

Did the Byzantine Negev settlements exhaust the surrounding environment? A response to “Environment and horticulture in the Byzantine Negev Desert, Israel: sustainability, prosperity and enigmatic decline”

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Abstract

The recently published Langgut et al. article claims that there was over-exploitation of the Byzantine Negev Desert. They suggest that the over-exploitation worked in conjunction with the Justinianic Plague and the Late Antique Little Ice Age (LALIA), and caused the decline of the Negev settlements in the middle of the 6th century CE. The current article wishes to respond to Langgut et al. article and show that what they found cannot be used to claim that there was an over-exploitation of the land. Moreover, contrary to what they suggest, their finds indicate and support the fact that the decline occurred later. As part of this rebuttal, we will also show that the dating used in this article, like the other articles published by the project titled “NEGEVBYZ,” is incorrect.

Keywords

Archaeology; Byzantine; Negev Desert; Viticulture; Justinianic Plague; Late Antique Little Ice Age

The authors in this publication are equal contributors.

The project “Crisis on the Margins of the Byzantine Empire: A Bio-archaeological Project in the Negev Desert” (NEGEVBYZ project), set for itself to explore the reasons for collapse and resilience in an ancient society with socio-political complexity, in a region where natural resources are scarce. The project’s case study was the settlements of the north-western Negev desert in Israel and this project explored both the settlements’ resilience in the desert, and the reasons for their decline. The questions raised by the project were investigated using various techniques and disciplines, for example radiocarbon dating,¹ stable isotope analysis, archaeobotany, palynology, and ceramic typology, with numerous articles being penned and published by the participants. One of the numerous articles of the project is an article by Langgut et al. (2021) which claims that over-exploitation of the land may be a possible factor in the decline of these settlements. However, there are several methodological and logical issues with the article, as well as with their overriding conclusions.

To answer Langgut et al., we need to start by examining their main claim. This claim rests on the assumption that if the inhabitants were using wooden architectural elements from abandoned houses as fuel, it can be seen as evidence for the lack of natural fuel resources in the area, which can in turn be perceived as due to the over-exploitation of land (Langgut et al. 2021: pp. 169, 174). However, this claim does not consider what fuel sources existed in the area, but it only discusses what the inhabitants used as fuel according to the archaeological evidence which has survived. This can be seen as survivorship bias, since only the fuel that has survived is analysed, as well as the fact that this analysis examines only the fuel that was used. This is despite the fact that it may not have been the only fuel source in the area, as the trees and shrubs outside of the city would not have been preserved in an archaeological context (Mangel & Samaniego 1984). Unfortunately, Langgut et al.’s article does not discuss this concept. Moreover, if there was a readily available fuel source, such as abandoned houses nearby, there would be no reason to collect and carry wood from outside of the city. Therefore, using the fact that wooden architectural elements from abandoned houses were burnt for fuel as evidence for over-exploitation, is not a strong claim and it is not fully explored. Furthermore, this problem is known to the authors, as they themselves mention that most wood, regardless of its original purpose and use, becomes fuel at a certain point (Langgut et al. 2021: p. 167).²

Another pressing problem in the article is the presentation of data, especially that of Table 2 (Langgut et al. 2021: pp. 165–166). Firstly, there is no sufficient explanation of what is presented in this table. Secondly, the purpose of a table, or graph, is to present the information to the reader in an accessible way, something which does not occur here. The table gives no indication of the context of the sample in terms of time period or stratigraphy, making the conclusions and claims difficult to grasp and fully understand. This problem also occurs in the supplementary material itself, where there is a list

1 Regarding the problems with the radiocarbon dating, a preliminary analysis of this can be seen in: Olshanetsky & Cosijns (2021: pp. 12–13; 2022: pp. 37, 40; Forthcoming 2023).

2 This point has been well defined by modern research in various publications: Théry-Parisot et al. (2010); Picornell Gelabert et al. (2011).

of the samples with their loci and basket numbers without any reference to the context, stratigraphy, or time period of the loci. This issue also leads us to the fact that nowhere in the article is there an explanation or description as to the reasons for allocating the samples to certain time periods. Moreover, this article, as well as several others, is based on a problematic chronology adopted by the NEGEVBYZ project, which needs to be further elaborated and discussed.

The Ceramic Typology

As the chronology the NEGEVBYZ project utilises is not discussed in Langgut et al.'s article or supplementary material, it is important to examine the discussion surrounding the dating in an article that Langgut et al. and the rest of the project rely upon. This article, by Bar-Oz et al., extensively discusses the chronology while detailing the dating of the end of the trash mounds of Elusa to the middle of the 6th century CE. It is the foundation of all the discussions and references to the chronology of the settlements in the subsequent NEGEVBYZ publications:

'In support of the survey results, excavation produced assemblages with only early-mid Byzantine diagnostic sherds, lacking late Byzantine or any later material (SI Appendix, Fig. S1). This is demonstrated mainly by the widespread presence of Gaza jar sherds, Majcherek's Form 2–3 (30), the ceramic "type fossils" of the early- mid Byzantine period.' (Bar-Oz et al. 2019: p. 8243)

This paragraph implies that the team found pottery only from the Early to Middle Byzantine periods (350–550 CE) in the excavated trenches in the garbage mounds of Elusa.³ They reached this conclusion by claiming that they only found Gaza Jars Form 2 and 3,⁴ which for them are the 'type fossils' for the mentioned periods according to Majcherek's typology. According to the NEGEVBYZ project, Form 2 represents the Early Byzantine period (350–450 CE) and Form 3 represents the Middle Byzantine period (450–550)

3 Regarding the debate on the use of Byzantine instead of Late Roman or Eastern Roman Empire, see: Elton (2018); Heather (2018: p. 6); Olshanetsky (2021: p. 8): in the research conducted on the Eastern and Western Roman Empires, there is a stark difference in the terminology used, especially in archaeological publications. Levantine scholarship (especially in the fields of archaeology and papyrology) tends to use the term Byzantine to define the period between 284 CE (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 are defining the Early Roman period as the 1st to the 2nd century CE, the Middle Roman period as the 3rd to the 4th century CE, and the Late Roman period as the 5th to the middle of the 7th century CE (Wilson & Grigoropoulos 2009; Kenawi 2014). On the other hand, in western scholarship the period from 325 to 636 CE is called the Late Roman period. We agree with Elton (2018) and 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 entity, the Byzantine Empire. However, due to the fact that the main article in question uses the term Byzantine, we will also be using this term in the current article.

4 The Gaza jar is most known as Late Roman 4 amphora, commonly written as LR 4 or LRA 4 in excavation reports (Riley 1975: pp. 27–31; Tomber 1996; Reynolds 2005: pp. 574–575).

(Bar-Oz et al. 2019: pp. 8242–8243). However, Majcherek's Gaza Jars Form 2 and 3 are dated differently. Firstly, Form 2 (or Type 2) is from around 300–450 CE according to Majcherek (Majcherek 1995: p. 168), meaning that according to the dating system used in the article, and by excavators in Israel, Type 2 is evidence for not only Early Byzantine, but also Late Roman.⁵ The same goes for Type 3 (or Form 3). According to Majcherek:

'...this form of container was identified in deposits from as early as the late 5th century CE. Here, as on other sites, the real expansion of the type came in the sixth century. In the deposits post-dating the earthquake of CE 535, sherds of this form make up to 40–45% of the total amphorae sherds. Production ceased at approximately the turn of the sixth century, when its place was gradually taken by vessels belonging to the next type-form.' (Majcherek 1995: pp. 168–169)

As we can see in this extract, the Type 3, which started to appear in the latter half of the 5th century CE, reached a peak in its production after the year 535 CE, possibly meaning that 550 CE was the earliest possible peak in the use of this vessel, unlike what was wrongly claimed by Bar-Oz et al.⁶ In addition, the Type 3 stopped being produced approximately around the year 600 CE (Majcherek 1995: pp. 168–169), yet there is a good chance its production continued until the Persian invasion of 614 CE. As Majcherek mentioned, vessels are often used long after their production has ceased, as no one would throw away hundreds or thousands of perfectly good jars. As a result, this suggests that the Type 3 jar was still used extensively in the first quarter of the 7th century, possibly even until the Arab invasion. In addition, it is important to raise the possibility that a change of the regime in the area did not mean a drastic change in the material record of the area. The vessels designated as Late Byzantine possibly continued several decades into the Early Islamic period (Magness 2003; Avni 2014; Olshanetsky & Cosijns 2022).

Israeli archaeologists tend to stick to Majcherek's typology of Gaza jars (Sazanov 2017: p. 631). This is despite the fact that there are other archaeologists who have extensively surveyed and published updated chronologies of the different forms of Gaza jars by examining this jar from excavations published after 1993. These publications have added to the discussion surrounding the typology of Gaza jars, a fact that Majcherek himself emphasised when noting that his article is only a preliminary work on the chronology of Gaza jars (Majcherek 1995: p. 169). Dominique Pieri added to the Gaza jar typology in 2005, where he questioned and developed Majcherek's typology from 1995. He redefined Majcherek's Form 2 as both LRA 4A2 (dated by Pieri to the 4th and 5th centuries CE) and LRA 4B1 (Pieri dated it to the second third of the 5th century to the first half of the 6th century CE). Similarly, Majcherek's Type 3 was reclassified as LRA 4B2 and dated to the second half of the 6th century to the 7th century CE (Pieri 2005: pp. 104, 106). In more recent publications, Pieri claimed that LR4 B can be found in Merovingian

5 Their dating of Type 2 was slightly amended in a different article of the NEGEVBYZ project: Fuks et al. (2020: SI, Table 1).

6 For a more extensive debate on Bar-Oz et al.'s dating and its various issues, see: Olshanetsky & Cosijns (Forthcoming 2023).

deposits dating to the late 6th century and first third of the 7th century CE (Bonifay & Pieri 2020: p. 871).

This is in line with what we can see in different excavation reports. For example, in the intensive excavations conducted in Marseille, LRA 4B was mostly found in layers dating to the 6th and the beginning of the 7th century CE. According to the sherds found, the peak of the imports of LRA 4B is from the end of the 6th century to the beginning of the 7th century CE (Bonifay & Pieri 1995: p. 112; Bonifay et al. 1998: pp. 125–127, 401). In Fig. 94 of the Marseille report (Bonifay et al. 1998: ceramic table 94), which depicts what was found in a stratigraphic layer defined as belonging to the period 4B of the chronology of the site (dated to the end of the 6th to the beginning of the 7th century CE), the rims of 15 LRA 4B are shown. It is clear from the figure that most of them should be considered LRA 4B2, and are parallel to Majcherek's Gaza jar Types 3 and 4 (Majcherek 1995: p. 172; Bonifay et al. 1998: p. 126), which once again shows and supports the claim that the dating of the NEGEVBYZ project is problematic (Olshanetsky & Cosijns 2021; 2022; Forthcoming 2023).

Further analyses of the Gaza jars and their different forms did not drastically change the dating of Pieri's typology, if at all. The most recent extensive work on the topic was an in depth recategorization of this amphora by Sazanov. In this article, he characterised the Gaza jar, or LR 4, typology by general body shape, the profile, the height of the vessel and other small body variations (Sazanov 2017). At the moment, this is the most extensive and in-depth typology we have, and the NEGEVBYZ project may have dated the assemblage more accurately by using this typology and chronology.

Consequently, Majcherek's Gaza jar Type 3 represents both the Middle and Late Byzantine periods. The dating the article by Langgut et al. uses, is entirely based on Bar-Oz et al. (2019) and Fuks et al. (2020), which have wrongly interpreted the old Gaza jar typology written by Majcherek, and so the dating given by these articles must be amended to a later date. Therefore, this would suggest that the decline in the region did not occur in the middle of the 6th century CE, but rather in the beginning of the 7th century CE, effectively eliminating both the Justinianic plague and the LALIA as the perpetrators of the decline (Olshanetsky & Cosijns 2021; 2022; Forthcoming 2023).

Further Issues

The ceramic typology is not the sole problem with Langgut et al.'s article. The article dedicates a significant part to exploring the difference between the two periods in the charcoal assemblages from the middens of Shivta and Nessana (Langgut et al. 2021: pp. 170–171), and the changes in pollen from the northern reservoir (Langgut et al. 2021: pp. 163–164, 168). However, the discussion on the changes in pollen raises several questions. According to the team, the sediment samples 10 to 19 date to the Late Byzantine period, while samples 1 to 9 come from the fill of previous excavations by Baly. In addition, samples 10 to 13, dated by the project to the Late Byzantine period, come from an area of silt which represents the deposition of dirt from when the reservoir stopped

being maintained. According to the project, the termination of the maintenance of the northern reservoir occurred in the Late Byzantine (Langgut et al. 2021), although it is unclear how they came to this conclusion. The dating of this or the samples is not fully explained in either Langgut et al.'s article or the article detailing the finds from the excavation. From what can be understood from both articles, the pollen was dated according to the dating of the ceramic assemblages found in abandoned houses (Tepper et al. 2018; Langgut et al. 2021). Therefore, the dating of several abandoned buildings in Shivta to the Late Byzantine drove the excavators to date the halting of the cleaning of the reservoir, and the end of municipal activities in Shivta, to the Late Byzantine. In addition, the chronology of the site of Shivta is not fully expanded upon in the article detailing the results of the excavation. The only explanation for their chronology was a general list of some of the pottery found at the site, with no explanation as to the different typological forms (Tepper et al. 2018: pp. 132–133). According to Fuks et al. (2020), a building or layer in the sites of the north-western Negev was dated to the Late Byzantine due to the prevalence of Majcherek's Gaza jar Type 4 and Riley's LR1 (Fuks et al. 2020: p. SI, Table 1). Thus, this dating probably needs to be amended, suggesting that the maintenance of the reservoir ceased in the 7th century CE.

Regarding the analysis of the species of burnt flora, a discrepancy in the charcoal between the two periods was attributed to the over exploitation of the area during the Late Byzantine period, rather than the 36 years of turmoil preceding 650 CE. This turbulent period includes the Persian invasion of 614 CE, the following 14 years of conquest (Elton 2018: pp. 331–352; Heather 2018: pp. 303–331), and the Arab conquest,⁷ following their victory at the Battle of Yarmuk in 636 CE.⁸ When pondering this period of invasions and conquests, the appearance of abandoned buildings, which were subsequently used for fuel, is not an anomaly that needs to be explained but rather an obvious turn of events. According to Langgut et al., the abandonment of these buildings is not a concept which needs to be discussed but is instead used as evidence for the over-exploitation of the surrounding land. As explained previously, the use of fuel from abandoned buildings does not necessarily imply an over-exploitation of the land. This is because abandoned buildings are part of the landscape and life of an urban environment. The existence of one or two abandoned buildings does not necessarily mean the entire city or region was in decline or abandoned. For example, the population density of modern-day Israel is the highest in the history of this land, and the real estate prices are sky high. Yet, there are thousands of abandoned buildings in all the major cities and towns of the country (Carmel 2020). In all these cities, there is a chance that any temporary residents of one of these abandoned buildings may have used parts of it to warm themselves. However, this certainly does not mean that any of these cities, or Israel as a whole, has exhausted the available fuel sources and vegetation, nor does it mean that any of these cities and towns were abandoned or in decline in the 20th and the beginning of the 21st century. In

7 For information on the Arab invasion, please see: Kennedy (2008); Donner (2014: pp. 91–156); Marozzi (2021).

8 For information on the Battle of Yarmuk, please see for example: Nicolle (1994); Ibrahim (2002).

general, a city can be considered declining or abandoned only when a large percentage of its buildings are abandoned, and not only a few.

Furthermore, if one were to base their main conclusion on over-exploitation, there must be an explanation in the article on how this process came about. Since the establishment of these settlements in the 3rd century CE, the Romans and Byzantines succeeded in converting desert lands into fertile agricultural lands which produced a stable economy entirely based on their agricultural exports for 350 years (Butler et al. 2020; Langgut et al. 2021). Therefore, an over-exploitation of the environment in the 6th or 7th century CE is puzzling at best. A strong explanation needs to be presented for such a thing to be claimed. Lastly, the most important paper the project has produced which discusses and proves the lack of change in vegetation in the area (Vaiglova et al. 2020) is surprisingly absent from the Langgut et al. (2021) article and its bibliography. This is especially puzzling as a few of the authors are credited in both publications.

Conclusion

As was shown, the NEGEVBYZ project used dating methods in an inaccurate way, and the dating of the project needs to be amended to a later date. As the dating is later than what was claimed by the project, a later date would have no correlation with any significant climatic data or evidence for the Justinianic plague. Nevertheless, if the dating of the decline of Shivta and Nessana were correct, there is still no reason to claim that this was due to overexploitation. The authors themselves say that this decline occurred in the Late Byzantine, dated from 550 to 650 CE. Thus, a decline in this period would suggest that rather than over-exploitation, the Persian wars and Arab conquest were instrumental in the decline of the area as they took place from 614 CE and onwards. From the data presented in Langgut et al.'s article, there is no reason to suggest over-exploitation rather than geopolitical instability as the reason for the decline in the region.

Modern scholarship is extremely interested in all theories of societal decline or shifts connected to either plague or significant climatic change. This may have skewed scholarly perception to such hypotheses. However, in some cases, such as this one, the simplest option of war and conquest or occupation can at times be the most correct for explaining either the decline or the abandonment of settlements and societies.

Bibliography

- Avni, G. (2014). *The Byzantine-Islamic transition in Palestine: An archaeological approach*. Oxford: Oxford University Press.
- Bar-Oz, G., Weissbrod, L., Erickson-Gini, T., Tepper, Y., Malkinson, D., Benzaquen, M., Langgut, D., Dunseth, Z. C., Butler, D. H., Shahack-Gross, R., Roskin, J., Fuks, D., Weiss, E., Marom, N., Ktalav, I., Blevis, R., Zohar, I., Farhi, Y., Filatova, A., Gorin-Rosen, Y., Yan, X., & Boaretto, E. (2019). Ancient trash mounds unravel urban collapse a century before the end of Byzantine

- hegemony in the southern Levant. *Proceedings of the National Academy of Sciences*, 116(17), 8239–8248 [https://doi.org/10.1073/pnas.1900233116].
- Bonifay, M., Carre, M. B., & Rigoir, Y. (1998). *Fouilles à Marseille: Les mobiliers, Ier–VIIe siècles ap. J.C.* Paris: Errance, ADAM.
- Bonifay, M., & Pieri, D. (1995). Amphores du Ve au VIIe s. à Marseille: Nouvelles données sur la typologie et le contenu. *Journal of Roman Archaeology*, 8, 94–120.
- Bonifay, M., & Pieri, D. (2020). Merovingian Gaul and the Mediterranean: Ceramics and trade. In B. Effros, & I. Moreira (Eds.), *The Oxford Handbook of the Merovingian World* (pp. 861–882): Oxford University Press.
- Butler, D. H., Dunseth, Z. C., Tepper, Y., Erickson-Gini, T., Bar-Oz, G., & Shahack-Gross, R. (2020). Byzantine–Early Islamic resource management detected through micro-geoarchaeological investigations of trash mounds (Negev, Israel). *PLoS ONE*, 15(10), 1–22 [https://doi.org/10.1371/journal.pone.0239227].
- Carmel, Y. (2020). At the end and beyond it. *Calcalist* [retrieved 10.11.2022 from https://newmedia.calcalist.co.il/magazine-20-02-20/m03.html].
- Donner, F. M. (2014). *The Early Islamic conquests*. Princeton: Princeton University Press.
- Elton, H. (2018). *The Roman Empire in late antiquity: A political and military history*. Cambridge: Cambridge University Press.
- Fuks, D., Bar-Oz, G., Tepper, Y., Erickson-Gini, T., Langgut, D., Weissbrod, L., & Weiss, E. (2020). The rise and fall of viticulture in the Late Antique Negev Highlands reconstructed from archaeobotanical and ceramic data. *Proceedings of the National Academy of Sciences*, 117(33), 19780–19791 [https://doi.org/10.1073/pnas.1922200117].
- Heather, P. J. (2018). *Rome resurgent: War and empire in the age of Justinian*. New York: Oxford University Press.
- Ibrahim, R. R. (2002). *The battle of Yarmuk: An assessment of the immediate factors behind the Islamic conquests*. Diss. California State University, Fresno.
- Kenawi, M. (2014). *Alexandria's hinterland: Archaeology of the Western Nile Delta*. Oxford: Archaeopress.
- Kennedy, H. (2008). *The great Arab conquests: How the spread of Islam changed the world we live in* (Paperback ed.). London: Phoenix.
- Langgut, D., Tepper, Y., Benzaquen, M., Erickson-Gini, T., & Bar-Oz, G. (2021). Environment and horticulture in the Byzantine Negev Desert, Israel: Sustainability, prosperity and enigmatic decline. *Quaternary International*, 593, 160–177.
- Magness, J. (2003). *The archaeology of the Early Islamic settlement in Palestine*. Winona Lake, Ind.: Eisenbrauns.
- Majcherek, G. (1995). Gazan amphorae: Typology reconsidered. In H. Meyza, & Y. Młynarczyk (Eds.), *Hellenistic and Roman pottery in the Eastern Mediterranean: Advances in scientific studies-acts of the II Nieborów Pottery Workshop, Nieborów, 18–20 December 1993* (pp. 163–178). Warsaw: Polish Academy of Sciences.
- Mangel, M., & Samaniego, F. J. (1984). Abraham Wald's work on aircraft survivability. *Journal of the American Statistical Association*, 79(386), 259–267 [https://doi.org/10.2307/2288257].
- Marozzi, J. (2021). *The Arab conquests*. London: Apollo.
- Nicolle, D. (1994). *Yarmuk, 636 AD: The Muslim conquest of Syria*. London: Osprey.

- Olshanetsky, H. (2021). On the walls of Naples. *Segula*, 127, 36–43.
- Olshanetsky, H., & Cosijns, L. (2021). The Persian invasion of 614 A.D. as a possible catalyst for the decline and fall of the Negev settlements. *Diogenes*, 12, 4–25.
- Olshanetsky, H., & Cosijns, L. (2022). Did they influence at all? A re-analysis of the effects of the Late Antique Little Ice Age and the Justinianic plague on the eastern Roman Empire during the 6th and 7th centuries CE. *Muza*, 5, 24–41.
- Olshanetsky, H., & Cosijns, L. (Forthcoming 2023). Did we stop throwing away the garbage? Questioning urban collapse at Elusa in the sixth century CE. *Israel Exploration Journal*.
- Picornell Gelabert, L., Asouti, E., & Martí, E. (2011). The ethnoarchaeology of firewood management in the Fang villages of Equatorial Guinea, central Africa: Implications for the interpretation of wood fuel remains from archaeological sites. *Journal of Anthropological Archaeology*, 30(3), 375–384 [https://doi.org/10.1016/j.jaa.2011.05.002].
- Pieri, D. (2005). *Le commerce du vin oriental à l'époque Byzantine (Ve–VIIe siècles): Le témoignage des amphores en Gaule*. Beyrouth: Institut français du Proche-Orient.
- Reynolds, P. (2005). Levantine amphorae from Cilicia to Gaza: A typology and analysis of regional production trends from the 1st to 7th centuries. In J. M. Gurt Esparraguera, J. Buxeda i Garrigós, & M. A. Cau Ontiveros (Eds.), *LRCW I: Late Roman coarse wares, cooking wares and amphorae in the Mediterranean: Archaeology and archaeometry* (pp. 563–611). Oxford: Archaeopress.
- Riley, J. A. (1975). The pottery from the first session of excavations in the Caesarea Hippodrome. *Bulletin of the American Schools of Oriental Research*, 218, 25–63.
- Sazanov, A. (2017). Les amphores LRA 4: Problèmes de typologie et de chronologie. In D. Dixneuf (Ed.), *LRCW 5: Late Roman coarse wares, cooking wares and amphorae in the Mediterranean: Archaeology and archaeometry* (Vol. 2; pp. 629–650). Oxford: Archaeopress.
- Tepper, Y., Erickson-Gini, T., Farhi, Y., & Bar-Oz, G. (2018). Probing the Byzantine/Early Islamic transition in the Negev: The renewed Shivta excavations, 2015–2016. *Tel Aviv*, 45(1), 120–152 [https://doi.org/10.1080/03344355.2018.1412058].
- Théry-Parisot, I., Chabal, L., & Chrzavzez, J. (2010). Anthracology and taphonomy, from wood gathering to charcoal analysis. A review of the taphonomic processes modifying charcoal assemblages, in archaeological contexts. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 291(1), 142–153 [from https://doi.org/10.1016/j.palaeo.2009.09.016].
- Tomber, R. S. (1996). Provisioning the desert: Pottery supply to Mons Claudianus. In D. M. Bailey (Ed.), *Archaeological research in Roman Egypt: the proceedings of the Seventeenth Classical Colloquium of the Department of Greek and Roman Antiquities, British Museum held on 1–4 December, 1993* (pp. 39–49). Ann Arbor, MI: Journal of Roman Archaeology.
- Vaiglova, P., Hartman, G., Marom, N., Ayalon, A., Bar-Matthews, M., Zilberman, T., Yasur, G., Buckley, M., Bernstein, R., Tepper, Y., Weissbrod, L., Erickson-Gini, T., & Bar-Oz, G. (2020). Climate stability and societal decline on the margins of the Byzantine Empire in the Negev Desert. *Scientific Reports*, 10(1), 1512 [https://doi.org/10.1038/s41598-020-58360-5].
- Wilson, P., & Grigoropoulos, D. (2009). *The West Nile Delta regional survey, Beheira and Kafr el-Sheikh provinces*. London: Egypt Exploration Society.

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