Ecocide in Late Antiquity: Environmental Spoliation and Human Resilience in the Negev

by Andrew McNey

Abstract

The dendroecological discovery of a "Little Ice Age" (536-660) has encouraged historiography of the Near East to lend greater agency to ecological factors within studies of the past. (2017, Harper, 287; 2012, Ellenblum, 121; 2019, Sessa, 244) Although this new paradigm introduces a series of factors hitherto missing from historical narratives, it is also constrained by deference to "veneer theory"; emphasising society's innate fragility in the face of great crises (2020, Bregman, 4). This dangerously limits the role of anthropogenic agents to mere witnesses, incapable of shaping historical narratives. The Negev Highlands in Southern Palestine offer a plethora of archaeological and textual evidence to investigate how communities during this unsettled period engaged with the natural landscape. Through an interdisciplinary study of archaeological discoveries, paleoclimatic data, and the Nessana papyri corpus, this article will re-introduce human agency in environmental narratives. Lying at the core of the present study is the concept of ecocide - the human spoliation of ecological systems. Applying notions of community resilience theories within this framework reveals a negative feedback loop that is yet to be examined (2020, Lewit, 75). As settlements became more adaptive, their exploitation of natural resources escalated, thus resulting in greater ecological deterioration. Introducing ecocide as a historical agent where anthropogenic and environmental forces meet; we can elucidate the need for economic adaptation in rural areas where, previously, agriculture was the main commodity. The main implication here is for modern historiography where new conceptual frameworks for the study of the Umayyad period emphasise greater economic continuity. For too long ecocide has been limited to academia of the modern era. Its application

to narratives of the past reveals untapped layers of knowledge that are uniquely related to the seeming ubiquity of human disregard for the natural environment.

Introduction

Early medieval scholarship established a narrative of destruction that was wrought by the Arab-Muslim conquests of the seventh century. (1941, Sauvaget, 247; 2001, Pirenne, 120-8). This was contradicted by a post-war paradigm that identified a greater continuity in the economic affairs of the near east. (1947, Lombard; 2000, Walmsley, 342; 1985, Kennedy, 3-27; 2000, Haldon, 376.) Recently, this continuity has been emphasised by studies of sustained agriculture and land use. (1996, Bartl, 333-48; 1992, Morony, 221-9; 2000, Wilkinson, 219-67; 2011, Kennedy, 177-99) The interdisciplinary archaeological project titled "Crisis on the Margins of the Byzantine Empire: A Bio-archaeological Project in the Negev Desert" (the NEGEVBYZ project) has continued this departure from the Pirennean narrative from a new angle. The findings of the project indicate an economic decline that pre-empted the Arab-Muslim conquests by as much as a century and was instead the product of several interconnected factors; plague, climate, conflict, global demand. (2018, Tepper et al., 148; 2020, Fuks et al., 19788; 2019, Bar-Oz et al., 8245.)

A paper published by researchers Langgut et al. entitled "Environment and horticulture in the Byzantine Negev Desert, Israel: sustainability, prosperity and enigmatic decline" was the first to use the NEGEVBYZ data to ask questions of human impact on ecological systems. The findings of the palynological and anthracological study suggested that greater consideration needs to be given to the overexploitation of natural vegetation. (2021, Langgut et al., 175.) Indeed, scholarship remains interested in how environmental change impacts humans, but a great gap remains when this relationship is turned around. How did humans shape the environment around them? Were these actions sustainable in the long-term, or did they contribute to an economic decline? To address this gap, we need to reconsider our approach to the history of environmental change. Ecocide in Late Antiquity proposes the introduction of

new conceptual terminology. Ecocide is, for the purpose of the present study, the anthropogenic destruction of environments for socio-economic gain. Investigations of ecological change should not underestimate the importance of human agency as a causal factor. Employing the concept of ecocide new layers of human-environment entanglement are unveiled that may explain local ecological change uniquely as a product of human action or inaction.

If we are to foreground human agency in shaping ecological narratives, we should also consider how humans respond to their environment. Formal Resilience Theory was defended in its applicability to the study of the Late Antique Eastern Mediterranean by John Haldon and Arlene Rosen. (2018, Haldon & Rosen, 277.) They define resilience as:

> "the capacity of any set of socio-economic and cultural relations to respond to pressure and stress – of any kind – in such a way as to permit the survival of the fundamental patterns of said relations, even if significant inflections and nuancing of the original framework does take place in the process."
> 2018, Haldon & Rosen, 278.

Employing this understanding of resilience, scholars can trace narratives of ecological change and social adaptation without the explicit need of complete "collapse" or "decline". It foregrounds the importance of appreciating human agency in its capability to conceal or accentuate socio-ecological shocks. Louise Blanke and Alan Walmsley demonstrated the value of resilience theory in a study of urban renewal in Late Antique Baysān, Fiḥl and Jarash. At each of the three sites the archaeological evidence indicates successful readaptation in the face of multiple catastrophes. While the urban built environment was renewed, or in some cases rebuilt, the social and cultural networks of these sites remained intact. (2022, Blanke & Walmsley, 99.) The possibility of human readaptation following viticultural decline has yet to be fully explored for the sixth century Negev. If viticultural production experienced a sudden decline was there an effort made to adapt? Did the economic and social networks of the Late Antique Negev remain intact despite urban reconfiguration?

The disentanglement of human-environment relations necessitates the consideration of a plethora of variables; social, economic, and environmental, each with their own chain of causality. Simply studying ecological and social narratives in parallel does not elucidate the relationships that govern their shared context. Instead, they must be studied as part of one broader operating system. To overcome this scholarship has increasingly united multiple disciplines under a shared sets of aims and interests. Ecocide in Late Antiquity continues this trend by integrating textual, archaeological, paleoclimate and palaeobotanical data within its analysis. New paleoclimate data has brought researchers closer to past climate systems than ever before. This data provides information on systems of weather and climate change over millennia. There is within this, however, a glaring problem. The resolution of the data is not always applicable to specific dates, spanning decades or centuries with only a handful of data points. Furthermore, scholarship is also increasingly convinced that paleoclimate data can only be applied to its immediate geographic region if we wish to be as accurate as possible. To overcome this, the present study will analyse in depth the findings of three different paleoclimate studies of the southern Levant. Focus will be placed on reconstructions of rain patterns from multiple resolution viewpoints. Alongside the paleoclimate data, investigations of archaeological material will provide an insight into economic narratives. The Gaza jar, a proxy for a large-scale wine trade, will be analysed together with palaeobotanical studies of grape pips. The resulting data should provide a record of the production side of a significant economic driver in the Late Antique Mediterranean, the wine trade. It is however difficult to accurately reconstruct complex social and cultural networks from this data. Individuals are not always easily identifiable. It is the responsibility of historians to offer in-depth analyses of the textual corpus for integration into resilience studies.

Ecocide in Late Antiquity draws on two documents within the corpus of Nessana papyri: P.Ness III 3. and P.Ness III 89. The full corpus of over one hundred documents records the legal administration of the community and its land management systems. The earliest document being dated to 505CE and the latest to 689CE, it offers an unparalleled view into Negev society

in the last phase of Byzantine administration and under the early Caliphate. P.Ness III 3. and P.Ness III 89. have been selected from this corpus for focused historical analysis. The selection has been made based on the access they offer to socio-economic relationships otherwise inaccessible in the archaeological material. The documents bear witness to the social networks that lay at the foundations of the economic operations of the region. However, they show each relationship only at one point in time. Unlike other corpora (e.g., the Dioskoros archive) individual actors do not appear multiple times and thus it is not possible to trace their economic affairs over a longer period. This limits the ability of the text to demonstrate explicit responses to specific phenomena. Nevertheless, the texts are highly unique in their ability to provide access to social networks otherwise unidentifiable in the archaeological data alone. They are deserving of detailed historical analysis because unpacking the social networks they document is crucial to understanding community resilience. In his study of the Dioskoros archive, Giovanni Ruffini unravels the web of social networks of 6th-Century Aphrodito, revealing a unique horizontal nexus of social ties. (2008, Ruffini, 149.) Ecocide in Late Antiquity attempts to look below the surface of the text to unpack the socio-economic relationships that lay at the foundation of the documents' legal and administrative contents. Careful attention will be placed on the individual economic actors documented in P.Ness III 3. and P.Ness III 89, their role in the wider socio-economic web, and also how they relate to each other.

New proxy data types continue to lead scholarship in exciting directions, (2009, Orland et al., 32; 2004, Bookman et al., 570; 2020, Vaiglova et al., 10.) however there is a growing concern that overemphasis on ecological agents can lead to misleading conclusions. (2019, Sessa, 231; 2018, Haldon et al., 321; 2021, Erdkamp, 5.) We should not underestimate the ability of anthropogenic action to shape the histories of local regions. In the case of the Negev Highlands, they are at least in part responsible for its decline and perhaps also its economic recovery.

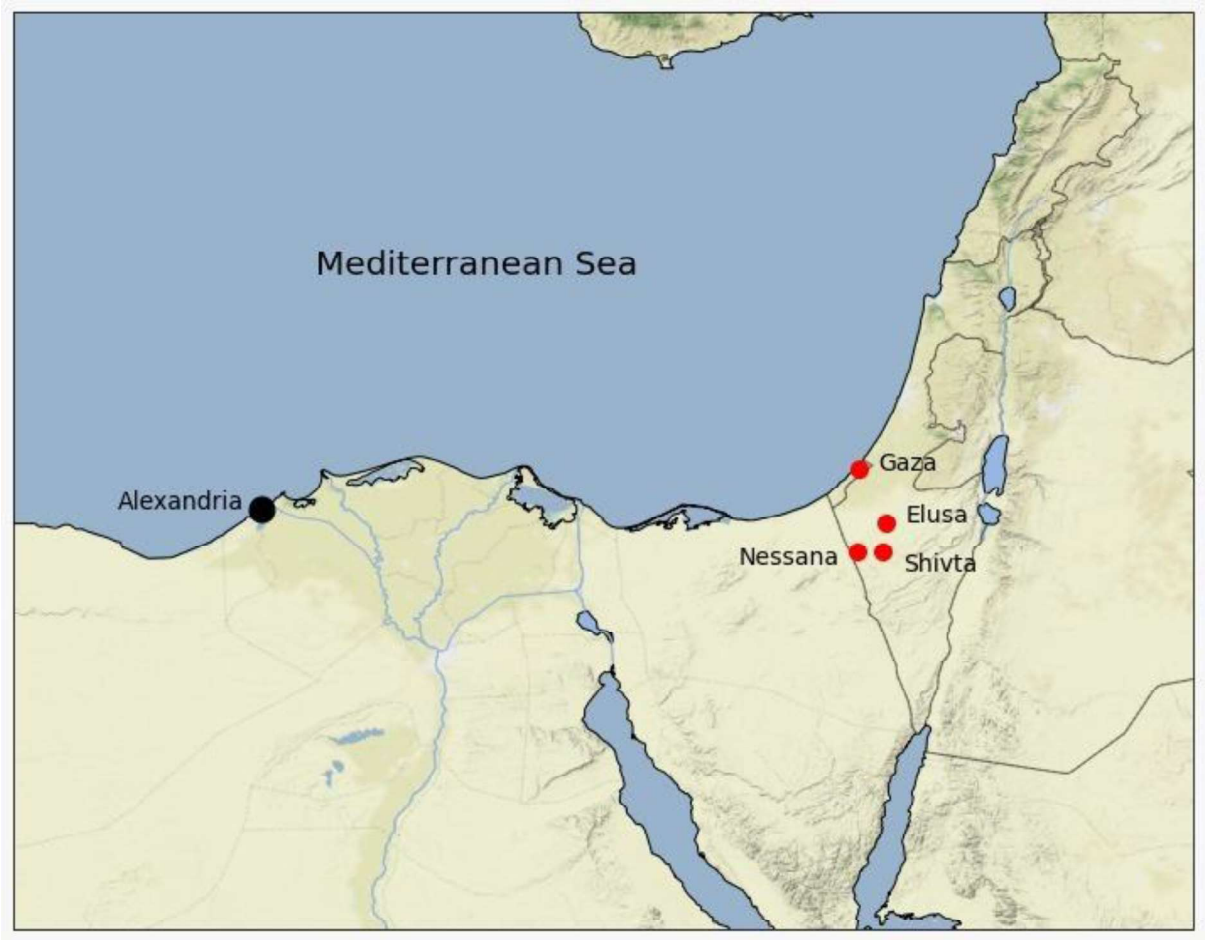

Figure 1 Eastern Mediterranean with modern international borders (sites under study highlighted in red)

Dating and Chronology

The chronology that will be used in this study is drawn chiefly from two papers produced by the NEGEVBYZ project: "Ancient trash mounds unravel urban collapse a century before the end of Byzantine hegemony in the southern Levant" by Bar-Oz et al. published in 2019, and "The rise and fall of viticulture in the Late Antique "Negev Highlands reconstructed from archaeobotanical and ceramic data" by Fuks et al. published in 2020. The chronology provided by Bar-Oz et al. is drawn from investigations of ancient trash middens located outside of the old city walls of Elusa. The researchers collected over 14,974 ceramic sherds from 22 squares (5x5m). Using the ceramic assemblage, it was possible to identify continuous use of the site from Hellenistic – Early Islamic time frames, though the material was dominated by Byzantine

ceramics (dated 350-640CE). In addition, four trenches (2x2m) were opened in two of the identified mound areas from which diagnostic coins and glassware were recovered. All material collected from these trenches was dated pre-7th century and mainly spans the 4th- mid 6th centuries. Furthermore, four probes were opened for the carbon-dating of short-lived materials and were strategically located nearby the squares from which late Byzantine and early Islamic material was recovered. The dating samples were extracted from the topmost layers of the mounds (approximately 0.5 meters in depth). With probability distributions of $\pm 2\sigma$ none of the calibrated dates extended beyond the mid-6th century. As these samples were drawn from the topmost layers of the middens the researchers propose that they offer the best possible estimation for a terminus ante quem of organised trash disposal at the middens. (2019, Bar-Oz et al., 8242-8243.)

The research produced by Fuks et al. provides further chronological information for the material discussed in this paper. The researchers conducted a wide investigation of eleven excavated middens at the sites of Elusa, Shivta and Nessana. The entire ceramic assemblage was identified and implemented in a chronological sequence of seven overlapping phases and subphases: Roman (0-300CE), early Byzantine (300-450CE), middle Byzantine (450-550CE), middle – late Byzantine (ca. 500CE), late Byzantine (550-650CE), late Byzantine-Umayyad (550-700CE) and Umayyad (650-750CE). The typologies used in the identification of these periods were: Gaza form 2 and African Red Slip ware (early Byzantine 300-450CE), Gaza form 3 and Elusa ware jars (middle Byzantine 450-550CE), Gaza form 4 and Riley's LR1 (late Byzantine 550-650CE), and Handmade ware and the Aqaba typology (Umayyad 650-750CE). Where a midden spanned more than one period the researchers implemented transitional loci to establish a stratigraphic sequence of the ceramic assemblage. (2020, Fuks et al., 19783) The researchers thus excavated material across a wide timeframe spanning Roman to Umayyad periods. Their results, which shall be discussed later in the present paper, span preconceived "transitional periods" allowing for the excavated material to indicate an independent timeframe of societal development and decline.

It is important to note that the chronology established in these papers has been the subject of criticism from Lev Cosijns and Haggai Olshanetsky. The researchers suggest that the dating of the NEGEVBYZ project is over-reliant upon Majcherek's Gaza Jars Form 2 and 3. They argue that using Dominique Pieri's Gaza jar typology pushes the dating forward around half a century, meaning that the Byzantine-Persian wars and the Arab-Muslim conquest were the key cause of any significant decline. (2022, Cosijns & Olshanetsky, 9.) The argument is certainly an interesting proposition as to the utility of additional Gaza jar typologies alongside Majcherek's. However, I would contend that the argument is unconvincing as it does not satisfactorily discuss all the dating methods used by the NEGEVBYZ project. The researchers do not address the significance of the coin and glassware finds, nor do they discuss the fact that Bar-Oz et al. and Fuks et al. identify late Byzantine (550-650CE) and early Islamic (650-750CE) separate to middle Byzantine (450-550CE). If the dating of the middle Byzantine period ceramics were incorrect, we would expect to find this accompanied by the late Byzantine and early Islamic material. Instead, these materials were excavated at separate loci. Furthermore, the chronology established by Bar-Oz et al. emphasises the carbon dating of samples as the best possible terminus ante quem for the trash middens. Out of a total of eight calibrated dates with probability distributions of $\pm 2\sigma$ can be dated after the mid-sixth century. (2019, Bar-Oz et al., 8243.)

The data discussed below implements the chronology established by Bar-Oz et al. and Fuks et al. to inform its interpretation of the archaeological evidence. The periodisation implemented is informed by the dating methods of these papers; early Byzantine (300-450CE), middle Byzantine (450-550CE), middle – late Byzantine (ca. 550CE), late Byzantine (550-650CE), early Islamic (640 – 750CE). This dating will be used to trace the rise and fall of viticulture in the Negev and explore the reasons for its decline in the mid-sixth century.

Viticulture in the Negev

P.Ness III 31

[I to Sergius]

2. The middle parcel of the vineyard, the boundaries being

> E and W rock wall
> N property of Victor, brother, and co-sharer
> S property of Khalaf Allah, brother and co-sharer

3. The middle two contiguous parcels of farmland, from the parcels above the vineyard there, the boundaries being

> E rock wall
> W water channel of Khalaf Allah, said brother N property of Khalaf Allah, said brother
> S property of Victor, brother, and co-sharer

P.Ness III 31, Trans Kraemer (2015)

This is an excerpt of a papyrus taken from the Nessana archive, of which, in its entirety, it is the largest of the collection. Dated to the sixth century, it details the property of one Eulios that is being split between his three sons: Sergios, Victor and Khalaf Allah, as shared inheritance. The full document details a vast list of properties, one of which contains ninety-six beds (possibly a caravanserai for traders entering Nessana). (2015, Kraemer, 95.) These are likely the dealings of a wealthy family who are economically significant within the local area. Each brother received one third of the total vineyard plot, however, control of the water channel falls to Khalaf Allah who also has ownership of the plot that is to receive water first. This would have afforded Khalaf Allah a highly advantageous position, having direct control of the water not only entering his own plot, but also consequently feeding his brothers'. The vineyard plots are housed either side by a rock wall, allowing for more directed percolation of moisture directly into the vineyard soil. Unfortunately, the text does not detail the size or extent of the plots and as such it is difficult to interpret the economic significance of their inheritance. It is also not possible to accurately evaluate the productive potential of the plots as we have little detail on their condition. We may infer that, as the other pieces of property in the document demonstrate the capacity to produce significant income, the inclusion of the vineyard plots suggests some economic significance. However, this type of conclusion drawn from the textual evidence alone is vulnerable to misinterpretation. Instead, it is helpful to integrate additional bodies of available evidence.

A key indicator of a possible viticultural economy is the study of the palaeobotanical assemblage. Fuks et al. documented the relative frequency of grape pips among the total assemblage of eleven middens located at Elusa, Shivta and Nessana. The palaeobotanical evidence was analysed using the ratio of grape pip to cereal grain frequency, allowing for the management of behavioural and taphonomic biases. A greater frequency of grape pips relative to cereal grains thus indicates the use of grapes as a major cash crop in the region. The results of the study (Table 1) demonstrate an increase of 29% in Elusa between the early to middle Byzantine phases in the presence of grape pips comprising the total assemblage. Similarly, Shivta reached a peak at 42% in the middle Byzantine period. Overall, the researchers propose the presence of an active local viticultural economy that reached high levels of commercial production in the middle to late Byzantine period (450-550CE). (2020, Fuks et al., 19786) Interestingly, there is a less significant decline in the Nessana assemblage, suggesting a degree of regional variability within this trend. Further research is needed to explain this discrepancy as there is not sufficient space within the parameters of this paper to explore this issue.

Chronological order	Period	Period CE	Site	Grape/(grape + cereal), %
1	Roman	0–300	Shivta	0.5
2	Early Byzantine	300–450	Elusa	14
3	Mid-Byzantine	450–550	Elusa	25
3	Mid-Byzantine	450–550	Elusa	43
3	Mid-Byzantine	450–550	Shivta	42
4	Mid- to Late Byzantine	Ca. 550	Shivta	18
4	Mid- to Late Byzantine	450–600	Nessana	4
5	Late Byzantine	550–650	Shivta	14
6	Late Byzantine to Umayyad	550–700	Nessana	36
6	Late Byzantine to Umayyad	550–700	Shivta	1
6	Late Byzantine to Umayyad	550–700	Shivta	1
7	Umayyad	650–750	Nessana	28
7	Umayyad	650–750	Shivta	19
7	Umayyad	650–750	Shivta	15
7	Umayyad	650–750	Shivta	4

Table 1 Palaeobotanical evidence (2020, Fuks et al., 19786.)

No more than 100km from the Negev Highlands, the port of Gaza was a large distributer of high-quality wines. In a poem celebrating the accession of Justin II on 14th November 565, Flavius Cresconius Corippus attests to the fame of the Gaza wine:

> Meanwhile the happy emperor with his holy wife had begun to partake of the blessed joys of the imperial table, the royal banquet and the sweet gifts of Bacchus, which wild Sarepta and Gaza had created ... The ancient gifts of the Palestinian Lyaeus were mingled in, white with the colour of snow and light with bland taste. They poured dusky chrysattic wines into the yellow metal, produced by nature without need of liquid honey, and blended in the gift of Garisaean Bacchus.
> Corippus, In Laudem Iustini Augusti Minoris; trans. Cameron (1976) 104.

These wines were transported in an amphora typology identified as the "Gaza jar" (Figure 4). This typology has been uncovered at numerous sites across the Late Antique Mediterranean (Figure 2), including modern Libya, Egypt, Sinai, Jordan, Cyprus, Turkey, Greece, Italy, France, Sardinia, and Spain. (2015, Kingsley, 53) The finds of these amphorae are rare in pre-fifth century Mediterranean contexts but rise significantly in the middle-late fifth century, reaching a peak in the early sixth century, before declining again by the early seventh century. (2004, Kingsley, 99; 2013, Decker, 110.) Holistic studies of the relationship between the Negev highlands and Gaza establish the Negev as a primary supplier for this wine. This is largely supported by high concentrations of Gaza jar finds in the Byzantine Negev assemblage. (2020, Lantos, 62.) The shape of the Gaza jar was particularly suited to long-distance trade. Its long body meant that it could carry high volumes of liquid, which could then be transported in large quantities. The mosaic of Kissufim (Figure 3) in the north-western Negev demonstrates the use of this jar typology in the overland transport of goods. (2020, Fuks et al, 19783.) The trader, here named Ορβικον, is holding a bunch of grapes in one hand while he leads a camel in the other. The camel is laden with jars, all of which are depicted in the style of Gaza amphorae. Thus, the evidence indicates the Gaza jar as a suitable indicator of an extensive wine trade.

In a study of the archaeological finds documenting the transition from Byzantine to early Islamic society at the site of Shivta, researchers Tepper et al. discovered an interesting relationship between the amphorae assemblage and social-economic shift. The report details the finds of two Gaza jars dating to the Byzantine period (4th to mid 7h Centuries). These were discovered alongside bag-shaped jars (also in the Byzantine context) less suitable for long-distance trade but still effective storage units (Figure 4). The report also records multiple finds of these bag-shaped jars in early Islamic (mid-7th to mid-8th centuries) middens, but no discoveries of the Gaza amphorae that can be dated past the mid-seventh century. (2018, Tepper et al., 132.) Thus, using the Gaza jar amphorae as an indicator of viticultural production on a commercial, international scale we can trace the growth of an industry that probably peaked in the late fifth to early sixth century. It is possible that the growing of vines continued into the mid-seventh and early eighth century, however it is unlikely that it remained at the levels of commercial output seen in the preceding centuries.

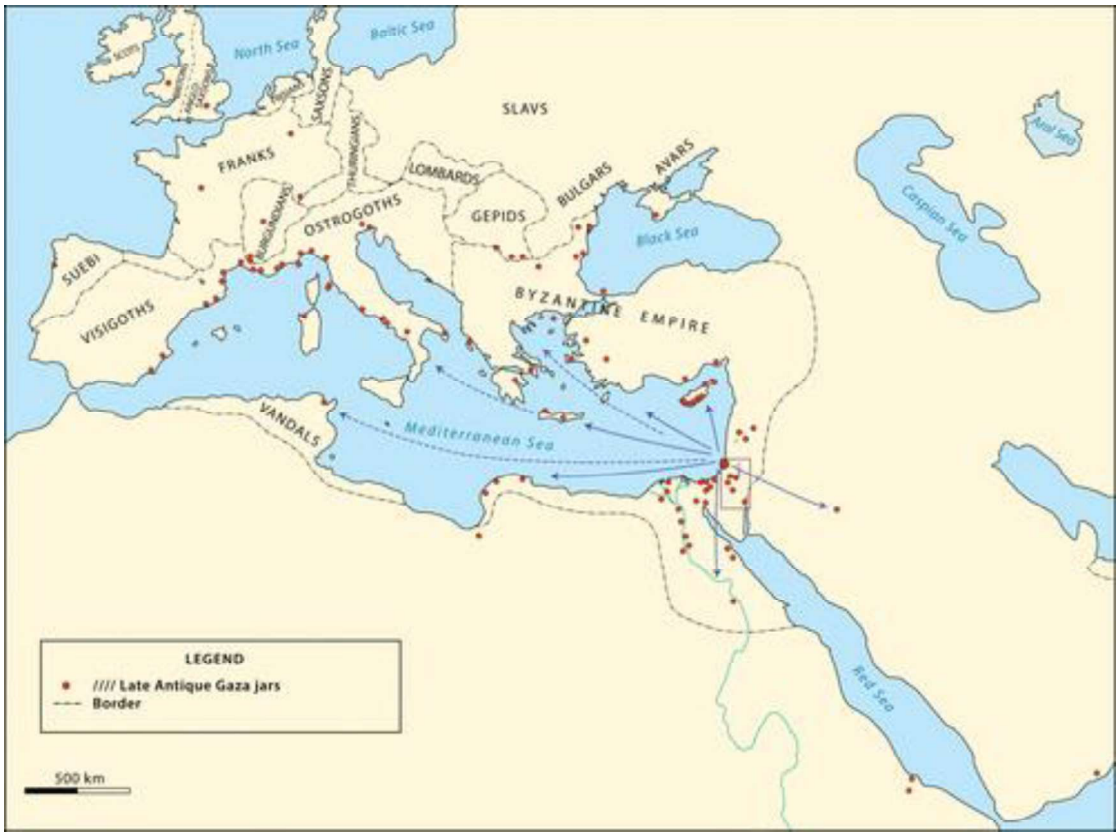

Figure 2 Distribution of Gaza Amphorae in Late Antiquity (2020, Lantos, 61.)

Figure 3 Part of a mosaic floor from a church depicting a man leading a camel laden with amphorae (wine jars), from Kissufim, 6th century AD, Israel Museum, Jerusalem.

It is important to note that the existence of industrial-scale viticultural production in the Late Antique Negev has been recently challenged by suggestions that the production capacities would permit only local levels of production. A paper published in 2020 by Jon Seligman presents a detailed analysis of the archaeologically excavated Byzantine wine press installations. Based on estimates of population sizes and the production capacity of the installations, Seligman contends that the presses were not sufficient to produce adequate surplus to act as suppliers of the Gaza wine trade. (2020, Seligman, 270.) The paper inspired a response from researchers Fuks, Avni and Bar-Oz on the debate surrounding the relationship between the Negev and the Gaza wine trade. (2021, Fuks, Avni & Bar-Oz, 151.) The researchers point to the problem of inferring surplus production and the issue of uncertainty brought about by the necessary initial assumptions applied to such calculations. Furthermore, they point to multiple lines of evidence that are not considered in Seligman's article. Chiefly these are the archaeobotanical evidence of

grape pips relative to grape seeds and the decline in use of dovecotes that were likely used as fertiliser in a system of intensive viticulture. (2020, Tepper, 104134;2020, Fuks et al., 19786) Furthermore, an article published by Lantos et al. summarises the textual, archaeological and archaeobotanical evidence for wine production in the Negev. The holistic study argues that the Late Antique Negev was one of the main production sites for the Gaza wine. (2020, Lantos et al., 62.) Thus, the debate would suggest that a broadening of the source-base consistently indicates the Negev as an industrial-scale producer of Gaza wines in the fifth and early sixth century.

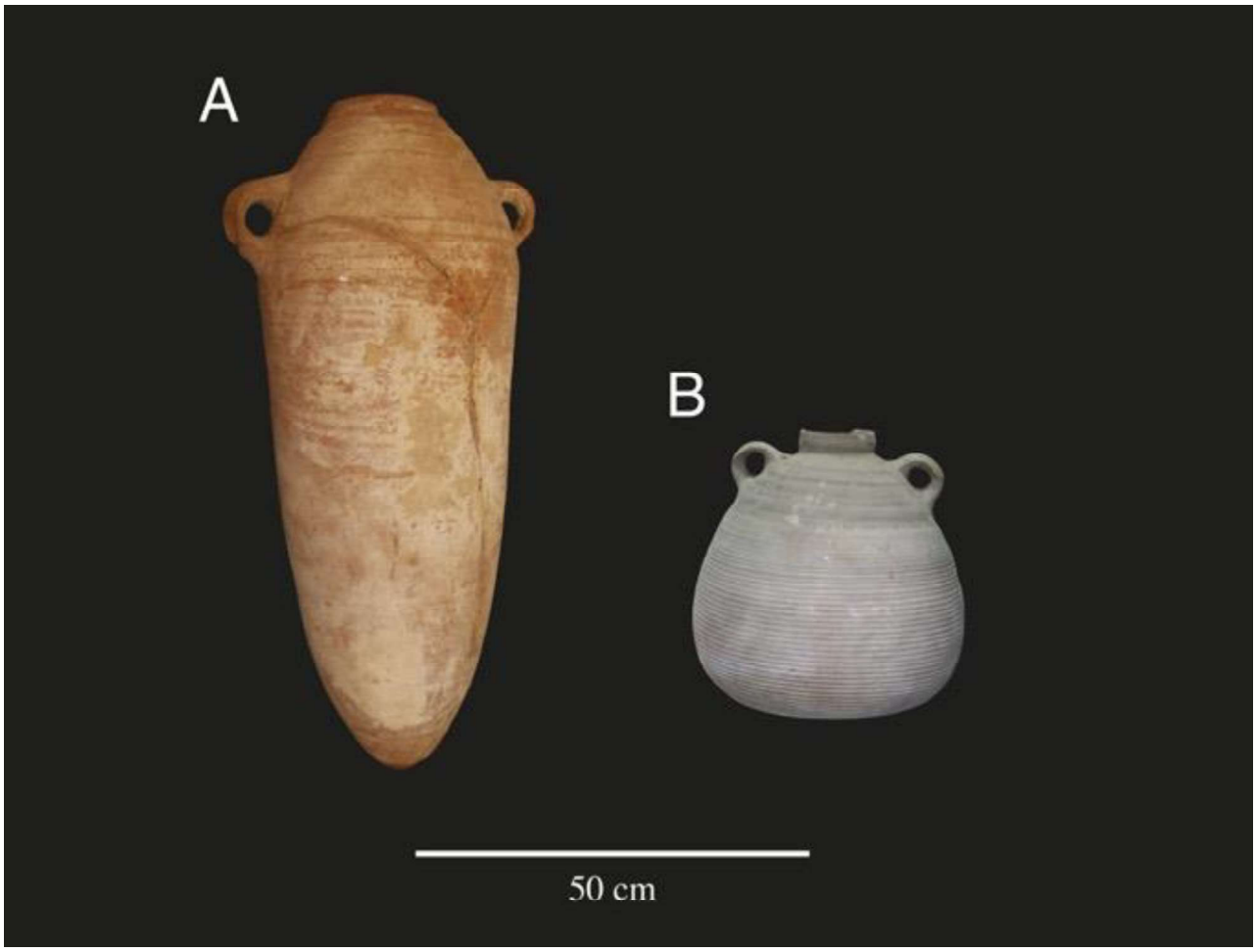

Figure 4 Gaza jar (A) and bag-shaped jar (B). Collection of the Israel Antiquities Authority. (A) Image credit: Davida isenberg-Degen (Israel Antiquities Authority, Omer, Israel). (B) Image credit: Itamar Taxel (Israel Antiquities Authority, Jerusalem, Israel) and Oren Tal (Tel Aviv University, Tel Aviv, Israel).

It seems that this profitable wine trade was not to sustain viticulture in the Negev highlands. A decline in grape-pip frequencies relative to cereal grains in the late sixth century indicate the diminishing significance of viticulture as an economic agent. This is further supported by the reduction in Gaza jar frequency relative to bag shaped jars in the Negev region, signalling a move away from commercial engagement with wider markets to more local levels of production. (2020, Fuks et al., 19786) Moreover, OSL dating of undisturbed trash deposits at the sites of Shivta, Elusa and Nessana show increased discarding of fresh animal dung, indicating a reduction of its use as fertiliser on agricultural plots in the late sixth century. (2020, Butler at al., 8-10) Consequently we can deduce that ensuring the soil remained fertile was no longer as much of a priority, suggesting viticultural production was no longer an important economic vehicle past the mid-sixth century.

The decline of viticulture came well before the Arab-Muslim conquests and its chain of causality has thus been reconsidered within scholarship. Research generally argues that it was likely the combined effort of a series of factors; plague, climate, conflict, global demand, that instigated the fall of viticultural production (2018, Tepper et al., 148; 2020, Fuks et al., 19788; 2019, Bar-Oz et al. 8245.) The scholarly analysis of these factors, while clearly significant, has potential for greater nuance. Indeed, these agents of major socio-political and ecological shift leave little room for the agency of local communities of the Negev itself. In the current narrative the farmers of Elusa, Nessana and Shivta were helpless in the face of historical actors more instrumental than themselves. What I hope to do here is not to negate the impact of other agents, but to position another underappreciated one within their company. The next section will build upon the work of Langgut et al. by studying the role of local anthropogenic manipulation of the environment in limiting the long-term sustainability of desert agriculture in the Negev. (2021, Langgut et al., 175.)

Ecocide

> There will be a day when you will see Elusa again and you will weep at the sand being shifted by the wind stripping the vines naked to their roots.
> Proc. Gaz. Epist. 81; trans. Westberg 2019

The author from whom we take the quote above is Procopius of Gaza, a sophist active between 465 and 526. Writing out of the port of Gaza, Procopius would have likely been aware of an active viticulture economy of the Negev Highlands and, thus, the emotive weight of these words to anyone native to the region. The most striking part of this text is its dramatic implementation of the process of desertification. Written in the early 6th century, a fear of agricultural unsustainability was perhaps at least present in the consciousness of local populations. To what extent was this potential unsustainability a product of human actions? To approach this question, I will employ the concept of ecocide. I define ecocide as the anthropogenic destruction of environments for socio-economic gain that is long-lasting in nature. Approaching the evidence within this framework suggests that the draining of ecological resources through advanced and intensive irrigation was a possible factor that limited the longevity of the viticulture in the Negev Highlands.

The geomorphology of the Negev was key to its function as a site of desert agriculture. The accumulation of fine loess sediments during the Middle-Late Pleistocene glacial phases resulted in arable soil that was to be the basis of later ancient farming. A shift to erosive conditions gradually revealed a hard bedrock surface that intensified hydrological run-off and contributed to positive feedback whereby run-off fed erosion, which in turn intensified run-off. This resulted in a unique window of opportunity in the ancient world whereby the co-existence of available run-off and arable soil enabled the establishment of desert agriculture. (2019, Avni et al., 136.) Local communities were efficient in utilising this opportunity, constructing sophisticated systems of irrigation. In depth study of the structures preserved by the arid climate of the Negev have allowed for the identification of 10 different types of water-management systems. (2012, Ashkenazi et al., 63) Most implemented were stone terraces, retaining walls, water conduits,

cisterns and stone mounds positioned strategically on or near natural slopes. (2013, Avni et al., 335; 2012, Haiman, 45) The irrigation techniques were not fixed but were applied based on what would work best where. It was the goal of local populations to extract as much production as possible out of the surrounding landscape, leading to the development of a highly intensive system of irrigation farming.

It is helpful to employ Avni's "Desert Agriculture Window of Opportunities" here. (2019, Avni et al., 136.) This is because it is important to stress that this was a unique situation and required careful maintenance to be effectively exploited. The intensity of the run-off landscape established a precarious situation. On the one hand it meant that water could be effectively collected and stored for continuous use throughout the dry months. On the other it threatened to produce flash floods that could wreak severe damage to agricultural plots. The need to trap large quantities of water during high rainfall necessitated the construction of tall terraces and stone dams, particularly for the cultivation of perennial crops and trees (such as grape and olive orchards). Optically stimulated luminescence dating of sediments has revealed that this method of water management was prone to rapid siltation and resulted in the accumulation of sediment estimated at 4.5–8 mm per year. (2019, Avni et al., 134.) Thus, the biproduct of this system was the collection of fluvial deposits at the base of constructed walls and channels. This siltation effectively lowered the height of the walls relative to the new ground level, requiring ancient farmers to build increasingly tall and precarious structures. This is evidenced at the site of Nahal Lavan, located 3km south of ancient Shivta where several large agriculture farms, based on runoff-harvesting techniques, were in use. (2012, Avni et al., 24.) If farmers did not keep on top of these rising ground levels flash floods could breach the walls and effectively negate the fertility of the plot through highly destructive soil erosion. (2019, Avni et al., 132.)

There is a counter to the argument being made here that would highlight the opportunity afforded by the build-up of loess sediments behind constructed walls. These fluvial sediments would have added to the fertility of the soil in the plots. It is therefore plausible that farmers would have retrieved the collected fluvial deposits and spread them across agricultural fields. This

would have the impact of simultaneously retaining the height of the wall and maintaining agriculture production. Additionally, if the water did breach the wall and flood the plot (thus eroding the soil) farmers would have access to arable loess with which to replace the fertile soil lost. Indeed, I would agree that this is likely the reasoning behind the impressive growth of viticultural production in the Southern Levant, and perhaps a possible explanation for regional variation (Table 1). However, I would contend that this mode of agriculture was not sustainable in the long-term.

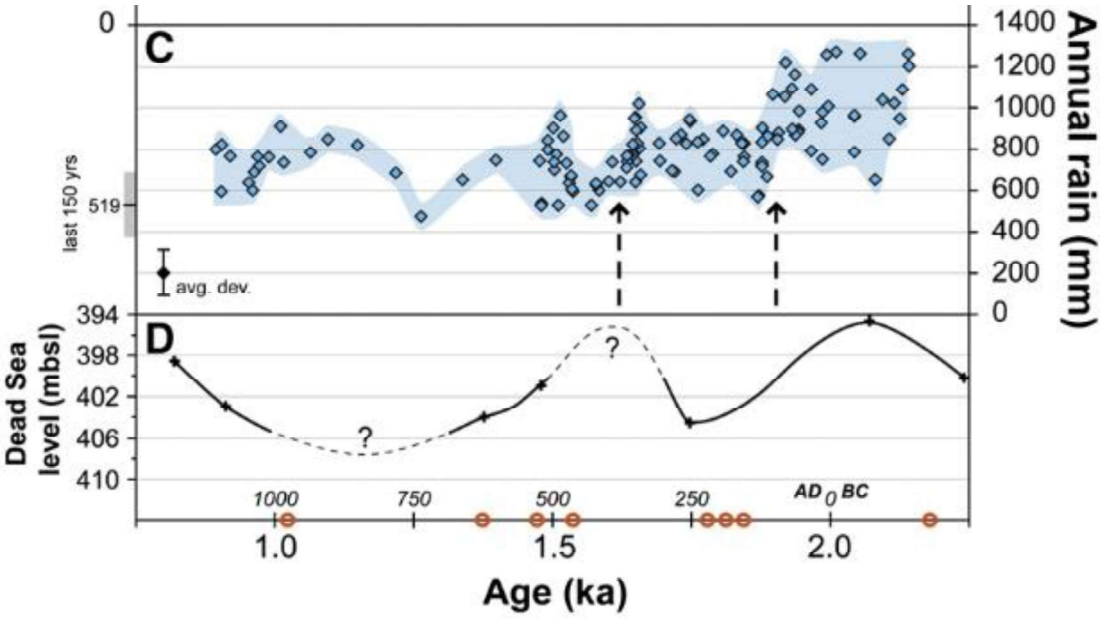

Table 2 Annual precipitation inferred from Soreq Cave speleothem records (2009, Orland et al., 32.)

Analysis of oxygen isotope ratios by ion microprobe retrieved from Soreq cave provide a sub-annual climate record for the Eastern Mediterranean centred on the western flank of the Judean Hills in central Israel. The records indicate a peak in precipitation levels around the late 3rd century and the early 6th century (Table 2). The period running from the early fourth century to the late fifth century demonstrates a more consistent precipitation programme that closer reflects the average over the last 1500 years. (2009, Orland et al., 32.) This would suggest that the growth phase of viticultural production in the Negev coincided with a period of more consistent

and manageable precipitation and began to decline alongside increased precipitation levels. This is however contradicted by research into Dead Sea Lake levels for the same period. This research studied the radiocarbon dating of fluvial sediment cores with an annual resolution. The data suggests a low stand in lake levels for our period, indicating a drop in annual precipitation from the fifth to the ninth centuries. (2004, Bookman et al., 570.) The discrepancy in these two sets of results clearly demonstrate the challenge of implementing paleoclimate data and the need for a regional, or even micro-regional, focus. The indirect nature of evidence that is available only in the form of proxies entails the complication of biases originating principally from resolution availability. (2021, Erdkamp, 5.) This does not however mean we should exclude considerations of climate fluctuations from investigations into past ecologies. Instead by integrating archaeological evidence I aim to demonstrate the plausibility of human-aided destruction of the environment.

The paleoclimatic data that is closest geographically to the Negev Highlands is a study carried out by Vaiglova et al. using stable isotopic proxies obtained from sheep and goat remains at the sites of Nessana, Shivta and Elusa. The data is unable to provide the resolution to track precipitation levels in the region but can suggest a consistency of vegetative cover through the sixth and seventh Centuries. The researchers conclude that: 'the Northern Negev Desert did not experience an abrupt downturn that would have affected the dietary behaviour of animals that spent the entire year in the desert'. (2020, Vaiglova et al., 10.) The natural conclusion could be one of no severe ecological disruption during the sixth century. Furthermore, if the period from fifth to the ninth centuries was unusually dry we might expect a change in nomad pastoralism to be reflected in movement towards regions of greater moisture availability. This is however not reflected in the study of ovicaprine isotopes or in the investigation of ancient middens, where fresh dung continued to make up a large amount of the overall assemblage. (2020, Vaiglova et al., 10; 2020, Fuks et al., 19786) Thus it seems unlikely that an unusually dry phase occurred during the Late/Byzantine Early Islamic period.

Is it therefore possible to account for an ecological influence on viticultural decline in the 6th century? This is where human agency becomes crucial as a factor to consider. As discussed earlier, the communities of the Negev were highly advanced in their collection and direction of water resources. This would mean that an increase in precipitation large enough to cause agricultural damage need not have also been reflected in the surrounding environment, that was itself not influenced by anthropogenic manipulation. This would account for the lack of changing patterns within nomad pastoralism that continued to rely on the surrounding Negev hinterland if precipitation did indeed increase. Alternatively, if precipitation remained consistent in the fifth and sixth centuries the repeated collection of fluvial deposits at the walls of could have conceivably continued to build to an unsustainable level. In either case, an argument can be made for the irrigation systems becoming more precarious and thus increasingly prone to flooding or destruction. This would explain the continuous maintenance projects we see at sites such Nahal Lavan. (2012, Avni et al., 24.) Therefore, even without an unusually wet phase at the beginning of the 6th century it is likely that these structures would have required progressively greater labour attention to maintain. Without the ability to maintain these structures the plots they fed would have been subject to high destructive soil erosion on an annual basis, making agricultural production unfeasible.

This argument has built into it a degree of flexibility. Here I will again stress the importance of human action, or inaction. Within this framework agricultural plots were made vulnerable through human manipulation of the environment; however, they would have also only been abandoned if not properly maintained. Whether this was a conscious decision, or the result of external factors remains up for debate. The main argument is the role of human responsibility. It is also key to note that this argument is based primarily on Avni et al.'s study of "Type B" agricultural systems. This is one of two major types of desert agricultural technologies that employed intensive irrigation. This system was used mainly for cultivating perennial crops and therefore would apply principally to the production of wine and olives. This may therefore have applied differently to "Type A" systems that were better designed for the cultivation of cereals.

(2019, Avni et al., 132.) This would account for evidence of continued occupation at sites, such as Nessana, despite the apparent fall in viticultural production. Foregrounding the importance of human action could also account for regional variations, as certain localities may have invested differing levels of manpower in maintaining their agricultural structures.

By introducing conceptions of ecocide, we can nuance our understanding of the limitations of sustained desert agriculture. It is plausible that the gradual degradation of the environment was caused by intensive irrigation that eventually limited the possibility of a sustainable agricultural economy in the long-term. A period of high precipitation would have caused widescale destruction of agricultural technologies and either buried or removed important deposits of fertile loess sediments, however this is equally possible if levels of precipitation also remained the same. The argument made here intends to demonstrate the possibility for new directions rather than supplant existing narratives. I am not aiming to disprove the role of other socio-economic or political factors; instead, the goal is to demonstrate the plausibility of inferring greater levels of local human agency than has thus far been appreciated. The hope is that the conclusions drawn here indicate the need for further research that better integrate local agents into ecological narratives of the past. One area in which this may be particularly beneficial is in the reconstruction of regional variability.

Evidence of Adaptation

If we are to get closer to historical accuracy, then I believe we must continue to foreground notions of local human agency. This next section will turn to an investigation of conscious human adaptation following the decline of viticulture in the Negev. To do so we will apply archaeological and papyrological evidence to the model of Formal Resilience.

Formal Resilience Theory was first introduced to the study of the Late Antique Eastern Mediterranean by John Haldon and Arlene Rosen, and has been emphasised in its value by Louise Blanke, Alan Walmsley, and Tamara Lewit. (2018, Haldon & Rosen, 277; 2022, Blanke & Walmsley, 100; 2020, Lewit, 75.) This model is highly applicable to our current study and will

help to unpack notions of adaptive change. The theory is a cyclical model within which a social-ecological system moves through a series of stages before repeating the cycle again. The first phase is the growth phase (or r-phase) whereby innovation allows for impressive development. This is followed by a stability phase (or K-phase) within which the previous growth has allowed for the solid establishment of a system or set of rules that are increasingly inflexible in their ability to respond to change. This leads to a release phase, or Ω-phase. This next phase is one of catastrophic shift whereby the inflexibility of the system leads to eventual collapse. The natural response of the cycle is a reorganizational phase, or α-Phase. This is the final stage whereby the collapse of previous infrastructure allows for a highly resilient and flexible restructuring of the system that builds a new equilibrium, different from the previous one. In the evidence presented thus far we have indications of a growth and stability phase, in the form of commercial viticultural production. We can also see the existence of a release phase, whereby the necessity for intensive irrigation resulted in a level of inflexibility that resulted in a decline of the viticultural economy. What I intend to investigate now is the possibility of a reorganizational α-Phase in the form of conscious economic adaption.

Before investigating the existence of a reorganisation of the socio-ecological system in the Late Antique/Early Islamic Negev it is important to explore how and why this would have been possible. The collapse of the key economic driver of the region (viticulture) would have had a large impact on prosperity in the region and perhaps limited options for survival in a desert environment. This is where modes of mixed farming may have come into play. Zooarchaeological investigations have indicated an active sheep/goat livestock economy that ran parallel to viticultural production. At the site of Shivta ovicaprine remains (those of sheep and goat) constitute 80% of the total assemblage, while at the site of Elusa these remains comprise 88%. (2020, Butler et al., 15) Further detailed analysis of the faunal remains reveals a shift towards a goat dominated pastoral economy (away from a preference for sheep) through the 5th and 6th centuries. While sheep pastoralism requires access to good quality pastureland, water and markets for surpluses, the favouring of the more durable goat indicates the application of a

more resilient survival strategy in the face of increased desertification. (2019, Marom et al., 7) Thus while incomes may have been damaged by the dwindling of the wine trade, this may have been somewhat mitigated by effective management of a mixed farming economy. It is unlikely this could have replaced viticultural production at the commercial levels of its 5th/6th century peak; however, it may have cushioned the impact of diminishing levels of income. This could have conceivably provided local communities with an opportunistic window within which to enact effective adaptation to the new ecological regime.

Conducting original research into the archaeological, material, and textual evidence of the Early Islamic period, Fanny Bessard demonstrates the presence of an understudied development in labour economies. The consolidation of the early Caliphate and the corresponding improvement of pilgrim routes opened networks of trade across the Levant and further east. The accessibility of these new markets consequently prompted a growth in nucleated workshops specialising in artisanal crafts in Levantine urban centres. (2015, Bessard, 377.) Of particular interest to this study is the possible development of a textile economy in the Negev.

The archaeological findings of the excavations at Nessana reveal the interestingly native nature of the textiles uncovered. Dominated by discoveries of linen, one might expect these fabrics to be Egyptian imports. This is contradicted by the considerable discoveries of wool and silk. (1962, Bellinger, 92) Further analysis of the specific techniques employed in the production of two woollen textiles exhibit the cultural transmission inherent in these wares. The textiles recorded as T.M.12.28 and T.M.12.29 are made predominantly of wool and both employ the use of the sehna knot. While this technique is found commonly in Persia, India, and the Far East, the unique application of these knots being tied to the warps of one cloth (instead of two adjacent warps) indicates regional adaptation. This specific process has been identified only in a handful of other fabrics originating from Mesopotamia. (1962, Bellinger, 92) Researchers Alisa Baginsky and Orit Shamir document 73 textile fragments recovered from excavations at Nahal 'Omer in the Southern Negev (1981-1991). Using Carbon-14 dating the researchers define the textiles as "Early Islamic" (650CE – 810CE). (1995, Baginski & Shamir, 21.) The textile

assemblage displays an impressive variety of materials, techniques, and decorations, supporting the suggestion that Nahal 'Omer was an important node on the Early Islamic trade route linking Central Asia to the Mediterranean. The high quality of the textiles further supports the argument that the site benefited economically as an important resting point for caravans. (1995, Baginski & Shamir, 36) Significantly, the cotton ikat textiles are the earliest physical evidence of this technique and are likely of Indian or Yemeni origin. (1995, Baginski & Shamir, 31) Among the wider assemblage was a "cut-to-shape" tunic (IAA No. 2003-9109). This is the earliest example of this production technique in Israel, signifying a departure from the 'woven-to-shape' tunics of the Late Roman/Byzantine period. The 'cut-to-shape' tunic becomes more frequent in later periods; 25 are documented for the 8th-9th centuries at Qasr el-Yahud, situated along the Jordan River, and in a ninth-thirteenth century context at Jebel Quruntul. (2017, Shamir & Baginski) The evidence suggests that while researchers can identify signifiers of "decline" we should equally not ignore indicators of adaptation. In the case of the Negev, investigating textiles may offer an interesting proxy for the study of economic restructuring not only in response to socio-economic/ecological shock, but also to increasing accessibility to new trade routes and markets.

P.Ness III 89

Late 6th century – early 7th century

	Sol.
... for the month of Apellaeus there was assigned to our partnership (Sergius, Abraham and myself Zunayn)	16
given as the price of a she-ass (it died) for the trip to Nessana	5/13
we recovered as the price of the camel which the Arabs, the bani al-Udayyid took	4
...	10

we spent when we went to Emazen to the wife of the guardsman	I
... everything in every way	10
	sol.
received as the price of a mare	3
the price of a foal	I
the price of ...	I
my share	I
as the price of wool and oil	2
total	18
... which we gave you and Martyrius, as expenses of God, for the price of a linen curtain	2
... given to the Arab 'Adī, the money we borrowed for the price of wool	I 1/6
... of Stephan and John	5
we have recovered from him ... modii of barley	
given as the price of a camel	6
also as the price of a large camel	6
also purchased for you – wine	I
...	?
For the 10 measures of ... which Theodore received from him	7

The translated papyrus included above (P.Ness.89.) can be dated to sometime between the late sixth and early seventh century. This document records the business transactions of a trading caravan operating in and around the Negev Highlands. The style of the writing indicates that the author (Zunayn) is an agent of a superior, or a partner, on behalf of whom the transactions were made. The text regularly refers to actions done on behalf of someone i.e., "for you", and is

particularly careful to detail the gain or unfortunate loss of any capital – this includes the loss of a stolen camel and the death of a donkey. The later entries in the document describe a trip taken to Nessana, perhaps also providing another reason for the discovery of the text at the site. (2015, Kraemer, 258) The document seemingly ends with Zunayn closing various business operations, such as the returning of loans; "given to the Arab ʿAdī, the money we borrowed for the price of wool". It would seem from the accounts that the aforenamed ʿAdī, on account of greater liquidity, loaned Zunayn the money to purchase wool on their travels, which is recorded in the same document as being sold upon return. It would make sense for there to be a greater market for products in Nessana, as both the textual evidence and the palaeobotanical evidence indicate this settlement to be one of greater economic continuity, when compared to sites such as Elusa and Shivta. Thus, it was perhaps the aim of the trading caravan to obtain products from elsewhere and transport them to Nessana where they could sell them for a profit, thanks to a more vibrant local economy. Furthermore, as demonstrated earlier, archaeological evidence indicates a shift towards a goat-dominated form of pastoralism in the region, explaining why wool would not be as easily accessible to local populations, and therefore could potentially fetch a handsome profit. This reading of the text does not prove the growth of a thriving textile industry, but an income could perhaps be earnt through the obtaining and sale of wool, perhaps for the manufacturing of fabrics.

The evidence presented here indicates that there is an argument to be made for conscious adaption by local populations. One way in which this may be evidenced is in the investment by local agents into a textile-based industry. The goal here is not to assess the scale of a possible textile economy, but to indicate the evidence for a possible conscious response to viticultural decline by local actors. To assess the full scale of plausible human-adaptation following the decline of viticulture in the Negev requires further holistic study. Unfortunately, there is not the space within the parameters of this current paper to do so.

Conclusion

The goal of this study has been to demonstrate the importance of integrating local actors into wider ecological narratives of the past. Recent scholarship has convincingly demonstrated the likelihood of a decline in viticultural production in the Negev that significantly pre-dates the Arab-Muslim conquests of the 7th century. This has led to a consideration of a wider nexus of factors incorporating a greater appreciation of ecological agency within historical narratives. For the Negev, viticultural decline has been explored as chiefly related to plague, climate change and a diminishing market. While the introduction of ecological agents as causal factors in this narrative of decline has proved significant, scholarship must continue to scrutinise how these historical components relate to anthropogenic intervention. In the case of the Negev there is an argument to be made for the development of intensive irrigation systems contributing to the long-term infeasibility of desert agriculture. This intensive irrigation likely placed higher demands upon the continual maintenance of this agricultural system. It is therefore possible that a conscious decision was made by local populations to abandon this form of farming as it became less sustainable and too costly to maintain. If this was the case, we would expect local farmers to have transitioned to new forms of economic production. This narrative has received minimal scholarly attention, however integrating material culture with the papyrological corpus may suggest, for example, the growth of a textile industry in the late-6th/early-7th century. Further study is needed in this area to effectively answer questions of economic readaptation. In such studies it is important to continue to foreground the significance of local populations as central historical agents within the wider context of local ecological systems and the socio-political environment.

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