desert or arid area is considered an indication for a peak in population, trade and wealth. The investment of funds and personnel to render an inhospitable area habitable and economically viable, despite the harsh climate and environment, creates a society which would be highly susceptible to various crises. This fragility means that such regions would be a good barometer for any social and economic changes occurring within the region and beyond (Bailey 1989, p. 200).

One such region, which has come under scrutiny in the last few decades, is the south of Israel, more specifically, the Negev desert. In the last decade, this desert was at the heart of a debate regarding the dating of its peak and decline in settlements in Late Antiquity, especially in its highlands (Figure 1). In the past, the Arab conquest of 636 CE was thought to be the reason behind the decline of the Eastern Roman Empire (Issar and Tsoar 1987, p. 577; Negev and Gibson 2001, pp. 311–310, 367, 429, 443). However, recent research has suggested that the decline of the Negev region occurred in the mid-6th century CE (Avni et al. 2023; Bar-Oz et al. 2019; Fuks et al. 2020, 2021; Kennedy 1985; Langgut et al. 2020; Yan et al. 2021), and was connected to the Late Antique Little Ice Age (LALIA) – from 536–560 CE (Büntgen et al. 2016; Fuks et al. 2017, p. 210) or from 536–660 CE (Peregrine 2020) – and/or the Justinianic plague, whose initial occurrence occurred in 541–544 CE, and which allegedly had multiple occurrences in the 200 years that followed (Eisenberg and Mordechai 2020; Mordechai et al. 2019, p. 25547; Sarris 2002, 2020). A significant part of this debate has been conducted amongst historians and was mostly based on ancient texts that were either biased or inaccurate. If archaeological data was used, it was often in a highly localised manner, or merely as a supplement to the ancient texts. There was no attempt to gain a regional archaeological perspective on the entirety of the south, including both the Negev and the Arava, as most studies concentrate only on parts of the Negev.

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**Figure 1:** A map rendered in ArcGIS Pro v.3.1.3 showing the sites of the North-Western Negev desert which are commonly featured in the debate.

In the various discussions and debates on the topic of the south of Israel in Late Antiquity, one tool which has often been neglected is archaeological surveys. Surveys have commonly been used in the past to understand population dynamics and settlement patterns of a given region. It is vital to remember that the sole reliance on excavations of large sites to build a complete picture of the past is incorrect, as throughout the pre-modern periods, a majority of the population resided in the countryside (Cherry 2005, p. 249).

Accordingly, this paper aims to present and analyse the archaeological survey data of the territories south of latitude line 31.315, including the area of Beer Sheba, to time and examine the periods of demographic fluorescence and decline. Furthermore, this analysis also encompasses the Hellenistic and Early Roman periods to observe what transpired in earlier periods (Table 1). During the Early Roman period, another climatic change occurred, commonly known as the end of the “Roman Warm Period,” also occasionally referred to as the “Roman Climate Optimum” (Erdkamp 2021; McCormick et al. 2012). This change was considered detrimental to the residents of the Mediterranean. As the current article wishes to show, an analysis of the changes in settlement numbers in the south of Israel will reveal that the main cause for the fluctuations in settlement numbers lies in anthropogenic causes. Thus, it implies that the term “Optimum” to describe the climate of the 1st century BCE to the middle of the 2nd century CE is incorrect due to the highly variable microclimates of the Roman Empire. For example, the Negev desert prospered from the end of this supposed climatic period. Lastly, the examination of the shifts in settlements would show that a downturn in the number of sites occurred in the 7th century and not in the 6th century CE, refuting the idea that the LALIA and the Justinianic plague played a part. The analysis conducted

**Table 1:** The periods used in the article and their dates, alongside the terminology of different periods and their respective dates used in the survey maps of the Israeli archaeological survey.

Date	Period used in the current article	Periods in Israeli archaeology	
333–50 BCE	Hellenistic	333–140 BCE	Hellenistic
		140–50 BCE	Hasmonean
		Pre 106 CE	Nabatean
		37 BCE – 70 CE	Herodian
50 BCE – 325 CE	Early Roman	63 BCE – 325 CE	Roman
325–636 CE	Late Roman	Byzantine	
636–750/970/1099 CE	Early Islamic <sup>a</sup>	Umayyad/Early Islamic/Islamic	

<sup>a</sup>See p.7 for further details on the dating of the finds under this category.

will show that this was a continuous process throughout the 7th and 8th centuries CE, with the Persian invasion and the Arab conquest playing a significant role.

## 2 Environment and Landscape of the South of Israel

The main region in the south of Israel is the Negev desert, spreading out over 12,500 km<sup>2</sup> of land (Singer 2007, p. 47). To its west is the Sinai desert, to its east is the hyper-arid Arava Rift Valley which is part of the Syrian-African Great Rift, and its southernmost point is the Gulf of Aqaba and the Red Sea (Rosen 2017, pp. 3–4, 6–7; Singer 2007, pp. 47, 50). This region can largely be divided into several geomorphological regions: the Eilat hills in the south, the highlands and plateaus in the central Negev, the Beer Sheva basin, the sandy Western Negev, and the Arava Rift Valley in the east (Singer 2007, p. 47).

The two most important regions to note are the highlands and the Arava. The highlands in the central Negev is composed of valleys and ridges running parallel in a northeast to southwest direction, morphing into sandy plains in the south (Singer 2007, pp. 48–50). This region is often split into the northern Negev Highlands, central Negev Highlands and the southern Negev Highlands (Rosen 2011, 2017). The Arava Rift Valley, sometimes known as its own separate desert, extends 165 km from the Dead Sea to the Gulf of Aqaba (Singer 2007, p. 52).

The climate in the Negev changes from region to region and fluctuates year-round. For example, the northern Negev has average winter temperatures of around 12 °C and average summer temperatures of 26 °C, while the southern Negev has an average of 12 °C in winter and 32 °C in summer (Bruins 2012, p. 29; Goldreich 2003). Rainfall is largely in winter, while there are droughts in summer, with the amount of rainfall declining in a north-south and eastwards gradient (Figure 2), with up to 300 mm of rain in the northern Negev in certain years, and as low as 25 mm of rain in the south in some others (Bruins 2012, p. 29; Rosen 2011, pp. 3–4, 2017, p. 7).

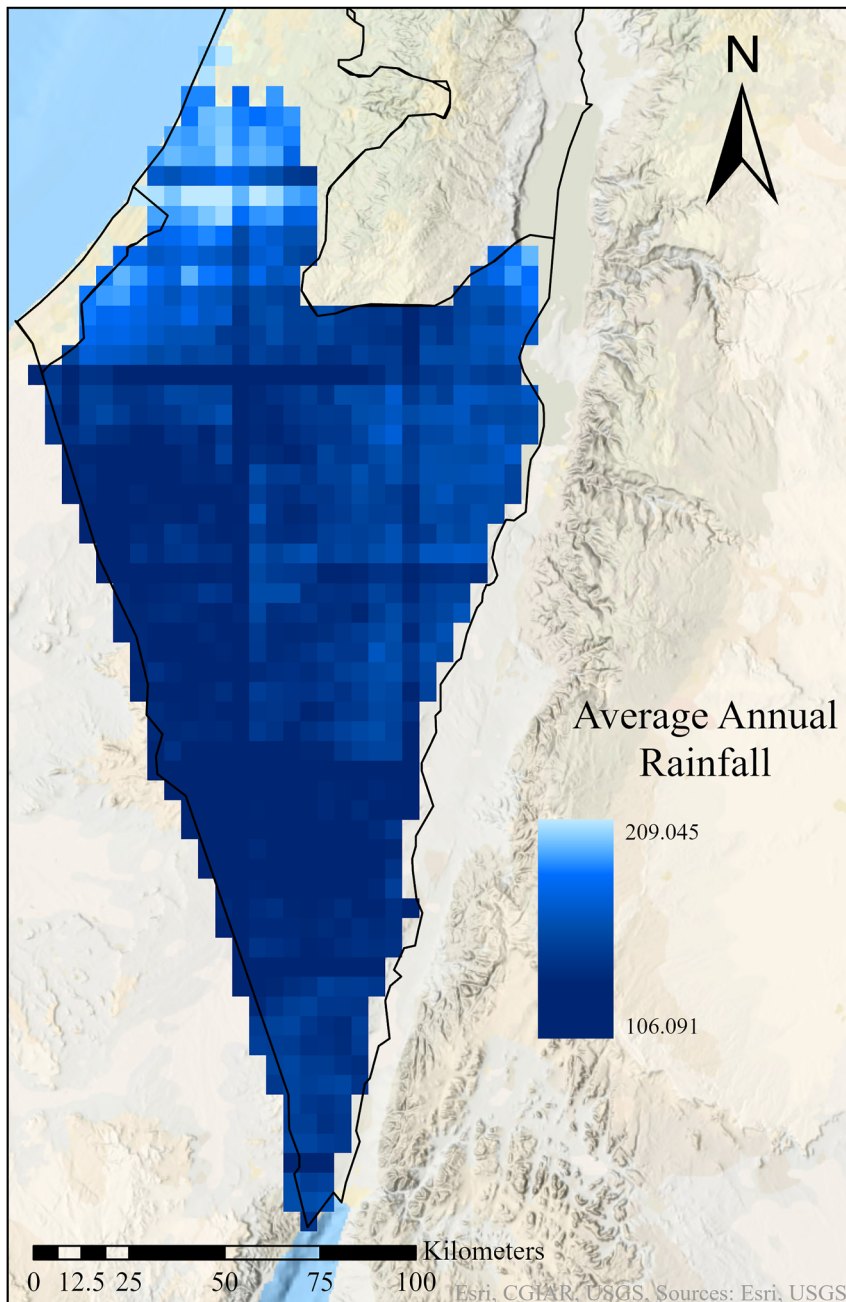
## 3 Methodology and Limitations

A large part of the data used was taken from the Israel Archaeological Survey (see Supplementary Material),<sup>1</sup> which is the most thorough archaeological survey conducted in any country. The entire country was carefully divided into survey grids of 100 km<sup>2</sup> (10 × 10 km) in the early 1960s, with each grid intended to be published as a survey map (Sion 2014), of which 70 % have been surveyed and published since the 1960s.<sup>2</sup> Each map was published after a team of archaeologists systematically surveyed the area on foot, and methodically inspected every square metre of the grid where possible. Individual teams plotted, marked, and noted any site with signs of anthropogenic activity, as well as dated the sites where possible using indicative sherds or other artefacts. Upon the completion of a survey, the team would include a summary and analysis of the various periods identified in the survey grid, as well as their conclusions concerning changes in settlement patterns, the date of these changes, and their possible causes. The subsequent sites, which are any place with evidence for any pre-modern human activity, were categorised by period and characteristics. Through this, one could understand the trends in settlement patterns throughout the different periods of history, and prehistory, in a given area (Sion 2014, pp. 58–59).

It is important to note the stark difference in the terminology used within the research conducted on the Eastern and Western Roman Empires (Elton 2018; Heather 2018, p. 6). This is especially true in archaeological publications and creates many complications in academic discourse. Levantine scholarship tends to use the term Byzantine to define the period between 284 CE (sometimes used in Egypt) or 325 CE (used in Israel, Lebanon and Syria) until 636 CE. Similarly, Late Roman is defined as the 2nd and the 3rd centuries CE, although in the archaeology of Egypt the terminology is currently changing and they define the Early Roman period as 1st to the

<sup>1</sup> Only half of the Negev desert was surveyed and the available maps that were used are: 114, 125, 127/128, 139, 140, 129, 131, 132, 143, 144, 145, 146, 159, 160, 173, 174, 153, 154, 161, 162, 163, 164, 177, 178, 155, 165, 166, 167, 168, 183, 156, 169, 170, 171, 172, 187, 193, 194, 195, 196, 212, 213, 198, 199, 200, 201, 214, 216, 217, 202, 203, 204, 219, 220, 206, 207, 224, 225, 238, 234, 255, 256, 257/259, 258, 260, 261, 262, 263, 264, 265, 266.

<sup>2</sup> The Archaeological Survey of Israel: [https://www.antiquities.org.il/survey/new/default\\_en.aspx](https://www.antiquities.org.il/survey/new/default_en.aspx).



**Figure 2:** A map rendered in ArcGIS Pro v.3.1.3 showing the annual average rainfall in the South of Israel from 2003 to 2024.

2nd century CE, the Middle Roman period as the 3rd to the 4th century CE, and the Late Roman period as 5th to the middle of the 7th century CE (Kenawi 2014; Wilson and Grigoropoulos 2009). On the other hand, the period from 325 to 636 CE is called the Late Roman period in western scholarship, similar to the terminology used in other countries, such as Turkey, which defines the 1st to the 3rd century CE as the Early Roman, and the 4th to the 7th century CE as the Late Roman (Blanton 2000, p. 60; Niewöhner 2011, p. 109; Rose 2011, p. 164). We agree with Elton (Elton 2018), and Heather (Heather 2018), regarding the lack of any significant change in the beginning of the 4th century CE in the east, which would deem the change in terminology from Roman to Byzantine as acceptable and logical. Only from 636 CE is there enough significant change in the Eastern Roman Empire to warrant a new definition for this entity, the Byzantine Empire. Furthermore, there is importance in common language when discussing the same period of time and entity, and there are several names for the same period in Israeli



archaeology. Therefore, a unified terminology was utilised in this current article, and corresponds with the research in Egypt, Turkey, Cyprus, Greece and so on, as well as clarifying any duplicate terms in Israeli archaeology (see Table 1).

Published data from the website of the archaeological survey and its hardback publications was collated in an Excel spreadsheet and was systematically reviewed to correct any discrepancies between the tables, maps and individual site information.<sup>3</sup> As the website in English and Hebrew, as well as the existing printed publication, were not always identical, the maps, the information on the sites and the general description and analysis of the individual surveys were compared to garner the maximum information for each of the individual sites and to successfully calculate the correct number of sites from each period for each map. Sites dated from the Hellenistic to the Early Islamic (Table 1) were extracted from the survey (see Supplementary Material), and the resulting data were qualitatively and quantitatively analysed. In addition, any instances in which sites were labelled as two periods, such as Roman-Byzantine, were included in the counts for both Roman (Early Roman, see Table 1) and Byzantine (Late Roman, see Table 1) sites. This information was then compared with the available excavation data from the south of Israel, especially with the collated salvage excavations published by Faust and Safrai in 2015 (Faust and Safrai 2005, 2015). The salvage excavations were also counted, and in cases where there were numerous salvage excavations conducted at one site, all the excavations were counted only once and represent one site. The resulting trends were analysed in light of the historical context and the available archaeological evidence.

There are several known problems with archaeological surveys, several of which pertain to the archaeological survey of Israel itself. The quality of the results is dependent on several objective factors such as the area of the survey. In addition, the experience, expertise and fatigue of the surveyors, as well as the basic assumptions of the researchers, can also influence the quality and interpretation of the results (Cherry 2005, p. 250; Dagan 2014, pp. 5–6). For example, periods which are more familiar to the excavators will be better represented in surveys, than those that are less familiar.

Another drawback to using archaeological surveys, and especially the Israel Archaeological survey, to examine settlement patterns is the lack of quantitative data which is published. As these survey maps were intended for documenting and registering archaeological sites, the dating of the sites is provided by the surveyor with limited to no database to support the surveyor's claims (Leibner 2009, p. 60), which can lead to various problems (Magness 2003). It is important to note that a selected assemblage of representative sherds of the different periods found at each site are collected during the survey and deposited at the IAA for future researchers.<sup>4</sup> Furthermore, the environmental conditions during the data collection can impact the survey results, such as weather, light or the seasons. For example, winter in Israel can obscure archaeological finds from the surveyors due to the significant increase in vegetation (Cherry 2005, p. 250), although this problem is less prevalent in the south of Israel. Moreover, in certain regions, it is difficult to differentiate certain sherds from the surrounding geology, and there is the common inability to subdivide periods with certain local pottery types.

A common argument regarding surveys is the extent to which the surface finds reflect the periods of settlement at a site (Leibner 2009, p. 60; Tartaron 2003, p. 24). This matter, as well as other issues, can be relatively settled with regards to the region of Israel, as a thorough re-examination of some of the survey squares in the Galilee was conducted via a new survey, some excavations and dozens of test pits and probes. Their results showed that the original survey finds stand the test of time and a more thorough examination, thus implying that the reliability of this data is high (Frankel 2001). It is important to note that the survey finds for a single site may be inaccurate in a few cases, but the survey is accurate in detecting general changes and trends in large regions – the type of research and debate the current article wishes to conduct.

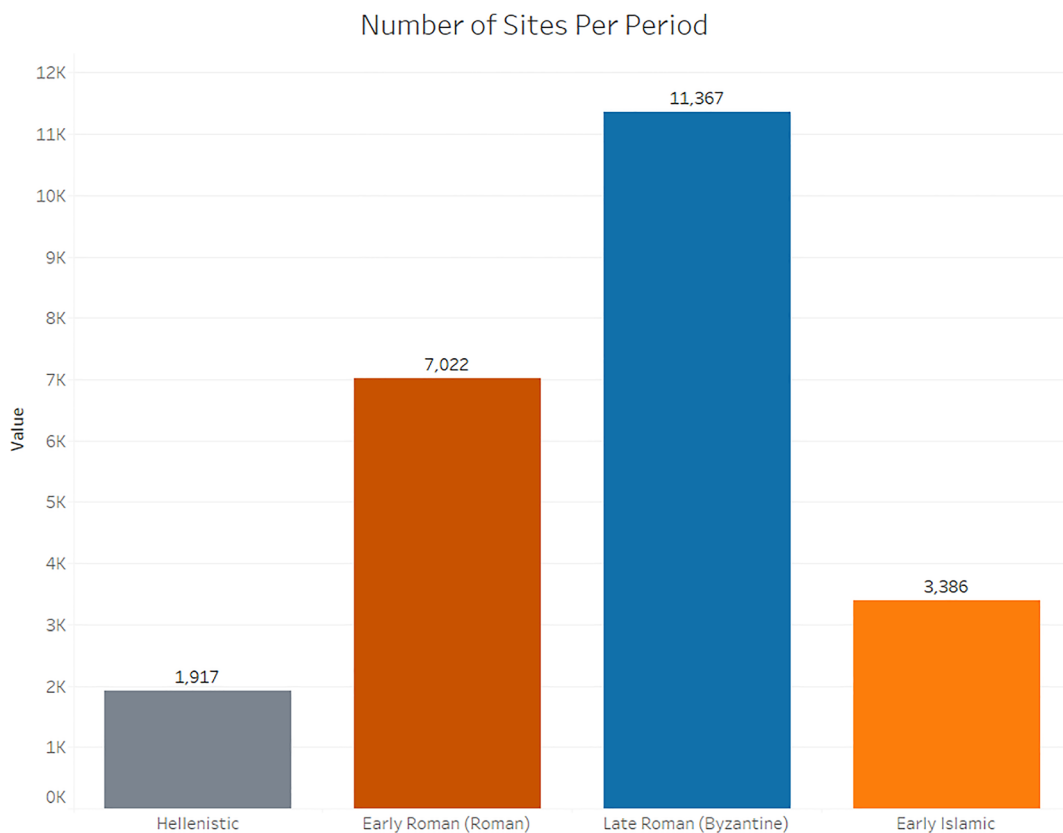
<sup>3</sup> For more information on the discrepancies found and corrected, see the Supplementary Material.

<sup>4</sup> The way to implement a survey, its publishing, and the requirement of the representative selected sherds to be deposited at the IAA warehouses is fully described in an official procedure. The regulation, number 3.2, titled “The Implementation of Land Surveys, the Writing of their Reports and their Submissions”, entered effect on 30/08/04, and was updated on 9/02/2014. According to subsection 2.1.9 and 2.2.5.7, the surveyors must submit all the survey's documentation and finds to the warehouses of the IAA after the final publication of the survey. This is fully explained in section 3 of the same document, and its 3 subsections (3.1, 3.2, 3.3).

This is further supported by the salvage excavation reports showing a similar trend when compared to the survey of the entirety of modern-day Israel (Figures 3 and 4). However, the salvage excavations do not present as stark an increase in the Late Roman period compared to the survey, as the largest increase in site number was in the south of the country, while salvage excavations mainly represent the north and the centre of the country (Olshanetsky and Cosijns 2024). When comparing the salvage excavations and the surveys in northern and central modern-day Israel (Figure 5), the almost identical results are clear, highlighting the reliability of the survey to identify general trends. Therefore, survey results need to be viewed with caution and to be supplemented with other data such as excavations or direct dating methods (Dagan 2014, pp. 5–6), as the current article does.

Regarding the Early Islamic, sites designated under this category do not represent all sites between 636 and 1099 CE. It was rather meant to represent the period 636 to 750 CE, i.e., the Umayyad period, as best as possible. However, not every survey managed to clearly identify all sites, and to split all sites into distinct categories. Therefore, all sites in categories that commenced in the year 636 CE were included, such as sites generally dated to the Islamic period. Nevertheless, where possible, sites which were dated after 750 CE were excluded. Henceforth, there may be some sites which are not precisely dated to the Early Islamic, i. e. 636–750 CE, and the value is slightly inflated.

Another factor which must be raised is the context of the Negev in the region. While the data from this article was collected within modern political borders, there was no such physical border during the time periods of this article. Therefore, the settlement trends visible in the south of Israel may well be perceptible in the Sinai Peninsula and central Jordan. Furthermore, geographic regions and archaeological sites do not exist in a vacuum, but are part of larger social, economic, and regional systems, and the more fragile and challenging a region is, the more they are influenced and impacted by their neighbours and other parts of their network. This is especially true for the south of Israel, a resource-limited environment that is inherently fragile to any drastic economic,



**Figure 3:** The number of sites found in archaeological surveys in Israel attributed to the Hellenistic, Early Roman, Late Roman and the Early Islamic.

Number of Sites by Period According to Salvage Excavations in Israel Until 2014

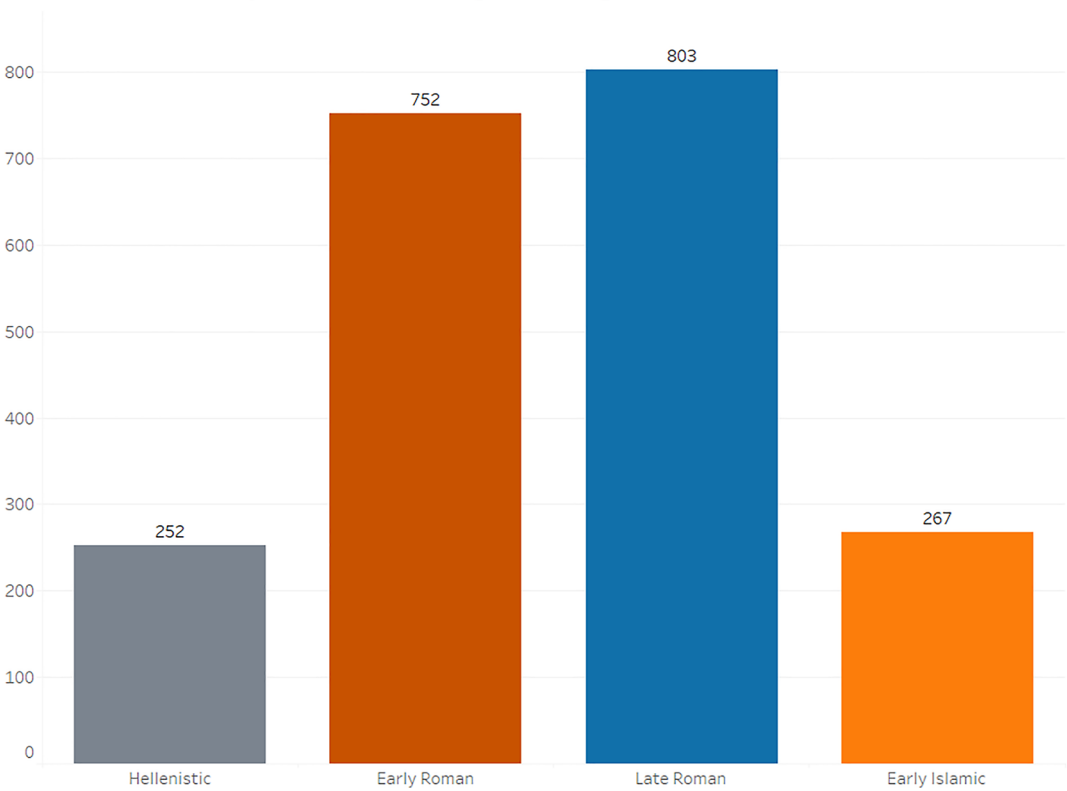


Figure 4: The number of sites excavated in salvage excavations dated until 2014 attributed to the different periods.

A Comparison of the Percentage of Sites Per Period Between Excavations and Surveys

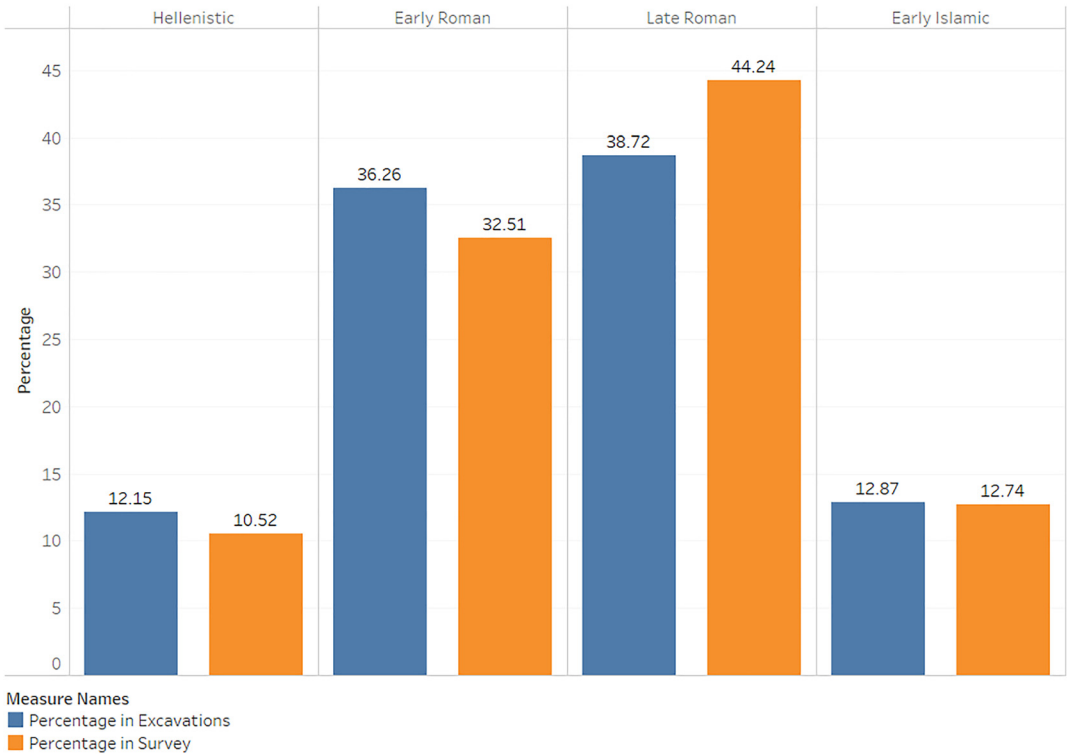


Figure 5: A comparison of the percentage of sites found per period between salvage excavations and archaeological surveys in the centre and North of modern-day Israel.

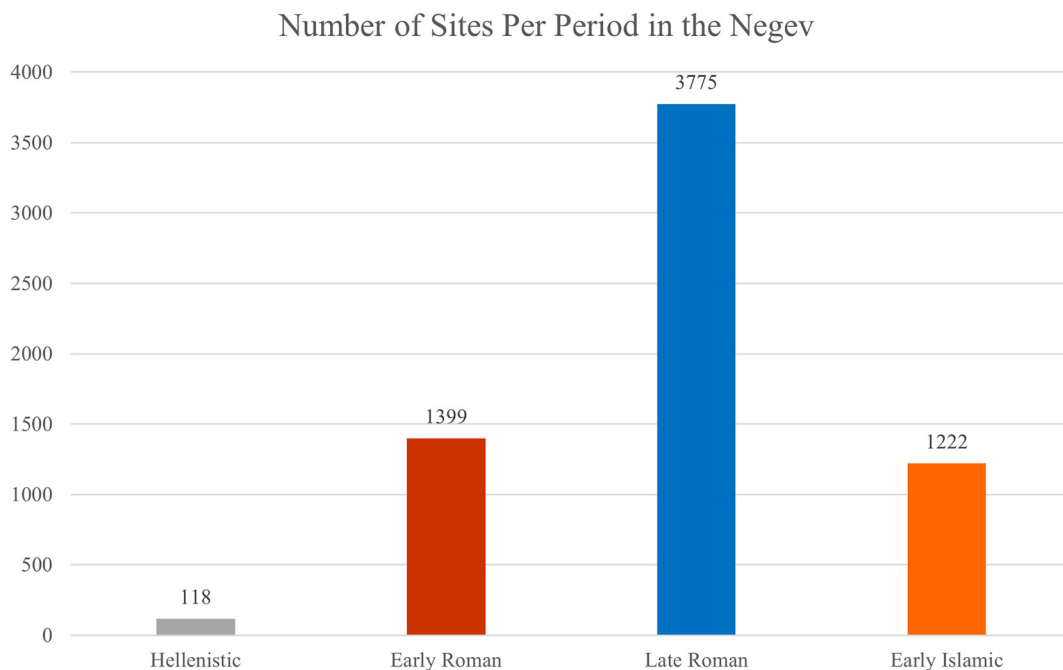
environmental or geopolitical changes within its region and beyond. Consequently, it would be incorrect to discuss any observable changes in the archaeological record of the south of Israel without considering observable vicissitudes, or textual accounts, in and from the neighbouring regions and beyond. Therefore, the following analysis takes into account changes, or events, in the neighbouring regions or the wider Empire, which may have caused the changes in the number of sites observable in the south of Israel.

## 4 Results

According to the archaeological survey of Israel, the number of anthropogenic sites in the south of Israel was 118 during the Hellenistic period. This number increased in the Early Roman period to 1,399 sites, with a further increase to 3,775 sites in the Late Roman period. There was a decrease in the number of sites to 1,222 in the Early Islamic period (Figure 6).

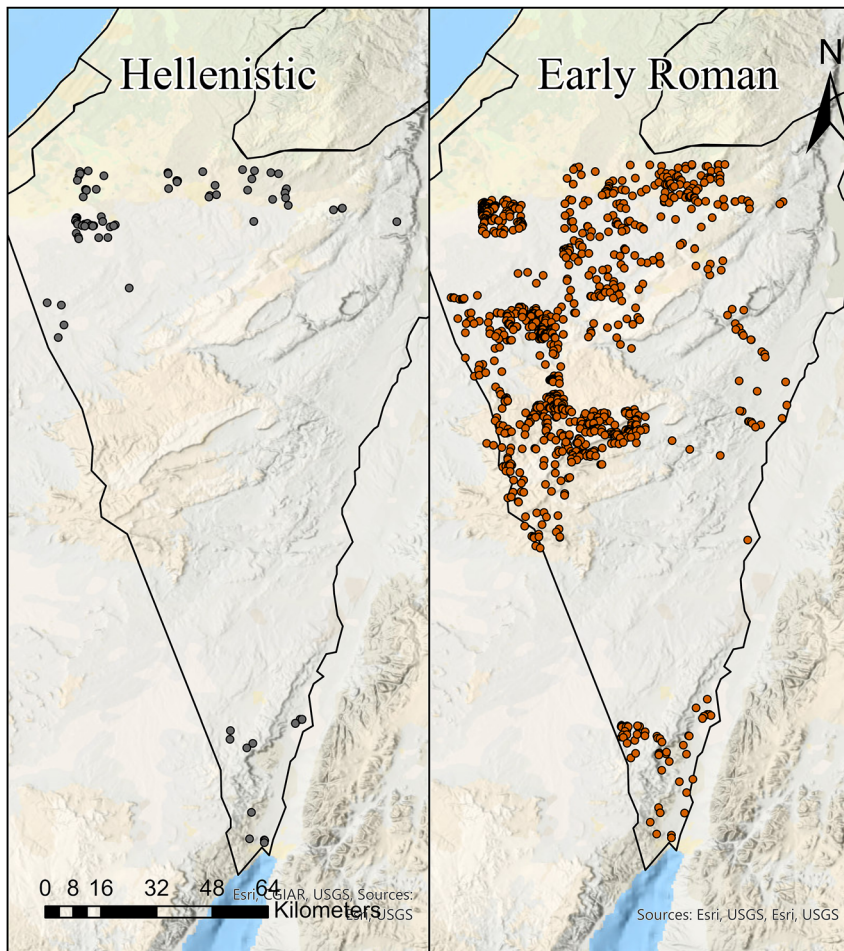
### 4.1 The Increase in Settlements from the Hellenistic to the Early Roman Period

The transition from the Hellenistic to the Early Roman period saw some of the most dramatic changes in settlement density in the south of Israel, as can be seen in Figures 6 and 7. While the Hellenistic period had just 118 sites in several concentrations of settlements in the far northern part of the Negev and the south of the Arava, the Early Roman period saw a stark increase to 1,399 sites. This increase is visible in the north-west and north-east regions of the Negev, as well as in the Arava valley and the southernmost point of Israel, near the city of Eilat. This same increase is reflected in the salvage excavations conducted in the south of Israel, with eight sites dated to the Hellenistic period, and 33 dated to the Early Roman period, and in Michael's analysis of the far northern Negev (Michael 2022, pp. 93, 96, 147, 150–151). The Hellenistic salvage excavation sites are largely in the Arava and the north of the Negev, with the former region composed of sites which are largely early Nabatean or Hasmonean fortresses, although it seems that their origins may even be attributed to the Early Hellenistic period (Patrich



**Figure 6:** A graph showing the number of survey sites showing human activity in the South of Israel from the Hellenistic to the Early Islamic period.





**Figure 7:** A map of the survey sites in the South of Israel dated to the Hellenistic (left) and Early Roman (right) period. The map was produced using Arc GIS Pro v.3.1.3.

2012). The Early Roman salvage excavation sites were spread out relatively equally (9 in the northern Negev, 2 in the west, 13 in the Central Negev and 9 in the Arava), with many of the Arava and Central Negev sites of Nabatean origin.

It is important to note that this increase in the number of sites can be split into two phases, as many of the Early Roman period settlements, especially to the south of Be'er Sheva, are Nabatean (258 sites). They were primarily traders who set up way stations and trading outposts in the desert for the transport of goods from Arabia to Egypt. As such, a majority of the Nabatean sites in the south of Israel are both concentrated around earlier infrastructure and ephemeral in nature, rather than sedentary settlements which characterise the advent of the Negev's Romanisation (Margulis and Rosen 2025). Archaeological evidence indicates that the south of Israel may have been under slight Nabatean influence, probably from the end of the 3rd century BCE, although there is no clear evidence for their presence in the region before 169 BCE (Erickson-Gini 2010, pp. 37–38; Margulis and Rosen 2025; Patrìch 2012, p. 15). The transition from a pastoral to sedentary lifestyle happened in the 1st century CE, with the commencement of large-scale unguent processing at Petra (Erickson-Gini 2010, p. 43; Negev 1988, pp. 9–22). Numerous settlements were constructed and fortified throughout the Nabatean kingdom, including in northern Arabia, the Hauran and the Negev desert, the latter of which includes sites such as Horbat Bor, Mizpe Ramon, Shivta, Avdat and Rehovot-in-the-Negev (Abadi-Reiss 2020; Dahari and Sion 2017; Erickson-Gini 2010, pp. 43–45, 2015; Sion et al. 2022; Tepper et al. 2018a, pp. 143–145, 148; Tsafrir and Holum 1988, pp. 119–123). The Nabatean Kingdom was subsequently annexed in 106 CE by the Empire, where it became part of the province of Arabia (Erickson-Gini 2010, pp. 46–49; Kennedy 1997, p. 72; Rubin 1996, p. 49; Tsafrir 1986, pp. 77–78).

This highlights a problem with using archaeological survey data. The terms and periods that are often used are at times artificial, and historical events and changes are sometimes within the periods themselves rather than

between periods. For example, each change occurred in different times, especially with regards to the transfer to direct Roman rule. The establishment of Roman rule in Judaea started in the middle of the 1st century BCE (Cameron 2018), or the beginning of the 1st century CE (Schwartz 1990; Zeichmann 2015, pp. 182–180, 189–188). However, it happened in earnest only from the beginning of the 2nd century CE in the Negev.

The annexation of areas under Roman rule brought an increase in settlement number, as can be seen in the archaeological record. Out of the 1,399 Early Roman sites, only 18.4 % of them (258 sites) have Nabatean pottery, suggesting that the main increase in the number of settlements occurred after 106 CE. The year 106 CE holds significance despite suggestions that Nabatean pottery may have continued to be produced after the annexation of the Nabatean Kingdom (Erickson-Gini 2021), as the presence of Nabatean pottery at various sites primarily reflects settlements that existed prior to 106 CE. In contrast, other sites, constructed by the Romans, are likely to date to post-106 CE. This increase can be explained by the continued development of run-off irrigation (Bruins 2012, p. 37), as well as the relative peace under Roman unified rule leading to an increase in building projects in the area (Erickson-Gini 2010, p. 50). This is especially true for the central Negev desert and the Arava, as these regions remained peaceful even in times of turmoil and war in the northern province of Judaea. On the other hand, the northernmost part of the Negev was impacted by the turmoil in the north, and numerous settlements to the north of Be'er Sheva were abandoned in the 2nd century CE (Heinzelmann et al. 2022, pp. 97–100, 151–154). A post-106 CE date for the increased number of settlements complements the fact that the rest of Judaea stabilised after the end of the Second Jewish Revolt in 136 CE (Olshanetsky 2024). It is interesting to note that an increase in the number of sites occurred when the rest of Judaea/Palaestine suffered major military turmoil and temporary depopulation. Therefore, the possibility that Jews may have immigrated from the north to the south due to war should be considered and must be further explored in the future. Furthermore, the stability in the Negev was brought to the area by the large amounts of imperial funds which were invested in the different regions in the form of roads, buildings, temples and facilities (Negev 1988). This can be seen in the establishment of the road linking Petra and Gaza, on which 23 milestones dated to the 2nd century CE were found (David and Isaac 2020), the investment and expansion of former Nabatean settlements (Abadi-Reiss 2020; Dahari and Sion 2017; Erickson-Gini 2010, p. 50, 2015; Sion et al. 2022; Tepper et al. 2018a, pp. 143–145, 148; Tsafirir and Holum 1988, pp. 119–123), as well as the establishment of new sites and agricultural installations in the south of Israel (Erickson-Gini and Bekes 2019; Junge et al. 2021; Tepper et al. 2020).

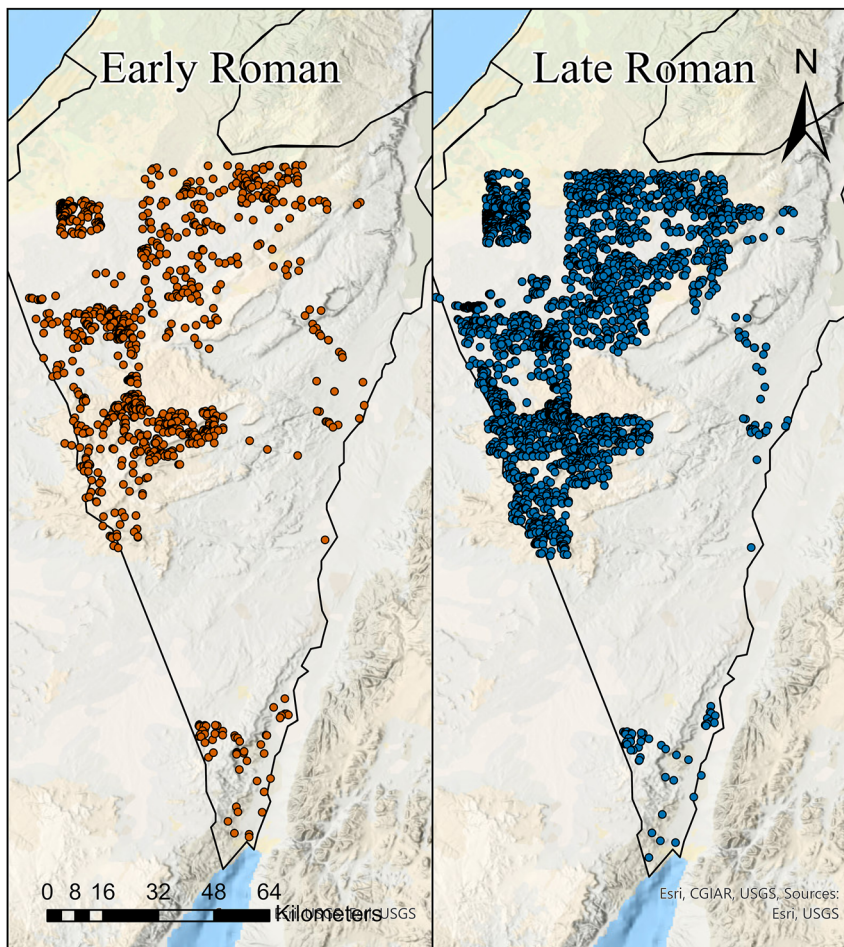
Thus, the area prospered due to imperial investments (Rubin 1998). As the new areas were annexed by the Empire, no custom duties were imposed on products from these areas, increasing the accessibility, affordability, and profits from the goods. The increase in wealth drove the Roman Empire to further invest money to improve accessibility and security in the area through the protection of roads and erecting forts (Beit-Arieh and Cresson 1991; Tsafirir 1986, pp. 83–85), to prevent raids from nomadic tribes (Mayerson 1989; Parker 1986). Crucially, the second phase of increase, which commenced in 106 CE, contradicts the definition of the Roman Climate Warm Period (a warmer climate which lasted from the 1st century BCE until the beginning of the 2nd century CE) as a period of optimal climate (or a Roman climate optimum) (Erdkamp 2019, p. 429). This is because, as is clear from the data, there was a different optimal climatic period for each region or sub-region, which often differed from other regions due to a regional microclimate (Izdebski et al. 2016). There is no century which was necessarily climatically optimal for the entire Mediterranean basin, and often the available climate proxies for a region contradict the fluctuations in settlement number and population which are visible in the archaeological record. As Kouki defines in her paper, it questions the reliability of climate proxies, even for regions adjacent to the sites where climate proxy data was collected (Kouki 2013, pp. 206–211).

## 4.2 The Increase Between the Early Roman and Late Roman Periods

The increase in the number of settlements continued and peaked in the Late Roman period with 3,775 sites (Figures 6 and 8). While 62.7 % of Early Roman sites were also occupied in the Late Roman period, settlement activity in the region intensified, except for the Arava, where the number of sites decreased. Although, the overall number of sites in the Arava is only slightly less (31) than in the Early Roman period (33). On the other hand, the

north-western Negev is an area largely devoid of any salvage excavations, with extensive archaeological excavations mostly conducted at the sites of Shivta, Elusa, Nessana, and Rehovot-in-the-Negev in the north-western Negev, demonstrating the expansion and intensification of the settlements during the Late Roman period (Dahari and Sion 2017; Heinzelmänn et al. 2022; Tchekhanovets et al. 2023; Tepper and Bar-Oz 2020; Tepper et al. 2018a; Tsafir and Holum 1988; Urman 2007). Other than this region, salvage excavations in the northern Negev highlight a drastic increase in the number of sites to 16 in the Late Roman compared to 9 in the Early Roman, as highlighted in Noe's analysis of the surveys and excavations from the Late Roman period in the most northern parts of the Negev (Michael 2022, pp. 108–109, 158). Furthermore, several important sites were developed in the western Negev, with an increase from only 2 sites in the Early Roman period to 4. On the other hand, the number of sites from salvage excavations in the Arava decreased from 9 sites in the Early Roman to 2 sites in the Late Roman period.

This peak in the number of sites can be explained by the rapid development of run-off farming, which expanded agriculture in the Negev desert, and the transition between sedentary and nomadic lifestyles 100 km further south (Rosen 2011, p. 10). In addition, the relative peace in the area, with no major conflicts in the region, contributed to this expansion (Avi-Yonah 1956; 1980, pp. 158–153; Nathanson 1986). The increase in population is attested in other parts of the Empire, such as in North Africa (De Vos Raaijmakers and Attoui 2013; De Vos Raaijmakers et al. 2013; Hirschfeld 1997; Rubin 1998), and modern-day Turkey, for example the Maeander Valley (Thonemann 2011, pp. 55, 259), Phrygia (Niewöhner 2013, p. 223), West Cilicia (Blanton 2000, p. 60), Miletus



**Figure 8:** A map of the survey sites in the South of Israel dated to the Early Roman (left) and Late Roman (right) period. The map was produced using Arc GIS Pro v.3.1.3.



(Niewöhner 2011, p. 109), Troad (Cook 1973, pp. 369–374),<sup>5</sup> and its surroundings (Rose 2011, p. 164). This may have been exacerbated due to large migration waves from the Western Roman Empire, refugees who either decided to flee east in its last century of decline, or escape after it dissolved when its last Emperor, Romulus Augustulus, was deposed in 476 CE (Ferrill 1986; Murdoch 2006), as many may have wished to remain under Roman rule.

Nevertheless, the demographic and settlement florescence which occurred in Palaestina was more significant. Therefore, there is a large question as to why people decided to settle in the desert. What were the pull factors which contributed to this increase in population and the number of settlements? One of the major pull factors, other than peace, prosperity, stability and imperial investment, may have been religious, as it was closer to the birthplace of the Christian faith.

When Christianity became a legal and recognised religion in the early 4th century CE, Christians were a minority (Cosijns 2024, p. 34). By the 5th century CE, the urban areas of Palaestina Tertia underwent intense Christianisation, and Christianity became one of the dominant religions in the area (Bar 2003). However, imperial investment in the region, some of which may have derived from the Christianisation of the Roman Emperors, already began from the reign of Constantine (Avi-Yonah 1958, pp. 541–543). Some of these investments were just standard investments, similar to what can be seen in other regions such as North Africa, which was conquered by Justinian in 534 CE (Rubin 1998). The prosperity in the land and the abundance of resources encouraged an increase in population, which in turn drove an increase in production and wealth. The situation drove the Empire, as well as the church, to further invest in the land. This investment can be seen by the enormous amount of churches and monasteries built throughout the Empire, but especially in Palaestina (Avi-Yonah 1958; Bar 2003, pp. 403, 406–407; Patrìch 2019; Patrìch et al. 2020). The increase in the number of ecclesiastical establishments played a few major roles: to show the dominance of Christianity, to facilitate and enable Christians to observe their faith, and, more importantly, to try and convert large parts of the population to the Christian faith. The construction of ecclesiastical buildings brought prosperity, wealth and pilgrims, which in turn brought more wealth, investment and people to the area.

This is especially evident in the Negev desert. The intensive habitation of the Negev desert was enabled through imperial investment, with the construction of numerous agricultural terraces during the Late Roman period (Avni et al. 2013; Bruins 2012). These terraces intended to harvest the flood waters which were in turn used to turn large swathes of uninhabited and uncultivated land into fertile agricultural land (Rosen 2017, p. 18). This brought people to settle in the area, who may have been predominantly Christian due to the area being tied to the Christian faith,<sup>6</sup> alongside a concerted effort by the authorities to convert the desert tribes to Christianity as they became the primary defenders of the borders of the Empire (Rubin 1996, p. 55). The growing Christian population in the region encouraged the construction of ecclesiastical establishments such as churches and monasteries, with roughly 30 churches and 15 monasteries constructed in the Negev desert by the end of the 6th century CE (Wacławik 2017, p. 108). The Church and its numerous facilities became the most prominent institution in the Negev, managing the administrative affairs in the settlements (Mayerson 1982, pp. 51–52), and closely interacting with the community to the point where the leaders of Nessana were designated as “a priest and an abbot” (Rubin 1996, pp. 55–56). This in turn brought more people to the area, including pilgrims, some of whom were drawn to the desert to witness the desert monastic and eremitic way of life, such as Antonius of Piacenza (the Piacenza Pilgrim) who made a detour in order to visit a convent near the Dead Sea (Mayerson 1982, p. 52). The pilgrims were an important source of manpower for the monasteries (Seligman 2020, p. 32; Whiting 2020, p. 75), who stimulated the creation of new ecclesiastical establishments, such as monasteries and *xenodochia* (Christian hostels) (Votaggio 2011; Whiting 2020, p. 76).

The pilgrims also travelled to the Negev because it was one of, if not the main, gateway to the Sinai Peninsula and Mount Sinai. The route is partially described by Antonius of Piacenza, who travelled from Elusa into the Sinai

<sup>5</sup> Nevertheless, Cook is incorrect in saying there was a decrease in maritime trade as there was no information on shipwrecks during his period, which show an increase in maritime trade in the eastern Mediterranean during the Late Roman period: (Leidwanger 2020).

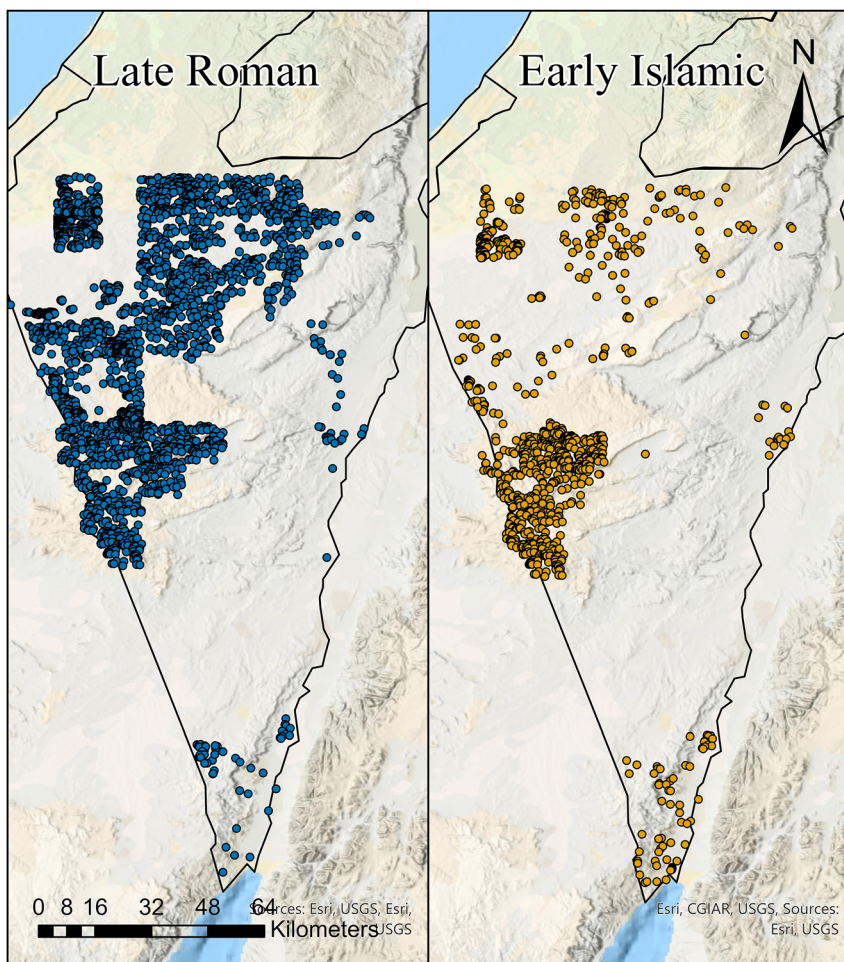
<sup>6</sup> The fact that the church, and the Christianised Roman Empire, heavily invested in Judaea/Palaestina due to its holy status is well documented by ancient authors, including church fathers, and is well established in modern research: Eusebius, *Vita Constantini*, 3.42; (Armstrong 1967; Avi-Yonah 1958, p. 136; Bar 2005, p. 61; Parker 1999; Sivan 2008, pp. 31, 210–211; Whiting 2020).



desert (Piacenza Pilgrim, *Itinerary*, 34). Although there was a different route through Egypt, as described by the nun Egeria (Egeria, *Itinerary*), it seems that, despite popular conjecture (Negev 1977, p. 79), the route through the Negev desert was also commonly used. Throughout the Sinai peninsula, there are around 8,500 inscriptions, rock drawings and graffiti in Nabatean, Greek, Latin, Coptic, Armenian, Hebrew, Aramaic and Arabic (Stone 2015). One of the largest concentrations of graffiti is in Wadi Haggag, a valley in the southeast of the Sinai Peninsula with over 400 inscriptions, a majority of which have a Christian nature. Some of these inscriptions date to the early 4th century CE, while a majority of them date from the 5th century CE and later (Negev 1977, pp. 3, 76–77). The route through Wadi Haggag would have been frequented by pilgrims travelling through the Negev desert (Mayerson 1982), and so this suggests that the Negev settlements may have greatly benefited from the pilgrim traffic in Judaea/Palaestina, which in turn would have attracted people to the area.

### 4.3 A Decline in the Number of Sites

There was a significant decrease in the number of sites between the Late Roman, with 3,775 sites, to the Early Islamic which had 1,222 sites (Figures 6 and 9). From the Early Islamic sites, 76.6 % of them (966 sites) had an earlier Late Roman phase. The decrease was seen almost entirely throughout the south of modern Israel, except for two points. The first, the Arava, saw an increase in the number of sites found in the archaeological survey. This fact is also reflected in the salvage excavations, where the number of sites increased from 2 in the Late Roman period to 5 in the Early Islamic. The second, in the west of the Negev, is due to a decision by the surveyors to define



**Figure 9:** A map of the survey sites in the South of Israel dated to the Late Roman (left) and Early Islamic (right) period. The map was produced using Arc GIS Pro v.3.1.3.

all Late Roman (Byzantine) sites as also Early Islamic, although this decision was not supported with sufficient evidence as they stated that they believed the Late Roman ceramic typology continued a few decades into the Early Islamic. Thus, there is no sufficient evidence to conclude these sites continued throughout the entirety of the Early Islamic period.

The decrease in the number of settlements in the Negev desert specifically has come under scrutiny in recent years. Some researchers have tried to attribute this decline to the middle of the 6th century, and so claim that the LALIA or the Justinianic plague caused a decline in the size and number of settlements (Bar-Oz et al. 2019; Fuks et al. 2020; Langgut et al. 2020; Lantos et al. 2020). Before discussing their methodology, conclusions and reliability, a few words on the LALIA and the Justinianic plague and the state of the research on these phenomena are in order.

#### 4.4 The Justinianic Plague and the LALIA

Two main cataclysmic events have lately been proposed to explain the reported decline in population and settlement numbers across the Eastern Roman Empire, not just in the southern region of Israel, alongside the continued debate whether this decline began in the 6th or the 7th century CE. The first is the Justinianic plague, which initially affected the Roman Empire, especially Constantinople, between 541 and 544 CE (Eisenberg and Mordechai 2019, pp. 25546, 25548; McCormick 2015, p. 345, 2016, p. 1005; Mordechai and Eisenberg 2019; Mordechai et al. 2019; Sarris 2002, pp. 174–175). It is believed to have spread across the Empire, with supposed outbreaks over the subsequent two hundred years (Sarris 2002, 2020). However, recent scholarship challenges the idea that the Justinianic plague was as devastating as previously thought (Harper 2017; McCormick 2021; Sarris 2020). These studies argue there is no concrete evidence that the plague decimated the Empire, that the numerous episodes linked to it over two centuries were catastrophic, or that they all stemmed from the same outbreak (Eisenberg and Mordechai 2019; Mordechai and Eisenberg 2019; Mordechai et al. 2019; Olshanetsky and Cosijns 2024).

There is some debate about the origins of the Justinianic plague and the exact timing of its first appearance. Phylogenetic evidence indicates that the earliest strain was found at Edix Hill near Cambridge, UK, with the sampled individual radiocarbon dated to 474–637 CE at 95.4 % probability. However, archaeological dating of this burial predates 550 CE (Keller et al. 2019, p. SI Table. S13). Since this is the earliest known *Y. pestis* (bubonic plague, linked to the Justinianic pandemic) strain from that period, Sarris argues that the burial should be dated to the late 5th or early 6th century CE (Sarris 2022, pp. 342–343). This suggests the Justinianic plague began before Justinian's reign and may have arrived in the empire from a different source, challenging previous assumptions and contemporary accounts (Benovitz 2014, p. 488; Keller et al. 2019, pp. SI 18–23; Mordechai et al. 2019, p. 25547).

The closest ancestor of the *Y. pestis* strain linked to the Justinianic plague originates from the Tian Shan mountains in Central Asia and dates back to the 2nd century CE. Some experts suggest Central Asia as the possible location where the divergence event that led to the Justinianic plague occurred. Combined with the potential earlier date for the plague's appearance in Europe, this supports the theory that the migration of the Huns to Europe introduced the ancestors of the Justinianic plague there (De Barros Damgaard et al. 2018, pp. 372–373; Keller et al. 2019, p. 12368). The discovery of the plague victim from Edix Hill suggests an earlier onset for the plague that affected the Mediterranean and raises questions about its infection rate, indicating that it may have circulated for centuries without causing noticeable outbreaks (Olshanetsky and Cosijns 2024). Moreover, there is no evidence of population decline in the 5th or early 6th centuries CE due to disease, especially in the eastern Mediterranean. The absence of such epidemiological records during this period is striking, considering the disease was likely widespread in the region. Furthermore, as of now, no mass graves, nor the *Y. pestis* bacteria in Late Roman remains, have been located in the Negev desert or the entirety of modern-day Israel and the West Bank, although several individuals infected with *Y. pestis* have been found in Jerash, modern-day Jordan (Adapa et al. 2025). According to the authors, the remains date to somewhere between 560 and 660 CE. However, as these remains were laid on top of the layer with late 6th to early 7th century pottery and before the 659 CE earthquake (Adapa et al. 2025, pp. 3–4), it is more likely they date to 620 to 650 CE. Yet, there is evidence for a change in climate for the period in question.

According to paleoclimatic research, the middle of the 6th century CE saw a period of global cooling caused by volcanic eruptions (Büntgen et al. 2016, pp. 231, 233; Peregrine 2020; Sigl et al. 2015; Toohey et al. 2016), which decreased the annual average temperature (Helama et al. 2017). These eruptions may have lowered the global average temperatures by up to 1.6 °C (Sigl et al. 2015), and 1.43 °C in the northern hemisphere (Stoffel et al. 2015, pp. 784–785). Yet, the decrease in temperatures was different in various areas. While the higher latitudes of the Northern Hemisphere faced a decrease of more than 2 °C (Sigl et al. 2015), the lower latitudes, which consisted of all the territories of the Late Roman Empire, may have experienced a decrease in temperatures as little as 0.25–1 °C. The southernmost areas of the Roman Empire, including Egypt and Israel, had a decrease of around 0.25 °C (Peregrine 2020). Some claim that the impact of this climate change was significant and lasted over a hundred years, from 536 to 660 CE (Büntgen et al. 2016; Fuks et al. 2017). However, there is a substantial debate about the extent and impact of this event, with some suggesting that it only lasted from 536 to 560 CE (Peregrine 2020). Furthermore, the presence of regional microclimates highlights that each region can and will experience climatic events differently.

This point is particularly emphasised in Arjava's research, where he demonstrates the absence of textual evidence supporting the idea that the dust cloud of 536 CE, which allegedly obscured the sun and initiated the Late Antique Little Ice Age (LALIA), had any impact beyond Europe. In fact, ancient sources explicitly indicate that the dust cloud's effects were almost entirely confined to Europe (Arjava 2005, pp. 80–81). Arjava suggests that the consequences of the 536 CE volcanic eruptions were likely limited to regions north of latitude 35, implying that much of the Eastern Roman Empire, including Judaea/Palaestina and Egypt, remained unaffected (Arjava 2005, pp. 82–83). According to his findings, Asia Minor (modern-day Turkey) is the only region within the Eastern Roman Empire where textual evidence points to any influence from the dust cloud (Arjava 2005, pp. 83, 93). Furthermore, literary, papyrological, and epigraphic sources do not report any long-term consequences. The few ancient writers who directly address the event note that its effects lasted no more than one or two years, and none mention any continued impact on agricultural production (Arjava 2005, pp. 83–94).

## 4.5 The LALIA and the South of Israel

While paleoclimate data from the Soreq cave speleothems and some Dead Sea sediment cores indicate low levels of precipitation (Bar-Oz et al. 2019; Fuks et al. 2020; Langgut et al. 2020; McCormick et al. 2012; Orland et al. 2009), other sediment cores from the Dead Sea (particularly from Ein Feshkah) and Levantine marine cores reveal higher precipitation levels, peaking in the 6th and 7th centuries CE (Izdebski et al. 2016; Migowski et al. 2006). The sudden peak in Dead Sea levels from Ein Feshkah could be linked to a brief period of increased rainfall. Therefore, the Soreq cave speleothems might be inconsistent with a cooling event, since a temperature decrease of 1–1.5 °C in Israel can sometimes lead to more rainfall in certain southern areas or improve habitability. Despite a slight increase in precipitation, the Negev desert's climate would remain marginally altered, still classed as arid (Bruins 2012). However, if the cooling was accompanied by reduced rainfall, the long-term soil water retention, achievable due to robust and extensive Roman-era agricultural systems (Ashkenazi et al. 2020), and reduced evaporation caused by lower temperatures, would still support ongoing agriculture in southern Israel during the LALIA. The former factor, the development of well-established agricultural practices in the south of Israel, could have been robust enough to mitigate climatic events. For instance, even though the agricultural terraces of the south have not been systematically maintained in the last 1400 years, the Bedouin tribes living in the region still use this infrastructure to grow their fruit trees in the inhospitable desert even today (Ashkenazi et al. 2020). Thus, while the south of Israel is a marginal environment with a complex socio-ecological system, the small climatic shift of the LALIA may have been alleviated due to the agricultural infrastructure and practices of the Late Romans. Additionally, stable isotope analysis of archaeological sheep and goat remains from the Late Roman and Early Islamic periods suggests that grazing patterns and management strategies continued consistently, indicating that the Negev's microclimate did not experience significant change (Vaiglova et al. 2020).

Another theory to explain the decline of this region, which was intertwined with the Justinianic plague and LALIA, is the over-exploitation of the land and its resources. This claim rests on the assumption that if the

inhabitants are using wooden architectural elements from abandoned houses as fuel, this can be seen as evidence of the lack of natural fuel resources in the area, which an over-exploitation of the land can explain (Langgut et al. 2020, pp. 10, 15). This was further supported by palynological evidence. However, this theory does not align with the papyrological evidence from Nessana, and the dating of the palynological evidence is not based on radio-carbon dating and is arbitrary (Cosijns and Olshanetsky 2022).

In discussing climate proxies, it is important to highlight a point made by Kouki in her 2013 article. She notes that climate proxies can sometimes contradict one another, and when compared with neighbouring regions, even those as close as Jordan, they may conflict with the archaeological record. For instance, some proxies suggest reduced rainfall during periods of population growth, and increased rainfall during times of contraction. According to Kouki, such inconsistencies cast doubt on the reliability of climate proxies and the ability to interpret them accurately. This, she argues, underscores the growing need to place greater emphasis on the tangible, anthropogenic evidence found in the archaeological record (Kouki 2013).

#### 4.6 Is the Decline in the Late Roman Period?

According to an extensive analysis and re-examination of the radiocarbon and OSL dating, stable isotope analysis and ceramic typology of the south of Israel, a decline did not occur in the middle of the 6th century CE. Some of the settlements at the heart of this matter are the large north-western Negev settlements of Elusa, Nessana and Shivta (Figure 1). The dating from the recent excavations of these sites was based on the ceramic typology of Gaza jars, commonly known as the Late Roman Amphora 4 (LR 4 or LRA 4) (Reynolds 2005, pp. 574–575; Riley 1975, pp. 27–31; Tomber 1996). The archaeologists largely utilised Majcherek's typology when dating the sites (Bar-Oz et al. 2019; Fuks et al. 2020; Langgut et al. 2020; Majcherek 1995). This vessel is commonly thought to have transported wine, specifically Gazan wine (Mayerson 1992). A large quantity of the vessels found were Gaza jar type 3, whose production is dated to the latter half of the 5th century CE until 600 CE and was still in extensive use during the beginning of the 7th century CE (Cosijns and Olshanetsky 2022, pp. 21–23; Majcherek 1995, pp. 168–169), which suggests that the settlements were in use after the middle of the 6th century CE (Cosijns and Olshanetsky 2022; Olshanetsky and Cosijns 2023).

This conclusion aligns with the results of a study of Elusa, headed by a team from the University of Cologne. In their preliminary analyses, they remarked that 'clear signs of transformation processes' can be seen only in the 7th century CE (Schöne et al. 2019, p. 149). However, a more recent publication proposed that the decline in Elusa occurred in the 6th and 7th centuries CE (Heinzelmann et al. 2022). This apparent contradiction of their initial assessment may lie in their use of a dating methodology which misinterpreted the dating of Majcherek Type 3 jar, dating it from the middle of the 5th until the middle of the 6th century CE (Heinzelmann et al. 2022, p. 274). Yet, despite this, their raw data highlights how none of the sondages excavated by the team was abandoned before the end of the Late Byzantine period (Heinzelmann et al. 2022, pp. 253, Fig. 216).

It is important to note that this is a common error in the excavation results of the NEGEVBYZ project and its adjacent members, having both misinterpreted Majcherek's 1995 typology and not employing updated typologies from the last two decades (Bar-Oz et al. 2019, pp. 8242–8243; Fuks et al. 2020, pp. SI Methods, Table 1). The updated Gaza jar/LRA 4 typology utilises data from excavations after 1993. However, Israeli archaeologists still tend to heavily rely on Majcherek's earlier typology of Gaza jars (Sazanov 2017, p. 631), despite this only being preliminary work (Majcherek 1995, p. 169). In 2005, Dominique Pieri built on Majcherek's typology from 1995 and reinterpreted Majcherek's Type 3 as LRA 4B2, redating it from the second half of the 6th century to the 7th century CE (Pieri 2005, pp. 104, 106). Pieri's recent publications also stated that the LR4 B was found in late 6th to first third of the 7th century Merovingian deposits in Marseille and the nearby region (Bonifay et al. 1998, pp. 125–127, 401; Bonifay and Pieri 1995, p. 112, 2020, p. 871). Thus, a correct reading of Majcherek's typology, alongside the new typologies, emphasises that the dating needs to be amended and any claimed 6th-century CE decline should be dated to the 7th century CE.

This conclusion is supported by the changes in the ceramic assemblages of the Negev. From late 6th century or early 7th century CE, there is a general increase in the number of sherds found at the sites in the northwestern



Negev, and especially an increase in the later type bag-shaped jar sherds, commonly known as Late Roman Amphora 5 (LR 5 or LRA 5) (Reynolds 2005, p. 573). Both bag-shaped jars (Kingsley 2004, p. 118; Mango 2001, pp. 49–50; Pieri 2005, pp. 114–125; Reynolds 1995, pp. 71–72), and Gaza jars (Mango 2001, pp. 50–51), were used to transport commodities, although bag-shaped jars were also used for storage (Meyers 1981, pp. 61–71). This increase in the number of sherds and the change in the ratio of bag-shaped to Gaza jar could have been caused by two possible scenarios (Olshanetsky and Cosijns 2021, pp. 15–16, 2022, pp. 38–40).

The first is that disruptions of the trade routes due to the Persian Invasion of 614 CE may have caused the farmers in the Negev to produce more local bag-shaped jars (Erickson-Gini and Mamalya 2022, pp. 155–157; Heinzelmann et al. 2022, p. 273), because of their dual usage for storage and trade, and as compensation for the decrease in the imports of the Gaza jars to the region. The situation only worsened with the Arab Conquest of 636 CE, prompting some farmers to concentrate on cultivating cereals, due to easier storage solutions. Another possibility is that Gaza jars became scarcer in the Negev once the wars reached the region, as they were initially transported already filled from the coastal areas. As the ability of Negev settlements to import goods declined, fewer vessels were imported to the region, reducing opportunities to repurpose them for export or domestic use. Consequently, local villages in the Negev responded by increasing the production of bag-shaped jars (Olshanetsky and Cosijns 2021, 2023, 2024).

Regarding the second scenario, the archaeological evidence suggests the region grew considerably wealthier throughout the 6th century CE. Due to this increase in prosperity, there may have been an increase in the imports packaged in bag-shaped jars, as they were used to import a variety of products. A good way to examine both theories is to analyse the fabric and petrology of the sherds found in the sites (Holmqvist 2009, 2019, pp. 118–119), as the pottery made in the desert settlements had a distinct, pale yellow colour (Holmqvist 2019, p. 55). This is true for both Gaza and bag-shaped jars (Erickson-Gini et al. 2018), with some naming the Negev produced Gaza jar, the Elusa jar (Fabian and Goren 2002).<sup>7</sup> It is also important to emphasise that the LRA 4 did not always contain wine (Caputo 2019, p. 187; Passi et al. 1981, pp. 783–784; Pecci et al. 2010, p. 367; Romanus et al. 2009, pp. 901, 903). This factor, alongside the distinct fabric of the LRA 4, which identifies them as being produced in the coastal region, damages the theory that the northwestern Negev was part of Gazan wine production.

This is further supported by the radiocarbon and OSL dates. Although there are few radiocarbon dates for the Negev for the Late Roman period, some of them show that some structures, such as pigeon towers, were used until the beginning of the 7th century CE. These towers were used to date the decline as the pigeons of the Negev were grown for their faeces, which was used as fertiliser (Tepper et al. 2018b; Yan et al. 2021). In addition, the limited radiocarbon dates from the garbage mounds of Elusa showed that they were in use in the second half of the 6th century CE (Bar-Oz et al. 2019, p. SI Table S6; Olshanetsky and Cosijns 2023), despite previous claims (Bar-Oz et al. 2019). Similarly, the OSL dates show that a significant number of agricultural terraces and water cisterns were constructed during the Early and Late Roman period, and some were in continuous use until the 7th to the 11th centuries CE (Avni et al. 2006, 2013; Junge et al. 2021).

The excavations of the Negev sites only further emphasise that a decline did not occur in the middle of the 6th century CE. Rather, there is evidence that renovation and construction work occurred during this period, as can be seen in the construction of a church in Rehovot-in-the-Negev (Tsafrir and Holum 1988, pp. 122–123), a large house in Nessana (Urman 2007, p. 122), and the renovation of several churches in Be'er Sheva during this period (Michael 2022, pp. 123–124). In addition, there is evidence of the expansion of settlements during the 6th century CE (Michael 2022, p. 127; Tsafrir and Holum 1988, pp. 117–119), as well as the erection of rural agricultural installations in the late 6th to early 7th century CE (Michael 2022, p. 127; Michael and Tepper 2021; Pasternak and Karkovsky 2022).

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<sup>7</sup> Thus, if there is an increase in the presence of locally made bag-shaped jars, which can be identified by their distinct colour, it is an indication in the increase of local production, and a possible decrease in imports. On the other hand, if there is an increase in imported bag-shaped jars, which would be easily identifiable due to their darker colour, this would imply that there is an increase in imports to the region.

This same trend is visible in numerous regions around the Mediterranean, including Cyprus,<sup>8</sup> northern Egypt (Alston 1999, pp. 138–141; Kenawi 2014; Römer and Bailey 2019; Wilson and Grigoropoulos 2009), and Asia Minor (modern-day Turkey).<sup>9</sup> For instance, the Maeander Valley saw a rise in agricultural acreage, population, and settlement size in the Late Roman period (Thonemann 2011, pp. 55, 259), with similar trends in Phrygia (Niewöhner 2013, p. 60), Miletus (Niewöhner 2011, p. 109), Sagalassos (Vanhaverbeke et al. 2021, pp. 258–260, 272), and the Troad (Cook 1973; Rose 2011, p. 164),<sup>10</sup> as well as a general increase in the population of the Anatolian countryside from the 4th until the middle of the 7th century CE (Roberts et al. 2018, p. 312).

Furthermore, as mentioned previously, one of the important incentives to travel to the Negev settlements was for pilgrimage reasons. Thus, it is vital to note that the monastery of St. Catherine at the foot of Mount Sinai was only constructed in the middle of the 6th century CE (Forsyth 1968; Liphshitz and Waisel 1976, p. 42). Only after its construction, which included guestrooms at the monastery for the pilgrims, did the Sinai region see an increase in the number of pilgrims to the site, with evidence of numerous noted church members who travelled to the region after the establishment of this monastery (Brown 2017, pp. 76–78).

#### 4.7 Is the Decline in the Early Islamic?

As can be seen in Figures 3–6, a general decline in settlement did occur (Michael 2022, p. 128; Schöne et al. 2019, p. 149). However, there is an important question of when. As explained, this decline did not occur during the Late Roman period, as supported by the surveys, excavations and other archaeological data. Most of the surveyors of the Negev indicated that many of the sherds found at the sites were sherds dated to the end of the Late Roman period, which may have continued to be used in the first decades of the Early Islamic period, and possibly even until the end of the 7th century CE (Michael 2022, p. 163).<sup>11</sup> In addition, if a decline was mentioned, it was dated to the 7th century CE. Therefore, this not only implies that the decline did not occur in the middle of the 6th century CE, but that it occurred during the 7th century CE or later.

As mentioned previously, there are several problems regarding the dating of Early Islamic sites which influenced the results of the survey slightly in both directions, such as the misdating of Early Islamic sites, dating Late Roman pottery as Early Islamic (Magness 2003, p. 136), or dating all sites as both Late Roman (Byzantine) and Early Islamic.<sup>12</sup> Furthermore, the pottery of the Late Roman period is often used to define the period until the end of the 7th to the beginning of the 8th century CE, as there was no significant change in the ceramic assemblages (Magness 2003, p. 136). All of this does not change the trend visible in the survey data, and further emphasises that the long process of decline continued from the 7th century CE onwards. The same can be inferred from Magness' reanalysis of some of the survey data, showing that some of the sites identified as only Late Roman (Byzantine) may either be incorrect, or also dated to Early Islamic, although this is only around 15 sites which is insignificant compared to the large number of sites (Magness 2003, pp. 130–194). Moreover, as two of the main surveyors of the Negev incorrectly dated Late Roman period sites to the Early Islamic, it implies that the number of settlements in the Negev declined in the Early Islamic period (Magness 2003, pp. 133–138). This is further supported by some limited stable isotope data from the remains of grazing animals from Nessana, Elusa and Shivta, that although may not reflect a general trend, shows they drank from closed water sources during the Late Roman period but

<sup>8</sup> Regarding Dhiorios-Mersineri, see: (Rautman 2021, p. 194); regarding the district of Famagusta, see: (Rautman 2021, pp. 194–195); on the Vasilikos Valley: (Rautman 2021, pp. 202–205; Todd 2013, pp. 106–109); it is important to note that in Cyprus, there was a tide of constructing new churches in the 5th and the 6th c. CE, which is well documented in the archaeological record.

<sup>9</sup> Regarding the general topic on increase in the size of the population, and an increase in the use of new territories for agriculture, and the foundation of new settlements in the region: (Heather 2018, p. 60).

<sup>10</sup> Cook claimed that there was a decrease in maritime traffic, yet the data presented in the current article, which contains information that he did not possess, disprove this suggestion.

<sup>11</sup> See maps: 120, 125, 127, 128, 136, 139, 140, 162, 164, 166, 167, 168, 169, 170, 172, 173, 174, 177, 178, 193, 194, 195, 196, 225.

<sup>12</sup> Maps 193, 202, 206, 224, 225 by Gideon Avni, and maps 198, 199, 200, 203 by Mordechai Haiman, shown in the Early Islamic map in Figure 9 as the highest concentrations of settlements. Furthermore, this problem does not only exist with Early Islamic sites, as numerous Late Roman sites were incorrectly identified as Early Roman (Heinzelmann et al. 2022, pp. 103–105).

not during the Early Islamic period, suggesting some of these installations were abandoned in the 7th century CE (Vaiglova et al. 2020, p. 1521).

It is important to emphasise that the central issue of this discussion is pinpointing when, during the 7th century CE, the ceramic vessels at the heart of the debate fell out of use. Although these vessels, commonly categorised as Byzantine/Early Islamic, are challenging to date precisely, they are not considered representative of the entire Early Islamic period (636–750 CE). The debate is narrowly focused on identifying the point between 636 and 700 CE when their use ceased. There is no suggestion that the vessels continued into the 8th century. Instead, their abandonment is consistently linked to the geopolitical transformations of the 7th century. Therefore, while the exact timing of the decline remains uncertain, this ambiguity is less consequential, as it clearly rules out earlier causes such as 6th century climate or plague events. For the purposes of this article, the archaeological evidence, drawn from both excavations and surveys, offers a sufficiently accurate basis for estimating when the decline began. This highlights the problematic and somewhat artificial nature of forcing every find into artificial categories and broad chronological labels such as “Late Roman” or “Early Islamic,” rather than referring to more precise timeframes like specific centuries or decades.

Nevertheless, there is a significant question regarding the rate and extent of the decline in the region, and the differences between urban and rural decline, as this differed within this region. According to archaeological data, it seems that the decline of the rural region was gradual while urban sites declined at different rates dependent on the importance of the site to the authorities. For example, Rehovot-in-the-Negev was abandoned in the 7th century (Korzhenkov and Mazor 2014, p. 87), Nessana in the middle of the 8th century (Ruffini 2011, p. 220), Elusa in the second half of the 8th century (Schöne et al. 2019, pp. 142, 149), and Shivta was abandoned in the 9th century CE (Tepper et al. 2018a, p. 149). Some of these urban centres may have remained relevant due to their importance as a pilgrimage site, and by being on the main pilgrimage road to Mount Sinai. For example, a church was constructed in Nessana in the late 7th or early 8th century CE and continued to be used as a Christian establishment until the end of the 8th or beginning of the 9th century CE (Stone et al. 2019, pp. 125–126; Urman 2004, p. 115). Furthermore, there are two papyri showing requests from the governor of the region, Abu-Rashid, who required guides from Nessana to take people to Mount Sinai (P.Ness. III 72; 73). This suggests that certain institutions, as well as certain settlements, remained important during the Early Islamic period and coexisted peacefully with the new leadership, possibly due to economic incentives. On the other hand, the agricultural terraces were only abandoned in the 11th century CE, although no new ones were found to have been built during the Early Islamic period (Avni et al. 2013).

By contrast, the south of the Arava rift valley, which was largely devoid of any settlements throughout these periods, appears to have been developed during the Early Islamic period. Despite there being a few agricultural terraces established during the Late Roman period (Stavi et al. 2021, pp. 1050–1051), the area only really flourished in the 7th to the 9th centuries CE, with evidence for the construction of numerous qanat systems and copper production sites (Davies and Magness 2015; Nol 2015; Porath et al. 2016; Singer-Avitz and Ayalon 2023), although there is evidence that copper production may have commenced a few centuries before in the Late Roman period (Avner et al. 2018). This suggests the area held some importance during the Early Islamic. The same trend can be seen in the Arabian peninsula, where under the Umayyad caliphate, new copper mining and smelting sites were established in Oman (Ibrahim and El Mahi 2000). Nevertheless, this is not reflective of the general trend, and despite an increase in the number of settlements in the Arava, there was a decline in the number of sites in the Negev desert.

A general decline in the 7th century CE can be found in other regions of the eastern Mediterranean, such as Tunisia (De Vos Raaijmakers and Attoui 2013; De Vos Raaijmakers et al. 2013), and Greece. In Greece, a stark decline in the 7th and 8th centuries CE is visible in most surveys, including those from Laconia (Armstrong 1996, p. 352; Shipley 1996, pp. 259–260), Methana (Bowden and Gill 1997a, pp. 84–85, 1997b, pp. 77–78; Koukoulis 1997, p. 97), Boetica (Bintliff and Snodgrass 1985, pp. 157–160), Argolid (Jameson et al. 1994, pp. 224, 229–243), and the Asea valley (Forsén 2003, p. 264; Forsén and Karivieri 2003, pp. 310–312). It is important to note that the material culture of the 6th and 8th centuries CE is well understood for the different Greek sub-regions, and so this decline in the number of sites cannot be attributed to ignorance of the ceramic typologies (Armstrong 1996, p. 352).

**Table 2:** A table comparing the trends of the available survey data, ancient texts, archaeological excavations and climate proxies.

Survey and Salvage excavations	Historical and archaeological record	Climate
Increase in number of sites between Hellenistic and Early Roman periods	Increase in number of sites is not actually between the Hellenistic and Roman – increase after 106 CE	High rainfall until 150 CE
–	Continuous increase in number of sites throughout 2nd and 3rd c. CE	Low rainfall
Large increase in number of sites between Early Roman and Late Roman periods	Continuous increase in number of sites until a peak at the end of the 6th or beginning of the 7th c. CE	Contradicting data – low rainfall but increase in Dead Sea levels from 500 CE
Decline in number of sites from the 7th c. onwards	Decline and abandonment of many sites in 7th to 9th c. CE	Limited data but <i>relatively</i> low rainfall

If the general decline of the Negev region were to have commenced in the 7th century CE, it may have been due to the conflicts with the Persians and Arabs. Although not much destruction is attributed to the Arab Conquest, there are mass graves dated to the Persian Invasion in other parts of Palaestina (Avni 2010, pp. 150–151; Zias 1991). Furthermore, there are several accounts which discuss the deportations conducted by the Persians (Foss 2003; Liebeschuetz 2015, p. 265), and although this occurred in adjacent regions, it would have affected the economy of the entire region, including the Negev. The decline in the number of settlements continued in the 8th century CE due to the turbulent Umayyad rule (Hawting 2000), and the earthquake of 749 CE (Tsafrir and Foerster 1992). During Umayyad rule, there were three civil wars (656–661, 680–692 and 744–747 CE) ending with the rise of the Abbasid Caliphate in 750 CE (Hawting 2000). The new caliphate transferred the capital from Damascus to Baghdad (Micheau 2008, p. 224), and in doing so transferred the concentration of power to the east, neglecting the whole area of Palaestina (Kennedy 1986, p. 24).

## 5 Conclusions

The survey results show the shifts and trends in settlement patterns and population in the Negev. There was a steady growth in the number of sites since the Nabatean Kingdom invested in the area in earnest in the 1st century BCE. This growth became almost exponential after the Nabatean Kingdom was annexed by the Roman Empire in 106 CE. This in turn suggests that the term “the Roman Climate Optimum” should not be used when referring to the Negev as its end marks the beginning of an optimal period for the region rather than its end, further enforcing the existence of different regional microclimates, and the detrimental effects such sweeping terms have in academic discourse (Table 2). The number of sites reached a peak during the 6th century CE in the Late Roman period, which continued until the beginning of the 7th century CE. The survey’s conclusion is supported by other finds and data, such as radiocarbon and OSL dates, showing that the pigeon towers and the agricultural terraces were in use at least during the beginning of the 7th century CE.

The decline in the Negev settlements commenced only from the 7th century CE, yet the rate of decline is still a matter of debate, although it seems the deterioration of the area was a long process. The bulk of the sites abandoned occurred under Umayyad rule. By the year 750 CE, the number of sites, and the population size in the Negev desert, was a mere shadow and a fraction of what was there only a century before. Moreover, even the relatively small number of sites which were still inhabited and in use after 750 CE were almost entirely abandoned by the middle of the 9th century CE.

The decline in population and settlement across the south of Israel began in the 7th century CE, well after the mid-6th-century LALIA and the initial outbreak of the Justinianic plague. This timing rules out both events as primary causes. The LALIA was a short-lived climate anomaly with limited regional impact, and climate data from Judaea/Palaestina show no major temperature shifts during that period. Likewise, while the Justinianic plague’s chronology is generally agreed upon, its scale, impact, and mortality remain contested, with little archaeological



evidence, such as mass graves, to support a major demographic collapse. In fact, settlement activity peaked in some areas of the Eastern Mediterranean after the plague's onset, aided by localised increases in precipitation.

Therefore, the more plausible explanation for the Negev's decline lies in anthropogenic factors, namely, the profound geopolitical, social, and economic disruptions caused by the Persian and Arab conquests. The following century, since the successful Arab conquest, would see turmoil after turmoil, as numerous civil wars, an earthquake, and a disastrous transfer of power for the whole of Palaestina changed the face of the Negev.

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